2014 Clear Creek Technical Team Report for the Coordinated Long-Term Operation Biological Opinions Integrated Annual Review October 3, 2014

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Draft
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Integrated Annual Review
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CHAPTER 1- BACKGROUND

1.1 Brief background on Clear Creek and the Technical Team: Since 1995, Central Valley Project Improvement Act (CVPIA) and later CALFED have undertaken extensive anadromous salmonid habitat and flow restoration in Clear Creek (See Figure 1). The restoration has increased stocks of fall-run Chinook four fold and re-established populations of spring-run Chinook and Central Valley steelhead. 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 have varied over the years depending on what topics are being covered in the meetings. The majority of the topics had involved physical habitat restoration. Since 2009 topics have included NOAA's National Marine Fisheries Service's (NMFS) Coordinated Long-Term Operations (CLTO) biological opinion (BO) Reasonable and Prudent Alternative (RPA) actions including flow and temperature management on Clear Creek.

The Clear Creek Restoration Program (CCRP) of CVPIA identified and implemented a variety of actions to improve salmon and steelhead populations and the ecosystem on which they depend, including increasing minimum flows, temperature control through flow management, dam removal, large scale stream and floodplain restoration, gravel augmentation, and erosion control. The effect of these actions has been to:

1) increase the escapement of fall-run Chinook four fold, primarily due to increased minimum flows,
2) re-establish populations of threatened spring-run Chinook and steelhead primarily through dam removal, increased flows and temperature management,
3) rehabilitation of stream and floodplain habitats,
4) re-initiation of sediment transport and stream channel movement processes, in some reaches, which help create and maintain fish habitat, and
5) greatly increase the amount of spawning habitat.

The actions are also believed to have increased the resilience of the fall-run Chinook population, allowing it to perform better than the rest of the Central Valley watersheds during the 2007 to 2010 coastal Chinook fishery collapse. During that period, while Central Valley escapement decreased to 24% of baseline, Clear Creek consistently maintained an average 74% of baseline escapement (Figure 2).

1.2 Current Active Members:

Alicia Young, Natural Resources Conservation Service/Point Blue Conservation Service
Brycen Swart, NOAA Fisheries
Eda Eggeman, CA. Department of Fish and Wildlife
Gary Diridoni, U.S. Bureau of Land Management
Gretchen Garwood, Western Shasta Resource Conservation District
Guy Chételat, CA. Regional Water Quality Control Board
Jason Roberts, CA Department of Fish and Wildlife
Jim Earley, U.S. Fish and Wildlife Service
Justin Day, Redding Electrical Utility, City of Redding
Laurie Earley, U.S. Fish and Wildlife Service
Mark Gard, U.S. Fish and Wildlife Service
Matt Brown, U.S. Fish and Wildlife Service
Matt Johnson, CA. Department of Fish and Wildlife
Mike Berry, California Department of Water Resources
Naseem Alston, NOAA Fisheries
Patricia Bratcher, CA. Department of Fish and Wildlife
Russ Weatherbee, Whiskeytown National Recreation Area, National Park Service
Sarah Gallagher, U.S. Fish and Wildlife Service
Smokey Pittman, Graham Matthews and Associates
Tom Kisanuki, U.S. Bureau of Reclamation

In addition to this list, there are other people from various agencies and entities that participate on a less frequent basis.

CHAPTER 2. REVIEW OF THE INDEPENDENT REVIEW PANEL

[Please note: For the remainder of this document, the responses provided by the CCTT are italicized]

The 2012 Delta Science Program Independent Review Panel (IRP) on the long-term operations opinions annual review (LOO) document presented its findings and recommendations to U.S. Bureau of Reclamation (Reclamation), NMFS, and the U.S. Fish and Wildlife Service (FWS). The IRP's 2012 review focused primarily on implementation of NMFS' RPA actions for Clear Creek (RPA Actions I.1.1 – I.1.6). A summary of the recommendations from the IRP that relate to Clear Creek activities is provided below, with the actions taken by CCTT in italics.

Page 8 of the LOO, 2nd paragraph under the heading, "General Scope and Charge to the 2012 LOO IRP;" reads as follows:

This year's annual review deals with the implementation of NMFS' Long-Term Operations Opinion's Clear Creek RPA Actions (I.1.1-I.1.6) and the Spring 2012 Delta Operations in lieu of NMFS' RPA Action IV.2.1 per joint stipulation (Spring 2012 Delta Operations) for operations and fisheries for water year 2012 (October 1, 2011 through September 30, 2012) and considers:

(1) Whether implementation of the Clear Creek RPA actions met the intended purposes of the actions; (2) The agency's responses to and implementation of independent review panel recommendations from the prior year's Long-term Operations Opinion Annual Review on the clear Creek RPA actions; (3) Study designs, methods, and implantation procedures used; and (4) Recommendations for adjustments to implementation of the RPA Actions or Suite of Actions for meeting their objectives.

At the time that the 2012 CCTT annual report was prepared, the document recognized that some of the NMFS' RPA actions and Joint Stipulation commitments had yet to be implemented or completed and so the 2012 IRP was unable to develop an opinion as to "…whether or not they [the RPA action] have or will meet their intended purpose."

Clear Creek Specific Actions:
On behalf of the CVPIA (b)(12) Program (the Clear Creek section of CVPIA) and the CCTT, the following responses and/or information updates are provided in italics to address each recommendation of the IRP.

1) Action I.1.2. Channel Maintenance Flows from re-operation of the Whiskeytown Glory Hole spills to include mean daily spills of 3250 cfs for one day to occur 7 times in a 10-yr period. This action was targeted for implementation in winter 2013 and will likely be delayed until 2014, so once again was not implemented and cannot be evaluated.

   The planning for the channel maintenance flows (Environmental Water Program) continued in 2013, and implementation of a pilot flow release previously targeted for 2014 will be delayed until 2015.

2) Action I.1.3. Spawning Gravel Augmentation was once again performed but there was little information available to evaluate whether it is meeting the intended purpose. The written report from the Clear Creek Technical Team (CCTT) contained a note to "[insert section here]" that may have been intended to provide salmonid or macroinvertebrate responses to the RPA. During the LOO 2012 workshop in Sacramento the CCTT indicated that the data were not currently available.

   Spawning gravel augmentation did not take place in Clear Creek in 2013, due to budgetary constraints. In 2010, Reclamation contracted with Graham Matthews and Associates (GMA) to conduct a multi-year geomorphic monitoring project. The focus of the project was to evaluate sediment transport, distribution, and abundance in Clear Creek. The final report, titled "2010-2013 Clear Creek Geomorphic Monitoring: Bedload sampling and gravel injection evaluation", provides helpful evaluations of the performance characteristics of some of the gravel injection sites.

   Based upon the conclusions and recommendations of the 2013 GMA report, the gravel augmentation program in Clear Creek is providing demonstrable benefits to the anadromous salmonids, and also contributes / supports fluvial, geomorphic processes within the stream. The GMA report will be provided to the IRP, along with this Clear Creek Annual Report.

3) Action I.1.4. Replacement of Spring Creek Temperature Control Curtain in Whiskeytown Lake. This action was completed by the Bureau of Reclamation in June 2011, but there was no test of its effectiveness that would allow an evaluation of the intended purpose of the action. Furthermore, the intended effect of the curtain was to lower water temperatures delivered to the Sacramento River and not necessarily Clear Creek, which was the focus of this year's annual review.

   Although the Spring Creek Temperature Control Curtain (SCTCC) was replaced, a formal evaluation has not been undertaken, to date, to determine its effectiveness. In recent years, the Oak Bottom Temperature Control Curtain (OBTCC) has undergone serious deterioration and is no longer functional. By the end of 2014, Reclamation will be taking action to have the curtain removed. At present, no time-frame is available for when a replacement curtain would be installed at Oak Bottom.

   As the SCTCC and OBTCC were designed to work in together in unison, conducting an evaluation of the effectiveness of the SCTCC with either a damaged OBTCC, or without the OBTCC would not be a meaningful action. Therefore, Reclamation and the CCTT recommend that any evaluation be postponed until both curtains are fully operational.

4) Action I.1.6. Adaptively Manage to Habitat Suitability/IFIM Study Results. Although the IFIM Study is completed, results were not provided for evaluation, so the IRP is unable to formulate an opinion this year.

   During 2013, the fourth and final IFIM report ("CVPIA instream flow investigations Clear Creek juvenile spring-run and fall-run Chinook salmon and steelhead/rainbow trout rearing) for the Clear Creek juvenile salmonid rearing habitat studies was completed by the FWS. Two of the IFIM reports were on adult salmonids, and the other two on the juvenile life stage of salmonids in Clear Creek. All four reports are available electronically at: http://www.fws.gov/sacramento/fisheries/Instream-Flow/fisheries_instream-flow.htm.

   One additional report, commonly known as the "Synthesis Report", is currently under joint preparation by Mark Gard, Ph.D., of the FWS' Restoration and Monitoring Program and Matt Brown of the FWS' Red Bluff Fish and Wildlife Office. The Synthesis Report would utilize information from the four previous IFIM reports to present a range of flow targets and the corresponding levels of habitat availability for the life stages of fall-run and spring-run Chinook salmon, and steelhead. A draft of this document will be reviewed by the CCTT in October 2014.

Page 10, Hydrographic analysis (LOO document):

The CCRP and the CCTT recognize the importance of both short-term and long-term climatic influences on the biological and physical landscape of Clear Creek. Additionally, the IRP's suggestion of reviewing "…annual flow records to detect any predictable patterns influenced by the Pacific Oscillation as well as proposed scenarios for climate change in California will be useful exercises to "fine-tune" future management options." has been considered and received as viable and helpful. The CCRP and CCTT currently do not possess technical expertise in the

subject areas of climatology, oceanic oscillations, and/or climate change. The CCRP would need to seek technical expertise to address these subjects, and given limited funding, any new study or work activity will be subject to program prioritization.

Page 11, Implementation of actions:

1) How well did implementation of the Clear Creek RPA Actions and Spring 2012 Delta Operations meet the intended purposes of the actions?

Spring attraction flows (Action I.1.1.)

The IRP states "Thus, there is evidence for a nonrandom difference in counts between the surveys, presumably (but not necessarily) due to the pulse flows."

In 2013, two pulse flow events were conducted, the first event (800 cfs target flow) beginning on 8APR13 and ending on 16APR13; the second event (400 cfs target low) was from 25JUN13 to 30JUN13. The first and second events resulted in measured flows (Igo, CA station) of 1,070 cfs, and 441 cfs, respectively.

A slight response in spring-run Chinook passage was observed during the first pulse event. Pre-pulse snorkel surveys indicated zero adult Chinook, and 14 adults after the pulse flow event. For the second pulse flow event; the pre-pulse survey count was 400 adults, and 561 adults in the post-pulse survey. Passage of adult Chinook into Clear Creek continued, at low (< 5 fish per day) levels, suggesting that the second pulse flow event was successful in stimulating the upstream movement of spring-run Chinook (Figure 4).

Channel maintenance flows (Action I.1.2)

The IRP report states "Channel maintenance flows (Action I.1.2) were not performed and were once again delayed until 2014. Discharges of about 3000 cfs were common events in the past and discharges above 5000 cfs are most likely required to establish geomorphic threshold crossing events. A one day spike of 3,250 cfs will not complete much in the form of geomorphic work other than water some rocks and result in negative ecological impacts to Clear Creek. Small pulses of 400 to 800 cfs have stage increases of 0.5 - 1 ft at the confined location of the Igo gauging station. These would barely be measurable differences in terms of stage along the floodplain sites where most of the spawning and rearing habitat exists."

