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Camilla Williams
State Water Resources Control Board
1001 I Street
P.O. Box 2000
Sacramento, Calif. 95812-2000

17 February 2009

Dear Ms. Williams:

I wish to comment in response to the petition filed on behalf of California Trout and Friends of the River in the matter of FERC Project no. 2426. I have read the petition and supporting documents, and was actively involved in providing biological information and advice to FERC and other agencies from the inception of project 2426, as well as in prior reviews by DWR, USFS and USFWS dating to 1989. I conducted parts of the biological research used to frame Project 2426, and maintain an active interest in the management of arroyo toads and other threatened, endangered and declining species, and in the management of Piru Creek.

Petitioners cite two grounds: (a) failure to ensure "beneficial use" of Piru Creek, specifically as related to the enhancement of threatened and endangered species habitat; and (b) alleged procedural shortcomings. I have no relevant expertise in the second matter, and thus restrict my response to petitioners' arguments related to the first-listed grounds. Petitioners base their arguments on a report submitted by Land Protection Partners, of Los Angeles, Calif. Because petitioners claim no independent expertise, a response to their petition logically involves a response to the LPP report.

I have read the LPP report in detail, and find that its recommendations are a hybrid of existing features of Project 2426 and a set of actions that depart from the FERC project. In terms of the petition, bullet items 1-3 (page 8) are essentially synonymous with FERC project terms, whereas bullet items 4-8 (page 9) depart. Based on my experience and expertise, I challenge the rationale for bullet items 4, 5 and 7 as scientifically unsupported, regard bullet item 5 as ill-defined and too ambiguous to stand as a condition, and suggest that bullet item 8 exists as a significant concern only in light of adverse conditions that would arise from implementing petitioners' bullet items 4 and 5. Upholding the current terms of FERC Project 2426 (by which outflow from Pyramid Dam would be matched to inflow throughout the year) would in my view render petitioners' bullet item 8 irrelevant.

Contrary to petitioners' claim (p. 9, line 16 ff.), the LPP report does not document a benefit to native trout other than by assertion. I found it difficult to review the LPP report because its core departures from the existing FERC proposal are stated as assertions that are not supported by any new or reanalyzed data, or are tied to further assertions that are factually incorrect. The LPP report suffers from a willingness to ignore or contradict a large body of research-based analysis in advocating its alternative proposal, and also demonstrates a lack of familiarity with the location.

I attach here, as an integral part of my response, a pdf file constituting a partial review of the biological arguments and assertions made in the LPP report. I reserve the right to present additional data that substantiate abbreviated comments on the LPP report as annotated here.

It is my professional assessment that the LPP report is: (1) factually incorrect in many matters of substance; that it (2) fails to provide sufficient (or often any) documentation to counteract the body of data and analysis considered in formulating FERC project 2426; and that (3) re-implementation of enhanced summer flow in Piru Creek would be deemed in violation of the Endangered Species Act, as per the body of data and analysis considered in formulating FERC Project 2426.

To the extent that the State Water Resources Control Board may base its actions on biological and hydrological assertions made by the petitioners, I urge that the petition be denied for lack of evidence.

Sincerely,

Samuel S. Sweet
Professor

Attached: annotated copy of LPP report (21 pp.) with 7 pp. of technical comments

Review comments on "**Alternate Flow Regime to Protect Rare Native Species in Middle Piru Creek (Los Angeles and Ventura Counties, California)"** as submitted 5 January 2009 by Land Protection Partners.

Reviewer: Dr. Samuel S. Sweet, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara. 9 February 2009.

1. General Comments

"*Perennial flows in Piru Creek therefore cannot be construed as causing take of arroyo toads or constituting an adverse modification of habitat in any manner. To the contrary, they are an improvement to habitat conditions for this species*" (LPP report, p. 15)

The LPP consultant's report attached and annotated here is intended as evidentiary support for a petition by Cal Trout and Friends of the River that seeks to overturn certain terms of FERC Project no. 2426. I found it difficult to review because the core departures from the existing FERC proposal are stated as assertions that are not supported by any new or reanalyzed data, or are tied to further assertions that are factually incorrect. The LPP report suffers from a willingness to ignore or contradict a large body of research-based analysis in advocating its alternative proposal, and also demonstrates a lack of familiarity with the location.

I was not looking for a dissertation here, but neither did I expect to find a double standard in which the coherent, data-based rationale for matching outflow with inflow to Pyramid Lake is accepted for the winter months but disputed for summer. In this respect the LPP report goes beyond mere incompetence, and is in my view deliberately dishonest. One cannot be so selective in making factual misrepresentations without being called on it by knowledgeable reviewers. The law requires that decisions be based on the best available scientific evidence, and I intend to ensure that this criterion is met.

In previous actions and comments both Cal Trout and Friends of the River have indicated a desire to place their special interests (fishing and water sports) ahead of endangered species considerations. I have some of these comments in writing, and others were made in the presence of numerous representatives of the action agencies. Now these outfits suddenly have become deeply concerned about the well-being of these same endangered species, and propose to reinstate the summer flow augmentation that all agencies have determined creates jeopardy, by arguing that this summer flow is essential to the well-being and recovery of endangered species. Remarkable.

2. Detailed Comments

Comments below are keyed to numbered, highlighted sections of the attached text. I have by no means provided an exhaustive list of misstatements and errors in the LPP report, and reserve the right to challenge the remainder.

1. The statement "… would maintain…" as used here is an assertion, which is inappropriate in the opening paragraph of a document that purports to "assess" the biological consequences of FERC Project No. 2426.

2. This statement (and paragraph) constitutes a red herring that is pervasive in the report, and is used to impugn the comprehensive nature of agency and biological evaluations of the situation leading to the project. A correct reading here is as follows: for much of the interval since Pyramid Lake became operational in 1973, DWR conducted water releases that did not match regional inflow to Pyramid Lake, whether in quantity or in timing. Large winter storm inputs were stored and metered out into Piru Creek, often several months after the event. Secondly, DWR conducted large water deliveries to Lake Piru via Piru Creek in several years between April and August, causing significant ecological damage; smaller washout events also accompanied periodic testing of the radial gates at Pyramid Dam. Thirdly, the mandated summer augmented flow regime introduced varying quantities of water into Piru Creek; a large number of uncontrolled variables (including temperature, humidity, wind velocities, transpiration and groundwater levels) resulted in highly variable hydrologic conditions in the mainstem between Frenchman's Flat and Lake Piru.

None of these situations was in any sense "natural", and much of the contemporaneous paperwork refers to "unnatural" discharge patterns and hydrology. All parties understood quite well that Pyramid Dam precludes a return to the pre-1971 hydrology of Piru Creek. Management efforts were directed at restoring **natural discharge** to the extent practicable; it is highly misleading to criticize FERC Project 2426 on the definitional grounds premised in this report, and such criticism is a red herring.

3. This statement is factually incorrect – any difficulty in assessing biological responses is **unrelated to** a determination of how "natural" or "unnatural" a flow regime may be. Methods and organisms are the same in either case.

4. This is a remarkably ignorant statement that implies that a goal of endangered species management is to "farm" them under artificially enhanced conditions. As developed in more detail below, any attempt to micromanage daily discharges so as to always enhance and never adversely affect conditions along 20 miles of wild streambed is misguided, and as an active measure places the responsible agency in jeopardy of "take".

5. Again, this discussion is misleading or at best irrelevant. For example, water temperatures promptly equilibrate to surface conditions on entering the creek, and its origin as top- or bottom-water is indistinguishable for >95% of the stream segment involved. In a like manner, sediment load of **summer water releases**, the topic of the LPP report, is irrelevant. There is no sediment load if the stream is not flowing, whereas summer release transports sediment in the absence of replenishment that would result from runoff from summer storms.

6. Another remarkable statement: "… we review why…" is a polemical assertion in what is purportedly a review. Comments such as these are highly unprofessional.

7. At this point we begin to see another feature of this report, which adopts aspects of FERC project 2426 **other than** elimination of summer flow as its own, and attempts to blur the distinctions between the existing project and the alternative. Again, the report asserts that the alternative would provide “adequate water”, when in fact it is the parts of the **existing project** incorporated here that provide all of the necessary water (and many other benefits). The LPP alternative is in fact actively deleterious, as will become clear below.

8. This is partially correct as a feature of the existing project. Design limitations preclude discharge >18,000 cfs from Pyramid Dam. This is less than the maximum inflow, but absent the removal of Pyramid Dam it is going to be a feature of **any** management plan. The LPP report here consistently fails to acknowledge that the greatest source of scouring flow (and sediment) in middle Piru Creek is not runoff from above Pyramid Lake, but instead from the several steep drainages between Frenchman’s Flat and Ruby Canyon, in Piru Gorge. Canyons including Fish Creek and Turtle Creek drain the SE extension of the Alamo uplift; together with Agua Blanca Creek these drainages receive orographically-enhanced rainfall in major storms. This arrives as rain and runs off very quickly. By contrast, the Piru drainage above Pyramid Lake lies too far inland to benefit from orographic effects, and much precipitation falls as snow. The difference yields markedly different flood peak profiles, and as discussed below also vitiates many of the LPP report concerns about sediment replenishment.

