BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

APPLICATION FOR LICENSE FOR MAJOR PROJECT

SUSITNA HYDROELECTRIC PROJECT

VOLUME 5B

EXHIBIT E

Chapter 2

(Figures)

FEBRUARY 1983

Prepared by:

ACRES

ALASKA POWER AUTHORITY

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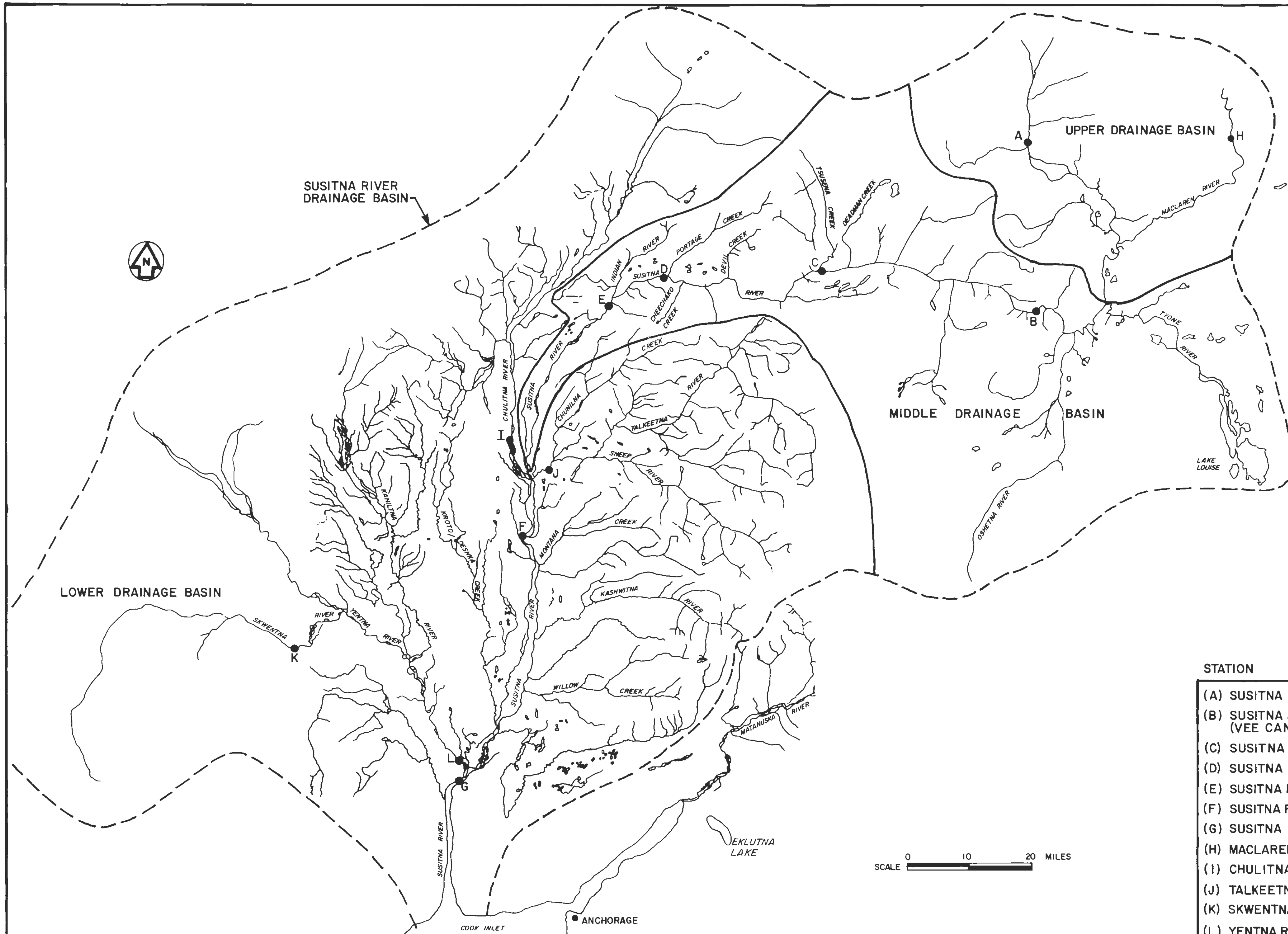


NOTES:

1. CONTINUOUS WATER QUALITY MONITOR INSTALLED.
2. DATA COLLECTION (JUL-SEP 1981 AND JUN-SEP 1982.)
3. THE LETTER BEFORE EACH STATION NAME IN THE TABLE IS USED ON THE MAP TO MARK THE APPROXIMATE LOCATION OF THE STATIONS.

STATION	STREAMFLOW GAGING	CREST STAGE GAGE	STAFF GAGE	WATER QUALITY	WATER TEMPERATURE	SEDIMENT DISCHARGE	BEDLOAD SAMPLING[2]	CLIMATE
(A) SUSITNA RIVER NEAR DENALI	X		X		X	X		X
(B) SUSITNA RIVER NEAR CANTWELL (VEE CANYON)	X		X	X	X	X		
(C) SUSITNA RIVER NEAR WATANA DAMSITE	X	X		X[1]	X			X
(D) SUSITNA RIVER NEAR DEVIL CANYON		X	X					X
(E) SUSITNA RIVER AT GOLD CREEK	X			X	X	X	X	
(F) SUSITNA RIVER NEAR SUNSHINE	X				X	X	X	
(G) SUSITNA RIVER AT SUSITNA STATION	X			X	X	X		
(H) MACLAREN RIVER NEAR PAXSON	X							
(I) CHULITNA RIVER NEAR TALKEETNA	X				X	X	X	
(J) TALKEETNA RIVER NEAR TALKEETNA	X			X	X	X	X	
(K) SKWENTNA RIVER NEAR SKWENTNA	X			X	X	X		X
(L) YENTNA RIVER NEAR SUSITNA STATION	X				X	X		

STREAMFLOW GAGING AND WATER QUALITY MONITORING STATIONS

FIGURE E.2.1

RIVER MILE 103.2

SINGLE CHANNEL:

- STABLE
- NON-ERODIBLE BANKS; CONTROLLED BY VALLEY WALLS, BEDROCK OR ARMOR LAYER CONSISTING OF GRAVEL/COBBLES.
- CHANNEL MAY BE EITHER STRAIGHT OR MEANDERING; IN STRAIGHT CHANNELS, THALWEG OFTEN MEANDERS ACROSS CHANNEL.
- OCCASIONAL FRAGMENTARY ALLUVIAL DEPOSITS IN FLOODPLAIN.

SINGLE-CHANNEL RIVER PATTERN

SOURCE: R & M 1982

FIGURE E.2.2

RIVER MILE 124.4

SPLIT CHANNEL:

- MAIN CHANNEL BEHAVES SIMILAR TO SINGLE CHANNEL AT LOW FLOW.
- SIDE CHANNELS PROVIDE FLOOD RELIEF AT HIGH FLOWS (GREATER THAN 20,000 CFS).
- ISLANDS WELL ESTABLISHED WITH VEGETATION.
- GRAVEL/COBBLE BED MATERIAL.
- MEAN ANNUAL FLOOD CORRELATES WITH BANKFULL FLOW.
- CHANNELS ARE MODERATELY STABLE.

SPLIT-CHANNEL RIVER PATTERN

SOURCE: R & M 1982

FIGURE E.2.3

CHULITNA RIVER NEAR CONFLUENCE WITH SUSITNA RIVER

BRAIDED CHANNEL:

- FLOODPLAIN IS VERY WIDE AND SHALLOW EVEN AT FLOOD FLOW.
- MULTIPLE AND INTERLACING CHANNELS IN UNVEGETATED GRAVEL FLOODPLAIN
- MOVE LARGE QUANTITIES OF BED MATERIAL DURING FLOWS GREATER THAN BANKFULL
- RESULTS FROM COMBINATION OF HIGH RATES OF BEDLOAD TRANSPORT, LOW CHANNEL STABILITY, HIGH SEDIMENT SUPPLY, HIGH GRADIENTS AND LOW UPSTREAM FLOW REGULATION.

BRAIDED-CHANNEL RIVER PATTERN

SOURCE: R & M 1982

FIGURE E.2.4

DELTA ISLANDS

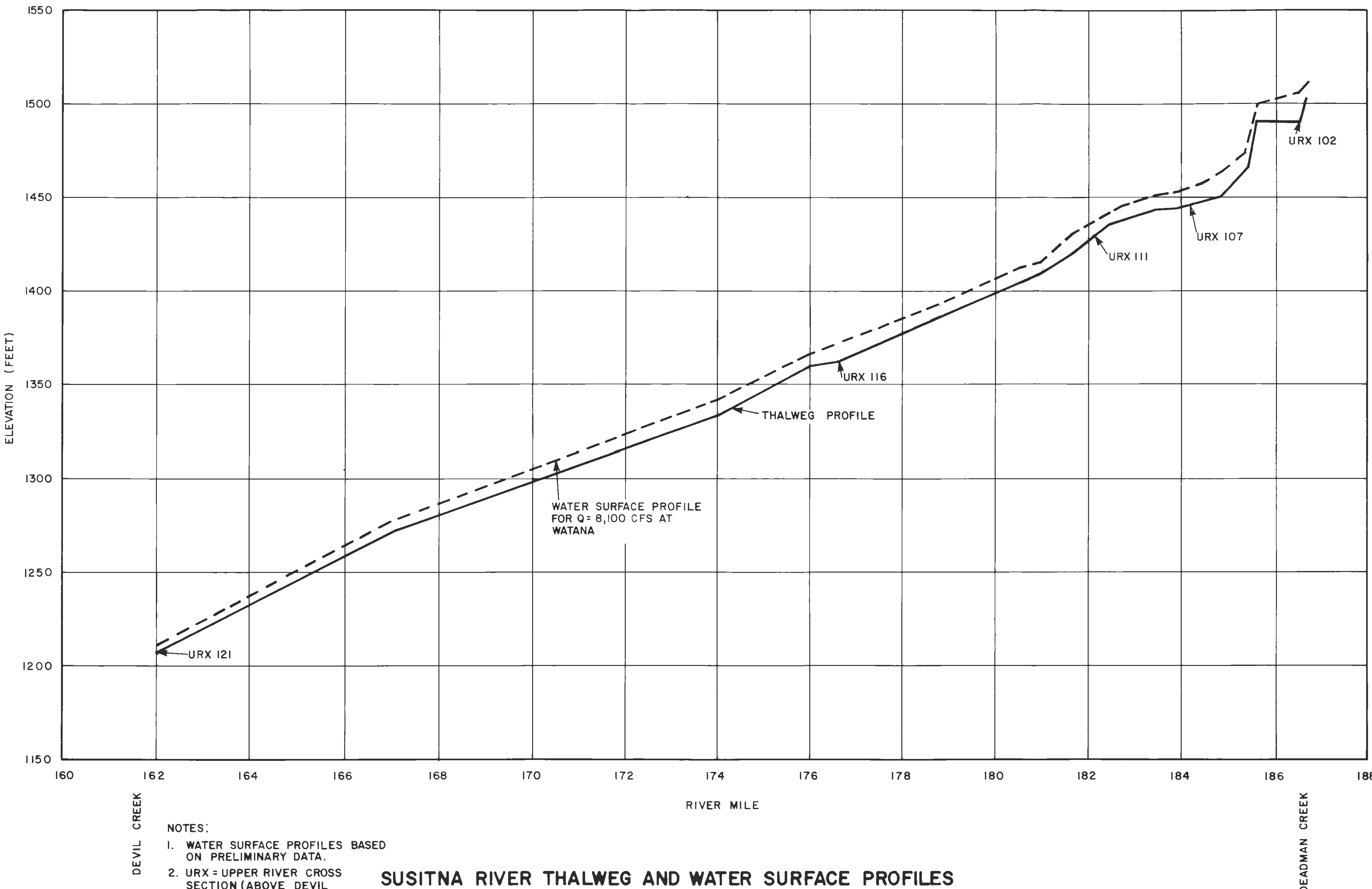
MULTI-CHANNEL (DELTA ISLANDS):

- VERY BROAD FLOODPLAIN WITH LITTLE LATERAL CONTROL.
- MULTIPLE CHANNELS CONSIST OF A MIX OF BRAIDED, SPLIT CHANNEL AND SINGLE CHANNELS WITHIN FLOODPLAIN.
- RELATIVELY UNSTABLE, SUBJECT TO MAJOR LOCAL CHANGES DURING SINGLE FLOOD EVENTS.
- LARGE AMOUNT OF FINE SUSPENDED SEDIMENT HELPS STABILIZE BANKS; DENSE VEGETATION EFFECTIVE IN TRAPPING SEDIMENT.
- BED MATERIAL CONSISTS OF GRAVEL/SAND WITH POCKETS OF SILT.

MULTI - CHANNEL RIVER PATTERN

SOURCE: R & M 1982

FIGURE E.2.5



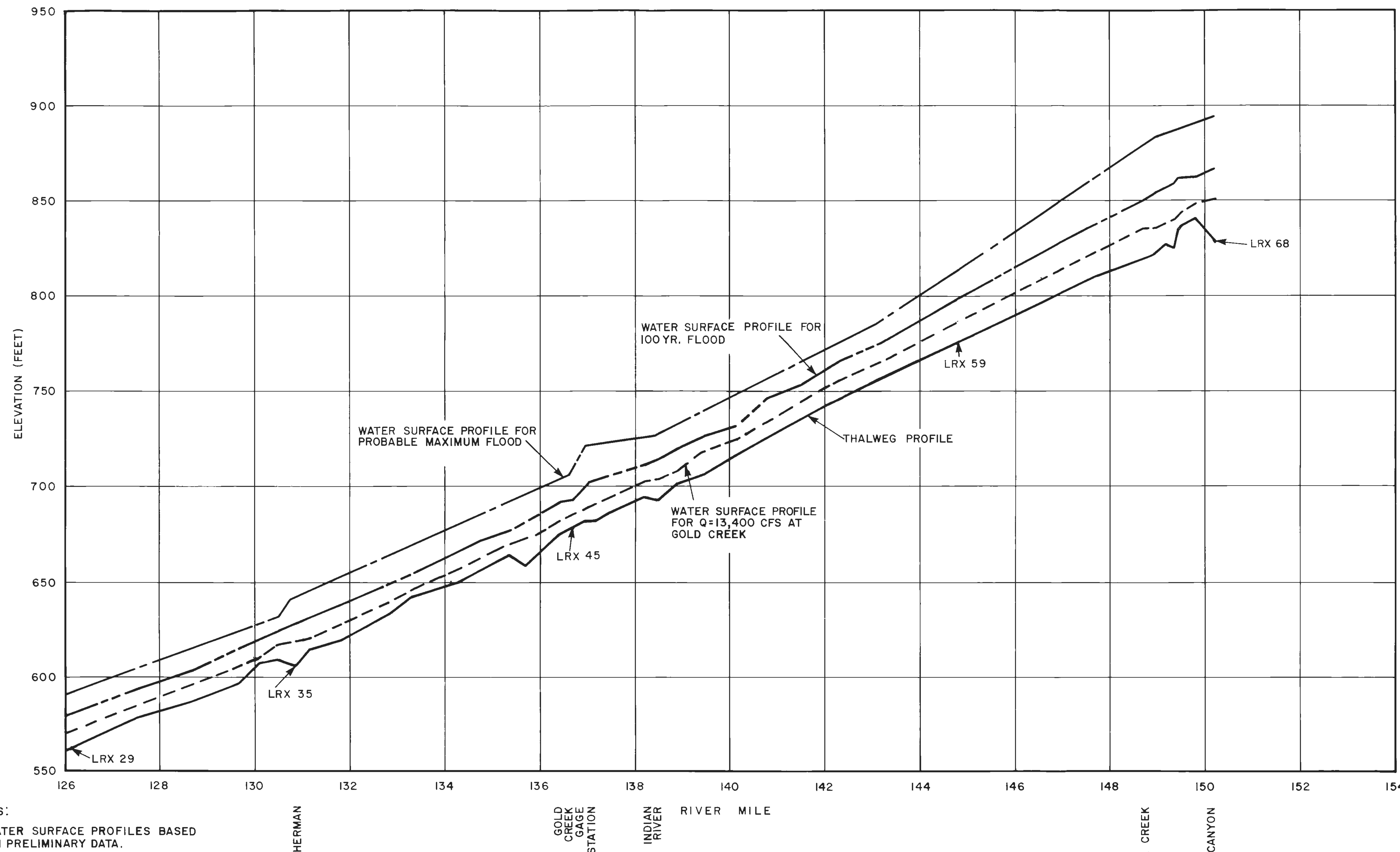
NOTES:

1. WATER SURFACE PROFILES BASED ON PRELIMINARY DATA.
2. URX = UPPER RIVER CROSS SECTION (ABOVE DEVIL CANYON).

SUSITNA RIVER THALWEG AND WATER SURFACE PROFILES DEADMAN CREEK TO DEVIL CREEK

SOURCE: R & M 1982

FIGURE E.2.6



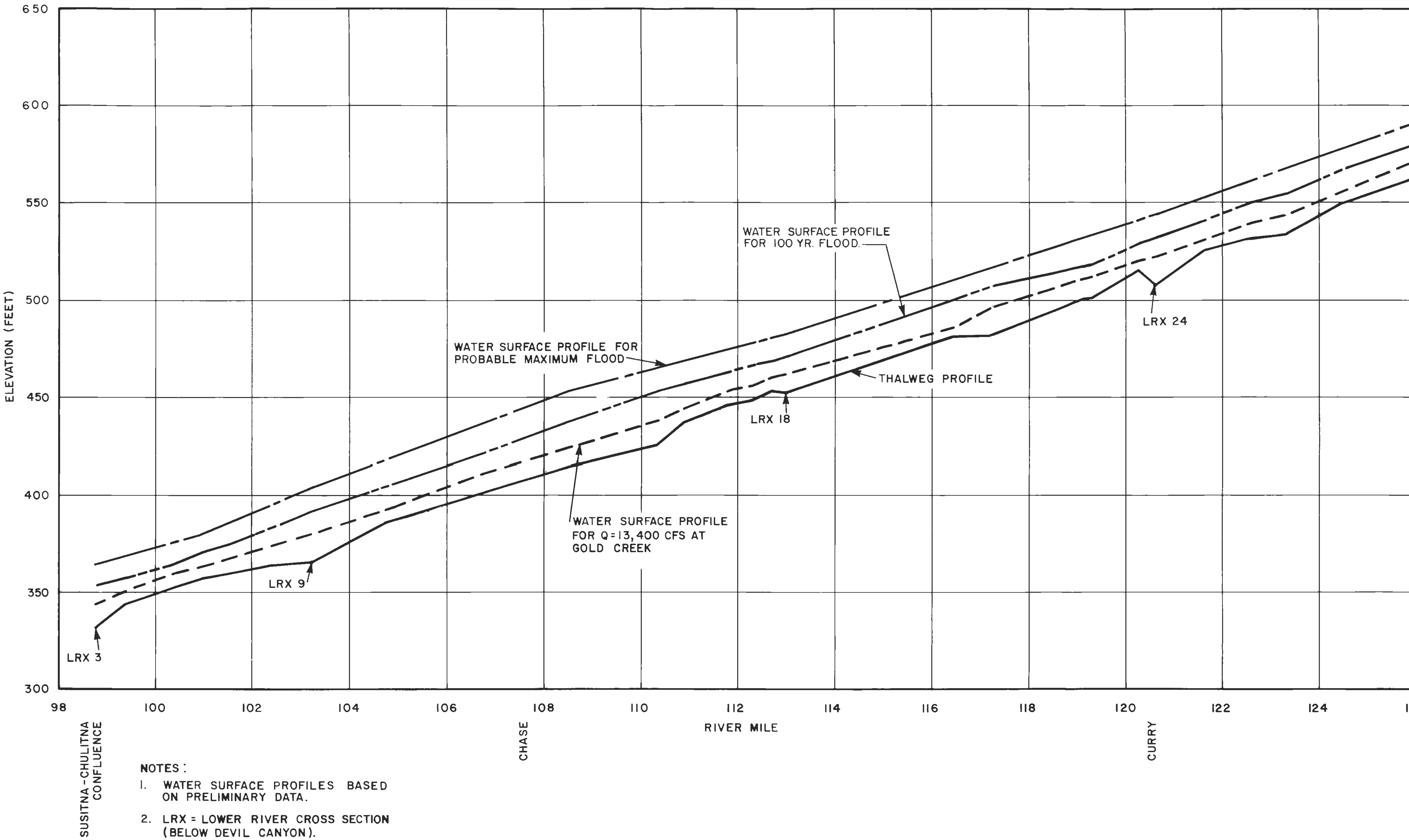
NOTES:

1. WATER SURFACE PROFILES BASED ON PRELIMINARY DATA.
2. LRX = LOWER RIVER CROSS SECTION (BELOW DEVIL CANYON).

SUSITNA RIVER THALWEG AND WATER SURFACE PROFILES
DEVIL CANYON TO RM 126

SOURCE: R & M 1982

FIGURE E.2.7



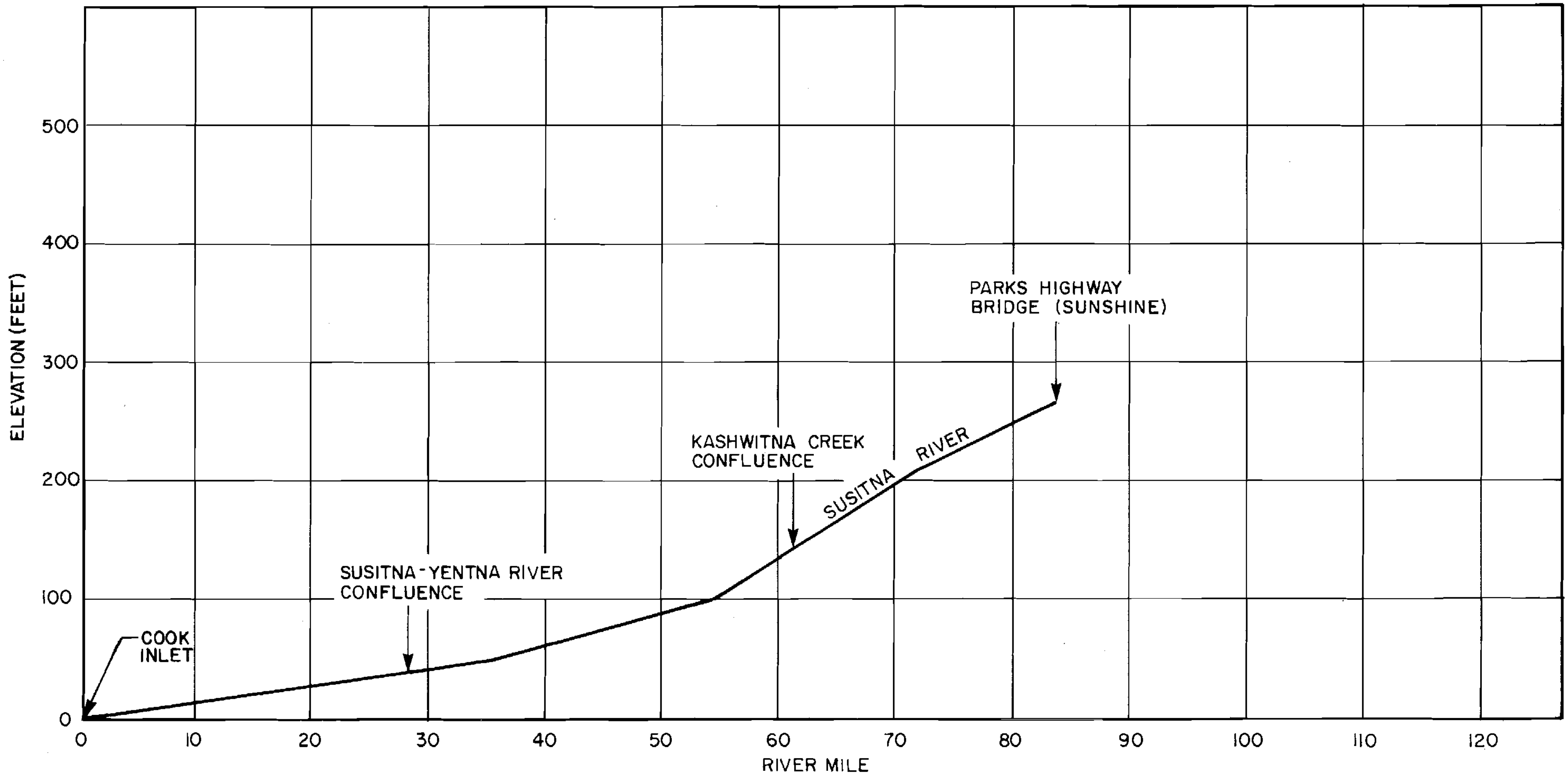
NOTES:

1. WATER SURFACE PROFILES BASED ON PRELIMINARY DATA.
2. LRX = LOWER RIVER CROSS SECTION (BELOW DEVIL CANYON).

SUSITNA RIVER THALWEG AND WATER SURFACE PROFILES RM 126 TO TALKEETNA

SOURCE: R & M 1982

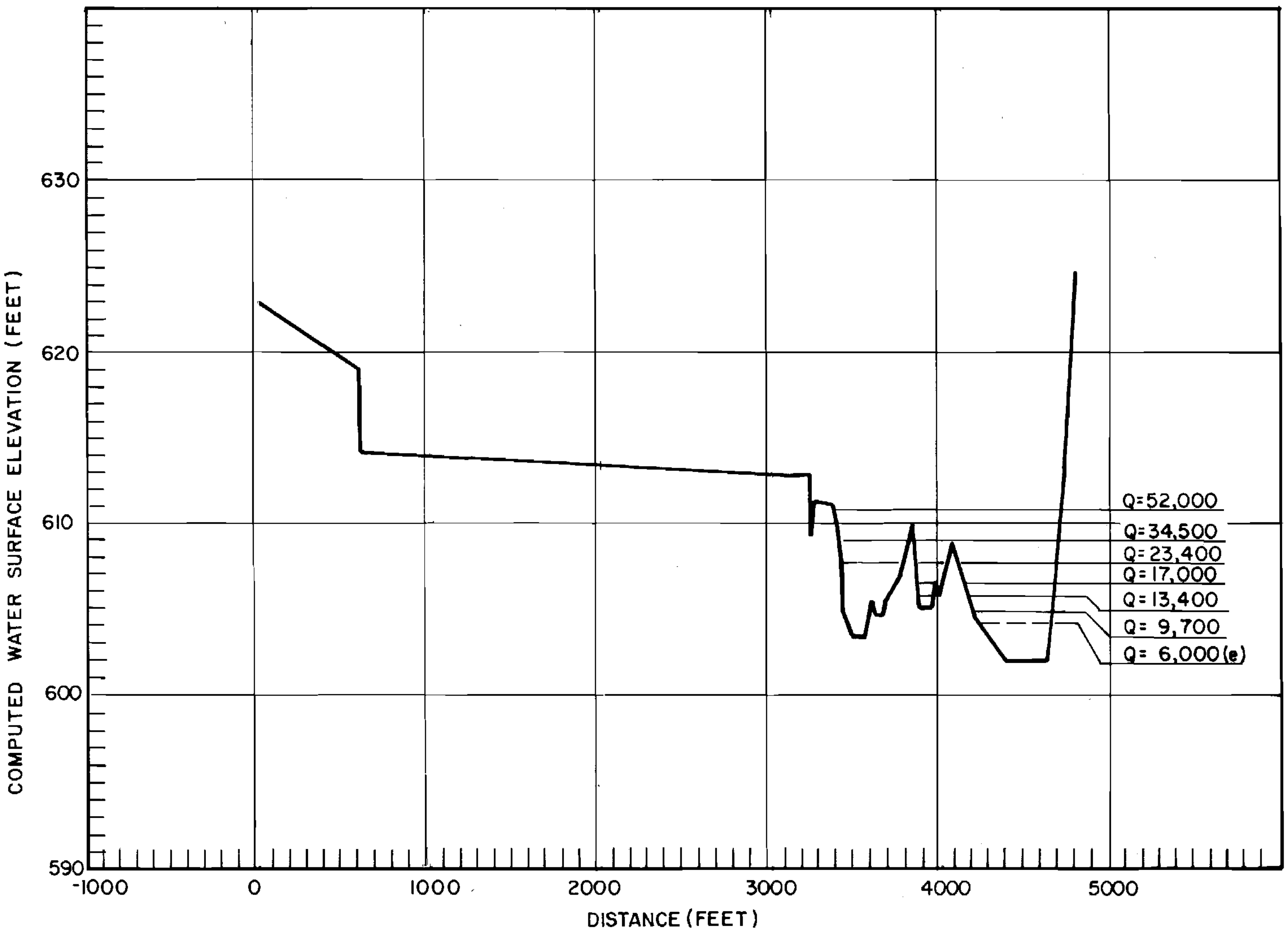
FIGURE E.2.8



SUSITNA RIVER THALWEG PROFILE
SUNSHINE TO COOK INLET

SOURCE: R&M 1982

FIGURE E.2.9



NOTES:

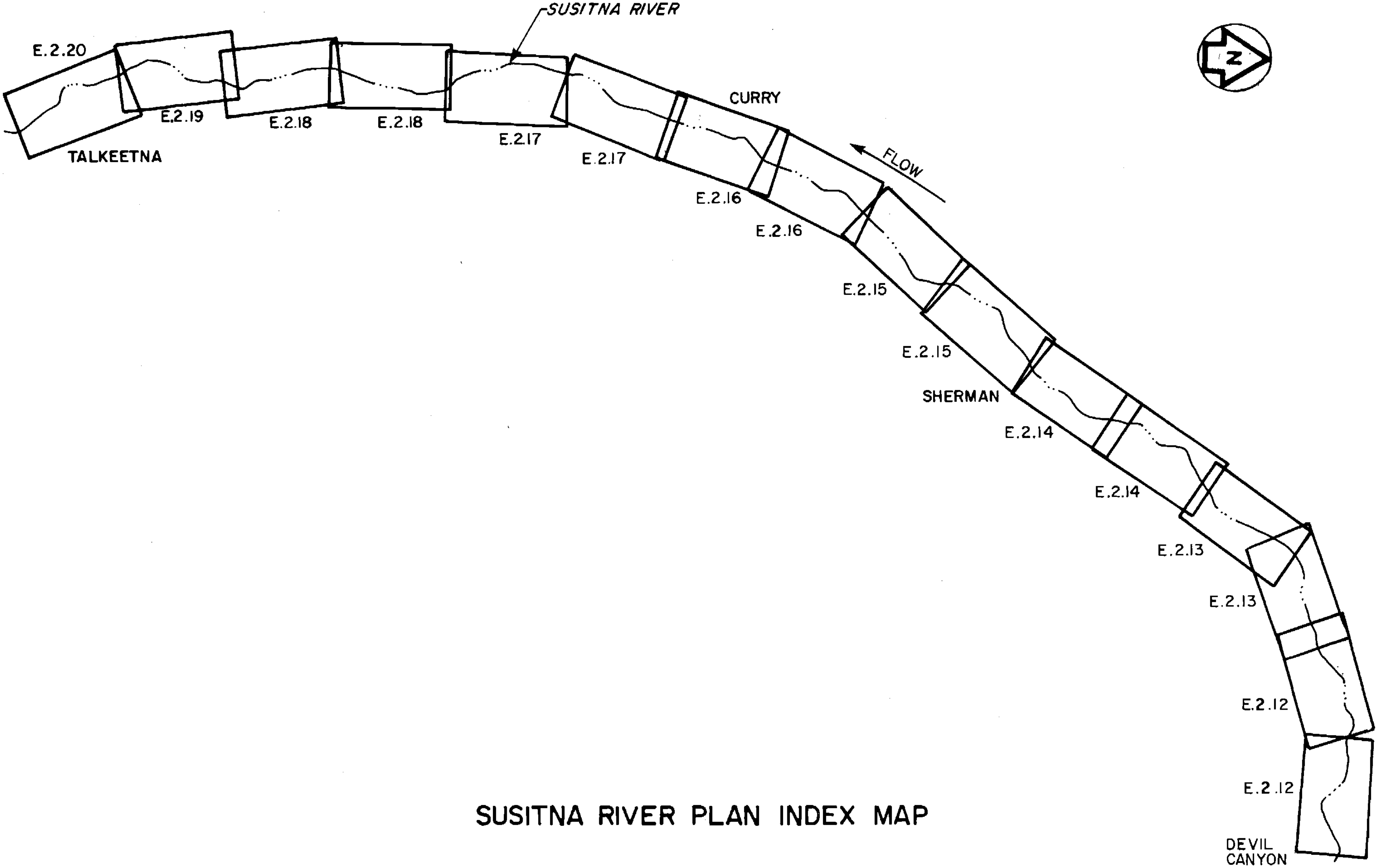
Q = FLOW (CFS)

(e) = ESTIMATED

CROSS-SECTION NUMBER 32
NEAR SHERMAN (RIVER MILE 129.7)

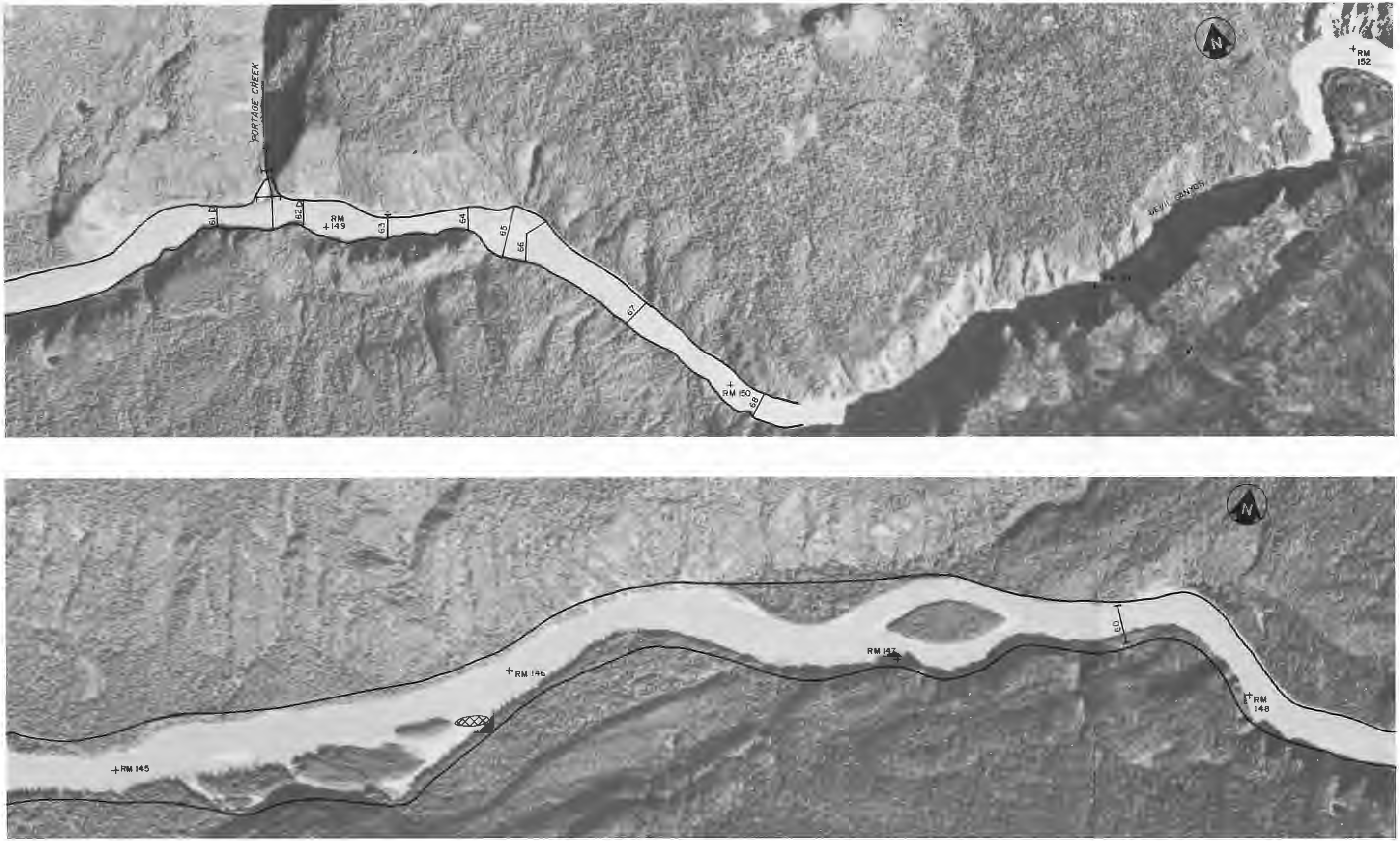
SOURCE: R & M 1982

FIGURE E.2.10



SUSITNA RIVER PLAN INDEX MAP

FIGURE E.2.11

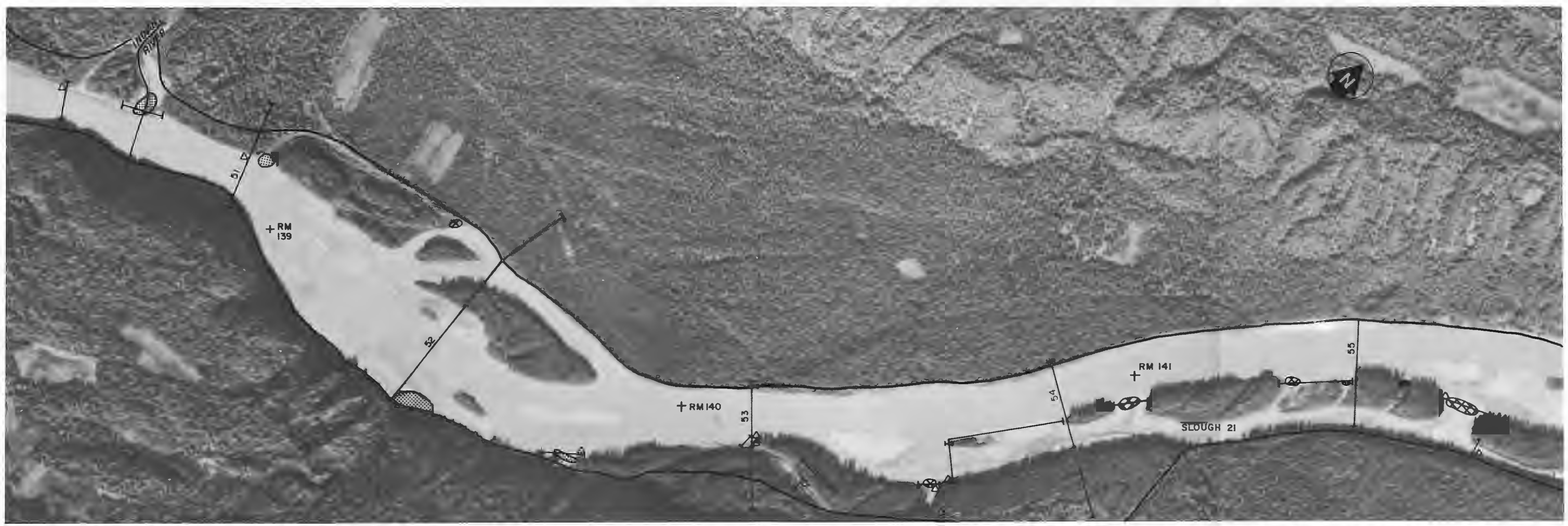


LEGEND:

- + RIVER MILE
- 62 LRX CROSS SECTION
- 100 YEAR FLOOD PLAIN BOUNDARY
- THERMALLY INDUCED OPEN LEAD DURING WINTER
- BERM
- Δ STAFF GAGE SITE

SUSITNA RIVER PLAN
RM 152 TO RM 145

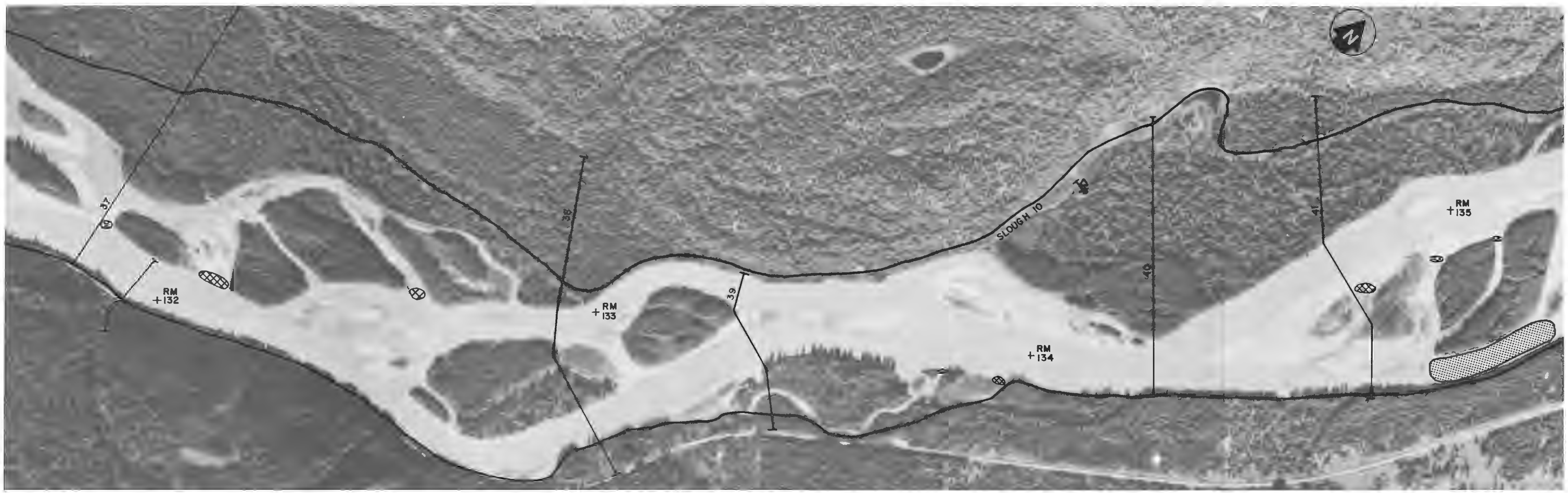
FIGURE E.2.12



NOTE: FOR LEGEND SEE FIGURE E.2.12

SUSITNA RIVER PLAN
RM 145 TO RM 139

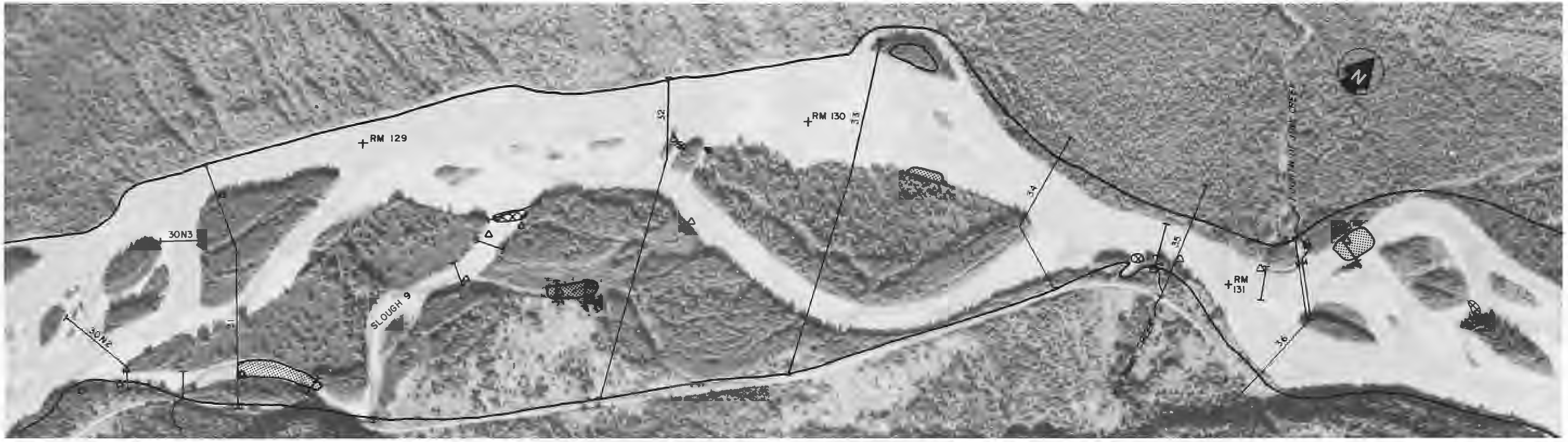
FIGURE E.2.13



NOTE: FOR LEGEND SEE FIGURE E.2.12.

SUSITNA RIVER PLAN
RM 138 TO RM 132

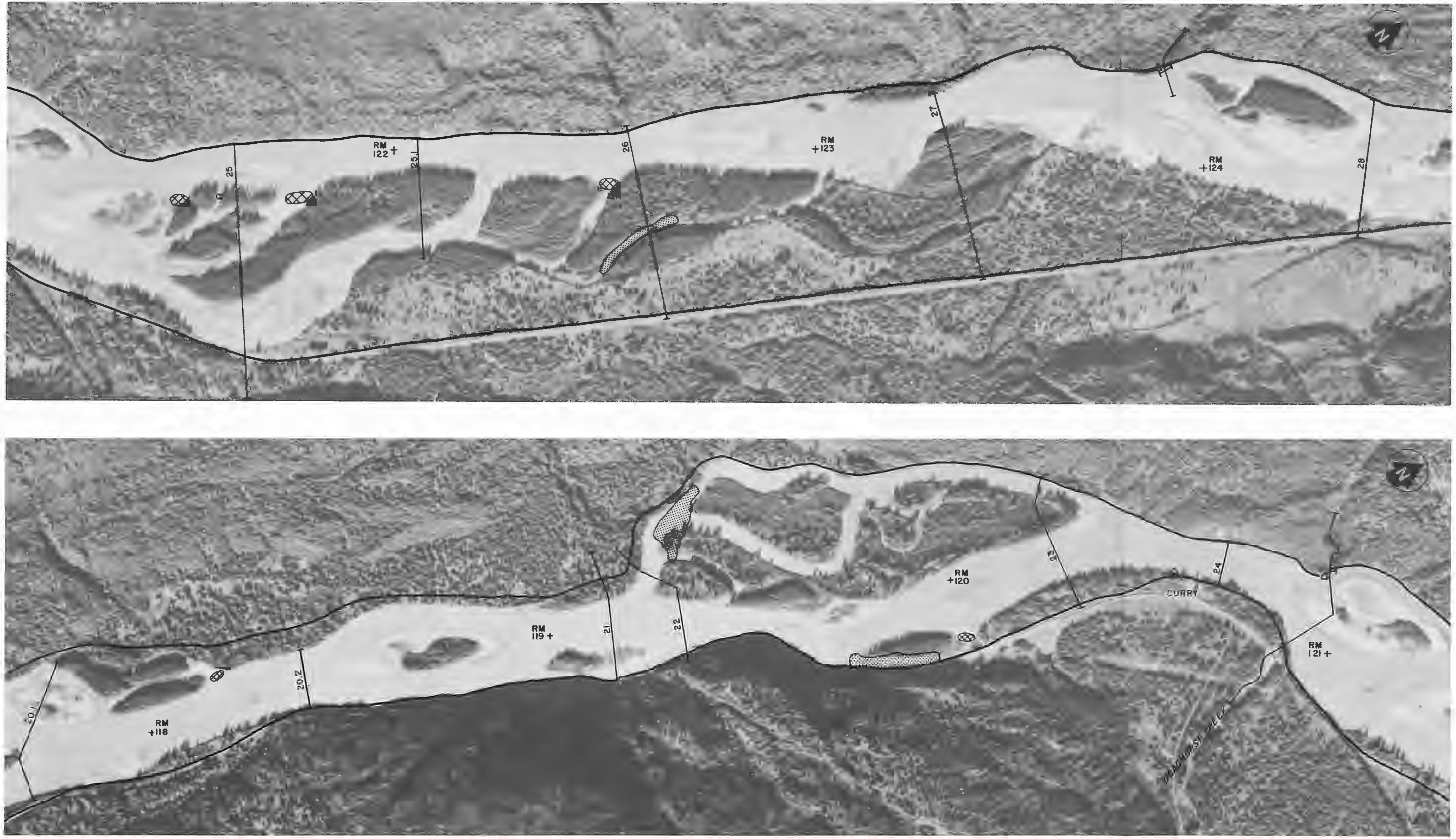
FIGURE E.2.14



NOTE: FOR LEGEND SEE FIGURE E.2.12.

