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NOAA TECHNICAL MEMORANDUM NMFS F/NWR-28

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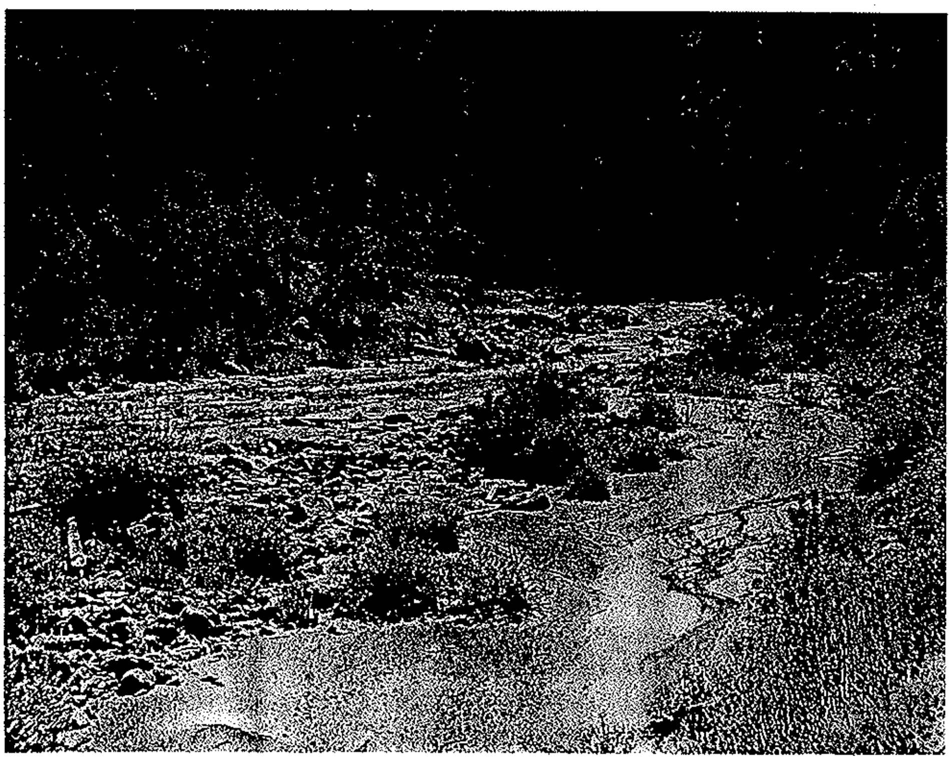
BRIAN D. WINTER

APRIL 1990



U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

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COVER PHOTO: SOUTH FORK CLEARWATER RIVER, IDAHO, AFTER REMOVAL OF HARPSTER DAM

U.S. DEPARTMENT OF COMMERCE
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A Brief Review of Dam Removal Efforts in Washington, Oregon, Idaho, and California

by

Brian D. Winter [1]

The following text describes some selected previous and current dam removal efforts and one dam failure in the states of Washington, Oregon, Idaho, and California. This review should not be considered exhaustive. Additional facilities have been removed (i.e., wooden crib dams) or are being evaluated for removal (e.g., Clear Creek Dam in the Yakima Basin, Washington; Elwha and Glines Dams on the Elwha River, Washington). As well, additional information on each removal effort reported below may also be available.

DAM REMOVAL - ACCOMPLISHED

Grangeville (Harpster) Dam, South Fork Clearwater River. Idaho.

This dam was constructed by the Washington Water Power Company (WWP) near Grangeville, Idaho, (Figure 1) in 1911. It was an arched concrete dam, 440 feet long and 56 feet in height (Figure 2). Although a fish ladder had been provided, passage of upstream migrating fish to approximately 20 miles of the South Fork Clearwater River was blocked in 1949 when the wooden fish ladder collapsed (Idaho Department of Fish and Game (IDFG) 1962).

According to WWP's Application for Surrender of License before the Federal Power Commission, the dam was removed in 1963 because the equipment and facilities were obsolete and because it was "...in the public interest to remove this facility as it is in keeping with the fishery rehabilitation program already established by the IDFG." According to WWP President George M. Brunzell, "...an operating power plant has never before been removed in the interests of a fisheries program" (WWP 1963).

Apparently, no estimate of the amount of sediment that was trapped behind the dam is available. However, sediment effects were considered. In its Application for Surrender of License, WWP proposed to remove the dam before the spring run-off occurred to provide for "...a more orderly removal of silt and debris thereby minimizing the effect on the fishery resource."

In an August 19, 1963, WWP memorandum to M. L. Blair, Tim Vaughan described the removal of the dam:

> "On August 3, 1963, at 6:35 p.m. the Grangeville Dam was completely removed. This was after two previous attempts earlier

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the same day. The first explosion at 1:00 p.m. simply cracked the right abutment. The second, about 3:00 p.m., breached the dam allowing a considerable amount of silt to flow down the river channel.