Based upon the monitoring results performed by GMA (2013), we respectfully disagree with certain statements offered by the IRP, particularly the sentence: "A one day spike of 3,250 cfs will not complete much in the form of geomorphic work other than water some rocks and result in negative ecological impacts to Clear Creek." The one day mean daily flow of 3,250 is considered minimum criteria for a successful channel maintenance flow. The 3,250 cfs (minimum) target is measured at the Whiskeytown outlet. If the flow occurs during a natural storm event, downstream flows in the alluvial reach could be much higher due to accretions from tributaries. While these larger flows would be more beneficial, they are not necessary to provide the desired benefits. The threshold was chosen because it is the same magnitude and

duration of the glory hole in 2003 which did a large amount of geomorphic work moving large amounts of sediment and creating large areas of high quality fish habitat. The 2003 glory hole spill occurred without the benefit of significant accretion flows. While it is true that 3,000 cfs flows were more common before the construction of Whiskeytown Dam, the stream channel long ago adjusted to the smaller flow regime resulting in smaller channel geometry and lower bankfull flows. The RPA also identified the 3,250 cfs flow to occur 7 out of 10 years frequency.

The GMA monitoring work verified that the annual (400 and 800 cfs events) pulse flow events result in the movement of injected gravels at some of the sites that have been injected in recent years (e.g. Below Dog Gulch site). GMA reported that for the Guardian Rock site (aka "NEED Camp"), the March 2012 storm which peaked at a discharge of 1,120 cfs at the NEED Camp location, resulted in a 75 percent mobilization of the 3,000 tons of gravel that were placed there in the previous year (2011). Thereafter, the December 2, 2012 storm (1,870 cfs peak event), and the 2013 pulse flow event resulted in total evacuation of the injected gravels. GMA has also documented mobilization of large amounts of fine sediment during pulse flows. These deleterious fine sediments can negatively impact salmonid production.

Spawning gravel augmentation (Action I.1.3)

The IRP states that this action "was intended to enhance and maintain previously degraded spawning habitat for spring-run Chinook and CV Steelhead. In 2011, 10,000 tons of gravel was placed at 5 sites in Clear Creek. Again there was no reliable metric to determine whether or not these augmentations are replacing or enhancing the quality of the spawning habitat for the targeted salmonid species or other fish and macroinvertebrate assemblages. Despite this lack of reliable metrics to gauge success, there is a clear intention to continue the spawning gravel augmentation project, with a concern expressed about the future source of gravel. The current plan is to use mine tailings that will be washed to remove the finer sediments containing mercury and potentially other contaminants and use a retention pond to permanently isolate those contaminants from the watershed. It is unclear how the quality of spawning habitat might be affected."

Despite the IRP statement that [*there] "…was no reliable metric to determine whether or not these augmentations are replacing or enhancing the quality of the spawning habitat for the targeted salmonid species or other fish and macroinvertebrate assemblages."*

The results of the GMA (2013) geomorphic monitoring noted that the bedload materials greater than 8mm observed in their bedload sieve data showed that this size composition after 2010, increased each year thereafter, doubled from 2011-2012, and doubled again from 2012-2013. Moreover, GMA's observations have confirmed that the gravel injections have recharged 5,945 feet of the approximate channel length (11,125 ft) of Reach One.

Also, please recall that Matt Brown provided a presentation to the IRP during the annual review meeting on October 31, 2012, whereby he described the various monitoring efforts to connect biological outcomes to the gravel augmentations in Clear Creek. The evaluation of

the gravel augmentation program is being conducted at three relative scales – the watershed scale, spawning reach scale, and on a smaller scale. The frequency of monitoring is conducted in a timescale appropriate to address objectives and questions posed.

Watershed scale monitoring includes:

- *Longitudinal topographic surveys, LiDAR,*
- *Bedload transport and Sediment budget*
- *Annual adult salmonid population estimates*
- *Annual juvenile production estimates*
- *Annual juvenile productivity estimates (juvenile production / adult escapement)*
- *Temperature monitoring system of loggers*

Spawning reach scale monitoring includes:

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

Smaller scale monitoring includes:

- *Spawning gravel evaluation: 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*

Please refer to the document, "Clear Creek Technical Team Combined Long-term Operations Annual Review, October 31, 2012" in the background reading materials). These monitoring efforts use many metrics. Some examples were provided in the presentation, including a) comparisons of escapement to other watersheds, b) changes in juvenile Chinook produced per redd following catastrophic fire, c) comparison of movement of spawning gravel during pulse flows which is desirable at some sites and not in others, d) differences in juvenile Chinook density in different restoration projects, e) differences in juvenile Chinook density between habitat treatment types and f) increases in macroinvertebrate abundance due to restoration. An additional metric for the spawning gravel use is the percent of steelhead redds that are in the added gravel which has doubled since 2003 from 30% to 60% (Figure 7).

Replacement of the Spring Creek Temperature Control Curtain (SCTCC) (Action I.1.4)

This action was intended to reduce adverse impacts of project operations on water temperatures for listed salmonids in the Sacramento River. The USBR replaced the SCTCC in Whiskeytown Lake on schedule in June 2011 at a cost of $3 million. However, unidentified "technical problems" with monitoring equipment apparently precluded pre-project monitoring to evaluate the effectiveness of this action. Effects, if any, of the SCTCC on temperatures in Clear Creek were not considered. However, in connection with the discussion on this temperature curtain, the IRP was informed that the Oak Bottom temperature control curtain (OBTCC) in Whiskeytown Lake was also damaged and in need of replacement or repair. While the agencies involved seemed to agree that the OBTCC should be replaced, no plan was advanced to test its effectiveness in meeting the intention of this action. It is unclear how the effectiveness of these temperature control curtains on water temperatures will be determined in either the Sacramento River or in Clear Creek.

We acknowledge that a formal plan to test the effectiveness of the temperature curtains have not been addressed by the CCRP and the CCTT. We recognize the importance of demonstrating the effectiveness of these two devices in providing cold water to the Sacramento River (via the Spring Creek tunnel) and Clear Creek, as there are maintenance and replacement costs associated with these curtains. The Oak Bottom Temperature Control Curtain (OBTCC) is in need of replacement, and its removal is scheduled to begin in December 2014. We do not have a target date for when the replacement would occur. The CCRP continues to collaborate with Reclamation and FWS CVPIA management in obtaining funding for replacement of the OBTCC.

Although holistic temperature monitoring and evaluation of Whiskeytown, and Spring Creek Powerhouse and Clear Creek releases, without a OBTCC in place, would provide comparative "baseline" information, we do not have a viable plan, and funding for developing and implementing a monitoring action has not been prioritized.

There has been continued advocacy to perform a comprehensive temperature modeling of the Whiskeytown system (reservoir, Spring Creek powerhouse and Francis Carr powerhouse operations (Trinity River Basin water), and Whiskeytown Dam power operations.

However, at present, and in regards to a specific evaluation of the effectiveness of the temperature curtains, we are not aware of any immediate interest or urgency to evaluate their effectiveness. The CCRP will discuss this subject at the September 2014 CCTT meeting to arrive upon a tentative action plan.

Thermal Stress Reduction (Action I.1.5)

This action was intended to improve conditions in Clear Creek for over-summering steelhead and spring-run Chinook during holding, spawning and embryo incubation. Seasonal temperature target maxima in Clear Creek at the USGS Igo gauge (about 6.5 miles downstream of Whiskeytown Dam) were set at 60° F during June 1 to September 15, and 56°

F during September 15 to October 31. Thus far during 2009-2012, the temperature target was achieved consistently during the June to mid-September period, but frequently failed to be met during mid-September to October. In 2012, the temperature during this period exceeded the target maxima 69% of the time. During 2009-2011, temperatures exceeded the target 38% to 72% of the time. In prior years (2001-2008) temperatures at the Igo gauge exceeded the temperature target during September and October only 7% of the time. Once again there was mixed success in meeting the physical targets set by this RPA Action and no biological response data on which to base an opinion as to the intended effects on salmonids.

Page 13, 2nd paragraph:

The Clear Creek Technical Team (CCTT) put forth a complex hypothesis that involved potential impacts of an interaction involving the Oak Bottom and Spring Creek temperature control curtains and the effects of "power-peaking" at generating stations above Whiskeytown Lake as a possible explanation for the failure to meet the conditions of Action I.1.5 during mid-September to October in recent years. There seemed to be agreement among the agencies that the Oak Bottom Temperature Control Curtain (OBTCC) was in need of replacement but there was no consensus regarding the role of power-peaking in current conditions.

There was a paucity of hard evidence provided to the IRP on which to form an opinion as to the scientific soundness of alternative hypotheses to explain the temperature observations at the Igo gauge.

The CCRP and the CCTT are in agreement that the OBTCC needs replacement. Meaningful assessments of the role of the temperature curtains and the influences of "power-peaking" may be pursued upon replacement of the OBTCC. In the interim, we will continue to observe the relationship between water temperatures in Clear Creek and "power-peaking" operations at Francis Carr, and the Trinity Powerhouse.

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

This was intended to improve habitat conditions for spring-run Chinook and steelhead by adaptive management of flow conditions that favor salmonid survival. This Action is associated with what is perhaps the least definable objective. Also the IFIM Study which began in 2004 has been completed but reports on the findings were not available to the 2012 IRP. Consequently, there is no basis on which to develop an opinion as to the effectiveness of this RPA Action at this time.

Please refer to the previous response provided.

Page 15, "2011 IRP recommended adjustments for Clear Creek Actions"

2) Where the 2011 Independent Review Panel made recommended adjustments to implementation of the Clear Creek RPA Actions,
a) Were the adjustments made?
b) How well did these adjustments improve the effectiveness of implementing the actions?

The Clear Creek technical Team (CCTT) report and presentation frequently acknowledged the suggestions of the 2011 IRP. The recommended suggestion regarding gravel size in the spawning gravel augmentation program were followed but there were no biological response data upon which to base an opinion regarding whether or not this suggestion improved effectiveness of the action.

Although the CCTT agreed with the 2011 IRP's suggestion for improved temperature and flow modeling in the system, especially for Whiskeytown Lake, this has yet to be undertaken. Also, the IRP suggestion to give a more natural hydrograph shape to the pulse release flows was not done. The 2012 IRP reiterates these last two suggestions.

Page 17 of the 2011 IRP report:

Habitat modifications. Action I.1.3. addresses gravel augmentation to enhance and maintain degraded spawning habitat for spring-run Chinook and steelhead in Clear Creek. The construction of Whiskeytown Dam has led to a situation whereby perpetual augmentation of gravel for spawning habitat will be required. Maintaining an appropriate mix of gravel sizes is of some concern in providing suitable spawning habitat for both steelhead (smaller gravel) and Chinook (larger gravel). The discussion of meeting the intended purpose of this action was again focused on the amount of gravel injected (potential spawning habitat) into the system and not on its intended realized purpose of improving spawning conditions. Data relating the gravel augmentation efforts to improvements in salmonid spawning success was not provided.

Page 19 of the 2011 IRP report:

In general, for both Clear Creek and the Stanislaus River, the effects of habitat modifications seem to be very narrowly focused on injecting a target amount (cubic meters) of spawning gravel or altering flow management without consideration of the effects on the overall system that supports fish populations, including macroinvertebrate food resources. The maintenance of the entire community is critical to ecosystem integrity in support of the targeted salmonids.

The CCRP and the CCTT views the maintenance of the entire Clear Creek biotic community to be a prudent and worthy scientific and management goal. Although many of the CCRP goals and objectives would be consistent with the recommendation of the IRP, the central focus of the CVPIA (b)(12) program and the RPA actions are on the fishery populations and bringing about both the recovery of the anadromous salmonids and the habitats upon which they rely for (e.g., spawning, rearing, as well as upstream and downstream passage). The habitat conditions also include appropriate flows and temperatures to support the spectrum of their life history stages.

