McDonald 267

Devil Canyon Project - Alaska

DEVIL CANYON DAM SITE

INFLOW DESIGN FLOOD STUDY

Hydrology Branch
Div. of Project Invest. Denver June 1959

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COMMISSIONER'S OFFICE
BUILDING 53, DENVER FEDERAL CENTER
DENVER 2, COLORADO

REPLY REFER TO D-755

Air Mail

JUL - 9 1959

Have 1 copy

To: District Manager, Juneau, Alaska

From: Chief Development Engineer

Subject: Inflow design flood study for Devil Canyon Dam Site--
Devil Canyon Project, Alaska
(your letter dated October 22, 1958)

Preparation of the inflow design flood for Devil Canyon Dam site requested by the reference letter has been completed. The inflow design flood which is recommended for use in the preparation of feasibility estimates has a peak of 150,000 cfs and a 15-day volume of 2,000,000 acre-feet, and is presented graphically on Plate 1 of the study.

The routing recommendation would be to assume water surface elevation of the Devil Canyon Reservoir at the top of conservation storage at the beginning of the hydrograph.

The diversion during construction hydrographs which were derived in this study are presented graphically on Plate 9. These data include computed probable flood frequency values as tabulated below, and the daily discharge hydrographs for the Susitna River at Gold Creek for the years 1955 and 1956.

| Frequency (years) | Peak (cfs) | 15-day volume (acre-feet) | 30-day volume (acre-feet) |
|---|---|---|---|
| 5 | 50,000 | 1,093,000 | 1,952,000 |
| 10 | 55,000 | 1,190,000 | 2,063,000 |
| 25 | 61,000 | 1,289,000 | 2,200,000 |

Two copies of the inflow design flood study that discusses in detail the derivation of the inflow design flood are being transmitted to you under separate cover.

Under separate cover (78511)

J. R. Riter

Denver, Colorado

June 29, 1959

Memorandum

To: Head, Flood Hydrology Section

From: Donald L. Miller

Subject: Inflow design flood study for Devil Canyon Dam site--Devil Canyon Project, Alaska

AUTHORITY

District Manager's letter of October 22, 1958, requested the preparation of an inflow design flood for the Devil Canyon Dam site, Devil Canyon Project, Alaska, suitable for use in feasibility estimates being prepared in the Denver office.

RECOMMENDATIONS

An inflow design flood having a peak of 150,000 cfs and a 15-day volume of 2,000,000 acre-feet, as presented graphically on Plate 1, is recommended for use in the preparation of feasibility estimates for Devil Canyon Dam site.

Information recommended for use for estimating diversion requirements during construction is presented in Plate 9. These data include computed probable flood frequency values as tabulated below and the daily discharge hydrographs for the Susitna River at Gold Creek for the years 1955 and 1956.

| Frequency (years) | Peak (cfs) | 15-day volume (acre-feet) | 30-day volume (acre-feet) |
|---|---|---|---|
| 5 | 50,000 | 1,093,000 | 1,952,000 |
| 10 | 55,000 | 1,190,000 | 2,063,000 |
| 25 | 61,000 | 1,289,000 | 2,200,000 |

## DESCRIPTION OF THE STUDIES

### Description of the Basin

A map of the Susitna River drainage basin above the Gold Creek stream gaging station and showing the location of Devil Canyon Dam site is presented on Plate 2. Devil Canyon Dam will control approximately 6,100 square miles of drainage area.

The headwaters of the Susitna River originate in the Alaska Range, which contains a perennial cover of snow and ice which is the source of the Glaciers which come out of the Alaska Range and feed the Susitna River. The braided stream channels shown on Plate 1 depict the drainage from these glaciers, which also carry an extremely heavy sediment load. Immediately below the mountains, the area is flat, with hundreds of lakes caused by depressions left as the glaciers receded. Many of these depressions lack surface outlets, while others have small natural outlets that are conducive to long lag times. The reason for the lack of drainage patterns is that the recession of the glaciers has been so recent that there has not been sufficient time to develop an adequate drainage pattern.

The vegetative cover immediately below the perennial snow cover of the Alaska Range consists of muskeg and tundra, underlain by permafrost. Below the 3,000-foot elevation some small spruce and hemlocks, mostly under 20 feet in height, and small birch trees are found. The tundra and muskeg have the capability to detain rainfall or snowmelt, causing extremely long lag times.

The Susitna River is rather deeply entrenched for 25 miles or so above Devil Canyon Dam site, with somewhat steeper slopes. There are some bare rock outcroppings in this area, which would result in lower retention rates than in the upper and middle part of the basin. In the next 25 miles there is a gradual transition from the deeply entrenched channel to the broad, flat plains of the middle portion of the Susitna drainage basin. The southeast portion of this drainage area is confined to the very flat lake area drained by the Tyone River. It is believed that any flood peaks from this area would be flattened due to the effect of the lakes.

The Susitna River also drains the Talkeetna Mountains, which form a ridge along the southwest portion of the drainage basin. These mountains, although somewhat lower than the Alaska Range, contain small glaciers, and some of the streams originating from this area are glacier fed. The Talkeetna Mountain Range forms a natural barrier to the moist air from Bering Sea and the Cook Inlet, thereby reducing the storm potential of the Susitna drainage basin.

## Streamflow Records

The following discharge records were available for streams in the Susitna River Basin:

Susitna River at Gold Creek; drainage area 6,160 square miles (approximately); period of record, August 1949 through September 1958

Susitna River near Denali; drainage area 950 square miles (approximately); period of record, May 1957 through September 1958

Maclaren River near Paxson; drainage area 280 square miles (approximately); period of record, June through September 1958

Data from the records of the Susitna River near Denali and the Maclaren River near Paxson were not used in this study. Hydrographs of the daily discharge of the Susitna River at Gold Creek for the years 1949 through 1957 are shown on Plates 3 and 4. The provisional record for 1958 was available for use in the computations but was not plotted because it has several periods of estimated discharge.

## Precipitation and Temperature Records

There are no precipitation or temperature records for stations within the Susitna River Basin above Gold Creek. Locations of such stations near the basin are shown on Plate 2. Records at most of these stations are short - 10 to 20 years. The longest record is at Talkeetna, having precipitation and temperature records from July 1918 to date.

## Drainage area Measurement

The drainage area map presented on Plate 2 was prepared using maps of scale 1/250,000 edited and published by the U. S. Geological Survey. Planimetering the areas above the gaging station at Gold Creek and above Devil Canyon Dam site as shown on Plate 2 gave drainage areas of 6,290 and 6,160 square miles, respectively. Water Supply Paper 1486 lists a drainage area of 6,160 square miles, approximately, for the gaging station. Since the area tributary to the Susitna River between Devil Canyon Dam site and the gaging station at Gold Creek is approximately 2 percent of the total area above the gaging station, discharges at the gaging station were considered representative of discharges at the dam site without adjustment.

A total glacier-covered area of 215 square miles within the watershed above Devil Canyon Dam site was measured from the map. Discussions later in this memorandum point out our primary interest in the study is the rainfall-runoff contributing area. The description of the basin has discussed the presence of flat areas and numerous lakes which are noncontributing or partially contributing to rainfall-runoff. Future study may warrant a firm determination of contributing and noncontributing areas. A value of 6,100 square miles <u>contributing area</u> was used in this study for all computations of runoff, both at the gaging station and at the dam site.

<u>Critical Flood Conditions</u>

The Susitna River is primarily snowmelt and glacier-fed stream. However, examination of the daily hydrographs (Plates 3 and 4) show many rises that coincide with times at which precipitation has been recorded at the precipitation stations near the basin. Runoff from rainfall is quite evident during the months of August and September, the largest recorded event being that of August 1955 which will be discussed later in detail. Since there are no precipitation stations within the basin, climatic conditions must be estimated from the records of nearby stations. Talkeetna at elevation 345 feet, mean sea level, is located in the Susitna River Valley downstream from the dam site and southwest of the drainage basin. This location is in the path of the usual flow of moist air which supplies precipitation to the watershed. The following table lists mean monthly precipitation amounts for Talkeetna, period of record 1918-1957.

| Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.90 | 1.82 | 1.84 | 0.93 | 1.27 | 1.65 | 3.42 | 5.08 | 5.02 | 3.46 | 1.78 | 1.7[illegible] |

The above table shows April, May, and June as the months of least amount of average precipitation while August and September have the greatest amounts. Streamflow during the months May, June and into July originates chiefly from melting of the snow cover over the lower elevations. The chance of a major rainstorm occurring during this period is extremely unlikely. During the latter part of July and in August and September, glacier melt maintains a relatively high discharge in the river. This factor combined with the occurrence of a major rain storm is the situation most likely to produce the greatest peak discharge. Although the proposed reservoir above Devil Canyon Dam will be large, it will not have sufficient surcharge storage space to completely control runoff that may originate from rainfall. Therefore, the critical flood for design will be that resulting from the occurrence of a maximum probable rain storm in conjunction with a high discharge from glacier melt and a reservoir filled by previous snowmelt runoff.

