November 29, 2004

Jann O. Williams
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Placerville, CA 95667

Dear Ms. Williams:

SUBJECT: FOOTHILL YELLOW LEGGED FROGS (FYLF) AND RECOMMENDED FLOWS FOR CAMINO RESERVOIR REACH OF SILVER CREEK AND SLAB CREEK RESERVOIR REACH OF SOUTH FORK AMERICAN RIVER

I have reviewed the recommended flow regimes you provided to me on Nov. 15, 2004. To evaluate how these regimes might affect FYLF I have applied the information reported in the Amphibian Habitat Test Flow Technical Report and the Amphibians and Aquatic Reptile Technical Report. I have also consulted the relevant data presented in several other documents, including the Water Temperature, Channel Morphology, Stream Habitat Mapping, Stream Fisheries, PHABSIM, and Hydrology Technical Reports. I also incorporated my own field observations from my visit to the Camino Dam Reach of Silver Creek during Oct. 2003.

Below I respond to your specific questions.

1. Are the suggested flows in Slab Creek and Camino Reaches agreeable to FYLF in all water years and all months? Can they be improved?

To address the "all months" part of this question I consider both the short term direct effects of the flow regime on the frogs when they are biologically active and present in the channel, as well as the long term indirect effects of the flow regime on the physical habitat *vis a vis* channel morphology.

With respect to the indirect effects on morphology and maintenance of the appropriate channel cross-section shape and relatively open near shore canopy patches which FYLF prefer, it is my opinion that proposed flow regime is suitable. It is very interesting to note that the locations where FYLF have been found to persist in the upper South Fk. American system are in the reaches where channel morphology is

relatively less influenced by the altered hydrology and less sensitive to alteration in sediment inputs which the upstream dams and reservoirs cause. In the Channel Morphology Technical Report the Camino Reach, the SFAR reach downstream of the confluence with Silver Creek, and the Slab Creek Reach were all determined to be transport reaches, as opposed to response reaches. The report characterized these channels as mainly bedrock controlled with overlaying cobble substrates. The relatively straight and narrow channels had coarse boulder and cobble point bars forming in response to bedrock or very large boulder features which were functioning as bedrock. There was little fine sediment at the channel margins and thus limiting the riparian vegetation. Large supplies of coarse sediment were present from mass wasting on the steep hillsides. Thus it is not a concern whether the recommended flows are sufficient to flush fine sediments out of the reach in order to maintain interstitial spaces and refugia for tadpoles and frogs. Similarly it is not a concern whether the recommended flows are sufficient to maintain lateral bars which are often used for FYLF breeding, because in these reaches the frogs are primarily using larger rocks that are most likely stable under the recommended flow regimes.

When the frogs *are* in the channel, the salient months to focus on with regards to direct effects of discharge are the late spring and summer months. To evaluate whether the monthly decreases in discharge in the Camino Reach could cause stranding of eggmasses of the fairly immobile recently hatched larvae, I examined the stage to discharge relationships observed during the test flows when discharge varied from 100 to 50 to 20 cfs. These three test flows bracket the range of proposed flows for May, June, and July (shown in the table below) in all but the critically dry years. Although we only have one year of breeding date information for the Camino Reach, I assume that breeding will most likely occur during a similar time frame.

The repeated "at a point" measurements of depth (presented in Tables 4.3-1a and 4.3-1b of Test Flow Report) indicate that there is an average decrease of 4.5 inches as discharge varies from 100 cfs to 50 cfs at the Camino Adit site and 6 inches at the SFAR confluence site. The range is 2.4 to 10.8 inches. From 50 to 20 cfs the change in stage was 5.2 inches at Camino Adit and 2.6 inches at the SFAR confluence site. Because eggs are usually laid at average depth of 7.75 in. (range 2-18 in) (see Table

3.1.2 Test Flow Report), it is likely that the monthly flow transitions would keep most eggs and larvae within inundated patches. The declining discharge situation in which eggs are in progressively warmer and shallower water is what is most typically observed in unregulated systems. This can speed up development to hatching and thus decrease the time eggs are vulnerable to predators. Decreases in river stage later in the summer when tadpoles are more mobile and could follow the receding shore line present less of a concern.

