ANNUAL REPORT

NIMBUS SALMON AND STEELHEAD HATCHERY

FISCAL YEAR OF 1955-56

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NIMBUS HATCHERY IS A COOPERATIVE PROJECT BUILT
BY THE U. S. BUREAU OF RECLAMATION AND OPERATED
UNDER CONTRACT BY THE CALIFORNIA DEPARTMENT OF FISH AND GAME

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INTRODUCTION

This is the first annual report of the Nimbus Salmon and Steelhead Hatchery, built by the U. S. Bureau of Reclamation as a part of the Central Valley Project, and operated under contract with the Bureau of Reclamation by the California Department of Fish and Game to maintain the populations of salmon and steelhead which formerly spawned in that area of the American River above Nimbus and Folsom dams.

The assembled data summarize information for the period July 1, 1955, to June 30, 1956, on the numbers of fish trapped and spawned, progress of eggs and fry, and conditions of water quality and temperatures.

Included is an outline of the purpose of the hatchery and history of its development.

ACKNOWLEDGMENTS

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HISTORY OF THE NIMBUS SALMON AND STEELHEAD HATCHERY

King salmon, Oncorhynchus tshawytscha, enter the American River in well-defined spring and fall runs. The spring run arrives in the Nimbus area during the months of May, June, and July and involves comparatively few salmon. These spring runs of salmon used the ladder on the old Pacific Gas and Electric Company Dam at Folsom to reach the deeper and cooler waters upstream. In 1950, floods destroyed the ladder and no attempt was made to rebuild the structure since Folsom Dam, a complete block to migratory fish, was under construction a short distance upstream. A few fish of the spring run were seen below Nimbus Dam in the summer of 1955. One ripe female salmon arrived in the steelhead ponds at the hatchery late in July of 1956. No other salmon of the spring run were seen during this season.

The main salmon run takes place in the fall, beginning in late September, peaking in late October or early November, and tapering off in December.

Since 1944, with the exceptions of 1947 and 1950, estimates have been made of the size of the salmon run. From this information the average annual run was estimated at 25,948 fish, composed of 61.2 percent males and 38.8 percent females. Using data from the known fecundity of king salmon in adjacent streams, it was estimated that the average female produced 6,500 eggs.

Estimates were also made since 1944, with the exceptions of 1947 and 1950, of the numbers of spawning salmon above and below the Nimbus Dam site. It was found that 18,869 salmon or 72.5 percent of the annual run spawned upstream from the Nimbus Dam site. The females, comprising 38.8 percent of the total run, would number 7,079, and would deposit approximately 46,000,000 eggs per year.

Little is known of the history of the steelhead, Salmo gairdneri, in the American River. Counts were made of the steelhead at old Folsom Dam from 1943 through 1947. These counts, however, are inconclusive other than to show that some steelhead did pass Folsom in every month of the year except August and September, with the peak of the run in May and June.

At the time the Folsom Project was first proposed an afterbay dam was planned for construction near Folsom Dam. This afterbay dam would not have endangered the salmon, since it left the main portion of the spawning area accessible. This plan was discarded in 1949 in favor of the construction of Nimbus Dam at a site seven miles downstream from Folsom Dam. The lake formed by Nimbus Dam inundates the area in which a major portion of the annual run formerly spawned.

It then became necessary to determine the best way to maintain the run of salmon in the American River. A meeting of U. S. Fish and Wildlife Service, U. S. Bureau of Reclamation, and California Department of Fish and Game personnel was held in December, 1952, for the purpose of outlining the necessary investigative work on the salmon and steelhead problem. Three plans to maintain the runs were advanced:

1. The construction of a fish hatchery and related facilities.
2. Improvement of the natural spawning areas below Nimbus Dam.
3. Creation of artificial spawning channels.

On November 5, 1953, Fish and Wildlife Service, Bureau of Reclamation, and Department of Fish and Game personnel began to analyze the progress of the investigations to maintain the salmon and steelhead run. It was generally agreed that a hatchery was necessary. It was decided that even with improved water flows and other stream improvements the spawning area below Nimbus Dam could not be enlarged enough to take care of the total American River run. It was also decided that not enough investigative work had been accomplished to state whether or not the construction of artificial spawning channels would be satisfactory.

Inasmuch as hatcheries have generally been considered the best means for maintenance of salmon and steelhead runs blocked by dams, it was agreeable to all parties to go ahead with plans for Nimbus Salmon and Steelhead Hatchery.

The hatchery was designed by the Bureau of Reclamation, working closely with the Fish and Wildlife Service and the Department of Fish and Game, for a capacity of 30,000,000 salmon eggs and may be increased in size to a maximum capacity of 50,000,000 eggs, if necessary.

In order to incorporate the most efficient means of handling and caring for salmon and steelhead, the Fish and Wildlife Service presented plans of their most modern hatcheries and also acted as hosts to Department of Fish and Game personnel on a tour of the newest Columbia River hatcheries.

Upon completion of the hatchery a contract (see Appendix II) was drawn up between the United States and the State of California for the operation of Nimbus Hatchery. This contract points out the various responsibilities acknowledged by the two parties. These responsibilities are mainly the following:

1. The State will accept full responsibility for the operation and maintenance of the installation.

2. The United States will transfer to the State of California, at the beginning of each fiscal year, the sum of money estimated necessary to operate, maintain, and repair the installation. The contract is for a period of five fiscal years or until such time as the runs of salmon and steelhead spawning naturally in the American River equal the average runs which prevailed in the American River during the period 1944 to 1954.

THE INSTALLATION

General Description

Nimbus Salmon and Steelhead Hatchery is located approximately 20 miles east of Sacramento on the American River directly below Nimbus Dam, which in turn is seven miles below Folsom Dam (see Figures 1 and 2 for location map and general plan).

Hatchery Building

The hatchery building is 100 feet by 80 feet in size and is constructed of corrugated aluminum siding and roofing on a steel framework, as are all of the buildings. This building contains 136 aluminum hatching troughs, each 16 feet long by 16-1/8 inches wide by 7-1/2 inches deep, mounted in pairs on steel supports, with storage shelves for hatchery equipment under the troughs.

Hatching baskets having a capacity of 500 ounces are used for uneyed eggs.

Eyed eggs are held on standard aluminum screen frame trays with a 14 by 18 per inch mesh aluminum screen on the bottom. A 1/4-inch plastic spline was added to the perimeter of the trays to provide additional spacing between the trays for the eggs. The trays are stacked nine deep, with the top tray used as a cover. Two specially designed aluminum C clamps hold the stacked trays together. Six stacks of trays are used in each trough. Each stack has a capacity of 400 ounces of eggs (liquid measure), making the capacity of each trough 2,400 ounces of eggs, or approximately 200,000 eggs based on the average size of American River king salmon eggs.

A medicinal injection system was installed in the hatchery water intake system, to be used principally for application of a malachite green solution to combat fungus infection of the eggs. This consists of a 200-gallon steel tank to hold the chemical solution, a small pump to inject the solution into the water system, and two flow meters, one for each side of the hatchery, so that the chemical may be injected into either or both sides. A detailed description of this system is found in THE PROGRESSIVE FISH-CULTURIST, Volume 17, No. 2 (April, 1955).

Office and Shop Building

The office and shop are combined in one building 40 feet by 40 feet in size. The shop occupies one-half of the building, and is equipped with tools for maintenance of the installation. The employees' locker-room and shower, as well as public rest rooms, are in this building.

Food Processing and Storage Building

This building and its equipment are designed for the processing and storage of salmon carcasses derived from the spawning activities, also the preparation and storage of other foods required in the diets of salmon and steelhead.

The building is 100 feet by 40 feet in size and contains the machinery for processing, freezing, and storage of fish food, refrigeration compressors, and the domestic water system.

The various units and capacities are:

1. Food Processing and Packaging Machinery.
    a. Hog (food shredder) - 25 H. P. motor - capacity 8,000 pounds per hour.
    b. Grinder - 40 H. P. motor - capacity 8,000 pounds per hour.
    c. Sausage mixer - 10 H. P. motor - capacity depending upon consistency of material mixed.
    d. Bag holder - manually operated, holds 10 bags.
    e. Freezer rack carts (5) - each capable of holding forty 50-pound bags of food.
2. Sharp Freeze Room. Size: 22 feet by 22 feet. Has the capacity to sharp freeze 10,000 pounds of meat in 24 hours at 10 degrees Fahrenheit.
3. Frozen Food Storage. Size: 40 feet by 33 feet. Has a capacity of 300,000 pounds of meat held at 0 degrees Fahrenheit.
4. Refrigeration Compressor Room contains refrigeration machinery.
5. Dry Food Storage Room. Capacity: up to 25,000 pounds of dry foods.

The processing building also contains the domestic water system, consisting of pumps and a pressure tank with a chlorine injector.

Pond System

The pond system consists of twelve gravel-bottomed raceway-type ponds, 12 feet wide by 100 feet long, used principally for the rearing of steelhead. These ponds may also be used for rearing young salmon. There are eight nursery ponds, lined with concrete, 8 feet wide, 86 feet long, and 5 feet deep. These are used primarily for holding young salmon after they leave the hatchery building, but also may be used as auxiliary adult salmon holding ponds if needed.

There are two concrete-lined adult salmon holding ponds, 46 feet wide, 157 feet long, and 6 feet deep. Each of these may be divided by metal rack sections into 27 square pens, 13 feet wide, for sorting salmon. The water enters through submerged orifices at the upper ends of the ponds. The upwelling of water from this type of entrance reduces the jumping activities of the salmon.

There is one steelhead holding pond, 68 feet wide, 201 feet long, and 6 feet deep. This pond has a gravel bottom and earthen sides. Water can be supplied to this pond either through a submerged orifice, or near the surface through a self-trapping device. As the steelhead mature, the water is supplied through the surface entrance and the fish move up the pond, trapping themselves in small pens, where they may be spawned.

Fish Ladder

The fish ladder is 502 feet in length with 30 pools, each 9 feet wide by 16 feet long and 5 feet deep. The salmon blocked by the fish rack enter the fish ladder and surmount the 20 feet of elevation differential between the river and the holding ponds.

Fish Rack and Hoist

The fish rack is 306 feet long. There are 10 concrete piers permanently imbedded in the river. The tops of the piers are 10 feet above the river bed. Nine rack support frames, with walkways, are placed on these piers. Twenty pipe rack frames, holding the 3/4-inch galvanized pipe pickets, are then placed upon the rack support frames. A steel wire fabric mat 7 feet wide is in place 6 to 12 inches below the surface of the river bed. The pickets are driven through the river bed gravel below the fabric mat. This prevents salmon from digging under the racks.

An electric high line hoist of 5,000 pounds capacity is provided to place or remove the racks and rack support frames. There is a 100-foot tower on the south side of the river, to which the load cable is attached. This cable extends 543 feet to the north side of the river, where it is attached to a concrete block imbedded in the bluff.

Water System

Water for the installation is obtained from Nimbus Reservoir. A 42-inch concrete pipe line conveys the water from the south abutment of Nimbus Dam to a terminal structure. This pipe is capable of carrying 50 c.f.s. Thirty c.f.s. is the requirement for the present plant.

During the planning of Nimbus Hatchery the conduit capable of carrying 50 c.f.s. was requested by the Department of Fish and Game for a possible future trout hatchery below Nimbus Hatchery. The cost of increasing the size of the pipe line from 30 c.f.s. to 50 c.f.s. capacity was borne by the Wildlife Conservation Board.

Nimbus Reservoir fluctuates as much as 10 feet in surface elevation, reducing or increasing the head of water at the hatchery inlet; an electrically operated automatic gate was installed in the inlet of the terminal structure to compensate for this fluctuation and provide an even volume of flow in the supply line.

Manually operated outlet gates in the terminal structure control the water flow to the pond system, hatchery, and domestic water system.

A 33-inch concrete pipe carries water to the rearing pond control structure, where water may be diverted to these ponds. From the rearing pond control structure the 33-inch pipe continues to the nursery ponds. From here the water is conveyed in an open conduit to the salmon holding ponds, steelhead holding ponds, and down the fish ladder into the river.

A 24-inch concrete pipe conducts water to two 16-inch concrete-lined steel pipes that supply the hatchery.

An 8-inch concrete-lined steel pipe conducts water from the terminal structure to pumps in the processing building. The water is chlorinated, pumped into a pressure tank, then under 70 pounds pressure distributed to all the buildings, fire hydrants, and outside faucets.

CONSTRUCTION CONTRACTS

Three contracts were let for the construction of Nimbus Hatchery and related facilities:

1. Bids were opened July 13, 1954, for constructing piers and abutments for the fish rack structure, fish ladder, cableway, 42-inch water supply line, and electrical distribution line. Work was started August 14, 1954, by the George Pollock Company and accepted as complete April 7, 1955.

2. February 10, 1955, bids were opened for furnishing and installing the fish rack superstructure and pipe pickets. Installation of the shop fabricated steel work began August 5, 1955, by the Dondo-Roza Company. The work was accepted as complete August 23, 1955.

3. Bids were opened March 24, 1955, for the completion of Nimbus Hatchery comprising the following items: earthwork and structures for ponds; water distribution and drain lines; domestic water pressure system; fish hatchery building with water supply piping, hatchery troughs, and medicine injection system; office and maintenance building; food processing building with processing machinery and refrigeration facilities; septic tank and drainage field; electrical system; and grading and paving the hatchery area and access road. Work was started April 20, 1955, by Johnson-Drake and Piper, Inc., and accepted as complete October 17, 1955.

Construction costs to June 30, 1956, were $1,089,139.00. This expenditure included the above three contracts and all equipment, such as hatching baskets and trays, shop equipment, pond screens, etc.

Dedication

Nimbus Hatchery was formally dedicated December 3, 1955. Governor Goodwin J. Knight was the principal speaker. Representatives of the Department of Fish and Game, Fish and Wildlife Service, Bureau of Reclamation, and sport and commercial fishermen participated.