Limitations due to Available Data

Analyses of recorded flood events and computation of the inflow design flood were made using mean daily discharge amounts and 24-hour precipitation amounts because data for using smaller time increments were not available.

Approach for Developing the Inflow Design Flood

The following approach was adopted after having determined from general analysis that the maximum probable rain flood would be critical for design.

1. Analysis of the August 1955 flood for development of a 24-hour unitgraph and a retention rate

2. Comparison of August 1955 storm with other storms of record

3. Determination of design precipitation amounts

4. Selection of applicable glacier-melt discharge as "base flow"

5. Computation of inflow design rain flood applying adopted unitgraph, retention rate and design storm values

Analysis of August 1955 Flood

The hydrograph of daily discharge of the Susitna River at Gold Creek for August 1 through September 23 is shown on Plate 5. The event which peaked on August 26 was analyzed and by trial-and-error procedure the 24-hour unitgraph shown on Plate 6 was obtained. This analysis consisted of subtracting a base flow of 10,000 cfs as representing glacier-melt contribution and making trial separations of the net hydrograph using an indicated recession constant of 0.75. Since the net hydrograph resulted from more than one unit time (24 hours) of precipitation, increments of excess precipitation were assumed proportional to daily amounts reported at Talkeetna and the unitgraph computed by a modification of the progressive average procedure. Unitgraph values were last tested by making the separation shown on Plate 5 and computing the hydrograph values shown for comparison with the net rainflood hydrograph. This comparison was considered sufficiently satisfactory to adopt the unitgraph for computation of the inflow design flood.

During this analysis various approaches were made to estimate average precipitation over the basin in order to determine a usable retention rate. Since Talkeetna is located in the path of the moist air traveling toward the basin, an attempt was made to use Talkeetna as a single index station, estimating the precipitation over the basin to be equivalent to the amount of precipitation recorded at Talkeetna. This attempt was partially successful but a somewhat better estimate was believed obtained by including other factors which will be further discussed in subsequent paragraphs. These factors resulted in estimating the August 22-25 precipitation over the basin to be 0.9 times the Talkeetna precipitation amounts.

Although the location of Talkeetna is favorable for use as an index of rainfall occurring over the subject watershed, particularly for large storms generated by conditions similar to those of August 1955, its record cannot be used alone. As indicated on Plate 5, large amounts of precipitation were recorded at Talkeetna on August 26 and 27 but the hydrograph does not show any appreciable runoff associated with these precipitation amounts. However, reports for Summit at elevation 2400 feet show 1 inch of snow fell on August 26 and 6 inches of snow fell on August 27. It was concluded that precipitation over the watershed on these days was mostly in the form of snow and did not contribute runoff to the rainflood portion as separated.

The volume of the rain flood as separated was equivalent to 1.8 inches of runoff from 6,100 square miles. Relating this value to the daily basin average precipitation amounts for the period August 22-25 (0.9 times recorded amounts at Talkeetna) gave an average daily retention rate of 0.83 inch. The incremental excesses applied to the unitgraph gave a favorable reproduction of the net hydrograph as shown on Plate 5. Although a retention rate of about 0.8 inch per day is low by comparison with rates used in many flood studies, it should be considered more as an "index" value than as a real value because of the lack of precipitation data within the basin. There is an inter-relationship between the retention rate, the 1955 storm estimate, the design storm estimate yet to be discussed and the unitgraph. Since 0.8 inch per day was the retention rate obtained as a part of this inter-relationship, it was adopted for use for computing the excess precipitation from the design storm values.

Comparison of the August 22-25, 1955 Storm with other Storms of Record

A search of available precipitation records showed that the storm of September 19-22, 1942 was the largest storm of record in this general area. We made inquiry to the U. S. Weather Bureau office, Anchorage, seeking additional information about this storm. Mr. C. E. Watson, Climatologist, located a record for Middle Fork, an old mining location site established at latitude 63° 10' north, longitude 144° 13' west and operated for less than 1 year but including a record for September 1942, a copy of which was sent to us (1009 Form). The Middle Fork precipitation station was located at an elevation between 4000 and 5000 feet in the Chistochina River drainage to the east of the Susitna Basin (see Plate 2). It is believed the large amount of precipitation recorded at this station during the September 1942 storm is indicative of an orographic effect due to the Alaska range. The following table lists precipitation stations and precipitation amounts recorded for the August 1955 storm and the September 1942 storm.

| | Date | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | August 1955 | | | | September 1942 | | | |
| Station | 22 | 23 | 24 | 25 | 19 | 20 | 21 | 22 |
| Gulkana | T | T | .04 | .12 | | no record | | |
| Meir | .30 | .14 | .32 | .27 | | no record | | |
| Curry | | no record | | | .12 | 1.85 | 2.96 | 2.44 |
| McKinley | .04 | .01 | .05 | .39 | .10 | T | .05 | .15 |
| Rapids | | no record | | | T | .30 | .84 | 1.03 |
| Summit | .07 | .27 | 1.34 | .66 | .02 | 1.08 | 1.74 | .85 |
| Middle Fork | | no record | | | .08 | 1.25 | 3.54 | 1.74 |
| Talkeetna | .95 | 1.88 | 1.93 | .85 | | 2.22 | 3.12 | .81 |

The synoptic situations for these two storms were almost the same, causing moist air to flow from Cook Inlet northeastward toward the Susitna River Basin above Gold Creek. Flow of moist air from Cook Inlet after passing over the Talkeetna precipitation station would encounter lifting due to the Talkeetna Mountains rising to elevations of approximately 5,000 to 6,000 feet. This lift would cause greater precipitation on the windward side of the mountains than would be recorded at valley stations such as Talkeetna but this increased intensity of precipitation would decrease rapidly in the Susitna drainage above Gold Creek on the leeward side of the Talkeetna Mountains. After crossing the middle portion of the subject basin, a second lifting would be effected by the Alaska range rising to peaks of 12,000 and 13,000 feet at the headwaters of the Susitna River. Since there are no precipitation data within the basin by which to evaluate this variation in precipitation believed to occur due to the topographical characteristics, the following reasoning was used to arrive at quantitative values. The 3-day totals, September 20-22, 1942, for Talkeetna and Middle Fork were 6.15 and 6.53 inches, respectively, a rather close agreement. The corresponding 3-day total for Summit was 3.67 inches. An average of daily precipitation recorded at these three stations gave the following: September 20, 1.51 inches; September 21, 2.80 inches; and September 22, 1.13 inches; 3-day total 5.44 inches. In this averaging, it was reasoned that Talkeetna and Middle Fork precipitation amounts might be considered representative of precipitation amounts along the leeward side of the Talkeetna Mountains and the windward side of the Alaska range, respectively, and that precipitation amounts at Summit might represent the precipitation in the middle portion of the basin. It was not believed warranted to try to assign areal distribution to the respective stations as a weighing factor. Another computation made reducing the point rainfall values recorded at Middle Fork to areal rainfall by a factor of 0.8 1/ gave a maximum 1-day value of 2.83 and a 3-day total of 5.22 inches which agreed closely with the 3 station average values. The record at Middle Fork was given weight in considering precipitation amounts because it showed a large amount of precipitation during a general storm at a point well beyond the natural inflow barrier to the moisture source.

