To : Ed Dito
Division of Water Rights

Date : JUL 11 1990

EXHIBIT F
Committee To
Save The Mokelumne

ORIGINAL SIGNED BY

Tom Howard, Chief
Nonpoint Source Unit
Division of Water Quality
From : STATE WATER RESOURCES CONTROL BOARD

R49-J

Subject: OPERATION OF PARDEE AND CAMANCHE RESERVOIRS

I have reviewed the record of the fishery resources problems on the Mokelumne River. It is my opinion that a substantial portion of the problems are due to East Bay Municipal Utility District's operation of Pardee and Camanche Reservoir. The attached staff report provides a summary of the water quality problems in Camanche Reservoir and the lower Mokelumne River and recommendations for their resolution.

If you require further assistance, please feel free to telephone me at 4-7970.

Attachment

cc: Antonia Vorster
Central Valley Regional Board,
Sacramento

STAFF REPORT
DIVISION OF WATER QUALITY
STATE WATER RESOURCES CONTROL BOARD

WATER QUALITY PROBLEMS ASSOCIATED WITH OPERATION OF PARDEE AND CAMANCHE RESERVOIR

I. Background

Pardee and Camanche Reservoirs were constructed and are operated by the East Bay Municipal Utility District (EBMUD) on the Mokelumne River. Camanche Reservoir is downstream from Pardee Reservoir. Water is diverted from Pardee Reservoir for municipal purposes in Alameda and Contra Costa Counties. Water collected in Camanche Reservoir is released into the Mokelumne River to satisfy senior downstream water rights and to provide a water supply to the Mokelumne River Fish Installation (MRFI).

Over the last few years, there have been problems with the fishery resources on the Mokelumne River. There have been fish kills at MRFI and a decline in the number of anadramous fish returning to spawn in the Mokelumne River. The following discussion provides a summary of the water quality problems in Camanche Reservoir and the lower Mokelumne River and recommendations for their resolution.

II. Beneficial Uses

The beneficial uses of Camanche Reservoir and the lower Mokelumne from Camanche Reservoir to the Delta are listed in the Regional Water Quality Control Board, Central Valley Region's (Central Valley Regional Board) Water Quality Control Plan (Basin Plan)[1]. Camanche Reservoir's beneficial uses are municipal and domestic supply, irrigation, stock watering, water-contact recreation, nonwater-contact recreation, warm freshwater habitat, cold freshwater habitat, fish migration, fish spawning, and wildlife habitat. The lower Mokelumne's beneficial uses are irrigation, stock watering, water-contact recreation, rafting, nonwater-contact recreation, warm freshwater habitat, cold freshwater habitat, fish migration, fishspawning, and wildlife habitat.

III. Water Quality Objectives and Criteria

Regional Boards are required to adopt Basin Plans for all areas within the region (Water Code Section 13240). The Basin Plans establish water quality objectives which ensure the reasonable protection of beneficial uses (Water Code Section 13241). State offices, departments, and boards, in carrying out activities which may affect water quality, are required to comply with Basin Plans approved or adopted by the State Water Resources Control Board (State Board) unless otherwise directed or authorized by statute (Water Code Section 13246).

The Central Valley Regional Board Basin Plan contains the following, applicable water quality objectives.

A. Dissolved Oxygen (DO) - The monthly median of the mean daily DO concentration shall not fall below 85 percent of saturation in the main water mass and the 95 percent concentration shall not fall below 75 percent of saturation. The D.O. concentrations shall not be reduced below the following minimum levels at any time.

o Waters designated cold freshwater habitat - 7.0 mg/l
o Waters designated fish spawning - 7.0 mg/l

B. Temperature - The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses.

At no time or place shall the temperature of any warm or cold freshwater habitat be increased more than 5°F above natural receiving water temperature.

C. Sediment - The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

D. Turbidity - Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.

Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

o Where natural turbidity is between 0 and 50 Jackson Turbidity Units (JTU), increases shall not exceed 20 percent.

E. Toxicity - All waters shall be maintained free of toxic substances in concentrations that are toxic to or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration or other appropriate methods as specified by the Regional Board.

In addition to these Basin Plan objectives, EPA and the State Board have derived water quality criteria for specific pollutants. These criteria have not been adopted as objectives, but they are used as guidelines by State and Regional Board staff in assessing whether beneficial uses are completely protected. The following table lists the applicable criteria.

Element	EPA National Ambient Water Quality Criteria to Protect Freshwater Aquatic Life (ug/l)[2] 4-day Average	1-hour Average	Maximum	State Board Criteria (ug/l)[3]
Al	87	750		
Cd	0.32	0.64		
Cu	3.0	3.9		
Fe			1000	
Mn				150
Zn	27	30		

IV. Problem Description

Review of the record indicates that, for management purposes, the problems in Camanche Reservoir and the lower Mokelumne River can be divided into two separable categories. The first problem is a long-term chronic problem caused by high concentrations of dissolved metals. Data collected by the California Department of Fish and Game from 1981 to 1983 at MRFI illustrate this problem. Out of 535 samples, 154 samples exceeded the chronic zinc criterion (28.8% exceedance, maximum concentration of 1.2 mg/l)[4]. Review of more recent data shows that this problem continues[5]. The source of this problem appears to be abandoned mines in the watershed[5].

