PACIFIC GAS AND ELECTRIC COMPANY

Hat Creek Hydroelectric Project, FERC No. 2661
Pit 1 Hydroelectric Project, FERC No. 2687

Shasta Crayfish Technical Review Committee 2009 Annual Report

May 2010

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Shasta Crayfish Technical Review Committee
2009 Annual Report

Addressing License Articles 409, 410, 411, 412, and 413
Hat Creek Hydroelectric Project (FERC No. 2661, USFWS Biological Opinion 1-1-02-F-0182)
Pit 1 Hydroelectric Project (FERC No. 2687, USFWS Biological Opinion 1-1-00-F-0210)
Upper Fall River Crayfish Barrier Project (USFWS Biological Opinion 1-1-07-F-0333)
PG&E's USFWS Recovery Permit TE-755945-3
Spring Rivers' USFWS Recovery Permit TE-806679-3

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Executive Summary

The Federal Energy Regulatory Commission (FERC) licenses for Pacific Gas and Electric Company's (PG&E) Hat Creek Hydroelectric Project (FERC No. 2661) and Pit 1 Hydroelectric Project (FERC No. 2687) require the formation of a technical review committee (TRC) to oversee certain management activities for the endangered Shasta crayfish (*Pacifastacus fortis*). Consequently, the Shasta Crayfish TRC, which consists of representatives from both federal and state agencies, academia, PG&E and other members of the private sector, was formed in April 2003. As stated in both licenses, the TRC's role is to assist in the design and implementation of the terms and conditions required in the biological opinions for the protection and recovery of the Shasta crayfish in the two project areas. In addition to license implementation, the TRC expanded its role to include species recovery throughout the range of the Shasta crayfish. As a result, the United States Fish and Wildlife Service (USFWS) formed the Shasta Crayfish Recovery Team, which is comprised of a subset of TRC members. TRC actions are defined as Shasta crayfish actions specifically required by a FERC license, whereas Recovery Team actions are not specifically required by a FERC license. Although originally restricted to within the FERC Project boundary, TRC as well as Recovery Team activities can occur outside the Project boundary or on lands not owned by PG&E. All members agreed that TRC actions would be done where it most benefited the Shasta crayfish and would not be restricted by FERC project boundaries.

TRC Activities

TRC actions include TRC/Recovery team meetings, crayfish monitoring and habitat delineation, removal or eradication of non-native signal crayfish (*Pacifastacus leniusculus*) and non-native fantail crayfish (*Orconectes virilis*), implementation of the Crayfish Barrier Plan, development and installation of Shasta crayfish interpretive and education signs, and investigations into the reintroduction of Shasta crayfish into Rock Creek. In 2009, these activities included the third round of the Pit 1 crayfish monitoring surveys (2009/2010), non-native crayfish removal surveys at Thousand Springs and Springs Creek, the installation of the California Department of Fish and Game (CDFG) fishing regulation sign at the Crystal Lake Outflow, and planning related to the

development of a Rock Creek Shasta Crayfish Reintroduction Plan, including a Rock Creek Restoration Plan.

Recovery Team Activities

Recovery Team actions include the Sucker Springs Restoration Project and the temperature and genetics studies being conducted by the CDFG.

The Sucker Springs Restoration Project involves the re-establishment of a natural channel, removal of non-native crayfish, and construction of crayfish barriers to maintain an allopatric subpopulation of Shasta crayfish. Non-native crayfish surveys continued in 2009. In addition, two crayfish barriers were constructed in Ponds 4 and 5 of Sucker Springs Creek to prevent signal crayfish from moving upstream from the Pit River and lower Sucker Springs.

CDFG received a third grant authorized under Section 6 of the Endangered Species Act for the Shasta crayfish Genetics Study. The study is being conducted at the Genomic Variation Laboratory of Bernie May, Ph.D. at the University of California, Davis. The Section 6 Funding proposal, which was submitted on June 1, 2009 and funded for 2010, includes:
(1) Mitochondrial DNA work on existing Shasta crayfish genetic samples; (2) Development of a Genetic Management Plan; and (3) Refugia investigation.

As part of the CDFG Temperature Study, temperature recorders were deployed in 2009 in order to document the range of water temperatures experienced by extant Shasta crayfish populations. Data loggers placed in Shasta crayfish locations strongly influenced by spring accretion (e.g., Thousand Springs, Big Lake Springs) recorded relatively constant water temperatures throughout the year. In these areas, mean daily water temperatures ranged from about approximately 9.5 to 12.5 °C. In areas with less spring influence (e.g., Pit River and Big Lake Levee), mean daily water temperatures ranged from approximately 2.5 to 26.0 °C. Temperature recorders were also deployed at both locations where Shasta crayfish were found in the Pit 1 Bypass Reach upstream of the Pit River Falls. In the upper location, Shasta crayfish were found in coldwater refugia habitat created by springs in the Pit 1 Bypass Reach. In the lower location, Shasta crayfish were found in mainstem Pit River in an area of the Pit 1 Bypass Reach not influenced by springs.

During summer flushing flows in July and August 2009, temperature monitoring documented the resultant increase in temperature and loss of thermal refugia habitat during summer pulsed flows. Summer flushing flows increased the maximum daily water temperatures and resulted in rapid and substantial changes in the temperature within the area influenced by coldwater springs. In the mainstem habitat, summer flushing flows in the Pit 1 Bypass Reach muted the maximum and minimum daily water temperatures, overwhelmed the effects of fluctuating day-to-night air temperatures, and eliminated diel thermal refugia.

Based on these findings, the TRC/Recovery Team reiterates its recommendation made at the Shasta Crayfish TRC/Recovery Team Year 5/6 Review Workshop held in April 2009 that summer flushing flows in the Pit 1 Bypass Reach be eliminated because they reduce or eliminate coldwater habitat for Shasta crayfish and provide beneficial habitat for the competitor/predator non-native signal and fantail crayfish.

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Introduction

In 2002 and 2003, the Federal Energy Regulatory Commission (FERC) issued licenses for two Pacific Gas and Electric Company (PG&E) hydroelectric projects in northeastern California (Shasta County). The licenses for the Hat Creek Hydroelectric Project (FERC No. 2661) and the Pit 1 Hydroelectric Project (FERC No. 2687) were issued on 4 November 2002 and 19 March 2003, respectively. Both licenses contain Articles designed to monitor and protect the federally and state-listed endangered Shasta crayfish (*Pacifastacus fortis*), which exists in both project areas (Figure 1). The licenses include measures to protect Shasta crayfish from non-native, invasive crayfish. The non-native signal crayfish (*Pacifastacus leniusculus*), which is both a competitor and predator of the Shasta crayfish, is considered the greatest threat to the continued existence of the Shasta crayfish (USFWS 1998, Ellis 1999). The non-native fantail crayfish (*Orconectes virilis*) is also found within the range of the Shasta crayfish.

In both the Hat Creek and Pit 1 licenses (Appendix A), Article 410 requires PG&E to establish a technical review committee (TRC) to assist PG&E in the design and implementation of the terms and conditions required in the biological opinions for Shasta crayfish protection and recovery in the two project areas. Article 409 of each license requires the development of a plan to monitor the habitat and populations of Shasta crayfish in the project areas. Article 412 of each license requires the development of a Shasta crayfish management plan, including provisions to fund non-native signal crayfish removal. Article 413 of the Pit 1 license requires the development of a plan to construct and maintain a minimum of two exclusion barriers to protect Shasta crayfish habitat from invasion by signal crayfish. Article 413 of the Hat Creek license and Article 416 of the Pit 1 license require the development of recreational management plans to educate the public about the status of Shasta crayfish, including potential threats from recreational activities.

The TRC was established in April 2003 in coordination with the United States Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG), and other resource agencies and interested stakeholders. The TRC consists of representatives from USFWS, CDFG, California Department of Parks and Recreation (CDPR), Spring Rivers Ecological Sciences LLC (Spring Rivers), academia, and PG&E. In addition to helping PG&E implement the terms and

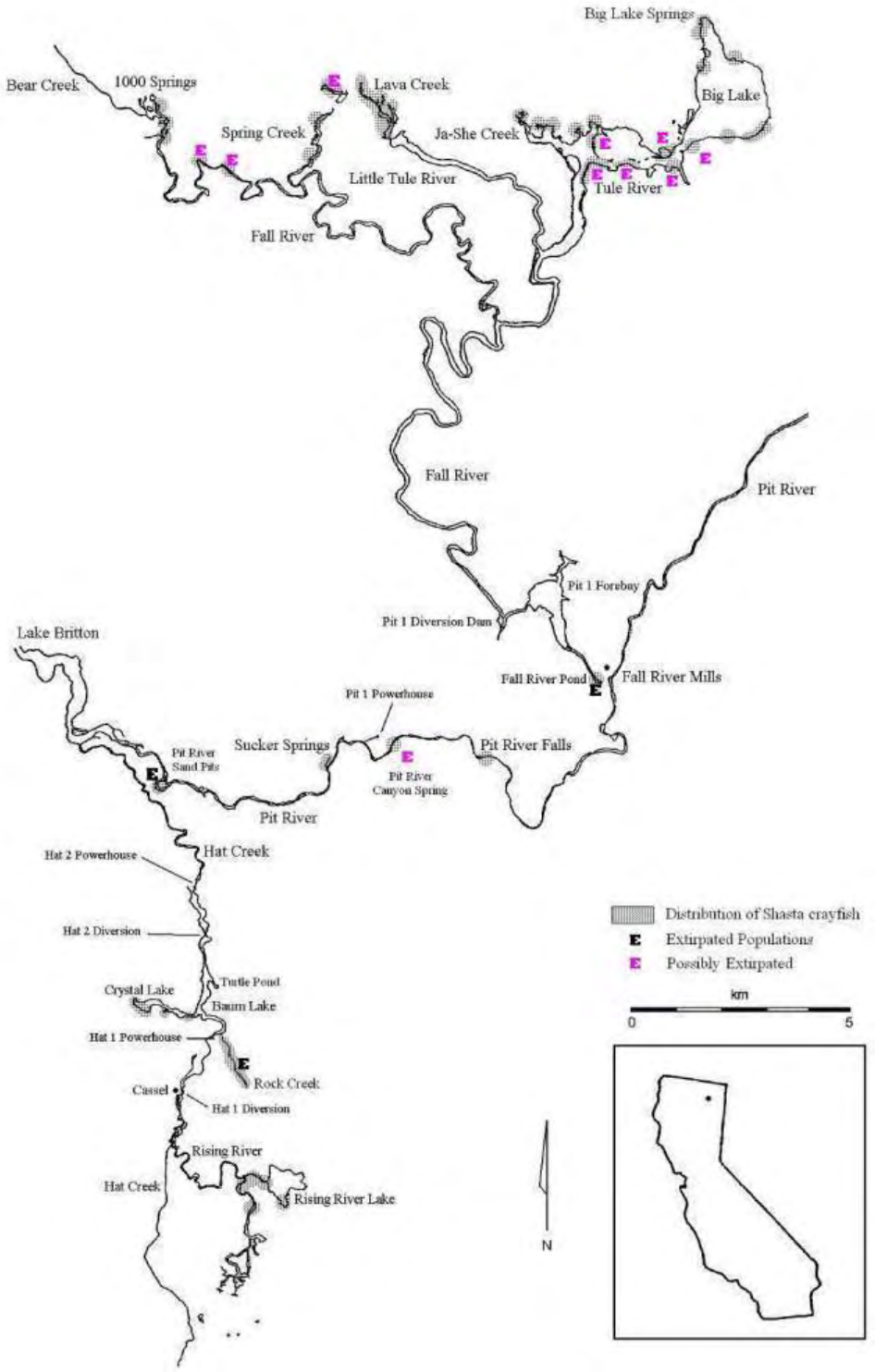

Figure 1 Known distribution of the Shasta crayfish (*Pacifastacus fortis*).

conditions of the license, the TRC also serves as a working group for other Shasta crayfish recovery projects. As a result, the USFWS formed the Shasta Crayfish Recovery Team (Recovery Team), which is comprised of a subset of TRC members. TRC actions are defined as Shasta crayfish actions specifically required by a FERC license, whereas Recovery Team actions are not specifically required by a FERC license. Although originally restricted to within the FERC Project boundary, TRC as well as Recovery Team activities can occur outside the Project boundary or on lands not owned by PG&E.

To address the requirements of Articles 409 and 412 in each project license, a Shasta Crayfish Management Plan (Plan) was written in consultation with the USFWS, CDFG, Natural Resources Conservation Service, and interested stakeholders. FERC approved the Hat Creek Plan (PG&E 2003a), which includes crayfish monitoring and management and recreational management (Article 413) components, on 30 April 2003. FERC approved the Pit 1 Plan (PG&E 2003b), which includes crayfish monitoring and management components on 7 July 2004.

The two Shasta Crayfish Plans (PG&E 2003a, 2003b) specify the following three monitoring tasks: (1) map and quantify the existing habitat in the Project areas; (2) collect baseline data on Shasta crayfish in delineated habitat areas; and (3) monitor Shasta crayfish in delineated habitat areas over the length of the license. The first two tasks have been completed, and the third continues to be implemented. Table 1 provides the implementation schedule for these tasks over the course of the two licenses. In addition, the Plans call for the removal of non-native crayfish found during the monitoring surveys. The Hat Creek Plan calls for formulation of a plan to reintroduce Shasta crayfish to Rock Creek, a spring-fed tributary to Baum Lake (Figure 1).

Both Shasta Crayfish Plans specify that habitat and populations of Shasta crayfish will be monitored within the respective Project areas. During the 3 May 2007 meeting, however, the TRC approved the inclusion of all known Shasta crayfish locations (e.g., Rising River, Rainbow Spring, Lava Creek, Thousand Springs, etc.) in the study area for the surveys outlined in the Plans. The expansion of the study areas resulted in no additional monetary requirements, and facilitated sample collection for the genetic study. The additional survey sites are scheduled

Table 1 Schedule [a] of Shasta crayfish surveys included in the Hat Creek and Pit 1 Shasta crayfish management plans

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Hat license year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30											
Pit license year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Hat Surveys [b]	1	2			5					10					15					20					25					30												
Pit Surveys [c]		1			4		6				10					15					20					25					30					35					39	

[a] Schedule was revised because the initial baseline Pit 1 Project surveys took 3 years. It was approved during the 3 May 2007 TRC meeting.
[b] Surveys for the Hat Creek Project are scheduled for years 1, 2, 5, 10, 15, 20, 25, and 30 of the license.
[c] Baseline Pit 1 Project surveys took 3 years; future surveys will take 1-2 years each and are scheduled for years 4/5, 6/7, 10/11, 15/16, 20/21, 25/26, 30/31, 35/36, and 39/40 of the license.

when there are monitoring funds available, for instance during years when regular monitoring surveys are not scheduled (e.g., 2008 through 2011 for Hat Creek; see Table 1).

Articles 411 and 412 of both the Hat Creek and Pit 1 licenses require PG&E to establish Shasta crayfish management funds to cover the cost of monitoring, non-native crayfish removal, and other TRC-approved Shasta crayfish activities. The annual amounts for crayfish surveys (Article 411) and non-native crayfish removal (Article 412) are adjusted annually from the original amounts stated in the licenses (2003 dollars for Hat and 2004 dollars for Pit 1) based on the Consumer Price Index as specified in the license. During years in which monitoring surveys are not scheduled (e.g., 2008–2011, years 6 through 9 of the Hat Creek license) or when the annual management funds are not completely spent, the remaining annual management funds are allocated as recovery funds to be used for other TRC-approved Shasta crayfish projects, such as the Sucker Springs Creek Restoration Project. Shasta crayfish management/recovery funds that are not spent during the year roll over to subsequent years. Beginning in 2008, barrier non-native crayfish control funding and implementation included the Spring Creek barrier project (i.e., Spring Creek Road Crossing Cavity-Filling Project). Appendix B provides a summary of the Shasta crayfish management funds, including barrier non-native crayfish control, for both licenses through 1 April 2010.

As required by Article 413 of the Pit 1 license, PG&E developed and implemented a Crayfish Barrier Plan (PG&E 2006) to construct and maintain a minimum of two exclusion barriers to protect Shasta crayfish and their habitat from invasion by signal crayfish and other non-native crayfish species. The Crayfish Barrier Plan, which was approved by FERC on 8 March 2007, included the following four required elements: (1) provisions to fund the design and construction of two crayfish barriers; (2) detailed design drawings and map locations of the exclusion barriers; (3) a schedule for construction and initial performance testing; and (4) a monitoring and reporting schedule for long-term evaluation of barrier effectiveness. The first three elements have been completed, and the fourth continues to be implemented.

Both Crayfish Barrier Plan projects were completed in 2007 (Spring Rivers 2007). The upper Fall River crayfish barrier, which is located outside the Pit 1 Project area, was installed just

downstream of the large Shasta crayfish population at Thousand Springs. Annual non-native crayfish removal surveys have been conducted in Thousand Springs upstream of the barrier to control the signal crayfish population since 2007. The second project was the improvement of the Spring Creek Road crossing, where culverts create velocity barriers to signal crayfish that occur downstream in lower Spring Creek and Fall River. The crossing was improved by filling in crevices and gaps surrounding the culverts thereby eliminating habitat being used by signal crayfish. Annual surveys to remove signal crayfish have also been conducted in Spring Creek upstream of the culverts since 2007. In addition to the Crayfish Barrier Plan, the USFWS Biological Opinion and Incidental Take Statement (1-1-07-F-0333) for the Upper Fall River Crayfish Barrier Project also include reporting requirements. To streamline reporting, PG&E requested and USFWS agreed to a change in the deadline for reporting on post-construction monitoring, including the non-native crayfish removal surveys, from the 1st of January to the 31st of May each year (Spring Rivers 2009). The extension allows the monitoring results to be included in the annual reports for the TRC.

In 2009, the Shasta Crayfish TRC/Recovery Team Year 5/6 Review Workshop was held on April 22. The purpose of the meeting was to review the first five and six years of monitoring for the Pit 1 and Hat Creek projects, respectively. On 28 May 2009, PG&E submitted to FERC the Shasta Crayfish Technical Review Committee Summary Report (Spring Rivers 2009), which summarized all Shasta crayfish TRC and/or Recovery Team activities between April 2003 and April 2009 and provided recommendations for future activities.

This annual report is divided into two parts: (1) TRC activities, including the crayfish monitoring from January 2009 through March 2010, and (2) Recovery Team activities, including the Sucker Springs Restoration Project and CDFG's temperature and genetics studies. Because the third Pit 1 monitoring survey has not been completed yet, there is no comparison of the results with those collected during earlier surveys.

Technical Review Committee Activities

This document reports on the Shasta crayfish management activities in 2009 and early 2010, which include: (1) TRC/Recovery team meetings; (2) Rock Creek site visits with PG&E; (3) the status and results to date from the on-going third Pit 1 crayfish monitoring survey; and (4) verification and correction of delineated crayfish habitat.

2009 and 2010 Meetings

The TRC and Recovery Team held joint meetings on 22 April 2009, 15 September 2009, and 9 March 2010 (see Appendix C for Meeting Agendas and Summaries). The 2010 fall TRC/Recovery Team meeting is scheduled for 14 September 2010.

On 18 March 2009, Spring Rivers' personnel met with PG&E personnel at Rock Creek to review issues related to potential habitat restoration. A second site visit with Spring Rivers and PG&E personnel was held on 11 May 2010 to discuss the geological and hydrological conditions on Rock Creek.