SUSITNA RIVER PLAN
RM 131 TO RM 125

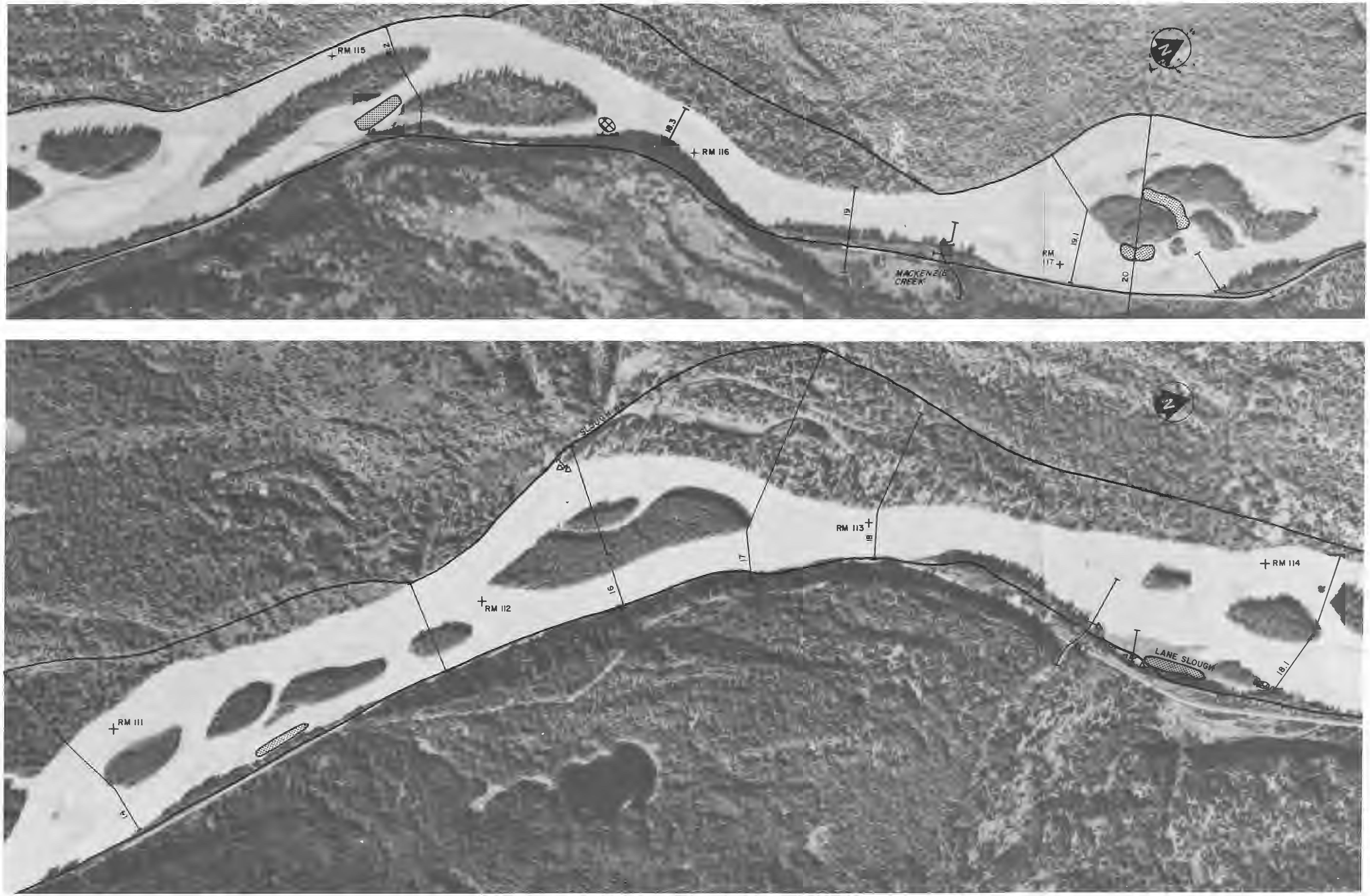
FIGURE E.2.15



NOTE: FOR LEGEND SEE FIGURE E.2.12.

SUSITNA RIVER PLAN
RM 124 TO RM 118

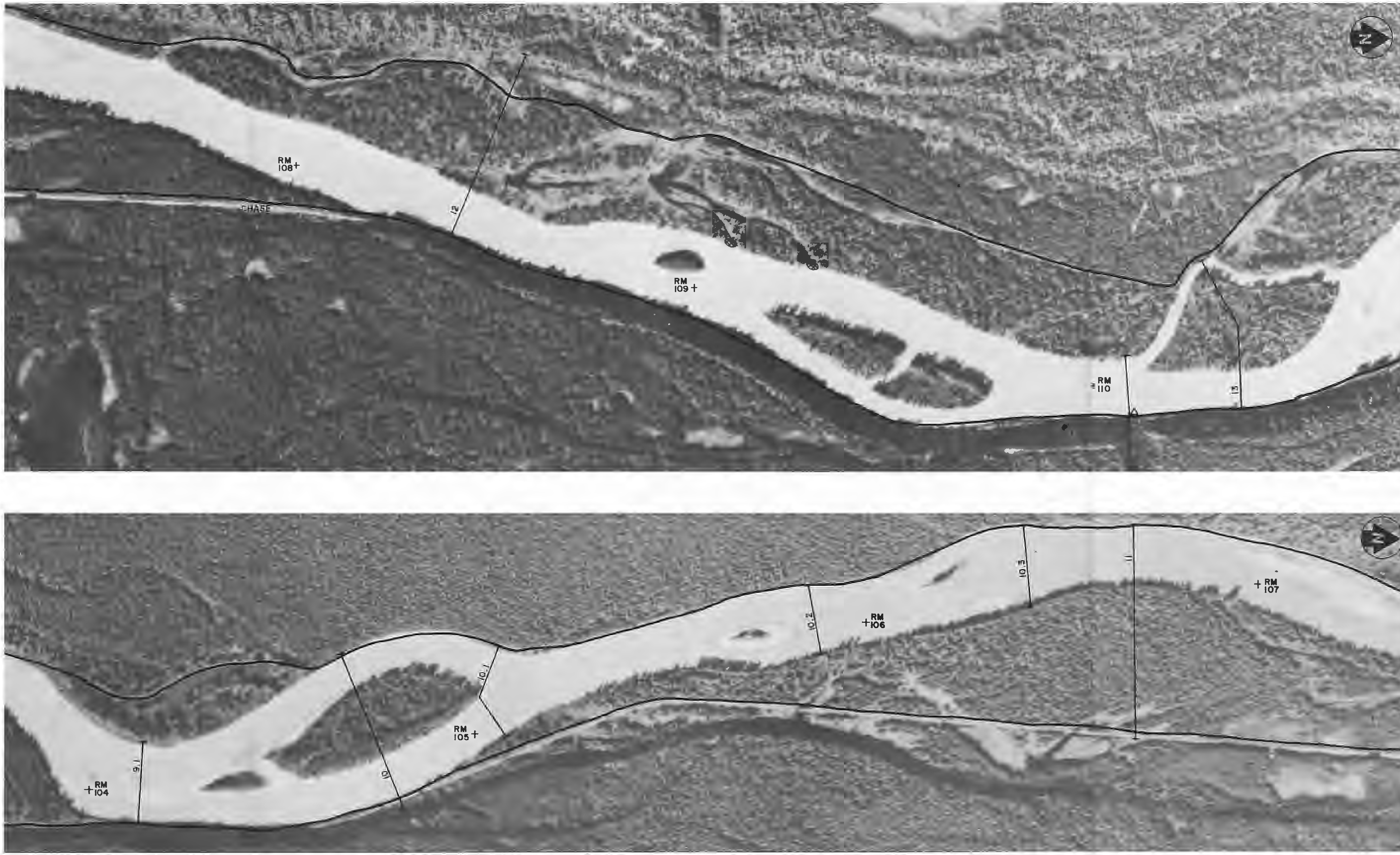
FIGURE E.2.16



NOTE: FOR LEGEND SEE FIGURE E.2.12.

SUSITNA RIVER PLAN
RM 117 TO RM 111

FIGURE E.2.17



NOTE: FOR LEGEND SEE FIGURE E.2.12.

SUSITNA RIVER PLAN
RM 110 TO RM 104

FIGURE E.2.18

NOTE: FOR LEGEND SEE FIGURE E.2.12.

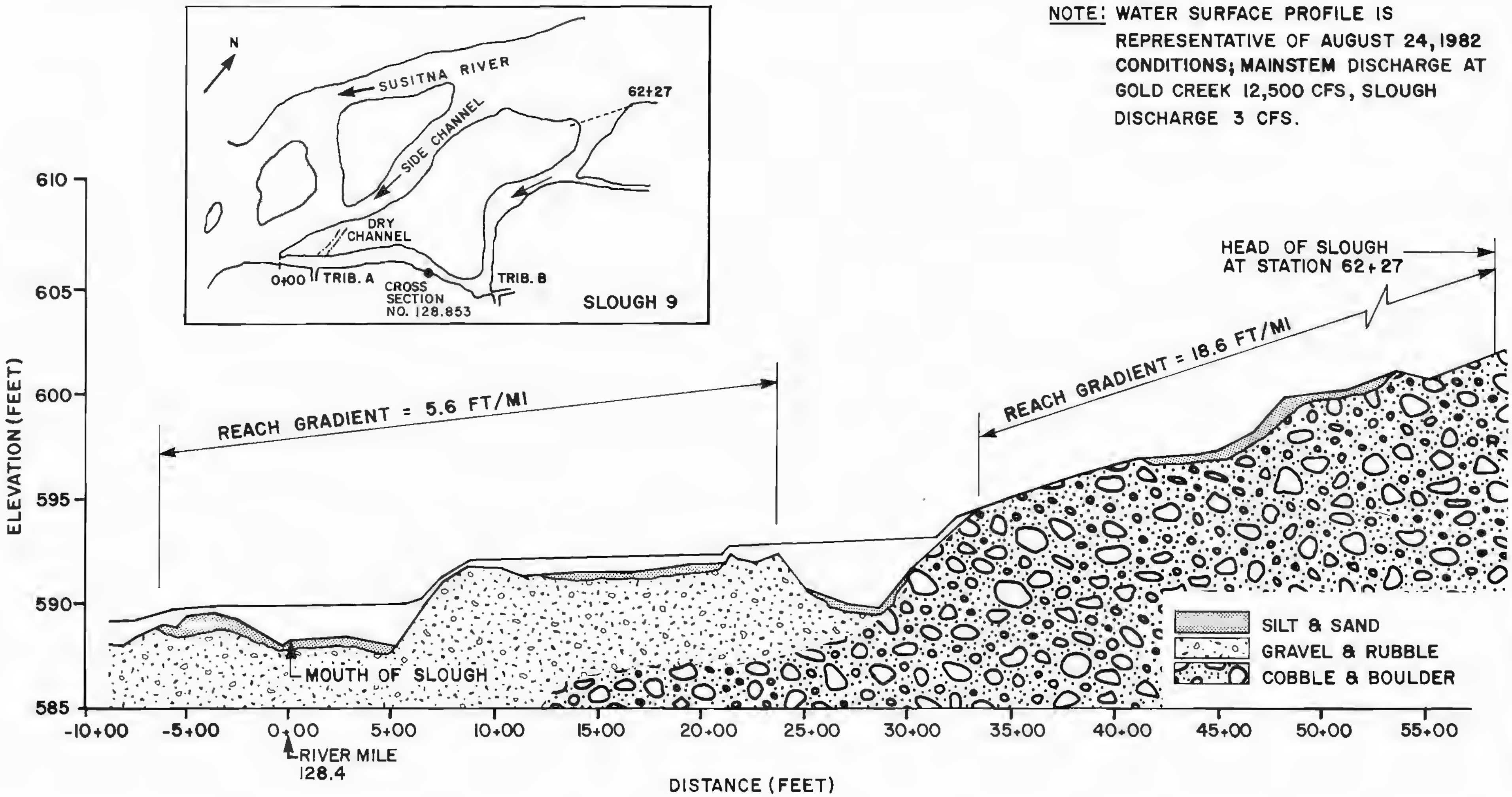
SUSITNA RIVER PLAN
RM 103 TO RM 101

FIGURE E.2.19

NOTE: FOR LEGEND SEE FIGURE E.2.12.

SUSITNA RIVER PLAN
RM 100 TO RM 97

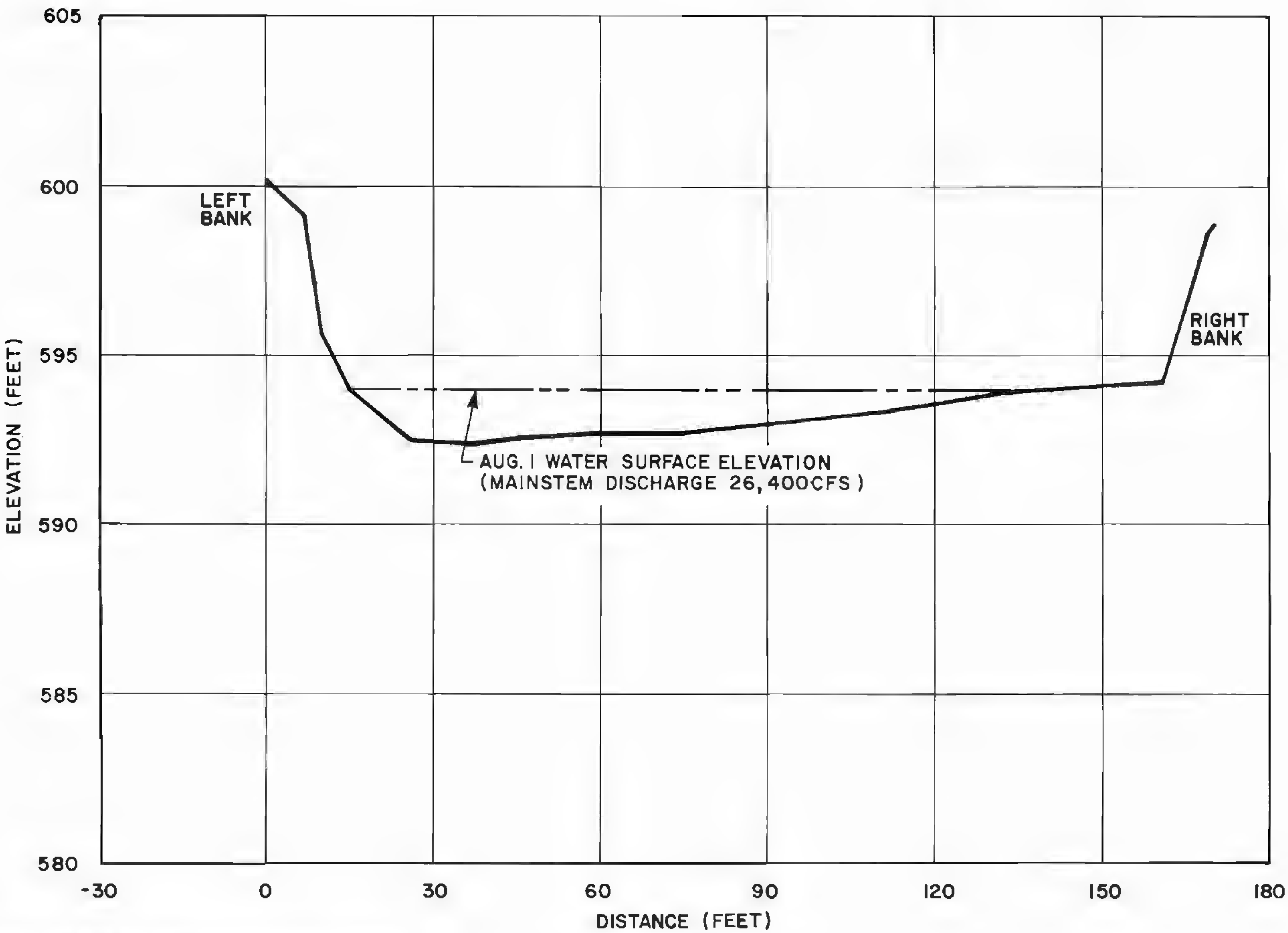
FIGURE E.2.20



SLOUGH 9 THALWEG PROFILE

SOURCE: TRIHEY 1982

FIGURE E.2.21

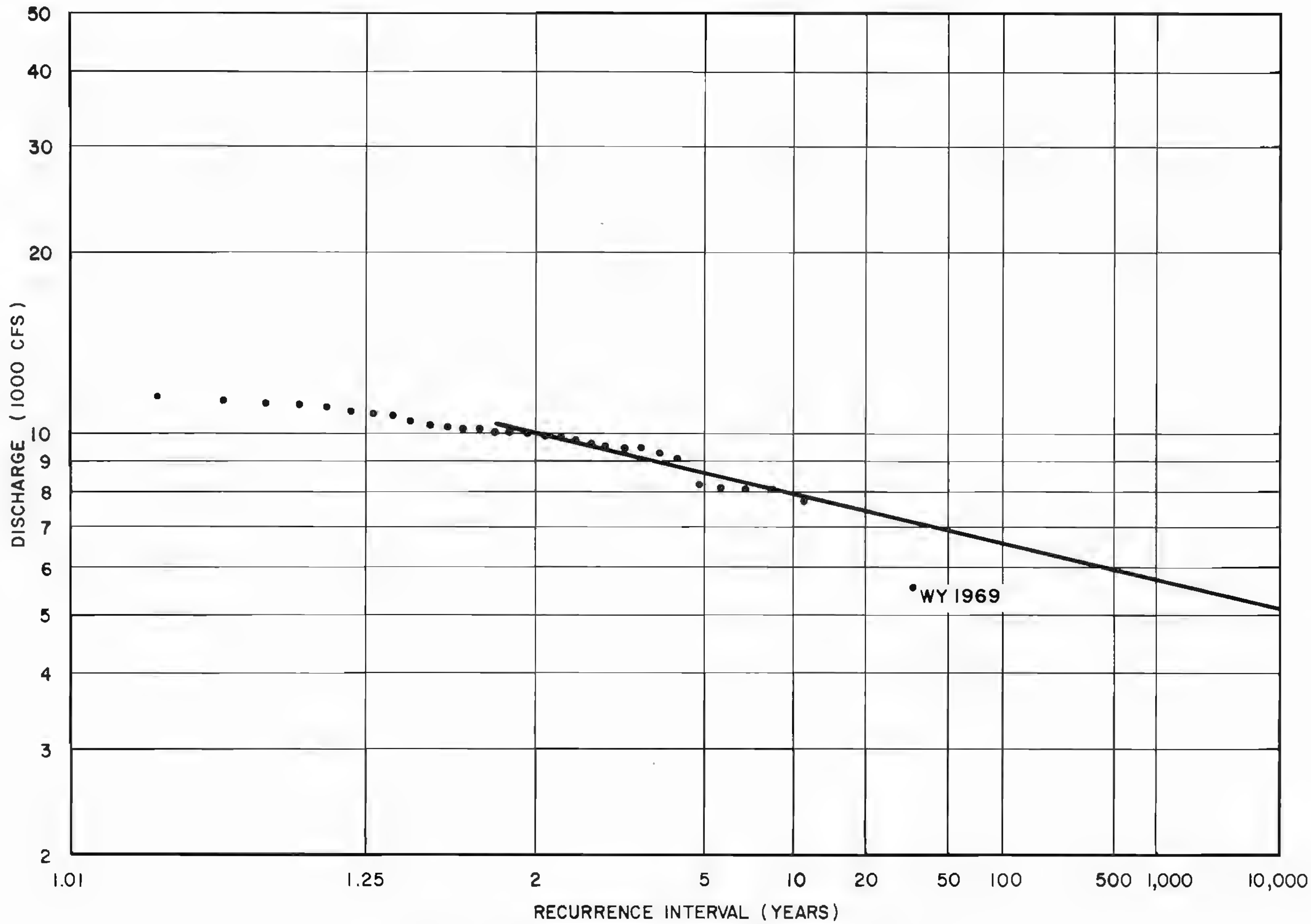


NOTES:

1. CROSS SECTION # 128.8S3 APPROXIMATELY 2400 FEET UPSTREAM OF SLOUGH MOUTH.
2. CROSS SECTION REPRESENTS VIEW LOOKING DOWNSTREAM.
3. MAINSTREAM DISCHARGE MEASURED AT GOLD CREEK.