As Middle Fork had less than 1 year of record, a comparison between the August 1955 and September 1942 precipitation amounts at that station could not be made. Records at Gulkana and Mair were available for August 1955 but it was believed these stations were not comparable to the location represented by Middle Fork because they were situated at lower elevations and farther away from the Alaska range. The close agreement between 3-day precipitation amounts at Talkeetna and Middle Fork suggested that double weight could be given the Talkeetna record for estimating a basin precipitation value. A 3 station average similar to that computed for the 1942 storm was made by including the record at Summit along with doubled weight for Talkeetna. The 4-day values obtained were:

| August 22 | 23 | 24 | 25 | |
|---|---|---|---|---|
| .66 | 1.34 | 1.73 | .79 | Total 4.52 inches |

Another estimate of average basin precipitation was made using doubled Talkeetna precipitation amounts and substituting 0.7 times Talkeetna precipitation for the Summit record as representing precipitation over the central portion of the watershed. The factor

1/ From Figure 1, Design Storm Values for the Area West of the 105th Meridian, by R. A. Clark.

0.7 was obtained from Table 2, U. S. Weather Bureau and U. S. Corps of Engineers publication "Rainfall Intensities for Local Drainage Design in Artic and Subartic Regions of Alaska, Canada, Greenland and Iceland" September 1955. The 0.7 factor is suggested as a modification factor to be applied to valley rainfall lying in a storm pathway for estimating precipitation on watersheds with slopes having dominately leeward orientation. This method of obtaining average values reduces to a factor of 0.9 times Talkeetna precipitation. Checking this assumption with the 3 station average method used for the 1942 storm, that is, multiplying the September 1942 precipitation amounts reported at Talkeetna by 0.9, gave a maximum 24-hour precipitation of 2.81 and a 3-day total of 5.54 inches compared with the 3 station average values of 2.80 and 5.44 inches, respectively. Applying the 0.9 factor to the August 1955 precipitation amounts at Talkeetna gave the following:

| | | | | | |
|---|---|---|---|---|---|
| August | 22 | 23 | 24 | 25 | |
| | .86 | 1.69 | 1.74 | .76 | Total 5.05 inches |

Testing the two methods of storm estimates by computing an average retention rate and using indicated excess precipitation increments to reconstruct the net rainflood hydrograph (see Plate 5) resulted in a conclusion that the method using the 0.9 factor gave the better results.

Design Precipitation

Mr. H. P. Grout, Head, Flood Hydrology Section, attended a meteorological conference with Hydrologic Services Division, U. S. Weather Bureau, Washington, D. C., December 1958. The following excerpt from Mr. Grout's Travel Report dated December 29, 1958, summarizes discussions pertinent to this study.

"The procedures to be used in deriving a design storm for the Susitna River Basin, Alaska, were discussed with Dr. Gilman and Mr. Paulhus. The Northern Hemisphere Synoptic Charts for September 19 through September 22, 1942, were examined to determine the causes and associated dew points of the so-called storm of record on the Susitna River Basin that occurred during those dates. This period being during World War II, the synoptic situation charts were not available in published form and had to be obtained from their archives. Similarly, the storm of August 22 to 24, 1955, was examined in a like manner, using the Northern Hemisphere Synoptic Siutation Charts. The synoptic situation leading up to these two storms was almost identical. A low-pressure area was located in the Bering Sea and waves were sent out of this low in 24- to 48-hour intervals. Dr. Gilman was of the opinion that the rainfall associated with this type of synoptic situation is primarily orographic and it was his belief that a design storm should be of a similar synoptic situation. Representative dew points for both of these events were found to be 52 degrees. Data were examined for the maximum observed dew point at Anchorage for the approximately 10 years of record which were available in their office. It was found that the highest persisting 12-hour dew point during this period was 56 degrees."

The precipitation amounts for the 3-day period September 20-22, 1942, obtained by averaging reported amounts at Talkeetna, Middle Fork and Summit were accepted as representative of basin average precipitation for that storm period - the largest known recorded storm. Mr. Grout's travel report stated the representative dew point for this storm was 52 degrees and the maximum observed dew point at Anchorage for the period examined was 56 degrees. Additional information concerning persisting dew point temperatures at Anchorage has not been received. However, other storm studies in the Alaska area performed by the Cooperative Studies Section, U. S. Weather Bureau, have shown that 56 degrees is the maximum observed persisting dew point temperature at Juneau which has a longer record. It is believed 56 degrees is an acceptable value to use for storm adjustment in this instance. The September 20-22, 1942 storm values were adjusted to maximum in accordance with procedures outlined in Chapter 6.5 of Volume IV, Reclamation Manual. Computations are shown on Plate 7A. A depth-duration curve for the resulting design storm is shown on Plate 7 along with depth-duration curves for the recorded storm, 1942, and the August 22-24, 1955 storm, basin average values estimated as previously discussed.

Base Flow

A constant base flow of 20,000 cfs was selected as representing a reasonable discharge from glacier melt that might be present at the time of occurrence of a design rain storm during the months of August or September. This value was selected by inspection using the hydrographs shown on Plates 3 and 4. Computation of the maximum probable discharge that might occur during these months due to glacier melt was not believed warranted for combination with runoff from a maximum probable rain storm.

## Inflow Design Flood

An inflow design flood having a peak discharge of 150,000 cfs and a 15-day volume of 2,000,000 acre-feet presented graphically on Plate 1 was computed using the design storm values shown by the depth-duration curve, Plate 7, a daily retention rate of 0.8 inch, the 24-hour unitgraph shown on Plate 6, and adding a constant discharge of 20,000 cfs to the computed flood discharges. This flood is recommended for use for feasibility designs for Devil Canyon Dam site.

## Envelope Curves

An envelope curve of peak discharges for Interior Alaska streams is presented on Plate 8. This curve indicates a peak discharge of 75,000 for 6,100 square miles. The inflow design flood peak discharge is 2 times this value.

An envelope curve study of 15-day volumes has not been prepared for Alaska streams. However, an envelope curve of May-September volumes was presented in the inflow design flood study for Denali Dam site. The control points on this curve were the Susitna River at Gold Creek and the Susitna River near Denali. It can be inferred that records at these stations would control or be near the control points of a 15-day volume envelope curve. The maximum 15-day volume recorded for the Susitna River at Gold Creek was 1,199,000 acre-feet, June 7-21, 1956. The inflow design flood 15-day volume of 2,000,000 acre-feet is 1.67 times the maximum recorded 15-day volume.

## Diversion Requirement During Construction

Frequency curves of maximum annual momentary peak discharges, 15-day volumes and 30-day volumes were computed by Hazen's method using 9 years of available record of the Susitna River at Gold Creek. The probable 5-, 10-, and 25-year values indicated by these curves are tabulated on page 1 and also on Plate 9. The Susitna River rises to high discharge early in June and maintains a relatively high discharge with considerable variations until late in September. The daily hydrographs for the year 1956 which included the maximum 15-day and 30-day volume of record and the year 1955 which included the maximum momentary peak of record are presented on Plate 9 along with the values obtained from the frequency computations as information to be used as a guide for estimating diversion requirements during construction.

Acknowledgments

Grateful acknowledgment is made to the persons listed below for excellent cooperation and assistance in furnishing information helpful to the preparation of this study.

Mr. Marvin J. Slaughter, Engineer
in Charge
U. S. Geological Survey
Water Resources Division, SW
Palmer, Alaska

Mr. C. E. Watson, Climatologist
U. S. Weather Bureau
Anchorage, Alaska

Mr. R. H. Anderson, General Manager
The Alaska Railroad
U. S. Department of Interior
Anchorage, Alaska

Donald L. Miller

I concur:

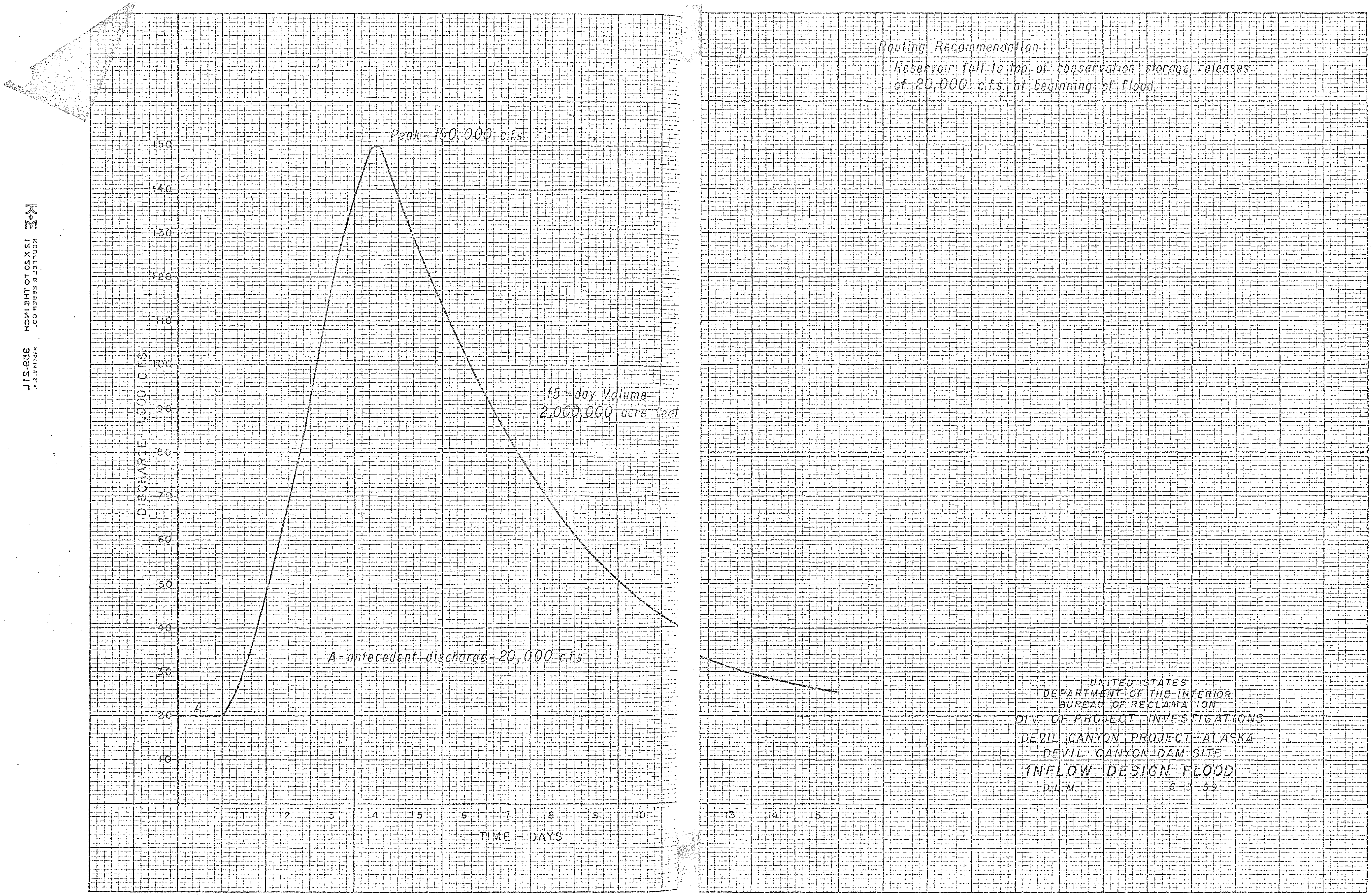
H. P. Grout

Head, Flood Hydrology Section

Approved:

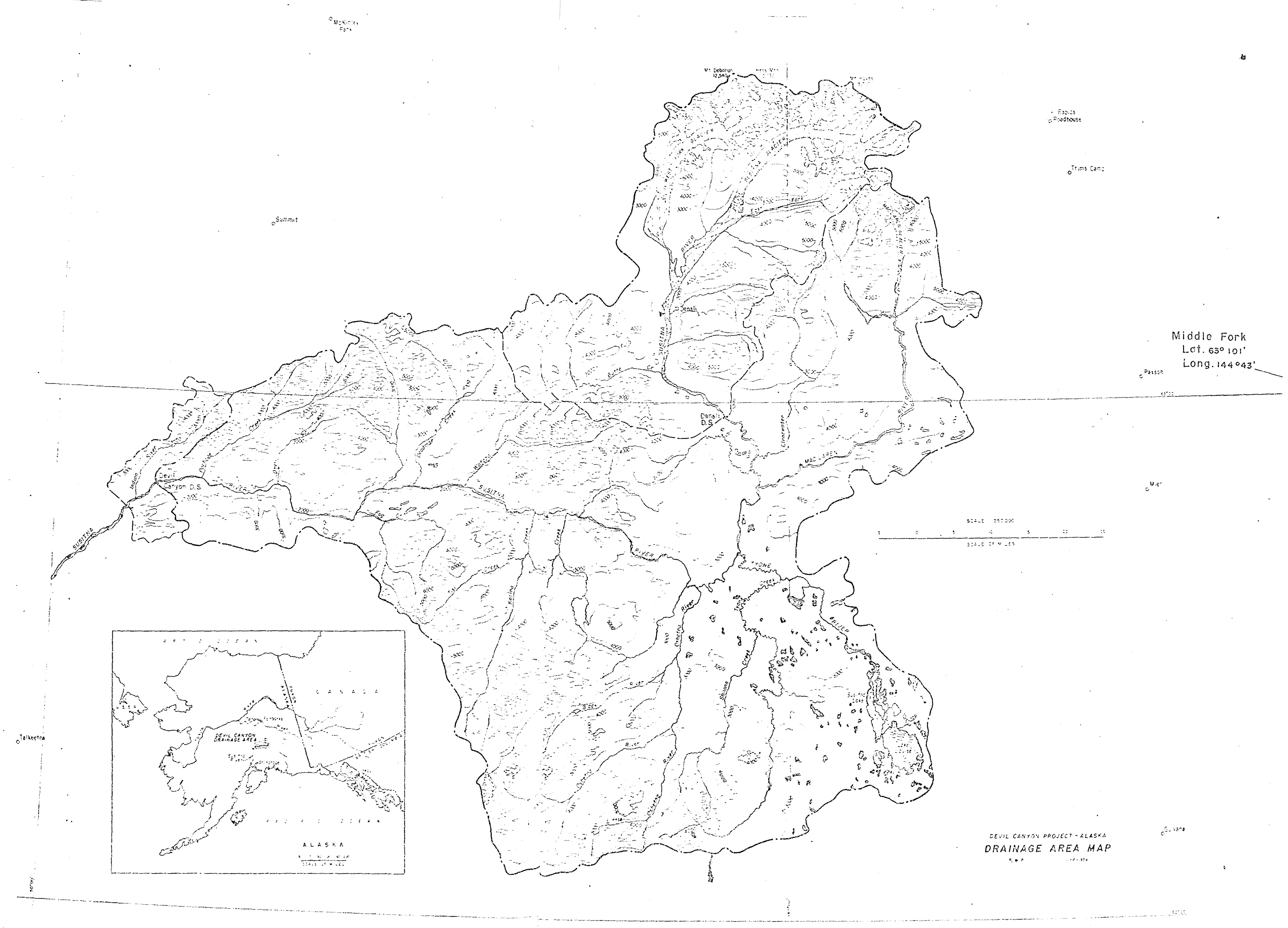
H. S. RIESBOL

Chief, Hydrology Branch



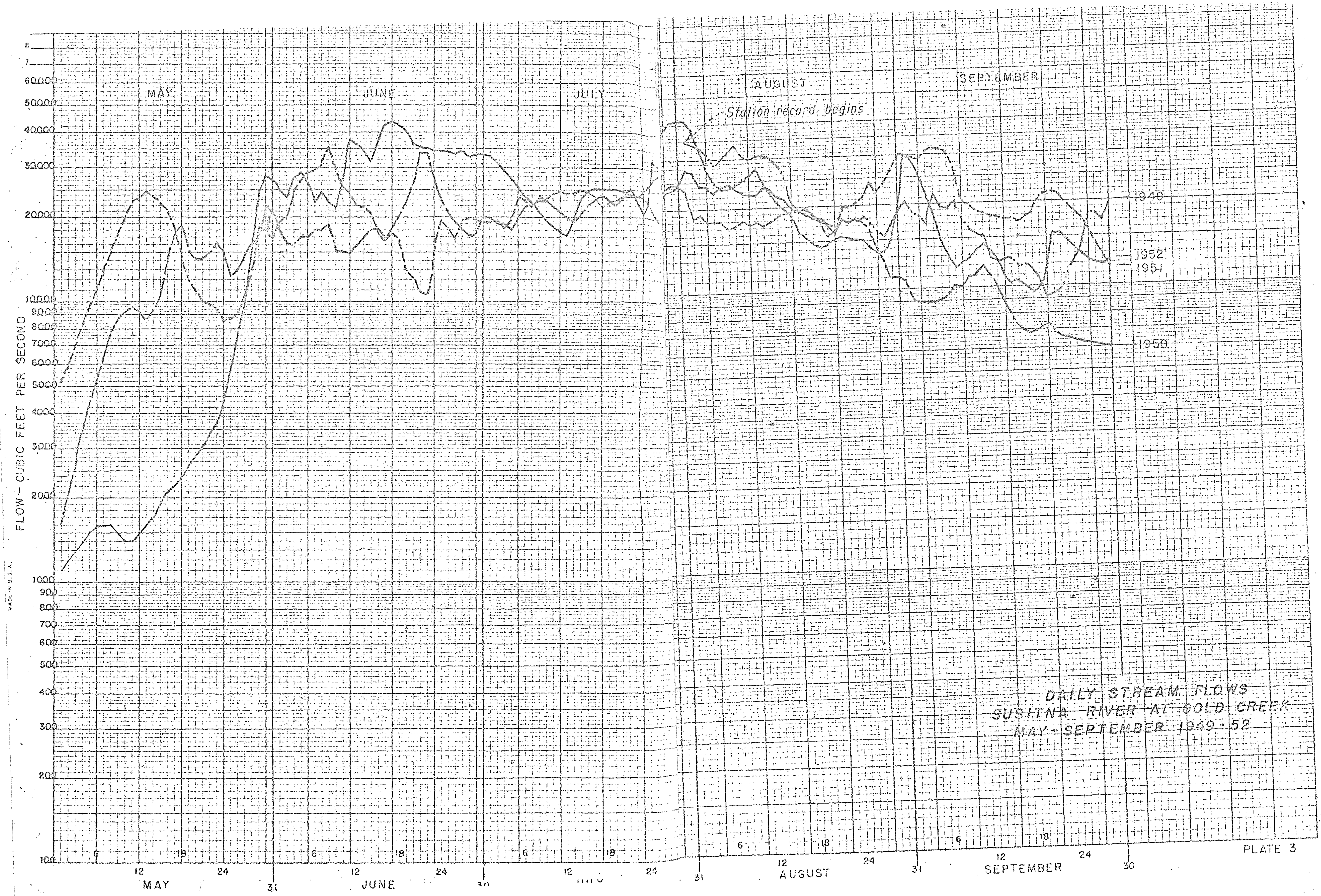

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DIV. OF PROJECT INVESTIGATIONS
DEVIL CANYON PROJECT - ALASKA
DEVIL CANYON DAM SITE
INFLOW DESIGN FLOOD
D.L.M. 6-3-59

PLATE I



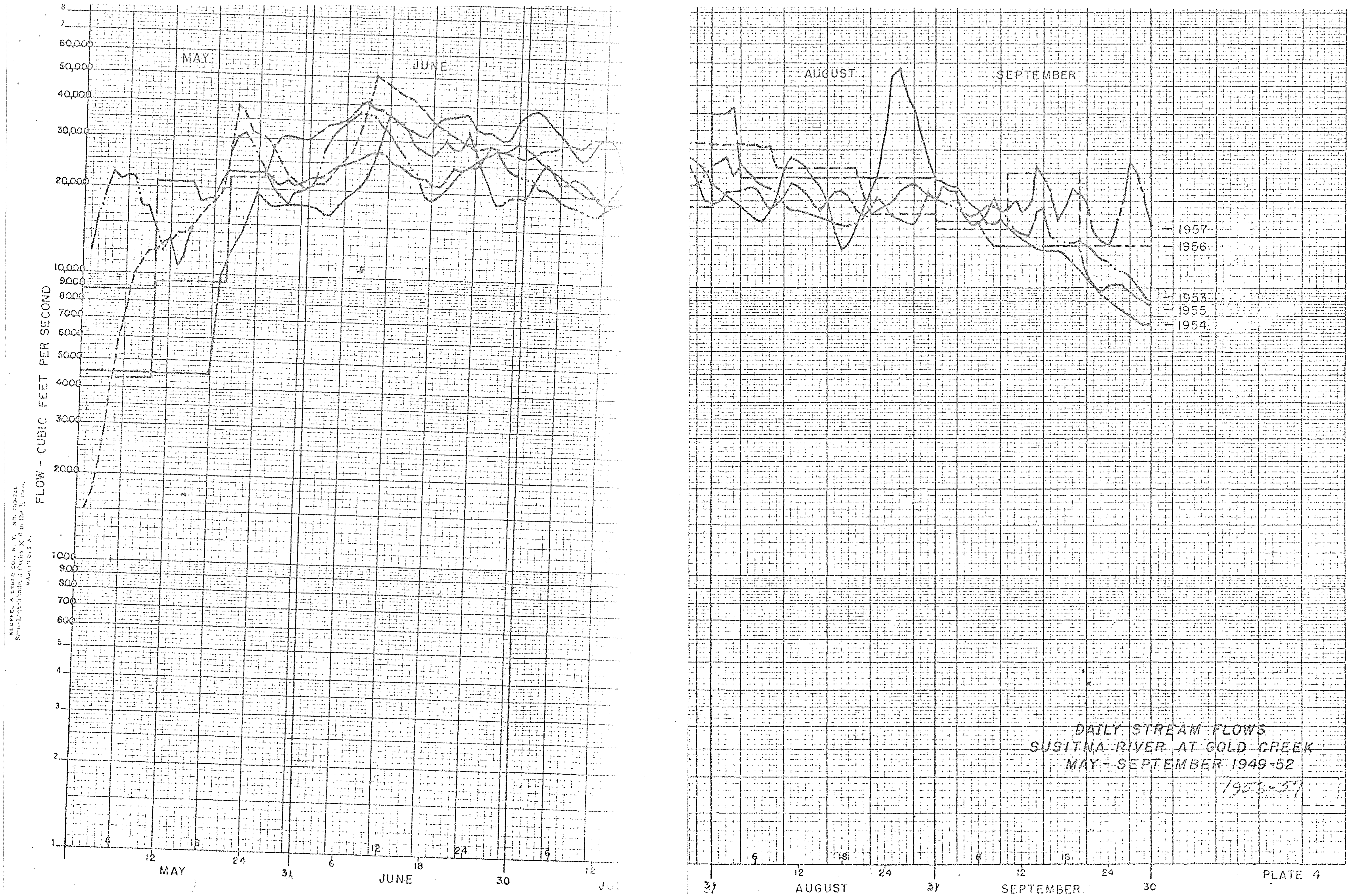
McKinley Park
Mt. Deborah
Summit
Rapids Roadhouse
Trims Camp
Middle Fork
Lat. 63° 101'
Long. 144°43'
Paxson
SUSITNA
Devil Canyon D.S.
Denali D.S.
SUSITNA RIVER
MACLAREN
TYONE
Talkeetna
DEVIL CANYON DRAINAGE AREA
CANADA
ALASKA
SCALE OF MILES
DEVIL CANYON PROJECT - ALASKA
DRAINAGE AREA MAP