The second problem is a short-term acute problem associated with drought conditions. The problem is caused by both low water levels and high energy events at the liquid-solid interface of Camanche Reservoir. The following specific events are in the record. On September 23, 1977, EBMUD released a 30 minute discharge of 750 cfs from Pardee Reservoir which scoured sediments from the old Mokelumne River channel. Sediment associated toxicants caused a major fish kill in Camanche Reservoir[6]. There have been major fish kills in the Mokelumne River Fish Installation (MRFI) in the fall of 1987 and in the fall of 1989 due to poor water quality. In the fall of 1988, MRFI was nonfunctional due to low flow, but most of the few test fish held at the hatchery died[7]. Presumably, the poor water quality over these years also caused fish kills on the lower Mokelumne River. The poor water quality is characterized by low DO, high hydrogen sulfide, high temperatures, high turbidity, and sediment associated toxicants such as aluminum, iron, copper, and zinc[5,7]. The poor water quality is caused by depletion of the hypolimnion in Camanche Reservoir followed by early destratification and wind-induced mixing at the water-sediment interface[7]. These types of water quality problems (scouring of the sediments, depletion of the hypolimnion, wind-induced mixing of sediments) are within EBMUD's water resource management control of Camanche and Pardee Reservoirs.

One of the primary water quality concerns at Camanche Reservoir is polluted sediments. These sediments contain high concentrations of aluminum, iron, copper, and zinc, and leachate derived from these sediments also contains high concentrations of these elements[5]. Laboratory toxicity tests demonstrate that the leachate is capable of inducing toxic effects[5]. The most likely sources of the polluted sediments are abandoned mines in the area; however, even if these sources are eliminated, the remaining polluted sediments in the reservoir constitute a long-term management problem.

There are two general approaches to solving the short-term acute problem cited above. The first approach is to change the water resource management practices at Camanche and Pardee Reservoirs to keep the water quality problems from occurring. The specific management practices that will solve the problem are maintenance of a minimum pool depth at Camanche Reservoir and elimination of surge flows from Pardee Reservoir which scour downstream river channels. A second approach is to develop a physical or chemical fix to these problems. A number of proposals of this nature are being installed or considered by EBMUD including potassium permanganate injection, pumping water to the upper outlet, addition of a multi-level selective withdrawal outlet structure, in-reservoir hypolimnetic aeration, and pure oxygen injection at the reservoir outlet. None of these proposals, however, will solve the entire range of water quality problems in both the lower Mokelumne and Camanche Reservoir.

Chemical oxidant injection eliminates toxicity caused by reduced compounds such as hydrogen sulfide, but it does not eliminate other water quality concerns such as temperature, suspended sediment, and metal toxicity. In some cases, such as potassium permanganate injection, the oxidant itself introduces pollutants into the water column. Physical alterations of reservoir outlets and addition of aeration systems will not eliminate problems caused by high energy events at the liquid-solid interface.

V. Conclusions

The aquatic habitat beneficial uses of Camanche Reservoir and the lower Mokelumne River are not being protected. This conclusion is based on documented fish kills in the watershed and evidence that the following specific water quality objectives are not being met.

A. The dissolved oxygen objective of 7.0 mg/l is occasionally not being met[7,8] on the lower Mokelumne River.

B. It is difficult to quantitatively establish whether the temperature objective is being exceeded because the natural receiving water temperature is not defined. However, depletion of the hypolimnion over the last several years has caused significant temperature increases in the lower Mokelumne. For example, in September 1988 the water temperature in MRFI reached approximately 23.5°C (74.3°F)[9]. A temperature of 20°C is often used as a maximum for salmon growth and these higher temperatures indicate thermal stress[7].

C. The suspended sediment discharge rate from Camanche Reservoir is adversely affecting beneficial uses.

D. The turbidity objective is occasionally exceeded in the lower Mokelumne. As an example, the 1987 turbidity, measured in JTU at MRFI, increased from a summer value of less than 2 JTU to 12 JTU on September 1 to 30 JTU on October 2[7].

E. The toxicity objective is not being met.

VI. Recommendations

The following conditions should be incorporated into EBMUD's water right permits in the Mokelumne watershed.

