State of California
The Resources Agency
Department of Water Resources
Northern District

Contribution of Frenchman Lake Spill to the Fishery of Little Last Chance Creek

December 1998

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COVER PHOTO: A net placed at the end of the Frenchman Dam spillway was used to capture rainbow trout emigrating from the lake into the creek below.

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FOREWORD

The Department of Water Resources' efforts to enhance recreation and fish and wildlife values at State Water Project facilities take many forms. At the Department's Upper Feather River Reservoirs in Plumas County, operations and resources are regularly monitored and evaluated to improve recreation and environmental resources at these reservoirs and in the Feather River watershed.

Fisheries and environmental science professionals in both the public and private sectors have expressed interest in our work at Antelope Lake in 1995, documenting the phenomenon of sport fish and nongame fish leaving a reservoir via spillway releases. Department personnel have also observed such fish movement into Little Last Chance Creek below Frenchman Lake, noting that recent successive years of spill coincided with restoration of an exceptional stream fishery after a poisoning of this stream several years before. To give fishery and reservoir managers an additional tool for optimizing benefits and minimizing impacts of reservoir operations, we sought a better understanding of the causes and influences of spillway fish migration. We also sought to document the scope and effectiveness of factors contributing to the ongoing process of restoring the Little Last Chance Creek fishery to its pre-poisoning quality.

Northern District personnel studied Frenchman Lake spillway fish emigration during 1997. This report summarizes that investigation and presents the results in the context of other local fishery and recreation information the Department has collected. It also provides information on the status of Frenchman Lake and Little Last Chance Creek fisheries, especially noteworthy following the 1991 chemical treatment of these waters to eradicate northern pike. The findings are especially timely given the State's interest in restoring Lake Davis and Big Grizzly Creek following chemical treatment there in 1997.

This work was performed under the Department's Recreation Planning and Implementation Program (Upper Feather River Monitoring) and included services provided under a contract with the Department of Fish and Game's Bay-Delta and Special Water Projects Division. The results of this work will subsequently be made available to the fisheries science community through submission for publication to the *North American Journal of Fisheries Management*.

Naser J. Bateni, Chief
Northern District

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DEPARTMENT OF WATER RESOURCES
David N. Kennedy, Director

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Deputy Director

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Chief Deputy Director

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Deputy Director

L. Lucinda Chipponeri
Assistant Director for Legislation

Susan N. Weber
Chief Counsel

DIVISION OF PLANNING AND LOCAL ASSISTANCE

William J. Bennett . . . . . Chief

NORTHERN DISTRICT

Naser J. Bateni . . . . . Chief, Northern District

This report was prepared under the supervision of

Ralph N. Hinton . . . . . Chief, Water Management Branch

by

Douglas Rischbieter . . . . . Environmental Specialist

with assistance during data collection from

David Elkins . . . . . Student Assistant
Laura Katz . . . . . Student Assistant
Don Hand (Retired) . . . . . DWR, Beckwourth Operations and Maintenance Subcenter
Ralph Howell . . . . . DWR, Beckwourth Operations and Maintenance Subcenter
Charles Brown . . . . . California Department of Fish and Game (DWR Contract Services)
Josh Brown . . . . . California Department of Fish and Game (DWR Contract Services)
Bridget Yerkes . . . . . California Department of Fish and Game (DWR Contract Services)

Special Acknowledgments

Jim Hespen, DWR-Beckwourth Operations and Maintenance Subcenter, assisted with preparation of the study site.

Brenda Main, Division of Planning and Local Assistance, provided valuable editorial review.

Janet Rischbieter provided invaluable volunteer assistance on several days during data collection.

Printed by DWR Reprographics

EXECUTIVE SUMMARY

In April 1997, Department of Water Resources personnel counted the fish emigrating from Frenchman Lake through the spillway and evaluated the effect of this phenomenon. This study was undertaken to corroborate findings of a similar investigation conducted at Antelope Lake for seven weeks in 1995, and to refine the collection method pioneered there. The findings of the Antelope Lake study were noteworthy, reporting fish behavior that had not been adequately documented in fisheries science literature: that the rate of sport fish emigration over the reservoir spillway was usually directly related to the stage of the spill, was predominantly a nocturnal event, and that relatively few fish passed over the spillway when reservoir surface elevation was less than 0.8 feet above the spillway crest. The findings also suggested that the emigration of large rainbow trout from the lake into the stream made them especially susceptible to capture (though they do contribute to an exceptional tailwater fishery that attracts many anglers early in the season), that they did not persist in the stream fishery very long, and that rainbow trout (*Oncorhynchus mykiss*) in such situations generally might reproduce more successfully if they had migrated into reservoir tributaries instead.

The 1997 study was divided into several phases because the year's first spill event occurred unexpectedly early and it was not feasible to begin sampling at the commencement of spill. The four main phases of this study were: 1) collect, identify, mark, and release fish from Little Last Chance Creek (below Frenchman Lake) in March 1997, after the year's first significant spill event had subsided, as the basis for a subsequent mark-recapture study to estimate the total number of fished passed from the reservoir prior to that time; 2) collect, identify, mark, and release fish passing over the Frenchman Lake spillway during the year's second significant episode of seasonal spill, until the beginning of the downstream fishing season, to directly measure the rate of spillway emigration; 3) conduct a creel census along Little Last Chance Creek to evaluate the contribution of spilled fish to the downstream fishery; and 4) conduct fish

population sampling along Little Last Chance Creek near the end of the fishing season to investigate the persistence of reservoir fish in the stream fishery. Phases 3 and 4 would provide the "recapture" data necessary to complete analyses of phases 1 and 2.

A net was used to confine emigrating fish in the spillway until they were collected (twice daily). Hydrologic conditions during the 1997 study period did not permit sampling of spillway emigration over as wide a range of flows as in 1995. Reservoir stage ranged only between 0.39 and 0.62 feet over spillway level during the 22 days spillway collections were made, and only 29 rainbow trout were collected from the spillway during that period. This relatively small number of fish is consistent with what would be predicted at these spill stages, although an undetermined number of fingerling rainbow trout (too small to be captured by the net or contribute to the sport fishery) also passed during this study. No other species were observed in the spillway during that period. The California Department of Fish and Game reported that four species were present in Frenchman Lake in 1997: Lahontan redside (*Richardsonius egregus*), speckled dace (*Rhinichthys osculus*), and brown bullhead (*Ameiurus nebulosus*) in addition to rainbow trout.

Based on the ratio of total fish marked in phase 1 to creel census results (marked and unmarked trout), about 700 additional medium- and large-sized rainbow trout passed over the spillway during a two-week period in January 1997. Spill stage peaked at 1.86 feet and was above 0.8 feet for 13 days during this period. Anglers caught an estimated 600 of these 700 fish during the first month of the stream fishing season, and few large rainbow trout appeared to remain at the end of fishing season. Lahontan redside and brown trout (*Salmo trutta*) were also collected in Little Last Chance Creek, the latter contributing substantially to the sport fishery.

The 1995 findings that fish passage appears minimal at spill stages below 0.8 feet are supported by this study. Thus, fishery and reservoir managers could use this finding with greater confidence to better coordinate reservoir operations and water supply objectives with fishery management objectives at Frenchman Dam. The Department

of Water Resources has successfully employed such operation strategies at Lake Davis in recent years. Local reservoirs (and other large reservoirs) could also potentially be managed to encourage or discourage fish emigration to downstream areas. Such management could enhance one fishery over another or discourage the spread of nuisance or invasive fish species.

Planners can also use these findings to minimize the environmental impacts of water facilities. Although previous investigators have determined water velocity thresholds at which fish can avoid entrainment or impingement, or are encouraged to outmigrate, this study supports the hypothesis that a channel with a wide, shallow entrance can retard fish movement compared to a narrow, deep channel, even if both have the same cross-sectional area.

This investigation also gives a useful insight into the current status of the Frenchman Lake and Little Last Chance Creek fisheries. The results of this study indicate the creek fishery appears to have completely recovered from its total destruction during the 1991 chemical treatment. This recovery was delayed by three years of drought and reduced reservoir outflow but then greatly enhanced by three consecutive years of spill and normal releases from Frenchman Lake, suggesting the importance of both spill and higher fall/winter flows to restoration and maintenance of the downstream fishery. Because of the quality of the fishery which again exists in Little Last Chance Creek, operational latitude available to the Department to provide additional fishery and habitat enhancement below Frenchman Dam should be reviewed and the potential for beneficial change further evaluated.

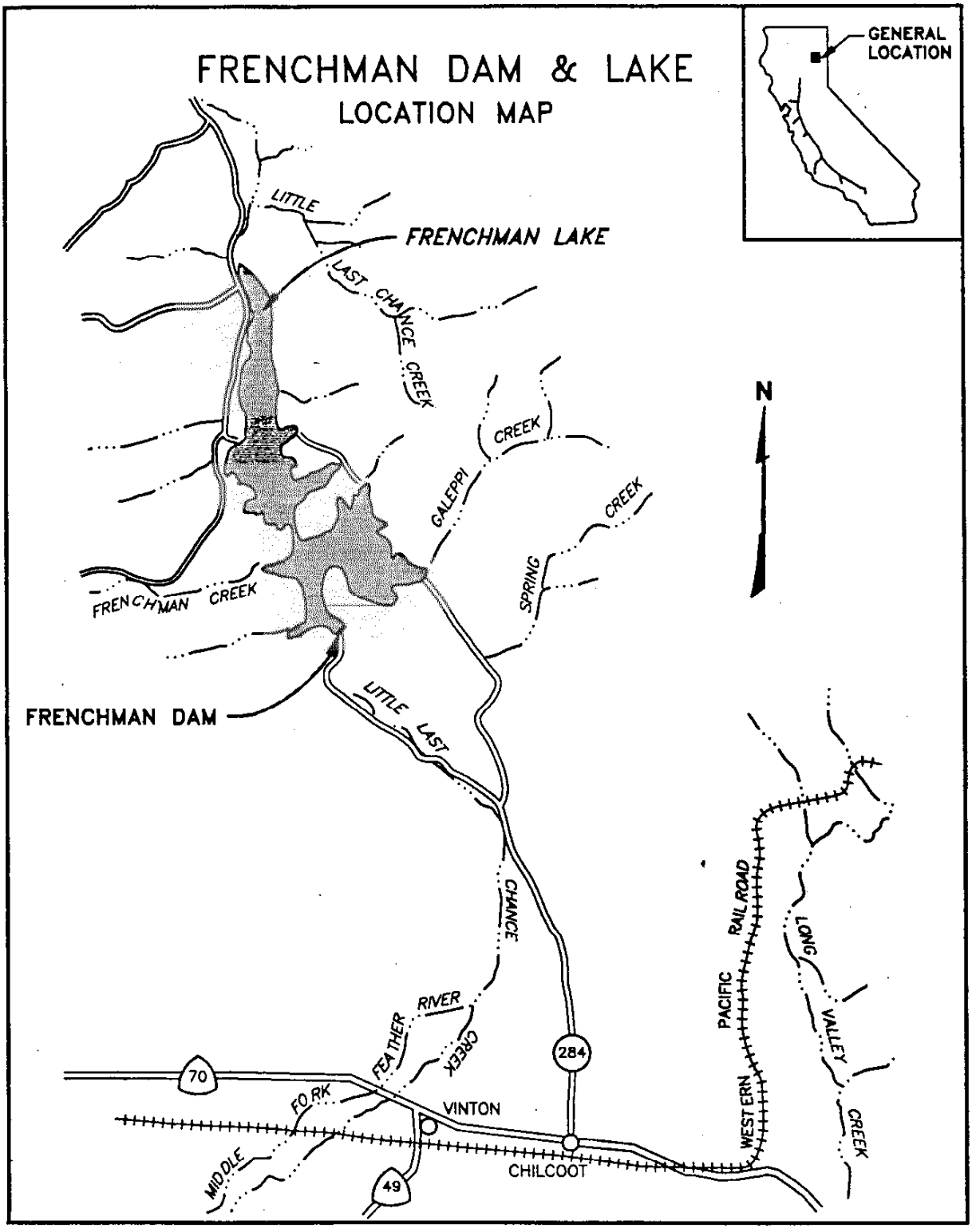
INTRODUCTION

Fish have apparently passed over the Frenchman Lake spillway into Little Last Chance Creek every year that the reservoir has had significant spill. Such fish are most apparent when anglers catch them early in the fishing season, which begins on the last Saturday in April. Creel census and fish population surveys by the Department of Water Resources and the Department of Fish and Game have shown that this popular springtime fishery predominantly consists of hundreds of mature/spawning rainbow trout which overwintered in the reservoir after being planted during the previous year(s). Few of these fish persist in the stream fishery until the end of the season, most having been captured in the reach of Little Last Chance Creek immediately below Frenchman Dam.

This investigation was designed to document this phenomenon both qualitatively and quantitatively. It was proposed as a follow-up to an investigation into similar circumstances, conducted in 1995 at nearby Antelope Lake and Indian Creek, which suggested that opportunities exist to manage fisheries by controlling spillway releases (DWR 1996). Until the Antelope Lake study, existing fisheries science literature had shed little light on factors influencing fish passage over spillways.

A study of these phenomena at Frenchman Lake was undertaken to focus on trout, since unexpectedly few trout (the primary species of interest for the 1995 study) were collected at Antelope Lake. Warmwater species had become dominant there. Frenchman Lake, on the other hand, had been restocked with only trout after chemical treatment in 1991 to eradicate northern pike, and other species had not yet become reestablished in large number. Rainbow trout had not reestablished in the downstream Little Last Chance Creek fishery until 1995 and 1996, the first years of reservoir spill since the loss of the fishery in 1991. Distinguishing between lake- and stream-origin fish was fairly easy there.

FIGURE 1. Frenchman Lake: location and vicinity.



Hydrologic conditions during the 1997 study period did not permit sampling of spillway emigration over as wide a range of flows as at Antelope Lake in 1995. Also, an early commencement of spill, induced by a series of large storms beginning the last week of December 1996, prevented monitoring of the entire period of seasonal spill prior to the opening of fishing season in late April. For these reasons, only three weeks of spillway sampling was conducted and therefore this study also included the collection and marking of some fish which presumably had emigrated over the Frenchman Dam spillway after the initial spill but before placement of the spillway net. This marking, followed by an early-season creel census and late-season fish population sampling, was the basis of a simple mark-recapture study to estimate the total number of rainbow trout discharged into Little Last Chance Creek and the persistence of those fish in the stream fishery through the 1997 stream fishing season.

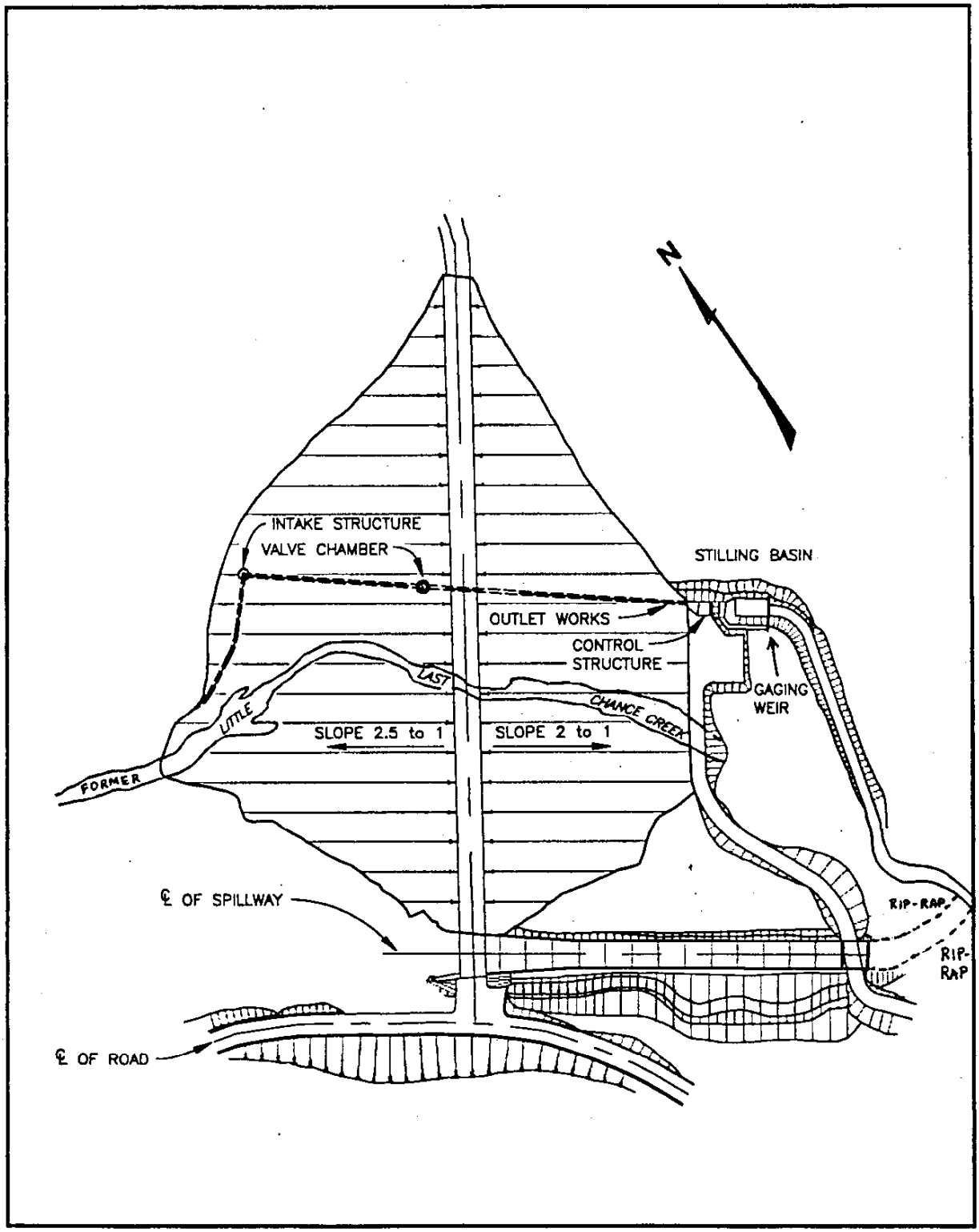
Location and General Features

Frenchman Lake is located about 8 miles north of Chilcoot in Plumas County within the Plumas National Forest (Figure 1). The reservoir is in the middle of the Little Last Chance Creek watershed, a major tributary of the Middle Fork Feather River, and impounds a watershed area of about 81 square miles. Average annual runoff from the watershed upstream from the dam is about 28,000 acre-feet.

The Department of Water Resources completed Frenchman Dam in 1961 to provide recreation opportunities and irrigation water for local agriculture as part of the State Water Project. The earthfill dam is 139 feet high and the crest is 720 feet long; the dam is lined with large riprap on the reservoir side. At spillway elevation (5,588.00 feet above mean sea level) the reservoir has a surface area of 1,580 acres, storage capacity of about 55,500 acre-feet, and a maximum depth of about 100 feet. Below Frenchman Dam, Little Last Chance Creek flows another 8 miles and transitions into the origin of the Middle Fork Feather River in the northeast corner of Sierra Valley.

The Frenchman Lake spillway (Figure 2) is located at the right abutment of the dam. It is constructed of reinforced concrete and

FIGURE 2. Frenchman Lake dam and spillway: plan view.



consists of 1) a short unlined approach channel (proximal water depth 5 to 7 feet), 2) a convex 50-foot-long ungated ogee crest structure, 3) a 470-foot-long discharge chute that tapers (in the upper 116 feet) from 50 to 30 feet wide with a slope of about 0.24, and 4) a terminal concave "flip-bucket" about 30 feet in elevation above the Little Last Chance Creek channel. The horizontal lip of the flip-bucket, which is poised about 40 inches higher than the lowest point of the spillway, creates a pool with a surface area of approximately 42 feet by 30 feet inside the spillway terminus. Water spilling over the terminal lip enters the Little Last Chance Creek channel after coursing over and through a jumble of large boulder riprap for about 100 feet.

Frenchman Lake fills and spills (uncontrolled release) in winter or spring in most years of at least 80 percent of mean annual precipitation/inflow. When Frenchman Lake is not spilling, controlled releases are made into Little Last Chance Creek to meet contractual demand of irrigators downstream (usually between April or May and October) and/or to maintain minimum instream flows. In some years releases are made early in the spring to fill "Little Last Chance Lake" in Sierra Valley under a water rights entitlement.

Controlled releases vary widely, between 2 and 100 cfs, and are typically contingent on the supply available and needs of users in the Last Chance Creek Water District; flows of about 40 cfs are most common during the growing season. When there is no demand for contracted water (October or November through April) releases for streamflow maintenance are usually 2 cfs. Releases are occasionally less than 2 cfs during drought conditions as specified by Licenses for Diversion and Use of Water № 9182 and № 9928 (Appendix A).

Under present operating conditions, seasonal releases for irrigation and streamflow maintenance cause about 7 to 10 feet of annual change in the reservoir water surface elevation. The amount of water available under contract each year varies depending upon the predicted October 1 storage and is usually determined in late winter. The current contract between the Department of Water Resources and the Last Chance Creek Water District is included as Appendix B. A monthly

summary of the history of Frenchman Lake operation and hydrology is included in Appendix C.

Downstream of the dam, the creek winds through a steep, lava-rock canyon for about four miles and then flows through the sagebrush country of the northeastern Sierra Valley. The descent from Frenchman Dam to Sierra Valley is about 500 feet of elevation. The first 3.5 miles below the dam are within the Plumas National Forest. Frenchman Lake Road (State Highway 284) closely follows the creek and provides easy access to it.

Frenchman Lake Road also provides access to camping facilities at Chilcoot Campground, operated by a concessionaire of the U. S. Forest Service. Chilcoot Campground is located about 3 miles downstream from Frenchman Reservoir and offers 40 campsites (35 drive-in and 5 walk-in), potable water, and restroom facilities in an attractive riparian setting. It is the only developed (and legal) camping area on the creek. In Sierra Valley most of Little Last Chance Creek flows through private ranch lands generally closed to public use.

The first four miles of creek below the dam remain cold in summer and are slightly turbid due to deep-water outflow from the dam. Brown trout and rainbow trout are the only sportfish present until the stream enters Sierra Valley where some warmwater species have historically been present. Elevated water temperatures in the Sierra Valley portion of the stream can occur on hot days as the stream flows slowly through open rangeland. Summer flows typically diminish downstream as successive irrigators divert large fractions of the available water at their respective points; the upper reaches of the Middle Fork Feather River often flow intermittently during summer.

Fish and wildlife resources at State Water Project facilities are managed by the California Department of Fish and Game. Frenchman Lake is currently managed as a "put-and-grow" trout fishery, meaning that planted fish are usually of fingerling or "subcatchable" size and are expected to grow to "catchable" size in the lake's rich and productive environment. Frenchman Lake is open to fishing year-round and is popular in some years for ice fishing in winter. The fishing season

in Little Last Chance Creek and other local streams and reservoir tributaries conforms with the general California Sierra District stream trout fishing season. It begins on the last Saturday in April and continues through November 15. Little Last Chance Creek is not normally or routinely planted with fish though it has been previously planted; trout populations in this stream have generally been naturally-reproducing.

Purpose and Scope

This report investigates and documents important factors influencing the fishery resources of Little Last Chance Creek. The investigation was originally conceived to accomplish two objectives. First, it would determine the magnitude and impact of the "loss" of trout from Frenchman Lake over the spillway during periods of seasonal spill. For instance, it would help determine if the number of fish emigrating to downstream areas represented a significant percentage of the reservoir population and to what degree such fish contribute to the downstream fishery. Second, this investigation would attempt to corroborate the findings of a similar study conducted at nearby Antelope Lake in 1995 (DWR 1996). Because little information is available describing fish emigration over a spillway--a phenomenon which also occurs at other local reservoirs--this investigation would provide information useful to State and other fishery and reservoir managers.

Although fishery resources at SWP facilities are managed by DFG, these resources are often affected by operating criteria of the respective dams and diversions. These criteria may include operation for recreation and for fish and wildlife enhancement as specified in the Davis-Dolwig Act of 1961 (Water Code 11900-11925). For example, at Antelope Lake and Lake Davis, DWR operates the dams to maximize collective recreation and environmental benefits at each reservoir and downstream.[1] On the other hand, Frenchman Dam was not constructed nor is operated specifically for downstream recreation and fishery

[1] At Antelope Lake the sole purpose of the facilities is "recreation and fish and wildlife enhancement"; at Lake Davis the project purposes are recreation, water supply of for domestic and municipal use, and downstream fisheries enhancement.

purposes, although the water released into Little Last Chance Creek nonetheless supports substantially enhanced fishery and recreation resources. This study could indicate if opportunities exist to review operation criteria and improve fishery management at Frenchman Lake and Little Last Chance Creek.

This investigation focuses on rainbow trout, the most widely planted fish species in California and arguably the most popular target of anglers. Like most salmonids, rainbow trout normally migrate and seek spawning habitat in tributary streams during the spring, when streamflow is higher and water temperature is lower. Rainbow trout are often relatively more successful at natural reproduction in California's Mediterranean climate, since species which spawn in the fall (e.g., brown trout) typically have to contend with less streamflow (less habitat and greater barriers to migration) and winter freshets (which scour gravels). In natural lakes, spawning habitat can also exist at a lake's outlet, where a zone of proper water velocity and acceptable substrate can create a spawning and rearing area. If the gradient is not too great, transmigration between the stream and lake can also occur.

In reservoir impoundments, spill and the associated migration of trout over spillways often occur during spring, when rainbow trout spawn. Moving water is probably one important factor that attracts lake fish to potential spawning habitat, and instinctual spawning behavior in trout normally leads them to migrate upstream, but not downstream. The fish may therefore migrate to spawning habitat in reservoir tributaries. Alternatively, this behavior, when influenced by a dam and spillway, often result in crowding of fish spawning below the dam.

This behavior can be a detriment to a fishery because reservoir's spillway outlet area frequently does not contain usable habitat. For example, stream habitat below reservoirs has often been scoured of gravel substrate. Since the dam impedes recruitment of new gravel from the watershed, substrate for some distance below the dam is often unsuitable for use by spawning salmonids.

When mature fish are attracted to a spillway area and swept downstream, as they are at Frenchman Lake, the lake loses fish that are of the highest biological and recreational value to the lake fishery. While both Frenchman Lake and its outlet stream, Little Last Chance Creek, provide popular sport fisheries, studies at the creek have indicated that large ("trophy") rainbow trout do not persist in this stream fishery very long into the year. Though these rainbows often reproduce successfully in Little Last Chance Creek, the progeny neither grow as quickly nor attain trophy size as they do in the reservoir.

