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Mr. Eagle

RESERVOIR REGULATION MANUAL

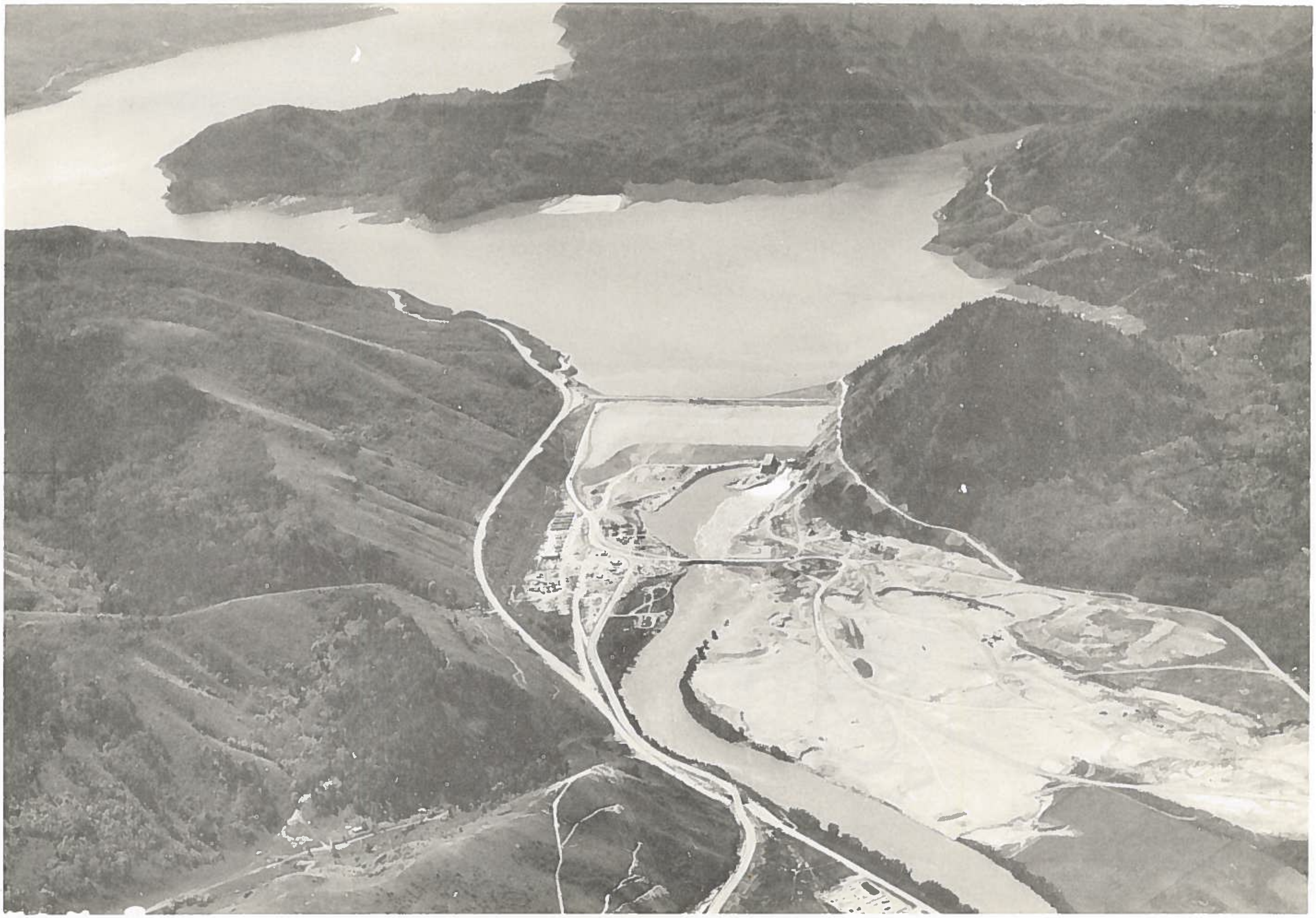
FOR

PALISADES RESERVOIR

U. S. ARMY ENGINEER DISTRICT, WALLA WALLA

CORPS OF ENGINEERS

NOVEMBER 1958



PALISADES DAM

JACKSON LAKE DAM

1953 start construction
1957 first storage

PALISADES RESERVOIR
PERTINENT DATA

RESERVOIR

Total Capacity at normal water surface, (Elev.5620)	1,401,600 ac.ft.
Joint use storage space	1,200,000 ac.ft.
Minimum power pool (Elev. 5497.5)	200,000 ac.ft.
Inactive storage	155,500 ac.ft.
Dead storage	44,100 ac.ft.
Minimum power pool elevation	5,497 m.s.l.
Dead storage pool elevation	5,452 m.s.l.
Superstorage	Approx. 16,000 ac.ft.
Superstorage elevation	5,621 m.s.l.
Surface area at normal water surface	Approx. 16,000 acres
Size	Approx. 21 miles by 2-1/2 to 3 miles

DAM

Located on Snake Piver 7 miles upstream from Irwin, Idaho

Type	rolled earth fill
Volume	Approx. 14,000,000 cu. yds.
Maximum height	260 feet
Crest elevation	5,630 m.s.l.
Crest length	2,200 feet
Spillway crest elevation	5,570 m.s.l.
Combined outlet and spillway capacity at normal water surface (Elevation 5,620)	90,000 c.f.s.
Spillway	47,000 c.f.s.
Outlet discharge	29,000 c.f.s.
By-pass discharge	14,000 c.f.s.

POWER PLANT

Installed capacity (4 Units at 28,500 KW)	114,000 KW
Power tunnel discharge capacity at minimum power head	10,000 c.f.s.
Powerhouse, 132 ft. wide by 298 feet long by 113 feet high	
Operating head	122 to 244 feet

Transmission, 6 - 115 KV lines totaling 230 miles and forming a network with the American Falls and Minidoka Projects.

HYDROLOGY

Drainage area above Heise, Idaho	5,110 sq.mi.
Drainage area upstream from Palisades Dam	5,110 sq.mi.
Average annual runoff at Heise (1903-1950)	5,047,000 ac.ft. 1/
Maximum annual runoff at Heise (1956)	6,523,000 ac.ft.
Minimum annual runoff at Heise (1934)	2,881,600 ac.ft.
Peak discharge of record at Heise (June 15-16;1918)	51,600 c.f.s. 2/
Minimum discharge of record at Heise (Jan. 27, 1935)	1,210 c.f.s.
Inflow design flood, volume 30 days	3,320,000 ac.ft.
Inflow design flood, peak discharge	105,000 c.f.s.

1/ Runoff at Heise is 1-1/4 percent higher than at Palisades Dam.
2/ Peak discharge of 60,000 c.f.s. occurred May 19, 1927 as result of washing out of landslide on Gros Ventre River.

BENEFITS AND REPAYMENT

	BENEFITS (Annual)	REPAYMENT
Irrigation	$1,981,000	$10,800,000
Power	1,604,000	42,554,700
Flood Control	899,330	*
Fish and Wildlife	7,940	*
Recreation	252,300	*

* Nonreimbursable

COSTS

Total project construction and development costs $76,601,000

JACKSON LAKE RESERVOIR

PERTINENT DATA

RESERVOIR

Location	On Snake River about 25 miles north of Jackson, Wyoming and 1 mile west of Moran, Wyoming.
Capacity	847,000 ac.ft.
Surface area . . . . Approx.	25,500 acres
Normal water surface	6,769 ft.(m.s.l.)

DAM

Type	Concrete gravity, embankment wings
Structural height	70 feet
Hydraulic heights	41 feet
Base width	61 feet
Crest width	21 feet
Crest length	4,920 feet
Altitude of crest	6,776.8 ft.(m.s.l.)
Volume	491,700 cu.yds.
Spillway type	Overflow weir with 19 radial gates, each 8 feet by 6 feet
Spillway capacity	13,000 c.f.s.

OUTLET WORKS

Type	20 slide gates, each 8 feet by 6.5 feet
Capacity	15,000 c.f.s.

HYDROLOGY

Drainage area above Moran, Wyoming	824 sq.miles
Average annual runoff at Moran (1904-1950) . . .	1,020,000 ac.ft.

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TABLES

PLATES

SECTION I - INTRODUCTION

1.01 Authority. - This manual is prepared under authority contained in Section 7 of the Flood Control Act of 1944 (58 Stat. 890) which reads in part as follows:

> "Hereafter, it shall be the duty of the Secretary of War to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds provided on the basis of such purposes, and the operation of any such project shall be in accordance with such regulations:"

General instructions regarding the preparation of the manual are contained in Part CXXXVI, Reservoir Regulation, Engineering Manual, Civil Works Construction, August 1951.

1.02 Purpose and scope. - Purpose of this manual is to present information for reference pertinent to system operation for flood control of Palisades Reservoir in conjunction with Jackson Lake Reservoir including details of facilities and regulation criteria. It contains a general description of the drainage basin and development. It describes the plan of operation, including regulation schedules for flood control, special regulation for unusual conditions and exceptionally large floods, and regulation examples. Comprehensive pertinent data are presented, including basin and reservoir maps, outlet and spillway discharge curves and tables, storage allocations, discharge rating tables for key stations, climatological data and hydrographs of stream flow at key stations for the period of record. The organization and responsibilities of those concerned with proper operation of the projects are also included. The Bureau of Reclamation and Corps of Engineers in cooperation with other Federal and State agencies and private organizations, made extensive studies of water supply, bank protection and multiple-purpose water usage in the development of the operation plan. The degree of flood protection provided was determined from an analysis of flood records and historical data, with consideration given to present and future needs of irrigation and additional flood control storage facilities.

1.03 Revisions to this manual. - As a continuing program, it will be necessary to revise portions of this manual to keep it up to date. Pertinent discharge rating tables must be revised when changes become evident in the stage-discharge relation; likewise, changes in the plan of operation will be made for the purpose of improving regulation technique, and project developments may occur which require revision of the information presented in the manual. Whenever revisions are necessitated, new pages containing the revised material will be printed and issued to each person having a copy of the manual so that substitution may be made. Revised pages will show the date of revision.

SECTION II - DESCRIPTION OF DRAINAGE AREA

2.01 Topography and streams. - The drainage area above Palisades Dam is 5,110 square miles and is located in northwestern Wyoming and southeastern Idaho. The main stem of the Snake rises in the Rocky Mountains of Yellowstone National Park, Wyoming, from where it flows westerly in deep canyons or narrow valleys for approximately 35 miles to the junction of Lewis River, thence southerly into Jackson Lake Reservoir. From Jackson Lake the river flows southerly for about 50 miles through a flat valley known as Jackson Hole. At the lower end of Jackson Hole the river enters a canyon and gradually bends until it is flowing northwesterly as it crosses the Wyoming-Idaho border and into the upper end of Palisades Reservoir. Below Palisades Reservoir the Snake River continues to flow northwesterly through a narrow valley, emerging into Snake River plain over an alluvial fan and thence flowing southwesterly through highly developed irrigated areas and into American Falls reservoir. Regulation by Palisades effects most of its local flood benefits in the area between Palisades and American Falls. Tributaries to the Snake River above American Falls are generally mountain streams with steep slopes. The largest of the tributaries is Henrys Fork which has a drainage area of 3,280 square miles and enters the Snake about 30 miles below Palisades. Pertinent data regarding the tributaries are given in the following table:

Name	Drainage Area	Discharge in cfs: Average Annual	Max. Year	Max. Peak
Henrys Fork	3,280	1,914	2,820	9,490
Blackfoot	1,295	159	294	868
Portneuf	1,000	259	414	2,000 +

A general plan of the area is shown on Plate 1.

2.02 Economy. - The principal natural resource of the Upper Snake River area is the fertile agricultural land. Because of the shortness of the growing season in the valleys above Palisades Dam, the economy is based upon raising of cattle for beef and dairy farming on Salt River in Star Valley. In this area ranches engage in raising hay on all available valley floor lands for winter use to supplement upland summer range. The Snake River plains below Palisades has developed into one of the most productive irrigated areas in the nation. At least 85 percent of the employment in the area is provided directly or indirectly by irrigated farms. Manufacturing is characterized by a preponderance of food processing plants, including sugar beet refineries, creameries, canneries, and meat packing establishments. Production of phosphate fertilizer and elemental phosphorus is of recent but increasing importance. Forestry, mining, and recreation are other industries of the area. The leading exports of the area are livestock, potatoes, sugar, beans, wool, grain, onions, and dairy products.

2.03 Irrigation. - Because of the short growing season in the area above Palisades, irrigation of lands is not extensive being mostly confined to irrigation of pasture and hay lands. However, in the Snake River plain below Palisades, irrigation has reached a high degree of development. In this area the entire natural flows of all streams for many years have been diverted for irrigation use during July, August and September. During flood periods the diversion of flow for irrigation makes a substantial reduction in the magnitude of floods. Since 1920, expansion of storage facilities has been the chief irrigation development.

The following table shows average irrigation diversions from Snake River during the 10-year period 1944-53.

Irrigation diversions in 1,000 acre-feet

Month	Palisades to Shelley	Shelley to Blackfoot	Total	CFS
May	267.1	147.5	414.6	6,731
June	400.6	170.1	570.7	9,574
July	538.5	219.5	758.0	12,306
August	452.2	177.7	629.9	10,226
September	327.7	125.3	453.0	7,598

2.04 Population. - The population of the area above Palisades Reservoir is 2,593 based on the 1950 census. The town of Jackson with a population of about 1,200 is the largest community. In the area downstream of Palisades to American Falls there is a population of about 60,000. The principal towns with 1950 populations are as follows:

Pocatello	26,004
Idaho Falls	18,855
Rexburg	4,253
Blackfoot	5,178
American Falls	1,874

SECTION III - HYDROLOGY

3.01 Climate. - Because of its geographic location, diversified topography, and wide range in elevation, the upper Snake River area has a variable climate ranging from semi-arid on the plains area below Palisades Dam to moderately wet on the west slopes of the Teton Mountains. Annual precipitation varies from less than ten inches in the plains area to a maximum of about 60 inches in the Teton Mountains. Characteristic of seasonal distribution is a May-June maximum occurring at lower elevations and a January maximum at higher elevations. July and August are uniformly the months of minimum precipitation. Much of the winter precipitation falls as snow. Mean monthly minimum and maximum temperatures in valley areas vary from 10.3 degrees to 86.0 degrees at Idaho Falls, Idaho, to minus 6.2 degrees and 76.4 degrees at Moran, Wyoming. Extreme temperatures vary from 104 at Idaho Falls to minus 63 degrees at Moran, Wyoming. Representative climatological data for the area are shown in Table 1.

3.02 Stream-flow characteristics. - Snake River and its tributaries in the area have rather regular patterns of natural stream flow with high flows during the months of May through July, receding stream flow in August and September and low flows in the months of October through April. High flows in the late spring and early summer result from the melting of the winter-accumulated snow pack, sometimes augmented by runoff from rain storms. Maximum annual discharges usually occur as a result of above normal temperatures existing for a period of several days in succession. Daily discharge hydrographs for Snake River at Moran are shown on Plate 6. Plates 7, 8 and 9 show daily discharge hydrographs for Snake River at Heise.

3.03 Past floods. - The largest flood of historical record in upper Snake River area was that of 1894. No actual observations of discharge during this flood were made in the area, but estimates based on high-water marks and concurrent records in adjacent watersheds indicate a peak flow of approximately 65,000 cfs for the Snake River at Heise. The highest recorded discharge occurred in May 1927 and was the result of the failure of a landslide dam on Gros Ventre River. Approximately 50,000 acre-feet of water were released in a period of about three hours, resulting in a peak discharge of 60,000 cfs at Heise. Other large floods since 1902 were those of 1904, 1909, 1917 and 1918, with maximum discharges of 50,800, 44,000, 38,900 cfs and 52,000 cfs respectively. A tabulation of annual peak discharges and May-July volumes for the Snake River at Heise are given in Table 2. Tables 10 and 11 show the natural monthly volumes of runoff for period of record through 1950 at Moran and Heise.

3.04 Snake River channel capacity. - The channel of the Snake River through Jackson Hole is generally inadequate to carry discharges of 8,000 cfs without appreciable damage from overflow and bank erosion. Below Palisades Dam the safe channel capacity varies from 15,000 cfs to 35,000 cfs. At 15,000 cfs, small areas, usually covered with natural pasture grass and which are annually subject to main river overflow, are inundated. For flows up to 20,000 cfs only pasture inundation occurs; however, some appreciable damage results from bank cutting. At the present time, levees constructed mainly by the Federal Government protect areas lying along the Snake River from Heise to Henrys Fork for flows up to 30,000 cfs. Below Henrys Fork to American Falls, emergency works constructed by the Federal Government and local interests give a measure of protection to several critical locations.

3.05 <u>Flood frequencies</u>. - Frequency curves of maximum annual flood peak discharges for Snake River at Heise have been determined for actual conditions where flood control was incidental to regulation of Jackson Lake Reservoir for irrigation interests; for natural conditions approximating flows that would have occurred without regulation of Jackson Lake; and for conditions reflecting regulation of Palisades Reservoir and 200,000 acre-feet of storage space at Jackson Lake for flood control. Peak discharge data are available for Snake River at Heise for years 1903 to date. Frequency statistics for flood peak discharges were compiled and adjusted to the 97-year period of stream-flow records of Columbia River near The Dalles by methods described in Civil Works Engineer Bulletin 51-1 and subsequent publications by OCE on the subject of flood frequencies. Plate 2 depicts peak discharge frequency curves for Snake River at Heise, Idaho. The following tabulation briefly summarizes natural peak discharge magnitudes for various recurrence intervals.

Average recurrence interval	Maximum annual flood peak discharge	
	Natural	Regulated
Years	c.f.s.	c.f.s.
2	32,500	20,000
5	42,300	21,000
10	48,700	21,900
20	54,500	23,000
50	62,000	25,800
100	68,000	29,800

3.06 <u>Flood damages</u>. - Flood damages in the region are mostly to agricultural lands and produce. Without the advantage of flood-control storage facilities the average annual damages along the Snake River from Palisades Dam to American Falls are estimated at $2,700,000. Operation of Palisades Reservoir and Jackson Lake as outlined in this manual is expected to reduce average annual damages by about $1,350,000. Plate 3 shows the average relationship of flood damages to peak discharges. The use of space in Jackson Lake in conjunction with Palisades space for flood control purposes also provides a reduction of flood damages in the Jackson Hole area between Jackson Lake and Palisades Dams.

In addition to the reduction of flood damages in the upper reaches of the Snake River, regulation by Palisades will be effective in reducing damages along the lower reaches of the Snake and along the lower Columbia River. The main control plan for control of floods on the lower Columbia River includes Palisades in the system of flood control reservoirs.

SECTION IV - PROJECT DESCRIPTIONS

4.01 Palisades Dam. - Located on Snake River seven miles upstream from Irwin, Idaho, was authorized for construction by the Secretary of Interior on 9 December 1941 under provisions of Section 9 of the Reclamation Project Act of 1939. Reauthorization was made by Public Law 864, 81st Congress, 2nd Session; approved 30 September 1950. The total storage capacity of the reservoir at normal water surface is 1,401,600 acre-feet. Of the total storage, 1,200,000 acre-feet are allocated for joint use of irrigation, flood control, and production of power; 155,500 acre-feet are inactive storage for power head and for preservation and propagation of fish and wildlife; and 44,100 acre-feet are dead storage. Construction of Palisades Dam was started in 1951 and completed in 1957. The general plan and sections of the dam are shown on Plate 4. Table 3 shows capacity of the reservoir at one foot elevation increments. The spillway is a tunnel, located in the left abutment and designed to discharge 47,000 cfs at normal water surface elevation. Control of the spillway is effected by two radial regulating gates, 20 by 50 feet each. The tunnel is 1,890 feet long and, except for inlet and outlet ends, lined with unreinforced concrete. The outlet works consist of a trashrack structure, two circular tunnels with steel liners downstream from the dam axis, manifold section, valve house, and stilling basin. The two tunnels, one power and one outlet with diameters of 26 feet, have a total capacity of 32,500 cfs at minimum power pool elevation of 5,497.5 feet m.s.l.; 10,000 cfs through the power tunnel and 22,500 cfs through the outlet tunnel at minimum power head. The outlet tunnel has six discharge tubes for control of irrigation and flood water. The power tunnel has two bypass tubes for routing floods and four penstocks for generation of power. There are four regulating gates, four emergency gates, two 96-inch hollow jet valves and two 96-inch ring follower gates for control of the outlet tunnel discharge, and two regulating and two emergency gates for control of the power tunnel bypasses. The regulating gates are hydraulically operated 7 foot-6 inch by 9 foot-0 inch rectangular gates. Spillway and outlet discharge curves are shown on Plate 4. Pertinent data are summarized in the table at the forepart of this manual.

4.02 Jackson Lake Dam. - Jackson Lake Dam is located on Snake River in the State of Wyoming and controls the outflow from Jackson Lake. Originally, in 1907, the reservoir was formed by a temporary log crib dam creating a usable capacity of 300,000 acre-feet. This dam washed out in July 1910 and was replaced by an earth dam, forming a reservoir with a usable capacity of 380,000 acre-feet. The earth dam was raised in 1916, increasing the usable capacity to 780,000 acre-feet. In 1919, the capacity was further increased to 847,000 acre-feet between elevations 6,730 and 6,769 m.s.l. by dredging the outlet. The reservoir covers an area of about 25,540 acres. Table 4 is a storage capacity table for Jackson Lake. The spillway dam is a concrete gravity type with embankment wings having a structural height of 70 feet and hydraulic height of 41 feet. The spillway is an overflow weir controlled by 19 radial gates, 8 feet by 6 feet each with a total capacity of 13,000 cfs. The outlet works consist of 20 slide gates, 8 feet by 6.5 feet each, having a total capacity of 15,000 cfs. The general plan and sections of the dam are shown on Plate 5. Pertinent data are summarized in a table at the forepart of this manual.

SECTION V - PLAN OF OPERATION

5.01 History of plan of operation. - A draft of the plan of operation for Palisades Reservoir was prepared by the Bureau of Reclamation in cooperation with the Portland District, Corps of Engineers, and submitted to the Chief of Engineers in January 1948, along with a report on the derivation of the operation plan showing estimates of flood control benefits. The Office, Chief of Engineers concurred with estimates of flood control benefits expected to accrue from proposed plan of operation, and informed the Commissioner, Bureau of Reclamation by letter dated 28 January 1948 that, upon completion of the structure, recommendations of the Chief of Engineers to the Secretary of the Army for regulation under Section 7 of the 1944 Flood Control Act would be in accordance with the allocation for flood control as contained in the adopted plan of operation. Copies of the operation plan as prepared in 1948 were attached to contract with water user organizations for use of Palisades water. It was included as an appendix to the Bureau of Reclamation supplemental report on Palisades Dam and Reservoir Report, dated June 1949, which was basic to final authorization of that project. Also it was contained in the Definite Plan Report for Palisades Reservoir prepared by the Bureau of Reclamation and dated November 1951. Appendix A is a copy of this operating plan.

Recent studies have indicated some improvement and interpretations to the plan. The following items have been agreed to by exchange of letters between the Corps of Engineers and the Bureau of Reclamation:

a. That the best available forecasts be adopted, regardless of the basis upon which they were made.

b. That the wording of the Original Operating Plan be interpreted to provide for the development and maintenance of an adequate hydrologic reporting network.

c. That numbered paragraph 2 of the Original Operating Plan is broad enough to accommodate the power plant operations relative to and consistent with the flood-control evacuation program.

In accordance with Federal law the regulations were summarized for publication in the Federal Register. This summary of regulations which includes the revisions mentioned above is included as Appendix B to this manual.

5.02 Essential features of plan of operation. - The operation plan provides for the optimum feasible use of the storage space in Palisades Reservoir for flood control in coordination with its uses for irrigation, power and recreation, and in coordination with use of storage in Jackson Lake. Salient features of the plan are summarized as follows:

a. Storage space up to 1,400,000 acre-feet in Palisades and Jackson Lake will be made available for flood control on a forecast basis by the Bureau of Reclamation in accordance with Flood Control Storage Reservation Diagram shown on Plate 10. However, not less than 75 percent of total storage space required at any time will be made available in Palisades Reservoir.

b. Forecasts of runoff volume from forecast date until 31 July for operation of reservoir will be made periodically beginning 1 February by Bureau of Reclamation, Region I after consultation with U. S. Army Engineer District, Walla Walla, and Idaho State Watermaster District 36.

c. Reservoir releases will be scheduled to evacuate and refill reservoir space in accordance with Flood Control Storage Reservation Diagram without exceeding 20,000 cfs at the Heise gaging station insofar as practicable.

d. For extraordinarily large floods which require more than 1,400,000 acre-feet in Palisades and Jackson Lake to regulate flow to 20,000 cfs at Heise, releases in excess of 20,000 cfs will be planned as given in paragraph 5.05.

e. When the forecasted runoff for the period 1 June through 31 July exceeds 2,500,000 acre-feet, and when, after 1 June, the available space is not within 10,000 acre-feet of the space required by the Flood Control Storage Reservation Diagram, the releases from the reservoir may be increased so that the flow at Heise will exceed 20,000 cfs up to a limit of 30,000 cfs to the extent of 1,000 cfs for each 5,000 acre-feet of deficient storage space, except that the release shall not be greater than natural inflow. The change in discharge will be made in such manner as to minimize the adverse downstream effects.

f. A hydrologic reporting netowrk sufficient to provide the necessary basic data for determination of required flood control reservation shall be developed and maintained by the Bureau of Reclamation.

g. Current information on forecasts, reservoir releases, reservoir storage and such other operating criteria which affect the schedule of operation shall be furnished the District Engineer, Corps of Engineers and Watermaster, Water District No. 36, by the Bureau of Reclamation.

5.03 Runoff forecasts. - Satisfactory results from the operating plan depend to a great extent on the adequacy of the runoff forecasts. Because runoff above Palisades Dam is primarily from melting of the accumulated winter and spring snow pack, forecasts of runoff volume can be made with a reasonable degree of accuracy. In accordance with the operating plan, the Bureau of Reclamation will make forecasts of seasonal volume runoff for operation of reservoirs periodically commencing with 1 February of each year after consultation with Corps of Engineers and State Watermaster District 36. The forecasting equations developed by the Bureau are included as Appendix C to this manual. They consist of statistically derived relationships of past occurrences of runoff and snow fall, precipitation, and temperature. Results of the forecasts as would have occurred in past years are also shown on Table C-1 of Appendix C. Plate C-1 shows probability levels for various magnitudes of forecast errors.

5.04 Derivation of storage reservation diagram. - The allocation of flood control storage space in the reservoirs is based on a storage reservation diagram shown on Plate 10. This diagram was developed by enveloping points relating the volumes of flood season runoff with co-ordinates of time and storage reservation required for control of the floods. Analysis of past floods provide the points from which the curves were drawn. Flood season runoff for each year of record was analyzed for the amount of storage reservation that would be required to control the runoff to the allowable discharge in Snake River channel at the Heise gaging station. This value is defined as bankfull capacity in the main channel below Palisades Dam (20,000 cfs). The values of storage reservation required were plotted on the date the storage would be required and, adjacent to each plotted point, the runoff from that date to 31 July was noted. Curves were sketched as enveloping lines which encompassed the maximum required storage reservation on any date for any of the floods studied. In addition to enveloping the points of maximum storage requirements, the curves were shifted so as to provide increasing amounts for an additional safety factor in the early part of the season, prior to 1 June. Curves as originally developed are shown on Plate A-1 of Appendix A. Subsequent studies indicated a need for modifying the curves as applicable to low runoff years to insure re-filling of the reservoir. Accordingly, the curves were modified to provide greater assurance of filling and still provide required flood control space by construction of two sets of curves; one set to be used until natural inflow to Palisades first exceeds 20,000 cfs and the other set to be used after that time. The curves are shown on Plate 10, and Plate B-1 of Appendix B.

5.05 Regulation of extraordinary large floods. - Although most floods can be regulated to bankfull by use of the storage reservation diagram, Snake River is occasionally subjected to floods much larger which cannot be so regulated. With present downstream channel capacity, there is insufficient reservoir capacity to regulate the standard project flood and maximum historical floods to bankfull. Also, heavy precipitation and consequent snow accumulation may develop late in the season, leaving insufficient time to evacuate the reservoir to obtain required space for regulation to bankfull. For these floods, operation of the reservoir to permit releases above bankfull will materially reduce the magnitude of the peak discharge downstream. These extraordinarily large floods are expected to occur very rarely. The rate of releases from Palisades and Jackson Lake Dams for such floods will be determined in accordance with the following rule curve showing the relationship of required discharge to the 1 May - 31 July forecast of runoff volume:

1 May - 31 July Forecasted Volume (acre-feet)	Required Discharge 1/ (cfs)
Less than 4,100,000	20,000
4,100,000	23,000
4,300,000	24,000
4,600,000	25,000
4,900,000	26,000
5,300,000	27,000
5,600,000	28,000
6,000,000	29,000
6,300,000 or larger	30,000

1/ Applicable only when exceeded by natural inflow to Palisades Reservoir.