9. This statement is factually incorrect for the reasons noted in item 8 above. Also, I believe there have been at least two occasions when drawdown from Pyramid via the Castaic tunnels failed to keep pace with inflow, such that the radial gates had to be opened to allow peak discharge into Piru Creek.

10. “Regulated flow” was not the primary cause of arroyo toad habitat loss in the 2000-2005 interval. Instead, these were low rainfall years without significant natural scouring, coupled with channelization driven by bank armoring. The armoring resulted in large part from dense growth of alders supported by summer flow. Contrary to the views expressed in the LPP report, this effect had been predicted by the responding agencies and was taken as evidence in support of implementing FERC project 2426.

11. The assertion that the Santa Margarita River is hydrologically similar to Piru Creek is an important component of the LPP report, but it is nowhere justified. I would like to see the specific reasons for this claim listed. Apart from being 6^{th} or 7^{th} order streams in a Mediterranean climate, inhabited by arroyo toads, my own examination shows little resemblance between them in critical features such as flood hydrology or sediment transport.

12. I do not see how these comments are novel or how they pertain to the thrust of the LPP report. They are quite similar to observations I reported in 1992, and are embedded in most of the USFWS publications on status and critical habitat for arroyo toads. In other words, they are routine observations, and actually constitute part of the argument against artificially enhanced summer flows.

13. This paragraph begins with general statements that apply to all dammed streams, but then makes a highly questionable set of extensions. It is true that Piru Creek displays sediment depletion to the lower edge of Frenchman's Flat, but depletion is reversed in the upper portion of Piru Gorge due to massive erosion in the drainages of Turtle and Fish creeks, and smaller unnamed tributaries. The report acknowledges this, but then asserts that scouring from dam releases will progressively strip sediment from throughout the middle reach of the creek. In the absence of any quantification of sediment import and transport I fail to see how this assertion can be made. Thirty-five years has passed since sediment transport through Pyramid ceased, yet the sediment load at the lower end of Piru Gorge still exceeds the transport capacity of the stream, and new gravel bar and terrace habitat is formed there in most years. Simply put, the observational evidence is that Piru Creek is incompetent to transport the sediment it gains in passing through the gorge, and peak flood flows there have always been recruited locally as opposed to deriving from the basin above Pyramid Dam.

14. The FERC proposal and agency advice underpinning it incorporates the site-specific information summarized in #13 above.

15. These two sentences are somewhat oddly cast here. Due to its linkage to the California Aqueduct, Pyramid Lake is the source of many exotics. High-volume flows are less likely to introduce living exotics than are low-volume discharges. The comment they attribute to me was in fact presented as identifying a risk factor from the low-volume summer flows that the report ends up advocating. This comment had nothing to do with bullfrogs, but instead referred to fish and invertebrate larvae.

16. I am not sure what makes a predator "egregious", but I can guarantee that density and persistence are each important variables!

17. A natural hydrologic cycle will of course be preferable to an artificial cycle for native semiaquatic species such as pond turtles and *Thamnophis hammondii*. Since this is the stated goal of the FERC proposal, calling it an attribute of the LPP proposal hinges on whether the **differences** between proposals are significant. I find no discussion of this issue, and this bothers me since augmented summer flows have negative effects on both species.

18. I have no idea what logic underlies this assertion, or why it is placed here.

19. This is simply untrue. It appears to depend only on the concept that "more water later is better than less water later", without taking into consideration either **timing** or **quantity**, and without considering any other factor associated with the attempt to provide perennial flow. This is an irresponsible statement here. It is flatly contradicted by extensive, research-based analyses conducted throughout the range of arroyo toads.

20. This is absolutely untrue in general, and in specific terms. Arroyo toads breed in portions of pools that are not suitable for continuous habitation by bullfrogs, but other

regions of the **same pools** are often highly suitable. Bullfrog predation on breeding adult arroyo toads occurs when bullfrogs are attracted to the calling sites by ripples and movements of toads – they swim a few meters across the pool from the deep cut-bank areas to the shallows, and predate the toads. No one has documented predation by bullfrogs on larval or juvenile arroyo toads – juvenile toads are active on exposed sand and gravel bars by day, and are inactive at night. Bullfrogs do not forage on these bars either by day or night.

This argument, besides being dead wrong about biology, also conveniently ignores the point that it is enhanced summer flows that enable bullfrogs to persist in high densities in pools used by arroyo toads. Again, it is incorrect biology and incorrect logic.

21. In the absence of summer augmentation, much of the middle reach of Piru Creek will be completely dry in many years from midsummer through late fall. Native species are adapted to these conditions, whereas the great majority of exotics are not. The statement made here is not an argument for the provision of summer flow, if for no other reason than that 25 cfs cannot maintain continuous flow in late summer and fall below Piru Gorge. At best, the LPP proposal would **increase** the number of sites where exotics can adversely affect natives, for a **greater portion** of the dry season.

22. This is a hypothetical, with no relevance to the present issue. Lacking any documentation of either effect or benefit, the inclusion of such hypothetical scenarios here as an argument for the LPP proposal is specious.

23. There are few current records for *Rana draytoni* on the mainstem of Piru Creek, and their continued persistence in Agua Blanca Creek after the devastation of that drainage by the Day fire is in doubt. Previously abundant in the drainage, their disappearance from Piru Creek is attributed to predation by bullfrogs, crayfish and warm-water fish maintained in the drainage by augmented summer flows. The LPP report does not address this issue.

24. This is simply false. The authors are either ignorant of the biology of *Rana draytoni*, or willing to lie about it for a client.

25. This paragraph indicates a lack of familiarity with the biology of western pond turtles in inland streams. Pond turtles leave the water in early summer except where large pools exceeding ~2m in depth persist. If depredation by humans was a significant factor on Piru Creek (it is not, save in the immediate vicinity of Frenchman's Flat and Blue Point campgrounds), it would be exacerbated by summer flows.

26. Here and elsewhere, the LPP report confuses bullfrog elimination and control. No biologist believes that bullfrogs can be eliminated from a system as complex as Piru Creek by any feasible management strategy. However, any strategy that renders significant parts of the drainage inhospitable either to tadpoles or to adults has a strong positive effect. Both winter flushes and summer drying are major contributors.

27. This is factually incorrect.

28. Citing two anecdotal papers over 50 years old does not substantiate a vague claim that bullfrog larvae can metamorphose in a single season in California riparian systems. All the evidence is to the contrary. Bullfrogs are very late breeders (eggs in June to early August), and metamorphs less than 35 mm SVL are virtually never seen. Newly metamorphosed bullfrogs begin to appear in early July, and these animals must be (by exclusion) about one year of age. Late metamorphs are found into early September, and unless tadpoles can reach 70-90 mm TL in less than 3 months, a single-season larval period is insupportable. I am unaware of any data-based statement to the contrary. This being the case, the generally accepted view remains that both flushing winter flows and summer drying control bullfrog populations by eliminating significant numbers of tadpoles.

29. It is hardly "specious" to make an argument based on a large body of data, as countered by an irrelevant anecdote.

30. The relevance of Fig. 3 to the present situation is nil. Even in its context, it means nothing if bullfrogs metamorphose then virtually all die when the impoundment dries.

31. No one has argued that reduced summer flows will eliminate *Tamarix* spp. The authors seem to be unfamiliar with tamarisk recruitment, which occurs when wind-dispersed seeds are stranded along drying pools. Seedlings are extremely susceptible to drying, and do not persist through the summer where pools dry out. The fact that mature plants are deep-rooted is irrelevant to the **spread** of tamarisk.

32. Hypotheticals have no place in the current discussion.

33. Hardly as misguided as the misuse of biological and hydrological information here!

34. I do not find a citation to support a "natural" flow volume of 54,000 cfs. The comparison here is with 18,000 cfs maximum discharge from Pyramid Dam, but I believe the 54,000 figure derives from the Blue Point gauging station. If so, this paragraph is quite dishonest.

35. Here I want to see what "research" supports this argument. There is no "research" in the LPP document, only a series of assertions, incorrect extrapolations, and bad biology. As a summary of the foregoing sections of the LPP document the statement is false, and provides no credible basis for clients such as Cal Trout or Friends of the River to challenge the FERC proposal.

36. The "alternate flow regime" suggested here is a hybrid of the existing FERC proposal and components of other schemes that have already been evaluated far more completely (and competently) in the 20 years of analysis leading to the present solution. The fact that all divergent aspects of the LPP proposal have already been evaluated and rejected should require a much higher bar to trigger reconsideration. The LPP proposal falls far short of credibility, and could be summarily rejected.