"The final blast at 6:35 p.m. completely removed the dam structure leaving only relatively small concrete blocks scattered in the river channel below the axis of the dam. After 24 hours the river still carried a considerable amount of silt. Where the South Fork enters the main Clearwater, the silt was still clearly visible, but was confined to a narrow strip on the left bank of the main river. The silt-bearing water retained its identity for a few miles below the confluence of the South Fork and the Clearwater, then it gradually dispersed and became homogenous with the main river.

"On Monday the same condition existed but to a lesser degree. The South Fork carried some silt and was somewhat discolored and as it entered the main Clearwater the silt confined itself to the right bank but soon mixed with the main river.

"Mr. James Keating, Fisheries Biologist for the IDFG, reported that on Saturday, August 10, 1963, one week after the dam removal, the South Fork was nearly clear and that only a slight discoloration in the main river appeared below the town of Kooskia. He also reported that the silt discharge had no apparent biological effect and that fishing would not be adversely affected below the dam location or on the main river."

Editorial note: Typographical errors in original memorandum corrected above (e.g., North Fork changed to South Fork in last two paragraphs).

References:

Brunzell, G. M. 1963. Before the Federal Power Commission, Application for Surrender of License. Washington Water Power Company.

Idaho Department of Fish and Game. 1962. Annual Project Progress Report, Transfer of Adult Steelhead for Spawning Purposes, South Fork of the Clearwater River, Idaho. Project No. 912.2-OS-1.4. Contract No. 14-17-0001-380. Columbia River Fishery Development Program.

Vaughan, T. M. August, 19, 1963. Memorandum to M. L. Blair. Washington Water Power Company Interdepartmental Correspondence.

<u>Lewiston Dam, Clearwater River</u>. Idaho.

This WWP dam was completed in 1927 at river mile 4 on the Clearwater River near Lewiston, Idaho, (Figure 1). The project included a 45 foot high and 1060 foot long concrete spillway dam (Figure 3) and two earth dams, 4800 feet long and 2400 feet long, separated by a powerhouse containing a generating unit rated at 10,000 kilowatts.

Two fishways had originally been provided, one at each end of the dam, but were considered inadequate especially for spring chinook passage (DeLarm, et al., 1989). The south ladder was rebuilt in 1963 and a third fishway added to the powerhouse tailrace in 1965. The fishways functioned satisfactorily until 1973 when Lewiston Dam was removed by blasting (DeLarm, et al., 1989).

The dam was removed because the construction of Lower Granite Dam would "...encroach upon project tail waters to the degree that available hydraulic head [would] be diminished so as to render the Lewiston project inefficient and uneconomical to operate" (Kidd 1972). The project owner agreed to remove "...its equipment, personal property, and all installed fixtures used for generation and transmission of power" within one year after cessation of hydropower operations (Plumb 1972). The Army Corps of Engineers (COE) agreed to remove the spillway since it would impact the Lower Granite reservoir.

The amount of sediment trapped behind the dam may not have been estimated (Anderson, pers. comm.; Cunningham, pers. comm.), but the reservoir was completely filled with sediments at the time dam removal began (Cunningham, pers. comm.). This material was allowed to naturally flush downstream upon dam removal with no apparent significant adverse impacts. A major flood in the Clearwater River in 1974 probably removed most of the remaining sediments (Cunningham, pers. comm.).

Removal of Lewiston Dam eased anadromous fish passage to about 450 miles of mainstem and tributary stream habitat (DeLarm, et al., 1989). However, construction of Dworshak Dam on the North Fork Clearwater River in the early 1970's blocked access to approximately 150 miles of the above habitat.

References:

DeLarm, M. R., E. Wold, and R. Z. Smith. 1989. Columbia River Fisheries Development Program, Fishways and Stream Improvement Projects. NOAA Technical Memorandum NMFS F/NWR-20. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Kidd, M. B. 1972. Notice of Application for Surrender of Major License. The Washington Water Power Company.

Plumb, K. F. 1972. Order Accepting Surrender of License. Federal Power Commission.

Personnel Communications:

Bob D. Anderson. Environmental Coordinator. Washington Water Power. Spokane, WA.

Lester Cunningham. Engineer. Department of the Army, Corps of Engineers, Walla Walla District. Walla Walla, WA.

Sweasey Dam, Mad River. California.

Sweasey Dam was located northeast of Eureka, California, on the Mad River (Figure 4). The spill crest rose approximately 55 feet above the river bottom (Figure 5) and was provided with a functional fish ladder (Walter, pers. comm.). The dam was built to provide approximately 1,300 acre feet of municipal water supply storage. However, the dam was designed for only a limited (about 20 years) life expectancy (Walter, pers. comm.). By 1969, severe winter storms had completely silted in the reservoir. According to the Humboldt County Department of Public Works, this represented "...2,400,000 cubic yards of sand, gravel and logs" (Titera 1969a).