Intensive fishing at Little Last Creek, beginning the last weekend in April when the fishing season opens, is believed to be partly responsible for reducing persistence. Disturbance by anglers may interfere with successful spawning under certain conditions. For instance, comparably little reproduction occurred in 1995 (Brown 1996) when many large fish were present (R. Howell, pers. comm.). Because rainbow trout instinctively tend to swim upstream to spawn, they are not normally observed dispersed more than a mile downstream from Frenchman Dam. Thus, many large fish are concentrated in a small area, where anglers quickly catch them. Their rapid removal from the fishery during the remainder of the season. Moreover, reproduction could be limited by high variability in flows during the incubation period, especially since cold tailwater tends to lengthen development times.

The first mile of Little Last Chance Creek below Frenchman Dam is markedly different from subsequent reaches downstream. It is of relatively low gradient, has a variety of habitat types, and is characterized by a variety of alluvial substrates but little bedrock (unlike areas below many other dams). Ample trout spawning habitat exists in this reach, and substantially less occurs for the next three miles downstream. Creel censuses on Little Last Chance Creek have indicated that most rainbow trout are caught in this upper mile. Therefore, for this study, as many "catchable" trout as possible were captured from this reach before the opening of the 1997 stream fishing season. The fish were captured by electrofishing, marked, and released. Then creel and marking data were compared to estimate the

number of fish that emigrated from the reservoir and the rate at which they did so.

The techniques of this investigation allowed enumeration of all fish (larger than about 11 inches long) passing over the spillway. Since all captured fish were marked and released into the downstream fishery, their persistence in the fishery could be monitored through a creel census and other sampling. In addition, by observing when fish pass over the spillway and measuring the physical parameters present during the period of emigration, conditions which trigger (and, conversely, might prevent) such passage could be identified.

Previous Work and Overview of Management History

The DFG Region II office in Rancho Cordova maintains files of previous survey work and related resource issues at Frenchman Lake dating back to at least 1959. Much of the information in this section was obtained from those files. Little information specific to Little Last Chance Creek is available from DFG, but DWR has periodically produced reports describing various angler, creel, recreation, flow, habitat, fishery, water quality, and other surveys conducted at Little Last Chance Creek (and Frenchman Lake) since 1979. Few papers have been published on the subject of emigration of fish over spillways.

Frenchman Lake. Water is stored in Frenchman Lake by DWR to provide for irrigation, domestic, stockwatering, and recreational uses according to the terms of Licenses 9182 and 9928 (in reality "domestic use" does not occur except for outside watering). Contracts between the Last Chance Creek Water District and DWR, in addition to these licenses, govern the release of water from the reservoir.

Fishery managers originally conceived that Frenchman Lake would support a productive "put and grow" trout fishery. The reservoir was first planted in May and June of 1962, as it was first filling, with fingerling rainbow trout. Trout grew rapidly in the generally eutrophic conditions (99.8 mg/l total dissolved solids, 55 mg/l total alkalinity; Ryan 1977).

The lake provided excellent rainbow trout fishing through the 1960s but the fishery declined in the 1970s following illegal introduction of golden shiners (Ryan 1977). Brown bullheads also were common in the catch. In November 1975, DFG chemically treated the lake with antimycin A to eradicate the nongame fish. The project was deemed successful, and Frenchman Lake was planted early in 1976 with catchable rainbow trout to restore angling opportunity. In the years thereafter, primary management strategy was again based on the planting of fingerling- and subcatchable-sized rainbows to grow for catch in subsequent years. Lesser numbers of brown trout and brook trout (*Salvelinus fontinalis*) were also occasionally planted.

In 1988, the presence of northern pike (*Esox lucius*) was confirmed in Frenchman Lake (DFG 1990). It soon became apparent that a thriving population of this predatory nonnative species was established, and DFG sought to treat the lake with a rotenone formulation. Local controversy erupted over this plan, with the ultimate consequence of delaying treatment until June 1991. Indications are that this treatment was successful in eradicating all fish from the lake, possibly excepting a few brown bullheads, and the lake was again planted with rainbow and brown trout of various sizes (Table 1).

Tributaries to Frenchman Lake contain some spawning habitat for lake-run trout though many of these streams have been degraded by cattle grazing and erosion of streambanks. Local anglers, USFS and DFG staff, and DWR staff have observed large trout in tributaries upstream from the lake during spring spawning periods. However, DFG also reports fry, fingerling, and adult trout trapped in intermittent, isolated pools of the tributaries during the summer of low-runoff years. The total contribution of naturally-spawned trout to the lake fishery is unknown but probably minor (Jensen 1981).

Little Last Chance Creek. Little Last Chance Creek has received relatively little detailed study by DFG. However, DWR has periodically conducted fishery, recreation, and angler surveys and completed numerous reports over the last 20 years which have described the fishery quite well.

TABLE 1. Frenchman Lake planting record summary, 1991-1996

YEAR	RAINBOW TROUT			BROWN TROUT	
	Catchable	Subc'able	Fingerling	Catchable	Fingerling
	Rotenone treatment in June 1991.				
1991	35,500*	0	138,500	1,700	0
1992	20,500	0	199,766	0	15,834
1993	0	54,400	126,000	0	0
1994	0	44,000	581,884	0	0
1995	0	0	280,800	0	0
1996	0	102,615	0	0	0

*Additional plant: 513 rainbow trout broodstock.

The current operating criteria stipulating reservoir releases into Little Last Chance Creek are based primarily on requirements for providing irrigation water under contract. Early planners did not foresee the potential for significant recreation and fishery benefits downstream from Frenchman Dam (DWR 1957). Although DWR has modified operations at the other Upper Feather River SWP facilities in recent years to enhance downstream recreation and fishery resources, operation of Frenchman Dam has continued essentially unchanged since the dam's completion.

However, Little Last Chance Creek has proven to be a significant recreation and fishery resource (Elkins 1998). Recreation use of the creek increased following construction of the Chilcoot Campground in 1970. A post-project fishery composed of brown and rainbow trout was first studied in 1976 (Brown 1976). Subsequent surveys (Brown, unpublished data; Elkins 1998) documented that some trophy-sized trout

occur. The quality of the fishery was surprising considering the relatively erratic flow releases required to meet irrigation needs.

Recreation monitoring and creel censuses by DWR have illustrated that, despite an often high-quality fishery, angling is only about 5 to 10 percent of total recreation activity at Little Last Chance Creek because of the large amount of campground use (J. Brown 1989; Elkins 1997, 1998). Still, several thousand angler-hours a year are comparable to streams below the two other local SWP reservoirs. Most of the angling use occurs early in the season, often on opening weekend, with relatively low levels of use outside Chilcoot Campground the rest of the year. Because of Frenchman Lake's proximity to Reno, most visitors and anglers at Little Last Chance Creek are Nevada residents (Elkins 1997, 1998).

DFG personnel under contract to DWR have repeatedly sampled fish populations by electrofishing at three locations along Little Last Chance Creek in 11 different years since 1976. This sampling has been conducted in conjunction with the recreation monitoring to evaluate effects of project operation and management actions on the fishery. Data demonstrate correlations between good water years and standing crop and catch; age and growth relationships have also been described. Reports summarizing these studies (Brown 1996, 1997, 1998a) also indicate that fish from Frenchman Lake are introduced into the stream fishery during spill.

In June 1991 the fishery of Little Last Chance Creek was completely destroyed by accidental escape of lethal concentrations of rotenone from the Frenchman Lake Northern Pike Eradication Project. Portions of the creek in Sierra Valley, upstream as far as the Chilcoot Campground, were purposely chemically treated in September 1992 as an emergency operation because a few northern pike had been found nearby in the Middle Fork Feather River. Efforts to restore the fishery consisted of planting rainbow and brown trout as detailed in Table 2, but recovery of the fishery proceeded slowly because of persistent drought conditions and low (0.3 cfs) fall and winter streamflow (Elkins 1997).

TABLE 2. Little Last Chance Creek planting record summary, 1991-1996.

YEAR	RAINBOW TROUT			BROWN TROUT	
	Catchable	Subc'able	Fingerling	Catchable	Fingerling
	Rotenone treatment in June, 1991.				
1991	500	0	0	1,300*	0
1992	1,000†	0	0	0	0
1993	1,540	0	0	0	3,000
1994	0	0	0	0	5,240
1995	0	0	0	1,250	0
1996	0	0	0	0	3,000

*Additional plant: 20 brown trout broodstock.
†Only plant was in mid-April.

After spring spill resumed in 1995, the Little Last Chance Creek fishery has steadily and progressively improved to a state which existed prior to 1991. The current period of recurring spill has also been characterized by minimum flows of at least 2 cfs.

Escape of Fish over Spillways. An inquiry into the escape of fish over spillways was apparently first published by Clark (1942). Louder (1958), Elser (1960), and Lewis et al. (1968) each subsequently conducted similar studies targeting a small number of very small to medium-sized Eastern and Midwestern ponds or reservoirs with warmwater fisheries. The duration of each study varied from a few months to several years, but most sampling only measured migration through a fraction of the outlet area.

Results of earlier studies allow no clear generalization about escape of fish over spillways. The relative effects on various warmwater

species varied, in some cases mirroring the relative abundance of species in the lake (Clark 1942; to a lesser extent Louder 1958). In other cases an important lake species was greatly underrepresented. There was some consensus that volume of flow and depth of spill were of little or no influence and that seasonal/reproductive influences seemed to be of primary importance. However, sampling techniques varied and catch at similar reservoirs varied from hundreds to thousands to tens of thousands of individual fish. Elser (1960) suggests that design of the spillway (including construction material) is the most important factor influencing emigration at one reservoir versus another; he postulated that turbulence at the lip of the spillway inhibits fish loss. Each investigator noted that their findings, though limited, may be very useful to reservoir and fishery managers. All investigators stated that additional study would be desirable.

Recently, Grost and Prendergast (1997) investigated entrainment of aquatic organisms through canals and penstock intakes on the Umpqua River. They found correlations between some species' movements and the act of first opening of diversion gates, the rate of change of gate opening, rapid rise in canal/intake volume (water level), and season. At a site not subject to the above causes, entrainment of trout followed a roughly monthly cycle which appeared somewhat related to moon phase.

Otherwise, current interest and thorough documentation of migration of fish through reservoirs, and passage over dams and through penstocks/turbines, has almost exclusively been related to passage of anadromous salmonids. Schoeneman et al. (1961), Leman and Paulik (1966), Sims et al. (1978), Raymond (1968, 1969), and many others have described these problems and possible solutions, primarily from the standpoint of salmon and steelhead fisheries of the Columbia and other Pacific Northwest rivers.

The lack of further published study on the general topic is surprising given that each early study raised more questions than were answered. No documentation of the spillway emigration phenomenon has apparently been conducted to describe physical influences directly at the point

of emigration. Several papers, however, note such fish movement occurring within the scope of a broader or unrelated investigation. Huston and Vaughan (1968) recognized that management of rainbow trout populations in large multipurpose reservoirs is greatly complicated by attrition of the population downstream through spillways and turbines. Hansen (1971) trapped hundreds of planted cutthroat trout leaving a natural lake via its outlet between April and July. Stober et al. (1983) sought to reduce the entrainment of kokanee from a large reservoir where an irrigation canal intake previously entrained many tens of thousands of fish annually. These three studies collectively used a downstream creel census and/or placed a net, screen, or trap across all or part of the outlet stream/canal. Jahn et al. (1987) collected (using rotenone and electrofishing) many thousand gizzard shad and a few hybrid striped bass below a spillway over four years of a lake stocking study. A screen on the spillway in Jahn's study impinged gizzard shad; impingement decreased as spill decreased.

Several of these investigators noted some public concern about fish being "lost" from lake fisheries but generally noted that such migration could be beneficial to downstream fisheries. Pfitzer (1967) describes tailwater areas below dams as often supporting fisheries with high recreational value.

METHODOLOGY

Spill commenced on January 2 at Frenchman Lake in 1997; this unusually early timing did not allow an ample opportunity to place the spillway net, discussed below, before initial spill. This episode of spill continued for 39 days (until February 9), though it peaked on January 5 at 1.85 feet above the spillway crest and was only greater than 0.8 feet from January 3 through January 15. Based on the findings of DWR (1996), almost all spillway emigration from Frenchman Lake would have occurred during this approximately two-week period.

Marking Fish in Little Last Chance Creek

To determine the number of trout discharged from the reservoir to the creek during the relatively brief high-spill episode, an electrofishing crew of four members used a backpack electroshocker on the afternoon of March 17 and the morning of March 18, 1997 to capture and mark as many fish as possible in the portion of Little Last Chance Creek from the uppermost State Highway 284 bridge upstream to Frenchman Dam, a distance of about one mile. Most of this reach is easily accessible by wading, except for one deep pool at the base of a prominent bluff at the lower end of the upper third of this reach. Controlled releases from Frenchman Lake had been increased in the days preceding this activity and then shut off on March 17 to facilitate ease of capture; spill during this activity maintained streamflow between 5 and 14 cfs.

The crew methodically electrofished the upstream third of the above reach, from the deep pool to the dam, on March 17. The lower two-thirds, methodically proceeding from the upper SR 284 bridge upstream to the deep pool, was electrofished on March 18. Stunned fish which appeared to be about 30 centimeters (cm)[2] or longer were netted and temporarily placed in a pail of creek water. Fish this size and larger were uncommon in fall 1996 and were most likely 1997 emigrants

[2] To convey proper accuracy and precision, results of fish measurements are reported in metric units throughout this report. Measurements of structural features and environmental parameters will continue to be reported in units of English measure.

from the reservoir; relatively large fish would also probably be most likely to be retained by anglers and provide the best recapture data. Each time several fish had been captured, the crew paused briefly to collect data and mark and release the fish. Each fish was identified to species, measured (fork length to nearest 0.5 cm), given a mark on the dorsal fin by punching a hole with a single-hole paper-punch, and released in the general vicinity of their capture.

Fish Emigration Counts

The configuration of the Frenchman Dam spillway prevents fish from returning to the reservoir once they have passed over the spillway crest. Typical water velocity in the inclined chute rapidly delivers these fish to the shallow pool in the flip-bucket, where they can spend varying amounts of time before swimming or being swept over the lip into Little Last Chance Creek. Stream anglers have often been observed catching rainbow trout in this artificial pool.

Investigators sought to trap all fish leaving Frenchman Lake via the spillway in the flip-bucket, periodically collect them by electrofishing, and mark them prior to releasing them into Little Last Chance Creek below the dam. To prevent fish from exiting the flip-bucket pool, 2" x 4" wooden flashing was attached using 3/8" expansion bolts to the terminal outside edges of the spillway walls and lip. This wood surface then allowed temporary placement of a 30' x 6' net flush across the terminal end of the spillway, anchoring it between a second layer of 2" x 4" boards nailed firmly onto the bolted ones. The 1.5"-mesh barrier net was constructed of #84 heavy-duty knotted nylon, reinforced with nylon rope borders, and treated with a black plastic coating to enhance durability (except that some of the coating had been worn from prior use). The net was installed March 29, 1997 while the reservoir stage was 0.51 feet above the spillway crest the crew electrofished the pool at 5:00 PM and determined that it harbored no fish at that time. Ropes were also attached to points along the top of the net and secured and tightened to reduce the amount of sag in the net's span.

The dimensions of the flip-bucket pool made conventional electrofishing (Smith-Root Type 12 and/or Type VII, 60 Hz, 300 or 400 VDC) difficult . While some fish were collected at the anode, the most effective routine was to proceed methodically back and forth through the entire volume of the pool to "herd" fish toward the barrier net, where they tended to be swept into the net and pinned there until collected by hand. Because of these circumstances, the twice-daily (typically near dawn and dusk) removal of fish from the pool included inspection of the entire length of the net by hand. The net was also cleaned of debris during each inspection.

Each check of the net took from a few minutes to almost an hour, depending on flow, debris conditions, and number of penned fish present. After the net had been inspected and all pinned fish and debris removed, it was immediately double-checked to ensure that no fish had been missed. The approximate times of all such fish removal are summarized in Table 3 (Results).

In a few instances and for varying reasons, some fish were seen but not immediately collected. Thus, removal of some fish was delayed for one or more days. In such instances, when a fish which had appeared to have previously escaped capture was finally recovered (dead or alive) from the net or pool, it was generally possible to determine how many days an individual had been in the pool since first observation because relatively few fish were emigrating. A fish determined to have been the same one which escaped the previous day, for example, was counted among fish observed the day prior to recovery.

All fish collected were stored for the duration of the net check in a pail filled with spillway water. Creatures other than fish trapped by the net were also removed, identified, and counted. Immediately after the net was cleared, each fish was identified, measured (fork length to nearest 0.5 cm), marked if still alive with a single-hole paper-punch hole in the dorsal fin and a clip off of the adipose fin, and released into Little Last Chance Creek below the spillway.

General weather and sky and water conditions, and flow/spill level, were recorded during each sampling episode. Reservoir water level, to the nearest 0.01 foot, was read from a staff gage near the spillway and corroborated by a digital readout near the dam. Reservoir surface water temperature was measured (nearest 1°F) in the spillway; reservoir bottom temperature was measured at the outlet valve discharge. Air temperature was measured in the shade.

Sampling was conducted under a variety of flow/spill conditions as created by natural runoff. On several occasions, releases from the reservoir's 24" outlet valve were adjusted (to either 15, 80, 100, or 150 cfs) to modify the reservoir surface elevation and either lower or heighten the spill stage. This manipulation was intended to allow observation of a greater variety of flow conditions but was of limited success because of unexpectedly variable weather and hydrologic conditions.

Angler Creel Census

A creel census was conducted on Little Last Chance Creek during the first three days of the 1997 stream fishing season (April 25, 26, and 27), the first two days of the Memorial Day holiday weekend (May 24 and 25), two other weekend dates (May 10 and August 31) and August 11, a Monday. Recreation use counts were made on the first five of these dates to provide an indication of angling effort and to compare numbers of anglers with reported numbers from "opening weekends" and Memorial Day weekends, two periods of relatively high recreationist and angler use, of previous years (Elkins 1997, 1998; J. Brown 1989). The counts were made using the same methods used in these previous studies.

Investigators interviewed anglers along about 4.5 miles of Little Last Chance Creek (Frenchman Dam to Guidici Ranch) to determine fishing success. The public road along the creek was driven at least five times each day between sunrise and sunset in search of stream anglers. Anglers encountered at Frenchman Lake were also interviewed as time permitted (on most stream census dates, plus additional dates prior to the commencement of the stream fishing season). The terminal gear,

length of time spent fishing so far that day, and county of residence were recorded for each angler contacted. Fish censused were counted, inspected for marks, measured (fork length to nearest 0.5 cm), and identified to species.

To determine total catch from Little Last Chance Creek, the catch per hour determined from the interviews was multiplied by estimated hours of fishing for each stratum (Elkins 1997, 1998).

Fish Population Sampling

Several episodes of fish population sampling were conducted to gather anecdotal information about fish distribution near the controlled outlet of the reservoir, fish use of Frenchman Lake tributaries during the spring, persistence of lake-origin fish in Little Last Chance Creek below the dam, and general Little Last Chance Creek trout population data. All such sampling was done with a backpack electroshocker except that a dipnet was used in some reservoir tributaries.

A branch of the Little Last Chance Creek channel flows for about 100 yards from the outlet valve works to where it is joined by flow from the spillway. On April 11, 1997, following an April 10 reduction in valve release from 100 to 15 cfs, this section was thoroughly electrofished by a crew of two (one shocker and one netter). Visibility in this reach was good except in the stilling basin near the valves where water was turbulent. Several electrofishing passes were made in the stilling basin and below the adjacent weir, and one pass was made through the rest of the reach to determine if previously marked fish were holding in this area and if any reservoir fish had been passed through the valves. Fish collected were temporarily stored in a pail, measured, marked (caudal mark only) and released.

Cursory observation and dipnetting of likely fish habitat was conducted on several dates in April 1997 in three major Frenchman Lake tributaries (Spring, Lookout, and upper Little Last Chance Creeks). Several hundred feet of each stream, beginning near their respective crossings of the main road around the reservoir, were walked and

sampled at areas of likely cover. Fish collected were cursorily observed, some were photographed, and returned to the point of capture shortly thereafter.

Sampling of fish in Little Last Chance Creek below the dam was also conducted during late October 1997. Crews electrofished areas within a mile of the dam, in a manner similar to the sampling (fish marking) done during March 1997 and described above, on October 28, 1997 (the entire distance was covered in one day, instead of two as in April, because of lower flows and fewer fish). Also, standing stocks of fishes were estimated at three representative stations in Little Last Chance Creek ranging from 1.1 to 3.5 miles from the dam (Brown 1998a). Stations were at the identical locations sampled in previous DFG studies (Bumpass et. al. 1989; Brown 1992, 1993, 1994, 1995, 1996, 1997). Stations varied in length from 123 to 220 feet.

For standing stock estimates, fish were captured with a battery-powered backpack electroshocker in stream sections blocked by seines as described by Platts et al. (1983). Captured fish were removed from the net-enclosed section on each pass. The weights of trout were measured by displacement. Fork length of each fish caught was measured to the nearest millimeter (mm). Standing stock estimates were developed using the MicroFish 3.0 computer program (Van Deventer and Platts 1989), as employed by Brown (1998a).

RESULTS

Three species of fish were observed during the course of the 1997 investigation. Rainbow trout, brown trout, and Lahontan redside were collected in Little Last Chance Creek below Frenchman Dam. A total of 84 rainbow trout and 26 brown trout were collected from the creek on March 18 and 19 and released after marking. Only one species, 29 individual rainbow trout, was collected from the pool and net in the Frenchman Dam spillway. Nineteen of the 29 were alive and released after marking. The only other animals recovered from the spillway net were two dead muskrats (*Ondatra zibethicus*) found on different dates.

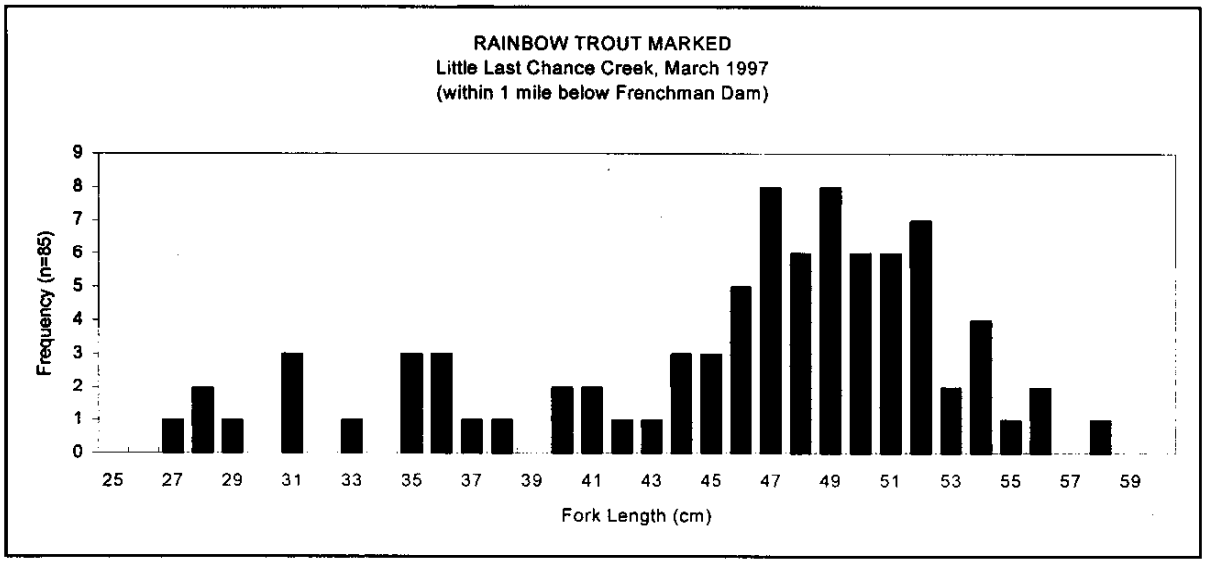
One hundred and nine unmarked rainbow trout and 13 unmarked brown trout were in the creels of Little Last Chance Creek anglers censused during the first three days of the 1997 fishing season. These anglers also caught 16 marked rainbow trout (15 marked in March during electrofishing and 1 marked from the spillway net) and no marked brown trout during the same period. No marked fish were observed in the creel during any of the 5 dates censused later in the season, although one marked rainbow trout was collected by electrofishing below the dam on October 28.

Figures illustrating rainbow trout lengths and frequency of occurrence for each sampling episode of this study are displayed in Figures 3A through 3D. Brown trout lengths and frequency are discussed below or illustrated in Figures 4A and 4B, as appropriate.

