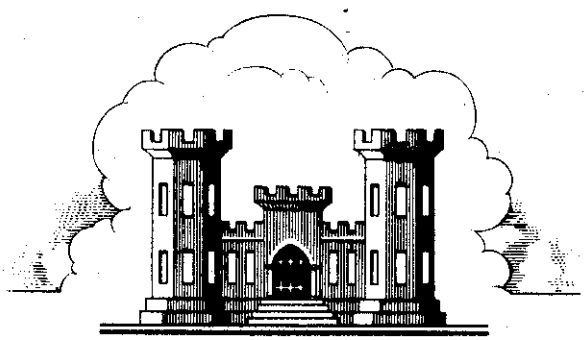
LADM 1110-2-1

MOJAVE RIVER BASIN, CALIFORNIA

RESERVOIR REGULATION MANUAL

FOR

MOJAVE RIVER DAM



U. S. ARMY ENGINEER DISTRICT, LOS ANGELES
CORPS OF ENGINEERS

AUGUST 1974
REVISED SEPTEMBER 1985

DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION, CORPS OF ENGINEERS
630 Sansome Street, Room 720
San Francisco, California 94111-2206

REPLY TO
ATTENTION OF:

CESPD-ED-W (1110-2-240b)

MAR 20 1991

MEMORANDUM FOR Commander, Los Angeles District
Commander, Sacramento District

SUBJECT: Planned Deviations from Approved Water Control Plans

1. All planned deviations from approved water control plans for reservoir projects within the South Pacific Division must be coordinated with the Coastal Engineering and Water Management Division at CESPD. Approval must be given prior to implementation of the deviation.

2. Emergency deviations do not require prior approval but coordination must still be made as soon as is practical.

ROGER E. YANKOPE
Brigadier General, U.S. Army
Commanding

SPDED-H (30 Aug 1974) 1st Ind
SUBJECT: Reservoir Regulation Manual for Mojave River Dam, Mojave River Basin, California

DA, South Pacific Division, Corps of Engineers, 630 Sansome Street Room 1216, San Francisco, California 94111 16 October 1974

TO: HQDA (DAEN-CWE-Y), WASH DC 20314

Approval of the subject regulation manual is recommended.

FOR THE DIVISION ENGINEER:

JOHN W. GERHART
Chief, Engineering Division

1 Incl
wd 2 cys

DAEN-CWE-Y (30 Aug 74) 2d Ind

DA, Office of the Chief of Engineers, Washington, D. C. 20314 29 Oct 74

TO: Division Engineer, South Pacific (SPDED-H)

Subject reservoir regulation manual is approved as recommended.

FOR THE CHIEF OF ENGINEERS:

for Jack R. Thompson
HOMER B. WILLIS
Chief, Engineering Division
Directorate of Civil Works

wd all incl

SPDED-H 3rd Ind

Division Engineer, South Pacific 4 Nov 74

To: District Engineer, Los Angeles
ATTN: SPLCO-O

J. W. G.

SPLCO-O

24 December 1974

SUBJECT: Reservoir Regulation Manual for Mojave River Dam, Mojave River Basin, California

Division Engineer, South Pacific
ATTN: SPDED-H

1. Reference your letter dated 16 Oct 74, above subject.

2. Inclosed are four copies of the replacement sheets per request contained in paragraph 2 of referenced letter for your files and OCE.

3. The location of Deep Creek Stream Gaging Station has been changed, therefore, discharge rating curve published in previous copy is no longer applicable (see text).

FOR THE DISTRICT ENGINEER:

R. P. YOUNG, Chief
Construction-Operations Division

1 incl (quad)
as

CF: Res Reg Sec

RPY
YOUNG

LAND

PS
SIENKIEW
/ebr/564

MOJAVE RIVER DAM

LADM 1110-2-1

US ARMY ENGINEER DISTRICT, LOS ANGELES

CORPS OF ENGINEERS

RESERVOIR REGULATION MANUAL

FOR

MOJAVE RIVER DAM

MOJAVE RIVER BASIN, CALIFORNIA

AUGUST 1974

REVISED SEPTEMBER 1985

R E S E V O I R R E G U L A T I O N M A N U A L

FOR

MOJAVE RIVER DAM

MOJAVE RIVER BASIN, CALIF.

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RESERVOIR REGULATION MANUAL
FOR
MOJAVE RIVER DAM
MOJAVE RIVER BASIN, CALIFORNIA

PERTINENT DATA

Construction completion date		May 1971
Drainage area	sq. miles	215
Reservoir:		
Elevation -		
Flood-control pool (spillway crest)	ft., m.s.l.	3,134
Spillway design surcharge level	ft., m.s.l.	3.165.4
Area -		
Spillway crest	acres	1,980
Spillway design surcharge level	acres	3,135
Top of dam	acres	3,390
Capacity, gross -		
Allowance for sediment	ac.-ft.	11,000
Spillway crest	ac.-ft.	89,700
Spillway design surcharge level	ac.-ft.	179,400
Top of dam	ac.-ft.	191,000
Embankment - type		Rolled earthfill
Top of elevation	ft., m.s.l.	3,172
Height above original streambed	ft.	200
Top length	ft.	106
Top lenth	ft.	1,255
Top width	ft.	20
Freeboard	ft.	6.6
Saddle dike - type		Rolled earthfill
Top elevation	ft., m.s.l.	3,172
Maximum height above existing ground	ft.	106
Top length	ft.	1,255
Top width	ft.	20
Freeboard	ft.	6.6
Spillway - type		Detached, broadcrested
Crest length	ft.	200
Crest elevation	ft., m.s.l.	3,134
Design surcharge	ft.,	31.4
Discharge at design surcharge	c.f.s.	105,400
Outlet conduit:		
Intake invert elevation	ft., m.s.l.	2,988
Type		"D" section
Height	ft.	17.75
Width	ft.	19.00
Length	ft.	974
Maximum capacity at spillway crest	c.f.s.	23,500

PERTINENT DATA--Continued

Reservoir Design Flood:
- Duration.....days.....3
- Total volume.....ac.-ft.....154,000
- Inflow peak.....c.f.s.....94,000
- Outflow peak.....c.f.s.....23,500
- Reduction in peak.....c.f.s.....70,500

Spillway Design Flood:
- Duration.....days.....5
- Total volume.....ac.-ft.....383,000
- Inflow peak.....c.f.s.....186,000
- Outflow peak.....c.f.s.....131,000
- Reduction in peak.....c.f.s.....54,700

R E S E R V O I R R E G U L A T I O N M A N U A L

FOR

MOJAVE RIVER DAM

MOJAVE RIVER BASIN, CALIF.

AUTHORITY

1. The authority for preparation of this manual is contained in ER 1110-2-240. Detailed instructions pertaining to the contents of the manual are contained in EM 1110-2-3600.

SCOPE

2. This manual contains (a) descriptive information pertaining to the project and its drainage area; (b) a description of the plan of operation; and (c) the basis of design for the project, including the reservoir design and spillway design flood routings.

BASIN INFORMATION

3. PHYSIOGRAPHIC CHRACTERISTICS. The Mojave River basin, which, in its entirety, comprises about 4,700 square miles, lies on the northern side of the rugged and precipitous San Bernardino Mountains (see pl. 1). Ninety-five percent of the entire Mojave River drainage area is desert, consisting primarily of alluvial plains sloping away from scattered, irregular, sharp-crested hills and mountains. The Mojave River Dam's drainage area consists of 215 mountainous square miles. This area is drained by 2 main tributaries, Deep Creek and West Fork Mojave River, which converge at the base of the San Bernardino Mountains to form the Mojave River. Nearly all the surface runoff that reaches the Mojave River is contributed by this relatively small area. The drainage area of Deep Creek comprises about 140 square miles. Elevations in the area range from more than 8,300 feet at Crafts Peak to about 3,000 feet at the mouth, while the average elevation of the area is about 5,800 feet. The main channel flows through a narrow canyon with an average gradient of 185 feet per mile. The drainage area of the West Fork Mojave River comprises about 75 square miles. Elevations in this area range from more than 6,100 feet at Strawberry Peak to about 3,000 feet at the mouth, with an average elevation of about 4,000 feet. The average gradient of the channel is 195 feet per mile. The upper reaches are very steep while the lower reaches are in a broad, relatively flat valley.

a. Geology. The mountainous headwaters of the Mojave River basin are composed, chiefly, of crystalline rock consisting of metamorphic rocks of both igneous and sedimentary origin. The mountain soil mantle is shallow (varying from 2 to 10 feet, with occasional large areas of rock outcrops), low in organic content, and well leached of soluble salts.

b. Vegetation. The vegetal cover of the mountain drainage area is segregated into zones, which are characterized by elevation and the precipitation distribution within the area. The plant associations found in the Mojave River drainage area, in order of increasing elevation are desert shrubs, desert woodland, chaparral and the yellow pine forest.

4. ECONOMIC DEVELOPMENT. The Mojave River Dam provides protection to essentially the entire downstream length of the Mojave River. Plates 2 through 6 identify the 44,200 acre overflow area of the standard project (reservoir design) flood prior to the construction of the dam. The potential value of damage that would be caused by this flood calculated to be $12,310,000 in 1965. Furthermore, the total value of property subject to inundation by this flood was estimated to be $65,800,000 in 1965. Most damage would occur to agricultural, military, and railroad property; however, considerable damage would also occur to highway, residential, business and industrial improvements. Nearly all damage in the overflow area would be prevented by the dam. The remaining damage would be due to downstream tributary inflows. The economic analysis of the project found in the "Design Memorandum No. 2, General Design for Mojave River Forks Reservoir" dated October 1966 indicates that this is a well-justified project with a benefit-cost ratio of 1.3 to 1.

5. EXISTING STRUCTURE AFFECTING RUNOFF. No other flood-control reservoirs are in the drainage area of the Mojave River Dam. Lake Arrowhead and Lake Gregory, with a combined drainage area of only 9.1 square miles, are both used almost exclusively for recreation. The Cedar Springs Dam and its associated Silverwood Lake are part of the California Aqueduct operated by the State of California Department of Water Resources and are used both for water supply and recreation. The drainage area tributary to the reservoir is 34.3 square miles, and the capacity of the reservoir is approximately 200,000 acre-feet at spillway crest. None of these reservoirs make any significant contribution to flood control.

6. CLIMATOLOGY. Climatic conditions (particularly temperature and precipitation) in the basin generally vary with elevation. Average annual temperatures vary inversely with elevation from 63°F in the desert (with extremes of 12° and 114°) to 51°F in the mountains (with extremes of -7° to 99°). Mean seasonal precipitation, however,

varies directly with elevation ranging from about 12 inches at the damsite to about 55 inches in the vicinity of Strawberry Peak (see pl. 7). Approximately 85 percent of this precipitation occurs during the months of December through March. Snowfall is common during the winter months above 5,000 feet. Here snow accumulates to depths great enough that the melt will slightly increase stream runoff. However, this does not substantially increase the peak flows. Summaries of pertinent data for three selected climatological stations are given in tables 1, 2 and 3. Most precipitation in the drainage area results from general winter storms that are associated with extratropical cyclones of North Pacific origin areas. Such storms commonly result in precipitation over large areas. Major storms that consist of one or more cyclonic disturbances occasionally last 4 days or more. Rainfall intensity and depth are usually greater in the mountains, because there, under most meteorological conditions, the moisture-laden air masses are deflected upwards, causing them to release much of their moisture as rain. Since the major winter storms release the greater part of their moisture in passing over the San Bernardino Mountains, winter rainfall intensities in the desert area are moderate. During major storms rainfall rates of flood-producing magnitude have extended over periods ranging from a few hours to about 2 days. These storms have resulted in the greatest floods of record. Thunderstorms, which may result in intense precipitation over areas of approximately 200 square miles or less occur occasionally, either in association with general storms or independently. Such storms seldom have a period of intense precipitation lasting longer than 2 or 3 hours. During the summer months, rainfall associated with tropical cyclones has occurred in this region, but such occurrences are infrequent and relatively unimportant in the flood history of the drainage area.

7. RUNOFF. Flow in Deep Creek is perennial while flow in the West Fork Mojave River is intermittent. During heavy storms, especially those occurring soon after other storms, the streamflow increases rapidly in response to rainfall. The shallow surface soils, impervious bedrock, fan-shaped collecting system, and steep gradients are also important factors in producing high runoff rates and rapid concentration of floodwaters. Runoff records for Deep Creek and West Fork Mojave River are contained in tables 4 and 5, respectively.

8. FLOODS. The largest floods that have occurred during the period for which runoff records are available (1904 to date), occurred in January 1910, January 1916, December 1921, March 1938, January 1943, January 1969, and February 1969. These floods resulted from storms of the general winter type. Summer floods,

usually caused by local storms of small areal extent, but occasionally by storms covering the whole basin, occur infrequently in the area.

9. FLOOD DAMAGES. The estimated damages from the march 1938 flood, which had a peak discharge of about 73,000 cubic feet per second on the main stream just below the junction of Deep Creek and the West Fork Mojave River, are estimated at $2,184,000. The January 1943 flood of 42,000 cubic feet per second caused damages of $204,000. Theses values have not been converted to present prices.

10. DOWNSTREAM CHANNEL. The San Bernardino County Flood Control District has given assurance to the Corps of Engineers that it will maintain a minimum channel capacity of 23,500 cfs (cubic feet per second) through improved areas downstream from the dam. Therefore, the reservoir design flood peak outflow of 23,500 cfs would not overflow the river in the improved areas. In addition, San Bernardino County is currently (1974) in the process of designating a floodway along the entire length of the Mojave River. The floodway is the natural channel of the river and that part of the adjoining flood plain used to carry a flood flow of 30,000 cfs or less. The floodway design flow is based on the 23,500 cfs release from the dam plus downstream tributary inflow. The floodway boundary is controlled by county zoning ordinances. Development is not permitted to encroach into the floodway. Some undeveloped lowlands adjacent to the floodway are subject to inundation by peak flows. Zoning ordinances require that future development in these areas be protected from the floodway design flow. At present the floodway has been established for the reach extending 63 miles downstream from the Mojave River Dam. Plates 2 through 6 illustrate the established floodway alignment. These plates also identify the area that was expected to be inundated by the reservoir design flood before the dam was constructed. The reach of the Mojave River extending 63 miles downstream from the dam has been studied in two Corps of Engineers flood plain information reports entitled "Mojave River (Vicinity of Barstow) San Bernardino County California, October 1968" and "Mojave River (Vicinity of Victorville) San Bernardino County California, April 1969." Both of these reports consider the effects of the Mojave River Dam related to the potential overflow areas and profiles of the standard project and intermediate regional (100-year-frequency) floods. Table 7 presents travel times for the peak reservoir design flood outflow to reach downstream points of interest.

PROJECT INFORMATION

11. AUTHORIZATION. The Mojave River Dam was authorized by act of Congress, Flood Control Act of 1960, Public Law 86-645, 86th Congress, 2d Session, approved 14 July 1960.

12. CONSTRUCTION HISTORY. Construction of Mojave River Dam began in March 1968. Work was completed in May 1971. The cost of the project through FY 71, not including expenditures by the local interests, was $15,667,800.

13. PURPOSE. The purpose of the project is to provide protection against floods to lands and improvements and public-access facilities. The property protected includes cultivated lands; industrial, residential and commercial property; utilities; highways; and railroads. The property protected extends about 125 miles along the Mojave River from the base of the San Bernardino Mountains to Silver Lake near Baker, California.

14. RELATIONSHIP TO COORDINATED PLAN OF DEVELOPMENT FOR THE BASIN. Consideration was given to both initial and ultimate development of public-access areas at the Mojave River Dam. The initial development provides facilities for camping, riding, hiking and picnicking, plus trailers and support facilities. The ultimate phase of public-access development will be provided by the recreation lessee. This will include facilities such as a golf course, shooting ranges, natural areas, and fishing areas.

15. DESCRIPTION. The project consists of Mojave River Dam and Flood-Control Basin on the Mojave River near Hesperia in San Bernardino County, California. A general plan of the project is shown on pl. 8, and a detailed description is contained in the following paragraphs.

16. DAM. The dam is a zoned, rolled-earthfill structure with a crest length of 2,223 feet, and a crest width of 20 feet. The top of the dam is at elevation 3,172. The maximum height above the original streambed is 200 feet. The slope of the upstream side of the embankment is 1 vertical on 2.5 horizontal, and the face is covered with an 18 inch layer of protective stone, while the downstream face has a slope of 1 vertical on 2.2 horizontal with a 12 inch layer of protective stone. Typical embankment sections are shown on pl. 9.

17. SADDLE DIKE. The saddle dike is also a zoned, rolled-earthfill structure with a crest length of 1,255 feet. Its elevation and crest width are the same as those of the dam structure. The slopes of both the upstream and downstream faces of the saddle dike are the same as those of the dam, but the upstream face has a 36 inch layer of protective stone while the layer on the downstream face remains at 12 inches. Typical saddle dike sections are shown on pl. 10.