In September 1969, a COE representative inspected Sweasey Dam. Based on this site visit, the COE developed some general conclusions: (1) there was an estimated 1,500 acre feet of sediment behind the dam; (2) release of sediments downstream could result in an increase in flood stage of about one foot; (3) if an abundance of fines were present, some adverse impacts to fish spawning could occur; and (4) adverse impacts should decrease with time but could disappear in just a few years (Reilly 1969).

The City of Eureka Department of Public Works conjectured that (1) siltation impacts would be about the same as that produced by a two year storm and (2) no serious flood consequences could be expected below the dam site (Titera 1969b).

On October 14, 1969, the California Department of Fish and Game (CDFG) granted the City of Eureka the permission to remove Sweasey Dam through the use of explosives. Two of the conditions set forth by the CDFG included: (1) all rubble or debris could not exceed three feet in diameter and (2) a 30 feet wide channel had to be cleared upstream and downstream of the dam site (CDFG 1969).

After the dam was removed, representatives of the CDFG inspected the dam site. R. J. O'Brien (1970), CDFG Regional Manager, provided the following comments:

> "Presently, the channel is stabilizing, however, at a very slow rate. We suspect that the final channel will not be evident until next summer, providing that the coming winter storms will be sufficient to remove the fines. Until this is realized, we recognize that Mad River will be subject to higher turbidities than normal. In the long run, the removal of the dam should improve salmon and steelhead runs in the river."

A review of City of Eureka, Department of Public Works files did not uncover any additional observations of the Mad River following the removal of the dam (Walter, pers. comm.). However, the Mad River has returned to a natural state. Even though anadromous fish passage had been provided at the dam, the salmon and steelhead runs in the Mad River have benefited from removal of the dam (McCloud, pers. comm.).

References:

California Department of Fish and Game. 1969. Explosives Permit B-3-69 dated October 14, 1969.

O'Brien, R. J. 1970. Letter to M. T. McGovern, City of Eureka Public Works dated August 25, 1970.

Reilly, G. P. November 10, 1969. Letter to R. S. Titera, Humboldt County Public Works dated November 10, 1969.

Titera, R. S. 1969a. Memo to D. F. Peterson, Humboldt County Supervisor dated September 15, 1969.

Titera, R. S. 1969b. Letter to Board of Supervisors, County of Humboldt dated November 6, 1969.

Personal Communication:

Dave McCloud. Fishery Biologist. California Department of Fish and Game. Eureka, CA.

Richard Walter. Engineering Technician. Department of Public Works, City of Eureka. Eureka, CA.

DAM REMOVAL - ASSESSMENTS

Enloe Dam, Similkameen River. Oregon.

Enloe Dam and a powerhouse with about 3,200 KW capacity were constructed between 1916 and 1923 by the Okanogan Valley Power Company (OVPC). The rights of the OVPC were transferred to the Okanogan County Public Utility District No. 1 (PUD No. 1) in the 1940's. PUD No. 1 generated power at the site until 1959 when the facility was abandoned because of high operational cost and the availability of less expensive power (Anonymous 1977).

Enloe Dam is located at river mile 8.8 on the Similkameen River approximately 3 miles northwest of Oroville, Washington. The dam is a concrete arch-gravity structure with a height of 54 feet above streambed and a crest length of 290 feet. The dam creates a reservoir approximately 1.5 miles in length (Fanning 1985). As of 1971, fluvial sediments had been deposited in the reservoir such that the depth of water behind the dam averaged less than 20 feet (Nelson 1972).

As a part of the environmental review for the Oroville-Tonasket Unit Extension (a new irrigation system), two alternatives to provide fish passage at Enloe Dam were identified: (1) remove the dam and provide a fish ladder at a small falls immediately downstream and (2) construct a fish ladder from the crest of the dam to a point below the falls (Anonymous 1977). The total cost of alternative (1) was estimated at $525,000 while the cost of alternative (2) would be $1,300,000.

A review of the two fish passage options identified the removal of Enloe Dam as the best solution. The fishery agencies determined that adverse sediment effects downstream resulting from dam removal would be short-term and would be greatly outweighed by the long-term benefits (Anonymous 1977). Laddering of Enloe Dam was not preferred because (1) fish would be delayed while they searched for the ladder entrance; (2) a large number of the fish would fall back over the dam after ascending the ladder; (3) juvenile migrants would experience mortalities and injuries when passing over the spillway; and (4) there would be annual operation and maintenance costs of $3,000 associated with the ladder. The agencies conservatively estimated losses related to the ladder of 7% (Anonymous 1977).