Releases of the above amounts begun in May will be modified after 1 June in accordance with the procedure set forth in 5.02e. Regulation of the Standard Project Flood as would occur by this plan is shown on Plate 11. Regulation of the 1953 flood is shown on Plate 12.

5.06 Regulation for power production. - As an integral part of the Palisades Project, a power plant has been constructed with an installed capacity in four units totalling 114,000 kilowatts. The power plant is designed to operate through a range of head varying from a minimum of 122 feet to a maximum of full reservoir of approximately 245 feet. Use of water for power production will be limited to water released for irrigation or flood control purposes including release of water to fill the prior storage right of American Falls Reservoir. The normal production of hydroelectric power at Palisades Dam will be incidental to the operation of the reservoir for irrigation and flood control. There are no power-generating facilities in operation at Jackson Lake Dam.

5.07 Continuing and additional operation studies. - In the interest of obtaining maximum benefits from the operation of the reservoir, a program of continuous study of each current flood for possible improvements in the regulation schedules will be necessary at all times. Some of the continuing and additional studies are enumerated as follows:

a. Review runoff forecasting techniques with a view toward gaining greater accuracy.

b. Analysis of recent and current data to determine what additional data are required for improvement in forecasting.

c. Studies to determine a reliable method of forecasting short-term stream flows.

d. Review of Storage Reservation Diagram.

e. Review of basis for releases in excess of 20,000 cfs when required for control of extraordinary large floods.

f. Studies to provide for better integration of Palisades Reservoir into the entire Upper Snake water control system, including all irrigation and storage features above American Falls Dam.

SECTION VI - COLLECTION OF DATA AND COMMUNICATION

6.01 General. - It is essential for efficient regulation of the reservoir that those responsible for regulation keep advised of weather, snow pack, and stream flow conditions within the watershed, and also informed regarding current storage in the reservoirs. Facilities for gathering and transmitting this information are discussed in the following paragraphs.

6.02 Hydrologic reporting network. - The hydrologic network in the upper Snake River drainage basin for operation of the reservoirs in the interest of both irrigation and flood control consists of three reservoir-stage stations, five stream-flow stations, seven precipitation stations and 33 snow courses. Locations of stations in the Hydrologic Network are shown on Plate 1. All the precipitation network stations are equipped with manual-type gages; however, two stations, Moran and Jackson, are also equipped with recording gages. Reports received from the Hydrologic Network may be divided into two groups; those received daily for short-term stream flow forecasting and project regulation during the spring runoff period, and those received monthly or semimonthly primarily for forecasting seasonal volume of runoff. Tables on Plate 1 list snow courses, stream and reservoir stations and precipitation gages together with the period, frequency, and method of reporting. Table 5 shows representative snow course data. Discharge rating tables for stream gaging stations are included as Tables 6, 7, 8 and 9.

As indicated on Plate 1, nearly all of the required daily reports are received at the Corps of Engineers' District office by Teletype

Service "C". Reports used for daily forecasts of stream flow as well as daily reservoir reports are received daily during the flood season, 1 April through 15 July. The Minidoka Project Office at Burley will collect the reports from most of the local observers by telephone, mail, and radio; transmitting them each morning to the U. S. Weather Bureau at Boise, from where they are transmitted by Teletype Service "C". Precipitation reports from Snake River Station, Jackson, Island Park and Moran will be collected through the Bureau of Reclamation operator at Jackson Lake and relayed to Burley, together with reservoir and stream flow observations through the Palisades Project. The cooperative observers at Bedford and Grover will report daily precipitation amounts in excess of 0.20 inch by telephone directly to Burley. For lesser daily amounts of precipitation the reports will be forwarded to Burley by mail.

Monthly and semimonthly reports of snow conditions in the upper watershed are obtained by the Soil Conservation Service in cooperation with the Bureau of Reclamation, the Corps of Engineers, the Forest Service, Water District No. 26, and the States of Wyoming and Idaho. These reports are transmitted to the District Engineer in accordance with the schedule shown on Plate 1.

Daily precipitation, temperature, reservoir stages and outflows are observed by the operators at Island Park, Jackson Lake and Palisades Reservoirs and transmitted by radio (telephoned from Palisades) to the Bureau of Reclamation's Minidoka Project office at Burley and thence by teletype, during the period 1 April through 15 July, to the U. S. Weather Bureau office at Boise for transmission over Teletype Service "C". Daily stream-flow reports of Wilson, Heise, and Rexburg are telegraphed by the observers, during the 1 April through 15 July period, to the Weather Bureau at Boise for transmission by Teletype Service "C". The reservoir outflows and stream-flow data are from rated stream-gaging stations. During the 15 July through 31 March period, no daily reservoir or stream-flow reports are received by the District Engineer, but a weekly report showing daily flows at gaging stations and periodic observations of reservoir stages is received by mail from the Watermaster of District No. 36 at Idaho Falls.

6.03 Communication facilities. - As indicated in the foregoing paragraphs, use is made of all types of communication facilities in the collection and dissemination of hydrologic data and exchange of regulation requirements. Normal use was adopted for that facility which gave dependability and was most economical. Duplication of reporting requirements was avoided wherever practical, and use of more costly communication service was avoided where the data are not material in the determination of immediate operation requirements. Improvements and economics will be effected as indicated by accumulation of experience in operation of the network.

SECTION VII - ORGANIZATION AND RESPONSIBILITIES

7.01 General. - The various interests affected by regulation of Palisades and Jackson Lake Reservoirs demand close cooperation among the Corps of Engineers, Bureau of Reclamation and Reclamation Engineer for State of Idaho. The administration of regulating programs will at all times reflect due consideration for the integrated interests involved. The organization and responsibility of these agencies as they relate to the operation of Palisades are given in the following paragraphs.

7.02 Corps of Engineers. - The Army Engineer District, Walla Walla of the Corps of Engineers has the responsibility of prescribing flood control regulations in accordance with Section 7 of the Flood Control Act of 1944 as referred to in paragraph 1.01. Within the District, the Engineering Division is responsible for conformance with Section 7 with primary responsibility assigned to the Water Control Section. The organization of the District as it pertains to flood control regulations is as follows:

District Engineer
Colonel Paul H. Symbol

↓

Engineering Division
Edwin C. Franzen, Chief

↓

Planning and Reports Branch
Louis E. Rydell, Chief

↓

Water Control Section
Melvin J. Ord, Chief

By collection of hydrologic and reservoir data, the Water Control Section will keep informed on the hydrological and meteorological situation in the Upper Snake drainage area and in the operation of Palisades and Jackson Lake Reservoirs. The Section will make periodic forecasts of runoff and check with Bureau of Reclamation to assure maximum flood control regulations in accordance with agreement. The Water Control Section will make studies in coordination with the Bureau of Reclamation to refine regulation technique. The organization of the Water Control Section in execution of the above responsibilities is as follows:

Chief, Water Control Section
Melvin J. Ord

Projects Regulation Sub-Section
N. F. Meadowcroft
K. W. Wise

7.03 Bureau of Reclamation. - The Regional Office, Region 1, Bureau of Reclamation in Boise, Idaho, is directly responsible for the operation of Palisades and coordination of Palisades' operations with that of Jackson Lake to accomplish the flood control objectives. These objectives will at all times be in accordance with regulations set forth in the plan of agreement as given in Appendix A and B to this manual. The organization of the Bureau of Reclamation as it pertains to the operation of these projects is as follows:

Regional Director
H. T. Nelson

Assistant Regional Director
W. H. Tuller

Division of Irrigation

G. G. Stamm, Regional Supervisor of Irrigation

Irrigation and Operations Branch

Theodore Nelson, Chief
Richard E. Lindgren, Hydraulic Engineer

Minidoka Project, Burley, Idaho

M. L. Tillery, Project Superintendent
Glenn Simmons, Chief, River Control and Storage Division

Palisades Dam

B. J. Morton, Actg. Chief, Power Field Branch

Jackson Lake Dam

James L. Braman, Reservoir Superintendent

The responsibilities of the Bureau of Reclamation include the following:

a. Maintenance of adequate hydrologic reporting network;

b. Collection and dissemination of hydrologic and reservoir data;

c. Preparation of periodic forecasts of runoff for the period February through July and consultations with the Corps of Engineers and District Watermaster to coordinate forecasts and establish details of the flood control evacuation and refill schedules.

d. Execution of releases at Palisades and Jackson Lake as required to conform with Flood Control Storage Reservation Diagram or as these may be modified by agreement between Corps of Engineers and Bureau of Reclamation.

e. Performance of studies for refinement of forecasting and regulation techniques.

The coordination of the foregoing responsibilities will be carried on by Mr. Richard E. Lindgren, acting directly under the Assistant Regional Director, W. H. Tuller, who is directly responsible for the operation of all Bureau of Reclamation reservoirs in Region 1.

7.04 Reclamation Engineer. - The Watermaster for the Upper Snake River District is the representative for the locality of the Idaho State Reclamation Engineer. He is elected by the water users holding adjudicated rights and is responsible for the distribution of the waters of Snake River in accordance with established water rights. The Watermaster is also responsible for the functional regulation of Jackson Lake for flood control in accordance with existing agreements and in coordination with the flood control activities at Palisades. In this capacity, the Watermaster each year makes periodic forecasts of the runoff of Snake River which will be correlated with those made by the Bureau of Reclamation. The present Watermaster is Lynn Crandall and has his office in Idaho Falls, Idaho.

TABLE 1

CLIMATOLOGICAL DATA

(Snake River Basin above Idaho Falls, Idaho)

Station	Watershed	Elev. m.s.l.	Period of Record	Temperature-Degree Fahrenheit				Annual Precipitation in Inches				Snowfall-Inches	
				Years of Record	Mean Annual	Highest of Record	Lowest of Record	Years of Record	Average	Maximum	Minimum	Years of Record	Average Annual
Afton, Wyoming	Salt River	6,225	1904-1946	34	38.0	98	-55	32	17.63	26.41	12.35	37	90.1
Alta, Wyoming	Henrys Fk.	6,500	1910-1954	43	39.1	97	-46	44	18.23	28.02	9.47	38	100.0
Bechler River, Wyoming	Snake River	6,300	1931-1944	10	38.7	96	-47	13	36.90	48.89	10.06	12	297.7
Bedford, Wyoming	Salt River	6,221	1902-1954	46	38.5	100	-46	42	19.46	29.71	10.78	47	107.1
Jackson, Wyoming	Snake River	6,244	1905-1954	32	37.7	96	-52	30	15.94	21.47	10.93	25	82.3
Moose, Wyoming	Snake River	6,627	1936-1954	18	36.2	92	-44	19	26.89	32.94	17.70	12	177.6
Moran, Wyoming	Snake River	6,740	1911-1954	42	34.2	92	-63	42	21.36	29.32	13.51	35	134.9
Snake Riv.Sta.,Wyoming	Snake River	6,800	1906-1954	35	34.7	97	-56	32	30.13	50.10	21.32	35	208.3
Ashton, Idaho	Henrys Fk.	5,100	1897-1954	56	41.3	100	-37	53	16.37	24.18	8.97	47	72.5
Idaho Falls, Idaho	Snake River	4,744	1880-1954	50	44.6	104	-37	63	11.31	21.31	5.93	49	44.2
Irwin, Idaho	Snake River	5,200	1894-1954	51	41.8	102	-45	57	14.85	24.33	4.75	43	63.2
Island Park, Idaho	Henrys Fork	6,300	1942-1954	12	36.7	91	-60	12	30.27	37.43	24.15	5	179.0
Lake, Idaho	Henrys Fork	6,700	1890-1945	2	38.8	92	-39	22	17.65	22.35	11.93	15	132.2
Sugar, Idaho	Henrys Fork	4,892	1907-1954	35	41.6	104	-44	46	11.02	19.24	6.52	33	46.9
Grover, Wyoming	Salt River	6,115	1904-1952	45	37.7	96	-55	49	18.04	26.41	12.35	38	88.6

TABLE 2

RUNOFF AND DISCHARGE DATA

SNAKE RIVER NEAR HEISE, IDAHO

Year	Annual Oct.-Sept. Runoff 1,000 A.F.	Actual 1/ peak Discharge 1,000 cfs	Natural Peak Discharge 1,000 cfs	Natural May-July Volume 1,000 A.F.
1903		23.0	32.0	
04	6,573	49.5	52.2	4,275
1905	2,983	13.5	18.3	1,756
06	4,095	19.0	27.0	2,753
07	5,922	23.5	32.4	4,290
08	5,061	18.5	26.5	2,645
09	6,911	44.0	48.7	4,600
1910	5,599	22.0	30.9	2,862
11	5,758	32.6	40.6	3,633
12	5,949	39.3	45.6	3,806
13	6,442	30.5	38.9	3,787
14	5,809	26.0	35.0	3,384
1915	3,940	17.1	19.5	1,742
16	5,761	28.1	36.8	3,477
17	6,448	38.9	39.5	3,140
18	6,620	52.0	54.2	4,014
19	3,869	17.9	24.1	1,635
1920	5,082	26.0	35.0	3,348
21	5,690	34.0	40.5	3,545
22	5,129	26.3	33.9	3,196
23	5,144	24.5	33.1	3,007
24	3,766	15.4	20.6	1,831
1925	5,530	25.1	35.7	3,542
26	4,296	19.0	20.4	1,722
27	5,782	36.0	41.5	4,079
28	6,195	36.1	44.0	3,793
29	4,506	24.3	29.6	2,355
1930	4,419	20.5	24.1	2,143
31	3,231	12.6	14.8	1,264
32	4,325	21.3	30.5	2,942
33	4,323	25.6	31.5	2,358
34	2,980	13.6	15.1	1,173
1935	4,004	21.6	31.8	2,605
36	5,103	29.3	38.7	3,425
37	3,941	17.9	23.5	2,192
38	4,994	23.1	32.9	3,145
39	4,406	19.4	21.1	2,175
1940	3,566	13.9	20.8	1,769
41	3,635	14.5	20.5	1,961
42	4,219	19.5	27.6	2,320
43	6,183	36.0	36.4	3,909
44	4,321	20.0	20.2	2,085
1945	4,422	22.5	27.7	2,781
46	5,466	26.2	26.2	2,742
47	5,226	25.9	27.1	3,082
48	5,015	30.5	32.7	2,864
49	4,841	21.0	28.9	2,832
1950	5,760	28.5	35.7	3,730
51	6,284	30.4	36.3	3,607
52	6,036	26.8	31.5	3,286
53	4,633	26.0	31.1	2,631
54	4,993	29.7	30.2	3,076
1955	4,091	18.5	22.0	2,222
1956	6,523	33.1	43.0	4,246
Avg.	5,015			2,920

SNAKE RIVER AT MORAN, WYO.

Year	Natural Peak Discharge 1,000 cfs	Natural May-July Volume 1,000 A.F.	Annual Oct.-Sept. Runoff 1,000 A.F.
1904	8.2	885	1,302.0
05	5.0	467	780.0
06	6.0	591	899.0
07	7.6	894	1,270.0
08	6.4	560	1,124.0
09	14.2	814	1,461.0
1910	10.1	881	1,238.0
11	13.3	981	1,346.0
12	12.2	808	1,214.0
13	14.7	968	1,436.0
14	12.5	749	1,149.0
1915	6.9	408	769.8
16	13.5	874	1,223.0
17	13.0	880	1,238.0
18	17.0	921	1,249.0
19	7.2	417	685.2
1920	9.2	693	992.6
21	10.0	756	1,068.0
22	10.0	716	1,007.0
23	9.0	677	944.5
24	5.9	430	648.2
1925	12.9	924	1,328.0
26	9.5	465	763.4
27	14.2	1,038	1,416.0
28	15.2	984	1,331.0
29	9.0	578	866.1
1930	6.4	493	794.0
31	4.6	344	575.8
32	9.6	718	992.1
33	10.3	620	878.1
34	6.5	346	628.4
1935	10.9	654	933.7
36	11.4	759	1,069.0
37	7.9	558	779.4
38	10.8	816	1,146.0
39	8.8	576	892.9
1940	7.4	543	794.5
41	6.3	495	780.0
42	8.3	570	886.8
43	13.3	993	1,417.0
44	7.4	538	810.0
1945	9.5	625	896.4
46	9.5	668	1,059.0
47	10.2	809	1,129.0
48	9.9	736	1,026.0
49	8.6	775	1,107.0
1950	10.3	830	1,168.0
51	12.0	783	1,219.0
52	11.9	809	1,222.0
53	11.1	661	969.4
54	11.6	838	1,182.0
1955	7.5	619	898.2
56	14.1	1,054	1,484.0
Avg.		709	1,046.9

1/ Reflect regulation by Jackson Lake.

TABLE 3
PALISADES RESERVOIR
TOTAL STORAGE CAPACITY

ELEV. FEET	STORAGE CONTENT	STORAGE DIFF. PER FT.	ELEV. FEET	STORAGE CONTENT	STORAGE DIFF. PER FT.	ELEV. FEET	STORAGE CONTENT	STORAGE DIFF. PER FT.	ELEV. FEET	STORAGE CONTENT	STORAGE DIFF. PER FT.	ELEV. FEET	STORAGE CONTENT	STORAGE DIFF. PER FT.	ELEV. FEET	STORAGE CONTENT	STORAGE DIFF. PER FT.
5381	162	38	5421	6,095	385	5461	64,469	2,622	5501	217,353	5,236	5541	482,105	8,119	5581	866,207	11,257
82	200	42	22	6,480	418	62	67,091	2,684	02	222,589	5,312	42	490,224	8,191	82	877,464	11,371
83	242	47	23	6,898	452	63	69,775	2,745	03	227,901	5,389	43	498,415	8,264	83	888,835	11,484
84	289	50	24	7,350	486	64	72,520	2,807	04	233,290	5,466	44	506,679	8,337	84	900,319	11,598
85	339	55	25	7,836	518	65	75,327	2,868	05	238,756	5,542	45	515,016	8,409	85	911,917	11,711
86	394	58	26	8,354	552	66	78,195	2,930	06	244,298	5,619	46	523,425	8,482	86	923,628	11,825
87	452	63	27	8,906	586	67	81,125	2,991	07	249,917	5,696	47	531,907	8,555	87	935,453	11,938
88	515	67	28	9,492	619	68	84,116	3,053	08	255,613	5,772	48	540,462	8,627	88	947,391	12,052
89	582	71	29	10,111	652	69	87,169	3,114	09	261,385	5,848	49	549,089	8,699	89	959,443	12,165
90	653	76	30	10,763	708	70	90,283	3,172	10	267,233	5,917	50	557,788	8,776	90	971,608	12,298
5391	729	82	5431	11,471	787	5471	93,455	3,224	5511	273,150	5,974	5551	566,564	8,855	5591	983,906	12,450
92	811	88	32	12,258	866	72	96,679	3,276	12	279,124	6,032	52	575,419	8,933	92	996,356	12,602
93	899	93	33	13,124	944	73	99,955	3,329	13	285,156	6,091	53	584,352	9,013	93	1,008,958	12,754
94	992	100	34	14,068	1,023	74	103,284	3,382	14	291,247	6,149	54	593,365	9,092	94	1,021,712	12,906
95	1,092	105	35	15,091	1,101	75	106,666	3,434	15	297,396	6,207	55	602,457	9,171	95	1,034,618	13,058
96	1,197	112	36	16,192	1,180	76	110,100	3,487	16	303,603	6,265	56	611,628	9,250	96	1,047,676	13,210
97	1,309	117	37	17,372	1,258	77	113,587	3,540	17	309,868	6,324	57	620,878	9,330	97	1,060,886	13,362
98	1,426	123	38	18,630	1,337	78	117,127	3,592	18	316,192	6,382	58	630,208	9,408	98	1,074,248	13,514
99	1,549	129	39	19,967	1,416	79	120,719	3,645	19	322,574	6,439	59	639,616	9,487	99	1,087,762	13,666
5400	1,678	134	40	21,383	1,485	80	124,363	3,707	20	329,013	6,509	60	649,103	9,566	5600	1,101,428	13,809
5401	1,812	138	5441	22,868	1,546	5481	128,070	3,778	5521	335,522	6,589	5561	658,669	9,541	5601	1,115,237	13,941
02	1,950	142	42	24,414	1,606	82	131,848	3,850	22	342,111	6,667	62	668,210	9,817	02	1,129,178	14,075
03	2,092	147	43	26,020	1,667	83	135,698	3,922	23	348,778	6,748	63	678,027	9,794	03	1,143,253	14,208
04	2,239	150	44	27,687	1,727	84	139,620	3,993	24	355,526	6,827	64	687,821	9,870	04	1,157,461	14,341
05	2,389	155	45	29,414	1,788	85	143,613	4,065	25	362,353	6,907	65	697,691	9,946	05	1,171,802	14,474
06	2,544	158	46	31,202	1,848	86	147,678	4,137	26	369,260	6,987	66	707,637	10,022	06	1,186,276	14,607
07	2,702	163	47	33,050	1,909	87	151,815	4,208	27	376,247	7,066	67	717,659	10,100	07	1,200,883	14,741
08	2,865	167	48	34,959	1,969	88	156,023	4,279	28	383,313	7,145	68	727,759	10,174	08	1,215,624	14,872
09	3,032	171	49	36,928	2,030	89	160,302	4,351	29	390,458	7,225	69	737,933	10,250	09	1,230,496	15,007
10	3,203	181	50	38,958	2,084	90	164,653	4,424	30	397,683	7,303	70	748,183	10,329	10	1,245,503	15,127
5411	3,384	197	5451	41,042	2,130	5491	169,077	4,497	5531	404,986	7,376	5571	758,512	10,409	5611	1,260,630	15,235
12	3,581	214	52	43,172	2,178	92	173,574	4,571	32	412,362	7,452	72	768,921	10,489	12	1,275,865	15,342
13	3,795	230	53	45,350	2,224	93	178,145	4,644	33	419,814	7,525	73	779,410	10,568	13	1,291,207	15,450
14	4,025	246	54	47,574	2,272	94	182,789	4,717	34	427,339	7,601	74	789,978	10,648	14	1,306,657	15,558
15	4,271	262	55	49,846	2,318	95	187,506	4,791	35	434,940	7,674	75	800,626	10,727	15	1,322,215	15,665
16	4,533	278	56	52,164	2,366	96	192,297	4,864	36	442,614	7,750	76	811,353	10,808	16	1,337,880	15,773
17	4,811	294	57	54,530	2,412	97	197,161	4,937	37	450,364	7,823	77	822,161	10,888	17	1,353,653	15,881
18	5,105	311	58	56,942	2,460	98	202,098	5,011	38	458,187	7,899	78	833,049	10,961	18	1,369,534	15,988
19	5,416	327	59	59,402	2,506	99	207,109	5,084	39	466,086	7,979	79	844,016	11,047	19	1,385,522	16,096
20	5,743	352	60	61,908	2,561	5500	212,193	5,160	40	474,058	8,047	80	855,063	11,144	20	1,401,618	16,194
															5621	1,417,812	