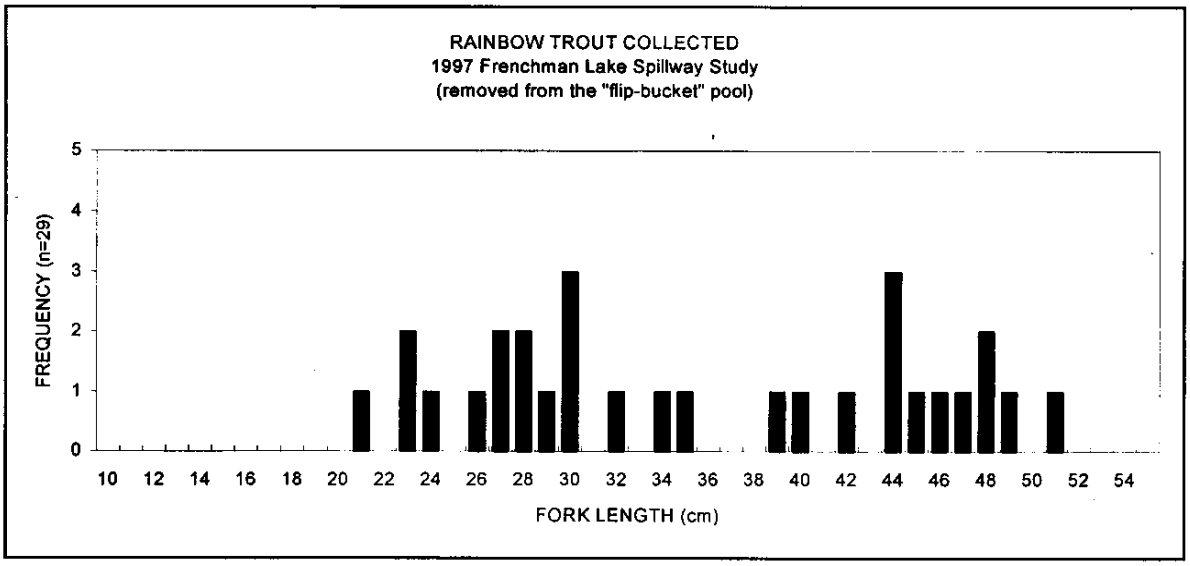
Rates of Spillway Emigration

The number of fish collected from the net and spillway pool during each of the 43 times the net was checked, and physical conditions recorded at the time, are summarized in Table 3. Reported collections on several dates are adjusted for fish which appeared to have emigrated more than one day before actual retrieval. On a few days of the study, fish were observed during electrofishing but escaped

FIGURE 3. Length-frequency distributions of rainbow trout collected during phases of this study

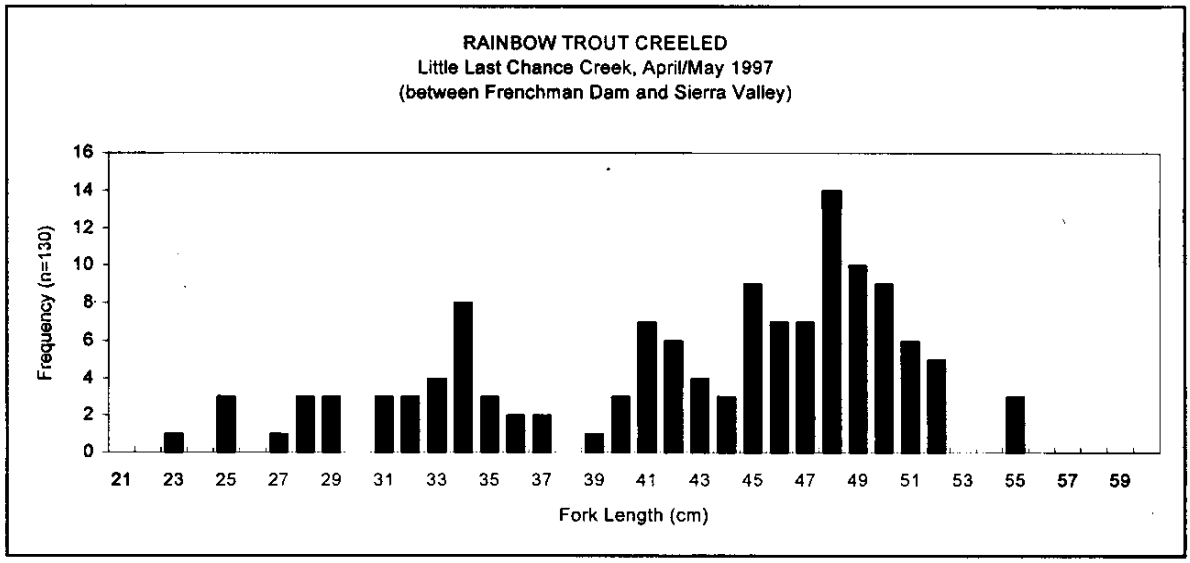


3A. Marked in March 1997 - January emigrants

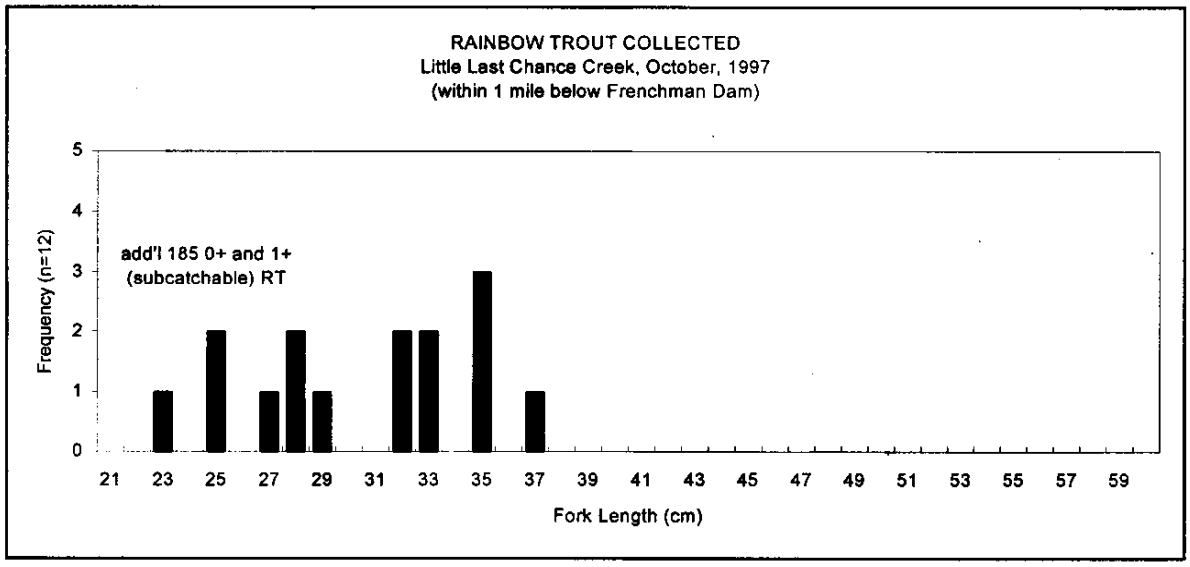


3B. Collected and/or marked in the spillway during April

FIGURE 3 (continued).

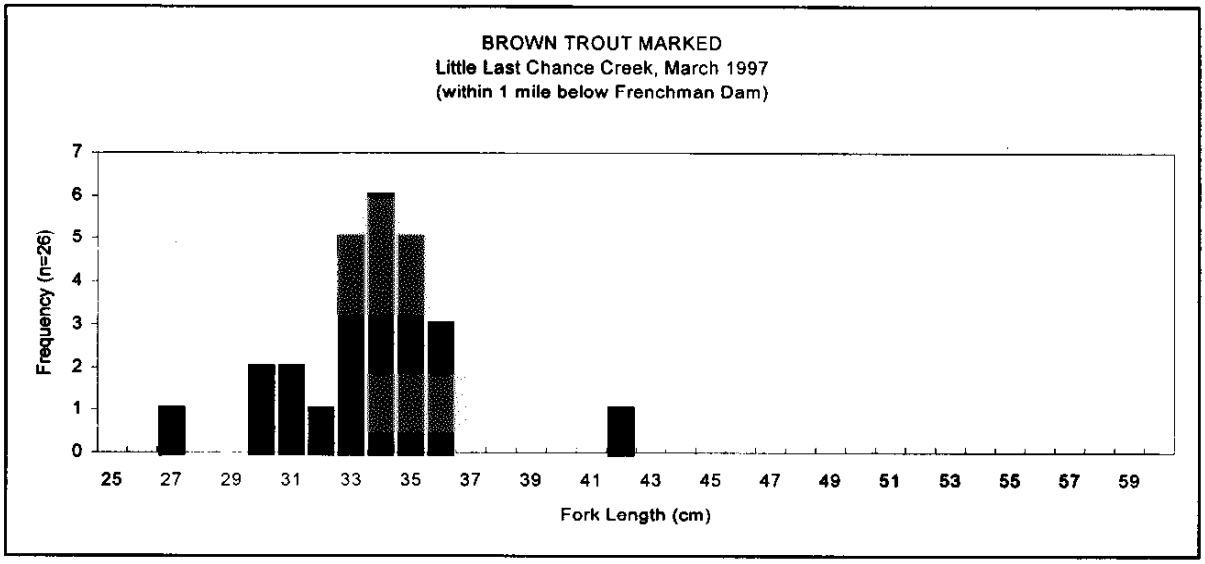


3C. Recovered in the creel during April and May surveys

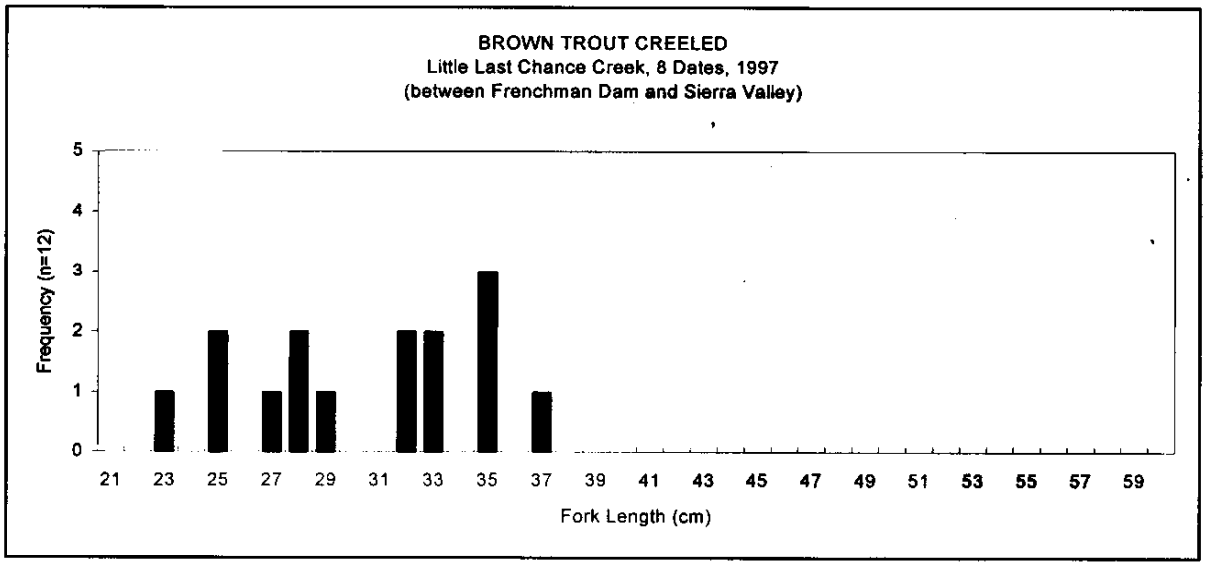


3D. Collected within a mile of the dam in October

FIGURE 4. Length-frequency distributions of brown trout collected during phases of this study



4A. Marked in March 1997 - resident fish



4B. Measured in the creel during surveys

TABLE 3. Collection record summary for each spillway sampling episode

ENTRY	DATE	TIME	ELAPSED	GAGE	FISH	LUNAR	SKY	Tair	Th2o	ALIVE	DEAD	RATE		KEY:
0	3-29	1730	0	0.51	0		PC		45	0	0	0		
1	3-30	600	12.5	0.50	0	2	PC	41	43	0	0	0		LUNAR
2	3-30	1800	12	0.49	1		FL	40	40	1	0	0.08		0 = Dark night
														1 = Little moonlight
3	3-31	600	12	0.47	0	1	PC	22	41	0	0	0		2 = Couple hours moon
4	3-31	1830	12.5	0.44	4		FL	27	42	3	1	0.32		3 = Moderate moonlight
														4 = Mostly moonlit
5	4-1	630	12	0.42	1	1	FL	22	42	1	0	0.08		5 = Very bright night
6	4-1	1800	11.5	0.43	0		FL	30	40	0	0	0		
														SKY
7	4-2	600	12	0.42	2	2	CL	24	40	2	0	0.17		CL = Clear
8	4-2	1800	12	0.41	2		CL	39	43	2	0	0.17		PC = Partly Cloudy
														CY = Cloudy
9	4-3	600	12	0.42	3	1	CL	26	42	3	0	0.25		RN = Rain
10	4-3	1800	12	0.41	2		CL	45	46	2	0	0.17		SH = Showers
														SN = Snow
11	4-4	630	12.5	0.39	2	1	CL			0	2	0.16		FG = Fog
12	4-4	1830	12	0.42	0		CL	33	42	0	0	0		
13	4-5	600	11.5	0.45	0	1	CL	21	40	0	0	0		
14	4-5	1830	12.5	0.49	0		CL	37	43	0	0	0		
15	4-6	700	11.5	0.50	0	0	CL	13	41	0	0	0		
16	4-6	1930	12.5	0.51	0		CY	41	43	0	0	0		
17	4-7	730	12	0.53	1	0	CL	32	40	1	0	0.08		
18	4-7	2000	12.5	0.51	2		PC	43	42	2	0	0.16		
19	4-8	700	11	0.46	0	0	PC	23	40	0	0	0		
20	4-8	1900	12	0.45	0		CY	40	42	0	0	0		
21	4-9	700	12	0.48	0	0	SN	26	39	0	0	0		
22	4-9	1930	12.5	0.45	1		PC			0	1	0.08		
23	4-10	730	12	0.42	0	1	PC	26	40	0	0	0		
24	4-10	1930	12	0.42	1		CL	35	42	0	1	0.08		
25	4-11	700	11.5	0.46	1	2	PC	23	41	1	0	0.09		
26	4-11	1930	12.5	0.48	1		CL	38	42	0	1	0.08		
27	4-12	700	11.5	0.49	0	2	PC	25	41	0	0	0		
28	4-12	1930	12.5	0.51	0		PC	42	42	0	0	0		
29	4-13	700	11.5	0.51	0	2	FG	25	41	0	0	0		
30	4-13	1900	12	0.53	0		PC	46	44	0	0	0		
31	4-14	700	12	0.55	0	2	PC	34	41	0	0	0		
32	4-14	1930	12.5	0.56	0		CY	51	46	0	0	0		
33	4-15	700	11.5	0.57	0	3	CL	27	44	0	0	0		
34	4-15	1900	12	0.57	0		CY	55	47	0	0	0		
35	4-16	700	12	0.57	1	1	FG	32	44	1	0	0.08		
36	4-16	1930	12.5	0.58	0		CY	50	44	0	0	0		
37	4-17	700	11.5	0.59	0	1	CY	36	42	0	0	0		
38	4-17	1930	12.5	0.59	2		PC	53	42	0	2	0.16		
39	4-18	700	11.5	0.61	1	2	CY	45	42	0	1	0.09		
40	4-18	1930	12.5	0.60	0		CY	44	41	0	0	0		
41	4-19	700	11.5	0.62	0	1	SH	42	42	0	0	0		
42	4-19	1930	12.5	0.62	1		PC	46	45	0	1	0.08		
43	4-20	730	12	0.61	0	2	CY	45	44	0	0	0		

immediate capture due to turbulent conditions. Overall, we believe the net and collection technique enabled collection of all fish which could not pass through the 1.5-inch square mesh (fish larger than 10 or 11 inches long).

Creel Census

Little Last Chance Creek. Anglers fished for an estimated 1,300 hours on the first weekend of the 1997 fishing season and caught an estimated 300 rainbow trout and 30 brown trout. We censused 548.5 hours of that effort and observed a catch of 118 rainbow trout and 13 brown trout. Fifteen of the rainbow trout were of the 84 we had marked five weeks earlier, and one was of the 19 released alive from the spillway. Several of the fish had obviously emigrated after April 20 because anglers caught 34 rainbow trout within the spillway flip-bucket structure, but one of these bore a mark from March, indicating that some large fish had recently arrived in the spillway by ascending from the creek. Fourteen of these were less than 35 cm long, presumably too small to make the steep ascent and thus believed to have arrived directly from the reservoir. Some anglers also reported seeing some fish tumbling down the spillway on April 26 while spill stage was about 0.57 feet.

During the two days sampled on the 1997 Memorial Day holiday weekend, anglers fished for an estimated 250 hours and creeled an estimated 3 rainbow trout and 3 brown trout. The survey clerk censused 80 hours of that effort and observed a catch of only 1 rainbow trout and 1 brown trout, neither of which was marked. Eleven trout were reported caught and released on these dates, however.

During the other four days surveyed during the season, only April 28 (the day after Opening Weekend) and May 10 showed a modest amount of stream angler interest and success. On April 28, one marked (March) rainbow trout was among seven creeled by 11 anglers who fished a collective 24.5 hours. By May 10 there were still large rainbow trout present; 27 anglers creeled nine unmarked rainbow trout (no brown trout) in 42.5 hours of angling effort. No stream anglers were present during surveys on August 11, but on August 31 (middle of Labor

Day holiday weekend) 17 anglers were contacted who caught one small brown trout and one small rainbow trout in 24.5 hours of effort. In addition, six rainbow trout were reported to have been caught and released during these four days.

The mean length of rainbow trout creeled during April and May 1997 was 42.6 cm, with a range of 24.5 to 55 cm. Only one creeled fish measured, a 45 cm rainbow trout, bore a mark from the spillway study. The mean fork length of brown trout creeled during 1997 was 30.2 cm, with a range of 23 to 36.5 cm. About 74 percent of the anglers censused fished exclusively with bait, 8 percent with flies, and 3 percent with lures. Another 15 percent fished with some combination of these methods, mostly bait and lures.

Frenchman Lake. A total of 296 reservoir anglers (278 shore, 18 boat) were contacted in the months of March and April 1997. They had fished 805.0 hours, with an observed catch of 120 rainbow trout (only four of these were caught by boat anglers). In addition, 23 rainbow trout were reported to have been caught and released. The mean fork length of rainbow trout creeled in March and April 1997 was 36.7 cm, with a range of 27 to 59 cm. About 73 percent of the anglers fished with bait, 6.5 percent with flies, 2.5 percent with lures, and 18 percent with some combination of these methods.

Fish Population Sampling

Little Last Chance Creek (below dam). Table 4 presents the summarized results of fish population sampling conducted at three stations in October 1997. Additionally, 203 rainbow trout and five brown trout (11.5, 20.4, 23.8, 27.8 and 41.0 cm, respectively) were collected during the search for marked fish in the first mile below the dam on October 28, 1997. About 185 of the 203 rainbow trout were "subcatchable" (age 0+ and 1+, ranging from 7.5 to 16.5 cm fork length). Only one rainbow trout, 45.4 cm fork length, bore any marks from earlier study; it was one of only three rainbows collected on this date which exceeded 35 cm in length (40.1, 45.4, and 46.4 cm).

TABLE 4. Results of fish population sampling at three stations on Little Last Chance Creek, October 1997.

	Station 1	Station 2	Station 3	MEAN
Below Dam	1.6 km	3.2 km	4.4 km	
Length	47.9 m	49.1 m	46.6 m	47.9 m
RT Pop. Est.	28	113	33	58
RT Mean Length	124 mm	141 mm	121 mm	135 mm
RT Biomass	10.4 g/m²	18.9 g/m²	3.7 g/m²	110 kg/ha
BN Pop. Est.	28	18	28	74
BN Mean Length	210 mm	191 mm	204 mm	202 mm
BN Biomass	15.4 g/m²	9.0 g/m²	12.4 g/m²	123 kg/ha

KEY: RT = rainbow trout, BN = brown trout
(from Brown 1998a, 1998b)

Outlet Valve Vicinity. Several small (15 to 25 cm fork length) rainbow trout were found in the vicinity of Frenchman Dam outlet release valves. Only one, plus a dismembered Lahontan redside, was collected above the weir (clearly indicating they had passed through the valves). Large rainbow trout were observed in this channel when releases were high, but when flow was reduced they moved a short distance downstream, below the discharge of the spillway.

Frenchman Lake Tributaries. The three Frenchman Lake tributaries sampled flowed clear and cool during April 1997. Large rainbow trout, presumably lake-run fish, were found in Lookout Creek below where it crosses the main road. Fish were prevented from advancing further upstream because the flood earlier in the season had clogged the culvert, and the flow of water over the road shoulder did not allow fish passage. Two specimens, approximately 40 and 45 cm fork length, were easily netted in Lookout Creek's 2 to 3 cfs flow. Little Last

Chance Creek was the only other tributary in which lake-run fish were observed; several large rainbow trout were observed upstream from the bridge at the head of the reservoir but were not netted. No fish were observed or collected in Spring Creek; it was not determined whether lake-run fish ascend this stream.

CONCLUSIONS AND DISCUSSION

The results of this investigation are noteworthy for at least two reasons. First, they corroborate the earlier findings (DWR 1996) that emigration of fish from DWR's Upper Feather River reservoirs is substantially reduced during periods when spill stage is less than 0.8 foot. Second, they illustrate that Frenchman Lake spill and reservoir operation are important factors influencing the quality of the downstream fishery by contributing both more water (habitat) and fish to Little Last Chance Creek. Historically, the occurrence of spill normally indicates adequate water supply and ensures that subsequent fall and winter flows will not be less than 2 cfs, even though such operation is not necessarily required by law.

Since Frenchman Lake was not proposed to be operated specifically for downstream fishery and recreation purposes, the lower reaches of Little Last Chance Creek were not expected to support a significant fishery or substantial recreation use under post-project conditions (DWR 1957). The absence of recreation potential here was expected to be replaced by the increased stream recreation potential provided by the Indian Creek Project (Antelope, Abbey Bridge, and Dixie Refuge Reservoirs; the latter two of which were never constructed). However, Little Last Chance Creek has proven to be a significant recreation and fishery resource. The construction of Chilcoot Campground (*ca.* 1970) has provided a facility for people who prefer to camp or picnic there rather than at Frenchman Lake. The stream fishery has proven to be better than expected, considering the relatively erratic flow releases required to meet irrigation needs. In 1997 the biomass of the Little Last Chance Creek trout population was among the highest found in California streams (Brown 1998b; Gerstung 1973).

Fish Migration and the Spillway

The Antelope spillway findings (DWR 1996) are corroborated by comparing the rate of emigration observed during the period the spillway net was in place (spill stages 0.39 to 0.62 feet) to the emigration rate that occurred during the January 1997 spill episode.

The total number of fish that entered the creek during this period can be inferred from the ratio of marked to unmarked rainbow trout creeled. Because no rainbow trout of large size were collected during fish population sampling in fall 1996 (Brown 1997), and because high gradient portions of Little Last Chance Creek can be expected to prevent Feather River fish from reaching the area immediately below Frenchman Dam, it is reasonable to assume that virtually all the large rainbow trout collected in the creek during 1997 emigrated from Frenchman Lake after the commencement of spill on January 2. Those marked on March 18 and 19 emigrated between January 2 and February 2 (between February 2 and March 19 spill stages were between 0.00 and 0.25 feet, suggesting little additional opportunity for emigration). During the January spill period, spill peaked at 1.85 feet on January 5 and remained over 0.8 feet until January 15. Between January 15 and February 2, and between March 20 and 29, the emigration rate was probably similar to that observed after March 30 when the net was in place because the spill stages were similar. Making these assumptions, the results suggest that about 700 rainbow trout emigrated during the higher January spill period (more than 50 per day) compared to 29 (1.4 per day) between March 30 and April 19 (spillway sampling period) and other periods of similarly low spill.

The conclusion about the importance of spill and reservoir operation to the quality of the downstream fishery is based on observations of large "lake-origin" rainbow trout below Frenchman Dam after spill, comparison of fish population sampling studies by Brown (Bumpass et. al 1989; Brown 1992, 1993, 1994, 1995, 1996, 1997, 1998a; [Table 5]), and analyses of creel survey results from four years between 1988 and 1997 (J. Brown 1989; Elkins 1997, 1998 [Table 6]). Following the extirpation of all fish from Little Last Chance Creek in 1991, fish planted by DFG were not sufficient to restore a self-sustaining fishery because of low drought flow conditions. The catchable rainbow trout planted by DFG in 1991 and 1992 (Table 2) were the only fish present then and apparently did not persist beyond those years, and rainbow trout were not an important element of the Little Last Chance Creek fishery (Table 5) again until 1996 (after two years of spill). Early-season catch of large rainbow trout was substantially higher in the recent years characterized by spill (Table 6), although catch per

TABLE 5. Results of fish population sampling at three stations on Little Last Chance Creek, 1991 through 1997

STATION NUMBER-YEAR	TOTAL		DENSITY*		OTHER SPECIES COLLECTED
	RT	BN	RT	BN	
1-1991	0	0	0	9	None
2-1991	0	1	0	2	None
3-1991	0	0	0	0	1 SK
1-1992	2	8	4	27	None
2-1992	1	0	2	0	None
3-1992	0	0	0	0	None
1-1993	0	12	0	26	None
2-1993	n/a	n/a	n/a	n/a	n/a
3-1993	0	20	0	35	None
1-1994	0	59	0	150	None
2-1994	0	7	0	9	None
3-1994	0	4	0	7	None
1-1995	1	44	2	99	None
2-1995	0	32	0	76	None
3-1995	1	17	2	39	None
1-1996	29	40	61	92	None
2-1996	46	34	126	189	None
3-1996	30	52	77	133	None
1-1997	19	19	59	59	1 LR
2-1997	97	17	230	37	None
3-1997	31	28	66	56	None

KEY:RT = rainbow trout, BN = brown trout,
LR = Lahontan Redside, SK = Sacramento sucker
* estimated number of fish per 100 meters of stream

TABLE 6. Estimated total catch and angler catch rate from Little Last Chance Creek creel censuses: 1988, 1992, 1996, and 1997

	1988 (J. Brown 1989)	**1992** (Elkins 1997)	**1996** (Elkins 1998)	**1997**
Days Surveyed	28	30	29	8
RT Catch	3,200	900†	900	n/a
RT Rate*	0.44	0.28	0.13	0.19
BN Catch	850	0	600	n/a
BN Rate*	0.11	0.00	0.09	0.02
Opening Weekend RT Catch	135	150†	200	300
Opening Weekend RT Rate*	0.28	0.61	0.16	0.23
RT Mean Length - Opening Weekend	23.4 cm	30.5 cm	39.3 cm	42.7 cm
Opening Weekend BN Catch	30	0	90	30
Opening Weekend BN Rate*	0.06	0.00	0.07	0.01
Peak Spill	none	none	1.41'	1.85'
Spill Duration	0	0	108 days	64 days
Prior Spill Year	1986	1986	1995	1996
DFG LLCC Plants	none	1000 RT catchables	3000 BN fing'lings	3000 RT+BN fing'lings

* fish per angler hour. RT = rainbow trout, BN = brown trout

† all planters (catchable, 26-35 cm) stocked April 1992 and July 1991.

angler hour has varied for several reasons; mean length of rainbow trout was also much greater following spill because fish from Frenchman Lake typically attain a greater size in the reservoir's rich environment. Anecdotal reports indicate that the tailwater fishery for rainbow trout was also good during the spill of 1995, but Brown's (1996) data show there was little successful reproduction (nor persistence of rainbows in the creek) below Frenchman Dam that year.