PERSONNEL

Actual operation of the plant did not start until October 5, 1955, when the first water was turned through the ponds and into the fish ladder and the first fish were received in the holding ponds. However, to be prepared for operation of the unit, a Fisheries Manager II was assigned in April, 1955, and a Fisheries Manager I in August, 1955. These men acted as liaison between the Bureau of Reclamation and Department of Fish and Game in the acquisition of specialized equipment and materials, interviews with prospective personnel, and acquisition of knowledge of the installation as it was being constructed.

The initial staffing pattern consisted of four permanently assigned employees, nine employees assigned for seven months (during the peak load period of September 15 to April 15), one stenographer one-half time for 12 months, and 10 man-months of seasonal aid personnel.

Staffing Pattern

(1)	Fisheries Manager II	12 months
(1)	Fisheries Manager I	12 months
(2)	Fish Hatchery Assistants	12 months
(1)	Fisheries Manager I	7 months
(8)	Fish Hatchery Assistants	7 months
(1)	Intermediate Stenographer-Clerk	One-half time
	Seasonal Aids	10 man-months

This staffing was based on the anticipation of housing being provided for three employees, with one of the men on stand-by duty at all times. Since the Bureau of Reclamation did not build the houses for the first year of operation, additional seasonal aid time was needed for two night shifts.

The construction of two houses is planned during the coming fiscal year. With two employees living on the grounds, the night shift assignments may be lessened, depending upon the work load during the coming fiscal year.

A considerable training problem was encountered, since seven newly appointed employees had no experience in fish hatchery work, and three others transferred from some of the Department's trout or warmwater hatcheries had little experience with salmon. Fortunately, the three supervisors were experienced in salmon and steelhead culture.

PUBLIC RELATIONS

Since Nimbus Hatchery is located near the Sacramento metropolitan area, it had been anticipated that the number of visitors would be considerable, and that some public relations duties would be required by the employees, but the numbers of visitors and the time required by hatchery personnel in public relations work exceeded all expectations.

During the 1955 salmon season, October 5 through December, over 50,000 persons visited the hatchery. Forty organized groups, consisting of school children, Boy Scouts, Girl Scouts, service clubs, and other interested organizations contributed to 1,242 of these visitors. These groups were conducted through the installation by hatchery personnel. On Saturdays, Sundays, and holidays the full time services of one employee were required, and on week days an average of two and one-half hours was required of one employee to take care of the visitors.

To aid in this public information work, an arrangement was made with the Sacramento County Superintendent of Schools for a representative group of teachers to be conducted through the installation, and its various functions explained, so that during the coming seasons the teachers could conduct their classes through the hatchery without the guidance of hatchery personnel.

WATER CONDITIONS AFFECTING THE FIRST YEAR'S OPERATION

It had been anticipated that water conditions would not be as good as desired for the start of the first season's operation. Folsom Reservoir had been partially filled the previous spring with comparatively warm water, and by July surface temperatures reached 84 degrees F. At 60 feet below the surface near the entrance to the powerhouse draft tube, the temperature reached 74 degrees F. Oxygen demand by the decaying vegetation in the newly filled Folsom Reservoir increased as water levels dropped and temperatures increased. Sulphides were also being released by the decaying vegetation. These actions affected the quality of the American River water for several miles below Nimbus Dam.

Late in August water conditions began to deteriorate rapidly. Salmon and steelhead between Nimbus Dam and the fish rack showed signs of distress from oxygen depletion, became listless, and laid in shallow water near the river bank.

During the first two weeks of September a heavy mortality occurred among the salmon and steelhead in the river, when the dissolved oxygen reached a low of 2.0 p.p.m. From the middle of September until the first good rain on November 13, 1955, the oxygen content varied from 4.0 p.p.m. to over 9.0 p.p.m. This variance was attributed to algae "blooms" in Nimbus Reservoir. As algae developed the amount of dissolved oxygen increased; as it died off the dissolved oxygen decreased.

The water temperature was 69 degrees F. when the first salmon were trapped and did not drop below 57.5 degrees F. (the upper limit of salmon egg temperature tolerance), until the middle of November.

The combination of high water temperatures, low dissolved oxygen content, and presence of sulphides contributed to the heavy losses of adult salmon in the holding ponds and to the poor condition of eggs taken.

Gases Causing Embolism

Shortly after the first roiling of the hatchery water by the December storms, gas formed in the yolk sacs of large numbers of the newly hatched salmon, causing a high mortality. It appeared that there was a relationship between the occurrence of gas embolism and increased turbidity of the water at Nimbus Hatchery. As the water cleared, the number of fish affected lessened, and as another period of heavy runoff and roily water occurred, the numbers affected increased.

The December Storm

Starting December 17, 1955, some rain fell each day until January 5, 1956. On December 20, 1955, releases from Nimbus Dam were increased from 580 c.f.s. (mean flow) to 677 c.f.s. On December 22, 1955, the flow was increased to 10,506 c.f.s. and the fish racks were removed. On December 23, 1955, the releases were stepped up to a mean flow of 47,938 c.f.s., with peak releases nearing 70,000 c.f.s. With no signs of abatement of the storm and the possibilities of American River flows reaching over 100,000 c.f.s. below Nimbus (the inflow to Folsom Reservoir was 189,680 c.f.s. on December 23), hatchery personnel, with help from personnel of the Region II office and the Central Valleys Hatchery, moved most of the equipment and supplies to higher ground.

Fortunately, the peak of the storm was reached December 23, 1955, and further increases in the river flows, which would probably have caused flooding of the hatchery grounds, became unnecessary.

KING SALMON MAINTENANCE PROGRAM

History of 1955 Salmon Run

Water was started through the holding ponds and ladder on October 5, 1955. Within 34 minutes the first fish arrived at the holding pond. The trend of daily arrivals was steadily upward, reaching a peak of 1,859 fish during the week of November 6-13. By far the largest number (79.9 percent) were taken during the period of October 23 through November 27, with 13.5 percent preceding and 6.6 percent after these dates.

A total of 7,439 fish entered the holding ponds. Of this number 4,427 were males (grilse included) and 3,012 were females. Of the males, approximately 40 percent were grilse. Adults averaged 14 pounds, while grilse averaged 2-1/2 pounds each.

Fecundity was somewhat less (17.7 percent) than anticipated from past surveys. Expected fecundity was 6,500 eggs per female, while in actual experience it was 5,347.

The average number of eggs per ounce was 86.5. The actual number of females spawned was 1,989, or 66 percent of the 3,012 which entered the holding ponds. This difference between females entering holding ponds and fish actually spawned was primarily a result of losses in the period between arrival time of the first fish in the holding ponds and initial spawning on October 26, 1955. Water temperatures at this time were excessively high (64 to 68 degrees F.) and oxygen content unsatisfactory. These conditions persisted for some time after spawning began and practically all losses of adult fish in the holding ponds prior to the spawning period can be attributed to this cause. It is also probable, as will be mentioned later in this report, that these conditions contributed to the subnormal survival of eggs in the hatchery.

It has been estimated that approximately 3,000 fish of all sizes escaped through the racks, or had already ascended above the ladder area before the racks were installed. This would indicate a total run at Nimbus of approximately 10,500 fish. Comparing the above figure with the published Fish and Game average "above Nimbus" of 18,869 king salmon per year for the 1942-1952 period, indicates that the run of 1955 was only 55.7 percent of normal.

Spawning above the racks was negligible, since almost all carcasses recovered above the racks were grilse or adult males.

Egg, Alevin, and Fingerling Production

Total king salmon egg take amounted to 10,634,530, at an average size of 86.5 per ounce.

The first eggs were taken on October 26, 1955, and the last eggs on December 28. Eggs were taken in 28 separate lots. These varied from 35,000 to 994,680 eggs per lot.

The first seven lots were taken when water temperatures were between 62 and 67 degrees F. The percentage reaching the eyed stage averaged 38.6, with an individual low of 26 percent and a high of 54 percent.

As water temperatures continued to drop, the number of eggs reaching the eyed stage increased in relation to temperature drop, reaching a high of 95 percent in the later lots, with only one lot among the latter dropping below 50 percent.

The term "reaching eyed stage" is used advisedly, since there was considerable difference in fertility and the number of eggs reaching the eyed stage. On December 5, 1955, two-ounce samples of dead eggs were taken from eight different lots for checking. These eggs were treated with a 10 percent solution of acetic acid to bring back normal clarity, and then checked for fertility. Lots checked were numbers 5 through 12. The percentage of

fertility and number reaching the eyed stage would appear to indicate a definite relationship between fertility, embryonic development, and water temperatures. While these tests were on a small scale, they did tend to indicate high initial fertility, with poor embryonic development. In almost all instances the arrested development took place within the first 48 hours, or at the time the blastoderm begins to encircle the egg. A very few eggs reached the primitive streak stage (Table 2).

There would also appear to be a relationship between fertility and development of eggs in fish which had ripened in water with a temperature in excess of 58 to 60 degrees F. No facts have been gathered to back up this supposition, but Messrs. Harlan Johnson and John Pelnar of the U. S. Fish and Wildlife Service have expressed opinions that this may be true (see Appendix II for letter from J. A. Hinze to J. C. Fraser relative to "Investigation of Salmon Egg and Fry Mortalities at the Nimbus Fish Hatchery").

As the eggs approached the eyed stage an unusual amount of coagulated yolk began to appear and was a contributing factor to the continued heavy losses after hatching.

The number of king salmon eggs hatched amounted to 5,586,660, or 52 percent of the total number taken. Coagulation in the egg sac carried over into the early swimming stage. At about this time serious gas embolism was also experienced. Together, these caused unduly heavy losses. The greatest amount of gas embolism was present during and subsequent to the heavy storm and flood period of late December. As long as the above troubles lasted, there was a very definite deterioration and breakdown of tissues throughout the fish's body before death occurred.

A vertical tray incubator was obtained to try to determine if its use would reduce the gas embolism. Work with this incubator is described under EXPERIMENTAL WORK.

Approximately 75 percent or a total of 2,527,700 losses occurred before the fish reached two inches in length. Losses after this period were nominal and remained so through the remainder of the year.

The total king salmon production for Nimbus Hatchery amounted to 2,216,390 fish, plus 19,980 fish resulting from eggs supplied by the U. S. Fish and Wildlife Service Coleman Station.

Planting

Planting was by two methods: directly into the river from nursery ponds through the hatchery water discharge system, and by truck. Those planted directly into the river were weighed by the standard California weighing system, passed over the tail screen in nursery ponds, and released into the outlet drain. It had been planned to release all fish in this manner. Soon after the first planting in early April, it was realized this method of planting was impractical because of low stream flows, large amounts of water being pumped from the river below Nimbus, and the presence of a

large concentration of predaceous adult steelhead in the immediate vicinity of the hatchery outlets. Trucking fingerlings to downstream areas was resorted to, to prevent stranding and excessive predation. Fish were planted in the American River below heavy pumping diversions and away from the concentration of adult steelhead immediately below Nimbus Dam. It is not expected that truck planting will have to be used as a regular part of the Nimbus planting program.

On completion of the planting program, 31,000 king salmon, at nine per ounce, were retained in the raceway ponds as an experiment in production of yearlings. Progress of these fish has been very satisfactory and they had reached a size of six per ounce by the end of the fiscal year. The number of king salmon from this lot on hand as of July 1, 1956, was 30,750.

Salmon Carcass Processing

Salmon carcasses are transported from the spawning platform in aluminum boxes, to the processing building. Here they are raised to the upper deck by an electric hoist, where they go through the hog machine which breaks the carcasses before they fall into the grinder hopper, directly below. From the grinder a tube leads the product to a circular paper bag holder. The paper bags are filled, stapled, and placed on specially designed freezer carts. The carts are then placed in the sharp freeze room. After 24 hours the carts are taken to the cold storage room, where the bagged food is stored for future consumption.

The greatest difficulty experienced in the grinding of salmon carcasses was in reducing them to small enough particles for future use without thawing and regrinding. It was found that the three-eighths size grinder plate was the smallest size which could be used. The probable reason for this is the large amounts of hard tissue in the carcasses; i.e., heads, fins, scales, etc. The carcasses are reduced quite satisfactorily in the "hogger". Difficulty starts with the actual grinding. A method can be worked out whereby the carcasses are reduced to small enough particles while in the fresh state.

Reasons for desiring a complete grind before sacking and freezing are these:

1. Provides satisfactory product for direct use in frozen food frames.

2. Eliminates extra man hours required to rehandle.

3. Prevents deterioration of food values when foods are partially thawed before regrinding.

When it is necessary to thaw and regrind feeds, it is never practical to refreeze. This prevents the use of one of our best methods of feeding, the frozen food block. The frozen block method insures most of the feed being utilized, as well as a minimum pollution of the water, and better preservation of food values. Regrinding also requires the use of nearly as much manpower as the original grinding, resulting in a nearly doubled

processing cost. There is also an unnecessary deterioration and loss in food values each time a fish food must be partially thawed before regrinding. It was definitely determined at Nimbus that regrinding in the hard frozen state is impossible, even with the powerful equipment at this hatchery.

STEELHEAD MAINTENANCE PROGRAM

History of the 1955 Steelhead Run

Due to the heavy storm and flood conditions of late December, it was impossible to get a true picture of the steelhead run at Nimbus Hatchery this season. Because of flood flows, the fish rack across the American River was removed on December 22, 1955. It was not replaced during the period covered by this report. Consequently, all steelhead captured after the above date were fish which had entered the ladder of their own accord, with no rack to direct them. The rack was not replaced because large amounts of gravel had been scoured from the stream bed under the racks by the flood waters. After the flood waters subsided approximately five feet of open area would have existed beneath the rack, making stoppage of fish impossible. Regrading of the river bed to facilitate replacement of the rack could not be done until the late summer of 1956.

Twenty-five steelhead had entered the ponds prior to removal of the rack. Eighty-five additional fish entered the ponds between December 22, 1955, and June 30, 1956, for a total of 110, of which 74 were females and 36 males. Of this number, 62 females were spawned and a total of 205,674 eggs was taken. The average size of the eggs was 278 per ounce. The average number of eggs per fish was 4,200.

