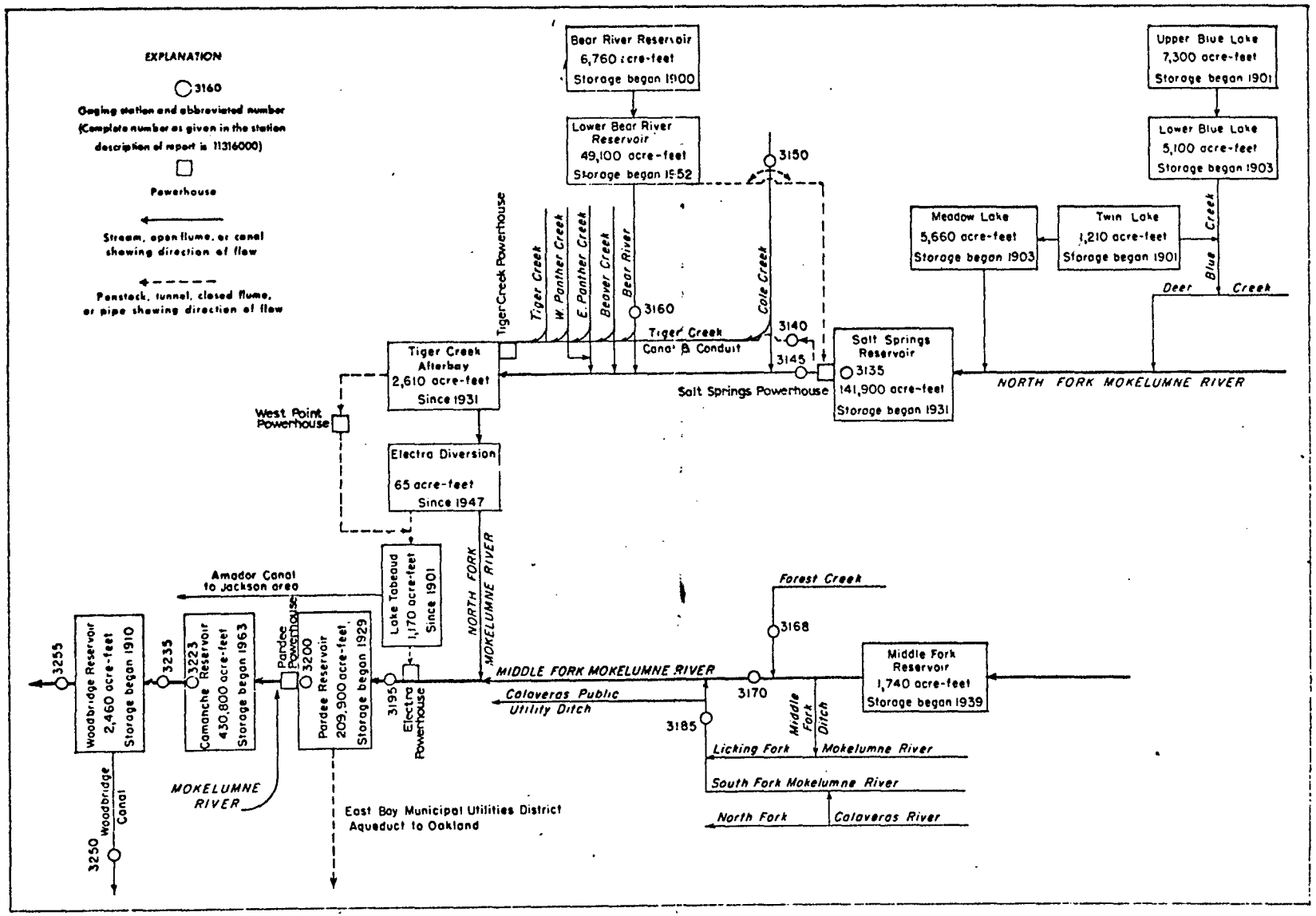
CASE STUDY REPORT #35
SALT SPRINGS RESERVOIR
NORTH FORK MOKELUMNE RIVER

I. Project Description

Salt Springs Reservoir is one of eleven reservoirs comprising the Mokelumne River project. The reservoir was built in 1931 in a deep canyon near the west end of the Mokelumne River wilderness area. It is long, narrow and has about 91 surface acres. Additional details are contained in the attached survey form. The Mokelumne River project starts at Upper Blue Lake at an elevation of 7,300 feet and terminates at the Electra powerhouse at an elevation of 700 feet (Figure 1). Water flow in the North Fork Mokelumne River has been influenced by four reservoirs since 1901.

Salt Springs powerhouse lies immediately below Salt Springs Reservoir at an elevation of 3,705 feet. Salt Springs Unit #1 has an installed capacity of 11 megawatts and operates on the variable head established by water levels in Salt Springs Reservoir. Discharges from this unit range from 350 to 640 cubic feet per second (cfs). Salt Springs Unit #2 has an installed capacity of 33 megawatts and operates on a static head of 2,190 feet between lower Bear River Reservoir and the powerhouse (Figure 1). The maximum discharge of this unit is 225 cfs. Discharge from Salt Springs may go either into



--Schematic diagram showing diversions and storage in Mokelumne River basin.

Figure 1

Source: U. S. Geological Survey, 1973, water resources data for California.

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the river or the Tiger Creek canal and conduit. Capacity of the canal at the intake is 550 cfs. About 18 miles of river with an average gradient of 76 feet per mile and flowing through U. S. Forest land is below the reservoir.

II. Pre-Project Conditions

Mean monthly flows in the Mokelumne for water years 1927-1930 were at a mean monthly minimum flow of 28 cfs in November and a mean monthly maximum of 1,490 cfs in May (Figure 2). The runoff in this basin is directly related to California wet and dry seasons with snowmelt and the maximum flow in the spring and early summer.

Stream flow records prior to the period shown in Figure 2 were not discovered. Consequently, records of unimpaired stream flow above Salt Springs Reservoir are not available.

The examination of records that were open to inspection did not contain any pre-project fish and wildlife information. General accounts of fish success found in correspondence to the Department of Fish and Game in the pre-project years indicate that a viable trout fishery existed. The most experienced fishermen were able to catch limits of trout with an occasional trophy-sized fish. State and federal records concerned with description or evaluations of the North Fork Mokelumne River prior to construction of the Salt Springs Reservoir were limited. No evidence of fish and wildlife evaluations was found.