In 1971, a study was jointly undertaken by the Washington Department of Ecology and the United States Geological Survey to determine the amount of sediment trapped behind Enloe Dam and the effects on the Similkameen and Okanogan rivers if the dam was removed (Nelson 1972).

The study estimated most of the sediment in Enloe Reservoir was sand and amounted to 1.79 million cubic yards. Nelson (1972) concluded that removal of the dam (without dredging) would result in a reduction of the channel capacity of 17 miles of the Okanogan River immediately downstream of the Similkameen River and there could be some long-term adjustments of the river to the temporary increase in sediment load. However, Nelson also concluded that sediment deposition in the Okanogan River and the associated adverse effects could be reduced if the dam was removed in segments over several years.

Dam passage alternatives were further studied in 1984. Fanning (1985) identified two ladder and three trap and haul alternatives and the alternative of dam removal. The dam removal alternative was further subdivided into two options: (1) removal of the dam after dredging the trapped sediment and (2) removal of the dam and allowing the sediment to naturally scour.

Fanning (1985) estimated most of the sediment in the upper portion of the reservoir consisted primarily of cobbles and sand while the sediment in the lower part of the reservoir is mostly sands and fines. For the dredging option, Fanning (1985) estimated a 20 inch suction-dredge could remove the 1.79 million cubic yards of sediment in approximately four months. Natural scour, however, would probably take about six years.

Fanning (1985) estimated the capital costs associated with the dredging option would be $27,088,000 while the scour option was estimated to cost $1,916,000. Including the cost of a ladder at the falls downstream would increase those costs to $27,371,000 and $2,199,000, respectively. The economic benefits of passage at Enloe Dam were assumed to derive only from the harvest of steelhead trout. Therefore, the dredging option would only result in a benefit/cost ratio, assuming a 10% harvest rate for a natural steelhead run, of 0.23/1 while the scour option would yield a benefit/cost of 1.22/1 (Fanning 1985). Assuming a 20% harvest rate, the benefit/cost would increase to 0.29/1 and 1.55/1, respectively.

Fanning (1985) determined that a combination of natural scour and dredging could yield "the most economic and environmentally sound solution." However, as of this date, a final solution for fish passage at Enloe Dam has not yet been implemented (Morris, pers. comm.).

References:

Anonymous. 1977. Option Paper Regarding Enloe Dam, Prepared as a Part of the Advance Planning Study for the Oroville-Tonasket Unit Extension Chief Joseph Dam Project, Washington. Bureau of Reclamation, Boise, ID.

Fanning, M. L. 1985. Enloe Dam Passage Project Annual Report 1984, Volume 1. Project No. 83-477, Contract No. DE-AC79-83BP11902, Bonneville Power Administration, Portland, OR.

Nelson, L. M. 1972. Potential Transport of Sediment from Enloe Reservoir by the Similkameen and Okanogan Rivers, Washington. Open-File Report, United States Department of the Interior Geological Survey, Tacoma, WA.

Personal Communication:

Dr. Steve Morris. Fish Biologist. National Marine Fisheries Service. Portland, OR.

Savage Rapids Dam, Rogue River. Oregon.

Savage Rapids Dam was completed in 1921 as the primary diversion structure for the Grants Pass Irrigation District (Bureau of Reclamation (BR) 1979). The dam was originally built with one fish ladder. The facility now has two ladders and screens although they do not function very well (BR 1979, Johnson 1985).

In the 1970's, the BR determined that anadromous fish losses at Savage Rapids Dam were substantial. With the construction of Cole Rivers Fish Hatchery upstream from the dam, the BR concluded that passage problems would intensify. In an effort to solve the passage problems at Savage Rapids Dam and rebuild the salmon and steelhead runs in the Rogue River, the BR conducted a feasibility study to determine the best course of action.

The feasibility study focused on three areas of concern: (1) upstream fish passage; (2) downstream fish passage; and (3) disruption of streamflow (BR 1979). To address these concerns, the options of (1) rehabilitation of existing fish passage facilities and (2) dam removal were evaluated.

An economic analysis conducted as part of the study found that the annual benefits accruing from dam removal resulted in a favorable benefit: cost ratio of 2.52 to 1. The study concluded that "...the fishery interests and the economic analysis favor removal of the dam...." (BR 1979). However, the final decision has been delayed.

References:

Bureau of Reclamation. 1979. Formulation Working Document, Grants Pass Division, Rogue River Basin Project, Oregon. Bureau of Reclamation, Pacific Northwest Region. 28p.

Johnson, P. 1985. Blowing up dams. Audubon 87(1):26-29.

Cascade Dam, Merced River. Yosemite National Park, California.

An Environmental Assessment (EA), on the replacement of the existing electrical system in the valley, was published in July 1987. The preferred alternative involves abandoning the electrical system and replacing it with a new, primarily underground, system bringing power into the valley from existing Pacific Gas and Electric facilities outside the Park. This alternative was selected because it would allow about two acres of forest and 1 1/2 miles of the Merced River to return to natural conditions (National Park Service (NPS) 1988).