Crayfish Barriers

The upper Fall River crayfish barrier at Thousand Springs appears to function as planned and requires minimal, if any, maintenance. During crayfish surveys, the barrier was inspected for integrity and the presence of debris and/or algal growth that could compromise the barrier. In addition to snorkel surveys, Thousand Springs' personnel also monitored for the presence of debris or other disturbances to the barrier. Table 2 provides a summary of the upper Fall River barrier inspection, including dates, persons conducting the inspection, and details pertaining to cleaning, debris loading, algal growth, or other pertinent barrier information.

The 2009 non-native crayfish removal survey data are reported in the Non-Native Crayfish Removal Surveys section of this report.

Table 2 Upper Fall River barrier inspection summary.

Date	Inspector(s)	Comments
January 26, 2009	Stalcup, Breedveld	Surface clean and free of debris and snails
July 28, 2009	Stalcup, Haley	Surface clean and free of debris and snails

Rock Creek Reintroduction

Pursuant to the Hat Creek Shasta Crayfish Management Plan (PG&E 2003a), investigations to assess the feasibility of the restoration of Rock Creek and subsequent reintroduction of Shasta crayfish began in 2003. Based on reliable anecdotal evidence, Shasta crayfish inhabited Rock Creek up until 1950 when the majority of the flow was diverted near the upper end of the perennially wetted channel to supply CDFG's Crystal Lake Fish Hatchery. The stream was subsequently rotenoned in 1962 and 1963 (Schafer 1968). Reintroduction of Shasta crayfish into Rock Creek restoration area would require rewatering some portion of the channel, which still retains suitable cobble and boulder substrate, to restore natural crayfish habitat. In order to do that, however, several concerns need to be addressed, including: (1) ensure that CDFG's water needs for the Crystal Lake Fish Hatchery continue to be met, (2) a high level of confidence that a reintroduced Shasta crayfish population would be viable and protected from invasion by non-native crayfish, and (3) determine an appropriate source population for the reintroduction.

In 2009, Spring Rivers' personnel met with PG&E personnel at Rock Creek to review the site and issues related to potential habitat restoration and to help plan the next steps. In addition, the development of a Rock Creek Restoration Plan, including measures to ensure that the water needs for the Crystal Lake Fish Hatchery continue to be met and to restore historical Shasta crayfish habitat, was begun in 2009 as the first part of a proposal to reintroduce Shasta crayfish to Rock Creek. On 11 May 2010, PG&E and Spring Rivers, including staff with expertise in hydrology, geology, and biology, met at the planned restoration site to investigate the geological and hydrological conditions on Rock Creek and to determine the feasibility of moving the CDFG hatchery intake structure downstream. During the site visit, John Woodruff, a PG&E groundwater geologist, found no indications that the meadow reach between the current diversion and the proposed diversion location downstream was a losing reach. He suggested that PG&E monitor water discharge at the current diversion and the proposed downstream diversion over a course of a year to verify that it is not a losing reach. The most reliable method of measuring discharge at these locations would be to install temporary measuring weirs.

Shasta Crayfish Interpretive and Education Signs

In compliance with Article 413 of the Hat Creek license and Article 416 of the Pit 1 license, PG&E developed interpretive and education (I&E) signs that were installed at designated locations in 2008 (Spring Rivers 2009). In 2009, PG&E installed a permanent version of CDFG's regulation sign that needed to be replaced annually at the outflow of Crystal Lake. This sign posts the CDFG regulation prohibiting fishing in the Crystal Lake Outflow from November 16th through the last Friday in April (Figure 2). In addition to protecting spawning wild rainbow and brown trout, redds, and spawning habitat, this CDFG regulation protects Shasta crayfish in the shallow outflow area of Crystal Lake from disturbance by wading.

Crayfish Monitoring

Crayfish monitoring surveys were implemented in delineated habitat areas for the Pit 1 Project. No surveys were scheduled for the Hat Creek Project in 2009.

Surveys were conducted by snorkelers and/or scuba divers who first inspected the undisturbed substrate before turning over individual cobbles and boulders. Snorkel/scuba hand-removal surveys for crayfish result in little bias in terms of gender or age class as compared to other sampling methods such as trapping (Abrahamsson 1971, Westman et al. 1978, Ellis 1999). All crayfish encountered, regardless of species, were collected, except Shasta crayfish too small to be handled safely. To minimize possible injury, Shasta crayfish were kept separate from introduced crayfish species in either a rigid tube collector or in a bucket with water. After data collection, Shasta crayfish were released next to the rock where they were found and observed until they moved back underneath the rock. Non-native crayfish were destroyed after data collection.

The following data were recorded for each collected crayfish: (1) species, (2) size measured as total carapace length (TCL) with vernier or dial calipers to the nearest tenth of a millimeter, (3) sex of crayfish greater than approximately 12 mm TCL, (4) general condition (e.g., reproductive state, missing appendages, and molt state), and (5) area or zone of capture. Crayfish less than 10 to 12 mm TCL cannot be reliably sexed and were therefore grouped as young of year (YOY). Shasta crayfish reach sexual maturity at approximately 27 mm TCL,

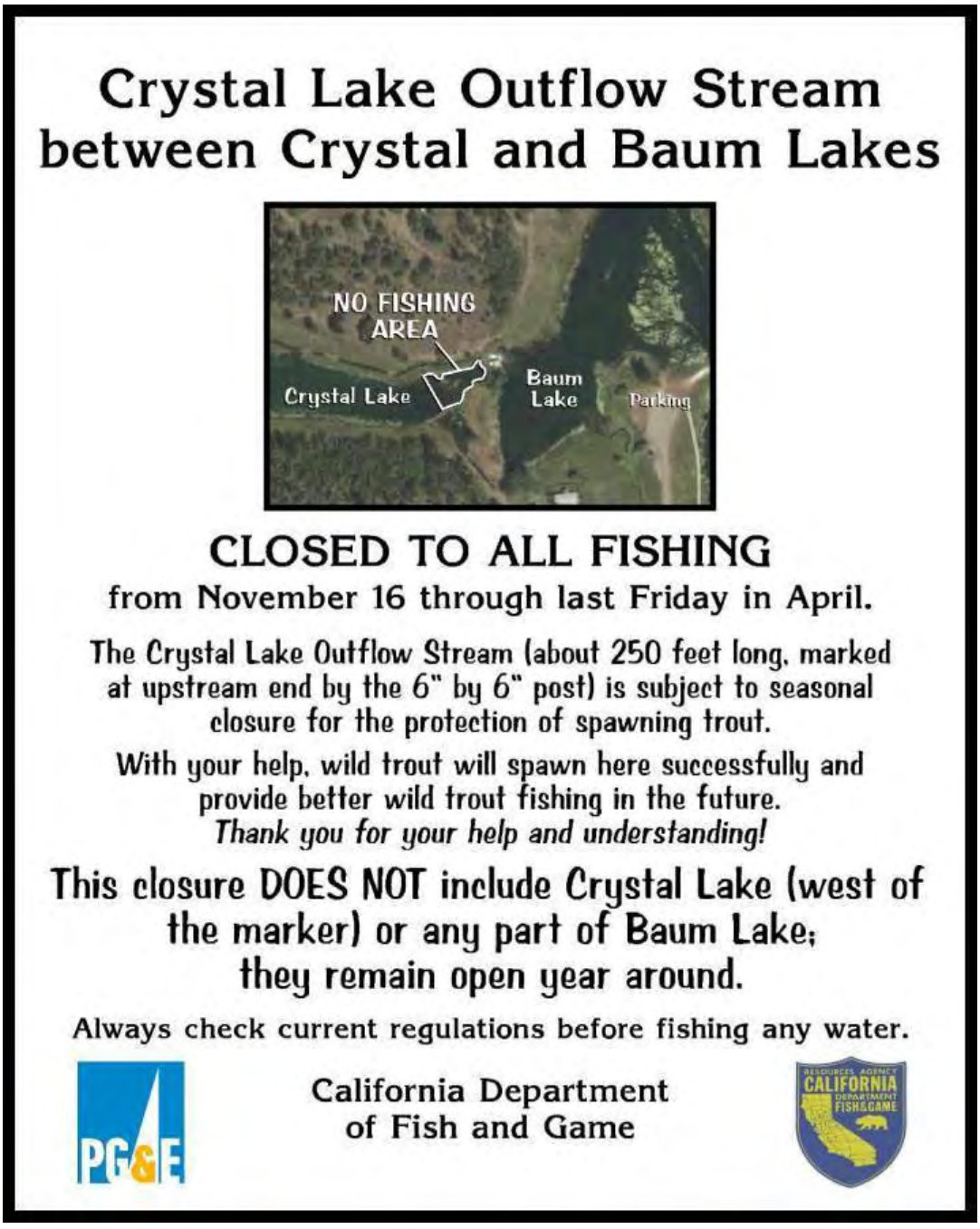

Figure 2 Crystal Lake Outflow sign posting the CDFG regulation prohibiting fishing in the Crystal Lake Outflow from November 16th through the last Friday in April.

whereas signal crayfish reach sexual maturity at approximately 30 mm TCL (Ellis 1999). Fantail crayfish can reach sexual maturity at approximately 19 mm TCL (Spring Rivers unpublished data). Shasta crayfish between 10 and 27 mm TCL were categorized as juveniles, and those greater than 27 mm TCL were categorized as adults. Signal crayfish between 12 and 30 mm TCL were categorized as juveniles, and those greater than 30 mm TCL were categorized as adults. Fantail crayfish between 10 and 19 mm TCL were categorized as juveniles, and those greater than 19 mm TCL were categorized as adults.

Crayfish densities were calculated for the monitoring surveys based on the number of individuals found within each survey site. Because the vast majority of Shasta crayfish were found in areas classified as either prime or adequate habitat in most sites, the total area of prime and adequate habitat was used for density calculations.

Pit 1 Crayfish Surveys

The third round of crayfish surveys for the Pit 1 Project was begun in 2009 and will be completed in 2010. Shasta crayfish have not been found in the Fall River at Fletcher's Bend or Lennihan's Footbridge, Northeast Upper Tule River, South Shore Upper Tule River, East Shore Upper Tule River, Horr Pond Levees, Fall River Pond, and the Pit River Sand Pits during at least two consecutive surveys. Therefore, these sites will not be surveyed (Spring Rivers 2009). These locations are all inhabited by signal crayfish, fantail crayfish, or both non-native species. The third round of monitoring surveys at Thousand Springs, North Big Lake area, and northeast Big Lake has been completed. Shasta crayfish from Big Lake Springs and North Big Lake (excluding Big Lake Springs) were recorded separately to be consistent with earlier surveys, but no distinction was made for signal crayfish. Preliminary data are presented in Table 3.

Non-Native Crayfish Removal Surveys

In addition to crayfish monitoring surveys, several non-native crayfish removal surveys were done at Thousand Springs and Spring Creek. These surveys focused solely on removal of invasive crayfish and are part of the Pit 1 Plan (PG&E 2003b) as required by Articles 412 and 413 of the license and the Crayfish Barrier Plan (PG&E 2006). Removal surveys followed the same methods as crayfish monitoring surveys, but focused more on areas where non-native

Table 3 Preliminary number of crayfish, by species, sex[a], and age class[b], encountered in the Pit 1 Project vicinity during the third year monitoring survey (2009–2010).

	Shasta crayfish[c]						Signal crayfish[d]						Fantail crayfish					
Region and Location	**M**	**F**	**Adult**	**Juv**	**YOY**	**Total**	**M**	**F**	**Adult**	**Juv**	**YOY**	**Total**	**M**	**F**	**Adult**	**Juv**	**YOY**	**Total**
Upper Fall River																		
Thousand Springs above barrier	42	42	68	34	11	113	38	43	16	80	229	325	0	0	0	0	0	0
Thousand Springs below barrier																		
Rainbow Spring																		
Spring Creek																		
Upper coves							57	82	59	94	3	156						
Lower coves							63	71	45	86	3	134						
Ja She Creek																		
Ja She Creek headwaters																		
Crystal Springs Cove																		
Tule Coves																		
Upper Big Lake																		
Big Lake Springs	1	0	0	2	0	2	341	462	611	209	117	937	0	0	0	0	0	0
North Big Lake (excl. Springs)	1	4	5	1	0	6	-	-	-	-	-	-	-	-	-	-	-	-
Northeast Big Lake																		
Northwest Big Lake	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0
Tule River Levee System																		
South shore Big Lake (Cove)																		
Totals																		

[a] M=male, F=female
[b] Juv=juvenile, YOY=young of year
[c] Shasta crayfish numbers are from monitoring surveys only. Shasta crayfish were not generally handled during non-native crayfish removal surveys.
[d] Numbers of signal crayfish collected during both crayfish monitoring and non-native crayfish removal surveys.
NOTE: Sex totals may differ from adult and juvenile totals, because not all adults and juveniles were sexed.

crayfish have previously been found and included more marginal habitat often used by non-native crayfish but not Shasta crayfish. Similar effort was applied to each removal survey in terms of time and area surveyed, so that trends in numbers and species composition could be discerned.

The number of Shasta crayfish observed during non-native crayfish removal surveys was visually estimated and recorded. Shasta crayfish encountered during these surveys were not collected, however, and the data were not used in crayfish density calculations. Non-native crayfish were collected and destroyed after data collection.

Figure 3 shows multi-year data on the number of signal crayfish captured and removed from Thousand Springs during non-native crayfish removal and monitoring surveys upstream of the current barrier location since 2003. Signal crayfish were first found upstream of the barrier at Thousand Springs in 2005. In 2009, a total of 325 signal crayfish (including 229 YOY) were collected at Thousand Springs. The majority of signal crayfish were collected during non-native crayfish removal surveys in 2009 with 69 signal crayfish (including 53 YOY) in January and early February (also reported in Spring Rivers 2009) and 256 signal crayfish (including 176 YOY) during August through December. The 2009 signal crayfish totals, however, also include 89 signal crayfish (including 60 YOY) collected during the crayfish monitoring surveys in July. A total of 382 signal crayfish have been captured and removed from Thousand Springs upstream of the current barrier location since 2005. The increase in the number of signal crayfish in 2009 was largely due to 229 YOY and 80 juveniles found in the Fish Trap Cove area.

Figure 4 shows multi-year data on the number of signal crayfish captured and removed from Spring Creek upstream of the Spring Creek Road crossing since 2003. Signal crayfish were first found upstream of the culverts in 1997, before the Spring Creek Road crossing was replaced in 2000 (Ellis and Cook 2001). Signal crayfish were first found in the upper headwaters coves of Spring Creek in 2003. In 2009, a total of 290 signal crayfish (including 6 YOY) were collected during non-native crayfish removal surveys in February and March with 156 and 134 signal crayfish in the upper and lower coves, respectively. A total of 1187 signal crayfish have been captured and removed from Spring Creek upstream of the road crossing since 2003.

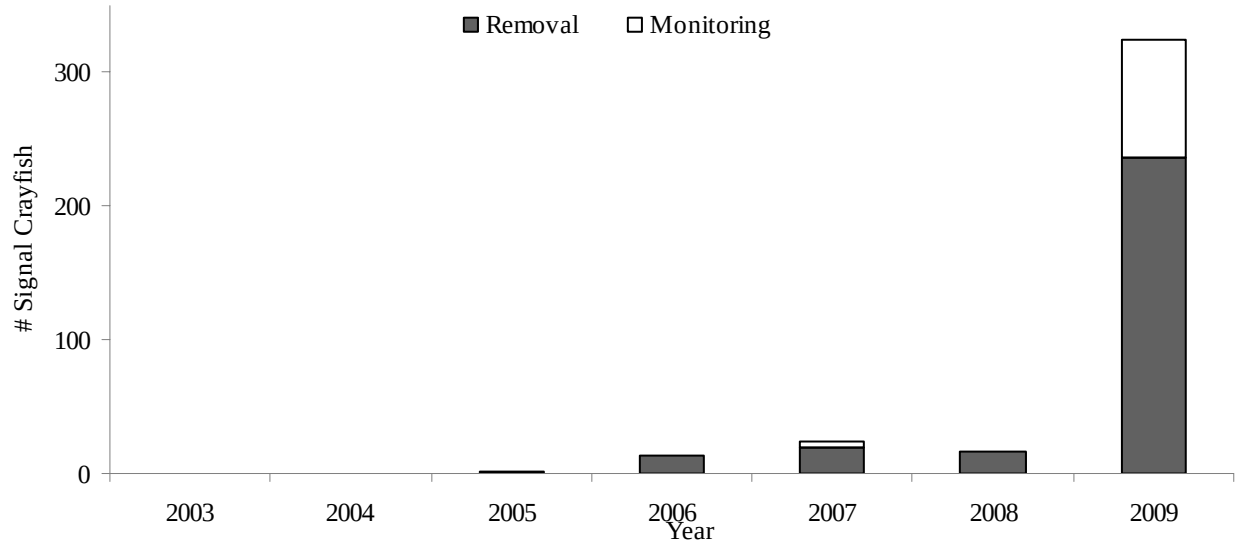

Figure 3 Number of signal crayfish found upstream of the Thousand Springs barrier location during non-native crayfish removal and monitoring surveys since 2003.

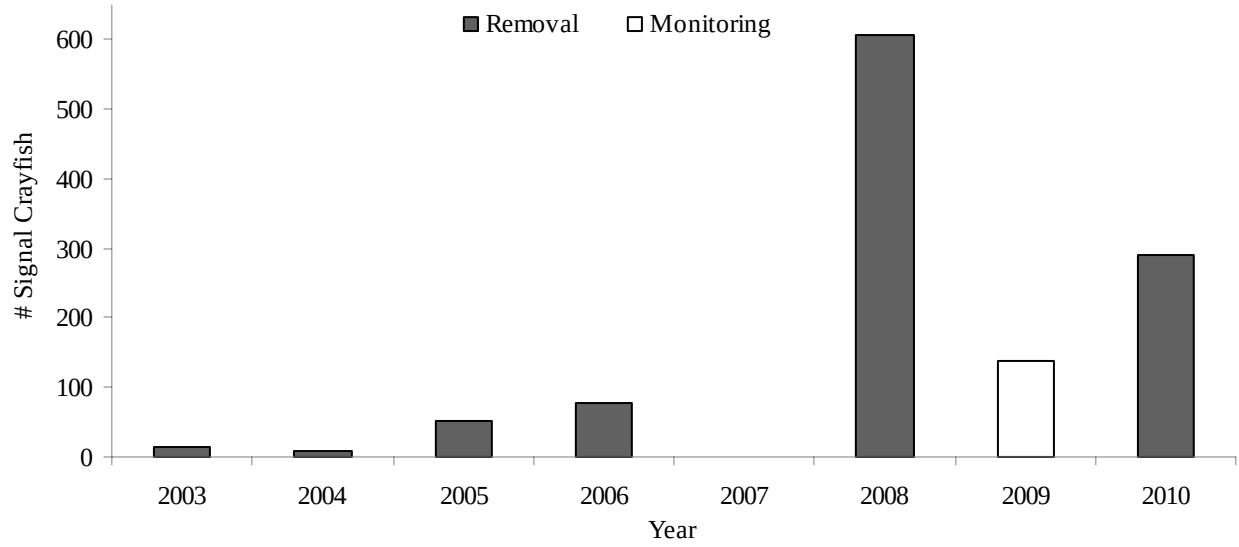

Figure 4 Number of signal crayfish found upstream of the Spring Creek Road crossing during non-native crayfish removal and monitoring surveys since 2003. No surveys were done in 2007.

Recovery Team Activities

Grant Funding

Although proposals submitted to USFWS for Preventing Extinction Funding in 2007 and 2008 were not awarded, Spring Rivers was awarded Director's Deferred Funds in July 2008. The proposed project consists of non-native crayfish suppression efforts that target the major population centers of Shasta crayfish in each of the three genetically distinct clusters: (1) Rising River/Crystal Lake, (2) Sucker Springs/Spring Creek/ Ja She Creek, and (3) Rainbow Spring/Thousand Springs between 2008 and 2012. Concurrent with the suppression efforts, the feasibility of additional potential crayfish barrier and refugia locations in each of these genetically distinct clusters will be investigated to prioritize future recovery efforts.