PLATE 2



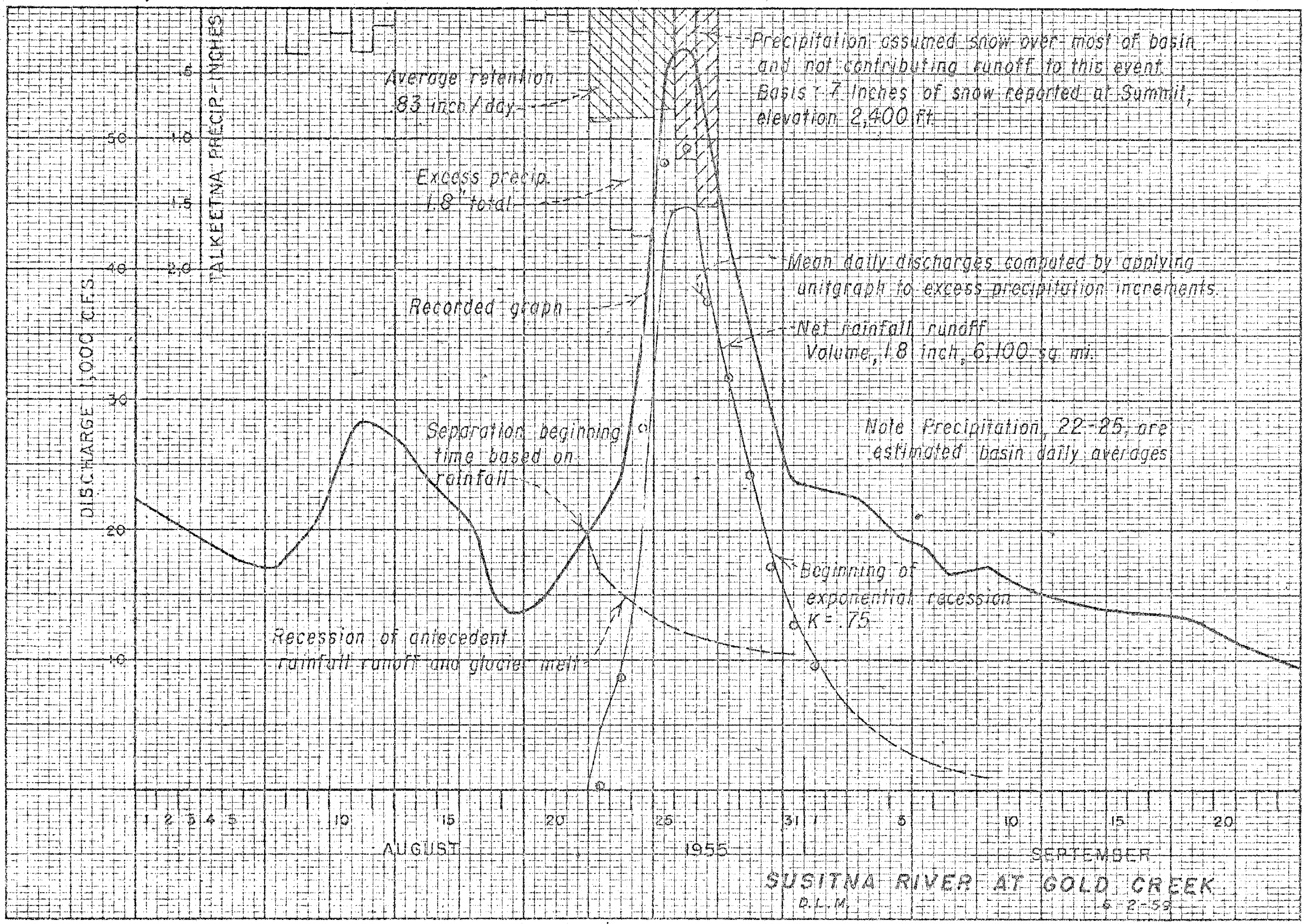
FLOW - CUBIC FEET PER SECOND
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Station record begins
1949
1952
1951
1950
DAILY STREAM FLOWS
SUSITNA RIVER AT GOLD CREEK
MAY - SEPTEMBER 1949 - 52


PLATE 3




DAILY STREAM FLOWS
SUSITNA RIVER AT GOLD CREEK
MAY - SEPTEMBER 1949-52
1953-57

PLATE 4



TALKEETNA PRECIP.-INCHES
DISCHARGE 1,000 C.F.S.
.5
1.0
1.5
2.0
50
40
30
20
10
Average retention
.83 inch/day
Excess precip.
1.8" total
Recorded graph
Precipitation assumed snow over most of basin
and not contributing runoff to this event.
Basis: 7 inches of snow reported at Summit,
elevation 2,400 ft.
Mean daily discharges computed by applying
unitgraph to excess precipitation increments.
Net rainfall runoff
Volume, 1.8 inch, 6,100 sq mi.
Separation beginning
time based on
rainfall
Note Precipitation, 22-25, are
estimated basin daily averages
Beginning of
exponential recession
K = .75
Recession of antecedent
rainfall runoff and glacier melt
1 2 3 4 5
10
15
20
25
31 1
5
10
15
20
AUGUST
1955
SEPTEMBER
SUSITNA RIVER AT GOLD CREEK
D.L.M.
6-2-59


PLATE 5

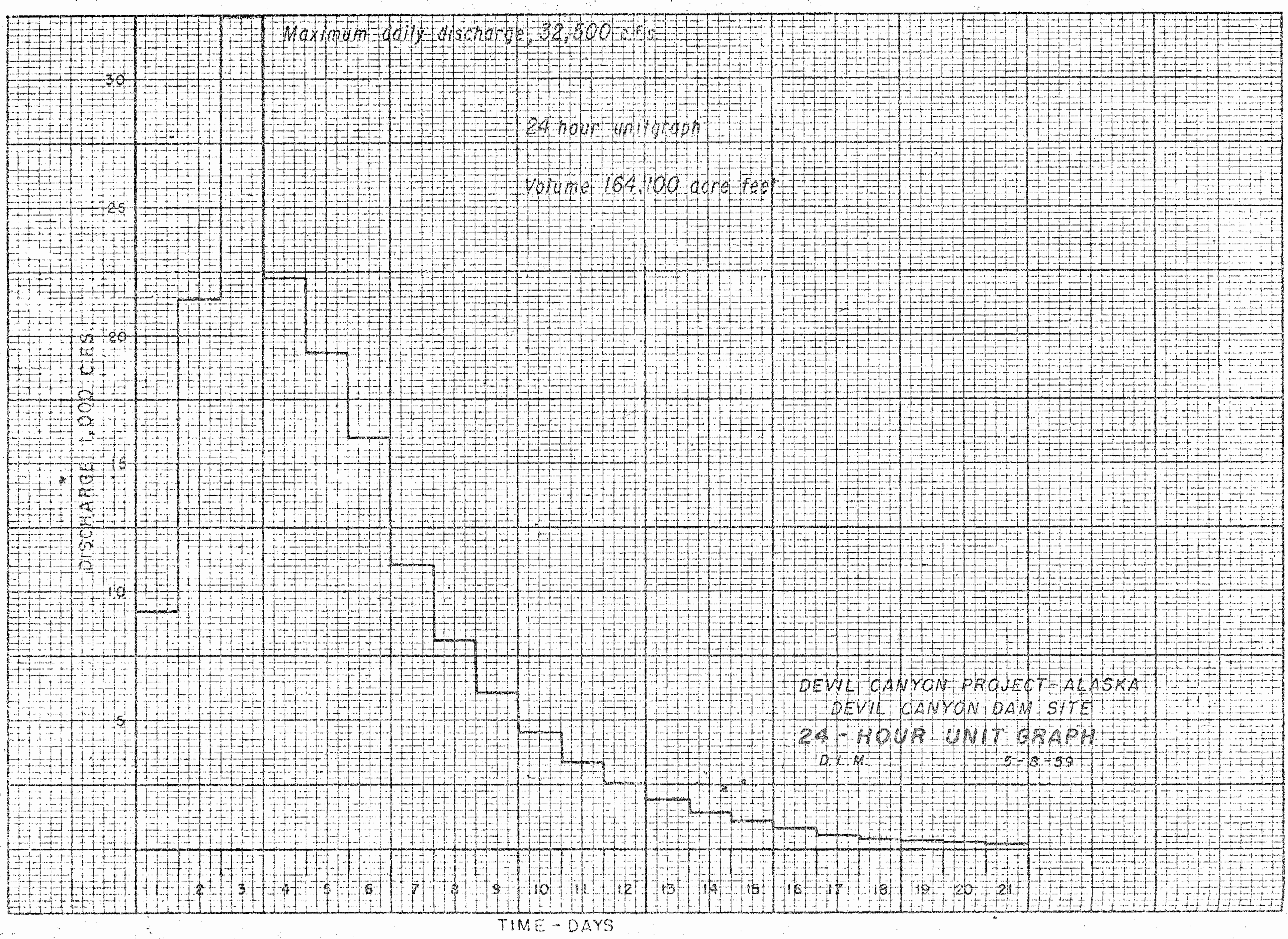

Maximum daily discharge, 32,500 c.f.s.
24 hour unitgraph
Volume 164,100 acre feet
DISCHARGE 1,000 C.F.S.
30
25
20
15
10
5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
TIME - DAYS
DEVIL CANYON PROJECT-ALASKA
DEVIL CANYON DAM SITE
24 - HOUR UNIT GRAPH
D.L.M.
5-8-59