If 50 large trout per day pass out of Frenchman Lake when spill stage exceeds 1 foot (as the results suggest), only about 3 weeks of such spill would result in the "stocking" of Little Last Chance Creek with a quantity of fish comparable to planting efforts of earlier years (Table 2). The spilled fish are larger than traditional planted fish but cannot be expected to be widely dispersed; they tend to congregate in the short reach below the dam. Alternatively, reducing or eliminating spill will retain these large fish in the lake fishery which remains popular later into the season. It also appeared that delayed spill provided less attraction for misinformed anglers or poachers to illegally fish below the dam prior to the beginning of the stream season.

While it is not unusual to operate reservoirs so as to avoid spill altogether, these findings suggest that coordination of such operations can be a fishery management tool in addition to a water management tool. While the phenomenon of fish emigration may differ among other species, geographic location, and facilities, the reported results are reasonably applicable to all three of the Department's Upper Feather River reservoirs. Dissemination of these findings among other reservoir and fishery managers is also warranted.

Besides directly introducing hundreds of rainbow trout into the creek below, spill from Frenchman Lake in spring normally indicates a good water supply year and thus ensures higher flows in fall and winter, presumably keeping the fishery in better condition until the following year. Low winter flows can damage the fishery by reducing available habitat and allowing the formation of anchor ice (DWR 1982). Persistent low fall flows in the early 1990s, following attempts to

restore the fishery, probably hampered brown trout spawning and delayed fish population recovery by at least two years.

Several other assumptions about the behavior of rainbow trout in Little Last Chance Creek were made which have important bearing upon some of the conclusions of this study. Also, several anecdotal observations indicate some unexpected behavior occasionally occurs. The tendency of rainbow trout to move upstream in lotic environments during their spawning season was assumed to "prevent" fish from leaving the study area, allowing anglers an equal opportunity to capture all trout (marked and unmarked) which passed over the spillway during 1997. This is supported by the relative absence of rainbow trout in the creel of anglers fishing more than one mile below the dam.

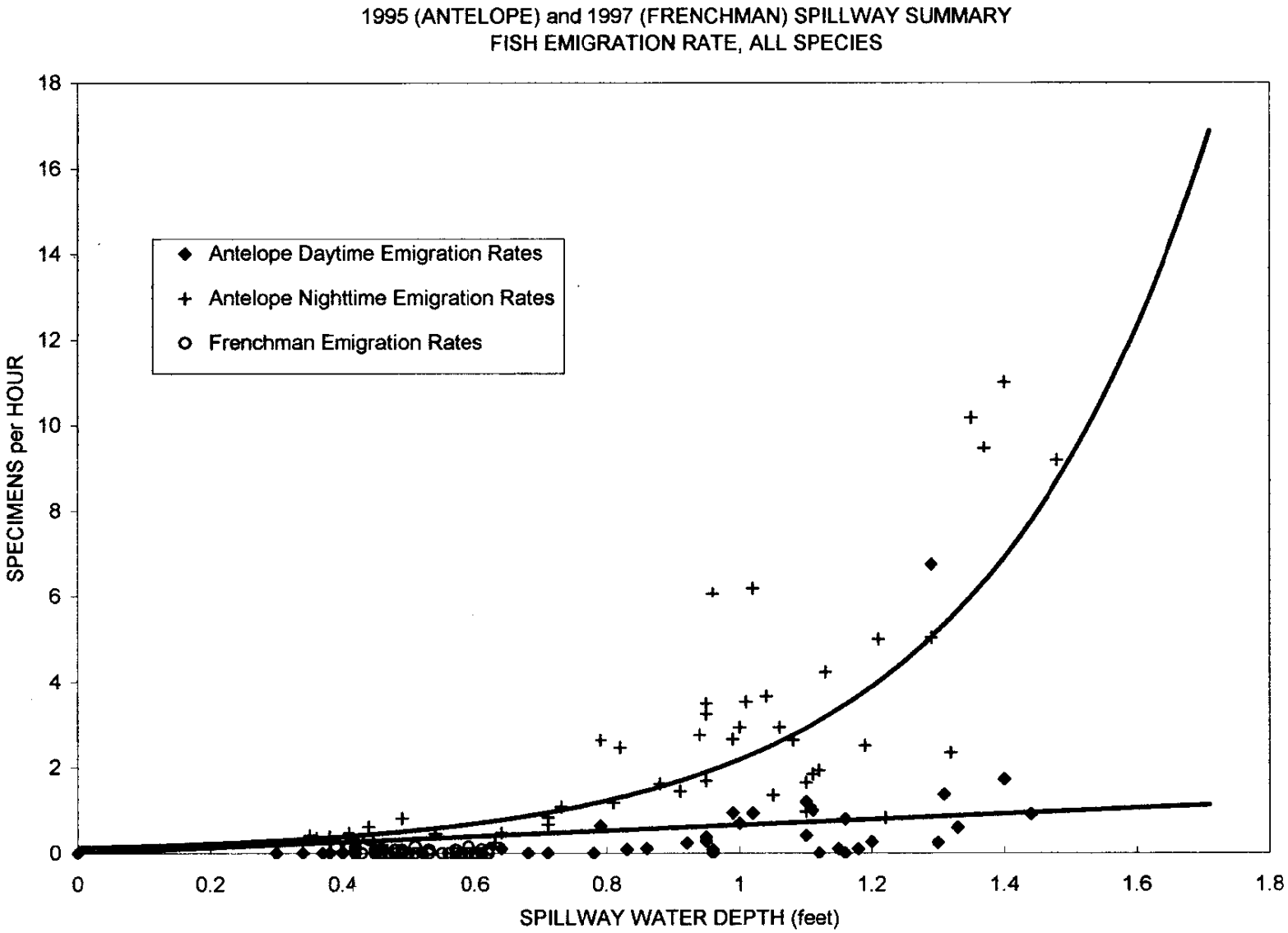
Also, we observed a few large trout trying to jump over the net back up into the spillway pool (and occasionally others in unlikely "habitat" amidst the riprap). One collected in the flip-bucket pool on April 14 bore abrasions suggesting it had been successful after numerous tries; it was not subsequently recovered in the creel. However, at least one creeled, marked rainbow trout was observed caught from the spillway pool on Opening Day (this individual had been marked in March and entered the pool sometime after the net was removed [after April 20]). An additional 22 large (>35 cm), unmarked rainbow trout (and 14 additional <35 cm) were also caught in this pool during the first days of the season. Since only about a dozen medium to large rainbow trout would have been expected to spill out of the lake after the net was removed (based on observations made while the net was in place), many if not most of these larger fish (creeled from the spillway pool) probably emigrated earlier in the year (January) and ascended back into the spillway pool after April 20. The smaller fish probably spilled, and a few of the 14 less than 35 cm in length were small enough that they may have been able to pass through the mesh of the spillway net (and thus not be among the size range sampled nor contribute to the rate calculations).

The successful ascent of large trout from Little Last Chance Creek through a steep maze of large riprap and shallow water, back into the

spillway pool, is not known to have been previously observed. When seasonal spill ceases, stranded fish have routinely been observed and sometimes salvaged from the flip-bucket pool. At the Frenchman spillway it seems reasonable to assume that all smaller fish found in this enclosure had earlier spilled from the lake but that at least some of the larger individuals stranded after spill stops (or caught there by anglers) may have ascended from the creek. If anglers are aware that fish are in this pool they fish there, but often the stagnating water is dismissed as being devoid of fish. Many dozen trout have been rescued from these conditions by DWR and DFG employees in past years, but there is no policy or routine for the collection or disposition of fish from the Frenchman (or Antelope) spillway.

Variations in the rate of rainbow trout emigration over the range of higher spill stages, such as those which occurred in January, cannot be determined because high spill conditions did not occur while the spillway net was in place. At Antelope Lake, it was demonstrated that emigration rates tended to increase as spill stage increased, and was higher at night (DWR 1996). However, both the low emigration rate observed during relatively low stage at Frenchman Reservoir, and the high rate inferred to have occurred during January, are consistent with the rates observed for all species collectively over the range of similar stages at Antelope Lake. Comparisons between the two studies must be made cautiously because the fish assemblages, spillway width, and size of the two reservoirs are so different, but there is a striking similarity between the general rates of emigration over the two spillways (Figure 5). Annual numbers of trout planted in Frenchman Lake in recent years (Table 1) are an order of magnitude greater than plants at Antelope, but at Antelope other warmwater species contributed to spill emigration abundance (trout composed 6.6 percent of the all fish passing over the Antelope spillway in 1995). The emigration rates observed during the Frenchman study are superimposed over the Antelope results (all species collectively; DWR 1996) in Figure 5 and illustrate this similarity under low spill conditions. At Frenchman Lake there was no significant difference observed between daytime and nighttime emigration rates, but at Antelope daytime emigration was rare at low spill stages.

FIGURE 5. Average emigration rate (all fish) over Antelope Lake spillway at various spill stages (DWR 1996), compared to observations at Frenchman Lake (rainbow trout).



Effects of Fall and Winter Stream Conditions

Some discussion of fall and winter flow conditions in Little Last Chance Creek is appropriate because of the nature and quality of the fishery which has become reestablished during recent years of recurring spill. Operating criteria and minimum release requirements (Appendix A) have remained unchanged since Frenchman Dam construction. With over 30 years of operation history and hydrologic records now available, an analysis (Appendix C) suggests that somewhat higher fall/winter minimum flows could be maintained without significant impact to reservoir levels and carryover storage. Fall/winter minimum flows even slightly higher than current conditions have been previously recognized as having the potential to provide significant benefits to Little Last Chance Creek habitat and the fishery.

Low minimum releases from Frenchman Dam which occur following the irrigation season, and persist through the winter, limit the spawning habitat available for brown trout and overwintering habitat for all species. If anchor ice forms in the winter, releases less than 2 cfs (which have occurred in some years) may not be sufficient to keep the fishery in good condition. While it was recognized many years ago that any increase above the common 2 cfs release would benefit Little Last Chance Creek trout (DWR 1982), no detailed operation studies of alternative minimum releases have been conducted.

Appendix C provides some preliminary illustrations of the impact that implementation of higher minimum release criteria (4 cfs or 5 cfs) historically would have had on Frenchman Lake storage. In wet years there is almost no discernable impact on reservoir levels during winter. However, these figures show that over the past 35 years there have been four occasions (1978, 1980, 1993, and 1994) when a historical 4 cfs minimum release might have had an impact on the quantity of water available for delivery for irrigation, assuming terms identical to those contained in the current contract between DWR and the Last Chance Creek Water District (Appendix B). It should also be noted that impacts to water supply availability during two of these years (1978 and 1980) were exacerbated by the special drawdown (for a DFG chemical treatment project) which occurred in 1975 immediately

prior to a two-year drought. The figures in Appendix C also show that the impacts of these higher minimum releases on the availability of boat ramps at Frenchman Lake is even more infrequent.

There is a striking difference between the relative abundance of rainbow trout and brown trout in the creel of Little Last Chance Creek anglers compared to standing stock estimates. In 1996 (Elkins 1998) and 1997, rainbow trout were far more common in the creel than brown trout, but fish population estimates by Brown (1998a) illustrate that catchable-sized brown trout are far more common than rainbows in Little Last Chance Creek. These differences are probably due to a combination of factors which include the pattern of diminishing angler activity as the fishing season progresses, the intense and selective removal of large rainbow trout during the early part of the season, and the specific behaviors of brown trout (Moyle 1976) which often make them more difficult to catch compared to other species of trout. Thus, higher minimum flows would especially benefit the Little Last Chance Creek fishery since brown trout are the persistent, major component of this fishery and because their spawning season occurs in fall and winter when higher flows would provide more spawning and overwintering habitat.

The density of young rainbow trout in Little Last Chance Creek greatly increased by 1997 (Brown 1998b). Many of these fish were the progeny of fish which emigrated from Frenchman Lake during recent years of spill, and some were planted fingerlings/subcatchables from the lake which emigrated. If habitat becomes limiting because of the historically high densities which have been observed recently, these fish would be expected to disperse downstream into Sierra Valley and the Feather River. Additional overwintering habitat, provided by increased minimum flows, may thus also benefit rainbow trout by allowing more progeny to mature in the creek between Frenchman Dam and Sierra Valley. An abundance of small rainbow trout probably also significantly benefits the brown trout by providing a good food supply for this especially piscivorous species (Moyle 1976) which, as discussed, is the basis for the persistence of the stream fishery. Other prey species which previously existed as forage (Sacramento

sucker, Lahontan redside, speckled dace) in Little Last Chance Creek have apparently not recovered during the 1990s.

Collection Methodology

Some discussion of the feasibility of the spillway net and collection method is also appropriate, both in the context of the range of environmental conditions and the effect on aquatic species. The collection methods used in the Frenchman spillway became difficult as spill stages increased toward the higher end of the range occurring during the study period (±0.6 feet; 70 cfs), so it is presumed that these methods may have been inefficient or impractical if higher flow conditions, such as those of January 1997, had occurred. The taper and relatively steep slope of the Frenchman spillway chute generated a continuous series of variable-amplitude waves which crashed into and surged through the flip-bucket pool, making backpack-electrofishing difficult. If future study is desired, the mounting of a generator-powered electroshocking apparatus (perhaps on or under the bridge above the flip-bucket pool) may be a superior method.

Under the April 1997 conditions, debris was not a problem in the net; the relative absence of forest and woody debris around Frenchman Lake probably influenced this. It should be noted that the spillway net method conceivably could have been used to sample flotsam, detritus, and other matter discharged from the reservoir to the stream below, if such study was of interest to researchers. At Antelope Reservoir a large amount of large and small organic matter was contributed to Indian Creek via spillway releases (DWR 1996) but the significance of the amount of such material to the ecology of the creek was not determined.

There was some unavoidable mortality of fish collected at the spillway net. The mortality rate induced by the net at Antelope Lake (DWR 1996) was unacceptably high, thus this study included modifications of the technique, equipment, and sampling schedule. Still, about 35 percent of the rainbow trout collected from the Frenchman spillway were dead. Because of the low rate of emigration this was only 10 individuals during the course of this study; if higher rates had

occurred we were prepared to check and empty the net more frequently to further reduce mortality. An important recommendation of DWR (1996) was that checking the net more often, perhaps six times per day and night instead of twice, might greatly diminish mortality.

Potential Application of Findings

The opportunity exists to review operation criteria and fishery management at Frenchman Lake in the context of the downstream sport fishery and recreation resources, now that these resources have been restored from the decimation of the early 1990s. Several examples of possible actions exist as precedent at the State's other Upper Feather River Reservoirs: special fishing regulations apply to the tributaries of nearby Lake Davis, where rainbow trout from the lake congregate in spring and are especially vulnerable early in the angling season; implementation of revised operating criteria at nearby Antelope Dam in 1978 delivered measurable benefits by augmenting flow conditions in Indian Creek (Cartier 1979a,b; Haines 1980, 1981; DWR 1981) without significant adverse effects on reservoir recreation values; modifications were made to Grizzly Valley Dam (Lake Davis) operation, and water right Permits/Applications associated with that facility, beginning in 1997 to provide downstream habitat enhancement with negligible impact to reservoir level; spill has been controlled during recent years at Lake Davis to prevent the downstream emigration of northern pike; spill was delayed by more than two months at Antelope Lake in 1998 and resulted in substantially fewer fish entering Indian Creek compared to past years (Cartier 1979b; Haines 1981; Hinton 1983; Tittel 1987; Rischbieter, unpublished data); fish are occasionally salvaged from the flip-bucket pools of the Frenchman and Antelope spillways after seasonal spill ceases.

In light of the findings of this study and data collected by DFG during recent years, any or all of the above actions warrant further evaluation and could help protect and enhance the quality fisheries of Little Last Chance Creek and Frenchman Lake. It is also important to be aware that while Licenses 9182 and 9928 specify minimum flows (2 cfs, or less under certain conditions; Appendix A) below Frenchman Dam between October 1 and March 31, there have never been specific minimum

flow requirements between April 1 and September 30.[3] It may be possible to clarify and refine, through an administrative process like the one completed in 1997 for Grizzly Valley Dam water right Permits/Applications, the obligation to provide a minimum flow year-round specifically appropriate for Little Last Chance Creek.

In the case of Lake Davis, this study also contributes more assurance that the State was probably successful in preventing a population of northern pike from spreading beyond Lake Davis, via Big Grizzly Creek, prior to the 1997 chemical treatment there. Since 1986, Lake Davis spill has not exceeded 0.21 feet (Spring 1995), and more recently was negligible (1996) or non-existent (1997), suggesting that pike had little opportunity to enter Big Grizzly Creek. Valves allowing deepwater outflow from the Upper Feather River Reservoirs occasionally pass fish (DWR 1996; Rischbieter, unpublished data[4]), including at Frenchman Dam as demonstrated by one rainbow trout collected in the stilling basin at the outlet valves, but a large percentage of such emigrants are probably killed (Stier and Kynard 1986; DWR 1996).

[3] An unspecified quantity of water must be released at all times in order to "keep in good condition any fish that may be planted or exist below the dam" (California Fish and Game Code §5937).

[4] Since December 1996, special structures have been in place at the outlet of the Lake Davis valves to increase the likelihood of mortality to northern pike passing through the outlet works; descriptions of these structures and the monitoring of their effectiveness will be the basis of a future DWR report.

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APPENDIX A

Water Rights Permits for Frenchman Dam and Lake

3898 249

Recording Requested by:
STATE WATER RESOURCES CONTROL BOARD
Pursuant to Government Code Sec. 6103.

When Recorded Mail to:
STATE WATER RESOURCES CONTROL BOARD
Room 1140, Resources Building
Sacramento, California 95814

RECORDED AT REQUEST OF
STATE WATER RESOURCES CONTROL BOARD
MARCH 17, 1970
AT 30 MIN. PAST 10 AM
VOL 193 PAGE 249
OFFICIAL RECORDS
PLUMAS CO. CAL. RECORDS

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STATE OF CALIFORNIA
THE RESOURCES AGENCY
STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER RIGHTS

License for Diversion and Use of Water

APPLICATION 16952 PERMIT 12945 LICENSE 9102

THIS IS TO CERTIFY, That STATE OF CALIFORNIA, DEPARTMENT OF WATER RESOURCES 1416 - 9TH STREET, ROOM 1123-15, SACRAMENTO, CALIFORNIA 95814

has made proof as of SEPTEMBER 25, 1969 (the date of inspection) to the satisfaction of the State Water Resources Control Board of a right to the use of the water of

LITTLE LAST CHANCE CREEK IN PLUMAS COUNTY

tributary to MIDDLE FORK FEATHER RIVER THENCE FEATHER RIVER

for the purpose of IRRIGATION, DOMESTIC, STOCKWATERING AND RECREATIONAL USES under Permit 12945 by the Board and that the right to the use of this water has been perfected in accordance with the laws of California, the Regulations of the Board and the permit terms; that the priority of this right dates from MARCH 20, 1956 and that the amount of water to which this right is entitled and hereby confirmed is limited to the amount actually beneficially used for the stated purposes and shall not exceed THIRTY THOUSAND (30,000) ACRE-FEET PER ANNUM, TO BE COLLECTED FROM ABOUT NOVEMBER 1 OF EACH YEAR TO ABOUT JUNE 1 OF THE SUCCEEDING YEAR. THE MAXIMUM WITHDRAWAL IN ANY ONE YEAR SHALL NOT EXCEED 15,194 ACRE-FEET.

THE POINT OF DIVERSION OF SUCH WATER IS LOCATED:

SOUTH 28° EAST 7,200 FEET FROM NW CORNER OF SECTION 28, T24N, R16E, MDB&M, BEING WITHIN NW1/4 OF NE1/4 OF SECTION 33, T24N, R16E, MDB&M.

A DESCRIPTION OF LANDS OR THE PLACE WHERE SUCH WATER IS PUT TO BENEFICIAL USE IS AS FOLLOWS:

RECREATIONAL AND DOMESTIC USE AT FRENCHMAN LAKE WITHIN SECTIONS 8, 16, 17, 20, 21, 22, 27, 28, 32 AND 33, T24N, R16E, AND ALONG THE NATURAL CHANNEL OF LITTLE LAST CHANCE CREEK WITHIN SECTION 33, T24N, R16E, AND SECTIONS 3, 4, AND 10, T23N, R16E, MDB&M. IRRIGATION OF 10,000 NET ACRES OF 31,600 GROSS ACRES AND INCIDENTAL DOMESTIC AND STOCKWATERING USE WILL BE MADE WITHIN THE BOUNDARIES OF LAST CHANCE WATER DISTRICT, BEING WITHIN T22N, R15E AND 16E; AND T23N, R14E, 15E AND 16E, MDB&M, AS SHOWN ON MAP FILED WITH STATE WATER RESOURCES CONTROL BOARD.

LICENSEE SHALL:

(A) MAINTAIN DAILY RECORDS OF THE VOLUME OF WATER IN FRENCHMAN RESERVOIR, RESERVOIR WATER SURFACE ELEVATIONS AND INFLOW INTO THE RESERVOIR AND OUTFLOW AND DIVERSIONS THEREFROM.

(B) PROVIDE AND MAINTAIN SUCH MEASURING FACILITIES AS MAY BE NECESSARY TO ACCUMULATE SAID RECORDS.

(C) MAKE SAID RECORDS AVAILABLE TO THE STATE WATER RESOURCES CONTROL BOARD, THE STATE DEPARTMENT OF FISH AND GAME AND THE PACIFIC GAS AND ELECTRIC COMPANY UPON REQUEST.

(D) ALLOW AUTHORIZED REPRESENTATIVES OF THE BOARD, THE STATE DEPARTMENT OF FISH AND GAME AND THE PACIFIC GAS AND ELECTRIC COMPANY REASONABLE ACCESS TO FRENCHMAN DAM AND RESERVOIR FOR THE PURPOSE OF CHECKING MEASURING FACILITIES OF LICENSEE.

FOR THE PURPOSE OF MAINTAINING FISH LIFE, LICENSEE SHALL RELEASE OR BYPASS DOWN THE NATURAL CHANNEL OF LITTLE LAST CHANCE CREEK BELOW FRENCHMAN DAM A CONTINUOUS FLOW OF NOT LESS THAN 2 CUBIC FEET PER SECOND BETWEEN OCTOBER 1 OF EACH YEAR AND MARCH 31 OF THE FOLLOWING YEAR; PROVIDED, HOWEVER, THAT WHENEVER FRENCHMAN RESERVOIR STORAGE IS LESS THAN 16,000 ACRE-FEET ON OCTOBER 1, THE REQUIRED MINIMUM RELEASES BETWEEN THAT DATE AND THE FOLLOWING MARCH 31 SHALL BE THE NATURAL INFLOW TO THE RESERVOIR OR 2 CUBIC FEET PER SECOND, WHICHEVER IS LESS.

THIS LICENSE IS SUBJECT TO COMPLIANCE WITH WATER CODE SECTION 10504.5(A).

Licensee shall allow representatives of the Board and other parties, as may be authorized from time to time by the Board, reasonable access to project works to determine compliance with the terms of this license.

All rights and privileges under this license including method of diversion, method of use and quantity of water diverted are subject to the continuing authority of the Board in accordance with law and in the interest of the public welfare to prevent waste, unreasonable use, unreasonable method of use or unreasonable method of diversion of said water.

Reports shall be filed promptly by licensee on appropriate forms which will be provided for the purpose from time to time by the Board.

The right hereby confirmed to the diversion and use of water is restricted to the point or points of diversion herein specified and to the lands or place of use herein described.

This license is granted and licensee accepts all rights herein confirmed subject to the following provisions of the Water Code:

Section 1625. Each license shall be in such form and contain such terms as may be prescribed by the Board.

Section 1626. All licenses shall be under the terms and conditions of this division (of the Water Code).

Section 1627. A license shall be effective for such time as the water actually appropriated under it is used for a useful and beneficial purpose in conformity with this division (of the Water Code) but no longer.

Section 1628. Every license shall include the enumeration of conditions therein which in substance shall include all of the provisions of this article and the statement that any appropriator of water to whom a license is issued takes the license subject to the conditions therein expressed.

Section 1629. Every licensee, if he accepts a license does so under the conditions precedent that no value whatsoever in excess of the actual amount paid to the State therefor shall at any time be assigned to or claimed for any license granted or issued under the provisions of this division (of the Water Code), or for any rights granted or acquired under the provisions of this division (of the Water Code), in respect to the regulation by any competent public authority of the [illegible] of the services to be rendered by any licensee or [illegible]

CERTIFICATE 8647
APPLICATION 16952
PERMIT 12945
LICENSE 9162

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD } ss.

I, Kathryn Holley, having custody of the files and records of the State Water Resources Control Board, State of California, do hereby certify that the attached License

is a true copy of the original on file in this office.

WITNESS my hand and the seal of the State Water Resources Control Board, State of California, this 16th day of March, 1970.

Title Supervising File Clerk

WRCB 127 (9-66)
24162-000 9-66 AM GSP

Recording Requested by:
STATE WATER RESOURCES CONTROL BOARD
Pursuant to Government Code Sec. 6103.

When Recorded Mail to:
STATE WATER RESOURCES CONTROL BOARD
Room 1140, Resources Building
Sacramento, California 95814

5639

155

RECORDED AT REQUEST OF State Water Resources Control Board
May 23, 1972
AT 5 MIN. PAST 11
VOL 212 PAGE 155
Official Records
PLUMAS CO., CA. RECORDS

INDEXED

COMPARED

DOROTHY MAE MARLEY
RECORDER
FEE No Fee

STATE OF CALIFORNIA
THE RESOURCES AGENCY
STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER RIGHTS

License for Diversion and Use of Water

APPLICATION 18044 PERMIT 12946 LICENSE 9928

THIS IS TO CERTIFY, *That* STATE OF CALIFORNIA, DEPARTMENT OF WATER RESOURCES
1416 - 9TH STREET, ROOM 1123,
SACRAMENTO, CALIFORNIA 95814

HAS *made proof as of* SEPTEMBER 25, 1969 *(the date of inspection) to the satisfaction of the State Water Resources Control Board of a right to the use of the water of* LITTLE LAST CHANCE CREEK IN PLUMAS COUNTY

tributary to MIDDLE FORK FEATHER RIVER THENCE FEATHER RIVER

for the purpose of RECREATIONAL USE
under Permit 12946 *of the Board and that the right to the use of this water has been perfected in accordance with the laws of California, the Regulations of the Board and the permit terms; that the priority of this right dates from* JULY 6, 1959 *and that the amount of water to which this right is entitled and hereby confirmed is limited to the amount actually beneficially used for the stated purposes and shall not exceed* FOUR THOUSAND NINE HUNDRED SIXTY-TWO (4,962) ACRE-FEET PER ANNUM, TO BE COLLECTED FROM NOVEMBER 1 OF EACH YEAR TO JUNE 1 OF THE SUCCEEDING YEAR.