Sucker Springs Restoration Project

The Sucker Springs Creek Restoration Project is a multi-year, cooperative effort by the USFWS Endangered Species Recovery Program, the USFWS Partners for Fish and Wildlife, PG&E, and Spring Rivers Foundation, a non-profit 501(c)(3) corporation dedicated in part to working toward the recovery of Shasta crayfish. The goal of the restoration project is to improve habitat for Shasta crayfish by eliminating non-native signal crayfish and restoring geomorphic features to create more suitable physical habitat for Shasta crayfish. Spring Rivers Foundation is responsible for design and implementation of the restoration work.

In early 2006, all appropriate permits were acquired for stream restoration activities, including (1) CDFG 1600 Streambed Alteration Permit (May 22, 2005 – December 10, 2010); (2) Water Quality Certification from Regional Water Quality Control Board (May 11, 2006 through project completion); (3) Section 7 ESA consultation; (4) USFWS Wildlife Extension Agreement (December 5, 2005 – December 5, 2020); (5) Army Corps Nationwide 27 permit; and (6) Section 106 programmatic agreement with the State Historic Preservation Officer. As part of the eradication efforts, the Pond 2 and Pond 3 weirs were removed in September and October 2006, because they provided habitat for signal crayfish that could not be adequately surveyed. Before the Pond 2 weir was removed, an aluminum velocity barrier was constructed to halt any signal crayfish from migrating upstream (Spring Rivers 2007).

In 2009, Big Valley Divers, Inc. were contracted to construct two new velocity barriers at Sucker Springs Creek. The new barriers were needed because neither the Pond 4 or Pond 5 weirs provide a solid barrier to the upstream movement of signal crayfish. Both barriers utilize a combination of physical and velocity barrier designs are shown in Figure 5 (additional design details can be found in the September 15, 2009 Meeting Summary in Appendix C). The first barrier is about three meters upstream of the dilapidated Pond 4 weir (Figure 6) and the second velocity barrier is in the middle of Pond 5 (Figure 7).

In 2009, Spring Rivers, under contract with Spring Rivers Foundation, continued signal crayfish eradication efforts from Sucker Springs Creek by hand and with baited traps. A total of 143 signal crayfish (30 adults, 39 juveniles, and 74 YOY) were removed from ponds 2, 3, and 4, with 133 signal crayfish collected during snorkel surveys in the main channel and 10 signal crayfish collected from traps. The sex, size measured as total carapace length (TCL), and general condition (e.g., reproductive state, missing appendages, and molt state) were collected from all crayfish captured by all methods. All signal crayfish were destroyed. Figure 8 shows the number of signal crayfish collected annually during eradication efforts in ponds 2, 3, and 4 at Sucker Springs Creek since 2001.

Restoration of the complete channel cannot begin until we can demonstrate that signal crayfish no longer inhabit the restoration area (i.e., no reproduction has occurred for at least one year, and no signal crayfish have been collected for at least one year).

CDFG Temperature Study

The initial objective of the CDFG Temperature Study, which was conducted at the Crystal Lake Fish Hatchery, was to compare the growth of Shasta crayfish and signal crayfish at water temperatures of 50 °F and 56 °F in order to determine if Rock Creek is suitable for a Shasta crayfish reintroduction. The temperature growth study began with young-of-year signal crayfish in December 2004. CDFG made three attempts to rear young-of-year Shasta crayfish without success beginning in May 2005, June 2007, and May 2008 (Spring Rivers 2009). As of the

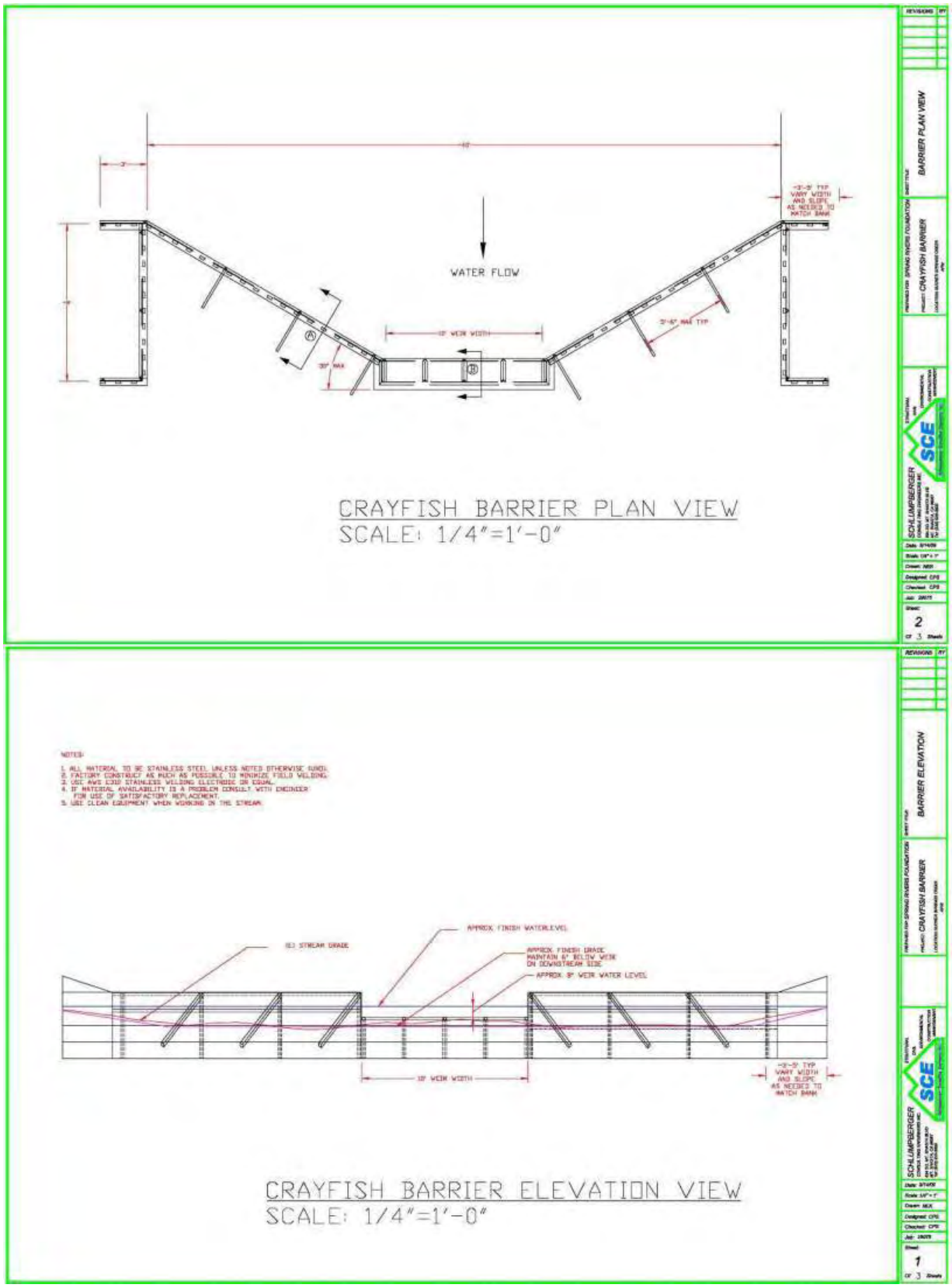

Figure 5 Engineering drawings for the Sucker Springs Creek crayfish barriers.

Figure 6 Operational crayfish barrier at Pond 4 of Sucker Springs Creek.

Figure 7 Construction of the velocity barrier portion of the crayfish barrier in Pond 5 of Sucker Springs Creek.

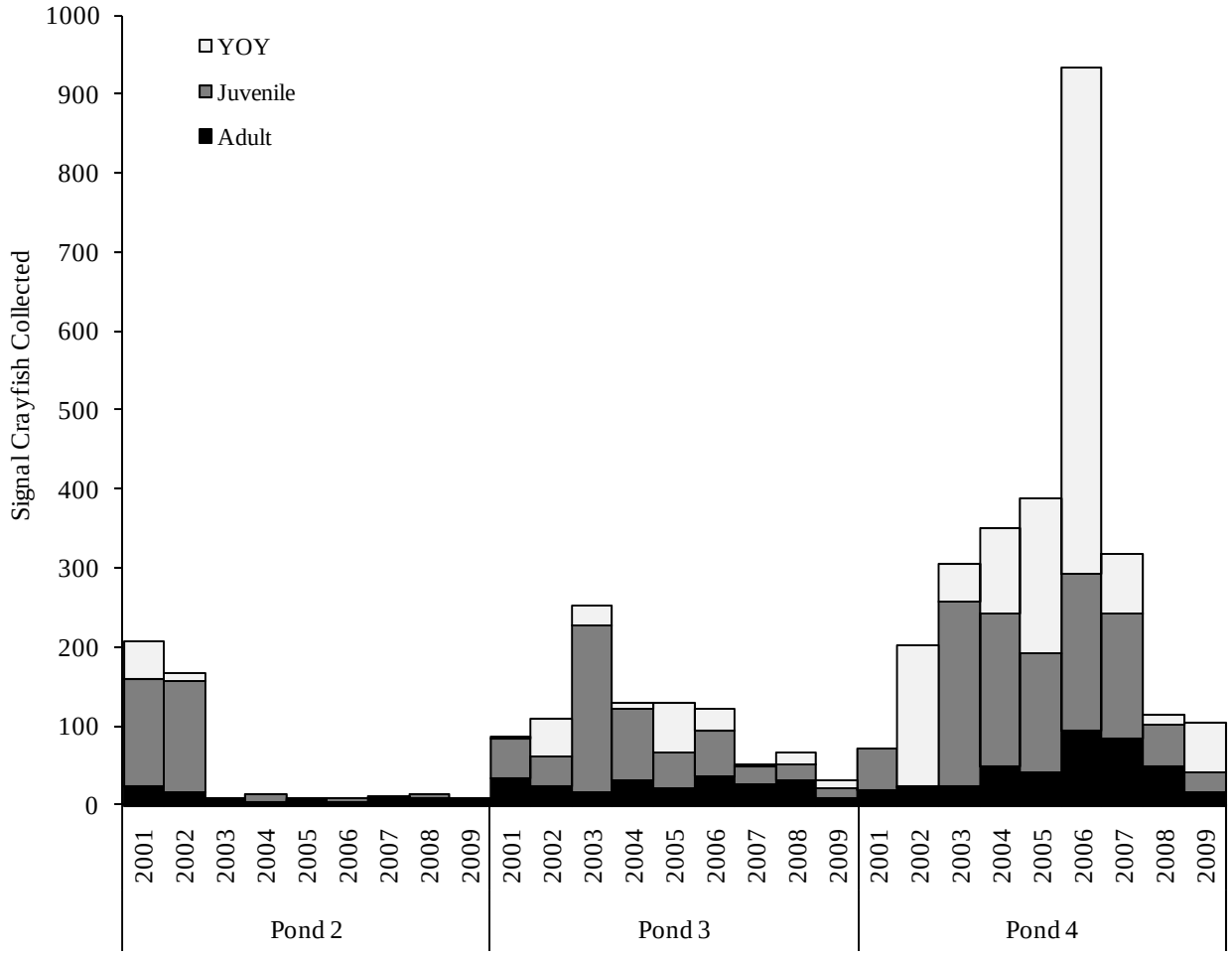

Figure 8 Signal crayfish collected during eradication efforts in ponds 2, 3, and 4 at Sucker Springs Creek since 2001.

9 March 2010 TRC/Recovery Team meeting, five YOY Shasta crayfish are still being held in 50 °F treatment raceway at Crystal Lake Fish Hatchery.

A second component of the CDFG Temperature Study is to document the range of water temperatures experienced by extant Shasta crayfish populations. In 2009, 14 (of 18 planned) temperature recorders were deployed at 7 (of 10 planned) areas known or thought to have had Shasta crayfish. HOBO Watertemp Pro v2 and HOBO TidbiT data loggers (Onset Computer Corporation) were installed at Thousand Springs, Spring Creek, Big Lake Springs, South Big Lake Levee Cove, Pit River Falls, Sucker Springs Creek, Crystal Lake, and Rock Creek (Figure 9). Recorders will also be installed at Ja She Creek and Rising River Lake (landowner permission pending) and the recorder in southwestern Crystal Lake will be relocated into actual

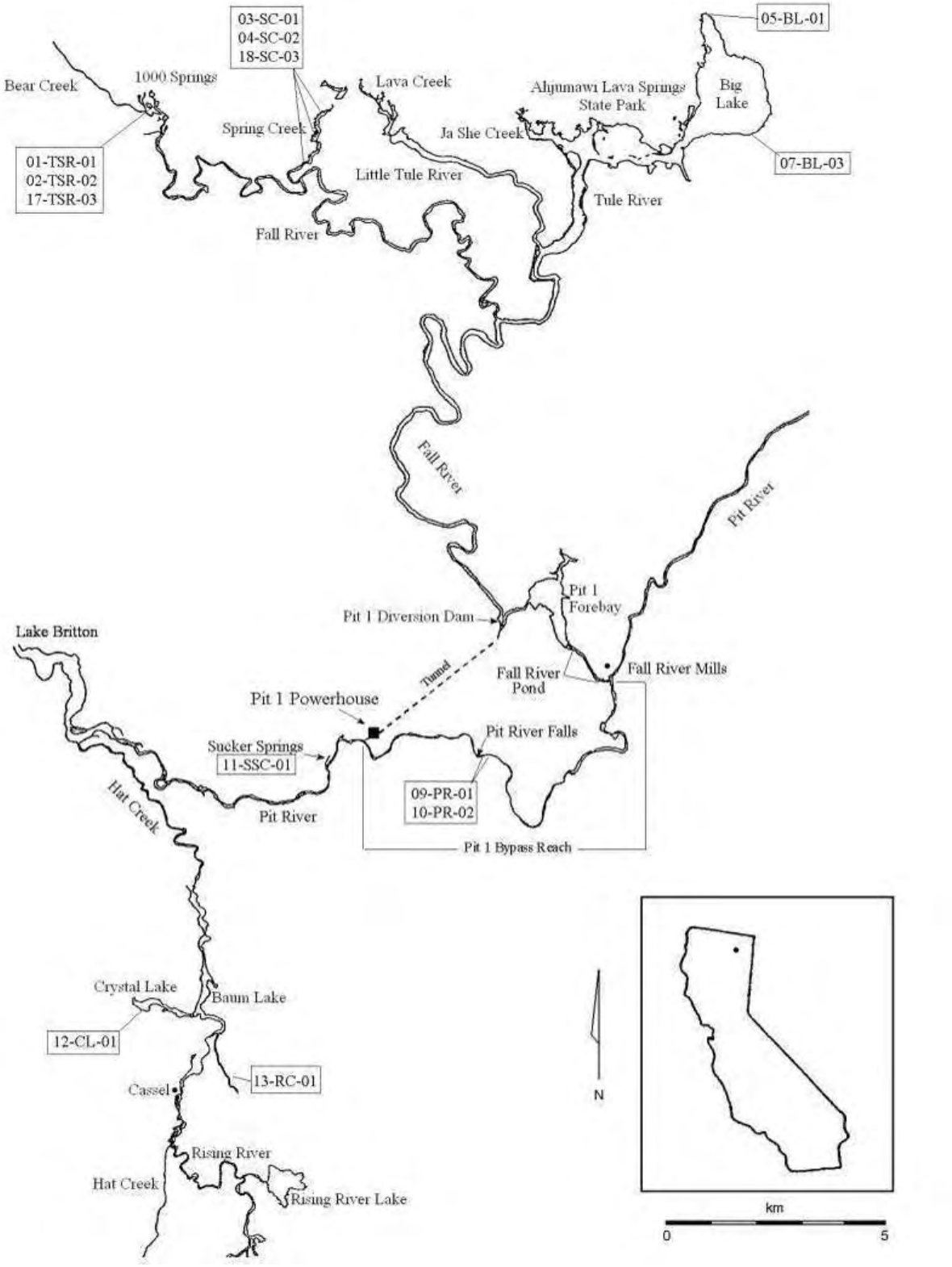

Figure 9 Locations of water temperature data loggers within the Fall River, and Pit River, and Hat Creek drainages in 2009 and 2010.

Shasta crayfish habitat. Recorders were left in place for at least one year. In the Pit River, the recorders were removed for the winter until after spring runoff. Mean daily temperature (based on hourly temperature readings) are presented in Figure 10.

Data loggers placed in Shasta crayfish locations strongly influenced by spring accretion (e.g., Thousand Springs, Big Lake Springs) recorded relatively constant water temperatures throughout the year. In these areas, mean daily water temperatures ranged from about approximately 9.5 to 12.5 °C. In areas with less spring influence (e.g., Pit River and Big Lake Levee), mean daily water temperatures ranged from approximately 2.5 to 26.0 °C.

Pit River

In July 2009, two data loggers were deployed at Shasta crayfish locations upstream of the Pit River Falls. Logger 09-PR-01 was deployed at the upper-most known Shasta crayfish location. Springs provided clear cold water, which visually provided an area of improved water clarity with a measurable lower summer water temperature as compared to the mainstem river temperature. Mean daily water temperature was fairly stable and was minimally affected by air temperature during July through September (Figure 11). Logger 10-PR-02 was deployed at the lower-most known Shasta crayfish location, which did not have any apparent direct spring influence. Mean daily water temperature was highest in the summer months and was clearly affected by air temperature (Figure 11).

Pit River Spring-Influenced Site (upper Shasta crayfish location)—During the week before the scheduled July 2009 flushing flow, which were designed to control aquatic vegetation in Fall River Pond, the mean (± standard error) daily water temperatures (based on hourly readings) in the spring area (09-PR-01) ranged from 15.7 ± 0.2 °C to 17.2 ± 0.2 °C; mean daily difference was 1.6 ± 0.1 °C. Similarly, during the week following the July flushing flow, mean daily water temperatures ranged from 15.9 ± 0.1 °C to 17.2 ± 0.1 °C; mean daily difference was 1.2 ± 0.1 °C. On the two days of the flushing flow, however, mean daily water temperatures ranged from 16.0 ± 0.5 °C to 20.4 ± 0.3 °C (Figure 12a) with a mean daily difference of 4.5 ± 0.8 °C.