As part of the project, the Park is considering the removal of Cascade Dam. The 170 foot long dam is of timber crib construction and was completed in 1917. The crest height of the dam is 17 feet 4 inches with two concrete abutments 30 feet high. It impounds less than one surface acre of water.

The preferred dam removal alternative involves the removal of as much of the estimated 5,700 cubic yards of trapped sediment as possible prior to removal of the dam. Little information was provided in the EA concerning the physical removal of the dam other than stating that the use of helicopters to remove the penstocks was being considered. Additionally, no cost estimate was included. Other removal alternatives considered included removing the dam at one time or a phased removal of the dam, both allowing the sediments to naturally scour. Review of dam removal alternatives is ongoing (Huddleston, pers. comm.).

References:

National Park Service. 1987. Environmental Assessments and Addendums, Electrical Distribution System Replacement and Cascade Dam Removal, Yosemite National Park, CA. U.S. Department of the Interior. 24 p.

Personal Communication:

Jim Huddleston. California Regional Office, National Park Service. San Francisco, CA.

Lost Man Creek, Upper Dam. Redwood National Park, California.

The dam was built in 1936 as a water source to the Prairie Creek Fish Hatchery. It is a rock filled, concrete faced, gravity dam and is 24' long, 57' wide by 7' high. The pool behind the dam has filled with about 5,000 cubic yards of sediment. The dam is a partial barrier to salmonids, particularly chinook salmon, trying to reach 1.8 miles of spawning and rearing habitat (NPS 1987).

In August 1987, an EA evaluating dam removal options was produced by the NPS. The preferred alternative of the Park is to completely remove the dam within one season, at a cost of $29,000, because it "conflicts with NPS Management Policies which call for the restoration and preservation of natural resources of the park" (NPS 1987). This alternative would involve using heavy equipment to remove the dam and much of the trapped sediment. Other alternatives considered include completely removing the dam over six seasons, dismantling and partially removing the dam in one season, and no action.

References:

National Park Service. 1987. Environmental Assessment, Upper Dam Removal, Lost Man Creek, Redwood National Park. U.S. Department of the Interior. 28 p.

DAM FAILURE

English Dam, Middle Fork Yuba River. California.

The reservoir created by English Dam was in place from the mid-1850's to the mid-1880's. In the 1880's, the dam failed. The dam was never rebuilt and little trace of it can now be found (Figure 6) (Eric Gerstung, pers. comm.).

Personal Communication:

Eric Gerstung, California Department of Fish and Game, Rancho Cordova, CA.