37. To say that 25 cfs in summer is “in the range of natural variation” is hardly a fair use of the large database available. “Twice in 17 years” is most likely attributable to rare monsoonal thunderstorms, and the duration of such flows will be quite brief by comparison to that created by releasing up to 25 cfs 24 hours 7 days from a dam gate. I do not personally have time to go through the stream gauge records, whereas this is part of what LPP was presumably paid to do. The fact that no defensible statistical analysis bolsters the LPP proposal is again grounds to dismiss it as an irrelevant challenge to the expertise of DWR, USFWS and USFS in matters of this sort.

38. Of all of the left-field, pulled-out-of-somewhere text in the LPP report, this is my favorite. Ordinarily, someone would explain why a particular statement was made, but not here.

39. This is false, and charitably would be called misleading. Cunningham worked on the Mojave River, which is not perennial in any common use of the term. I would like to see the LPP authors list *any* stream inhabited by arroyo toads “north of Orange County” that is perennial in the reaches occupied by arroyo toads. Go ahead, I will ask this in court.

40. The statement that “<u>*Perennial flows in Piru Creek therefore cannot be construed as causing take of arroyo toads or constituting an adverse modification of habitat in any manner. To the contrary, they are an improvement to habitat conditions for this species*</u>” is of real value in establishing the credibility of the LPP report.   It is a great pity that there exist no minimum standards to be met to operate as an environmental consulting firm, is all I will say here.

41. The odd thing here, in a statement that acknowledges a possibly deleterious side effect of the LPP alternative, is that no one has suggested that bullfrogs wash down from Pyramid Lake. Bullfrogs come up from Lake Piru, and breed in Piru Creek, but the one thing they do not do is come through the radial gates of Pyramid Dam!

42. *Taricha torosa* is only slightly more qualified than a blue-ringed octopus as a “surrogate” for red-legged frogs or native fish. This is a truly bizarre assertion. Why not base this on all of the existing research on *Rana draytoni* and rainbow trout??

43. This is not entirely what happened at Frenchman’s Flat. Local sediment starvation is a contributing factor, but an equal burden is borne by the establishment of very robust trees that have channelized the creek, preventing its lateral movement and concentrating 30 years of flow into a single path. Once the stream enters upper Piru Gorge any observer can see (a) that it rapidly reaches an equilibrium sediment load, and (b) that there is no fine sediment deficit downstream.

Without feeling any particular need to educate LPP or their clients, I would nonetheless mention that all sources of granitic rock in Piru Creek are upstream of Pyramid Dam, until one reaches Canton Canyon at the head of Lake Piru. This means that all granite bedload in the middle reach of Piru Creek is a minimum of 30 years old. Quantifying the size-frequency distribution of granite clasts vs. stream mile below Pyramid Dam will give an objective measure of the rate of depletion. The steam terraces at least from Ruby Canyon southward provide abundant controls for pre-dam conditions. Until something of this nature is done, there is no basis for an assertion that sediment depletion affects the portion of middle Piru Creek. My casual inspections directed at this matter convinced me some years ago that depletion was a nonissue, but I would welcome a formal study.

44. This is a bizarre proposal. How it could be implemented without massive collateral damage is hard to imagine, and there is nothing in the LPP report to indicate that such mitigation is needed.

45. Throughout, the LPP report ignores the fact that it is Lake Piru, not Pyramid Lake, which is the source and reservoir for most of the exotics in Piru Creek. New species are being introduced from Pyramid Lake via the California Aqueduct, but the principal problem lies downstream, not up. Failing to understand this makes some of the more preposterous assertions about exotics control understandable, but this is hardly what LPP was paid to do.

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Alternate Flow Regime to Protect Rare Native Species in Middle Piru Creek (Los Angeles and Ventura Counties, California)

January 5, 2009

Prepared by:

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Alternate Flow Regime to Protect Rare Native Species in Middle Piru Creek
(Los Angeles and Ventura Counties, California)

On December 10, 2008, the California State Water Resources Control Board issued a Water Quality Certification for the California Aqueduct Hydroelectric Project, FERC Project No. 2426, certifying that the project protected beneficial uses identified under the Clean Water Act. This project changes the operation of Pyramid Dam so that releases from Pyramid Lake that are discharged down Piru Creek are roughly equivalent in amount and timing of water entering Pyramid Lake from natural sources, with the addition of 3,150 acre-feet of water deliveries during the winter. This report assesses the environmental impacts of the proposed project, especially on rare and endangered species, and proposes an alternative flow regime that would maintain rare and endangered species. #1 It responds both to the Water Quality Certification issued by the Water Resources Control Board and to the final Environmental Assessment ("EA") approved by the Federal Energy Regulatory Commission ("FERC") approved in June 2008.

The proposed project raises an interesting set of questions because it was formulated in response to a request by the U.S. Fish and Wildlife Service ("USFWS") to reinstate a "natural" flow regime to avoid unauthorized take of arroyo toads (Letter from Bridget Fahey, USFWS to Eva Bagley, Department of Water Resources, August 20, 2003). Although the project and analysis of its impacts are discussed in terms of recreating "natural" conditions, middle Piru Creek remains 2 highly modified and influenced by the two reservoirs at either end (Pyramid Lake and Lake Piru). Thus, although the flow regime may be considered more "natural," the system is by no means restored to natural conditions, especially given the water deliveries during the winter. Consequently, assessing whether actions will benefit or adversely affect native species remains 3 difficult. In the sections that follow, we consider the complexity of this situation and the potential impacts of implementing the proposed action over the long term.

Those assessing environmental impacts often rely on the idea of something being "natural" as being synonymous with not having adverse biological impacts. The Department of Water Resources ("DWR") and FERC take shortcuts in their analysis by asserting that the changes in flow regime are more "natural" and therefore do not cause significant adverse impacts. Not only is such analysis flawed, because a return to natural conditions may have adverse impacts on state 4 and federally protected species (e.g., removal of a water source that supports an endangered species), but the proposed new flow regime is not "natural" either. The new flow regime is unnatural in any number of ways, including the temperature of the released water, the lack of sediment 5 suspended in released water, and the non-equivalency of simulating assumed surface flows with natural hydrologic flow in a watershed, including subsurface flows.

In this report we review why the proposed flow regime will have significant adverse impacts on 6 sensitive species and beneficial uses in middle Piru Creek and why it will not provide some of the benefits that have been asserted by project proponents. In particular, we present evidence that the proposed flow regime would not reduce the impact of exotic bullfrogs (*Lithobates catesbeianus* [=*Rana catesbeiana*]) on arroyo toads (*Bufo californicus*). We then present an alternative flow regime that will minimize impacts to native species and propose mitigation measures to offset some of the adverse impacts of the project.

Our proposed flow regime includes the release of water flowing into Pyramid Lake during the winter, which is an element of the proposed project, because these peak flows would change the morphology and vegetation of middle Piru Creek in a manner that would benefit arroyo toads. We differ from the proposed project in the provision of water during the spring and summer, proposing a minimum 15 cfs baseflow from March 15 to August 31, with a gradual decline from September 1 until the winter when releases would be tied to inflows. This proposed regime would provide adequate water for reproduction of arroyo toads, California red-legged frogs (*Rana draytonii*), and native rainbow trout (*Oncorhynchus mykiss*), while the winter storms would rework the vegetation and morphology of the stream to provide appropriate habitat for arroyo toads. This approach also ensures that water is available to mitigate against the drier and hotter climate that is expected in southern California. 7

1 Elements of the Proposed Project

1.1 Release of Winter Flows in Approximate Quantity and Velocity as Flowing into Pyramid Lake

The proposed project would release flows into Piru Creek equivalent to the inflows into Pyramid Lake as measured upstream and adjusted for inflows from ungauged tributaries. The major difference from previous conditions is that stormwater flowing into Pyramid Lake (which occurs predominantly during the winter) would be released, with a slight delay, into middle Piru Creek. This change would allow peak winter stormflows to reach the maximum operational limit of 18,000 cfs. We identify these events, tied to natural precipitation, as "peak winter flows." Assuming this methodology were effective, it would allow large flows during wet years that would dramatically affect the ecology of the downstream reach. These peak winter flows have been absent during the course of the operation of Pyramid Lake and only returned to Piru Creek under the interim operating agreement. Such peak flows dramatically influence the geomorphology and vegetation of southern California riparian systems. Specifically, they scour and deposit sediments, widen channels, and remove emergent aquatic and riparian vegetation. These flows keep upland plant species from colonizing riparian zones where they would be subjected to submerging, scouring, physical damage, and low soil fertility (Nilsson & Berggren 2000). Lack of peak winter flows leads to maturation of vegetation and overall increased canopy cover and dramatically decreased active flood plain area (Graf 2006; Ligon et al. 1995). 8 9

1.1.1 Arroyo Toad

Scouring peak winter flows, as caused by natural storms, are necessary to create and maintain ideal habitat for arroyo toads (Campbell et al. 1996; Madden-Smith et al. 2003; U.S. Fish and Wildlife Service 1999). Large floods remove vegetation that grows under regulated conditions and provide the open breeding habitat and adjacent terraces as well as access to and from those terraces that are necessary for the long-term survival of arroyo toads (Haas 2005).