The CCRP and the CCTT have been supportive and involved in a diverse range of restoration actions in Clear Creek, including floodplain restoration, riparian / upslope revegetation, channel realignment and restoration, upland erosion control, fuels

management, restoration of unneeded roads, and advocacy in seeking pulse flows to promote and sustain geomorphic processes. The majority of spawning habitat creation has been through large-scale floodplain and channel reconstruction, rather than simple gravel supplementation. The CCRP has also supported public awareness and education which will foster public understanding and support for the importance of fish and wildlife conservation.

We respectfully disagree with the IRP impression of the CCRP. The IRP appears to have a disproportionate attention/critique of the spawning gravel augmentation program. This may be because the history and background of the program has not been presented. The CCTT was encouraged to limit its presentations and reports to project operations within the scope of the NMFS OCAP BO. Extensive habitat restoration takes place on the Sacramento, American, Stanislaus River and Delta, but the technical teams have not been asked to present this work. An attempt was made at the 2012 Annual Review to give a general scope of the monitoring and metrics used. For instance on pages 9 to 12, the presentation made to the IRP on October 31, 2012 outlined 3 levels and at least 17 types of monitoring metrics to evaluate the gravel program. Pages 13 to 19 were intended to highlight examples of monitoring metrics and how they relate back to the restoration process. Unfortunately we did not have time to incorporate the information into the annual review report.

The program has produced two gravel management plans in 2000 and 2006 and a gravel management model (the Clear Creek Decision Analysis Model (CCDAM) gravel management sub-model) to guide the program and estimate the level of effort, timing and locations of gravel placement. A sediment transport model was developed in 2000 to guide the removal of Saeltzer Dam and anticipate changes in upstream and downstream spawning habitats. A sediment routing model was used to estimate the time it would take for spawning gravel to transport through long pools and reaches. An individual-based life cycle model developed for Clear Creek (InSALMO) was used to evaluate and compare the benefits of further gravel placement, stream channel restoration and other restoration actions. Results of this modeling have been published in peer reviewed journals. An ecological monitoring plan was developed to provide conceptual models, goals, objectives, hypotheses, and metrics for habitat restoration from the perspectives of fish, geomorphology, riparian vegetation, and birds. These plans and models have been tested through implementation and monitoring to further develop the scientific basis for our efforts.

Fundamentally the CCRP and CCTT recognize that Whiskeytown Dam blocks the transport of coarse material, and that a perpetual gravel augmentation effort will be needed to compensate / mitigate for the blockage of the gravel.

Since 2007, the CCRP has used annual macroinvertebrate sampling with the assistance of the Utah State University "Buglab", to evaluate the impacts of habitat restoration (Figure 8). An overall goal is to compare the different types of habitat treatment to find the most biologically and cost effective approach in the very different environments of the bedrock and alluvial reaches. After the 2011 IRP suggested incorporating macroinvertebrate habitat suitability indexes, we obtained indices from IRP member Dr. James Gore and found that they were generally compatible with stream flow prescriptions for Clear Creek. We have discussed using them in the future.

Since 1997, the CCTT has used the extensive avian monitoring performed by the Point Reyes Bird Observatory (now known as Point Blue Conservation Science) to guide restoration planning and implementation. Significant changes to floodplain elevation, sediment transport, riparian re-vegetation design and implementation, and pulse flow timing have resulted. Construction impacts on special status bird species were avoided, and mitigation plantings occurred. This work was not undertaken for regulatory reasons, but to better address watershed and ecosystem goals.

Page 16 (2012 IRP report), 2nd thru the 4th paragraphs:

Although the CCTT agreed with the 2011 IRP's suggestion for improved temperature and flow modeling in the system, especially for Whiskeytown Lake, this has yet to be undertaken. Also, the IRP suggestion to give a more natural hydrograph shape to the pulse release flows was not done. The 2012 IRP reiterates these last two suggestions.

In 2013 and 2014 pulse flows were given a more natural hydrograph shape while attempting to increase turbidity as a cue for migration, minimize juvenile fish stranding, and allow collection of monitoring data.

Effectiveness of coordinating real-time operations with CCTT input

3) How effective was the process for coordinating real-time operations with the Clear Creek technical team analyses and input as presented in NMFS' Long-term Operations Opinion [NMFS' 2009 RPA with 2011 amendments (pages 8-9)]?

The CCTT Report lists topics associated with coordinated long-term operations on eight dates between December 15, 2011 and September 20, 2012 but there appeared to be no real-time operation effects related to analysis and input. However, there appeared to have been at least two incidents relevant to the implementation of actions. These were (a) a week-long period (June 3-11, 2012) during which warmer than intended water was released from Whiskeytown Lake due to an upper release gate being "inadvertently" left open, and (b) operations at the Redding power station which apparently is not under the control of USBR. The presentations from the CCTT and USBR made at the workshop in Sacramento on October 31, 2012 along with subsequent discussions with the IRP suggested that there may be a need for improved coordination between real-time operations and some of the RPA Actions intended to benefit salmonid populations in Clear Creek.

The CCRP and CCTT acknowledges that the City of Redding's power generation station is not directly under the immediate control or authority of Reclamation. However, the two entities do coordinate closely together, as Reclamation's operations of the flow releases (and the power generation operations of City of Redding) also may have serious consequences on the infrastructure of the Clear Creek Community Services Water District, which draws its water from the overall Whiskeytown Dam plumbing infrastructure.

The CCRP and CCTT also agrees that inter-agency coordination is important in operating and sharing a common resource for the efficiency and safety of all parties. Reclamation is ultimately responsible to ensure that timely and efficient teamwork / agency cooperation occurs to manage

the Whiskeytown Dam facilities. There is a need for improved coordination between real-time operations and some of the RPA Actions intended to benefit salmonid populations in Clear Creek.

Indicators, study designs, methods and implementation procedures

4) (a) Were the scientific indicators, study designs, methods, and implementation procedures used appropriate for evaluating the effectiveness of the Clear Creek RPA Actions and the Spring 2012 Delta operations?

The approach in the Tech Memo was clearly articulated. Whether it was supported by the best available science prior to the study is less clear. In general, there can be little certainty as to the effectiveness of the indicators, study designs, methods and implementation procedures without reliable and accurate measures of biological responses.

Page 17 through 19 (2012 IRP Report) had extensive comments, and therefore our responses / comments appear after each logical paragraph.

Clear Creek RPA Actions

In general, the CCTT report tended to consider progress toward meeting RPA Action targets as a measure of success, which could be appropriate for actions intended to follow some expected trajectory over time (e.g., multi-year projects) but most actions are not defined in that manner.

Comment noted.

A list of restoration goals have been created by the CCTT, but these goals must be continuously reviewed as studies are completed or different goals and endpoints are identified. These goals cannot remain static and the IRP urges the CCTT to review these goals annually to determine if the objectives and endpoints remain realistic. "River restoration" has been variously defined in the literature over the past three decades, ranging from "the complete structural and functional return to a pre-disturbance state" (Cairns 1991) to something less than ideal ["a return to an ecosystem which closely resembles unstressed surrounding areas"] (Gore 1985). Four overall targets can be identified (modified from Brookes and Shields [1996]):

Target	Definition	Management Approach
Full Restoration	Complete functional and structural return to an identified pre-disturbance conditions	Direct intervention, natural recovery, or enhanced recovery
Rehabilitation	Partial return to an identified pre-disturbance condition	Direct intervention or enhanced recovery
Enhancement	Any improvement in physical or biological quality	Mainly direct intervention
Creation	Development of a resource	Direct intervention

	that did not previously exist, including "naturalization' which creates a configuration of contemporary magnitudes and rates of riverine processes	

Gore and Shields (1995) argue that rehabilitation is probably the most likely obtainable target, yet the most expensive, while creation or abandonment of the project, is least expensive but most manageable. Targets continually shift in this broad spectrum of possibilities and the CCTT should consider modifying these targets as a component of their adaptive management strategy.

Comment and recommendation noted.

One of the goals of this project is the completion of the IFIM studies in order to create an adaptive management strategy. The successful completion of this study should allow the analysis of the appropriateness of other activities such as gravel augmentation and the achievement of restoration goals. It is imperative that the results of IFIM studies be reported. An adaptive management plan provides the flexibility that allows managers to respond to future change. These strategies must adapt to the actual results of the Clear Creek restoration plan as it progresses, yet one of the fundamental tools for the development of these strategies, after 16 years of restoration planning and work remains incomplete. The location, duration, and availability of habitat (as expressed as weighted usable area in PHABSIM or other habitat simulations]) over time under various operational scenarios can become a valuable planning tool.

Comment noted and we concur.

Ultimately, completion of the IFIM study will require the correct choice of index period; that is, the previous historical records that best replicate natural hydrographs in the region, assuming that restoration of the hydrograph is, indeed, an acceptable restoration target. The choice of index period can be important as it must include a target condition prior to alteration and include the effects of regular climatic changes such as the Pacific Oscillation (see comparable work by Kelly and Gore, 2008, in the Southeastern US) and the effect of changing land use in PHABSIM predictions (Casper et al. 2011). For example, with changes in the Atlantic Multidecadal Oscillation, PHABSIM predicts a significant change in both fish and macroinvertebrate communities with each cycle (Warren and Nagid 2009) with shifts in dominant functional feeding groups and species composition, among macroinvertebrates, and top carnivores in the fish community. Such modeling results allow the focus of management strategies to shift as natural hydrographic conditions change.

Comments noted.

During the CCTT presentation and later discussions at the workshop in Sacramento, it appeared that the team did not yet have an effective way to assess the effect of the temperature control curtains on temperatures of water releases from the reservoir into either the Sacramento River or Clear Creek. Also, there was a greater emphasis on relatively small (a few degrees) decreases in the temperature of the water released from Whiskeytown Lake rather than on stream water

temperature when it reached targeted reach boundaries such as the Igo gauge, approximately 6.5 miles downstream or the lower reaches of Clear Creek approximately 12 miles from the dam.

Comment noted – the CCRP and CCTT have not yet considered or developed strategies or methods whereby the effectiveness of the temperature control curtains may be evaluated.

Gravel augmentation has been a very active restoration activity in Clear Creek since 1996 (150,000 tons) and is planned to be continued into the future ($4.5 million). At this point there is insufficient data to support the ecological effectiveness of the gravel augmentation activities. It appears that two related responses follow this restoration activity. Spawning increases a couple percentage points and then just as rapidly declines (Fig. 9 CCTT 2012 report).

We respectfully disagree with this comment, and offer the GMA (2013) report for your review.

The CCTT 2012 report alludes to physical monitoring since 1996 and Figure 10 and 11 in that report show that pulse flows since 2009 have moved gravel in the Dog Gulch site just below Whiskeytown Dam, but there was less movement of gravel in the Peltier site just downstream. The IRP was unable to determine the type of data that were collected to distinguish the spread of gravel from the existing stream bed or how the magnitude of movement was assessed. Spawning seems to occur very near the channel banks which may be a species preference or it could be that these areas had less gravel. At the 2012 LOO workshop, it was indicated that the channel was deeper at the edges as a result of how the gravel was placed and perhaps how the river flow encountered the gravel deposits. However, this only underscores the need to step back and quantitatively evaluate a set of metrics aimed at testing the restoration goals.

We believe the GMA (2013) report will be very helpful (e.g. in addressing the IRP comments and questions regarding the relationship between flow magnitude and the routing of coarse sediment, as well as the empirical means of assessment).