PLATE 6

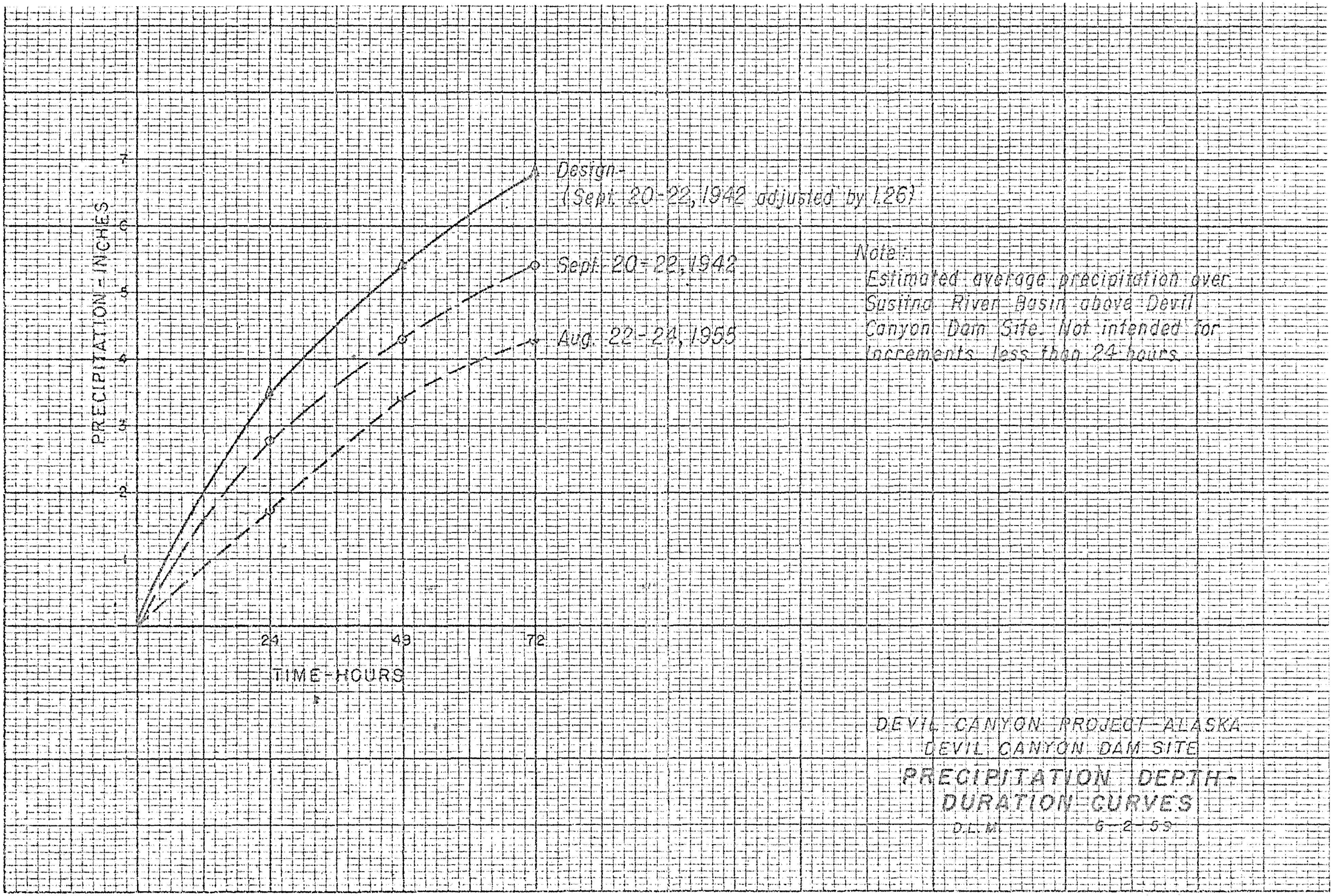

PRECIPITATION - INCHES
1
2
3
4
5
6
7
24
48
72
TIME - HOURS
Design -
(Sept. 20-22, 1942 adjusted by 1.26)
Sept. 20-22, 1942
Aug. 22-24, 1955
Note:
Estimated average precipitation over Susitna River Basin above Devil Canyon Dam Site. Not intended for increments less than 24 hours.
DEVIL CANYON PROJECT - ALASKA
DEVIL CANYON DAM SITE
PRECIPITATION DEPTH-DURATION CURVES
D.L.M. 6-2-59

PLATE 7

HD-34
(12-56)
Bureau of Reclamation

Computed by DLM
Date 6-2-59
Checked by
Date

## STORM TRANSPOSITION AND ADJUSTMENT

Storm ____ of Sept 1942 at Susitna River
to ____ above Devil Canyon Dam site
Total drainage area ____ sq. mi.; Contributing drainage area ____ sq. mi.

### MAXIMUM OBSERVED DEPTHS

| AREA – SQ. MI. | DURATION - HOURS | | | | | | | | ____ HRS. ENDING |
|---|---|---|---|---|---|---|---|---|---|
| | 24 | 48 | 72 | | | | | | |
| 6,100 | 2.80 | 4.31 | 5.44 | | | | | | |

### OBSERVED STORM DEWPOINTS

| STATION | ELEVATION | DURATION | ENDING | OBSERVED | SEA LEVEL |
|---|---|---|---|---|---|
| Anchorage | | | | | |

| OBSERVED | ADJUSTED |
|---|---|
| Sea level dewpoint 52 °F. | Sea level dewpoint 56 °F |
| Inflow ( ____ ) 5,000 Ft. ____ MB | Inflow ( ____ ) 5,000' Ft. ____ MB |
| Precipitable water (200 MB) 40,000 ft .93 In. | Precipitable water (200 MB) 40,000 ft 1.13 In. |
| Precipitable water (5,000' MB) .47 In. | Precipitable water (5,000 ft. MB) .55 In. |
| Precipitable water available .46 In. | Precipitable water available .58 In. |