The arroyo toad survey report from middle Piru Creek during 2005 provides ample evidence that peak winter flows improved the geomorphology of the creek as toad habitat (Sandburg 2006). The floods washed out the incised channel that had developed over years of regulated flows, removed vegetation that had invaded breeding habitat and adjacent refugia, increased stream sinuosity, and established systems of pools and terraces preferred by toads (Sandburg 2006). 10

Studies from the Santa Margarita River by W. E. Haas provide additional evidence of the beneficial effects of winter scouring floods (Haas 2004, 2005). During the period 2001–2004, Haas monitored arroyo toad populations over 8 km of the Santa Margarita River at the Fallbrook Naval Weapons Station. The hydrograph for this period is shown below (Figure 1). Haas's study area along the Santa Margarita River presents an excellent situation for comparison with Piru 11
Creek due to similarities in hydrology and geomorphology. Although the daily flows are not directly comparable, the geomorphology of Haas's study area and the flow patterns exhibited in this system provide insight for predicting the response of arroyo toads to flow regimes in Piru Creek.

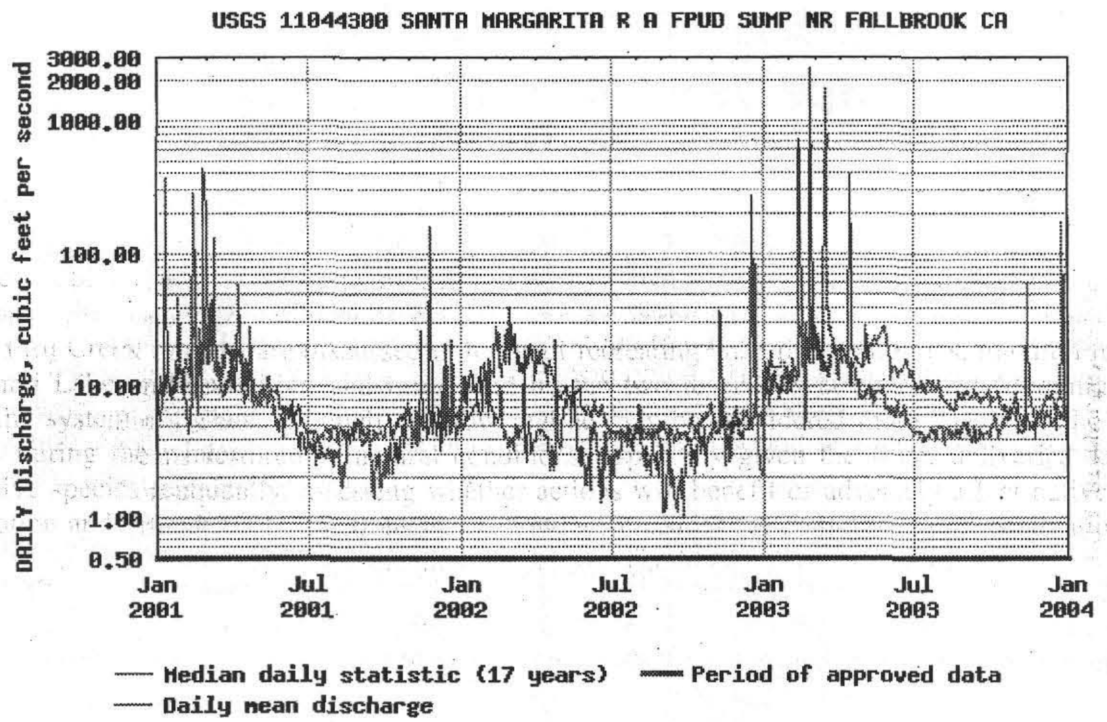

Figure 1. Hydrograph of Santa Margarita River as measured by the USGS (Gauge Station # 11044300). The gauging station is located approximately 1.3 km east of the eastern edge of Haas's Santa Margarita River study site on Detachment Fallbrook.

The results of the study showed the following:

2001: Virtually no breeding occurred along the portion of the Santa Margarita River that most resembles Piru Creek. Little scouring occurred in the period between 1998 and 2002. Hence, in 2001, the river was channelized and densely populated by cattails (*Typha* spp.); where the river broadened, watercress (*Rorippa nasturtium-aquaticum*) formed margins along the river's edge where cattails were absent.

2002: In February of 2002, because a major fire (the Gavilan Fire) affected the eastern half of the study area, access to the river from non-breeding habitat was made possible along the eastern half of the station. This was also the year of the lowest annual rainfall total in San Diego County since recordkeeping was initiated in 1850. Still, some arroyo toad breeding was documented along the eastern half of the study area, facilitated primarily because freshwater marsh vegetation had been burned along and within the river channel and exotic herbaceous layer vegetation had been eliminated from adjacent terraces.

2003: Three major events (in February and March) and a lesser event in April (Figure 2) resulted in scouring and re-formation of the riverbanks, which facilitated arroyo toad breeding along much of the northern edge of the weapons station. Breeding in 2003, an unexceptional rainfall year, was of similar density of number of breeding males to 1998, a year described meteorologically as an El Niño. Breeding activity did not commence in 2003 until very late in April, that is, following the last of three major flow peaks.

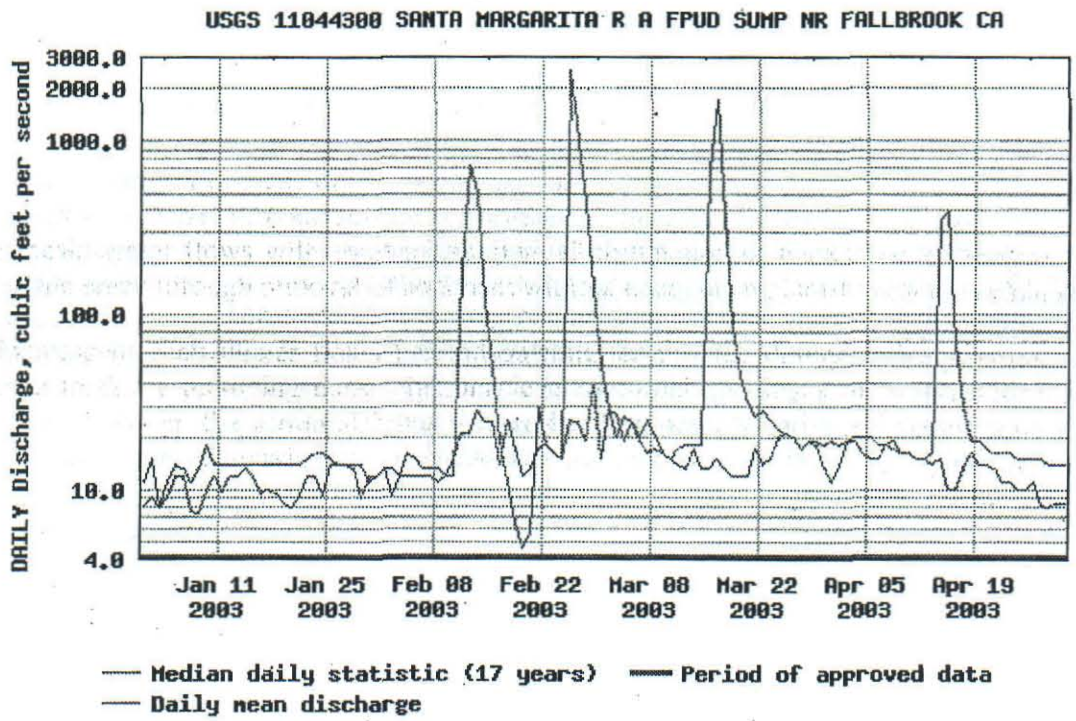

Figure 2. Hydrograph of Santa Margarita River as measured at USGS Gauge Station # 11044300 between 1 January and 30 April 2003.

Given the presence of suitably low flows and suitable/available breeding sites, the following conclusions can be made regarding the arroyo toad along portions of the Santa Margarita River: 12

- Peak breeding of the arroyo toad is not tied to either low or high annual rainfall totals. Periodicity and timing of rainfall and resultant flows dictate stream character breeding suitability;

- Presence of suitable breeding sites, even when stream conditions are favorable, does not ensure arroyo toad breeding. Access to breeding sites (that is, the absence of vegetation barriers, native and non-native) is required to facilitate arroyo toad breeding;

- Scouring and consequent re-structuring/re-forming river banks (along with in-stream vegetation removal) appear to be the most important factors that facilitate arroyo toad breeding, especially in areas where exotic vegetation has become problematic;

- An incised channel limits (but does not absolutely preclude) arroyo toad breeding substantially.

The benefits of winter floods to arroyo toads depend on the presence of sufficient rocks, cobbles, gravel, and other material to be worked downstream. As described by Madden-Smith et al. (2003), "A balance of scouring flows and sufficient sediment supply is required to maintain arroyo toad breeding habitat." Because Pyramid Lake traps sediments, the creek downstream suffers increased erosion (Baxter 1977; Ligon et al. 1995; Nilsson & Berggren 2000), which destroys arroyo toad habitat (Madden-Smith et al. 2003). The top four miles of Piru Creek have already been degraded as habitat because of this phenomenon. Farther down the creek, tributaries 13
and erosion of upstream reaches provide sufficient sediment to maintain toad habitat. The proposed release of peak winter flows will result in the gradual elimination of habitat even in the middle reaches of the creek through removal of sediment without adequate replenishment.