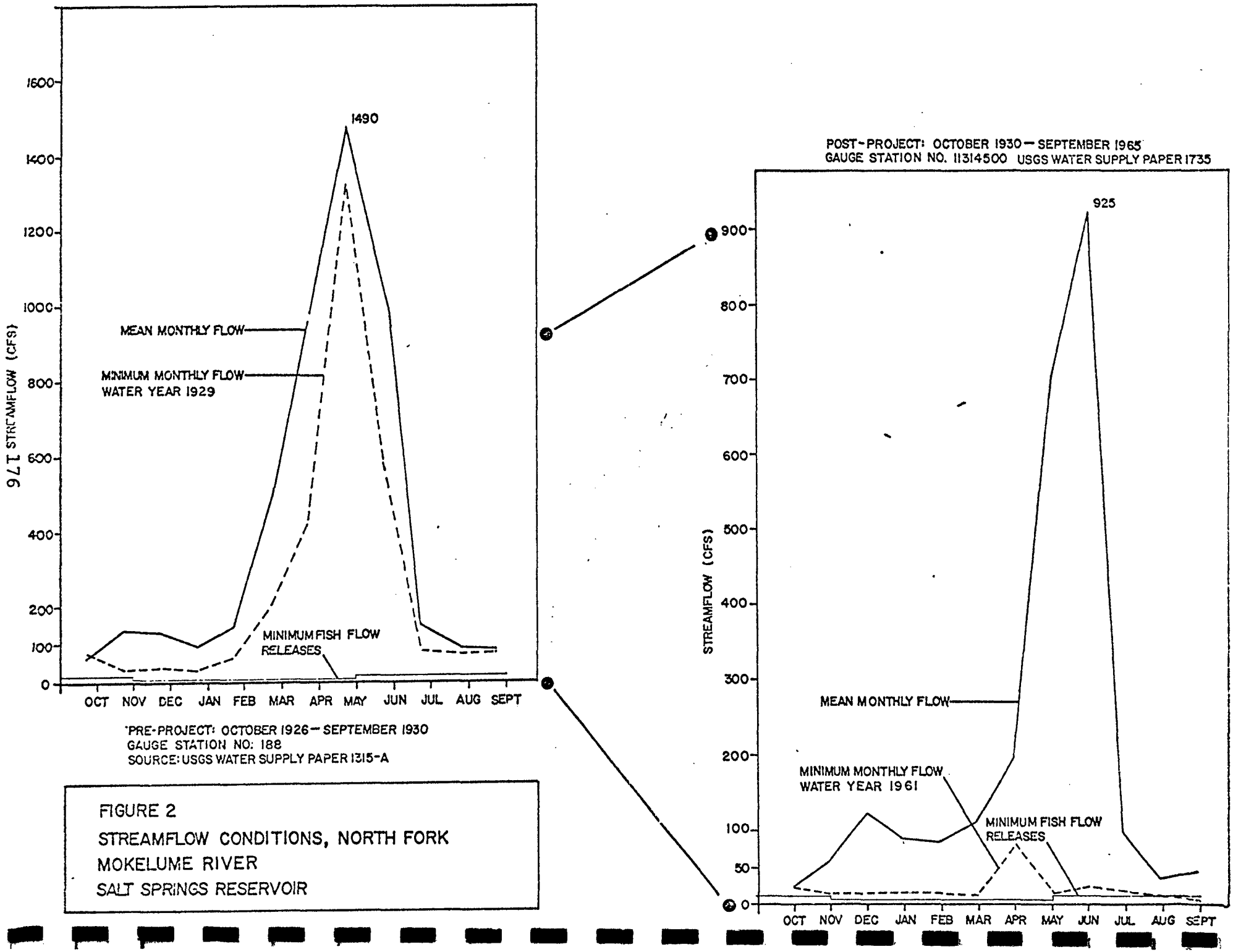

FIGURE 2
STREAMFLOW CONDITIONS, NORTH FORK
MOKELUME RIVER
SALT SPRINGS RESERVOIR

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III. Project Development

The Mokelumne River project of the Pacific Gas & Electric Company was licensed by the Federal Power Commission in 1925. This license (No. 137) was issued for a term of 50 years and expired in November 1975.

No record was discovered which pertained to fish and wildlife resources as they related to the development of the Salt Springs Reservoir project. Apparently, in about 1947, some form of agreement was reached whereby Pacific Gas & Electric Company normally maintains minimal flows of 10 cfs from May through the end of October and 5 cfs during the rest of the year. In dry years the flow may be held at a minimum of 5 cfs. Figure 2 incidates that mean monthly flows were generally much higher; however, in a dry year of record, flow was near the stipulated minimum.

IV. Post-Project

Since relicensing of the project was necessary in 1975, the California Department of Fish and Game conducted studies in cooperation with Pacific Gas & Electric Company and others to provide information and data relative to minimum stream flows and relicensing of the project. These investigations were to assess the effects the project may have on fish, wildlife and recreational resources in the Mokelumne River basin, i.e., the total project.

Investigations in the area below Salt Springs included measurements of trout habitat including temperature, food, spawning and cover, population size, minimum flow requirements, recreational and angler use. Wildlife studies were principally devoted to investigations of the loss of deer and other wildlife in the Tiger Creek canal and the maintenance of wildlife habitat on lands controlled by the Pacific Gas & Electric Company.