An independent 2005 review specifically of gravel augmentation practices in the Central Valley listed 20 unanswered questions concerning gravel augmentation practices (Lave et al. 2005.). One of the largest data gaps for Clear Creek, and most likely for the other sites, is linking threshold entrainment to discharge and routing/deposition of gravel through Clear Creek system.

Comment noted and our previous response would also apply here.

The long-term future source of material for the gravel augmentation activities will come from mining tailings and hence there may be a potential to introduce additional mercury contamination to the system. The direct transfer of mercury - and other metals from sediments - through the aquatic food chain is a concern wherever past mining is prominent, such as in the Clear Creek basin. Fine sediments contain the higher levels of mercury then gravel and the fine bed sediments of Clear Creek have been shown to contain mercury levels 2 to 10 times natural background levels (Moore 2002).

The Lower Clear Creek Aquatic Habitat and Mercury Abatement Project ("LCCAHMAP") will separate and wash the gravel to minimize the entry of mercury into the aquatic environment.

Gravel augmentation seems to encourage spawning and hence the excavation of redds. There is also an expectation that gravel augmentation will result in favorable alterations of channel morphology. Both small- and large-scale morphological changes to the bed can result in an increased flow of hyporheic water through the surface sediment. Merz et al. (2004) reported on the possible benefits of gravel augmentation on spawning bed enhancement showing that it increases survival and growth of Chinook salmon embryos in the Mokelumne River. Other authors have shown the exchange of hyporheic water enhances the formation of riffle complexes with measurable impacts in terms of moderating riverbed water temperature (Grant et al. 2006a, b, Hanna et al. 2009). Brown et al. (2007) showed that spatial variation in sediment source resulting from flood transport of mine tailings along with temporal changes in hydrology, combine to dictate the role of the hyporheic zone in the transport and retention of arsenic.

In the lower reaches of Clear Creek bed sediments have mercury concentrations that are already above background levels and high flows that scour the bed reintroduce fine sediments into the flow. This coupled with gravel augmentation could be enhancing geomorphic change that in turn enhances hyporheic water flow through sites that encourage spawning soon after mobilization of the gravel. If so, gravel augmentation and flushing flows could be encouraging spawning in gravels where intra-gravel flow contaminated fines passed through incubating salmon embryos. The total net effect on salmon reproduction from the restoration activities of gravel augmentation coupled with flooding is unknown but it is not unlikely that gravel augmentation to encourage salmon spawning in an already highly contaminated creek bed could adding an additional layer of stress detrimental to the survival of the very species it is trying to help.

The LCCAHMAP should not increase the amount of mercury-laden sediments into Clear Creek, as the sediment would be separated during the size gradation process. The CCRP and the CCTT views the LCCAHMAP action to be a positive step in reducing the mercury loading into Clear Creek. At present, the existing mining tailings are known to contain mercury in the sediment, and the potential for the sediments to be entrained exists during flood events that inundate and/or scour the tailings.

<u>Indeed, Moore (2002) in discussing Clear Creek specifically states:</u>
"Understanding the distribution of such widespread contamination is essential to river restoration, especially where dredging, filling, excavation, floodplain construction and changing sediment dynamics may lead to remobilization of contaminants from the riverbed/floodplain, making them more bioavailable. Specific river restoration efforts can also be stymied by bed-sediment contamination, especially those designed to increase/recreate fish spawning habitat. An example is the dependence of some salmonids on areas of upwelling through a gravel bed. If the bed is contaminated with mercury or other heavy metals, geochemical reactions within the bed can release contaminants to the water that irrigates fish eggs. This increased metal loading can decrease reproduction and productivity at spawning sites."

The IRP recognizes that the plan is to wash the gravel used in the augmentation and remove the more heavily contaminated fine sediments, storing them in containment areas. However, this commits one or all of the agencies involved to the perpetual obligation of preventing the concentrated contaminants from entering the watershed.

Comment noted. The spoils site of the LCCAHMAP that will receive the sediments is above the 100-year floodplain, and it will be capped off as per regulations to prevent runoff into the aquatic environment. Moreover, upon project completion, the disposal site will be fenced and signed to ensure that future activities do not disturb or excavate the site. The Bureau of Land Management, who manages the land where the spoils site is located, understands its long-term stewardship responsibility for the spoils site.

The CCTT Report also included speculation about what may be learned through the use of both video and sonar. There are many "may's" here. The IRP suggests that CCTT members posit some specific, realistic outcomes from these two monitoring sources and think through exactly what conclusions could be drawn before investing substantial financial resources in video and sonar monitoring programs.

The CCRP and CCTT respectfully submit that the video and sonar technology does not represent a little-known or developing technology. The technologies are widely used throughout the Pacific Northwest. The resource agencies have already installed and have been utilizing both video and sonar technology to assist in the enumeration of salmonids in Clear Creek. This technology is being used, in conjunction with current enumeration methods, and is yielding results which are cost-effective, and improve adult passage counts.

Page 26, 4th paragraph:

Clear Creek Technical Team Report specific questions
Were the approaches used to develop the recommended actions to reduce water temperatures scientifically appropriate? The CCTT report provided a number of suggestions aimed at reducing water temperatures in discharges from the Whiskeytown Reservoir. The presumed effects of replacing the OBTCC and power peaking on Clear Creek temperatures (Fig. 16 in the CCTT Report) were largely speculative and need to be verified through modeling, analysis of existing temperature data and controlled experiments, if possible.

Comment noted, and concur that verification would be appropriate, but the potential costs to perform modeling, analyses, and monitoring would need to be weighed in regards to cost-benefits of utilizing the resources elsewhere.

Releases of colder water from lower in the reservoir as temperatures warm in the summer seems to be a common sense recommendation but still requires some verification with respect to the available volume of cooler bottom water in storage and how far downstream the intended effects on temperature are likely to extend under different climatic conditions, ranging from sunny and hot to cloudy and cooler.

Comment noted.

What recommended adjustments to actions and implementation procedures for reducing water temperatures might be scientifically appropriate for the next year, while maintaining equal or greater protection for fish?

Any of the suggestions "might be" scientifically appropriate but require some objective testing to be certain. The IRP suggests that CCTT consider options for assessing the potential temperature-specific pools of water available, through modeling and real-time monitoring within Whiskeytown Reservoir and upstream.

Recommendation noted.

Given that there seems to be consensus among the agencies in favor of repair/replacement of the OBTCC, the 2012 LOO IRP can see no reason to object but would strongly recommend that this action be conditioned on an evaluation of effectiveness that includes measurements before and after installation of a replacement curtain. Recommendation noted, and a limited amount of measurements have been collected. The challenge faced by the CCRP and the CCTT is the perceived and actual burden of evaluating and monitoring many of the actions undertaken under the CVPIA (b)(12) program. Costs of evaluations and monitoring generally are not readily supported by managers, agencies, cooperators, and stakeholders, especially when such actions come at the cost of paring other evaluations and monitoring that are deemed to be of a high priority.

Page 35, entire page:
The IRP suggests that the Delta Science Program could facilitate a workshop where industry and academic leaders in this field can present their approaches and potential solutions to the agency partners. Perhaps the Clear Creek working group could provide a test bed model to start building such a web-based collaboration tool.

Comment noted.

Another significant need for the Clear Creek group and restoration effort is that of an independent synthesis of all the restoration work and systems management to date. There has been 16 years of restoration effort in Clear Creek below Whiskeytown reservoir without an apparent synoptic review of that work. Instead, the CCTT continues to emphasize perpetual spawning gravel augmentation and changes to the timing and magnitude of reservoir releases without an objective assessment of what has been accomplished to date.

Comment noted, a synthesis of restoration progress could prove beneficial.

See earlier comments on the IRP impression of the CCRP.
Temperature control in Clear Creek is directly related to the manner in which water flow is managed within the Trinity-Whiskeytown reservoir complex. A temperature control curtain has been replaced in Whiskeytown reservoir near the Spring Creek Tunnel intake and is expected to force more cold water toward that outflow. However, there has not been any data to corroborate that assumption. It is not known how this repair action has or could impact temperature control actions in Clear Creek through operation of the upper and lower intake gates at the Glory Hole intake tower. However, water temperature measured at the Whiskeytown outflow while water intake was shifted between the upper and lower intakes indicates that changes in water temperature outflow can be achieved (Figs. 6 and 16 of the CCTT 2012 report). Indeed, even a mix of water (referred to as middle gate) from both intakes shows an immediate change in water

temperature that brackets the entire temperature regime from May to November measured over the past 12 years (Fig. 16, CCTT 2012 report). This suggests that water temperatures in Clear Creek can be controlled to benefit spring-run Chinook and steelhead, but it remains to be seen how far downriver temperature reductions can be maintained.

Comment noted.

What is not clear from the CCTT 2012 report is how to assess the potential to achieve this in different water years and whether cooler temperatures in Clear Creek can be extended below the Igo gauging station throughout the summer.

Development of a water temperature model to compare effects of alternative operations on Clear Creek stream temperatures and the Whiskeytown cold water pool, including trade-offs with the Trinity and Sacramento River watersheds would be an important first step. Such a model could examine changing the pattern and volume of water delivery from the reservoirs to find more optimal operations for the 3 watersheds. The model could help evaluate the usefulness of: 1) Using the upper and lower Whiskeytown outlets including alternate timing and amounts of water; 2) Avoiding full power peaking to help determine if and when to avoid power peaking; 3) Maintaining higher releases after temperature control is over to avoid dewatering redds or loss of habitat; and 4) Moving the temperature compliance point further downstream than Igo. The model could also be used to establish new temperature criteria for the system, which NMFS has proposed in recent years. This multi-project storage system has multiple large Federal reservoirs, different temperature criteria for multiple species and runs, complex routing and difficulty meeting established criteria.

Two planned pulsed flows of 400 cfs and 800 cfs from Whiskeytown reservoir were released in May and June of 2012 with the intent of attracting spring-run Chinook salmon into the upper reaches above Igo. Snorkel data conducted before and after the pulsed flows showed that Chinook salmon moved upstream but it was unclear that they did so in response to the pulsed flows. Reaching such a conclusion would require comparable snorkel surveys without pulsed flows, which could not be done simultaneously.

Please refer to earlier responses to similar question/comment.

The 2012 LOO IRP reiterates the suggestion of the 2011 OCAP IRP that if pulsed flows are going to be released they should follow a more gradual rising limb with a longer smooth falling limb. *Comment noted, and submit that we have been adaptively modifying the manner in which pulse flows are conducted to also achieve other desired outcomes, such as ramping up in a manner that would create turbidity (e.g., to help stimulate salmonids to migrate upstream). We concur with the importance of a "longer, smooth falling limb" to help reduce stranding of fish]*

CHAPTER 3 - SUMMARY OF CLEAR CREEK RPA ACTIONS

RPA Action Item	Progress in WY 2014
• Spring Attraction Flows	Yes
• Channel Maintenance Flows	Yes
• Spawning Gravel Addition	Yes
• Replace Temperature Curtain	Yes
• Thermal Stress Reduction	Yes / Not for water temperature modeling
• Adaptively Manage to Habitat Suitability / IFIM Study Results	Yes
• Other required monitoring and operations	Yes

3.1 Summary of Clear Creek Team Meeting CLTO Related Discussions

The following list is of topics that were covered in CCTT meetings in 2013. The list does not include non-quarterly meetings related to special on-going projects, such as the "Cloverview Mercury Abatement Project", annual gravel injections, and other special needs. Items with asterisks (*) involve NMFS CLTP BO RPA required monitoring.

January 29, 2013 – Revegetation monitoring results were presented by Jeff Souza of Tehama Environmental Solutions, Inc. Recommendations were provided to the CCTT on how to improve future restoration and monitoring actions, such as types of vegetation, and increasing the number of scour channels.