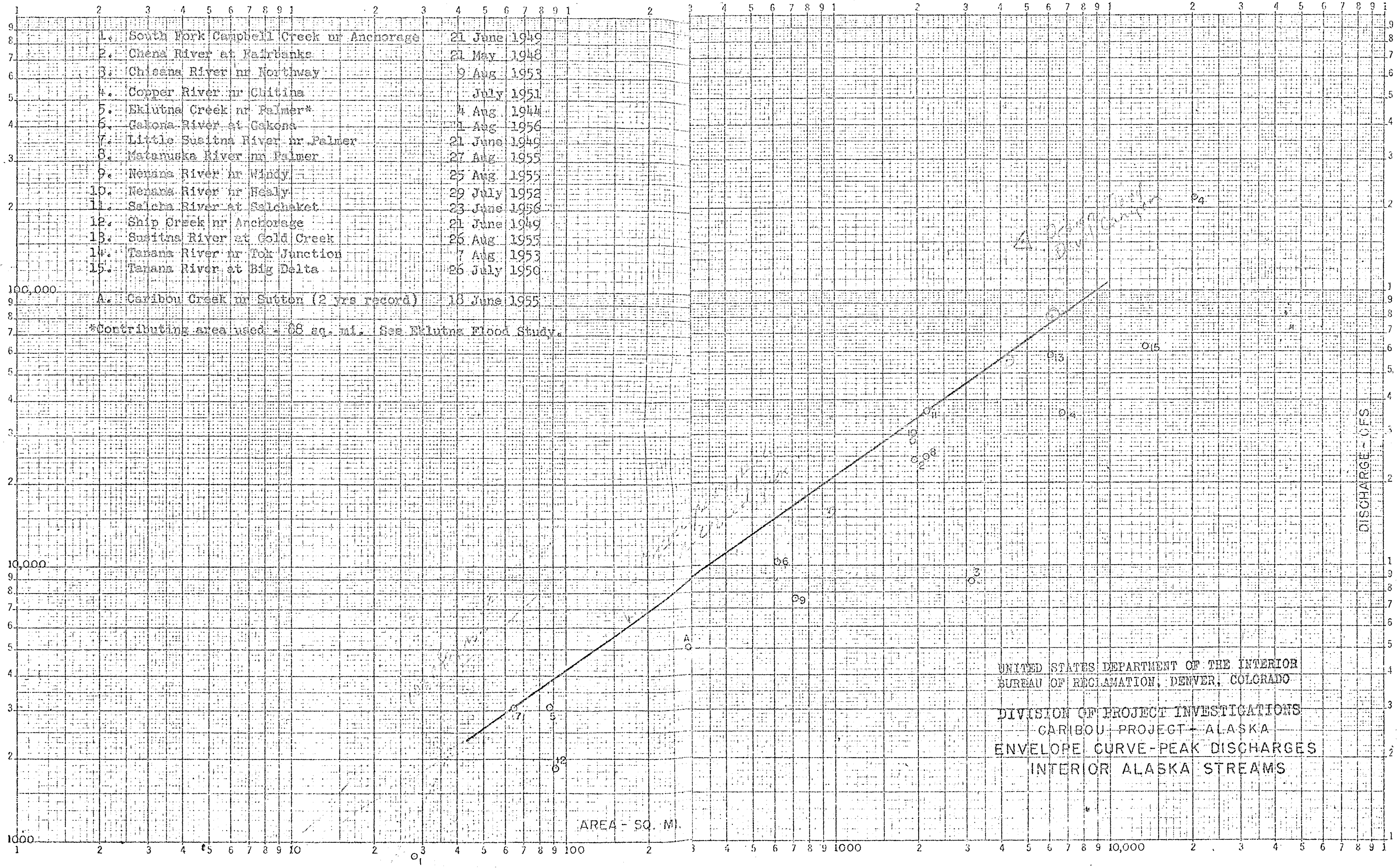
Adjustment 0.58 ÷ 0.46 = 1.26

### MAXIMUM TRANSPOSED DEPTHS

| AREA – SQ. MI. | DURATION — HOURS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 24 | 48 | 92 | | | | | | | |
| 6,100 | 3.5 | 5.4 | 6.8 | | | | | | | |



GPO 834717


1. South Fork Campbell Creek nr Anchorage 21 June 1949
2. Chena River at Fairbanks 21 May 1948
3. Chisana River nr Northway 9 Aug 1953
4. Copper River nr Chitina July 1951
5. Eklutna Creek nr Palmer* 4 Aug 1944
6. Gakona River at Gakona 1 Aug 1956
7. Little Susitna River nr Palmer 21 June 1949
8. Matanuska River nr Palmer 27 Aug 1955
9. Nenana River nr Windy 25 Aug 1955
10. Nenana River nr Healy 29 July 1952
11. Salcha River at Salchaket 23 June 1956
12. Ship Creek nr Anchorage 21 June 1949
13. Susitna River at Gold Creek 26 Aug 1955
14. Tanana River nr Tok Junction 7 Aug 1953
15. Tanana River at Big Delta 26 July 1950
A. Caribou Creek nr Sutton (2 yrs record) 18 June 1955
*Contributing area used - 68 sq. mi. See Eklutna Flood Study.
100,000
10,000
1000
10
100
1000
10,000
AREA - SQ. MI.
DISCHARGE - CFS
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION, DENVER, COLORADO
DIVISION OF PROJECT INVESTIGATIONS
CARIBOU PROJECT - ALASKA
ENVELOPE CURVE-PEAK DISCHARGES
INTERIOR ALASKA STREAMS

7-1364

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION HYDROGRAPH FOR SUSITNA RIVER AT GOLD CREEK

File No. Washington ........ Field ........

# INFORMATION FOR USE FOR ESTIMATING DIVERSION REQUIREMENTS DURING CONSTRUCTION

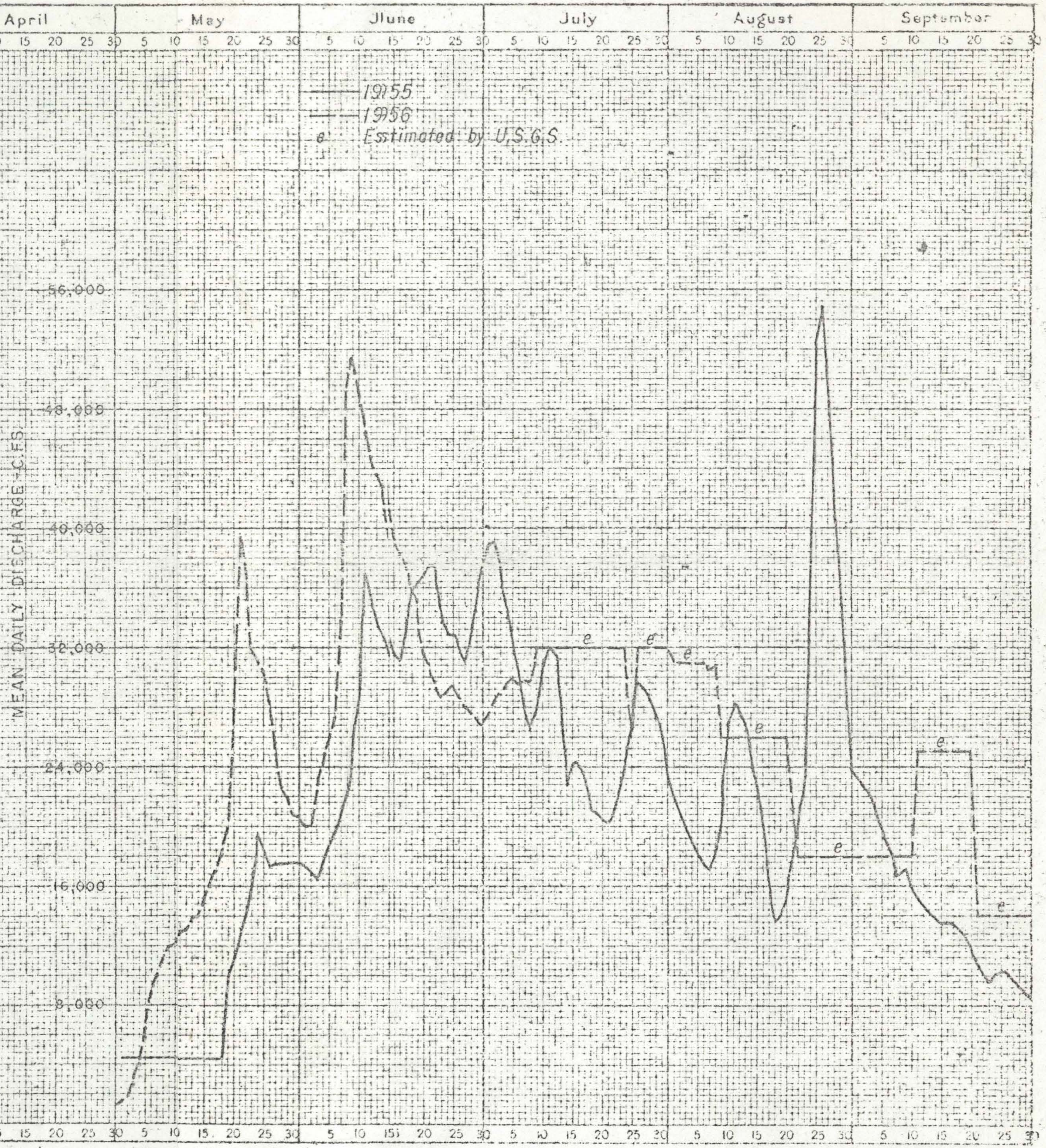
Recorded data:

| | | |
|---|---|---|
| Maximum momentary peak discharge, cfs | 58,100 | August 26, 1955 |
| Maximum 15-day volume, acre-ft | 1,199,000 | June 7-21, 1956 |
| Maximum 30-day volume, acre-ft | 2,050,700 | June 7-July 6, 1956 |

Probability data:

Hazen's method of computation, period of record 1949-58.

| Frequency in years | Maximum momentary discharge, cfs | Maximum 15-day volume acre-ft | Maximum 30-day volume acre-ft |
|---|---|---|---|
| 5 | 50,000 | 1,093,000 | 1,952,000 |
| 10 | 55,000 | 1,190,000 | 2,063,000 |
| 25 | 61,000 | 1,289,000 | 2,220,000 |




Plotted by.............. Checked by.............. Date..............

PLATE 9