Rainbow and brown trout are found in the river along with dace and hitch. The natural population of trout in the river has been supplemented by planting catchable size hatchery trout. The planting allotment for 1971 in the river below Salt Springs Reservoir was 6,025 fish. Populations of non-game fish such as dace and hitch are present in insignificant numbers in the Mokelumne River above West Point Dam.

Fishery investigations conducted for relicensing and reported by Department of Fish and Game are quoted as follows.

> "In a series of cooperative studies extending from 1969 through 1971, personnel of the Department, the PG&E, the U. S. Forest Service and the U. S. Fish and Wildlife Service investigated various aspects of the impact of the project on fish and wildlife resources.
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> "Criteria used to determine the amount of trout habitat available at different levels of stream flow were established before on-site studies. The criteria were:

"1. Food Producing Areas. Those areas of stream channel having rubble and/or gravel bottom, a water velocity between 0.5 and 3.0 feet per second when measured 0.2 feet from the bottom, and a water depth of 0.1 to 3.0 feet.

"2. Spawning Areas. Those areas of stream bottom having gravel ranging from pea-size to three inches in diameter, water velocities of 0.5 to 3.0 feet per second when measured 0.2 feet from the bottom, and a water depth greater than 0.3 feet.

"3. Cover. Those more-or-less permanent and local habitat features (under-cut banks, snags, water weeds, etc.) which afford protection to adult and juvenile trout against man, birds, snakes, furbearing animals, solar radiation and other hazards in the fish's environment.

"4. Wetted Area. That area of a segment of stream having a width defined as a perpendicular distance between the two sides of the stream as established by the margin of visible standing or flowing water minus the width of exposed (non-wetted) rocks within the line of measurement.

Trout Habitat Study Procedures

"Initially, two or three 'transect stations' or study areas were selected as typical sections of the streams to be studied. Some of the physical characteristics of the stream and channel considered in the selection were gradient, substrate size and composition, and type of flow (run, riffle, pool, etc.). The chosen stations were about one-half mile apart. Four to six transect or cross-section lines were then established within each study station. They were spaced 20 to 30 feet apart, aligned perpendicularly to the banks and marked with driven steel stakes.

"When the studies were underway, the PG&E maintained specific flows through the transect sections. On consecutive days the rates of flow were regulated according to prearranged schedule in North Fork Mokelumne River below Salt Springs Reservoir -- 52, 35, 19 and 14 cfs.

"During each day of pre-specified flow, a four-man crew recorded water velocity, water depth, measurements of non-wetted rocks, and substrate composition occurring along a steel tape stretched between the stakes marking the transect lines. The measurements were made at two or three-foot intervals depending upon the width of the stream, and the water velocities were measured with a standard Pygmy Current Meter.

"The crew also recorded the extent and type of trout cover existing under the varying conditions of flow, and, on each day, photographed the study station at identical locations.

"Standard electro-fishing techniques were used to determine standing crops of fish in project-influenced streams. When high flows prevented the use of electro-fishing equipment, visual underwater observations (snorkel and mask) were employed. In 1969 thermographs were installed in the South Fork Mokelumne River below the outfall from Salt Springs Reservoir and below Tiger Creek Afterbay.

"Figures 3 and 4 are graphic representations of data derived from the trout stream habitat studies. The plotted lines of the odd-numbered figures represent the rate of change in food producing areas, spawning area, wetted areas and cover at the various rates of flow.

"The plotted lines in the even-numbered figures represent the percent of change in the same elements when compared to conditions of highest flow. The usefulness of this representation is that habitat values of each increment of inflow can be analyzed in terms of the maximum study flow.