The proposed increase in peak winter flows has the potential to provide dramatic short-term benefits for arroyo toads by removing dense riparian vegetation and creating a more suitable stream morphology. However, the action also has foreseeable long-term negative effects in the form of increased movement of alluvia and sediments downstream, thereby reducing breeding 14
habitat. This adverse impact is neither fully discussed nor mitigated in the EA, which improperly defers mitigation to future nonbinding discussions to increase sediment supply.

1.1.2 Native Fishes

Peak winter flows are associated with increased reproductive success of native fishes (Baltz & Moyle 1993; Brown & Ford 2002; Brown & Moyle 1997; Moyle & Light 1996a, b). As summarized by Marchetti and Moyle (2001) from a study in northern California, "[C]onditions for native species improved during years with large peak flows in winter and sustained flows in summer." Furthermore, as discussed below, peak winter flows can reduce populations of exotic fishes.

The vegetation changes resulting from peak flows are not entirely beneficial to native fishes. Elimination of streamside vegetation through peak winter flows can reduce refugia for fishes in the summer. Overhanging willow vegetation provides lower temperature conditions for native fishes to escape to in the summer (Marchetti & Moyle 2001), although recent research shows that juvenile steelhead tolerate and forage in conditions warmer than previously presumed (Spina 2007).

1.1.3 Exotic Predators

Many of the exotic species that have invaded and threaten native species in California streams are specialists of lentic (slow-moving) habitats (Power et al. 1996). These include bullfrogs (Hayes & Jennings 1986), large-mouth bass and related species (Moyle 1976; Moyle et al. 1986), and mosquitofish (Meffe 1984; Meffe & Minckley 1987). It is widely asserted that high peak flows will wash out exotic bullfrogs and exotic fishes from California riparian systems (Kats & Ferrer 2003; Madden-Smith et al. 2003; Marchetti & Moyle 2000; Meffe 1984).

The most applicable research to the effects of peak winter flows on bullfrogs was completed to provide guidance for managers seeking to protect red-legged frogs (Doubledee et al. 2003). Because bullfrog larvae, which can (but not always) require two breeding seasons to mature, remain in streams during periods of peak winter flows, they are susceptible to being washed away. Doubledee et al. (2003) constructed a mathematical model to assess the flooding regime that would minimize bullfrog survival and maximize red-legged frog survival, using data from Ventura and Santa Barbara counties, including Piru Creek, to calibrate the model. The results predicted that coexistence between red-legged frogs and bullfrogs would be highest if flooding occurred at least every five years; a scenario similar to what we propose (i.e., scouring releases every 5–7 years) is a necessary management practice to maintain the health of the Lower Piru Creek system.

Notwithstanding the literature stating that winter floods can wash out invasive exotic species, releases from Pyramid Lake can introduce exotic fish downstream. As described by Sweet (1992), "Every water release from Pyramid Dam thus carries the threat of further exotic species being introduced." Moreover, adult bullfrogs are capable of overwintering in a host of refugia and are not tied to aquatic habitats year-round. Bullfrog larvae are hardy and while some may perish during release events, others (even if in small numbers) will persist (Haas unpublished data). It is not the population size that makes the bullfrog an egregious predator but rather its persistence. 15 16

1.1.4 Exotic Plants

Sweet (1992) observed that tamarisk (*Tamarix ramosissima*) had been established in Piru Creek and attributed its success to the summer flows. The lack of flooding and stable hydrology downstream of dams causes the densest infestations of tamarisk (Shafroth et al. 2005). On average, however, tamarisk is found in drier conditions than are native riparian species such as willows and cottonwoods (Cooper et al. 2003; Shafroth et al. 2000) and tamarisk is less tolerant to flooding and scouring than are native trees (D'Antonio et al. 1999). Consequently the release of peak winter flows will help to decrease this invasive species. With a decrease in scouring floods, tamarisk, along with other woody vegetation, will increase (Shafroth et al. 2002). Release of scouring winter flows, as proposed in the project, would have a beneficial effect on the riparian vegetation by favoring native trees over exotic tamarisk.

1.1.5 Western Pond Turtle

Reestablishment of winter flows is expected to benefit western pond turtle (*Actinemys marmorata*) because the flows will rework the incised channel to create broader, shallower pools preferred by the turtles (Holland 1994). 17

1.1.6 Two-striped Garter Snake

By reducing populations of exotic predators, peak winter flows can be expected to benefit two-striped garter snakes (*Thamnophis hammondii*).

1.2 Proposed Elimination of Summer Flows Does Not Protect RARE Beneficial Use

The proposed flow regime does not include any predictable summer releases and consequently differs from the constant 25 cfs flows through the summer that is the baseline condition for analysis. The impact analysis therefore must consider the impacts of this change, regardless of whether it is perceived to be a return to a "natural" condition or not. The elimination of predictable summer water releases will not protect the existing beneficial uses in middle Piru Creek, primarily by adversely modifying habitat for rare species (RARE). 18

1.2.1 Arroyo Toad

Arroyo toad breeding is low or absent during years with low precipitation (Haas 2001, 2004; Holland et al. 2001; Jennings & Hayes 1994; Sweet 1992). Once female toads emerge from overwintering, they must forage for a period of time to be able to produce eggs. In dry years, breeding habitat may be gone by the time eggs have matured. Elimination of summer base flow in Piru Creek will decrease or eliminate arroyo toad recruitment during dry years. 19

The agencies promoting this project have asserted that reduction in summer flows to match input to Lake Pyramid will have benefits for arroyo toads by eliminating breeding habitat for the bullfrog, an exotic predator. Although bullfrogs may indeed depredate arroyo toads, their ecologies are sufficiently distinct that it is rare for the two to co-occur in quintessential arroyo toad breeding habitat consisting of low-gradient, shallow, sandy/gravelly streambed. The reduction of summer flows rather may have a far more adverse effect on arroyo toads than on bullfrogs by limiting the length of the arroyo toad breeding season and by concentrating arroyo toad larvae (and subsequently neonates) in deeper pools. These deeper pools, compared with quintessential arroyo toad breeding habitat, are more likely harbor bullfrogs (and bullfrog larvae) and thus make depredation of arroyo toads (or death by other means such as limitation of larval foraging habitat) more likely. This phenomenon has been observed at numerous arroyo toad breeding sites throughout the range of the species including along the Santa Margarita, San Luis Rey, and Sweetwater rivers (Haas unpublished manuscript, 2008). 20

Rather than eliminating exotic predators of arroyo toads, reduction of summer flows would have the result of creating isolated ponds of water where aquatic species are concentrated. Concentrated food resources result in greater competition between native and exotic species (Kiesecker et al. 2001). Concentration in isolated pools is likely to exacerbate the impacts of interactions with exotic species already existing in the system. 21

With the previous summer water release of 25 cfs and no winter storms, Piru Creek developed an incised channel and extensive riparian vegetation. These conditions are adverse to arroyo toad breeding success. With the large winter storms that reconfigured the channel to make it broader and shallower and removed the extensive riparian vegetation, the summer flows of 25 cfs were beneficial for arroyo toads (Sandburg 2006, p. 49):

> A 25 cfs flow in the entrenched channels of year 2004 were excessive for arroyo toad breeding, but **this same flow was suitable and productive** in naturally widened 2005 channels [emphasis added].

This is exactly what Haas found along the Santa Margarita River in 1998 (following a winter of El Niño rains) and again in 2003 following serendipitously well-timed rainfall events.

Furthermore, the guarantee of water being released into Piru Creek during dry years is a buffer against climate change. If the climate becomes drier and little or no summer water is released 22
from Pyramid Lake for an extended period, then there is a risk of creating conditions adverse to arroyo toad breeding, with a long-term potential for extirpation if lack of surface water precludes breeding for an extended period or a shortened breeding season and elevated predation pressure in remaining pools causes a downward population trajectory. From a practical perspective it is far better to ensure that such water continues to be available rather than waiting until a future crisis to try to negotiate the release of water from Pyramid Lake after a switch to the proposed flow regime. Under such a scenario, the needs of riparian-dependent species in Piru Creek are not likely to prevail.

1.2.2 Red-legged Frog 23

The California red-legged frog requires aquatic and riparian habitats. In the vicinity of water, adults favor dense, shrubby or emergent riparian vegetation (protective embankment overhangs may also be favored hiding spots) closely associated with pools and ponds greater than two feet deep, usually with still or slow-moving water. Jennings et al. (1993) suggested that intermittent streams must retain surface water in pools year-round for red-legged frogs to survive. However, California red-legged frogs may aestivate in small mammal burrows, under large rocks, and in moist leaf litter, and may be found several hundred feet from their riparian haunts (Jennings et al. 1993). Where climatic conditions are extreme (e.g., in southern California) well-vegetated terrestrial areas within a riparian corridor near to the streambed may provide important sheltering habitat during periods of drought and for overwintering.