18. OUTLET WORKS. The outlet works are located in the left abutment of the dam and consist of an approach channel with log rack, an ungated lined tunnel and an outlet channel. The plan, profile, and sections

of the outlet works are shown on pl. 11, and the outlet discharge curve is shown on pl. 12. A general description of the outlet works is contained in the following subparagraphs.

a. Approach Channel. The approach channel is 32 feet wide and about 160 feet long. It consists of about 60 feet of unlined trapezoidal channel, 100 feet of reinforced-concrete trapezoidal channel, and a steel log rack with 9-by-11.83-foot openings.

b. Tunnel. The tunnel is concrete lined and 974 feet long. The tunnel cross-section is 17.75 feet high by 19 feet wide with a semicircular roof of 9.5 foot radius. There is a 2.5 foot radius fillet at each right-angle corner of the cross-section. The invert elevation of the tunnel is 2,988 feet at the inlet portal and 2,967 feet at the outlet portal.

c. Outlet Channel. The outlet channel is 19 feet wide and about 128 feet long. It consists of 28 feet of reinforced-concrete rectangular channel (including flip bucket and cutoff walls at downstream end) and about 100 feet of unlined trapezoidal channel.

19. SPILLWAY. A detached, broad crested spillway (see pl. 13), with a crest elevation of 3,134 feet, and a crest width of 200 feet is located on the right abutment of the dam. The spillway channel is a reinforced concrete rectangular section founded in rock. The spillway discharge curve is shown on pl. 14.

20. RESERVOIR. The reservoir formed by Mojave River Dam has an area and gross capacity at spillway crest (elevation 3,134) of 1,980 acres and 89,700 acre-feet, respectively. At the maximum water surface (elevation 3,165.4) the area is 3,135 acres and the gross capacity is 179,400 acre-feet. There is an 11,000 acre-foot allowance for sediment below spillway crest. Area and capacity curves are shown on pl. 15, and a tabulation of areas and capacities is given in table 6.

21. BASIS FOR DESIGN. The Mojave River Dam and appurtenances were designed to: control the reservoir design flood, provide storage for sedimentation, and effectively covey the spillway design flood without endangering the dam. The establishment of the spillway crest and top of the dam elevations is described in "General Design Memorandum No. 2 for Mojave River Forks Reservoir" dated 1966. The development of the design floods and sediment volume appear in Appendix 2 of the report. The following subparagraphs briefly describe the design criteria.

a. Reservoir Design Flood. The reservoir design flood is expected to occur from the most severe combination of meteorologic

and hydrologic conditions that are reasonably characteristic of the geographical area. The storm of 21-24 January 1943 was used to synthesize this flood. The reservoir design flood was computed using a total precipitation over the drainage area of 23 inches and precipitation-loss rates that are variable with time. The loss rate was assumed to average 0.25 inches per hour with a minimum rate of 0.15 inches per hour. The effective rainfall over the drainage area was 12.2 inches. This rainfall resulted in a flood having a peak discharge of 94,000 cfs and a volume of 154,000 are-feet.

b. Sediment Volume. Part of the reservoir's storage volume was designed to accommodate the total quantity of sediment that would accumulate behind the dam during a 100-year period. Sediment was considered to be contributed by the floods normally expected to occur during this period plus the reservoir design flood. The reservoir was expected to trap 11,000 acre-feet of sediment, which is 60% of the drainage area's total sediment load. The total sediment load was derived on the basis of data collected from other streams and reservoirs in the general area.

c. Spillway Design Flood. The spillway design flood represents a discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillway design flood was based on the assumed occurrence of probable maximum precipitation as determined by a method presented in the U.S. Weather Bureau's Hydrometeorological Report No. 36, titled "Interim Report, Probable Maximum Precipitation in California," and dated October 1961. In general, the precipitation-runoff relationships assumed for the reservoir design flood were also assumed applicable for use in developing the spillway design flood, except for precipitation-loss rates and base flow. Ground conditions conducive to maximum runoff were reflected in minimum rainfall-loss rates equal to the minimum rate (0.15" per hour) used for the reservoir design flood. For the spillway design flood, this minimum loss rate was assumed to be constant throughout the storm. The base flow rate during the spillway design flood was assumed constant at the peak rate used for the reservoir design flood, until 12 hours after peak of surface runoff when the same hourly recession factor (0.95) used for the reservoir design flood was applied. The total precipitation over the drainage are was 40.4 inches with an effective precipitation of 29.7 inches. The resultant peak inflow was 186,000 cfs with a total volume of 383,000 acre-feet.

d. Reservoir Design Flood Routing. The spillway crest elevation was determined by routing the reservoir design flood through the reservoir assuming it is dry and contains a 100 years accumulation of

sediment at the beginning of the routing. Using set storage, a maximum water-surface elevation 3,133.6 feet was calculated. The peak inflow of 94,000 cfs was reduced to a peak outflow of 23,500 cfs. On this basis, the spillway crest elevation was set a 3,134 feet above mean sea level. See plate 16 for the reservoir design flood routing.

e. Spillway Design Flood Routing. The spillway design flood was routed through the reservoir assuming that the ungated outlet was not blocked by trash. The inflow hydrograph was a combination of the reservoir-design and spillway-design floods with five days between the inflow peaks. A maximum water surface elevation of 3,165.4 feet was calculated. The peak inflow of 186,000 cfs was reduced to a peak outflow of 131,280 cfs. Using a freeboard of 6.6 feet to prevent from overtopping the dam, the elevation of the top of the dam was set at 3,172 feet, NGVD (National Geodetic Vertical Datum). See plate 17 for the spillway design flood routing.

22. RECREATION DEVELOPMENT OF THE RESEROIVR AREA. Initially about 120 acres of land has been used for recreational purposes. This area was designed and constructed by the Corps of Engineers. Ultimate recreational development will include about 2,790 acres. An area used exclusively for flood control operations includes about 460 acres. The initial recreational area is located about one mile upstream of the damsite and above the reservoir area. This area consists of a combined camping and picnic area, trailer camp, equestrian area, administration building and nature interpretation area. San Bernardino County operates and maintains this area under lease arrangement with the Corps of Engineers. The recreation lessee (San Bernardino County) has the added responsibility for future recreational development which is subject to approval by the Corps of Engineers. Plate 18 shows the recreational development plan.

OPERATION

23. RESPONSIBILITY FOR OPERATION. The operation and maintenance of Mojave River Dam is the responsibility of the Los Angles District of the Corps of Engineers. The District Engineer has delegated authority for this function through the Chief, Engineering Division, Chief Hydrology and Hydraulics Branch and Chief, Hydrologic Engineering Section to the chief, Reservoir Regulation Unit. The chain of command for reservoir operations decisions is given on plate 19.

24. FLOOD-CONTROL OPERATION PLAN. Inflows of magnitudes up to and including the reservoir design flood would be controlled by the project, such that peak outflows from the reservoir would be safely carried in the downstream reach of the Mojave River. Inflows would be released from the reservoir through the outlet tunnel. The outlet works do not include any mechanical equipment that would permit adjustment to reservoir outflows.

25. RESERVOIR FILLING FREQUENCY. A filling frequency curve for Mojave Dam is shown on plate 23. In deriving this curve, inflow records for the water years 1938 through 1968 were routed through the reservoir using the gross capacity based on the 1962 survey.

26. REPORTING CRITERIA. A radio telemetry station was installed during FY 1981 in the recording house at the top of the dam. However, the COE District office in downtown Los Angeles has been unable to interrogate this station because of the distance and the mountains between the District Office and the station. During 1986, a GOES (Geostationary Operational Environmental Satellites) Data Collection Platform will be installed to replace this telemetry station. The recording house is also equipped with a strip chart and a punched tape. The strip chart records the water surface elevation continuously. The punched tape reports the precipitation and water surface elevation every 15 minutes from October through March and every hour from April through September.

27. EMERGENCY NOTIFICATION. During the event of heavy rains or high discharges from the Mojave Dam, personnel at the Los Angeles District should be in communication with the San Bernardino County Flood Control District. The San Bernardino County Communications Center (telephone no. (714) 383-3915) and the San Bernardino County Emergency Services (telephone no. (714) 383-2414) are on alert 24 hours a day as the County's central coordinators for disaster control. The Communications and Emergency Services functions in conjunction with the County's flood control district according to an established disaster plan. If anticipated high outflows from the reservoir pose a threat to people along the downstream channel, the Communications and Emergency Services, at their discretion, could direct the operation to warn and, if need be, evacuate people located in hazardous areas.

COLECTION OF HYDROLOGIC DATA

28. HYDROLOGIC FACILITIES. Hydrologic facilities include the following:

a. Reservoir Water-Surface Recorder System. A concrete block instrument house is provided to house the bubbler gage installation used to obtain the water level. The installation consists of a 120-inch mercury servomanometer; water-surface recorder; gas purge system with gas bottle, and three 1/4 inch outside diameter polyethylene lines, one terminating at the invert, one about 10 feet above the invert, and the third about 100 feet above the invert. A telemark that was installed to provide a means of obtaining a reservoir water-surface elevation was removed and replaced with a telemetry station in 1981. Commercial power is required to operate the water-surface recording equipment. This gage was not used until 1974 when the dam's electrical system became operable.

b. Gaging Station. Stream gaging stations (see plate 7 for locations) upstream and downstream of the reservoir are described in the following subparagraphs.

(1) In 1974 the Corps of Engineers installed a stream gaging station on Deep Creek, about 1-1/2 miles above the dam. This station has equipment that continuously record water depths in a natural cross section of Deep Creek. The new station was built to replace the old Deep Creek stream gaging station that was in continuous operation since 1929 (see Table 4 for summary of significant discharges). The old station was located in the dam's reservoir area and was thus inadequate. The U.S. Geological Survey, who operated the old station, also operates the new station. A discharge rating curve for this station is located on plate 26.

(2) The West Fork Mojave River stream gaging station was discontinued from September 1971 to September 1974. This station was located about 1/2 mile upstream of the damsite. In October 1974 a new stage recording station was established further upstream from the site of the discontinued gage. This new recording station will also be discontinued on October 1, 1985. Table 5 is a summary of hydrologic data collected at these gaging stations by the U.S. Geological Survey. A discharge rating curve for this station is located on plate 27.

(3) A gaging station located just below the dam's outlet works was also abandoned. Stream flow measurements at this site were discontinued because an unstable riverbed negated accuracy. As a replacement in 1971 the U.S. Geological Survey constructed the Mojave River below Forks Reservoir station, about 1/2 mile downstream of the dam. This station consists of a continuous recording gage and a cableway that is used exclusively to measure large discharges. The recording gage was removed in October 1974 but it was installed again in October 1980. Sufficient data has not yet been collected to establish a discharge rating curve for the cross section.

(4) The California State Department of Water Resources operates the East Fork of the West Fork of the Mojave River above Cedar Springs station. This station is on Miller Canon 2-1/2 miles upstream of Silverwood Lake which is formed by the Cedar Springs Dam. The drainage area above this station is 11-1/2 square miles and the datum elevation for gage height is 3,580.30 feet, NGVD (National Geodetic Vertical Datum). The period of record for this station is from March 1961 to present. A discharge rating curve for the cross section is located on plate 30.

(5) The California State Department of Water Resources also operates the West Fork of the Mojave River above Cedar Springs station. This station is on Cleghorn Canyon just upstream of Silverwood Lake. The drainage area above this station is 3.2 square miles and the datum elevation for gage height is 3,552.3 feet, NGVD (National Geodetic Vertical Datum). The period of record for this station is from February 1961 to present. A discharge rating curve for the cross section is located on plate 31.

(6) The U.S. Geological Survey operates the Mojave River at Lower Narrows, near Victorville Stream gaging station. This stage recording station has been in continuous operation since October 1930

and was also operated between February 1889 and September 1906. The datum elevation for gage height at this station is 2642.97 feet, NGVD. A discharge rating curve for this station is located on plate 24.

(7) The U.S. Geological Survey also operates a stage recording stream gage on the Mojave River at Barstow. Operation of this gage height is 2089.80 feet NGVD. A discharge rating curve for this station is located on plate 25.

(8) The Mojave River near Hodge gaging station is also operated by the U.S. Geological Survey. The drainage area above this station is 1,091 square miles and the present altitude of the gage is 2,260 feet, NGVD (National Geodetic Vertical Datum). The period of record for this station is from October 1930 to September 1932 and from October 1970 to present. A discharge rating curve for the cross section is located on plate 28.

(9) The Mojave River at Afton gaging station is also operated by the U.S. Geological Survey. The drainage area above this station is 2.121 square miles and the present altitude of the gage is 1,398.15 feet NGVD. The period of record for this station is from October 1929 to September 1932 and from October 1952 to present. A discharge rating curve for the cross section is located on plate 29.

(10) In March 1979, three more stream gaging stations were added in the Mojave River Basin operated by the U.S. Geological Survey: The Houston Creek above Lake Gregory (drainage area 0.35 mi^2), the Abondigas Creek above Lake Gregory (drainage area 1.15 mi^2) and the Houston Creek below Lake Gregory (drainage area 2.68 mi^2).

(11) In October 1980, the West Fork Mojave River below Silverwood Lake station was added to the Mojave River Basin. This stream gaging station is also operated b the U.S. Geological Survey. The drainage area of this station is 34 square miles and the gage altitude is 3,160 ft., NGVD (National Geodetic Vertical Datum).

c. Reservoir Staff Gages. A reservoir staff gage system, consisting of 38 adjustable 5-foot sections are installed so that they can be read from the top of the dam.

d. Precipitation Gages. The San Bernardino County Flood Control District, the National Weather Service and the Corps of Engineers, together operate more than 20 precipitation gates, scattered throughout the dam's drainage area. The Corps of Engineers operates a recording station at the dam. A recording station at the community of Summit that was also operated the Corps of Engineers was abandoned in January 1980. Precipitation gage locations are shown on plate 7.

29. SEDIMENTATION. The sedimentation allowance in Mojave River Reservoir of 11,000-acre-feet is based on a 100-year design period. In order to check sedimentation periodically, four category "A" index ranges were established in the reservoir area and four Category "C"

index ranges across the downstream channel. Each index range is a surveyed cross-section. A reconnaissance survey will be made every two years, or after every major storm (whichever comes first) to determine if the index ranges should be resurveyed. A comprehensive survey of Mojave River Reservoir will be made whenever a survey of the Category "A" ranges indicates an appreciable amount of sediment. At least one such survey will be made every ten years. Category "C" ranges will be surveyed at least once every five years. Locations of index ranges are shown on plates 32 and 33.

Table 1

Climatological Data at Hesperia*

Month	Temperature			Precipitation		
	Mean monthly	Record highest	Record lowest	Mean monthly	Maximum monthly	Minimum monthly
	Degrees Fahrenheit	Degrees Fahrenheit	Degrees Fahrenheit	Inches	Inches	Inches
Jan.	46.6	82	10	1.51	5.80	0
Feb.	49.7	88	14	1.34	6.27	0
Mar.	52.9	90	20	1.04	4.65	0
Apr.	58.0	97	24	.49	3.44	0
May.	65.3	108	30	.09	1.07	0
Jun.	73.4	115	34	.02	.35	0
Jul.	82.0	119	46	.09	1.32	0
Aug.	80.8	112	44	.12	1.06	0
Sep.	74.8	110	40	.25	3.00	0
Oct.	64.7	110	30	.31	2.02	0
Nov.	53.0	88	14	.90	4.65	0
Dec.	46.4	78	12	1.06	5.77	0
Period of record	**62.3	119	10	**7.22	6.27	0

* 34°25'16"N latitude; 117°18'12"W longitude; 3,305 feet above mean sea level.

** Mean annual.

NOTE: Period of record for temperature is 23 years (Jan 1951 - Dec 1973). Period of record for precipitation is 42 years (Oct 1904-Sep 1915) and (Oct 1942 - Sep 1973)

Data supplied by San Bernardino County Flood Control District for station FCD No. 92.

Table 2

Climatological Data at Squirrel Inn No. 2*

Month	Temperature			Precipitation			Snowfall		
	Mean monthly	Record highest	Record lowest	Mean monthly	Maximum monthly	Minimum monthly	Mean monthly	Maximum monthly	Minimum monthly
	Degrees Fahrenheit	Degrees Fahrenheit	Degrees Fahrenheit	Inches	Inches	Inches	Inches	Inches	Inches
Jan.	38.8	71	0	7.90	50.29	0	18.8	115.7	0
Feb.	39.9	71	9	8.21	30.12	0	37.1	98.5	0
Mar.	43.0	79	-7	6.50	29.02	0	17.0	84.0	0
Apr.	47.6	82	13	4.08	21.24	0	8.4	83.6	0
May.	52.0	86	10	1.32	9.88	0	2.3	32.5	0
Jun.	61.2	99	10	.19	3.20	0	0.6	22.0	0
Jul.	69.4	97	25	.17	5.01	0	0	(T)	0
Aug.	69.4	99	36	.21	1.70	0	0	0	0
Sep.	65.2	96	22	.74	9.23	0	0	(T)	0
Oct.	56.1	96	18	1.79	8.97	0	0.6	10.0	0
Nov.	47.1	80	9	3.64	24.62	0	3.9	52.3	0
Dec.	40.2	73	5	6.76	30.70	0	11.1	62.5	0
Period of record	**52.4	99	-7	**41.51	50.29	0	**99.8	115.7	0

* 34°14'N Latitude; 117°14'W Longitude; 5,680 feet above mean sea level.

** Mean annual.

T Indicates less than 0.01 inch of precipitation.

NOTE: Period of record for temperature is 56 years (Jan 1911 - Dec 1923 and Jan 1929 - Dec 1971)
Period of record for precipitation is 62 years (Jan 1910 - Dec 1971)
Period of record for snowfall is 61 years (Jan 1911 - Dec 1971)

Station Discontinued January 1972.