"For example, reference to Figure 4 (Mokelumne River below Salt Springs Reservoir) reveals that good trout habitat increases rapidly with flow increases to about 35 cfs, and, at 40 cfs, is almost 87 percent of that available at the maximum study flow (52 cfs)."

The estimated annual number of anglers for this reach of river was 1,900 for 5,000 hours of fishing for trout.

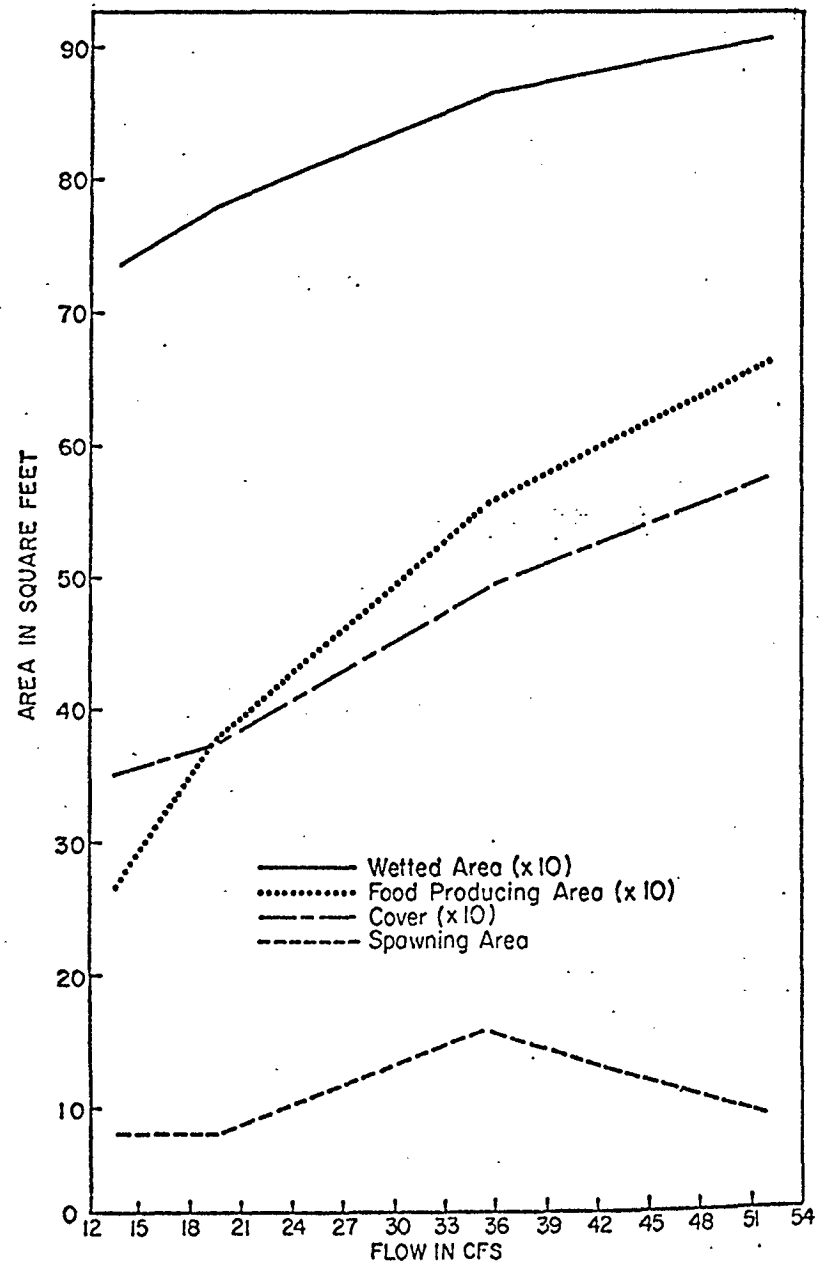

Figure 3. Trout habitat studies, 1969
North Fork Mokelumne River below Salt Springs Reservoir