California red-legged frogs breed variably in the period between November and March depending on rainfall regime, temperature, and presence of breeding habitat. Eggs are typically attached to emergent vegetation at or near the surface. Eggs may be dislodged during periods of elevated flows, especially when these occur in pulses. Eggs hatch in one to two weeks (egg development in colder climates may take considerably longer) and neonates emerge approximately 3.5–7 months later. Rate of larval development is tied to several factors, the most important of which is availability of forage, along with water and air temperatures. The northern red-legged frog (*Rana aurora*) has the lowest upper (21°C) and lower (4°C) lethal embryonic temperatures of any North American ranid frog (Licht 1971). Similar data are not available for the California red-legged frog, and although each may be expected to be several degrees higher because of the more southerly distribution, temperature of water releases (especially dependent on whether water is released from the surface or from below the surface) must be considered in developing a programmatic approach to water releases where this species occurs. Also, water temperatures downstream from release sites may experience dramatic increases during the period of larval development if overstory vegetation is reduced (e.g., due to reduced flows) and/or if pools begin to dry prematurely such that water temperatures rise, especially if subjected directly to radiant heat.

Drying of the streambed in and of itself may or may not adversely affect adult red-legged frogs, especially if adequate shade and moisture are available in the vicinity of drying pools. However, depending on many features (e.g., timing of egg deposition, water and air temperatures, level of competition within breeding pools), larvae may require breeding pools as late as June or July (rarely August). Thus, release regimes with late summer reductions in flow may have significant adverse effects on red-legged frog recruitment. Maintenance of emergent vegetation within instream pools is important to egg deposition sites. Thus, periodic, especially regular, drying of the streambed may have significant, adverse impacts on red-legged frogs and is contraindicated for the persistence of this species along Piru Creek. It should be noted that middle Piru Creek is designated critical habitat for the red-legged frog, but not the arroyo toad. In sum, the proposed regime would have a potentially significant impact on the red-legged frog, whereas the alternative regime would support the species. 24

1.2.3 Native Fishes

In California and other Mediterranean climates, numbers of native fishes are increased with increased flows, while exotic species increase with decreased flows (Marchetti & Moyle 2001; Moyle et al. 1986). Reducing summer flows would degrade habitat for native species, which prefer cooler water, and promote reproduction of exotic species (Marchetti & Moyle 2001). Most exotic fishes spawn in the summer (Moyle 1976). Although native fishes are adapted to surviving multiple years of low flow, they can do so only if there are sufficient refugia (Marchetti & Moyle 2001). Summer flows are beneficial to the native fishes, as described by Marchetti and Moyle (2001) for Putah Creek near Sacramento:

> [H]igher summer flows also favored native fishes by providing longer reaches of cool flowing water where juveniles of the native fishes could find suitable conditions for rearing, while simultaneously reducing the favorability of the habitats for spawning and rearing of alien fishes.

Therefore, the proposed license amendment would have a potentially significant impact on native fishes, including resident rainbow trout, whereas the alternative regime would support them. The resident rainbow trout in middle Piru Creek are not from hatchery stock and genetically cluster endangered southern steelhead elsewhere in the Santa Clara River watershed (Girman & Garza 2006).

1.2.4 Western Pond Turtle

Reduced summer flows would decrease the number of shallow ponds available for basking and foraging by western pond turtles. Reduced flows would furthermore concentrate turtles into fewer areas where chances of adverse impacts from recreation would be expected. This concern was raised by the Department of Fish and Game in its comments on the draft EA. 25

1.2.5 Exotic Predators

Exotic predators, including American bullfrogs, fishes, and invertebrates, are present in Piru Creek and could be affected by decreased summer flows. Reduction in bullfrogs in particular is promoted as a primary benefit of the flow regime proposed by DWR.

Doubledee et al. (2003) investigated draining ponds as a method to control bullfrogs. This approach is roughly analogous to eliminating summer flows in Piru Creek; along certain sections of the creek no ponds will remain. In a modeling experiment that included a full life history description of bullfrogs, Doubledee et al. (2003) found that draining ponds every two years would reduce bullfrog populations by 50%, but this result did not take emigration into account. They go on to recommend that ponds within 5–10 km of each other should be drained simultaneously to reduce bullfrog populations. If applied to Piru Creek, these results suggest that it would be nearly impossible to eliminate bullfrogs by reducing summer flows. Ponds of water would still remain 26 as refugia in the creek (where competition with native species would be heightened), the artificial reservoirs would serve as perpetual sources of immigrants, and bullfrogs would rapidly return. Incidentally, active control of bullfrogs (shooting) has not been effective in the past (Rosen and Schwalbe 1995). The only successful eradication projects have taken place in isolated ponds that could be entirely drained and all bullfrogs killed (Ficetola et al. 2007).

Although decreased summer flows would limit bullfrog reproduction to some degree, adult bullfrogs easily persist through dry periods and rapidly reproduce when conditions are suitable. In an eight-year study in the San Diegito River system, Haas found that extended periods during which dry conditions occur do not necessarily eliminate adult bullfrogs from local areas. Moreover, in studies of the arroyo toad in Santa Maria Creek, Haas found three live adult bullfrogs and a young blue catfish (*Ictalurus furcatus*) buried > 8 inches deep in relatively moist soils within the creek's riverwash in August, more than a month after surface flows had vanished. The ability of exotic invasive species to persist must not be underestimated. As shown by removal attempts (through shooting), populations rebound within 3–4 months when stressful conditions are removed (Rosen & Schwalbe 1995). Exotic aquatic predators, including invertebrates such as crayfish, rebound quickly when flushed out by winter storm flows (Kats & Ferrer 2003).

Periodic drying as would be experienced in middle Piru Creek under the proposed flow regime would not be sufficient to reduce populations of bullfrogs. Attempts to remove bullfrogs from 27 isolated ponds involve complete drying followed by excavation of sediment to remove adults and larvae (Banks et al. 2000). Even with this effort, bullfrogs were reproducing in the pond two years later (Adams & Pearl 2007). Mathematical modeling of bullfrog dynamics predicts that complete drying would be necessary every other year to allow coexistence with red-legged frog (Doubledee et al. 2003). Such drying would not be desirable in Piru Creek, because it would have adverse impacts on native species (Maret et al. 2006).

Moreover, the data upon which Adams and Pearl (2007) based their findings may not be fully applicable to warm southern California meta-populations of the bullfrog, which may be able to complete their transformation during the first summer in warm climates (Bury & Whelan 1984;

Cohen & Howard 1958) as opposed to many other locations where two seasons are required for their transformation. Indeed, bullfrog larval transformation has been reported at four months in 28 Louisiana (George cited in Willis et al. 1956) and at six months in California (Cohen & Howard 1958). For precisely this reason draining isolated ponds to control bullfrogs must be done rapidly, typically under controlled circumstances, so that larval development and transformation do not occur before water is removed and, importantly, to avoid selection of rapidly developing larvae (Adams & Pearl 2007). It is specious, therefore, to argue that establishing a "natural" flow regime in middle Piru Creek is going to reduce the impacts of bullfrogs by reducing their number 29 with summer drying (see Figure 3).