All spawning operations were on a very minor scale. The first eggs were taken on February 28, 1956, and the last on May 10, 1956. Largest take was 48,300 eggs from 13 females on March 26.

Eggs eyeing out satisfactorily amounted to 143,721 or 69.9 percent. This percentage was lower than expected and can probably be attributed, at least in part, to rough handling by the more inexperienced men in the crew. Generally speaking, the steelhead eggs were of good quality. Losses between eyeing and early fingerling stage were light and progress after hatching was very good during the time the fish were held in the hatchery. A light infection of Chilodon was experienced while the fish were still in the hatchery, but this was easily controlled. Light fin rot was experienced after the fingerlings were moved to the nursery ponds. This infection was controlled by using copper sulfate applied as a flush through the ponds.

Growth after removal of the fingerlings to nursery ponds was very good throughout the period covered by this report.

Steelhead eggs from the Coleman Station of the U. S. Fish and Wildlife Service, as well as from the Snow Mountain Station, were hatched on an experimental basis. Results are described under EXPERIMENTAL WORK.

Planting Plans

From studies made on other steelhead streams, a more satisfactory return of adults may be expected if the young fish are planted as yearlings rather than as fingerlings.

The basic steelhead planting plan of the Nimbus Hatchery is to hold as many steelhead as possible, and release them in the American River below Nimbus Dam as yearlings. There is at the present time pond space for 300,000 yearling steelhead.

Some 500,000 steelhead eggs were received from the Fish and Wildlife Service's Coleman Station on Battle Creek, a tributary of the Sacramento River, and the Department of Fish and Game's Snow Mountain Station on the Eel River. These eggs were obtained when it was known that the Nimbus Hatchery fish rack would not be replaced until after the steelhead run.

The final plans for the planting of the steelhead from the Snow Mountain and Coleman Stations have been postponed until later in the season.

The number of steelhead on hand June 30, 1956 from eggs taken at this hatchery is 105,000, received from Coleman Station 28,500, and received from Snow Mountain Station 326,000.

EXPERIMENTAL WORK

Rainbow Trout

On February 16, 1956, 155,000 green rainbow trout eggs at 291 per ounce were received from Mt. Whitney Hatchery. Five thousand of these eggs were used in experimental work on delayed embryonic development. The remaining 150,000 were held and hatched by standard California methods; i.e., baskets and trough.

The sole reason for handling rainbow at Nimbus Hatchery was to determine the suitability of the water for raising them.

Eye-out was 113,090 or 75.4 percent. The hatch from these eggs was very good and the progress of the fish was excellent. The only diseases experienced in this lot of fish was a light infection of Chilodon and fin rot.

By June 15, 1956, these fish had attained a size of 26 per ounce. On this date 25,376 were transferred to nursery ponds for further aging and observation. The remaining 72,216 fingerlings were planted in a mountain reservoir by the Department of Fish and Game's mobile fish planting crew on June 18 and 19, 1956.

Progress of the rainbow trout held in the nursery ponds was highly satisfactory and a size of 17 per ounce was attained by June 30, 1956. On hand as of this date were 25,300 fish, all in excellent condition.

From the above results it was concluded that, to date, the Nimbus water supply is satisfactory for the hatching and rearing of rainbow trout.

Steelhead - Coleman Station
(U. S. Fish and Wildlife Service)

These eggs were received in four small lots. While the eye-out from these eggs was somewhat better than from eggs taken at Nimbus (82.3 percent), the quality of the resulting fry was indistinguishable.

A total of 46,465 eggs was received from this source, of which 12,408 were eyed and 34,057 were in the green stage.

Steelhead - Snow Mountain Station
(Department of Fish and Game)

Of the eggs received from this station, 86,856 were eyed and 327,885 were in the green state.

Of the 327,885 received in the green stage, 288,900 or 88 percent reached the eyed stage. The fry from these lots were slightly inferior to those from Nimbus and from Coleman Station. However, by the time these fish had reached the No. 1 fingerling stage, it was impossible to distinguish a difference.

While there was a significant difference in the eye-out of the steelhead eggs from the foregoing stations, there was little, if any, difference noted within a short time after hatching.

King Salmon - Coleman Station
(U. S. Fish and Wildlife Service)

A total of 28,980 eggs was received from this station on December 13, 1956. Percentage of eye-out was 95. This percentage on so small a lot of eggs is not significant enough to draw any definite conclusion. It would, however, tend to verify the theory of damage to eggs by excessively high water temperatures before spawning. Other than the higher survival, no significant differences were observed in eggs or resulting fry in comparison with the Nimbus eggs. Slightly less coagulation was present in the Coleman eggs, but later losses from gas embolism were about equal.

Vertical Incubator and Gas Embolism

A vertical type Roberson incubator was purchased through the Bureau of Reclamation on January 26, 1956. The reason for obtaining this incubator was to determine if its use would help eliminate some of the gas embolism affecting newly-hatched king salmon fry.

A miniature aerating tower was built and placed on top of the incubator to assist in removal of gases from the water. This arrangement was put into use on January 26, 1956. Because the incubator was received so late in the season, when water turbidity had decreased and the king salmon egg

take had been completed, results of its use were inconclusive. Eyed eggs from both Nimbus and Coleman Station were placed in trays of the incubator to complete development. After hatching, the alevins remained in trays until absorption of the yolk sac, at which time they were liberated into troughs for feeding. At the time of liberation from the trays the alevins were closely examined. Slightly less coagulation was found, in comparison with the tray-trough method of handling. No gas embolism was evident in egg sacs of incubator-hatched fish. However, gas embolism in fry hatched by the regular tray-trough method were then showing less embolism than at any time in the previous weeks.

While use of the incubator did not produce positive results during the time used, it should be tried again during the 1956-57 season.

One positive feature of use of the incubator was proved. The ease and economy with which eggs can be handled with a minimum amount of handling, and the small amount of space and water flow needed, were advantages of the incubator.

DISEASE HISTORY

King Salmon

The heavy losses in king salmon eggs and early fry stages cannot be attributed to disease. They would appear to be definitely tied to the "Water Conditions" described earlier in this report. Virtually all losses prior to March 31, 1956, which amounted to approximately 8,049,000, can be attributed to the previously mentioned water conditions.

A small amount of fin rot was present during the month of March, but was controlled with the use of a copper sulfate flush through troughs and/or nursery ponds as the need arose.

On May 21, Harold Wolf, Department of Fish and Game Parasitologist, was called upon to examine salmon when an undetermined kidney infection threatened. Wolf prescribed the feeding of sulfamerazine at the rate of 8 grams per 100 pounds of fish. By the fourth day appearance of fish and losses had returned to normal and no further trouble was experienced.

Steelhead Trout

No unusual disease infections were experienced in steelhead during the period covered by this report.

Several light infections of fin rot were experienced in March and April. These were readily controlled with the use of a copper sulfate flush through troughs.

A minor infection of columnaris in some of the steelhead was found on June 18. Fish were given sulfamerazine in their food at the rate of 8 grams per 100 pounds of fish for a period of eight days. The trouble cleared up satisfactorily.

Rainbow Trout

These fish were relatively free of disease. Light infections of fin rot and Chilodon occurred. They were readily controlled by the use of a copper sulfate flush and an acetic acid bath, respectively. Mortality from both diseases was very light.

MISCELLANEOUS

Housing

The Department of Fish and Game asked that three houses be built during construction of the hatchery so that employees living in these houses would be available when needed at times of emergency and would possibly alleviate the need for year-round night duty.

The policy of the Bureau of Reclamation is not to build houses for its employees when residential areas exist within a reasonable distance of the installation. With additional information on the comparative costs of operation with housing and without housing, the Bureau of Reclamation reconsidered and will construct two houses in the near future.

Industrial Safety

In January, 1956, the hatchery and facilities were inspected by the State of California, Department of Industrial Relations, Division of Industrial Safety.

Many items were found that did not come up to standard safety specifications.

The Bureau of Reclamation is, at the present, studying the recommendations and will make such changes as are necessary to bring the safety standards in accord with the specifications of the Division of Industrial Safety.

SUMMARY

1. Nimbus Fish Hatchery was built and its operation financed by the United States Bureau of Reclamation, as part of the Central Valley Project, to maintain the king salmon and steelhead runs of the American River. It is operated under contract, by the State of California, Department of Fish and Game.

2. Water was turned through the ponds and ladder for the first time on October 5, 1955, and the first salmon arrived in the holding ponds on the same date.

3. The peak of the salmon run occurred during the week of November 6 to 13. The last salmon was taken December 22, 1956. A total of 7,439 salmon entered the holding ponds: 4,427 were males; 3,012 were females. From 1,989 females, 10,634,530 eggs were taken, an average of 5,347 eggs per female. Average size of the eggs was 86.5 per ounce. The number of eggs reaching the eyed stage was 5,586,660. Of the resulting fry, 2,216,390 reached planting size.

4. High water temperatures and the poor quality of the American River water at the time were the major causes of the high mortality of the salmon eggs and fry. There may be a relationship between the occurrence of gas embolism affecting salmon alevins and the turbidity of storm water at Nimbus Hatchery.

   After February 1, 1956, the salmon progressed satisfactorily, with no undue mortality.

5. A small number of king salmon eggs (28,980) was obtained from the Coleman Station of the U. S. Fish and Wildlife Service for the purpose of comparing the results with those obtained of Nimbus eggs. There were no outstanding differences.

6. Due to flood conditions necessitating the removal of the fish rack on December 22, 1955, and the resulting damage to the river bed, few steelhead entered the holding pond. A total of 205,674 eggs was taken from 62 females.

7. No serious diseases had been encountered to June 30, 1956.

8. The experimental hatching and rearing of rainbow trout indicates that conditions at Nimbus Hatchery are favorable for this purpose.

9. Comparisons of steelhead eggs, and subsequent fry, from Coleman Station, Snow Mountain Station, and Nimbus Hatchery showed no significant differences.

10. The Roberson vertical egg incubator was acquired too late in the season (January 26, 1956) to give conclusive results. Indications are that this type of device may be beneficial in the control of gas embolism at Nimbus Hatchery.

ANNUAL REPORT

NIMBUS SALMON AND STEELHEAD HATCHERY

FISCAL YEAR OF 1955-56

APPENDIX I

TABLES AND FIGURES

Inland Fisheries Administrative Report Number 56-25

TABLE 1

Number of King Salmon Eggs Taken and Number Reaching Eyed Stage
1955-56

Date		Lot number	Number females spawned	Number eggs taken	Average number of eggs per ounce	Water temperature range (degrees F.)	Number of eggs reaching eyed stage	Percentage of eggs reaching eyed stage
October	26	1	6	35,000	100	67 - 64	11,952	34
	31	2	31	248,000	90	62 - 62	66,202	27
November	2	3	43	212,500	85	62 - 62	114,800	54
	4	4	56	274,550	85	62 - 60	128,000	47
	8	5	182	911,040	78	62 - 60	343,980	38
	9	6	45	251,600	85	62 - 62	111,780	44
	10	7	57	260,700	79	62 - 62	67,200	26
	11	8	68	357,520	82	60 - 58	173,800	49
	14	9	60	297,040	79	58 - 56	237,000	80
	15	10	112	706,490	86	56 - 56	364,750	51
	16	11	102	563,760	81	56 - 54	281,960	50
	17	12	96	497,280	84	56 - 54	293,040	59
	18	13	72	399,840	84	55 - 54	362,600	91
	19	14	198	994,680	81	55 - 54	870,260	87
	22	15	109	617,920	83	54 - 54	453,220	73
	23	16	92	460,480	83	54 - 54	360,360	78
	25	17	167	957,440	88	55 - 54	311,250	33
	29	18	59	288,840	87	54 - 53	283,030	98
	30	19	63	324,720	82	53 - 53	304,560	91
December	1	20	38	180,970	93	54 - 53	171,720	95
	2	21	79	356,400	81	54 - 53	317,520	89
	6	22	58	301,320	93	53 - 52	268,640	89
	9	23	63	368,280	93	53 - 51	327,600	89
	13	24	50	297,040	94	52 - 52	239,040	80
	14	25	32	176,720	94	52 - 51	168,075	95
	20	26	22	129,720	94	52 - 51	104,995	81
	23	27	14	79,120	86	51 - 50	68,640	87
	28	28	15	85,560	93	49 - 48	75,690	88
		TOTAL	1,989	10,634,530	86.5		6,881,664	52

TABLE 2

Results of Fertility Checks on Dead King Salmon Eggs

Date eggs taken	Lot number	Water temperature range on day eggs taken (degrees F.)	Total number eggs checked in each lot	Number fertile dead eggs	Percentage of fertile dead eggs	Number infertile eggs	Percentage of infertile eggs
11- 8-55	5	62 - 60	141	76	54	65	46
11- 9-55	6	62 - 62	129	68	53	61	47
11-10-55	7	62 - 62	135	110	81	25	19
11-11-55	8	60 - 58	123	105	85	18	15
11-14-55	9	58 - 56	130	129	99	1	1
11-15-55	10	56 - 56	148	141	95	7	5
11-16-55	11	56 - 54	140	138	99	2	1
11-17-55	12	56 - 54	155	151	97	4	3

TABLE 3

Number of Steelhead Eggs Taken
and Number Reaching Eyed Stage
1955-56

Date		Lot number	Number females spawned	Number eggs taken	Average number of eggs per ounce	Water temperature range (degrees F.)	Number of eggs reaching eyed stage	Percentage of eggs reaching eyed stage
February	28	1	4	18,130	259	46 - 45	3,015	16.2
March	13	2	1	4,160	260	48 - 46	3,168	76.0
	26	3	13	48,300	230	52 - 50	31,390	65.0
April	2	4	6	20,619	237	54 - 50	18,662	90.5
	5	5	1	4,005	267	54 - 51	2,450	61.2
	10	6	10	33,744	296	52 - 50	30,660	90.9
	13	7	8	19,320	276	51 - 50	15,624	80.9
	16	8	2	8,310	277	53 - 51	5,775	69.5
	20	9	3	6,840	360	55 - 52	5,648	82.1
	23	10	5	19,170	355	53 - 51	16,200	84.5
	27	11	1	3,060	225	52 - 50	2,120	69.0
May	1	12	3	6,838	263	57 - 52	4,641	67.9
	7	13	4	9,178	353	54 - 53	4,368	47.6
	10	14*	1	4,000	250	52 - 51	-0-	-0-
		TOTAL	62	205,674	278		143,721	69.9

*These eggs were from one female. They were so poor they were discarded at eyed stage.