TABLE 4
JACKSON LAKE RESERVOIR
USABLE STORAGE CAPACITY

ELEV. FEET	STORAGE CONTENT	STOR DIFF	ELEV. FEET	STORAGE CONTENT	STOR DIFF	ELEV. FEET	STORAGE CONTENT	STOR DIFF	ELEV. FEET	STORAGE CONTENT	STOR DIFF	ELEV. FEET	STORAGE CONTENT	STOR DIFF	ELEV. FEET	STORAGE CONTENT	STOR DIFF	ELEV. FEET	STORAGE CONTENT	STOR DIFF	ELEV. FEET	STORAGE CONTENT	STOR DIFF
6730.0	0	1720	6735.0	88,070	1840	6740.0	182,520	1990	6745.0	284,450	2120	6750.0	392,900	2240	6755.0	506,550	2320	6760.0	624,360	2400	6765.0	746,280	2500
30.1	1,720	1720	35.1	89,910	1830	40.1	184,510	1980	45.1	286,570	2120	50.1	395,140	2230	55.1	508,870	2330	60.1	626,760	2400	65.1	748,780	2480
30.2	3,440	1720	35.2	91,740	1830	40.2	186,490	1980	45.2	288,690	2120	50.2	397,370	2240	55.2	511,200	2320	60.2	629,160	2410	65.2	751,260	2500
30.3	5,160	1720	35.3	93,570	1830	40.3	188,470	1980	45.3	290,810	2120	50.3	399,610	2230	55.3	513,520	2330	60.3	631,570	2410	65.3	753,760	2480
30.4	6,880	1720	35.4	95,400	1830	40.4	190,450	1980	45.4	292,930	2120	50.4	401,840	2240	55.4	515,850	2320	60.4	633,980	2400	65.4	756,240	2500
30.5	8,600	1720	35.5	97,230	1840	40.5	192,430	1980	45.5	295,050	2130	50.5	404,080	2240	55.5	518,170	2320	60.5	636,380	2400	65.5	758,740	2480
30.6	10,320	1720	35.6	99,070	1830	40.6	194,410	1980	45.6	297,180	2120	50.6	406,320	2230	55.6	520,490	2330	60.6	638,780	2410	65.6	761,220	2500
30.7	12,040	1720	35.7	100,900	1830	40.7	196,390	1980	45.7	299,300	2120	50.7	408,550	2240	55.7	522,820	2320	60.7	641,190	2410	65.7	763,720	2480
30.8	13,760	1720	35.8	102,730	1830	40.8	198,370	1980	45.8	301,420	2120	50.8	410,790	2230	55.8	525,140	2330	60.8	643,600	2400	65.8	766,200	2500
30.9	15,480	1720	35.9	104,560	1830	40.9	200,350	1980	45.9	303,540	2120	50.9	413,020	2240	55.9	527,470	2320	60.9	646,000	2400	65.9	768,700	2480
6731.0	17,190	1740	6736.0	106,390	1860	6741.0	202,330	2010	6746.0	305,660	2150	6751.0	415,260	2260	6756.0	529,790	2340	6761.0	648,400	2430	6766.0	771,180	2510
31.1	18,930	1740	36.1	108,250	1860	41.1	204,340	2010	46.1	307,810	2140	51.1	417,520	2250	56.1	532,130	2340	61.1	650,830	2420	66.1	773,690	2510
31.2	20,670	1740	36.2	110,110	1860	41.2	206,350	2010	46.2	309,950	2150	51.2	419,770	2260	56.2	534,470	2340	61.2	653,250	2420	66.2	776,200	2510
31.3	22,410	1740	36.3	111,970	1860	41.3	208,360	2010	46.3	312,100	2140	51.3	422,030	2250	56.3	536,810	2340	61.3	655,670	2420	66.3	778,710	2510
31.4	24,150	1740	36.4	113,830	1860	41.4	210,370	2010	46.4	314,240	2150	51.4	424,280	2260	56.4	539,150	2340	61.4	658,090	2420	66.4	781,220	2500
31.5	25,890	1740	36.5	115,690	1860	41.5	212,380	2010	46.5	316,390	2150	51.5	426,540	2250	56.5	541,490	2340	61.5	660,510	2420	66.5	783,720	2510
31.6	27,630	1740	36.6	117,550	1860	41.6	214,390	2010	46.6	318,540	2140	51.6	428,790	2260	56.6	543,830	2340	61.6	662,930	2430	66.6	786,230	2510
31.7	29,370	1740	36.7	119,410	1860	41.7	216,400	2010	46.7	320,680	2150	51.7	431,050	2250	56.7	546,170	2340	61.7	665,360	2420	66.7	788,740	2510
31.8	31,110	1740	36.8	121,270	1860	41.8	218,410	2010	46.8	322,830	2140	51.8	433,300	2260	56.8	548,510	2340	61.8	667,780	2420	66.8	791,250	2510
31.9	32,850	1730	36.9	123,130	1850	41.9	220,420	2010	46.9	324,970	2150	51.9	435,560	2250	56.9	550,850	2340	61.9	670,200	2420	66.9	793,760	2500
6732.0	34,580	1760	6737.0	124,980	1890	6742.0	222,430	2040	6747.0	327,120	2170	6752.0	437,810	2280	6757.0	553,190	2360	6762.0	672,620	2440	6767.0	796,260	2530
32.1	36,340	1760	37.1	126,870	1890	42.1	224,470	2040	47.1	329,290	2170	52.1	440,090	2270	57.1	555,550	2350	62.1	675,060	2440	67.1	798,790	2530
32.2	38,100	1760	37.2	128,760	1890	42.2	226,510	2040	47.2	331,460	2170	52.2	442,360	2280	57.2	557,900	2360	62.2	677,500	2440	67.2	801,320	2520
32.3	39,860	1760	37.3	130,650	1880	42.3	228,550	2040	47.3	333,630	2170	52.3	444,640	2270	57.3	560,260	2350	62.3	679,940	2430	67.3	803,840	2530
32.4	41,620	1760	37.4	132,530	1890	42.4	230,590	2040	47.4	335,800	2170	52.4	446,910	2270	57.4	562,610	2360	62.4	682,370	2440	67.4	806,370	2530
32.5	43,380	1760	37.5	134,420	1890	42.5	232,630	2040	47.5	337,970	2170	52.5	449,180	2280	57.5	564,970	2360	62.5	684,810	2440	67.5	808,900	2520
32.6	45,140	1760	37.6	136,310	1890	42.6	234,670	2040	47.6	340,140	2170	52.6	451,460	2270	57.6	567,330	2350	62.6	687,250	2440	67.6	811,420	2530
32.7	46,900	1760	37.7	138,200	1880	42.7	236,710	2040	47.7	342,310	2170	52.7	453,730	2280	57.7	569,680	2360	62.7	689,690	2440	67.7	813,950	2520
32.8	48,660	1760	37.8	140,080	1890	42.8	238,750	2040	47.8	344,480	2170	52.8	456,010	2270	57.8	572,040	2350	62.8	692,130	2440	67.8	816,470	2530
32.9	50,420	1760	37.9	141,970	1890	42.9	240,790	2040	47.9	346,650	2170	52.9	458,280	2270	57.9	574,390	2360	62.9	694,570	2430	67.9	819,000	2520
6733.0	52,180	1790	6738.0	143,860	1920	6743.0	242,830	2070	6748.0	348,820	2190	6753.0	460,550	2300	6758.0	576,750	2370	6763.0	697,000	2460	6768.0	821,520	2550
33.1	53,970	1780	38.1	145,780	1910	43.1	244,900	2060	48.1	351,010	2200	53.1	462,850	2290	58.1	579,120	2370	63.1	699,460	2460	68.1	824,070	2540
33.2	55,750	1780	38.2	147,690	1920	43.2	246,960	2070	48.2	353,210	2190	53.2	465,140	2290	58.2	581,490	2380	63.2	701,920	2450	68.2	826,610	2550
33.3	57,530	1780	38.3	149,610	1920	43.3	249,030	2070	48.3	355,400	2190	53.3	467,430	2290	58.3	583,870	2370	63.3	704,370	2460	68.3	829,160	2540
33.4	59,310	1790	38.4	151,530	1920	43.4	251,100	2070	48.4	357,590	2190	53.4	469,720	2290	58.4	586,240	2370	63.4	706,830	2450	68.4	831,700	2550
33.5	61,100	1780	38.5	153,450	1910	43.5	253,170	2060	48.5	359,780	2200	53.5	472,010	2290	58.5	588,610	2370	63.5	709,280	2460	68.5	834,250	2540
33.6	62,880	1780	38.6	155,360	1920	43.6	255,230	2070	48.6	361,980	2190	53.6	474,300	2300	58.6	590,980	2370	63.6	711,740	2450	68.6	836,790	2550
33.7	64,660	1780	38.7	157,280	1920	43.7	257,300	2070	48.7	364,170	2190	53.7	476,600	2290	58.7	593,350	2380	63.7	714,190	2460	68.7	839,340	2540
33.8	66,440	1790	38.8	159,200	1920	43.8	259,370	2070	48.8	366,360	2200	53.8	478,890	2290	58.8	595,730	2370	63.8	716,650	2450	68.8	841,880	2540
33.9	68,230	1780	38.9	161,120	1910	43.9	261,440	2060	48.9	368,560	2190	53.9	481,180	2290	58.9	598,100	2370	63.9	719,100	2460	68.9	844,420	2580
6734.0	70,010	1810	6739.0	163,030	1950	6744.0	263,500	2100	6749.0	370,750	2210	6754.0	483,470	2310	6759.0	600,470	2390	6764.0	721,560	2470	6769.0	847,000	2530
34.1	71,820	1800	39.1	164,980	1950	44.1	265,600	2090	49.1	372,960	2220	54.1	485,780	2310	59.1	602,860	2390	64.1	724,030	2470	69.1	849,530	2570
34.2	73,620	1810	39.2	166,930	1950	44.2	267,690	2100	49.2	375,180	2220	54.2	488,090	2300	59.2	605,250	2390	64.2	726,500	2480	69.2	852,100	2560
34.3	75,430	1810	39.3	168,880	1950	44.3	269,790	2090	49.3	377,400	2210	54.3	490,390	2310	59.3	607,640	2380	64.3	728,980	2470	69.3	854,660	2560
34.4	77,240	1800	39.4	170,830	1950	44.4	271,880	2100	49.4	379,610	2210	54.4	492,700	2310	59.4	610,020	2390	64.4	731,450	2470	69.4	857,220	2570
34.5	79,040	1810	39.5	172,780	1950	44.5	273,980	2090	49.5	381,820	2220	54.5	495,010	2310	59.5	612,410	2390	64.5	733,920	2480	69.5	859,790	2560
34.6	80,850	1810	39.6	174,730	1950	44.6	276,070	2100	49.6	384,040	2220	54.6	497,320	2310	59.6	614,800	2390	64.6	736,400	2470	69.6	862,350	2560
34.7	82,660	1800	39.7	176,680	1950	44.7	278,170	2090	49.7	386,260	2210	54.7	499,630	2300	59.7	617,190	2390	64.7	738,870	2470	69.7	864,910	2570
34.8	84,460	1810	39.8	178,630	1950	44.8	280,260	2100	49.8	388,470	2210	54.8	501,930	2310	59.8	619,580	2390	64.8	741,340	2470	69.8	867,480	2560
34.9	86,270	1800	39.9	180,580	1940	44.9	282,360	2090	49.9	390,680	2220	54.9	504,240	2310	59.9	621,970	2390	64.9	743,810	2470	69.9	870,040	2560
																					6770.0	872,600	

TABLE 5

REPRESENTATIVE SNOW COURSE DATA

Snow Course	Map No.	Elevation m.s.l.	Years of Record and Average Water Equivalent - Inches																			
			January 1st		January 15th		February 1st		February 15th		March 1st		March 15th		April 1st		April 15th		May 1st		June 1st	
			Years	W.E.	Years	W.E.	Years	W.E.	Years	W.E.	Years	W.E.	Years	W.E.	Years	W.E.	Years	W.E.	Years	W.E.	Years	W.E.
Afton R.S.	1	6,200	19	2.2	-	-	21	3.8	-	-	21	4.7	-	-	21	2.1	1	0.0	4	0.0	-	-
Aster Creek	2	7,700	5	14.4	31	14.5	6	25.0	32	22.1	6	32.1	32	27.2	8	39.6	32	29.8	1	45.0	1	15.0
Blackrock	3	8,600	-	-	-	-	33	12.6	-	-	7	20.6	-	-	20	22.9	-	-	3	25.3	-	-
CCC Camp	4	7,500	19	4.5	-	-	21	7.7	-	-	21	10.1	-	-	21	11.9	1	15.0	7	4.4	-	-
Cottonwood Lake	5	7,500	2	7.4	-	-	1	11.2	-	-	3	14.1	-	-	18	17.5	-	-	1	10.6	-	-
Coulter Creek	6	7,600	5	9.1	30	11.0	6	17.1	32	16.7	6	22.2	32	20.3	8	26.4	30	21.0	-	-	-	-
Deadman Ranch	7	6,534	10	4.1	-	-	12	6.5	-	-	20	9.9	-	-	19	10.7	-	-	5	1.2	-	-
East Rim Divide	8	7,950	6	3.8	-	-	2	7.1	-	-	17	10.2	1	12.4	21	12.1	1	13.1	10	10.8	-	-
Four-Mile Meadows	9	7,770	-	-	-	-	33	8.3	-	-	7	12.3	-	-	21	13.4	-	-	-	-	-	-
Glade Creek	10	7,200	6	9.5	31	11.6	6	16.7	32	17.4	6	21.7	32	21.4	8	26.0	32	22.8	1	32.1	1	7.0
Grover Park Divide	11	7,500	19	4.4	-	-	20	7.5	-	-	21	10.1	-	-	21	11.6	1	14.7	7	4.4	-	-
Huckleberry Divide	12	7,300	6	8.4	31	9.7	6	14.8	32	14.9	6	19.0	32	18.0	7	22.8	32	18.8	1	17.5	-	-
Lewis Lake Divide	13	7,900	6	19.8	31	20.7	6	33.1	32	30.7	6	42.9	32	37.9	8	51.3	32	42.0	5	47.9	1	34.7
Togwotee Pass	14	9,600	-	-	-	-	33	18.9	-	-	7	27.6	-	-	21	29.6	-	-	7	35.5	1	37.0
Turpin Meadows	15	6,930	-	-	-	-	33	6.9	-	-	7	10.6	-	-	21	10.9	-	-	-	-	-	-
Yellowjacket	16	7,675	4	1.9	-	-	9	4.3	1	5.2	15	5.8	1	5.7	20	6.7	1	5.6	7	0.3	-	-

TABLE 6
RATING TABLE

SNAKE RIVER NEAR HEISE, IDAHO

GAGE HGHT FEET	DIS-CHARGE Cfs	DIFF Cfs	GAGE HGHT FEET	DIS-CHARGE Cfs	DIFF Cfs	GAGE HGHT FEET	DIS-CHARGE Cfs	DIFF Cfs	GAGE HGHT FEET	DIS-CHARGE Cfs	DIFF Cfs
1.00			5.00	11,040	360	9.00	30,270	570			
.10			.10	11,400	360	.10	30,840	570			
.20			.20	11,760	370	.20	31,410	570			
.30			.30	12,130	370	.30	31,980	570			
.40	1,830	110	.40	12,500	380	.40	32,550	570			
.50	1,940	120	.50	12,880	390	.50	33,120	570			
.60	2,060	130	.60	13,270	400	.60	33,690	570			
.70	2,190	150	.70	13,670	400	.70	34,260	570			
.80	2,340	160	.80	14,070	410	.80	34,830	570			
.90	2,500	180	.90	14,480	420	.90	35,400	600			
2.00	2,680	200	6.00	14,900	430	10.00	36,000	600			
.10	2,880	220	.10	15,330	440	.10	36,600	600			
.20	3,100	220	.20	15,770	440	.20	37,200	600			
.30	3,320	230	.30	16,210	450	.30	37,800	600			
.40	3,550	230	.40	16,660	450	.40	38,400	600			
.50	3,780	240	.50	17,110	450	.50	39,000	600			
.60	4,020	240	.60	17,560	460	.60	39,600	600			
.70	4,260	250	.70	18,020	470	.70	40,200	600			
.80	4,510	260	.80	18,490	480	.80	40,800	600			
.90	4,770	270	.90	18,970	490	.90	41,400	600			
						11.00	42,000				
3.00	5,040	270	7.00	19,460	500						
.10	5,310	270	.10	19,960	510						
.20	5,580	270	.20	20,470	510						
.30	5,850	280	.30	20,980	510						
.40	6,130	280	.40	21,490	510						
.50	6,410	280	.50	22,000	520						
.60	6,690	280	.60	22,520	520						
.70	6,970	290	.70	23,040	520						
.80	7,260	290	.80	23,560	540						
.90	7,550	290	.90	24,100	550						
4.00	7,840	290	8.00	24,650	560						
.10	8,130	290	.10	25,210	560						
.20	8,420	290	.20	25,770	560						
.30	8,710	300	.30	26,330	560						
.40	9,010	300	.40	26,890	560						
.50	9,310	320	.50	27,450	560						
.60	9,630	340	.60	28,010	560						
.70	9,970	350	.70	28,570	560						
.80	10,320	360	.80	29,130	570						
.90	10,680	360	.90	29,700	570						

Data from USGS table dated 12-28-54

TABLE 7

RATING TABLE
SNAKE RIVER AT MORAN, WYOMING

GAGE HGHT FEET	DIS-CHARGE Cfs	DIFF Cfs	GAGE HGHT FEET	DIS-CHARGE Cfs	DIFF Cfs	GAGE HGHT FEET	DIS-CHARGE Cfs	DIFF Cfs
1.00	3	5.3	5.00	2,110	100	9.00	8,050	180
.10	8.3	9.2	.10	2,210	100	.10	8,230	180
.20	17.5	10.5	.20	2,310	110	.20	8,410	190
.30	28	12	.30	2,420	110	.30	8,600	190
.40	40	14	.40	2,530	110	.40	8,790	190
.50	54	16	.50	2,640	120	.50	8,980	190
.60	70	20	.60	2,760	120	.60	9,170	190
.70	90	24	.70	2,880	120	.70	9,360	190
.80	114	26	.80	3,000	120	.80	9,550	190
.90	140	28	.90	3,120	130	.90	9,740	190
2.00	168	30	6.00	3,250	130	10.00	9,930	200
.10	198	32	.10	3,380	130	.10	10,130	200
.20	230	35	.20	3,510	130	.20	10,330	200
.30	265	38	.30	3,640	140	.30	10,530	200
.40	303	42	.40	3,780	140	.40	10,730	200
.50	345	45	.50	3,920	150	.50	10,930	200
.60	390	45	.60	4,070	150	.60	11,130	200
.70	435	45	.70	4,220	150	.70	11,330	200
.80	480	50	.80	4,370	150	.80	11,530	200
.90	530	50	.90	4,520	150	.90	11,730	200
						11.00	11,930	
3.00	580	55	7.00	4,670	150			
.10	635	55	.10	4,820	160			
.20	690	55	.20	4,980	160			
.30	745	55	.30	5,140	160			
.40	800	60	.40	5,300	160			
.50	860	70	.50	5,460	160			
.60	930	70	.60	5,620	170			
.70	1,000	70	.70	5,790	170			
.80	1,070	70	.80	5,960	170			
.90	1,140	70	.90	6,130	170			
4.00	1,210	80	8.00	6,300	170			
.10	1,290	80	.10	6,470	170			
.20	1,370	90	.20	6,640	170			
.30	1,460	90	.30	6,810	170			
.40	1,550	90	.40	6,980	170			
.50	1,640	90	.50	7,150	180			
.60	1,730	90	.60	7,330	180			
.70	1,820	90	.70	7,510	180			
.80	1,910	100	.80	7,690	180			
.90	2,010	100	.90	7,870	180			

Data from USGS table dated 12-31-43

TABLE 8

DISCHARGE RATING TABLE

SNAKE RIVER NEAR SHELLEY, IDAHO

GAGE HEIGHT Feet	DISCHARGE c.f.s.	DIFF. c.f.s.	GAGE HEIGHT Feet	DISCHARGE c.f.s.	DIFF. c.f.s.	GAGE HEIGHT Feet	DISCHARGE c.f.s.	DIFF. c.f.s.
3.00	470	30	7.00	6,370	330	11.00	21,370	430
.10	500	40	.10	6,700	330	.10	21,800	440
.20	540	40	.20	7,030	330	.20	22,240	440
.30	580	40	.30	7,360	340	.30	22,680	440
.40	620	50	.40	7,700	340	.40	23,120	440
.50	670	50	.50	8,040	340	.50	23,560	440
.60	720	50	.60	8,380	350	.60	24,000	450
.70	770	50	.70	8,730	350	.70	24,450	450
.80	820	50	.80	9,080	350	.80	24,900	450
.90	870	60	.90	9,430	360	.90	25,350	450
4.00	930	60	8.00	9,790	360	12.00	25,800	450
.10	990	70	.10	10,150	360	.10	26,250	450
.20	1,060	80	.20	10,510	360	.20	26,700	460
.30	1,140	90	.30	10,870	360	.30	27,160	460
.40	1,230	90	.40	11,230	370	.40	27,620	460
.50	1,320	90	.50	11,600	370	.50	28,080	460
.60	1,410	90	.60	11,970	370	.60	28,540	460
.70	1,500	100	.70	12,340	370	.70	29,000	460
.80	1,600	100	.80	12,710	370	.80	29,460	460
.90	1,700	110	.90	13,080	370	.90	29,920	
5.00	1,810	120	9.00	13,450	370			
.10	1,930	130	.10	13,820	370			
.20	2,060	150	.20	14,190	370			
.30	2,210	160	.30	14,560	380			
.40	2,370	170	.40	14,940	380			
.50	2,540	180	.50	15,320	390			
.60	2,720	190	.60	15,710	390			
.70	2,910	200	.70	16,100	400			
.80	3,110	210	.80	16,500	400			
.90	3,320	220	.90	16,900	400			
6.00	3,540	230	10.00	17,300	400			
.10	3,770	240	.10	17,700	400			
.20	4,010	250	.20	18,100	400			
.30	4,260	260	.30	18,500	400			
.40	4,520	270	.40	18,900	400			
.50	4,790	300	.50	19,300	410			
.60	5,090	320	.60	19,710	410			
.70	5,410	320	.70	20,120	410			
.80	5,730	320	.80	20,530	420			
.90	6,050	320	.90	20,950	420			

Data from USGS table dated 12-27-54

TABLE 9

DISCHARGE RATING TABLE

HENRYS FORK NEAR REXBURG, IDAHO

GAGE HEIGHT Feet	DISCHARGE c.f.s.	DIFF. c.f.s.	GAGE HEIGHT Feet	DISCHARGE c.f.s.	DIFF. c.f.s.	GAGE HEIGHT Feet	DISCHARGE c.f.s.	DIFF. c.f.s.
.00			4.00	1,340	70	7.00	3,850	100
.10			.10	1,410	70	.10	3,950	100
.20			.20	1,480	70	.20	4,050	100
.30			.30	1,550	70	.30	4,150	110
.40			.40	1,620	70	.40	4,260	110
.50			.50	1,690	70	.50	4,370	120
.60			.60	1,760	80	.60	4,490	120
.70			.70	1,840	80	.70	4,610	130
.80			.80	1,920	80	.80	4,740	130
.90			.90	2,000	80	.90	4,870	130
.00			5.00	2,080	80	8.00	5,000	140
.10			.10	2,160	80	.10	5,140	140
.20			.20	2,240	80	.20	5,280	140
.30			.30	2,320	80	.30	5,420	140
.40			.40	2,400	90	.40	5,560	140
.50			.50	2,490	80	.50	5,700	150
.60			.60	2,570	90	.60	5,850	160
.70	570	50	.70	2,660	90	.70	6,010	170
.80	620	50	.80	2,750	80	.80	6,180	170
.90	670	50	.90	2,830	90	.90	6,350	170
3.00	720	55	6.00	2,920	90	9.00	6,520	180
.10	775	55	.10	3,010	90	.10	6,700	180
.20	830	60	.20	3,100	90	.20	6,880	180
.30	890	60	.30	3,190	90	.30	7,060	180
.40	950	60	.40	3,280	90	.40	7,240	180
.50	1,010	60	.50	3,370	90	.50	7,420	180
.60	1,070	60	.60	3,460	90	.60	7,600	180
.70	1,130	70	.70	3,550	100	.70	7,780	180
.80	1,200	70	.80	3,650	100	.80	7,960	
.90	1,270	70	.90	3,750	100	.90		

Data from USGS table dated 12-29-50

SNAKE RIVER AT MORAN, WYOMING
Natural Flow In 1,000 Acre-feet

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1911	30.8	25.1			37.1	31.0	38.4	206.4	539.5	249.5	67.0	36.4
1912	41.2	43.1	22.2	29.4	35.9	32.0	36.1	133.6	479.9	205.8	103.6	51.3
1913	58.2	39.8	39.2	45.8	33.9	35.7	62.0	308.9	457.7	203.2	107.6	44.0
1914	48.1	45.9	32.7	42.9	39.3	32.7	57.2	298.9	330.3	238.0	43.1	57.3
1915	60.1	49.1	31.4	24.3	17.0	27.4	96.7	139.2	181.8	82.7	30.8	30.8
1916	23.9	29.0	28.1	37.4	33.6	37.9	47.0	174.9	421.5	279.0	74.0	36.0
1917	35.2	27.3	39.5	27.5	31.4	33.8	30.0	141.3	435.9	303.0	92.2	40.8
1918	25.7	24.0	44.6	33.3	30.0	28.4	35.2	166.2	601.2	150.7	73.3	35.6
1919	46.2	29.1	22.3	23.7	28.7	31.9	42.5	234.5	139.7	39.3	26.6	20.7
1920	26.2	29.8	30.0	28.0	23.1	28.6	30.0	173.3	360.0	162.1	67.8	39.2
1921	40.9	32.0	33.3	33.1	23.6	24.5	35.3	285.9	342.3	129.0	54.9	33.2
1922	25.7	33.6	34.0	29.2	26.8	25.1	24.8	179.4	393.6	142.0	59.3	34.1
1923	20.3	21.5	29.2	31.8	22.6	27.9	31.7	197.0	321.9	159.7	50.1	30.9
1924	30.1	24.3	27.4	27.8	23.2	19.5	30.4	216.2	141.8	67.3	20.0	20.0
1925	42.0	30.3	28.0	31.8	31.8	26.5	74.2	357.2	369.1	202.8	83.2	47.7
1926	45.3	31.6	26.5	23.1	26.0	22.6	78.6	244.5	148.1	67.4	37.5	21.2
1927	28.6	35.2	35.2	35.4	36.7	23.0	37.4	189.8	597.5	258.2	82.7	55.3
1928	40.5	61.0	49.5	39.9	26.4	32.5	48.6	478.9	293.1	171.7	58.5	32.5
1929	31.4	23.9	33.6	29.5	27.3	27.2	35.0	149.6	314.4	115.7	47.6	31.3
1930	22.7	14.4	27.5	18.5	26.4	22.6	67.3	185.8	207.4	98.8	64.1	31.5
1931	43.2	24.1	20.0	20.2	16.5	23.1	37.7	148.7	148.4	47.4	29.2	17.2
1932	21.7	19.6	24.8	26.4	26.7	29.6	35.4	228.3	358.5	135.9	61.5	24.8
1933	20.0	20.1	22.1	31.3	27.5	19.3	25.3	118.5	390.4	112.1	53.2	33.0
1934	21.0	19.4	19.9	28.4	20.8	28.7	111.5	208.7	86.2	48.9	20.7	38.4
1935	27.8	28.2	27.6	30.3	22.9	26.1	45.2	167.9	353.7	135.0	51.3	19.6
1936	21.9	23.4	19.6	40.1	38.0	27.7	66.0	382.5	283.5	91.3	51.6	23.3
1937	17.5	13.0	21.4	24.4	27.3	21.2	28.5	230.2	232.1	100.0	107.0	19.1
1938	24.5	22.6	32.1	29.2	26.6	36.1	50.9	223.2	438.2	157.8	64.1	41.3
1939	31.2	27.9	30.5	28.5	28.3	26.1	66.1	307.6	191.4	106.8	51.5	26.4
1940	23.0	14.0	19.0	26.7	29.4	27.6	48.7	264.5	205.4	73.3	38.4	24.5
1941	26.1	24.5	22.9	26.9	22.1	18.4	31.7	225.4	186.0	84.6	62.8	47.2
1942	40.4	31.7	40.4	27.9	24.8	20.4	59.2	160.0	278.8	133.3	55.1	23.0
1943	16.5	35.2	35.9	43.9	29.5	32.7	98.7	240.3	481.4	275.7	87.0	42.1
1944	33.6	29.8	23.1	19.8	22.7	25.6	29.0	168.6	242.6	126.0	66.6	22.2
1945	19.3	25.5	19.9	23.9	28.4	23.0	23.6	171.4	287.0	175.2	66.5	32.6
1946	29.1	31.4	34.9	33.0	35.8	35.6	105.2	271.3	268.0	121.2	50.6	36.5
1947	27.4	29.1	33.0	30.4	21.6	28.3	33.6	337.8	323.8	147.7	66.1	43.3
1948	28.8	29.6	26.8	29.6	26.4	26.1	41.3	247.7	368.0	119.9	52.3	29.4
1949	25.2	29.9	33.3	29.3	28.3	30.6	67.7	338.6	314.5	121.6	55.7	32.9
1950	32.0	27.0	23.9	35.5	34.2	33.9	40.5	160.6	442.4	217.3	70.2	40.6
Avg.	30.8	28.9	29.4	30.2	28.0	27.8	49.6	226.6	323.9	146.4	60.1	33.7