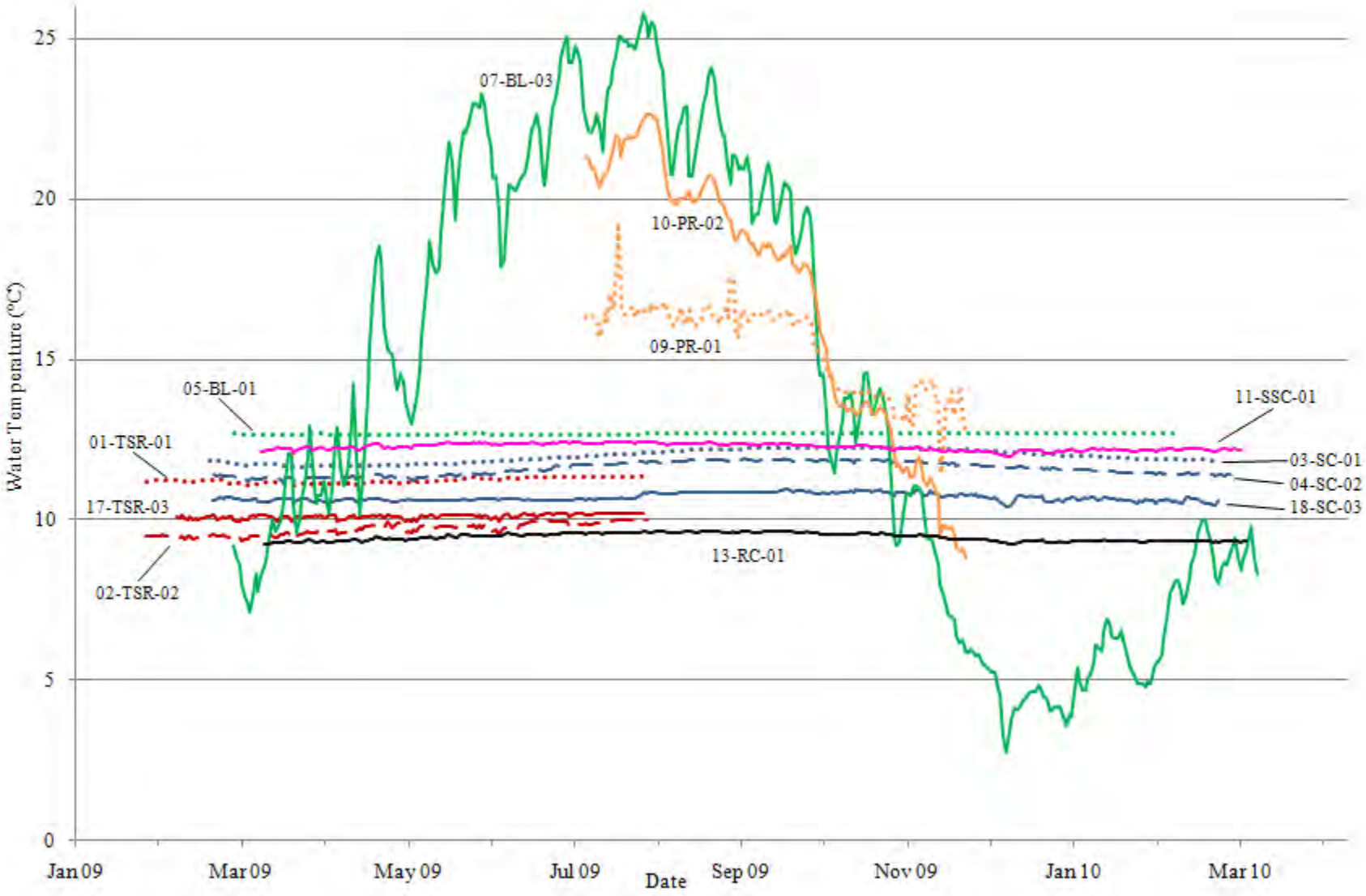

Figure 10 Mean daily water temperatures at Shasta crayfish locations in 2009 and 2010.

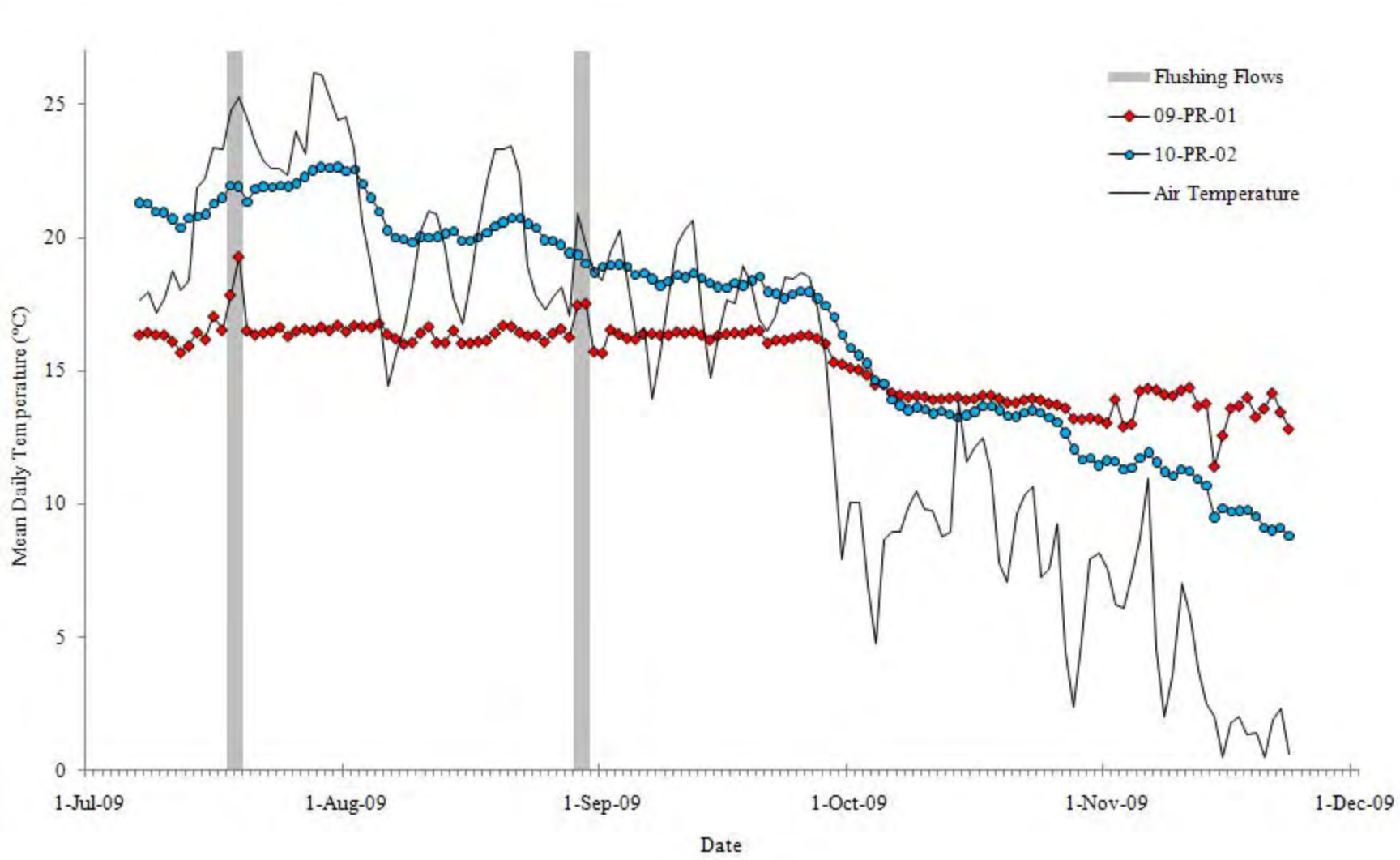

Figure 11 Mean daily water temperatures at two Shasta crayfish locations (Logger IDs 09-PR-01 and 10-PR-02) in the Pit River and mean daily air temperature (from the nearby Hat Creek Powerhouse #1) in 2009. Grey bars indicate flushing flows.

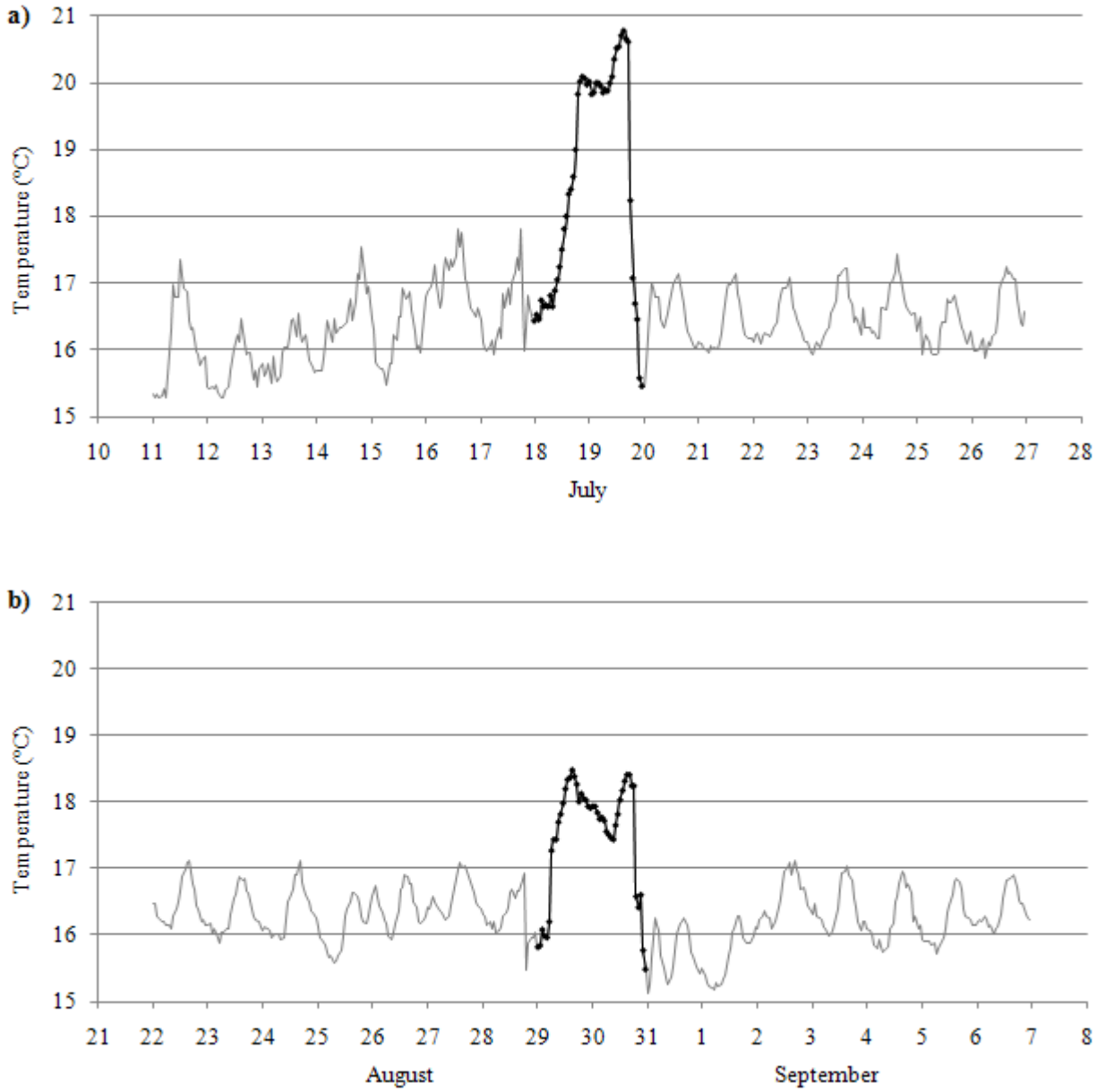

Figure 12 Hourly water temperatures at the upper Pit River Shasta crayfish location (Logger ID 09-PR-01) one week prior and one week post July (a) and August (b) flushing flows in 2009. Darker sections indicate flushing flow days with individual hourly data points as dots.

During the week prior to the August flushing flow, mean (± standard error) daily water temperatures (based on hourly readings) in the spring area (09-PR-01) ranged from 15.9 ± 0.1 °C to 17.0 ± 0.1 °C; mean daily difference was 1.1 ± 0.1 °C. Similarly, during the week post the August flushing flow, mean daily water temperatures ranged from 15.7 ± 0.1 °C to 16.8 ± 0.1 °C; mean daily difference was 1.1 ± 0.04 °C. On the two days of the flushing flow, however, mean daily water temperatures ranged from 15.7 ± 0.2 °C to 18.4 ± 0.04 °C (Figure 12b) with a mean daily difference of 2.8 ± 0.1 °C.

Pit River Mainstem Site (lower Shasta crayfish location)—During the week prior to the July flushing flow, mean (± standard error) daily water temperatures (based on hourly readings) in the mainstem (10-PR-02) ranged from 19.8 ± 0.1 °C to 22.4 ± 0.2 °C; mean daily difference was 2.6 ± 0.1 °C. Similarly, during the week post the July flushing flow, mean daily water temperatures ranged from 20.8 ± 0.1 °C to 23.4 ± 0.1 °C; mean daily difference was 2.6 ± 0.05 °C. On the two days of the flushing flow, mean daily water temperatures ranged from 21.2 ± 0.05 °C to 22.8 ± 0.1 °C (Figure 13a), with a mean daily difference of only 1.5 ± 0.1 °C.

During the week prior to the August flushing flow, mean (± standard error) daily water temperatures (based on hourly readings) in the mainstem (10-PR-02) ranged from 19.2 ± 0.2 °C to 21.3 ± 0.3 °C; mean daily difference was 2.1 ± 0.2 °C. Similarly, during the week post the August flushing flow, mean daily water temperatures ranged from 18.1 ± 0.1 °C to 20.0 ± 0.1 °C; mean daily difference was 1.9 ± 0.1 °C. On the two days of the flushing flow, daily mean water temperatures ranged from 18.7 ± 0.2 °C to 19.8 ± 0.1 °C (Figure 13b), with a mean daily difference of only 1.1 ± 0.05 °C.

During summer flushing flows in July and August 2009, temperature monitoring documented the resultant increase in temperature and loss of thermal refugia habitat during summer pulsed flows. Summer flushing flows increased the maximum daily water temperatures and resulted in rapid and substantial changes in the temperature within the area influenced by coldwater springs (09-PR-01). In the mainstem habitat (10-PR-02), summer flushing flows in the Pit 1 Bypass Reach muted the maximum and minimum daily water temperatures, overwhelmed the effects of fluctuating day-to-night air temperatures, and eliminated diel thermal refugia.

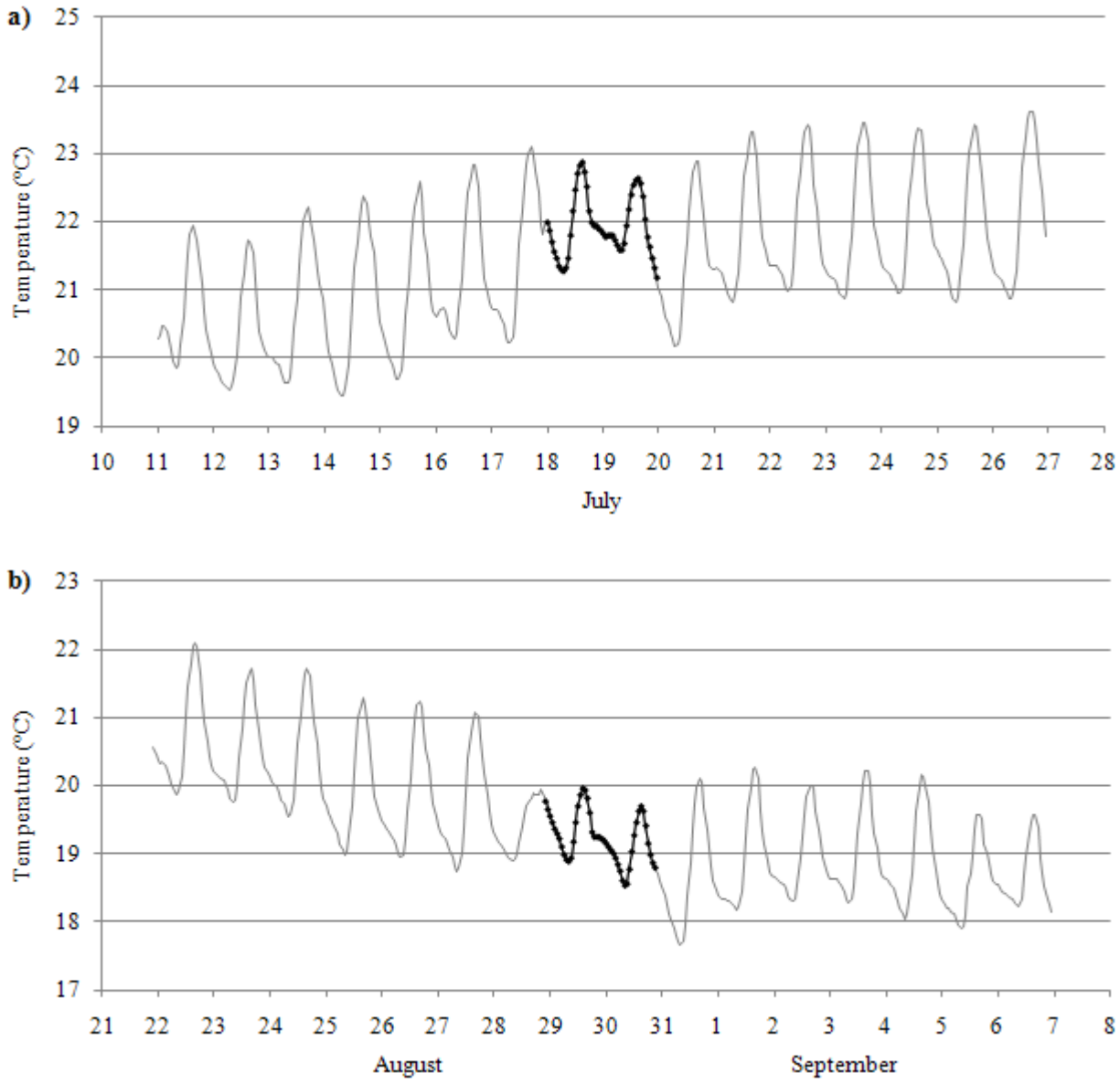

Figure 13 Hourly water temperatures at the lower Pit River Shasta crayfish location (Logger ID 10-PR-02) one week prior and one week post July (a) and August (b) flushing flows in 2009. Darker sections indicate flushing flow days with individual hourly data points as dots.

CDFG Genetics Study

CDFG received a third grant authorized under Section 6 of the Endangered Species Act for the Shasta crayfish Genetics Study. The study is being conducted at the Genomic Variation Laboratory of Bernie May, Ph.D. at the University of California, Davis. The Section 6 Funding proposal, which was submitted on June 1, 2009 and funded for 2010, includes:
(1) Mitochondrial DNA work on existing Shasta crayfish genetic samples; (2) Development of a Genetic Management Plan; and (3) Refugia investigation.

2010 Projected Activities

Technical Review Committee

The first 2010 Shasta Crayfish TRC/Recovery Team meeting was held in Redding on 9 March. The second 2010 meeting is scheduled for 15 September in Sacramento.

Based on the priorities discussed during the April 2009 Shasta Crayfish TRC/Recovery Team Year 5/6 Review Workshop and in subsequent meetings, the creation of refuge habitat to preserve the remaining populations of Shasta crayfish is of primary importance. The development of a Rock Creek Reintroduction Plan, Rock Creek Restoration Plan, and Genetic Management Plan are integral steps towards this goal. With section 6 funding received in 2010, the UC Davis Genomic Variability Laboratory will take the lead on the development of a genetic management plan to determine source populations for potential reintroductions of Shasta crayfish into Rock Creek and elsewhere. Spring Rivers will be providing assistance on the genetic management plan as well as working on a proposal for the Rock Creek Restoration Plan.

The third Pit 1 monitoring survey will be completed in 2010. The next scheduled survey of the Hat Creek Project vicinity, which will be the fourth survey, is in 2012. Efforts to obtain permission to survey Rising River will continue, and surveys will begin once permission is obtained.

The biannual non-native crayfish removal surveys related to the Upper Fall River Crayfish Barrier Project and the Spring Creek Road Crossing Cavity-Filling Project will continue in 2010. The 2010 survey data will be reported in the Shasta Crayfish Technical Review Committee 2010 Annual Report, which is due to the agencies and FERC by 31 May 2011.

Recovery Team

Eradication efforts in Sucker Springs Creek will continue in 2010 with the continued help of PG&E. Spring Rivers will apply for a new CDFG Streambed Alteration Permit in 2010 since the current permit is due to expire on 10 December 2010. Eradication methods will be reviewed and modified, as necessary, to improve effectiveness.