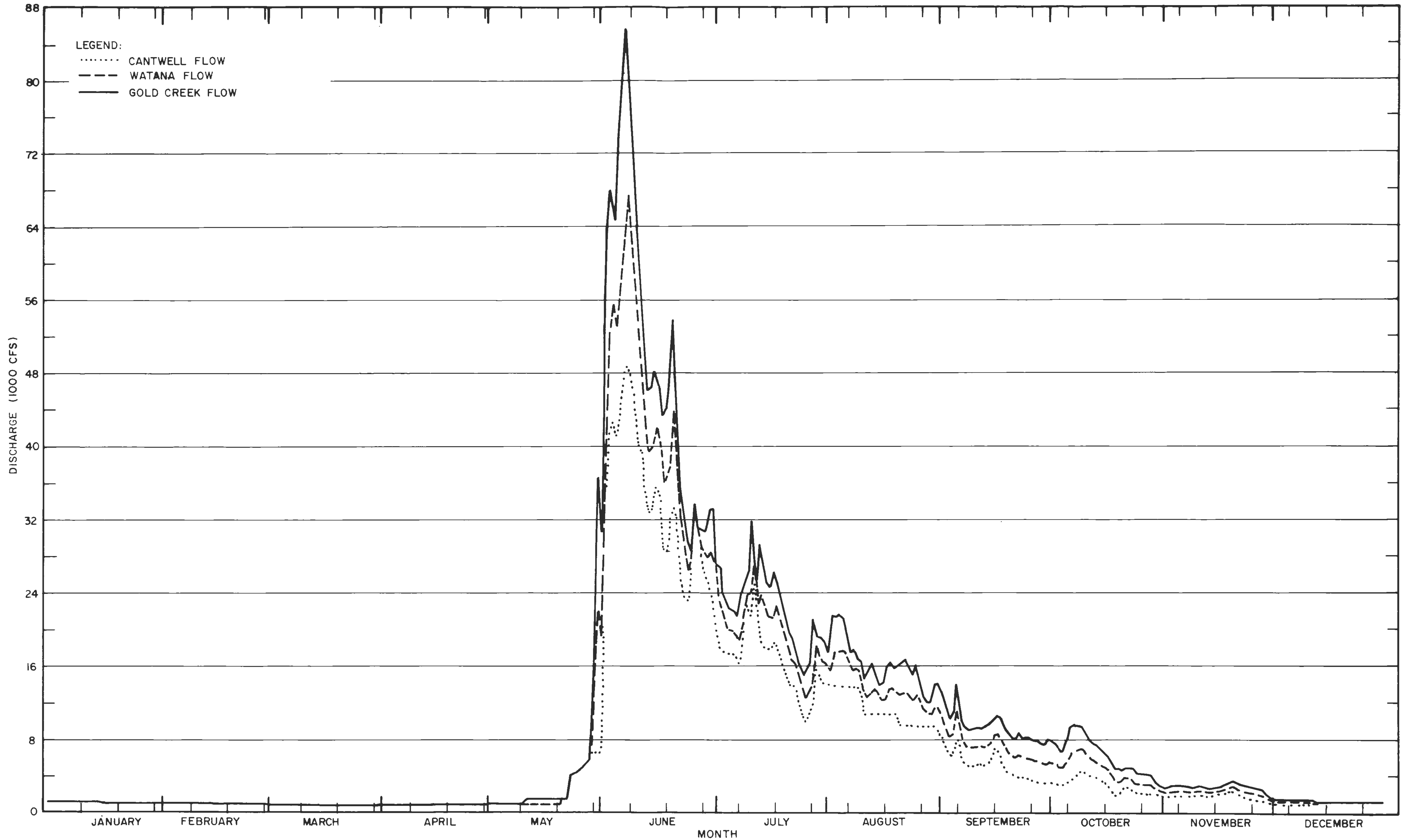
SLOUGH 9 CROSS SECTION

FIGURE E.2.22



LOW-FLOW FREQUENCY ANALYSIS
OF MEAN ANNUAL FLOW
AT GOLD CREEK

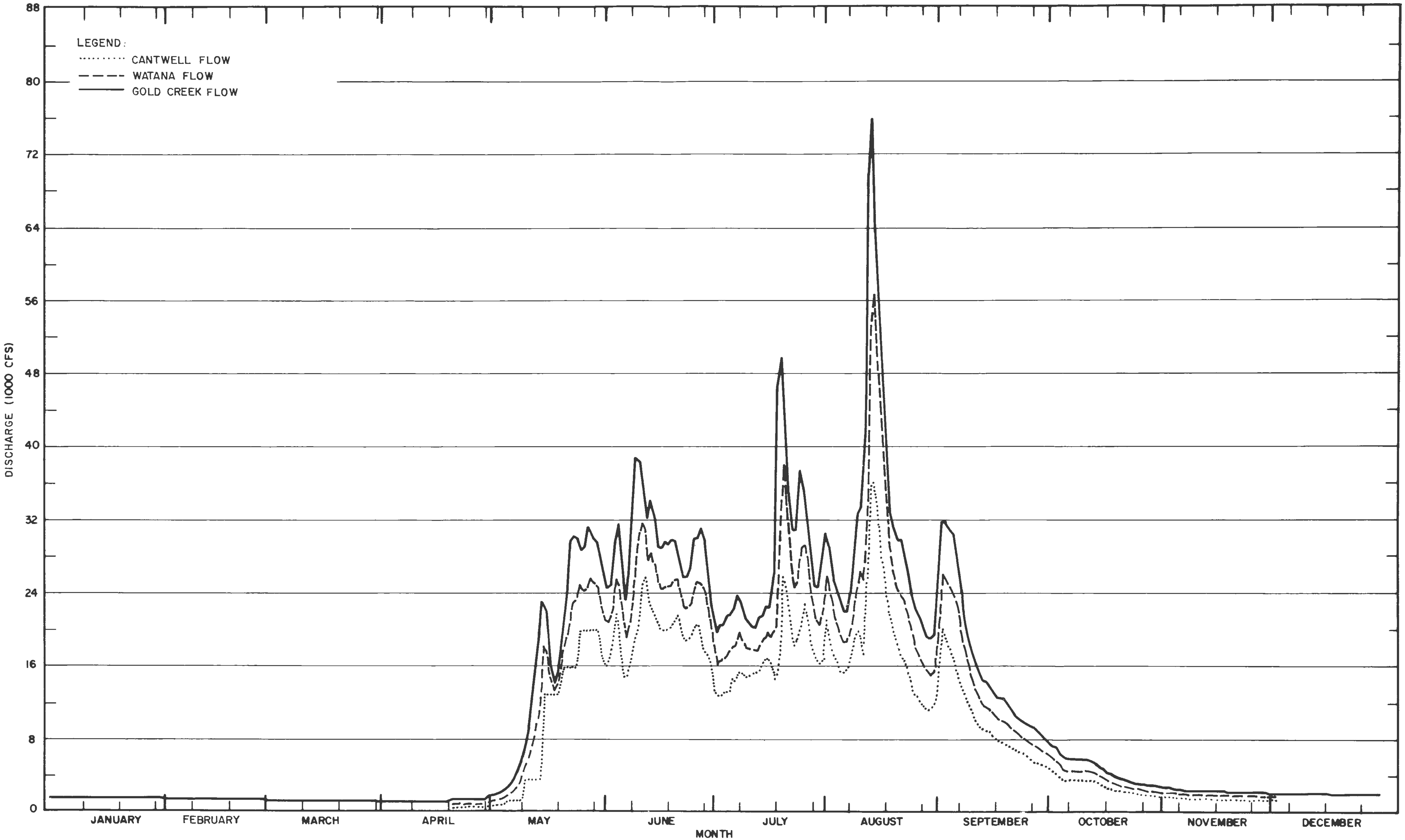
FIGURE E.2.23



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1964 NATURAL FLOWS
CANTWELL, WATANA AND GOLD CREEK

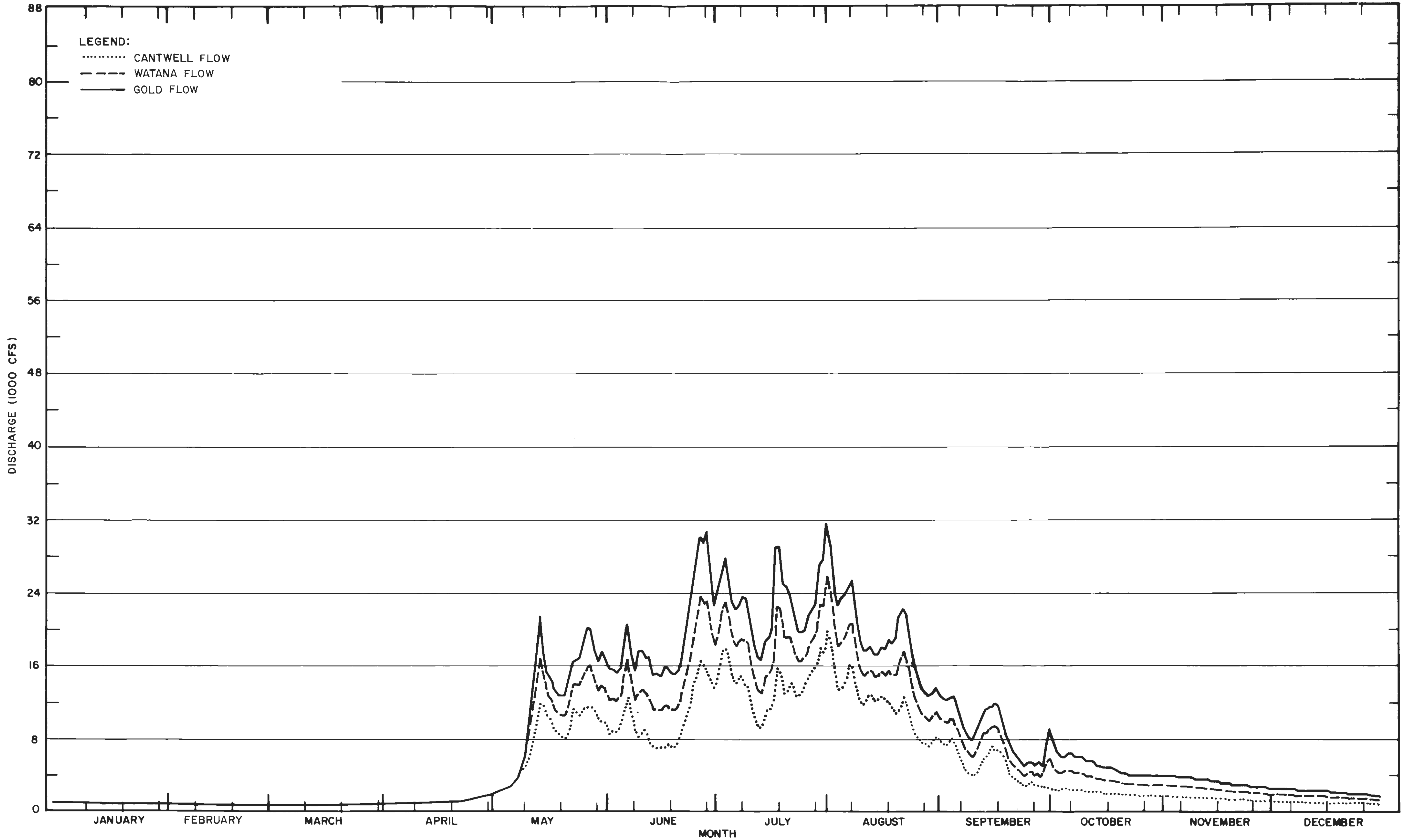
FIGURE E.2.24



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1967 NATURAL FLOWS
CANTWELL, WATANA AND GOLD CREEK

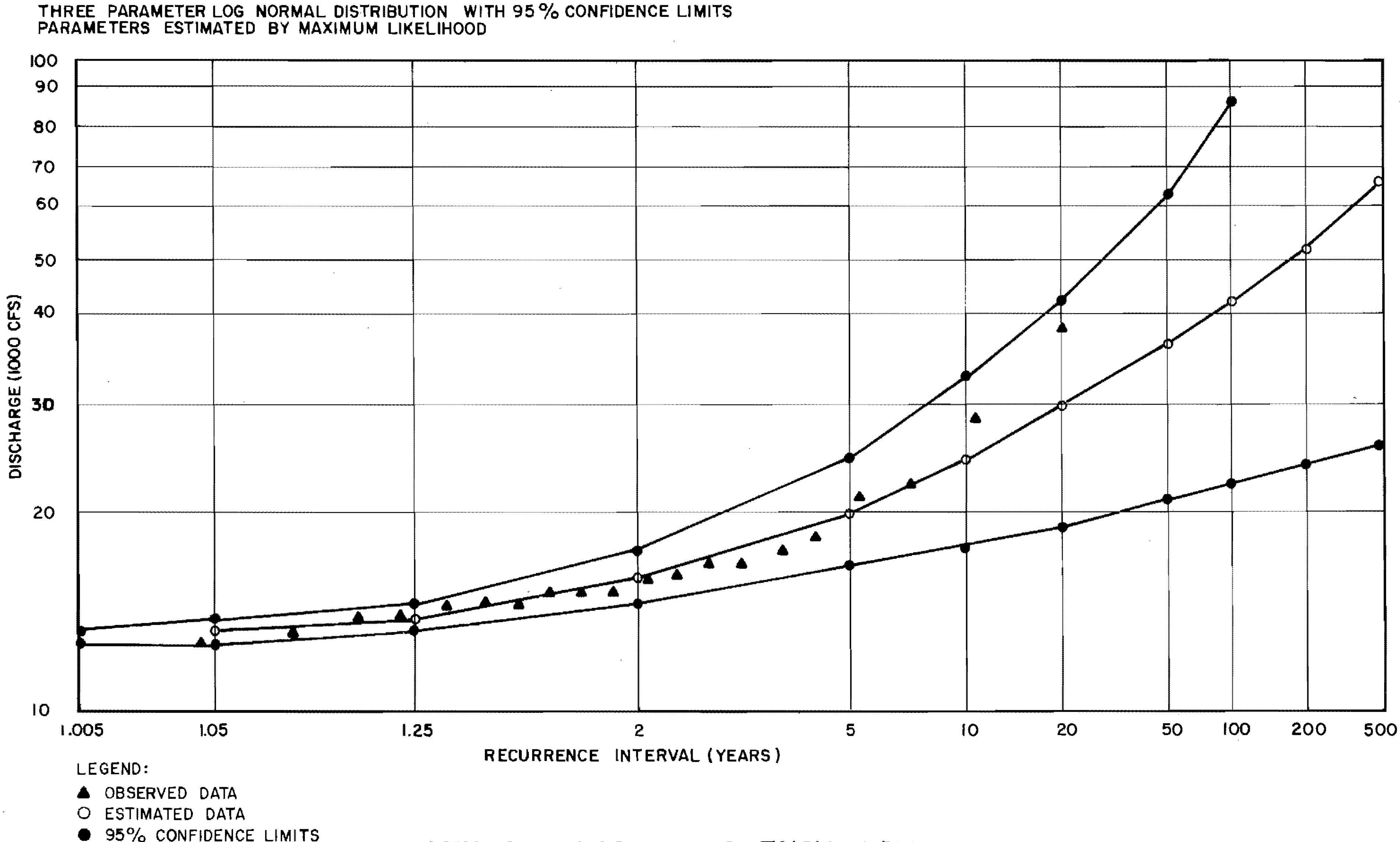
FIGURE E.2.25



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1970 NATURAL FLOWS
CANTWELL, WATANA AND GOLD CREEK

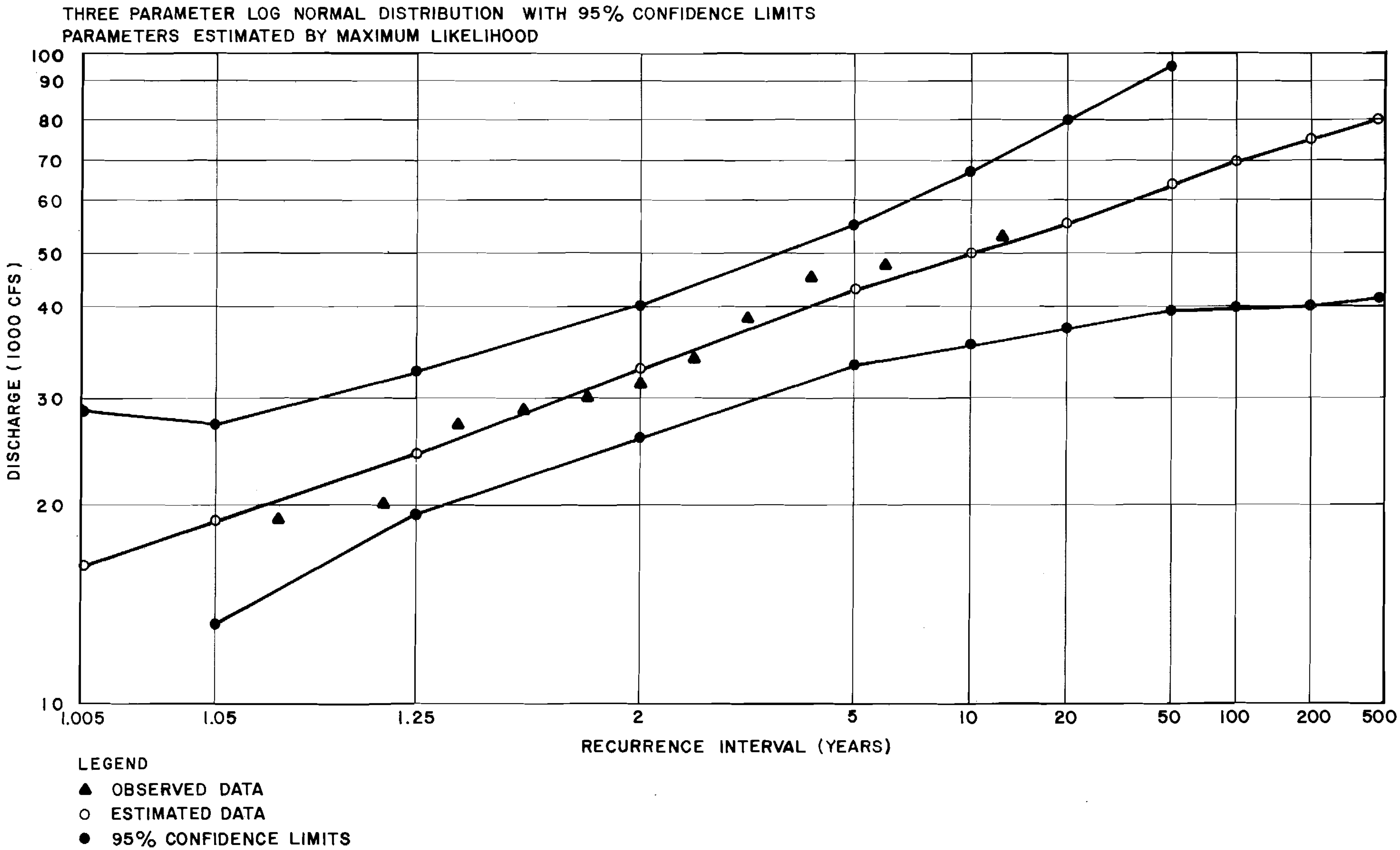
FIGURE E.2.26



ANNUAL FLOOD FREQUENCY CURVE
SUSITNA RIVER NEAR DENALI

SOURCE: R&M 1981

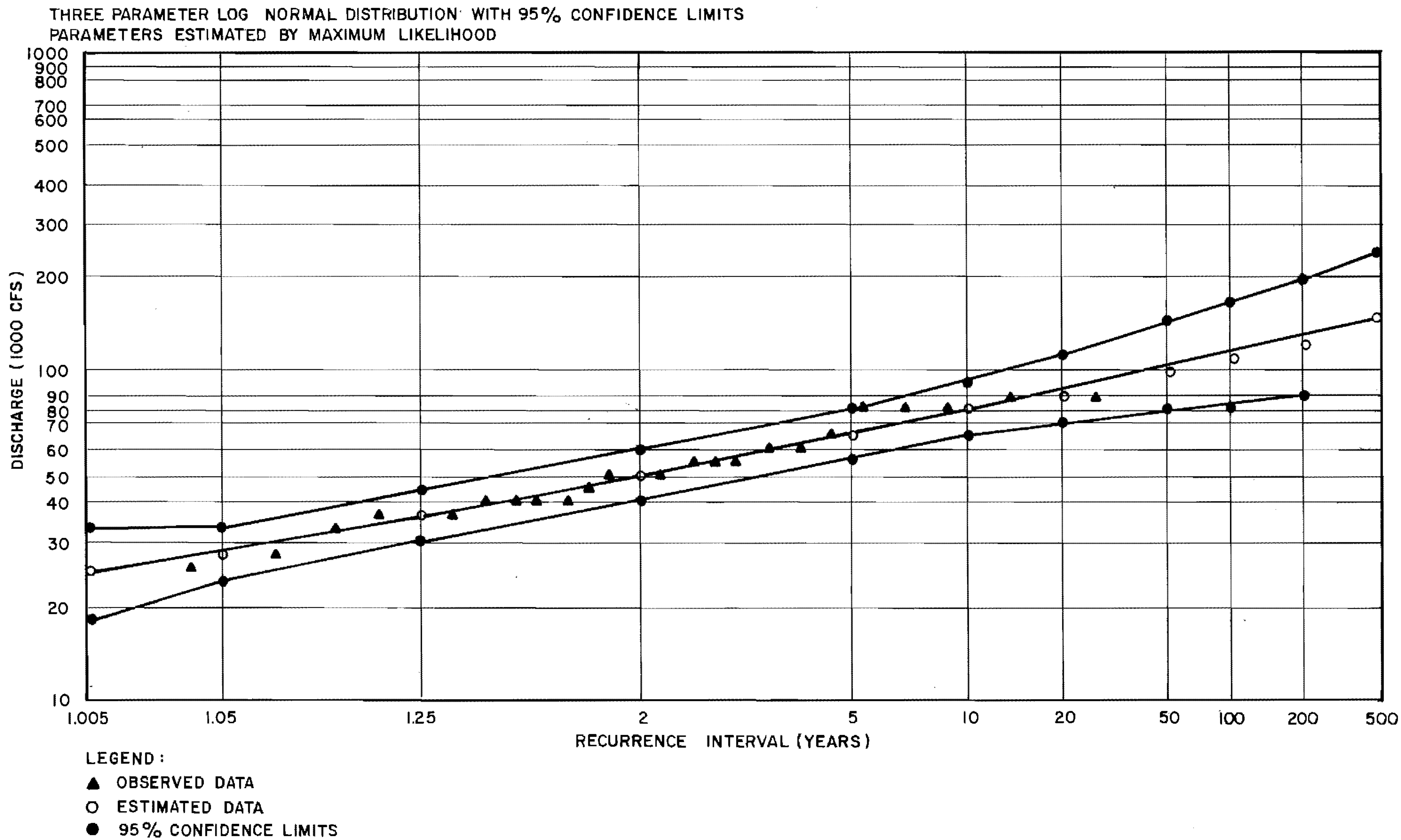
FIGURE E.2.27



ANNUAL FLOOD FREQUENCY CURVE
SUSITNA RIVER NEAR CANTWELL

SOURCE: R & M 1981

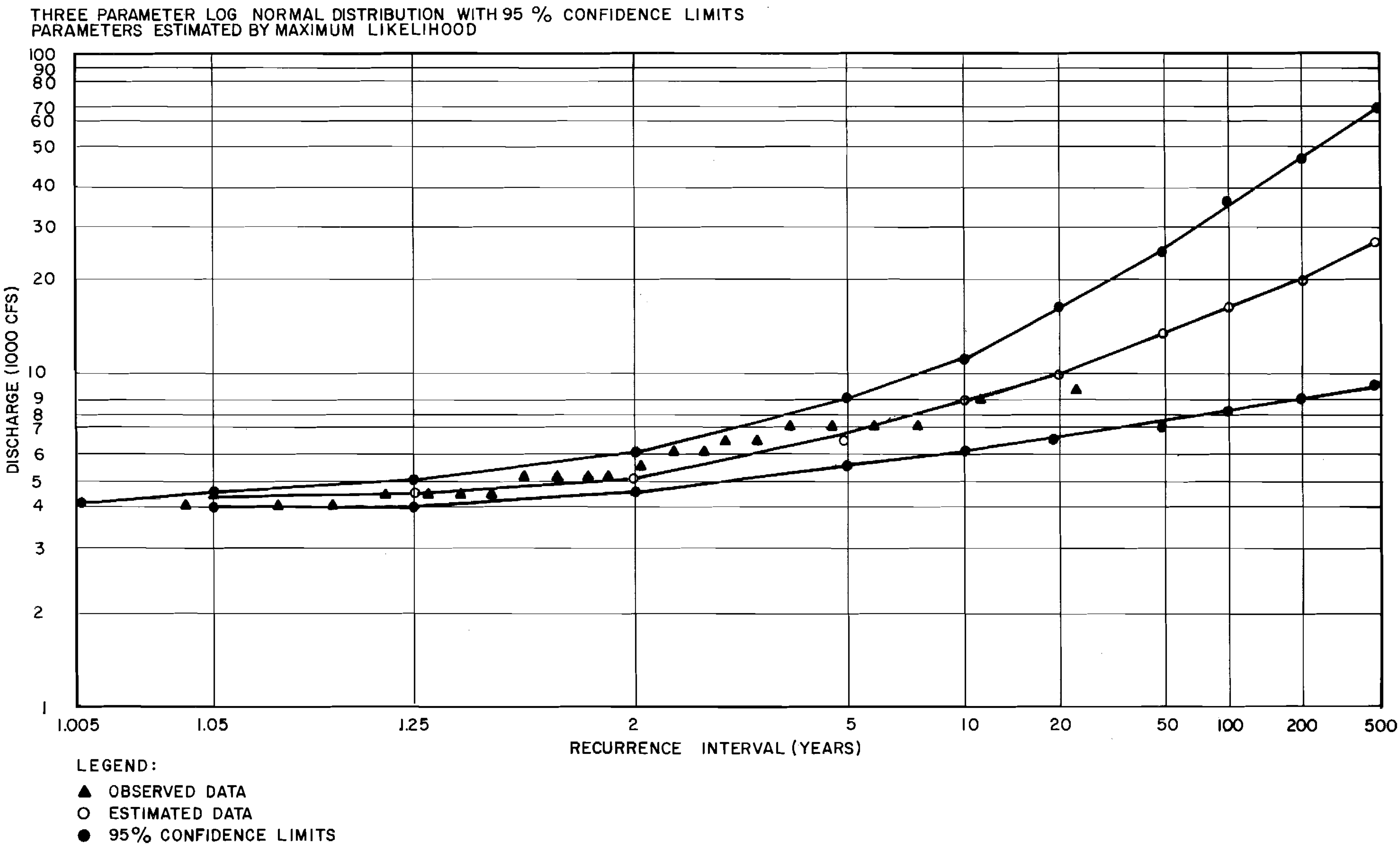
FIGURE E.2.28



ANNUAL FLOOD FREQUENCY CURVE
SUSITNA RIVER AT GOLD CREEK

SOURCE: R & M 1981

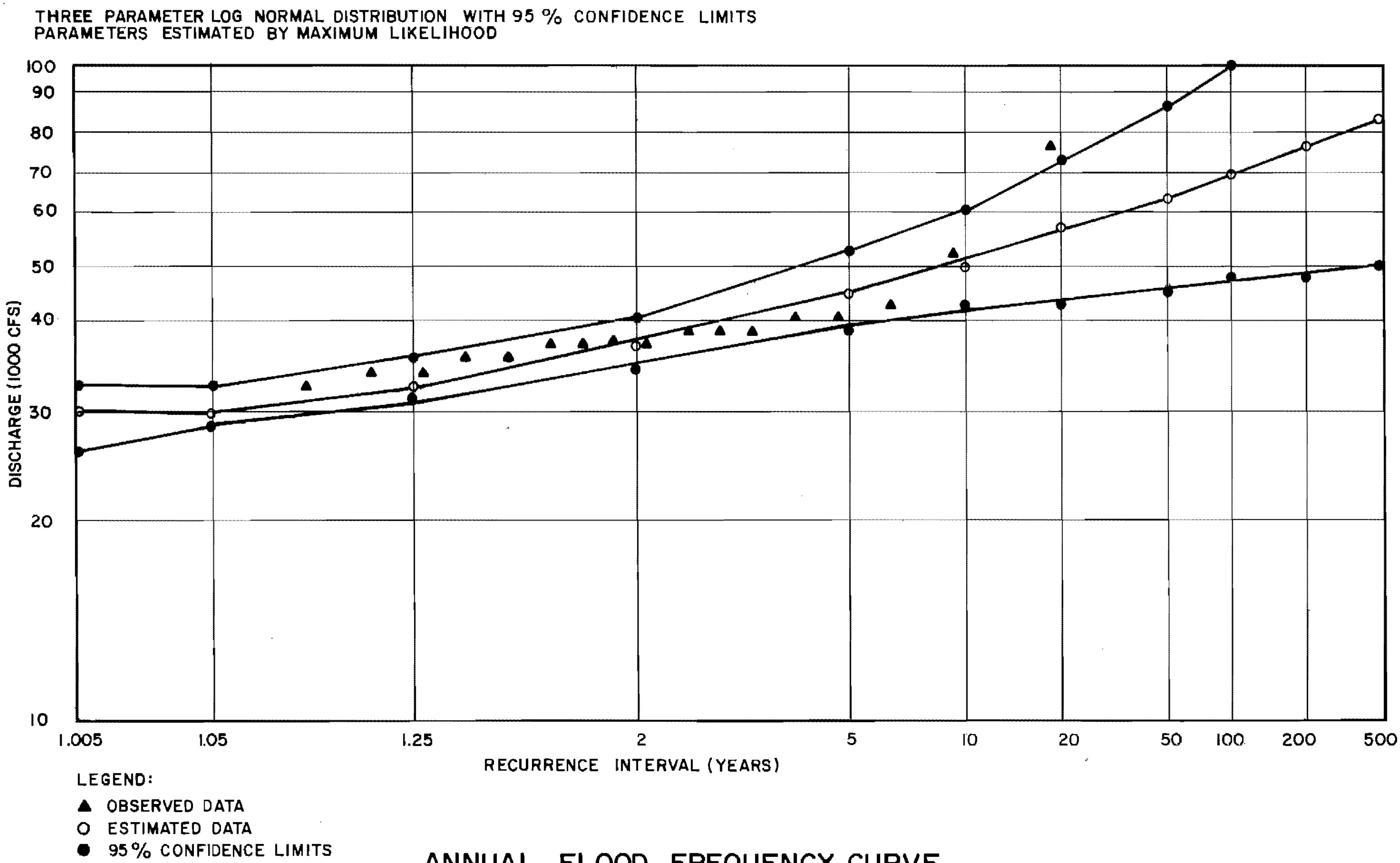
FIGURE E.2.29



ANNUAL FLOOD FREQUENCY CURVE
MACLAREN RIVER NEAR PAXSON

SOURCE: R & M 1981

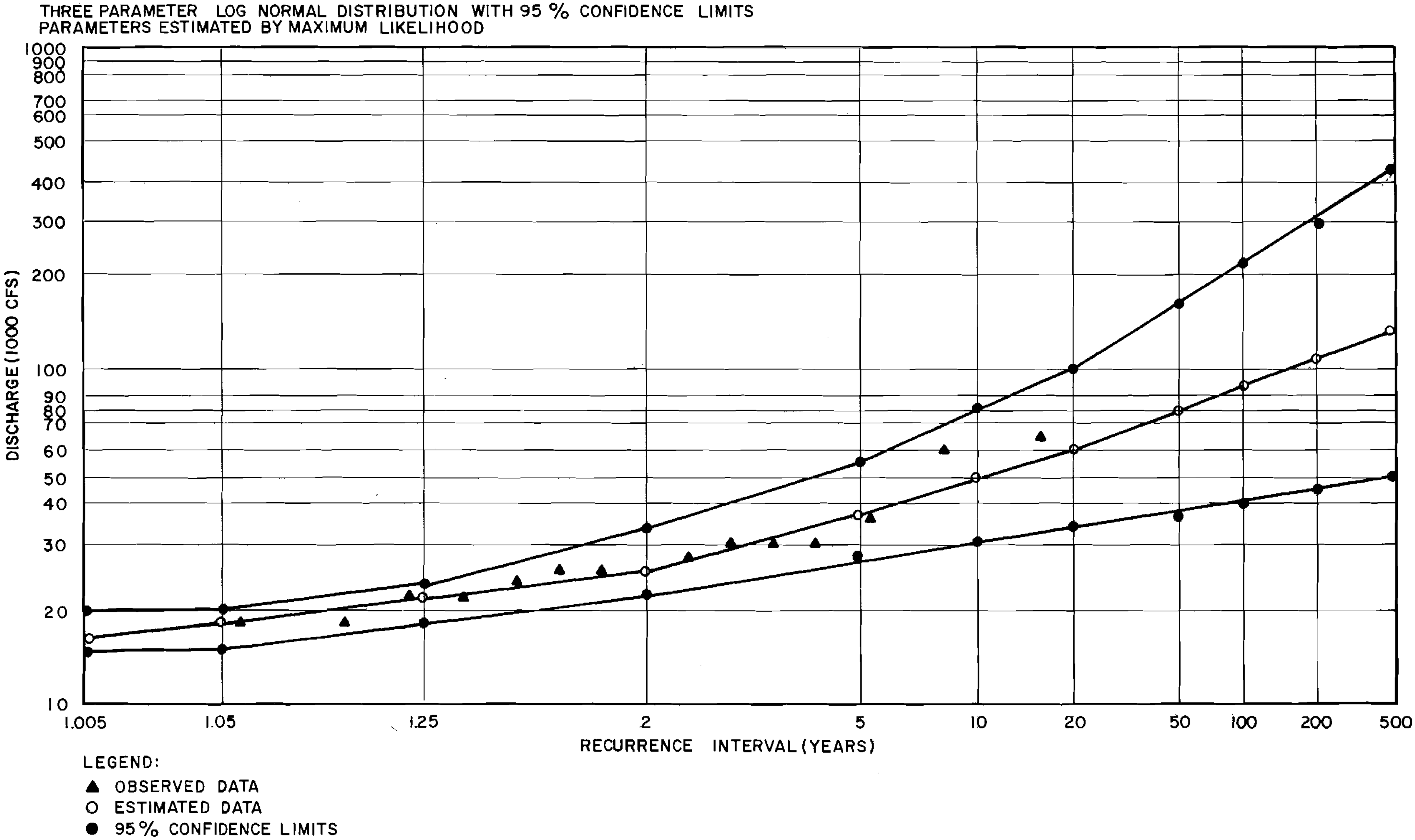
FIGURE E.2.30



ANNUAL FLOOD FREQUENCY CURVE
CHULITNA RIVER NEAR TALKEETNA

SOURCE: R & M 1981

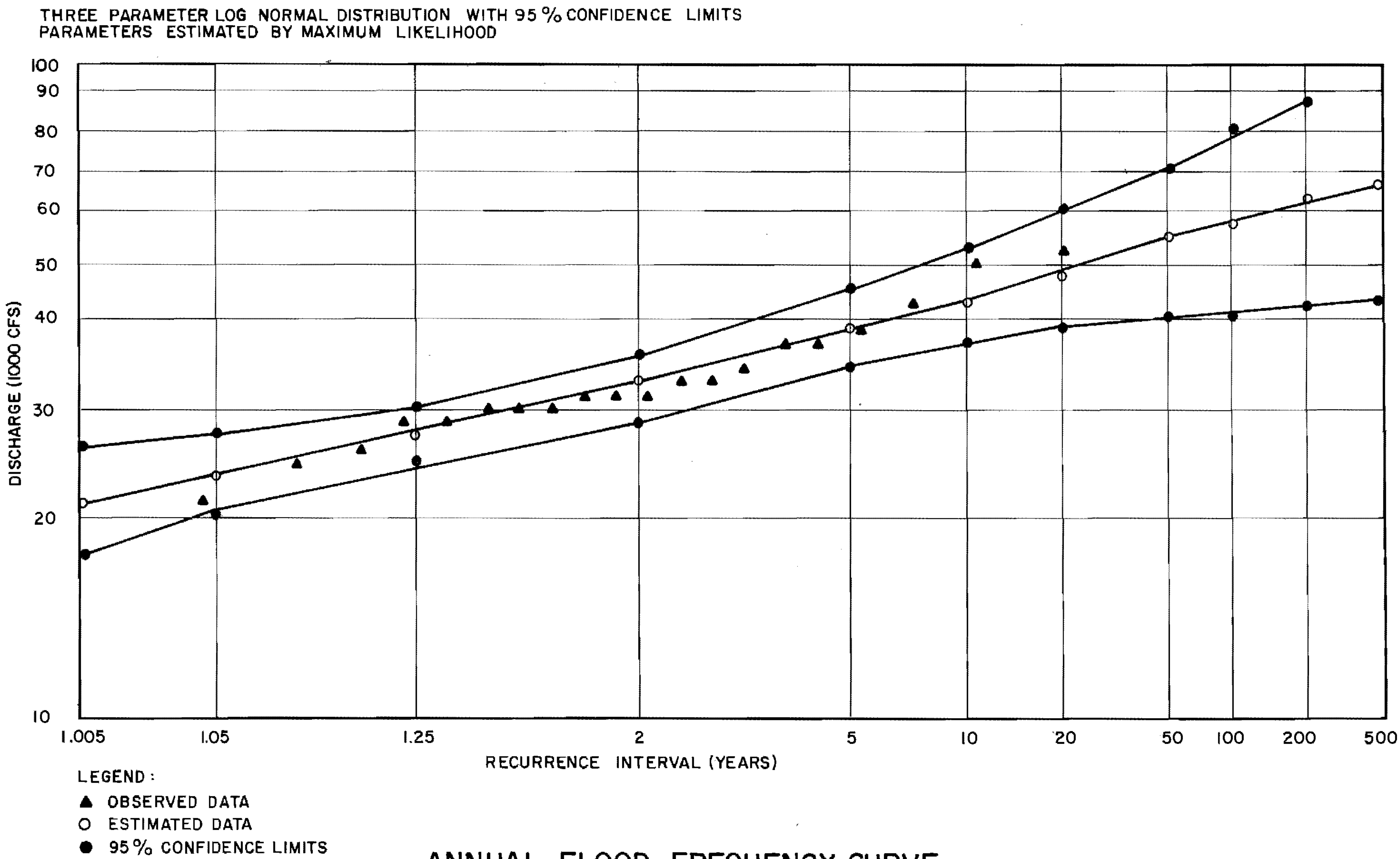
FIGURE E.2.31



ANNUAL FLOOD FREQUENCY CURVE
TALKEETNA RIVER NEAR TALKEETNA

SOURCE: R & M 1981

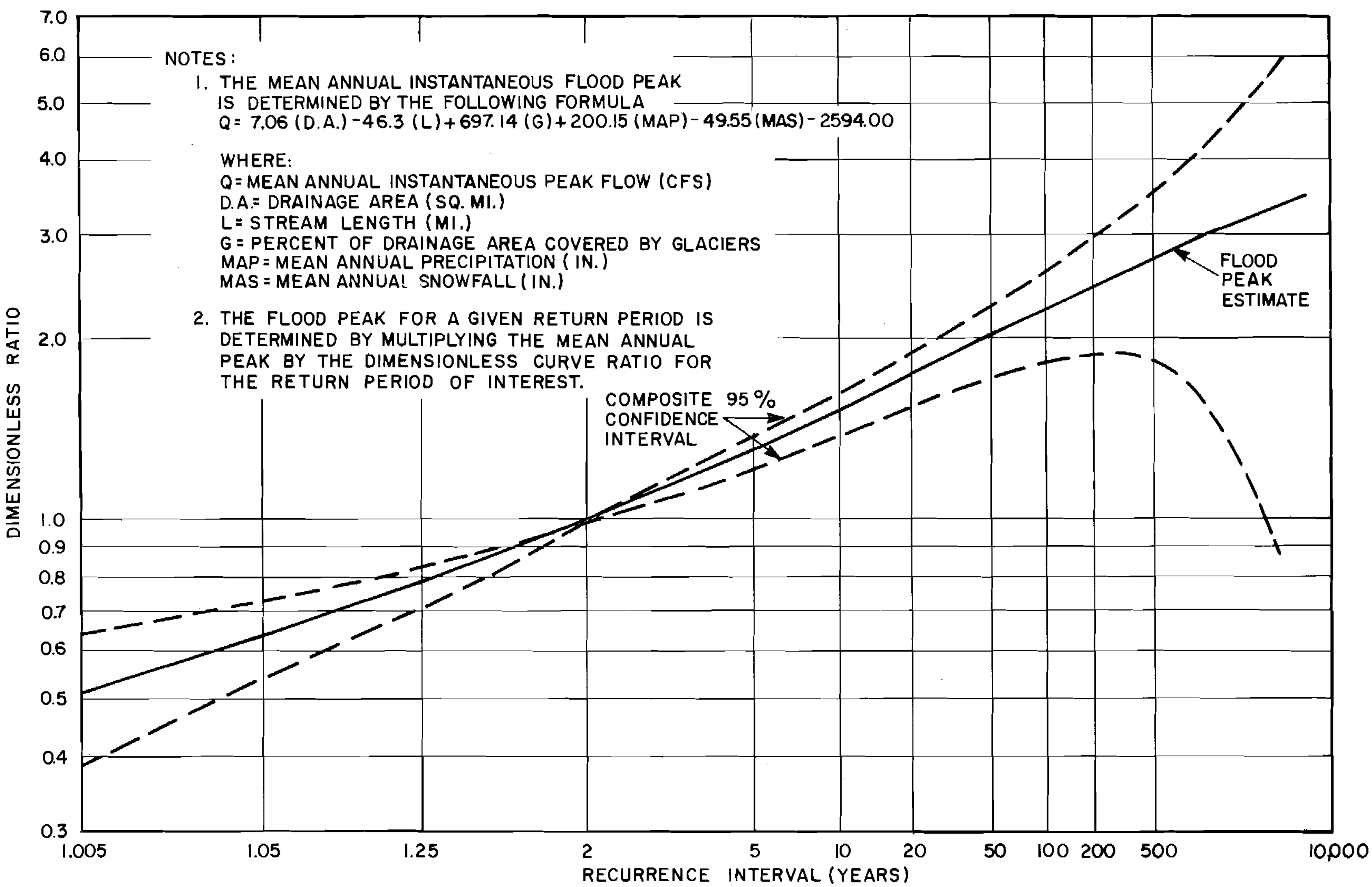
FIGURE E.2.32



ANNUAL FLOOD FREQUENCY CURVE
SKWENTNA RIVER NEAR SKWENTNA

SOURCE: R & M 1981

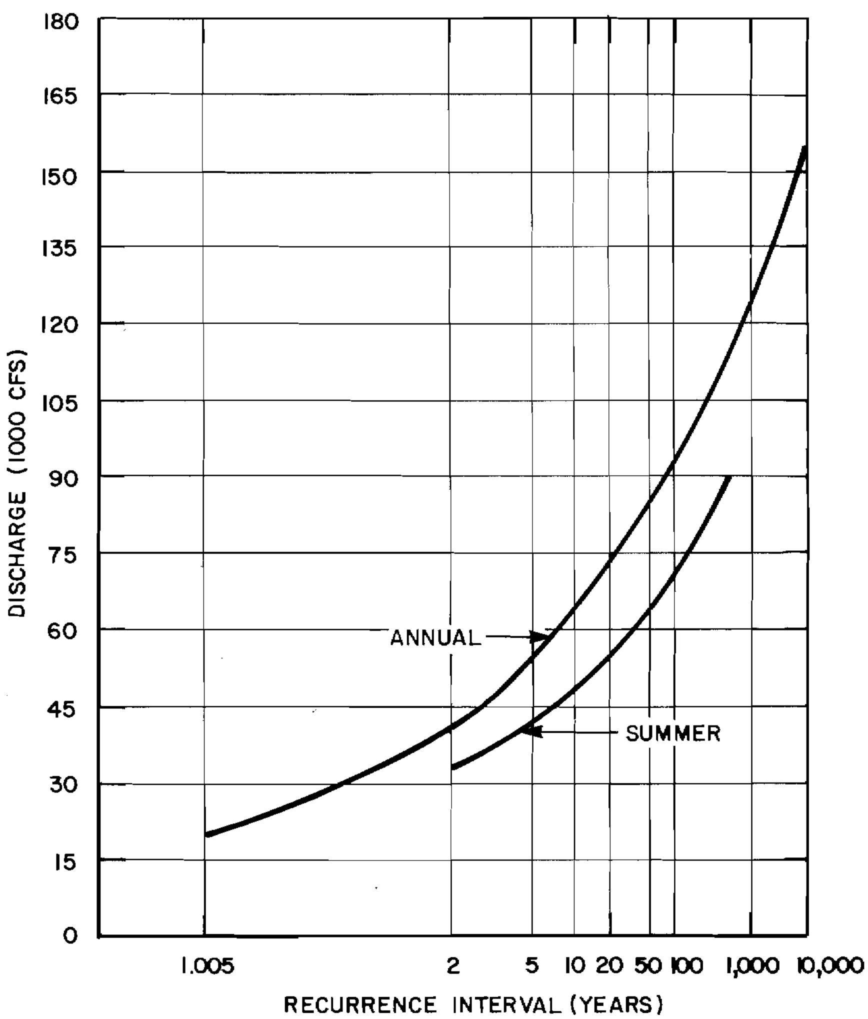
FIGURE E.2.33



DESIGN DIMENSIONLESS REGIONAL FREQUENCY CURVE ANNUAL INSTANTANEOUS FLOOD PEAKS

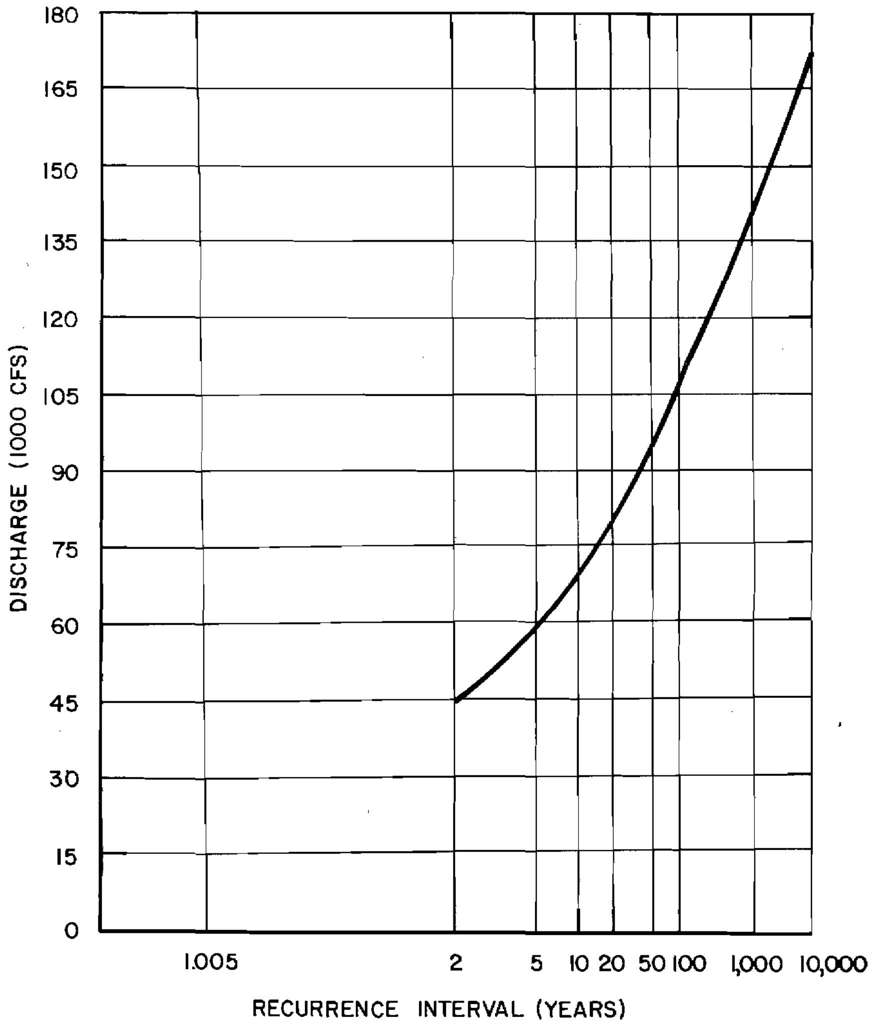
SOURCE: R & M 1981

FIGURE E.2.34



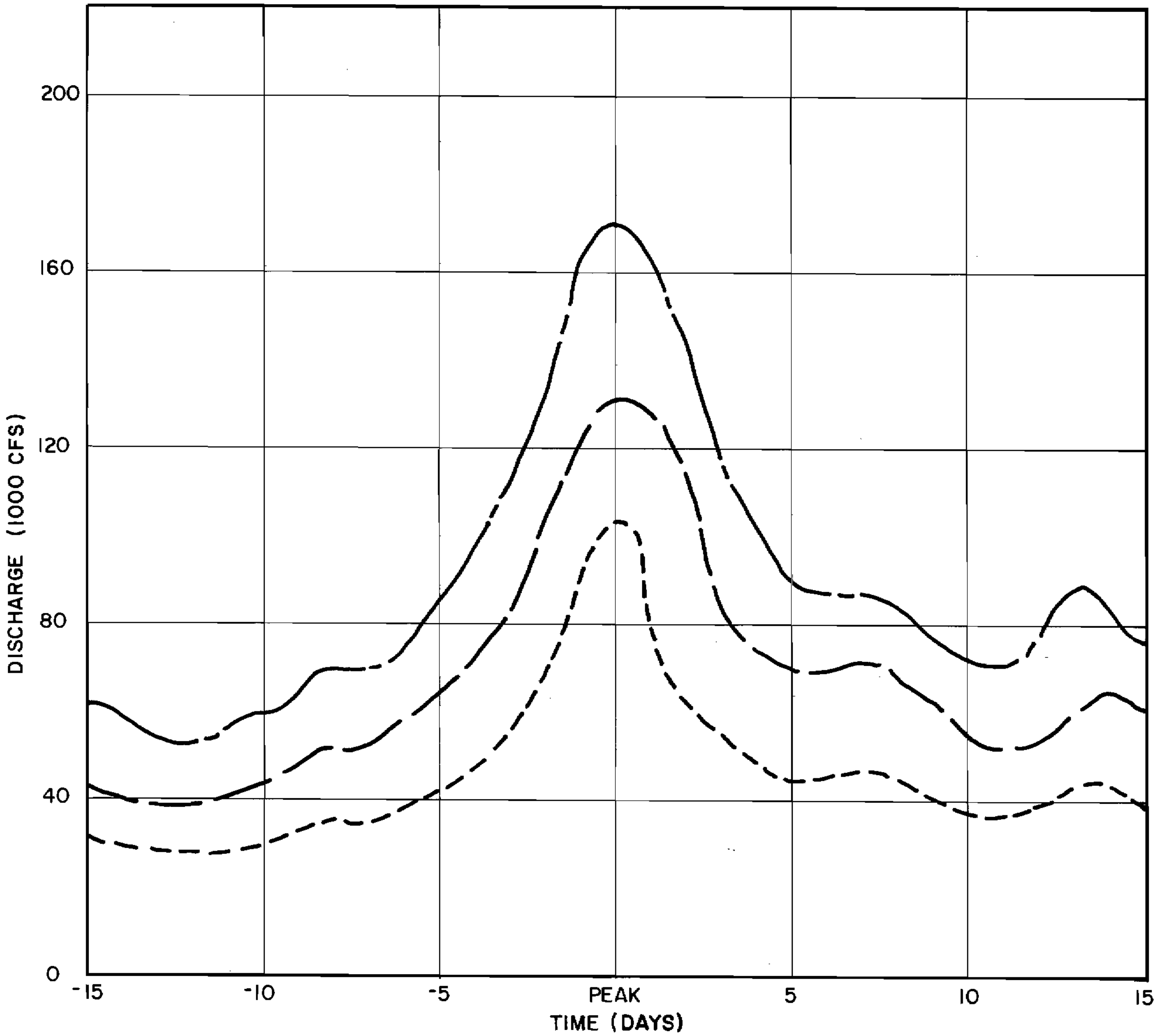
WATANA
NATURAL FLOOD FREQUENCY CURVE

FIGURE E.2.35



DEVIL CANYON
NATURAL FLOOD FREQUENCY CURVE

FIGURE E.2.36



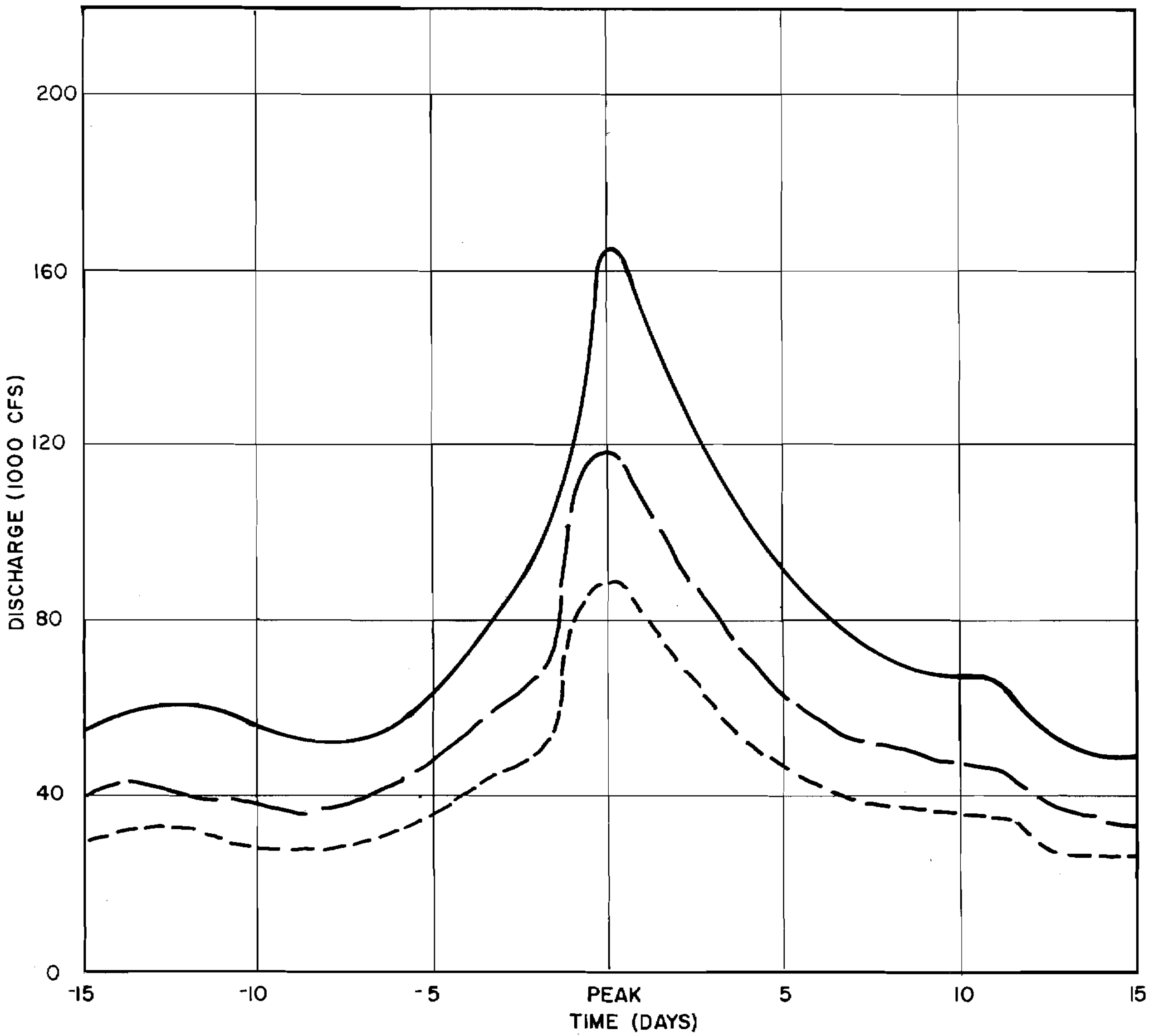
LEGEND

		FLOOD VOLUME (FT^3)	PEAK DISCHARGE (CFS)
— — —	100 YR.	122.3×10^9	104,550
—— ——	500 YR.	178.2×10^9	131,870
— - —	10,000 YR.	269.2×10^9	171,200

SUSITNA RIVER AT GOLD CREEK
FLOOD HYDROGRAPHS
MAY - JULY

SOURCE: R & M 1981

FIGURE E.2.37



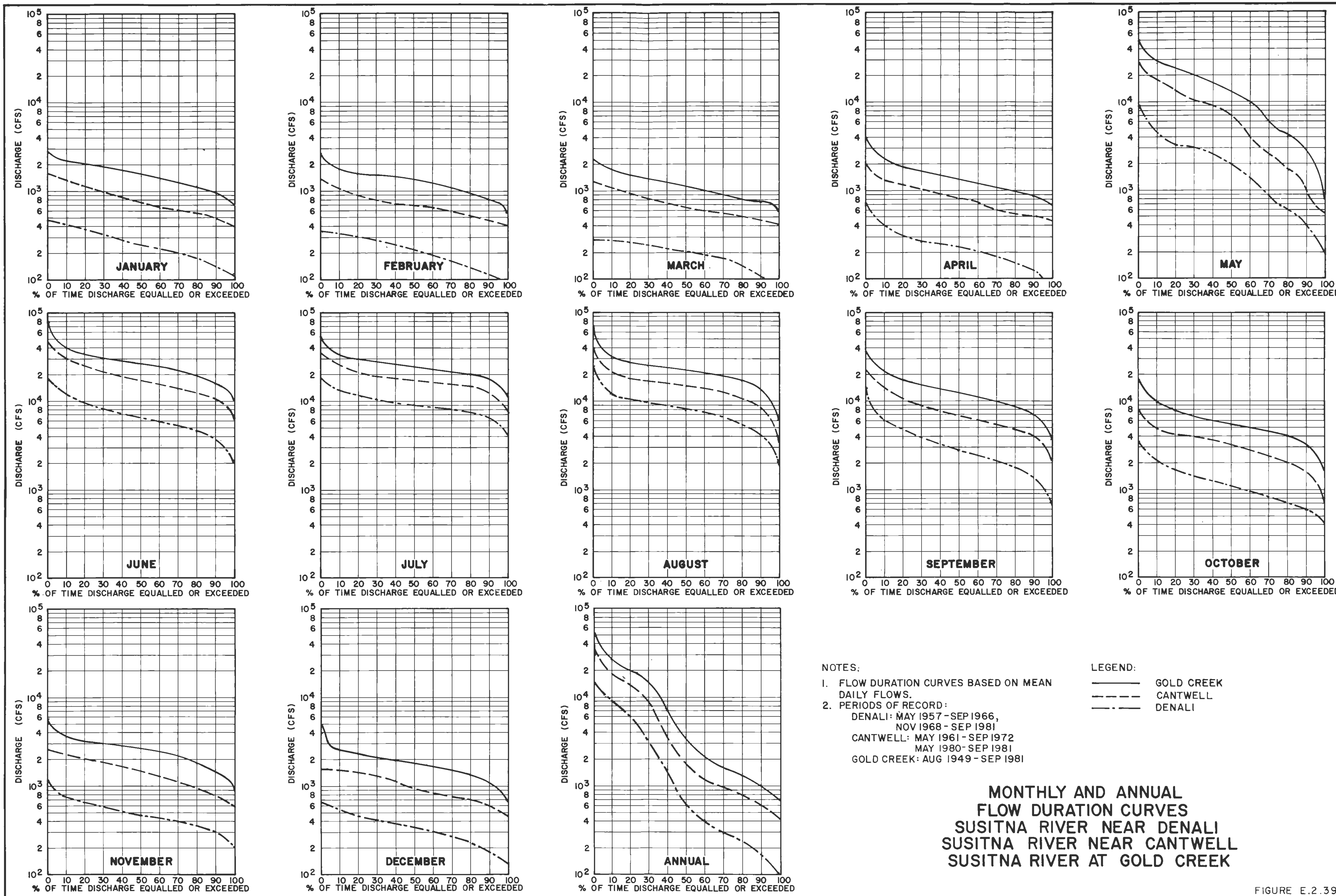
LEGEND:

		FLOOD VOLUME (FT^3)	PEAK DISCHARGE (CFS)
– – –	100 YR	53.8×10^9	90,140
——	500 YR	78.8×10^9	119,430
—·—	10,000 YR	119.5×10^9	163,960

SUSITNA RIVER AT GOLD CREEK
FLOOD HYDROGRAPHS
AUG - OCT

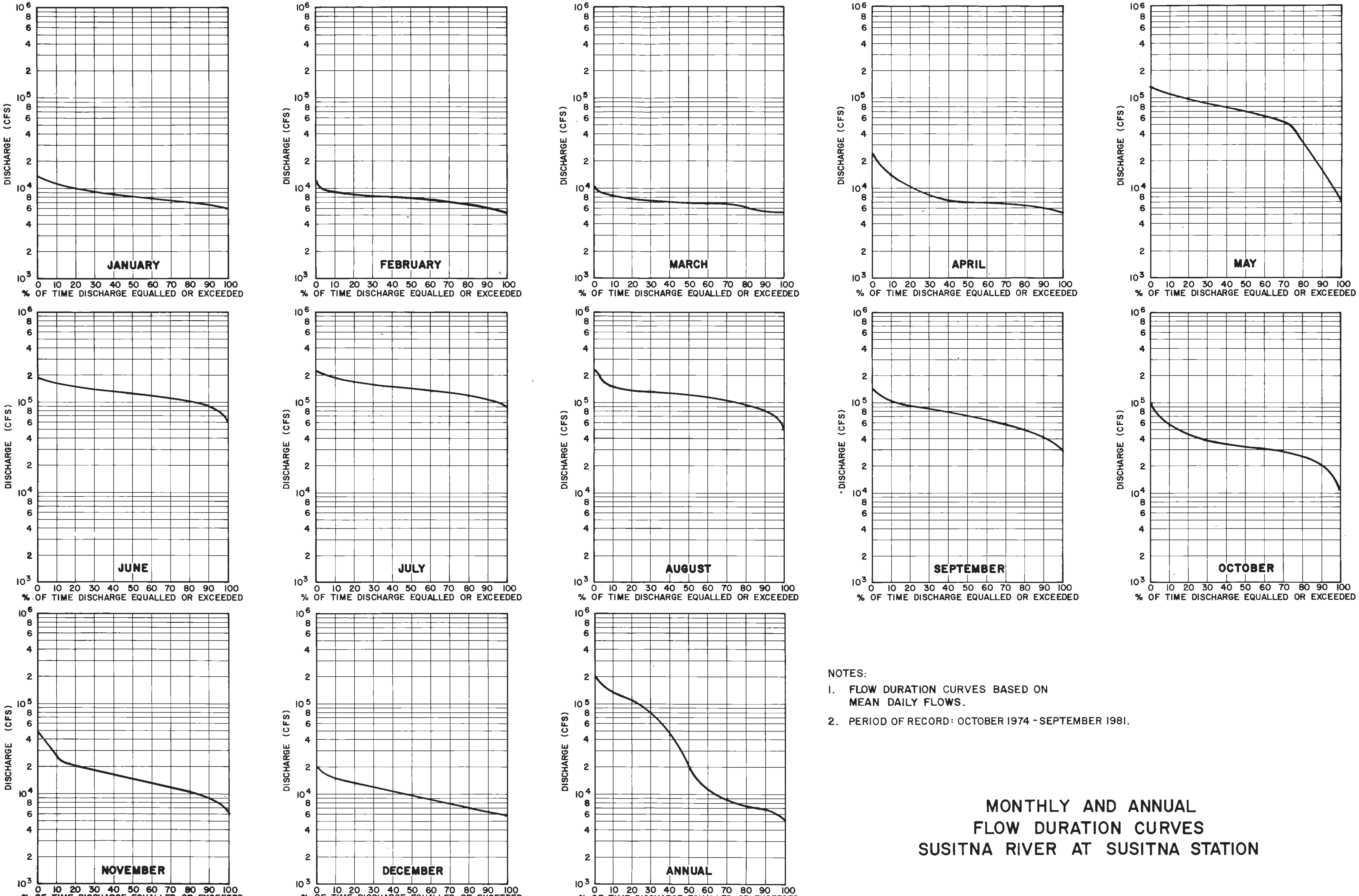
SOURCE: R & M 1981

FIGURE E.2.38



MONTHLY AND ANNUAL FLOW DURATION CURVES
SUSITNA RIVER NEAR DENALI
SUSITNA RIVER NEAR CANTWELL
SUSITNA RIVER AT GOLD CREEK

FIGURE E.2.39

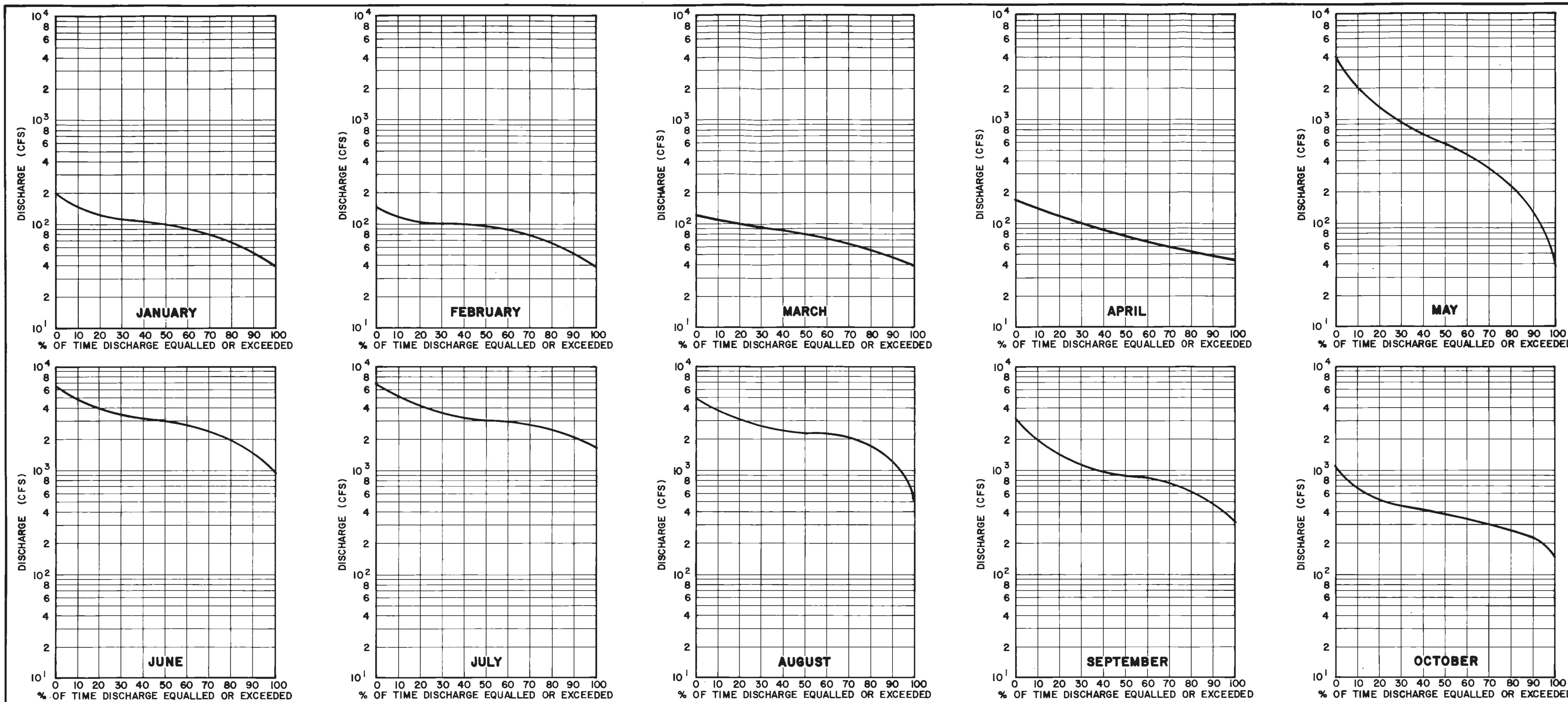


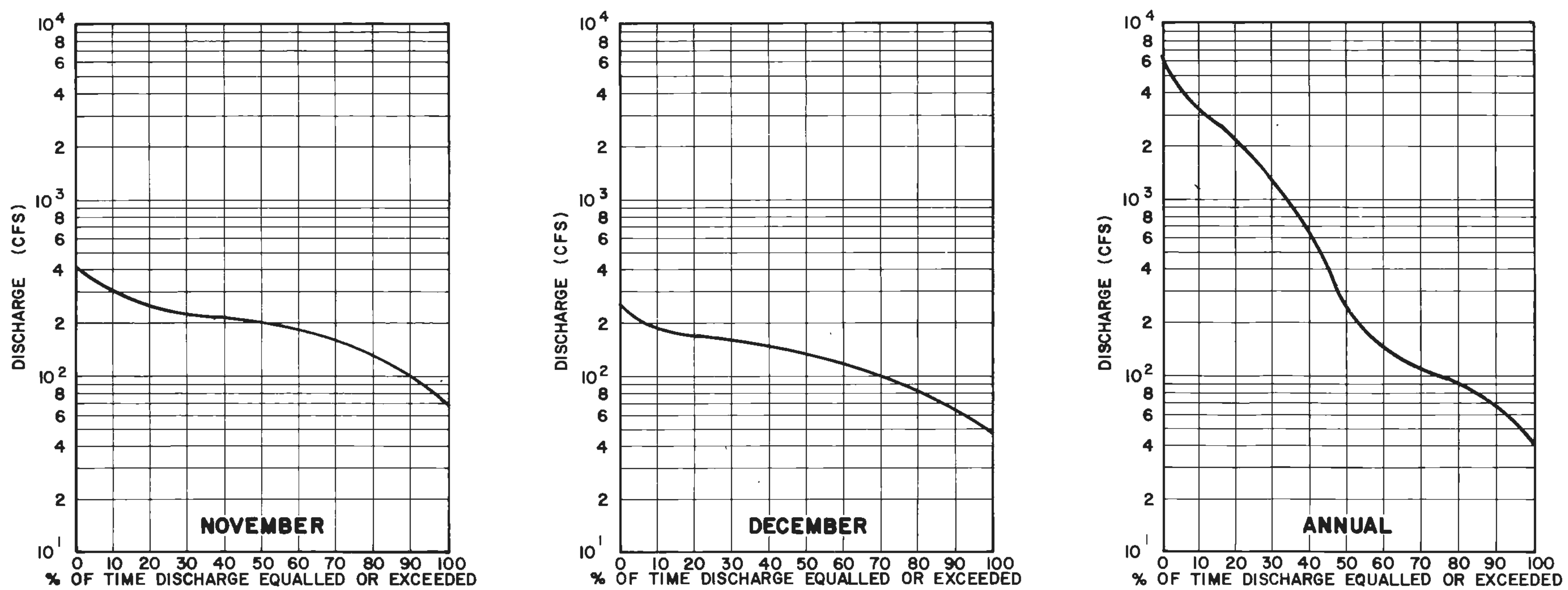
NOTES:

1. FLOW DURATION CURVES BASED ON MEAN DAILY FLOWS.
2. PERIOD OF RECORD: OCTOBER 1974 - SEPTEMBER 1981.

MONTHLY AND ANNUAL
FLOW DURATION CURVES
SUSITNA RIVER AT SUSITNA STATION

FIGURE E.2.40



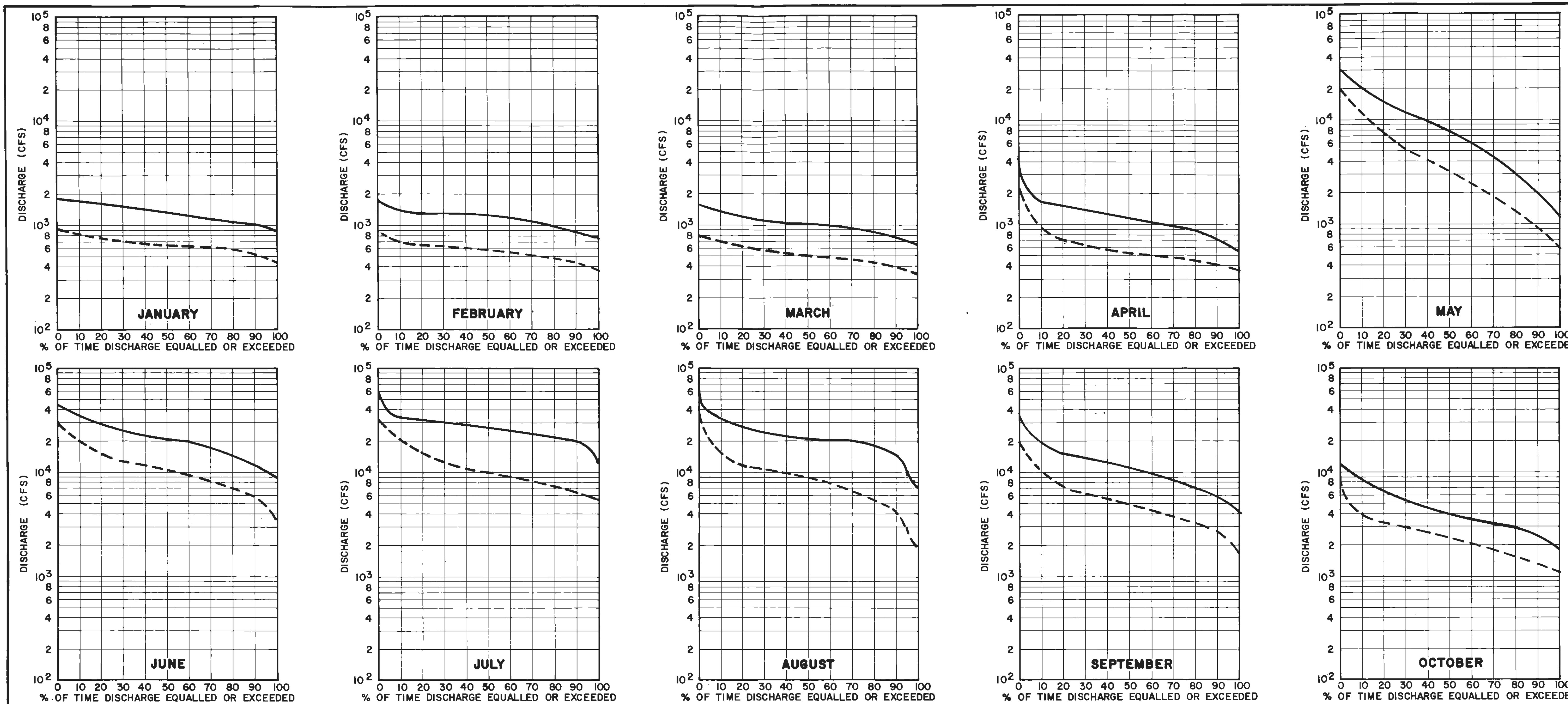


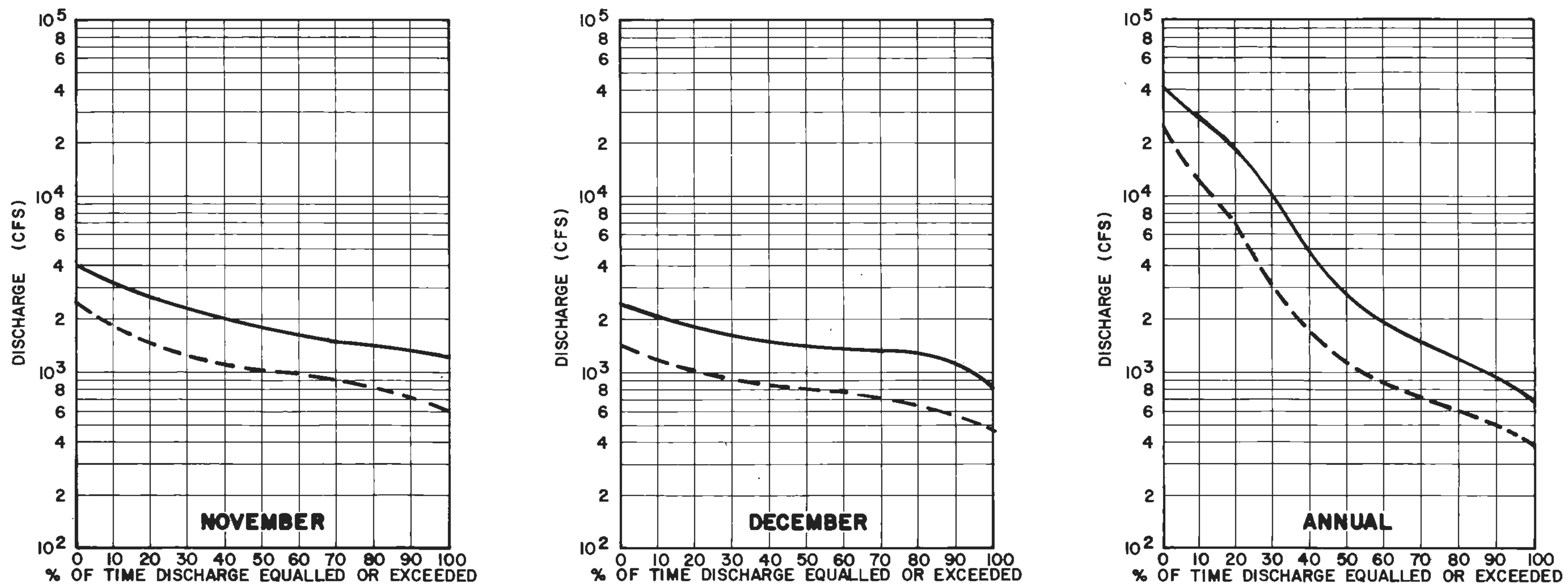
NOTES:

1. FLOW DURATION CURVES BASED ON MEAN DAILY FLOWS.
2. PERIOD OF RECORD: JUNE 1958 - SEPTEMBER 1981.

MONTHLY AND ANNUAL FLOW DURATION CURVES MACLAREN RIVER AT PAXSON

FIGURE E.2.41





NOTES:

1. FLOW DURATION CURVES BASED ON MEAN DAILY FLOWS.
2. PERIODS OF RECORD:
   CHULITNA RIVER NEAR TALKEETNA:
   FEBRUARY 1958 - SEPTEMBER 1972
   MAY 1980 - SEPTEMBER 1981
   TALKEETNA RIVER NEAR TALKEETNA:
   JUNE 1964 - SEPTEMBER 1981

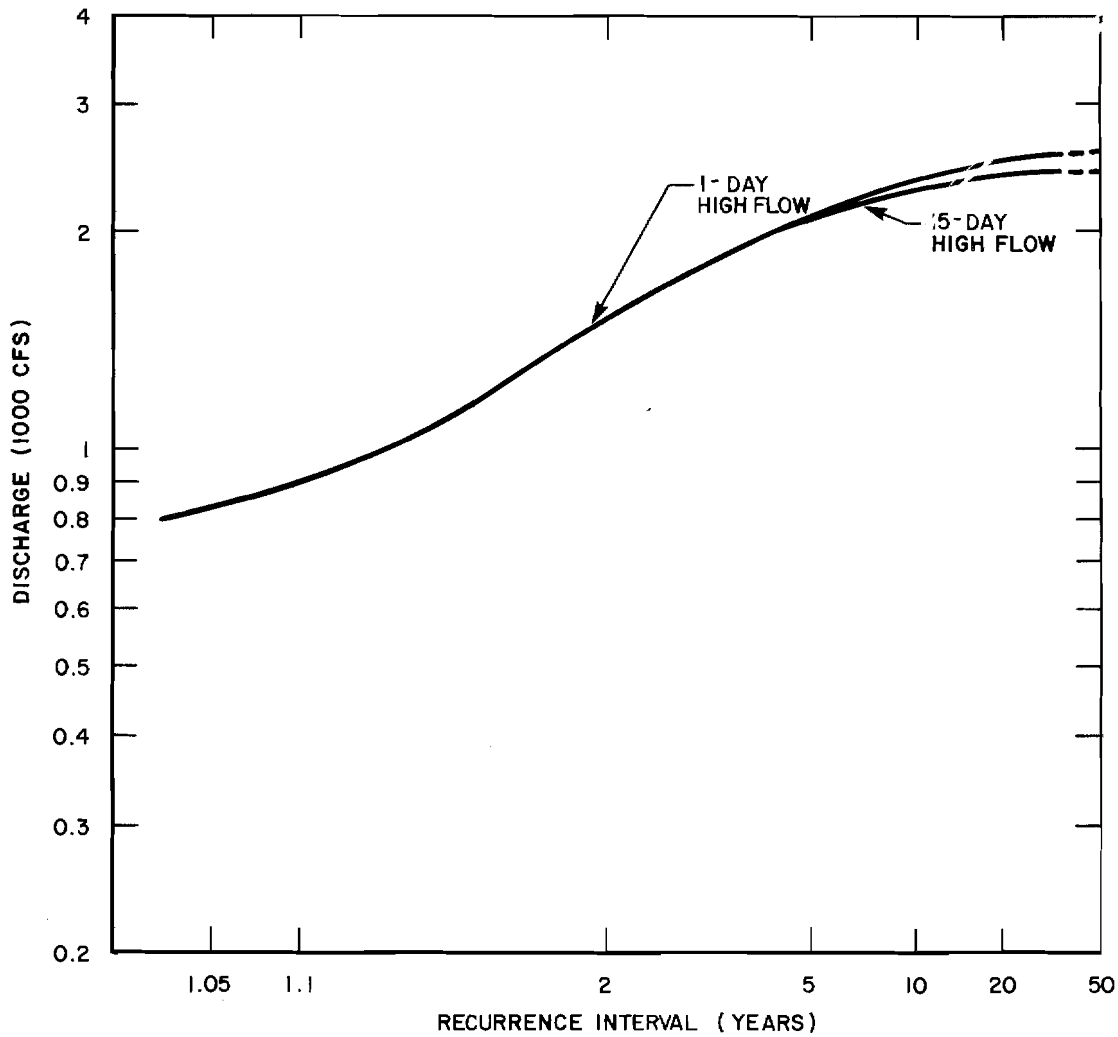
LEGEND:

——— CHULITNA RIVER

- - - - TALKEETNA RIVER

MONTHLY AND ANNUAL
FLOW DURATION CURVES
CHULITNA RIVER NEAR TALKEETNA
TALKEETNA RIVER NEAR TALKEETNA

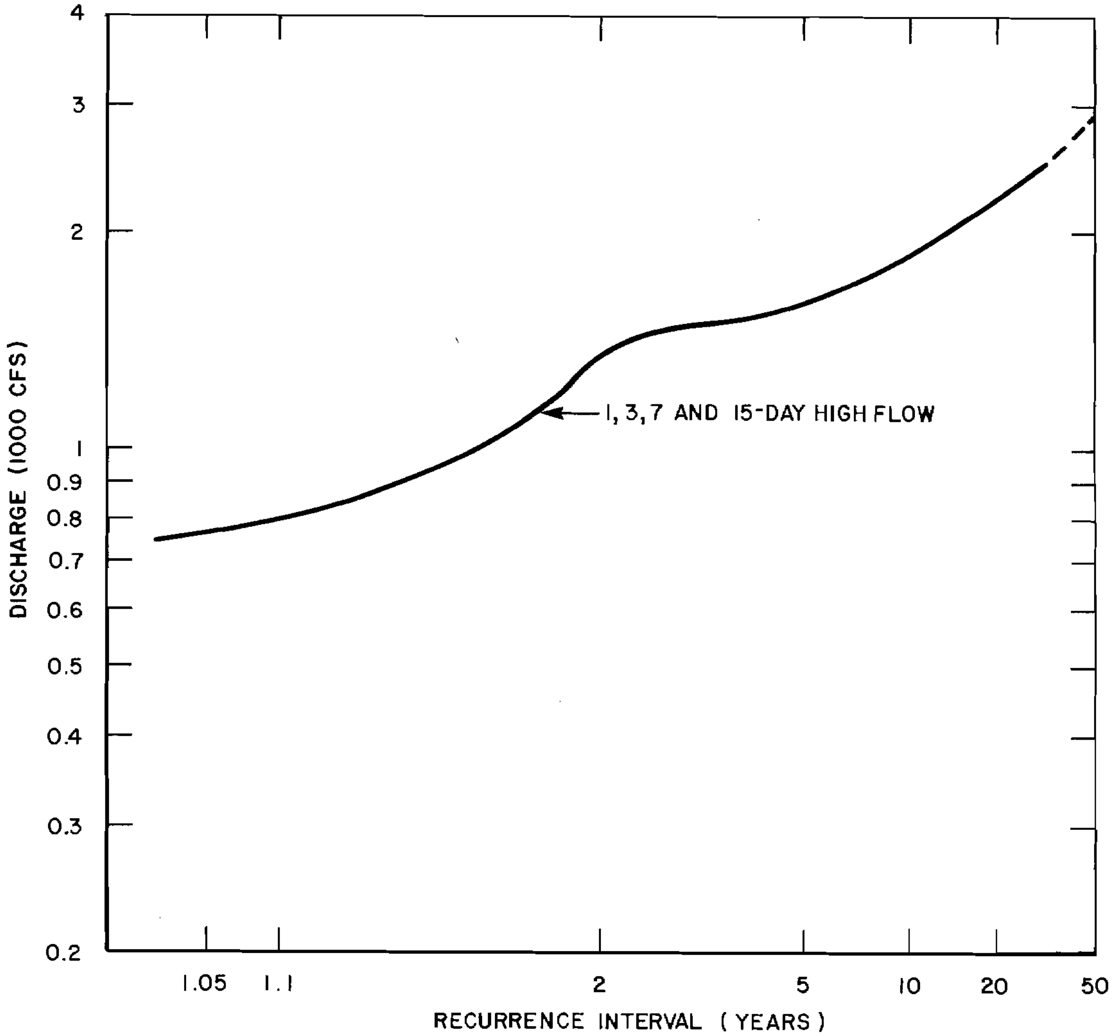
FIGURE E.2.42



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK HIGH-FLOW FREQUENCY CURVES JANUARY

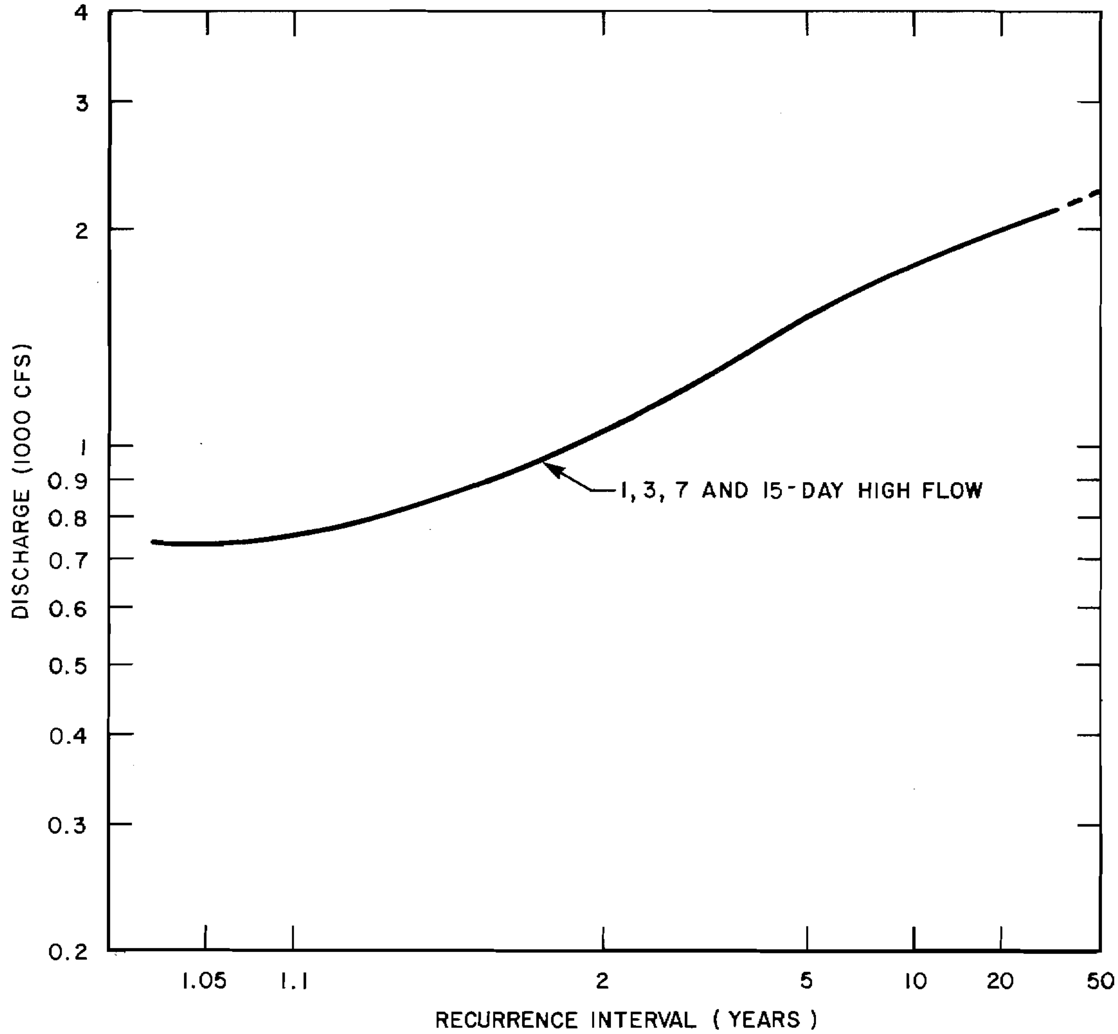
FIGURE E.2.43



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK
HIGH-FLOW FREQUENCY CURVES
FEBRUARY

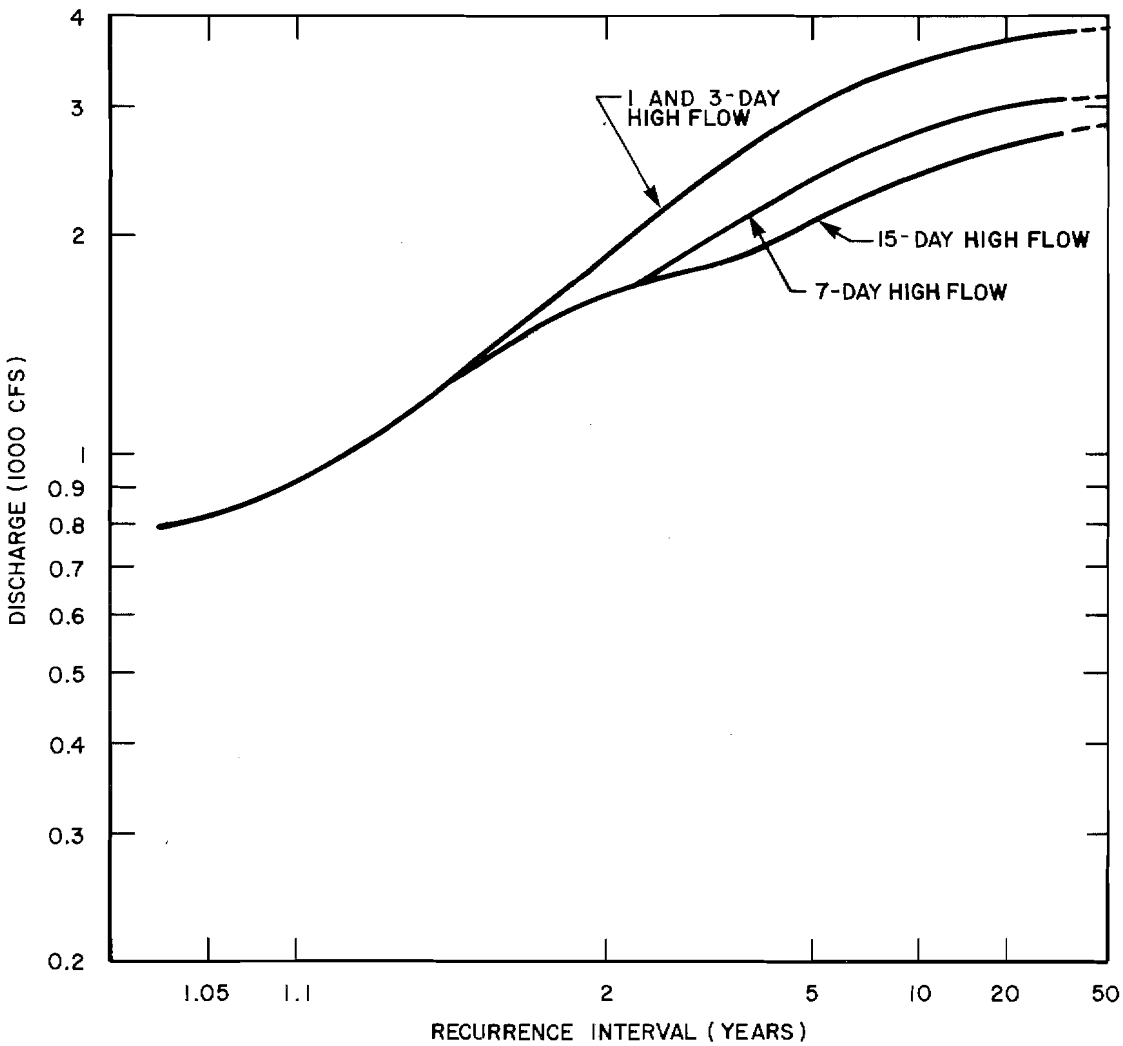
FIGURE E.2.44



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK
HIGH-FLOW FREQUENCY CURVES
MARCH

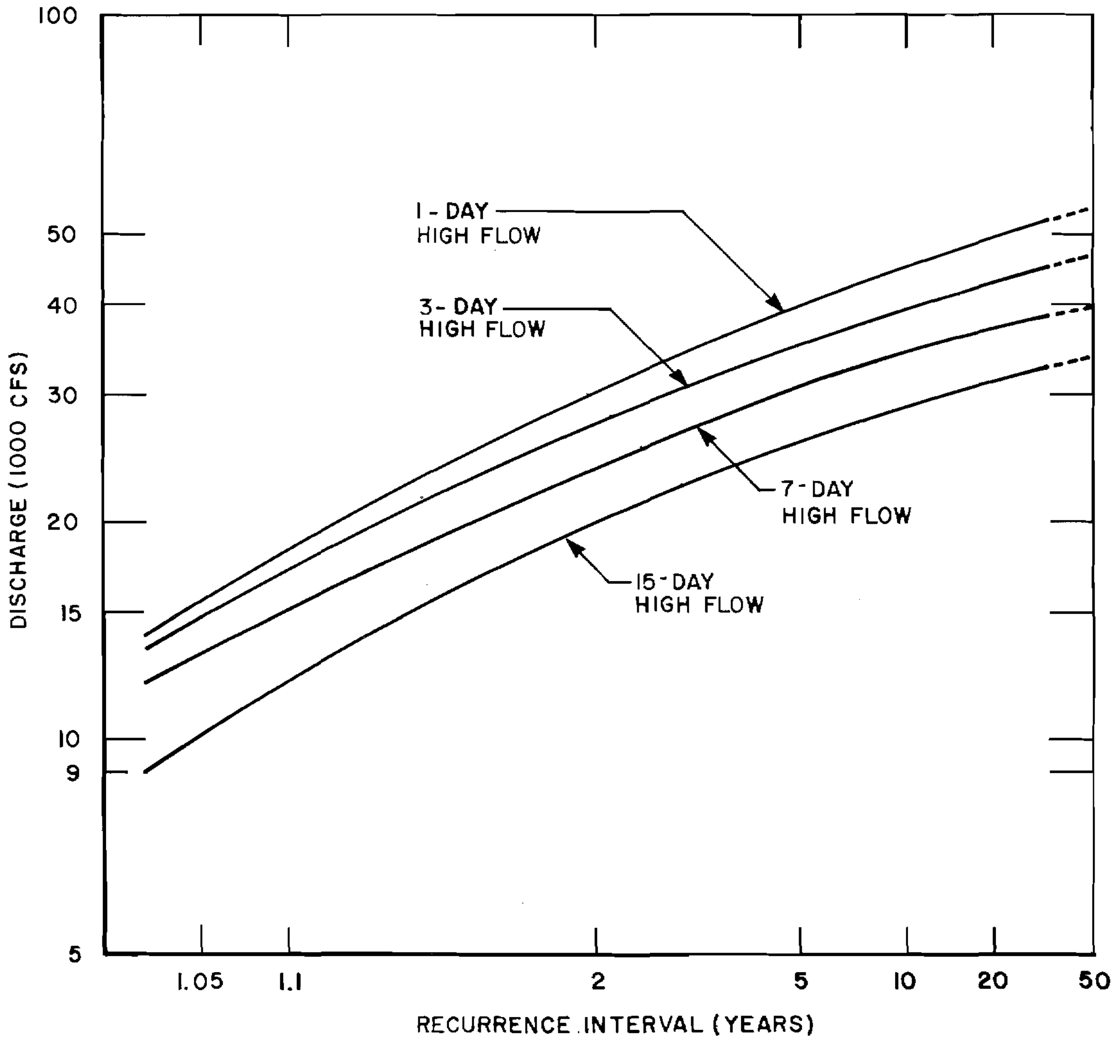
FIGURE E.2.45



NOTE: PERIOD OF RECORD WY 1950 - WY 1981

SUSITNA RIVER AT GOLD CREEK
HIGH-FLOW FREQUENCY CURVES
APRIL

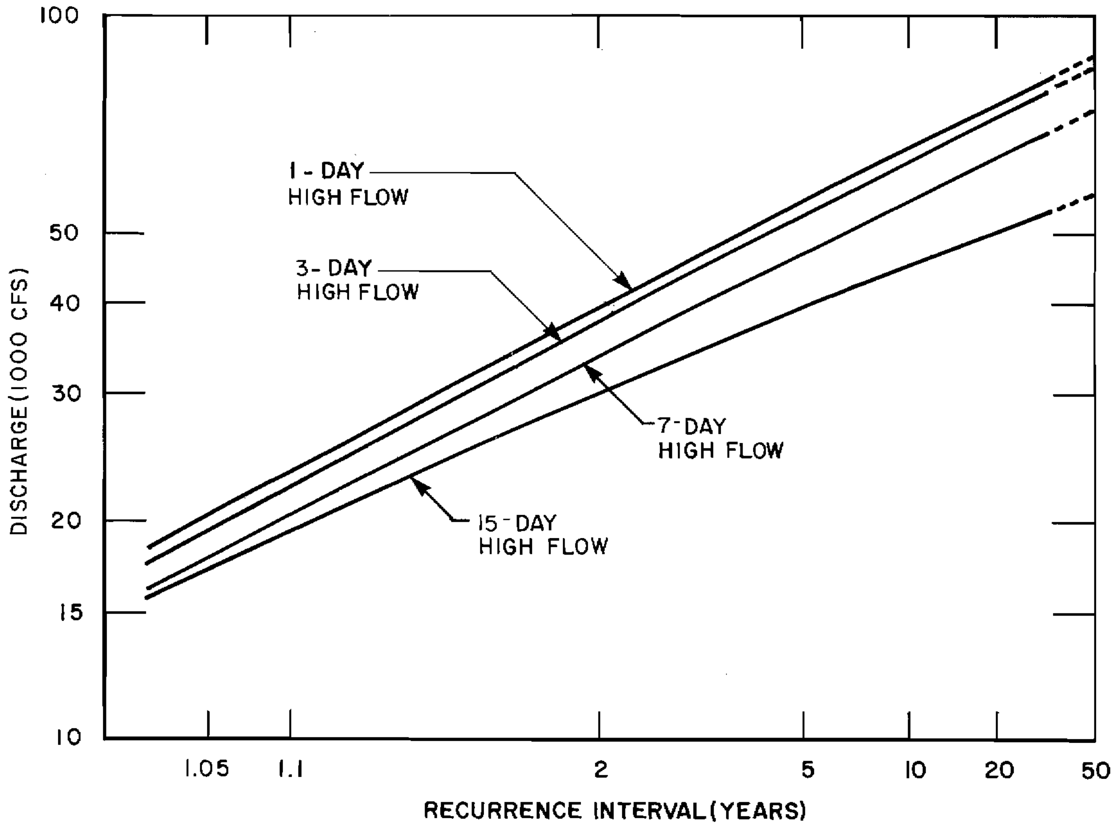
FIGURE E.2.46



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK HIGH-FLOW FREQUENCY CURVES MAY

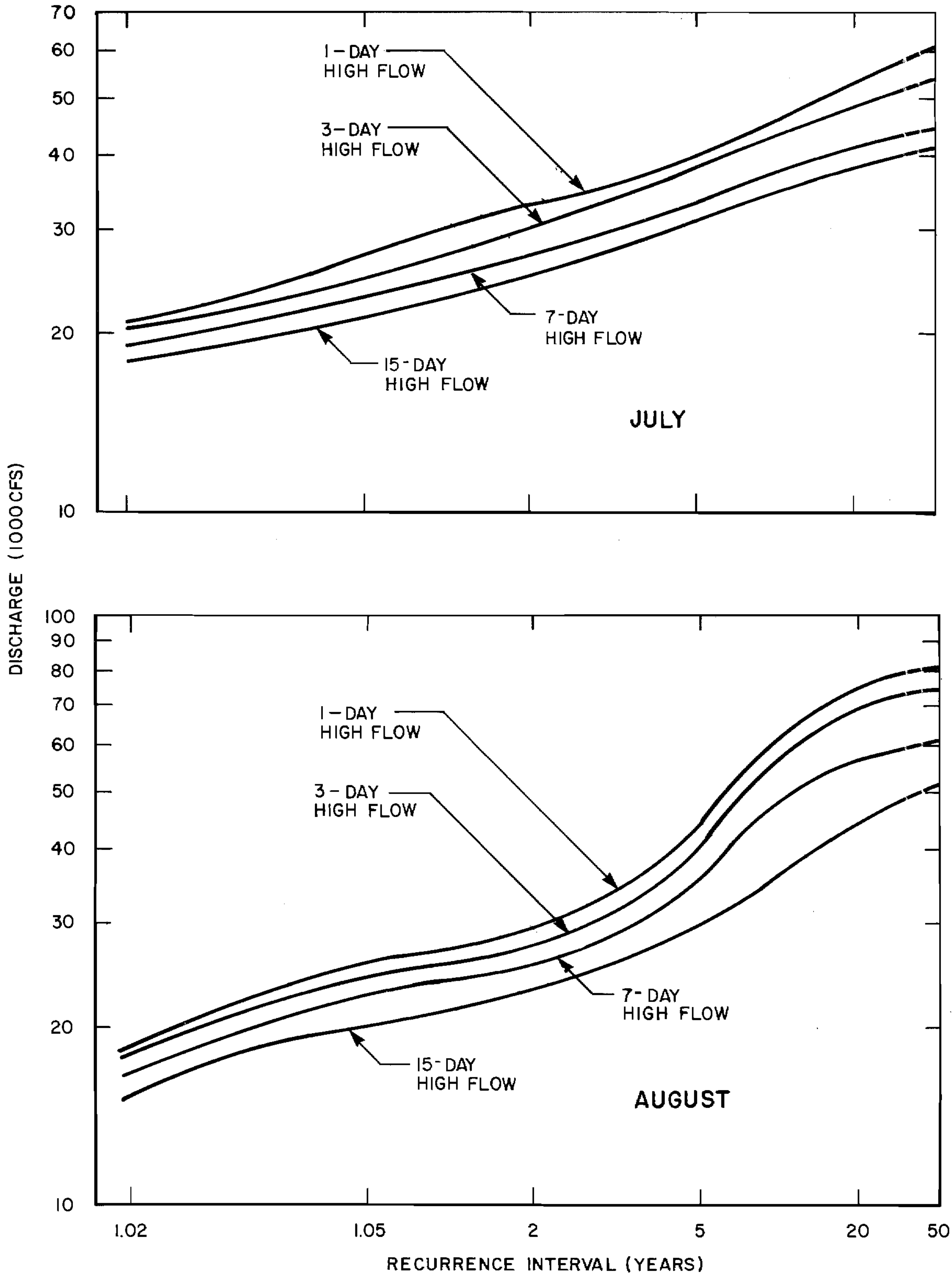
FIGURE E.2.47



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK HIGH-FLOW FREQUENCY CURVES JUNE

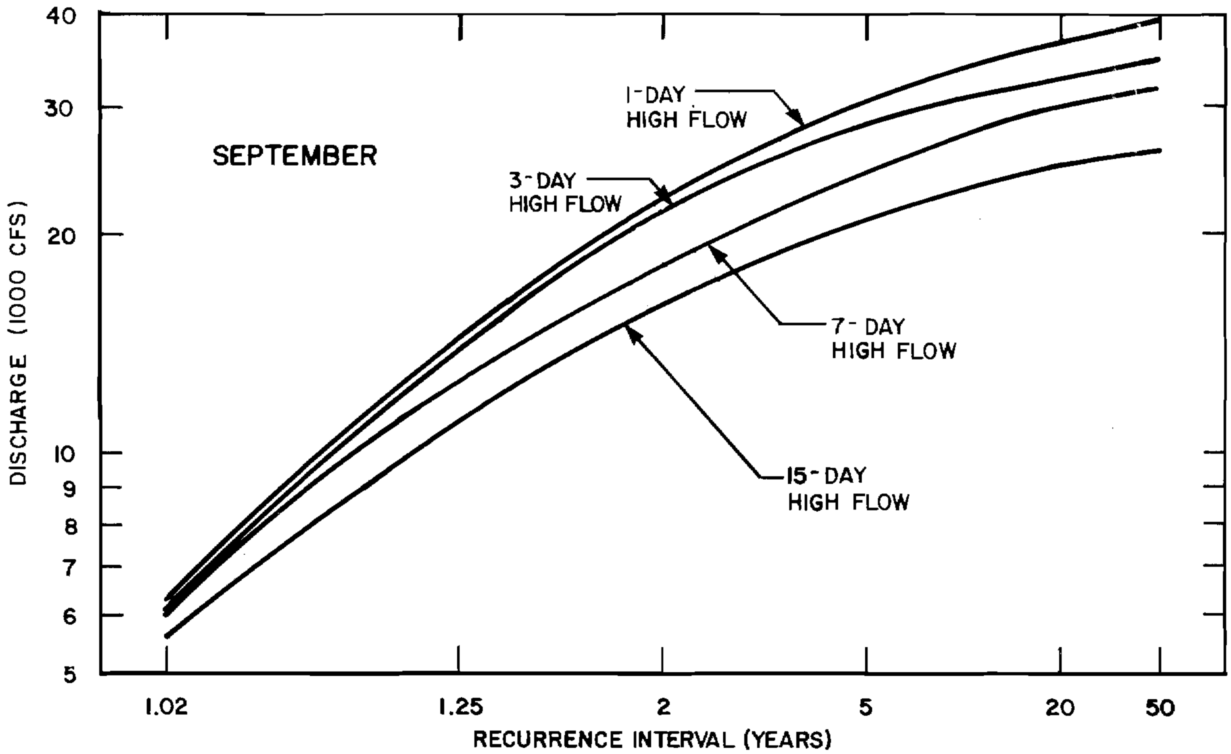
FIGURE E.2.48

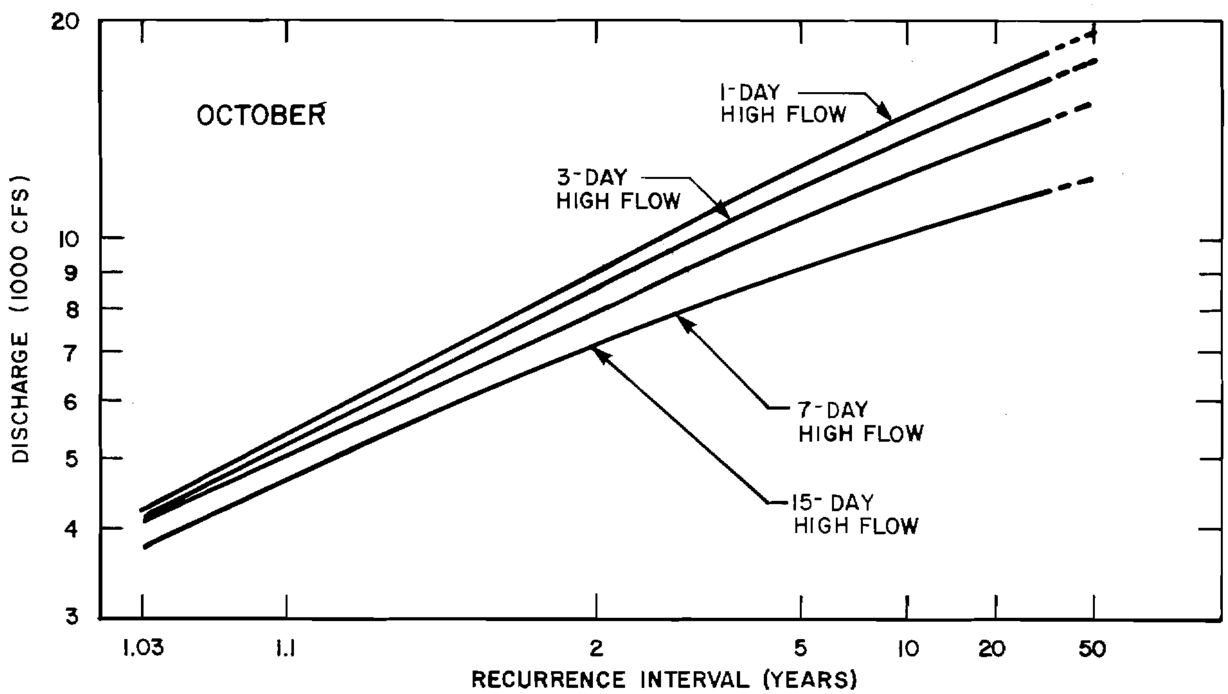


NOTE: PERIOD OF RECORD WY 1950 - WY 1981

SUSITNA RIVER AT GOLD CREEK HIGH-FLOW FREQUENCY CURVES JULY AND AUGUST

FIGURE E.2.49

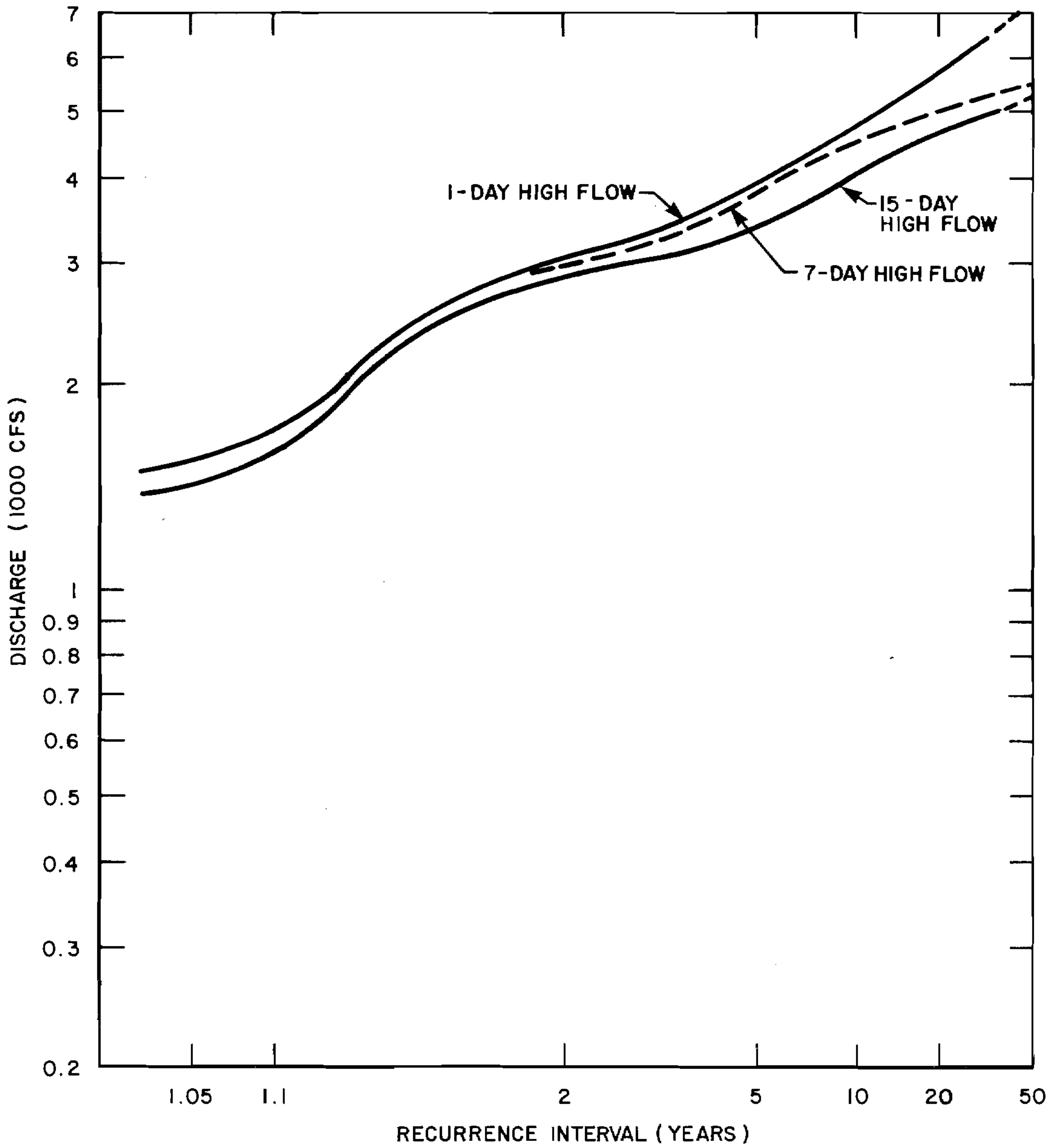




NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK HIGH-FLOW FREQUENCY CURVES SEPTEMBER AND OCTOBER

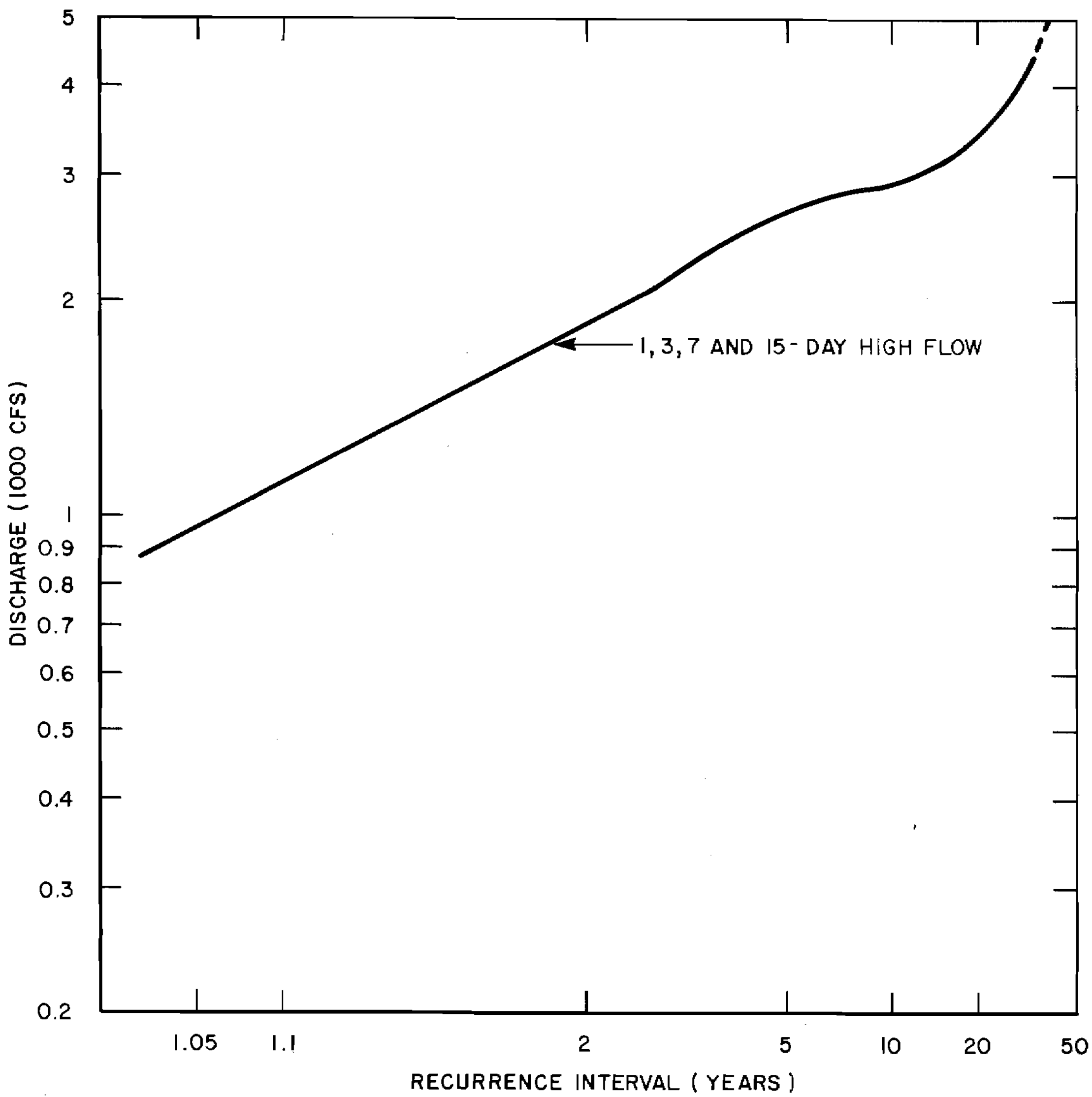
FIGURE E.2.50



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK HIGH-FLOW FREQUENCY CURVES NOVEMBER

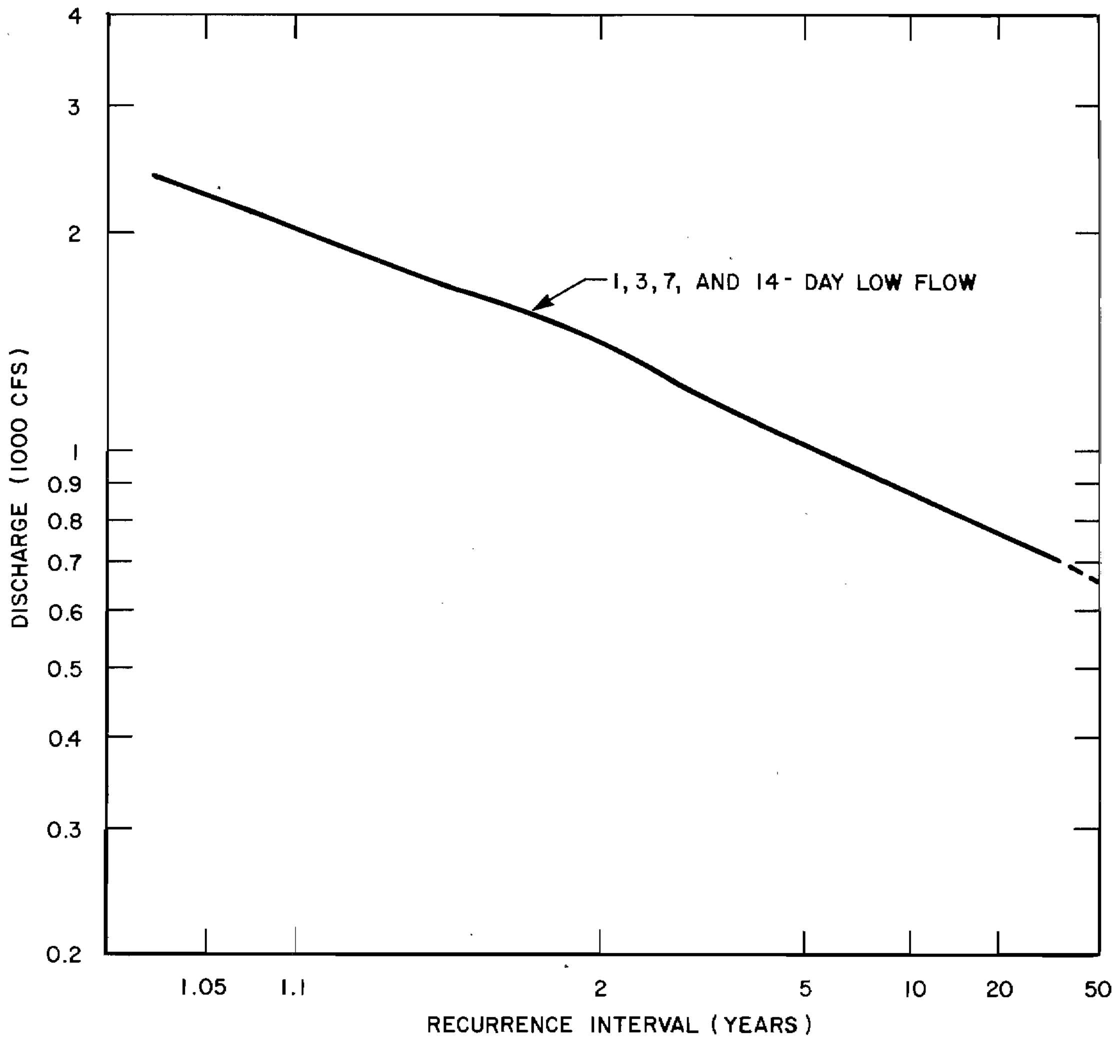
FIGURE E.2.51



NOTE:
PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK
HIGH-FLOW FREQUENCY CURVES
DECEMBER

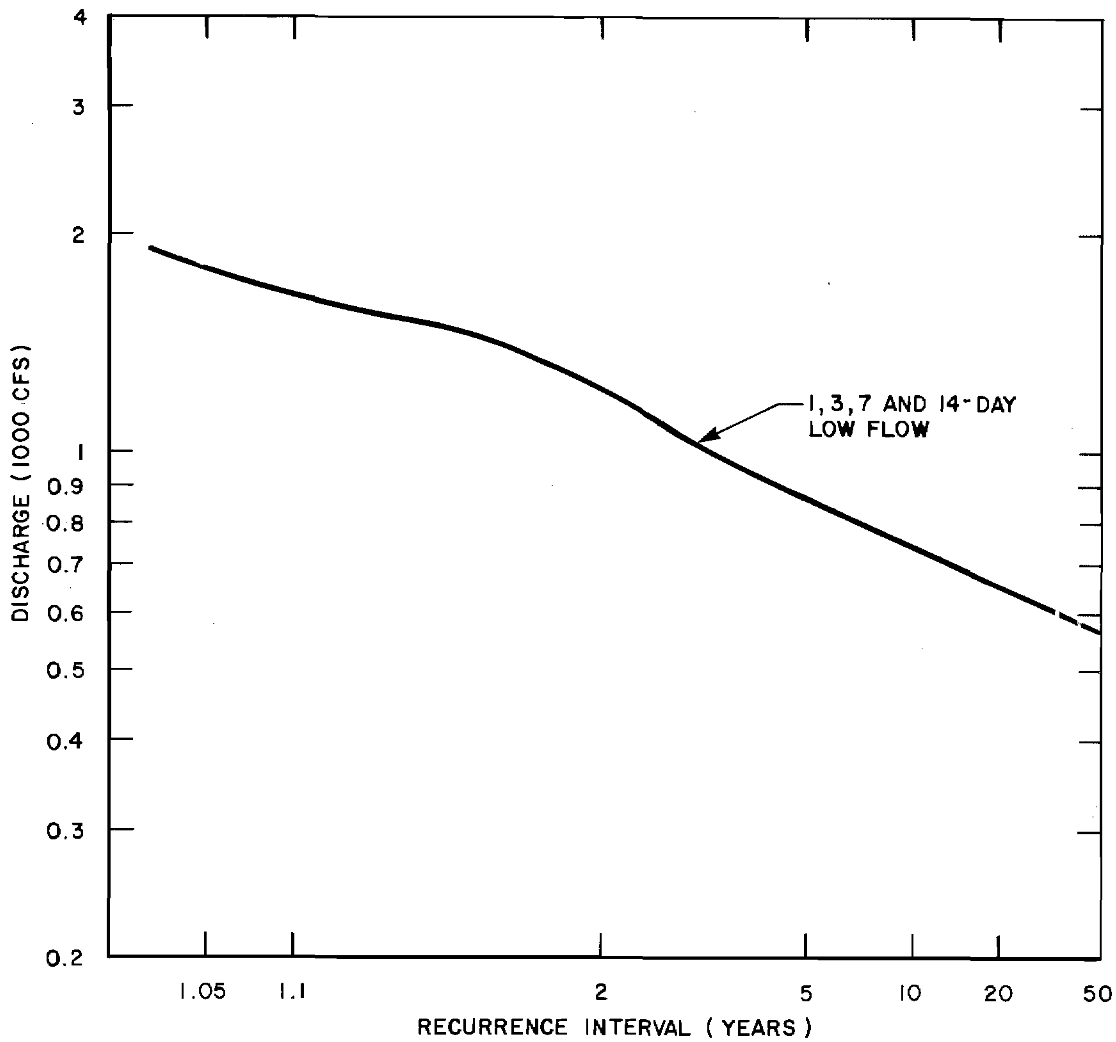
FIGURE E.2.52



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK LOW-FLOW FREQUENCY CURVES JANUARY