TABLE 4

Amount of Fish Food Received at Nimbus Hatchery
1955-56

Salmon carcasses (American River salmon)	73,405 pounds
Beef liver	46,018 pounds
Beef melts (spleen)	13,352 pounds
Fish solubles	4,950 pounds
Pellets	2,200 pounds

Amount of feed used at Nimbus:

Salmon	3,279 pounds
Beef liver	15,224 pounds
Beef melts	2,268 pounds
Fish solubles	191 pounds
Pellets	7 pounds

Amount of feed shipped to other hatcheries:

Salmon	31,338 pounds
Pellets	950 pounds

Inventory of fish feeds on hand July 1,-1956:

Salmon	38,788 pounds
Beef liver	30,794 pounds
Beef melts	11,084 pounds
Fish solubles	4,759 pounds
Pellets	1,243 pounds

TABLE 5
Nimbus Salmon and Steelhead Hatchery
Weather and Water Data Report
October, 1955

Date	TEMPERATURE AIR Maximum	AIR Minimum	WATER Maximum	WATER Minimum	Weather	American River flow at hatchery (c.f.s.)	King salmon taken
5*	94	61	69	67	Clear	1,002	0
6	92	60	69	67	Clear	1,005	60
7	93	59	69	67	Clear	1,014	56
8	90	59	69	66	Clear	1,007	0
9	89	56	69	68	Cloudy	1,013	0
10	92	60	68	67	Rain	1,001	257
11	95	61	68	67	Partly cloudy	1,012	112
12	90	59	68	67	Clear	1,008	0
13	91	59	67	66	Clear	998	0
14	93	58	67	66	Partly cloudy	1,007	173
15	94	57	68	67	Partly cloudy	1,009	0
16	91	55	68	66	Clear	1,003	0
17	90	56	68	66	Clear	1,002	140
18	88	55	67	66	Clear	943	0
19	90	52	68	66	Clear	510	182
20	92	56	68	66	Clear	507	0
21	89	52	68	66	Clear	507	25
22	93	55	68	66	Clear	507	0
23	70	48	67	64	Clear	507	0
24	71	47	67	64	Clear	506	0
25	69	46	67	64	Clear	507	198
26	72	49	67	64	Rain	507	86
27	65	46	67	64	Clear	507	457
28	71	43	65	64	Clear	507	244
29	73	47	64	64	Clear	507	0
30	72	50	64	63	Clear	507	0
31	56	46	64	63	Clear	507	254

*First water turned through ponds and ladder.

Water temperature recorded on thermograph at head of nursery ponds. Air temperatures from maximum-minimum thermometer on northeast corner of processing building. River flow data furnished by Bureau of Reclamation. All temperatures are in degrees Fahrenheit.

TABLE 6

Nimbus Salmon and Steelhead Hatchery
Weather and Water Data Report
November, 1955

Date	TEMPERATURE AIR Maximum	AIR Minimum	WATER Maximum	WATER Minimum	Weather	American River flow at hatchery (c.f.s.)	King salmon taken
1	61	36	63	62	Clear	508	126
2	58	36	64	62	Clear	507	213
3	62	36	62	60	Clear	507	237
4	65	40	62	60	Clear	507	133
5	66	48	60	60	Cloudy	507	0
6	68	46	62	60	Clear	507	0
7	72	44	62	60	Clear	507	801
8	72	45	62	60	Clear	507	219
9	74	45	62	62	Clear	507	190
10	70	46	62	62	Clear	507	328
11	48	46	60	58	Clear	507	321
12	48	30	60	58	Partly cloudy	507	0
13	42	41	58	54	Rain	510	0
14	43	42	58	56	Cloudy	533	554
15	48	33	56	56	Cloudy	570	340
16	43	42	56	54	Rain	573	256
17	48	42	56	54	Light rain	565	164
18	52	45	55	54	Cloudy	572	152
19	56	50	55	54	Cloudy	590	81
20	52	42	54	54	Rain	570	0
21	52	33	55	54	Clear	571	230
22	53	40	54	54	Partly cloudy	580	123
23	56	36	54	54	Rain	580	123
24	55	31	55	54	Clear	580	0
25	57	34	55	54	Clear	580	112
26	60	36	55	54	Clear	580	0
27	58	39	54	53	Clear	580	0
28	54	38	55	53	Clear	580	0
29	54	40	54	53	Fog	580	102
30	49	48	53	53	Cloudy	580	63

TABLE 7
Nimbus Salmon and Steelhead Hatchery
Weather and Water Data Report
December, 1955

Date	TEMPERATURE AIR Maximum	AIR Minimum	WATER Maximum	WATER Minimum	Weather	American River flow at hatchery (c.f.s.)	King salmon taken
1	50	38	54	53	Rain	580	93
2	50	41	54	53	Clear	580	0
3	52	32	54	53	Clear	580	0
4	52	32	53	52	Clear	580	0
5	48	46	53	52	Rain	580	91
6	57	50	53	52	Rain	580	18
7	52	47	53	52	Clear	580	6
8	50	48	53	51	Rain	580	20
9	52	50	53	51	Cloudy	580	0
10	54	37	53	52	Clear	580	0
11	57	41	52	51	Partly cloudy	580	0
12	47	45	52	51	Partly cloudy	580	42
13	48	48	52	52	Cloudy	580	0
14	49	48	52	51	Cloudy	580	0
15	50	46	52	51	Cloudy	580	0
16	51	46	52	51	Cloudy	580	0
17	50	48	51	51	Rain	580	0
18	61	55	51	50	Rain	580	0
19	58	53	51	51	Rain	580	17
20	60	58	52	51	Rain	677	15
21	58	53	52	51	Rain	1,098	0
22*	53	46	53	51	Rain	10,506	25
23	57	52	51	50	Rain	47,938	0
24	51	50	49	49	Rain	67,958	0
25	57	52	49	49	Rain	68,346	0
26	51	50	49	49	Rain	67,759	0
27	49	35	49	49	Rain	**	0
28	45	34	49	48	Rain	48,654	0
29	43	34	48	47	Rain	36,552	0
30	42	40	48	47	Rain	24,741	0
31	50	40	47	47	Rain	14,083	0

*The fish rack was removed on December 22, 1955 and no salmon were taken the balance of the year.
**Not available.

TABLE 8

Nimbus Salmon and Steelhead Hatchery
Weather and Water Data Report
January, 1956

Date	TEMPERATURE AIR Maximum	AIR Minimum	WATER Maximum	WATER Minimum	Weather	American River flow at hatchery (c.f.s.)
1	51	45	46	45	Rain	10,762
2	48	37	47	47	Light rain	10,835
3	46	40	46	46	Rain	9,972
4	52	44	46	46	Rain	9,756
5	52	45	46	46	Rain	14,054
6	55	52	46	46	Clear	18,460
7	55	42	46	45	Partly cloudy	9,030
8	55	52	47	47	Partly cloudy	7,657
9	54	42	46	46	Light rain	9,054
10	54	42	46	46	Rain	9,113
11	54	46	46	46	Cloudy	8,569
12	52	43	46	46	Cloudy	7,628
13	50	46	47	46	Light rain	5,982
14	56	47	47	47	Rain	11,654
15	55	53	47	47	Rain	22,381
16	54	42	48	46	Partly cloudy	32,459
17	53	35	48	47	Cloudy	33,543
18	55	45	48	47	Partly cloudy	33,398
19	55	40	47	47	Cloudy	23,814
20	52	44	47	47	Rain	12,895
21	53	46	47	47	Rain	11,759
22	52	46	46	46	Rain	12,325
23	48	38	47	46	Cloudy	20,009
24	59	48	48	47	Light rain	20,871
25	48	46	48	47	Rain	21,514
26	48	42	48	47	Rain	26,609
27	50	34	48	47	Rain	24,490
28	50	30	48	47	Clear	22,017
29	50	30	48	46	Clear	20,825
30	48	30	47	47	Clear	17,395
31	47	28	47	46	Clear	10,007

TABLE 9

Nimbus Salmon and Steelhead Hatchery
Weather and Water Data Report
February, 1956

Date	TEMPERATURE AIR Maximum	AIR Minimum	WATER Maximum	WATER Minimum	Weather	American River flow at hatchery (c.f.s.)
1	50	28	47	45	Clear	5,359
2	50	28	46	46	Clear	6,169
3	54	32	47	46	Clear	7,319
4	52	32	46	45	Clear	5,414
5	56	36	47	45	Clear	4,267
6	60	34	46	45	Clear	6,057
7	56	34	46	45	Clear	6,413
8	64	36	46	45	Clear	7,001
9	58	38	46	45	Clear	6,688
10	56	32	47	45	Clear	5,924
11	58	32	46	45	Clear	6,021
12	58	34	47	46	Clear	4,139
13	56	34	45	45	Clear	5,112
14	54	34	46	45	Clear	6,711
15	52	28	45	44	Clear	5,350
16	48	27	44	43	Clear	5,124
17	50	30	45	44	Partly cloudy	5,085
18	50	28	45	44	Partly cloudy	6,008
19	48	29	45	45	Rain	6,908
20	55	42	46	45	Rain	-0-
21	63	52	46	45	Cloudy	5,103
22	62	56	46	46	Intermittent rain	5,122
23	60	42	46	45	Partly cloudy	5,252
24	52	34	46	45	Rain	5,508
25	47	42	46	45	Rain	5,527
26	54	46	44	44	Partly cloudy	2,563
27	55	37	45	44	Clear	5,029
28	60	36	46	45	Cloudy	5,512

TABLE 10

Nimbus Salmon and Steelhead Hatchery
Weather and Water Data Report
March, 1956

Date	TEMPERATURE AIR Maximum	AIR Minimum	WATER Maximum	WATER Minimum	Weather	American River flow at hatchery (c.f.s.)
1	60	34	47	45	Clear	5,566
2	62	39	46	45	Partly cloudy	5,225
3	61	46	46	45	Partly cloudy	5,242
4	59	38	48	46	Partly cloudy	3,124
5	48	38	46	45	Light showers	4,564
6	50	32	47	46	Clear	6,582
7	60	30	46	45	Clear	6,783
8	60	42	49	46	Clear	7,168
9	62	38	49	46	Clear	6,825
10	62	36	49	46	Clear	5,494
11	62	40	48	46	Clear	3,679
12	64	36	48	46	Clear	4,042
13	70	38	48	46	Clear	5,343
14	64	42	49	48	Clear	5,706
15	68	38	49	47	Clear	5,868
16	70	40	51	48	Clear	5,870
17	74	42	51	48	Clear	3,828
18	70	40	50	47	Partly cloudy	5,379
19	68	48	49	47	Partly cloudy	5,964
20	70	38	49	48	Clear	7,081
21	70	40	50	48	Clear	7,253
22	70	44	49	48	Clear	7,291
23	70	42	50	48	Clear	7,157
24	71	42	50	49	Clear	4,959
25	66	43	50	49	Clear	4,988
26	64	40	52	50	Clear	4,944
27	65	36	51	50	Clear	5,102
28	70	38	52	50	Clear	5,111
29	74	40	51	50	Clear	4,979
30	62	45	50	50	Partly cloudy	4,969
31	55	45	50	49	Partly cloudy	4,982

TABLE 11

Nimbus Salmon and Steelhead Hatchery
Weather and Water Data Report
April, 1956

Date	TEMPERATURE AIR Maximum	AIR Minimum	WATER Maximum	WATER Minimum	Weather	American River flow at hatchery (c.f.s.)
1	61	40	53	49	Clear	4,894
2	64	38	54	50	Clear	4,594
3	72	36	53	50	Partly cloudy	4,998
4	72	40	52	51	Clear	4,990
5	76	45	54	51	Clear	4,996
6	78	42	55	51	Clear	4,928
7	77	46	53	51	Clear	3,874
8	80	44	55	51	Clear	3,890
9	80	46	53	51	Clear	3,997
10	58	46	52	50	Light rain	3,917
11	50	42	51	50	Rain	4,649
12	54	40	51	50	Rain	4,901
13	52	37	51	50	Rain	4,742
14	58	43	51	50	Showers	3,882
15	81	47	52	51	Cloudy	3,981
16	83	50	53	51	Partly cloudy	4,851
17	84	50	55	51	Clear	4,706
18	80	52	54	51	Clear	2,451
19	82	50	55	52	Clear	2,340
20	80	51	55	52	Clear	1,980
21	83	50	55	52	Partly cloudy	1,992
22	84	51	55	52	Clear	2,040
23	80	47	53	51	Clear	2,046
24	72	51	56	52	Partly cloudy	2,020
25	73	50	55	52	Showers	3,084
26	58	48	52	50	Rain	3,856
27	71	47	52	50	Partly cloudy	3,871
28	70	46	54	51	Partly cloudy	3,991
29	77	47	55	52	Clear	3,936
30	79	47	54	52	Clear	3,936