CDFG plans to continue its temperature and genetics studies in 2010. Spring Rivers will continue to monitor the temperature recorders for CDFG. Temperature recorders will be installed at Ja She Creek and Rising River Lake (landowner permission pending) and the recorder in southwestern Crystal Lake will be relocated into actual Shasta crayfish habitat in 2010. Efforts to obtain permission to survey Rising River will continue, and surveys will begin once permission is obtained. If permission can be obtained to survey and collect genetic samples, samples from Shasta crayfish in Rising River will be collected and sent to UC Davis Genomic Variability Laboratory.

Based on the findings of the temperature monitoring at the two locations where Shasta crayfish were found in the Pit 1 Bypass Reach upstream of the Pit River Falls, the TRC/Recovery Team strongly recommends that summer flushing flows in the Pit 1 Bypass Reach be eliminated because they reduce or eliminate coldwater habitat for Shasta crayfish and provide beneficial habitat for the competitor/predator non-native signal and fantail crayfish.

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APPENDIX A—FERC License Articles pertaining to Shasta crayfish for the Hat Creek and Pit 1 Projects

Hat 1 Project (FERC No. 2661) License Articles pertaining to Shasta Crayfish

Article 409. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, within six months of issuance of the license the licensee shall file with the Commission, for approval, an implementation plan to monitor the habitat and populations of Shasta crayfish in the Project Area. The plan shall include, but shall not be limited to, the following: (1) characterization of suitable Shasta crayfish habitat; (2) provisions to map and quantify amounts of existing (baseline) suitable habitat; (3) quantitative assessment of existing Shasta crayfish populations in the Project Area; (4) methodology for annual monitoring; and (5) annual reporting requirements including progress milestones.

The licensee shall include with the plan, documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee shall allow a minimum of 60 days for U.S. Fish and Wildlife Service and California Department of Fish and Game to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on site-specific conditions.

The Commission reserves the right to require changes to the plan. The plan shall not be implemented until the licensee is notified that the plan is approved. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Article 410. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, the licensee shall within three months of license issuance, in coordination with the U.S. Fish and Wildlife Service, California Department of Fish and Game, Natural Resources Conservation Service, other resource agencies and interested stakeholders, establish a technical review committee (committee) for the purpose of assisting the licensee in the design and implementation of the terms and conditions required in the biological opinion (primarily focused on Shasta crayfish protection and recovery in the project area). The licensee in coordination with committee members shall establish rules of protocol for conduct of meetings, correspondence, and other communications necessary for committee activities. The licensee in coordination with committee members shall develop written guidance for the committee that describes the purpose, goals, and objectives of the committee. The purpose, goals, and objectives shall be consistent with the Shasta crayfish recovery plan and any new scientific information that may become available. The licensee shall provide to the Commission and the committee by May 31 of each year an annual report of the activities of the committee. The licensee shall provide notice to the Commission within 30 days (but prior to implementing change) of any decisions by the committee that result in changes to project operations that fall outside normal operations as described in the licensed project.

Article 411. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, the licensee shall within three months of license issuance establish an inflation indexed interest bearing account (Funding Account). Within 30 days of establishing the Funding Account, the licensee shall establish a separate interest deposit account

(Interest Account). Funding Account interest payments shall accrue monthly to the Interest Account. The licensee shall be responsible for management of these accounts and all associated costs. Within 45 days following establishment of the Funding Account, the licensee shall deposit $500,000 in the Funding Account. The Funding Account and Interest Account shall be maintained for the term of the license. The licensee shall not withdraw funds from the Funding Account, and shall retain ownership of the asset value in the Funding Account, but all interest accrued shall be deposited into the Interest Account at the end of each month and shall be available for spending by the technical review committee for purposes of implementing the terms and conditions and conservation measures included in the license for protection and recovery of the Shasta crayfish, exclusive of Article 412. The licensee shall provide documentation of the establishment of these accounts to the Commission and the Service within 100 days of license issuance. In lieu of establishment of the Funding Account and Interest Account, the licensee can make available $30,000 annually, each year for the term of the license, adjusted annually for inflation using the Consumer Price Index, to be spent by the technical review committee for the same purposes as described above.

Article 412. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, the licensee shall file with the Commission within six months of the license issuance, for approval, a comprehensive Shasta crayfish management plan for the Project Area developed in coordination with the California Department of Fish and Game, Natural Resources Conservation Service, U.S. Fish and Wildlife Service and interested stakeholders within the Hat Creek drainage, and approved by the U.S. Fish and Wildlife Service. The plan will identify and examine action alternatives the licensee would implement to combat the rapid decline of Shasta crayfish in the Project Area. The plan shall include provisions to provide or maintain habitat refugia for Shasta crayfish isolated from populations of invasive non-native crayfish in the Project Area, and shall include but not be limited to the following: (1) provisions to fund signal crayfish removal on an annual basis in the amount of at least $10,000, and (2) annual reporting requirements including progress milestones. This plan shall include evaluation of known methods for reducing abundance such as hand removal and other methods that may require pilot testing or further research. Details of fish stocking in the Project Area developed in cooperation with the California Department of Fish and Game to protect and minimize the impacts on Shasta crayfish in the Project Area shall also be included in the Shasta crayfish management plan, and shall include but not be limited to the following: (1) written description and mapping of current locations being stocked and frequency of fish stocking on an annual basis, (2) record of historical stocking, and (3) a list of alternative planting locations. The Shasta crayfish management plan shall also include formulation of a plan to reintroduce Shasta crayfish to the Rock Creek springs area. At minimum this plan should include installation of a crayfish barrier, means to eradicate non-native crayfish above the barrier, and restoring historical Shasta crayfish habitat. This reintroduction plan should include methods to be implemented throughout the term of the license to protect and maintain this reintroduced population in stable condition.

The licensee shall include with the plan, documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee shall allow a minimum of 60 days for U.S. Fish and Wildlife Service and California

Department of Fish and Game to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on site-specific conditions.

The Commission reserves the right to require changes to the plan. The plan shall not be implemented until the licensee is notified that the plan is approved. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Article 413. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, the licensee shall file within six months of license issuance with the Commission, for approval, a recreational management plan (Shasta Crayfish). This plan shall include provisions for educating the general public about the status of the Shasta crayfish, information on potential threats from recreational activities, and protective measures to avoid take as part of the recreation planning for the project. The public outreach effort will serve to increase the public's awareness of the causes for species' endangerment. This information shall include an explanation of the fishing regulations restricting the use of crayfish as bait in the Project Area and distribution area of the Shasta crayfish.

The licensee shall include with the plan, documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee shall allow a minimum of 60 days for U.S. Fish and Wildlife Service and California Department of Fish and Game to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on site-specific conditions.

The Commission reserves the right to require changes to the plan. The plan shall not be implemented until the licensee is notified that the plan is approved. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Pit 1 Project (FERC No. 2687) License Articles pertaining to Shasta Crayfish

Article 409. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, the licensee shall, within six months of license issuance, file for Commission approval, an implementation plan to monitor the habitat and populations of Shasta crayfish in the project area. The plan shall include, but shall not be limited to, the following: (1) characterization of suitable Shasta crayfish habitat; (2) provisions to map and quantify amounts of existing (baseline) suitable habitat; (3) quantitative assessment of existing Shasta crayfish populations in the project area; (4) methodology for annual monitoring; and (5) annual reporting requirements including progress milestones.

The licensee shall include with the plan, a schedule for implementing the plan, for consulting with the U.S. Fish and Wildlife Service and the California Department of Fish and Game, and for filing monitoring reports with the consulted agencies and the Commission, documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments

are accommodated by the plan. The licensee shall allow a minimum of 60 days for the U.S. Fish and Wildlife Service and California Department of Fish and Game to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on site-specific conditions.

The Commission reserves the right to require changes to the plan. The plan shall not be implemented until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Article 410. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, the licensee shall within three months of license issuance, in coordination with the U.S. Fish and Wildlife Service, California Department of Fish and Game, California Department of Parks and Recreation, Bureau of Land Management, Natural Resources Conservation Service, other resource agencies and interested stakeholders, establish a technical review committee (committee) for the purpose of assisting the licensee in the design and implementation of the terms and conditions required in the U.S. Fish and Wildlife Service's biological opinion (primarily focused on Shasta crayfish protection and recovery in the project area). The licensee, in coordination with committee members, shall establish rules of protocol for conduct of meetings, correspondence, and other communications necessary for committee activities. The licensee, in coordination with committee members, shall develop written guidance for the committee that describes the purpose, goals, and objectives of the committee. The purpose, goals, and objectives shall be consistent with the Shasta crayfish recovery plan and any new scientific information that may become available. The licensee shall provide to the Commission and the committee, by May 31 of each year, an annual report of the activities of the committee. The licensee shall provide notice to the Commission within 30 days (but prior to implementing change) of any decisions by the committee that result in changes to project operations that fall outside normal operations, as described in the license.

Article 411. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, the licensee shall provide each year, beginning January 1, 2004, for the term of the license, $45,000, adjusted annually per the Consumer Price Index (CPI). These funds shall be for spending by the technical review committee, established pursuant to Article 410, for purposes of implementing the terms and conditions and conservation measures set forth in the biological opinion and incorporated in the license, for protection and recovery of the Shasta crayfish. These funds ($45,000) are distinct from funds required under Article 412 but may be used to supplement funds provided pursuant to Article 412, if approved by the technical review committee.

Article 412. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, within six months of license issuance, the licensee shall file for Commission approval a comprehensive Shasta crayfish management plan for project lands and waters developed in coordination with the U. S. Fish and Wildlife Service, California Department of Fish and Game, California Department of Parks and Recreation, and interested stakeholders within the Pit River drainage, and approved by the U.S. Fish and Wildlife Service. The plan shall identify and examine action alternatives the licensee would implement to combat

the rapid decline of Shasta crayfish in the project area. The plan shall include provisions to provide or maintain habitat refugia for Shasta crayfish isolated from populations of invasive non-native crayfish in the project area, and shall include but not be limited to the following: (1) provisions to fund signal crayfish removal on an annual basis in the amount of at least $20,000, beginning January 1, 2004, and (2) annual reporting requirements including progress milestones. The funds required in this article for signal crayfish removal are distinct from those required in Article 411 above; however, should signal crayfish removal be deemed no longer necessary (as determined by the technical review committee, established pursuant to Article 410), these funds may be used for implementation of other terms and conditions, if approved by the technical review committee. This plan shall include evaluation of known methods for reducing abundance, such as hand removal and other methods that may require pilot testing or further research. Details of fish stocking in the project area developed in cooperation with the California Department of Fish and Game to protect and minimize the impacts on Shasta crayfish in the project area shall also be included in the Shasta crayfish management plan, and shall include but not be limited to the following: (1) written description and mapping of current locations being stocked and frequency of fish stocking on an annual basis; (2) record of historical stocking; and (3) a list of alternative planting locations.

The licensee shall include with the plan, a schedule for filing any proposed protection and management measures, or any proposed modifications to the project and project operations necessary to protect Shasta crayfish or its critical habitat, documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee shall allow a minimum of 60 days for the consulted agencies to comment and to make recommendations before filing the plan with the Commission for approval. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on site-specific conditions.

The Commission reserves the right to require changes to the plan. The plan shall not be implemented until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Article 413. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, the licensee shall within one year of license issuance file for Commission approval a plan to construct and maintain a minimum of two exclusion barriers to protect Shasta crayfish habitat from invasion by signal crayfish. The plan shall include, but not be limited to, the following: (1) provisions to fund the design and construction of two crayfish barriers, not to exceed $150,000 over 4 years; (2) detailed design drawings and map locations of the exclusion barriers; (3) a schedule for construction and initial performance testing; and (4) a monitoring and reporting schedule for long-term evaluation of barrier performance.

The licensee shall include with the plan, documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the plan. The licensee shall allow a minimum of 60 days for U.S. Fish and Wildlife Service and California

Department of Fish and Game to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on site-specific conditions.

The Commission reserves the right to require changes to the plan. The plan shall not be implemented until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Article 416. Pursuant to the terms and conditions of the incidental take statement filed by the U.S. Fish and Wildlife Service, the licensee shall, within six months of license issuance, file for Commission approval, a recreation management and public outreach plan. The plan shall include, but not be limited to the following: (1) information regarding the location, design, construction, maintenance, and use of the licensee's five proposed forebay recreational areas; (2) information regarding the location, design, construction, and maintenance of the proposed recreational access to the Pit River near Big Eddy, or a comparable site; (3) information regarding how the licensee would maintain the Rat Farm boat launching access area at Big Lake; (4) protective measures to avoid take as part of the recreation planning for the project; and (5) provisions for educating the general public about the status of the Shasta crayfish and the bald eagle, including information on potential threats from recreational activities. The public outreach effort will serve to increase the public's awareness of the causes for species' endangerment. The information provided to the general public shall include an explanation of the fishing regulations restricting the use of crayfish as bait in the project area and distribution area of the Shasta crayfish.

APPENDIX B—Shasta Crayfish Management Plan Fund Summary

Shasta Crayfish Management Plan Fund for the Hat Creek (FERC No. 2661) and Pit 1 (FERC No. 2687) Projects

License Article	Annual Funding
Hat Creek Survey Article 411	$ 30,000
Hat Creek Removal Article 412	$ 10,000
Pit 1 Survey Article 411	$ 45,000
Pit 1 Removal Article 412	$ 20,000
Pit 1 Crayfish Barrier Plan Article 413	$ 35,000

Hat Creek License was issued on November 4, 2002. Shasta Crayfish Plan was approved on August 21, 2003. Funding began on January 1, 2003.
Pit 1 License was issued on March 19, 2003. Shasta Crayfish Plan was approved on July 7, 2004. Funding began on January 1, 2004
Based on Article 413 of the Pit 1 License, the Crayfish Barrier Plan was approved on 8 March 2007.
As part of the Barrier Plan, the biannual (2 times per year) crayfish removal surveys began in 2008 with an annual budget of $35 K.

Year (field season through annual report submittal)

	--2003--	---------2004---------		---------2005---------		---------2006--------		---------2007----------		---------2008----------		---------2009----------		---------2010----------	
Study/Task	**Principal**	**Principal**	**CPI**	**Principal**	**CPI**	**Principal**	**CPI**	**Principal**	**CPI**	**Principal**	**CPI**	**Principal**	**Estimated CPI**	**Principal**	**Estimated CPI**
Hat Surveys	$ 30,000	$ 30,000	$ 790	$ 30,000	$ 1,842	$ 30,000	$ 2,902	$ 30,000	$ 4,066	$ 30,000	$ 4,773	$ 30,000	$ 5,167	$ 30,000	$ 5,328
Hat Removal	$ 10,000	$ 10,000	$ 266	$ 10,000	$ 614	$ 10,000	$ 967	$ 10,000	$ 1,355	$ 10,000	$ 1,591	$ 10,000	$ 1,722	$ 10,000	$ 1,776
Pit 1 Surveys	$ -	$ 45,000	$ -	$ 45,000	$ 1,525	$ 45,000	$ 3,073	$ 45,000	$ 4,773	$ 45,000	$ 5,930	$ 45,000	$ 6,383	$ 45,000	$ 6,620
Pit 1 Removal	$ -	$ 20,000	$ -	$ 20,000	$ 678	$ 20,000	$ 1,366	$ 20,000	$ 2,121	$ 20,000	$ 2,635	$ 20,000	$ 2,837	$ 20,000	$ 2,942
Barrier Crayfish Removal	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 35,000	$ -	$ 35,000	$ -	$ 35,000	$ -
Subtotal	$ 40,000	$ 105,000	$ 1,056	$ 105,000	$ 4,659	$ 105,000	$ 8,308	$ 105,000	$ 12,315	$ 140,000	$ 14,929	$ 140,000	$ 16,109	$ 140,000	$ 16,666
Total Annual Budget	$ 40,000	$ 106,056		$ 109,659		$ 113,308		$ 117,315		$ 154,929		$ 156,109		$ 156,666	
Recovery Funds [1]	$ -	$ -		$ -		$ -		$ 12,403	Barrier	$ -		$ 62,097	Sucker Spring	$ 22,844	$ 47,104
Spring Rivers Invoiced Amount	$ 40,000	$ 105,000		$ 98,310		$ 113,308		$ 117,317		$ 92,832		$ 195,362			
Running Balance	$ -	$ 1,056		$ 12,405		$ 12,405		$ -		$ 62,097		$ 22,844		$ 179,509	
Balance To Date (4/1/2010)															**$ 179,509**

[1] During years in which monitoring surveys are not scheduled (e.g., 2008-2011, years 6 through 9 of the Hat Creek license) or when the annual management funds are not completely spent, the remaining annual management funds are allocated as recovery funds.

The annual amounts for Crayfish surveys (Articles 411) and non-native crayfish removal (Articles 412) are adjusted annually from the original amounts stated in the licenses (2003 dollars for Hat and 2004 dollars for Pit 1) based on the CPI (rate of inflation from 2003 for Hat and 2004 for Pit 1 to 2006) as specified in the license.

CPI was calculated based on the U.S. Department of Labor Bureau of Labor Statistics Consumer Price Index (CPI) inflation calculator (http://data.bls.gov/cgi-bin/cpicalc.pl).

APPENDIX C—2009 and March 2010 TRC Meeting Summaries

REVIEW WORKSHOP AND ANNUAL MEETING
SHASTA CRAYFISH TECHNICAL REVIEW COMMITTEE
Hat Creek (FERC Project No. 2661) & Pit 1 (FERC Project No. 2687)

April 22, 2009 (Wednesday) - 10:00 am to 2:00 pm
California Department of Fish and Game Region 1 Office Conference Room
601 Locust Street, Redding, CA 96001
(530) 225–2370
CDFG Meeting Host: Steve Baumgartner

MEETING SUMMARY

I. **Meeting Purpose and Objectives**
- A. The purpose of this summary review workshop is to review the first five and six years of monitoring for the Pit 1 and Hat Creek projects in order to determine future actions and revise the Hat Creek and Pit 1 Shasta Crayfish Management Plans as necessary.
- B. The Shasta Crayfish Technical Review Committee 2008 Summary Report, due May 31, 2009, summarizes the first five and six years of monitoring and other activities under the Pit 1 and Hat Creek Shasta Crayfish Management Plans, respectively.

II. **Shasta Crayfish TRC Summary Report Presentation**

III. **2009 TRC Projected Activities and Future Directions Discussion**
- A. Crayfish Barriers—Continue snorkel surveys of the Upper Fall River barrier at least twice a year to inspect the barrier and to monitor for the presence of debris and/or algal growth that could compromise the barrier.
- B. Rock Creek Restoration
  1) Given the observed decline in Shasta crayfish numbers, both during the monitoring period and compared to historic conditions, the importance of refuge habitat to preserving the remaining populations is increasing.
  2) TRC/Recovery Team members expressed the importance of moving forward, without delay, with the Rock Creek reintroduction plan.
  3) Develop a written proposal to reintroduce Shasta crayfish to Rock Creek. Article 412 of the Hat Creek Project license requires PG&E to develop a Shasta Crayfish Management Plan that includes formulation of a plan to re-introduce Shasta crayfish into Rock Creek. Prior to implementation of a Rock Creek Reintroduction Plan:
     a. Develop a Rock Creek Restoration Plan to restore historical Shasta crayfish habitat, including measures to ensure that the water needs for the Crystal Lake Fish Hatchery continue to be met.
     b. Consult Genetic Management Plan to help determine source population for potential reintroductions of Shasta crayfish into Rock Creek.
- C. Crayfish Monitoring
  1) Continue with the Pit 1 and Hat Creek crayfish monitoring surveys according to the monitoring schedule and methods described in this report.
     a) Hat Creek Crayfish Surveys—2003/2004 and 2007. Next surveys in 2012.
     b) Pit 1 Crayfish Surveys—2004/05/06 and 2007/08. Next surveys in 2009/10.
  2) Conduct the Rising River survey, upon receipt of landowner permission.