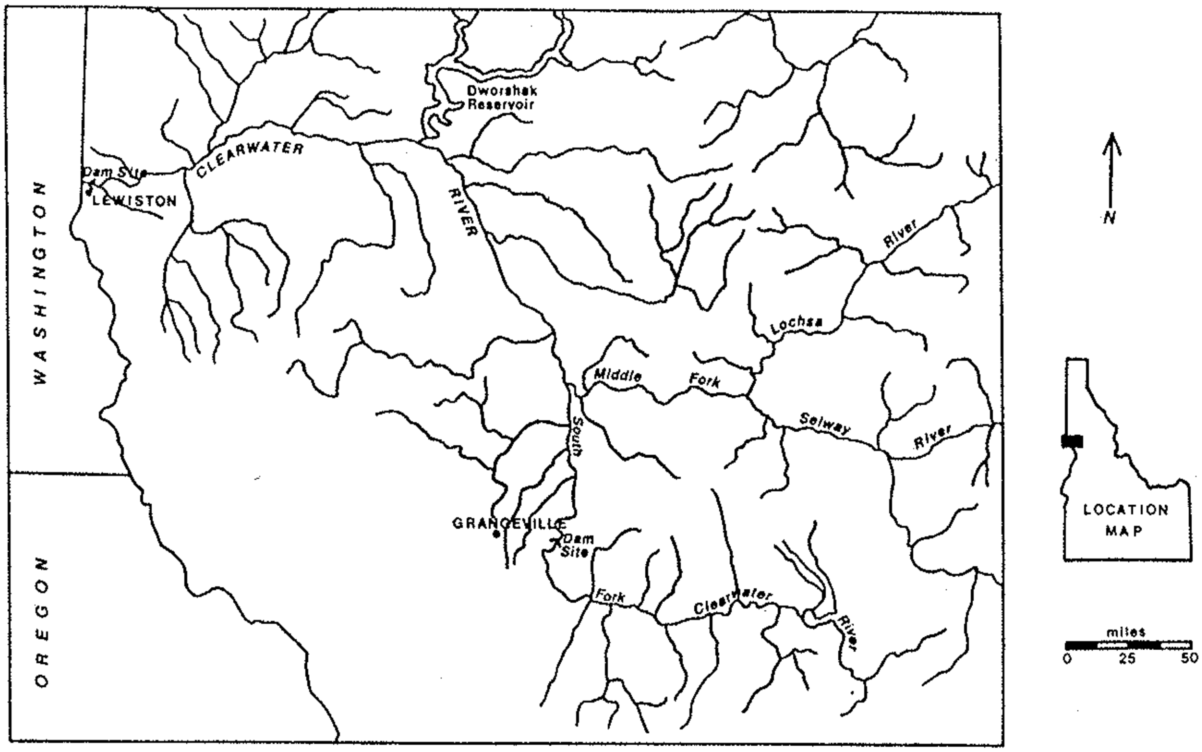

FIGURE 1. Locations of Lewiston and Grangeville Dams

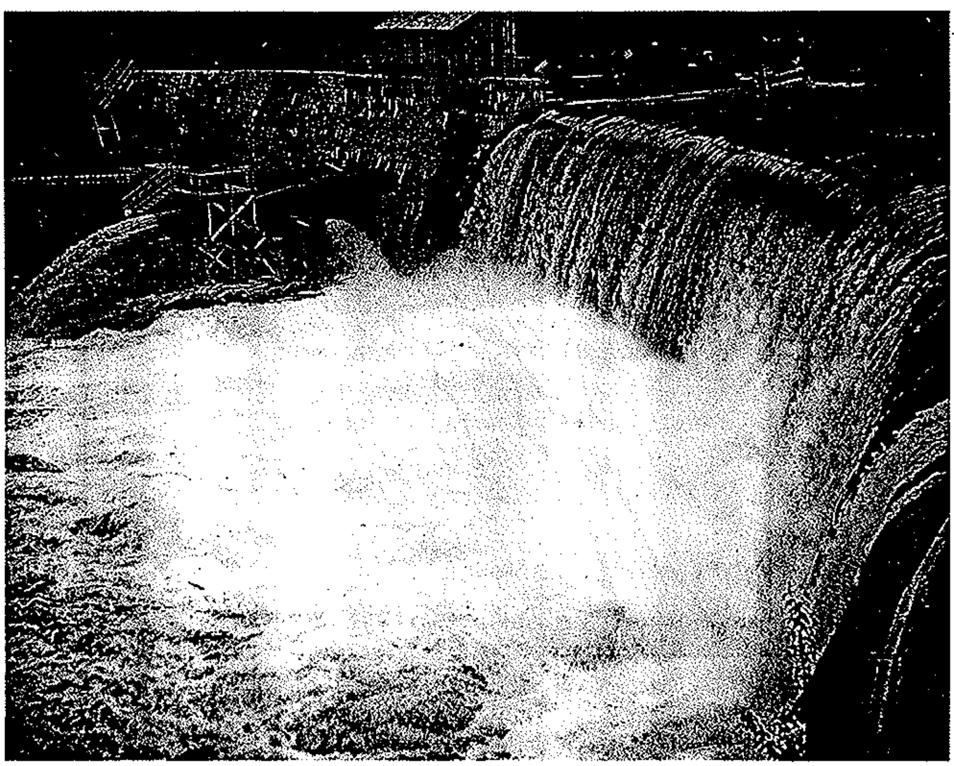

FIGURE 2. Grangeville Dam in May 1962.