LICENSEE'S RIGHT UNDER THIS LICENSE EXTENDS TO STORAGE OF WATER AS NECESSARY TO REFILL THE RESERVOIR IF EMPTIED FOR NECESSARY MAINTENANCE AND REPAIR OR FOR CONTROL OF ROUGH FISH (TO THE EXTENT OF 20,000 ACRE-FEET PER ANNUM).

MAXIMUM AMOUNT TO BE COLLECTED TO STORAGE UNDER THIS LICENSE AND LICENSE 9182 SHALL NOT EXCEED 34,962 ACRE-FEET PER ANNUM, UNLESS THE RESERVOIR HAS BEEN EMPTIED AS PROVIDED ABOVE, IN WHICH CASE THE MAXIMUM AMOUNT TO BE COLLECTED TO STORAGE IN ONE COLLECTION SEASON SHALL NOT EXCEED 50,000 ACRE-FEET PER ANNUM. SUCH RIGHTS SHALL BE EXERCISED ONLY DURING THE AUTHORIZED STORAGE SEASON.

LICENSEE SHALL HAVE THE RIGHT TO RETAIN 55,477 ACRE-FEET IN STORAGE IN FRENCHMAN RESERVOIR.

THE POINT OF DIVERSION OF SUCH WATER IS LOCATED:

SOUTH 28° EAST 7,200 FEET FROM NW CORNER OF SECTION 28, T24N, R16E, MDB&M, BEING WITHIN NW1/4 OF NE1/4 OF SECTION 33, T24N, R16E, MDB&M.

A DESCRIPTION OF LANDS OR THE PLACE WHERE SUCH WATER IS PUT TO BENEFICIAL USE IS AS FOLLOWS:

AT FRENCHMAN LAKE WITHIN SECTIONS 8, 16, 17, 20, 21, 22, 27, 28, 29, 32 AND 33, T24N, R16E, MDB&M, AS SHOWN ON MAP FILED WITH STATE WATER RESOURCES CONTROL BOARD.

LICENSEE SHALL:

(A) MAINTAIN DAILY RECORDS OF THE VOLUME OF WATER IN FRENCHMAN RESERVOIR, RESERVOIR WATER SURFACE ELEVATIONS AND INFLOW INTO THE RESERVOIR AND OUTFLOW AND DIVERSIONS THEREFROM.

(B) PROVIDE AND MAINTAIN SUCH MEASURING FACILITIES AS MAY BE NECESSARY TO ACCUMULATE SAID RECORDS.

(C) MAKE SAID RECORDS AVAILABLE TO THE STATE WATER RESOURCES CONTROL BOARD, THE STATE DEPARTMENT OF FISH AND GAME AND THE PACIFIC GAS AND ELECTRIC COMPANY UPON REQUEST.

(D) ALLOW AUTHORIZED REPRESENTATIVES OF THE BOARD, THE STATE DEPARTMENT OF FISH AND GAME AND THE PACIFIC GAS AND ELECTRIC COMPANY REASONABLE ACCESS TO FRENCHMAN DAM AND RESERVOIR FOR THE PURPOSE OF CHECKING MEASURING FACILITIES OF LICENSEE.

FOR THE PURPOSE OF MAINTAINING FISH LIFE, LICENSEE SHALL RELEASE OR BYPASS DOWN THE NATURAL CHANNEL OF LITTLE LAST CHANCE CREEK BELOW FRENCHMAN DAM A CONTINUOUS FLOW OF NOT LESS THAN 2 CUBIC FEET PER SECOND BETWEEN OCTOBER 1 OF EACH YEAR AND MARCH 31 OF THE FOLLOWING YEAR; PROVIDED, HOWEVER, THAT WHENEVER FRENCHMAN RESERVOIR STORAGE IS LESS THAN 16,000 ACRE-FEET ON OCTOBER 1, THE REQUIRED MINIMUM RELEASES BETWEEN THAT DATE AND THE FOLLOWING MARCH 31 SHALL BE THE NATURAL INFLOW TO THE RESERVOIR OR 2 CUBIC FEET PER SECOND, WHICHEVER IS LESS.

THIS LICENSE IS SUBJECT TO COMPLIANCE WITH WATER CODE SECTION 10504.5(A).

Licensee shall allow representatives of the Board and other parties, as may be authorized from time to time by the Board, reasonable access to project works to determine compliance with the terms of this license.

All rights and privileges under this license including method of diversion, method of use and quantity of water diverted are subject to the continuing authority of the Board in accordance with law and in the interest of the public welfare to prevent waste, unreasonable use, unreasonable method of use or unreasonable method of diversion of said water.

Reports shall be filed promptly by licensee on appropriate forms which will be provided for the purpose from time to time by the Board.

The right hereby confirmed to the diversion and use of water is restricted to the point or points of diversion herein specified and to the lands or place of use herein described.

This license is granted and licensee accepts all rights herein confirmed subject to the following provisions of the Water Code:

Section 1625. Each license shall be in such form and contain such terms as may be prescribed by the Board.

Section 1626. All licenses shall be under the terms and conditions of this division (of the Water Code).

Section 1627. A license shall be effective for such time as the water actually appropriated under it is used for a useful and beneficial purpose in conformity with this division (of the Water Code) but no longer.

Section 1628. Every license shall include the enumeration of conditions therein which in substance shall include all of the provisions of this article and the statement that any appropriator of water to whom a license is issued takes the license subject to the conditions therein expressed.

Section 1629. Every licensee, if he accepts a license does so under the conditions precedent that no value whatsoever in excess of the actual amount paid to the State therefor shall at any time be assigned to or claimed for any license granted or issued under the provisions of this division (of the Water Code), or for any rights granted or acquired under the provisions of this division (of the Water Code), in respect to the regulation by any competent public authority of the services or the price of the services to be rendered by any licensee or by the holder of any rights granted or acquired under the provisions of this division (of the Water Code) or in respect to any valuation for purposes of sale to or purchase, whether through condemnation proceedings or otherwise, by the State or any city, city and county, municipal water district, irrigation district, lighting district, or any political subdivision of the State, of the rights and property of any licensee, or the possessor of any rights granted, issued, or acquired under the provisions of this division (of the Water Code).

Section 1630. At any time after the expiration of twenty years after the granting of a license, the State or any city, city and county, municipal water district, irrigation district, lighting district, or any political subdivision of the State shall have the right to purchase the works and property occupied and used under the license and the works built or constructed for the enjoyment of the rights granted under the license.

Section 1631. In the event that the State, or any city, city and county, municipal water district, irrigation district, lighting district, or political subdivision of the State so desiring to purchase and the owner of the works and property cannot agree upon the purchase price, the price shall be determined in such manner as is now or may hereafter be provided by law for determining the value of property taken in eminent domain proceedings.

Dated: MAY 22 1972

STATE WATER RESOURCES CONTROL BOARD

K. E. Dunlap

Chief, Division of Water Rights

APPENDIX B

Contract for Sale of Water Stored in Frenchman Lake

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

CONTRACT
BETWEEN THE DEPARTMENT OF WATER RESOURCES OF THE STATE OF CALIFORNIA AND LAST CHANCE CREEK WATER DISTRICT FOR THE SALE OF WATER

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STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

CONTRACT BETWEEN THE DEPARTMENT OF WATER RESOURCES OF THE STATE OF CALIFORNIA AND LAST CHANCE CREEK WATER DISTRICT FOR THE SALE OF WATER

THIS CONTRACT, made this 6th day of June, 1996, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, between the Department of Water Resources of the State of California, herein referred to as the "Department," and Last Chance Creek Water District, a public agency in the State of California, duly organized, existing, and acting pursuant to the laws thereof with its principal place of business in Vinton, California, herein referred to as the "District."

WITNESSETH, That:

EXPLANATORY RECITALS

WHEREAS, the Department is authorized to construct and operate facilities for the storage and conveyance of water, certain of which facilities will make water available to the District, and

WHEREAS, funds have been provided under the California Water Resources Development Bond Act and appropriation acts for the construction of such facilities; and

WHEREAS, the Department has constructed Frenchman Unit, consisting of Frenchman Dam and Lake and appurtenances, on Little Last Chance Creek in the County of Plumas as a conservation project of said facilities; and

WHEREAS, under permits issued by the State Water Resources Control Board, herein referred to as the "Board," in approval of Applications Nos. 16952 and 18844, the Department is authorized to appropriate unappropriated water from Little Last Chance Creek for storage in Frenchman Lake in an amount not to exceed 34,962 acre-feet per annum or, under special circumstances stipulated in the Board approval of Application No. 18844, a maximum of 50,000 acre-feet per annum; and

WHEREAS, prior rights to the use of the water of Little Last Chance Creek were determined and established by decree of the Superior Court of the State of California in and for the County of Plumas in Action No. 3095, entitled "In the matter of the determination of the rights of the various claimants to the water of that portion of Middle Fork of Feather River and its tributaries situate above Beckwith [Beckwourth]

in Plumas County and being within Sierra and Plumas Counties, California" dated January 19, 1940, and entered January 22, 1940, in Judgment Book No. 5, at page 245; and

WHEREAS, water was supplied by the Department in 1962 pursuant to agreements with the holders of assumed rights under such decree, and from 1963 through 1995 pursuant to several successive contracts with the District; and

WHEREAS, the District proposes to obtain the assignment to it of established prior rights under such decree and to supply water in satisfaction of such rights during 1996 through 2000; and

WHEREAS, the District desires to obtain a supply of water from the Department; and

WHEREAS, the District and the Department intend to enter into a more detailed long-term contract for a supply of water at a later date;

NOW, THEREFORE, it is mutually agreed as follows:

A. INTRODUCTORY PROVISIONS

1. **Definitions.** When used in this contract, the following terms shall have the meanings hereinafter set forth:

(a) **"Bond Act"** shall mean the California Water Resources Development Bond Act, comprising Chapter 8, commencing at Section 12930, of Part 6 of Division 6 of the Water Code.

(b) **"SWP"** shall mean the California State Water Project.

(c) **"SWP Contractors"** shall mean entities contracting with the Department for a dependable supply of Project Water.

(d) "Project Water" shall mean water made available for delivery to SWP Contractors by and through SWP facilities.

2. **Term of Contract**. This contract shall become effective on the date first above written for the sale and delivery of water during the years 1996 through 2000 and may be renewed from time to time upon terms and conditions satisfactory to the parties. However, no right to such renewal shall vest at any time in the Department or in the District.

3. **Service of Water**. The delivery of water to the District under this contract shall be subject to the obligations of the Department to deliver Project Water to SWP Contractors or other long-term obligations of the SWP.

4. **Pledge of Revenues**. This contract is entered into for the direct benefit of the holders and owners of all general obligation bonds issued under the Bond Act, and the income and revenues derived from the contract are pledged to the purposes and in the priority set forth in that act.

B. WATER SERVICE PROVISIONS

5. **Delivery of Water**

(a) The quantity of water which the Department shall deliver to the District pursuant to this contract shall be based on the criteria set forth in subdivision (c) of this article and shall be inclusive of the quantity necessary to satisfy all rights downstream from Frenchman Dam on Little Last Chance Creek during the years 1996 through 2000. Such water shall be delivered to the District by the Department at the outlet works measuring weir of Frenchman Dam. At any time or times the District may

refuse to accept delivery of water made available to it; however, the District shall remain obligated to make all payments required under this contract.

(b) Water diverted at times when Frenchman Lake is full and spilling shall not be included in the controlled release amount which the Department agrees to deliver under the terms of this contract.

(c) On or before March 15 of each year, the Department shall forecast the anticipated storage for Frenchman Lake as of October I of the forecast year. Such forecast shall include the effects of all releases (including those to be made to the District under the terms of this contract), current storage, estimated evaporation, and estimated inflow. Based on the above-mentioned forecast, the Department shall set the quantity of water which will be available for delivery through controlled irrigation releases between April 1 and December 31 of the forecast year in accordance with the following criteria:

(1) The quantity shall not be less than five thousand (5,000) acre-feet.

(2) The predicted decrease in storage from October 1 of the previous year to September 30 of the forecast year, giving effect to releases, evaporation, and inflow, shall not exceed ten thousand (10,000) acre-feet unless a greater decrease results from the delivery to the District of the quantity specified in subdivision (c)(1) of this article.

(3) Subject to the ten thousand (10,000) acre-feet maximum allowable annual decrease in storage:

(i) The quantity shall not exceed twelve thousand (12,000) acre-feet unless the predicted storage as of October 1 of the forecast year exceeds thirty-eight thousand five hundred (38,500) acre-feet.

(ii) The quantity shall not exceed seven thousand (7,000) acre-feet unless the predicted storage as of October 1 of the forecast year exceeds twenty-seven thousand five hundred (27,500) acre-feet.

(iii) The quantity shall not exceed five thousand (5,000) acre-feet unless the predicted storage as of October 1 of the forecast year exceeds twenty-one thousand five hundred (21,500) acre-feet.

If precipitation or other weather conditions after March of the forecast year warrant, the Department may, at any time or from time to time before May 1 of the forecast year, adjust the forecast of anticipated storage and redetermine the quantity of water which will be available for delivery to the District under the above criteria.

6. **Measurement of Water Delivered**. The Department shall measure all water delivered to the District and shall keep and maintain accurate and complete records thereof. At any time or times, the District may inspect such measuring devices and equipment as are installed by the Department and the measurements and records taken therefrom.

7. **Water Delivery Schedules**

(a) As soon as it is reasonably possible within each year, the District shall notify the Department of the desired amounts, times, and rates of delivery of water pursuant to this contract. Insofar as such amounts, times, and rates of delivery to the

District are consistent with the delivery capability of Frenchman Lake under its established operation criteria, the Department shall make a reasonable attempt to comply with the District's requested water delivery schedules and shall notify the District, as far in advance as possible, of any substantial variance therefrom.

(b) A water delivery schedule may be changed by the Department upon the District's request. The District shall notify the Department within a reasonable time before the desired change is to become effective, and such change shall be subject to review and modification by the Department in like manner as the schedule itself.

8. **Responsibilities for Delivery and Distribution of Water**

(a) Neither the Department nor any of its officers, agents, or employees shall be liable for the control, carriage, handling, use, disposal, or distribution of water supplied to the District under the terms of this contract after such water has passed the delivery point described in Article 5; nor for claim of damage of any nature whatsoever, including but not limited to property damage, personal injury or death, arising out of or connected with the control, carriage, handling, use, disposal, or distribution of such water beyond said delivery point.

(b) Neither the District nor any of its officers, agents, or employees shall be liable for the control, carriage, handling, use, disposal, or distribution of water before such water has passed the delivery point described in Article 5; nor for the claim of damage of any nature whatsoever, including but not limited to property damage, personal injury or death, arising out of or connected with the control, carriage, handling, use, disposal, or distribution of such water before it has passed said delivery point.

(c) The District shall be responsible for apportionment and delivery of all water supplied to it under the terms of this contract including the delivery of water in satisfaction of rights to the use of the water of Little Last Chance Creek determined and established by decree of the Superior Court of the State of California, in and for the County of Plumas, in Action No. 3095, and will hold the Department harmless against any claims for damages arising out of the District's apportionment and delivery of water in satisfaction of such rights and from any failure or omission of delivery of such water.

(d) In the event that a shortage occurs in the quantity of water estimated to be available to the District under this contract, or in the event that for any reason the Department does not deliver the quantity of water to the District at the times and rates requested by the District, no liability shall accrue against the Department or any of its officers, agents, or employees, for any damage, direct or indirect, arising from a shortage in such deliveries of water.

9. **Suspension of Service**. In the event of any default by the District in the payment of any money required to be paid to the Department hereunder, the Department may suspend deliveries of water under this contract for so long as such default continues. During such period the District shall remain obligated to make all payments required under this contract. Action taken pursuant to this article shall not deprive the Department of or limit any remedy provided by this contract or by law for the recovery of money due or which may become due under this contract.

C. PAYMENT PROVISIONS

10. **Water Charge**

(a) Each year, the District shall pay the Department a sum of money to be calculated as follows:

(1) At as early a date each year as is reasonably possible, the Department shall determine the total Department costs attributable to the operation and maintenance of Frenchman Dam and Lake during the ten calendar years immediately preceding the forecast year. This total shall be divided by ten to determine an average annual cost.

(2) The average annual cost shall be divided by $35,370 to determine an escalation factor.

(3) The sum of money to be paid shall be the product of $14,000 multiplied by the escalation factor and shall be rounded to the nearest $1,000.

(b) Notwithstanding the water charge specified in subdivision (a) of this article, the annual water charge shall not be increased by more than two thousand dollars ($2,000) from one year to the next.

11. **Invoice and Water Charge Statement**. On or before April 10 of each year, the Department shall mail to the District an invoice indicating the District's payment obligation for the current year, and a water charge statement listing all steps used to calculate the District's payment obligation for that year, as set forth in Paragraph 10 of this contract, which shall include a listing of all operation and maintenance costs for Frenchman Dam and Lake for the previous year.

12. **Time and Method of Payment**

(a) The District shall make payment to the Department under this contract as follows:

(1) One-half of the total annual payment shall be made on or before May 1 of each year.

(2) The remaining one-half of the total annual payment shall be made on or before October 31 of each year.

(b) In the event that the Department discontinues the delivery of water in any one year for the remaining portion of that year, payments made by the District in that particular year in excess of the amount necessary to pay for the water actually delivered to the District in that year will be refunded within sixty (60) days after the discontinuance of operations under this contract; however, at the District's option, excess payments will be credited to the District's account for future deliveries of water.

13. **Delinquency in Payment**

(a) The governing body of the District shall provide for the punctual payment to the Department of payments which become due under this contract.

(b) Upon every amount of money required to be paid by the District to the Department pursuant to this contract which remains unpaid after it becomes due and payable, interest shall accrue at an annual rate equal to that earned by the Pooled Money Investment Account, as provided in Government Code Sections 16480, et seq., calculated monthly on the amount of such delinquent payment from and after the due date until it is paid. No interest shall be charged to or be paid by the District unless such delinquency continues for more than thirty (30) days.

14. **Obligation of the District to Make Payments**

(a) The District's failure or refusal to accept delivery of water made available for delivery to it pursuant to this contract shall in no way relieve the District of its obligation to make payments to the Department as provided for in this contract. The Department, however, shall make reasonable efforts to dispose of any water made available to but not required by the District, and any net revenues from such disposal shall be credited to the District's account provided that the District has made all payments to the Department required under this contract.

(b) The District as a whole is obligated to pay to the Department the payments becoming due under this contract, notwithstanding any individual default by its constituents or others in the payment to the District of assessments, tolls, or other charges levied by the District.

15. **Obligation of the District to Levy Taxes and Assessments**

(a) If the District fails or is unable to raise sufficient funds by other means, the governing body of the District shall levy upon all property in the District not exempt from taxation, a tax or assessment sufficient to provide for all payments under this contract.

(b) Taxes or assessments levied by the governing body of the District pursuant to subdivision (a) of this article shall be enforced and collected by all officers of the District charged with the duty of enforcing and collecting taxes or assessments levied by the District.

(c) All money collected for taxes or assessments under this article shall be kept in a separate fund by the treasurer or other officer of the District charged with the

safekeeping and disbursement of funds of the District, and, upon the written demand of the Department, the treasurer or other officer shall pay over to the Department all such money in the officer's possession or control then due the Department under this contract, which money shall be applied by the Department to the satisfaction of the amount due under this contract.

(d) In the event of failure, neglect, or refusal of any officer of the District to (1) levy any tax or assessment necessary to provide payment by the District under this contract; (2) enforce or collect the tax or assessment; or (3) pay over to the Department any money then due the Department collected on the tax or assessment, the Department may take such action in a court of competent jurisdiction as it deems necessary to compel the performance in their proper sequence of all such duties. Action taken pursuant hereto shall not deprive the Department of or limit any remedy provided by this contract or by law for the recovery of money due or which may become due under this contract.

D. GENERAL PROVISIONS

16. Remedies Not Exclusive. The use by either party of any remedy specified herein for the enforcement of this contract is not exclusive and shall not deprive the party using such remedy of, or limit the application of, any other remedy provided by law.

17. Opinions and Determinations. Where the terms of this contract provide for action to be based upon the opinion, judgment, approval, review, or determination of either party hereto, such terms are not intended to be and shall never be construed as permitting such opinion, judgment, approval, review, or determination to be arbitrary, capricious, or unreasonable.

18. **Contracting Officer of the Department**. The contracting officer of the Department shall be the Director and the Director's successors, or their duly authorized representatives. The contracting officer shall be responsible for all discretionary acts, opinions, judgments, approvals, reviews, and determinations required of the Department under the terms of this contract.

19. **Successors and Assigns Obligations**. This contract and all of its provisions shall apply to and bind the successors and assigns of the parties hereto.

20. **Assignment**. No assignment or transfer of this contract or any part hereof, rights hereunder, or interest herein by the District shall be valid unless and until it is approved by the Department and made subject to such reasonable terms and conditions as the Department may impose.

21. **Waiver of Rights**. Any waiver at any time by either party hereto of its rights with respect to a default or any other matter arising in connection with this contract shall not be deemed to be a waiver with respect to any other default or matter.

22. **Notices**. All notices that are required either expressly or by implication to be given by one party to the other under this contract shall be signed for the Department by its contracting officer, and for the District by its President and the President's successors or their duly authorized representatives. All such notices shall be deemed to have been given if delivered personally or if enclosed in a properly addressed envelope and deposited in a United States Post Office for delivery by registered or certified mail. Unless and until formally notified otherwise, the District shall address all notices to the Department as follows:

Department of Water Resources
State Water Project Analysis Office
Post Office Box 942836
Sacramento, California 94236-0001

and the Department will address all notices to the District as follows:

Last Chance Creek Water District
Post Office Box 24
Vinton, California 96135

23. **Maintenance and Inspection of Books, Records, and Reports**. During regular office hours, each of the parties hereto and their duly authorized representatives shall have the right to inspect and make copies of any books, records, or reports of the other party pertaining to this contract or matters related hereto. Each of the parties hereto shall maintain and make available for such inspection accurate records of all of its costs, disbursements, and receipts with respect to its activities under this Contract and the Bond Act.

APPENDIX C

Historical Operational Record of Frenchman Lake
and
Hypothetical Operation Study of Two Alternative Minimum Release Rates

FRENCHMAN LAKE OPERATION HISTORY			Capacity 55,477 acre-feet								INFLOW
MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	STREAM FLOW MAINT.	WATER SUPPLY CONTRACT	WATER RIGHT ENTITLEMENT	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
1962											
Jan	5503.17	359	359	0	0	0	0	0	0	0	359
Feb	5510.62	988	629	0	0	0	0	0	0	0	629
Mar	5519.34	2,208	1,220	0	0	0	0	0	31	31	1,251
Apr	5549.86	13,619	11,411	0	0	922	922	0	196	1,118	12,529
May	5550.15	13,811	192	0	0	3,096	3,096	0	250	3,346	3,538
Jun	5546.38	11,473	-2,338	0	0	2,791	2,791	0	284	3,075	737
Jul	5545.99	11,250	-223	0	0	128	128	0	304	432	209
Aug	5540.49	8,418	-2,832	5	0	2,446	2,451	0	387	2,838	6
Sep	5540.18	8,274	-144	13	0	0	13	0	227	240	96
Oct	5544.82	10,602	2,328	80	0	0	80	0	126	206	2,534
Nov	5545.58	11,020	418	113	0	0	113	0	88	201	619
Dec	5547.11	11,900	880	117	0	0	117	0	60	177	1,057
Total			11,900	328	0	9,383	9,711	0	1,953	11,664	23,564
1963											
Jan	5554.61	16,995	5,095	120	0	0	120	0	43	163	5,258
Feb	5565.64	26,731	9,736	115	0	0	115	0	73	188	9,924
Mar	5567.73	28,875	2,144	52	0	65	117	0	129	246	2,390
Apr	5574.63	36,703	7,828	0	0	119	119	0	206	325	8,153
May	5579.69	43,236	6,533	0	0	689	689	0	398	1,087	7,617
Jun	5578.12	41,138	-2,098	0	0	3,022	3,022	0	484	3,506	1,408
Jul	5577.35	40,133	-1,005	0	0	591	591	0	851	1,442	437
Aug	5572.66	34,341	-5,792	0	0	4,919	4,919	0	901	5,820	28
Sep	5572.41	34,049	-292	0	0	224	224	0	442	666	374
Oct	5572.17	33,770	-279	30	0	151	181	0	288	469	190
Nov	5572.89	34,611	841	94	0	31	125	0	188	313	1,154
Dec	5573.19	34,966	355	117	0	0	117	0	124	241	596
Total			23,066	528	0	9,811	10,339	0	4,127	14,466	37,529
1964											
Jan	5573.69	35,563	597	123	0	0	123	0	83	206	803
Feb	5574.05	35,996	433	117	0	0	117	0	93	210	643
Mar	5575.45	37,717	1,721	124	0	0	124	0	154	278	1,999
Apr	5578.52	41,667	3,950	136	0	0	136	0	397	533	4,483
May	5578.30	41,376	-291	70	0	3,534	3,604	0	513	4,117	3,826
Jun	5576.59	39,155	-2,221	51	0	2,543	2,594	0	560	3,154	933
Jul	5574.85	36,973	-2,182	28	0	1,468	1,496	0	742	2,238	56
Aug	5571.30	32,771	-4,202	8	0	3,564	3,572	0	693	4,265	63
Sep	5571.42	31,782	-989	12	0	581	593	0	550	1,143	154
Oct	5570.06	31,383	-399	52	0	182	234	0	318	552	153
Nov	5570.13	31,460	77	110	0	16	126	0	178	304	381
Dec	5576.22	38,685	7,225	123	0	0	123	0	120	243	7,468
Total			3,719	954	0	11,888	12,842	0	4,401	17,243	20,962
1965											
Jan	5579.88	43,494	4,809	123	0	0	123	0	92	215	5,024
Feb	5580.93	44,938	1,444	2,432	0	0	2,432	0	107	2,539	3,983
Mar	5585.54	51,617	6,679	232	0	0	232	0	181	413	7,092
Apr	5589.71	58,160	6,543	417	0	0	417	6,935	310	7,662	14,205
May	5588.49	56,194	-1,966	147	0	285	432	9,961	597	10,990	9,024
Jun	5586.98	53,821	-2,373	0	0	3,160	3,160	654	670	4,484	2,111
Jul	5585.53	51,602	-2,219	0	0	1,763	1,763	0	945	2,708	489
Aug	5583.62	48,768	-2,834	0	0	2,501	2,501	0	738	3,239	405
Sep	5582.05	46,510	-2,258	0	0	1,817	1,817	0	520	2,337	79
Oct	5581.63	45,917	-593	0	0	470	470	0	435	905	312
Nov	5581.97	46,397	480	80	0	83	163	0	227	390	870
Dec	5582.40	47,008	611	123	0	0	123	0	149	272	883
Total			8,323	3,554	0	10,079	13,633	17,550	4,971	36,154	44,477