A. A minimum pool elevation at Camanche Reservoir should be established. EBMUD should collect sufficient information to calculate an appropriate minimum pool. In the interim, a minimum pool of approximately 190 feet (water depth=27 meters) should be established. This elevation is based on the limnology analysis of Camanche Reservoir[7], and a review of reservoir elevations over the last twenty years (Attachment 1). EBMUD presently appears to be operating Camanche and Pardee Reservoir in such a way as to ensure that an approximate Camanche Reservoir elevation of 190 feet will be met this fall.

B. A DO limit of 7.0 ppm should be established on discharges from Camanche Reservoir. A point of compliance which protects beneficial uses should also be established. The current U.S. Army Corps of Engineers Power Plant Permit for Camanche Dam requires a DO level of 5.0 ppm measured 500 feet downstream of the powerhouse.

C. A maximum turbidity level should be established for discharges from Camanche Reservoir. In order to implement the Basin Plan turbidity limit, the turbidity from Camanche Reservoir discharges should not exceed 20 percent of the turbidity of flows into Pardee Reservoir. It is not clear that EBMUD has the capacity to comply with such a requirement. If compliance is infeasible, EBMUD should be required to develop a technically feasible turbidity limit that will protect beneficial uses.

D. A temperature limit should be established for discharges from Camanche Reservoir. A recent State Board action for releases from Shasta Dam established a maximum temperature of 56°F when necessary to protect the salmon fishery. A similar limit should be set for the Mokelumne River and the California Department of Fish and Game should establish the periods in which this limit applies. If compliance is infeasible, EBMUD should be required to develop a technically feasible temperature limit that will protect beneficial uses.

E. Sudden high releases from Pardee Reservoir which scour sediments should be eliminated during low water levels in Camanche Reservoir.

F. This summary has not discussed flow requirements, but protection of the spawning and migratory fish habitat beneficial uses requires minimum flows on the Mokelumne River. The California Department of Fish and Game is preparing minimum flow recommendations for the lower Mokelumne, and the recommended flows should be included in the water rights permit.

These water quality-based recommendations have obvious water quantity implications. No attempt was made in this analysis to balance water quality/water quantity issues. The balancing of these issues is the responsibility of the State Board.

Attachment 1

CAMANCHE RESERVOIR
STORAGE AND SURFACE EVALUATION (USGS)

YEAR	MONTH	MIN STORE (AF)	APPROXIMATE ELEV (AMSL)	YEAR	MONTH	MIN STORE (AF)	APPROXIMATE ELEV (AMSL)
68	SEP	219100	202	79	SEP	343600	223
	OCT	214000	201		OCT	318100	219
69	SEP	305000	217	80	SEP	323900	220
	OCT	265000	211		OCT	298400	216
70	SEP	288900	215	81	SEP	256300	209
	OCT	276500	212		OCT	254200	209
71	SEP	313300	218	82	SEP	350500	224
	OCT	275300	212		OCT	313400	218
72	SEP	246100	207	83	SEP	353200	224
	OCT	244500	207		OCT	304300	217
73	SEP	317200	219	84	SEP	351700	224
	OCT	304900	217		OCT	322040	220
74	SEP	336000	222	85	SEP	246170	207
	OCT	304300	217		OCT	246000	207
75	SEP	337300	222	86	SEP	337000	222
	OCT	307300	217		OCT	318000	219
76	SEP	186100	196	87	SEP	118000	180
	OCT	177800	194		OCT	109000	178
77	SEP	54800	158	88	SEP	10000	
	OCT	52500	157		OCT		
78	SEP	339200	222	89	SEP		
	OCT	307100	217		OCT	142187	186

REFERENCES

1 Central Valley Regional Board Basin Plan, Chapter 2.

2 Cd, Cu, Fe criteria are listed in Quality Criteria for Water 1986, U.S. EPA Publication #440/5-06-001, May 1, 1986. Zn criteria is listed in Update #2 to Quality Criteria for Water 1986, May 1, 1987. Al criteria is listed in U.S. EPA Publication #440/5-86-008, August 1988. The criteria for Cd, Cu, and Zn are dependent on hardness. A hardness of 20 mg/l was used in the calculations.

3 The manganese criteria was derived by the Ocean Plan Method. The criterion is listed in Regulations on Agricultural Drainage to the San Joaquin River, SWRCB Order No. WQ 85-1, Appendix D, March 1988.

4 California Department of Fish and Game, MRFI monitoring data, 1981-1983.

5 Final Report, Camanche Reservoir Water Quality Studies, Prepared by E.V.S. Consultants, Inc., File 4/233-07, for EBMUD, November 1989.

6 Central Valley Regional Board, Penn Mine TPCA Technical Report, Appendix 2, November 3, 1988.

7 Limnology and Water Quality of Camanche Reservoir in the 1987-88 Drought as it Relates to the Fish Facility Problems, Alex Horne Associates, October 1989.

8 California Department of Fish and Game, Lower Mokelumne River Fisheries Study, June 1988.

9 California Department of Fish and Game, Annual Report, Mokelumne River Hatchery, 1988-89.