Data is from "Climatological Data, California," National Oceanic and Atmospheric Administration.

Table 3

Snowfall Data at Victorville Pump Station*

Year	Date	Inches**
1942	15 Mar	2.0
1943	21 Dec	(T)
1944	26 Jan	2.0
	14 Mar	(T)
1945	20 Jan	(T)
	2 Feb	(T)
1947	2 Jan	(T)
	23 Nov	(T)
	5 Dec	1.0
1948	5 Feb	(T)
1952	18 Jan	3.0
	16 Mar	1.0
1953	2 Mar	3.0
1954	13 Jan	1.5
1956	13 Apr	1.0
1957	30 Jan	9.0
1964	16 Feb	1.0
	23 Mar	(T)
	18 Nov	10.0
1967	15 Dec	4.0
1974	5 Jan	17.0

* 34°32'N Latitude; 117°18'W Longitude; elevation 2,900 feet above mean sea level.

** Maximum depth on ground.

T Indicates less than 0.01 inch of precipitation.

NOTE: Period of record for snowfall is 32 years (January 1942 - February 1974).

Table 4

Runoff Data - Deep Creek near Hesperia*

Years**	Maximum peak discharge	Date	Maximum mean daily discharge	Date
	Cubic feet per second		Cubic feet per second	
1929-30	340	5 Mar	240	4 May
1930-31	1,260	26 Apr	557	27 Apr
1931-32	7,900	9 Feb	4,050	9 Feb
1932-33	168	4 Apr	126	3 & 4 Apr
1933-34	2,340	31 Dec	1,570	1 Jan
1934-35	2,760	8 Apr	1,160	8 Apr
1935-36	2,170	12 Feb	669	12 Feb
1936-37	6,800	14 Feb	4,180	14 Feb
1937-38	46,600	2 Mar	12,000	2 Mar
1938-39	1,850	25 Sep	508	25 Sep
1939-40	2,610	8 Jan	1,040	8 Jan
1940-41	5,500	24 Dec	1,850	21 Feb
1941-42	395	4 Apr	214	4 Apr
1942-43	19,000	23 Jan	7,850	23 Jan
1943-44	490	11 Mar	410	13 Mar
1944-45	6,350	2 Feb	2,700	2 Feb
1945-46	5,800	23 Dec	2,550	24 Dec
1946-47	2,740	23 Nov	873	23 Nov
1947-48	840	4 Apr	421	4 Apr
1948-49	248	14 Apr	183	14 & 15 Apr
1949-50	708	7 Feb	500	7 Feb
1950-51	40	3 May	30	4 May
1951-52	2,830	30 Dec	1,760	30 Dec
1952-53	144	7 Jan	109	8 Jan
1953-54	7,340	25 Jan	3,400	25 Jan
1954-55	313	17 Feb	207	17 Feb
1955-56	6,740	27 Jan	3,550	27 Jan
1956-57	11,500	13 Jan	4,070	12 Jan
1957-58	12,400	3 Apr	4,590	3 Apr
1958-59	6,920	16 Feb	843	17 Feb
1959-60	112	24 Apr	53	14 Mar
1960-61	1,580	4 Aug	133	4 Aug
1961-62	7,040	11 Feb	4,150	11 Feb
1962-63	627	10 Feb	214	10 Feb
1963-64	409	1 Apr	275	1 Apr
1964-65	443	23 Apr	313	25 Apr
1965-66	21,700	22 Nov	6,480	23Nov/29Dec

See footnotes at end of table.

Table 4--Continued

Runoff Data - Deep Creek near Hesperia*

Years**	Maximum peak discharge	Date	Maximum mean daily discharge	Date
	Cubic feet per second		Cubic feet per second	
1966-67	15,400	6 Dec	9,980	6 Dec
1967-68	654	20 Nov	411	20 Nov
1968-69	23,000	25 Jan	14,700	25 Jan
1969-70	559	28 Feb	343	1 Mar
1970-71	3,320	29 Nov	687	29 Nov
1971-72	8,910	24 Dec	3,240	24 Dec
1972-73	6,810	11 Feb	2,180	11 Feb
1973-74	1,020	2 Mar	391	2 Mar
1974-75	503	8 Mar	207	8 Mar
1975-76	5,050	11 Sep	1,480	9 Feb
1976-77	696	8 May	324	9 May
1977-78	24,800	4 Mar	11,000	4 Mar
1978-79	5,690	27 Mar	2,920	28 Mar
1979-80	16,400	17 Feb	7,700	17 Feb
1980-81	130	1 Mar	74	20 Mar
1981-82	2,900	11 Apr	1,180	12 Apr
1982-83	16,600	1 Mar	8,280	1 Mar
1983-84	4,690	25 Dec	2,250	25 Dec

* Latitude 34°20'28"N; longitude 117°13'39"W; in NW ¼ NE ¼ SE ¼, sec 18, T.3N, R.3W. San Bernardino County on right bank 0.5 mile upstream from confluence with West Fork Mojave River and 7 miles southeast of Hesperia. Data from U.S.G.S. Water Records of California.

** 1 October to 30 September, inclusive.

Note: Period of record for discharge is 55 years (1930-1984).

Revised September 1985

Table 5

Runoff Data - West Fork Mojave River near Hesperia*

Year**	Maximum peak discharge	Date	Maximum mean daily discharge	Date
	Cubic feet per second		Cubic feet per second	
1929-30	518	14 Mar	264	15 Mar
1930-31	712	26 Apr	248	26 Apr
1931-32	6,000	9 Feb	2,630	9 Feb
1932-33	464	19 Jan	123	20 Jan
1933-34	1,380	1 Jan	946	1 Jan
1934-35	1,280	8 Apr	466	8 Apr
1935-36	418	11 Feb	188	15 Feb
1936-37	4,100	13 Mar	1,960	14 Feb
1937-38	26,100	2 Mar	7,000	2 Mar
1938-39	681	19 Dec	316	19 Dec
1939-40	1,390	8 Jan	344	8 Jan
1940-41	2,280	4 Mar	1,530	4 Mar
1941-42	450	10 Dec	126	11 Dec
1942-43	23,000	23 Jan	6,000	23 Jan
1943-44	6,600	22 Feb	3,270	22 Feb
1944-45	2,350	2 Feb	1,120	2 Feb
1945-46	6,600	30 Mar	2,330	30 Mar
1946-47	3,000	13/20Nov	1,100	20 Nov
1947-48	700	3 Apr	203	4 Apr
1948-49	335	20 Jan	225	20 Jan
1949-50	706	19 Dec	322	19 Dec
1950-51	109	28 Apr	50	27Nov/29Jan
1951-52	6,780	15 Mar	2,340	16 Jan
1952-53	117	20 Mar	60	20 Mar
1953-54	2,440	25 Jan	953	25 Jan
1954-55	261	27 Feb	140	28 Feb
1955-56	880	27 Jan	506	27 Jan
1956-57	562	13 Jan	237	13 Jan
1957-58	10,200	3 Apr	3,120	3 Apr
1958-59	2,800	16 Feb	688	16 Feb
1959-60	856	2 Sep	37	2 Sep
1960-61	296	6 Nov	44	6 Nov
1961-62	3,750	11 Feb	1,430	12 Feb
1962-63	164	18 Sep	32	18 Sep
1963-64	198	1 Apr	112	2 Apr
1964-65	1,460	9 Apr	492	10 Apr
1965-66	21,200	29 Dec	4,910	29 Dec

See footnotes at end of table.

Table 5--Continued

Runoff Data - West Fork Mojave River near Hesperia*

Years**	Maximum peak discharge	Date	Maximum mean daily discharge	Date
	Cubic feet per second		Cubic feet per second	
1966-67	6,320	6 Dec	2,880	6 Dec
1967-68	755	20 Nov	325	20 Nov
1968-69	20,000	25 Feb	11,100	25 Feb
1969-70	494	2 Mar	330	2 Mar
1970-71	2,200	29 Nov	447	29 Nov
1971-72	Discontinued			
1972-73	Discontinued			
1973-74	Discontinued			
1974-75	324	8 Mar	170	8 Mar
1975-76	1,510	9 Feb	886	9 Feb
1976-77	302	8 May	131	9 May
1977-78	11,300	10 Feb	4,900	10 Feb
1978-79	1,180	28 Mar	883	28 Mar
1979-80	8,380	16 Feb	3,150	16 Feb
1980-81	252	29 Jan	132	30 Jan
1981-82	3,200	17 Mar	1,240	17 Mar
1982-83	5,500	2 Mar	4,490	2 Mar
1983-84	1,180	25 Dec	559	26 Dec

* 1929-1971: Latitude 34°20'27"N; longitude 117°14'24"W; in SW 1/4 SW 1/4, Sec. 18, T.3N., R.3W., San Bernardino County, on left bank at highway bridge 0.5 mile upstream from confluence with Deep Creek and 6.5 miles southeast of Hesperia. Data from U.S.G.S. Water Records of California, discontinued September 1971.
1974-1984: Lat 34°20'20"N; longitude 117°15'25"W; in NW 1/4 NW 1/4 sec. 24, T.3N., R.4W., San Bernardino County, on left bank on upstream wingwall of concrete double box culvert on Arrowhead Lake Road, 0.1 mi (0.2 km) northeast of junction with Highway 174, and 6.5 mi (10.5 km) southeast of Hesperia. Data from U.S.G.S. Water Records of California.

** 1 October to 30 September, inclusive.

Note: Period of record for discharge is 51 years (1930-1971) and (1975-1984).

Revised September 1985

Table 6

Area and Gross Capacity - Mojave River Dam

Elevation	Capacity	Area	Elevation	Capacity	Area
Feet above mean sea level	Acre-feet	Acres	Feet above mean sea level	Acre-feet	Acres
2980	0.0	2	3018	1,090	90
2981	3.3	3	3019	1,183	99
2982	7.1	4	3020	1,280	108
2983	11.2	5	3021	1,402	116
2984	15.5	5	3022	1,531	123
2985	20.0	6	3023	1,670	132
2986	27.3	7	3024	1,817	140
2987	35.4	8	3025	1,973	149
2988	44.5	10	3026	2,119	157
2989	54.3	11	3027	2,271	165
2990	65.0	12	3028	2,432	174
2991	77.8	13	3029	2,599	183
2992	91.8	14	3030	2,775	192
2993	107.0	16	3031	2,971	200
2994	123.0	17	3032	3,172	207
2995	140.0	18	3033	3,381	215
2996	158.0	19	3034	3,601	222
2997	178.0	20	3035	3,830	230
2998	199.0	21	3036	4,059	237
2999	220.0	22	3037	4,297	244
3000	243.0	23	3038	4,545	251
3001	268.0	25	3039	4,803	259
3002	294.0	26	3040	5,070	266
3003	321.0	28	3041	5,340	275
3004	349.0	29	3042	5,620	284
3005	378.0	31	3043	5,910	293
3006	412.0	33	3044	6,209	303
3007	448.0	36	3045	6,519	312
3008	485.0	39	3046	6,832	320
3009	505.0	41	3047	7,154	329
3010	565.0	44	3048	7,487	338
3011	615.0	48	3049	7,830	346
3012	668.0	53	3050	8,183	355
3013	724.0	57	3051	8,544	366
3014	782.0	62	3052	8,915	376
3015	843.0	67	3053	9,297	387
3016	921.0	74	3054	9,689	398
3017	1003.0	82	3055	10,093	409

Table 6 -- Continued

Area and Gross Capacity - Mojave River Dam

Elevation	Capacity	Area	Elevation	Capacity	Area
Feet above mean sea level	Acre-feet	Acres	Feet above mean sea level	Acre-feet	Acres
3056	10,504	418	3095	35,298	941
3057	10,925	430	3096	36,248	957
3058	11,358	438	3097	37,214	975
3059	11,802	447	3098	38,198	992
3060	12,258	457	3099	39,199	1010
3061	12,712	465	3100	40,218	1027
3062	13,177	473	3101	41,264	1049
3063	13,654	480	3102	42,328	1071
3064	14,141	488	3103	43,410	1093
3065	14,640	496	3104	44,511	1115
3066	15,153	505	3105	45,630	1138
3067	15,678	514	3106	46,785	1160
3068	16,215	523	3107	47,959	1182
3069	16,764	533	3108	49,154	1205
3070	17,325	542	3109	50,368	1228
3071	17,857	553	3110	51,603	1251
3072	18,400	565	3111	52,873	1275
3073	18,953	577	3112	54,163	1299
3074	19,516	588	3113	55,476	1324
3075	20,090	600	3114	56,810	1349
3076	20,701	614	3115	58,165	1374
3077	21,323	627	3116	59,556	1399
3078	21,958	641	3117	60,969	1423
3079	22,604	655	3118	62,406	1448
3080	23,263	669	3119	63,865	1474
3081	23,949	686	3120	65,348	1499
3082	24,647	703	3121	66,884	1533
3083	25,359	720	3122	68,445	1567
3084	26,084	737	3123	70,030	1602
3085	26,823	755	3124	71,642	1637
3086	27,595	773	3125	73,278	1673
3087	28,381	791	3126	74,976	1705
3088	29,182	809	3127	76,702	1737
3089	29,997	828	3128	78,455	1769
3090	30,828	847	3129	80,236	1801
3091	31,690	865	3130	82,045	1834
3092	32,567	884	3131	83,904	1870
3093	33,461	903	3132	85,792	1906
3094	34,371	922	3133	87,709	1942

Table 6--Continued

Area and Gross Capacity - Mojave River Dam

Elevation	Capacity	Area	Elevation	Capacity	Area
Feet above mean sea level	Acre-feet	Acres	Feet above mean sea level	Acre-feet	Acres
*3134	89,672	1980	3154	136,350	2679
3135	91,665	2014	3155	139,055	2712
3136	93,707	2050	3156	141,781	2747
3137	95,780	2086	3157	144,545	2783
3138	97,886	2123	3158	147,346	2819
3139	100,024	2160	3159	150,185	2855
3140	102,195	2198	3160	153,063	2891
3141	104,410	2231	3161	155,988	2936
3142	106,658	2265	3162	158,953	2981
3143	108,940	2299	3163	161,957	3026
3144	111,257	2333	3164	165,001	3072
3145	113,608	2367	3165	168,085	3118
3146	115,995	2403	3166	171,227	3160
3147	118,418	2439	3167	174,410	3202
3148	120,876	2476	3168	177,635	3245
3149	123,370	2513	3169	180,901	3289
3150	125,900	2550	3170	184,210	3332
3151	128,457	2582	**3171	187,546	3361
3152	131,051	2614	**3172	190,925	3390
3153	133,682	2647			

Based on Survey of 1965.

* Spillway Crest
** Top of Dam

Table 7

TRAVEL TIMES FOR OUTFLOW FROM

MOJAVE RIVER DAM TO REACH

DOWNSTREAM POINTS OF INTEREST

Location	River Miles Below Mojave River Dam	Travel Time *
	Miles	Hours
Hesperia	6	2
Victorville	15	4
Oro Grande	20	6
Helendale	32	10
Hodge	41	15
Barstow	54	17
Daggett	63	19
Soda Lake	116	30

*Based on steady flow conditions for the peak outflow of the reservoir design flood plus contemporaneous flow from tributaries located downstream of the dam.