The timing of 2013 pulse flows was discussed, in relation to findings of the three years of pulse flow, but the small sample size and inconsistent findings made it difficult to apply these data for planning future flows.

The CCTT discussed the Science Panel Review comments, and arrived upon which specific topics would be addressed by the team, and which would be deferred to another meeting.

March 21, 2013 – The CCTT came to agreement in regards to timing of the two proposed different pulse flow levels. The first pulse (800 cfs target) would begin on April 8th, and the second (400 cfs) pulse would begin on June 24th. NMFS was in support of the proposal. Smokey Pittman (GMA) reported on the results of the Reach 2 monitoring (NEED Camp Bridge to the Clear Creek Road Crossing). In this reach, 1,500 cfs flow event is the threshold level of gravel movement, with gravel placement below the NEED Camp area being of strategically importance.

June 20, 2013 - Results of the 2012 fall-run Chinook monitoring was presented by the California Department of Fish and Wildlife (CDFW). Three different population estimation methods resulted in a range of 7,003 to 8,857. Natural origin fall-run Chinook comprised 50.4% of the total, hatchery origin fish was 49.6%. Juvenile hatchery fish trucked downstream from to be released strayed into Clear Creek as returning adults at a much higher rate than on-site released fish. Phase 3C spawning area mapping was discussed. Chinook spawning downstream of the former Saeltzer Dam location has more than doubled since 2000 (year of dam removal), with

one-third of all spawning occurring in Renshaw Riffle. Spawning activity has increased in the 3A and 3B areas and this is attributed to the restoration work done in these areas.

September 19, 2013 – The CCTT expressed concerns that the team was not provided timely opportunity to review the draft 2013 CCTT annual report. Reclamation committed to providing CCTT with greater transparency. The results of the 2013 pulse flow events were discussed. The first pulse flow results may be inconclusive due to the small sample size of adult Chinook observed. For the second pulse event, there was a 40% increase in the number of adults observed relative to the pre-pulse monitoring counts.

December 12, 2013 – Smokey Pittman (GMA) provided a summary of GMA's geomorphic monitoring results to date. GMA determined that spring pulse flows moved the most injected gravel during the study period compared to Glory Hole spill events and storm events. Reach 2 may be the limiting factor to sediment transport, and the two factors impacting the geomorphic function may be riparian encroachment and sediment starvation. GMA noted that the gravel injections have created complex bar sequences, caused mechanical disturbance of riparian vegetation, and increased the mobility of areas that were previously armored.

3.2 Summary of Whiskeytown Operations

Releases of 200 cfs continued after October 1, 2013 until April 1, 2014 when releases were reduced to 190 cfs due to shortages due to the drought. Pulse flows were provided in April and June. After the June pulse flow, releases were decreased to 190 cfs. On July 11 releases were reduced to 175 cfs and were maintained until at least September 26 when this report was drafted. The upper Whiskeytown outlet was used as much as possible until September 14 and 15 when it was reduced and then shut off.

3.3 Implementation of RPA Actions in WY 2014

Action I.1.1. Spring Attraction Flows

Objective: Encourage spring-run movement to upstream Clear Creek habitat for 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)".

Results: Pulse flows were provided in April and June (Figure 4). Similar to 2013, the June pulse was successful in attracting spring-run Chinook into Clear Creek (Figures 4 and 5). A 66% increase in adult salmon counts occurred between before and after snorkel surveys in 2014, more than the 47% increase seen in 2013. Use of the video and sonar counting weir was instrumental in evaluating the success of the pulse flows in both years. Snorkel surveys provided similar results to the counting weir in both years, with the advantage of estimating the distribution of spring-run Chinook in the watershed. Unfortunately 35% of the salmon were distributed downstream of the Igo temperature compliance point (Figure 5).

Impacts of pulse flows on song sparrow nesting were evaluated. Nests were surveyed to estimate the number of young before and after the second pulse flow, which was high enough to inundate some nests. This information will be considered in planning the timing of future pulse flows. The larger June pulse flow moved significant amounts of gravel and created new spawning habitat downstream of the Below Dog Gulch site. Results from other sites will be analyzed.

The CCTT planned pulse flows in 2013 and 2014 to occur when spring-run Chinook are beginning to enter other spring-run Chinook tributaries in early April. The CCTT will revisit the timing of the pulse in 2015, perhaps to occur in May when peak numbers of spring Chinook are anticipated to enter Clear Creek.

Action I.1.2. Channel Maintenance Flows

Objective: Minimize project effects by enhancing and maintain previously degraded spawning habitat for spring-run Chinook 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 yet. Planning and permitting are continuing through an Ecosystem Restoration Program contract between CDFW and the FWS. On March 14th 2014, the Core Effectiveness Monitoring and Adaptive Management Plan was reviewed, revised and finalized by Stillwater Sciences and participants from the Core Effectiveness Monitoring and Adaptive Management Plan workshop which was held February 22 to 24, 2012. The report was discussed at a coordination teleconference held February 19, 2014. A stream gage was re-activated and operated by GMA. An annual report was produced. The gage will be used to estimate flows in lower Clear Creek during EWP events. Pre-event monitoring was begun in 2014 where it overlapped with CVPIA program geomorphic monitoring needs. The CVPIA program has on-going evaluation and monitoring of gravel and stream channel restoration projects, bedload transport, and other watershed wide scale monitoring.

Recommendations: Reclamation and other agencies should continue discussions through the EWP Pilot Program regarding implementation of this RPA Action. The agencies should discuss the incorrect FEMA 100-year base flood elevations with the City of Redding.

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. Gravel projects were not conducted in 2013, due to lower overall CVPIA program funding availability, and higher priority program actions. For 2014, gravel injections are proposed at five sites, for a total tonnage of 7,700 tons:

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

The Lower Clear Creek Aquatic Habitat and Mercury Abatement Project (also known as Lower Clear Creek Long-term Gravel Supply Project): CVPIA continued work on projects to provide a long-term supply of spawning gravel and provide long-term permits for placing it instream. CVPIA funded 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 CDFW land, could provide gravel for 20 to 40 years with a fixed acquisition cost. In February 2012, the Ecosystem Restoration Program decided to fund the entire 4-year project ($4.5 million) 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 CCEE. Implementation of this project is expected to begin in 2015.

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. For instance, Figure 7 displays the proportion of steelhead redds in injected gravel has doubled since 2003. This reflects both an increase in gravel and an affinity by steelhead for the introduced gravel. Figure 8 provides results of a macroinvertebrate study evaluating the effectiveness of the different techniques of habitat restoration such as talus cone injection, lateral berm placement, riffle construction, and stream channel / floodplain restoration. In particular the figure presents differences in macroinvertebrate abundance between treatment and control reaches of a large scale stream channel and floodplain restoration project.

Recommendations: The CCTT recommends that Reclamation review and revise the Ecological Monitoring Plan (EMP) for Clear Creek in part to respond to comments made by the IRP. The EMP includes geomorphic, fish, bird and vegetation objectives and metrics for physical habitat restoration.

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".

Results: Replacement of the broken 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. 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. The OBTCC is damaged and cannot be fully deployed. This allows warm and cold water to mix and 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 the RPA. The CCTT recognizes the importance of having the SCTCC and OBTCC functioning together in tandem, and being maintained in proper working condition to reduce water temperatures of water that will be released into Clear Creek through Whiskeytown Dam, as well as the Sacramento River via the Spring Creek Tunnel. There is agreement within the CCTT and the SRTTG that the OBTCC should be replaced. Presently, Reclamation has contracted the removal of the deteriorated OBTCC, with removal work beginning in December 2014.

Recommendations: Reclamation should replace the OBTCC as soon as possible, and update evaluations of the four TCC's. Two of the TCCs are in Lewiston Reservoir and two are in Whiskeytown Reservoir.

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 water temperatures at Clear Creek Igo gage met targets.

	From	To	Target	Average before 2009[1]	2009	2010	2011	2012	2013	2014
Holding	01-Jun	14-Sep	60° F	99%	100%	100%	100%	100%	100%	100%
Spawning	15-Sep	31-Oct	56° F	93%	**26%**	**26%**	**62%**	**64%**	**96%**	**0%**

Temperature control targets were met in the holding period in 2014 in part because of the large amount of cold water that was brought over from the Trinity River, and relatively higher releases into Clear Creek. Spawning temperature target was not achieved in part due to ongoing drought conditions. Use of the upper and lower outlets resulted in a 0.9 degree improvement in water temperatures near the onset of spawning. Water released from Whiskeytown was above the temperature criterion of 56 degrees at IGO. Releases were not increased to reduce water temperatures. Trinity River diversions to Whiskeytown were reduced in September as water temperatures increased in Whiskeytown (Figure 9) and Clear Creek.

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.

R**esults:** The FWS began a new IFIM study on Clear Creek in 2004 looking at flow habitat relationships for salmon and steelhead. The results of the study are contained in 4 final reports. In addition, a fifth report known as the "Synthesis Report" takes the findings of the four IFIM studies and recommends flows based on flow habitat relationships. This report is in draft form and should be finalized before the IRP meets in November. When these five 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.

The CCTT has proposed to include 5 types of flow in this proposed operational plan:

1) to meet habitat needs based on IFIM and habitat suitability study results;
2) to provide temperature control;
3) to move and maintain spawning gravels and create and maintain riparian vegetation;

[1] It is anticipated that the report that will address and meet the needs of both the RPA Action I.1.6 and the CVPIA Clear Creek Restoration Program which has a mandate under CVPIA to provide a long-term flow prescription to mitigate for the impacts of the CVP.

4) to avoid fish and redd stranding / dewatering; and
5) to encourage anadromy of *Oncorhynchus mykiss* (steelhead / rainbow trout) through an adaptive management approach.

The CCTT (which includes a NMFS representative) intends the report to address and meet the needs of both the RPA Action I.1.6 and the CVPIA Clear Creek Restoration Program which has a mandate under CVPIA to provide a long-term flow prescription to mitigate for the impacts of the CVP.

NMFS will review this report and determine whether the proposed operational flows are sufficient to avoid jeopardizing spring-run and CV steelhead or adversely modifying their critical habitats. Reclamation shall implement the flows on receipt of NMFS' written concurrence. If NMFS does not concur, NMFS will provide notice of the insufficiencies and alternative flow recommendations. Within 30 days of receipt of non-concurrence by NMFS, Reclamation shall convene the CCTT to address NMFS' concerns. Reclamation shall implement flows deemed sufficient by NMFS in the next calendar year.

Recommendations: Working with NMFS and the CCTT, Reclamation should assess if Clear Creek flows should be further adapted to reduce adverse impacts on spring-run Chinook and steelhead and encourage the restoration of these runs/species.