With respect to temperature, I believe that the proposed flow regimes will be agreeable in the Camino Reach of Silver Creek in all but wet years. In wet years, it is not clear whether water would warm sufficiently early for timely larval development. Wet years represent 9 out of the 27 years of record. According to the temperature model for the Camino Reach of Silver Creek, average daily temperatures would be in the 12-15° C range, during the late spring months when spawning is likely to commence. The variation in temperatures among water year types due to the different flow regimes would be commensurate with what we know about the spawning behavior of this species in unregulated rivers. Generally the frogs breed later in cold wet years and earlier in warm dry years. This flow regime, which mimics the timing and shape of the natural hydrograph re-couples the water temperature to the other climatic cues that frogs likely key into for initiating spawning. During the summer however, with water being drawn from the depths of the reservoir, the water may not be sufficiently warm for sufficiently long enough time to support larval development. A question remains as to what the temperatures in the shallow margin tadpole habitats would be compared to the modeled temperatures. If there is a big difference between the modeled temperatures and the margin habitat temperatures then this concern is not as great. I suggest that the temperatures in tadpole habitats, and the time to metamorphosis, be closely monitored during the early years of the new license period. I think that taking an "adaptive management" approach to this problem would be advisable.

For tadpole rearing, I am assuming that the observed temperatures in Silver Creek upstream of the confluence with SFAR (Fig. 4.4-10 of Temperature Technical Report, mislabeled), represent a favorable thermal regime because tadpoles have been

observed to successfully metamorphose by late summer. For most of June and July, mean daily temperatures were between 20 and 25 ˚C. To assess how different the new thermal regime would be, I very roughly interpolated from the temperature model what the approximate temperature ranges would be. I suggest that it would be worthwhile to have the temperature models rerun to match the flows, because it was difficult to fill in the table below. The figure in the Temperature Technical Report did not plot the 15 cfs flow, so I estimated it would be in between the temps for 5 and 30cfs. Also the maximum flow was 60 cfs, so I couldn't figure out what the temperatures would be in June of a wet year when discharge would be 87 cfs.

Table 1. Approximate thermal regime to be experience by FYLF in Camino Reach of Silver Ck. Question marks indicate that the discharge is outside the range of values modeled.

Water year	May		June		July		Aug	
	cfs	˚C range	cfs	˚C range	cfs	˚C range		
Wet	100	??	87	??	52	17-20	26	17.5-20
Above Normal	80	??	59	15-20	35	20-22.5	18	17-20
Below Normal	68	8-15	50	16-21	30	20-22.5	15	17-20
Dry	46	10-17	31	17-22	21	>22.5	14	17-20
Critical	24	10-17	16	18-23?	12	>22.5	12	17-20

For the Slab Creek Reach the temperature model predicts that June – July temperatures would be above 20˚C in the 60 – 90 cfs range. However the proposed discharges for those months would produce much colder temperatures. I only saw the model ouput for 270 cfs, but at that discharge temperatures would range from 12 to 17 in June and 17 back down to 12

Another criterion in evaluating the flows is the incidence of spills which might cause velocities to increase in near shore habitat patches to the extent that egg masses