FRENCHMAN LAKE OPERATION HISTORY			Capacity 55,477 acre-feet								INFLOW
MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	STREAM FLOW MAINT.	WATER SUPPLY CONTRACT	WATER RIGHT ENTITLEMENT	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
1966											
Jan	5572.83	47,480	472	123	0	0	123	0	100	223	695
Feb	5583.07	47,969	489	111	0	0	111	0	111	222	711
Mar	5574.75	50,433	2,464	123	0	0	123	0	184	307	2,771
Apr	5574.86	50,596	163	20	0	2,011	2,031	0	293	2,324	2,487
May	5582.54	47,208	-3,388	0	0	3,779	3,779	0	698	4,477	1,089
Jun	5579.99	43,644	-3,564	3	0	2,902	2,905	0	761	3,666	102
Jul	5577.17	39,900	-3,744	58	0	2,928	2,986	0	840	3,826	82
Aug	5575.49	37,767	-2,133	3	0	1,395	1,398	0	831	2,229	96
Sep	5575.05	37,220	-547	106	0	0	106	0	553	659	112
Oct	5574.67	36,752	-468	124	0	0	124	0	353	477	9
Nov	5575.11	37,294	542	119	0	0	119	0	198	317	859
Dec	5576.09	38,520	1,226	123	0	0	123	0	132	255	1,481
Total			-8,488	913	0	13,015	13,928	0	5,054	18,982	10,494
1967											
Jan	5577.5	40,327	1,807	123	0	0	123	0	89	212	2,019
Feb	5579.42	42,871	2,544	111	0	0	111	0	102	213	2,757
Mar	5585.69	51,844	8,973	123	0	0	123	959	180	1,262	9,276
Apr	5588.57	56,322	4,478	158	0	0	158	18,590	306	19,054	5,901
May	5589.41	57,673	1,351	126	0	0	126	9,402	523	10,051	20,590
Jun	5588.45	56,131	-1,542	119	0	0	119	787	563	1,469	8,542
Jul	5587.28	54,287	-1,844	45	0	1,163	1,208	0	995	2,203	1,146
Aug	5583.04	47,926	-6,361	0	0	5,665	5,665	0	1,005	6,670	309
Sep	5581.72	46,044	-1,882	0	0	1,537	1,537	0	683	2,220	338
Oct	5581.64	45,931	-113	117	0	15	132	0	409	541	428
Nov	5581.78	46,128	197	119	0	0	119	0	254	373	570
Dec	5582.15	46,652	524	123	0	0	123	0	212	335	859
Total			8,132	1,164	0	8,380	9,544	29,738	5,321	44,603	52,735
1968											
Jan	5582.77	47,537	885	123	0	0	123	0	114	237	1,122
Feb	5585.52	51,587	4,050	115	0	0	115	0	117	232	4,282
Mar	5587.52	54,662	3,075	123	0	0	123	0	185	308	3,383
Apr	5587.43	54,521	-141	71	1,704	0	1,775	618	316	2,709	2,568
May	5585.72	51,889	-2,632	0	3,257	0	3,257	0	510	3,767	1,135
Jun	5583.12	48,042	-3,847	0	3,320	0	3,320	0	812	4,132	285
Jul	5581.14	45,231	-2,811	0	1,954	0	1,954	0	1,004	2,958	147
Aug	5578.48	41,614	-3,617	0	2,807	0	2,807	0	810	3,617	0
Sep	5577.69	40,575	-1,039	56	458	0	514	0	656	1,170	131
Oct	5577.42	40,224	-351	109	63	0	172	0	390	562	211
Nov	5577.58	40,432	208	119	0	0	119	0	208	327	535
Dec	5578.03	41,020	588	123	0	0	123	0	144	267	855
Total			-5,632	839	13,563	0	14,402	618	5,266	20,286	14,654
1969											
Jan	5582.19	46,767	5,747	123	0	0	123	0	94	217	5,906
Feb	5583.87	49,192	2,425	126	0	0	126	0	101	227	2,710
Mar	5585.63	51,812	2,620	2,543	0	0	2,543	0	177	2,720	5,340
Apr	5589.48	57,847	6,035	1,265	0	0	1,265	12,470	321	14,056	20,091
May	5588.69	56,574	-1,273	21	0	0	21	13,555	323	13,899	12,626
Jun	5588.06	55,571	-1,003	40	2,116	0	2,156	853	603	3,612	2,609
Jul	5586.54	53,200	-2,371	0	1,880	0	1,880	1	1,017	2,898	527
Aug	5582.40	47,066	-6,134	0	5,135	0	5,135	0	1,037	6,172	38
Sep	5581.40	45,652	-1,414	0	849	0	849	0	692	1,541	127
Oct	5581.30	45,512	-140	61	157	0	218	0	336	554	414
Nov	5581.31	45,526	14	119	0	0	119	0	224	343	357
Dec	5582.10	46,639	1,113	123	0	0	123	0	155	278	1,391
Total			5,619	4,421	10,137	0	14,558	26,879	5,080	46,517	52,136

FRENCHMAN LAKE OPERATION HISTORY					Capacity 55,477 acre-feet						INFLOW
MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	STREAM FLOW MAINT.	WATER SUPPLY CONTRACT	WATER RIGHT ENTITLEMENT	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
1970											
Jan	5588.95	56,991	10,352	123	0	0	123	1,308	104	1,535	11,887
Feb	5588.60	56,430	-561	111	0	0	111	4,848	112	5,071	4,510
Mar	5588.56	56,366	-64	123	0	0	123	3,935	192	4,250	4,186
Apr	5588.42	56,143	-223	119	0	0	119	3,116	319	3,554	3,331
May	5588.25	55,873	-270	73	677	0	750	2,759	526	4,035	3,765
Jun	5585.32	51,344	-4,529	0	5,092	0	5,092	43	630	5,765	1,236
Jul	5583.49	48,637	-2,707	0	1,890	0	1,890	0	968	2,858	151
Aug	5579.36	42,848	-5,789	0	4,732	0	4,732	0	1,057	5,789	0
Sep	5579.01	41,051	-1,797	31	1,182	0	1,213	0	797	2,010	213
Oct	5577.69	40,632	-419	18	282	0	300	0	379	679	260
Nov	5578.68	41,937	1,305	119	0	0	119	0	211	330	1,635
Dec	5579.56	43,118	1,181	123	0	0	123	0	148	271	1,452
Total			-3,521	840	13,855	0	14,695	16,009	5,443	36,147	32,626
1971											
Jan	5581.38	45,624	2,506	129	0	0	129	0	96	225	2,731
Feb	5583.16	48,158	2,534	118	0	0	118	0	100	218	2,752
Mar	5587.43	54,580	6,422	118	0	0	118	0	177	295	6,717
Apr	5588.94	56,975	2,395	119	0	0	119	7,454	321	7,894	10,289
May	5589.24	57,458	483	123	0	0	123	14,000	534	14,657	15,140
Jun	5588.03	55,524	-1,934	81	1,212	0	1,293	6,993	769	9,055	7,121
Jul	5586.46	53,077	-2,447	0	2,590	0	2,590	0	971	3,561	1,114
Aug	5582.77	47,596	-5,481	0	4,608	0	4,608	0	981	5,589	108
Sep	5581.51	45,806	-1,790	0	1,305	0	1,305	0	665	1,970	180
Oct	5581.26	45,456	-350	0	301	0	301	0	336	637	287
Nov	5581.43	45,694	238	77	103	0	180	0	224	404	642
Dec	5582.15	46,710	1,016	123	0	0	123	0	155	278	1,294
Total			3,592	888	10,119	0	11,007	28,447	5,329	44,783	48,375
1972											
Jan	5582.75	47,567	857	123	0	0	123	0	100	223	1,080
Feb	5583.64	48,856	1,289	115	0	0	115	0	101	216	1,505
Mar	5586.69	53,431	4,575	123	0	0	123	0	181	304	4,879
Apr	5587.81	55,177	1,746	93	692	0	785	0	313	1,098	2,844
May	5586.82	53,632	-1,545	16	2,642	0	2,658	0	514	3,172	1,627
Jun	5584.12	49,559	-4,073	0	3,664	0	3,664	0	750	4,414	341
Jul	5580.09	43,839	-5,720	0	4,629	0	4,629	0	1,140	5,769	49
Aug	5577.96	40,986	-2,853	0	2,005	0	2,005	0	889	2,894	41
Sep	5577.36	40,203	-783	0	478	0	478	0	469	947	164
Oct	5577.23	40,035	-168	0	322	0	322	0	350	672	504
Nov	5577.47	40,346	311	202	0	0	202	0	207	409	720
Dec	5577.97	40,999	653	209	0	0	209	0	144	353	1,006
Total			-5,711	881	14,432	0	15,313	0	5,158	20,471	14,760
1973											
Jan	5578.82	42,124	1,125	209	0	0	209	0	93	302	1,427
Feb	5579.63	43,213	1,089	189	0	0	189	0	94	283	1,372
Mar	5581.42	45,680	2,467	209	0	0	209	0	165	374	2,841
Apr	5584.79	50,551	4,871	151	837	0	988	0	290	1,278	6,149
May	5583.31	48,376	-2,175	0	4,669	0	4,669	0	532	5,201	3,026
Jun	5581.73	46,116	-2,260	0	1,777	0	1,777	0	758	2,535	275
Jul	5578.77	42,057	-4,059	0	3,301	0	3,301	0	824	4,125	66
Aug	5576.60	39,225	-2,832	0	2,072	0	2,072	0	817	2,889	57
Sep	5575.98	38,438	-787	0	312	0	312	0	646	958	171
Oct	5575.82	38,237	-201	168	3	0	171	0	415	586	385
Nov	5576.41	38,970	733	144	0	0	144	0	202	346	1,079
Dec	5577.75	40,711	1,741	120	0	0	120	0	141	261	2,002
Total			-288	1,190	12,971	0	14,161	0	4,977	19,138	18,850

FRENCHMAN LAKE OPERATION HISTORY					Capacity 55,477 acre-feet						INFLOW
MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	STREAM FLOW MAINT.	WATER SUPPLY CONTRACT	WATER RIGHT ENTITLEMENT	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
1974											
Jan	5581.19	45,345	4,634	117	0	0	117	0	94	211	4,845
Feb	5582.11	46,653	1,308	128	0	0	128	0	98	226	1,534
Mar	5586.93	53,802	7,149	141	0	0	141	0	176	317	7,466
Apr	5588.69	56,574	2,772	1,335	0	0	1,335	3,258	318	4,911	7,683
May	5588.17	55,746	-828	171	454	0	625	4,935	528	6,088	5,260
Jun	5584.71	50,432	-5,314	0	5,262	0	5,262	9	869	6,140	826
Jul	5581.02	45,122	-5,310	0	4,542	0	4,542	0	927	5,469	159
Aug	5577.58	40,489	-4,633	0	3,612	0	3,612	0	1,091	4,703	70
Sep	5575.67	38,049	-2,440	0	1,693	0	1,693	0	797	2,490	50
Oct	5575.40	37,711	-338	38	199	0	237	0	362	599	261
Nov	5575.31	37,599	-112	0	232	0	232	0	174	406	294
Dec	5575.60	37,961	362	85	96	0	181	0	137	318	680
Total			-2,750	2,015	16,090	0	18,105	8,202	5,571	31,878	29,128
1975											
Jan	5575.94	38,388	427	137	0	0	137	0	88	225	652
Feb	5576.64	39,276	888	427	0	0	427	0	89	516	1,404
Mar	5576.67	39,315	39	2,366	0	0	2,366	0	154	2,520	2,559
Apr	5578.31	41,446	2,131	3,669	0	0	3,669	0	257	3,926	6,057
May	5584.60	50,269	8,823	2,696	3,610	0	6,306	0	392	6,698	15,521
Jun	5580.89	44,941	-5,328	1,684	5,891	0	7,575	0	718	8,293	2,965
Jul	5577.97	40,999	-3,942	750	2,463	0	3,213	0	841	4,054	112
Aug	5571.20	32,712	-8,287	1,769	5,964	0	7,733	0	680	8,413	126
Sep	5567.95	29,158	-3,554	2,519	674	0	3,193	0	474	3,667	113
Oct	5563.99	25,157	-4,001	3,768	0	0	3,768	0	375	4,143	142
Nov	5564.23	25,390	233	42	0	0	42	0	155	197	430
Dec	5564.66	25,810	420	0	0	0	0	0	107	107	527
Total			-12,151	19,827	18,602	0	38,429	0	4,330	42,759	30,608
1976											
Jan	5565.10	26,243	433	0	0	0	0	0	69	69	502
Feb	5565.71	26,851	608	0	0	0	0	0	70	70	678
Mar	5566.38	27,529	678	0	0	0	0	0	122	122	800
Apr	5565.07	26,213	-1,316	4	1,563	0	1,567	0	204	1,771	455
May	5561.03	22,391	-3,822	0	3,654	0	3,654	0	466	4,120	298
Jun	5557.02	18,944	-3,447	0	2,545	0	2,545	0	739	3,284	-163
Jul	5554.43	16,904	-2,040	0	1,575	0	1,575	0	511	2,086	46
Aug	5552.20	15,265	-1,639	0	1,360	0	1,360	0	363	1,723	84
Sep	5551.20	14,566	-699	13	529	0	542	0	376	918	219
Oct	5550.82	14,306	-260	18	211	0	229	0	246	475	215
Nov	5550.72	14,238	-68	147	0	0	147	0	109	256	188
Dec	5550.77	14,272	34	145	0	0	145	0	75	220	254
Total			-11,538	327	11,437	0	11,764	0	3,350	15,114	3,576
1977											
Jan	5551.07	14,477	205	105	0	0	105	0	48	153	358
Feb	5551.53	14,794	317	187	0	0	187	0	48	235	552
Mar	5551.82	14,997	203	121	0	170	291	0	84	375	578
Apr	5551.74	14,941	-56	112	30	44	186	0	140	326	270
May	5551.00	14,429	-512	68	671	0	739	0	231	970	458
Jun	5546.52	11,594	-2,835	0	2,748	0	2,748	0	334	3,082	247
Jul	5542.83	9,594	-2,000	0	1,548	0	1,548	0	474	2,022	22
Aug	5539.60	8,041	-1,553	2	1,223	0	1,225	0	343	1,568	15
Sep	5538.87	7,715	-326	7	152	0	159	0	200	359	33
Oct	5538.85	7,706	-9	20	0	0	20	0	70	90	81
Nov	5538.99	7,768	62	44	0	0	44	0	70	114	176
Dec	5539.90	8,178	410	133	0	0	133	0	49	182	592
Total			-6,094	799	6,372	214	7,385	0	2,091	9,476	3,382

FRENCHMAN LAKE OPERATION HISTORY					Capacity 55,477 acre-feet						INFLOW
MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	STREAM FLOW MAINT.	WATER SUPPLY CONTRACT	WATER RIGHT ENTITLEMENT	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
1978											
Jan	5542.35	9,352	1,174	141	0	0	141	0	34	175	1,349
Feb	5544.93	10,699	1,347	128	0	0	128	0	36	164	1,511
Mar	5559.80	21,296	10,597	141	0	0	141	0	85	226	10,823
Apr	5566.40	27,550	6,254	123	210	0	333	0	193	526	6,780
May	5567.09	28,259	709	0	3,060	0	3,060	0	341	3,401	4,110
Jun	5563.76	24,936	-3,323	0	3,650	0	3,650	0	586	4,236	913
Jul	5561.11	22,463	-2,473	0	2,099	0	2,099	0	637	2,736	263
Aug	5558.39	20,082	-2,381	0	1,857	0	1,857	0	597	2,454	73
Sep	5557.51	19,346	-736	0	520	0	520	0	375	895	159
Oct	5557.12	19,025	-321	54	116	0	170	0	345	515	194
Nov	5557.12	19,025	0	120	0	0	120	0	131	251	251
Dec	5557.20	19,091	66	135	0	0	135	0	90	225	291
Total			10,913	842	11,512	0	12,354	0	3,450	15,804	26,717
1979											
Jan	5557.74	19,536	445	123	0	0	123	0	58	181	626
Feb	5558.49	20,166	630	122	0	0	122	0	59	181	811
Mar	5560.25	21,693	1,527	126	0	165	291	0	106	397	1,924
Apr	5561.27	22,608	915	50	0	182	232	0	269	501	1,416
May	5558.94	20,550	-2,058	60	2,791	0	2,851	0	389	3,240	1,182
Jun	5555.10	17,416	-3,134	0	2,711	0	2,711	0	466	3,177	43
Jul	5551.77	14,962	-2,454	0	2,045	0	2,045	0	519	2,564	110
Aug	5550.22	13,903	-1,059	62	629	0	691	0	460	1,151	92
Sep	5549.26	13,275	-628	42	316	0	358	0	345	703	75
Oct	5549.09	13,165	-110	117	0	0	117	0	199	316	206
Nov	5549.01	13,114	-51	110	0	0	110	0	102	212	161
Dec	5549.46	13,404	290	106	0	0	106	0	70	176	466
Total			-5,687	918	8,492	347	9,757	0	3,042	12,799	7,112
1980											
Jan	5557.33	19,197	5,793	128	0	0	128	0	52	180	5,973
Feb	5563.01	24,221	5,024	128	0	0	128	0	61	189	5,213
Mar	5567.29	58,466	34,245	141	0	0	141	0	120	261	4,506
Apr	5573.05	34,858	-23,608	124	290	0	414	0	220	634	7,026
May	5576.00	38,463	3,605	50	1,191	0	1,241	0	407	1,648	5,253
Jun	5575.60	37,961	-502	0	1,574	0	1,574	0	543	2,117	1,615
Jul	5572.96	34,752	-3,209	0	2,711	0	2,711	0	780	3,491	282
Aug	5569.27	30,569	-4,183	0	3,453	0	3,453	0	757	4,210	27
Sep	5567.36	28,539	-2,030	0	1,638	0	1,638	0	498	2,136	106
Oct	5566.64	27,796	-743	0	582	0	582	0	334	916	173
Nov	5566.52	27,674	-122	0	232	0	232	0	164	396	274
Dec	5566.90	28,063	389	43	124	0	167	0	113	280	669
Total			14,659	614	11,795	0	12,409	0	4,049	16,458	31,117
1981											
Jan	5567.38	28,559	496	123	0	0	123	0	72	195	691
Feb	5568.38	29,613	1,054	109	0	0	109	0	73	182	1,236
Mar	5569.21	30,504	891	123	0	0	123	0	129	252	1,143
Apr	5569.39	30,700	196	89	696	183	968	0	361	1,329	1,525
May	5566.71	27,868	-2,832	0	2,922	0	2,922	0	486	3,408	576
Jun	5562.89	24,108	-3,760	0	3,170	0	3,170	0	690	3,860	100
Jul	5557.97	19,728	-4,380	0	3,596	0	3,596	0	814	4,410	30
Aug	5555.31	17,579	-2,149	0	1,615	0	1,615	0	590	2,205	56
Sep	5554.65	17,070	-509	84	146	0	230	0	339	569	60
Oct	5554.64	17,063	-7	139	0	0	139	0	183	322	315
Nov	5561.78	23,074	6,011	125	0	0	125	0	129	254	6,265
Dec	5569.79	31,137	8,063	138	0	0	138	0	109	247	8,310
Total			3,074	930	12,145	183	13,258	0	3,975	17,233	20,307

FRENCHMAN LAKE OPERATION HISTORY			Capacity 55,477 acre-feet								INFLOW
MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	STREAM FLOW MAINT.	WATER SUPPLY CONTRACT	WATER RIGHT ENTITLEMENT	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
1982											
Jan	5572.55	34,270	3,133	126	0	0	126	0	80	206	3,339
Feb	63.00	44,581	10,311	122	0	0	122	0	88	210	10,521
Mar	5574.87	50,670	6,089	136	0	0	136	0	173	309	6,398
Apr	5589.31	57,570	6,900	134	0	0	134	7,005	315	7,454	14,354
May	5588.51	56,285	-1,285	109	0	0	109	8,118	642	8,869	7,584
Jun	5587.00	53,910	-2,375	37	2,289	0	2,326	756	688	3,770	1,395
Jul	5584.39	49,957	-3,953	9	3,409	0	3,418	0	899	4,317	364
Aug	5581.47	45,751	-4,206	0	3,457	0	3,457	0	962	4,419	213
Sep	5580.49	44,388	-1,363	10	1,344	0	1,354	0	580	1,934	571
Oct	5580.87	44,914	526	123	0	0	123	0	345	468	994
Nov	5581.56	45,877	963	119	0	0	119	0	223	342	1,305
Dec	5582.88	47,755	1,878	123	0	0	123	0	156	279	2,157
Total			16,618	1,048	10,499	0	11,547	15,879	5,151	32,577	49,195
1983											
Jan	5584.44	50,301	2,546	123	0	0	123	0	102	225	2,501
Feb	5587.21	54,236	3,935	198	0	0	198	0	106	304	4,509
Mar	5588.25	55,871	1,635	9,269	0	0	9,269	3,945	190	13,404	15,039
Apr	5588.93	56,957	1,086	10,413	0	0	10,413	4,179	319	14,911	15,997
May	5590.24	59,088	2,131	7,087	0	0	7,087	18,004	536	25,627	27,758
Jun	5588.31	55,967	-3,121	166	302	0	468	12,312	839	13,619	10,498
Jul	5586.67	53,400	-2,567	0	2,583	0	2,583	200	1,098	3,881	1,314
Aug	5584.16	49,618	-3,782	0	3,792	0	3,792	0	867	4,659	877
Sep	5582.69	47,482	-2,136	0	2,053	0	2,053	0	754	2,807	671
Oct	5582.79	47,625	143	30	236	0	266	0	387	653	796
Nov	5585.46	51,555	3,930	87	107	0	194	0	234	428	4,358
Dec	5588.90	56,909	5,354	393	0	0	393	1,015	171	1,579	6,933
Total			9,154	27,766	9,073	0	36,839	39,655	5,603	82,097	91,251
1984											
Jan	5586.54	53,200	-3,709	6,343	0	0	6,343	1,465	110	7,918	4,209
Feb	5586.14	52,587	-613	2,823	0	0	2,823	0	108	2,931	2,318
Mar	5586.69	53,431	844	5,744	0	0	5,744	0	307	6,051	6,895
Apr	5588.25	55,871	2,440	3,247	0	0	3,247	154	314	3,715	6,155
May	5587.96	55,412	-459	1,262	611	0	1,873	2,122	525	4,520	4,061
Jun	5585.43	51,510	-3,902	0	4,149	0	4,149	0	818	4,967	1,065
Jul	5582.69	47,482	-4,028	0	3,390	0	3,390	0	1,080	4,470	442
Aug	5579.53	43,076	-4,406	0	3,666	0	3,666	0	972	4,638	232
Sep	5578.21	41,313	-1,763	0	1,237	0	1,237	0	785	2,022	259
Oct	5577.88	40,879	-434	0	486	0	486	0	315	801	367
Nov	5578.32	41,458	579	10	241	0	251	0	210	461	1,040
Dec	5578.64	41,882	424	123	0	0	123	0	146	269	693
Total			-15,027	19,552	13,780	0	33,332	3,741	5,690	42,763	27,736
1985											
Jan	5579.00	42,362	480	123	0	0	123	0	93	216	696
Feb	5579.64	43,225	863	144	0	0	144	0	94	238	1,101
Mar	5581.49	45,779	2,554	139	0	0	139	0	165	304	2,858
Apr	5586.33	52,877	7,098	139	0	0	139	0	297	436	7,534
May	5584.82	50,581	-2,296	1	3,120	0	3,121	0	726	3,847	1,551
Jun	5582.00	46,498	-4,083	0	3,656	0	3,656	0	961	4,617	534
Jul	5579.16	42,577	-3,921	0	3,094	0	3,094	0	967	4,061	140
Aug	5576.93	39,647	-2,930	0	2,108	0	2,108	0	916	3,024	94
Sep	5576.15	38,653	-994	0	670	0	670	0	522	1,192	198
Oct	5575.69	38,074	-579	0	370	0	370	0	403	773	194
Nov	5575.84	38,262	188	70	168	0	238	0	201	439	627
Dec	5576.17	38,678	416	123	123	0	246	0	139	385	801
Total			-3,204	739	13,309	0	14,048	0	5,484	19,532	16,328