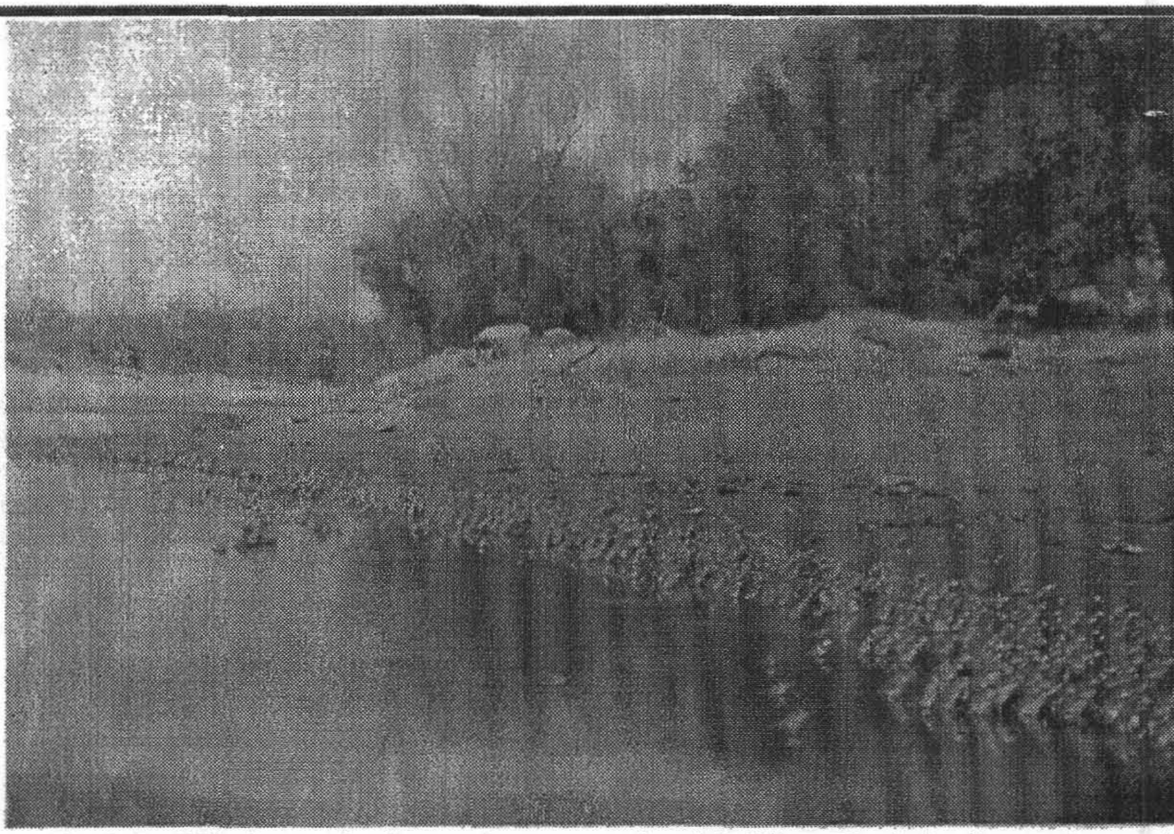

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Fig. 1. In 1950 thousands of recently metamorphosed bullfrogs lined the shores of one of the earthen reservoirs at the San Joaquin Experimental Range, California. The eggs had been laid only about seven months earlier. This reservoir went completely dry during the late summer of the previous season.

Figure 3. Photograph and caption reproduced from Cohen and Howard (1958) showing that permanent water is not needed for bullfrog development.

1.2.6 Exotic Plants

Removal of summer flows will not likely reduce extent of tamarisk because plants are already 31 established and can easily reach subsurface water with their taproots. Furthermore, as discussed above, tamarisk cover is documented to increase under lower water conditions in southwestern rivers. Compared with allowing peak winter flows with scouring floods, the evidence does not support use of removal of summer water as a means of tamarisk control (Shafroth et al. 2002; Shafroth et al. 2000; Stromberg et al. 2007a; Stromberg et al. 2007b). To the contrary, summer water releases from reservoirs have been shown to mitigate the effects of natural drought on native seedling mortality when they occur after winter flooding events that are conducive to establishment of native trees (Lytle & Merritt 2004).

1.2.7 Climate Change Scenarios 32

It is shortsighted to commit to the long-term management of middle Piru Creek by institutionalizing the proposed "flow in/flow out" release schedule for Pyramid Lake. Under foreseeable future climate change scenarios, this region is likely to be warmer and drier (Westerling & Bryant 2008). In an extended drought, the sensitive amphibians currently supported in Piru Creek could face extirpation as a result of inadequate breeding habitat. Because releases of water from Pyramid Lake were originally established as mitigation for destruction of stream habitat, the rights to such flows should be retained to be able to maintain the remaining downstream habitat under future climate emergencies.

2 Proposed Alternative Flow Regime for Piru Creek

The stated purpose of the proposed project is to avoid take of arroyo toad by water releases along
Piru Creek. This stated purpose is misguided. The purpose should instead be to devise a flow re- 33
gime that protects all of the beneficial uses of the creek, including as habitat for rare species other than arroyo toad. The currently proposed flow regime attempts to create a "natural" flow regime, but because of the capping off of peak winter flows at 18,000 cfs (far below the natural
flows of 54,000 cfs) and by delivering water in addition to natural flows during the winter, the 34
hydrological conditions in Piru Creek between Lake Pyramid and Lake Piru will not be natural under the proposed project.

The implementation of the flow regime by eliminating all "artificial" summer baseflow will not be effective in reducing populations of exotic bullfrogs or protecting the beneficial uses of mid-
dle Piru Creek. Rather, the research demonstrates that reduction of the extent of surface waters 35
without complete drying may exacerbate the adverse impact of introduced predators such as bullfrogs on native fish and amphibian species. Furthermore, the scientific literature and observations on Piru Creek indicate that additional summer water releases benefit sensitive native spe-
cies. We therefore offer an alternative flow regime. 36

2.1 Flow Characteristics

2.1.1 Winter Flows

From the period of the first winter storm to May 1, a volume of water equivalent to that which flows into Lake Pyramid will be released from it, within the operational constraints of Pyramid Dam. At a period of at least once every 5–7 years, a release event of significant volume adequate to produce scouring flows must be implemented if such flows do not occur naturally from rainfall events. Evidence from both Piru Creek and the Santa Margarita River suggest that floods of this periodicity are necessary to rework sediments and clear vegetation (Haas 2005; Sandburg

2006). Models predicting coexistence of red-legged frogs with bullfrogs suggest flooding every five years (Doubledee et al. 2003). The three-year period of variance we recommend (years five, six, or seven) offers sufficient leeway to accommodate periods of extended drought-like conditions and/or a natural scouring event in a high rainfall year. Any water deliveries will take place during the winter period (November to February) and be released to emulate the flows of a winter storm in volume and timing. Water deliveries can be used for the scouring flows described above.

2.1.2 Summer Flows

As discussed above, many species depend on sufficient water to complete reproduction. While some native species can withstand droughts, others, such as the native rainbow trout, require water year-round and many native riparian species thrive with additional water at appropriate times. The project proponents describe inflow to Lake Pyramid from 1977–2002 and adjusted for watershed area as peaking at 255 cfs in February and decreasing to an average of 8–9 cfs from August through October.

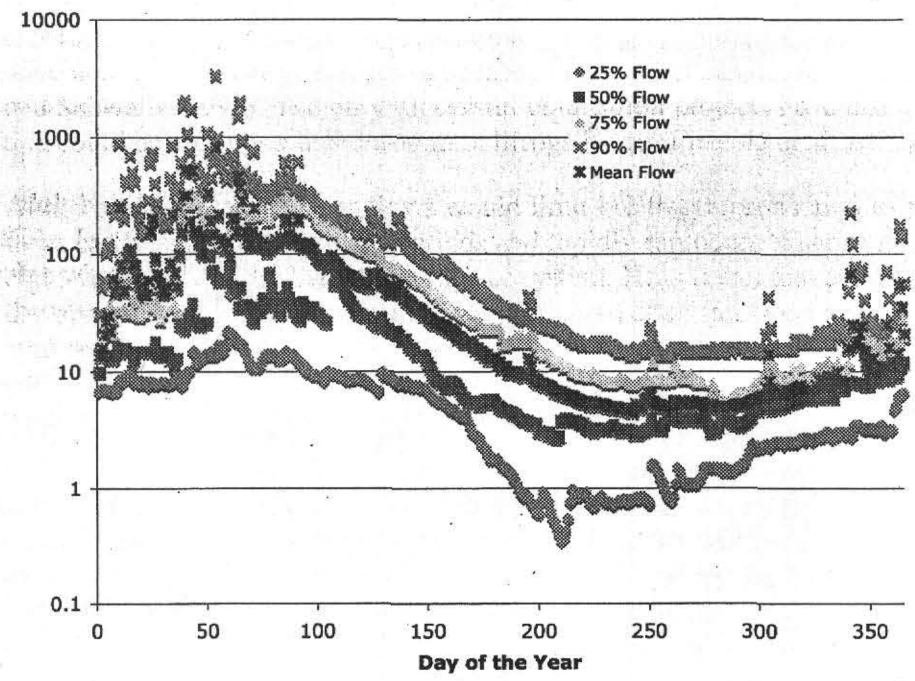

Figure 4. Gauged flow (cfs) in Piru Creek above Pyramid Lake near Bucks Creek (USGS Gauge Station # 11109375) during a 17-year period. Mean flows exceed median (50%) flows because peak flows are so large (not logarithmic scale).

The flow into Lake Pyramid reported in the Environmental Assessment is an extrapolation of the record at Piru Creek near Bucks Creek (Figure 4). This record is for a 198-square mile watershed, whilst Piru Creek directly below Pyramid Lake drains 295 square miles. Adjusting this record upward to account for the larger watershed produces the mean flow numbers reported by the agencies. This method is a back-of-the-envelope extrapolation because it does not account for any groundwater baseflow or spring-fed input that could be provided in the additional 100 square mile watershed above Pyramid Lake.