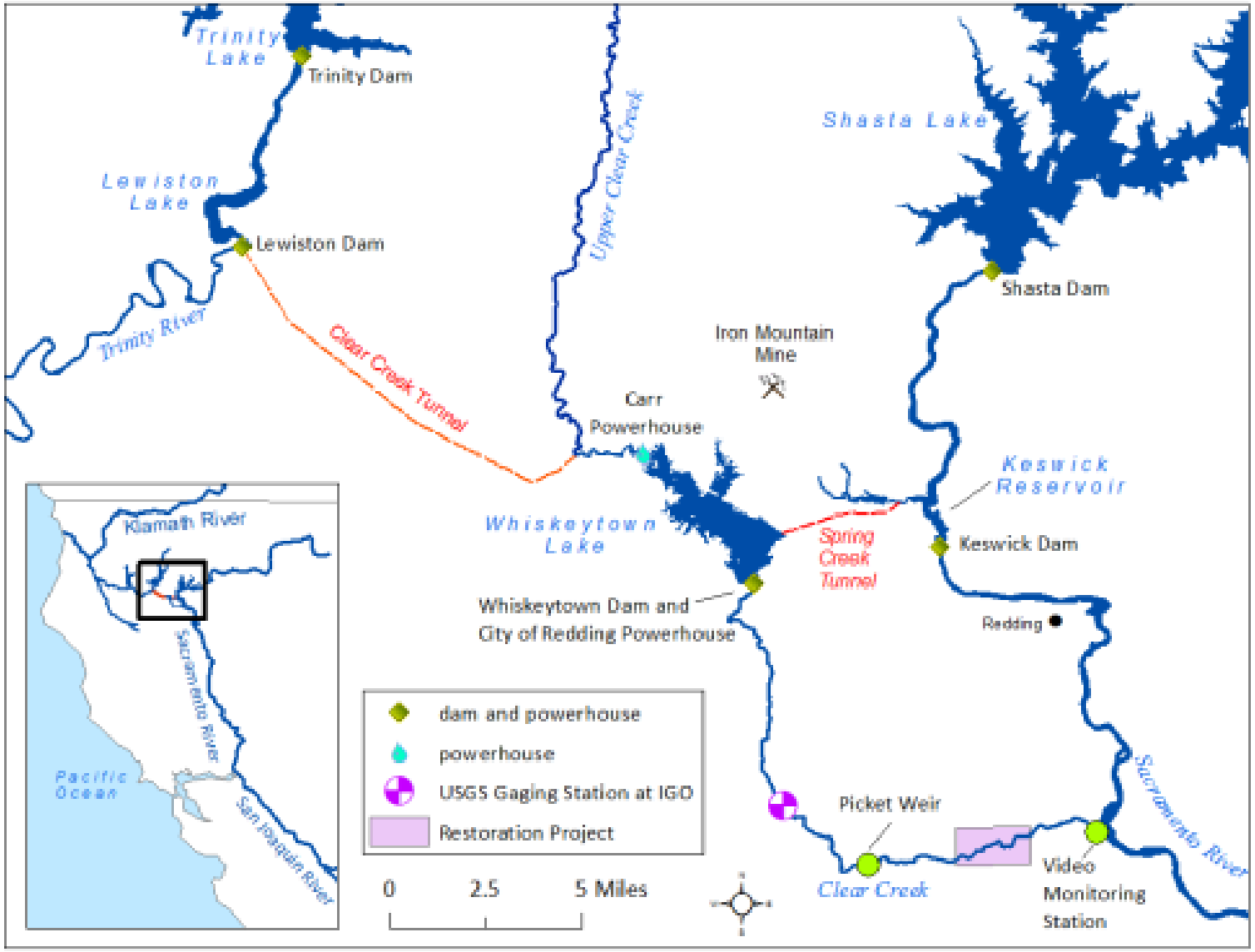

Figure 1. Location of Lower Clear Creek in Northern California, showing Trinity, Whiskeytown, and Shasta Reservoirs and related CVP facilities.

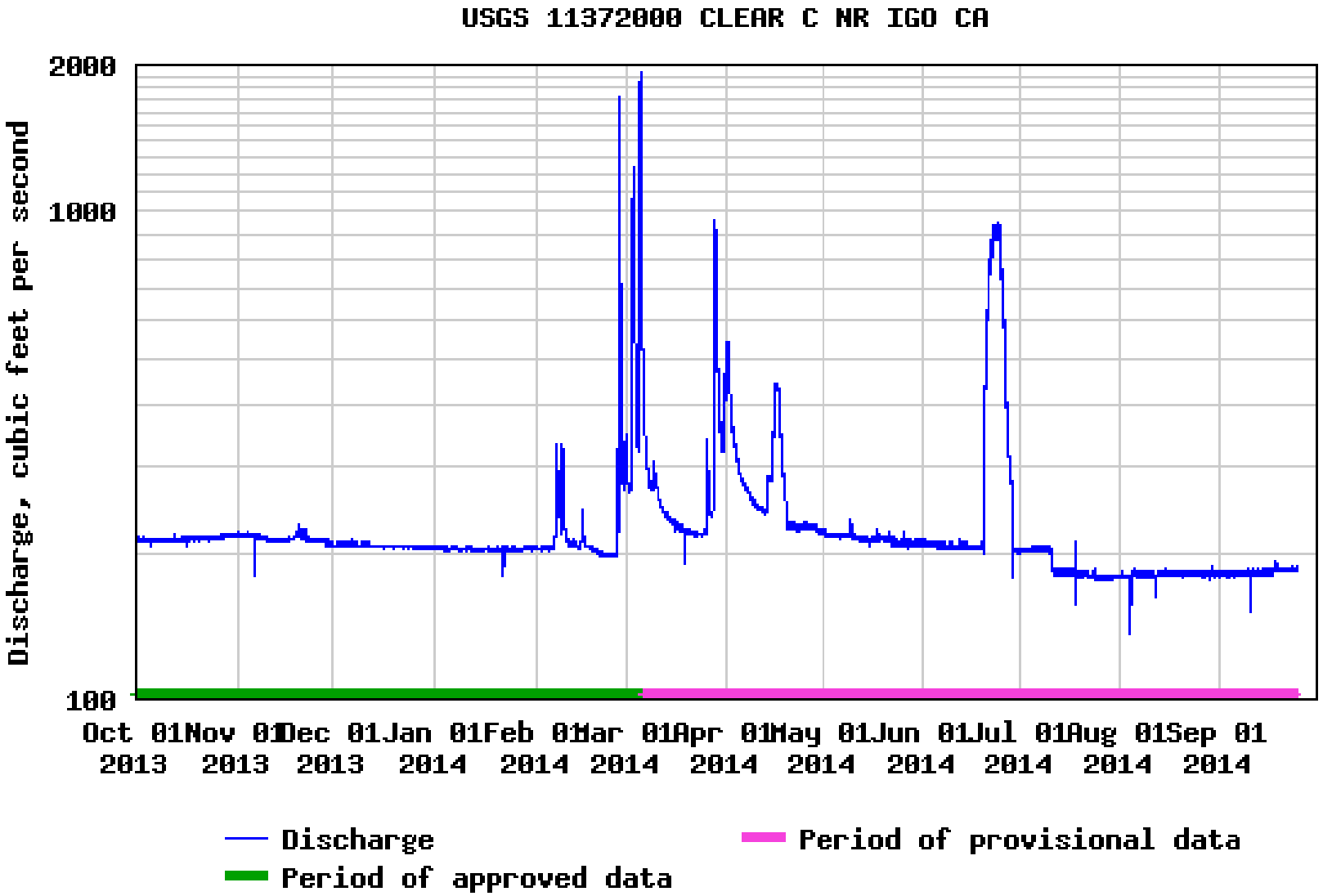

Figure 2. Clear Creek at Igo Water Year 2014 annual hydrograph.

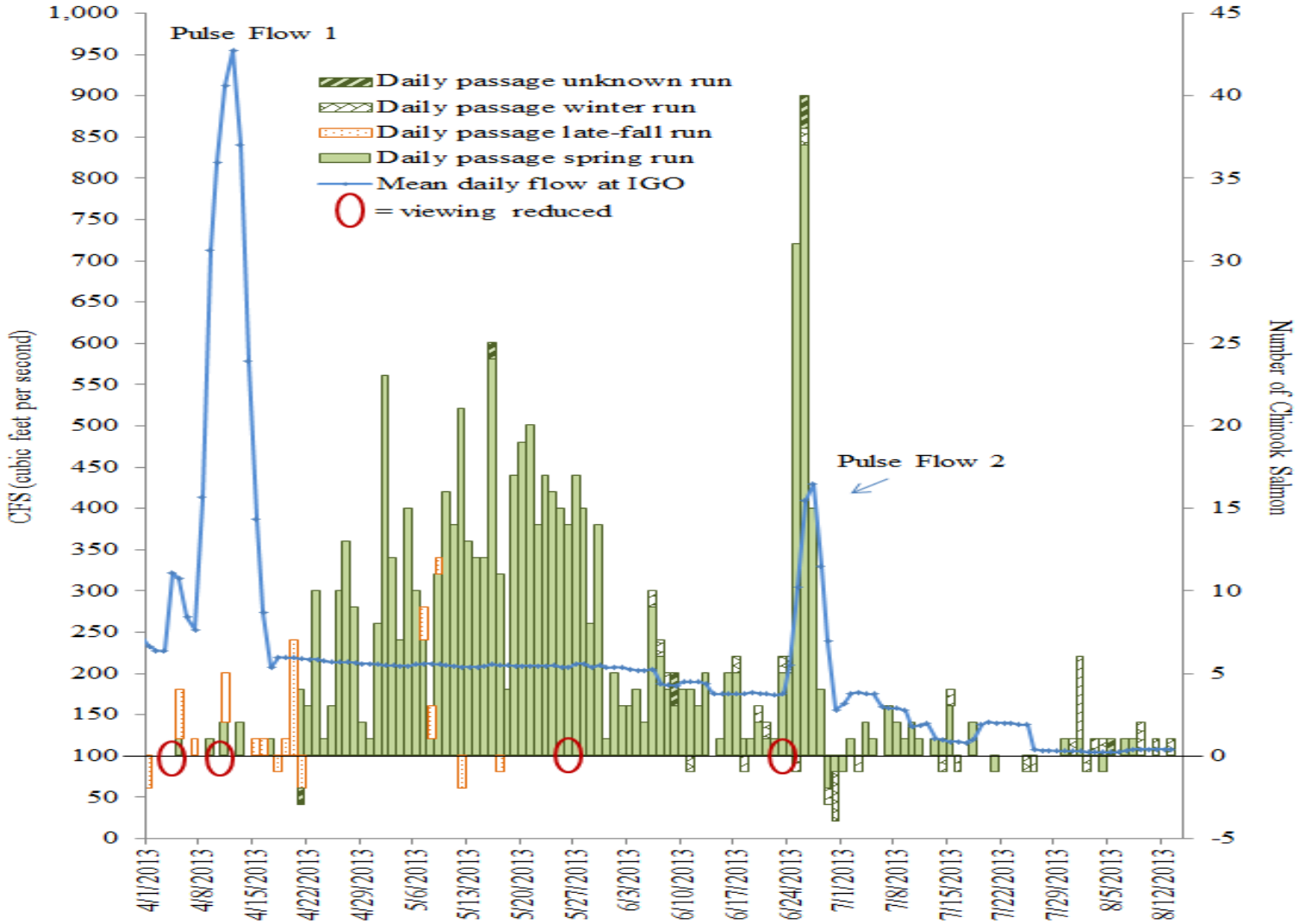

Figure 3. Adult spring-run Chinook passage in Clear Creek during 2013 pulse flow events in April and July.