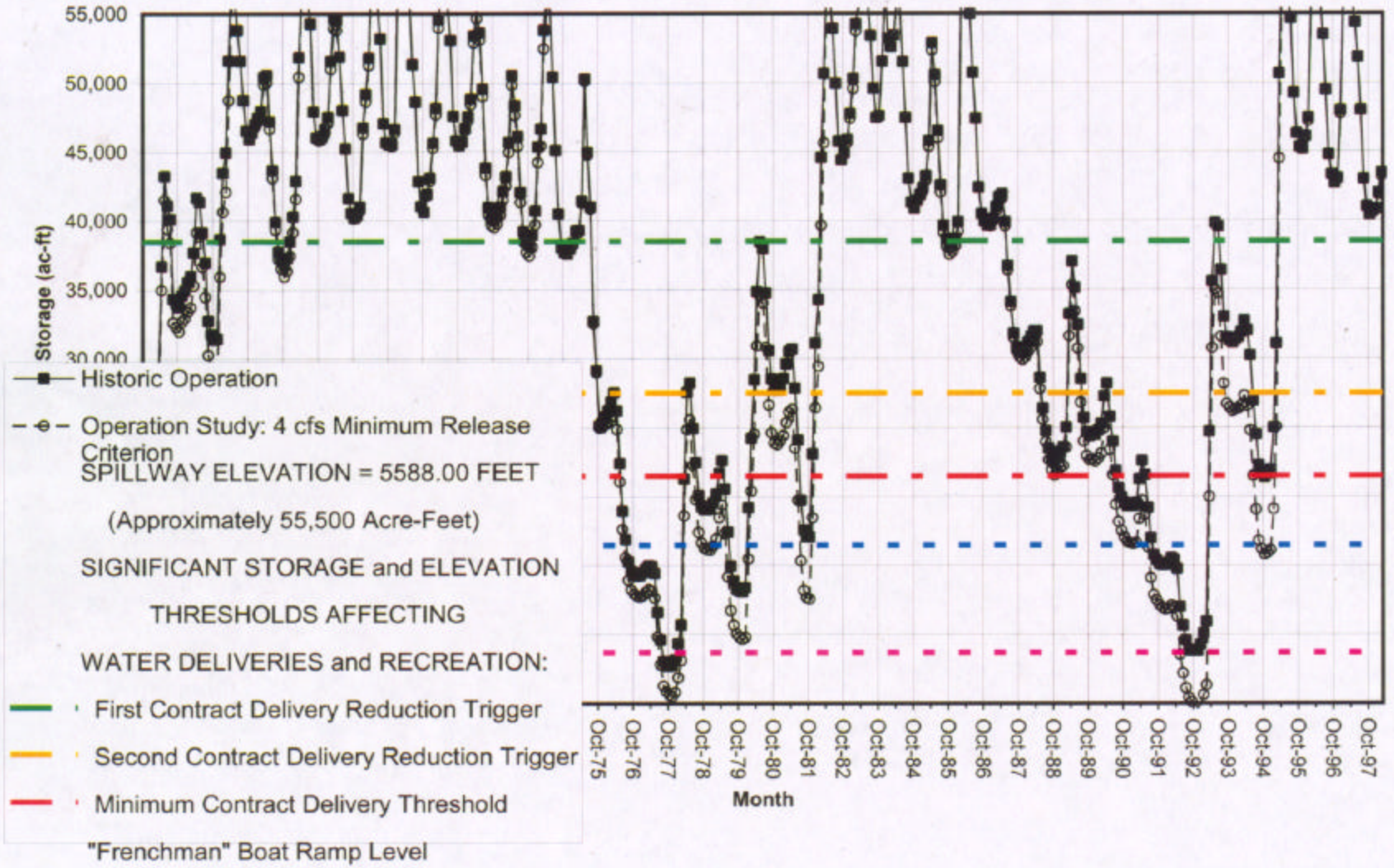
FRENCHMAN LAKE OPERATION HISTORY					Capacity 55,477 acre-feet						INFLOW
MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	STREAM FLOW MAINT.	WATER SUPPLY CONTRACT	WATER RIGHT ENTITLEMENT	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
1986											
JAN	5,577.12	39,892	1,214	119	0	0	119	0	89	208	1,422
FEB	5,588.62	56,460	16,568	128	0	0	128	111	98	337	16,905
MAR	5,589.17	57,344	884	148	0	0	148	16,644	194	16,986	17,870
APR	5,588.30	55,951	-1,393	2,880	0	0	2,880	5,357	320	8,557	7,164
MAY	5,587.66	54,940	-1,011	1,775	1,047	0	2,822	728	522	4,072	3,061
JUN	5,584.91	50,730	-4,210	0	4,003	0	4,003	1,026	1,026	6,055	1,845
JUL	5,582.64	47,410	-3,320	0	2,848	0	2,848	0	1,050	3,898	578
AUG	5,579.02	42,389	-5,021	0	4,169	0	4,169	0	970	5,139	118
SEP	5,577.59	40,501	-1,888	0	1,566	0	1,566	0	564	2,130	242
OCT	5,577.16	39,943	-558	0	413	0	413	0	402	815	257
NOV	5,576.92	39,634	-309	0	318	0	318	0	206	524	215
DEC	5,576.94	39,660	26	158	15	0	173	0	141	314	340
TOTAL	—	—	982	5,208	14,379	0	19,587	23,866	5,582	49,035	50,017
1987											
JAN	5,577.32	40,150	490	116	0	0	116	0	90	206	696
FEB	5,577.97	40,997	847	126	0	0	126	0	91	217	1,064
MAR	5,578.51	41,710	713	57	0	258	315	0	158	473	1,186
APR	5,578.66	41,909	199	63	322	88	473	0	266	739	938
MAY	5,577.12	39,892	-2,017	0	2,218	0	2,218	0	533	2,751	734
JUN	5,574.59	36,712	-3,180	0	2,715	0	2,715	0	789	3,504	324
JUL	5,572.40	34,094	-2,618	0	1,861	0	1,861	0	897	2,758	140
AUG	5,570.40	31,813	-2,281	0	1,626	0	1,626	0	717	2,343	62
SEP	5,569.52	30,842	-971	3	505	0	508	0	552	1,060	89
OCT	5,569.18	30,472	-370	75	105	0	180	0	304	484	114
NOV	5,569.09	30,374	-98	58	92	0	150	0	173	323	225
DEC	5,569.36	30,667	293	123	0	0	123	0	119	242	535
TOTAL	—	—	-8,993	621	9,444	346	10,411	0	4,689	15,100	6,107
1988											
JAN	5,569.83	31,181	514	123	0	0	123	0	77	200	714
FEB	5,570.23	31,623	442	115	0	0	115	0	77	192	634
MAR	5,570.56	31,991	368	94	12	188	294	0	134	428	796
APR	5,570.57	32,002	11	44	75	156	275	0	223	498	509
MAY	5,567.43	28,610	-3,392	0	3,044	0	3,044	0	490	3,534	142
JUN	5,565.24	26,384	-2,226	0	1,819	0	1,819	0	508	2,327	101
JUL	5,563.57	24,754	-1,630	0	1,029	0	1,029	0	693	1,722	92
AUG	5,562.19	23,453	-1,301	0	769	0	769	0	593	1,362	61
SEP	5,561.40	22,726	-727	44	194	0	238	0	519	757	30
OCT	5,561.06	22,418	-308	105	46	0	151	0	218	369	61
NOV	5,561.52	22,836	418	119	0	0	119	0	145	264	682
DEC	5,561.96	23,240	404	123	0	0	123	0	101	224	628
TOTAL	—	—	-7,427	767	6,988	344	8,099	0	3,778	11,877	4,450
1989											
JAN	5,562.30	23,555	315	23	0	0	23	0	65	88	403
FEB	5,563.86	25,033	1,478	111	0	0	111	0	66	177	1,655
MAR	5,571.65	33,226	8,193	123	0	0	123	0	136	259	8,452
APR	5,574.85	37,031	3,805	130	5	0	135	0	240	375	4,180
MAY	5,573.29	35,143	-1,888	0	2,505	0	2,505	0	432	2,937	1,049
JUN	5,570.96	32,441	-2,702	0	2,454	0	2,454	0	546	3,000	298
JUL	5,567.35	28,528	-3,913	0	3,080	0	3,080	0	1,015	4,095	182
AUG	5,564.56	25,713	-2,815	0	2,364	0	2,364	0	645	3,009	194
SEP	5,563.46	24,649	-1,064	0	805	0	805	0	461	1,266	202
OCT	4,963.14	24,345	-304	0	221	0	221	0	256	477	173
NOV	5,563.30	24,497	152	88	53	0	141	0	152	293	445
DEC	5,563.28	24,478	-19	123	0	0	123	0	67	190	171
TOTAL	---	---	1,238	598	11,487	0	12,085	0	4,081	16,166	17,404

FRENCHMAN LAKE OPERATION HISTORY					Capacity 55,477 acre-feet						INFLOW
MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	STREAM FLOW MAINT.	WATER SUPPLY CONTRACT	WATER RIGHT ENTITLEMENT	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
1990											
JAN	5563.63	24,812	334	123	0	0	123	0	67	190	524
FEB	5564.13	25,294	482	111	0	0	111	0	67	178	660
MAR	5566.12	27,267	1,973	123	0	0	123	0	119	242	2,215
APR	5567.04	28,207	940	119	0	0	119	0	276	395	1,335
MAY	5564.65	25,802	-2,405	6	2,495	0	2,501	0	402	2,903	498
JUN	5562.76	23,986	-1,816	0	1,418	0	1,418	0	625	2,043	227
JUL	5560.42	21,844	-2,142	0	1,743	0	1,743	0	712	2,455	313
AUG	5558.98	20,584	-1,260	0	710	0	710	0	580	1,290	30
SEP	5558.22	19,938	-646	0	432	0	432	0	339	771	125
OCT	5557.74	19,536	-402	0	184	0	184	0	268	452	50
NOV	5557.46	19,304	-232	113	38	0	151	0	132	283	51
DEC	5557.46	19,304	0	148	0	0	148	0	91	239	239
TOTAL	---	---	-5,174	743	7,020	0	7,763	0	3,678	11,441	6,267
1991											
Jan	5,557.49	19,329	25	148	0	0	148	0	56	204	229
Feb	5,557.74	19,536	207	117	0	0	117	0	58	175	382
Mar	5,559.77	21,270	1,734	71	0	418	489	0	104	593	2,327
Apr	5,561.25	22,590	1,320	86	167	0	253	0	179	432	1,752
May	5,560.10	21,560	-1,030	0	2,178	0	2,178	0	298	2,476	1,446
Jun	5,557.35	19,213	-2,347	137	1,946	0	2,083	0	426	2,509	162
Jul	5,554.54	16,986	-2,227	18	1,749	0	1,767	0	556	2,323	96
Aug	5,552.88	15,753	-1,233	42	710	0	752	0	548	1,300	67
Sep	5,552.37	15,386	-367	57	274	0	331	0	250	581	214
Oct	5,552.01	15,130	-256	129	0	0	129	0	213	342	86
Nov	5,551.89	15,045	-85	119	0	0	119	0	112	231	146
Dec	5,551.91	15,060	15	123	0	0	123	0	77	200	215
Total	—	—	-4,244	1,047	7,024	418	8,489	0	2,877	11,366	7,122
1992											
Jan	5,552.13	15,215	155	123	0	0	123	0	49	172	327
Feb	5,552.64	15,580	365	115	0	0	115	0	72	187	552
Mar	5,552.41	15,414	-166	69	0	338	407	0	86	493	327
Apr	5,551.50	14,774	-640	64	375	132	571	0	212	783	143
May	5,547.20	11,995	-2,779	0	2,472	0	2,472	0	389	2,861	82
Jun	5,544.84	10,652	-1,343	0	1,032	0	1,032	0	362	1,394	51
Jul	5,542.78	9,568	-1,084	5	802	0	807	0	322	1,129	45
Aug	5,541.43	8,897	-671	14	307	0	321	0	364	685	14
Sep	5,541.22	8,796	-101	20	0	0	20	0	168	188	87
Oct	5,541.30	8,835	39	18	0	0	18	0	96	114	153
Nov	5,541.22	8,796	-39	18	0	0	18	0	77	95	56
Dec	5,542.20	9,276	480	18	0	0	18	0	34	52	532
Total	---	---	-5,784	464	4,988	470	5,922	0	2,231	8,153	2,369
1993											
Jan	5,543.78	10,085	809	121	0	0	121	0	36	157	966
Feb	5,545.38	10,945	860	111	0	0	111	0	43	154	1,014
Mar	5,563.52	24,707	13,762	123	0	0	123	0	86	209	13,971
Apr	5,573.69	35,621	10,914	119	0	0	119	0	219	338	11,252
May	5,577.06	39,814	4,193	11	2,424	0	2,435	0	404	2,839	7,032
Jun	5,576.87	39,570	-244	45	1,929	0	1,974	0	652	2,626	2,382
Jul	5,574.37	36,443	-3,127	0	2,489	0	2,489	0	853	3,342	215
Aug	5,571.47	33,020	-3,423	0	2,821	0	2,821	0	709	3,530	107
Sep	5,570.17	31,557	-1,463	0	1,014	0	1,014	0	561	1,575	112
Oct	5,569.95	31,313	-244	26	202	0	228	0	332	560	316
Nov	5,569.81	31,159	-154	119	0	0	119	0	176	295	141
Dec	5,570.02	31,391	232	123	0	0	123	0	121	244	476
Total	—	—	22,115	798	10,879	0	11,677	0	4,192	15,869	37,984

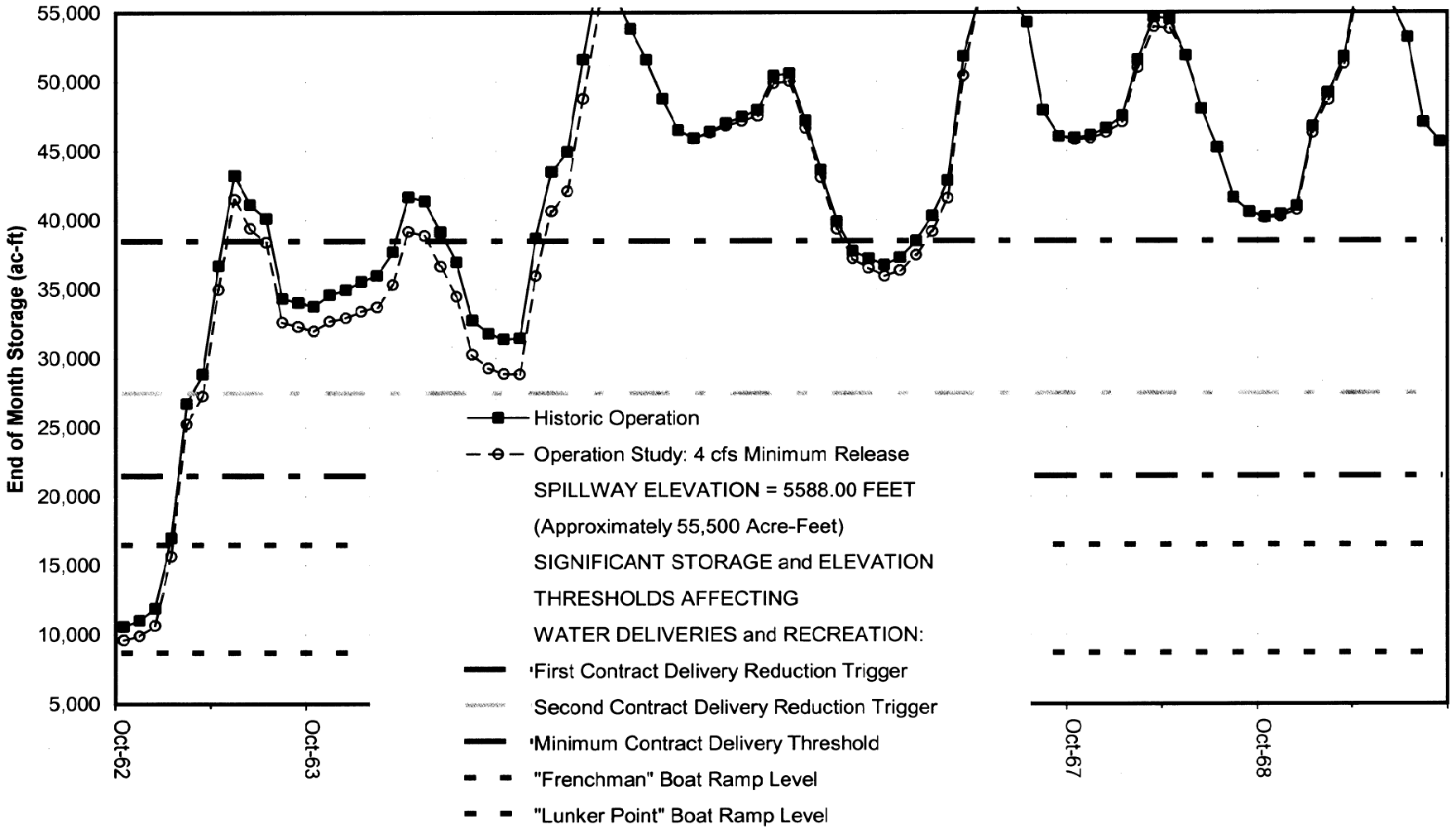
FRENCHMAN LAKE OPERATION HISTORY			Capacity 55,477 acre-feet								INFLOW
MONTH	WATER SURFACE ELEVATION (in feet)	STORAGE*	STORAGE CHANGE	STREAM FLOW MAINT.	WATER SUPPLY CONTRACT	WATER RIGHT ENTITLEMENT	TOTAL REGULATED RELEASE	SPILL	ESTIMATED EVAPORATION AND SEEPAGE	TOTAL OUTFLOW	COMPUTED OR ESTIMATED
1994											
Jan	5,570.19	31,579	188	123	0	0	123	0	78	201	389
Feb	5,570.52	31,946	367	111	0	0	111	0	78	189	556
Mar	5,571.25	32,770	824	123	0	0	123	0	136	259	1,083
Apr	5,570.59	32,025	-745	31	799	171	1,001	0	283	1,284	539
May	5,568.97	30,245	-1,780	0	1,868	0	1,868	0	363	2,231	451
Jun	5,565.80	26,944	-3,301	0	2,614	0	2,614	0	804	3,418	117
Jul	5,563.31	24,506	-2,438	0	1,738	0	1,738	0	780	2,518	80
Aug	5,560.87	22,246	-2,260	0	1,615	0	1,615	0	656	2,271	11
Sep	5,560.18	21,631	-615	48	287	0	335	0	338	673	58
Oct	5,559.89	21,375	-256	123	0	0	123	0	167	290	34
Nov	5,560.16	21,613	238	119	0	0	119	0	141	260	498
Dec	5,560.50	21,915	302	123	0	0	123	0	98	221	523
Total	---	---	-9,476	801	8,921	171	9,893	0	3,922	13,815	4,339
1995											
Jan	5563.84	25,013	3,098	123	0	0	123	0	65	188	3,286
Feb	5569.76	31,106	6,093	111	0	0	111	0	73	184	6,277
Mar	5584.87	50,670	19,564	123	0	0	123	0	158	281	19,845
Apr	5589.68	58,172	7,502	94	0	0	94	6,774	317	7,185	14,687
May	5589.30	57,555	-617	0	0	0	0	20,507	537	21,044	20,427
Jun	5588.51	56,286	-1,269	0	0	0	0	7,289	802	8,091	6,822
Jul	5587.46	54,627	-1,659	0	1,134	0	1,134	1,051	997	3,182	1,523
Aug	5583.90	49,236	-5,391	0	4,865	0	4,865	0	984	5,849	458
Sep	5581.86	46,299	-2,937	0	2,344	0	2,344	0	721	3,065	128
Oct	5581.17	45,331	-968	92	576	0	668	0	561	1,229	261
Nov	5581.05	45,163	-168	224	0	0	224	0	362	586	418
Dec	5581.71	46,088	925	123	0	0	123	0	154	277	1,202
Total	---	---	24,173	890	8,919	0	9,809	35,621	5,731	51,161	75,334
1996											
Jan	5582.67	47,453	1,365	123	0	0	123	0	99	222	1,587
Feb	5588.25	55,873	8,420	342	0	0	342	56	181	579	8,999
Mar	5589.11	57,248	1,375	861	0	0	861	8,218	224	9,303	10,678
Apr	5588.99	57,055	-193	833	0	0	833	12,141	323	13,297	13,104
May	5588.50	56,270	-785	861	0	0	861	6,736	529	8,126	7,341
Jun	5586.72	53,477	-2,793	260	2,499	0	2,759	795	817	4,371	1,578
Jul	5584.07	49,486	-3,991	0	3,457	0	3,457	0	1,104	4,561	570
Aug	5580.76	44,761	-4,725	0	4,048	0	4,048	0	1,002	5,050	325
Sep	5579.73	43,348	-1,413	0	952	0	952	0	795	1,747	334
Oct	5579.25	42,700	-648	38	448	0	486	0	472	958	310
Nov	5579.53	43,077	377	119	0	0	119	0	216	335	712
Dec	5583.04	47,985	4,908	123	0	0	123	0	151	274	5,182
Total	---	---	1,897	3,560	11,404	0	14,964	27,946	5,913	48,823	50,720
1997											
Jan	5588.26	55,888	7,903	1,993	0	0	1,993	7,313	112	9,418	17,321
Feb	5588.20	55,793	-95	4,108	0	0	4,108	325	111	4,544	4,449
Mar	5588.48	56,238	445	7,268	0	0	7,268	1,204	190	8,662	9,107
Apr	5588.38	56,079	-159	3,485	0	0	3,485	3,275	313	7,073	6,914
May	5587.28	54,345	-1,734	3,548	252	0	3,800	278	520	4,598	2,864
Jun	5585.64	51,827	-2,518	0	2,741	0	2,741	0	802	3,543	1,025
Jul	5583.05	47,999	-3,828	0	3,357	0	3,357	0	889	4,246	418
Aug	5579.49	43,023	-4,976	0	4,199	0	4,199	0	925	5,124	148
Sep	5577.99	41,025	-1,998	0	1,640	0	1,640	0	611	2,251	253
Oct	5577.53	40,424	-601	62	399	0	461	0	457	918	317
Nov	5577.70	40,645	221	179	0	0	179	0	208	387	608
Dec	5577.86	40,855	210	184	0	0	184	0	144	328	538
Total	—	—	-7,130	20,827	12,588	0	33,415	12,395	5,282	51,092	43,962