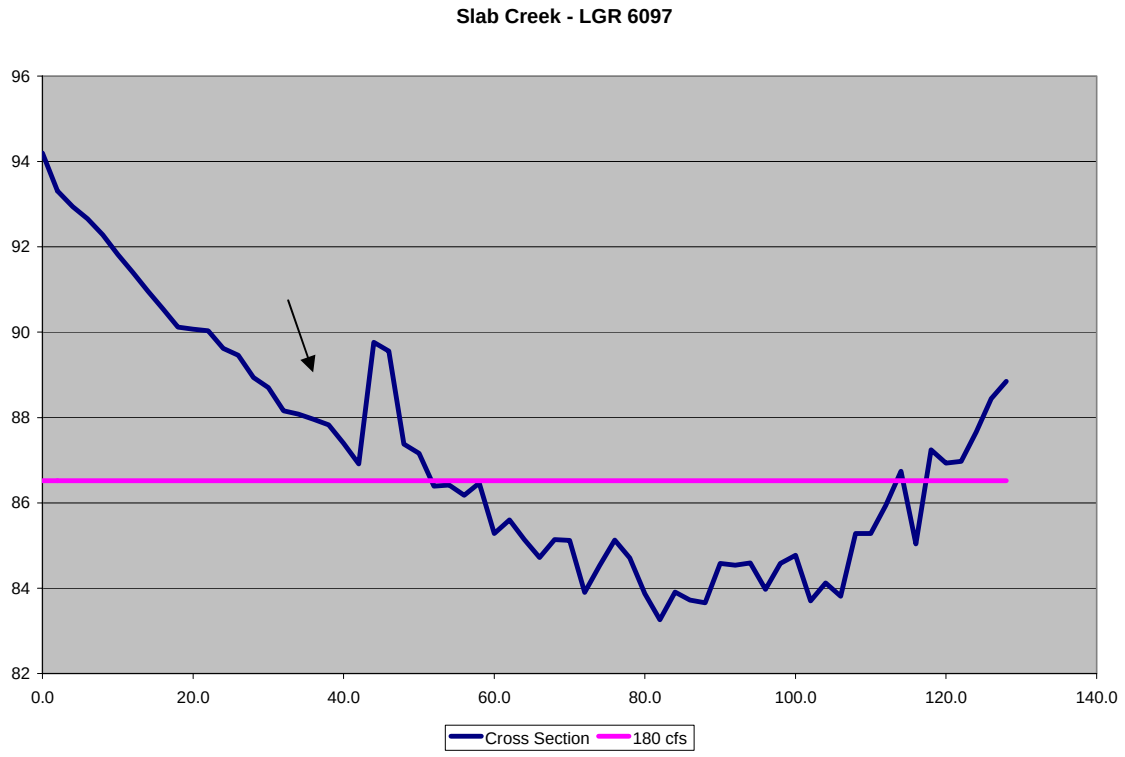
may detach from substrates or larvae may get swept downstream. After examining hydrographs for historic flows, it appears that this concern is mostly relevant for wet years in the Camino Reach. Having the higher base flows in May (100 cfs) and June (87 cfs) would buffer the impact of any spill events. Also, the higher base flows mean lower temperatures, so egg laying is less likely to occur when the possibility of spills is still present.

2. Do you foresee any possible effects to them with these flows?

A possible negative effect, in terms of stranding of eggs and larvae, might occur in a wet year that was also warm such that a large snow pack melts early. If frogs spawned at the end of May when flows were at 100 cfs, it is possible that stranding could occur when flows drop to 50 cfs at the beginning of July. At the SFAR confluence site the eight polygons identified as suitable habitat at 100 cfs were not wet at the lower flows. Thus, if there was slow time to hatching and/or only limited dispersal of larvae prior to the transition to 50 cfs on July 1, it is possible that the reproductive output for that year could be lost. The likelihood of this scenario is difficult to evaluate. At the Camino Adit site I do not think a similar stranding situation would occur because the four polygons that were identified at 100 cfs were within or contiguous to the wetted perimeter of the channel at 50 and 20 cfs (see fig. 4.1.1 of Amphibian Test Flow Technical Report).

For the Slab Creek Reach, although there have been sightings of FYLF, we do not know whether, or exactly where, FYLF are breeding in the reach. Therefore we do not have the benefit of test flow data as we do for the Camino Reach. In the absence of empirical relationships between discharge and conditions in known occupied FYLF habitat patches I examined the channel cross sections measured for the IFIM / PHABSIM study which had the water surface elevation at 180 cfs noted. It is difficult to assess the effects on the frogs in terms of depth and velocity as flows are ramped down without further data or model output about what the water surface elevations would be for the proposed flow regimes. However, making a guess about water surface elevations for parts of the reach where channel morphology resembles

cross sections LGR 6097 and LGR 6098, I would say that there was a high likelihood of stranding especially in wet and above normal water years. There are side pools/ side channels which would be inundated at the higher flows (indicated by the arrow in the cross section below), which would be isolated or dry out at the flows reached by the end of July.



3. In the Slab Creek Reach would a gradual decline (as is proposed) be better than a sudden drop in flows from one month to the next?

During every water year type, except critically dry, the suggested flows during July have been gradually tapered off. This is over a one month period which is similar to the length of decline under a natural hydrograph. I think that a gradual decline is a good idea, because it would decrease the chances of stranding eggs and give tadpoles a chance to follow the receding water line, if eggs and tadpoles were already present. Because of the cold water temperature concerns, however, it is likely that egg laying would not yet have

commenced. I think beginning the stepped decline earlier in June instead of July, would make sense in all water years to the extent that water temperatures would be warmer earlier .

If you have any questions or concerns regarding my interpretations please do not hesitate to contact me.

Sincerely,

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