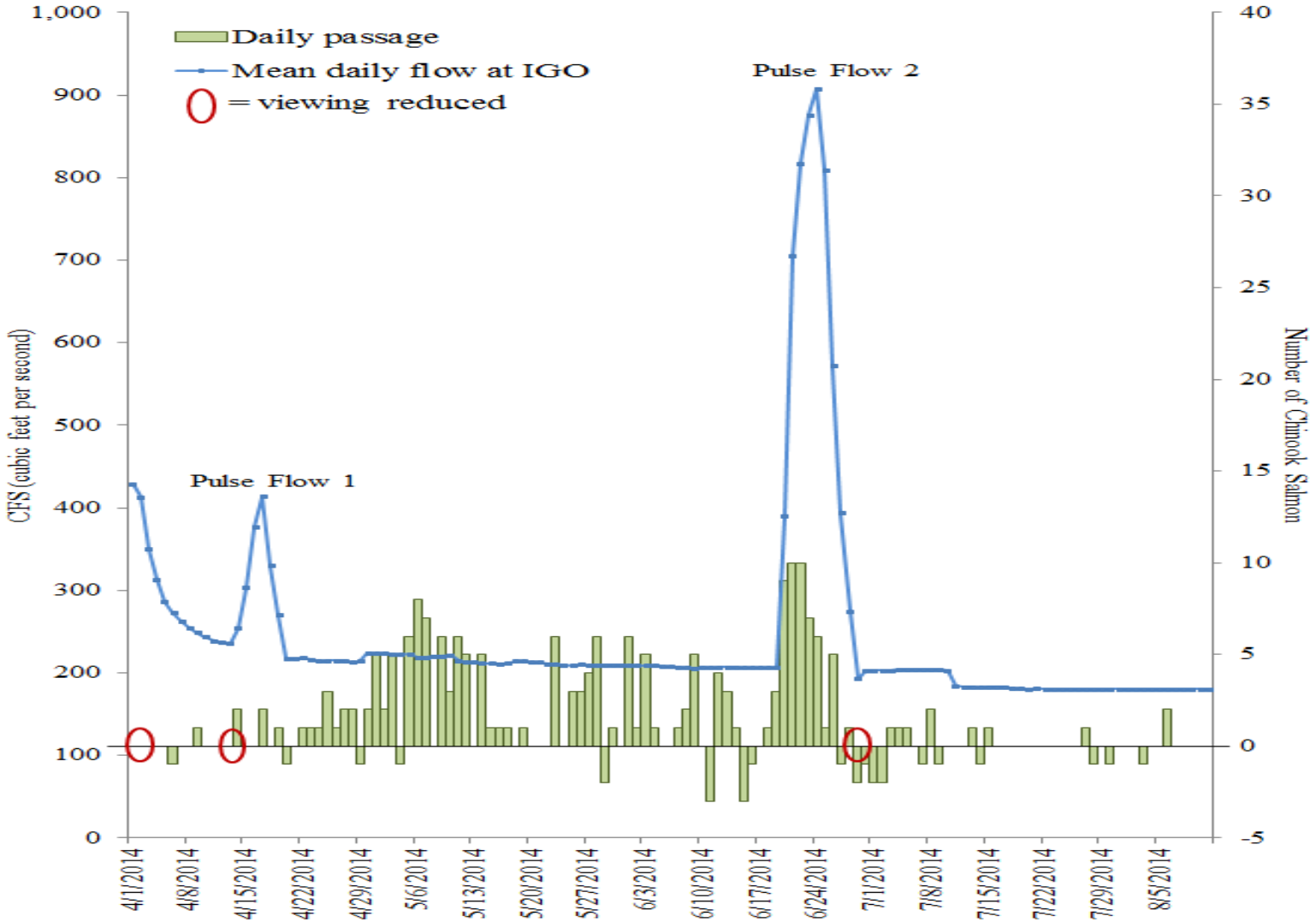

Figure 4. Adult spring-run Chinook passage in Clear Creek during 2014 pulse flow events in April and July.

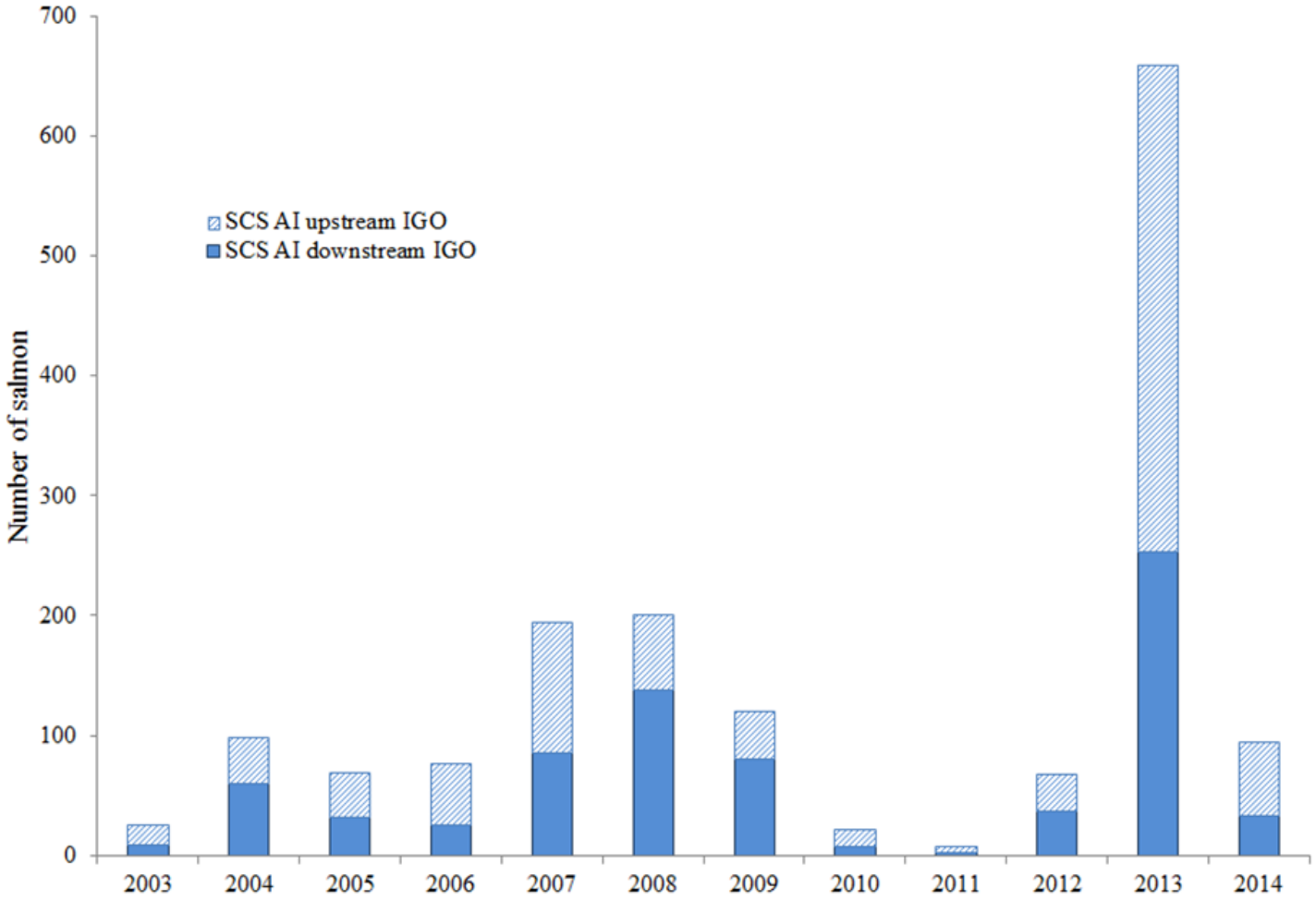

Figure 5. Spring Chinook salmon (SCS) returns to Clear Creek, 2003 to 2014.

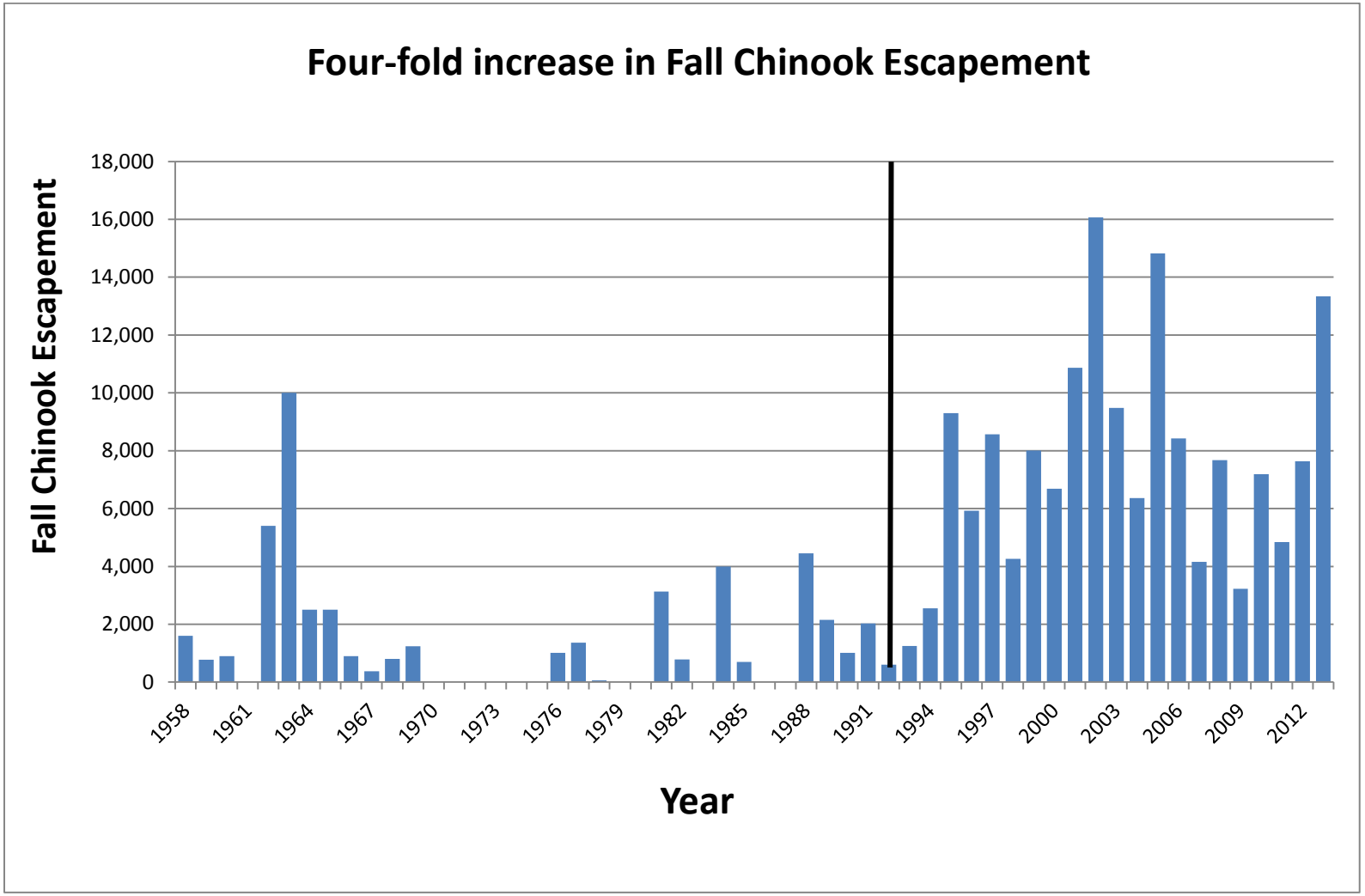

Figure 6. Fall Chinook escapement into Clear Creek increased four to five fold since restoration began in 1992. The CVPIA doubling goal for Clear Creek is 7,100 adults. The 1993 to 2013 average was 7,648.