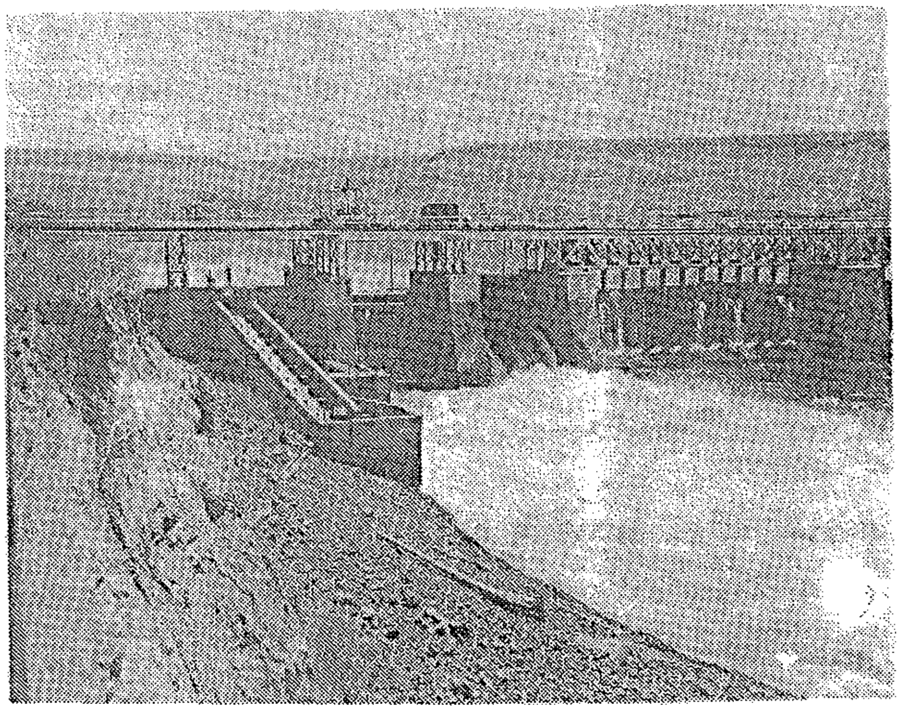

FIGURE 3. Lewiston Dam in 1953.

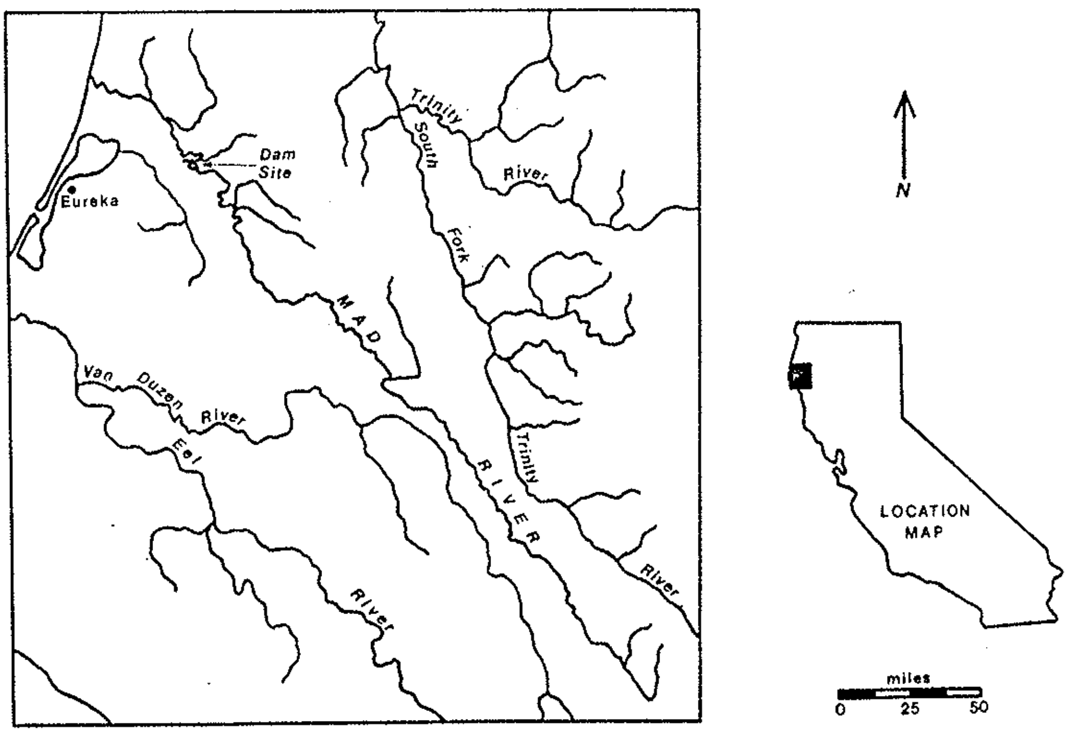

FIGURE 4. Location of Sweasey Dam.