TABLE 12

Nimbus Salmon and Steelhead Hatchery
Weather and Water Data Report
May, 1956

Date	TEMPERATURE AIR Maximum	AIR Minimum	WATER Maximum	WATER Minimum	Weather	American River flow at hatchery (c.f.s.)
1	80	48	57	52	Clear	3,842
2	80	46	55	52	Mostly fair	3,904
3	80	47	54	51	Partly cloudy	3,904
4	71	54	54	51	Partly cloudy	3,953
5	74	48	54	51	Partly cloudy	3,112
6	70	48	57	54	Partly cloudy	3,077
7	72	50	54	53	Partly cloudy	3,140
8	72	44	55	53	Few clouds	3,089
9	70	52	54	52	Cloudy, showers	3,043
10	63	46	52	51	Cloudy, showers	3,092
11	69	46	53	51	Partly cloudy	3,071
12	69	46	55	51	Partly cloudy	3,046
13	74	44	58	53	Clear	3,042
14	82	44	55	53	Clear	3,047
15	88	45	55	53	Clear	3,021
16	96	51	56	53	Clear	3,033
17	94	56	56	53	High clouds	3,074
18	93	58	56	53	High clouds	3,048
19	83	52	56	53	Clear	3,776
20	86	52	60	54	Clear	3,938
21	89	52	60	55	Clear	6,060
22	89	52	59	54	Clear	14,897
23	76	51	57	54	High clouds	11,870
24	84	48	60	54	Clear	12,088
25	90	52	59	56	Clear	12,431
26	89	52	57	55	Clear	14,003
27	80	52	59	54	Clear	14,170
28	86	58	61	59	Clear	13,227
29	81	52	57	55	Clear	11,005
30	75	52	58	54	Clear	10,101
31	76	51	59	54	Partly cloudy	9,919

TABLE 13

Nimbus Salmon and Steelhead Hatchery
Weather and Water Data Report
June, 1956

Date	TEMPERATURE AIR Maximum	AIR Minimum	WATER Maximum	WATER Minimum	Weather	American River flow at hatchery (c.f.s.)
1	81	48	61	55	Clear	11,822
2	94	50	62	56	Clear	11,992
3	80	49	61	56	Clear	10,082
4	74	48	61	54	Clear	8,002
5	79	46	58	54	Clear	7,404
6	82	49	58	54	Clear	8,750
7	90	52	59	54	Clear	8,217
8	93	56	58	55	Clear	8,019
9	94	64	57	55	Clear	8,086
10	87	56	58	55	Clear	8,086
11	89	46	58	56	Clear	7,902
12	86	52	58	56	Clear	7,956
13	90	54	58	56	Clear	6,654
14	89	58	57	55	Clear	6,856
15	80	48	58	55	Clear	6,089
16	84	52	59	56	Clear	5,979
17	93	58	59	55	Clear	6,070
18	92	58	56	55	Clear	5,862
19	90	58	57	56	Clear	3,977
20	85	50	58	56	Clear	3,977
21	92	50	58	56	Clear	3,944
22	97	54	58	57	Clear	3,794
23	96	58	58	56	Clear	3,912
24	98	54	58	57	Clear	3,928
25	98	54	58	56	Clear	3,864
26	104	60	58	56	Clear	3,931
27	108	66	58	54	Clear	3,937
28	110	76	59	55	Clear	3,859
29	98	66	59	55	Clear	3,914
30	88	62	59	54	Clear	4,921

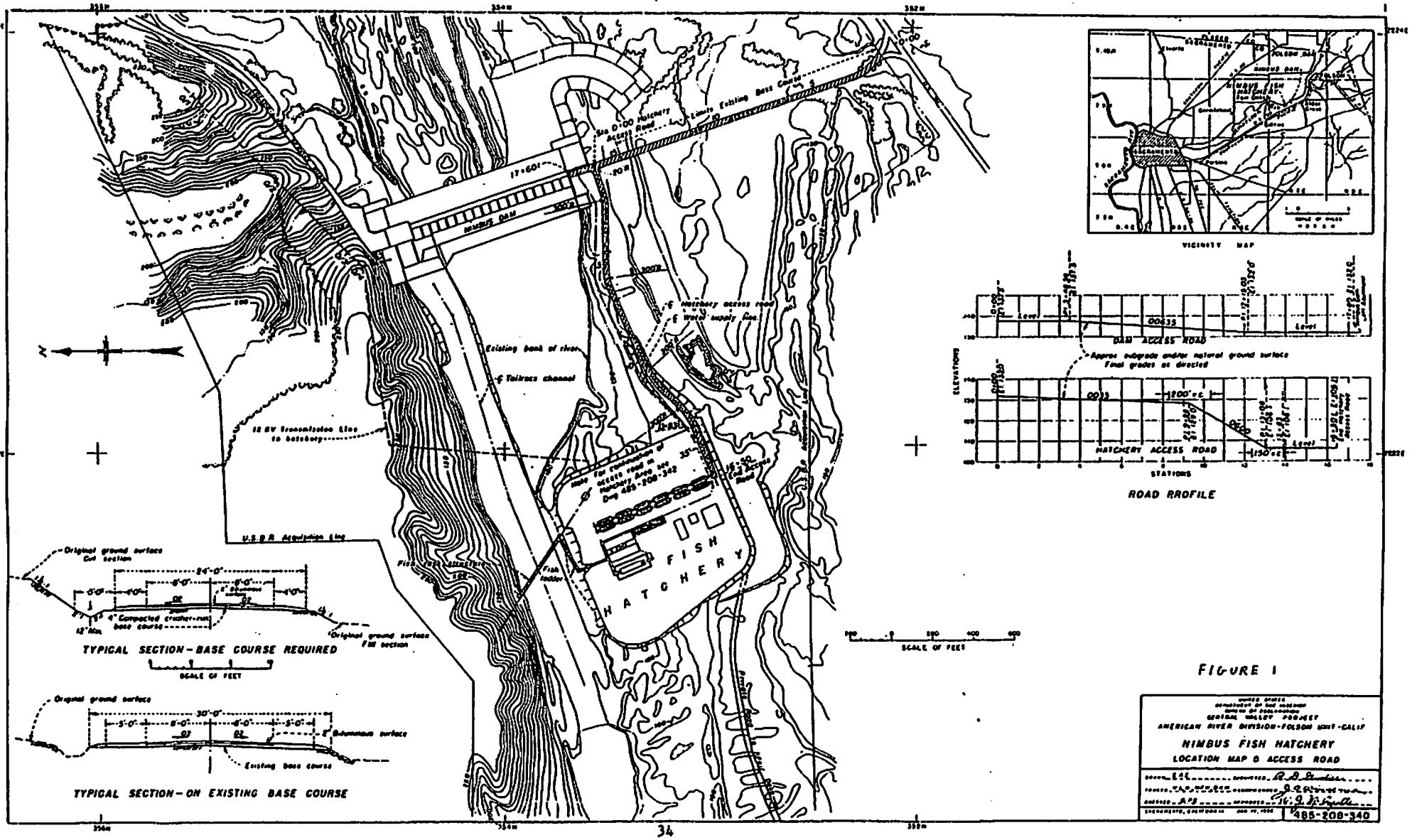

FIGURE 1

AMERICAN RIVER DIVISION - FOLSOM UNIT - CALIF

HIMBUS FISH HATCHERY

LOCATION MAP & ACCESS ROAD

485-208-340

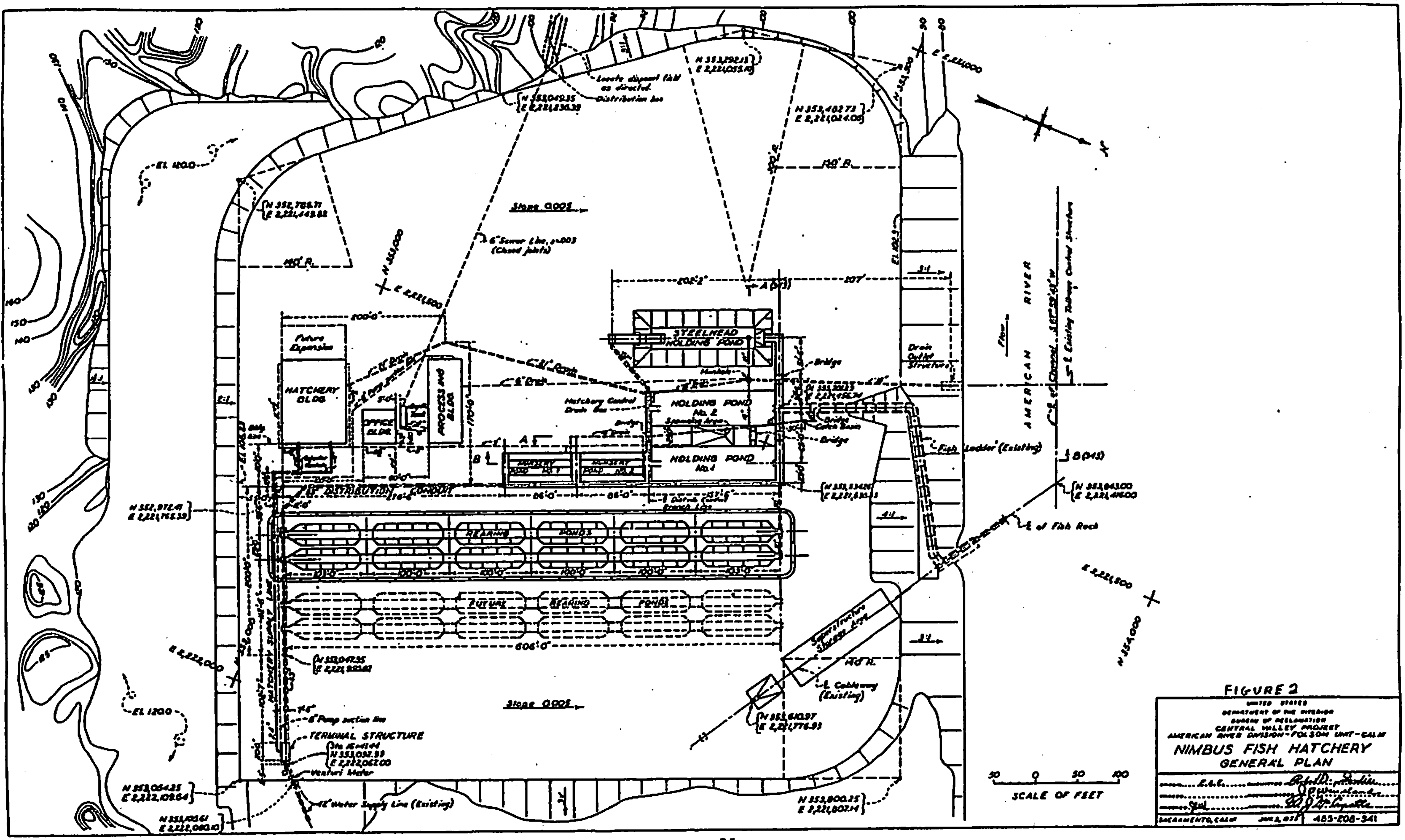
FIGURE 2
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT
AMERICAN RIVER DIVISION - FOLSOM UNIT - CALIF
NIMBUS FISH HATCHERY
GENERAL PLAN
SACRAMENTO, CALIF
485-208-341
SCALE OF FEET
AMERICAN RIVER
Flow
STEELHEAD HOLDING POND
HOLDING POND No. 2
HOLDING POND No. 1
HATCHERY BLDG
Future Expansion
OFFICE BLDG
PROCESSING BLDG
REARING PONDS
FUTURE REARING PONDS
DISTRIBUTION CONDUIT
HATCHERY SUPPLY LINE
TERMINAL STRUCTURE
Venturi Meter
12" Water Supply Line (Existing)
Slope 0.005
Fish Ladder (Existing)
Drain Outlet Structure
Bridge
Hatchery Control Drain Box
6" Sewer Line (Closed joints)
Distribution box
Cableway (Existing)
Superstructure Storage Area
EL 120.0