3) Non-Native Crayfish Eradication Surveys—Continue with the biannual non-native crayfish eradication surveys of Thousand Springs and Spring Creek according to the monitoring schedule and methods described in this report.

D. Shasta Crayfish Population Status—the dramatic decline of Shasta crayfish observed in the Pit 1 bypass reach since implementation of the new-license required flow regime was discussed. Although the cause of the decline is not known, the following potential factors were discussed: minimum instream flows and their effect on coldwater spring habitat, summer flushing flows, and increase in non-native crayfish populations.

1) On May 11, 2009, PG&E presented a summary of the results of the first five years of the water quality monitoring to the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Board in Sacramento. As part of Condition 17 of the 401, the SWRCB needs to determine if the beneficial uses identified in the Basin Plan for the Pit River are reasonably protected. If they decide that the beneficial uses are not reasonably protected, the SWRCB can increase flows an additional 50 cfs. Additionally, the *Order Modifying and Approving the Bald Eagle Compliance Monitoring Plan Pursuant To Article 415* requires PG&E to consult with the California Department of Fish and Game, US Fish and Wildlife Service, and the SWRCB regarding any proposed changes in Project Operation.
    a) Representatives of PG&E, SWRCB, RWQCB, USFWS, CDFG, other interested TRC/Recovery Team members attended the meeting.

IV. 2009 Recovery Team Projected Activities and Future Directions Discussion

A. Grant Funding

1) 2008 Director's Deferred Funds— Begin implementation of non-native signal crayfish suppression measures and refugia investigations as outlined in the scope of work for the 2008 Director's Deferred funding.
2) Check with Josh Hull in August because there are sometimes extra funds like the Director's Deferred Funds awarded last year.
3) Preventing Extinctions RFP—the 2009 due date has passed.
4) Section 6 Funding proposal due June 1, 2009 for 2010 funding.
    a) Mitochondrial DNA work on existing Shasta crayfish genetic samples
    b) Genetic Management Plan
    c) Refugia investigation

B. Sucker Springs Restoration Project—Eradication efforts and repair/replacement of weirs in Sucker Springs Creek will continue in 2009 with the continued help of PG&E.

1) In 2009, crayfish barriers, similar in design to the upper Fall River crayfish barrier, will be installed adjacent to and upstream of the Pond 4 and 5 weirs.
2) The Pond 4 and 5 weirs will be left in place so that the water level can be raised to facilitate snorkel surveys.

C. CDFG Temperature Study

1) CDFG hatchery and fisheries management have said that they require successful results from the temperature study, in terms of the growth and reproduction of Shasta crayfish, before they will discuss Rock Creek.
    a) Successful growth is probably defined as rearing Shasta crayfish in the 50 °F raceways at the Crystal Lake Fish Hatchery for about three years with measurable growth.
    b) Reproduction is covered by rearing of young of year.

2) Three attempts (i.e., 2005–2006, 2007, and 2008) to maintain Shasta crayfish in the raceways for the temperature study at the Crystal Lake Fish Hatchery have been unsuccessful.
    a) The reason for the failure of the temperature study in 2007 and 2008 is not known.
    b) Shasta crayfish were reared in both the 50 °F and 56 °F raceways at the Crystal Lake Fish Hatchery for more than a year before the equipment failure in 2006, but Shasta crayfish in both treatments were still too small to measure.
3) Shasta crayfish TRC/Recovery Team members recommended that a relatively small number of Shasta crayfish be introduced upstream of the CDFG diversion structure on Rock Creek in 2009 as an experiment in lieu of the temperature study in the raceways at the Crystal Lake Fish Hatchery.
    a) An experimental introduction of Shasta crayfish directly into Rock Creek will more directly and expeditiously address whether the reintroduction of Shasta crayfish into Rock Creek is likely to succeed.
    b) Need Genetic Management Plan to help determine source population for reintroduction of Shasta crayfish into Rock Creek.

D. CDFG Genetics Study
1) Collect genetic samples from Shasta crayfish in Rising River once landowner permission is obtained and send to UC Davis Genomic Variability Laboratory.
2) Develop a Genetic Management Plan to help determine source populations for potential reintroductions of Shasta crayfish into Rock Creek and elsewhere (UC Davis Genomic Variability Laboratory: Jessica Petersen, Bernie May)
3) Conduct Mitochondrial DNA work on existing Shasta crayfish genetic samples (UC Davis Genomic Variability Laboratory: Jessica Petersen, Bernie May)

V. **Shasta Crayfish Management Plan Fund Summary** (Attachment B)
A. Propose to use some of the unallocated Shasta crayfish management funds from 2008 and 2009 to pay for the installation of crayfish barriers upstream of the Pond 4 and 5 weirs at Sucker Springs Creek in 2009.

VI. **The next meeting will take place on Tuesday, September 15, 2009** at 10 am at the California Department of Fish and Game Region 1 Office Conference Room in Redding.

Attendees:

Charles White	415.973.3642	COW1@pge.com	PG&E Hydro License Coordinator
Ruth Sundermeyer	925.415.6376	D5SK@pge.com	PG&E Aquatic Biologist
Josh Hull	916.414.6742	josh_hull@fws.gov	USFWS Recovery Branch Chief
Kim Squires	916.414.6654	kim_squires@fws.gov	USFWS Forest and Foothills Ecosystems
Steve Baumgartner	530.225.2370	sbaumgartner@dfg.ca.gov	CDFG Region 1 Fishery Biologist
Matt Myers	530.225.3846	mmyers@dfg.ca.gov	CDFG Region 1 Environmental Scientist
Glenn Yoshioka	916.651.8764	gyoshioka@dfg.ca.gov	CDFG Species Conservation & Recovery
Woody Elliot	530.538.2212	welli@parks.ca.gov	CA Dept of Parks and Recreation
Theo Light	717.477.1093	TSLigh@ship.edu	Shippensburg University, Department of Biology
Jessica Petersen	530.752.6351	jlpetersen@ucdavis.edu	UC Davis Genomic Variation Lab
Maria Ellis	530.335.5446	maria@springrivers.com	Spring Rivers Ecological Sciences, LLC

Charles White (COW1@pge.com)
PG&E Senior License Coordinator for the Hat Creek and Pit 1 projects (415) 973-3642

Action Items from the April 2009 Shasta Crayfish TRC Meeting:

Project	Task	Who	When
	TRC Actions		
Barrier	Continue biennial Upper Fall River barrier inspection snorkel surveys	Spring Rivers	ongoing
Rock Creek	Develop a written proposal to reintroduce Shasta crayfish to Rock Creek	Spring Rivers	2009-2010
Rock Creek	Develop Rock Creek Restoration Plan	Spring Rivers	2009
Crayfish Plan	Pit 1 and Hat Creek monitoring surveys	Spring Rivers	ongoing
Crayfish Plan	Obtain landowner permission to survey Rising River	Spring Rivers	ongoing
Barrier/ Crayfish Plan	Biannual non-native crayfish eradication surveys of Thousand Springs and Spring Creek	Spring Rivers	ongoing
	Recovery Team Actions		
Deferred funds	Begin implementation of non-native signal crayfish suppression measures and refugia exploration funded by the 2008 Director's Deferred allocation	Spring Rivers	2009
Sucker Springs	Continue eradication efforts	Spring Rivers	ongoing
Sucker Springs	Install crayfish barriers, similar in design to the upper Fall River crayfish barrier, adjacent to and upstream of the Pond 4 weir and the Pond 5 weir	Spring Rivers	Summer 2009
Temperature	Install/Maintain temperature gages at ten Shasta crayfish locations	Spring Rivers/CDFG	ongoing
Temperature	Develop a proposal to reintroduce a relatively small number of Shasta crayfish upstream of the CDFG diversion structure on Rock Creek in 2009 as an experiment in lieu of the temperature study in the raceways at Crystal Lake Fish Hatchery	CDFG/ Spring Rivers	2009
Genetics	Collect genetic samples from Pit River Falls and Rising River and provide to Jessica	Spring Rivers	2009
Genetics	Write Section 6 Proposal for additional genetics funding	CDFG/ Steve B.	May 2009
Genetics	Conduct mitochondrial DNA research on samples	CDFG/ UC Davis Genome Lab	2009/2010
Genetics	Develop Genetic Management Plan	CDFG/ UC Davis Genome Lab	2009/2010
Funding	Research funding options including Bring Back the Natives grants	Spring Rivers	ongoing
General	Research environmental awards to continue to build ground swell for Shasta crayfish recovery	All	ongoing

SHASTA CRAYFISH TECHNICAL REVIEW COMMITTEE
Hat Creek (FERC Project No. 2661) & Pit 1 (FERC Project No. 2687)
SHASTA CRAYFISH RECOVERY TEAM

September 15, 2009 (Tuesday) - 10:00 am to 2:00 pm
California Department of Fish and Game Region 1 Office Conference Room
601 Locust Street, Redding, CA 96001
(530) 225–2370
CDFG Meeting Host: Steve Baumgartner

MEETING SUMMARY

I. **Joint Meeting of the TRC and Recovery Team**. Charles White is the leader of the TRC. Maria Ellis is the leader of the Recovery Team.

II. **CDFG Genetics Study—Genetic Management Plan** (Recovery Team)

- A. The Pit River sample and the additional samples from Sucker Springs fall within the Big Lake/Spring Creek/JaShe Creek/Lava Creek Cluster.
- B. Section 6 Funding proposal submitted on June 1, 2009 for 2010 genetic work, including Mitochondrial DNA work on existing Shasta crayfish genetic samples, Genetic Management Plan, and Refugia investigation.
  1) The Section 6 Grants has been evaluated by CDFG and forwarded to USFWS. They had not been reviewed by the Recovery Branch by the time of the meeting.
  2) CDFG cannot set up a contract until funding is secured, likely summer 2010.
- C. Jessica Petersen will be starting her post-doc in Minnesota in October! The Rising Rivers genetic samples will either be run at Bernie May's lab at UC Davis or forwarded to Jessica. The data will be forwarded to Jessica for analysis.
- D. Genetic Management Plan is needed in order to be able to relocate Shasta crayfish.
  1) Need information such as minimal optimal population size for the seed population, effects of removal on the source population, optimal life stage to move, target number of offspring per year, and target population size.
- E. Suggested development of an outline for the Genetic Management Plan is a group effort with Maria and Jessica putting together the draft outline with Species Plan, Population Viability Analysis (PVA), and synthesis. Steve will provide guidance from CDFG management
  1) Maria will put together an outline based on the Benefit Risk Analysis of Pacific Salmon done by Robin Waples (Waples and Drake 2004)
  2) Jessica will review outline and add to the PVA section
  3) Send draft outline to TRC/Recovery Team for review.

III. **Rock Creek Restoration** (TRC) / **CDFG Temperature Study** (Recovery Team)

- A. Shasta crayfish temperature trials were not repeated in 2009.
- B. Steve talked to the Region 1 Senior Hatchery Supervisor Linda Rathburn about the potential Pilot Introduction of a small number of Shasta crayfish upstream of the CDFG diversion structure on Rock Creek.

1) Strong lesson in the magnitude of hatchery management's disease concerns. Crystal Lake Hatchery raises one-third of the trout in the state. Crystal Lake has not had the disease issues experienced by most other hatcheries. CDFG Hatchery position is that putting Shasta crayfish above the water diversion for the Crystal Lake Hatchery is not an option—no level of comfort would be acceptable.

C. There needs to be an Internal CDFG Meeting with the top managers to discuss the Pilot Introduction of a small number of Shasta crayfish upstream of the CDFG diversion structure on Rock Creek. Steve will talk to the managers.

D. Question was raised as to whether CDFG Hatchery Operations Environmental Impact Report (EIR) / Environmental Impact Statement (EIS) that is developed addresses the disease issue.
   1) The EIR/EIS does not specifically address the issue. Stocked trout are not likely major predators on Shasta crayfish.

E. Castro Pond, one of the three spring-fed headwaters (Rock Springs, Kerns Pond, and Castro Pond) that are the water source for Rock Creek and hence the Crystal Lake Hatchery, has been stocked with largemouth bass without any controls, assurances, permits, or consequences apparently.

F. Should follow whatever protocol has been adopted by CDFG's pathology staff.

G. Question as to whether PG&E's water rights at Rock Creek, which are not currently being exercised, would provide enough water to support Shasta crayfish in Rock Creek downstream of the current diversion.

H. The 1945 agreement between CDFG and PG&E states that CDFG can divert up to 30 cfs, but that there must a minimum instream flow release of 2 cfs. PG&E reserves the right to 5 cfs of water for "beneficial purposes." The agreement also states that CDFG should pay a rental of $1/year to PG&E.

I. Send Steve the *Ceratomyxa* write-up (Spring Rivers completed).

IV. **Rock Creek Restoration Plan coming in to meeting** (TRC)

A. Develop a written proposal to reintroduce Shasta crayfish to Rock Creek. Article 412 of the Hat Creek Project license requires PG&E to develop a Shasta Crayfish Management Plan that includes formulation of a plan to re-introduce Shasta crayfish into Rock Creek. Prior to implementation of a Rock Creek Reintroduction Plan:
   1) Develop a Rock Creek Restoration Plan to restore historical Shasta crayfish habitat, including measures to ensure that the water needs for the Crystal Lake Fish Hatchery continue to be met.
      a. Consult Genetic Management Plan to help determine source population for potential reintroductions of Shasta crayfish into Rock Creek.
      b. Pilot Introduction of a small number of Shasta crayfish upstream of the CDFG diversion structure on Rock Creek would address the question of whether the reintroduction of Shasta crayfish into Rock Creek is likely to succeed.
         i. CDFG Hatchery Management strongly opposed.

B. Schedule
   1) Draft Rock Creek Restoration Plan to TRC 30 days before the April 2010 TRC meeting
   2) Draft Genetic Management Plan schedule?
   3) Experimental introduction of Shasta crayfish upstream of the CDFG diversion structure on Rock Creek in 2010.

C. Explore funding possibilities for Rock Creek Restoration and Reintroduction
   1) Bring Back the Natives Grant pre-proposal is due December 1

V. **Refugia needed to save/maintain Genetic Diversity.**

A. Losing genetic diversity as subpopulations disappear. Important to save as much genetic diversity as possible.

B. Move subpopulations at risk into refugia. Individuals from subpopulations within a genetic cluster (i.e., Big Lake/Spring Creek/JaShe Creek/Lava Creek, Thousand Springs, Crystal Lake) could be moved to the same refugia.

C. Potential Refugia Study will be funded by Director's Deferred Funds (for non-native signal crayfish suppression measures and refugia investigations).
   1) Potential refugia (Attachment A Figure 1—Shasta crayfish distribution map showing potential refugia locations)—Kerns' Pond, Castro Pond, Ivy Horr's Northern Pond, Medicine Pool (headwater pool of the west arm of Lava Creek).
   2) List Potential Refugia, pros and cons, feasibility, and estimated budget
   3) Useful tool for USFWS Recovery Branch
   4) Schedule for Potential Refugia Study—30 days before the April 2010 TRC meeting

D. Kerns' Pond, which has good habitat and is on private land with a cooperative landowner, would make a great smaller refugia and is ready to go as is.

E. Ivy Horr's Northern Pond supported Shasta crayfish in 1978. Largemouth bass have been introduced since that time and no Shasta crayfish were found during a survey in 1993.
   1) CDFG could put resources towards electroshocking and eradicating bass from Ivy Horr's Northern Pond.

F. Charlie asked about the potential to create a refuge at Hat 2 Spring during the upcoming Hat Gage and Weir replacement project.
   1) Not much habitat at Hat 2 Spring, which is a natural spring augmented by flow from the sinkholes at the downstream end of Baum Lake. Relatively small area upstream of the present weir. The pool behind the weir is filled with fines and the upper channel is higher gradient than generally used by Shasta crayfish. Signal crayfish are present upstream of the weir. The springs are still producing/running sediment from Baum Lake.

G. What permitting would be required before Shasta crayfish from some of the subpopulations at risk could be moved into refugia, such as Kerns' Pond.
   1) Recovery Permit (internal) pursuant to section 10(a)(1)(A) of the Endangered Species Act (ESA).
   2) Data showing precipitous decline of the subpopulation.
   3) Statement from Jessica saying that without safeguarding the remaining individuals in subpopulations are at risk; we will lose genetic diversity.
      a) Proportion of unique alleles that might be lost.
   4) CDFG need to issue a consistency determination under the California Endangered Species Act.
   5) Translocation to Private Land—Landowner protection against lawsuits, etc.

a) Safe Harbor Agreement (SHA)—a voluntary agreement involving private property owners whose actions contribute to the recovery of species listed under the ESA. No additional or different management activities of the property are required without the consent of the landowner. At the end of the agreement period, participants may return the enrolled property to the baseline conditions that existed at the beginning of the SHA

b) Memorandum of Understanding (MOU) between landowner, USFWS, CDFG, etc. similar to what was done for the Bear Creek Meadow Restoration Project.

c) Conservation Easement provide protection for Shasta crayfish because it stays with the property in the advent that ownership changes.

d) Charles White to check with PG&E staff Janet Walther (State Agency Relations), and Janelle Kellman (PG&E's ESA lawyer), who may provide insight.

VI. **Pit 1 Flushing Flows** (TRC)

A. Events of 2009

1) April 22 TRC Meeting—report of the dramatic decline in the number of Shasta crayfish observed in the Pit 1 bypass reach since implementation of the new-license required flow regime
2) May 11 Water Quality 5-Year Summary Meeting—discussion of flushing flows potentially resulting in take of an endangered species, USFWS requests recommendation from species expert.
3) May 13—As the Recovery Team leader and species expert, Maria Ellis wrote a letter to USFWS recommending the cessation of the Pit 1 flushing flows.
4) May 26 USFWS letter to FERC and SWRCB—expressed concern regarding a decline in the endangered Shasta crayfish and requesting the suspension of flushing flows at PG&E's Pit 1 Project, FERC No. 2687.
5) June 17 SWRCB response to USFWS request to suspend the Pit 1 flushing flows—SWRCB stated that PG&E should request modifications of the 401 Conditions related to flushing flows and include evidence that flushing flows are not required to control nuisance vegetation and mosquito production. Additional benefits to Shasta crayfish resulting from the cessation of flushing flows may also be included.
6) June 23 PG&E letter to SWRCB—requesting modifications to the Section 401 Conditions consistent with USFWS' recommendations. The requested modifications in Certification Conditions 13 and 14 were to review the results presented in the first four years of the annual flushing flow reports and terminate the flushing flows in Pit 1 during the summer months.
7) SWRCB also suggested in their June 17 letter—prudent to increase the monitoring frequency and conduct further studies to determine the exact cause of Shasta crayfish decline at the Pit River sites, because the TRC Summary Report is not conclusive that the flushing flows are the cause of the decline at the Pit 1 Canyon Spring location. State Water Board staff recommend the Recovery Team develop a monitoring plan that will more accurately assess the current population and develop recommendations to monitor and protect the existing population.
8) Flushing flows took place on June 19-21, July 18-20, and August 28-30, 2009.