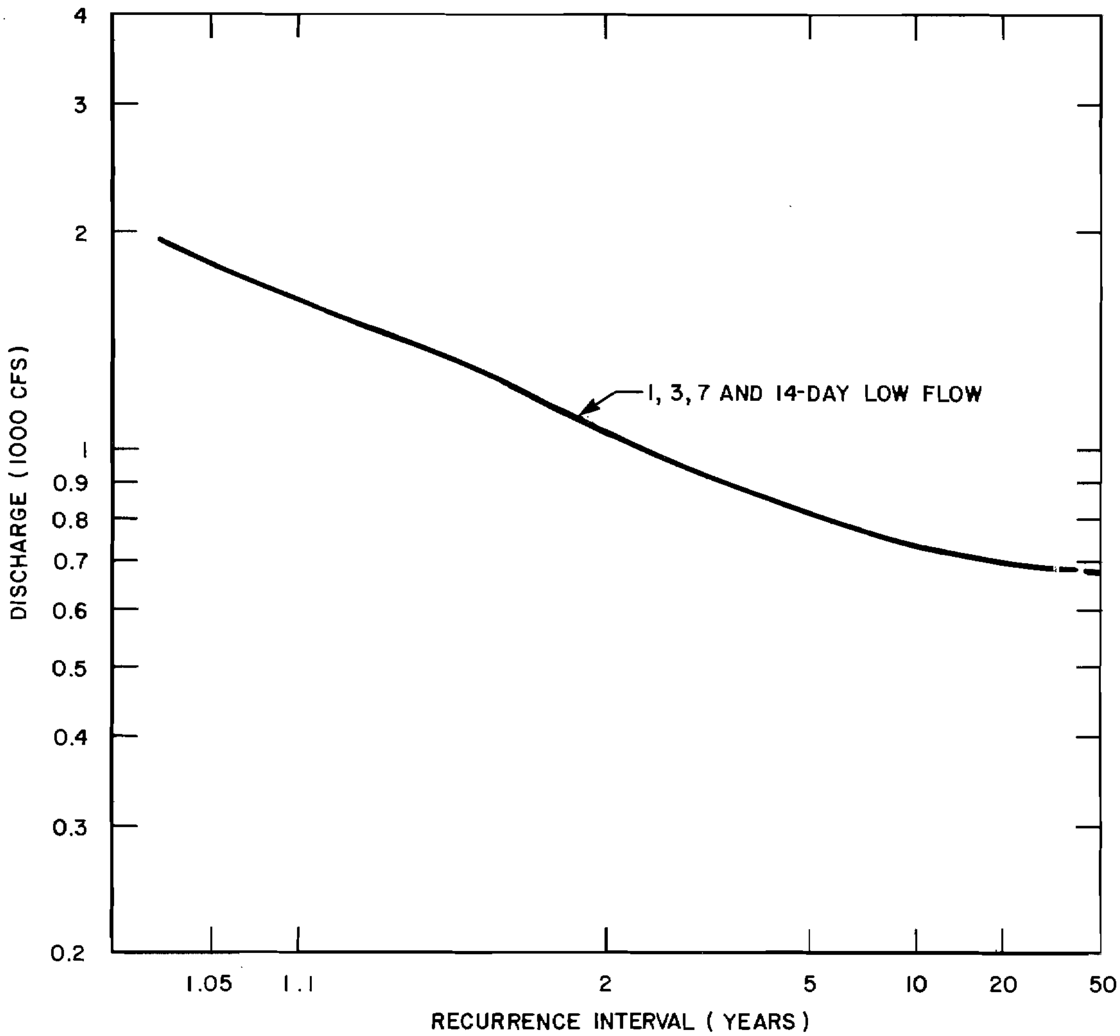
FIGURE E.2.53



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK
LOW-FLOW FREQUENCY CURVES
FEBRUARY

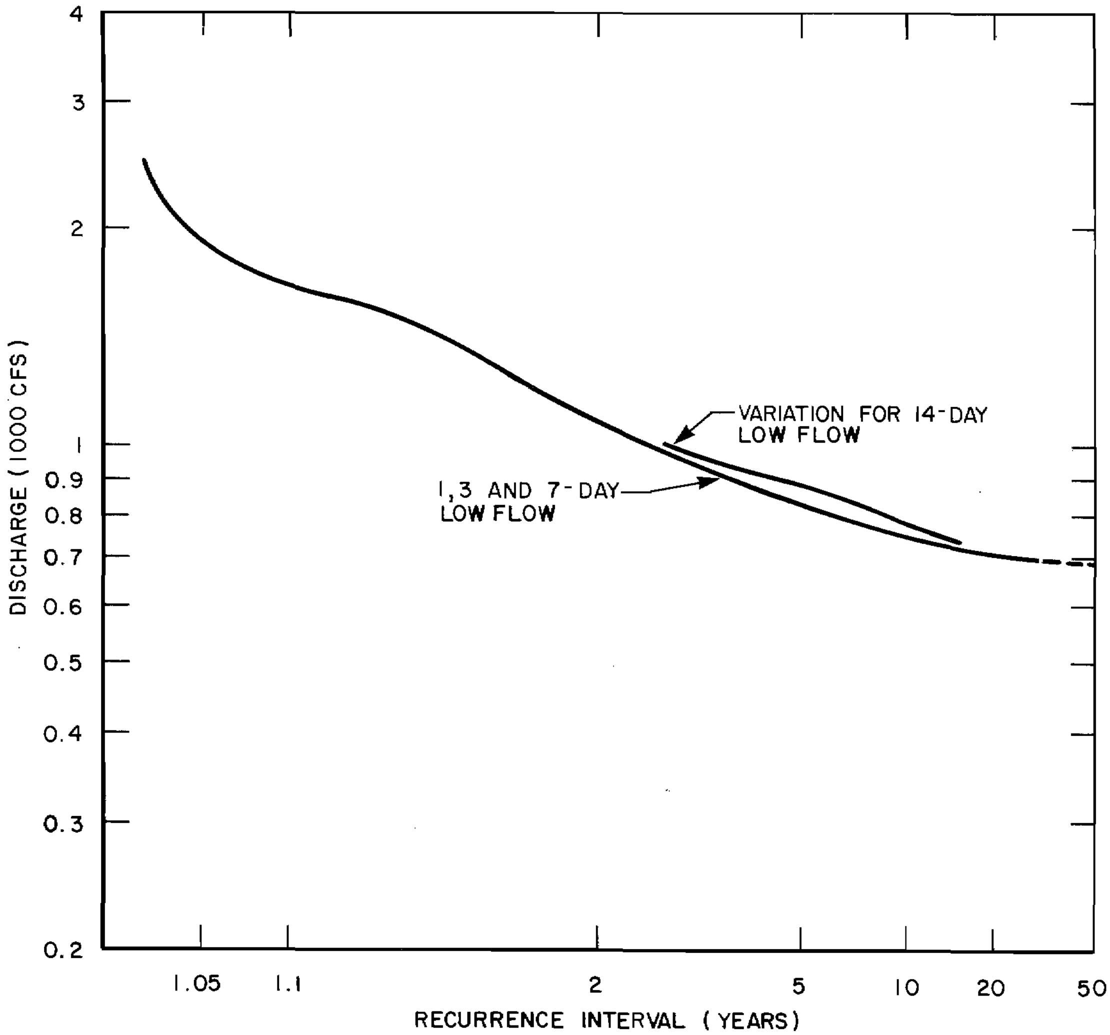
FIGURE E.2.54



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK
LOW-FLOW FREQUENCY CURVES
MARCH

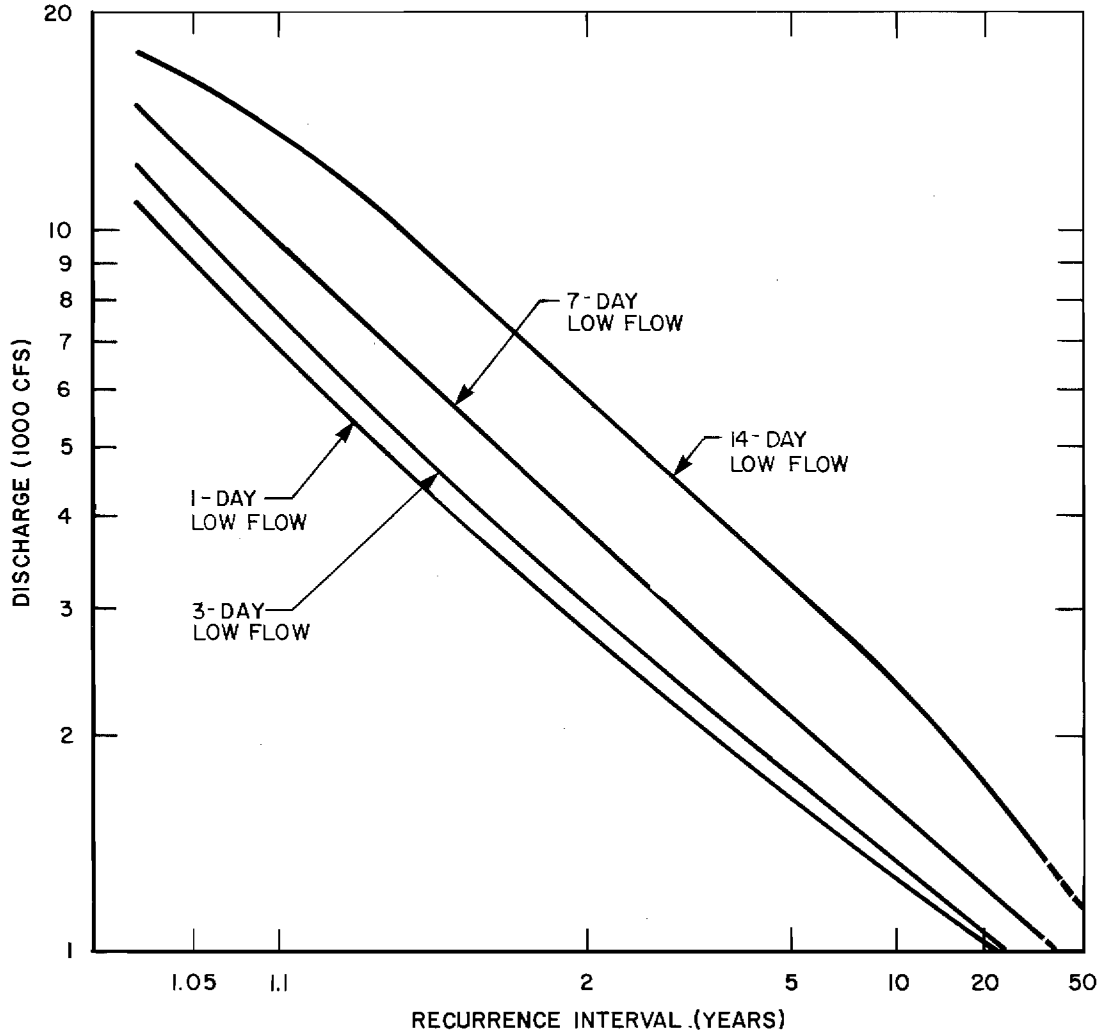
FIGURE E.2.55



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK
LOW-FLOW FREQUENCY CURVES
APRIL

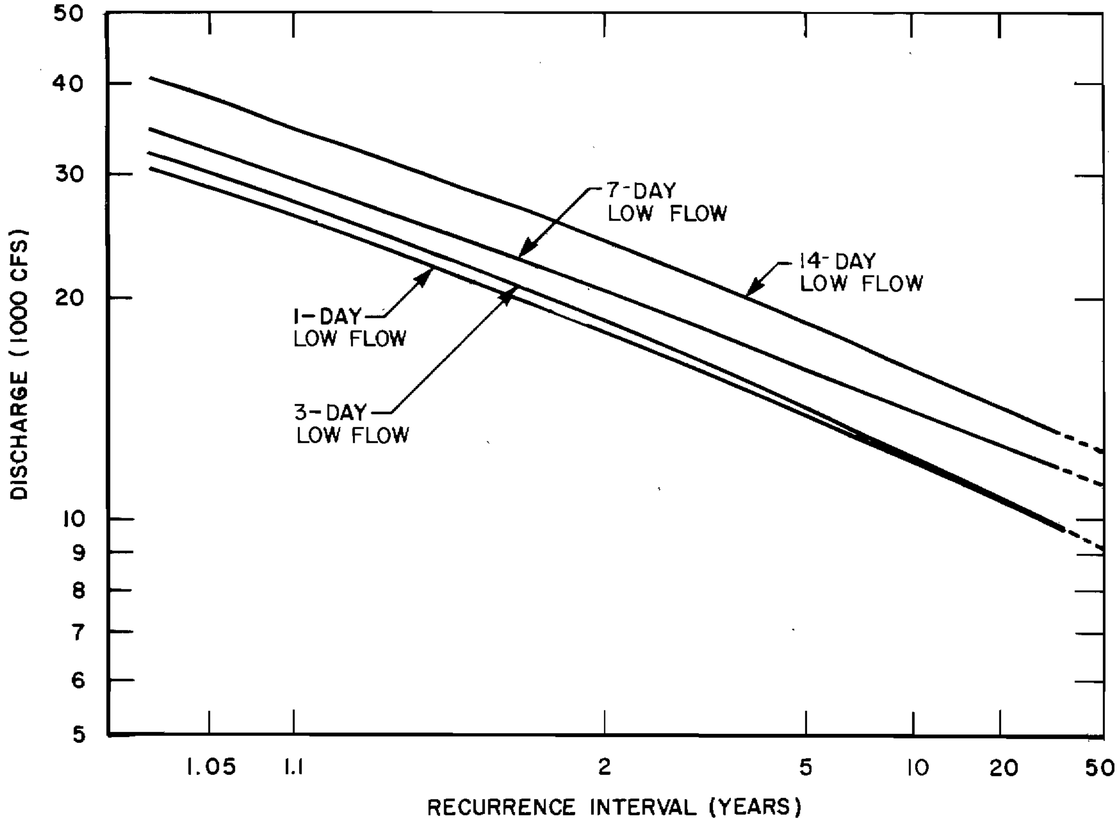
FIGURE E.2.56



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK LOW-FLOW FREQUENCY CURVES MAY

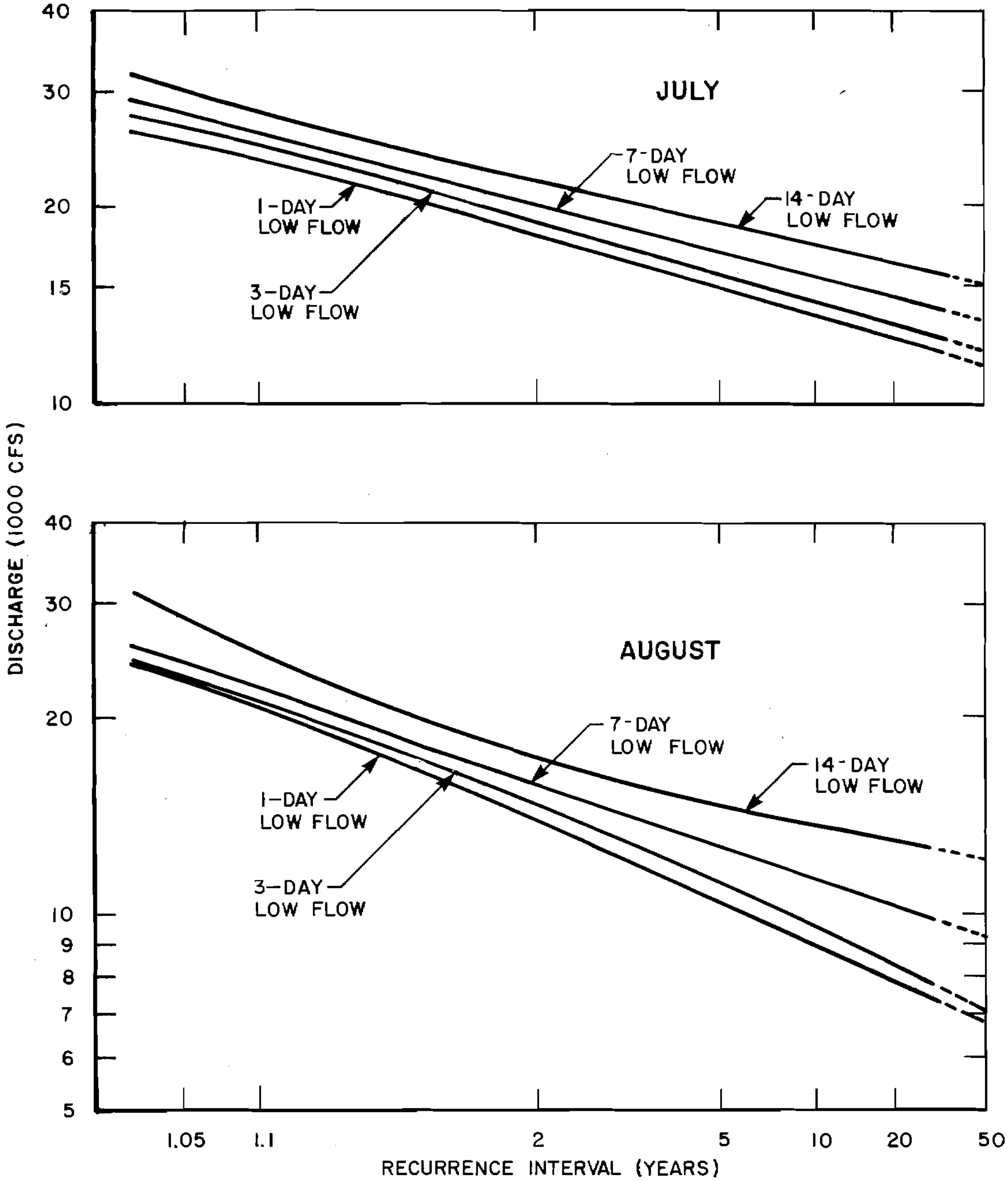
FIGURE E.2.57



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK LOW-FLOW FREQUENCY CURVES JUNE

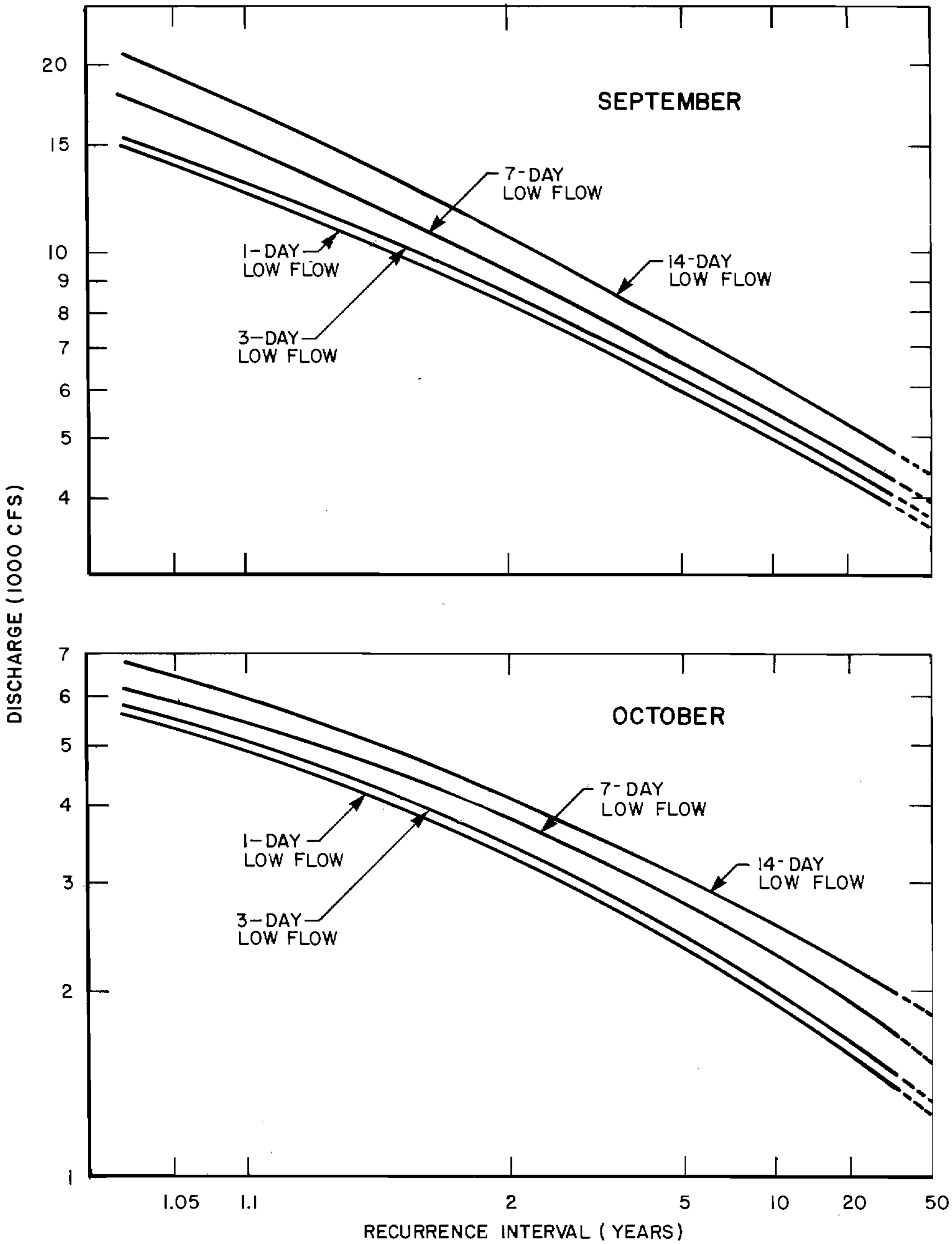
FIGURE E.2.58



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK LOW-FLOW FREQUENCY CURVES JULY AND AUGUST

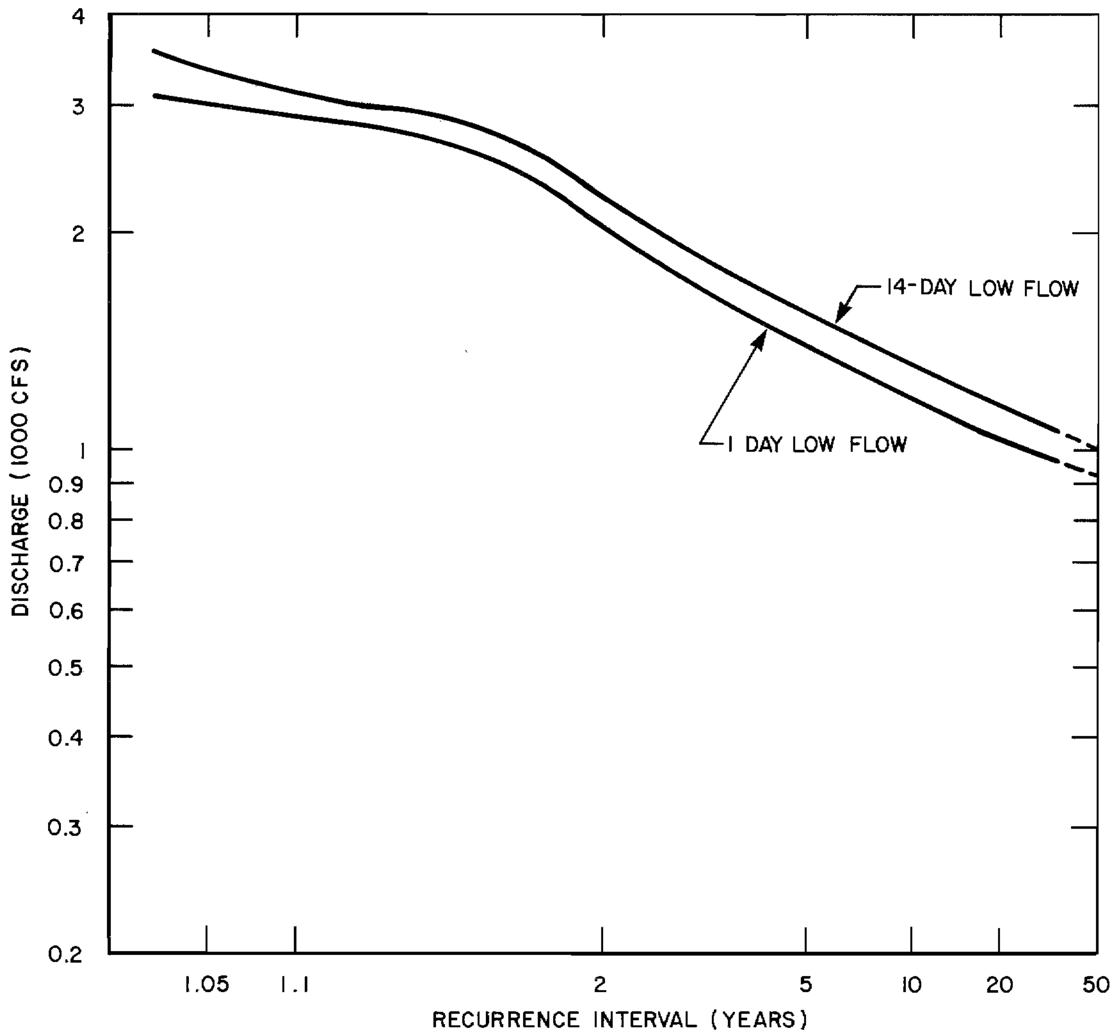
FIGURE E.2.59



NOTE: PERIOD OF RECORD WY 1950- WY 1981

SUSITNA RIVER AT GOLD CREEK LOW-FLOW FREQUENCY CURVES SEPTEMBER AND OCTOBER

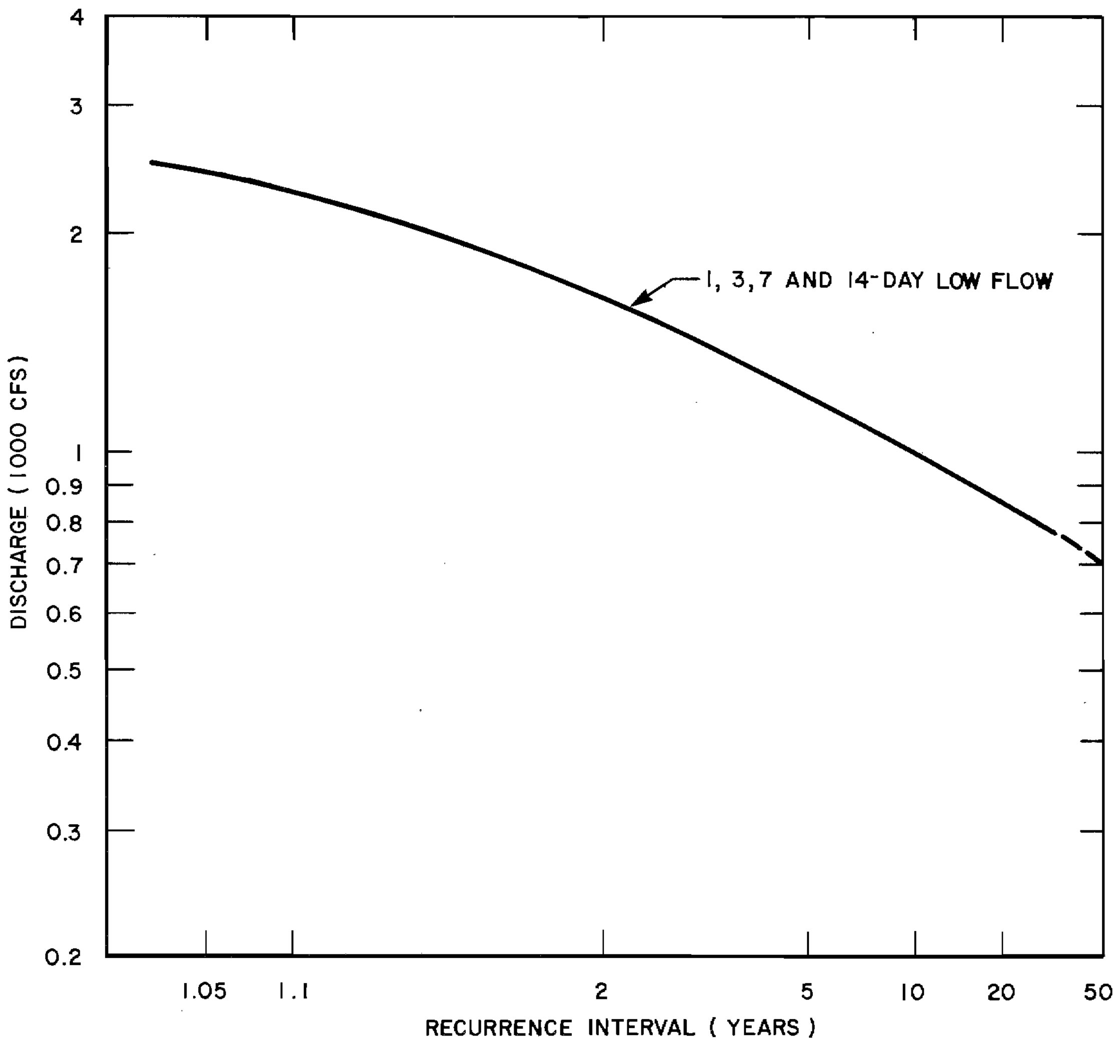
FIGURE E.2.60



NOTE: PERIOD OF RECORD WY 1950 - WY 1981.

SUSITNA RIVER AT GOLD CREEK
LOW-FLOW FREQUENCY CURVES
NOVEMBER

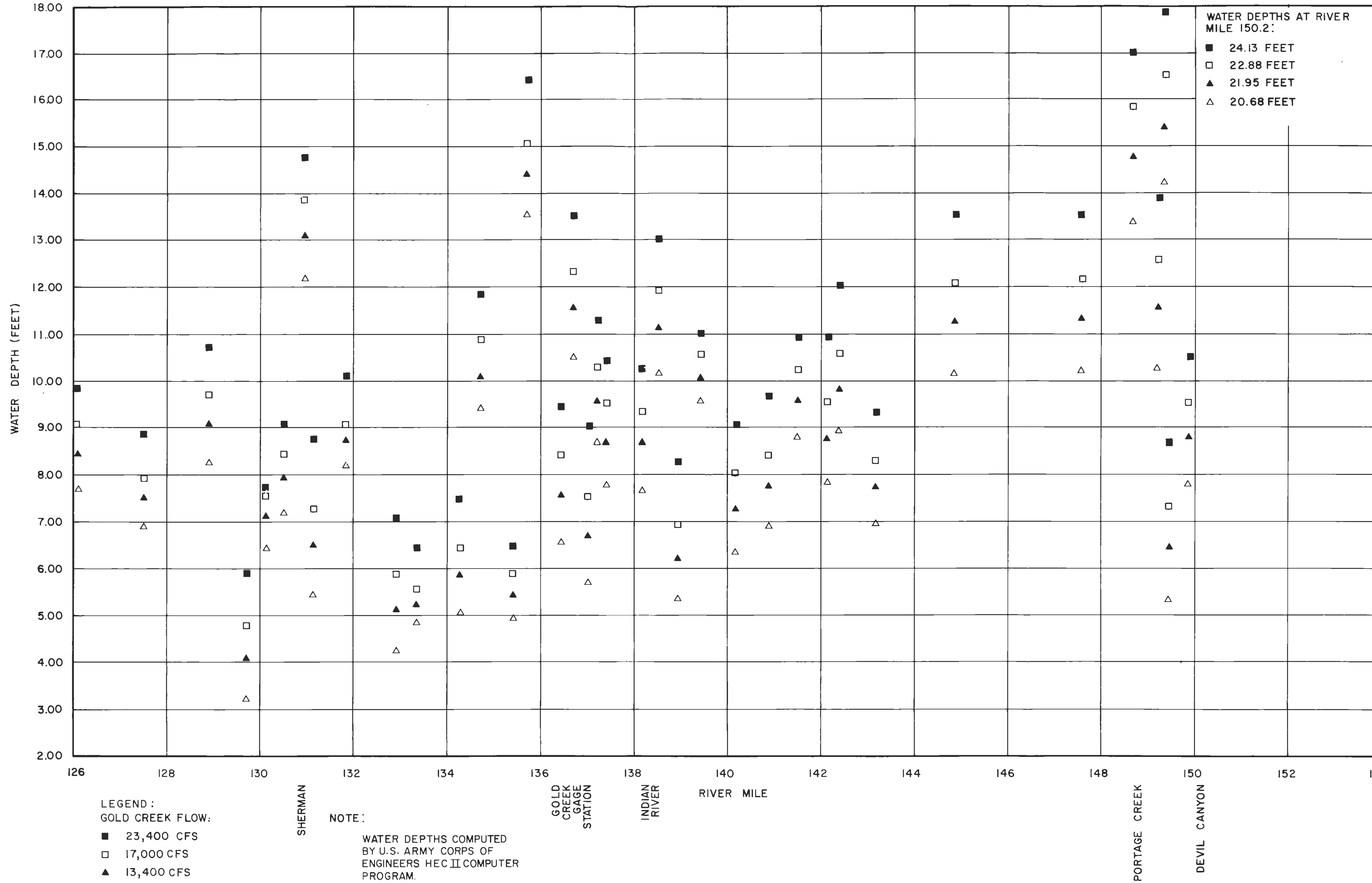
FIGURE E.2.61



NOTE: PERIOD OF RECORD WY 1950- WY 1981.

SUSITNA RIVER AT GOLD CREEK
LOW-FLOW FREQUENCY CURVES
DECEMBER

FIGURE E.2.62



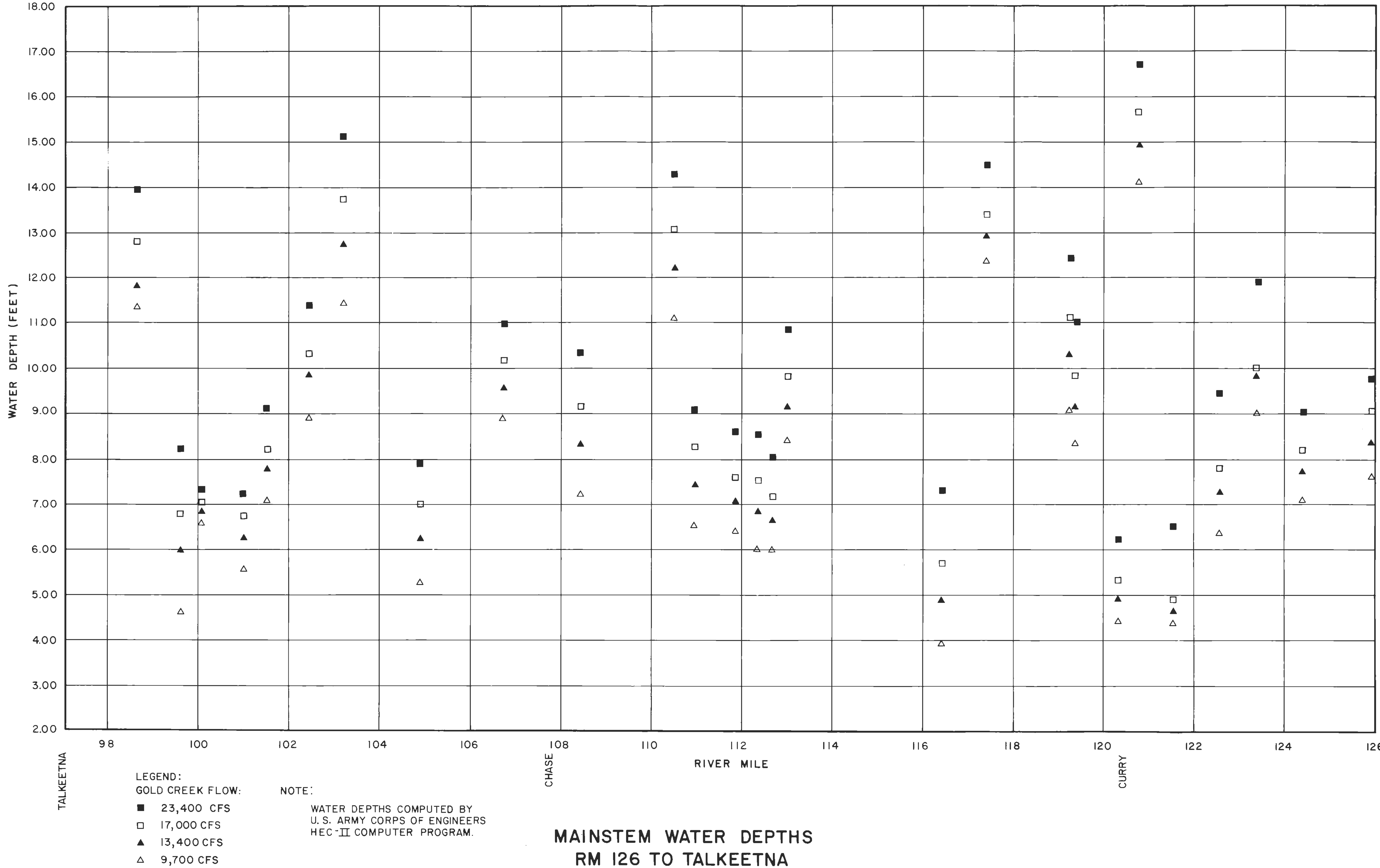
LEGEND:
GOLD CREEK FLOW:
■ 23,400 CFS
□ 17,000 CFS
▲ 13,400 CFS
△ 9,700 CFS

NOTE:

WATER DEPTHS COMPUTED BY U.S. ARMY CORPS OF ENGINEERS HEC II COMPUTER PROGRAM.

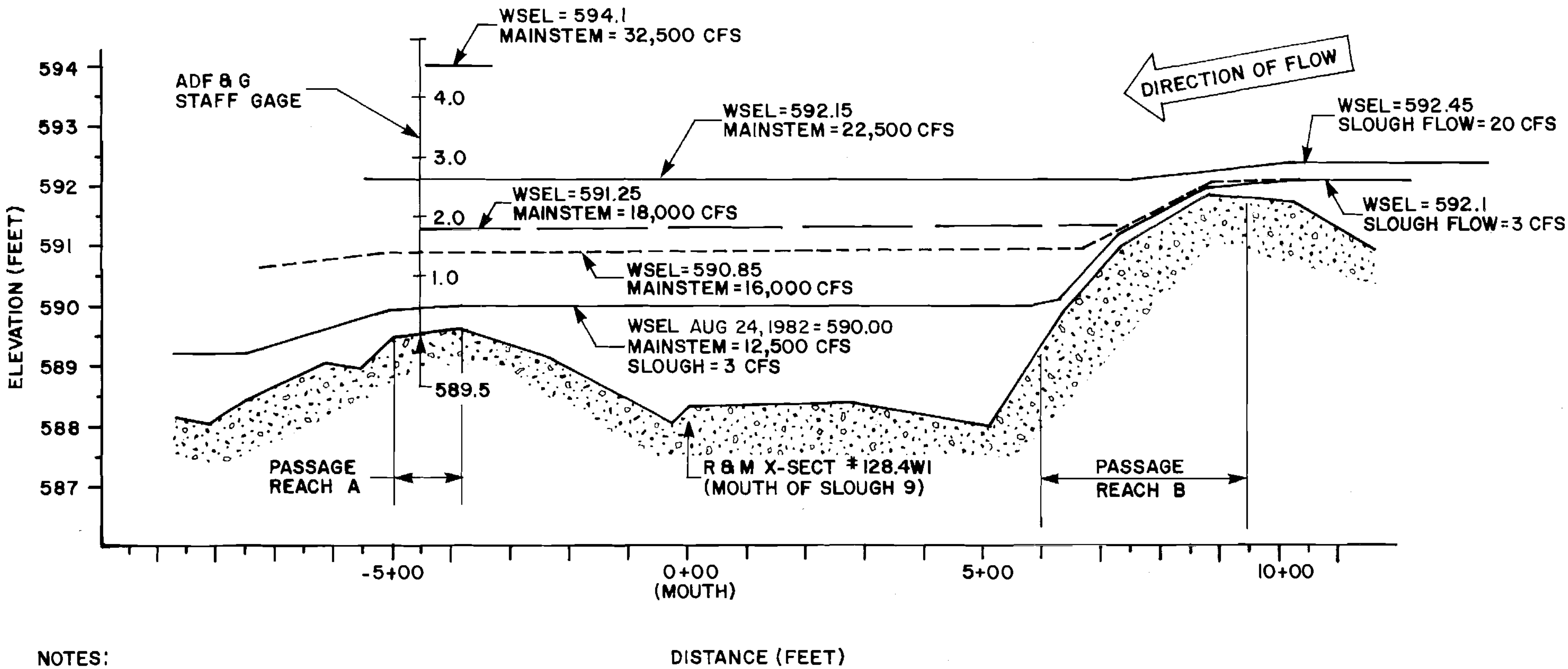
MAINSTEM WATER DEPTHS DEVIL CANYON TO RM 126

FIGURE E.2.63



MAINSTEM WATER DEPTHS
RM 126 TO TALKEETNA

FIGURE E.2.64



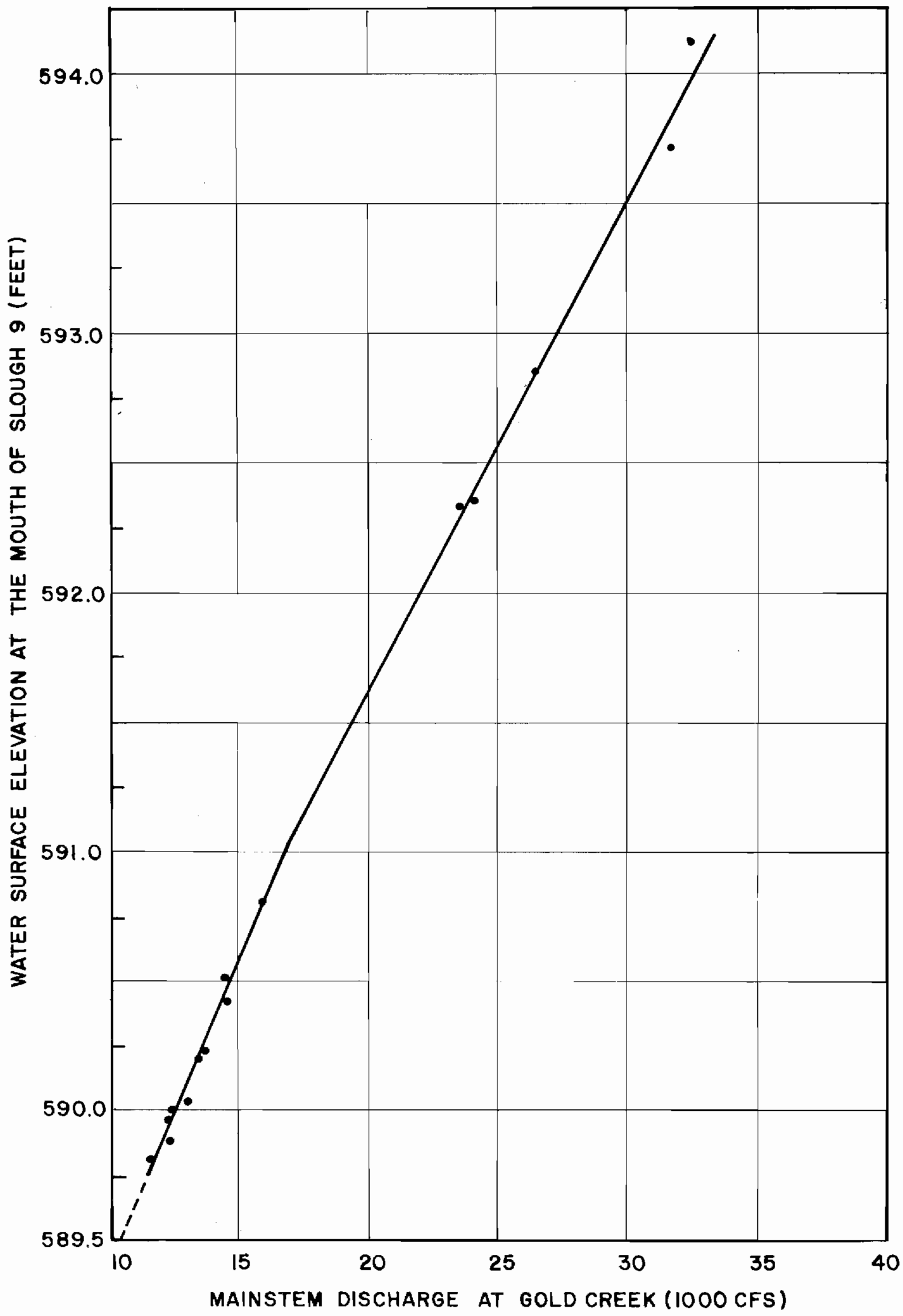
NOTES:

1. MOUTH OF SLOUGH AT STATION 0+00.
2. SELECT MAINSTEM DISCHARGES MEASURED AT GOLD CREEK.

BACKWATER PROFILES AT THE MOUTH OF SLOUGH 9

SOURCE: TRIHEY 1982

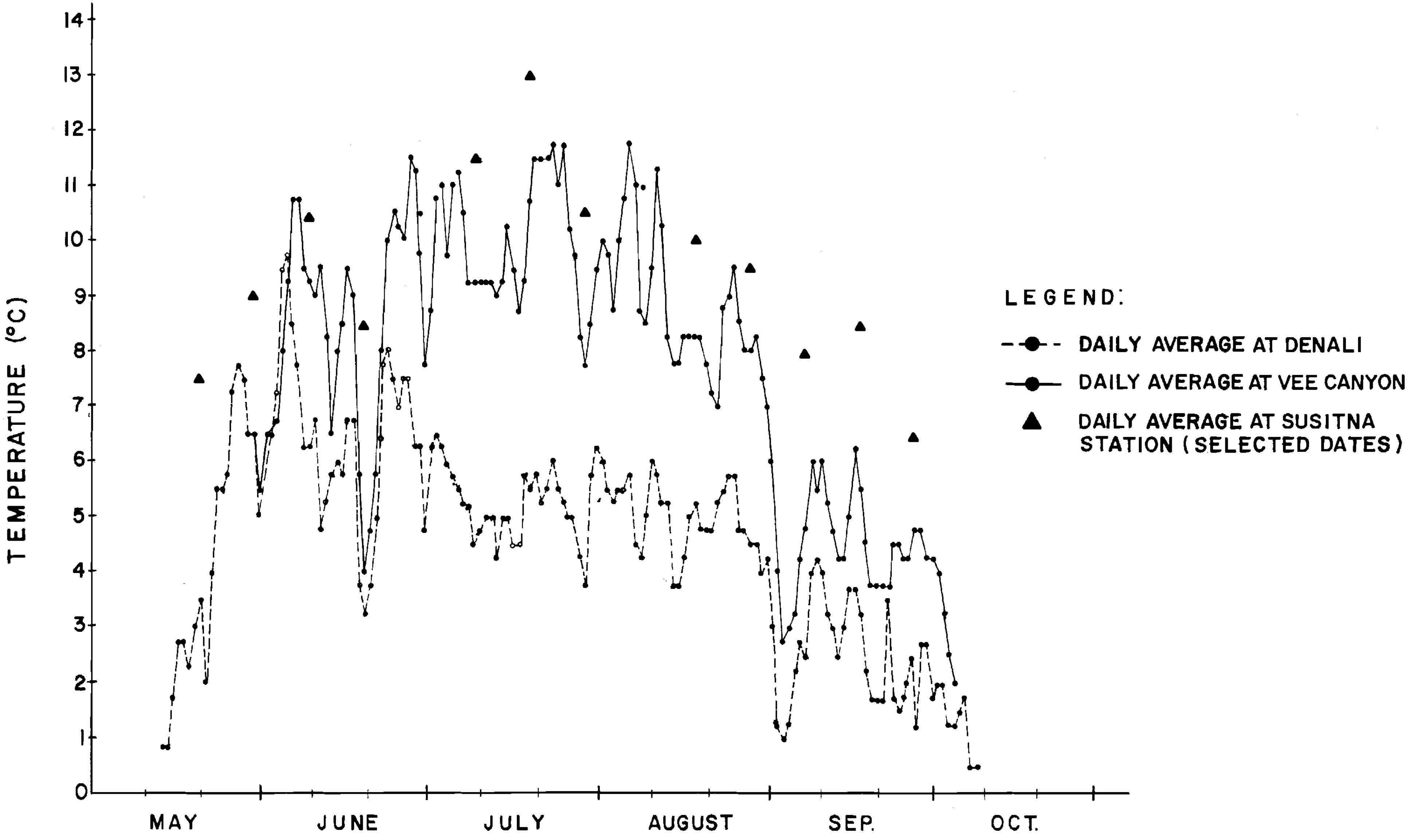
FIGURE E.2.65



OBSERVED WATER SURFACE ELEVATIONS AT MOUTH OF SLOUGH 9 FOR ASSOCIATED MAINSTEM DISCHARGES AT GOLD CREEK

DATA SOURCE : ADF & G 1982

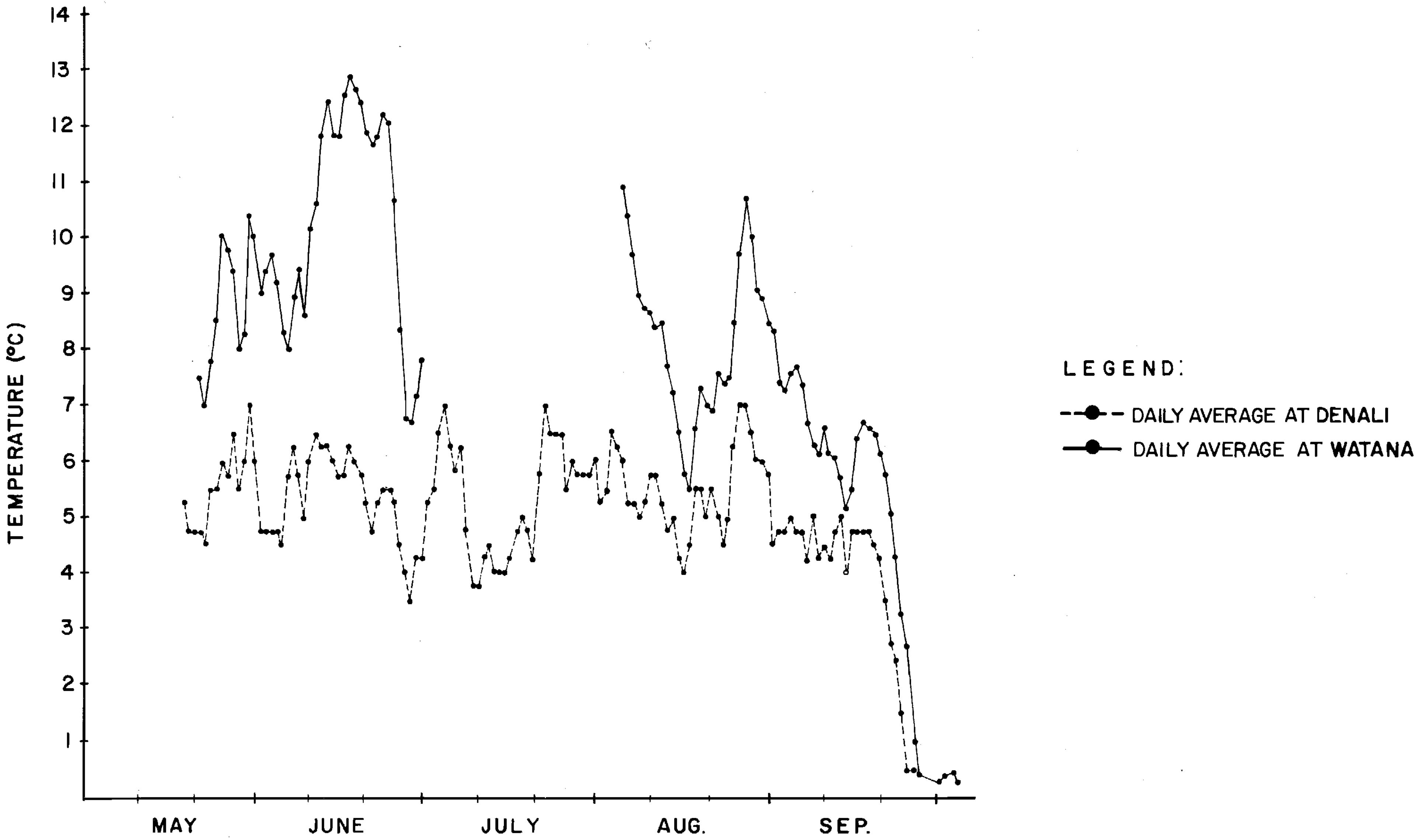
FIGURE E.2.66



SUSITNA RIVER WATER TEMPERATURES
SUMMER 1980

DATA SOURCE : USGS

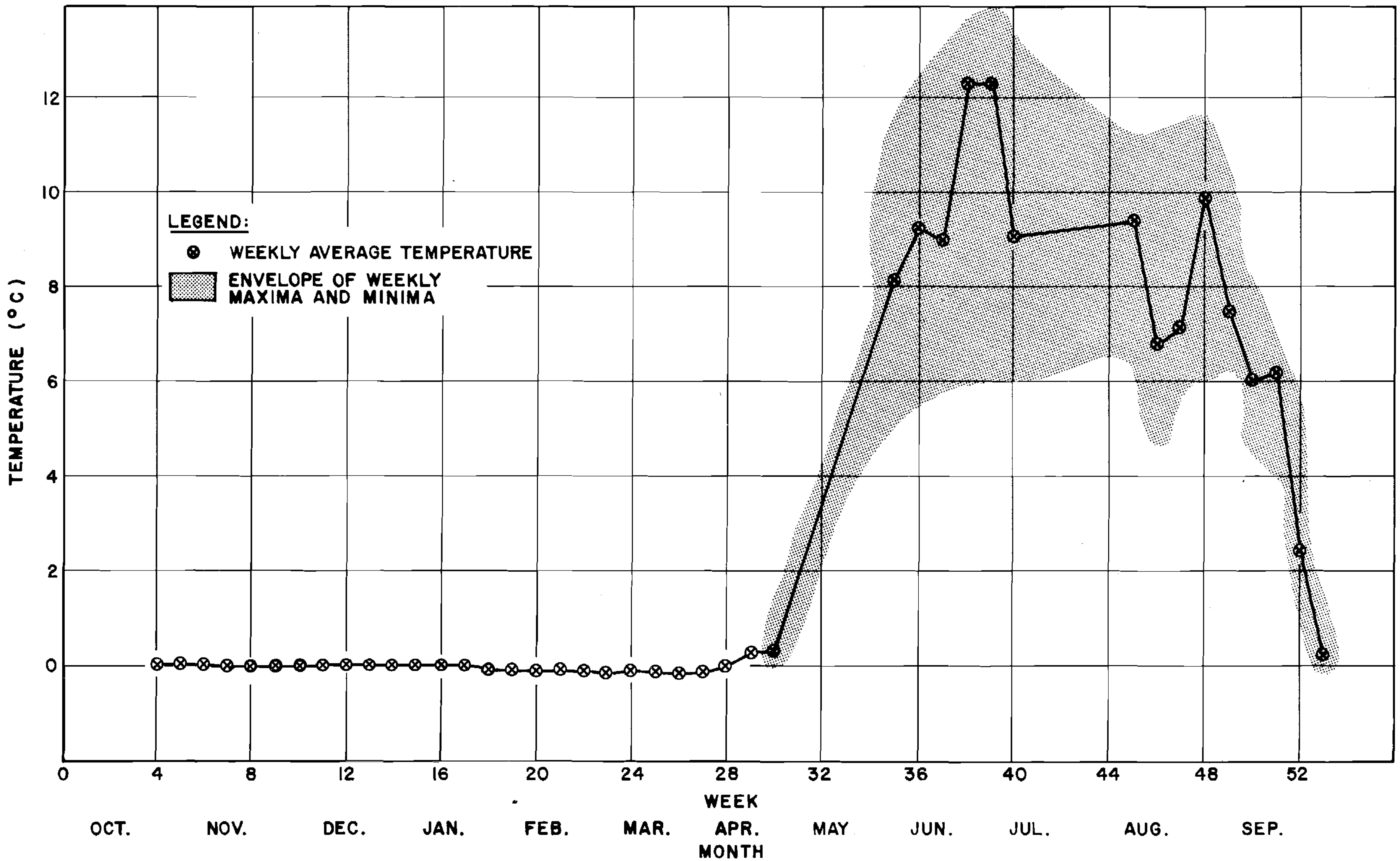
FIGURE E.2.67



SUSITNA RIVER WATER TEMPERATURES
SUMMER 1981

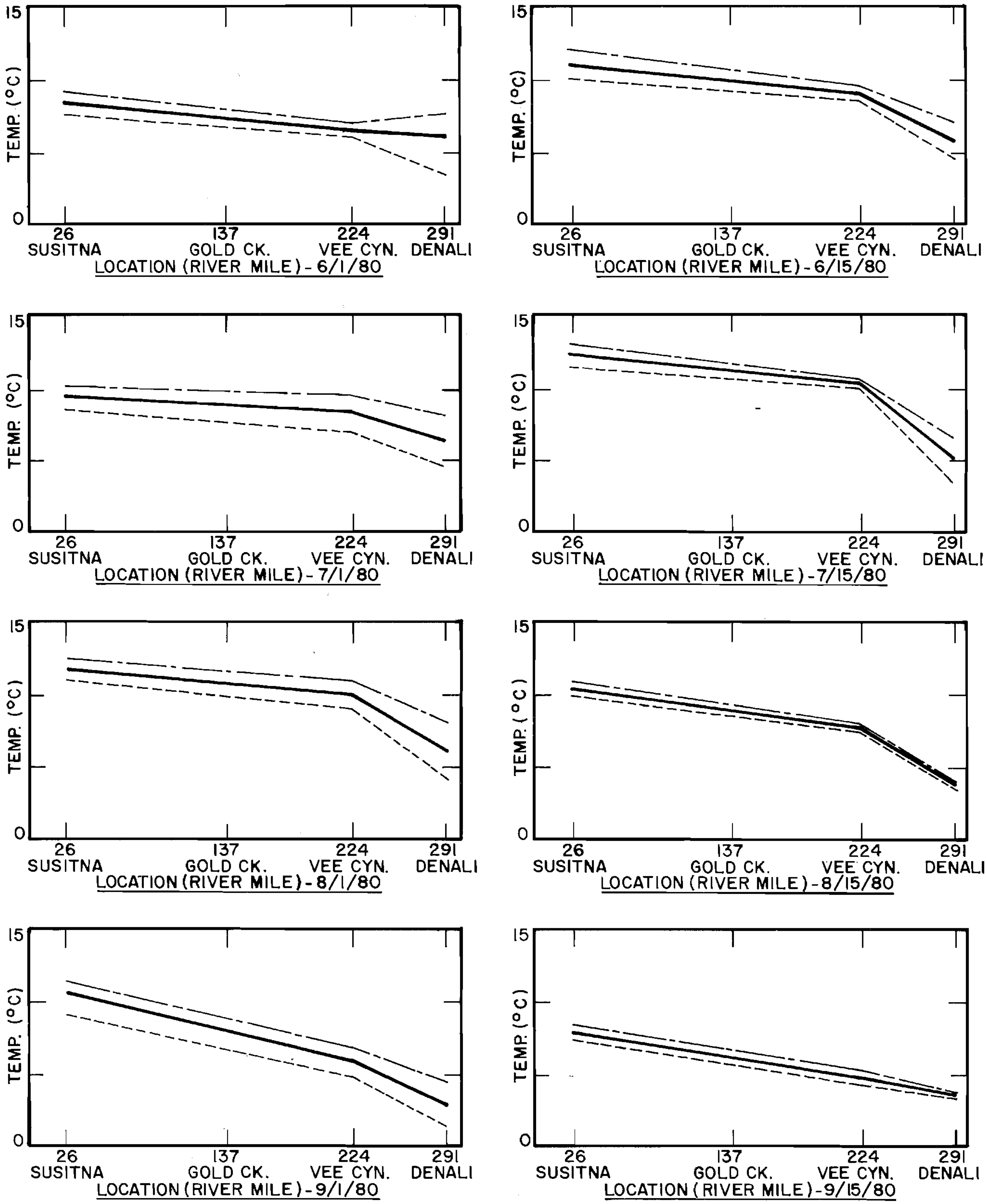
DATA SOURCE: USGS AND R&M

FIGURE E.2.68



SUSITNA RIVER AT WATANA
WEEKLY AVERAGE WATER TEMPERATURE
1981 WATER YEAR

FIGURE E.2.69



LEGEND

- MAXIMUM
- MEAN
- MINIMUM

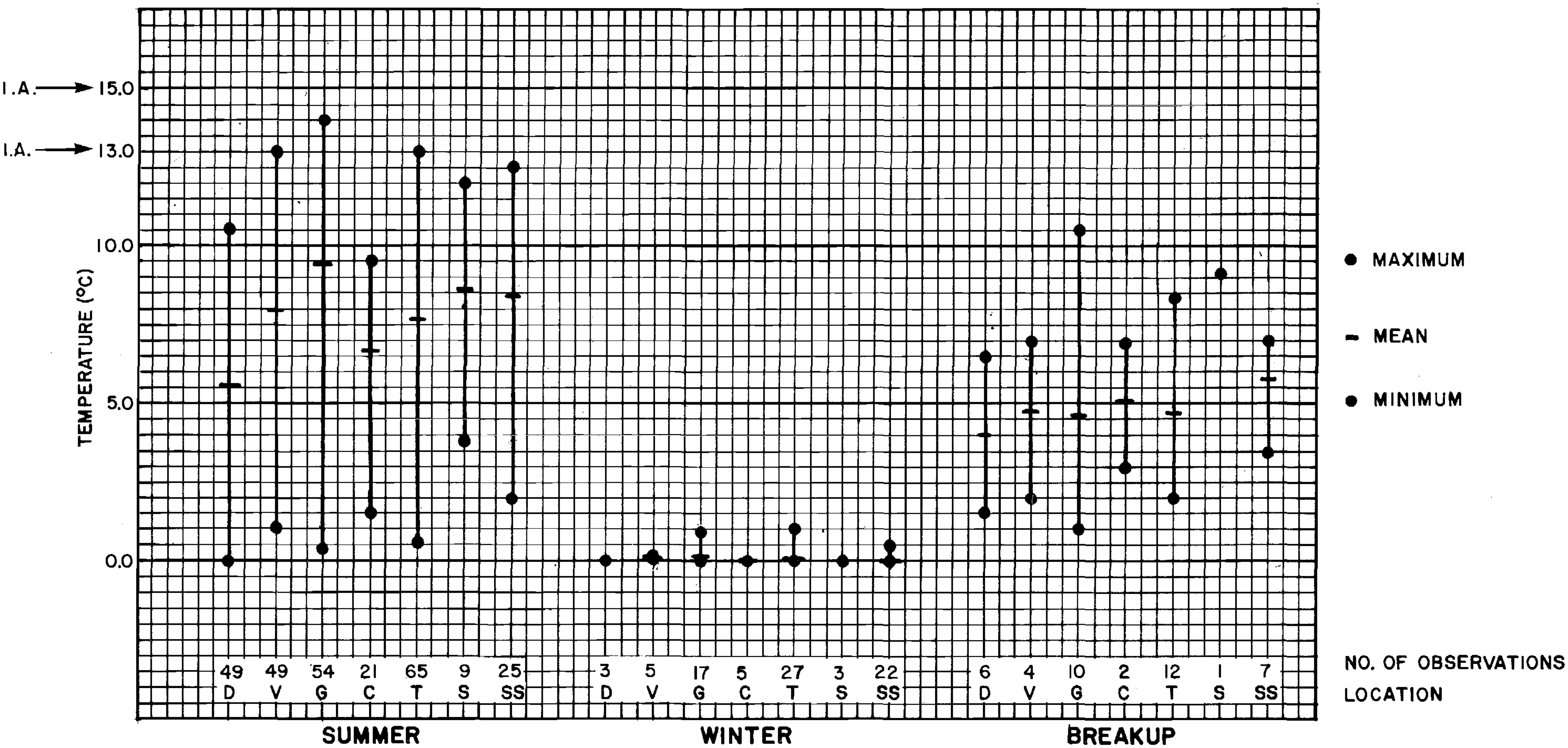
NOTES

1.) ALL TEMPERATURES WERE RECORDED BY THE USGS WITH SINGLE THERMOGRAPHS AT EACH SITE.
2.) GOLD CREEK'S TEMPERATURES WERE INFLUENCED BY TRIBUTARY INFLOW AT THE SITE AND THEREFORE WERE NOT INCLUDED.
3.) DAILY MEAN TEMPERATURES COMPUTED AS AVERAGE OF MINIMUM AND MAXIMUM FOR THE DAY.

SUSITNA RIVER - WATER TEMPERATURE GRADIENT

SOURCE: USGS

FIGURE E.2.70



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

I. A. CRITERIA: SHALL NOT EXCEED 20°C AT ANY TIME. THE FOLLOWING MAXIMUM TEMPERATURE SHALL NOT BE EXCEEDED WHERE APPLICABLE: MIGRATION ROUTES AND REARING AREAS -- 15°C, SPAWNING AREAS AND EGG AND FRY INCUBATION -- 13°C (ADEC, 1979).

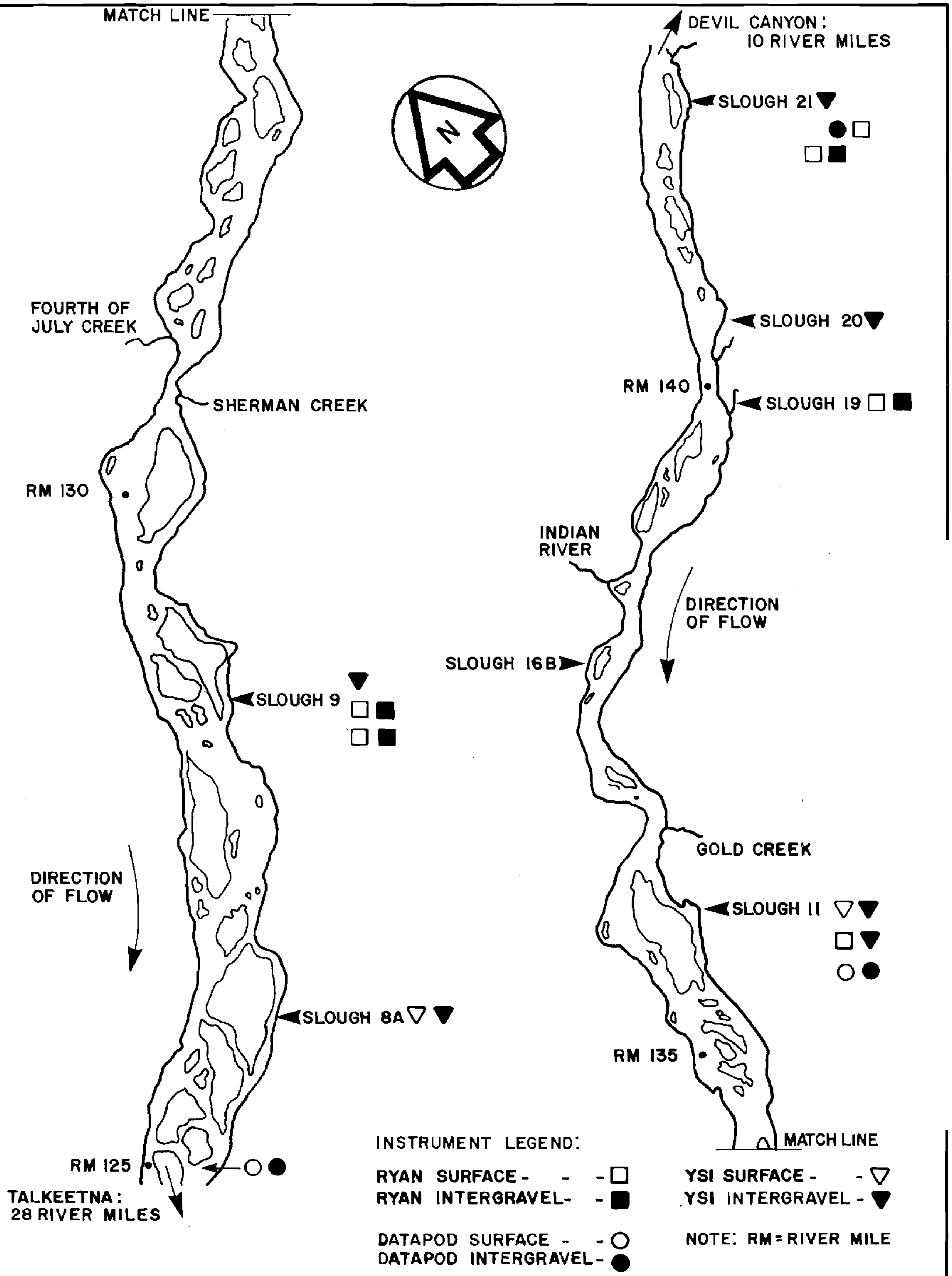
I. B. ESTABLISHED TO PROTECT SENSITIVE IMPORTANT FISH SPECIES, AND FOR THE SUCCESSFUL MIGRATION, SPAWNING, EGG-INCUBATION, FRY-REARING, AND OTHER REPRODUCTIVE FUNCTIONS OF IMPORTANT SPECIES.

2. MAXIMUM VALUES OF 12°C AT DENALI ON JUNE 4 AND 5, 1980; 15.0 °C AT GOLD CREEK ON JULY 3 AND 4, 1979; AND 16.5 °C AT SUSITNA STATION ON JULY 9, 1976 HAVE BEEN RECORDED BY USGS CONTINUOUS RECORDING EQUIPMENT, HOWEVER THESE WERE NOT INCLUDED IN THE ABOVE COMPILATION. ONLY DISCRETE OBSERVATIONS WERE UTILIZED SINCE CONTINUOUS RECORDERS ARE NOT PRESENT AT EACH STATION THROUGHOUT THE BASIN.

DATA SUMMARY - TEMPERATURE

SOURCE: USGS

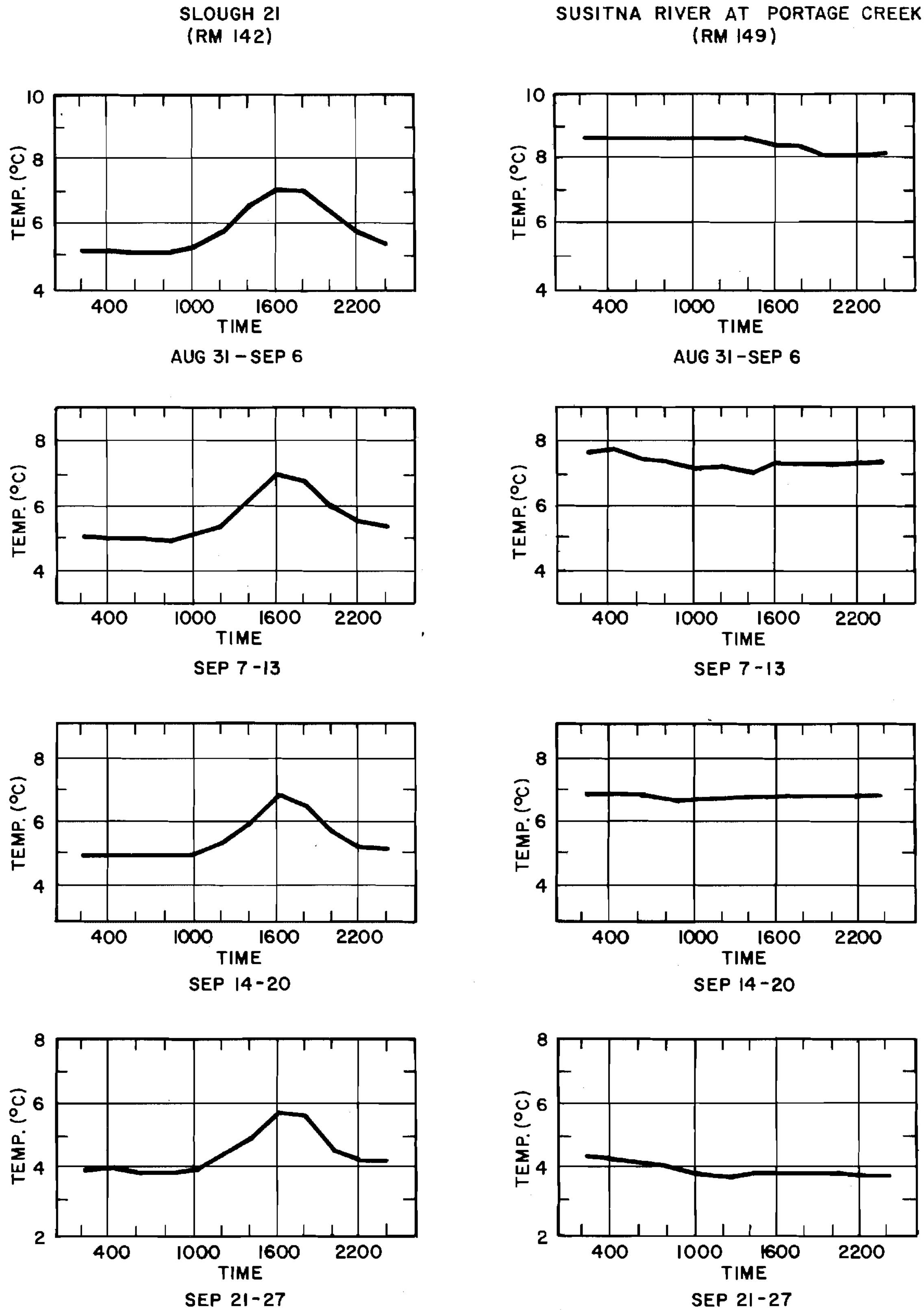
FIGURE E.2.71



LOCATION MAP FOR 1982 MIDWINTER TEMPERATURE STUDY SITES

SOURCE: TRIHEY 1982

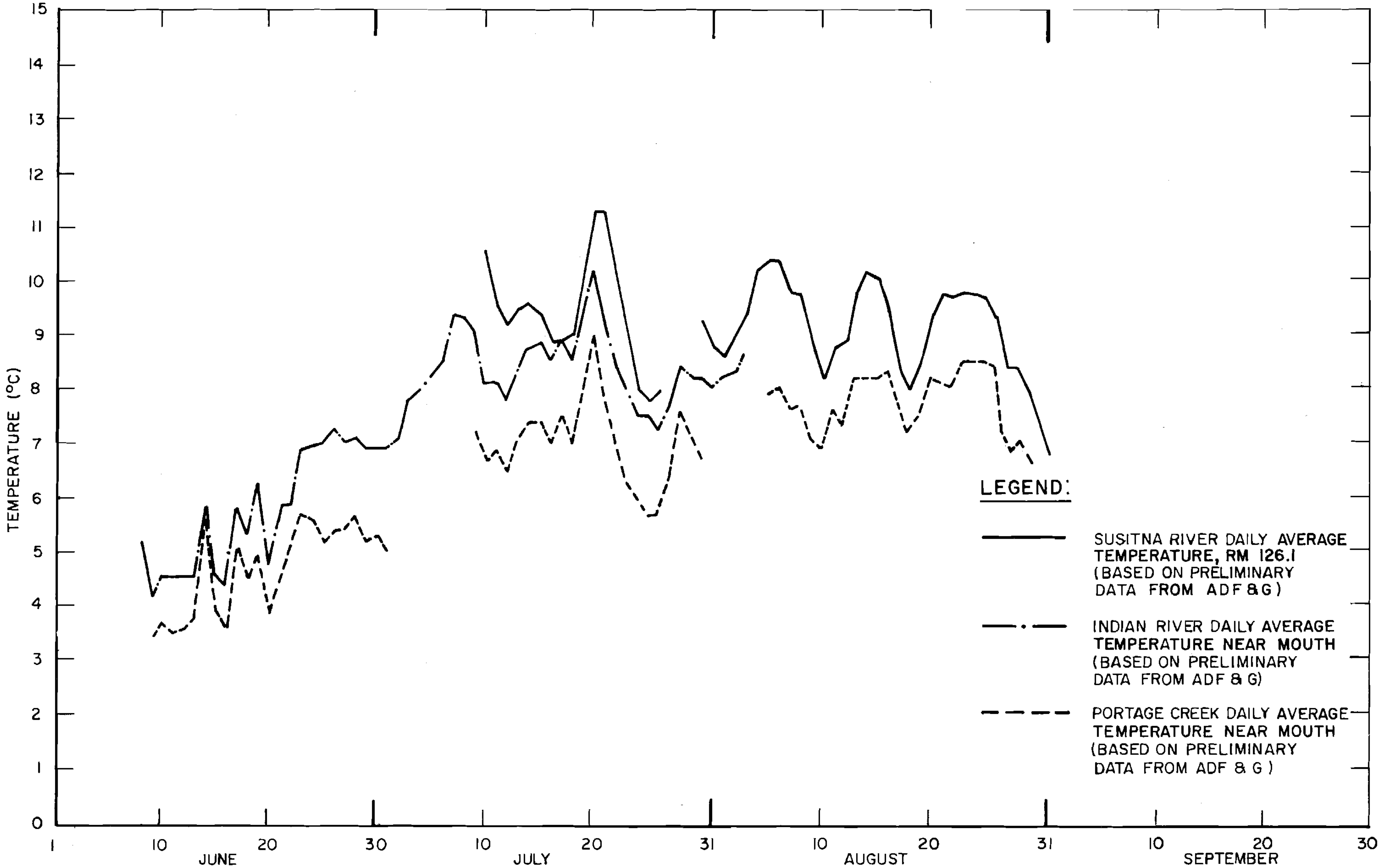
FIGURE E.2.72



COMPARISON OF WEEKLY DIEL SURFACE WATER TEMPERATURE VARIATIONS IN SLOUGH 21 AND THE MAINSTREAM SUSITNA RIVER AT PORTAGE CREEK 1981

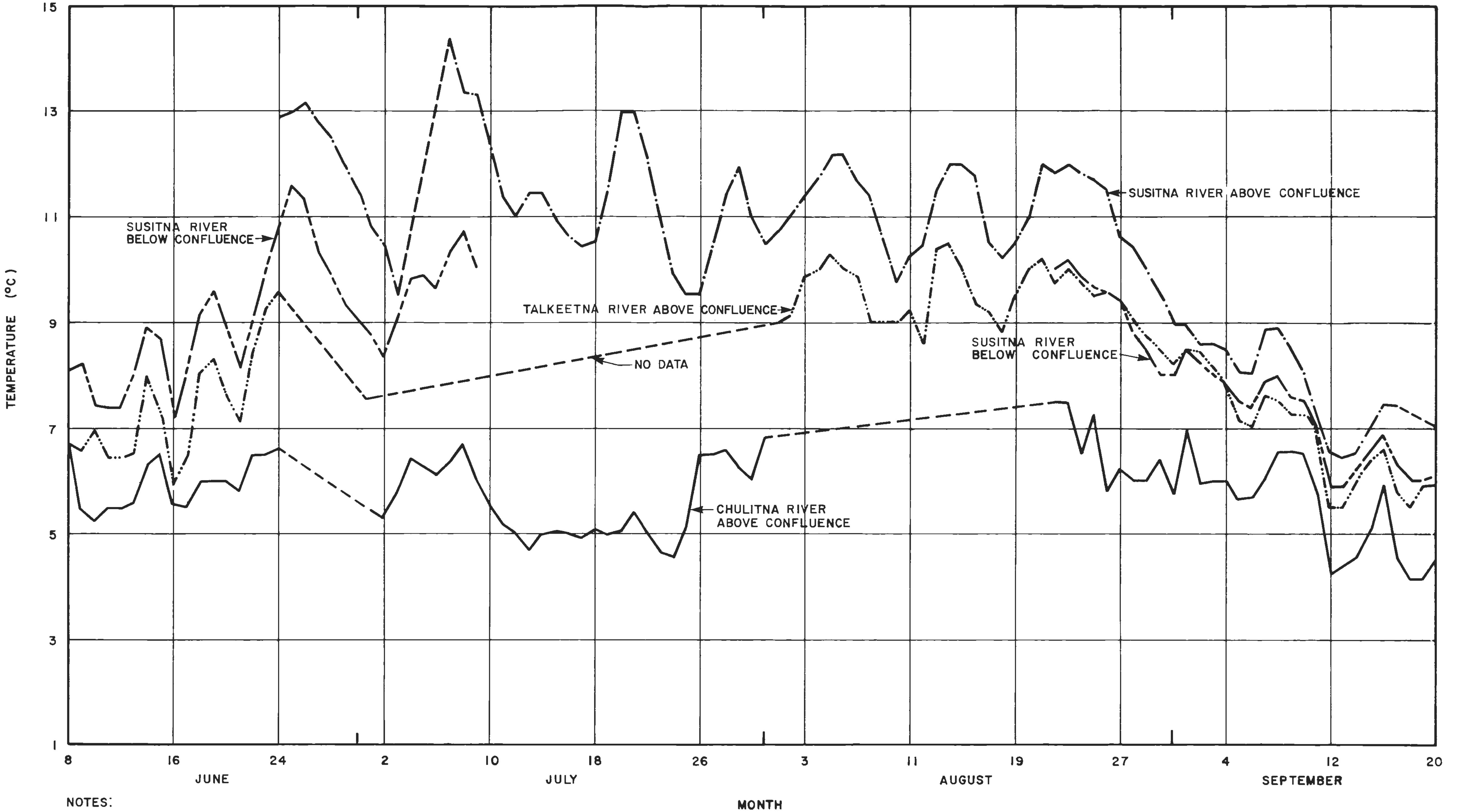
SOURCE: ADAPTED FROM ADF & G 1981

FIGURE E.2.73



SUSITNA RIVER, PORTAGE CREEK AND INDIAN RIVER WATER TEMPERATURES SUMMER 1982

FIGURE E.2.74



NOTES:

1) TIME SCALE IS IN INCREMENTS OF 8 DAYS.

2) CHULITNA DATA FOR JULY PROVIDED BY USGS FROM CHULITNA GAGE 18 MILES UPSTREAM OF CONFLUENCE.

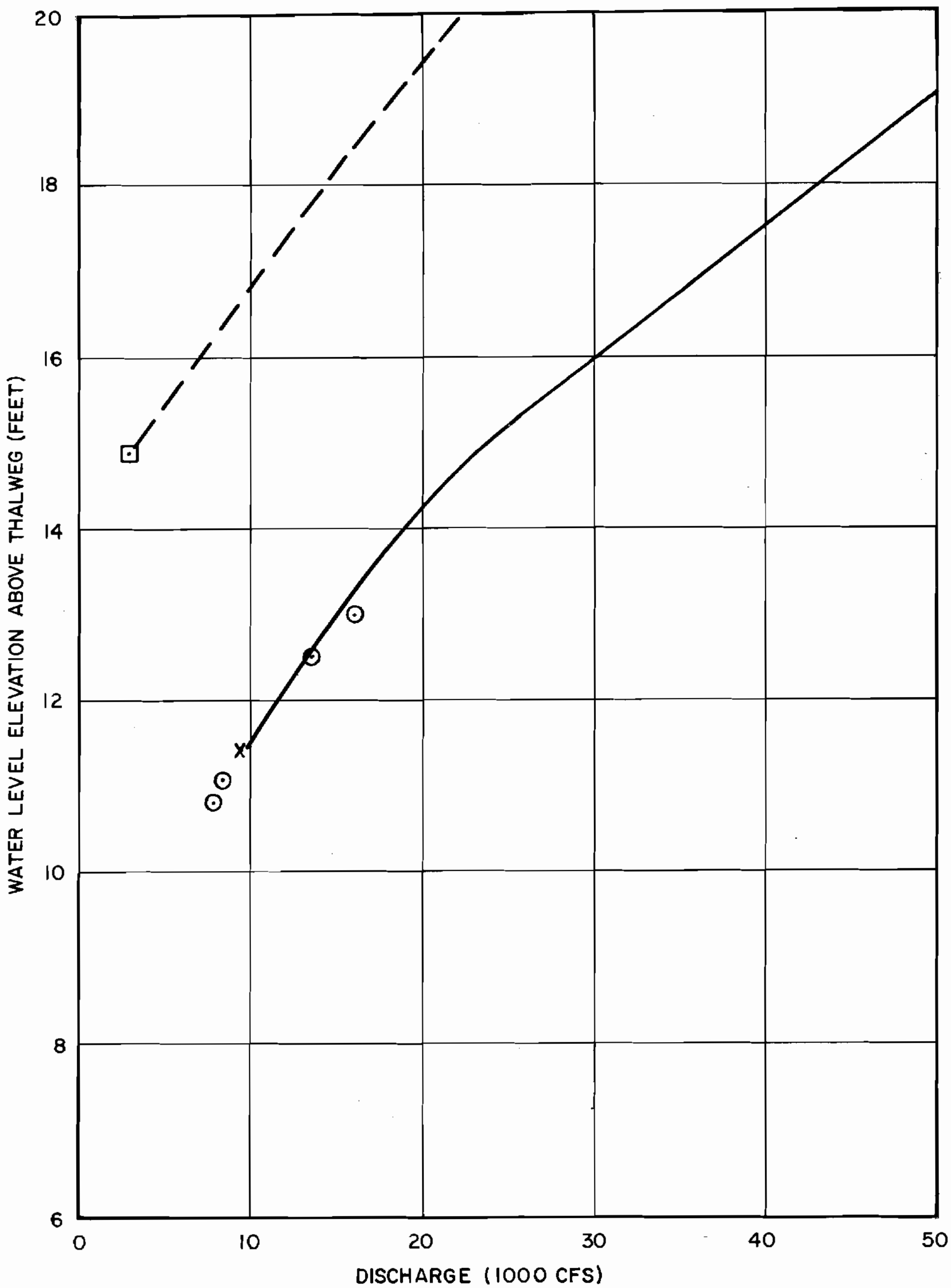
LEGEND:

- SUSITNA RIVER ABOVE CONFLUECE (RM. 103.0)
- SUSITNA RIVER BELOW CONFLUENCE (RM. 83.9)
- TALKEETNA RIVER IMMEDIATELY ABOVE CONFLUENCE
- CHULITNA RIVER IMMEDIATELY ABOVE CONFLUENCE
- NO DATA

COMPARISON OF 1982 TALKEETNA, CHULITNA, AND SUSITNA RIVER WATER TEMPERATURES

SOURCE: ADF & G 1982

FIGURE E.2.75



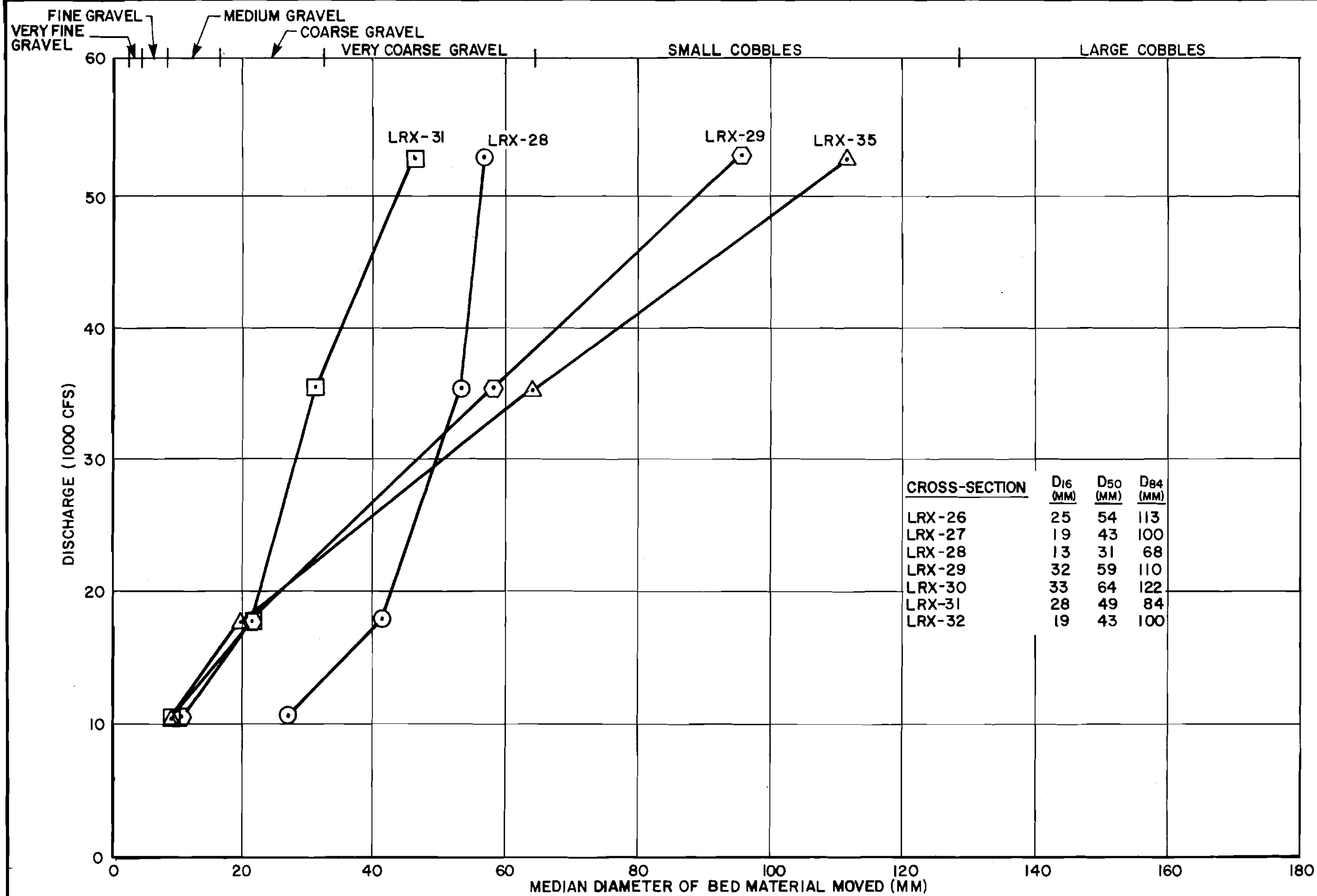
LEGEND:

- X FIELD MEASUREMENT OCT. 7, 1980 (R&M 1982d).
- ⊙ FIELD MEASUREMENTS ADF&G 1982.
- ——— HEC - 2 COMPUTED RATING CURVE.
- ⊡ FIELD MEASUREMENT DEC. 3, 1980 DURING ICE COVER PROGRESSION (R&M 1982d).
- — — — HYPOTHETICAL ICE COVER RATING CURVE WITH FREEZEUP AT DEC. 1980 DISCHARGE.

NOTE: ICE COVER RATING CURVE IS AN ILLUSTRATION ONLY AND IS NOT INTENDED TO REFLECT ACTUAL CONDITIONS.