This record, although only documenting a 17-year history, shows that the outflow of 25 cfs during the summer and fall is within the range of natural variation. This occurs during wet years, and we estimate based on flows from Piru Creek at Bucks Creek (Figure 4) that this flow level has occurred twice in 17 years. During the driest years, stream flow has been recorded at 2 cfs or less. Stream gauges are notoriously inaccurate at low flows, however, so these numbers should be used for analysis only with caution. Such extreme conditions occurred on average once every four years during the 17-year record. As discussed above, this is not a sufficiently long period to effectively reduce the number of adult bullfrogs in middle Piru Creek. 37

We therefore propose a flow regime that ensures that conditions in middle Piru Creek are always at or above the 75th percentile. This summer flow, combined with the natural winter flows to maintain a desirable stream morphology (see Sandburg 2006), would protect the beneficial uses of middle Piru Creek, including as rare species habitat and warm and cold fish habitat. 38

Under this scheme, inflow to Lake Pyramid would be released as outflow during the winter season from November to March 15. From March 15 to August 31 water would be released at 15 cfs (or natural inflows, whichever is greater), then decreased by 1 cfs every 2 days between September 1 and September 20 to achieve and maintain a 5 cfs minimum flow from September 20 until the first winter storm. During the winter, inflows would be released as outflows. Flows would be increased gradually to meet the 15 cfs flows in March during years when flows were less than 15 cfs leading up to March 15. In all instances these are minimum flows, to be exceeded if calculated inflows are greater.

These proposed flows are greater than in the average year and would eliminate drought years. Although this amount is less than the 25 cfs maintained since 1995, it should be sufficient to sustain native rainbow trout populations because the population has survived drier conditions than this in the past.

This proposal is based on the judgment that increasing summer flows, as long as there are adequate winter storm events to keep the stream channel sufficiently broad and shallow, will not have significant adverse impacts on arroyo toads. The adverse impacts of bullfrogs and other non-native predators will be reduced by the floods creating a stream morphology with habitat that is more amenable to arroyo toads than to bullfrogs. We also conclude that the impacts of non-native predators would be exacerbated by a flow regime that allowed for partial drying that would concentrate aquatic species into smaller and smaller pools, increasing pressure from predators. The basis for these judgments follows.

Arroyo toads do not require intermittent streams, and are more commonly found around perennial water in the northern part of their range (Cunningham 1962), which includes all areas north of Orange County. Cunningham (1962) found them to be most common along stretches of stream that were perennial, in areas were there are shallow reaches with sandy and gravelly beaches, and few boulders. The species recovery plan also describes habitat as including perennial streams that are flooded on a "fairly regular" basis (U.S. Fish and Wildlife Service 1999). 39

Perennial flows in Piru Creek therefore cannot be construed as causing take of arroyo toads or constituting an adverse modification of habitat in any manner. To the contrary, they are an improvement to habitat conditions for this species. 40

The presence of bullfrogs in Piru Creek (and their continued down-washing from Lake Pyramid) complicate the situation, but elimination of summer flows is not an effective solution to control their numbers (Adams & Pearl 2007). Eradication programs will not control bullfrogs at the population level in complex environments (Adams & Pearl 2007). Once established, bullfrogs are "difficult or impossible to directly control or eradicate" (Adams & Pearl 2007), although direct control of problem individuals may be beneficial (see below). 41

The most promising avenue to allow for coexistence of rare native amphibians with bullfrogs is through management of habitat structure rather than through alteration of hydroperiod (Adams & Pearl 2007). Bullfrogs and arroyo toads have quite different habitat preferences — bullfrogs prefer deep pools with extensive vegetation while arroyo toads prefer shallow pools with little vegetation. Providing habitat diversity, by changing stream morphology with winter storm flows in this instance, should decrease encounters between the two species (Smith 1972). Native amphibians, even red-legged frogs, can coexist with bullfrogs if habitat conditions mitigate for the adverse effects of bullfrogs (Adams 2000).

We also base this proposed regime on extensive research currently underway to examine the effects of water release on arroyo toads and the Coast Range newt (*Taricha torosa*) by Haas in the San Diego River watershed. For purposes of this discussion, the Coast Range newt serves as a surrogate for one or more Piru Creek species, including the red-legged frog or native fishes that require deep drop pools for breeding. These studies show that release rates of 6, 12, and 24 cfs may benefit both species, depending on the nature and timing of the releases. The preliminary conclusions of this research are as follows. 42

- Changes or fluctuations in release rate may have detrimental effects on the arroyo toad. Depending on the nature of the fluctuation, rapid increase in flow rate may wash out egg masses and larvae whereas even minor variations in stream channel height my subject egg masses and larvae to desiccation (via lowering of the water level) or washout (e.g., if the increase in height results in exposure to increased flow rates that are beyond the species' tolerance).

- Fluctuations in release rate have much less of an adverse effect on the Coast Range newt than on arroyo toad. This suggests that fluctuations in release rate would affect red-legged frog and native fishes less than arroyo toad in Piru Creek.

- The effect of the release on either species is dependent not only on the release rate but also the effect of the release relative to pre-release ambient flows. Thus, a complete analysis of the impacts of a flow regime would include an analysis of the effects of a release rate on different in-stream habitats (e.g., the low-gradient sandy habitats of the arroyo toad and the higher gradient reaches that exhibit deeper, including pooled, water that support red-legged frogs and native fishes) and take into account the effects of a release under various flow baselines. The arroyo toad requires breeding sites with channels, ox bows, or other breeding sites of less than 12-inch depth and flow rates no greater than 0.5 feet/second (15 cm/second).

- Winter releases of significant volumes should thus be timed to be complete several weeks before the onset of arroyo toad breeding.

- Arroyo toads benefit from lower rates of release especially if the release period is extended through the breeding season (e.g., between mid-March and mid-August). This is true even for the southernmost arroyo toad populations despite their ability to aestivate until fall and winter rains commence. A constant release regime of low volume, however, does not benefit the newt to the same extent it does the arroyo toad. Thus, to benefit more than just the arroyo toad, we proposed a higher release volume.

A final important issue must be considered in managing the system for persistence of native amphibians. Bullfrogs are reservoirs and vectors of the fungal pathogen *Batrachochytrium dendrobatidis* (Daszak et al. 2004; Sánchez et al. 2008), which causes a potentially fatal skin infection in many amphibians, including arroyo toads (Pessier et al. 1999) and red-legged frogs (Padgett-Flohr 2008). Reduction in bullfrog numbers is desirable for this reason as well. Future research may describe the mechanism and risk factors for exposure to *B. dendrobatidis* when carried by bullfrogs as a reservoir. Arroyo toads should be at less risk than red-legged frogs because of their habitat preferences, but the status of these populations should be monitored and researchers should take appropriate precautions to avoid spreading the disease (e.g., cleaning boots and equipment with bleach solution).

2.2 Adaptive Management and Mitigation Measures

The final Environmental Assessment and Clean Water Act certification err in failing to provide adequate mitigation measures to offset the predictable adverse impacts of the proposed project and to protect existing beneficial uses. For example, the EA proposes only monitoring as mitigation for impacts of winter flooding on red-legged frogs, but establishes no defined actions to be taken to mitigate adverse impacts of such flooding. Monitoring, without associated triggers for mitigative action, does not constitute effective mitigation. Furthermore, most conservation monitoring lacks sufficiently rigorous statistical design to evaluate hypotheses and is thus can be "a waste of time" (Legg & Nagy 2006). The EA also offers only monitoring as a mitigation for the long-term but predictable removal of sediment from the upper reaches of middle Piru Creek. The EA provides no management plan for exotic predators swept into middle Piru Creek from Pyramid Lake except the assertion that the winter flows and low summer flows will diminish their abundance. Rather than relying on monitoring as the mitigation, adaptive management programs should be put in place to address these predictable and significant adverse impacts on the biological resources of Piru Creek.

2.2.1 Sediment Provision

The arroyo toad habitat values of the first four miles of stream below Pyramid Dam have already been destroyed by clear water releases. Further stream degradation will take place with the larger and more frequent winter water releases. The Water Resources Control Board should require the DWR to commit to a sediment replenishment program as mitigation for this impact. Precedent 43 for replenishment of sediment below dams to restore in-stream habitat is provided in the restoration of salmon habitat on the Trinity River in northern California (U.S. Department of the Interior 2000). Fine sand and gravel (not silt) should be placed below Pyramid Dam in amounts commensurate with winter rainfall and allowed to be incorporated into the morphology of Piru Creek to restore and maintain habitat for native amphibians and fishes. This action will require additional planning and compliance steps to evaluate the quantity, source, and deposition method for the sediments, but the implementation of such a program should be guaranteed by the current project. 44

2.2.2 *Exotic Species Management*

Pyramid Lake is a constant source of exotic species that will be distributed downstream by the proposed flow regime. Although complete removal of these species, especially bullfrogs, is not feasible (Adams & Pearl 2007), this impact can be mitigated through an ongoing control plan. Sweet, in an online report, asserts that single bullfrogs at arroyo toad and red-legged frog breeding pools can cause significant harm to a population and removal of those individuals would provide a short-term benefit. Removal of problem individuals would be effective because arroyo toad breeding occurs before bullfrogs begin moving between pools. The management program should selectively remove adult bullfrogs in arroyo toad habitat during breeding season. Because bullfrogs are essentially impossible to eradicate in this complex environment, such targeted lethal control can at least reduce impacts on breeding populations of endangered species. 45

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