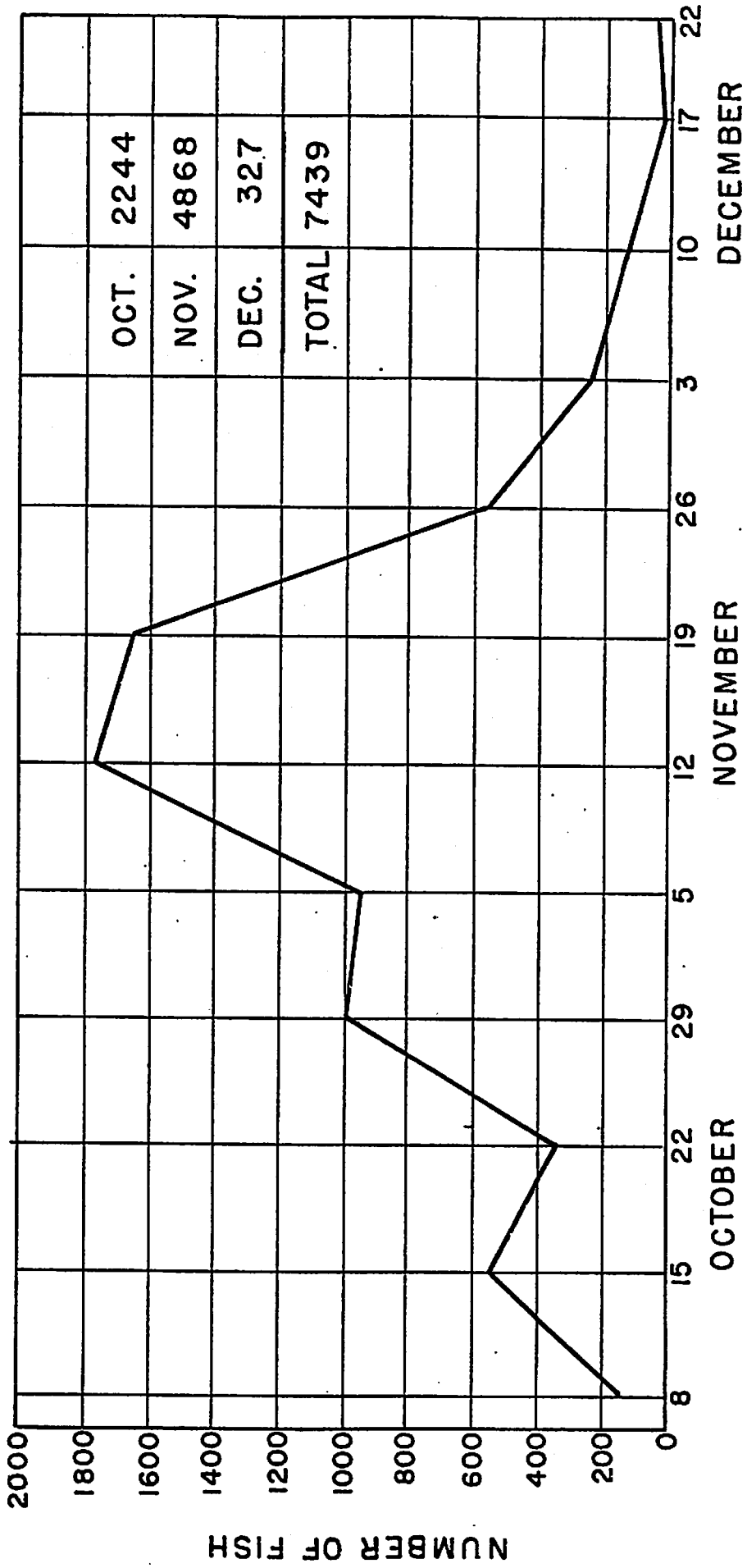

Fig. 3 NIMBUS FISH HATCHERY FALL KING SALMON RUN 1955

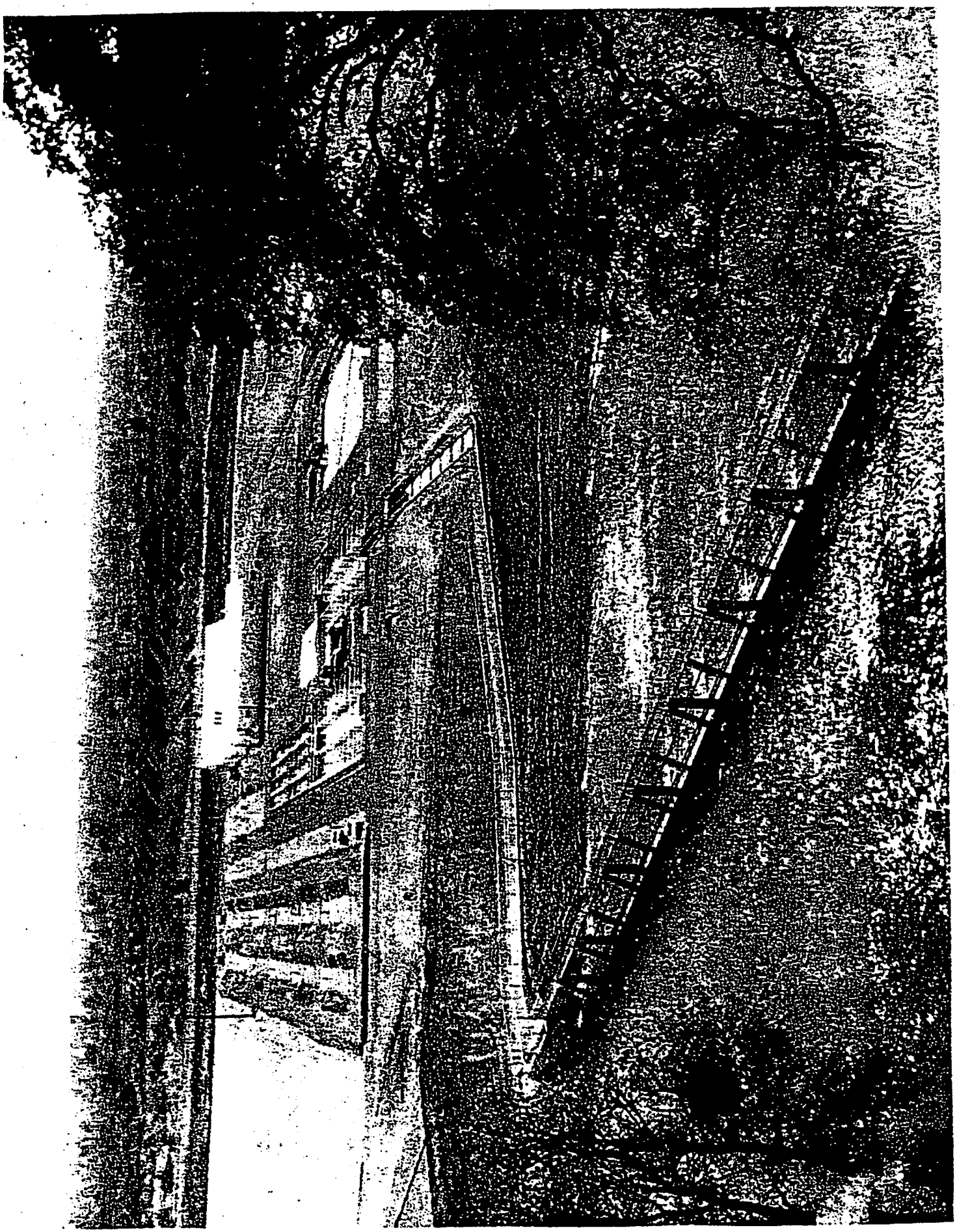

FIGURE 4. General View of Nimbus Hatchery - Fish Rack from north bank of the American River.

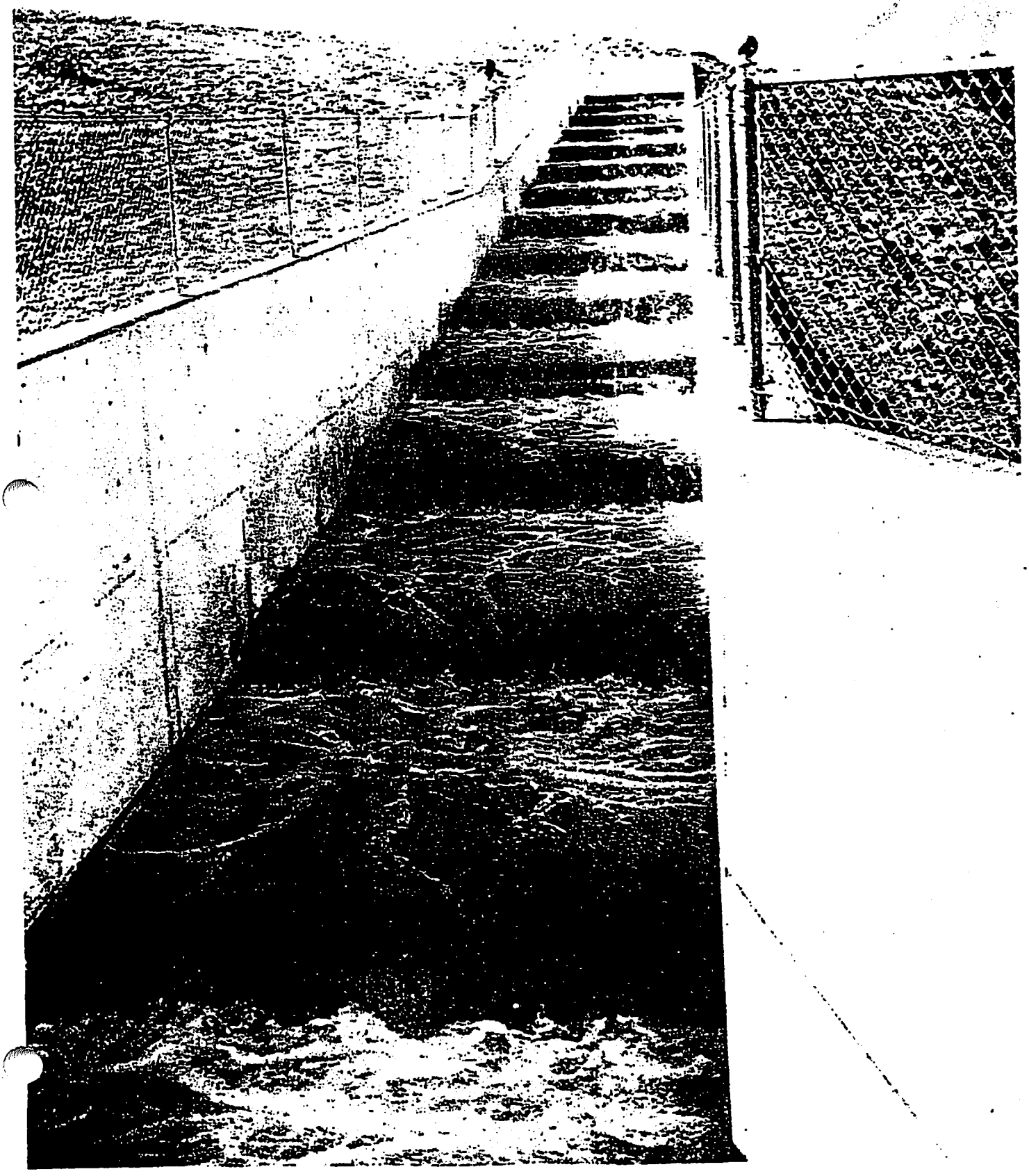

FIGURE 5. Fish ladder looking upstream.

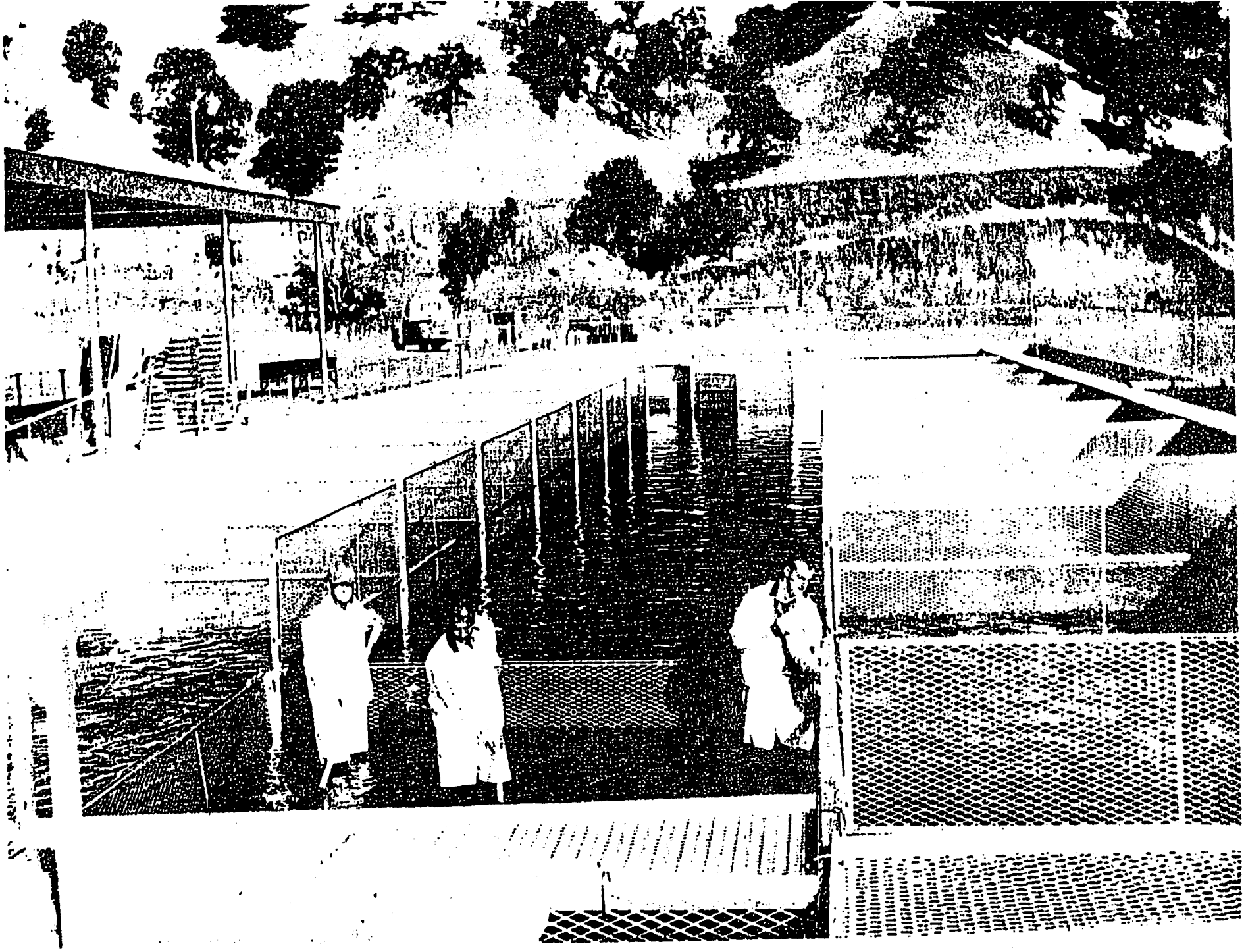

FIGURE 6. Salmon holding ponds - showing division racks. Spawning platform to left.