ICE AND OPEN WATER STAGE - DISCHARGE RELATIONSHIP, LRX-9, RM 103.2

FIGURE E.2.76

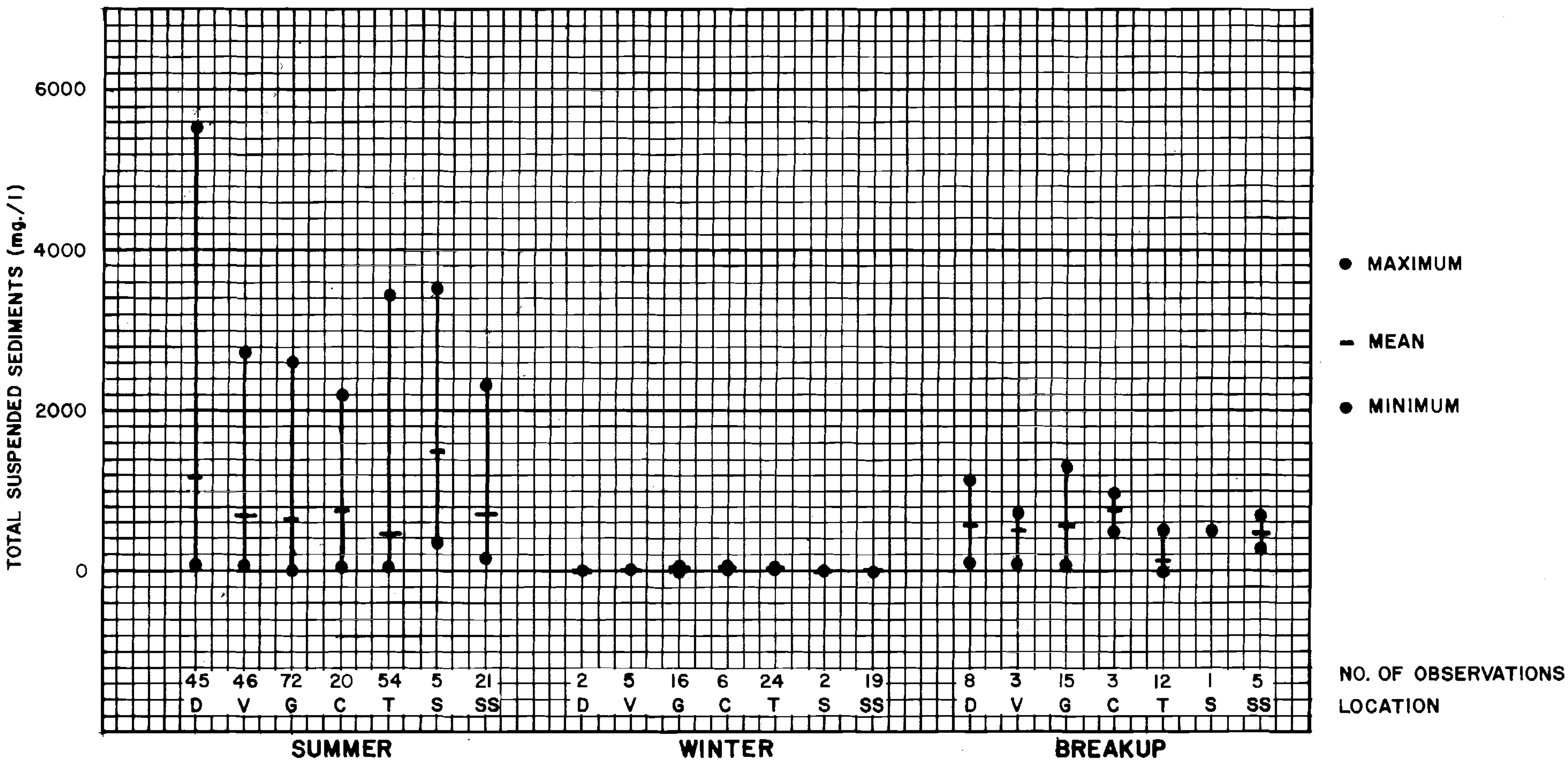


CROSS-SECTION	D16 (MM)	D50 (MM)	D84 (MM)
LRX-26	25	54	113
LRX-27	19	43	100
LRX-28	13	31	68
LRX-29	32	59	110
LRX-30	33	64	122
LRX-31	28	49	84
LRX-32	19	43	100

SOURCE: R & M 1982

BED MATERIAL MOVEMENT CURVES LRX-28, 29, 31, 35

FIGURE E.2.77



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTE:

1. A. CRITERION: NO MEASURABLE INCREASE ABOVE NATURAL CONDITIONS (ADEC 1979).

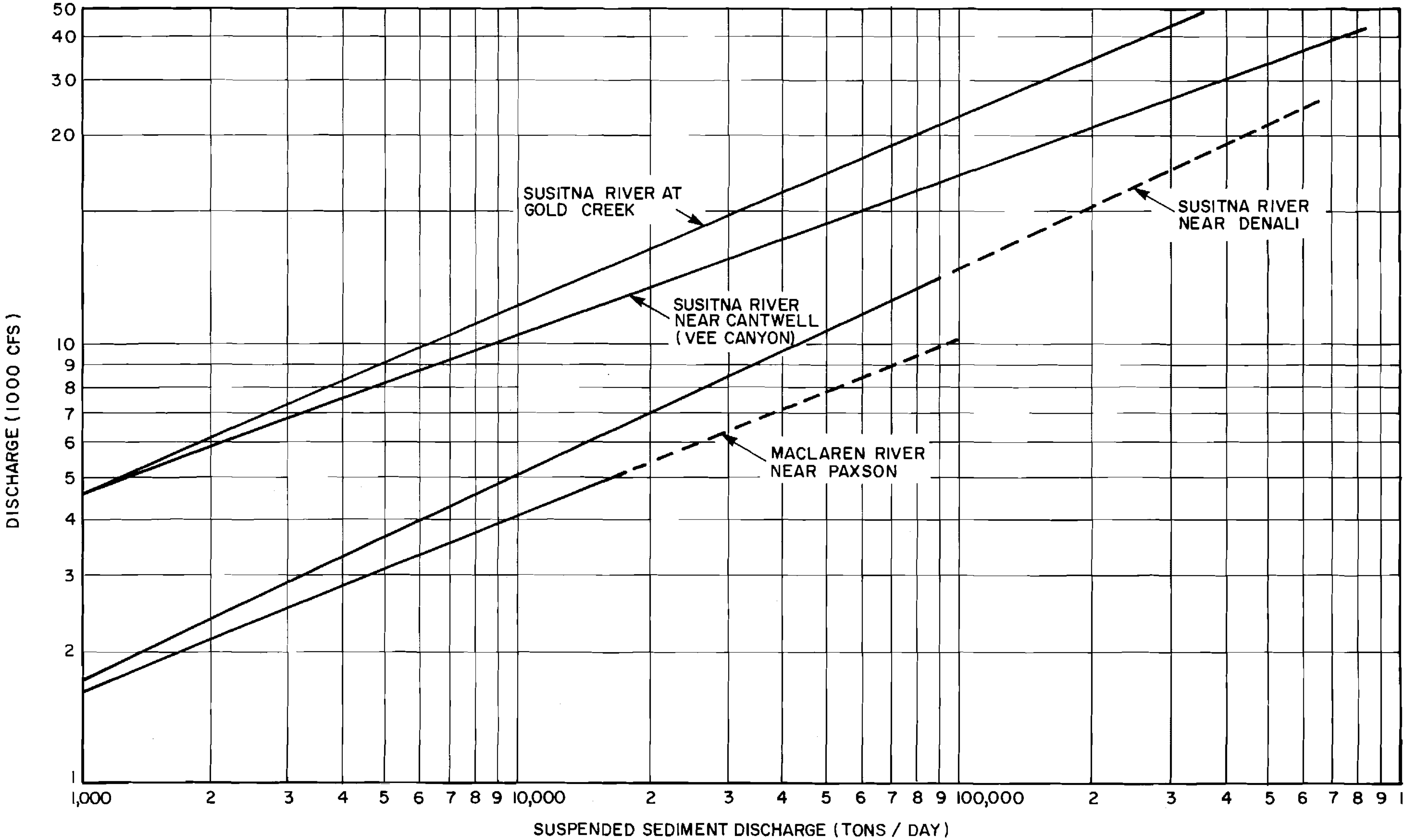
1. B. ESTABLISHED TO PREVENT DELETERIOUS EFFECTS ON AQUATIC ANIMAL AND PLANT LIFE, THEIR REPRODUCTION AND HABITAT.

2. AT GOLD CREEK, 2 WINTER OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 1.0 mg./l.

DATA SUMMARY-TOTAL SUSPENDED SEDIMENTS

SOURCE: USGS AND R&M

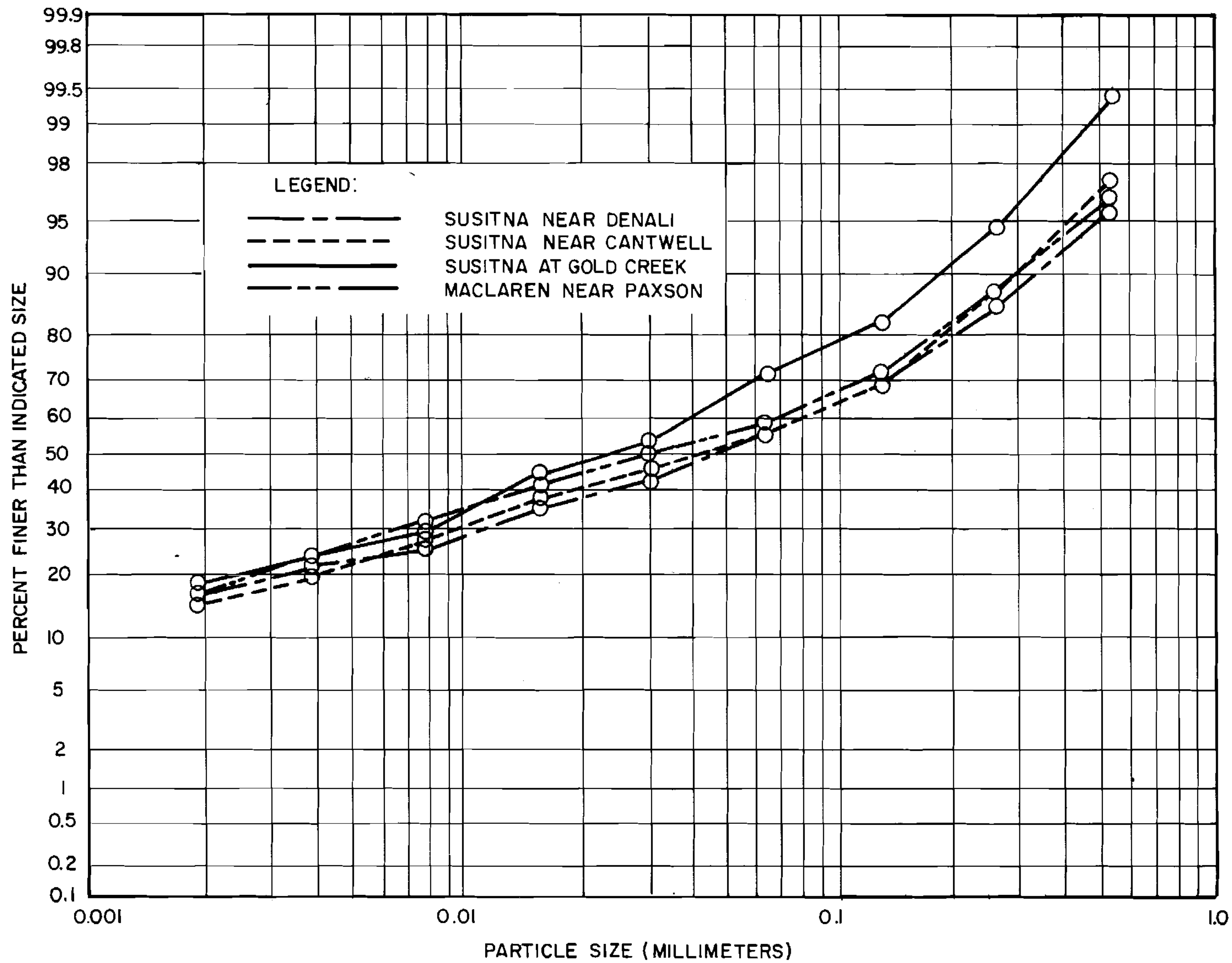
FIGURE E.2.78



SUSPENDED SEDIMENT RATING CURVES
MIDDLE AND UPPER SUSITNA RIVER BASINS

SOURCE: R & M 1982

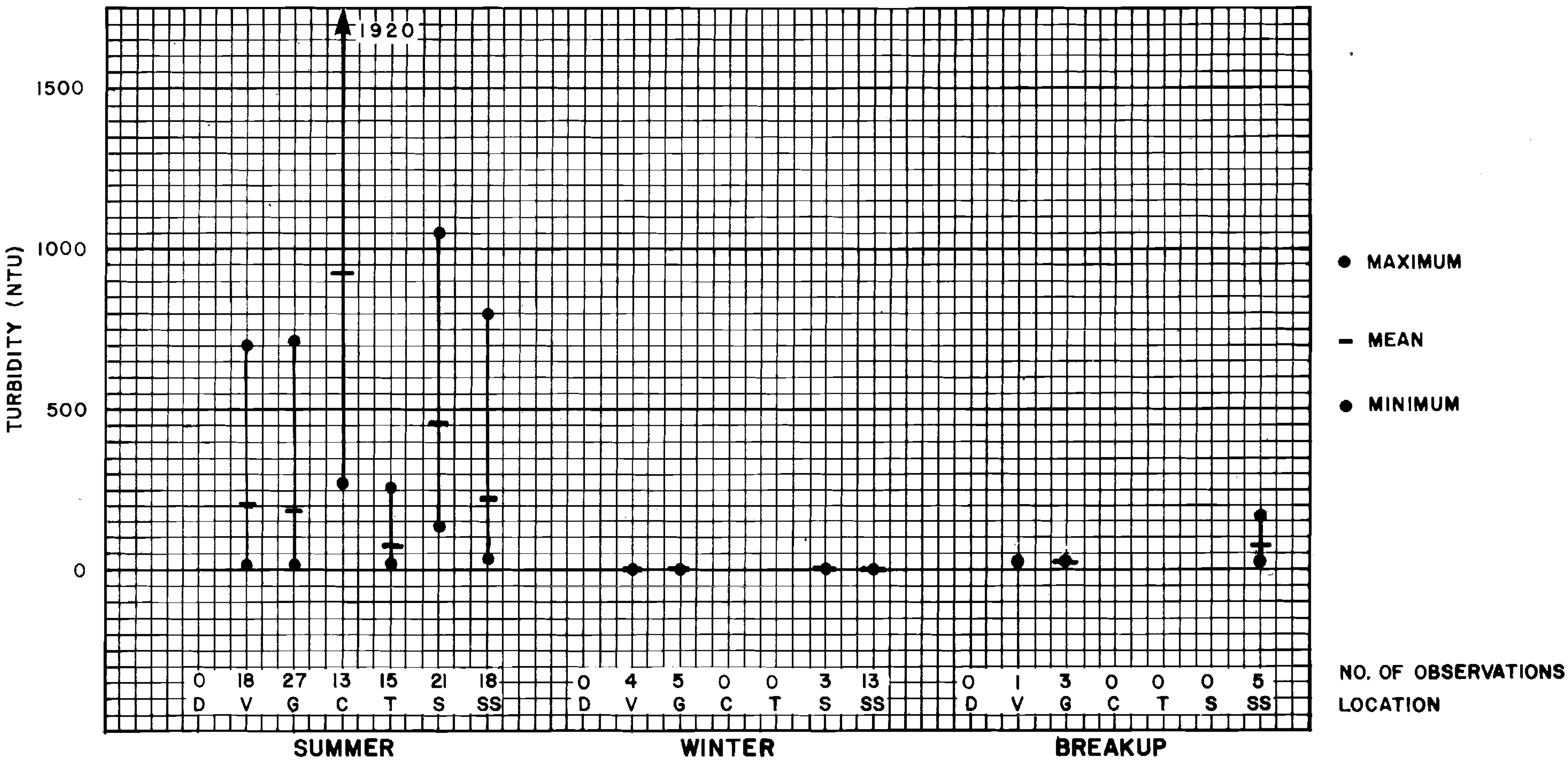
FIGURE E.2.79



SUSPENDED SEDIMENT SIZE ANALYSIS
SUSITNA RIVER

SOURCE: ALASKA DISTRICT CORPS OF ENGINEERS 1975

FIGURE E.2.80



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

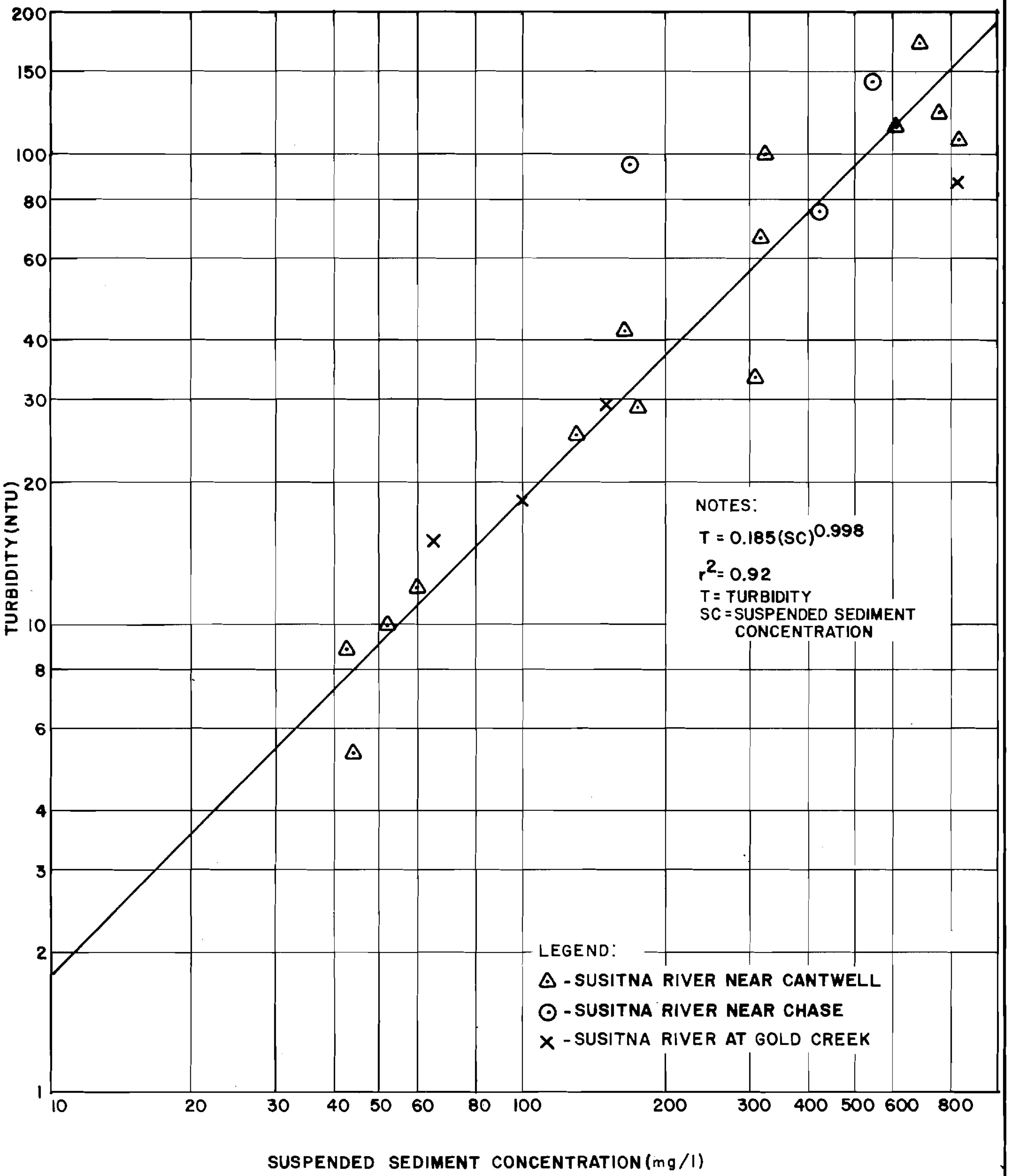
1\. A. CRITERION: SHALL NOT EXCEED 25 NTU ABOVE NATURAL CONDITIONS (ADEC 1979).

1\. B. ESTABLISHED TO PREVENT THE REDUCTION OF THE COMPENSATION POINT FOR PHOTOSYNTHETIC ACTIVITY, WHICH MAY HAVE ADVERSE EFFECTS ON AQUATIC LIFE.

DATA SUMMARY - TURBIDITY

SOURCE: USGS AND R&M

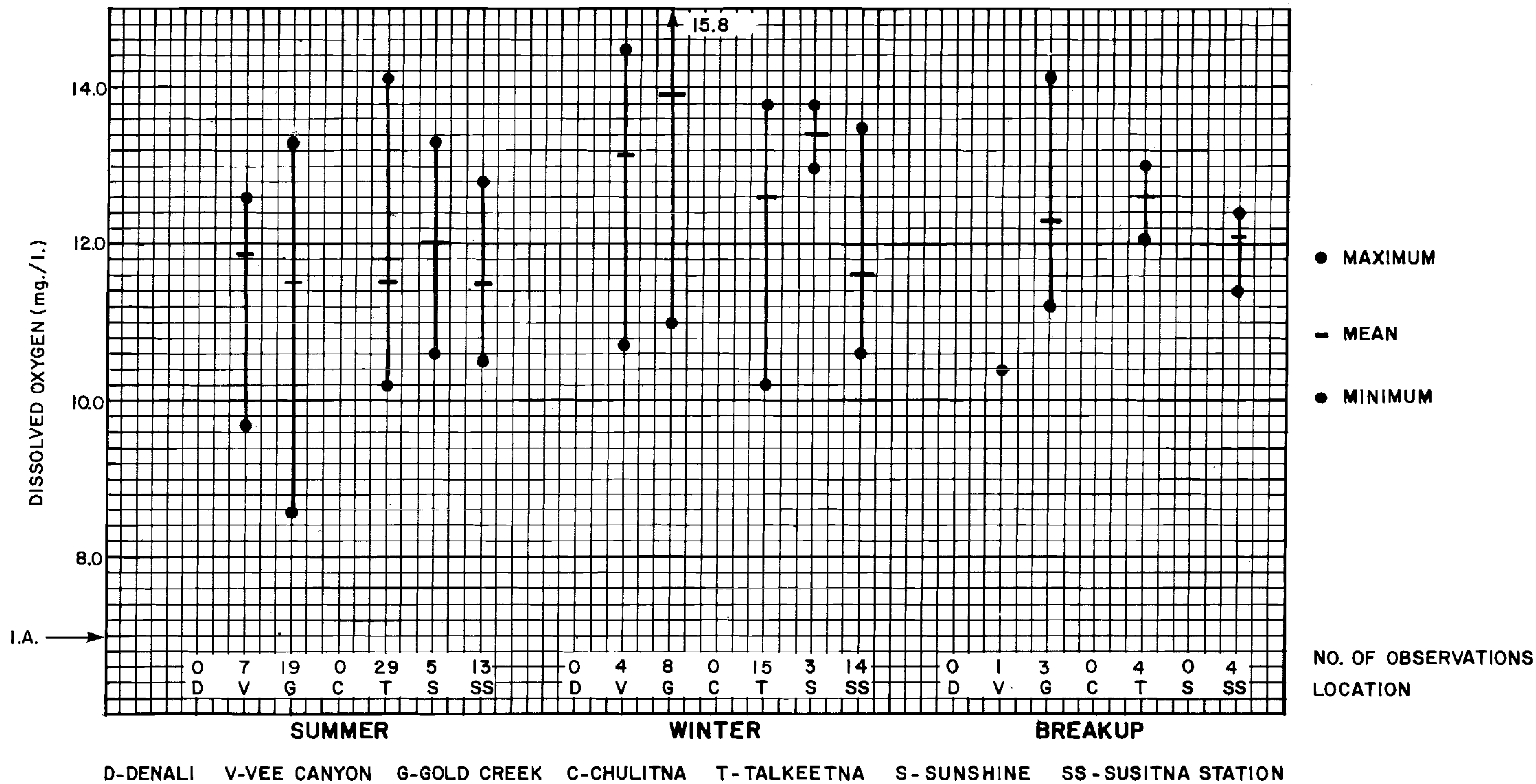
FIGURE E.2.81



TURBIDITY VS. SUSPENDED SEDIMENT CONCENTRATION

SOURCE: PERATROVICH, NOTTINGHAM AND DRAGE 1982

FIGURE E.2.82



NOTES:

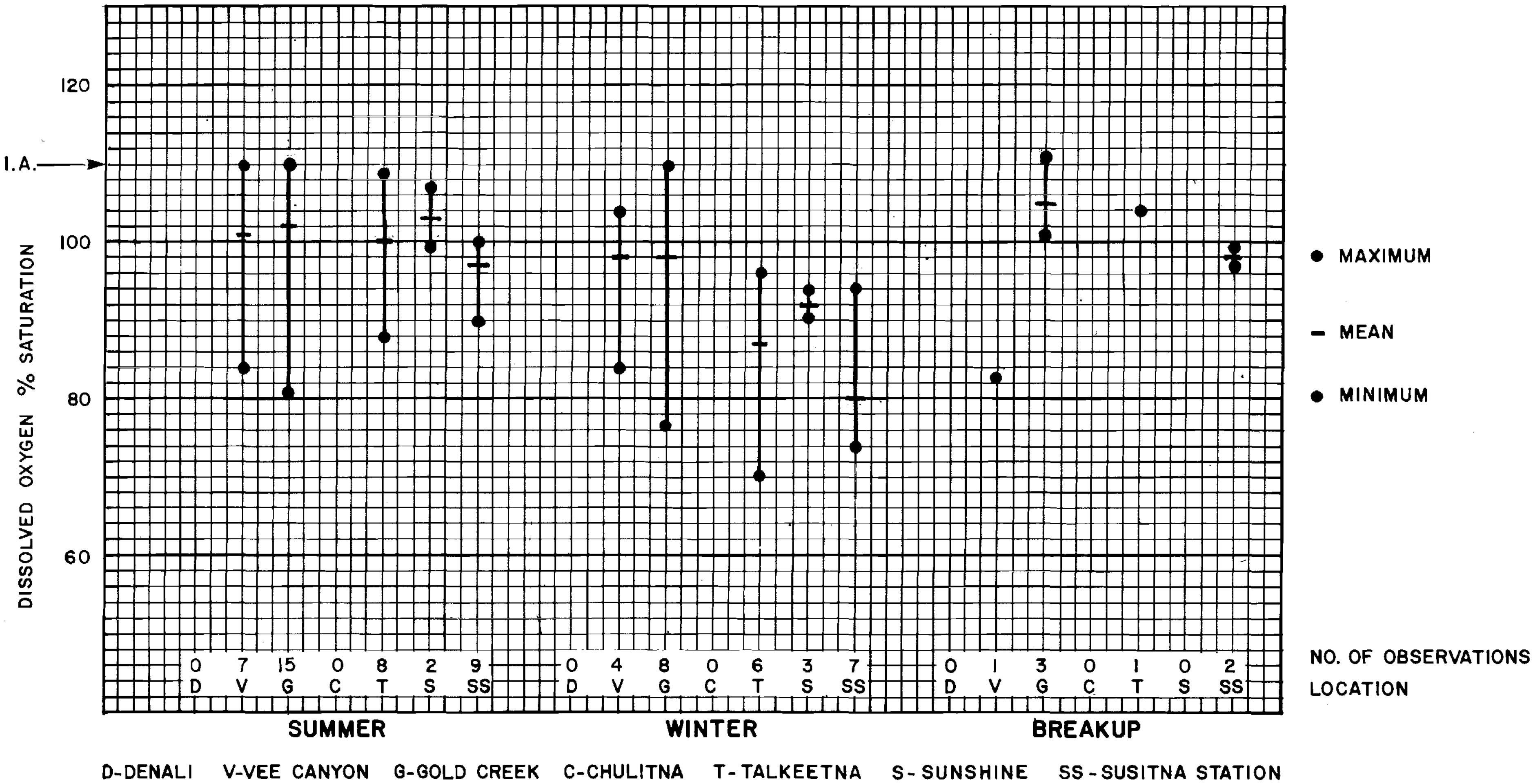
I. A. CRITERIA: GREATER THAN 7mg./l., BUT IN NO CASE SHALL DISSOLVED OXYGEN EXCEED 17 mg./l. (ADEC 1979).

I. B. ESTABLISHED FOR THE PROTECTION OF ANADROMOUS AND RESIDENT FISH.

DATA SUMMARY - DISSOLVED OXYGEN

SOURCE: USGS AND R & M

FIGURE E.2.83



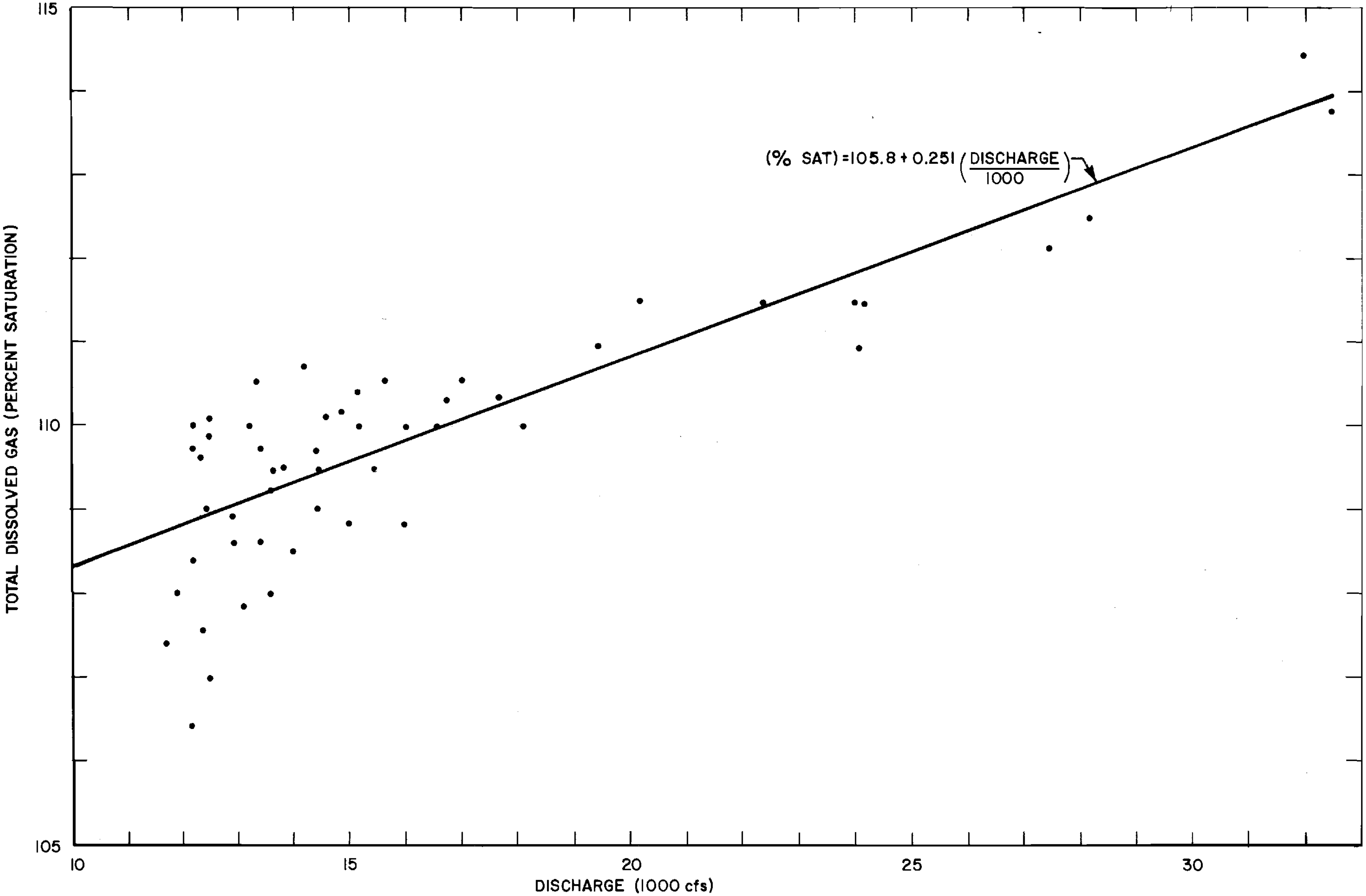
NOTES:

1. A. CRITERION: THE CONCENTRATION OF TOTAL DISSOLVED GAS SHALL NOT EXCEED 110 % SATURATION AT ANY POINT. (ADEC, 1979).
1. B. ESTABLISHED FOR THE PROTECTION OF ANADROMOUS AND RESIDENT FISH.

DATA SUMMARY – DISSOLVED OXYGEN % SATURATION

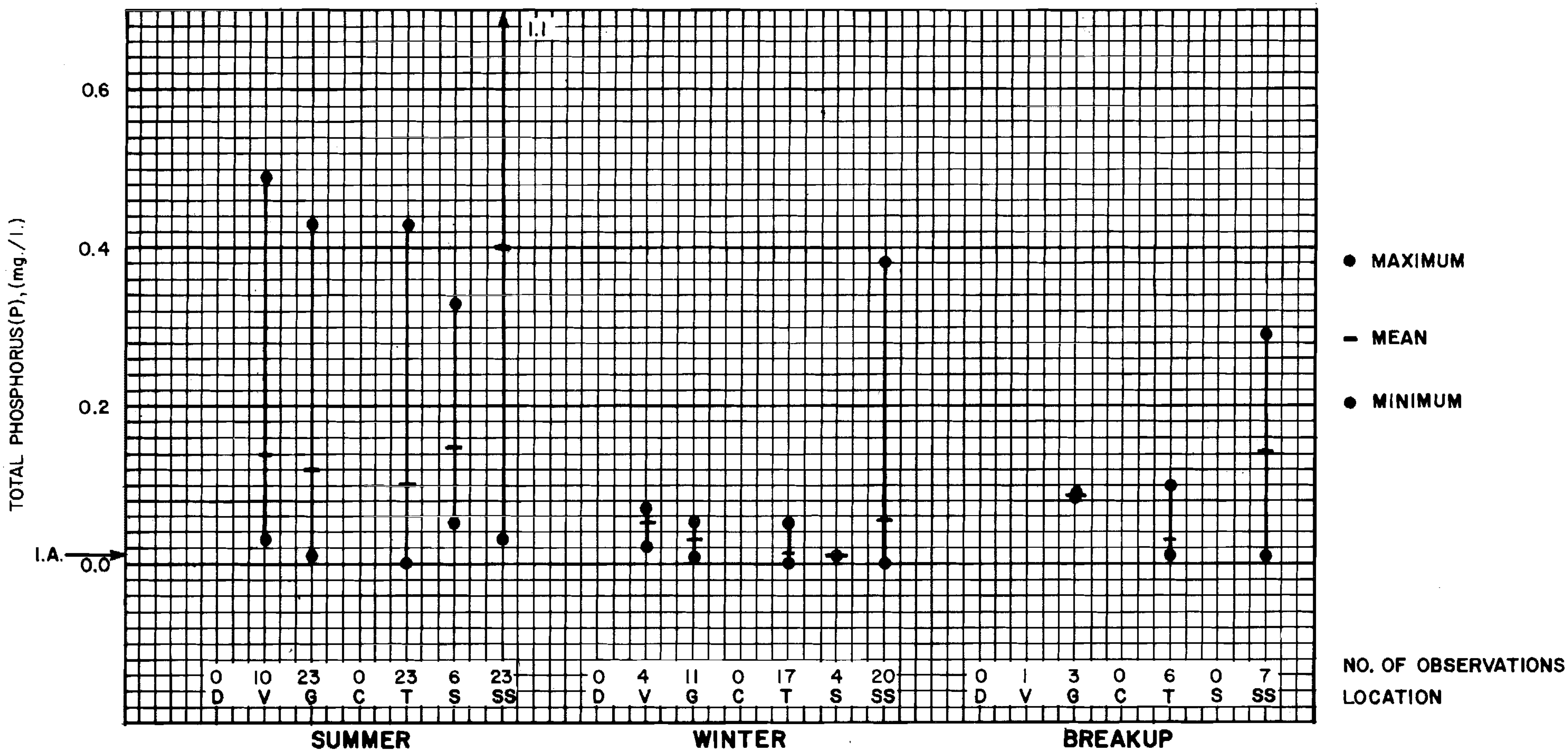
SOURCE: USGS AND R&M

FIGURE E.2.84



TOTAL DISSOLVED GAS (PERCENT SATURATION) VS. DISCHARGE

FIGURE E.2.85



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

I.A. CRITERION: LESS THAN 0.01 mg./l. FOR ELEMENTAL PHOSPHORUS (EPA 1976).

I.B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

2. AT VEE CANYON, 4 SUMMER OBSERVATIONS, 2 WINTER OBSERVATIONS, AND THE I BREAKUP OBSERVATION WERE LESS THAN 0.05 mg./l.

3. AT GOLD CREEK, 6 SUMMER OBSERVATIONS, 3 WINTER OBSERVATIONS, AND I BREAKUP OBSERVATION WERE LESS THAN 0.05 mg./l.

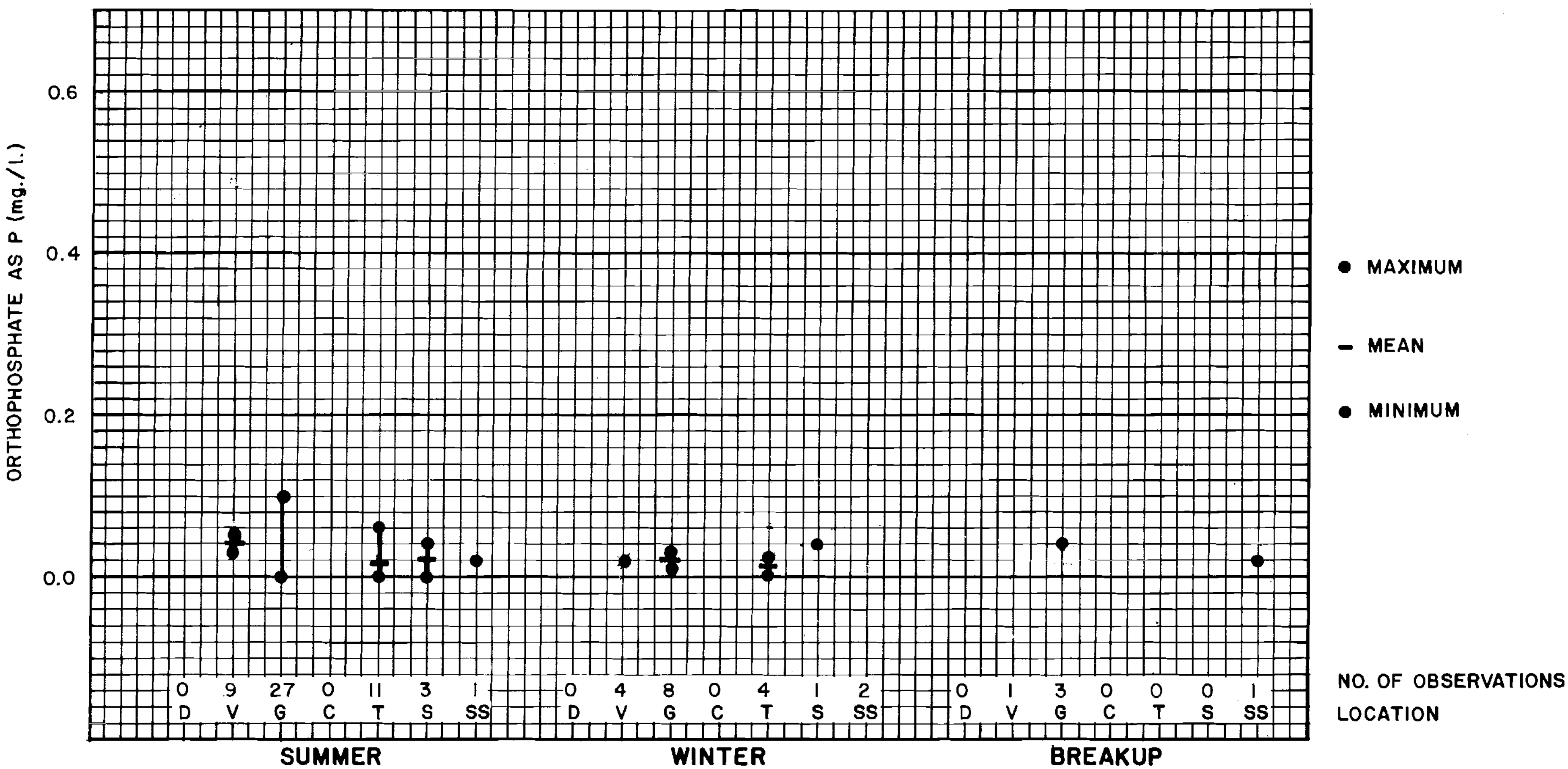
4. AT SUNSHINE, 2 WINTER OBSERVATIONS WERE LESS THAN 0.01 mg./l.

5. AT SUSITNA STATION, 2 WINTER OBSERVATIONS WERE LESS THAN 0.01 mg./l.

DATA SUMMARY - TOTAL PHOSPHORUS

SOURCE: USGS AND R & M

FIGURE E.2.86



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

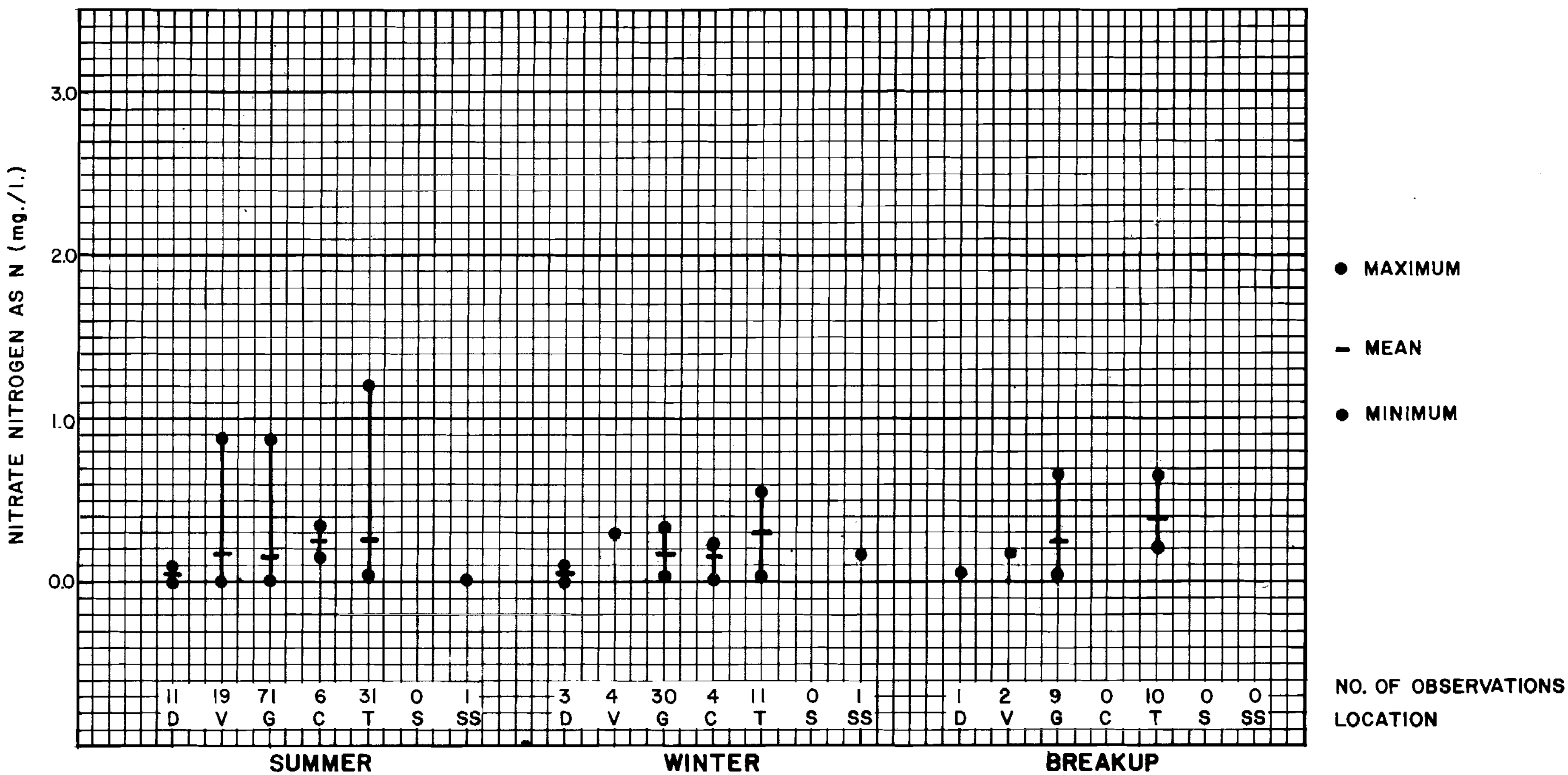
NOTES:

1. NO CRITERION ESTABLISHED.
2. AT VEE CANYON, 7 SUMMER OBSERVATIONS WERE LESS THAN 0.05 mg./l. 2 WINTER OBSERVATIONS AND THE 1 BREAKUP OBSERVATION WERE LESS THAN THE DETECTION LIMIT OF 0.01 mg./l.
3. AT GOLD CREEK, 13 SUMMER OBSERVATIONS WERE LESS THAN 0.02 mg./l. 2 WINTER OBSERVATIONS AND 2 BREAKUP OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 0.01 mg./l.
4. AT SUSITNA STATION, THE 2 WINTER OBSERVATIONS WERE LESS THAN 0.02 mg./l.

DATA SUMMARY-ORTHOPHOSPHATE

SOURCE: USGS AND R&M.

FIGURE E.2.87



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

1.A. CRITERION: LESS THAN 10 mg./l. (EPA 1976).

1.B. ESTABLISHED TO PROTECT WATER SUPPLIES.

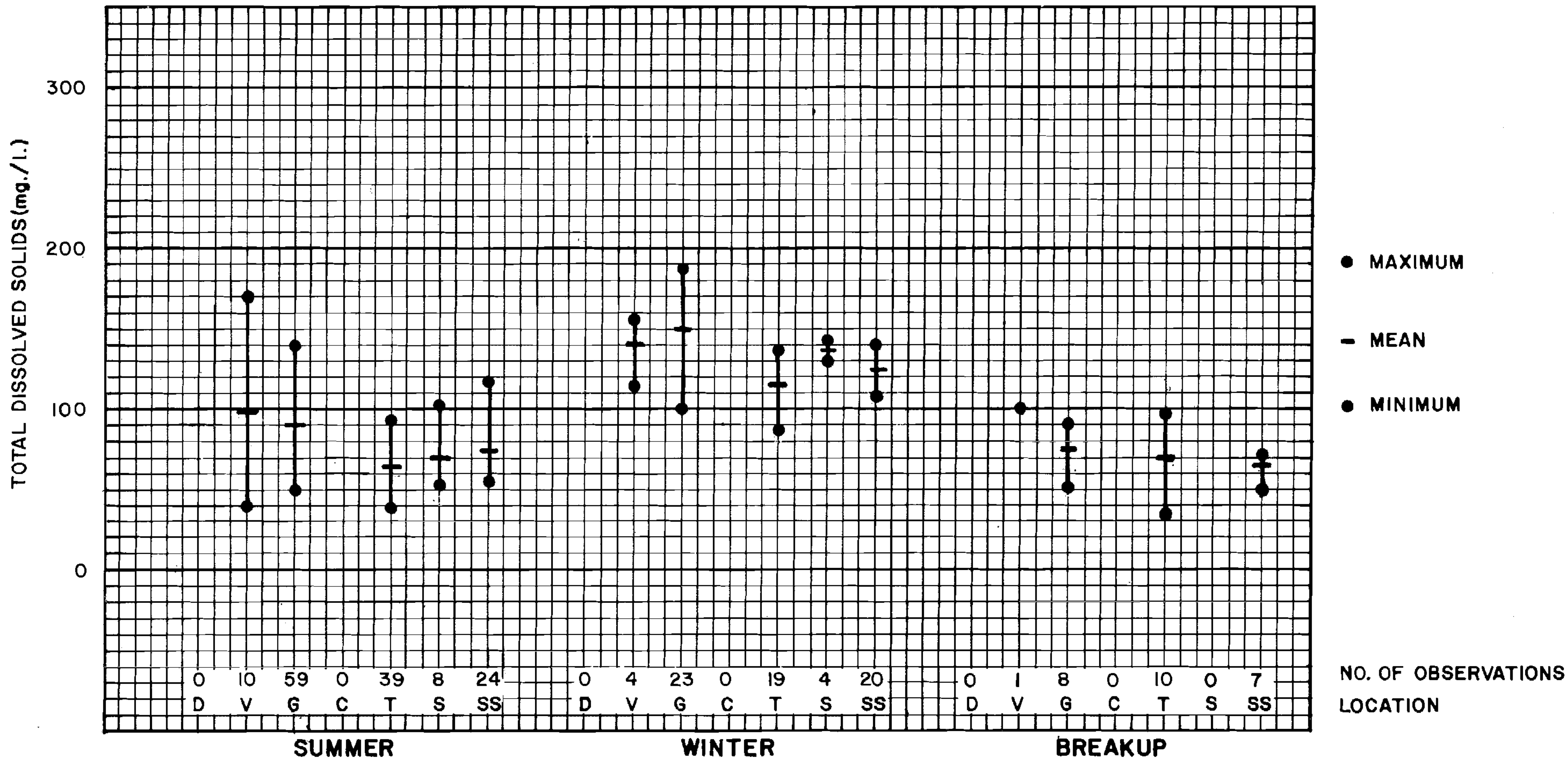
2. AT VEE CANYON, 5 SUMMER OBSERVATIONS, 3 WINTER OBSERVATIONS, AND 1 BREAKUP OBSERVATION WERE LESS THAN THE DETECTION LIMIT OF 0.10 mg./l.

3. AT GOLD CREEK, 6 SUMMER OBSERVATIONS, 2 WINTER OBSERVATIONS AND 2 BREAKUP OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 0.10 mg./l.