Averages.	evap-seep	outflow	Inflow	
1962-1997	4,536	27,183	28,057	ac-ft

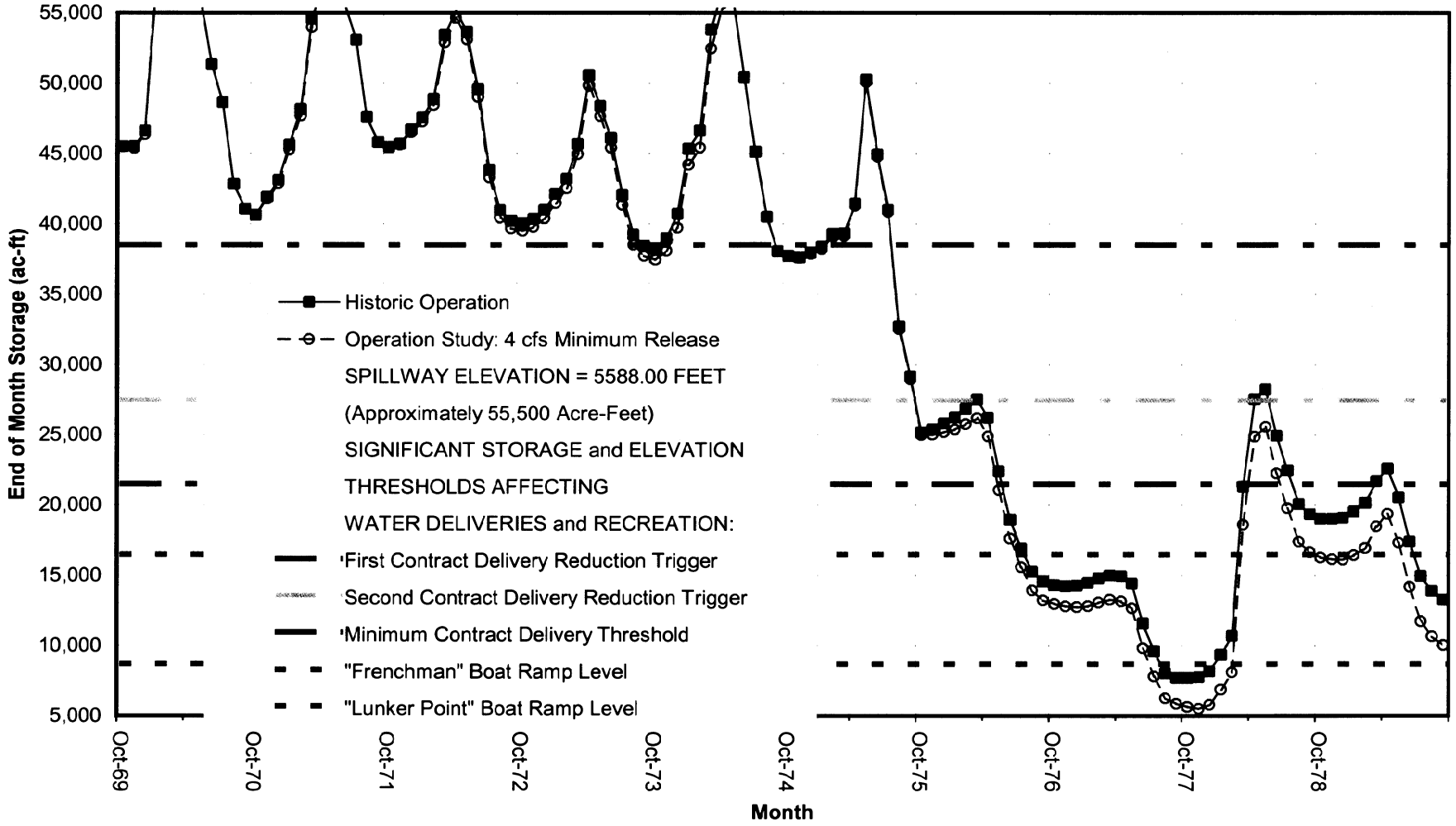
Frenchman Lake Operation Study



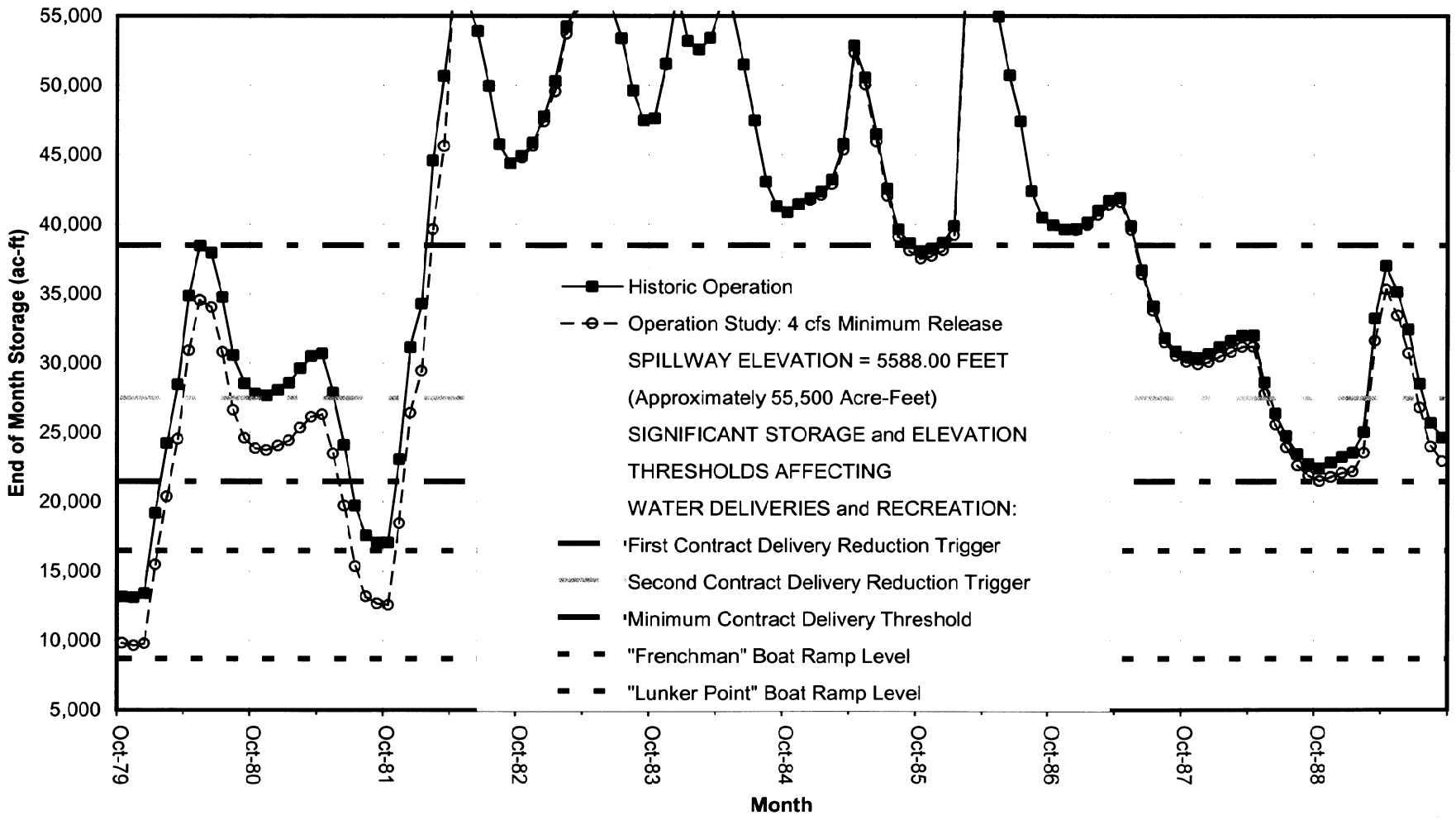
Frenchman Lake Operation Study, 1963-69

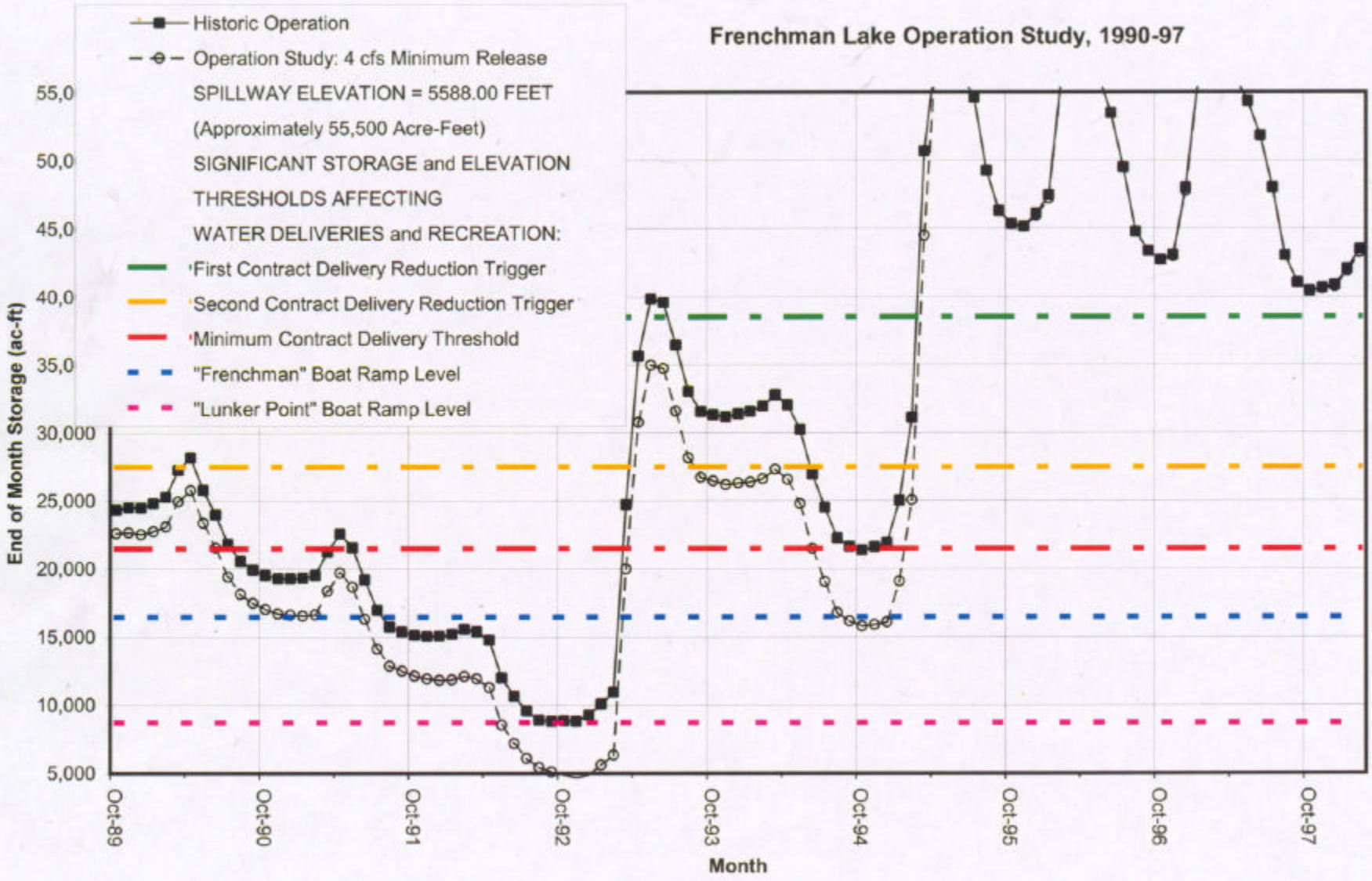


Frenchman Lake Operation Study, 1970-79

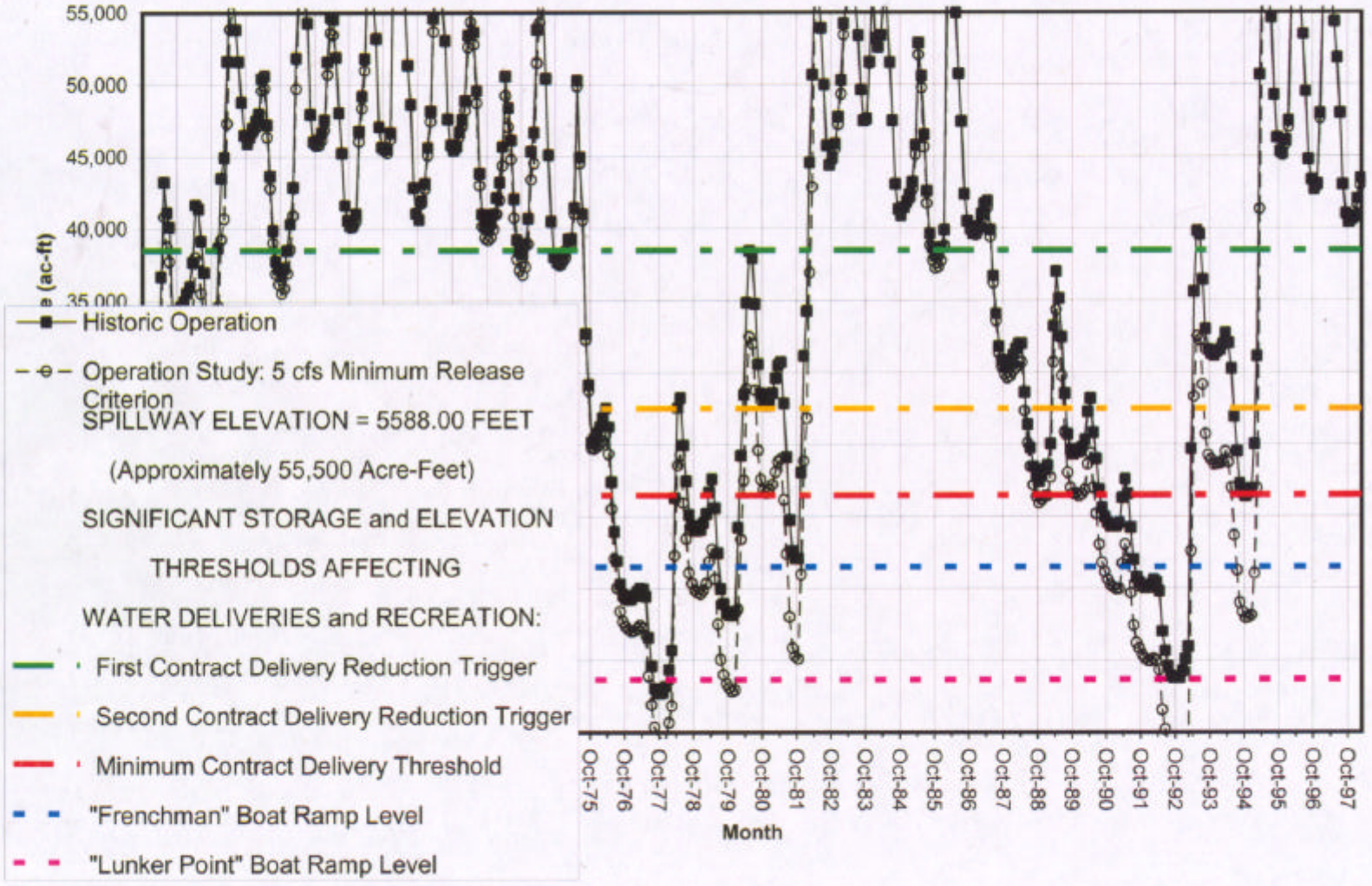


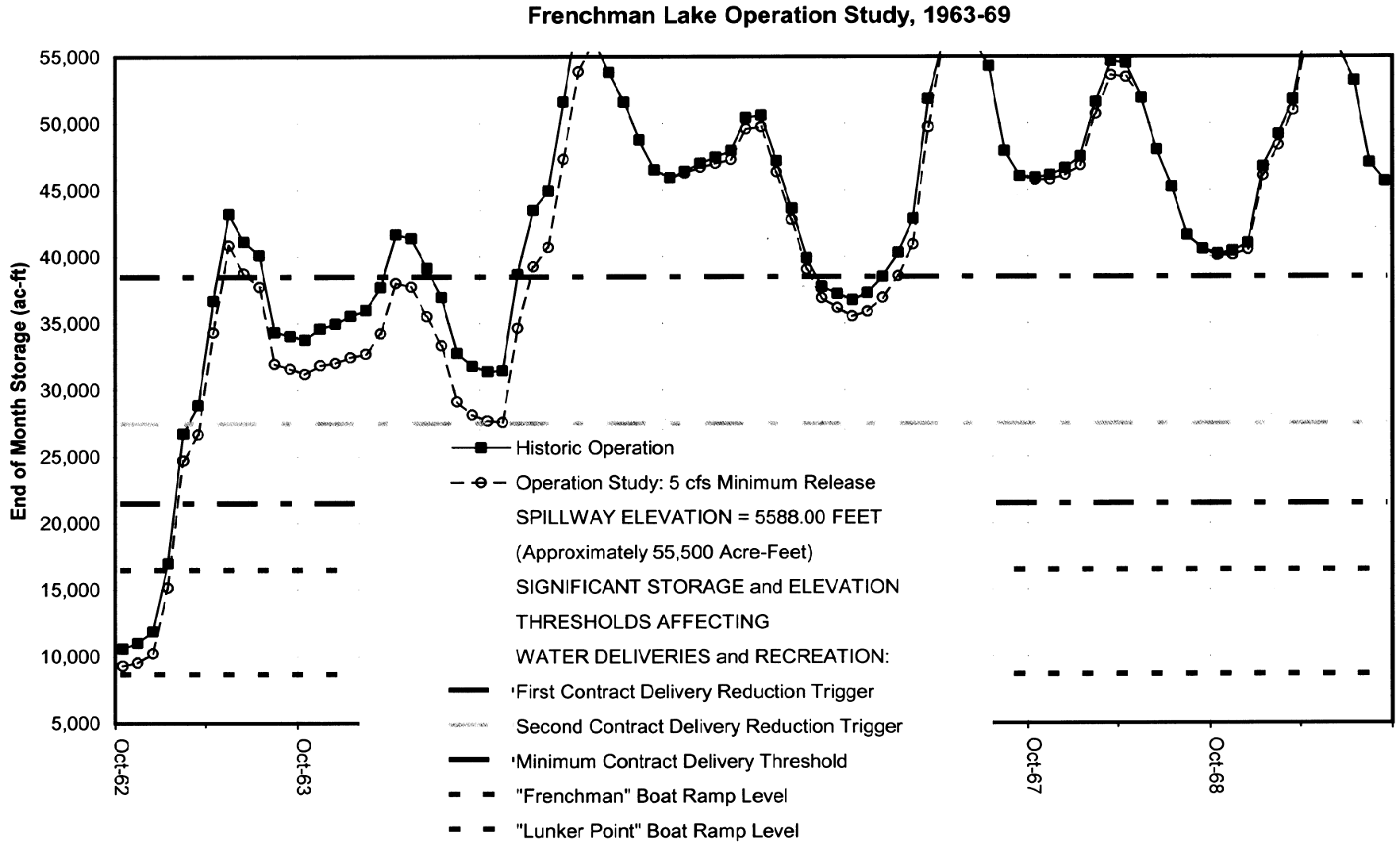
Frenchman Lake Operation Study, 1980-89




Frenchman Lake Operation Study, 1990-97
Historic Operation
Operation Study: 4 cfs Minimum Release
SPILLWAY ELEVATION = 5588.00 FEET
(Approximately 55,500 Acre-Feet)
SIGNIFICANT STORAGE and ELEVATION
THRESHOLDS AFFECTING
WATER DELIVERIES and RECREATION:
First Contract Delivery Reduction Trigger
Second Contract Delivery Reduction Trigger
Minimum Contract Delivery Threshold
"Frenchman" Boat Ramp Level
"Lunker Point" Boat Ramp Level
End of Month Storage (ac-ft)
55,0
50,0
45,0
40,0
35,0
30,000
25,000
20,000
15,000
10,000
5,000
Oct-89
Oct-90
Oct-91
Oct-92
Oct-93
Oct-94
Oct-95
Oct-96
Oct-97
Month

Frenchman Lake Operation Study

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30,000
25,000
20,000
15,000
10,000
5,000
Oct-62
Oct-63
Oct-67
Oct-68
Historic Operation
Operation Study: 5 cfs Minimum Release
SPILLWAY ELEVATION = 5588.00 FEET
(Approximately 55,500 Acre-Feet)
SIGNIFICANT STORAGE and ELEVATION
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WATER DELIVERIES and RECREATION:
'First Contract Delivery Reduction Trigger
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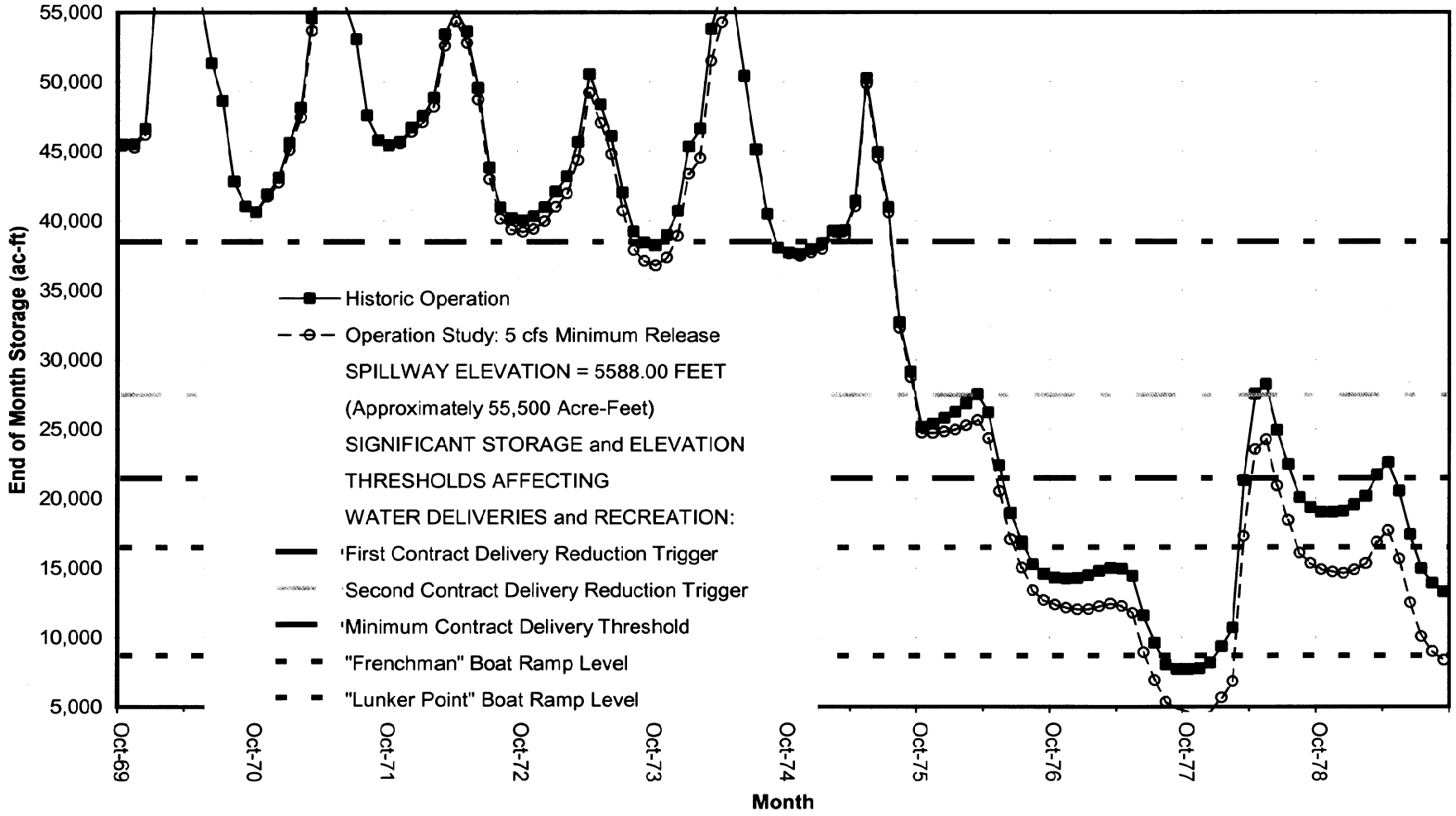
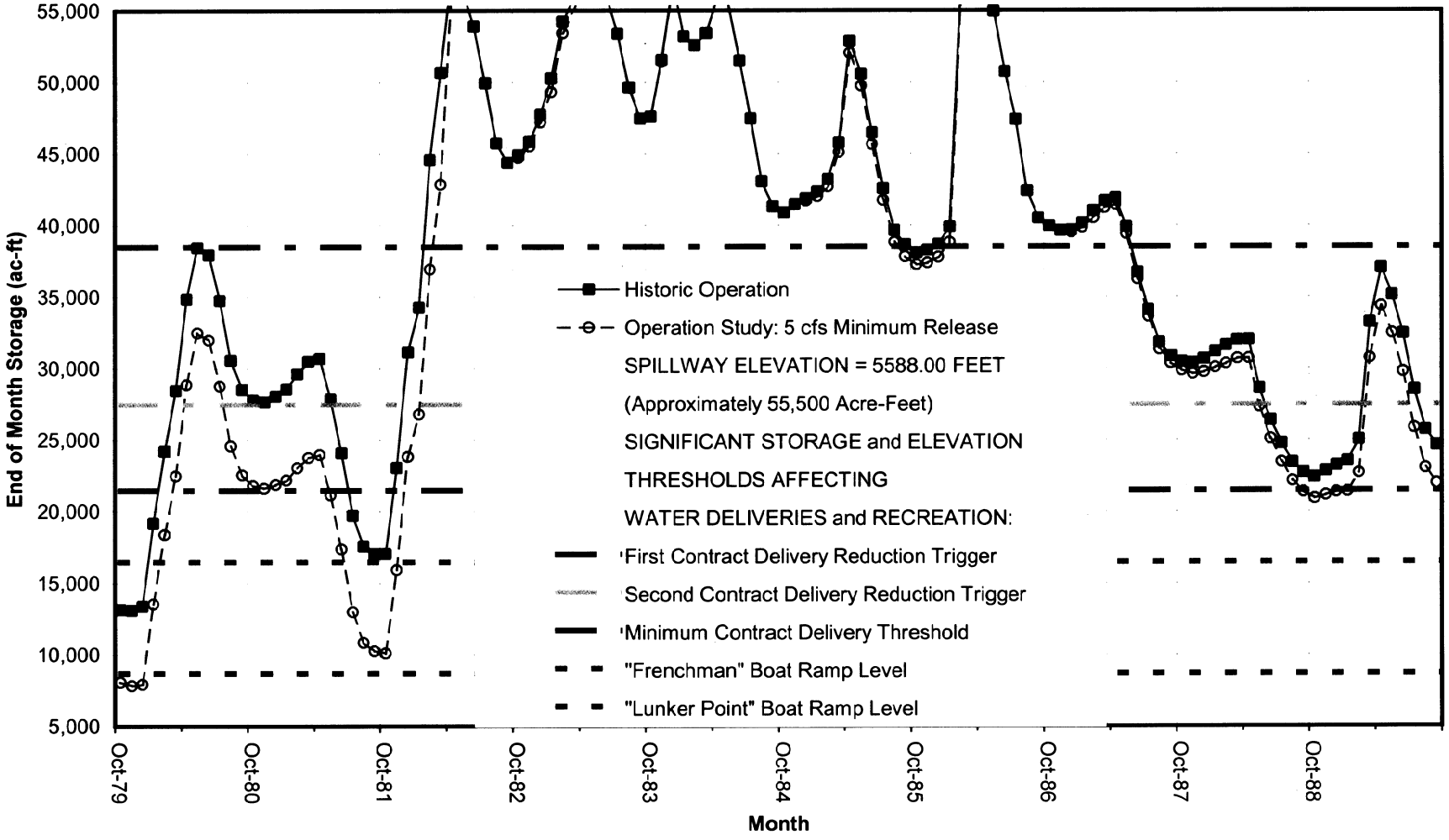
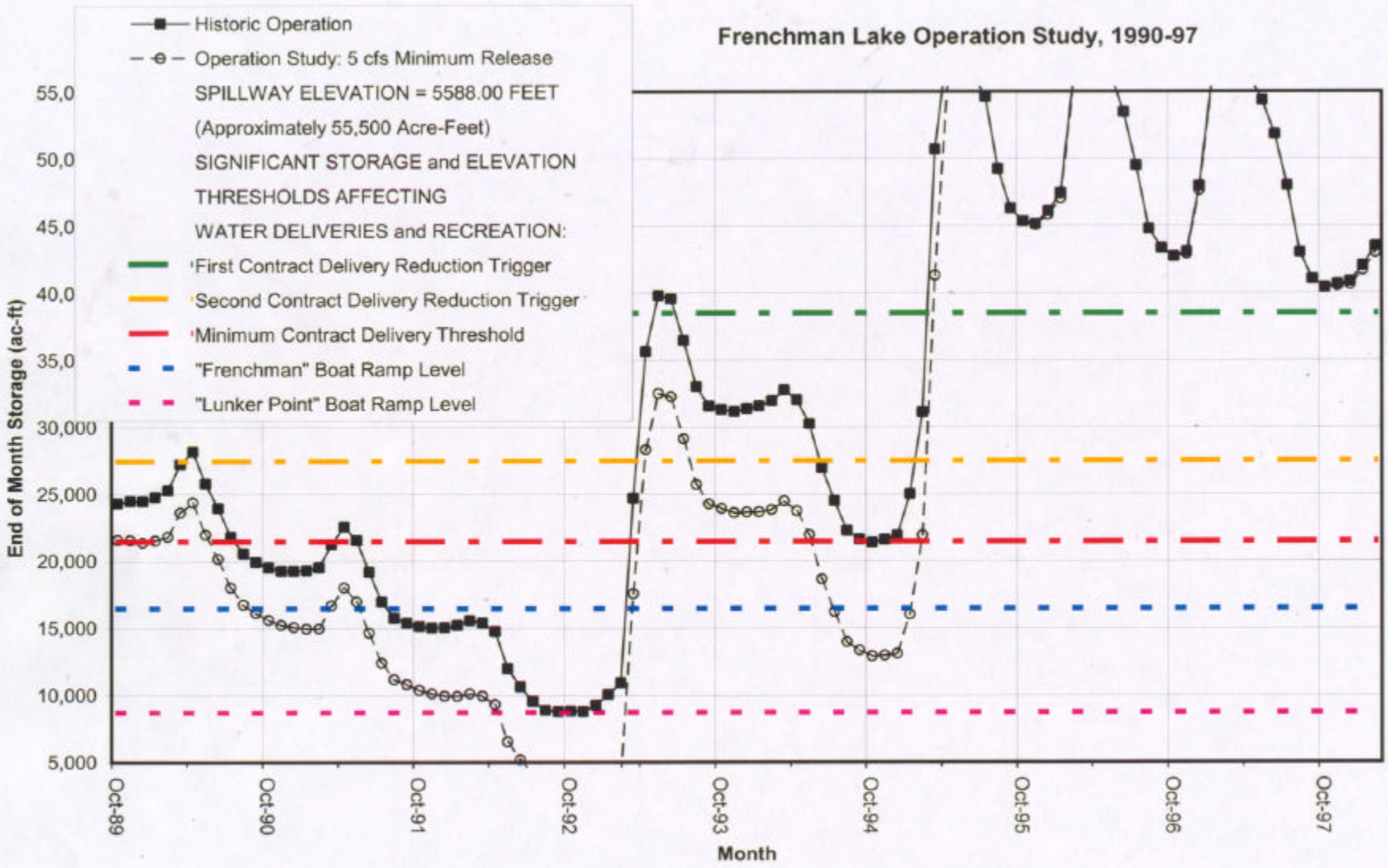
Frenchman Lake Operation Study, 1970-79



Frenchman Lake Operation Study, 1980-89

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Oct-93
Oct-94
Oct-95
Oct-96
Oct-97
Month