9) In an August 28 letter, SWRCB stated that amendment of the Water Quality Certification is a discretionary action that required SWRCB to comply with CEQA. SWRCB will be the lead agency for preparation of the environmental documents, which could be an Environmental Impact Report.
    a) SWRCB and PG&E have talked about preparing a Mitigated Negative Declaration

B. Pit 1 Biological Opinion (BO)—USFWS issued the BO, including the Incidental Take Statement to FERC on October 24, 2002.
1) Because of the large number of unresolved and not-yet-developed Project activities included in the FERC license for the Pit 1 Project, the Incidental Take Statement was for an interim period of no longer than three years.
2) The interim period was to allow for development and consultation on plans as necessary, approval of plans by the Commission, and development of information on Shasta crayfish habitat and population to allow rational estimation of take. Permanent loss of suitable habitat during the interim period was not anticipated or authorized. Because the impacts during the three-year interim period were to be temporary in nature, the Service believed the interim take and full implementation of the proposed action were not likely to jeopardize the species.

C. It is the USFWS position that take is occurring due to the reduction in habitat that occurs during flushing flows.
1) Provide USFWS with a simple, concise statement on how flushing flows result in a reduction in Shasta crayfish habitat.
2) Debbie Giglio, the USFWS FERC coordinator, is writing a letter to FERC stating that FERC is out of compliance.
3) Water temperatures in the mainstem river increase by 2 °C and by 5–10 °C in the spring areas.
    a) Need water temperature data from this year.
    b) Theo cited the UC Berkeley study where a sudden increase in water temperature resulted in near complete mortality of Shasta crayfish.
    c) Pulse of warmer water has a physiological effect that can kill Shasta crayfish outright or put them at a disadvantage to other species, such as non-native crayfish.
    d) Send Thermal refugia report to TRC/Recovery Team
4) Additional monitoring of Shasta crayfish in the Pit 1 Bypass (SWRCB's recommendation) is not needed or appropriate.
    a) Maria to provide statement to Kim
5) Need to reduce all possible stresses on all existing Shasta crayfish populations. Important to save the genetic diversity of all small populations.

D. Revisit whitewater boating flows in Pit 1 between September 15 and May.
1) USFWS position is that if flushing/whitewater boating flows occur, they should be after September 15.
2) In the Environmental Assessment (EA) prepared for the Pit 1 Project, FERC recommends a study of whitewater flow releases between September 15 and October 30. FERC recognized that high periodic flow releases during the period between May 1 and September 15 could result in fish stranding; increased riparian and wetland vegetation scouring; increased direct mortality on nesting birds, small

mammals, amphibians, and reptiles that breed in floodplain habitats; and an overall upsetting of the riverine ecology.

3) The whitewater releases in the Pit 5 Reach (two consecutive weekend days in both August and September) are considered experimental.
4) On the McCloud-Pit Project, Dave Steindorf (AWW) is not asking for flows outside the natural hydrograph.

E. TRC Recommendation—Concurrence letters after USFWS letter is posted on FERC website.

VII. **Shasta Crayfish Monitoring and Removal Surveys** (TRC)

A. The first 5 and 6 years of monitoring and other activities under the Pit 1 and Hat Creek Shasta Crayfish Management Plans, respectively, were completed in 2008. The Shasta Crayfish Technical Review Committee Summary Report was filed with FERC in May 2009. The Review Workshop was held on April 22, 2009 to determine future actions and revise the Hat Creek and Pit 1 Shasta Crayfish Management Plans as necessary.

B. Crayfish Monitoring schedule is unchanged. The next Hat Creek crayfish surveys are in 2012. The third round of Pit 1 crayfish surveys began in 2009 and will be completed in 2010.

C. Crayfish Barrier biannual monitoring and non-native crayfish eradication surveys are ongoing.

1) During July and August 2009 surveys of the upper Fall River upstream of the barrier, 255 signal crayfish were collected and destroyed. Most of these crayfish were young-of-year.

D. Based on the updated Shasta Crayfish Management Plan Fund summary, approximately $109,000 of unspent annual management funds (i.e., no Hat Surveys in 2008-2009) is allocated as recovery funds to be used for other TRC/Recovery Team-approved Shasta crayfish projects, such as the Sucker Springs Creek Restoration Project.

1) In October 2009, these recovery funds will be used to construct two crayfish barriers at the downstream ends of Ponds 4 and 5 in Sucker Springs.

VIII. **Sucker Springs Restoration Project** (Recovery Team)

A. During 2009 survey and trapping efforts in ponds 2 though 4, 130 signal crayfish were collected and destroyed.

B. Construction of a crayfish barrier at the downstream end of both Pond 4 and Pond 5 is scheduled for October 2009.

1) The crayfish barriers will be similar in design to the upper Fall River crayfish barrier and will be installed adjacent to and upstream of the Pond 4 and 5 weirs. The Pond 4 and 5 weirs will be left in place so that the water level can be raised to facilitate snorkel surveys.

2) Big Valley Divers, who constructed the upper Fall River crayfish barrier, will be doing the construction.

C. Permitting

1) CDFG 1602 Streambed Alteration Permit—May 22, 2005 through December 10, 2010.

2) State Water Resources Control Board (State Water Board) Clean Water Act, Section 401 Certification—May 11, 2006 through project completion (must notify State Water Board within 7 days of project completion).
3) Wildlife Extension Agreement between PG&E and USFWS—December 5, 2005 through December 5, 2020.
4) USFWS Section 7 Consultation, August 15, 2005 Determination—may affect, but is not likely to adversely affect species/adversely modify critical habitat.
5) Notification of Compliance with Section 106 of the National Historic Preservation Act (NHPA), September 22, 2005—No anticipated Project impact on Cultural Resources

D. Final Engineering Design Drawings (Attachment B)

E. Funding—$109,000 recovery funds (unspent annual management funds)

IX. During our September meeting, an April date was chosen for the spring 2010 TRC/Recovery Team meeting. Due to the schedule for the Pit 1 Project Endangered Species Act consultation, we would like to move the meeting forward into early March. The **next meeting is tentatively scheduled for Tuesday, March 9, 2010** at 10 am at the California Department of Fish and Game Region 1 Office Conference Room in Redding.

A. Please let me know if **Tuesday, March 9, 2010** will work with your schedule.

Charles White
Team Lead – Shasta Crayfish Technical Review Committee
Senior License Coordinator, Hat Creek (FERC No. 2661) and Pit 1 (FERC 2687)
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Maria Ellis	530.335.5446	maria@springrivers.com	Spring Rivers Ecological Sciences, LLC

Action Items from the September 2009 Shasta Crayfish TRC Meeting:

Project	Task	Who	When
	TRC Actions		
Pit 1 Flushing Flows	Provide USFWS with statements re: flushing flows reduce Shasta crayfish habitat and additional monitoring not needed or appropriate. Send Thermal Refugia report to TRC	Spring Rivers	October
	Write Concurrence letters after USFWS letter is posted on FERC website	TRC	December 2009
Rock Creek	Send *Ceratomyxa* write-up to Steve	Spring Rivers	November
	Develop a written proposal to reintroduce Shasta crayfish to Rock Creek	Spring Rivers	2009-2010
	Develop Rock Creek Restoration Plan	Spring Rivers	2009
Crayfish Plan	Obtain landowner permission to survey Rising River	Spring Rivers	ongoing
	Pit 1 and Hat Creek monitoring surveys	Spring Rivers	ongoing
Barrier	Continue biennial non-native crayfish eradication and barrier inspection snorkel surveys	Spring Rivers	ongoing
Refugia	Consult with PG&E legal staff (ESA) to identify potential protection measures for landowners willing to approve refuge habitat on their land.	Charles White	Fall 2009
	Recovery Team Actions		
Genetics	Draft Genetic Management Plan outline	Maria Ellis/ Jessica Petersen	2009/2010
Refugia	Talk to Kerns' Pond landowner	Spring Rivers	2009
	Potential Refugia Study-draft prior to April '10 TRC	Spring Rivers	2009-2010
Sucker Springs	Continue eradication efforts	Spring Rivers	ongoing
	Install Pond 4 and Pond 5 crayfish barriers	Spring Rivers	Fall 2009
Temperature	Install/Maintain temperature gages at ten Shasta crayfish locations	Spring Rivers/CDFG	ongoing
	Pilot Introduction upstream of CDFG diversion structure on Rock Creek	CDFG/ Spring Rivers	?
General	Collect genetic samples from Rising River	Spring Rivers	2010
	Conduct mitochondrial DNA research on samples	CDFG/ UC Davis Genome Lab	2010/2011
	Research environmental awards to continue to build ground swell for Shasta crayfish recovery	All	ongoing

Attachment A

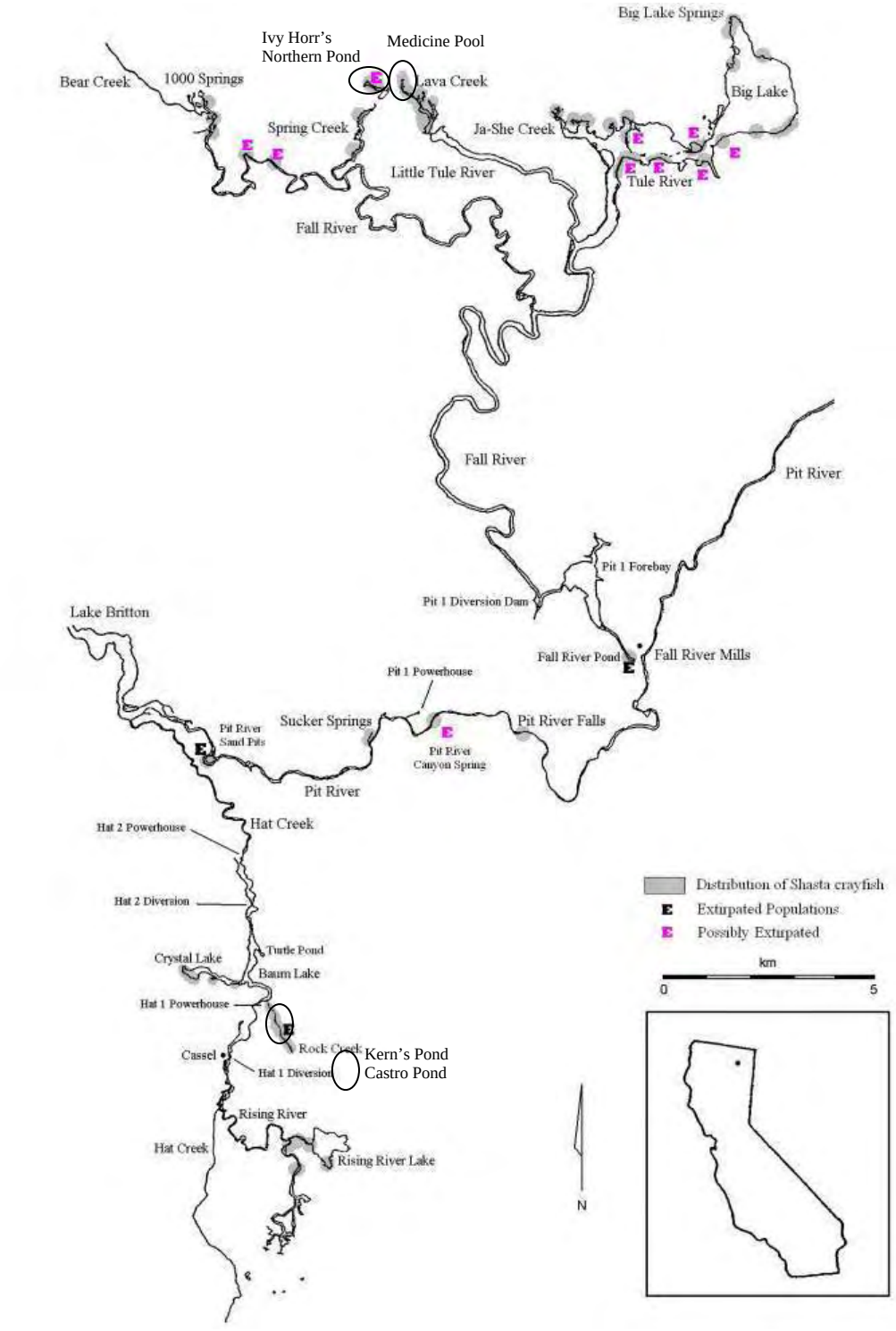
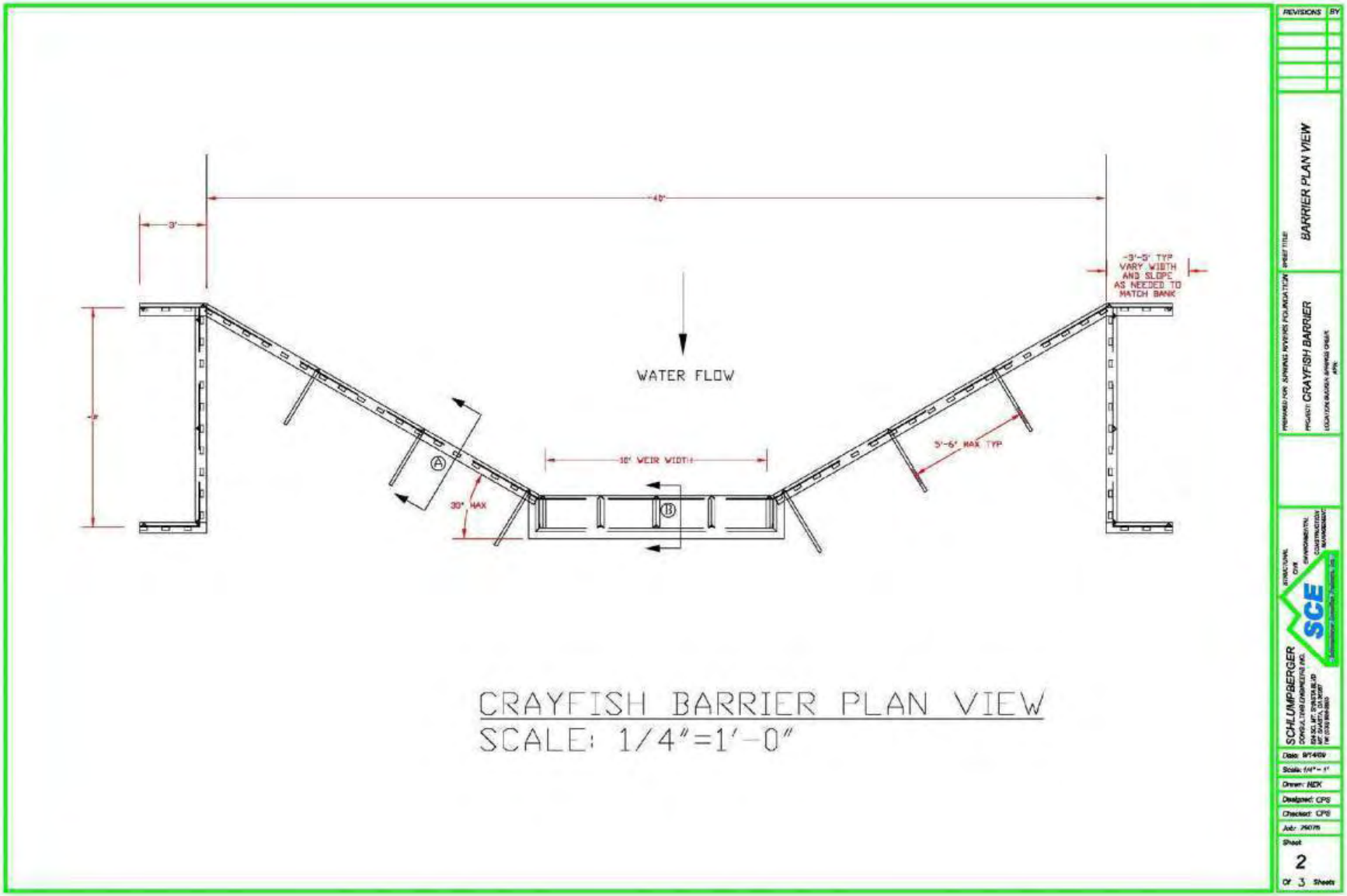
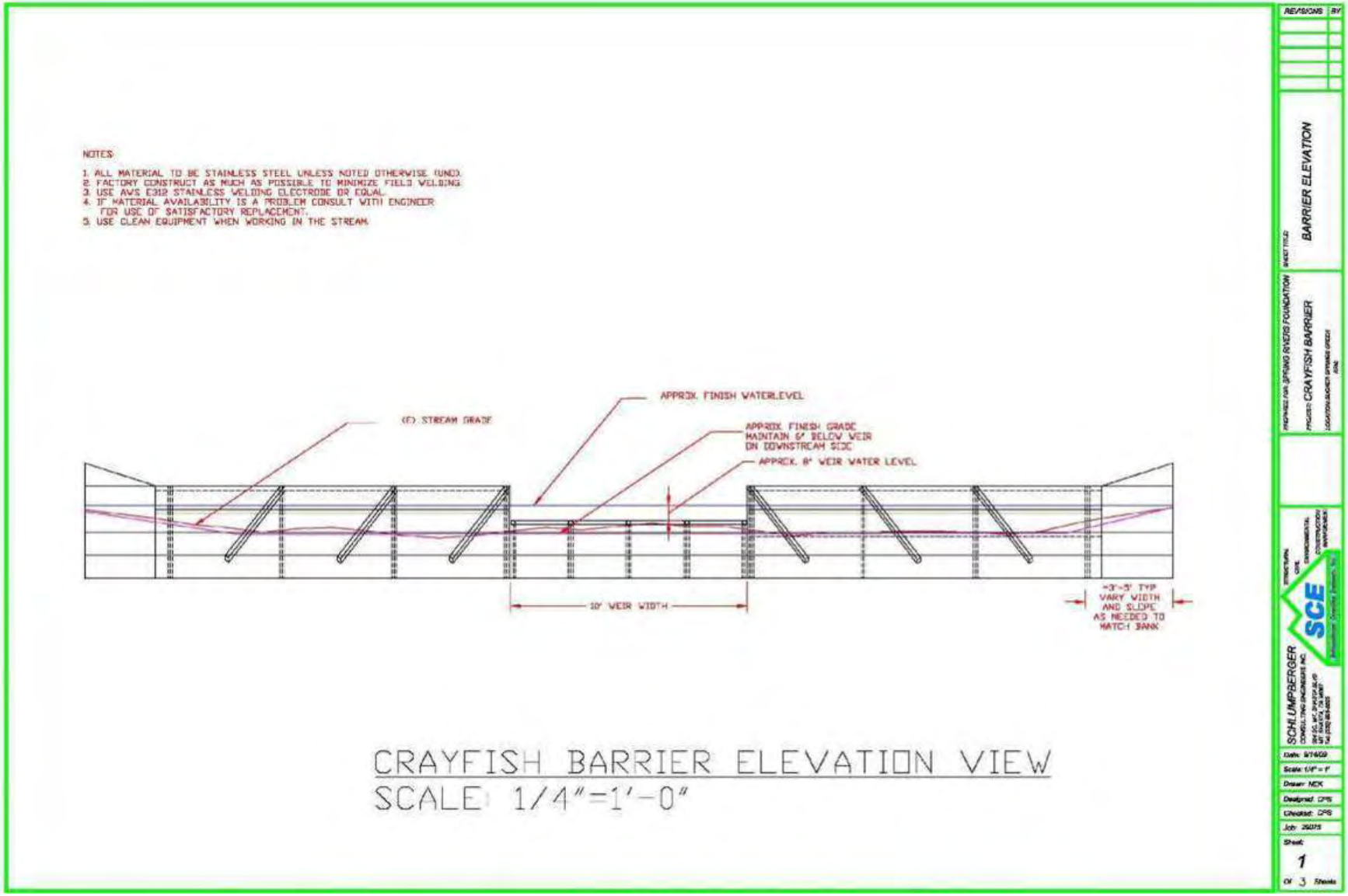


Figure 1 Shasta crayfish distribution map showing potential refugia locations at Kerns' Pond, Castro Pond, Ivy Horr's Northern Pond, and Medicine Pool (headwater pool of the west arm of Lava Creek).