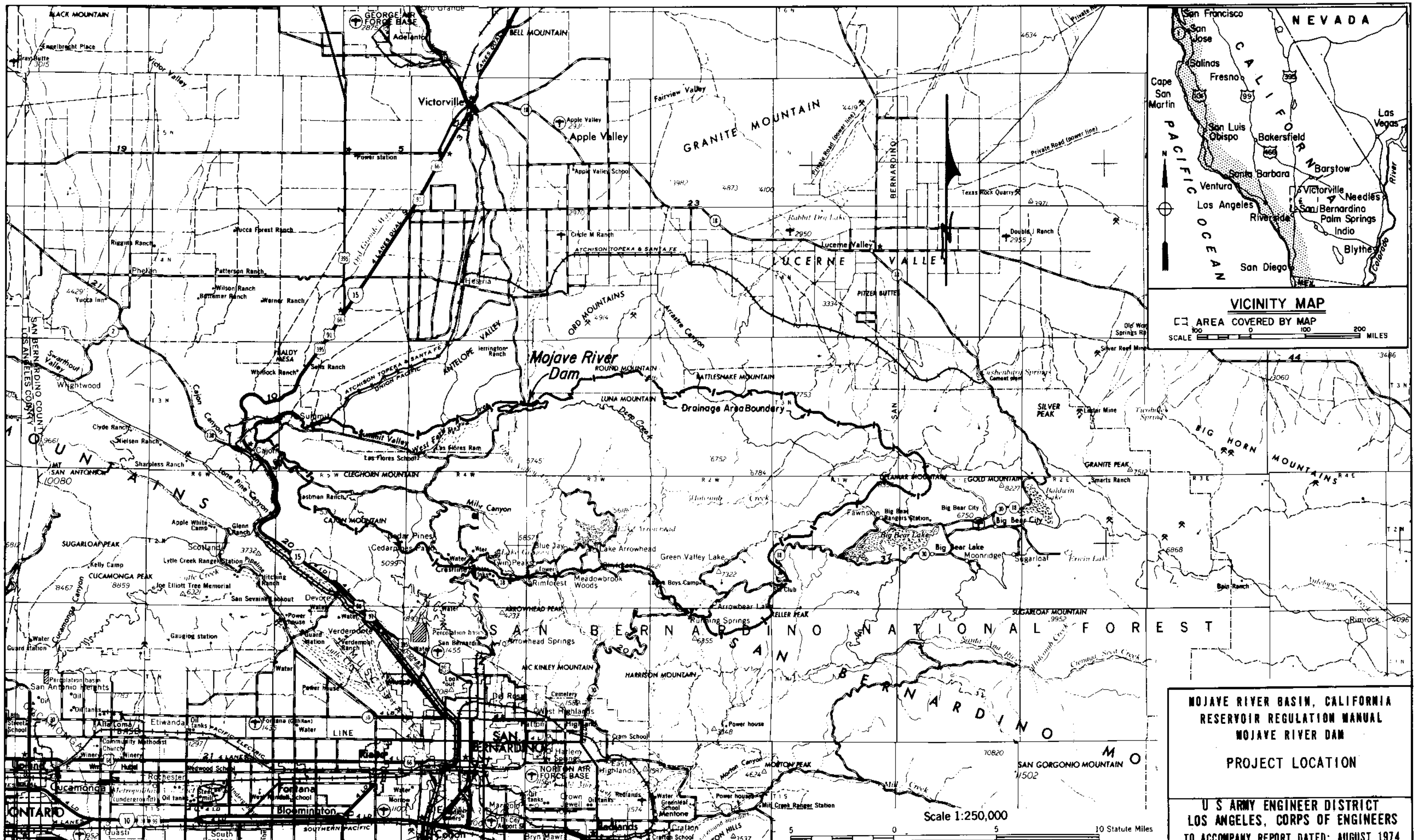

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM
PROJECT LOCATION
U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST 1974
VICINITY MAP
AREA COVERED BY MAP
SCALE 100 0 100 200 MILES
NEVADA
CALIFORNIA
PACIFIC OCEAN
San Francisco
San Jose
Salinas
Fresno
Cape San Martin
San Luis Obispo
Bakersfield
Barstow
Santa Barbara
Ventura
Victorville
Needles
Los Angeles
San Bernardino
Riverside
Palm Springs
Indio
Blythe
San Diego
Las Vegas
Colorado River
Scale 1:250,000
10 Statute Miles
Mojave River Dam
Drainage Area Boundary
Victorville
Apple Valley
GRANITE MOUNTAIN
LUCERNE VALLEY
Lucerne Valley
Hesperia
ORD MOUNTAINS
ROUND MOUNTAIN
RATTLESNAKE MOUNTAIN
LUNA MOUNTAIN
BIG HORN MOUNTAINS
Big Bear Lake
Big Bear City
Lake Arrowhead
Crestline
Running Springs
Green Valley Lake
SAN BERNARDINO NATIONAL FOREST
SAN BERNARDINO MO
SAN GORGONIO MOUNTAIN
SAN BERNARDINO
Redlands
Fontana
Bloomington
Cucamonga
ONTARIO
Etiwanda
Rialto
Cajon
Summit
Wrightwood
Phelan
GEORGE AIR FORCE BASE
NORTON AIR FORCE BASE
SAN BERNARDINO COUNTY
LOS ANGELES COUNTY

PLATE 1

MATCH TO PLATE 3

395

GEORGE AIR FORCE BASE

VICTORVILLE

15

18

APPLE VALLEY

GRANITE MOUNTAINS

MOJAVE RIVER

RR

UP

15

395

HESPERIA

RY

SF

AT

B

Flow

ORD MOUNTAINS

MOJAVE RIVER DAM

Deep Creek

River

West Fork Mojave

Cajon Pass

SAN BERNARDINO MOUNTAINS

LEGEND

OVERFLOW AREA

FLOODWAY

N

NOTE:

1. THE OVERFLOW AREA REPRESENTS THE LAND SUBJECT TO FLOODING BY THE STANDARD PROJECT FLOOD BEFORE THE MOJAVE RIVER DAM WAS CONSTRUCTED. THE OVERFLOW AREA WAS EXTRACTED FROM "REPORT ON SURVEY FOR FLOOD CONTROL, MOJAVE RIVER, SAN BERNARDINO COUNTY, CALIFORNIA, DECEMBER 26, 1956" BY THE CORPS OF ENGINEERS AND IS REPRESENTATIVE OF CONDITIONS AT THAT TIME.
2. THE FLOODWAY LIMITS HAVE BEEN DESIGNATED BY THE SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT. THE MINIMUM FLOW CAPACITY IS 30,000 CFS.

SCALE: 1" = 2 MI.

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

OVERFLOW AREA AND DOWNSTREAM CHANNEL

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED AUG. 1974

PLATE 2

MATCH TO PLATE 4

RIVER

UP RR

HELENDALE

99

MOJAVE

OLD U.S. HWY

AT & SF RY

395

15

ORO GRANDE

GEORGE AIR FORCE BASE

ADELANTO

MATCH TO PLATE 2

LEGEND

OVERFLOW AREA

FLOODWAY

N

NOTE:

1. THE OVERFLOW AREA REPRESENTS THE LAND SUBJECT TO FLOODING BY THE STANDARD PROJECT FLOOD BEFORE THE MOJAVE RIVER DAM WAS CONSTRUCTED. THE OVERFLOW AREA WAS EXTRACTED FROM "REPORT ON SURVEY FOR FLOOD CONTROL, MOJAVE RIVER, SAN BERNARDINO COUNTY, CALIFORNIA, DECEMBER 28, 1956" BY THE CORPS OF ENGINEERS AND IS REPRESENTATIVE OF CONDITIONS AT THAT TIME.
2. THE FLOODWAY LIMITS HAVE BEEN DESIGNATED BY THE SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT. THE MINIMUM FLOW CAPACITY IS 30,000 CFS.

SCALE: 1"=2MI.

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

OVERFLOW AREA AND DOWNSTREAM CHANNEL

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED AUG. 1974

PLATE 3

NOTE:

1. THE OVERFLOW AREA REPRESENTS THE LAND SUBJECT TO FLOODING BY THE STANDARD PROJECT FLOOD BEFORE THE MOJAVE RIVER DAM WAS CONSTRUCTED. THE OVERFLOW AREA WAS EXTRACTED FROM "REPORT ON SURVEY FOR FLOOD CONTROL, MOJAVE RIVER, SAN BERNARDINO COUNTY, CALIFORNIA, DECEMBER 28, 1956" BY THE CORPS OF ENGINEERS AND IS REPRESENTATIVE OF CONDITIONS AT THAT TIME.
2. THE FLOODWAY LIMITS HAVE BEEN DESIGNATED BY THE SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT. THE MINIMUM FLOW CAPACITY IS 30,000 CFS.

LEGEND

OVERFLOW AREA

FLOODWAY

N

HINKLEY

AT & SF RY

58

Flow

15

YERMO

UP RR

Flow

RIVER

MOJAVE

AT & SF RY

66

BARSTOW

40

OLD U.S. HWY

15

DAGGET

HODGE

MATCH TO PLATE 3

MATCH TO PLATE 5

SCALE: 1" = 2 MI.

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

OVERFLOW AREA AND DOWNSTREAM CHANNEL

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED AUG. 1974

PLATE 4

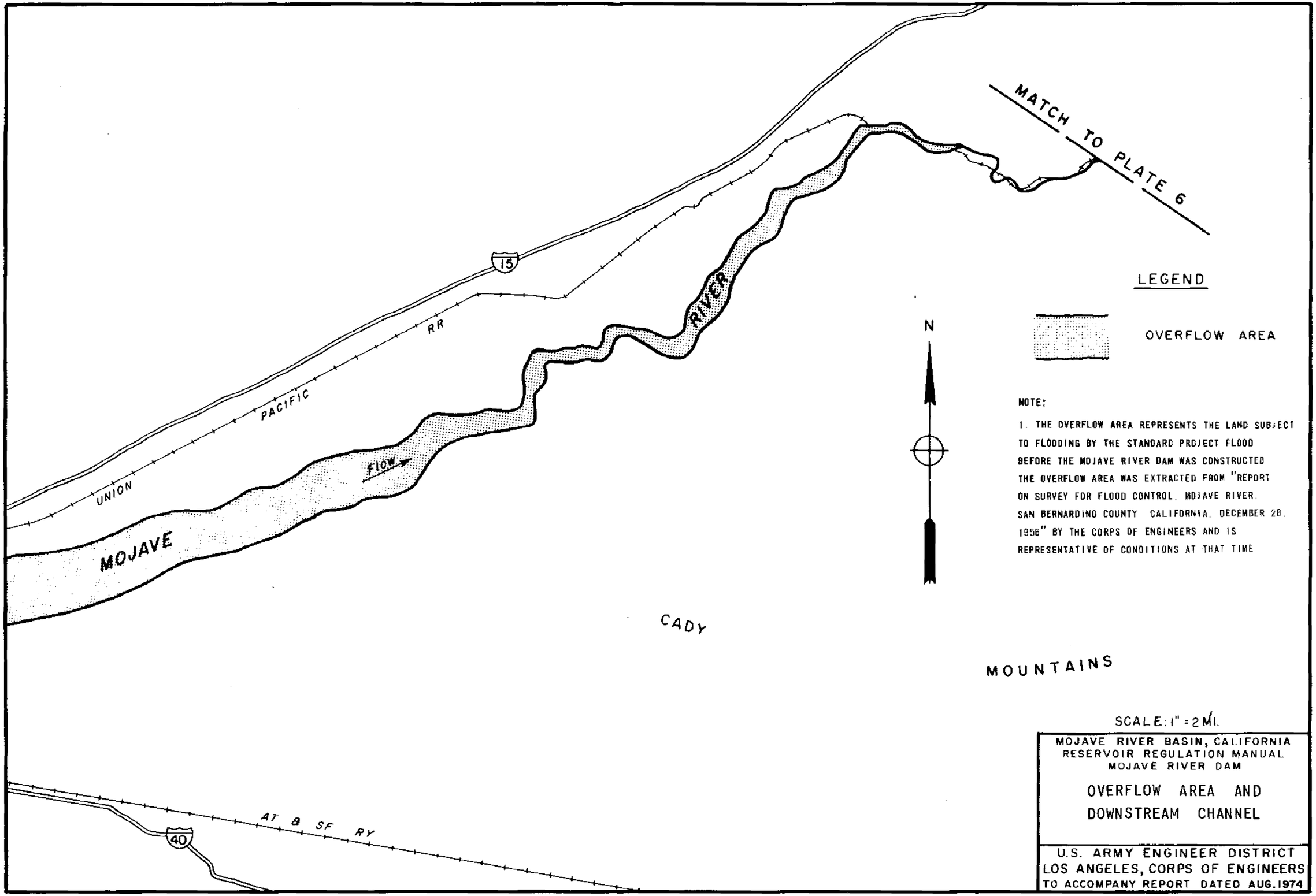
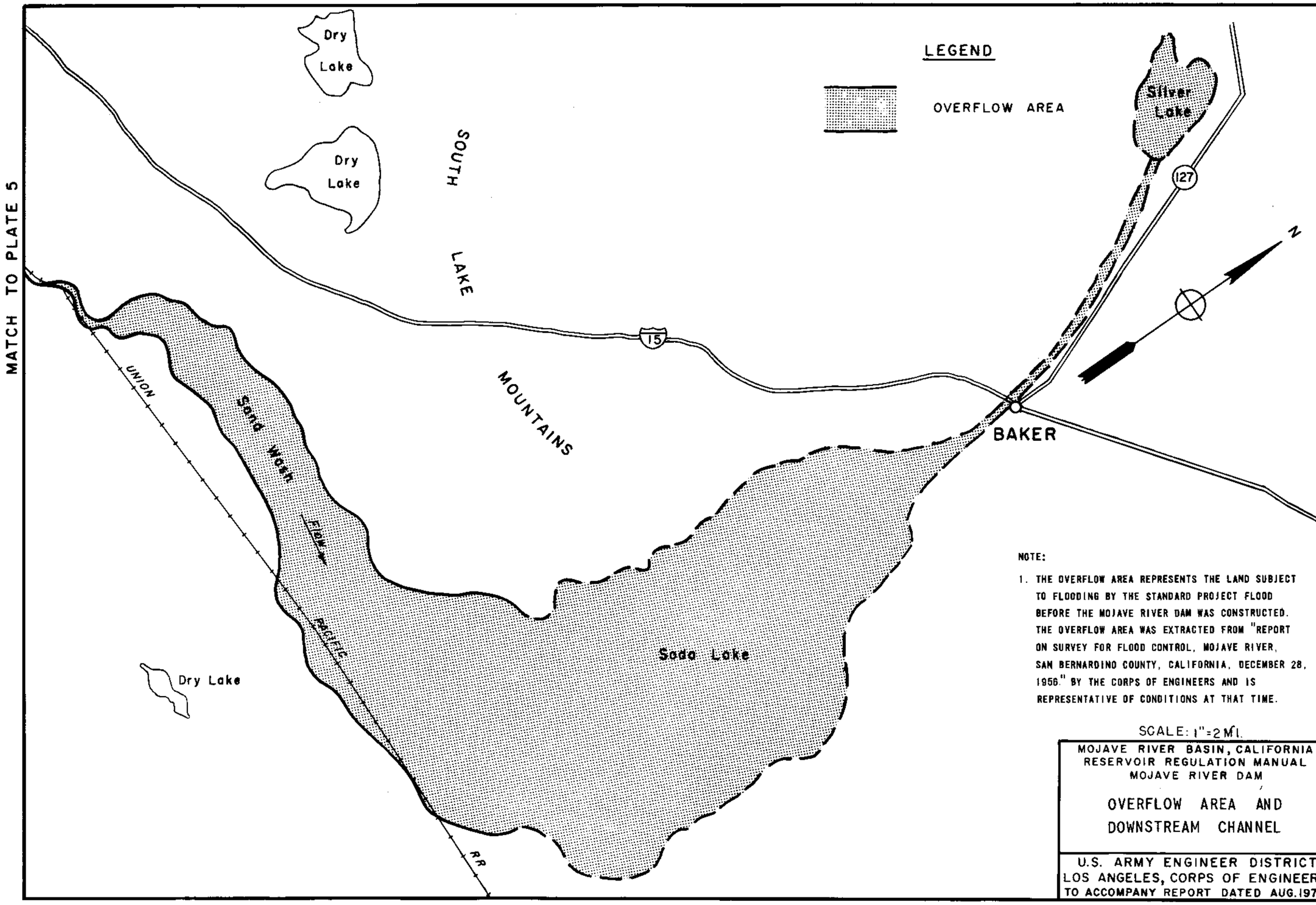

MATCH TO PLATE 6
15
PACIFIC
RR
UNION
RIVER
MOJAVE
FLOW
CADY
MOUNTAINS
MATCH TO PLATE 4
AT & SF RY
40
N
LEGEND
OVERFLOW AREA
NOTE:
1. THE OVERFLOW AREA REPRESENTS THE LAND SUBJECT TO FLOODING BY THE STANDARD PROJECT FLOOD BEFORE THE MOJAVE RIVER DAM WAS CONSTRUCTED THE OVERFLOW AREA WAS EXTRACTED FROM "REPORT ON SURVEY FOR FLOOD CONTROL, MOJAVE RIVER, SAN BERNARDINO COUNTY CALIFORNIA, DECEMBER 28, 1956" BY THE CORPS OF ENGINEERS AND IS REPRESENTATIVE OF CONDITIONS AT THAT TIME
SCALE: 1" = 2 MI.
MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM
OVERFLOW AREA AND DOWNSTREAM CHANNEL
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED AUG. 1974

PLATE 5



NOTE:

1. THE OVERFLOW AREA REPRESENTS THE LAND SUBJECT TO FLOODING BY THE STANDARD PROJECT FLOOD BEFORE THE MOJAVE RIVER DAM WAS CONSTRUCTED. THE OVERFLOW AREA WAS EXTRACTED FROM "REPORT ON SURVEY FOR FLOOD CONTROL, MOJAVE RIVER, SAN BERNARDINO COUNTY, CALIFORNIA, DECEMBER 28, 1956." BY THE CORPS OF ENGINEERS AND IS REPRESENTATIVE OF CONDITIONS AT THAT TIME.

SCALE: 1"=2 MI.