TABLE 10

SNAKE RIVER AT HEISE, WYOMING
Natural Flow In 1,000 Acre-feet

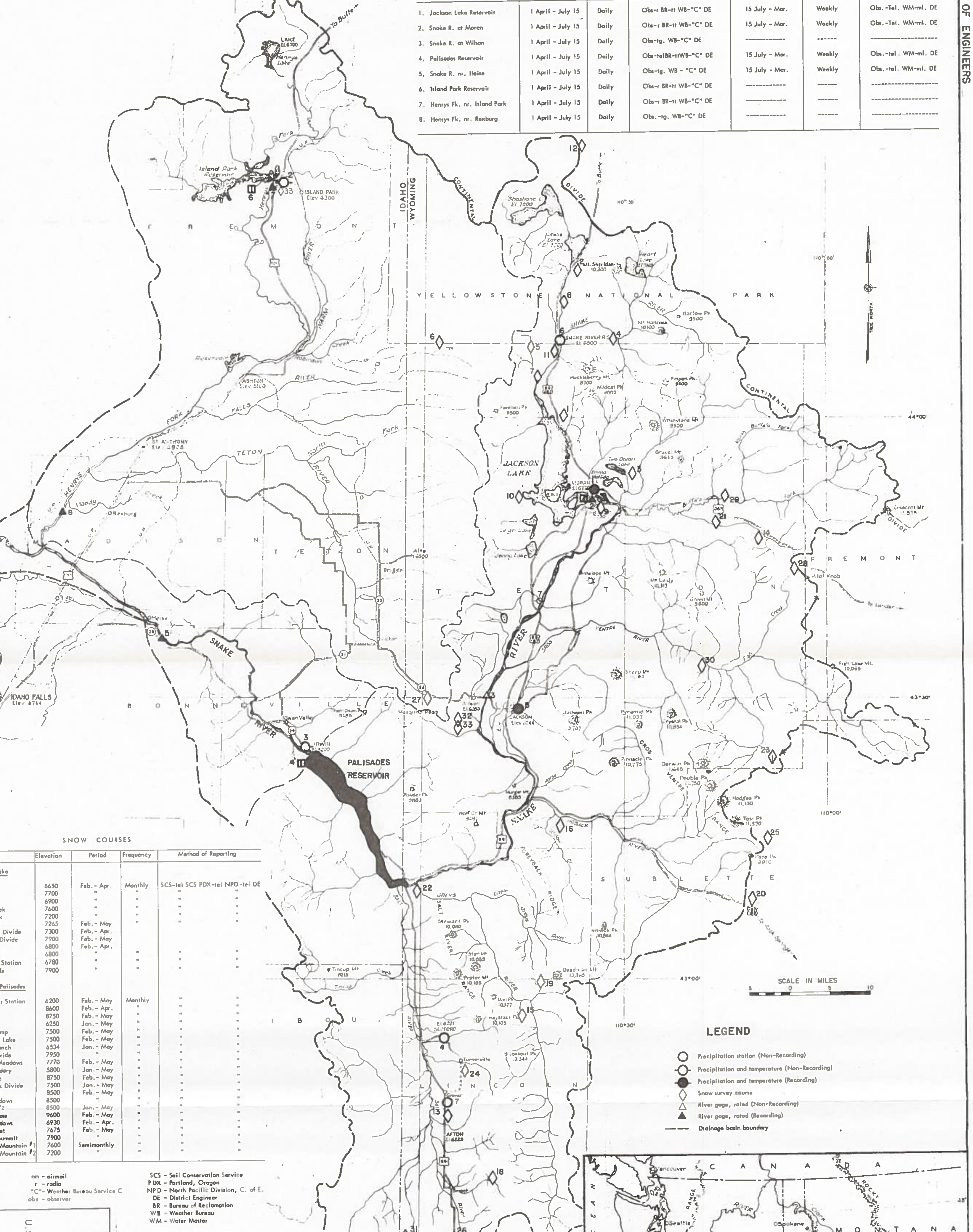
Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1911	211.2	201.6			186.7	203.8	320.7	968.4	1875.5	876.5	795.0	300.9
1912	247.7	226.6	178.1	176.8	169.5	181.5	246.1	911.9	1908.9	984.4	439.6	336.3
1913	343.6	245.1	215.3	216.8	186.2	193.7	518.9	1347.5	1583.7	857.2	434.6	298.0
1914	285.6	249.2	204.8	200.7	168.3	187.8	509.5	1349.8	1370.3	663.9	352.1	312.4
1915	320.8	243.9	204.3	192.2	159.4	176.6	428.3	596.1	687.8	457.5	262.8	233.9
1916	219.4	178.0	172.9	169.9	177.1	240.5	529.8	963.5	1484.5	1029.0	455.0	289.0
1917	272.0	213.0	201.8	171.7	167.0	184.0	256.2	1077.1	1801.9	1326.0	480.2	339.9
1918	287.2	277.9	300.5	252.1	216.5	259.5	381.8	961.4	2259.2	793.7	392.3	283.6
1919	315.7	259.6	235.8	219.2	210.3	252.4	411.6	896.4	498.7	244.7	196.9	179.3
1920	201.0	180.0	146.2	156.0	143.2	156.5	230.0	1142.8	1472.4	733.1	355.8	274.6
1921	261.2	239.3	235.6	229.4	200.9	238.5	358.6	1343.0	1604.3	598.0	364.9	284.7
1922	230.5	228.5	235.9	182.1	164.9	186.8	231.5	1092.0	1529.7	574.0	379.3	284.1
1923	209.9	193.3	194.3	202.9	165.9	198.8	285.7	1078.9	1217.1	711.0	357.9	244.9
1924	231.6	194.4	176.2	167.6	183.0	174.1	290.1	871.7	622.8	335.3	198.0	180.4
1925	232.8	184.7	156.3	177.4	165.2	188.7	515.5	1421.9	1276.4	843.8	422.7	332.2
1926	274.5	225.9	200.9	169.5	161.6	213.8	489.8	849.5	558.1	314.4	253.5	195.9
1927	213.8	206.4	198.6	195.8	170.1	163.3	300.1	1095.0	1952.5	1031.2	428.7	344.3
1928	297.2	298.4	255.8	243.2	180.6	219.6	359.4	1871.9	1149.1	771.7	361.5	257.5
1929	249.5	207.5	187.6	179.3	171.7	172.5	226.4	738.7	1072.4	543.7	294.6	267.3
1930	221.6	177.4	184.4	156.5	149.9	178.2	456.5	758.8	907.4	476.8	354.1	247.6
1931	288.5	202.3	176.4	153.7	143.3	165.6	254.7	503.2	548.4	212.4	150.8	160.2
1932	171.2	198.9	182.3	143.9	133.2	154.1	271.7	1025.0	1271.4	645.1	337.5	236.8
1933	214.1	193.6	175.0	184.2	150.6	157.2	237.5	588.1	1330.4	439.1	268.2	213.0
1934	186.1	169.0	253.7	157.3	130.8	176.0	357.4	632.7	335.2	204.4	150.7	127.6
1935	157.6	146.6	139.1	137.6	118.4	137.1	308.4	722.2	1231.0	551.3	274.2	198.4
1936	180.8	166.3	146.4	158.6	146.4	143.6	426.9	1655.2	1279.8	490.3	315.4	241.9
1937	206.3	173.3	168.8	142.8	135.4	146.9	218.4	988.7	805.2	397.9	219.8	189.7
1938	191.3	172.4	179.4	159.3	139.4	170.8	421.4	1052.1	1408.7	683.9	328.0	253.8
1939	236.6	206.3	192.9	181.1	152.8	194.9	489.3	982.6	734.9	457.3	274.6	217.5
1940	197.6	157.6	153.7	154.2	150.4	171.9	288.6	877.1	665.3	276.2	191.1	184.9
1941	181.6	163.3	149.4	147.3	127.7	154.6	248.2	822.8	761.7	376.3	305.6	256.4
1942	234.5	195.1	199.6	157.8	140.4	147.5	459.5	731.1	1039.3	549.4	254.8	204.8
1943	188.4	193.0	186.2	183.9	152.3	166.1	773.5	1166.4	1612.8	1140.1	460.3	289.2
1944	262.0	228.4	197.2	173.3	163.9	163.6	239.1	594.7	958.1	532.5	257.4	200.8
1945	190.2	187.1	167.1	156.9	150.4	155.6	207.4	837.0	1120.9	823.0	391.7	303.0
1946	251.0	223.6	205.3	179.2	162.6	205.8	760.0	1135.5	1068.1	538.7	308.3	262.5
1947	253.4	212.4	212.2	168.1	156.4	198.2	328.1	1254.1	1145.2	683.0	404.7	271.5
1948	233.9	207.6	187.2	177.9	156.2	159.0	299.8	1079.4	1319.9	464.4	281.0	223.2
1949	210.2	197.6	185.8	159.7	152.3	176.5	454.8	1239.0	1101.3	491.5	281.2	230.3
1950	226.0	208.6	181.4	178.1	167.5	188.1	425.9	976.6	1682.0	1071.1	422.7	311.3
Avg.	234.7	205.8	192.9	177.3	160.7	177.7	370.4	1005.0	1206.3	629.9	336.4	251.6

TABLE 11

Red figures computed by HCE

RESERVOIR AND STREAM STATIONS

Station	Prior to 15 July			After 16 July		
	Period	Frequency	Method	Period	Frequency	Method
1. Jackson Lake Reservoir	1 April - July 15	Daily	Obs-r BR-tt WB-"C" DE	15 July - Mar.	Weekly	Obs.-Tel. WM-ml. DE
2. Snake R. at Moran	1 April - July 15	Daily	Obs-r BR-tt WB-"C" DE	15 July - Mar.	Weekly	Obs.-Tel. WM-ml. DE
3. Snake R. at Wilson	1 April - July 15	Daily	Obs-tg. WB-"C" DE	------------	------	------------------
4. Palisades Reservoir	1 April - July 15	Daily	Obs-telBR-ttWB-"C" DE	15 July - Mar.	Weekly	Obs.-tel. WM-ml. DE
5. Snake R. nr. Heise	1 April - July 15	Daily	Obs-tg. WB - "C" DE	15 July - Mar.	Weekly	Obs.-tel. WM-ml. DE
6. Island Park Reservoir	1 April - July 15	Daily	Obs-r BR-tt WB-"C" DE	------------	------	------------------
7. Henrys Fk. nr. Island Park	1 April - July 15	Daily	Obs-r BR-tt WB-"C" DE	------------	------	------------------
8. Henrys Fk. nr. Rexburg	1 April - July 15	Daily	Obs.-tg. WB-"C" DE	------------	------	------------------



SNOW COURSES

Snow Course	Elevation	Period	Frequency	Method of Reporting
Above Jackson Lake				
1. Arizona	6650	Feb. - Apr.	Monthly	SCS-tel SCS PDX-tel NPD-tel DE
2. Aster Creek	7700	"	"	" "
3. Base Camp	6900	"	"	" "
4. Coulter Creek	7600	"	"	" "
5. Glade Creek	7200	"	"	" "
6. Grassy Lake	7265	Feb. - May	"	" "
7. Huckleberry Divide	7300	Feb. - Apr.		
8. Lewis Lake Divide	7900	Feb. - May		
9. Moran	6800	Feb. - Apr.		
10. Moran Bay	6800	"	"	" "
11. Snake River Station	6780	"	"	" "
12. Thumb Divide	7900	"	"	" "
Jackson Lake to Palisades				
13. Afton Ranger Station	6200	Feb. - May	Monthly	" "
14. Blackrock	8600	Feb. - Apr.	"	" "
15. Blind Bull	8750	Feb. - May	"	" "
16. Bryon Flat	6250	Jan. - May	"	" "
17. C.C.C. Camp	7500	Feb. - May	"	" "
18. Cottonwood Lake	7500	Feb. - May	"	" "
19. Deadman Ranch	6534	Jan. - May	"	" "
20. East Rim Divide	7950	"	"	" "
21. Four Mile Meadows	7770	Feb. - May	"	" "
22. Greys Boundary	5800	Jan. - May	"	" "
23. Gros Ventre	8750	Feb. - May	"	" "
24. Grover Park Divide	7500	Jan. - May	"	" "
25. Loomis Park	8500	Feb. - May	"	" "
26. Poison Meadows	8500	"	"	" "
27. Teton Pass #2	8500	Jan. - May	"	" "
28. Togwotee Pass	9600	Feb. - May	"	" "
29. Turpin Meadows	6930	Feb. - Apr.	"	" "
30. Yellowjacket	7675	Feb. - May	"	" "
31. Salt River Summit	7900	"	"	" "
32. Snow King Mountain #1	7600	Semimonthly	"	" "
33. Snow King Mountain #2	7200	"	"	" "

tel - telephone
ml - mail
tt - teletype
tg - telegraph

am - airmail
r - radio
"C" - Weather Bureau Service C
obs - observer

SCS - Soil Conservation Service
PDX - Portland, Oregon
NPD - North Pacific Division, C. of E.
DE - District Engineer
BR - Bureau of Reclamation
WB - Weather Bureau
WM - Water Master

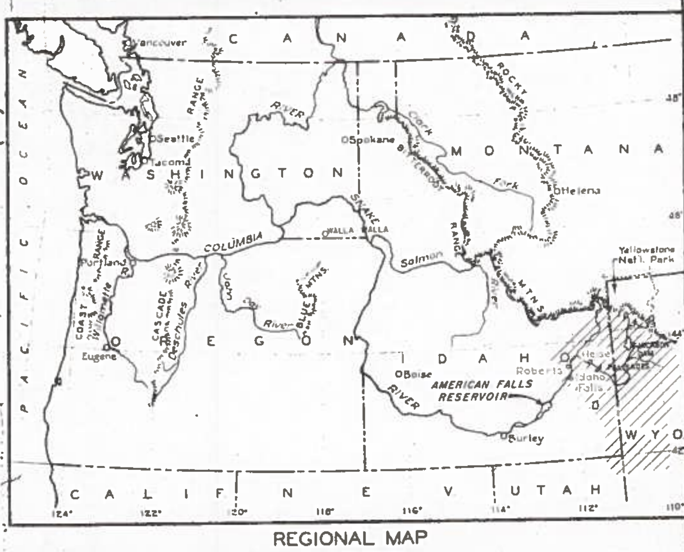
PRECIPITATION STATIONS

Station	Elevation	Type Gage	Period	Frequency	Method of Reporting
1. Moran*	6740	Manual and recorder	1 April - July 15	Daily	Obs. - tel BR - tt WB-"C"De
2. Island Park*	6300	Manual	1 April - July 15	Daily	" " "
3. Palisades*	5392	Manual	1 April - July 15	Daily	" " "
4. Bedford 2SE #	6221	Manual	1 April - July 15	Daily	Obs.-ml.BR-tt WB-"C"DE
5. Jackson	6244	Manual and recorder	1 April - July 15	Daily	Obs.-tel.BR-tt WB-"C"DE
6. Snake River	6800	Manual	1 April - July 15	Daily	" " "
7. Grover 2S #	6115	Manual	1 April - July 15	Daily	Obs.-ml BR-tt WB-"C"DE

* Also provides temperature.

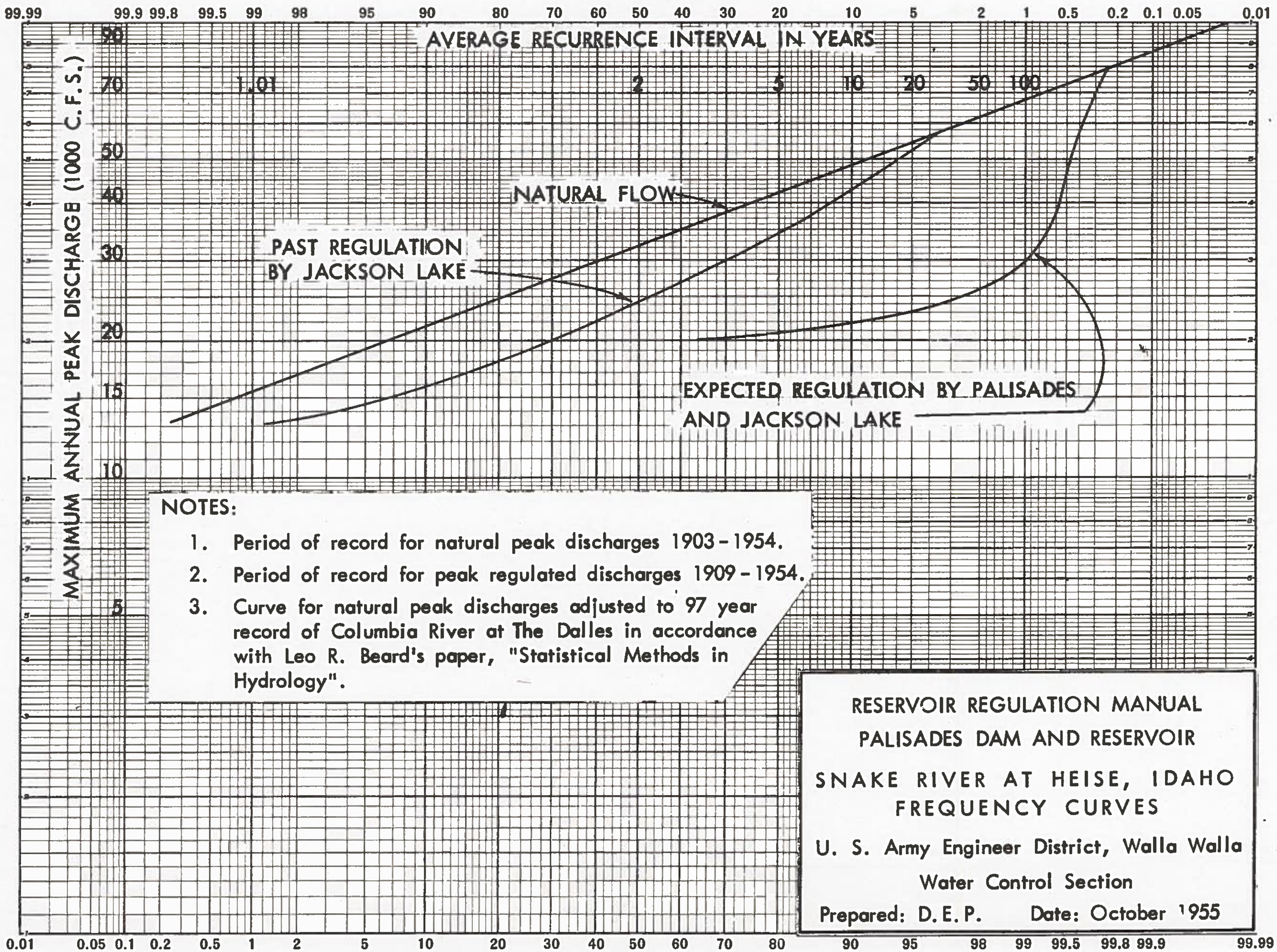
\# Daily report by mail to BR, when daily precip. exceeds 0.20 inch obs. makes telephone report to BR.

Reports prior to flood season are received monthly from Weather Bureau by mail as soon as reports are received from observers.



REGIONAL MAP
SCALE IN MILES
50 0 50 100 150 200

RESERVOIR REGULATION MANUAL
PALISADES DAM AND RESERVOIR
HYDROLOGIC STATIONS
U.S. ARMY ENGINEER DISTRICT, WALLA WALLA
WATER CONTROL SECTION
PREPARED: K. Wise DATE: Dec 1957



NOTES:

1. Period of record for natural peak discharges 1903 - 1954.
2. Period of record for peak regulated discharges 1909 - 1954.
3. Curve for natural peak discharges adjusted to 97 year record of Columbia River at The Dalles in accordance with Leo R. Beard's paper, "Statistical Methods in Hydrology".

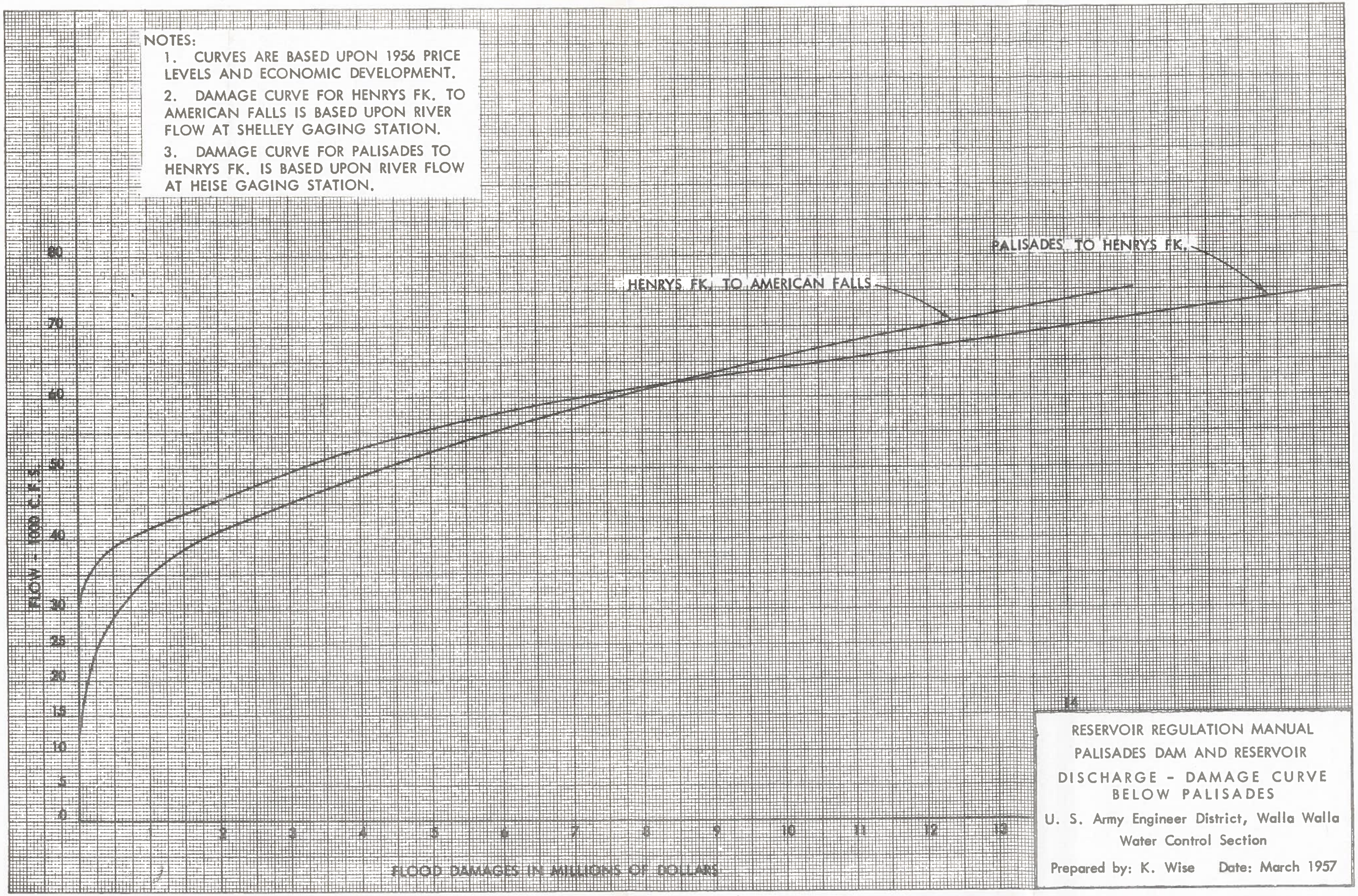
RESERVOIR REGULATION MANUAL
PALISADES DAM AND RESERVOIR

SNAKE RIVER AT HEISE, IDAHO
FREQUENCY CURVES

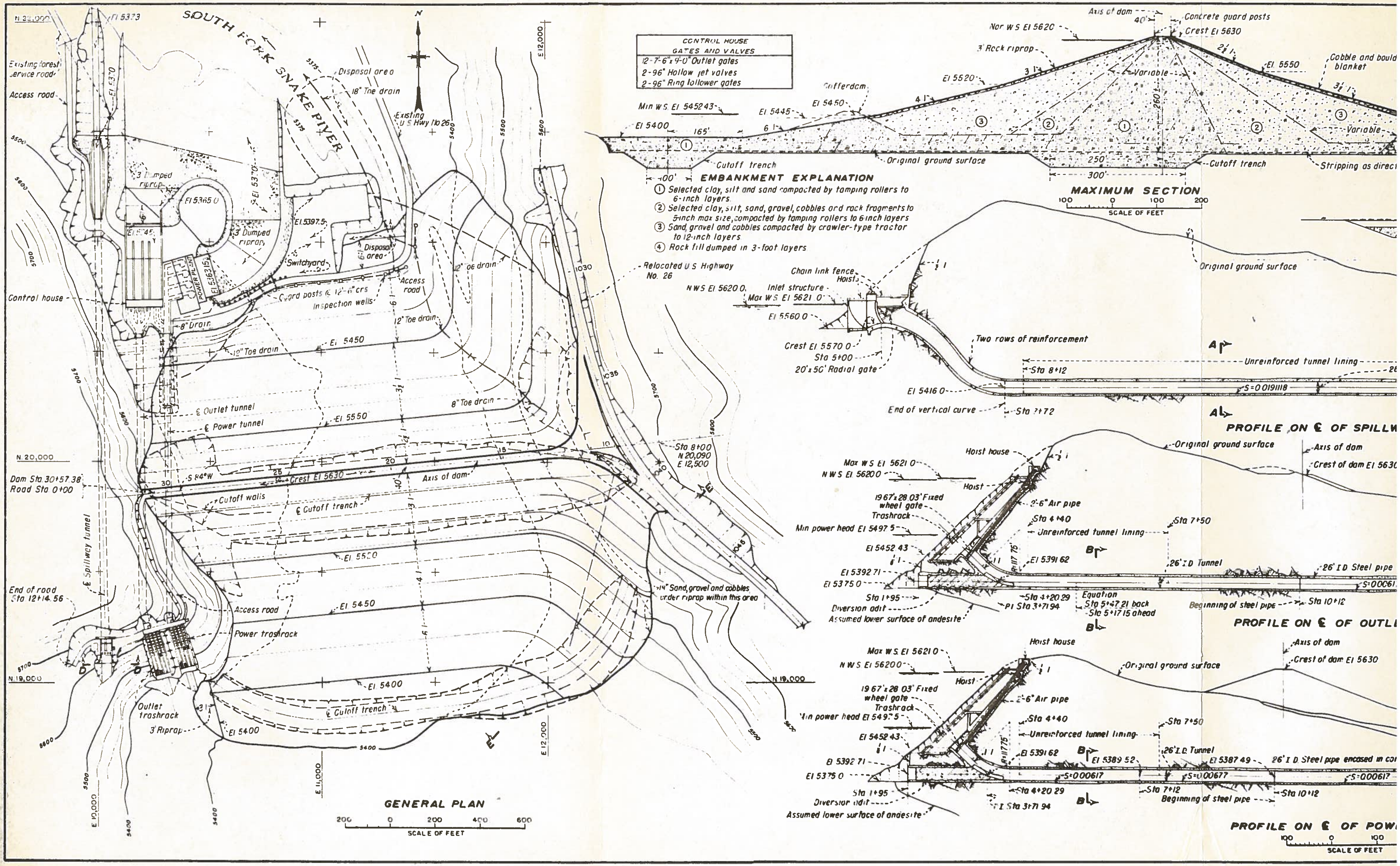
U. S. Army Engineer District, Walla Walla
Water Control Section

Prepared: D. E. P. Date: October 1955

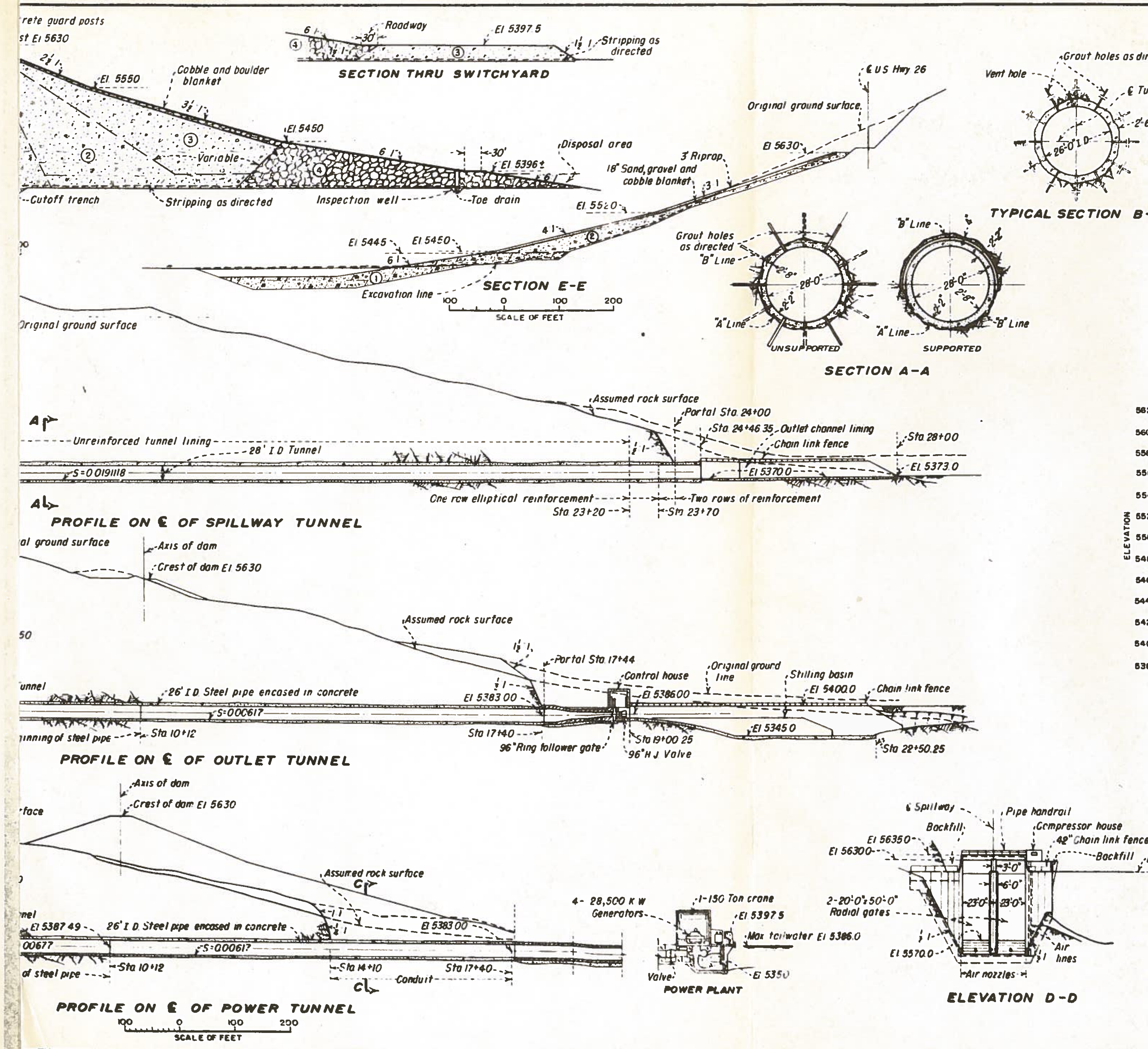
PLATE 2



RESERVOIR REGULATION MANUAL
PALISADES DAM AND RESERVOIR
DISCHARGE - DAMAGE CURVE
BELOW PALISADES
U. S. Army Engineer District, Walla Walla
Water Control Section
Prepared by: K. Wise   Date: March 1957

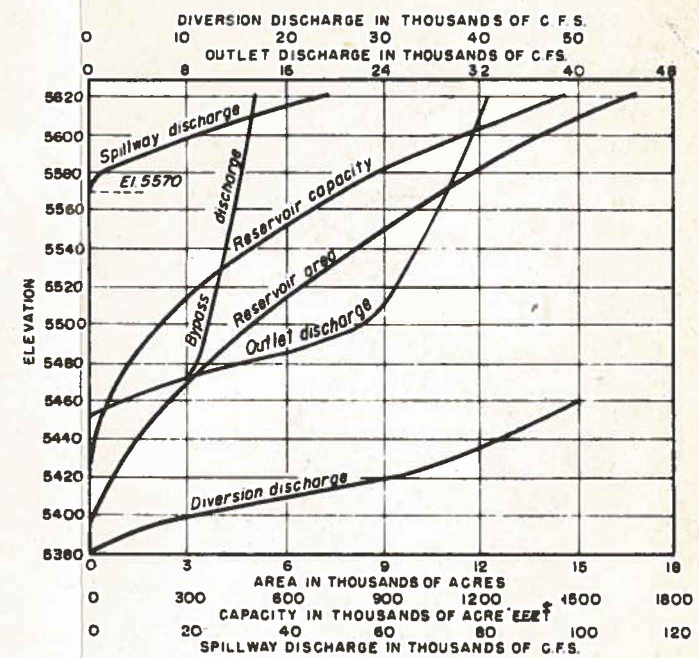


SOUTH FORK SNAKE RIVER
CONTROL HOUSE GATES AND VALVES
12-7'-6"x9'-0" Outlet gates
2-96" Hollow jet valves
2-96" Ring follower gates
EMBANKMENT EXPLANATION
① Selected clay, silt and sand compacted by tamping rollers to 6-inch layers
② Selected clay, silt, sand, gravel, cobbles and rock fragments to 5-inch max size, compacted by tamping rollers to 6 inch layers
③ Sand, gravel and cobbles compacted by crawler-type tractor to 12-inch layers
④ Rock fill dumped in 3-foot layers
MAXIMUM SECTION
SCALE OF FEET
Axis of dam
Concrete guard posts
Crest El 5630
Nor W S El 5620
3' Rock riprap
Cobble and bould blanket
Cofferdam
Min W S El 5452.43
Cutoff trench
Original ground surface
Stripping as direct
Existing forest service road
Access road
Control house
Disposal area
18" Toe drain
Existing U S Hwy No 26
3' Dumped riprap
Switchyard
Guard posts & 12-6" crs
Inspection wells
8" Drain
12" Toe drain
8" Toe drain
℄ Outlet tunnel
℄ Power tunnel
Crest El 5630
Cutoff walls
℄ Cutoff trench
Dam Sta 30+57.38
Road Sta 0+00
℄ Spillway tunnel
End of road Sta 12+14.56
Outlet trashrack
3' Riprap
Power trashrack
Relocated U S Highway No. 26
Sta 8+00 N 20,090 E 12,500
14" Sand, gravel and cobbles under riprap within this area
GENERAL PLAN
SCALE OF FEET
Chain link fence
Hoist
Inlet structure
N W S El 5620.0
Max W S El 5621.0
El 5560.0
Crest El 5570.0
Sta 5+00
20'x50' Radial gate
Two rows of reinforcement
Unreinforced tunnel lining
Sta 8+12
El 5416.0
End of vertical curve
Sta 7+72
S=0.019118
PROFILE ON ℄ OF SPILLW
Hoist house
19.67'x28.03' Fixed wheel gate
Trashrack
Min power head El 5497.5
El 5452.43
El 5392.71
El 5375.0
Sta 1+95
Diversion adit
Assumed lower surface of andesite
2-6" Air pipe
Sta 4+40
El 5391.62
Sta 7+50
26' I D Tunnel
26' I D Steel pipe
Sta 4+20.29
PI Sta 3+71.94
Equation Sta 5+47.21 back Sta 5+17.15 ahead
Beginning of steel pipe
Sta 10+12
PROFILE ON ℄ OF OUTL
Crest of dam El 5630
El 5389.52
El 5387.49
26' I D Steel pipe encased in co
S=0.00617
S=0.00677
Sta 7+12
PROFILE ON ℄ OF POW



RESERVOIR DATA

Surcharge capacity El 5620 to El 5621	16,000 A.F.
Joint use storage (Irrigation, flood control and power) El 5497.5 to El 5620	1,201,600 A.F.
Inactive storage (Power) El 5452.43 to El 5497.5	155,300 A.F.
Dead storage (Outlet sill) River bed to El 5452.43	44,700 A.F.
Total storage capacity	1,401,600 A.F.
Total reservoir capacity at maximum water surface	1,417,600 A.F.