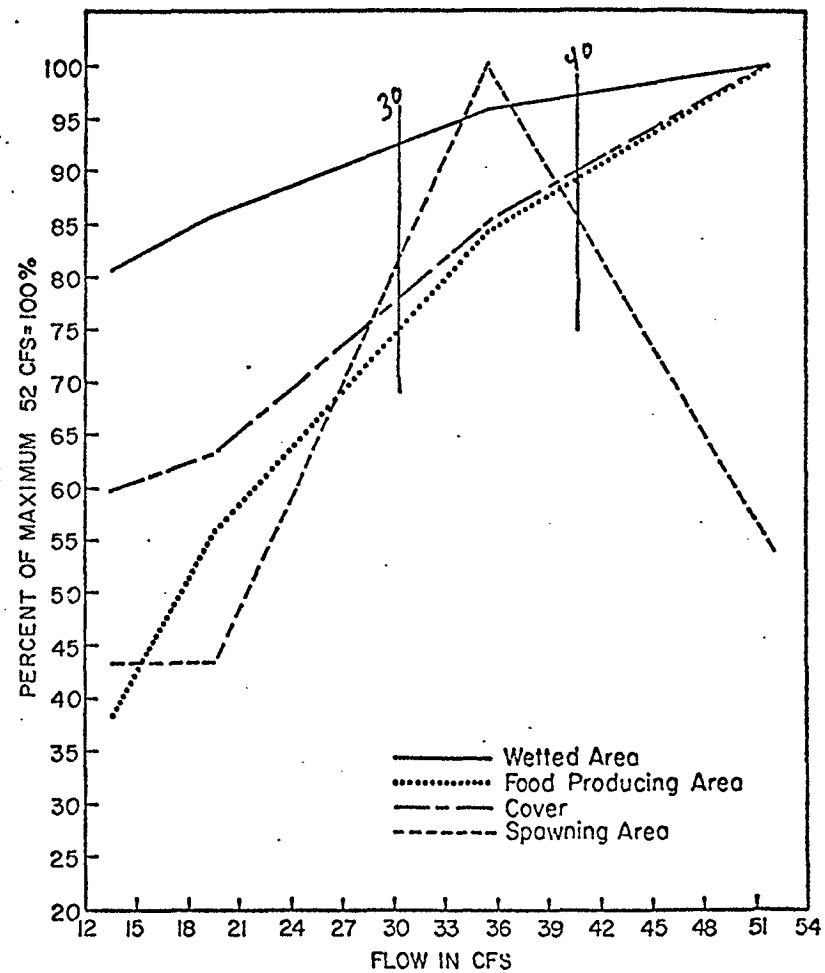

Figure 4. Trout habitat studies, 1969
Mokelumne River below Salt Springs Reservoir

Source: California Department of Fish and Game, 1974.

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"The estimated standing crop (a measure of the total pounds of trout per unit area present at a given time) for waters listed in the table varied from about ten pounds per acre in the North Fork Mokelumne River to about 72 pounds per acre in Summit City Creek. Significantly, flows in Summit City Creek are not subject to project operations.

"The North Fork immediately below Salt Springs Reservoir is the only section of stream within project limits where the presence of hatchery-reared trout of 'catchable' size could significantly affect estimates of standing crops, but fish of hatchery origin were, as far as possible, excluded from population sampling records (most hatchery fish can be identified by frayed fins and other visible characteristics).

"The studies intended to assist in determination of the pattern of water temperature changes at four locations in the North Fork Mokelumne River were hampered by vandalism and theft of the recording instruments.