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

OVERFLOW AREA AND DOWNSTREAM CHANNEL

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED AUG. 1974

PLATE 6

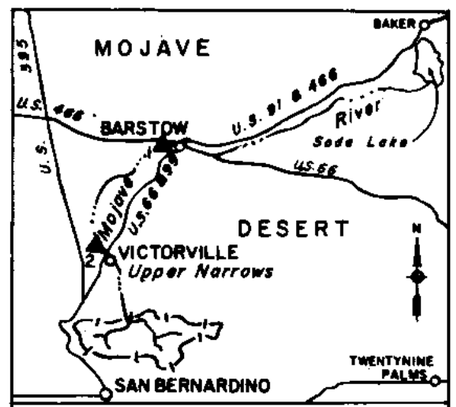
UNIT HYDROGRAPHS FOR SUBAREAS

TIME (1-HOUR PERIODS)	SUBAREA DISCHARGE* CFS						TIME (1-HOUR PERIODS)	SUBAREA DISCHARGE* CFS					
	A_1	A_2	A_3	A_4	B_1	B_2		A_1	A_2	A_3	A_4	B_1	B_2
1	2850	2870	540	660	1080	1350	18			80	30	180	530
2	3110	7340	2120	2960	4250	4510	19			50	20	160	410
3	690	2380	3350	3810	7400	8380	20			30		160	410
4	280	1040	2200	1930	6250	10720	21			20		160	350
5	130	628	1230	1050	3270	8840	22			10		60	350
6	40	380	750	580	2000	5270	23			10		60	280
7		270	510	470	1460	3340	24					30	230
8		140	380	350	1110	2580	25						230
9		40	310	300	780	2050	26						230
10		10	260	240	700	1700	27						180
11			200	190	570	1230	28						170
12			190	150	480	1110	29						120
13			140	130	380	880	30						120
14			130	110	350	820	31						60
15			100	90	320	760	32						60
16			80	70	250	640	33						60
17			90	40	250	580	34						

* AVERAGE DISCHARGE FOR ONE-HOUR PERIODS BASED ON ONE INCH OF RAIN FOR ONE HOUR.

LEGEND

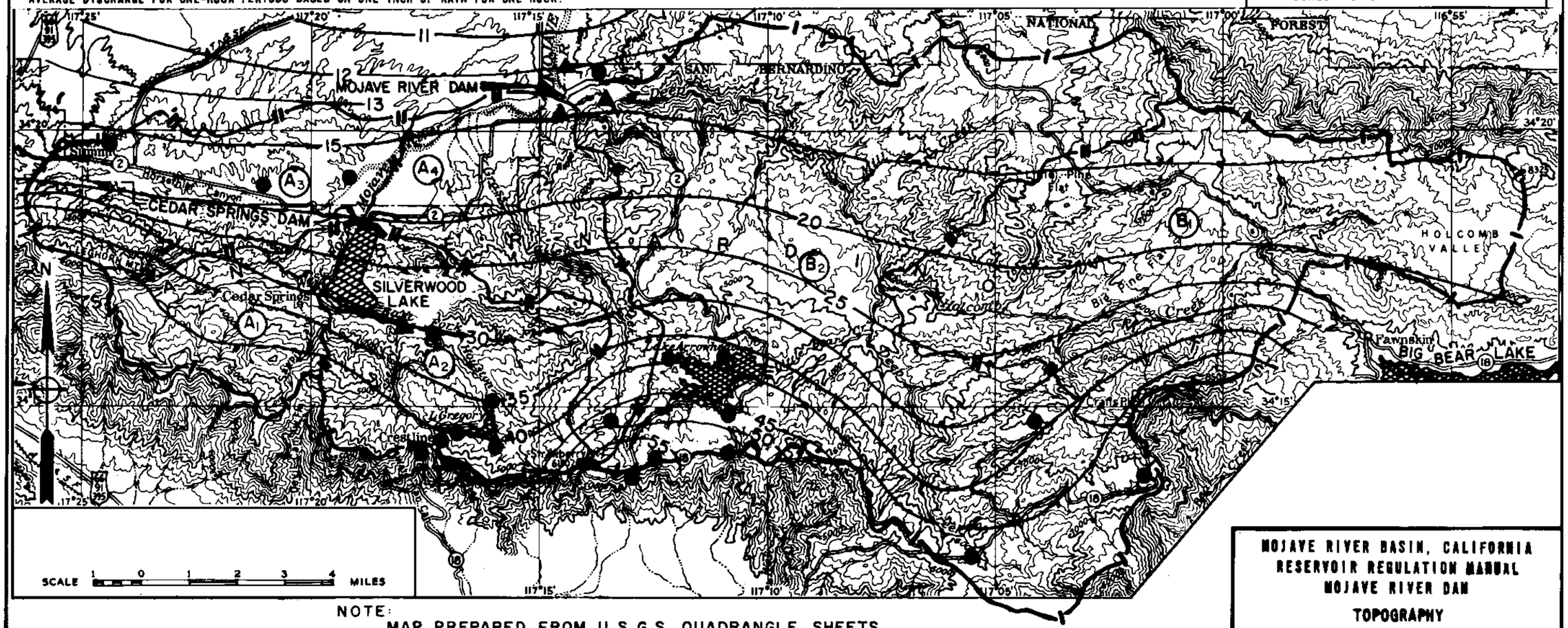
- —I— BOUNDARY OF DRAINAGE AREA
- —II— BOUNDARY OF DRAINAGE SUBAREA
- —20— LINE OF EQUAL 78-YEAR MEAN SEASONAL PRECIPITATION IN INCHES (1884-1961)
- ▲ STREAM-GAGING STATION
- (A1) SUBAREA DESIGNATION
- CORPS OF ENGINEERS PROJECT
- STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES PROJECT
- EXISTING WATER-CONSERVATION RESERVOIR
- ● PRECIPITATION GAGE.



VICINITY MAP

RESERVOIR DRAINAGE AREA

SCALE 10 5 0 10 20 MILES



NOTE:
MAP PREPARED FROM U.S.G.S. QUADRANGLE SHEETS
CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM
TOPOGRAPHY
DRAINAGE AREA & HYDROLOGIC MAP

U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST 1974

PLATE 7

The Plate you are attempting to access is not currently available.

For additional information, please contact the Los Angeles District Public Affairs Office at (213) 452-3908.

The Plate you are attempting to access is not currently available.

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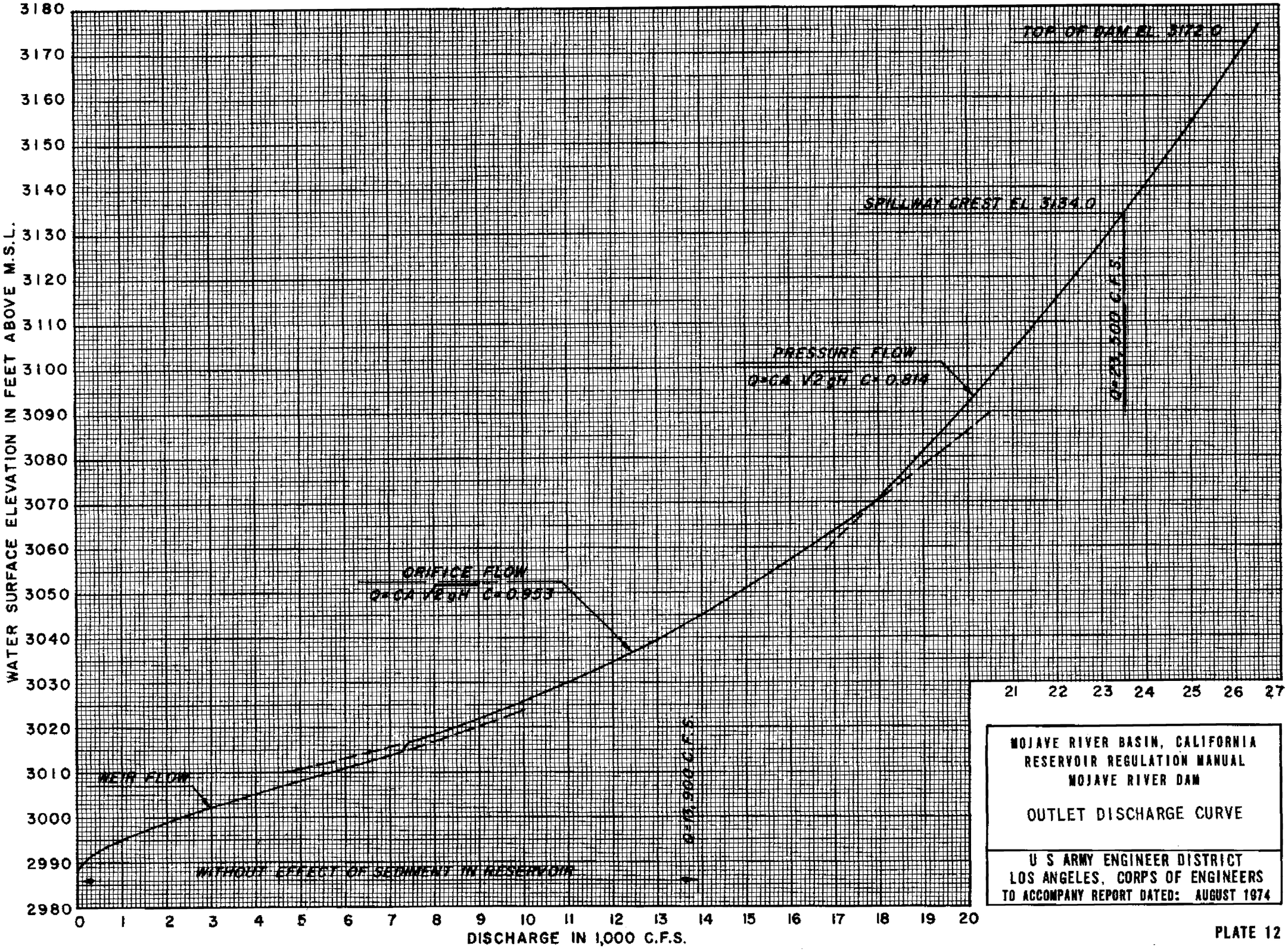

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

OUTLET DISCHARGE CURVE

U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST 1974

PLATE 12

The Plate you are attempting to access is not currently available.

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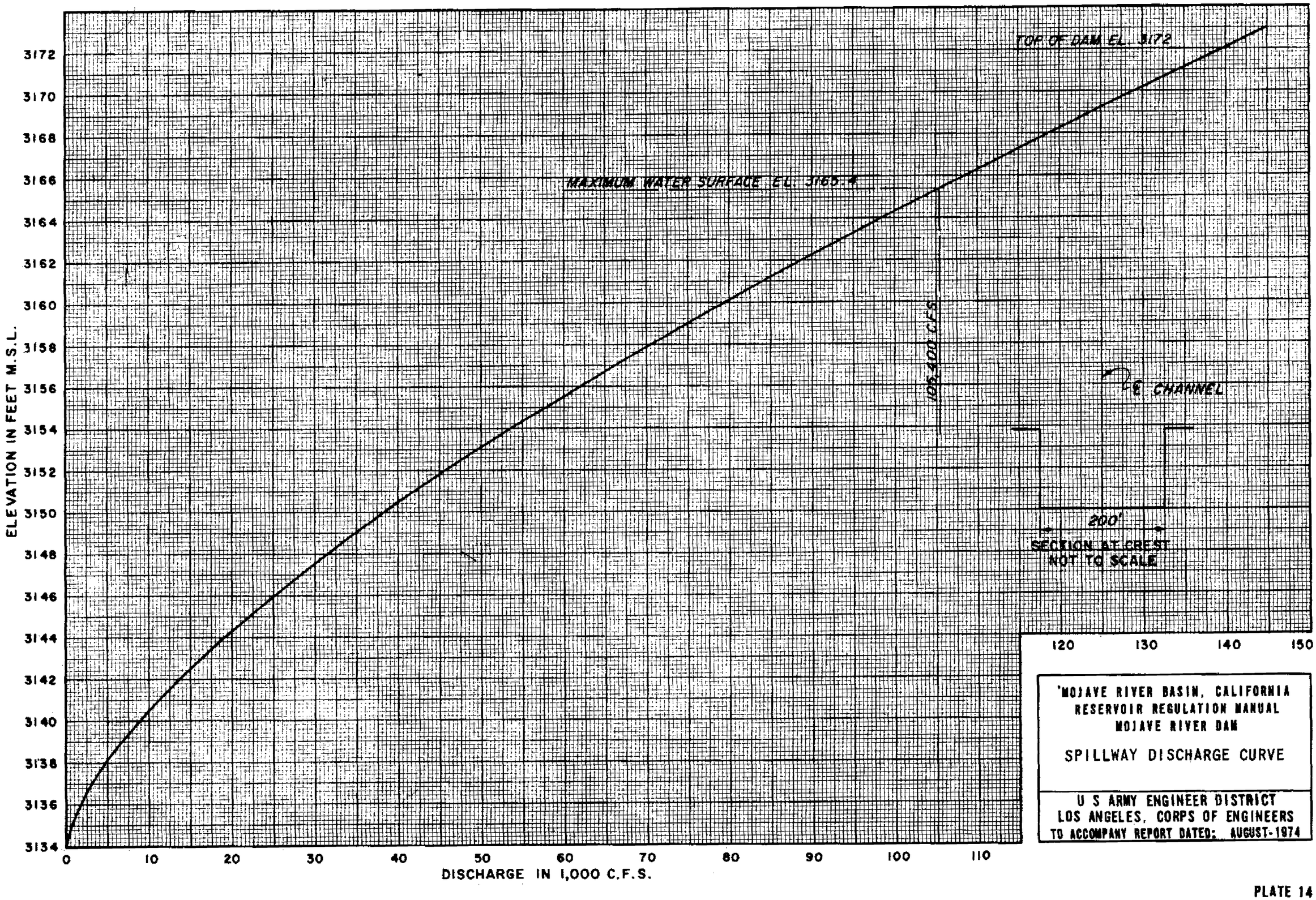
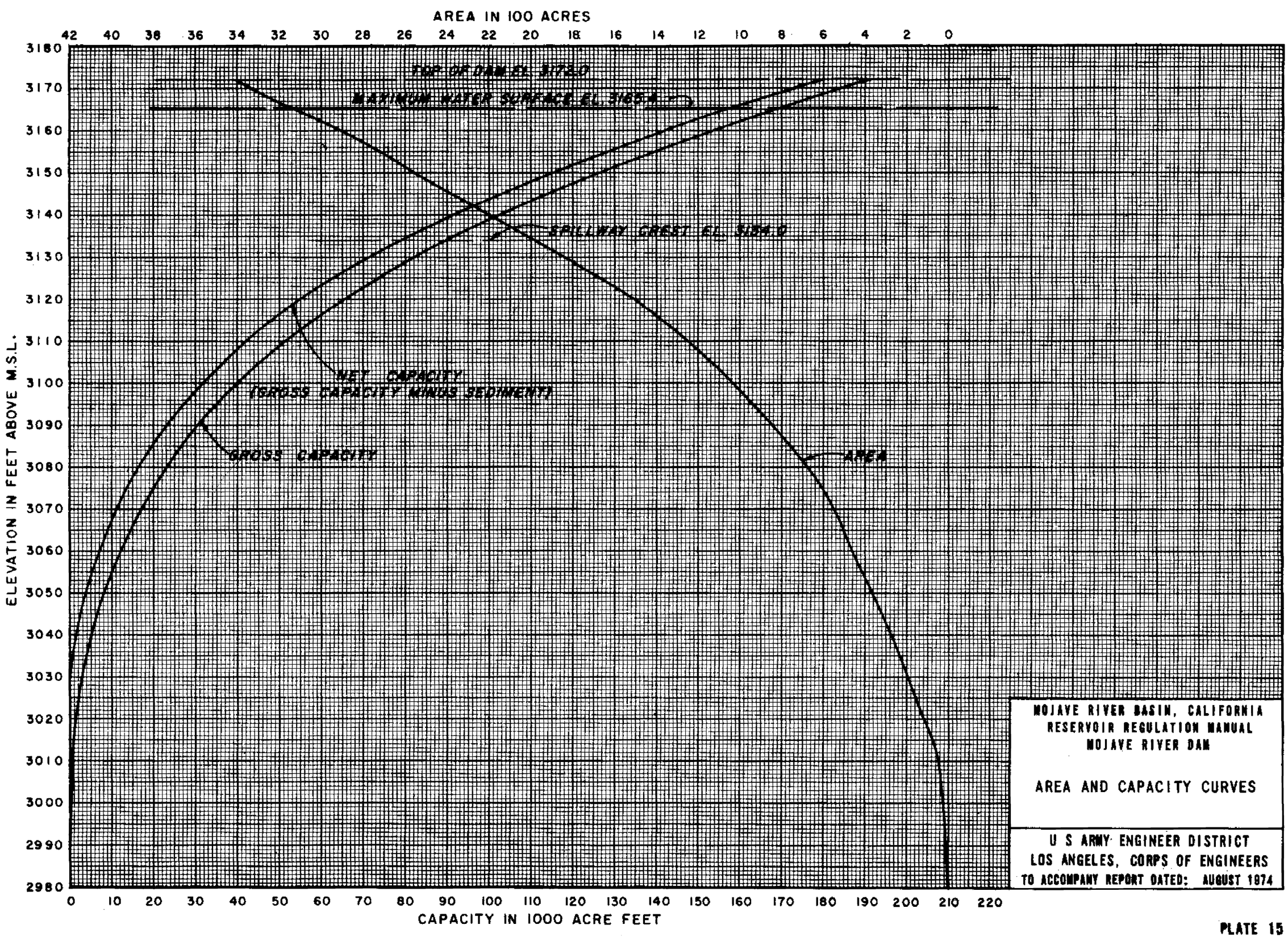


'MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

SPILLWAY DISCHARGE CURVE

U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST-1974

PLATE 14

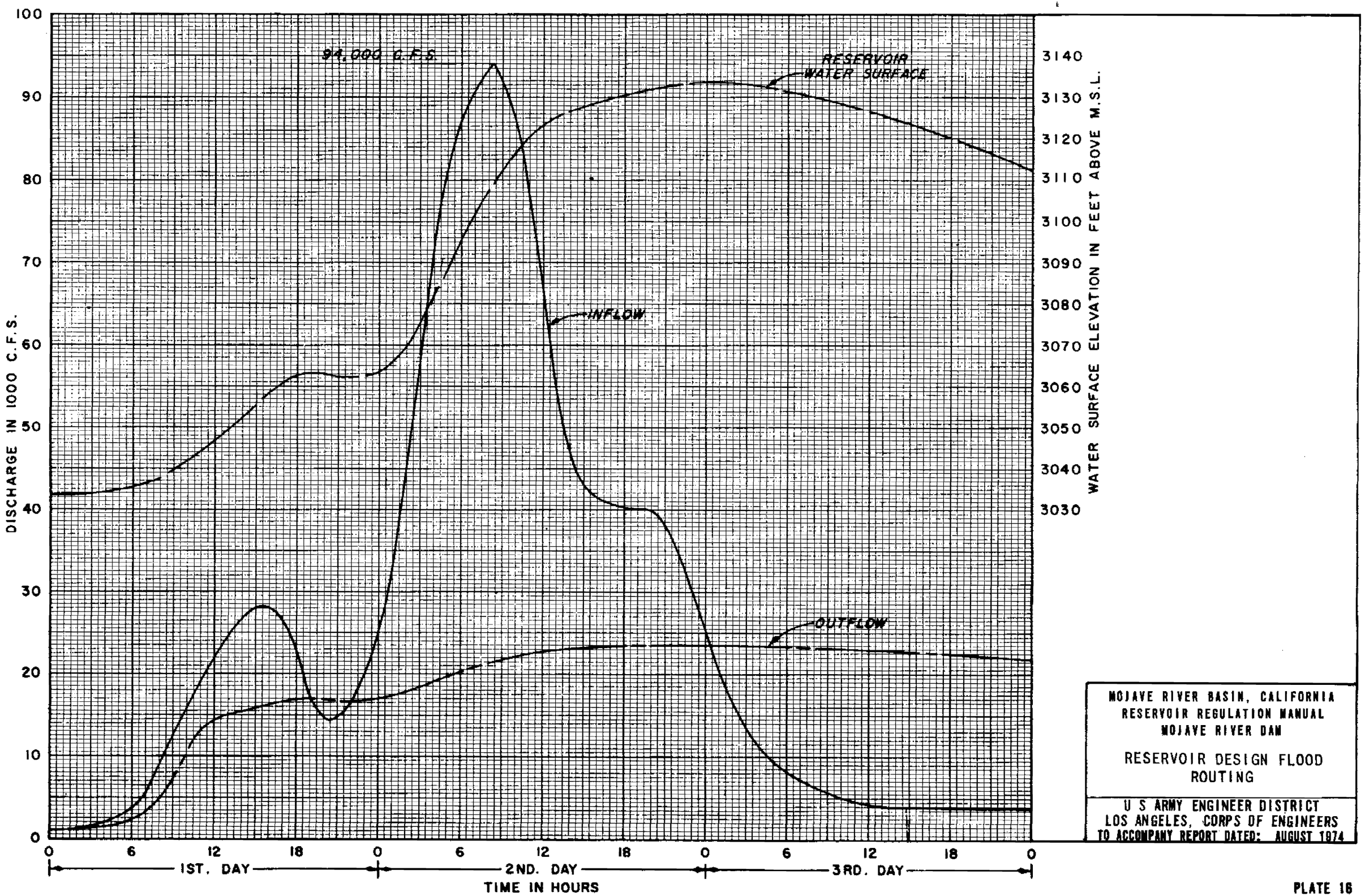


MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

AREA AND CAPACITY CURVES

U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST 1974

PLATE 15

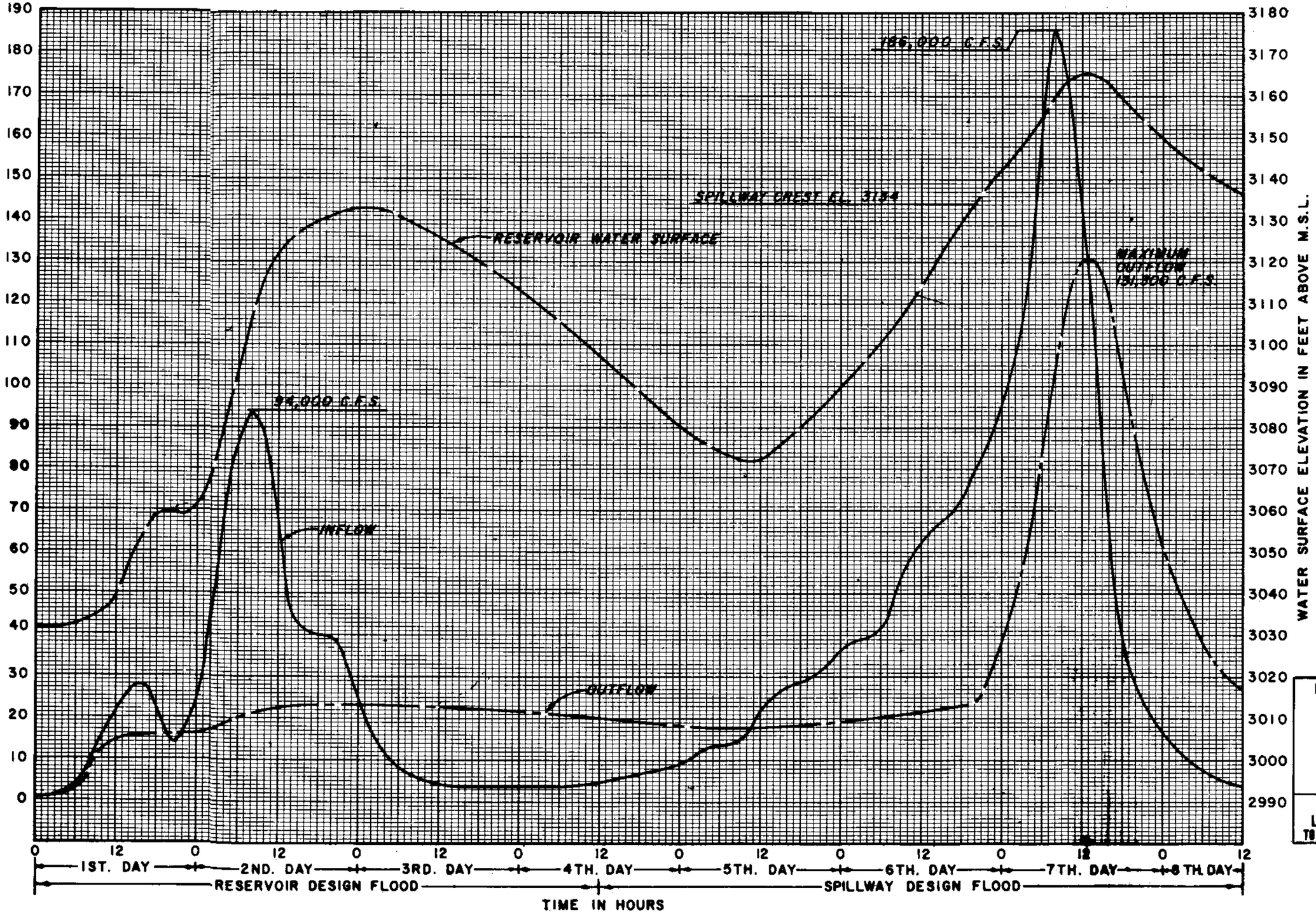


MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

RESERVOIR DESIGN FLOOD ROUTING

U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST 1974

PLATE 16



MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

SPILLWAY DESIGN FLOOD ROUTING

U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST 1974

PLATE 17

JOSHUA TREE LAKE
(Future)

OPERATIONAL AREA

ADMINISTRATION AREA

CEDAR HILL CAMPING &
PICNICKING AREA (Initial)

WATER SURFACE, RESERVOIR DESIGN FLOOD El 3134.0

SYCAMORE PICNIC AREA
(Future)

PINE GROVE CAMPGROUNDS
(Future)

SERRANO BEND
(Deep Creek Area)
(Future)

OVERLOOK AREA
(Initial)

TWIN OAKS NATURAL AREA
(Initial & Future)

GOLDEN MEADOW TRAILER CAMP
(Initial)

JEDEHIAH SMITH RIDING & HIKING TRAILS
(Initial & Future)

FRANCISCO GARCES AREA
(Future)

VICINITY MAP

REFERENCE:

TOPOGRAPHY REDUCED AND TAKEN FROM SAN BERNARDINO COUNTY FLOOD CONTROL. MAPS PREPARED BY STEREOPHOTOGRAMMETRIC METHODS FROM PHOTOGRAPHY DATED MARCH 24, 1952. CONTROLLED BY U.S.C. & G.S. - S.B.C.F.C.D. & S.B.C.S. SECTIONS, 12-13-14-21-22-23-24-26-27-28-29-32-33, T.3N. - R.4 W. AND SECTIONS, 18 & 19 - T.3 N. - R.3 W. PLOTTED FROM OFFICIAL RECORDS, SAN BERNARDINO COUNTY, CALIFORNIA.

CONTOUR INTERVAL 15 5, 10, & 25 FT.

DATUM IS MEAN SEA LEVEL

PLAN

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

RECREATIONAL DEVELOPMENT

U S ARMY ENGINEER DISTRICT
LOS ANGELES CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST 1974

PLATE 18

CHAIN OF COMMAND FOR RESERVOIR OPERATIONS DECISIONS

Corps of Engineers
Los Angeles District

Title	Office Phone Number
District Engineer	(213) 894-5300 FTS 798-5300
Chief, Engineering Division	(213) 894-5470 FTS 798-5470
Chief, Hydrology & Hydraulic Branch	(213) 894-5520 FTS 798-5520
Chief, Hydrologic Engineering Section	(213) 894-4753 FTS 798-4753
Chief, Reservoir Regulation Unit	(213) 894-4756 FTS 798-4756

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

CHAIN OF COMMAND FOR
RESERVOIR OPERATIONS DECISIONS

U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUG. 1974

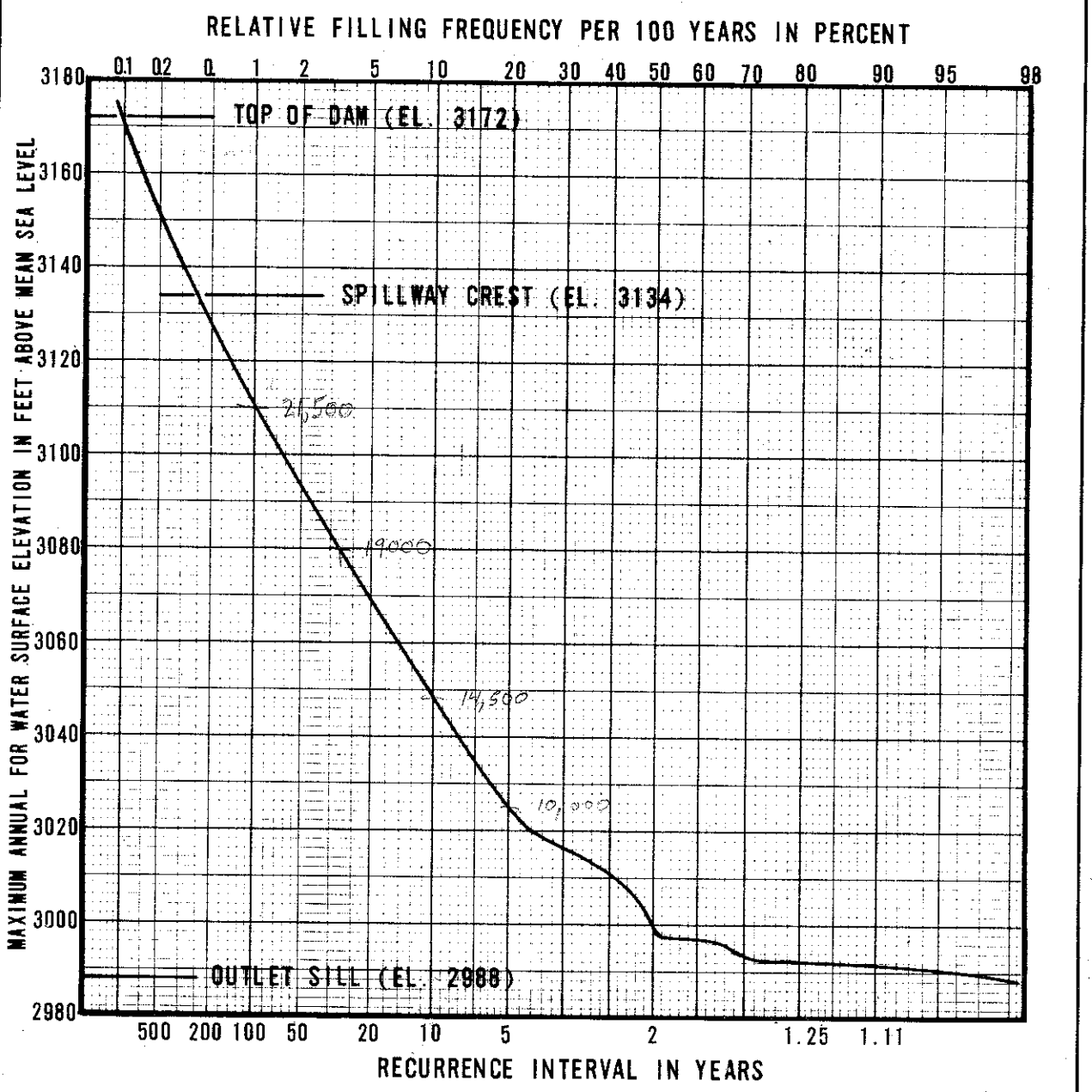
PLATE 19

Revised September 1985

NOTE

Plates 20, 21 and 22 are deleted. The information on these plates is outdated and has been revised, consolidated and included on plate 19.

Revised September 1985



NOTE:

FILLING FREQUENCY IS BASED ON ANNUAL SERIES FOR WATER YEARS 1938-39 TO 1968-69 INCLUSIVE.

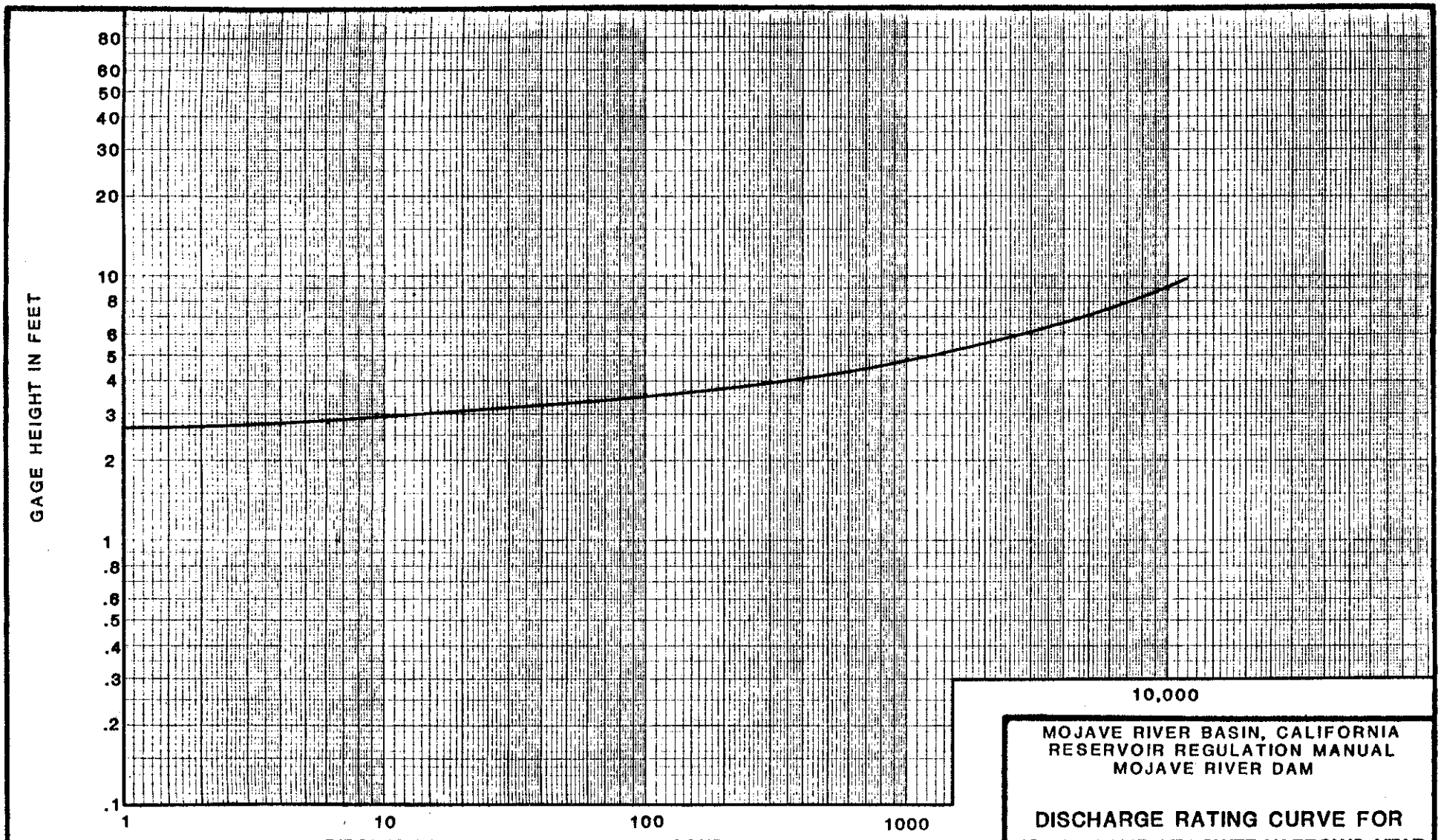
GROSS CAPACITY BASED ON TOPOGRAPHIC SURVEYS OF 1962 AND 1965, WAS USED TO DERIVE FILLING FREQUENCY.