AREA-CAPACITY-DISCHARGE CURVES

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
PALISADES PROJECT-IDAHO

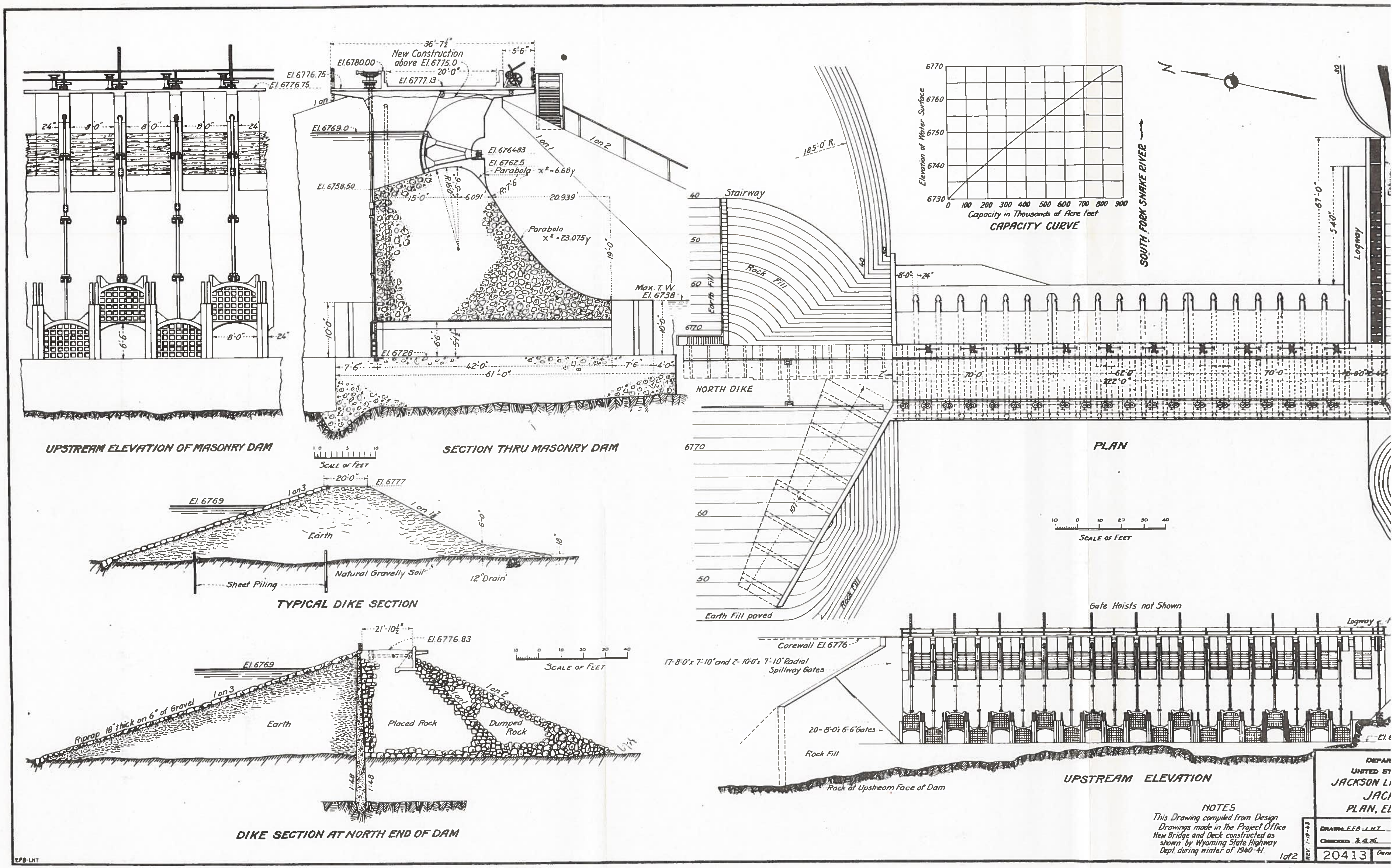
PALISADES DAM

GENERAL PLAN AND SECTIONS

DRAWN L.S.W. SUBMITTED [signature]
TRACED W.J.O. RECOMMENDED [signature]
CHECKED [signature] APPROVED [signature]
DENVER, COLORADO, JAN 18, 1952
SHEET 1 OF 2

REV. 2-27-52 E.C.P. | REV. 2-6-53 W.W.C. | REV. 4-20-53 E.C.P.

456-D-117


UPSTREAM ELEVATION OF MASONRY DAM
El. 6776.75
El. 6776.75
24"
8'-0"
8'-0"
8'-0"
24"
6'-6"
SECTION THRU MASONRY DAM
36'-7½"
New Construction above El. 6775.0
El. 6780.00
20'-0"
El. 6777.13
5'-6"
1 on 1
1 on 2
El. 6769.0
El. 6764.83
El. 6762.5
Parabola x² = 6.68y
El. 6758.50
R. 15'-0"
R. 7'-6"
15'-0"
6.091
20.939'
Parabola x² = 23.075y
19'-0"
Max. T.W. El. 6738
10'-0"
6'-6"
5'-1½"
El. 6728
7'-6"
42'-0"
7'-6"
4'-0"
61'-0"
Scale of Feet
TYPICAL DIKE SECTION
El. 6769
1 on 3
20'-0"
El. 6777
1 on 1½
6'-0"
Earth
18"
Natural Gravelly Soil
12" Drain
Sheet Piling
DIKE SECTION AT NORTH END OF DAM
21'-10½"
El. 6776.83
El. 6769
Riprap 18" thick on 6" of Gravel
1 on 3
Earth
Placed Rock
1 on 1
1 on 2
Dumped Rock
1:48
1:48
Scale of Feet
PLAN
185'-0" R.
Stairway
Rock Fill
Earth Fill
NORTH DIKE
Earth Fill paved
Rock Fill
101'-4"
70'-0"
62'-0"
222'-0"
70'-0"
8'-0" 24"
67'-0"
54'-0"
Logway
Scale of Feet
CAPACITY CURVE
Elevation of Water Surface
Capacity in Thousands of Acre Feet
SOUTH FORK SNAKE RIVER
N
UPSTREAM ELEVATION
Gate Hoists not Shown
Corewall El. 6776
17-8'-0" x 7'-10" and 2-10'-0" x 7'-10" Radial Spillway Gates
20-8'-0" x 6'-6" Gates
Rock Fill
Rock at Upstream Face of Dam
Logway
NOTES
This Drawing compiled from Design Drawings made in the Project Office
New Bridge and Deck constructed as shown by Wyoming State Highway Dept. during winter of 1940-41.
1 of 2
REV. 1-19-43
DRAWN: EFB-LHT
20413
JACKSON L
PLAN, EL
EFB-LHT

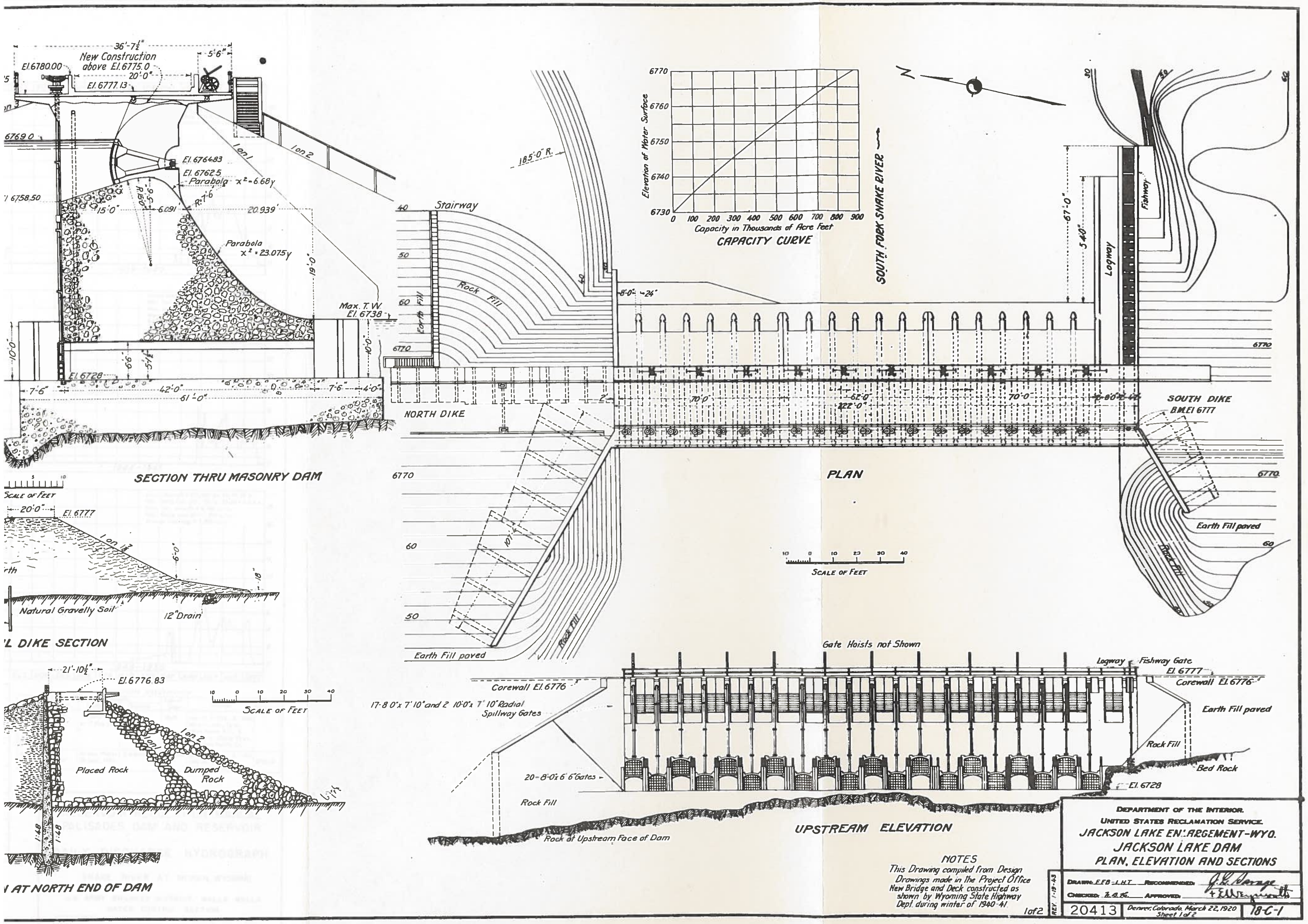
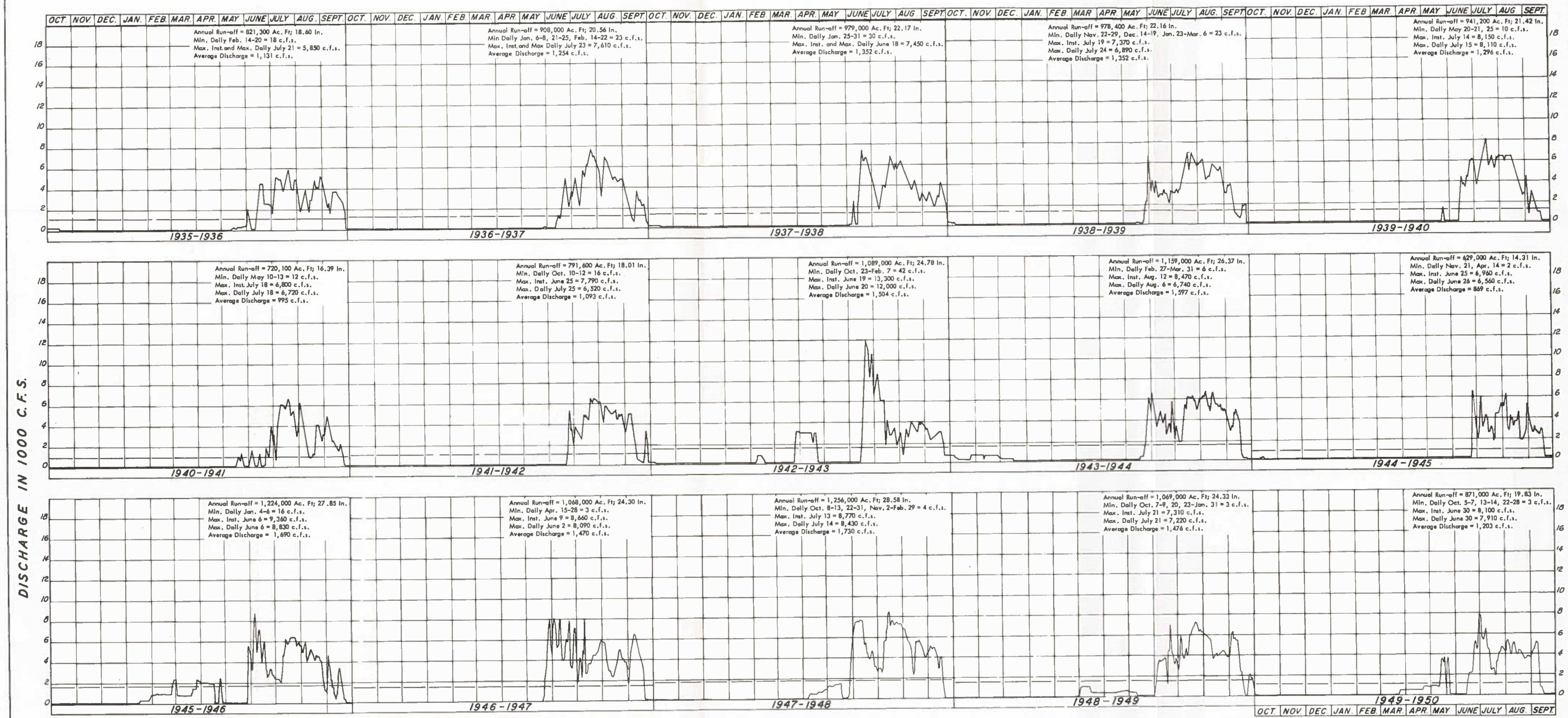
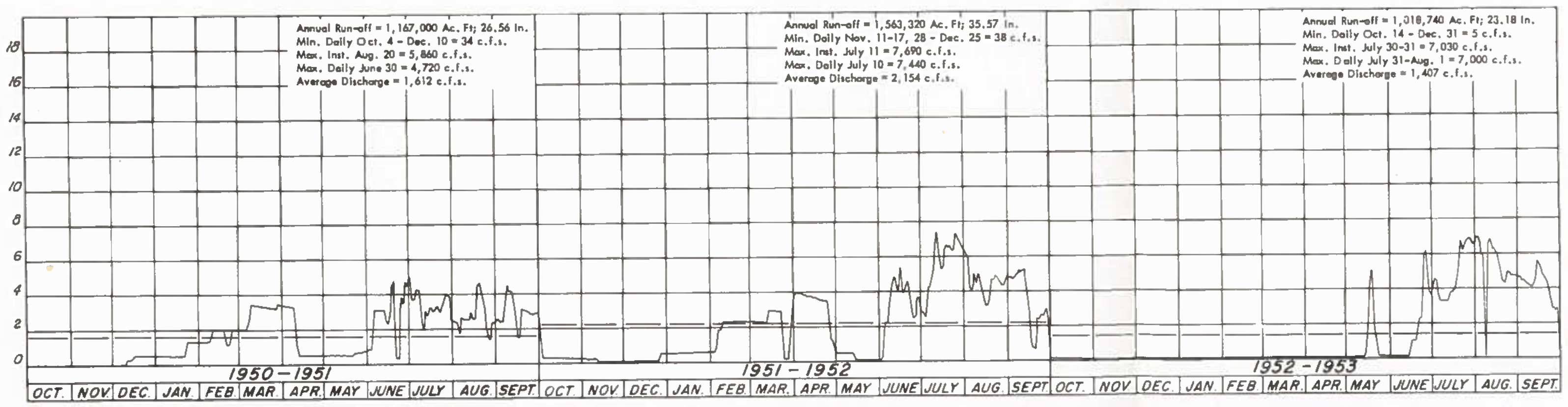
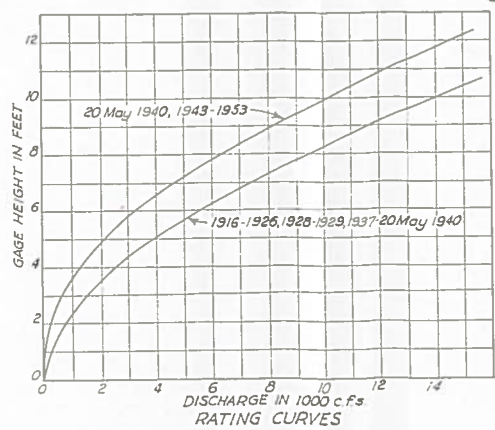

SECTION THRU MASONRY DAM
New Construction above El. 6775.0
36'-7½"
5'-6"
20'-0"
El. 6780.00
El. 6777.13
6769.0
El. 6764.83
El. 6762.5
Parabola x² = 6.68y
Parabola x² = 23.075y
1 on 1
1 on 2
6758.50
15'-0"
6.091
20.939'
19'-0"
Max. T.W. El. 6738
El. 6728
10'-0"
6'-6"
5'-½"
7'-6"
42'-0"
61'-0"
4'-0"
SCALE OF FEET
20'-0"
El. 6777
1 on 1½
6'-0"
18"
Natural Gravelly Soil
12" Drain
L DIKE SECTION
21'-10½"
El. 6776.83
Placed Rock
Dumped Rock
1 on 2
1 on 1
1:48
N AT NORTH END OF DAM
40
50
60
6770
Stairway
Earth Fill
Rock Fill
185'-0" R.
NORTH DIKE
8'-0"
24"
70'-0"
62'-0"
222'-0"
67'-0"
54'-0"
Logway
Fishway
SOUTH DIKE
BM. El 6777
Earth Fill paved
PLAN
Elevation of Water Surface
6730
6740
6750
6760
0
100
200
300
400
500
600
700
800
900
Capacity in Thousands of Acre Feet
CAPACITY CURVE
SOUTH FORK SNAKE RIVER
N
Gate Hoists not Shown
Logway
Fishway Gate
El. 6777
Corewall El. 6776
17-8'0" x 7'10" and 2 10'0" x 7'10" Radial Spillway Gates
20-8'0" x 6'6" Gates
Rock Fill
Rock at Upstream Face of Dam
Bed Rock
El. 6728
UPSTREAM ELEVATION
NOTES
This Drawing compiled from Design Drawings made in the Project Office
New Bridge and Deck constructed as shown by Wyoming State Highway Dept. during winter of 1940-41
1 of 2
REV. 1-18-43
DEPARTMENT OF THE INTERIOR
UNITED STATES RECLAMATION SERVICE
JACKSON LAKE ENLARGEMENT-WYO.
JACKSON LAKE DAM
PLAN, ELEVATION AND SECTIONS
DRAWN: E.F.B. - L.H.T.
RECOMMENDED:
CHECKED:
APPROVED:
20413
Denver, Colorado, March 22, 1920
Sheet 1 of 2
18-C-1

PLATE 5







RATING CURVES

STATION DESCRIPTION

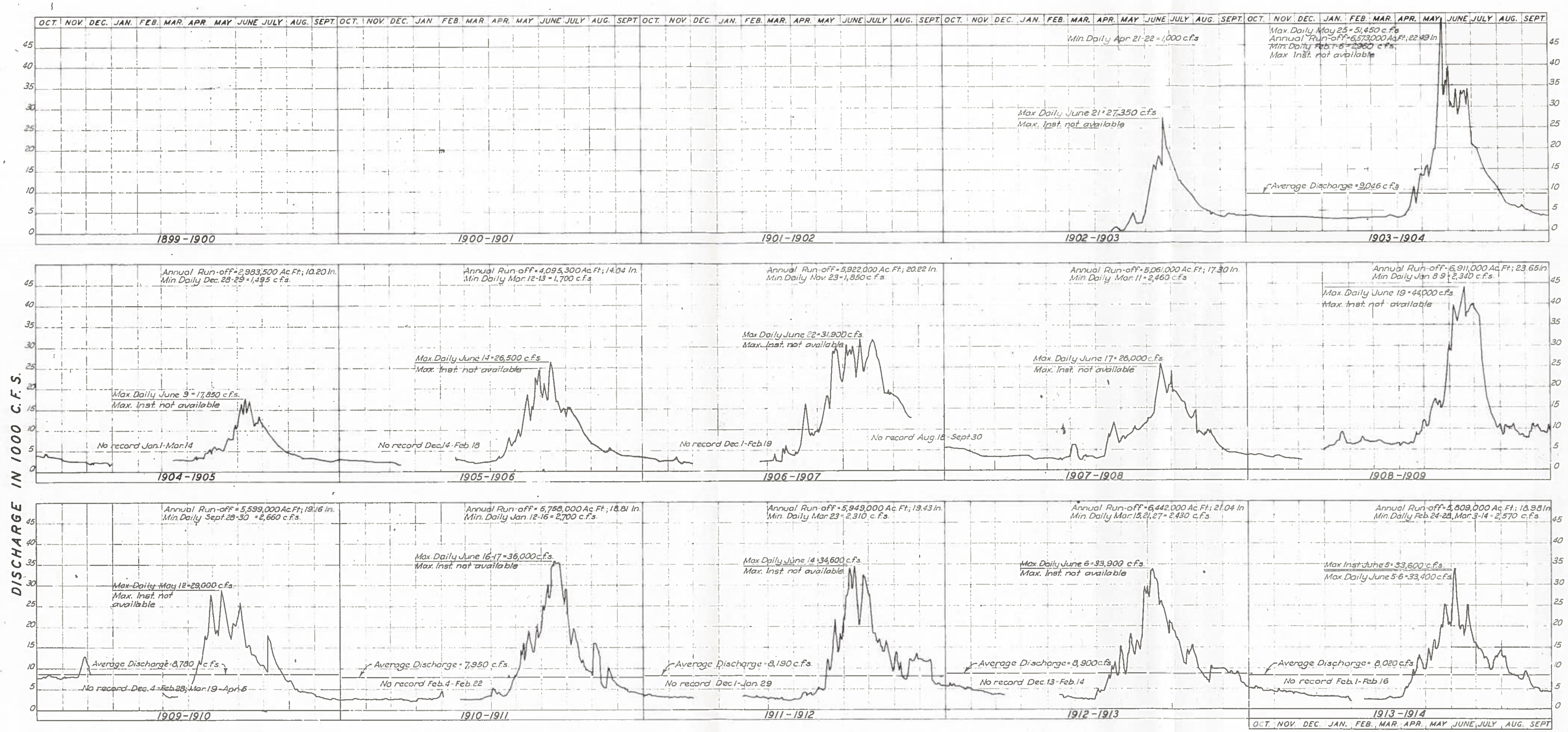
Station	Dr. Area Sq. Mi.	Records Available	Records Character	Type of Gage	Location	Datum (M.S.L.)
nr. Moran, Wyoming	828	14 June 1917 to 19 May 1940	Continuous	Staff	Sec. 17, T.45N., R.114W 6th prin. mer. 1½ mi. below Moran P.O. & Jackson L. Outlet 3½ mi. U.S. from Pacific Cr.	
At Moran, Wyoming	824	20 May 1940 to 30 Sept. 1953	Continuous	Recorder	Sec. 18, T.45N., R.114W, 1000 Ft. D.S. from Jackson L. Dam	6725.61

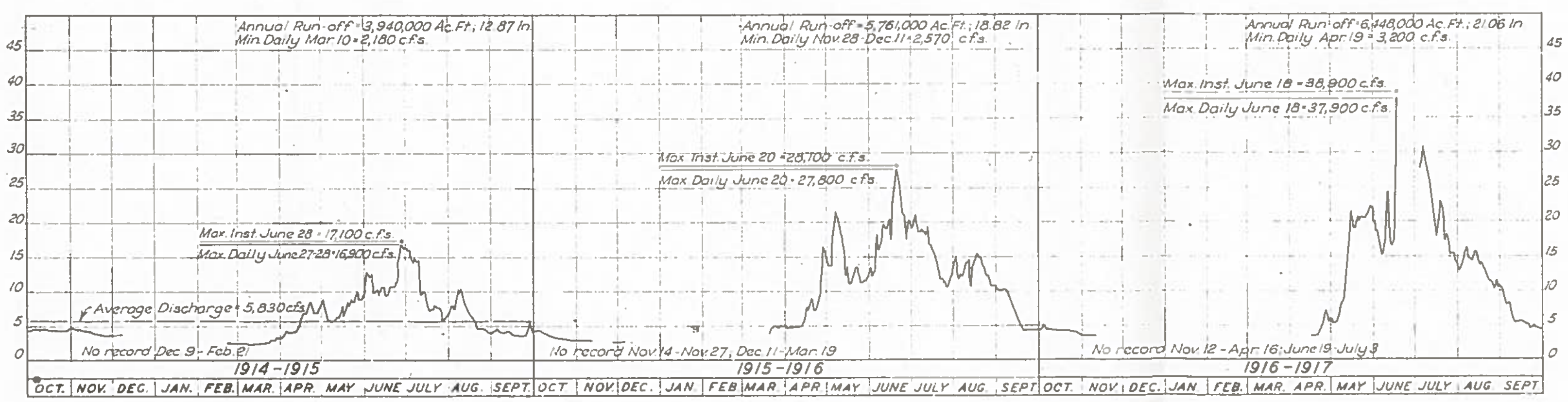
RESERVOIR REGULATION MANUAL
PALISADES DAM AND RESERVOIR