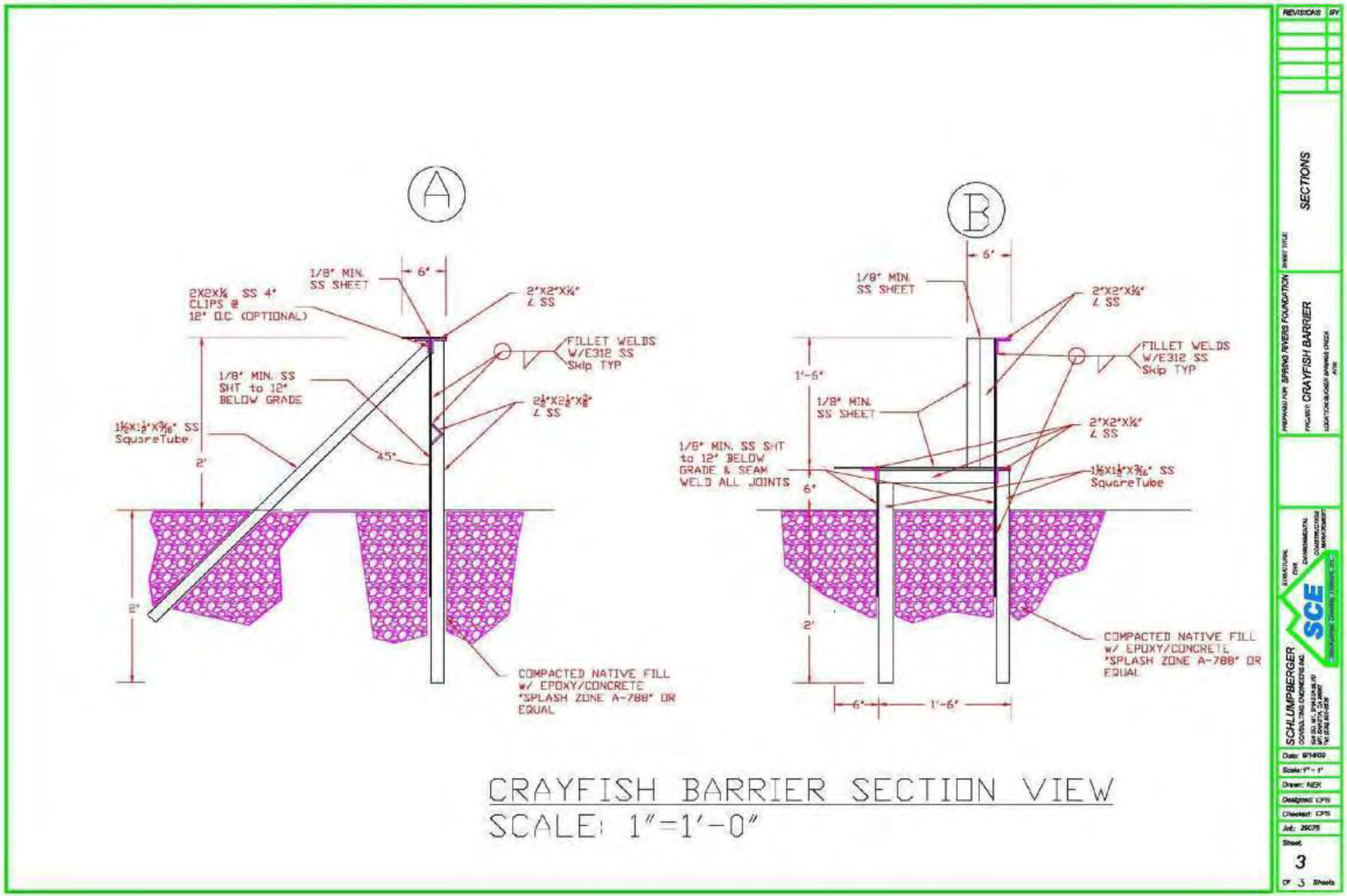
Attachment B.1—Sucker Springs Creek Pond 4 and 5 Crayfish Barrier—Plan View



Attachment B.2—Sucker Springs Creek Pond 4 and 5 Crayfish Barrier—Elevation View



Attachment B.3—Sucker Springs Creek Pond 4 and 5 Crayfish Barrier—Section View



CRAYFISH BARRIER SECTION VIEW
SCALE: 1"=1'-0"

SHASTA CRAYFISH TECHNICAL REVIEW COMMITTEE
Hat Creek (FERC Project No. 2661) & Pit 1 (FERC Project No. 2687)
SHASTA CRAYFISH RECOVERY TEAM

March 9, 2010 (Tuesday) - 10:00 am to 2:00 pm
California Department of Fish and Game Region 1 Office Conference Room
601 Locust Street, Redding, CA 96001
(530) 225–2370
CDFG Meeting Host: Steve Baumgartner

MEETING SUMMARY

I. **Joint Meeting of the Technical Review Committee (TRC) and Recovery Team**
   A. Recovery Team leader—Maria Ellis / TRC leader—Charles White

II. **Crayfish Monitoring Status Update (TRC)**
   A. Hat Creek crayfish surveys (next surveys in 2012); Pit 1 crayfish surveys (3rd round of surveys are on-going and will be completed in 2010); and non-native crayfish removal surveys (always on-going).
      1) Still working on landowner permission to survey Rising River.
   B. During crayfish monitoring and crayfish barrier biannual crayfish removal surveys in upper Fall River from July through December 2009, 256 signal crayfish, including 176 young-of-year (YOY), were found and destroyed. During the crayfish monitoring survey in July, 113 Shasta crayfish, including 11 YOY, were found.
   C. During crayfish barrier biannual crayfish removal surveys in Spring Creek in February and March 2010, 290 signal crayfish, including 6 YOY, were found and destroyed. Approximately 131 Shasta crayfish were observed during the crayfish removal surveys.
   D. Glenn expressed concern regarding the pressing need for safe refugia given the increasing number of signal crayfish being found upstream of the barriers in upper Fall River and Spring Creek.
   E. Shasta Crayfish Management Plan Fund Summary

III. **Pit 1 Flushing Flows (TRC)**
   A. During summer flushing flows in July and August 2009, temperature monitoring (CDFG Temperature Study) documented the resultant increase in temperature and loss of thermal refugia habitat during summer pulsed flows. Summer flushing flows increased the maximum daily water temperatures and resulted in rapid and substantial changes in the temperature within the area influenced by coldwater springs. In the mainstem habitat, summer flushing flows in the Pit 1 Bypass Reach muted the maximum and minimum daily water temperatures, overwhelmed the effects of fluctuating day-to-night air temperatures, and eliminated diel thermal refugia.
   B. Charles has been in communication of John Aedo of FERC.
   C. Russ Kanz of State Water Resources Control Board doesn't believe he has the authority to temporally suspend flushing flows. Under the California Environmental Quality Act, the State Water Board is required to develop an Environmental Impact Report for any permanent amendment to the 401 Water Quality Certificate.
   D. The 401 Water Quality Certificate for the Hat Creek Hydroelectric Project has specific language that allow flows to be temporarily modified with written consent under certain circumstances, which is useful language in a 401 Certification.

E. Update on ESA consultation
   1) PG&E is developing a Draft Biological Evaluation (BE) for the Pit 1 Project to submit to FERC. FERC will use the document to develop a Biological Assessment to initiate consultation with USFWS.
   2) BE lists all proposed actions from the continued operation of the Pit 1 Project under the current license that could affect Shasta crayfish including all potential aseasonal pulsed flows (i.e., flushing flows, planned outages, unplanned outages, and recreational whitewater releases).
   3) Recreational whitewater releases should be scheduled between September 15 to October 30 to avoid the effects to summer Shasta crayfish habitat and minimize the magnitude of the flow change effects of summer pulsed flows.
   4) What would happen if there were a mid-September heat wave?

F. Kim Squires clarified that USFWS can concur or disagree, but cannot approve projects.

IV. **CDFG Temperature Study (Recovery Team)**

A. As part of CDFG Temperature Study, the range of water temperatures experienced at known Shasta crayfish locations was documented. Spring Rivers installed 14 temperature recorders at seven Shasta crayfish locations in 2009. HOBO Watertemp Pro v2 and HOBO TidbiT data loggers (Onset Computer Corporation) were installed at Thousand Springs, Spring Creek, Big Lake Springs, South Big Lake Levee Cove, Pit River Falls, Sucker Springs Creek, Crystal Lake, and Rock Creek. Recorders will also be installed at Ja She Creek and Rising River Lake (landowner permission pending) and the recorder in southwestern Crystal Lake will be relocated into actual Shasta crayfish habitat.
   1) Data loggers placed in Shasta crayfish locations strongly influenced by spring accretion (e.g., Thousand Springs, Big Lake Springs) recorded relatively constant water temperatures throughout the year with mean daily water temperatures between 9.5 to 12.5 °C.
   2) In areas with less spring influence (e.g., Pit River and Big Lake Levee), mean daily water temperatures ranged from approximately 2.5 to 26.0 °C.
   3) Temperature monitoring of the two Shasta crayfish locations in the Pit 1 Bypass Reach upstream of the Pit River falls and the effects of the Pit 1 Flushing Flows during July and August 2009 were discussed earlier.

B. Five YOY Shasta crayfish, which were the offspring from the gravid females used for the May 2008 trial, are still being held in 50 °F treatment raceway at Crystal Lake Fish Hatchery. These crayfish should be released to Spring Creek where the gravid females were collected.

V. **CDFG Genetics Study / Genetic Management Plan (Recovery Team)**

A. Have contacted landowners/managers for both Rising River properties and hope to get permission to survey and take genetic samples in 2010.

B. Section 6 Funding proposal ($86,000) submitted on June 1, 2009 was funded for 2010.
   1) Mitochondrial DNA work on existing Shasta crayfish genetic samples
   2) Genetic Management Plan
   3) Refugia investigation

C. Jessica Petersen, who is now doing a post-doc in Minnesota, will be back at UC Davis for a week or two this summer to begin work on the Mitochondrial DNA and Genetic Management Plan.

D. Genetic Management Plan will provide the information needed to relocate Shasta crayfish, including: minimal optimal population size for the seed population, effects of removal on the source population, optimal life stage to move, target number of offspring per year, and target population size.

E. Brief review of preliminary draft outline for the Genetic Management Plan including Species Plan, Population Viability Analysis (PVA), and synthesis.

1) Maria put together a preliminary draft outline (Appendix D).

2) Jessica will review outline and add to the PVA section

3) Send draft outline to TRC/Recovery Team for review.

VI. **Safe Harbor Agreements for TRC and Recovery Team Shasta Crayfish Refugia (Kathy Brown USFWS and Susan Kester PG&E)**

A. Encourage non-federal landowners to restore, enhance, and maintain habitats for federally-listed species by providing assurances that USFWS will not impose additional regulatory restrictions because of their voluntary conservation actions.

B. USFWS authorizes incidental take coverage for routine and ongoing activities on the property.

C. Benefit for listed species must outweigh the potential impacts from routine and ongoing activities on the property.

D. Safe Harbor Agreement (SHA) must be maintained for a minimum of 10 years but can be for 20 to 30 years.

E. USFWS (or approved cooperators) and property owners develop the draft SHA, landowner applies to USFWS for an Enhancement for Survival permit with the draft SHA attached, USFWS complies with all applicable ESA provisions (internal section 7 review, publish notice in the *Federal Register* and public comment period on permit application), and USFWS then issues the landowner an Enhancement for Survival permit [10(a)(1)(A) permit] and finalizes the SHA.

1) State also has Safe Harbor program and you can dual list with State and Feds but it takes longer and is not required. State can adopt a consistency determination.

2) SHA sets up clear responsibilities, if landowner sells property hope new landowner would adopt the SHA, but it is not required.

F. Two types of SHA: Individual and Programmatic.

1) Individual SHA for each landowner

2) Programmatic SHA would have one Appropriate Entity for all Shasta crayfish refugia, only requires certificate of inclusion to include additional refugia location under the programmatic agreement.

a) The definition of an Appropriate Entity has changed in the last 6 months.

b) An Appropriate Entity is a local or state agency (non-profits or other types of organizations used to be allowed but the solicitors are more restrictive now—probably couldn't be the Recovery Team or Spring Rivers Foundation). The Fall River Resource Conservation District could potentially be the Appropriate Entity.

c) Responsibilities of Appropriate Entity include monitoring, reporting, and administration, including signing up new landowners.

G. Kathy Brown will talk to solicitors about the recovery team or non profit as an Appropriate Entity for a Programmatic SHA. On March 11, Kathy got back to Maria advising that the first landowner do an individual SHA instead of looking for a programmatic for the following reasons:

1) Finding an acceptable entity to hold the permit would be difficult with the current solicitor if it is not a state or local governmental agency

2) Programmatic SHA's can be tough to pull off in Shasta County unless you can get buyoff from ALL landowners. It only takes one vocal landowner that is not educated on SHA's to bring down the entire process.

H. Kathy recommended that Susan Kester and Spring Rivers could do all the up-front work with the landowner, document the baseline, set up a simple monitoring plan, help the landowner fill out the permit paperwork, and then submit to the Service so the landowner would minimize the time working with the Service (if there is a concern with working with the Service).

I. Toolbox of options for obtaining conservation goals, including SHA and Conservation Easement. Identify the range of options and educate the landowner(s).

1) Conservation Easement prevents development of the property but does not permit incidental take.

2) Public funding available for private landowners to pursue conservation goals, including Natural Resource Conservation Service (NRCS), USFWS Partners for Fish and Wildlife, and the USFWS Conservation Easement Program.

a) Partners Program provides technical and financial assistance to private landowners to help meet the habitat needs of our Federal Trust Species, by: (1) promoting and implementing habitat improvement projects; (2) providing conservation leadership and promote partnerships; (3) encouraging public understanding and participation; and (4) working with U.S. Department of Agriculture (USDA) to implement conservation programs.

b) Conservation Easement Program is a completely voluntary program where the Service pays landowners a percentage of their wetland or agricultural properties fair market value to purchase the farming and development rights in perpetuity.

J. Spring Rivers write up goals and potential locations of refuges (**Refugia Study**).

VII. **Refugia Study funded by Director's Deferred Funds (Recovery Team)**

A. Potential refugia—Kerns' Pond, Castro Pond, Ivy Horr's Northern Pond, Medicine Pool (headwater pool of the west arm of Lava Creek).

B. Kern's Pond landowner supportive—Start developing Safe Harbor Agreement.

VIII. **Rock Creek Restoration (TRC)**

A. Develop a written proposal to reintroduce Shasta crayfish to Rock Creek. Article 412 of the Hat Creek Project license requires PG&E to develop a Shasta Crayfish Management Plan that includes formulation of a plan to re-introduce Shasta crayfish into Rock Creek. Prior to implementation of a Rock Creek Reintroduction Plan:

1) Develop a Rock Creek Restoration Plan to restore historical Shasta crayfish habitat, including measures to ensure that the water needs for the Crystal Lake Fish Hatchery continue to be met.

2) Consult Genetic Management Plan to help determine source population for potential reintroductions of Shasta crayfish into Rock Creek.
3) Charles will provide Kim with the specific language of Article 412 pertaining to the Rock Creek Restoration—"*The Shasta crayfish management plan shall also include formulation of a plan to reintroduce Shasta crayfish to the Rock Creek springs area. At minimum this plan should include installation of a crayfish barrier, means to eradicate non-native crayfish above the barrier, and restoring historical Shasta crayfish habitat. This reintroduction plan should include methods to be implemented throughout the term of the license to protect and maintain this reintroduced population in stable condition.*"
4) Important to have PG&E management and agency support of the plan.

B. Two main issues: Water Supply and Disease.
1) Need a report on Water Supply and the feasibility of moving the water supply.
2) Charlie suggested a field trip with PG&E groundwater geologist, John Woodruff (the field visit was held on May 11, 2010).

C. Based on additional conversations with Linda Radford, Senior Hatchery Supervisor, CDFG Northern Region, Steve reported that CDFG's major concern with the potential Rock Creek Restoration is disease issues.
a) CDFG developed the Final Hatchery EIR-EIS that was released January 11, 2010.
b) *Ceratomyxa* concerns can be addressed—Quarantine individuals for 10+ days and/or do a genetic test on water samples taken from quarantined crayfish to determine if *Ceratomyxa* is present.
c) Steve will talk to Linda Radford again regarding the disease issue, including steps to ensure that *Ceratomyxa* is not present.

IX. **Sucker Springs Restoration Project (Recovery Team)**

A. Steve mentioned that the use of chemical eradication (e.g., rotenone) may be a possibility in California.

B. Eradication efforts—During 2009 a total of 143 signal crayfish (30 adults, 39 juveniles, and 74 YOY) were removed from ponds 2, 3, and 4, with 133 signal crayfish collected during snorkel surveys in the main channel and 10 signal crayfish collected from traps.

C. Construction of a crayfish barrier at the downstream end of both Pond 4 and 5.
1) The crayfish barriers, which are similar in design to the upper Fall River crayfish barrier, are adjacent to and upstream of the Pond 4 and 5 weirs. The Pond 4 and 5 weirs were left in place so that the water level can be raised to facilitate snorkel surveys.

D. Renew permits for Sucker Springs, due to sunset in 2010.

X. **Next Meeting is scheduled for Tuesday, September 14, 2010 in Sacramento. Location to be announced.**

Charles White
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Senior License Coordinator, Hat Creek (FERC No. 2661) and Pit 1 (FERC 2687)
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Shasta Crayfish TRC / Recovery Team Meeting
March 9, 2010

Attendees:

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Susan Kester	415.973.7202	S1KV@pge.com	PG&E Land Conservation Commitment, Power Generation
Kim Squires	916.414.6654	kim_squires@fws.gov	USFWS Forest and Foothills Ecosystems
Kathy Brown	916.414.6549	kathy_brown@fws.gov	USFWS Conservation Partnerships Program
Steve Baumgartner	530.225.2370	sbaumgartner@dfg.ca.gov	CDFG Region 1 Fishery Biologist
Glenn Yoshioka	916.651.8764	gyoshioka@dfg.ca.gov	CDFG Species Conservation & Recovery
Theo Light	717.477.1093	TSLigh@ship.edu	Shippensburg University, Department of Biology
Jessica Petersen	530.752.6351	jlpetersen@ucdavis.edu	UC Davis Genomic Variation Lab
Maria Ellis	530.335.5446	maria@springrivers.com	Spring Rivers Ecological Sciences, LLC

Action Items from the March 2010 Shasta Crayfish TRC Meeting:

Project	Task	Who	When
	TRC Actions		
Rock Creek	Arrange field trip with John Woodruff	Charlie	May
	Develop a written proposal to reintroduce Shasta crayfish to Rock Creek	Spring Rivers	2010
	Talk to Linda Radford, Senior Hatchery Supervisor, regarding disease issues and prevention	Steve B.	2010
	Develop Rock Creek Restoration Plan	Spring Rivers	2010
Crayfish Plan	Obtain landowner permission to survey Rising River	Spring Rivers	ongoing
	Recovery Team Actions		
Genetics	Draft Genetic Management Plan	Maria Ellis/ Jessica Petersen	2010
Refugia	Develop draft Safe Harbor Agreement	PG&E / Maria Ellis	2010
	Potential Refugia Study-draft	Spring Rivers	2010
Sucker Springs	Renew permits for Sucker Springs Restoration	Spring Rivers	2010
Temperature	Install/Maintain temperature gages at ten Shasta crayfish locations	Spring Rivers/CDFG	ongoing
Genetics	Collect genetic samples from Rising River	Spring Rivers	2010
	Conduct mitochondrial DNA research on samples	CDFG/ UC Davis Genome Lab	2010/2011