"The average maximum and minimum temperatures recorded at the thermograph stations during the summer months are:

North Fork Mokelumne River Water Temperature, 1969 and 1970 (Mean Minima and Maxima in °F)

Location	June		July		August		September	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Below Salt Springs Reservoir (1969)	—	—	54	57	54	55	58	60
Above Tiger Creek Afterbay (1970)	—	—	61	66	53	55	53	56

"Although the data are incomplete, they tend to confirm two prior conclusions of the Department: (1) summer water temperatures in the reach of the river between Salt Springs Dam and Tiger Creek Afterbay are generally within the limits tolerated by trout, and (2) a temperature-influenced change in fish habitat occurs between the West Point Diversion Dam and the Electra Powerhouse discharge (as previously noted, the fish population in this stretch of the river undergoes a change from dominance by trout to dominance by warmwater species).

The Department of Fish and Game concluded that existing minimum flows of 10 cfs in spring and summer and 5 cfs in the fall and winter are too low to maintain adequate habitat for fish and other aquatic life.

Analysis of the data indicates that an increase in minimum flow requirements is warranted and these flows should be in the 20 to 40 cfs range. Flows from 40 to 52 cfs produced only a minimal increase in trout habitat. The California Department of Fish and Game recommended the following minimum instream flow releases: (1) in years of normal runoff, 40 cfs from May 1 to October 31 and 20 cfs from November 1 to April 30; and (2) in years of subnormal runoff, 20 cfs from May 1 to April 30 of the following year. Normal and subnormal runoff years are defined as follows:

Normal Runoff Years. Those water years in which the predicted runoff of the Mokelumne River is greater than the average natural runoff of the river into Pardee Reservoir as computed by the Department of Water Resources for the 50-year period in use at the time.

Subnormal Runoff Years. Those water years in which the natural runoff of the Mokelumne River into Pardee Reservoir as forecast on April 1 by the Department of Water Resources is 50 percent of normal or less.

V. Conclusions

The Federal Power Commission is currently considering an application for the relicensing of the Mokelumne River project (license No. 137). As input to the Federal Power Commission process, the Department of Fish and Game investigated the present minimum flow releases to determine if these flows provide adequate fish and wildlife protection and concluded that they are not adequate; consequently, the Department of Fish and Game has requested an increase in the minimum flow requirement.

At least since 1947, the operation of Salt Springs Reservoir has maintained minimum flows of 10 cfs in the spring and summer and 5 cfs in the fall and winter. The Department of Fish and Game concluded "These minimum flows [10 cfs and 5 cfs] often prevail for as long as nine months of the year without any appreciable natural supplement and are too low to maintain adequate habitat for fish and other aquatic life. Consequently, the project has, from its inception, disregarded the important fish, wildlife and recreation value of this section of the river [North Fork Mokelumne]" (California Department of Fish and Game, 1972).

At the present time the instream flow release requirements are still under negotiation even though the license has expired. The Department of Fish and Game has made specific instream flow release recommendations. Pacific Gas & Electric

Company has also proposed instream flow releases which are more acceptable to their project operations. However, no agreement has been reached between these two agencies. A comparison of the Department of Fish and Game and Pacific Gas & Electric Company instream flow release recommendations is presented below.

	Years of Normal Runoff-Subnormal Runoff			
California Department of Fish and Game	5/1-10/31 40 cfs	11/1-4/30 20 cfs	5/1-10/31 20 cfs	11/1-4/30 20 cfs
Pacific Gas & Electric Company	7/1-10/31 30 cfs	11/1-5/31 20 cfs	7/1-10/31 20 cfs	11/1-5/31 20 cfs

The primary differences are the commencement dates of summer flows (Department of Fish and Game, May 1, Pacific Gas & Electric Company, July 1) and the normal year summer minimum flow release (California Department of Fish and Game, 40 cfs, Pacific Gas & Electric Company, 30 cfs).

These flow release recommendations are currently under negotiation and the previous instream flow release agreement will remain in effect until the Federal Power Commission has made a decision regarding the application for relicensing of the Mokelumne River project Federal Power Commission license No. 137.

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----------. 1974. Memorandum report recommendations for fish and wildlife mitigation in the relicensing of Pacific Gas & Electric Company's Mokelumne project (FPC no. 137).