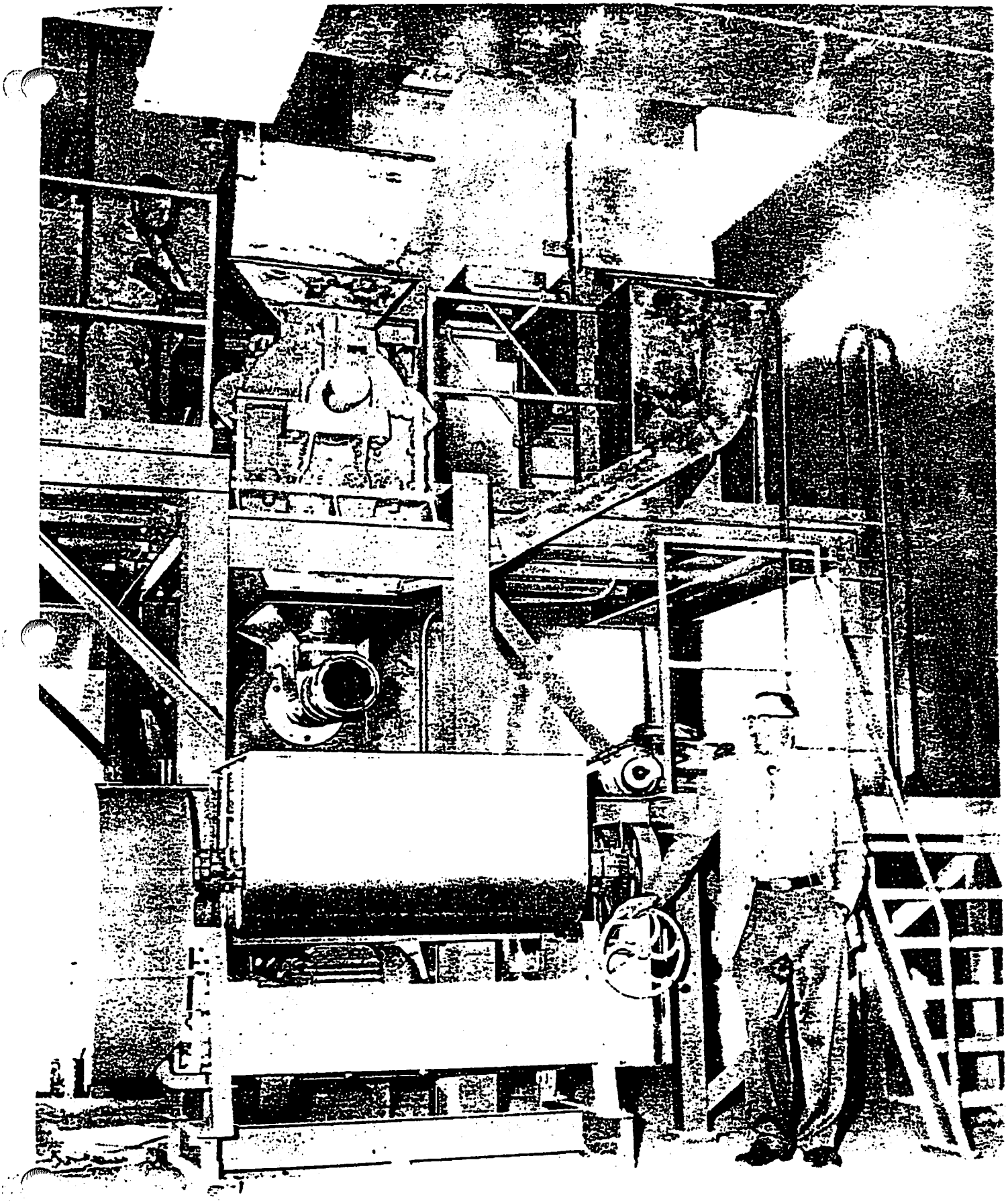

FIGURE 7. Processing equipment - Hydrauslicer, upper right; hog, upper center; grinder, center; sausage mixer, lower center.

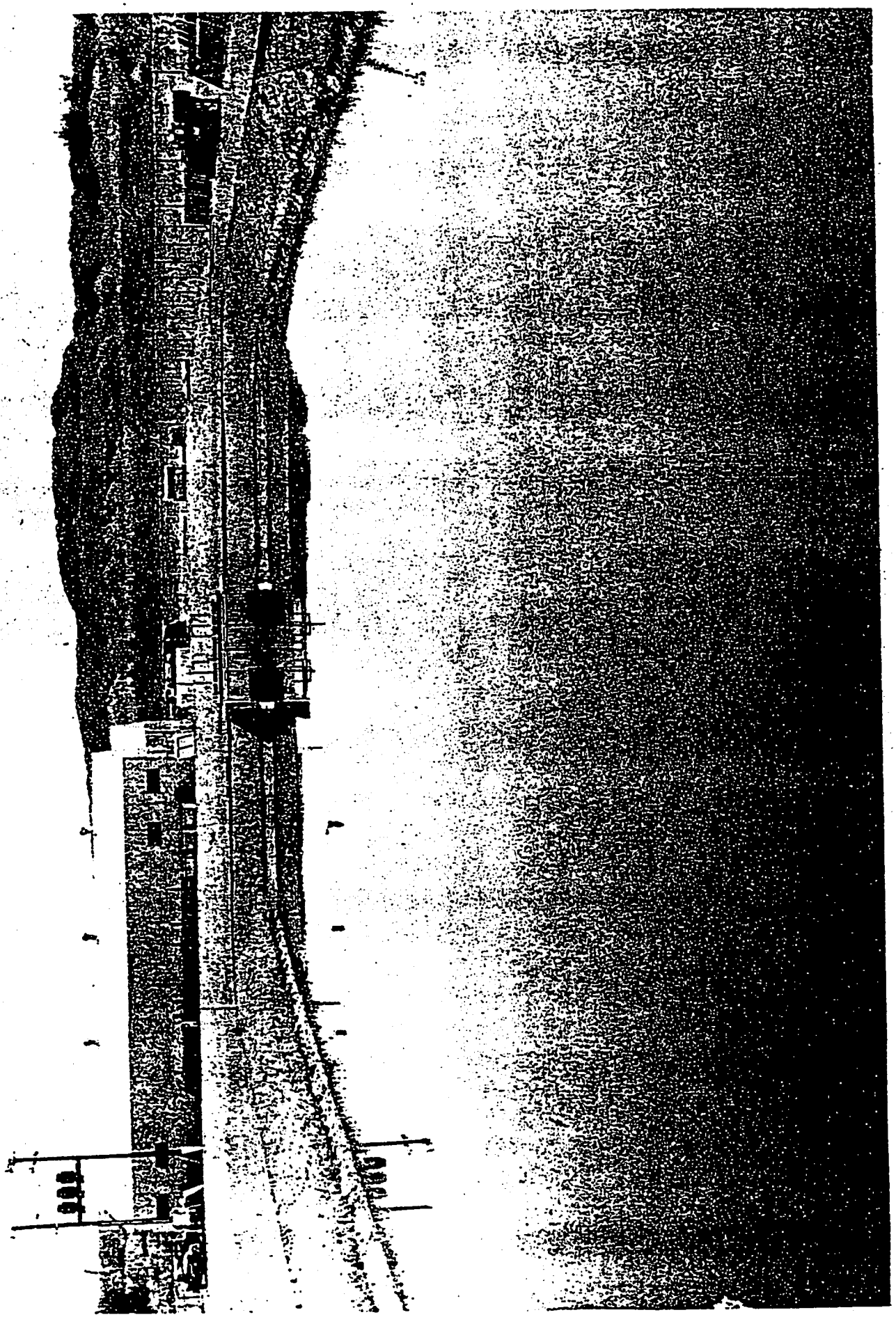

FIGURE 8. Steelhead holding po[illegible] inlet upper center.

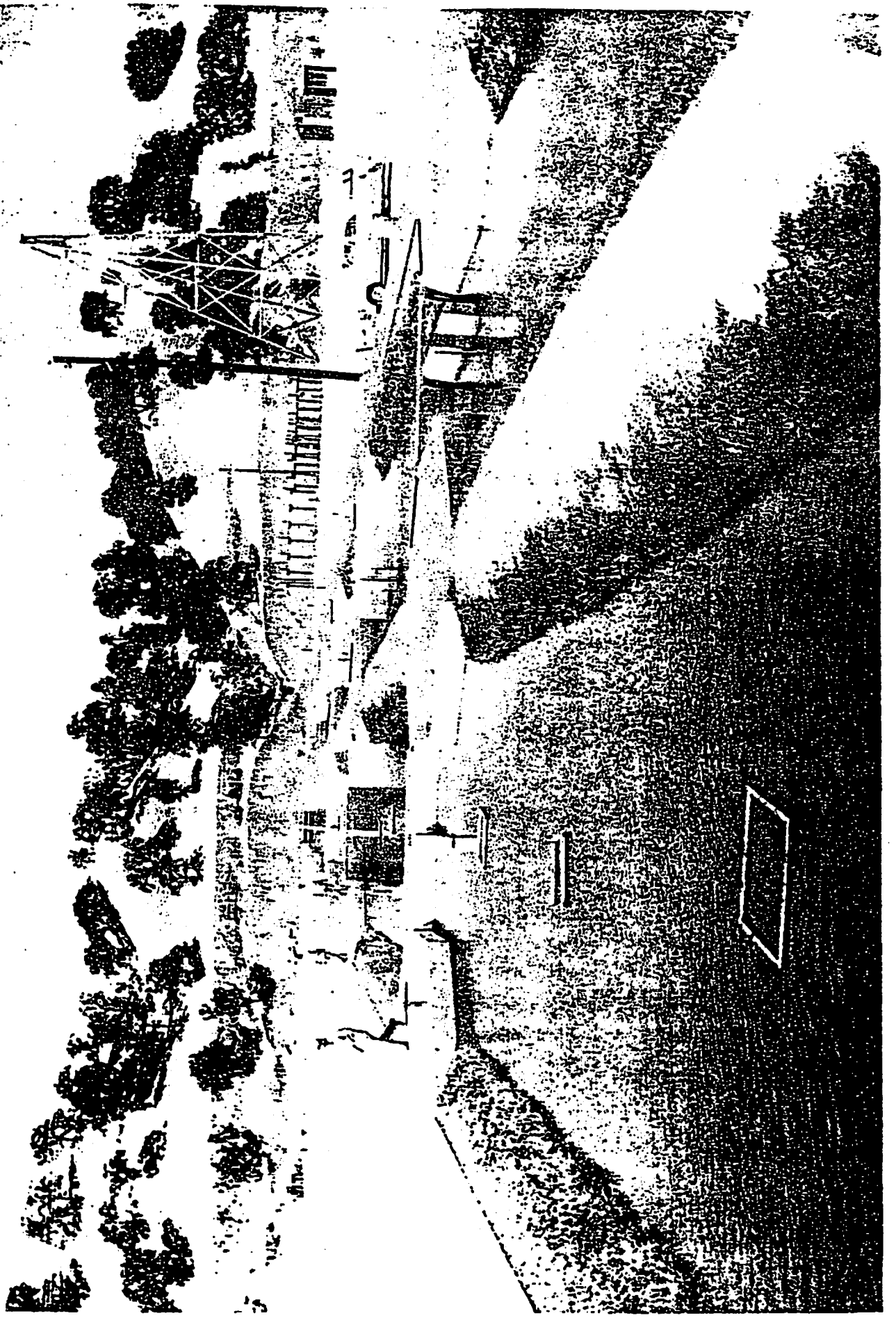

FIGURE 9. Rearing ponds (raceways) - looking downstream.

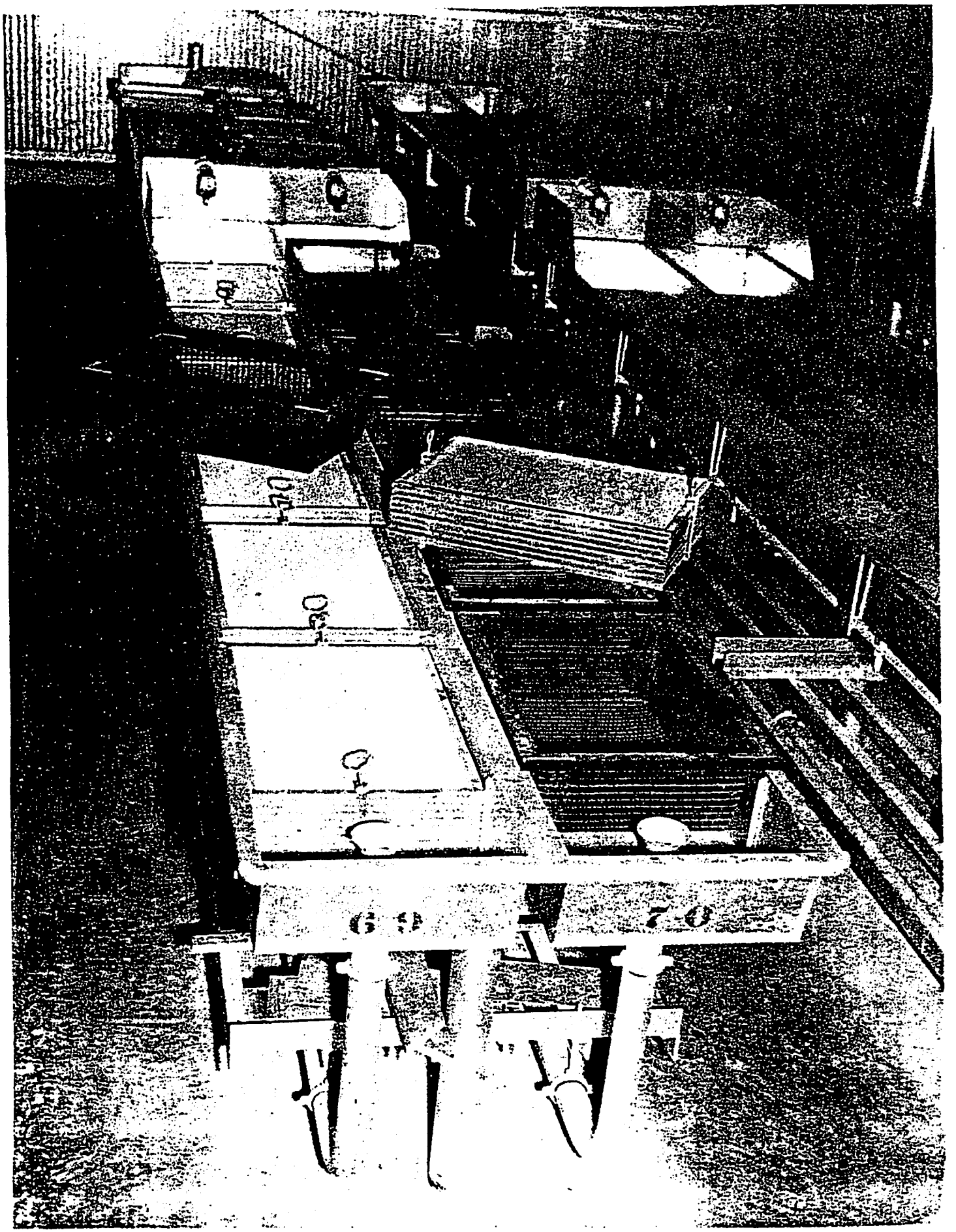

FIGURE 10. Hatching troughs - showing placement of the hatching trays and baskets.