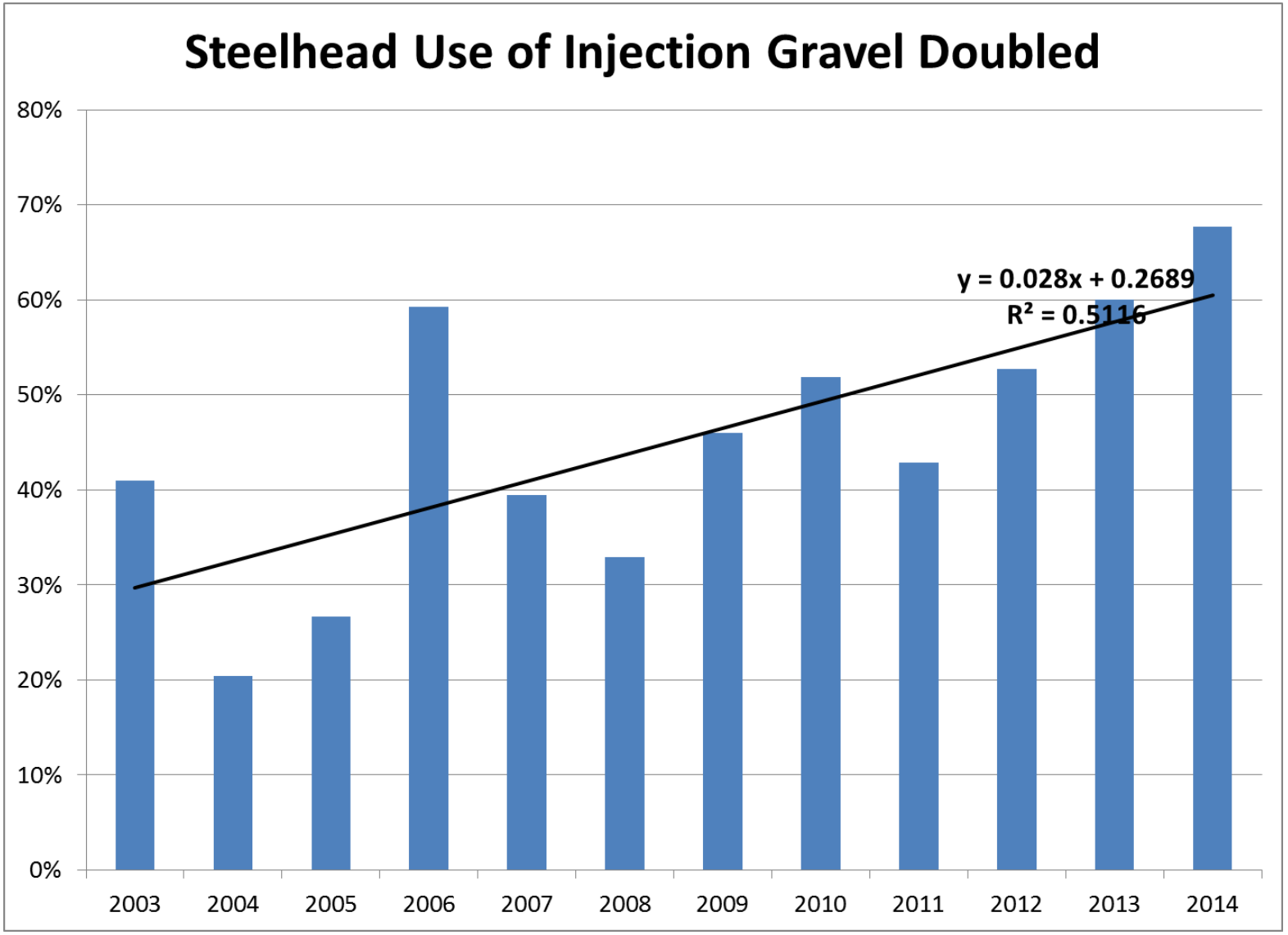

Figure 7. Increase in use of spawning habitat by steelhead, for the 2003 to 2014 period.

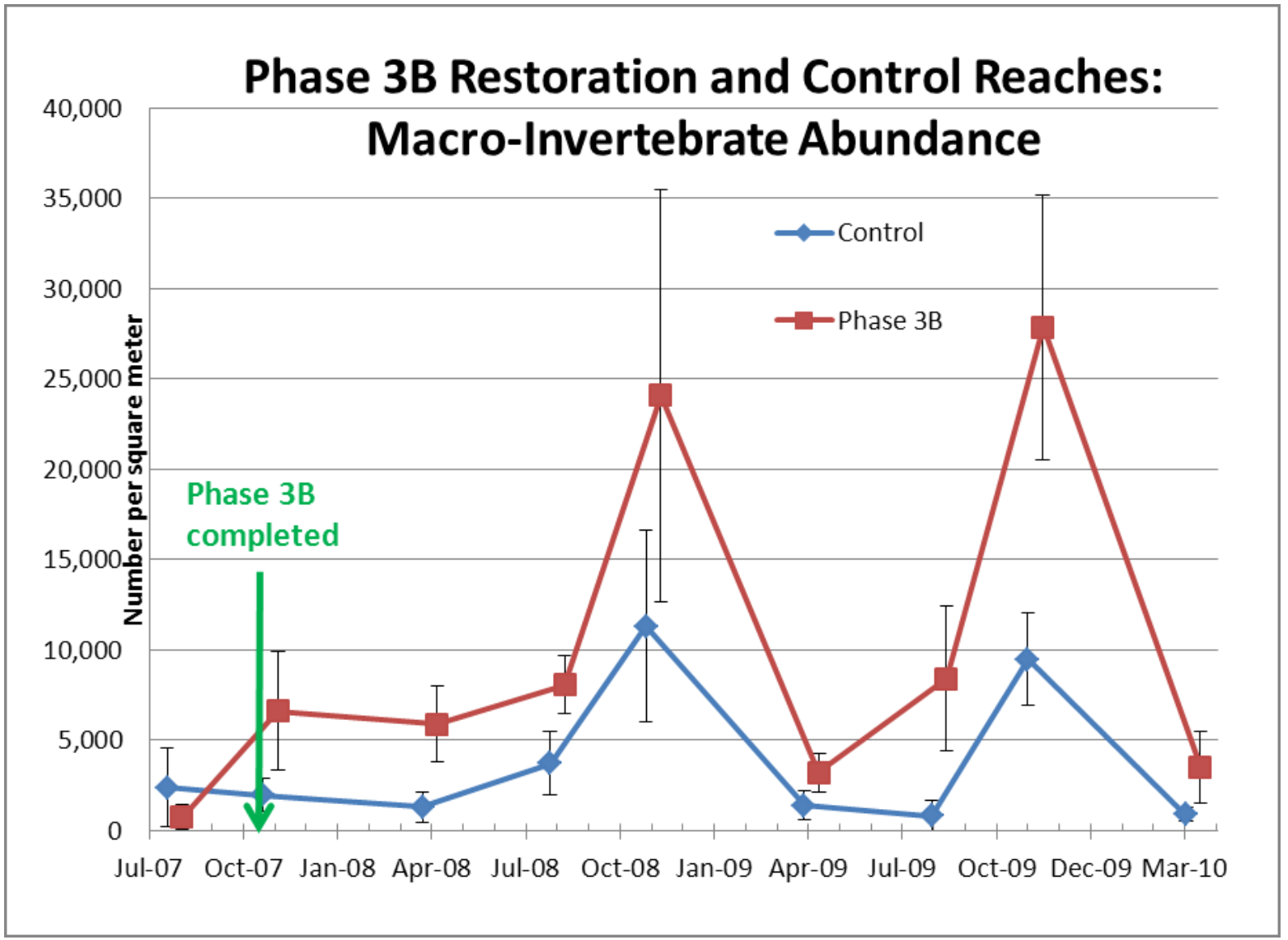

Figure 8. Higher abundance of macroinvertebrates in Phase 3B restoration project.

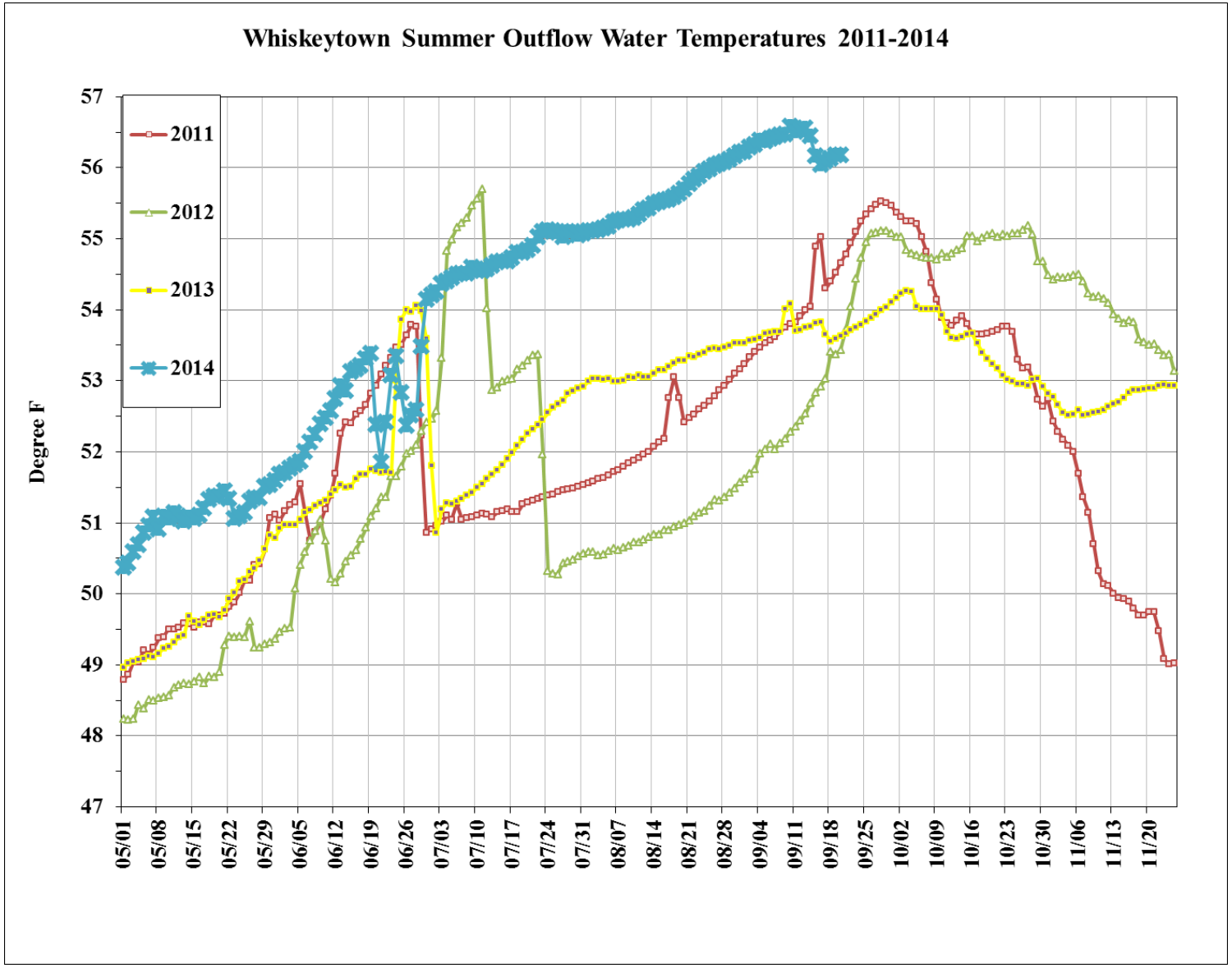

Figure 9. Summertime Whiskeytown Dam outflow water temperatures 2011 to 2014.

Acronyms and Abbreviations

BO	Biological Opinion
CCRP	Clear Creek Restoration Program
CCTT	Clear Creek Technical team
CDFW	California Department of Fish and Wildlife
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
GMA	Graham Matthews and Associates
IFIM	Instream Flow Incremental Methodology
NOAA-Fisheries	(National Marine Fisheries Service)
OBTCC	Oak Bottom Temperature Control Curtain
Reclamation	U.S. Bureau of Reclamation
RBFWO	Red Bluff Fish and Wildlife Office
rm	river mile
RPA	Reasonable and prudent alternative
SCTCC	Spring Creek Temperature Control Curtain
TCC	Temperature control curtain