EFFECTS OF STREAMFLOW REDUCTIONS ON FISH HABITAT QUALITY IN REDWOOD CREEK AND LAGOON

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The loss of about 0.09 cfs between 6:00 pm and 6:00 am from the Muir Beach well and about 0.14 cfs from the Banducci wells has significant adverse effects upon fish populations in Redwood Creek. Precise quantitative estimates of the effects would require a detailed investigation, but impacts on fish numbers and growth rates can be approximated by the effects observed during summers of 1992 and 1993.

Temporary Versus Persistant Streamflow Reductions.

Although the pumping by the two well systems only occasionally overlaps, and the pumping by the Banducci Wells occurs irregularly, the cumulative impacts of sporadic loss of streamflow by about 0.25 cfs can be almost as severe as persistant loss of that much flow. Stream sections which are briefly dried by the pumping will lose the fish populations using the shallow run and riffle habitats (mostly young-of-year steelhead); the fish populations will adjust to the degraded conditions available during the low flow "event". In addition, insect populations in the shallow habitats will be lost or severely reduced. Insects in the shallow habitats, lost to pumping, probably provide much of the drifting insect food available to fish in the deeper habitats. Therefore, food availability in the surviving habitats will be reduced. Brief periods of poor water quality, due to pumping, may similarly reduce or eliminate fish or insects from habitats that do not dry up and that usually have adequate water quality.

Effects of Streamflow Reductions

The impacts of flow reductions will vary with amount of unimpaired streamflow, and will thus vary with time of year and with year to year conditions. The probable effects of a 0.25 cfs reduction in streamflow under different runoff conditions are as follows:

Natural Streamflow of 0.75 cfs or Greater. At streamflows above 0.75 cfs pumping would reduce streamflow by less than 1/3 and at least 0.5 cfs would remain. Such a reduction would reduce the depth of the widest, shallowest riffles sufficiently to slightly

reduce young-of-the-year steelhead populations. However, these flows would probably only occur in early summer, and lower, late summer streamflows would have had the same effect anyway; there would be no ultimate effect on stream fish numbers.

Streamflow reduction at flows above 0.75 cfs would reduce velocities at feeding stations and reduce growth rates of steelhead. The effect would probably be approximately proportional to the rate and duration of daytime streamflow reduction; if pumping reduced streamflow by 1/3 for 20% of the daytime feeding periods, growth might be reduced by about 7%.

Streamflow reduction might also slightly reduce dissolved oxygen in pools immediately upstream of the lagoon and water level in the lagoon. More severe effects are likely due to natural decrease in streamflow in late summer, so there would be no net effect on fish numbers, but growth rates might be reduced.

Natural Streamflow of 0.27 cfs to 0.75 At streamflows in this range, which would occur in late summer of average and above average runoff years, the impacts of the wells would be greater and more widespread. A loss of 0.25 cfs to the wells would reduce fish growth rates approximately proportional to the daytime reduction in flows, by reducing velocities at feeding stations. For example, if streamflow was reduced from 0.5 to 0.25 cfs (50% reduction) 40% of the time, growth during that period would probably be reduced about 20%.

The loss in streamflow would also reduce depths in shallow runs and riffles substantially, reducing steelhead in those habitats. Fish reductions in the deeper glide and pool habitats would be much less. Coho usually do not occur in shallow riffles and runs and would not be significantly reduced in number. Shallow habitats make up about 30-35% of the stream channel. Fish losses would probably be about proportional to the reduction in streamflow. For example, a streamflow reduction from 0.5 cfs to 0.25 cfs would reduce steelhead numbers by about half in the shallow portion (35%) of the streambed, for a net reduction of 17%. A reduction from 0.27 cfs to 0.02 cfs would result in a 93% reduction in the shallow portion, for a net reduction of 32%.

Streamflow reductions to 0.5 cfs or less would probably result in a reduction in size and depth of the lagoon, when the sandbar is closed. At about 0.5 cfs the lagoon should have a depth of approximately 1 m, and should provide some rearing habitat for steelhead (but would probably be too warm for coho). A reduction in inflow to 0.25 cfs might reduce lagoon depth by about 1/3, producing conditions unlikely to support steelhead in late summer.

Low late summer streamflows would also reduce dissolved levels in the pools immediately upstream of the lagoon. Reduction of streamflows below about 0.1-2 cfs would probably eliminate coho. Steelhead might be eliminated by streamflows which dropped below about 0.05 cfs.

Natural Streamflow Below 0.27 cfs. In late summer of dry years the reduction in streamflow by the wells would have drastic impacts upon steelhead and coho numbers and growth. Almost all shallow runs and riffles would become too shallow or dry. In 1992 almost 1/2 of the streambed was dry at the site downstream of the diversions in September, and steelhead numbers were 83% less and coho 19% less than in September 1993. In addition, the elimination of surface flow resulted in low dissolved oxygen levels in the pools; coho were further reduced by the end of the summer (total reduction of 75% compared to 1992).

Elimination of surface flow would result in poor dissolved oxygen in the pools immediately upstream of the lagoon and also result in a very shallow shallow. No steelhead or coho would survive.

Table . Summary of approximate effects of a reduction in streamflow in Redwood Creek by 0.25 cfs due to the wells.

Flow Change (cfs)	Effects			
	Steelhead		Coho	
	Numbers	Growth	Numbers	Growth
0.75 to 0.5 (early summer)				
20% of time	-	-7%	-	-7%
100% of time	-	-35%	-	-35%
0.5 to 0.25 40% of time	-100% from lagoon			
	-17% from stream	-20%	-	-20%
0.27 to 0.2 60% of time	-32% from stream	-56%	-?	-56%
	-100% from pools above lagoon	-	-100%	-
0.2 to 0.0 %90 of time	-80%+ from stream	-90%	-75%+	-90%