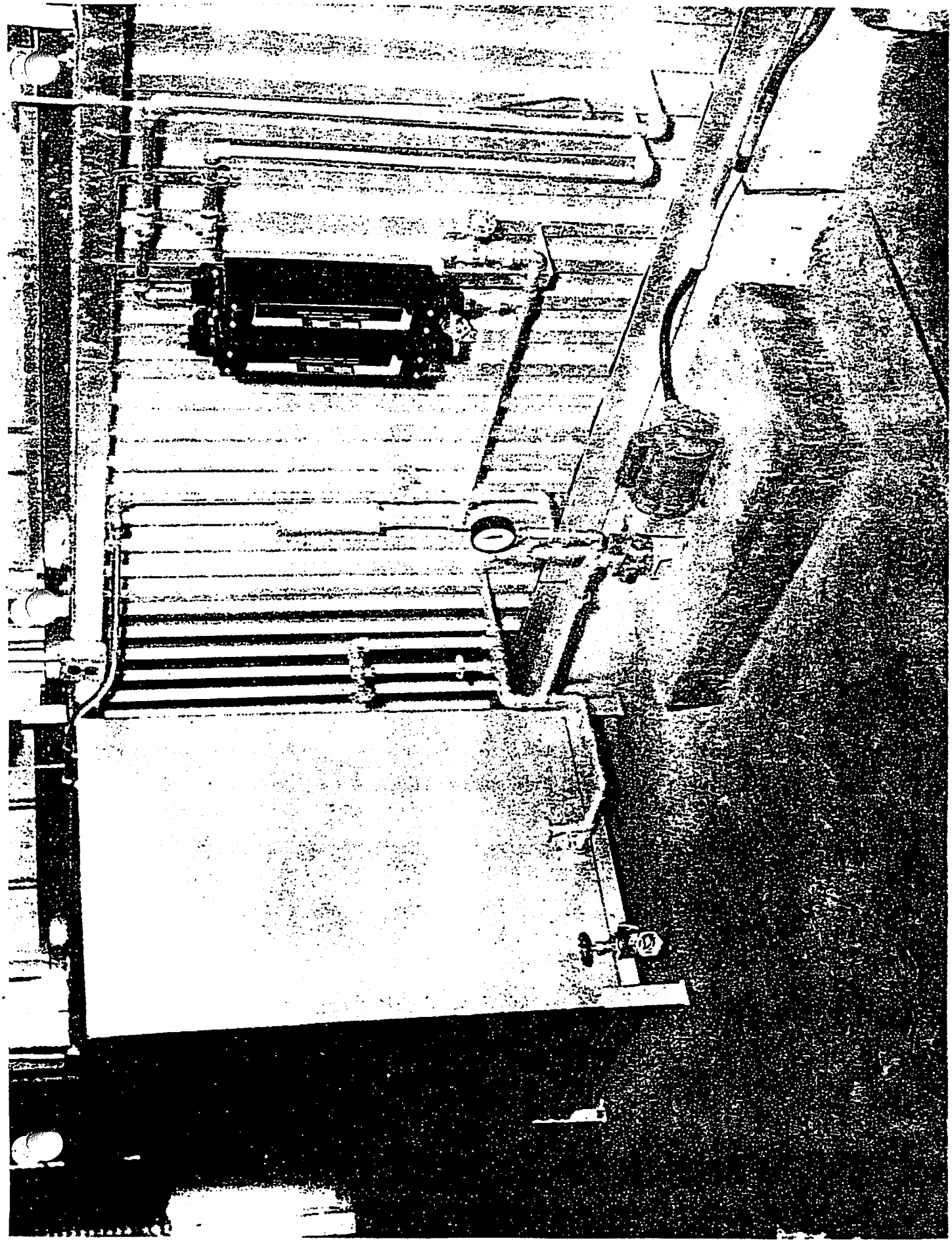

FIGURE 11. Medicinal injection system - 200-gallon capacity tank on left; injection pump, lower center; flow meters, center right.

ANNUAL REPORT

NIMBUS SALMON AND STEELHEAD HATCHERY

FISCAL YEAR OF 1955-56

APPENDIX II

CONTRACTS AND CORRESPONDENCE

Inland Fisheries Administrative Report Number 56-25

C O P Y

C O P Y

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Central Valley Project, California

CONTRACT BETWEEN THE UNITED STATES AND
THE STATE OF CALIFORNIA FOR THE OPERATION OF
THE NIMBUS FISH HATCHERY

THIS CONTRACT, made this 1st day of June, 1956, pursuant to the Act of Congress of June 17, 1902 (32 Stat. 388), and acts amendatory thereof or supplementary thereto, between THE UNITED STATES OF AMERICA, herein styled the United States, represented by the officer executing this contract, herein styled the contracting officer, and the STATE OF CALIFORNIA, represented by the Department of Fish and Game, herein styled the State:

WITNESSETH, THAT:

WHEREAS, the American River is an important nursery stream for the propagation of salmon and steelhead trout; and

WHEREAS, Nimbus Dam, a feature of the Central Valley Project, will block access to the portion of the spawning area previously utilized by approximately seventy-two percent (72%) of the salmon run and one hundred percent (100%) of the steelhead run heretofore available in the American River; and

WHEREAS, pursuant to recommendations of the California Department of Fish and Game and the United States Fish and Wildlife Service and the provisions of the Federal Wildlife Coordination Act (60 Stat. 1080), the United States is constructing and equipping a fish hatchery at Nimbus Dam to compensate for the loss of said salmon and steelhead spawning area; and

WHEREAS, the United States has agreed that initially the hatchery shall be built to a capacity of thirty (30) million eggs and ultimately, if necessary, to a capacity of fifty (50) million eggs; and

WHEREAS, by reason of its previous experience in the operation of fish hatcheries, it is desirable that the State operate said salmon and steelhead hatchery;

NOW THEREFORE, in consideration of the mutual and dependent covenants herein contained, it is hereby mutually agreed by the parties hereto as follows:

(1) Upon completion of the Nimbus fish hatchery by the United States to the stage where operation may begin, the United States shall transfer to the State and the State shall accept full custody of and complete responsibility for its operation, maintenance and repair including, but not limited to, buildings and grounds, pipelines, conduits, ponds, furnishings, fixtures, and equipment, all of which shall be inventoried and receipt therefor furnished by the State to the United States.

(2) Concurrently with the transfer of the operation and maintenance of the hatchery to the State, the United States shall, to the extent appropriations are available and allotments are made therefor by the Secretary of the Interior or his duly authorized representative, transfer to the State such sum of money as the parties hereto estimate will be required to pay the expense of such operation, maintenance and repair to the end of the fiscal year in which such transfer of operation and maintenance is made, and for each of the succeeding four (4) fiscal years the United States shall make a similar transfer of funds to the State for the estimated costs of operation and maintenance for each such fiscal year.

(3) The State shall maintain an accurate record of expenditures from funds transferred to it by the United States and shall furnish a statement of such expenditures to the United States within thirty (30) days after the close of each fiscal year. In the event that the actual costs for any fiscal year exceed the estimate agreed upon for such fiscal year, the amount of such excess shall be added to the sum transferred to the State for the succeeding fiscal year, subject to the limitations provided in Article 2 hereof. Any funds advanced hereunder that remain unobligated by the State at the expiration of each fiscal year during the term hereof shall be remitted to the United States with the statement of actual expenditures required by this article to be made. Any balance owing to the State upon the termination of this contract shall be promptly paid to the State.

(4) The State, as a part of the hatchery operations, shall make annual estimates of the number of salmon and steelhead spawning in the American River below Nimbus Dam and shall furnish annually to the contracting officer a record thereof.

(5) The United States shall furnish water for the operation of the hatchery in accordance with such schedule as may be agreed upon, but not to exceed thirty (30) cubic feet per second.

(6) The United States shall not be liable for property damage or personal injuries resulting from operation and maintenance of the hatchery by the State.

(7) Employees of the United States shall have access to the hatchery premises to the extent required for the performance of their official duties, but shall not interfere with the operations of the State.

(8) To the extent that the funds herein provided permit, the State shall maintain the tailrace control structure located downstream from the fish rack structure and shall maintain the stream bed and protective mats at the fish rack structure to assure a fish-tight operating condition.

(9) This contract may be terminated by either party giving sixty (60) days' written notice of termination to the other upon the occurrence of any of the following:

(a) The end of the last fiscal year for which the transfer of funds is provided in Article 2.

(b) Determination, as agreed upon by the contracting officer and the State and concurred in by the Fish and Wildlife Service, that the runs of salmon and steelhead spawning naturally in the American River below Nimbus Dam equal the average runs which prevailed in the American River during the period 1944 to 1954.

(c) Failure of the Congress of the United States or the Legislature of the State of California to make appropriations of money sufficient to carry out the provisions of this contract.

(10) Major repairs and replacements of hatchery facilities shall be the responsibility of the United States to the extent that appropriations are available and allotments are made therefor by the Secretary of the Interior or his duly authorized representative.

(11) No Member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this contract or to any benefit that may arise herefrom, but this restriction shall not be construed to extend to this contract if made with a corporation or company for its general benefit.

(12) (a) In connection with the performance of work under this contract, the State agrees not to discriminate against any employee or applicant for employment because of race, religion, color, or national origin. The aforesaid provision shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; lay off or termination, rates of pay or other forms of compensation; and selection for training, including apprenticeship. The State agrees to post hereafter in conspicuous places, available for employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of the nondiscrimination clause.

(b) The State further agrees to insert the foregoing provision in all subcontracts hereunder, except subcontracts for standard commercial supplies or raw materials.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

THE UNITED STATES OF AMERICA

By /s/ C. H. Spencer
Regional Director, Region 2
Bureau of Reclamation

STATE OF CALIFORNIA,
Acting by and through
Department of Fish and Game

By /s/ W. T. Shannon
Deputy Director

C O P Y

State of California
DEPARTMENT OF FISH AND GAME
Intraoffice Correspondence

Date: January 5, 1956

TO: J. C. Fraser, Fisheries Management Supervisor - Region II

FROM: James A. Hinze

SUBJECT: Investigation of Salmon Egg and Fry Mortalities at the Nimbus Fish Hatchery

On January 4, 1956 Mr. Harlan Johnson, of the Fish and Wildlife Service from the Willard Hatchery at Cook, Washington and Mr. John Pelnar, of the Fish and Wildlife Service from the Coleman Hatchery, California, Mr. Allan Pollit, Mr. Harold Wolfe, Mr. A. N. Culver and James Hinze, the latter four named, of the California Department of Fish and Game, met at the Nimbus Fish Hatchery to discuss the causes of the high egg and fry mortalities and possible ways of prevention.

The following remarks were given by Mr. Harlan Johnson and Mr. John Pelnar:

Egg Mortality

Probably caused by high water temperatures during early incubation period - over 60° F.

No explanation for losses of eggs taken when temperatures were 55° and lower unless this race of salmon cannot tolerate this temperature.

There is possibility that exposure of adults to high temperatures may have adversely affected the unspawned eggs.

Fry Mortalities

High percentage of newly hatched fry have coagulated yolk. Cause unknown unless it is continuation of egg losses.

Some older fry have gas bubbles in yolk sac. This possibly can be corrected by breaking up water at head of trough by passing through several screens.

There was an inch or more of silt on bottoms of troughs in which fry were loose on bottom. There has probably been some smothering from the silt and from fry crowding together on trough bottom. This can be avoided by placing all eggs on stacked trays after eying and keeping fry on trays until ready to feed.

We would suggest that in 1956 transfers of green Steelhead and Chinook Salmon eggs be made from Coleman to Nimbus and from Nimbus to Coleman at the earliest convenient time to determine if a weakness in the stock may be the cause of the high mortalities.

The following are some of the points brought out in the discussion, but are not necessarily the opinions of the Fish and Wildlife Service representatives.

Egg Mortalities:

It was definitely concluded that all eggs taken at water temperatures above 60 degrees would have a high mortality. According to Roger Burrows, Aquatic Biologist of the Fish and Wildlife Service, at the 1954 Northwest Fish Cultural Conference 57.5 degrees is the upper limits.

The quality of the eggs, taken after the water temperatures had dropped to 55 degrees and lower, did improve considerably. However, among these lots there would be portions of the take that were very poor and in one complete lot the mortality to the eyed stage was 67%, comparable to the losses in the eggs taken at the higher temperatures. No explanation for this has been determined other than the eggs or sperm, or both, may be affected by high water temperatures at some period during their development.

Fry Mortalities:

The high percentage of newly hatched fry having coagulated yolk may be caused by a continuation of the egg losses. This is also the thought of this hatcheries personnel. Although this condition has been found under other circumstances, the length of time of hatching a particular lot of eggs may have some bearing on this condition. Under normal circumstances a lot of eggs will hatch in about three days. These eggs are taking from 10 to 14 days to complete hatching. Apparently a premature hatching and probably a post hatching.

Some of the older fry have a gas bubble in the yolk sac. This has formed during the heavy influx of sediment and roily water due to heavy storm runoff in the American River Watershed. This condition may not exist when the water remains clear.

Most of the fry that are smothering in the silt on the trough bottoms probably would have been saved if they had been in good condition.

The suggestion of the transferring of green Steelhead and Chinook Salmon eggs from Coleman Hatchery to Nimbus Hatchery and from Nimbus Hatchery to Coleman Hatchery has considerable merit and may show a difference in the adult stock.

It is hoped that the abnormal water conditions that were present at the Nimbus Fish Hatchery this season will not occur in the future when there will be normal operation of the water from the Folsom Reservoir.

James A. Hinze
Fisheries Manager II

JH/gt