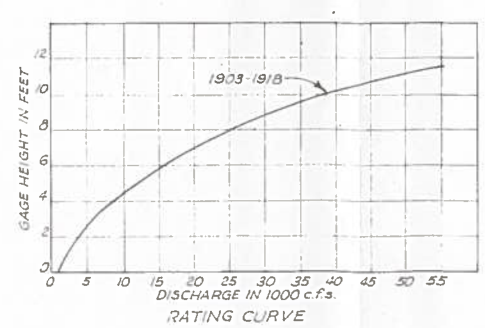
DAILY DISCHARGE HYDROGRAPH

SNAKE RIVER AT MORAN, WYOMING

U.S. ARMY ENGINEER DISTRICT, WALLA WALLA
WATER CONTROL SECTION
PREPARED K. Wise DATE Dec 1957







RATING CURVE

STATION DESCRIPTION

Station	Dr. Area Sq. Mi.	Records Available	Records Character	Type of Gage	Location	Datum (M.S.L.)
S. Fk. Snake R. nr. Lyons, Ida.	5,480	21 Apr. 1903 to 16 Oct. 1904	Broken	Staff	At old site Wee-kinds Ferry bet. Lyons and Swan Valley at upper end Conant Valley	5016.90
		16 Oct. 1904 to 30 Sept. 1910	Broken	Staff	N. bank 1 mi. above old gaging station	"
Snake R. nr. Heise, Ida.	5,740	10 Nov. 1911 to 8 July 1913	Broken	Staff	Sec. 5, T.3N., R.41E. B.M. 3 mi. above Heise & 25 mi. below Lyons	"
		8 July 1913 to 2 Apr. 1924	Broken	Recorder		

RESERVOIR REGULATION MANUAL
PALISADES DAM AND RESERVOIR

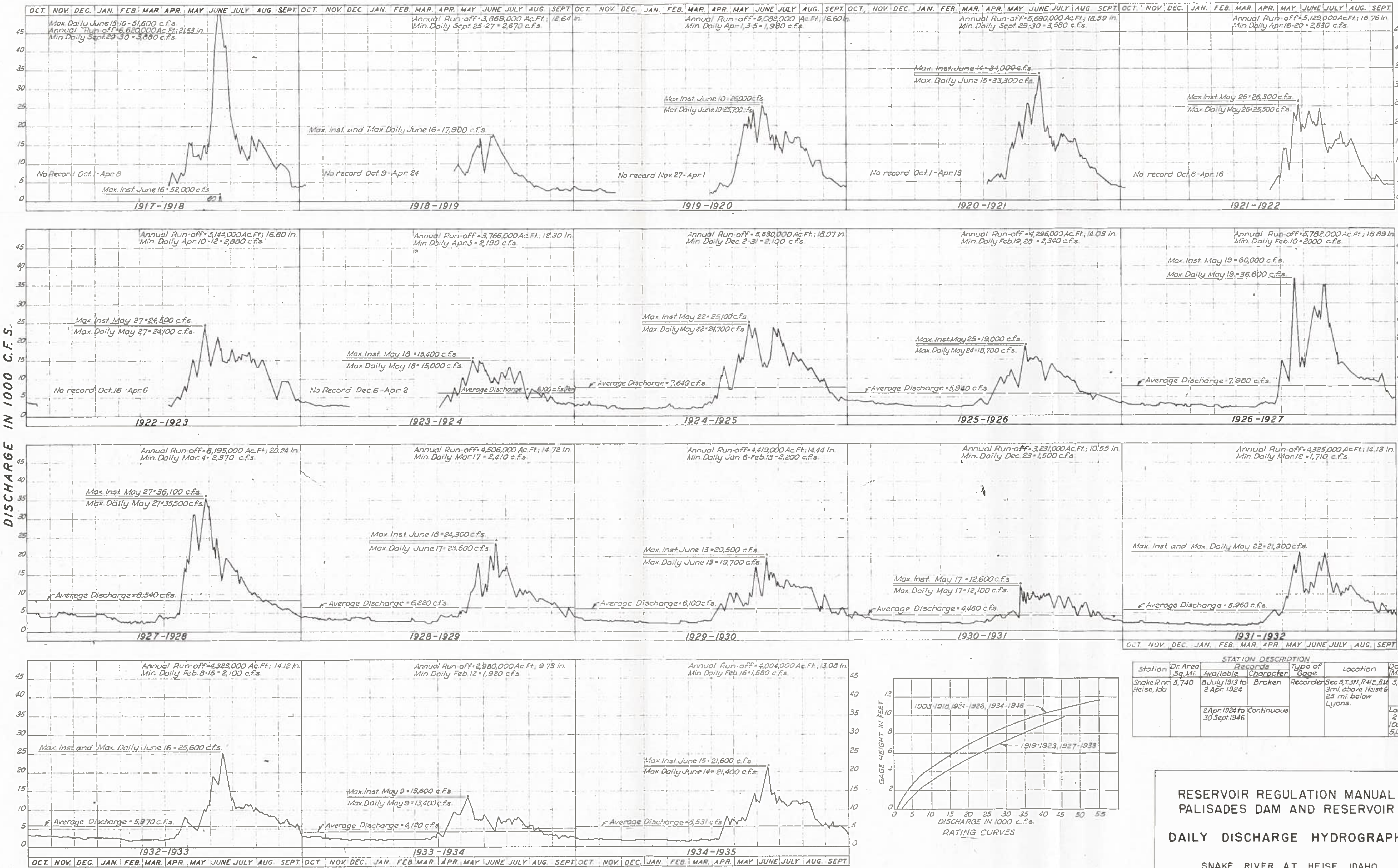
DAILY DISCHARGE HYDROGRAPH

SNAKE RIVER AT HEISE, IDAHO

U.S. ARMY ENGINEER DISTRICT, WALLA WALLA
WATER CONTROL SECTION

PREPARED: K. Wise DATE: Dec 1957

PLATE 7



RATING CURVES

STATION DESCRIPTION

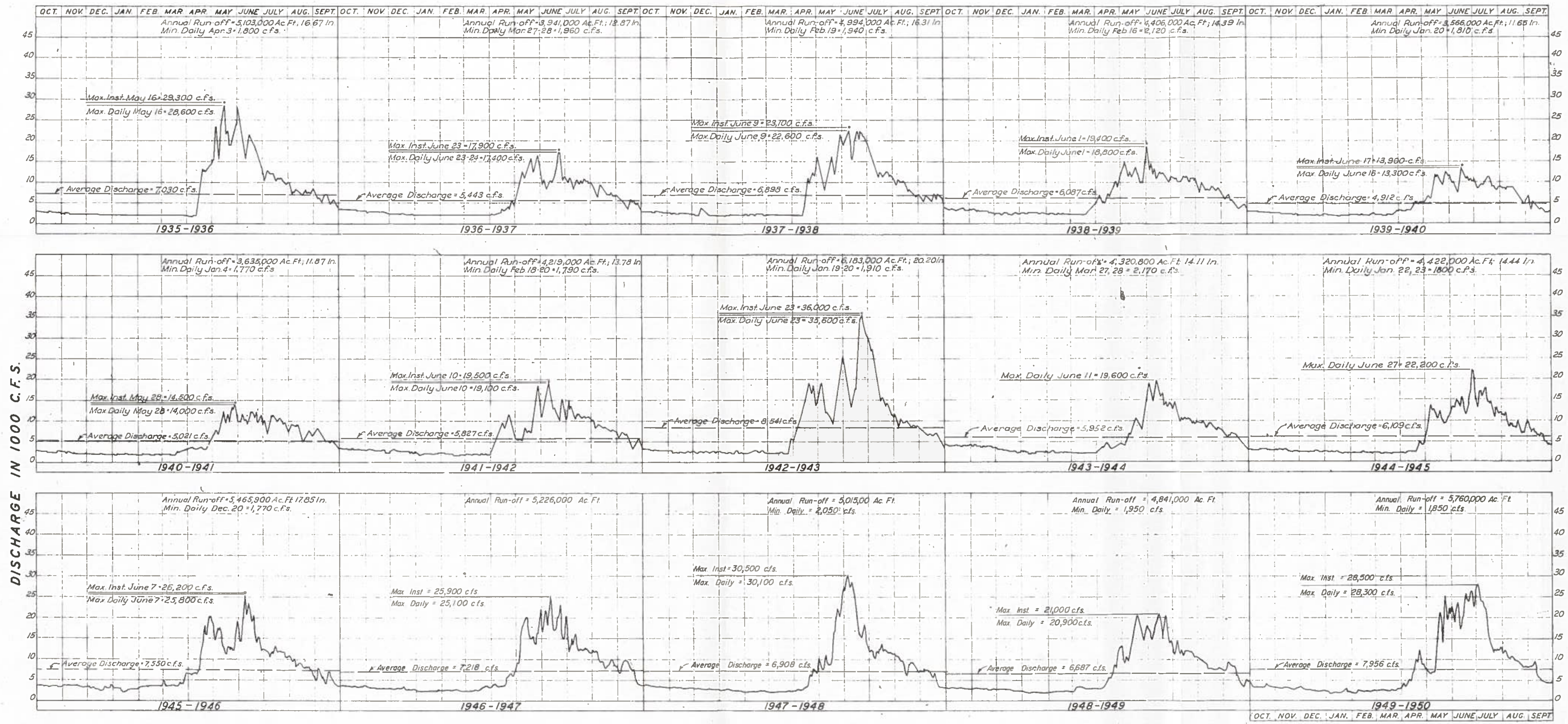
Station	Dr. Area Sq. Mi.	Records Available	Records Character	Type of Gage	Location	Datum (M.S.L.)
Snake R. nr. Heise, Ida.	5,740	8 July 1913 to 2 Apr. 1924	Broken	Recorder	Sec. 8, T.3N., R.41E., B.M. 3 mi. above Heise & 25 mi. below Lyons.	5,016.90
		2 Apr. 1924 to 30 Sept. 1946	Continuous			Lowered 2 ft. 1 Oct. 1933 5,014.90

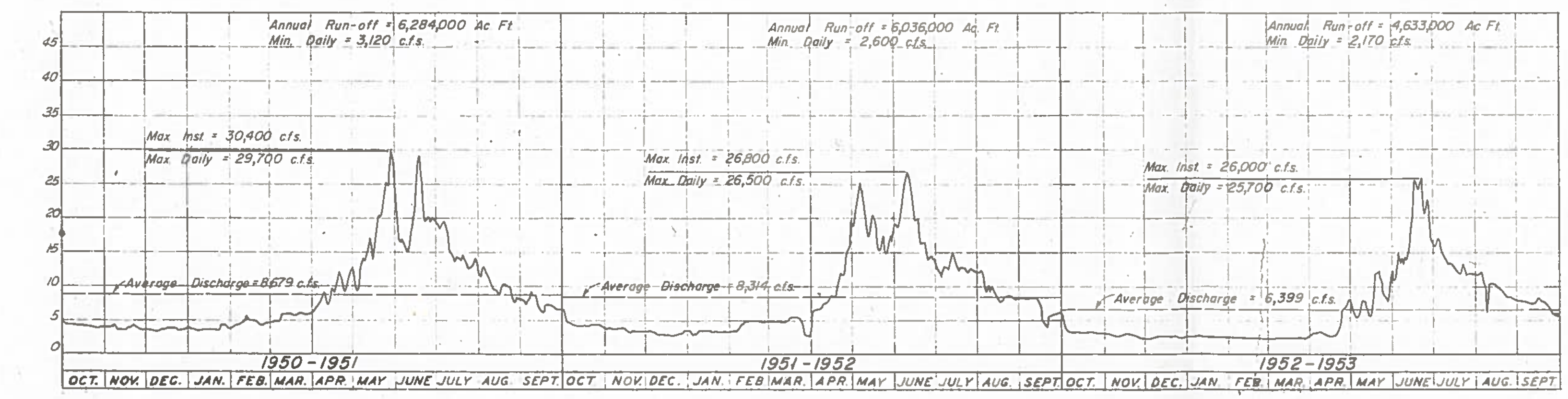
RESERVOIR REGULATION MANUAL
PALISADES DAM AND RESERVOIR

DAILY DISCHARGE HYDROGRAPH

SNAKE RIVER AT HEISE, IDAHO
U.S. ARMY ENGINEER DISTRICT, WALLA WALLA
WATER CONTROL SECTION

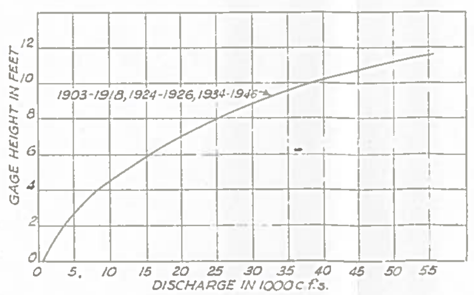
PREPARED: K. Wise DATE: Dec 1957





STATION DESCRIPTION

Station	Dr. Area Sq. Mi.	Records Available	Records Character	Type of Gage	Location	Datum (M.S.L.)
Snake R. nr. Heise Ida.	5,740	2 Apr. 1924 to 30 Sept. 1946	Continuous	Recorder	Sec. 5, T. 3N, R. 41E B.M. 3 mi. above Heise & 25 mi. below Lyons	5,014.90

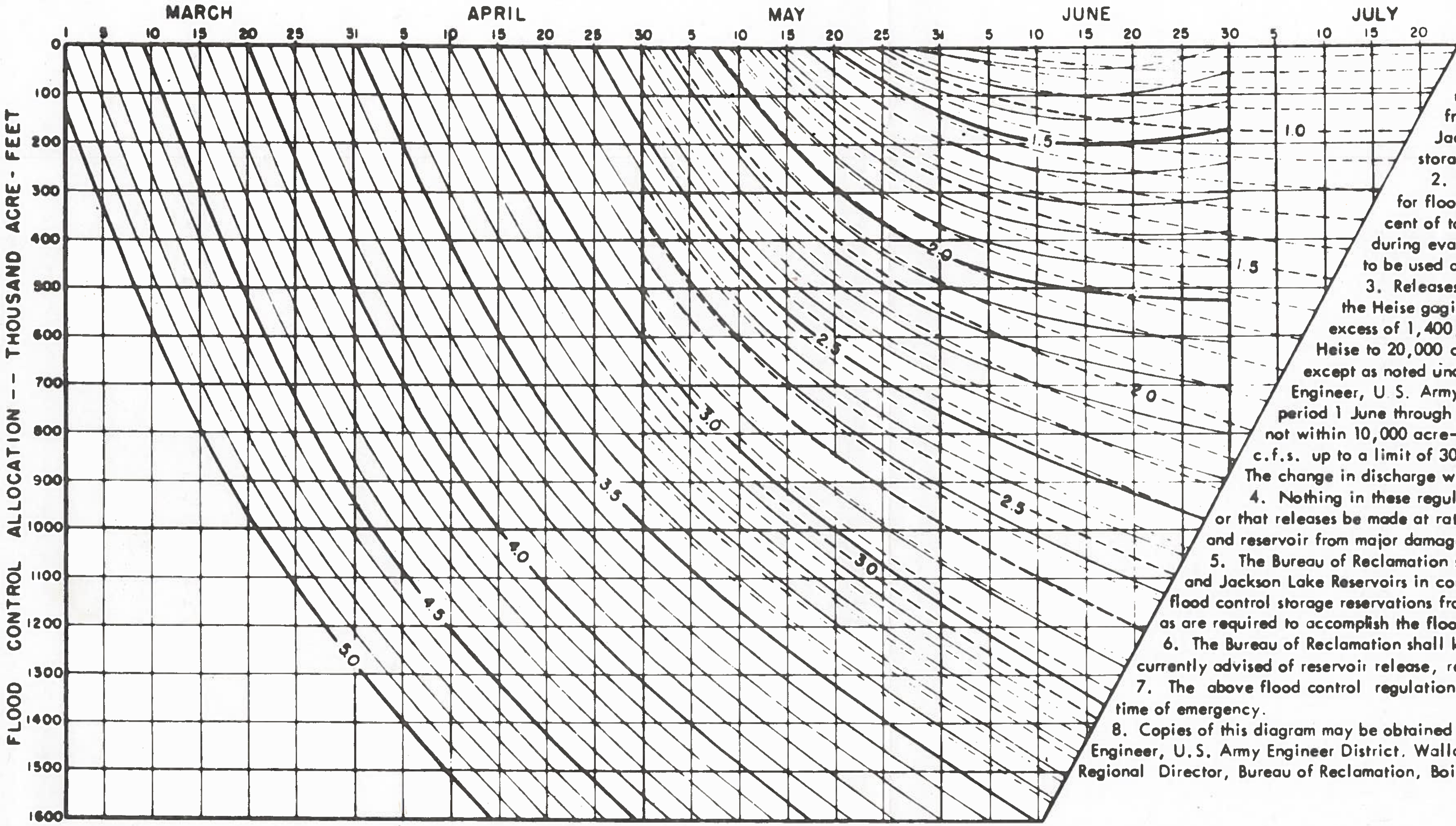


RATING CURVE

RESERVOIR REGULATION MANUAL
PALISADES DAM AND RESERVOIR

DAILY DISCHARGE HYDROGRAPH

SNAKE RIVER AT HEISE, IDAHO
U.S. ARMY ENGINEER DISTRICT, WALLA WALLA
WATER CONTROL SECTION
PREPARED K. Wise DATE Dec 1957



NOTES

1. The minimum flood control storage reservation required on c season is as indicated by the diagram. Parameter values are forec run-off of Snake River at Heise in millions of acre-feet for the rem from any given date to 31 July. A minimum of 200,000 acre-feet o Jackson Lake will be held vacant until 1 May every year unless the f storage should begin earlier to insure filling that space.

2. Storage space in Palisades Reservoir and Jackson Lake combined sh for flood control purposes in accordance with this diagram. However, no cent of total storage space will be made available in Palisades Reservoir. S during evacuation and until natural inflow to Palisades first exceeds 20,000 c to be used after natural inflow exceeds 20,000 c.f.s.

3. Releases from Palisades Reservoir shall be restricted to 20,000 c.f.s. or le the Heise gaging station except: (A) when the forecasted run-off indicates that excess of 1,400,000 acre-feet in Palisades and Jackson Lake combined is required Heise to 20,000 c.f.s., releases in excess of 20,000 c.f.s. will be made but not to except as noted under item 7 or as may be agreed upon by the Bureau of Reclamation c Engineer, U.S. Army Engineer District, during extremely large floods and; (B) when the period 1 June through 31 July exceeds 2,500,000 acre-feet, and, when after 1 June the not within 10,000 acre-feet of the space required by this diagram, the release may be incr c.f.s. up to a limit of 30,000 c.f.s. to the extent of 1,000 c.f.s. for each 5,000 acre-fee The change in discharge will be made in such manner as to minimize the adverse downstream

4. Nothing in these regulations shall be construed to require dangerously rapid changes in m or that releases be made at rates or in a manner that would be inconsistent with requirements for and reservoir from major damage.

5. The Bureau of Reclamation shall procure current basic hydrologic data necessary for forecastin and Jackson Lake Reservoirs in conformance with procedures mutually agreed to, make current deter flood control storage reservations from the diagram and make current calculations of permissible releas as are required to accomplish the flood control objectives.

6. The Bureau of Reclamation shall keep the District Engineer, U.S. Army Engineer District, in char currently advised of reservoir release, reservoir storage and such other operating data as the District Engin

7. The above flood control regulations are subject to temporary modification by the District Engineer, if time of emergency.

8. Copies of this diagram may be obtained from the offices of the District Engineer, U.S. Army Engineer District, Walla Walla, Washington, and the Regional Director, Bureau of Reclamation, Boise, Idaho.

PALISADES DAM

Snake Riv

FLOOD CONTROL STORAG

Prepared Pursuant to F for Palisades Dam and Re

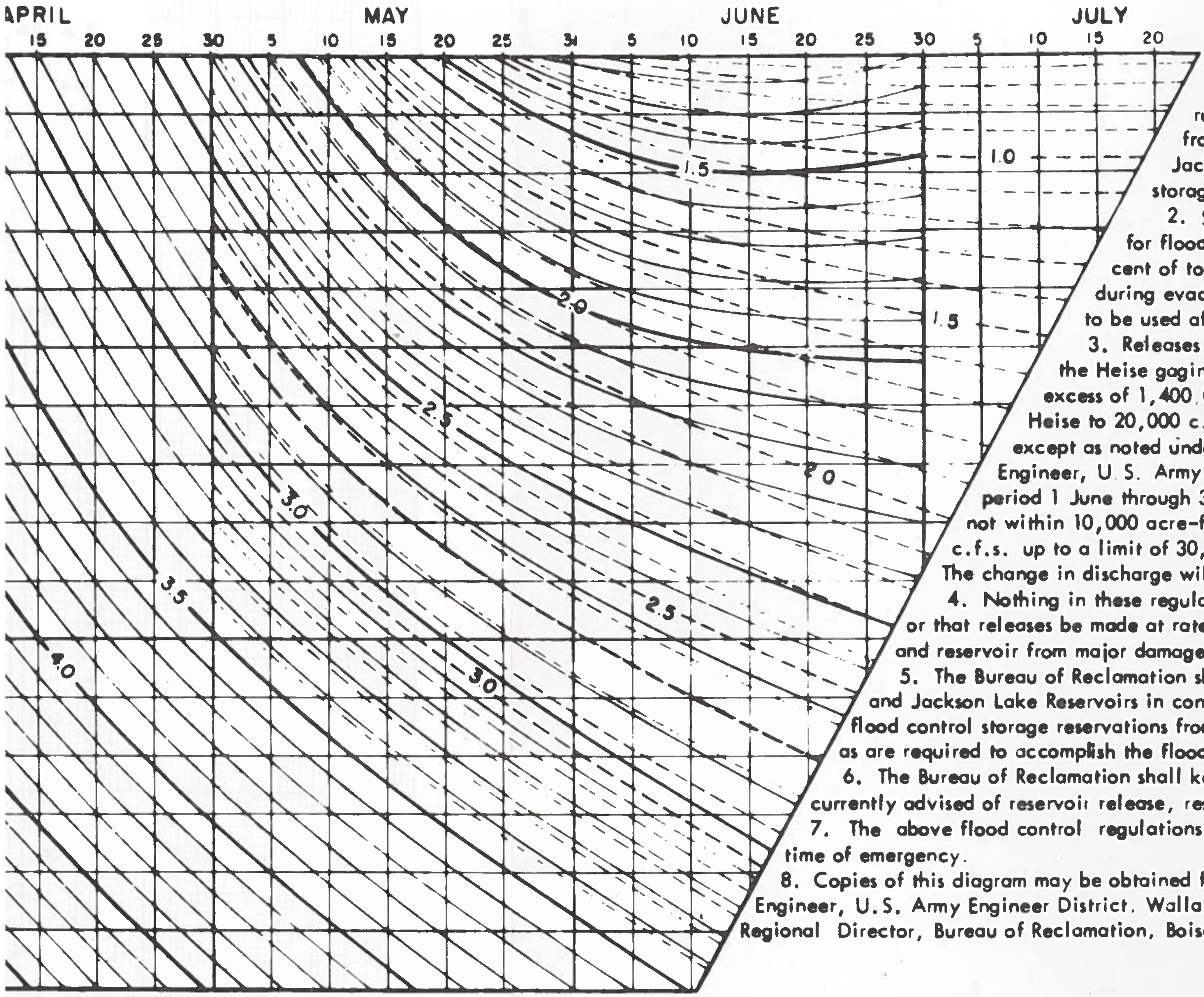
APPROVED [signature]

Commissioner of

APPROVED [signature]

Major Gene

Effective Date May 12, 19



NOTES

1. The minimum flood control storage reservation required on any day of the flood season is as indicated by the diagram. Parameter values are forecasted natural flood run-off of Snake River at Heise in millions of acre-feet for the remainder of the season from any given date to 31 July. A minimum of 200,000 acre-feet of storage space in Jackson Lake will be held vacant until 1 May every year unless the forecast indicates that storage should begin earlier to insure filling that space.

2. Storage space in Palisades Reservoir and Jackson Lake combined shall be kept available for flood control purposes in accordance with this diagram. However, not less than 75 per cent of total storage space will be made available in Palisades Reservoir. Solid lines to be used during evacuation and until natural inflow to Palisades first exceeds 20,000 c.f.s. Dashed lines to be used after natural inflow exceeds 20,000 c.f.s.

3. Releases from Palisades Reservoir shall be restricted to 20,000 c.f.s. or less as measured at the Heise gaging station except: (A) when the forecasted run-off indicates that storage capacity in excess of 1,400,000 acre-feet in Palisades and Jackson Lake combined is required to control flows at Heise to 20,000 c.f.s., releases in excess of 20,000 c.f.s. will be made but not to exceed 30,000 c.f.s. except as noted under item 7 or as may be agreed upon by the Bureau of Reclamation and the District Engineer, U.S. Army Engineer District, during extremely large floods and; (B) when the forecasted run-off for the period 1 June through 31 July exceeds 2,500,000 acre-feet, and, when after 1 June the available space is not within 10,000 acre-feet of the space required by this diagram, the release may be increased above 20,000 c.f.s. up to a limit of 30,000 c.f.s. to the extent of 1,000 c.f.s. for each 5,000 acre-feet of deficient storage. The change in discharge will be made in such manner as to minimize the adverse downstream effects.

4. Nothing in these regulations shall be construed to require dangerously rapid changes in magnitudes of releases, or that releases be made at rates or in a manner that would be inconsistent with requirements for protecting the dam and reservoir from major damage.

5. The Bureau of Reclamation shall procure current basic hydrologic data necessary for forecasting inflows to Palisades and Jackson Lake Reservoirs in conformance with procedures mutually agreed to, make current determinations of required flood control storage reservations from the diagram and make current calculations of permissible releases from the reservoirs as are required to accomplish the flood control objectives.

6. The Bureau of Reclamation shall keep the District Engineer, U.S. Army Engineer District, in charge of the locality currently advised of reservoir release, reservoir storage and such other operating data as the District Engineer may request.

7. The above flood control regulations are subject to temporary modification by the District Engineer, if found necessary in time of emergency.

8. Copies of this diagram may be obtained from the offices of the District Engineer, U.S. Army Engineer District, Walla Walla, Washington, and the Regional Director, Bureau of Reclamation, Boise, Idaho.

PALISADES DAM AND RESERVOIR

Snake River, Idaho

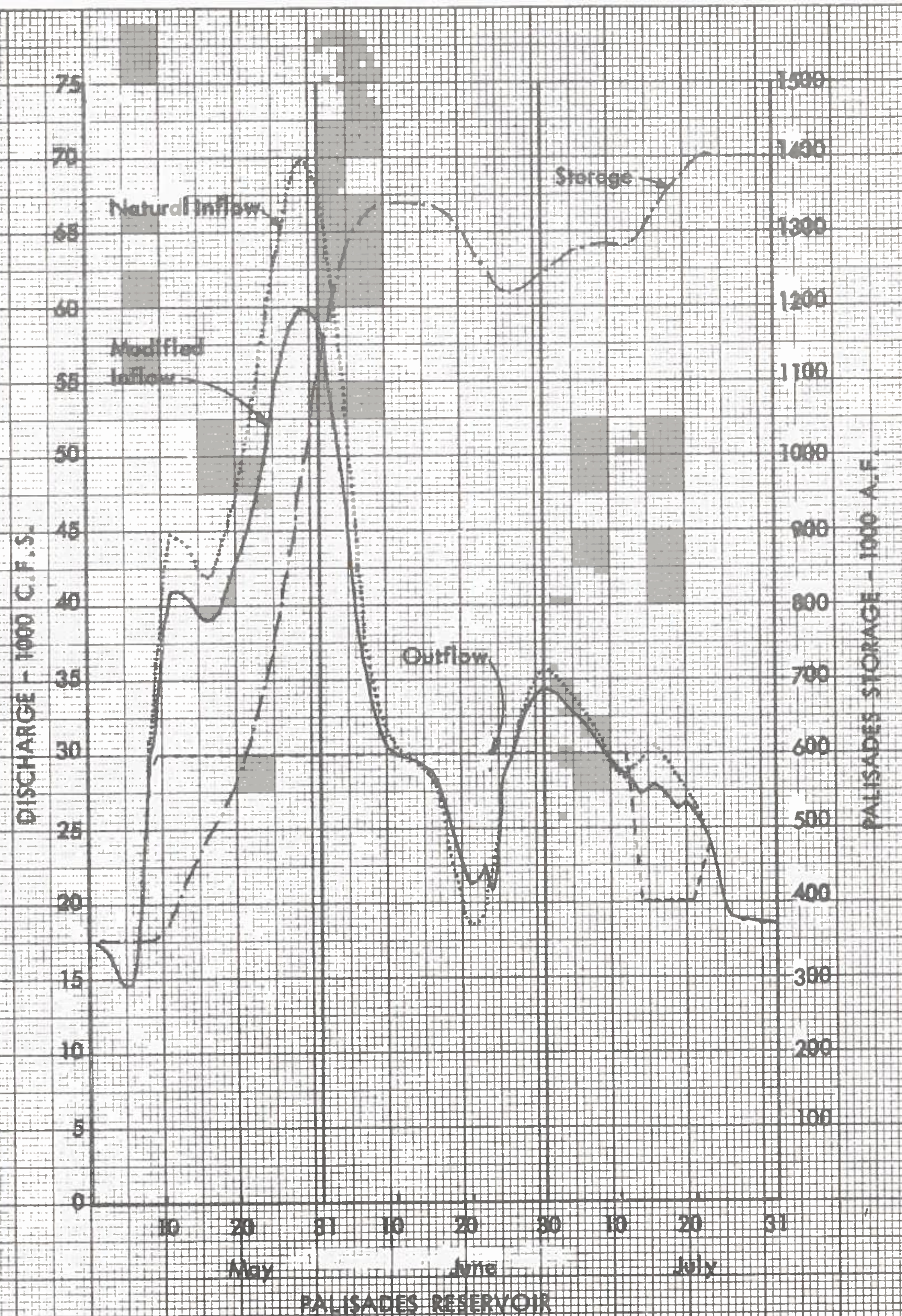
FLOOD CONTROL STORAGE RESERVATION DIAGRAM

Prepared Pursuant to Flood control Regulations for Palisades Dam and Reservoir (33 CFR 208.)