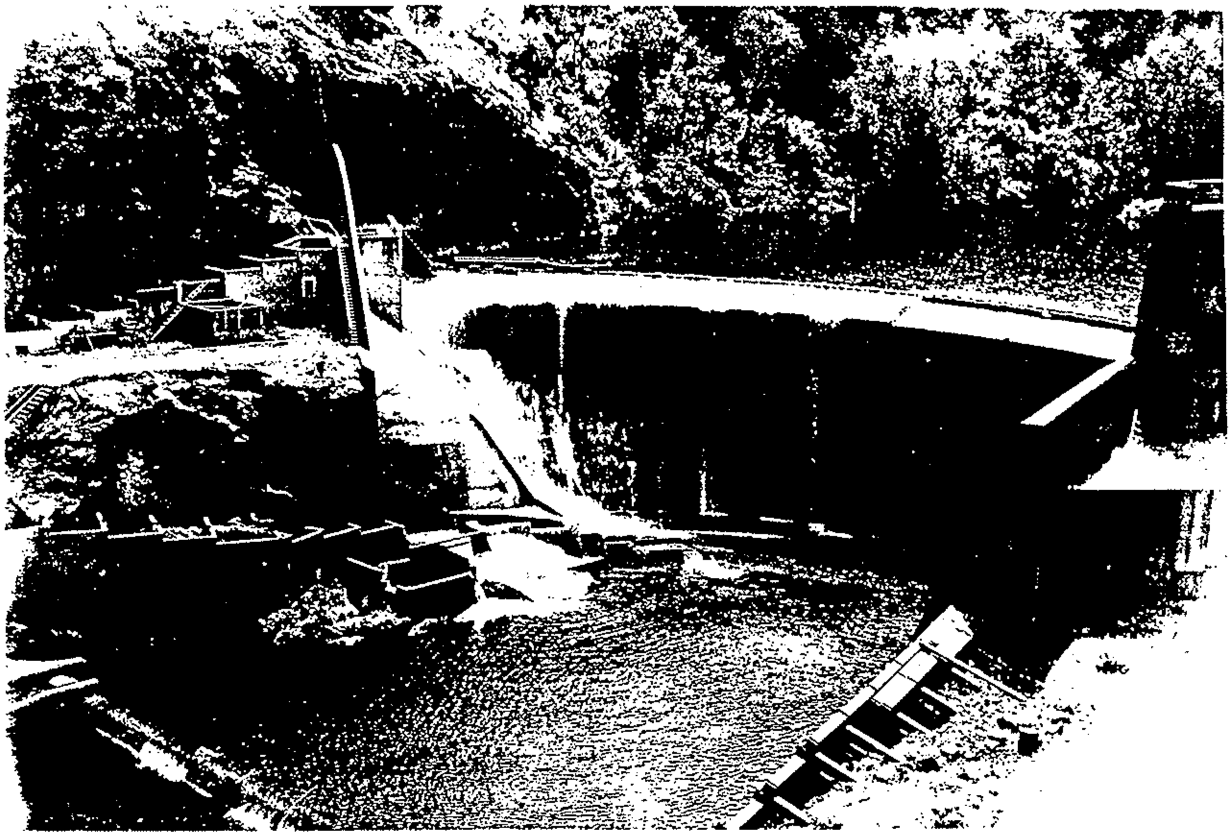

FIGURE 5. Sweasey Dam.

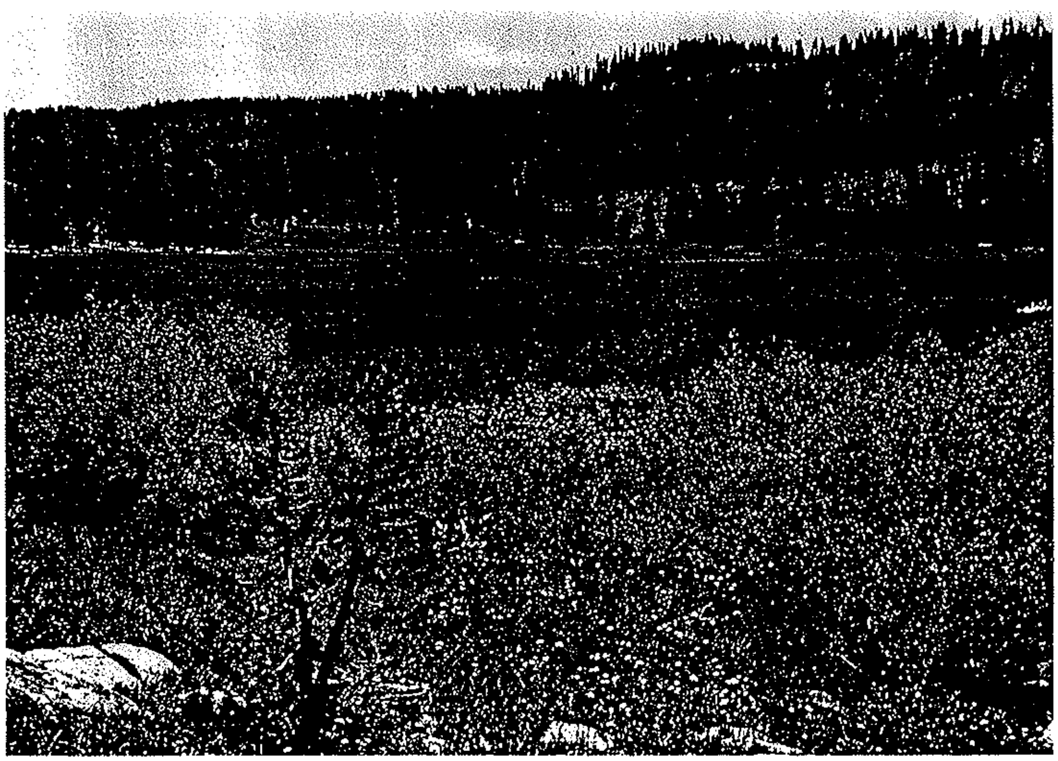

FIGURE 6. Location of reservoir created by English Dam.
Photo taken in July 1972.