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

FILLING FREQUENCY

U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST 1974

PLATE 23



NOTE:

1. RATING CURVE NO. 23 SUPPLIED BY UNITED STATES GEOLOGICAL SURVEY.
2. ZERO FLOW AT GAGE HEIGHT OF 2.30 FEET

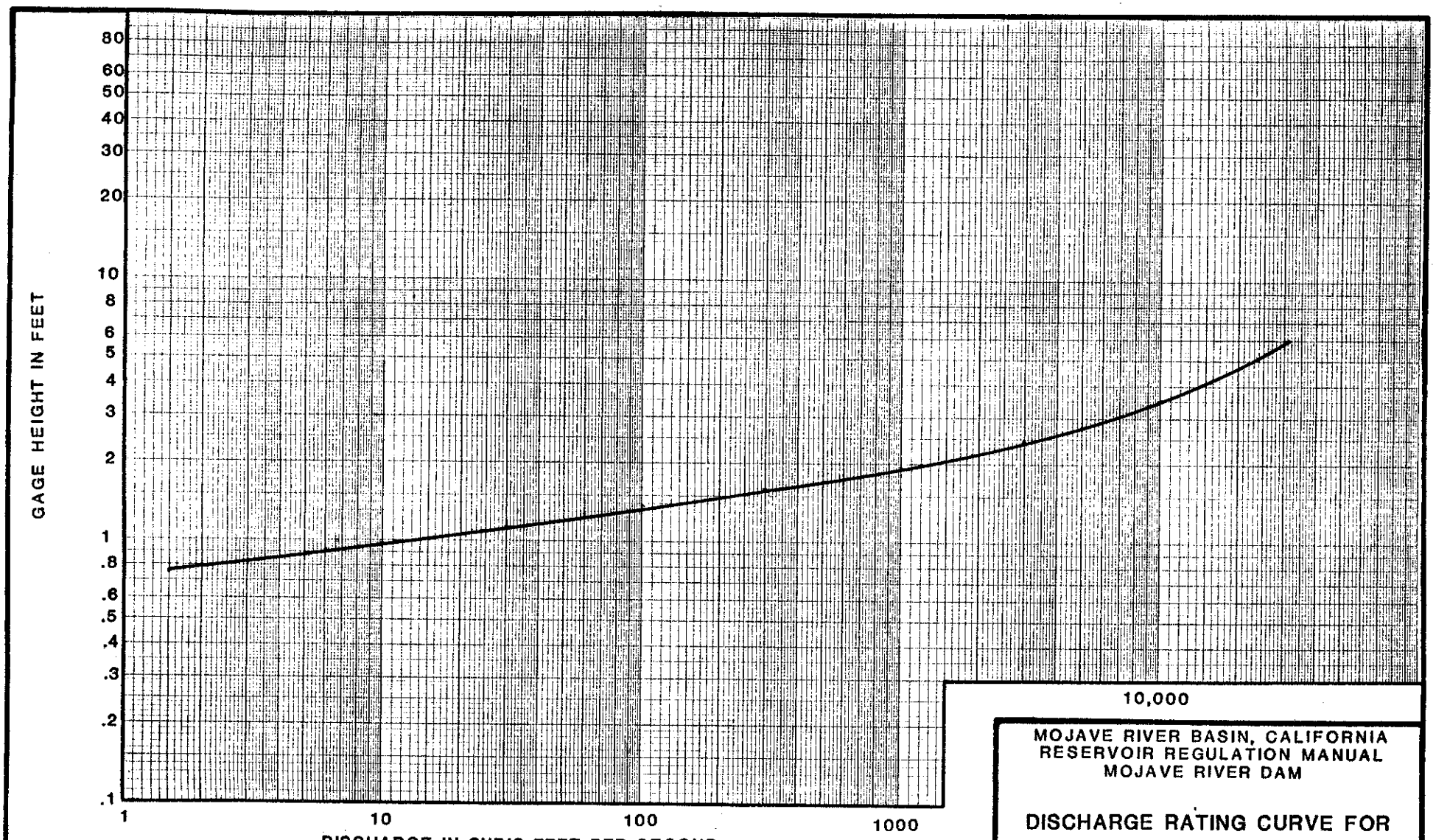
STREAM GAGE NO. 10261500

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

DISCHARGE RATING CURVE FOR MOJAVE RIVER AT LOWER NARROWS, NEAR VICTORVILLE, STREAM GAGING STATION

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUG 1974

REVISED SEPTEMBER 1985



NOTE:

1. RATING CURVE NO. 3 SUPPLIED BY UNITED STATES GEOLOGICAL SURVEY.
2. ZERO FLOW AT GAGE HEIGHT OF 0.60 FEET

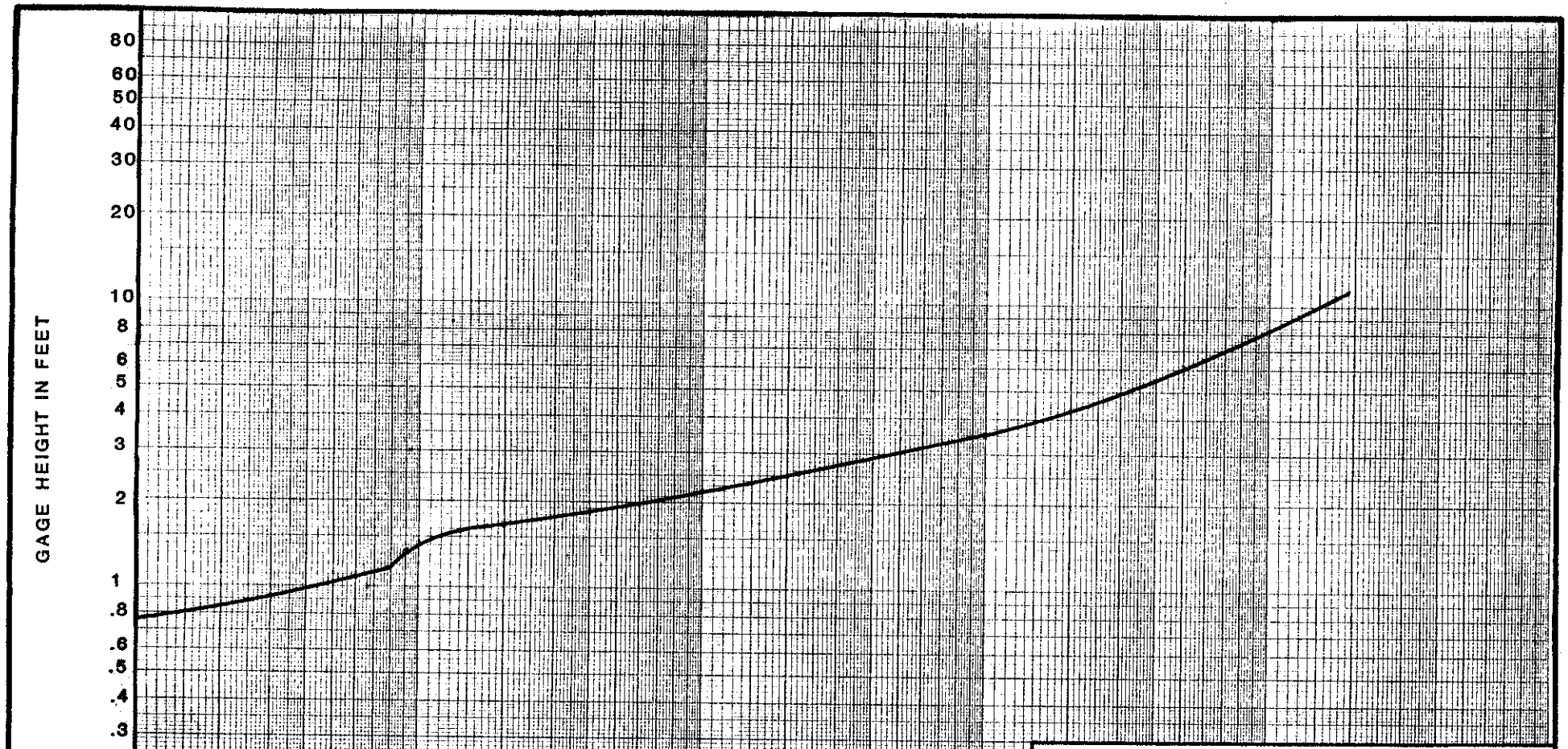
STREAM GAGE NO. 10262500

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

DISCHARGE RATING CURVE FOR MOJAVE RIVER AT BARSTOW STREAM GAGING STATION

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUG 1974

REVISED SEPTEMBER 1985



NOTE:

1. RATING CURVE NO. 7 SUPPLIED BY UNITED STATES GEOLOGICAL SURVEY.
2. ZERO FLOW AT GAGE HEIGHT OF 0.50 FEET

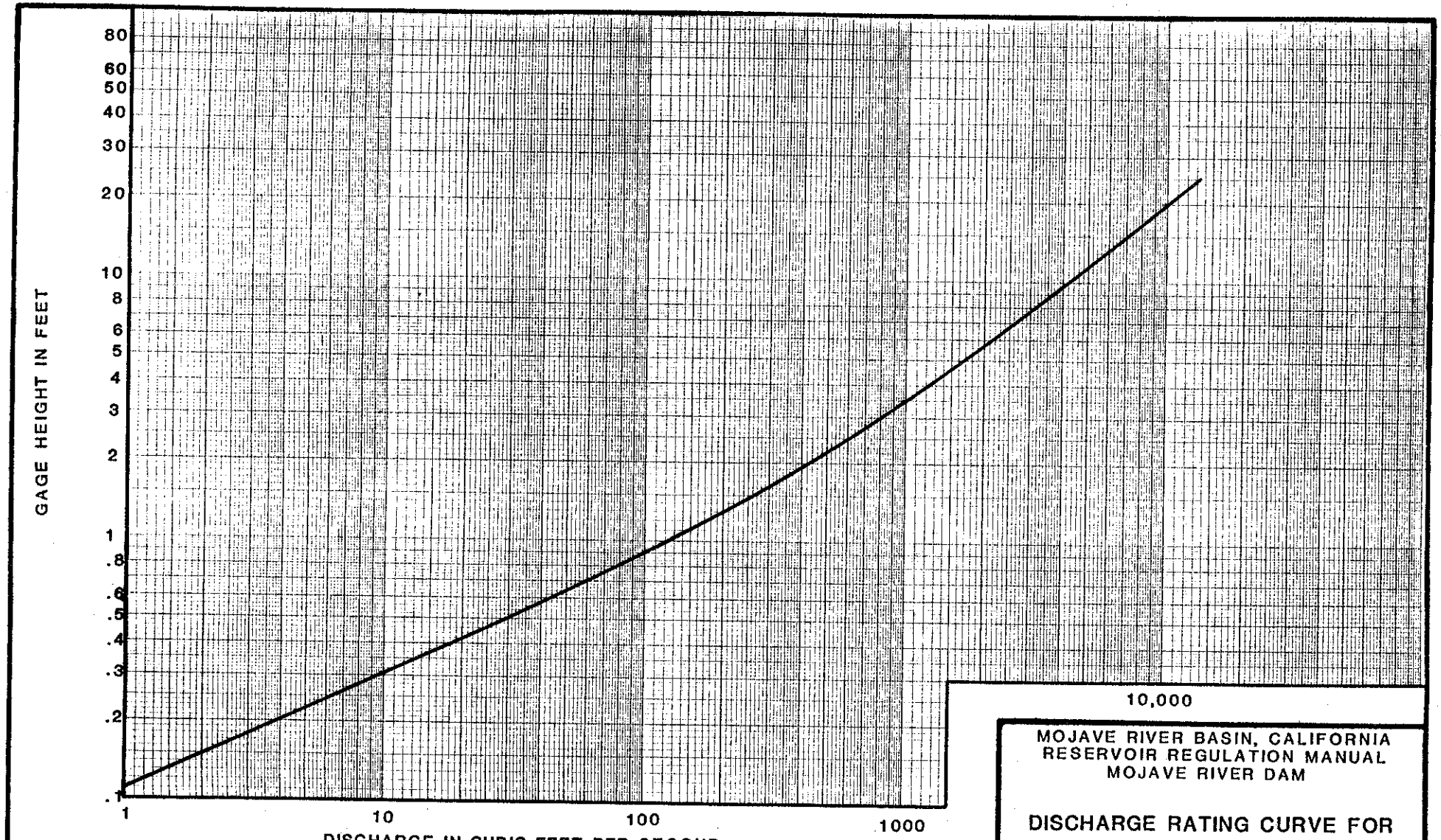
STREAM GAGE NO. 10260500

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

DISCHARGE RATING CURVE FOR
DEEP CREEK NEAR HESPERIA
STREAM GAGING STATION

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUG 1974

PLATE 26



NOTE:

1. RATING CURVE NO. 6 SUPPLIED BY UNITED STATES GEOLOGICAL SURVEY.
2. ZERO FLOW AT GAGE HEIGHT OF 0.01 FEET

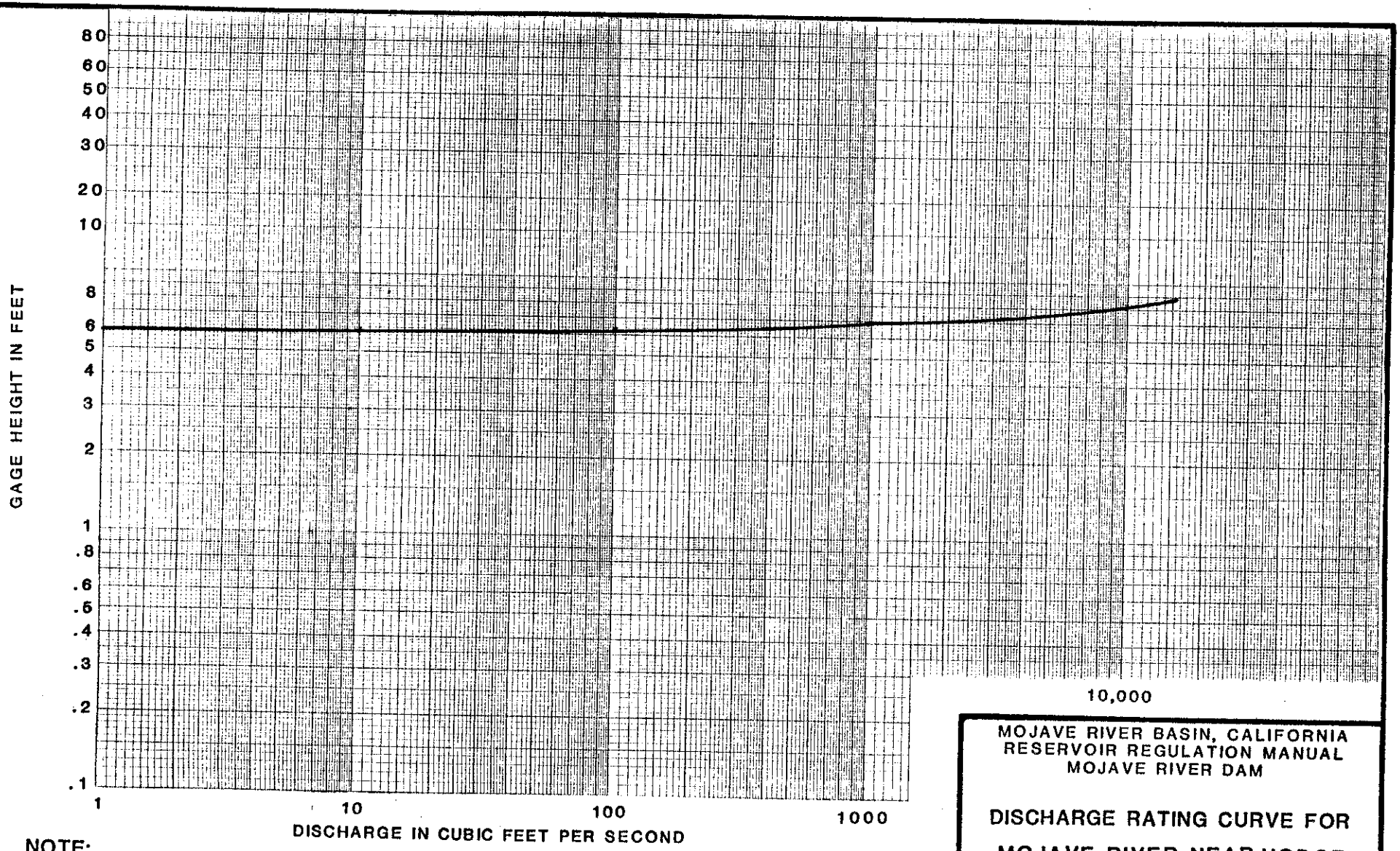
STREAM GAGE NO. 10261000

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

DISCHARGE RATING CURVE FOR WEST FORK MOJAVE RIVER, NEAR HESPERIA STREAM GAGING STATION

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUG 1974

PLATE 27



NOTE:

1. RATING CURVE NO. 4 SUPPLIED BY UNITED STATES GEOLOGICAL SURVEY.
2. ZERO FLOW AT GAGE HEIGHT OF 5.92 FEET

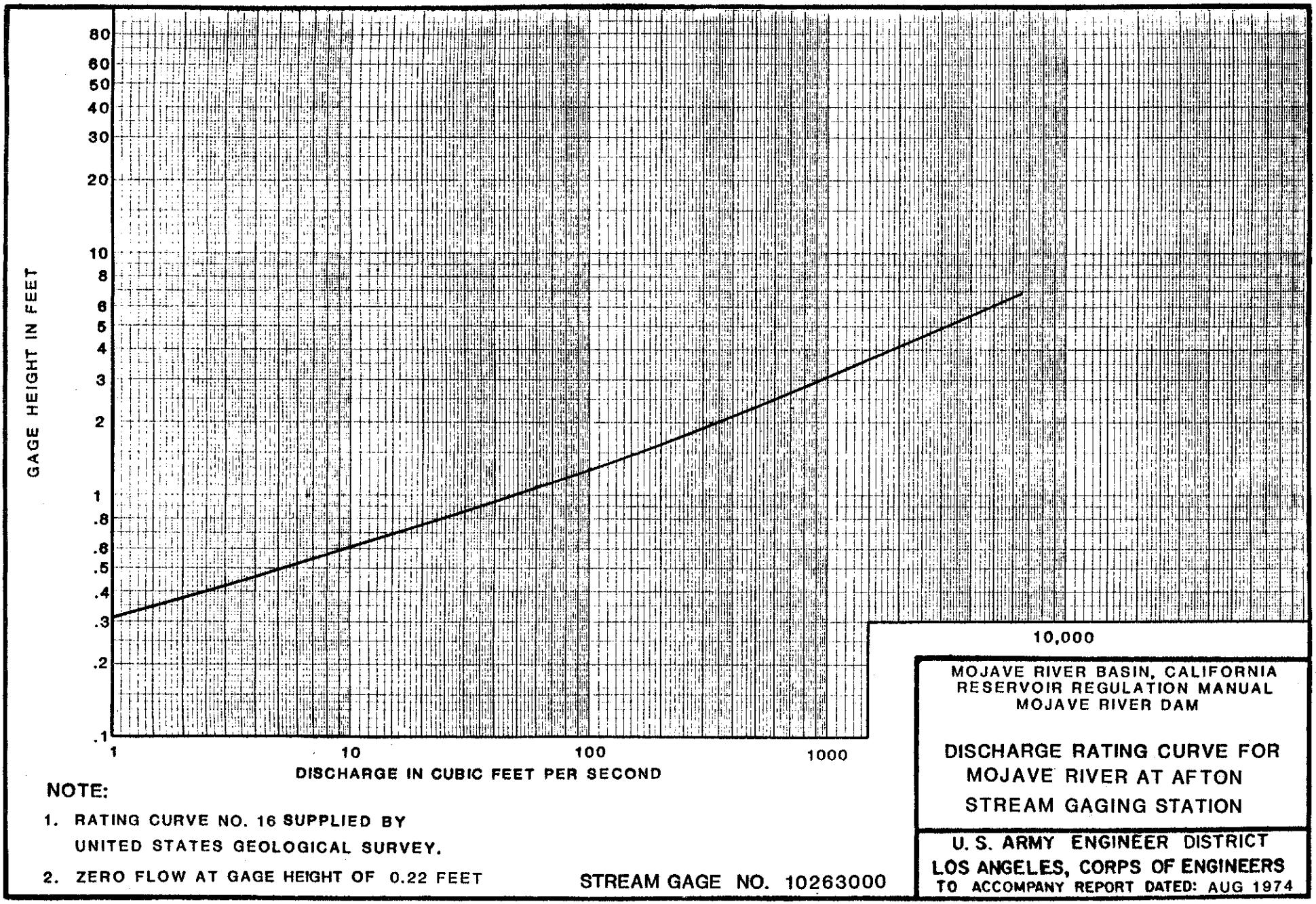
STREAM GAGE NO. 10262000

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

DISCHARGE RATING CURVE FOR MOJAVE RIVER NEAR HODGE STREAM GAGING STATION

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUG. 1974

PLATE 28



NOTE:

1. RATING CURVE NO. 16 SUPPLIED BY UNITED STATES GEOLOGICAL SURVEY.
2. ZERO FLOW AT GAGE HEIGHT OF 0.22 FEET

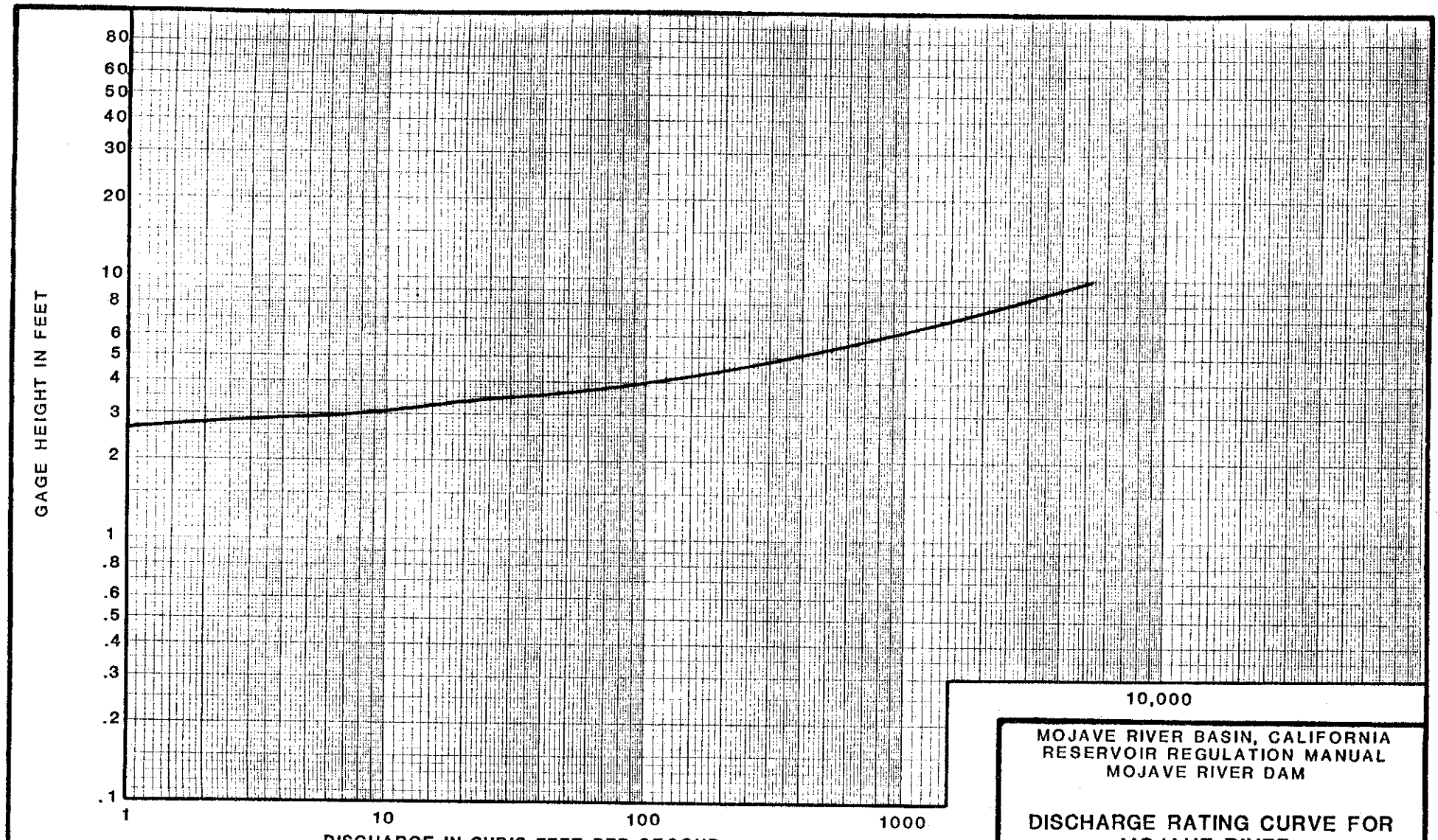
STREAM GAGE NO. 10263000

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

DISCHARGE RATING CURVE FOR
MOJAVE RIVER AT AFTON
STREAM GAGING STATION

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUG 1974

PLATE 29



NOTE:

1. RATING CURVE NO. 5 SUPPLIED BY STATE OF CA. - DEPT. OF WATER RESOURCES
2. ZERO FLOW AT GAGE HEIGHT OF 2.33 FEET

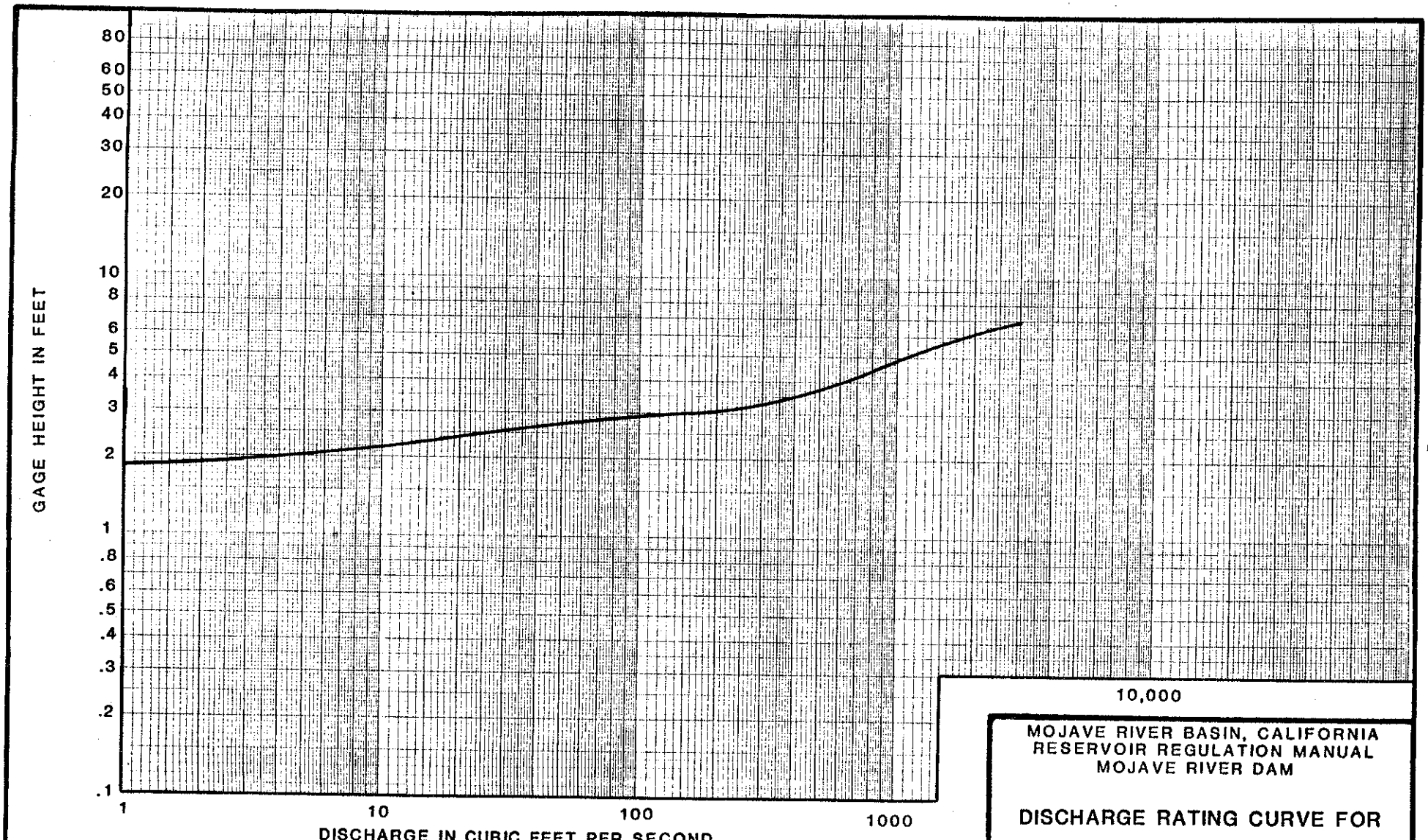
STREAM GAGE NO. V9-2250

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

DISCHARGE RATING CURVE FOR MOJAVE RIVER, EAST FORK OF THE WEST FORK, ABOVE CEDAR SPRINGS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUG 1974

PLATE 30



NOTE:

1. RATING CURVE NO. 8 SUPPLIED BY STATE OF CA. - DEPT. OF WATER RESOURCES
2. ZERO FLOW AT GAGE HEIGHT OF 1.43 FEET

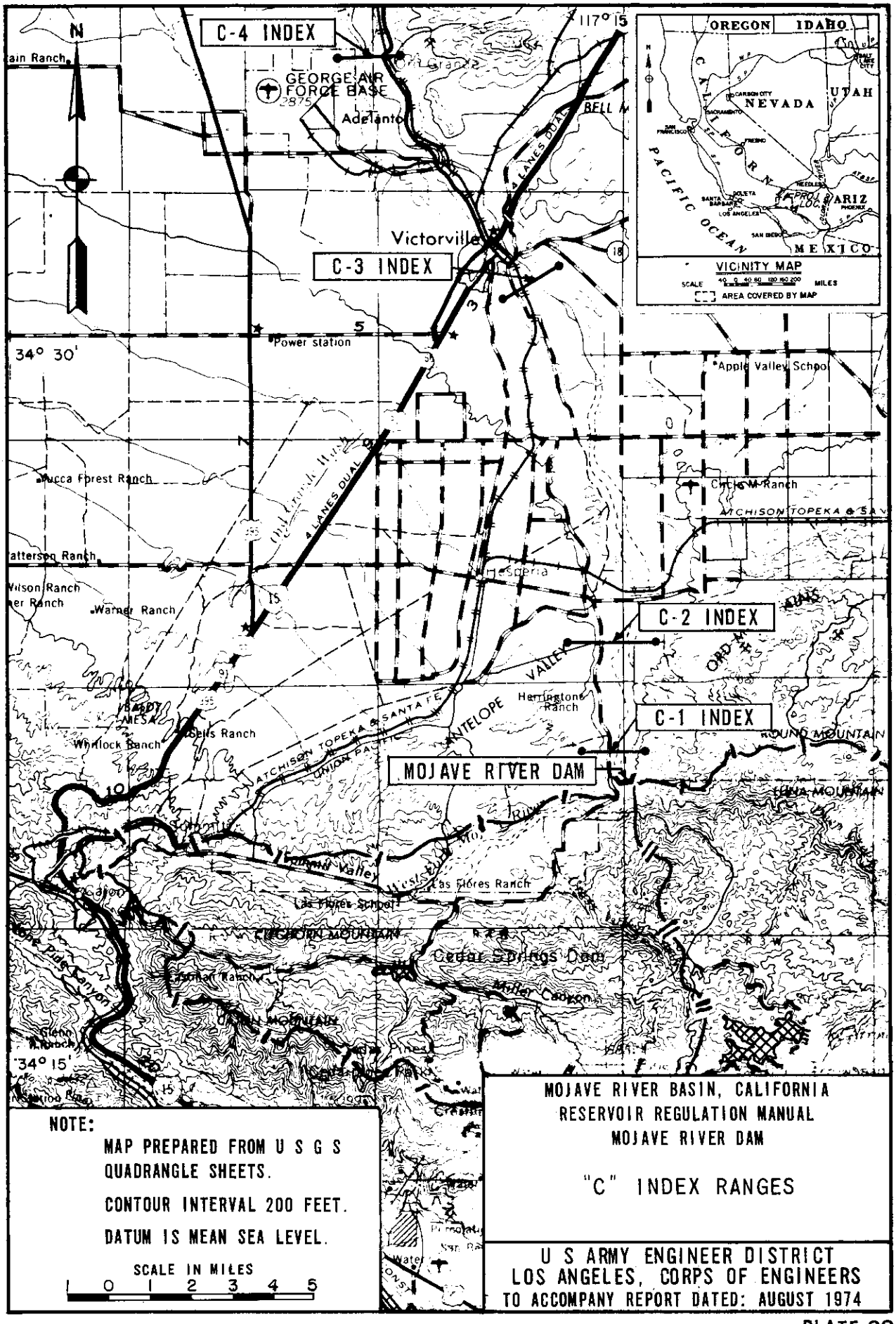
STREAM GAGE NO. V9-2300

MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

DISCHARGE RATING CURVE FOR MOJAVE RIVER, WEST FORK, ABOVE CEDAR SPRINGS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST 1974

PLATE 31



MOJAVE RIVER BASIN, CALIFORNIA
RESERVOIR REGULATION MANUAL
MOJAVE RIVER DAM

"C" INDEX RANGES

U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED: AUGUST 1974

PLATE 33