APPROVED W A Dexheimer
Commissioner of Reclamation

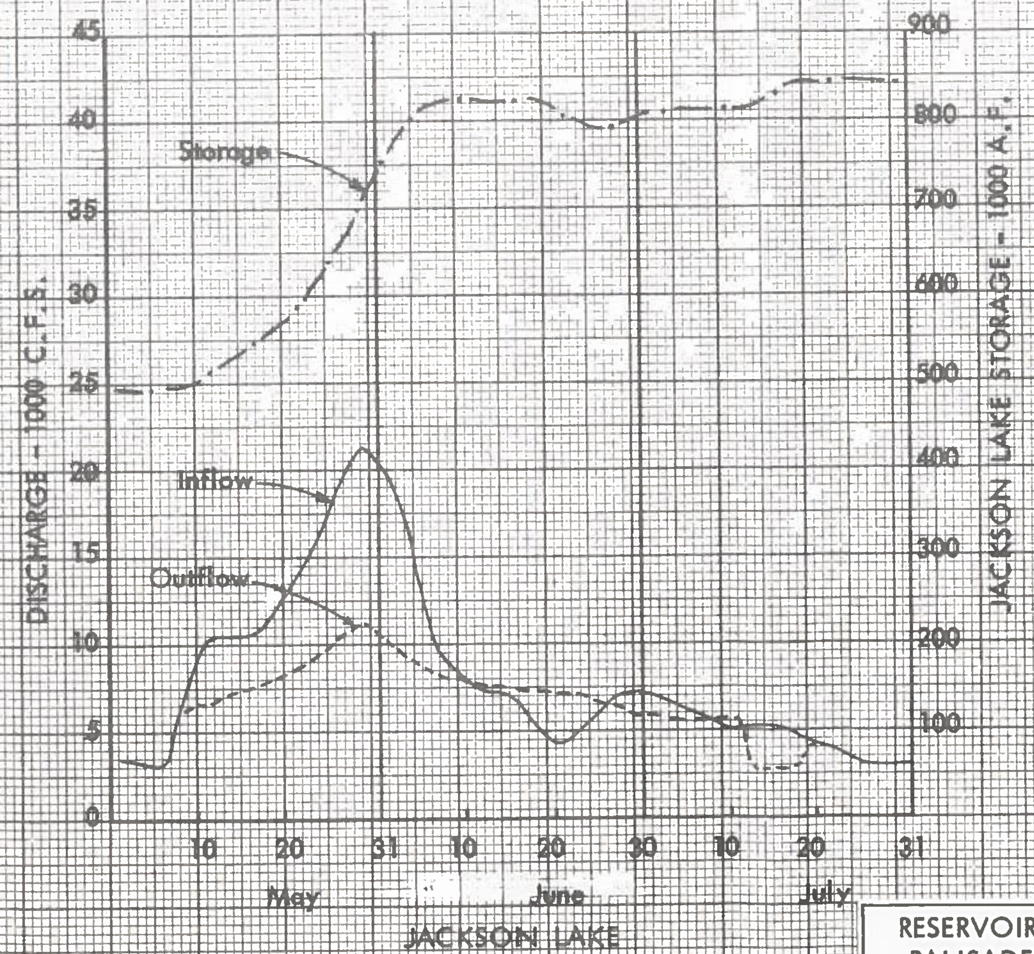
APPROVED E C Itschner
Major General, Chief of Engineers

Effective Date May 12, 1958 File No. SN-902-1/1

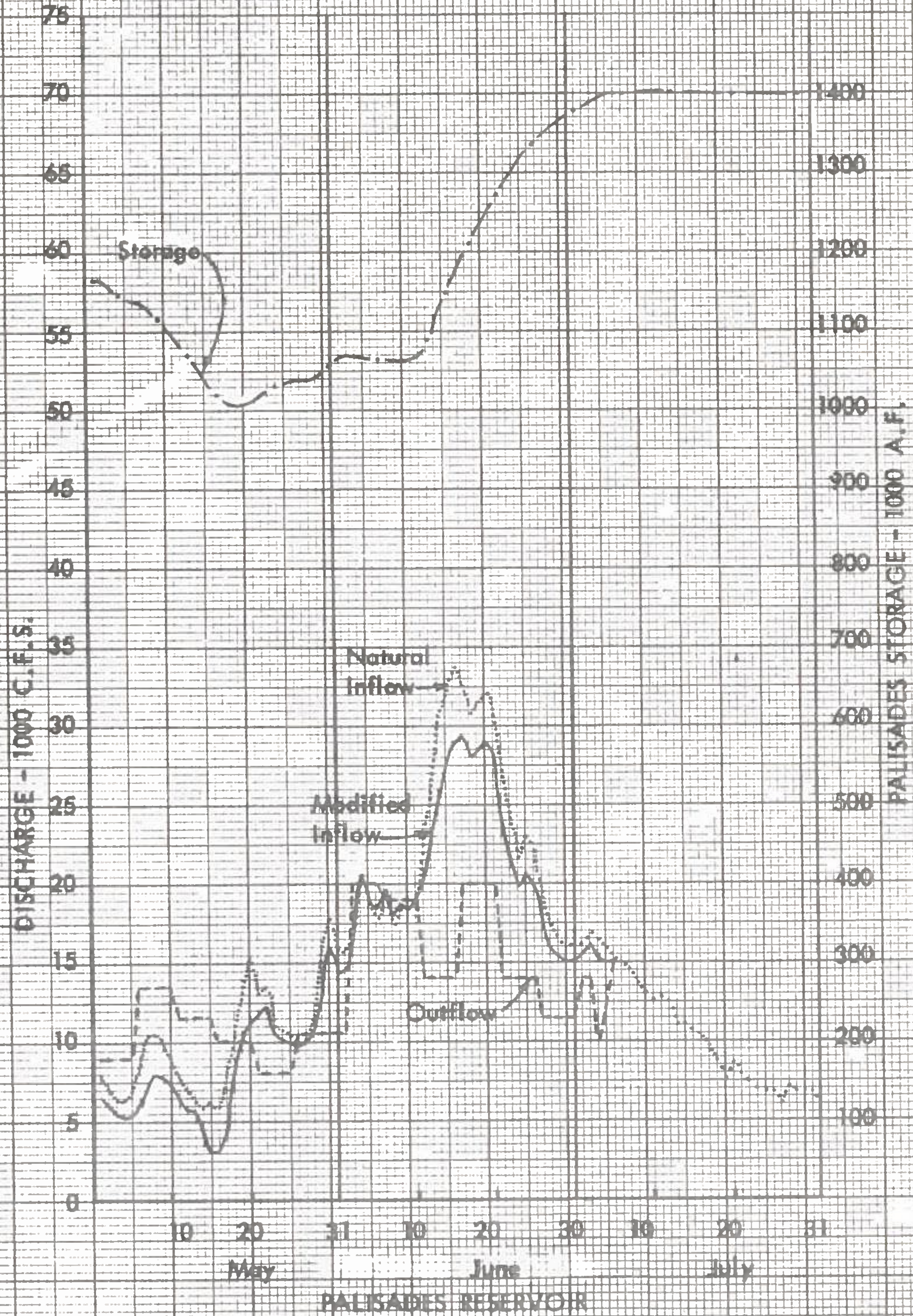


NOTES:

1. Flood regulation at Jackson Lake is result of maintaining 25% of total space in that reservoir.
2. Total natural May-July volume at Palisades is 6,338,400 A.F.
3. 1,400,000 A.F. of flood control space was used for regulatio with 75% in Palisades and 25% maintained in Jackson Lake. Actual operation for this magnitude flood would likely use a total of about 1,600,000 A.F. of space, but would require special negotiations at the time to obtain approval of local interest for the additional space in Jackson Lake.

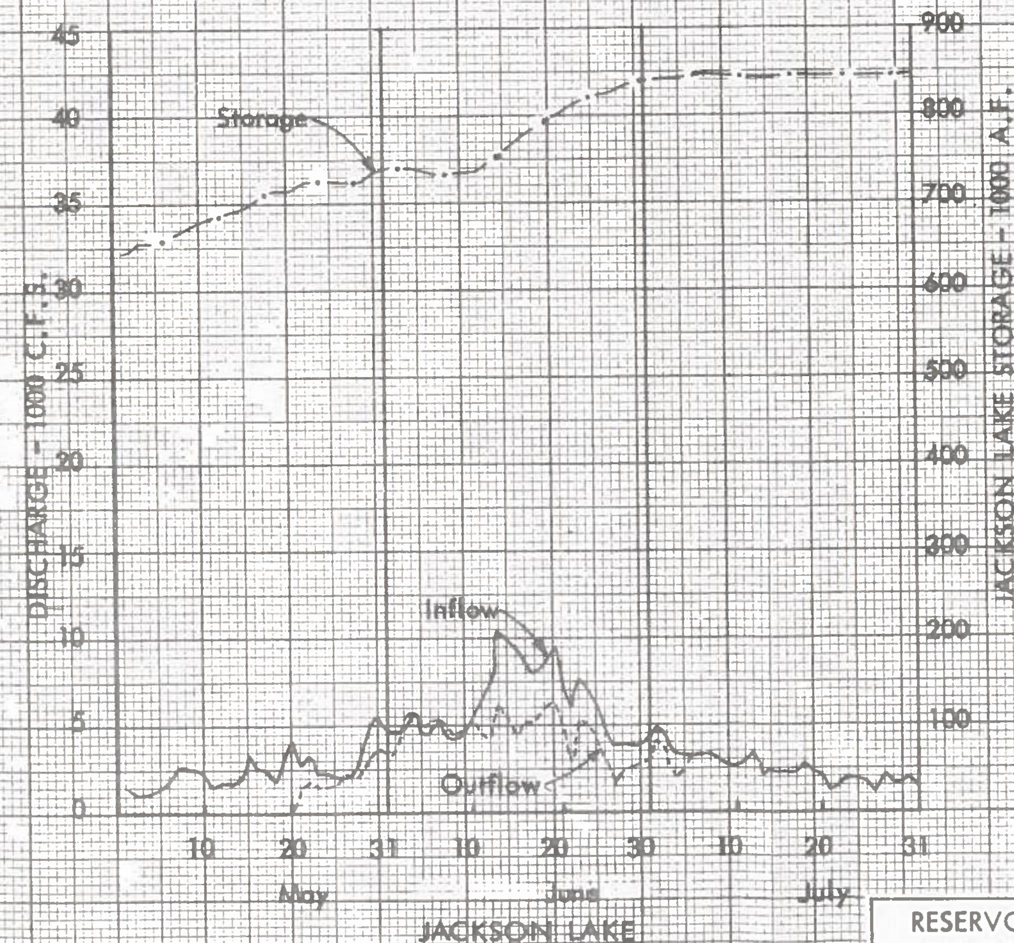


RESERVOIR REGULATION MANUAL
PALISADES DAM AND RESERVOIR
REGULATION OF STANDARD
PROJECT FLOOD
U.S. Army Engr. Dist., Walla Walla
Water Control Section
Prepared: K.W.W. Date: Feb 1958



NOTES:

1. Flood regulation at Jackson Lake is result of maintaining 25% of total space in that reservoir.
2. Total natural May - July volume at Palisades is 2,637,100 A.F.
3. Regulation based on assumed periodic forecasts of flow equal to recorded flows.



RESERVOIR REGULATION MANUAL
PALISADES DAM AND RESERVOIR

REGULATION OF 1953 FLOOD

U.S. Army Engr. Dist., Walla Walla
Water Control Section
Prepared: K.W.W. Date: Feb 1958

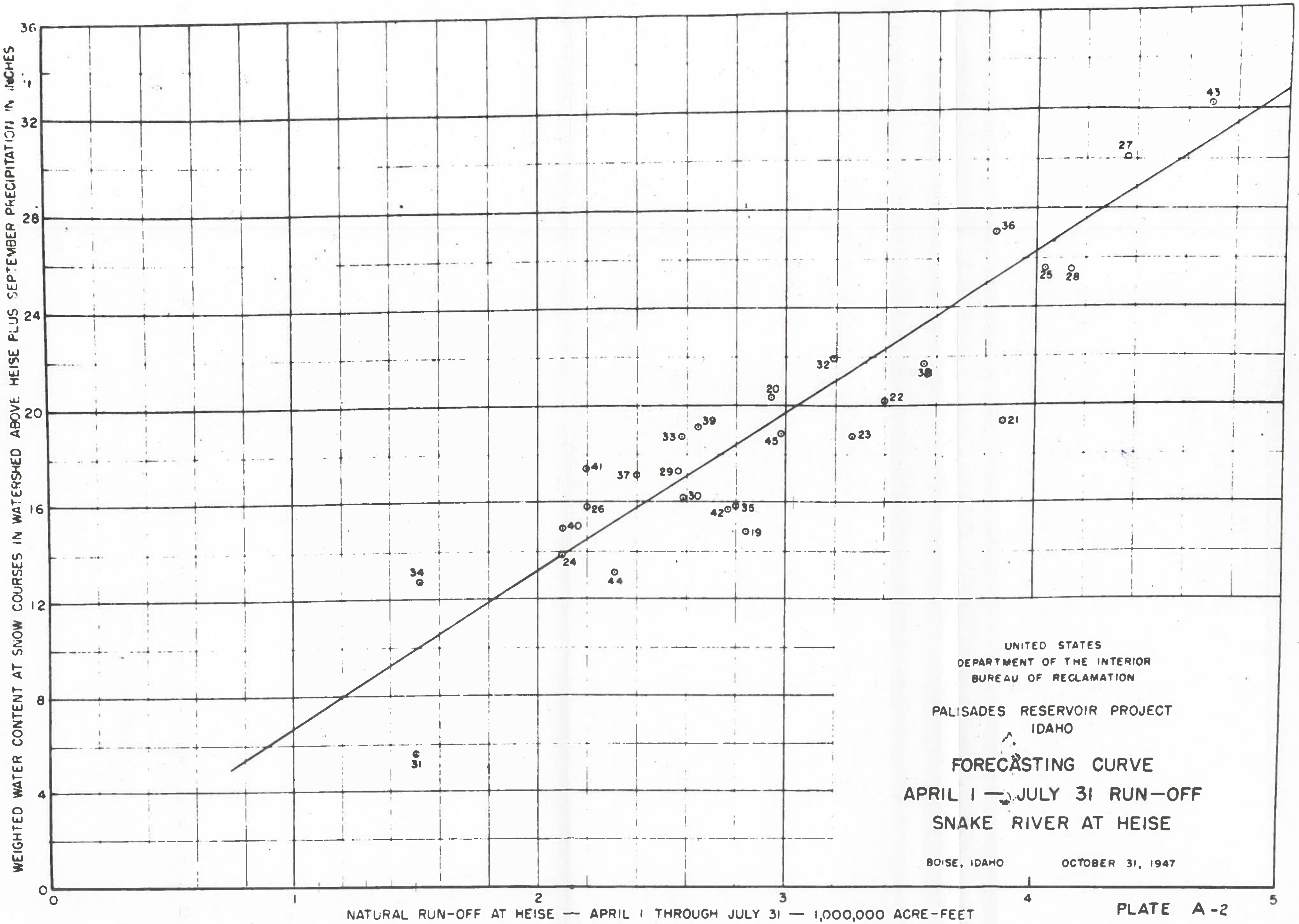
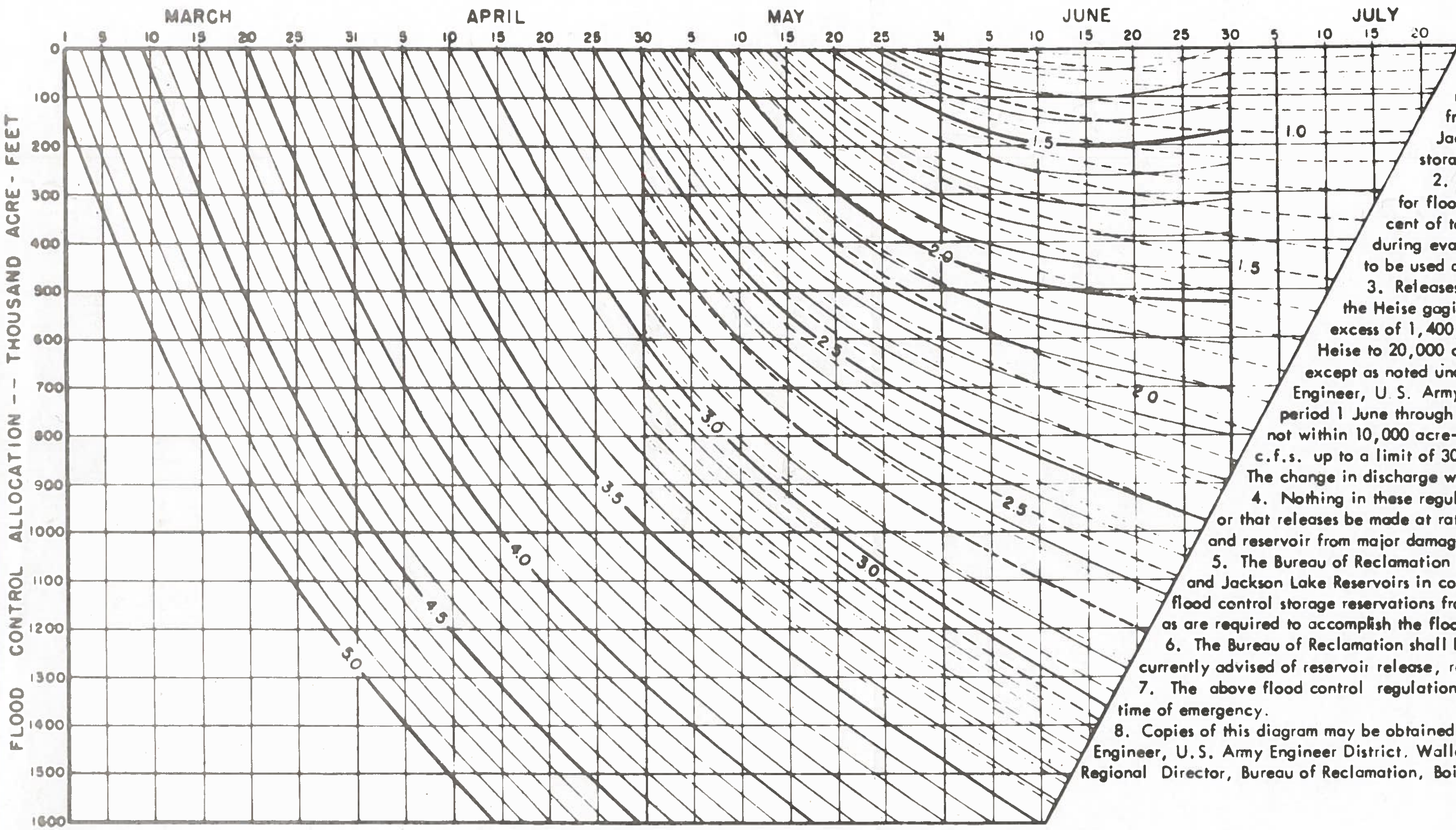

WEIGHTED WATER CONTENT AT SNOW COURSES IN WATERSHED ABOVE HEISE PLUS SEPTEMBER PRECIPITATION IN INCHES
NATURAL RUN-OFF AT HEISE — APRIL 1 THROUGH JULY 31 — 1,000,000 ACRE-FEET
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
PALISADES RESERVOIR PROJECT
IDAHO
FORECASTING CURVE
APRIL 1 — JULY 31 RUN-OFF
SNAKE RIVER AT HEISE
BOISE, IDAHO
OCTOBER 31, 1947

PLATE A-2



NOTES

1. The minimum flood control storage reservation required or season is as indicated by the diagram. Parameter values are for run-off of Snake River at Heise in millions of acre-feet for the re from any given date to 31 July. A minimum of 200,000 acre-feet Jackson Lake will be held vacant until 1 May every year unless the storage should begin earlier to insure filling that space.

2. Storage space in Palisades Reservoir and Jackson Lake combined for flood control purposes in accordance with this diagram. However, cent of total storage space will be made available in Palisades Reservoir. during evacuation and until natural inflow to Palisades first exceeds 20,000 to be used after natural inflow exceeds 20,000 c.f.s.

3. Releases from Palisades Reservoir shall be restricted to 20,000 c.f.s. or the Heise gaging station except: (A) when the forecasted run-off indicates tha excess of 1,400,000 acre-feet in Palisades and Jackson Lake combined is require Heise to 20,000 c.f.s., releases in excess of 20,000 c.f.s. will be made but not except as noted under item 7 or as may be agreed upon by the Bureau of Reclamatior Engineer, U.S. Army Engineer District, during extremely large floods and; (B) when t period 1 June through 31 July exceeds 2,500,000 acre-feet, and, when after 1 June th not within 10,000 acre-feet of the space required by this diagram, the release may be in c.f.s. up to a limit of 30,000 c.f.s. to the extent of 1,000 c.f.s. for each 5,000 acre-fe The change in discharge will be made in such manner as to minimize the adverse downstrear

4. Nothing in these regulations shall be construed to require dangerously rapid changes in or that releases be made at rates or in a manner that would be inconsistent with requirements fo and reservoir from major damage.

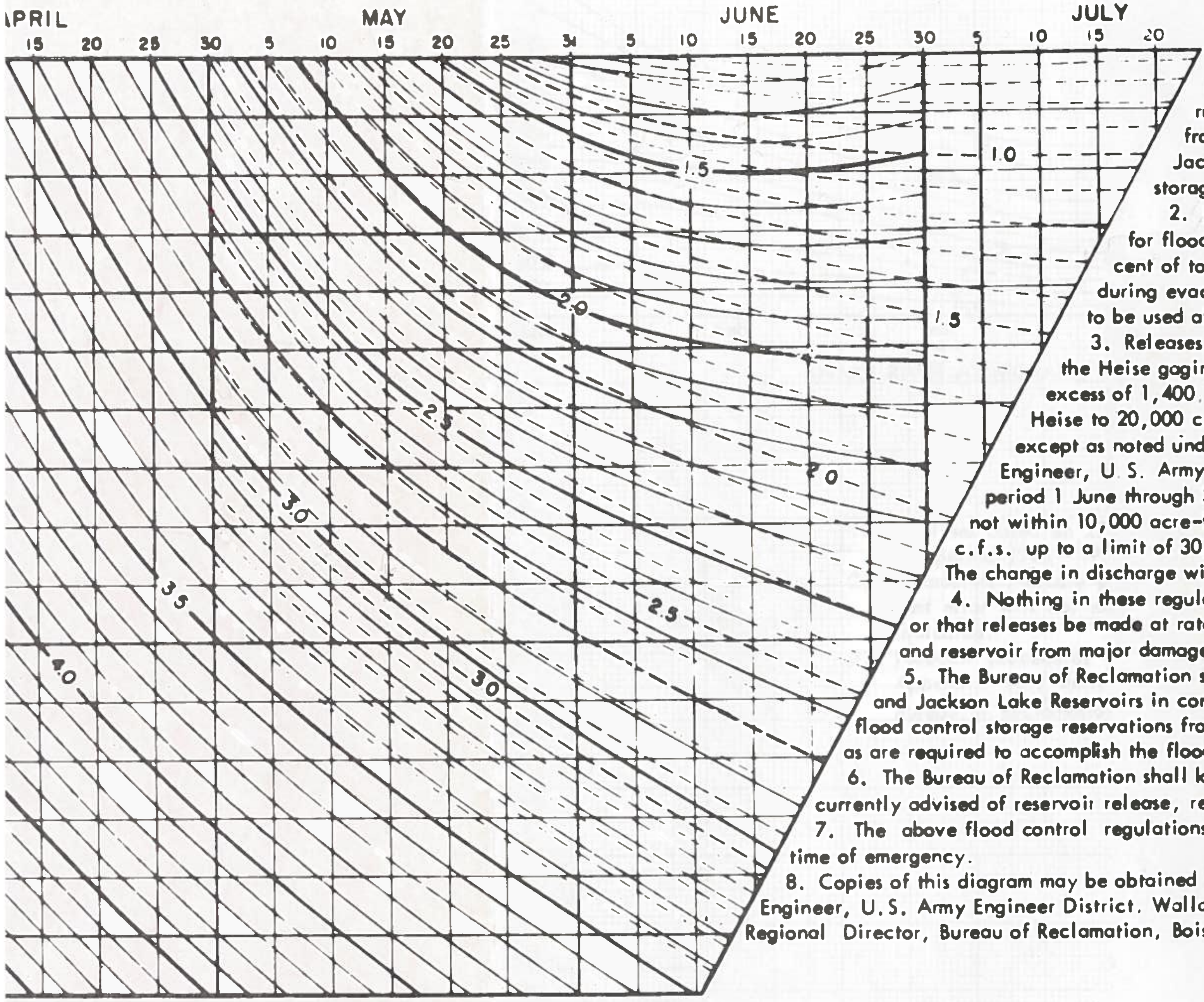
5. The Bureau of Reclamation shall procure current basic hydrologic data necessary for forecast and Jackson Lake Reservoirs in conformance with procedures mutually agreed to, make current dete flood control storage reservations from the diagram and make current calculations of permissible relec as are required to accomplish the flood control objectives.

6. The Bureau of Reclamation shall keep the District Engineer, U.S. Army Engineer District, in ch currently advised of reservoir release, reservoir storage and such other operating data as the District Engi

7. The above flood control regulations are subject to temporary modification by the District Engineer, time of emergency.

8. Copies of this diagram may be obtained from the offices of the District Engineer, U.S. Army Engineer District, Walla Walla, Washington, and the Regional Director, Bureau of Reclamation, Boise, Idaho.

PALISADES DA
Snake
FLOOD CONTROL STOR
Prepared Pursuant to
for Palisades Dam and
APPROVED [signature]
Commissioner
APPROVED [signature]
Major Ge
Effective Date May 12,



NOTES

1. The minimum flood control storage reservation required on any day of the flood season is as indicated by the diagram. Parameter values are forecasted natural flood run-off of Snake River at Heise in millions of acre-feet for the remainder of the season from any given date to 31 July. A minimum of 200,000 acre-feet of storage space in Jackson Lake will be held vacant until 1 May every year unless the forecast indicates that storage should begin earlier to insure filling that space.

2. Storage space in Palisades Reservoir and Jackson Lake combined shall be kept available for flood control purposes in accordance with this diagram. However, not less than 75 per cent of total storage space will be made available in Palisades Reservoir. Solid lines to be used during evacuation and until natural inflow to Palisades first exceeds 20,000 c.f.s. Dashed lines to be used after natural inflow exceeds 20,000 c.f.s.

3. Releases from Palisades Reservoir shall be restricted to 20,000 c.f.s. or less as measured at the Heise gaging station except: (A) when the forecasted run-off indicates that storage capacity in excess of 1,400,000 acre-feet in Palisades and Jackson Lake combined is required to control flows at Heise to 20,000 c.f.s., releases in excess of 20,000 c.f.s. will be made but not to exceed 30,000 c.f.s. except as noted under item 7 or as may be agreed upon by the Bureau of Reclamation and the District Engineer, U.S. Army Engineer District, during extremely large floods and; (B) when the forecasted run-off for the period 1 June through 31 July exceeds 2,500,000 acre-feet, and, when after 1 June the available space is not within 10,000 acre-feet of the space required by this diagram, the release may be increased above 20,000 c.f.s. up to a limit of 30,000 c.f.s. to the extent of 1,000 c.f.s. for each 5,000 acre-feet of deficient storage. The change in discharge will be made in such manner as to minimize the adverse downstream effects.

4. Nothing in these regulations shall be construed to require dangerously rapid changes in magnitudes of releases, or that releases be made at rates or in a manner that would be inconsistent with requirements for protecting the dam and reservoir from major damage.

5. The Bureau of Reclamation shall procure current basic hydrologic data necessary for forecasting inflows to Palisades and Jackson Lake Reservoirs in conformance with procedures mutually agreed to, make current determinations of required flood control storage reservations from the diagram and make current calculations of permissible releases from the reservoirs as are required to accomplish the flood control objectives.

6. The Bureau of Reclamation shall keep the District Engineer, U.S. Army Engineer District, in charge of the locality currently advised of reservoir release, reservoir storage and such other operating data as the District Engineer may request.

7. The above flood control regulations are subject to temporary modification by the District Engineer, if found necessary in time of emergency.

8. Copies of this diagram may be obtained from the offices of the District Engineer, U.S. Army Engineer District, Walla Walla, Washington, and the Regional Director, Bureau of Reclamation, Boise, Idaho.

PALISADES DAM AND RESERVOIR

Snake River, Idaho

FLOOD CONTROL STORAGE RESERVATION DIAGRAM

Prepared Pursuant to Flood control Regulations for Palisades Dam and Reservoir (33 CFR 208)

APPROVED W A Dexheimer
Commissioner of Reclamation

APPROVED E. L. Itschner
Major General, Chief of Engineers

Effective Date May 12, 1958 File No SN-902-1/1

APPENDIX A

ORIGINAL OPERATING PLAN - 1948

Palisades Project

The Bureau of Reclamation plans to construct and operate Palisades Reservoir for the optimum multiple-purpose use of the entire storage of 1,400,000 acre-feet. To attain this objective, the storage below elevation 5,497 feet mean sea level, approximating 200,000 acre-feet, will be reserved for dead storage and allocated exclusively to the production of hydroelectric power and the maintenance of a permanent pool for the preservation and propagation of fish and wildlife. The remainder of the storage capacity in the amount of 1,200,000 acre-feet will be operated in the joint interests of irrigation and flood control governed by the best available runoff forecasts.

The Bureau of Reclamation will forecast from time to time during the period from 1 February to 31 July of each year, on the basis of precipitation, temperature, snow survey and runoff data, the volume of runoff that may be expected in the drainage area tributary to the Snake River above Heise, Idaho. To the extent that such services can be arranged for by cooperative agreements, the Bureau of Reclamation will make the forecasts hereunder after consultation with the Reclamation Engineer of the State of Idaho or his authorized representative, and the Chief of Engineers or his authorized representative. To facilitate the forecasting of runoff the Bureau of Reclamation will expand the existing hydrologic network and will establish and operate continuously a system for the efficient assembling and analyzing of the basic data. Until such time as a better method of forecasting be devised, the forecasts will be based upon estimates of area-elevation weighted snow water content as determined from periodic snow surveys on or about 1 February, 1 March, 1 April, and 1 May, and upon precipitation for September of the preceding year. A sample curve of the correlation between weighted snow water content on 1 April of a given year plus precipitation of the preceding September and the resultant runoff from 1 April to 31 July, inclusive, of the year in question, is shown on Plate II.

To the end of accomplishing the optimum multiple-use of the reservoir, the Bureau of Reclamation, beginning with the first year the reservoir is put into operation, will operate the reservoir on the basis of the forecasted runoff as nearly as practicable in accordance with the following plan:

1. For the purpose of rules and regulations to be prescribed by the Secretary of the Army under Section 7 of the Flood Control Act of 1944 (58 Stat. 887, 890) the storage space allocated to flood control is defined as follows:

> It is the reservoir space which, using the governing forecast of flood runoff for the year, according to the curves shown on Plate I is required to the end of controlling the forecasted flood volume from the time in that year that reservoir inflow first exceeds 20,000 second-feet through the succeeding 31 July releases from the reservoir during that period such that the flow at the Heise gage will not exceed 20,000 second-feet, insofar as this control can be accomplished with a reservoir capacity not exceeding 1,200,000 acre-feet. The governing forecast of flood volume for each year is the forecast made as of the day when reservoir inflow in that year first exceeds 20,000 second-feet.

The parameters shown on Plate I, empirically derived from floods of record, are enveloping curves of the storage requirements for various volumes of total forecast runoff from any given date to 31 July. The reservoir capacity required to control the flood to a discharge of 20,000 second-feet (or less) below the dam is indicated by the ordinate of the parameter corresponding to the forecasted runoff on the date when the inflow to the reservoir exceeds 20,000 second-feet.

2. During the period of each year from the date of the first forecast about 1 February to the date of making the governing forecast for that year (approximately the middle of May) herein designated as the evacuation period, the reservoir will be operated in such a manner that the required reservoir level as determined by the parameters on Plate I at the time inflow to the reservoir exceeds 20,000 second-feet can be attained with minimum practicable rates and fluctuations of discharge. The rate of discharge during the evacuation period would be determined as follows: The reservoir level required on or about 15 May (the date on which inflows normally may be expected to exceed 20,000 second-feet) would be estimated by use of the parameters on Plate I and a 15 May forecast would be derived by deducting probable minimum inflows for the intervening period from the date of periodic forecasts beginning on 1 February. The reservoir levels thus estimated would comprise tentative allocations of flood control space at which to aim the evacuation procedure. The rate of discharge then would be selected as that required to release the probable maximum inflow for the period between date of forecast and 15 May plus the evacuation necessary to attain the required reservoir level indicated by the latest tentative allocation.

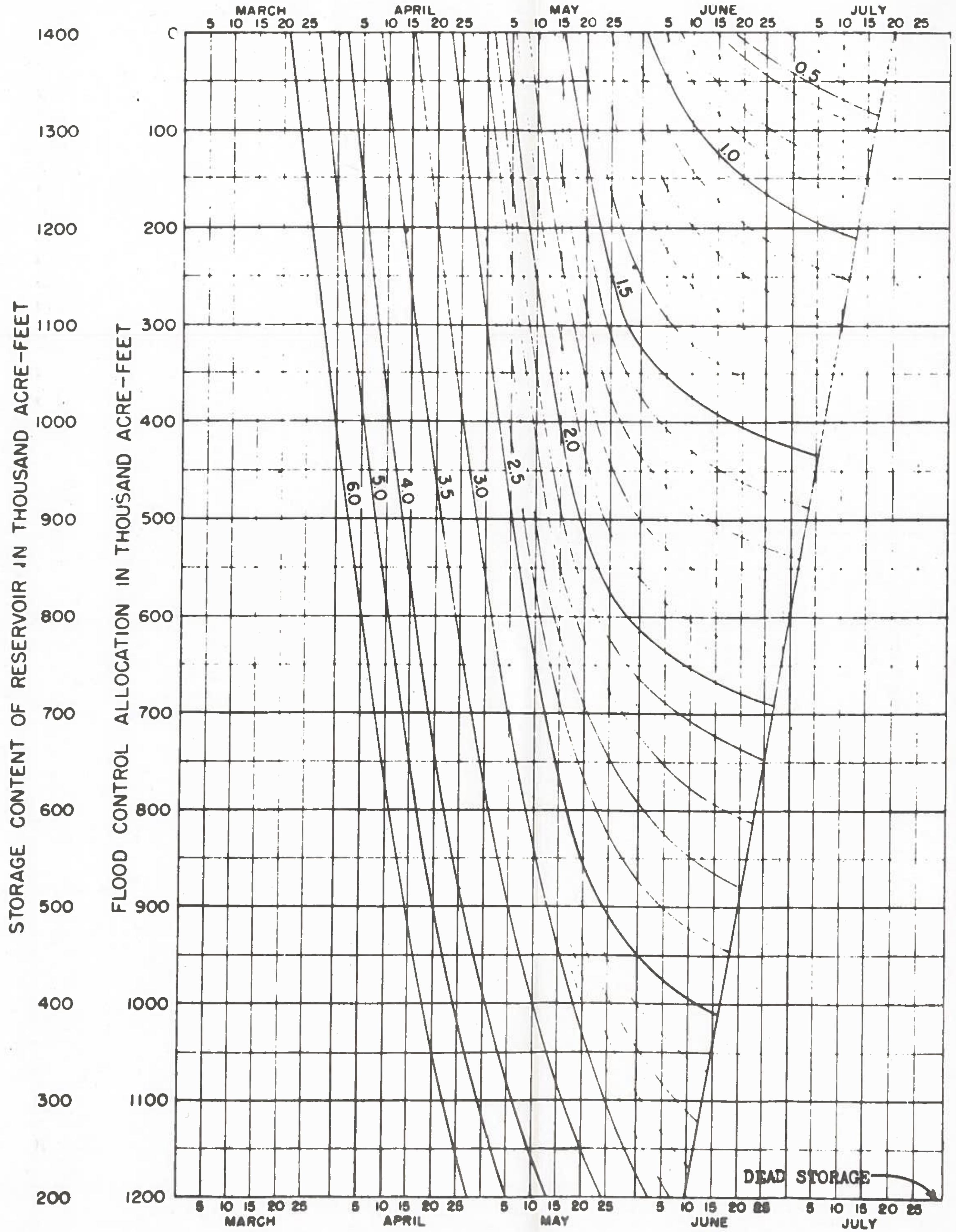
3. From the date of the governing forecast each year through 31 July of that year herein designated the filling period, the reservoir shall be operated in such a manner that

the reservoir content shown on the chart (Plate I) will be maintained but not be exceeded except when storage above those levels is required to limit the flows to 20,000 second-feet at Heise. When the forecasted runoff indicates a required storage capacity in excess of the total active storage capacity of the reservoir, releases in excess of 20,000 second-feet will be made as required but at rates not to exceed 30,000 second-feet, except as indicated in paragraph 4 below.

4. Whenever the pool shall have risen above elevation 5,620, the full reservoir level, due to an extraordinary excess of inflow over the maximum releases permitted under paragraph 1 or is expected to rise above that level within the next 48 hours, releases may be increased temporarily above those previously specified, so as to minimize the peak rate of release and to draw the reservoir down to the full reservoir level as rapidly as possible. However, the maximum rate of such extraordinary release shall not exceed the estimated maximum mean daily rate of inflow to the reservoir during the period when the reservoir level is above elevation 5,620.

5. All reservoir releases made as herein provided are subject to the condition that no releases shall be made at rates or in a manner that would be inconsistent with whatever operating rules and regulations are laid down by the Chief Engineer of the Bureau of Reclamation for the purpose of protecting the dam and reservoir from damage.

If operating experience indicates the desirability therefor, the Secretary of the Interior may, after consultation with the Secretary of the Army, modify from time to time the operating plan herein described with respect to the amount of space allocated to flood control each year on the basis of advance forecasts as to runoff, but no modification which would result in a substantial change in the control of floods herein stated to be the objective of the original operating plan shall be made without the concurrence of the Secretary of the Army. Revisions of the rules and regulations prescribed under the Flood Control Act of 1944 will be made by the Secretary of the Army if, in his judgment, these are requisite because of such modifications in flood control space allocations. Modifications in the operating plan not requiring the concurrence of the Secretary of the Army shall not be the occasion for a revision of the conclusions originally reached as to the flood control benefits to be realized from the original operating plan or of the formula adopted for the allocation of construction costs to flood control purposes.



NOTES:

1. Parameters are anticipated flood run-off of Snake River at Heise in millions of acre-feet for the remainder of the season from any given date to July 31. The anticipated run-off is the forecasted flow at Heise less the storage capacity available in Jackson Lake. A minimum of two hundred thousand acre-feet of storage space in Jackson Lake will be held vacant until May 1 of every year unless the forecast indicates that storage should begin earlier to insure filling that space.

2. Storage reservation based upon a release which would give a maximum regulated flow at Heise of twenty thousand second-feet.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PALISADES RESERVOIR PROJECT
IDAHO

ALLOCATION OF FLOOD CONTROL SPACE

BOISE, IDAHO OCTOBER 31, 1947

PLATE A-1

APPENDIX B

TITLE 33--NAVIGATION AND NAVIGABLE WATERS

Chapter II--Corps of Engineers
Department of the Army

PART 208--FLOOD CONTROL REGULATIONS

PALISADES DAM AND RESERVOIR, SNAKE RIVER, IDAHO

Pursuant to the provisions of section 7 of the Act of Congress approved December 22, 1944 (58 Stat. 890; 33 U. S. C. 709), the following #208.91 is hereby prescribed to govern the use and operation of Palisades Dam and Reservoir on Snake River, Idaho, for flood control purposes.

#208.91 Palisades Dam and Reservoir, Snake River, Idaho. The Bureau of Reclamation shall operate Palisades Dam and Reservoir in the interests of flood control as follows:

(a) Storage space in Palisades Reservoir and Jackson Lake combined shall be kept available for flood control purposes in accordance with the Flood Control Storage Reservation Diagram currently in force. Not less than 75 percent of the total flood control space shall be made available in Palisades Reservoir.

(b) Releases from Palisades Reservoir shall be restricted to quantities which will not cause downstream flows at the Heise gaging station to exceed 20,000 cubic feet per second, insofar as this control can be accomplished with combined reservoir capacity not exceeding 1,400,000 acre-feet in Palisades Reservoir and Jackson Lake.

(c) When the total active capacity of the reservoir has been evacuated and when the forecasted runoff indicates that storage capacity in excess of 1,400,000 acre-feet may be required for Palisades Reservoir and Jackson Lake combined to control the flows at Heise gaging station to 20,000 cubic feet per second, releases in excess of 20,000 cubic feet per second prior to June 1 will be planned on the basis of the following rule curve:

May 1-July 31 forecasted volume (acre-feet):	Required discharge[1] (c.f.s.)
Less than 4,100,000	20,000
4,100,000	23,000
4,300,000	24,000
4,600,000	25,000
4,900,000	26,000
5,300,000	27,000
5,600,000	28,000
6,000,000	29,000
6,300,000 or larger	30,000

[1]Applicable only when exceeded by natural inflow.

(d) When the forecasted runoff for the period June 1 through July 31 exceeds 2,500,000 acre-feet, and when, after June 1, the available space is not within 10,000 acre-feet of the space required by the Flood Control Storage Reservation Diagram currently in force, the releases from the reservoir may be increased so that the flow at Heise gaging station will exceed 20,000 c.f.s. up to a limit of 30,000 c.f.s. to the extent of 1,000 c.f.s. for each 5,000 acre-feet of deficient storage space, except that the release shall not be greater than the natural inflow. The change in discharge will be made in such manner as to minimize the adverse downstream effects.

(e) In no case will releases be made which will cause the flow of Snake River at Heise gaging station to exceed 30,000 c.f.s. except as may be agreed upon by the Corps of Engineers and Bureau of Reclamation in the case of exceedingly large floods or as provided in paragraph (f) or (h) of this section.

(f) The flood control regulations of the section are subject to temporary modification by the District Engineers, Corps of Engineers, if found necessary in time of emergency. Requests for and action on such modification may be made by any available means of communication, and the action taken by the District Engineer shall be confirmed in writing under date of the same day to the Office of the Regional Director of the Bureau of Reclamation in charge of the locality.

(g) The Flood Control Storage Reservation Diagram currently in force as of the promulgation of this section is that dated May 12, 1958, File No. SN-902-1/1, and is on file in the Office of the Chief of Engineers, Department of the Army, Washington, D. C., and in the Office of the Commissioner, Bureau of Reclamation, Washington, D. C. Revisions of the Flood Control Storage Reservation Diagram may be developed from time to time as necessary by the Corps of Engineers and the Bureau of Reclamation. Each such revision shall be effective upon the date specified in the approval thereof by the Chief of Engineers and the Commissioner of Reclamation, and, from that date until replaced, shall be the Flood Control Storage Reservation Diagram currently in force for purposes of this section. Copies of the Flood Control Storage Reservation Diagram currently in force shall be kept on file in and may be obtained from the office of the District Engineer, Corps of Engineers, and the Regional Director, Bureau of Reclamation, in charge of the locality.

(h) In the event that the reservoir level rises above elevation 5620 at the dam (top of spillway gates), care shall be taken that the maximum subsequent release from the reservoir does not exceed the corresponding rate of reservoir inflow.

(i) Nothing in the regulations in this section shall be construed to require dangerously rapid changes in magnitude of releases, or that releases be made at rates or in a manner that would be inconsistent with requirements for protecting the dam and the reservoir from major damage.

(j) The Bureau of Reclamation shall currently procure basic hydrologic data, make determinations of required flood control reservation from the Flood Control Storage Reservation Diagram currently in force and make calculations of permissible releases from the reservoir as are required to accomplish the flood control objectives prescribed in this section.

(k) The Bureau of Reclamation shall keep the District Engineer, Corps of Engineers, Department of the Army, in charge of the locality, currently advised of hydrologic data and other operating criteria which affect the schedule of operation. Also, the Bureau of Reclamation shall keep the Watermaster, Water District No. 36, acting for the Department of Reclamation, State of Idaho, currently advised of reservoir releases.

(Regs., May 12, 1958, ENGWE) (Sec. 7, 58 Stat. 890; 33 U. S. C. 709)

(SEAL)

HERBERT M. JONES
Major General, U. S. Army,
The Adjutant General

(F. R. Doc. 58-4387; Filed, June 10, 1958; 8:45 a.m.)

Copies from Federal Register dated 11 June 1958

APPENDIX C

FORECASTS OF RUNOFF - SNAKE RIVER AT HEISE

1955 Forecast Study - Upper Snake River
Revised

January through July forecasts of "Inflow to Jackson Lake" and the "Inflow Between Moran and Heise" are determined from two groups of equations: (1) An early set, with precipitation as the primary forecasting parameter to be used before snow data become available for forecasts on January 1, February 1, and March 1, 1/ and (2) a later set of equations with the snow variable as the primary forecasting parameter to be used for April 1, May 1, June 1, and July 1 forecasts.

It should be noted that each forecast equation was derived from information available on the latest date shown in the subtitle. Forecasts for the earlier dates are obtained by substituting long-term average values for unavailable information.

The forecast of the Snake River at Heise is the sum of forecasts of inflow to Jackson Lake and the inflow between Moran and Heise.

Forecast of Inflow to Jackson Lake

January and February Forecast Equation (F55-2)

$$Y = 26.36X_1 + 66.43X_2 - 15.21X_3 + 205.99$$

X_1 = Accumulated precipitation for September and October in inches, taken as average of measurements at Moran and Snake River.

1/ The inflow to Jackson Lake forecast on March 1 is an exception, since the April equation is used on March 1 by converting March 1 snow measurements to April 1 snow and substituting additional long-term averages where necessary.

X_2 = Accumulated precipitation for November, December and January in inches, taken as average of measurements at Moran and Snake River.

X_3 = The average variation of daily maximum temperatures above 35^o at Moran for the preceding month of December measured in average degree days.

Y = Forecast of inflow to Jackson Lake in 1,000 acre-feet for January 1 - July 31. February 1 - July 31 inflow forecast obtained by deducting recorded January inflow.

March, April, May, June, July Forecast Equation (A55-1)
(Inflow to Jackson Lake)

$$Y = 21.51X_1 + 13.40X_2 + 34.90X_3 - 1.20X_4 - 66.84$$

X_1 = Snow water content on April 1 in inches taken as the average measured at Aster Creek, Coulter Creek, Glade Creek, Huckleberry Divide and Lewis Lake Divide. (On March 1 use March 1 snow water content plus 3.75 inches)

X_2 = Accumulated precipitation at Snake River for period September through December, minus October through March inflow to Jackson Lake measured in inches. (Note: 1" over watershed = 43,520 acre-feet.) On March 1 use long-term average inflow for March.

X_3 = The average of precipitation stations Moran and Snake River for April + 2/3 May + 1/3 June measured in inches. Use long-term average figures when current data not available. On March 1 and April 1 use 4.01 inches. (April = 1.93" 2/3 May = 1.38" and 1/3 June = 0.70")

X_4 = December plus March maximum temperatures above 35^o at Moran in average degree days. On March 1 use long-term average for March of 4.34.

Y = Forecast of inflow to Jackson Lake in 1,000 acre-feet for April 1-July 31. Add average flow for March to obtain March 1-July 31 forecast of volume.

Forecast of Inflow Between Moran and Heise

January, February, and March Forecast Equation (M55-2)

$$Y = 246.96X_1 + 198.88X_2 - 121.96X_3 + 1017.40$$

X_1 = Accumulated precipitation for October, November and December in inches, taken as the average of measurements at Bedford, Jackson, Moran and Snake River, minus the runoff between Moran and Heise for October through December, measured in inches. 1" over the watershed = 262,613 acre-feet.

X_2 = Accumulated precipitation for January and February in inches, taken as the average of measurements at Bedford, Jackson, Moran, and Snake River. Use 2.45 as average of 4 stations for January and 2.25 for February.

X_3 = Average variation of daily maximum temperatures above 35° at Moran for the preceding December in average degree days.

Y = Forecast of inflow between Moran and Heise in 1,000 acre-feet for the period January 1-July 31, inclusive. (Forecasts of inflow for any date after January 1 estimated by subtracting actual flows.)

<u>April, May, June, July Forecast Equation (A55-1) (Between Moran and Heise)</u>

$$Y = 115.54X_1 + 15.04X_2 + 50.35X_3 + 19.43X_4 - 25.92X_5 + 321.3$$

X_1 = Snow water content on April 1 in inches taken as average measured at Togwotee Pass, Turpin Meadows, Yellowjacket, East Rim Divide, Blackrock and Four Mile Meadows.

X_2 = Snow water content on April 1 in inches taken as average measured at Afton Ranger Station, CCC Camp, Cottonwood Lake, Deadman Ranch and Grover Park Divide.

X_3 = Accumulated precipitation for October, November, and December taken as the average of measurements for Grover 2S, Bedford, Jackson, and Moran, minus 1/5 (November through March runoff between Moran and Heise) measured in inches. (1" over the watershed = 262,613 acre-feet.)

X_4 = April + 2/3 May + 1/3 June precipitation in inches taken as the average of measurements at Bedford, Jackson and Moran. On April 1 use 3.39 inches. (April = 1.46, 2/3 May = 1.25", 1/3 June = .69")

X_5 = The average variation of daily maximum temperatures above 35° at Moran for the preceding December and March measured in average degree days.

Y = Forecast of inflow between Moran and Heise in 1,000 acre-feet for the period April 1-July 31, inclusive.

TABLE C-1

FORECAST RESULTS

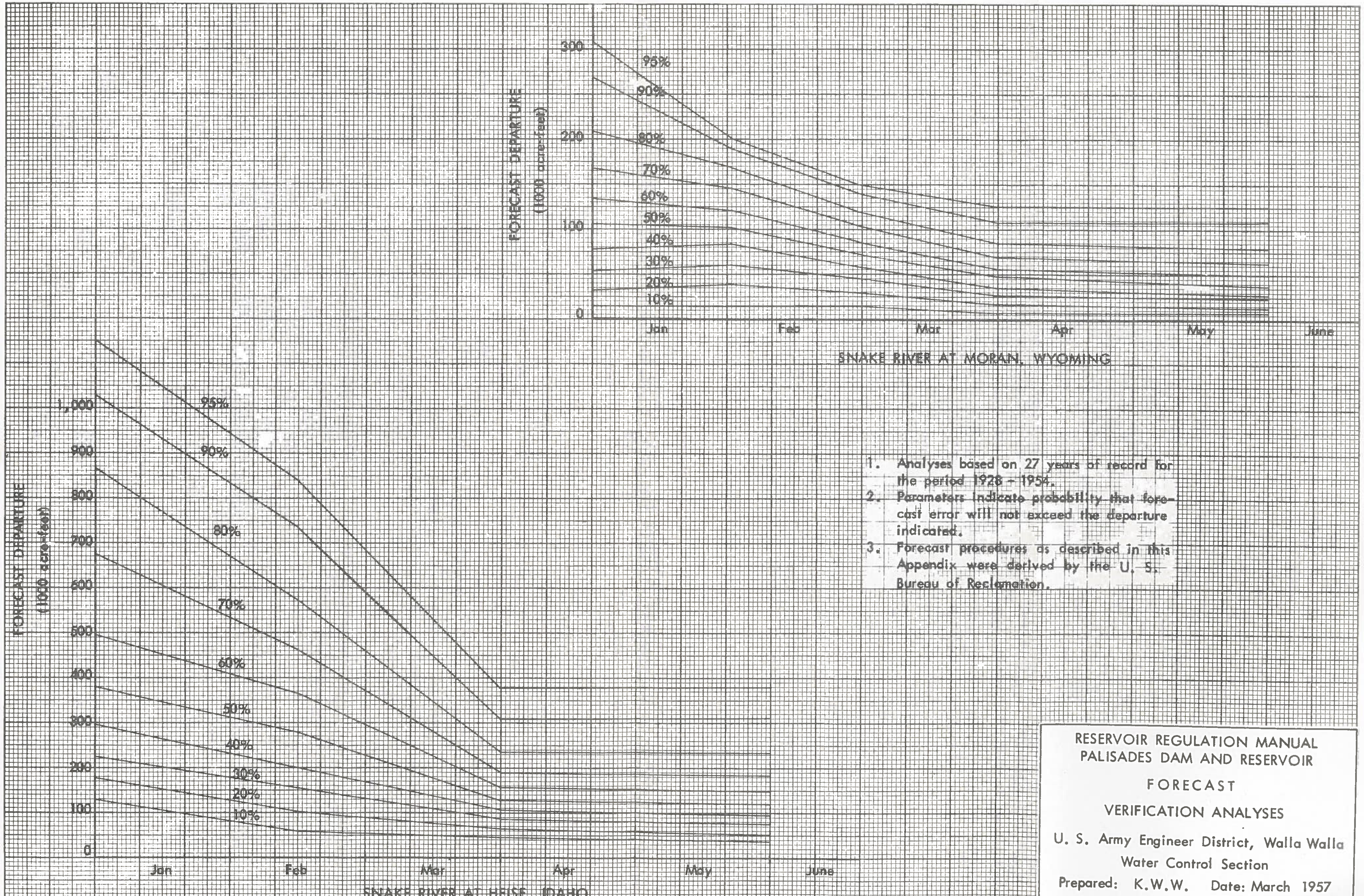
Snake R. Near Heise, Idaho

Date	May - July Volumes *		
	Forecast	Actual	Forecast Error
1928	3645	3793	-148
29	2473	2355	+118
1930	1844	2143	-299
31	1282	1264	+ 18
32	2746	2942	-196
33	2546	2358	+188
34	1271	1173	+ 98
1935	2613	2605	+ 8
36	3468	3425	+ 43
37	2447	2192	+255
38	2997	3145	-148
39	2287	2175	+112
1940	1740	1769	- 29
41	2292	1961	+331
42	2125	2320	-195
43	4087	3909	+178
44	2042	2085	- 43
1945	2651	2781	-130
46	2446	2742	-296
47	3024	3082	- 58
48	2717	2864	-147
49	3249	2832	+417
1950	3582	3730	-148
51	3586	3607	- 21
52	3352	3286	+ 66
53	2658	2631	+ 27
54	3175	3076	+ 99

Snake R. at Moran, Wyoming

Date	May - July Volumes *		
	Forecast	Actual	Forecast Error
1928	855	984	-129
29	569	578	- 9
1930	538	493	+ 45
31	361	344	+ 17
32	791	718	+ 73
33	716	620	+ 96
34	355	346	+ 9
1935	738	654	+ 84
36	890	759	+131
37	720	558	+162
38	846	816	+ 30
39	698	576	+122
1940	619	543	+ 76
41	569	495	+ 74
42	574	570	+ 4
43	991	993	- 2
44	457	538	- 81
1945	644	625	+ 19
46	636	668	+ 69
47	846	809	+ 37
48	710	736	- 26
49	903	775	+128
1950	811	830	- 19
51	830	783	+ 47
52	736	809	- 73
53	716	661	+ 55
54	872	838	+ 34

* All values in 1000 A.F.



1. Analyses based on 27 years of record for the period 1928 - 1954.
2. Parameters indicate probability that forecast error will not exceed the departure indicated.
3. Forecast procedures as described in this Appendix were derived by the U. S. Bureau of Reclamation.

RESERVOIR REGULATION MANUAL
PALISADES DAM AND RESERVOIR

FORECAST

VERIFICATION ANALYSES

U. S. Army Engineer District, Walla Walla
Water Control Section
Prepared: K.W.W. Date: March 1957