DATA SUMMARY - NITRATE NITROGEN

SOURCE: USGS AND R & M

FIGURE E.2.88



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

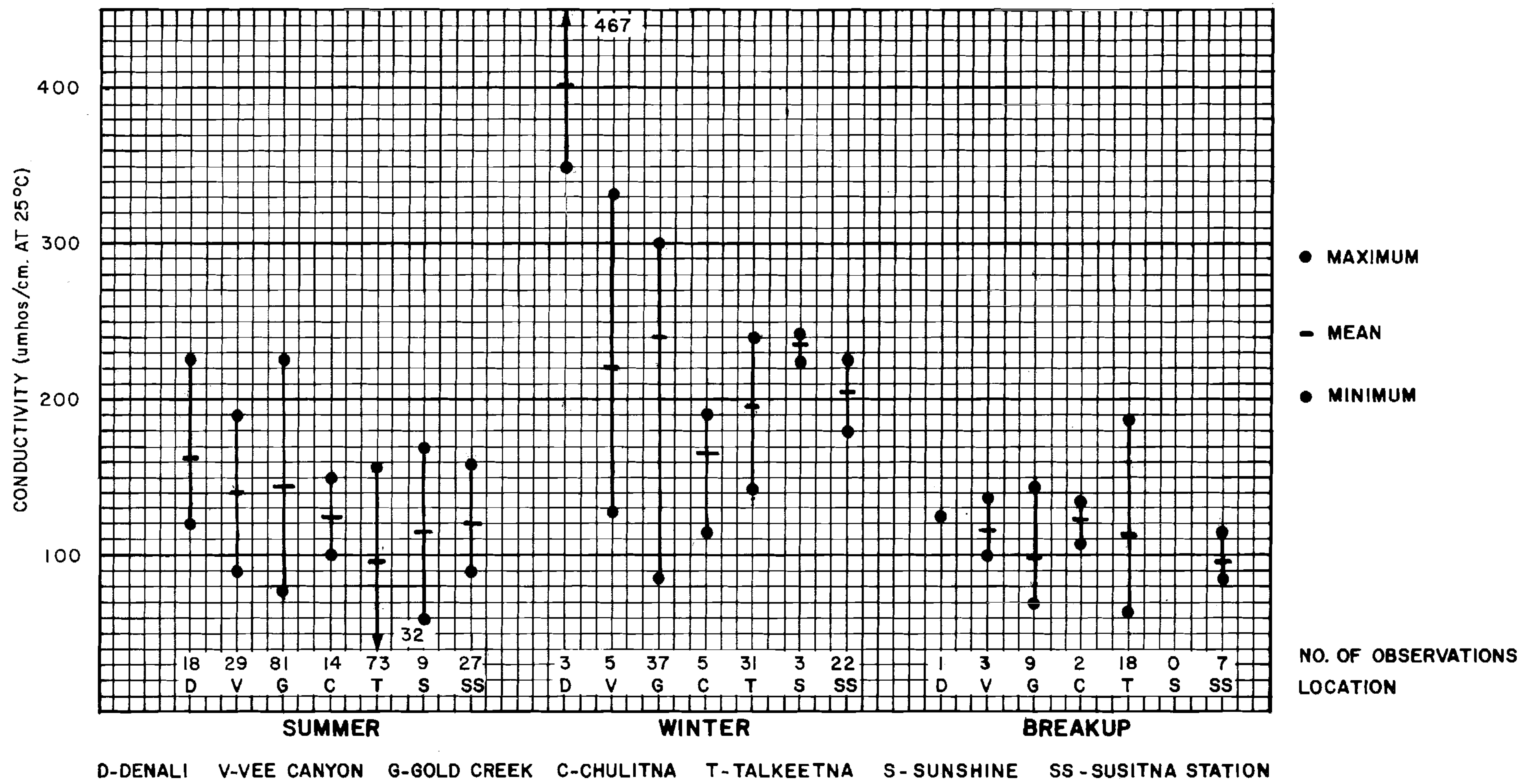
I.A. CRITERION: 1,500 mg./l. (ADEC 1979).

I.B. ESTABLISHED TO PROTECT NATURAL CONDITIONS OF FRESHWATER ECOSYSTEMS (500 mg./l. IS THE CRITERION FOR WATER SUPPLIES).

DATA SUMMARY – TOTAL DISSOLVED SOLIDS

SOURCE: USGS AND R&M

FIGURE E.2.89



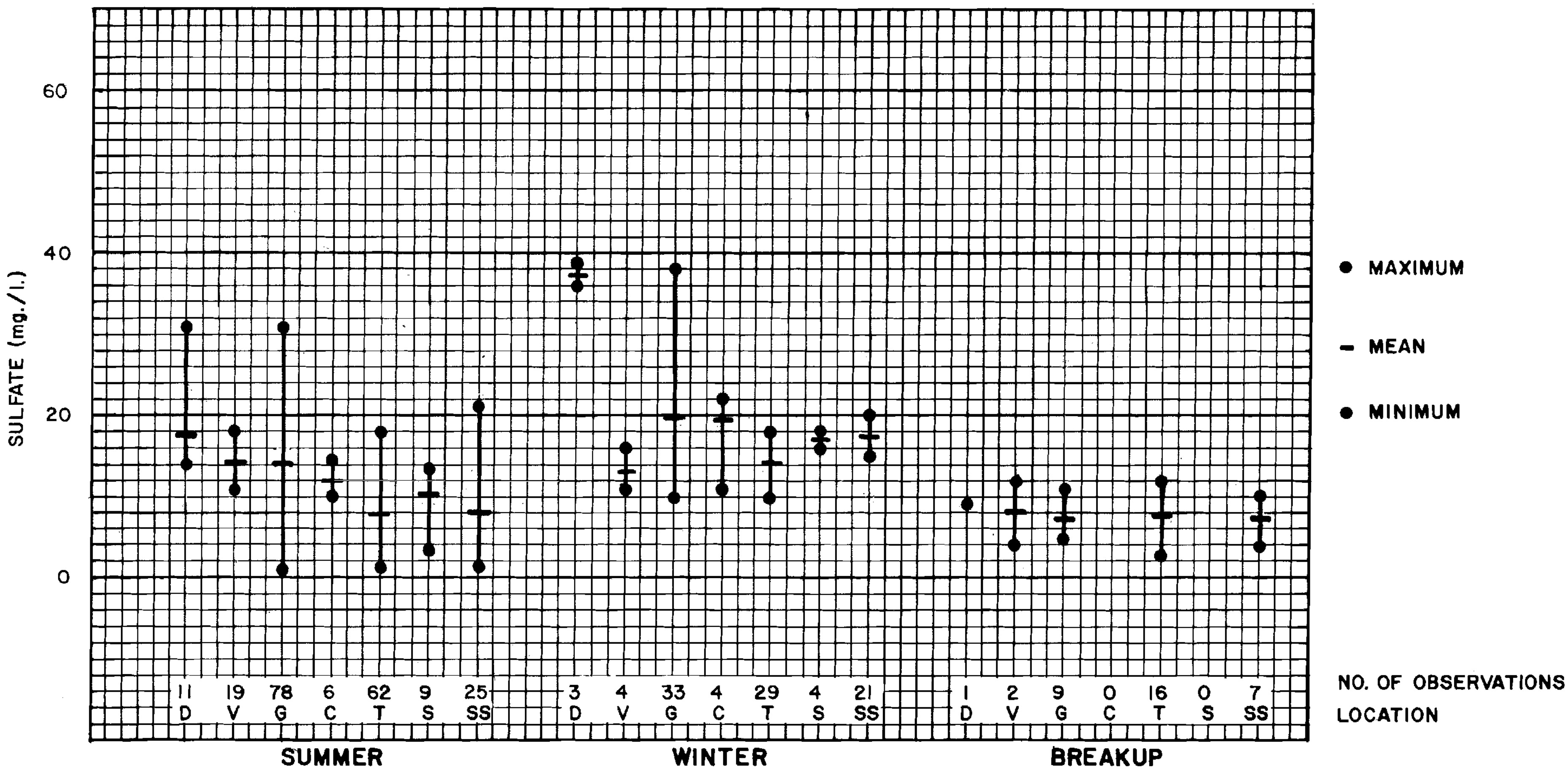
NOTES:

1. NO CRITERION ESTABLISHED.

DATA SUMMARY - CONDUCTIVITY

SOURCE: USGS AND R&M

FIGURE E.2.90



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

1.A. CRITERION: SHALL NOT EXCEED 200 mg./l. (ADEC 1979).

1.B. ESTABLISHED TO PROTECT WATER SUPPLIES.

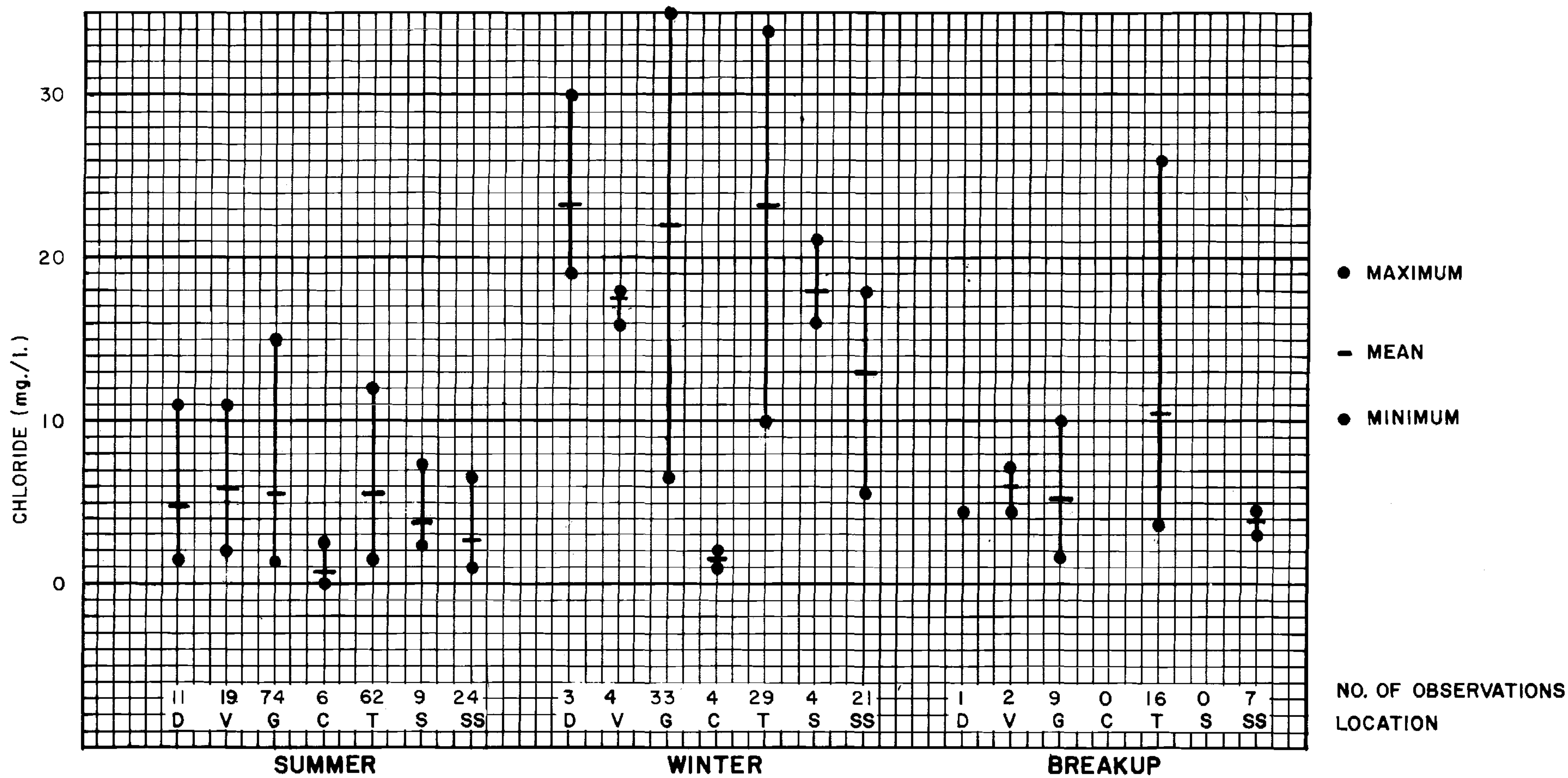
2. AT GOLD CREEK, 1 SUMMER OBSERVATION AND 1 BREAKUP OBSERVATION WERE LESS THAN 5.0 mg./l.

3. AT TALKEETNA, 1 SUMMER OBSERVATION WAS LESS THAN 1.0 mg./l.

SOURCE: USGS AND R&M

DATA SUMMARY - SULFATE

FIGURE E.2.91



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

I. A. CRITERION: LESS THAN 200 mg/l (ADEC 1979).

I. B. ESTABLISHED TO PROTECT WATER SUPPLIES.

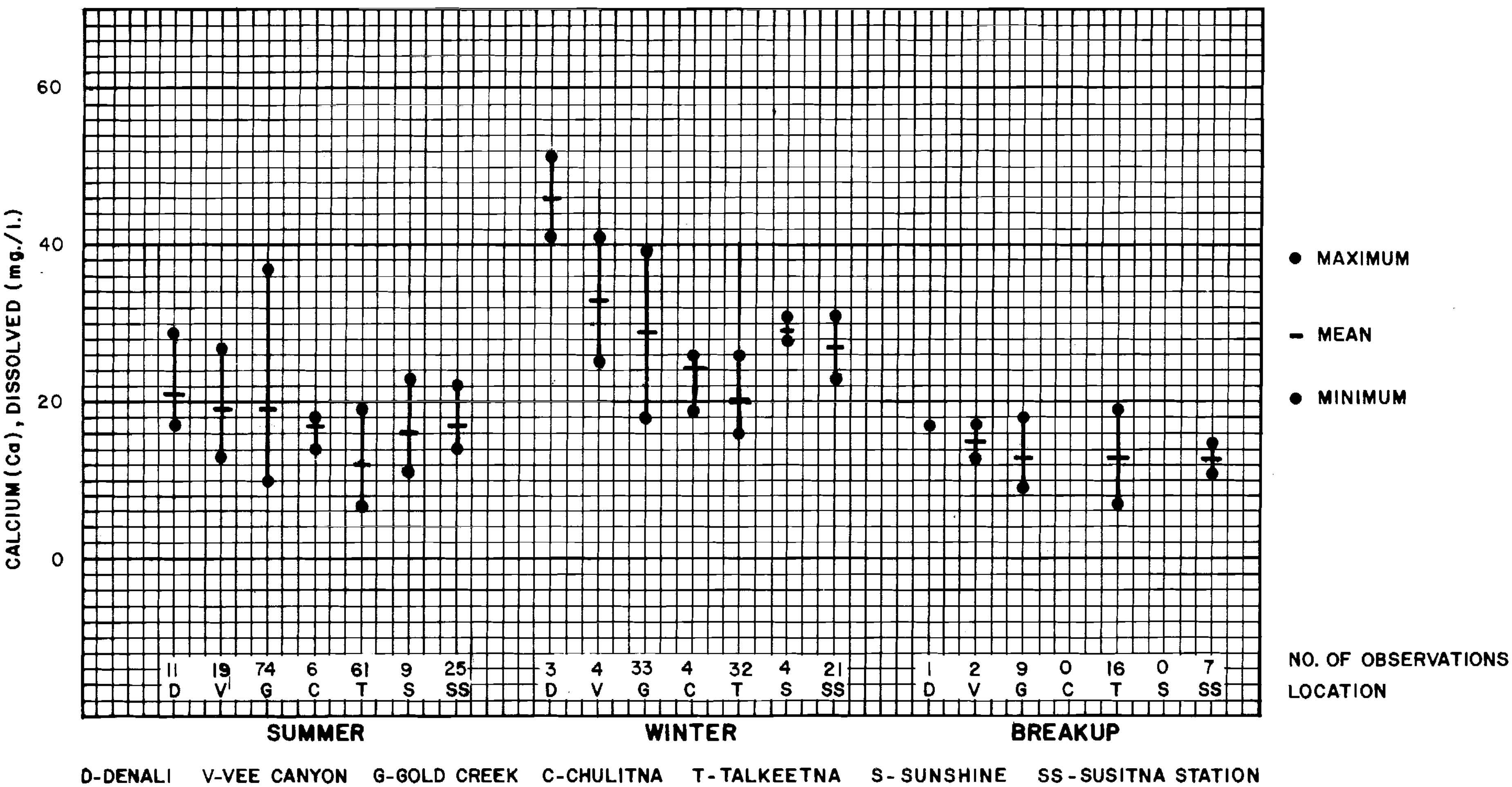
2. AT VEE CANYON, 3 SUMMER OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 1.0 mg/l.

3. AT GOLD CREEK, 2 SUMMER OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 1.0 mg/l.

DATA SUMMARY – CHLORIDE

SOURCE: USGS AND R&M

FIGURE E.2.92

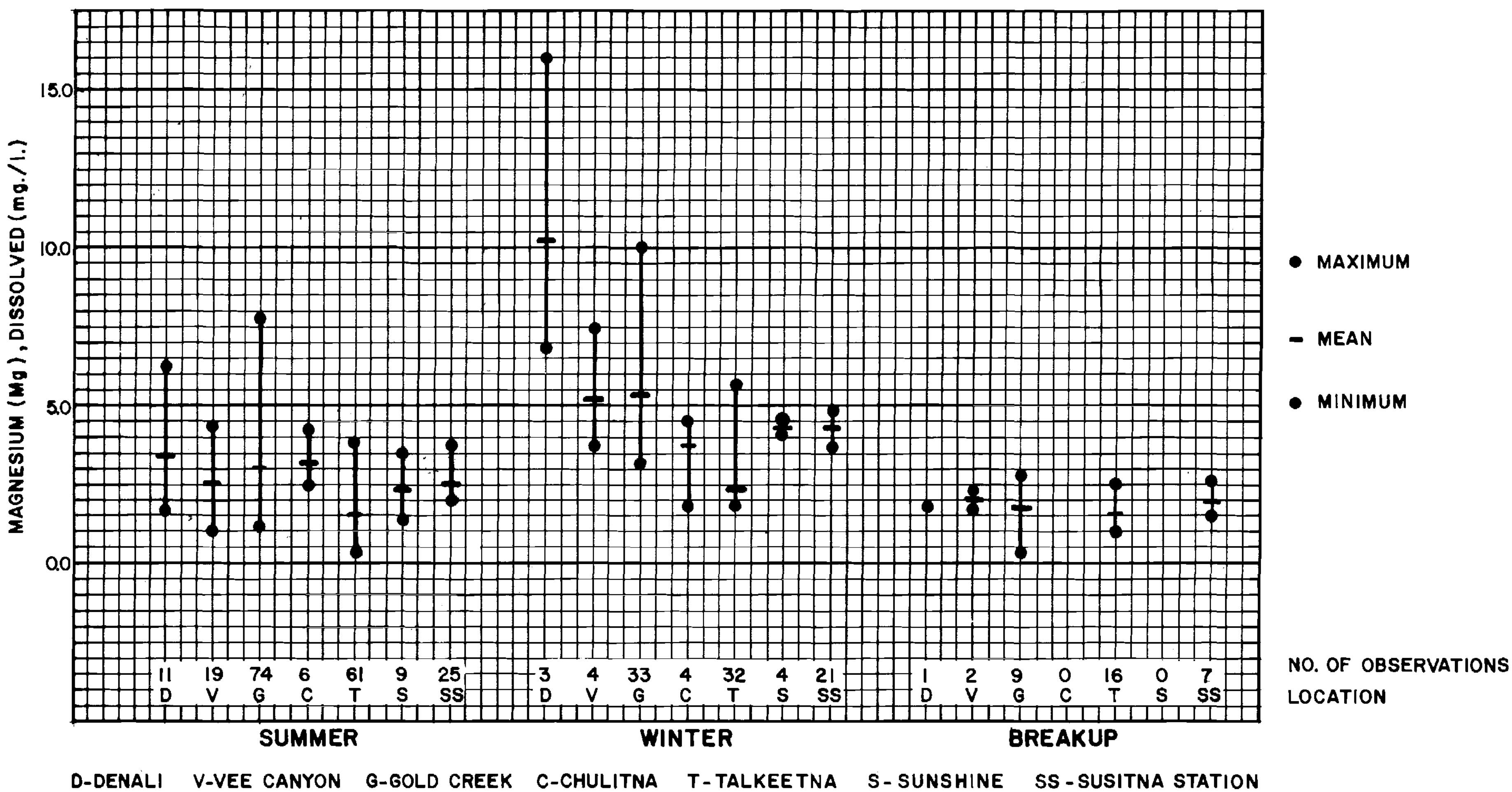


NOTES:
1. NO CRITERION ESTABLISHED.
2. (d)= DISSOLVED

DATA SUMMARY - CALCIUM (d)

SOURCE: USGS AND R&M

FIGURE E.2.93

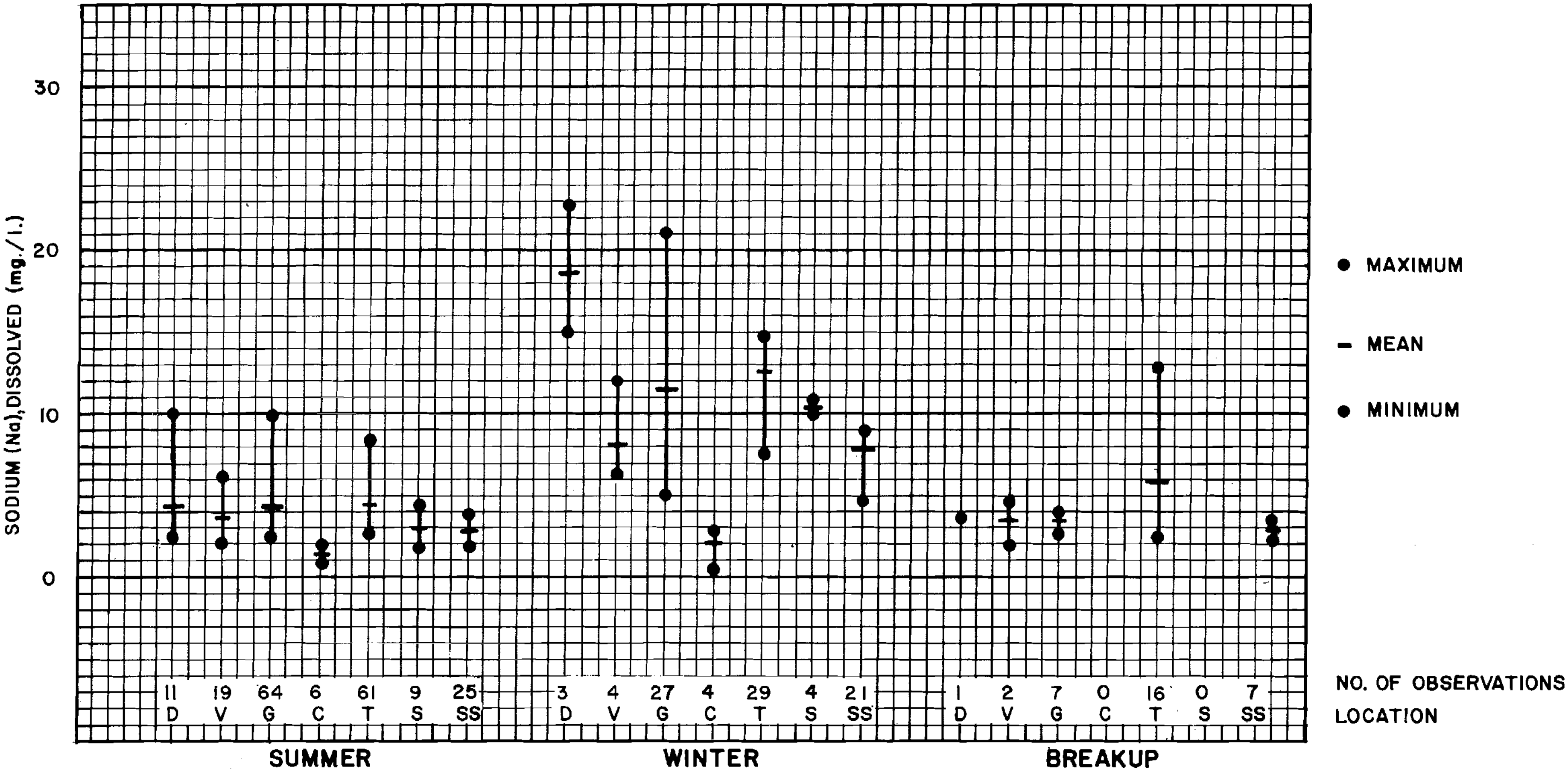


NOTES:
1. NO CRITERION ESTABLISHED.
2. (d)- DISSOLVED.

DATA SUMMARY-MAGNESIUM (d)

SOURCE: USGS AND R&M

FIGURE E.2.94



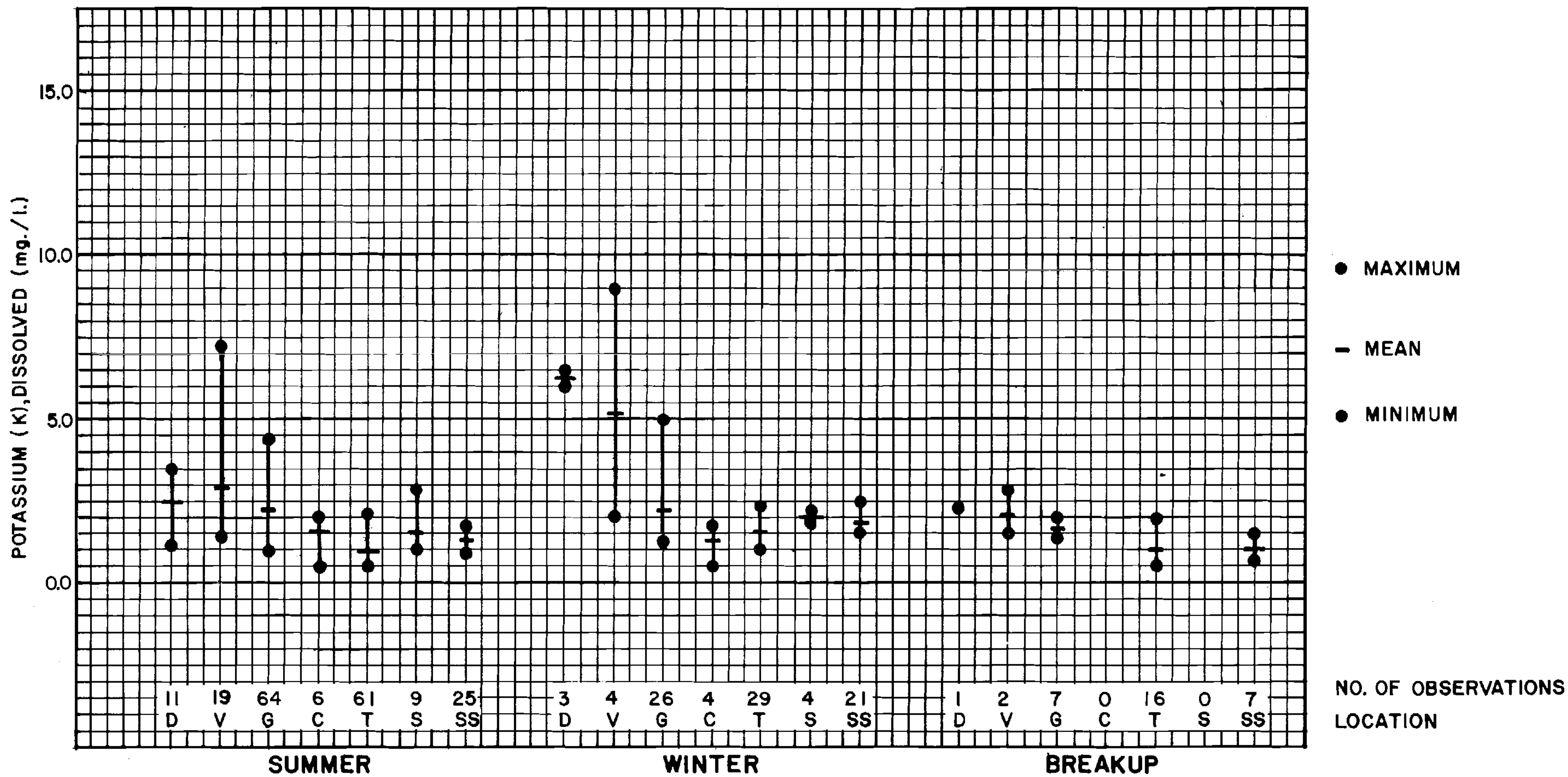
D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:
1. NO CRITERION ESTABLISHED.
2. (d)- DISSOLVED

DATA SUMMARY-SODIUM (d)

SOURCE: USGS AND R&M

FIGURE E.2.95



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

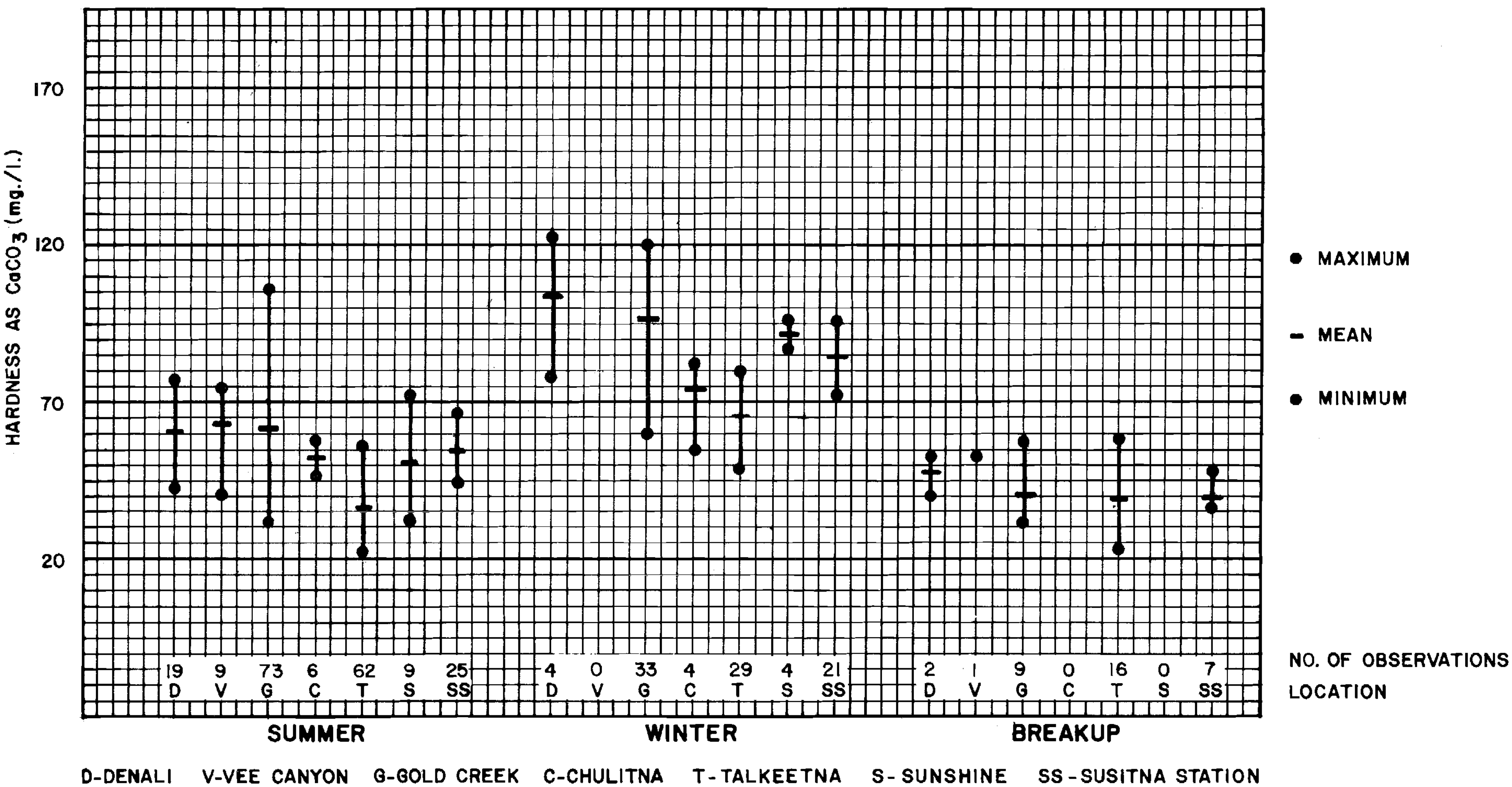
NOTES:

1. NO CRITERION ESTABLISHED.
2. AT VEE CANYON, 1 SUMMER OBSERVATION AND 1 WINTER OBSERVATION WERE LESS THAN THE DETECTION LIMIT OF 1.0 mg./l.
3. (d) = DISSOLVED

DATA SUMMARY - POTASSIUM (d)

SOURCE: USGS AND R&M

FIGURE E.2.96

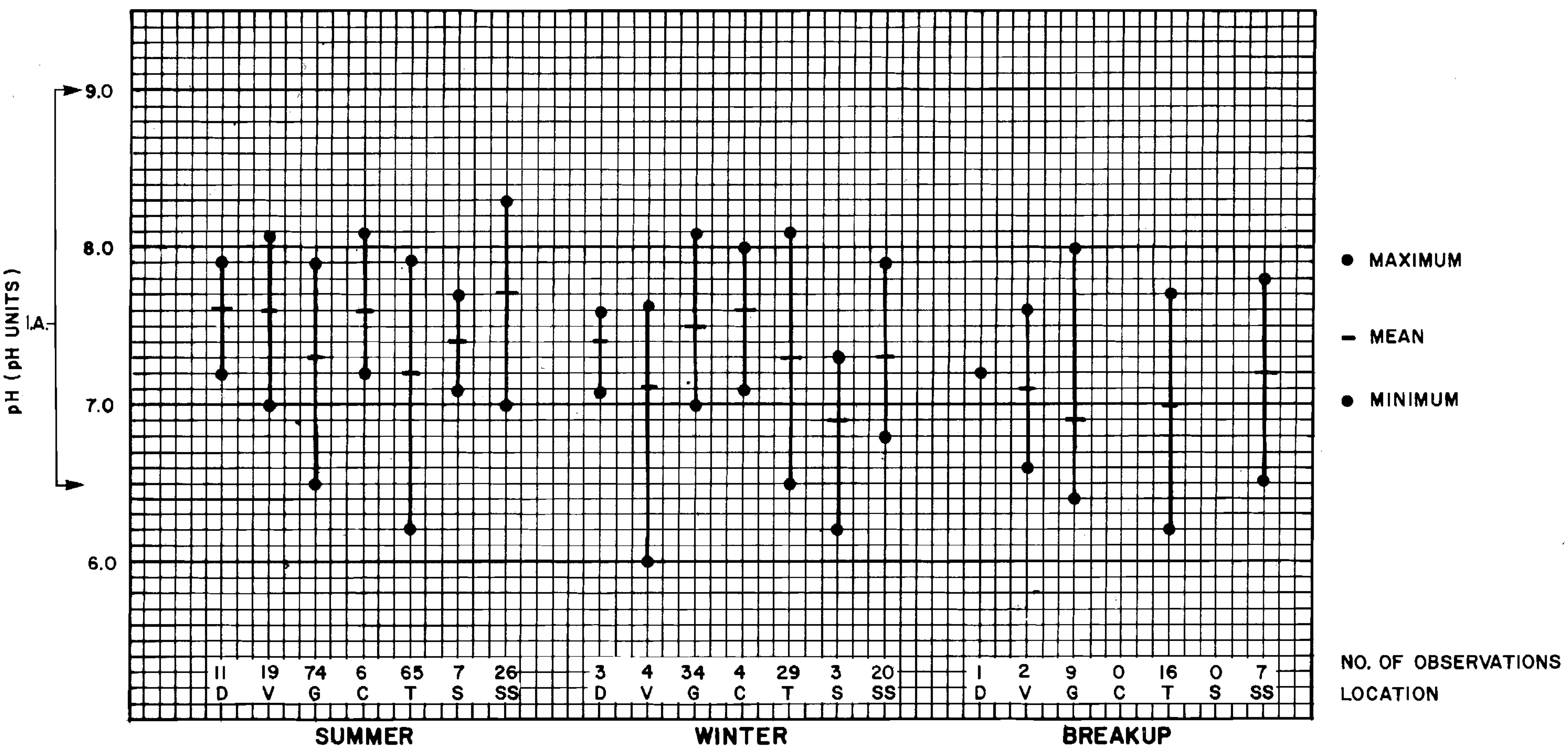


NOTES:
1. NO CRITERION ESTABLISHED.
2. SOME METALS HAVE VARIABLE SYNERGISTIC EFFECTS WITH HARDNESS, DEPENDENT ON THE PREVAILING HARDNESS IN THE WATER. THE CRITERIA FOR CADIUM, FOR EXAMPLE, ARE 0.0012 mg./l. IN HARD WATER AND 0.0004 mg./l. IN SOFT WATER.

DATA SUMMARY - HARDNESS

SOURCE: USGS AND R&M

FIGURE E.2.97



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

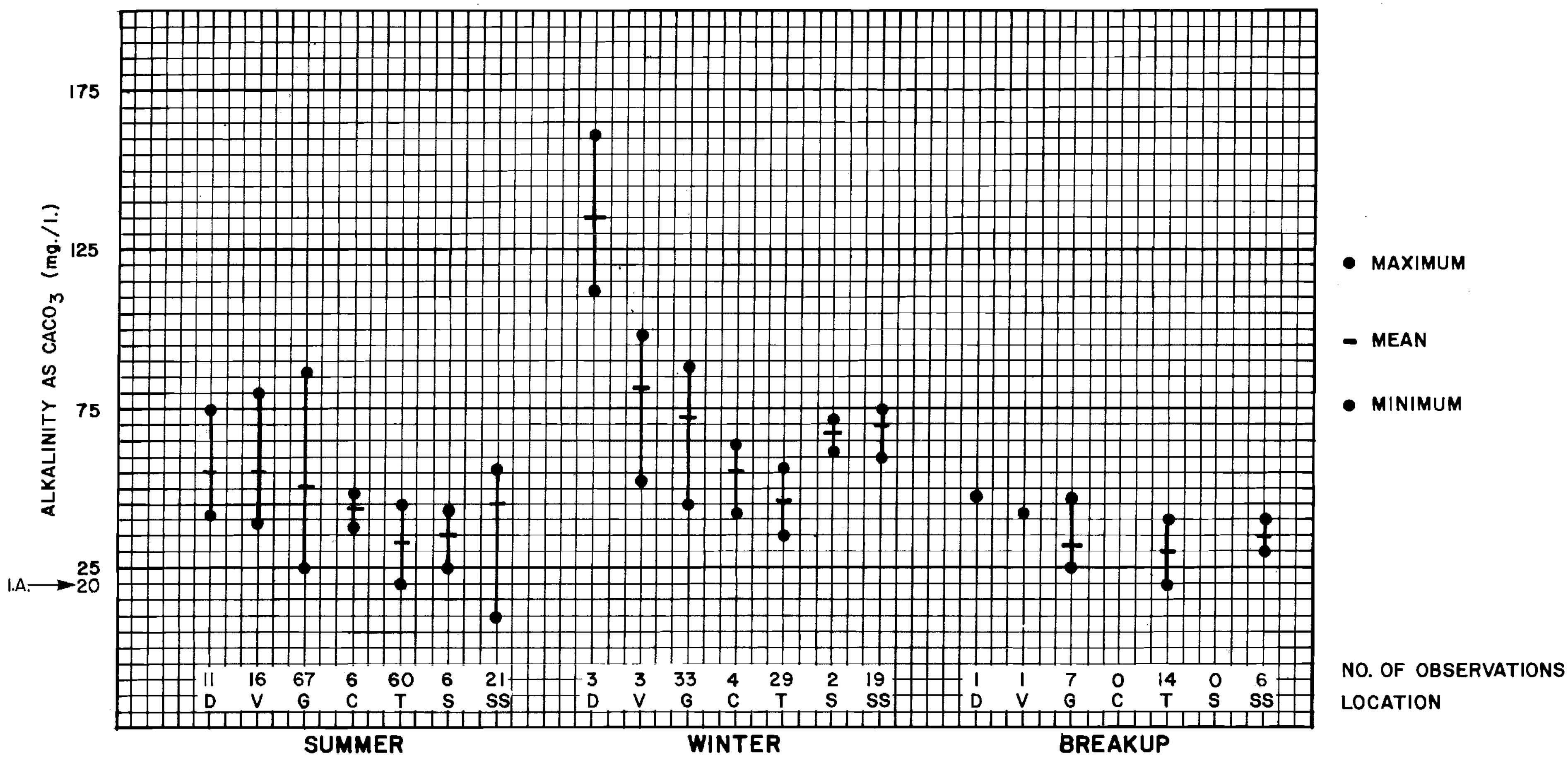
I. A. CRITERIA: NOT LESS THAN 6.5 OR GREATER THAN 9.0 pH UNITS. SHALL NOT VARY MORE THAN 0.5 pH UNITS FROM NATURAL CONDITION (ADEC 1979).

I. B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

DATA SUMMARY - pH

SOURCE: USGS AND R&M

FIGURE E.2.98



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

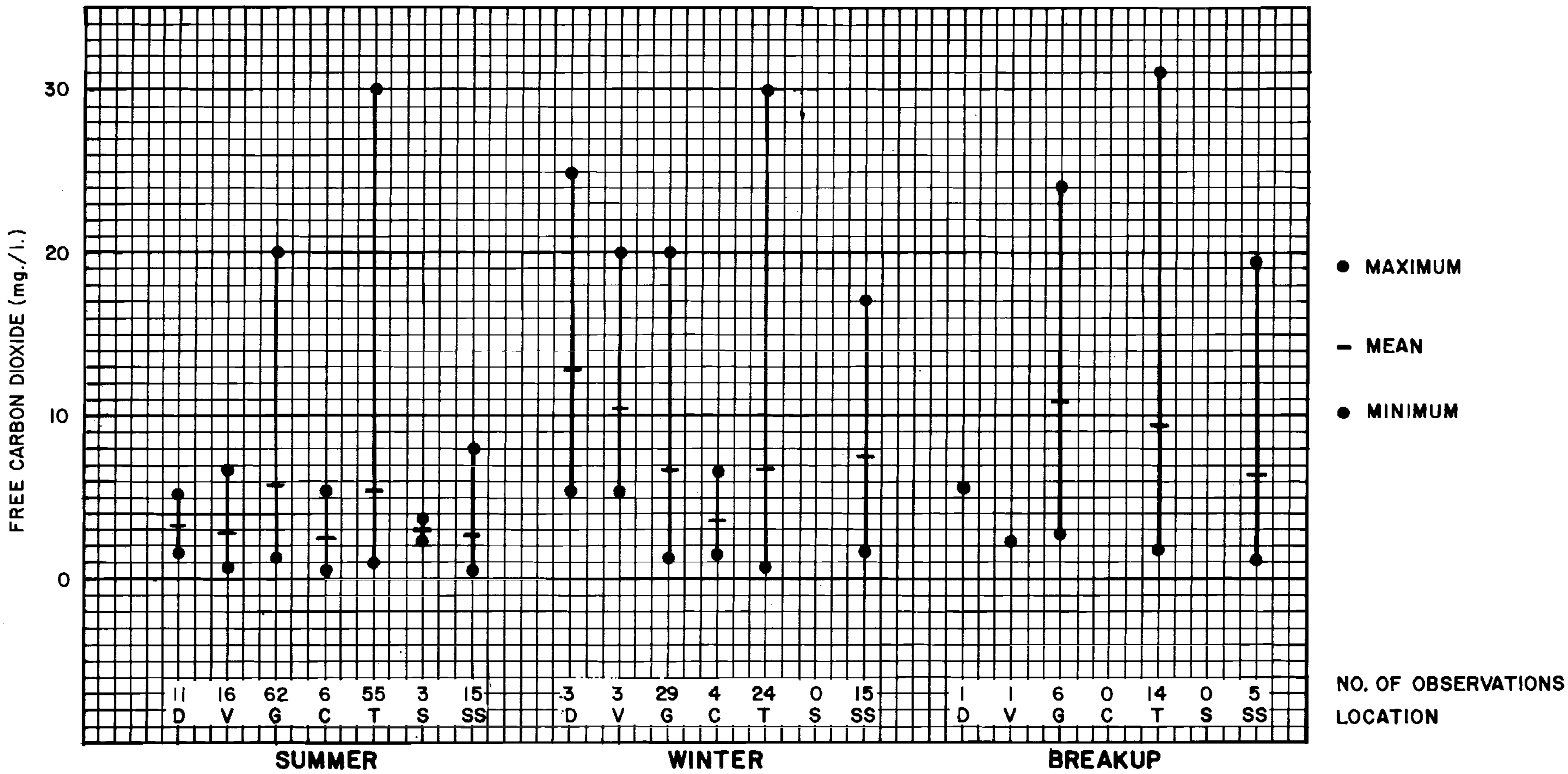
I. A. CRITERION: 20 mg./l. OR MORE EXCEPT WHERE NATURAL CONDITIONS ARE LESS (EPA 1976).

I. B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

DATA SUMMARY - ALKALINITY

SOURCE: USGS AND R&M

FIGURE E.2.99



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

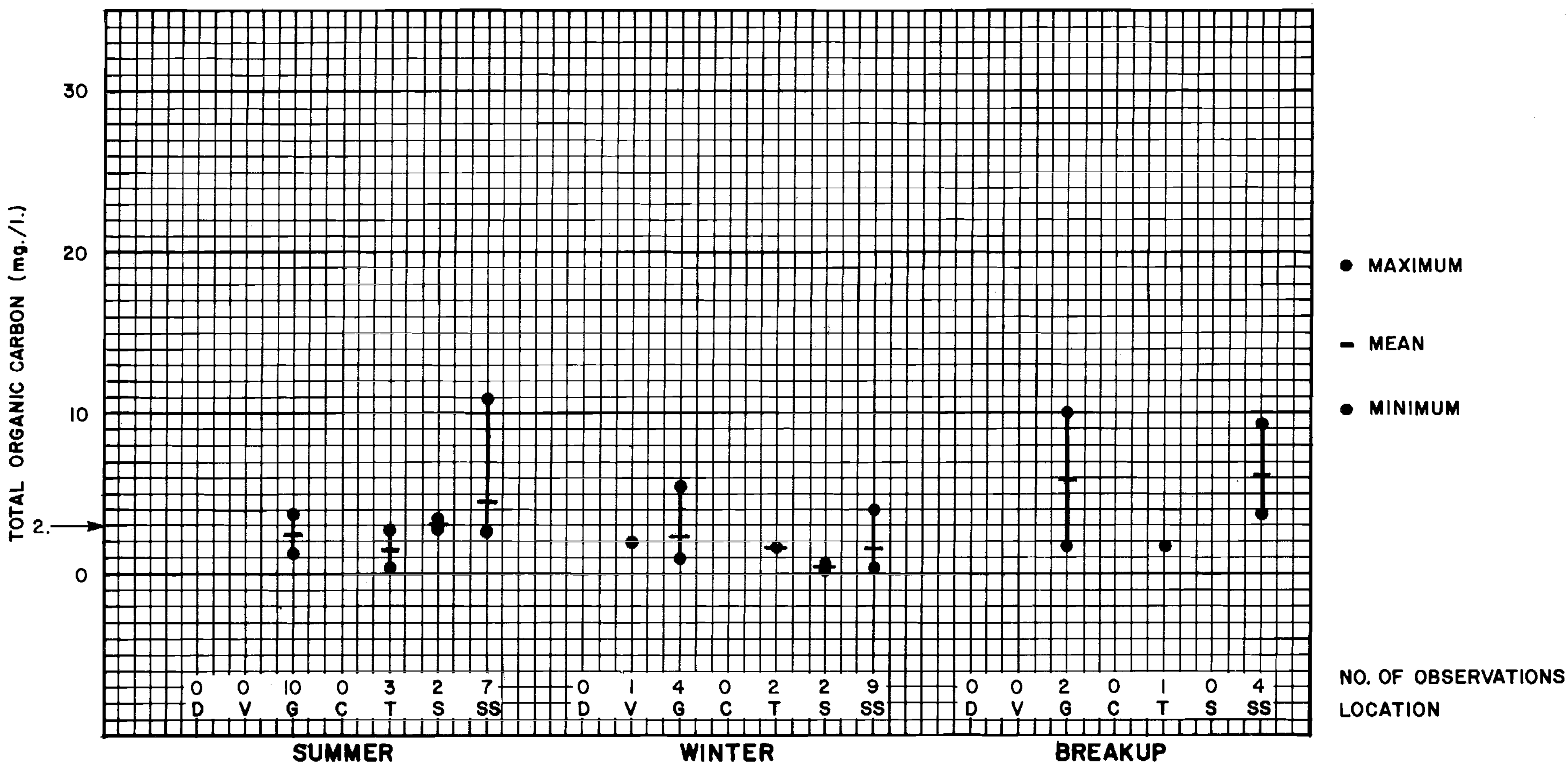
NOTE:

1. NO CRITERION ESTABLISHED.

DATA SUMMARY - FREE CARBON DIOXIDE

SOURCE: USGS AND R&M

FIGURE E.2.100



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

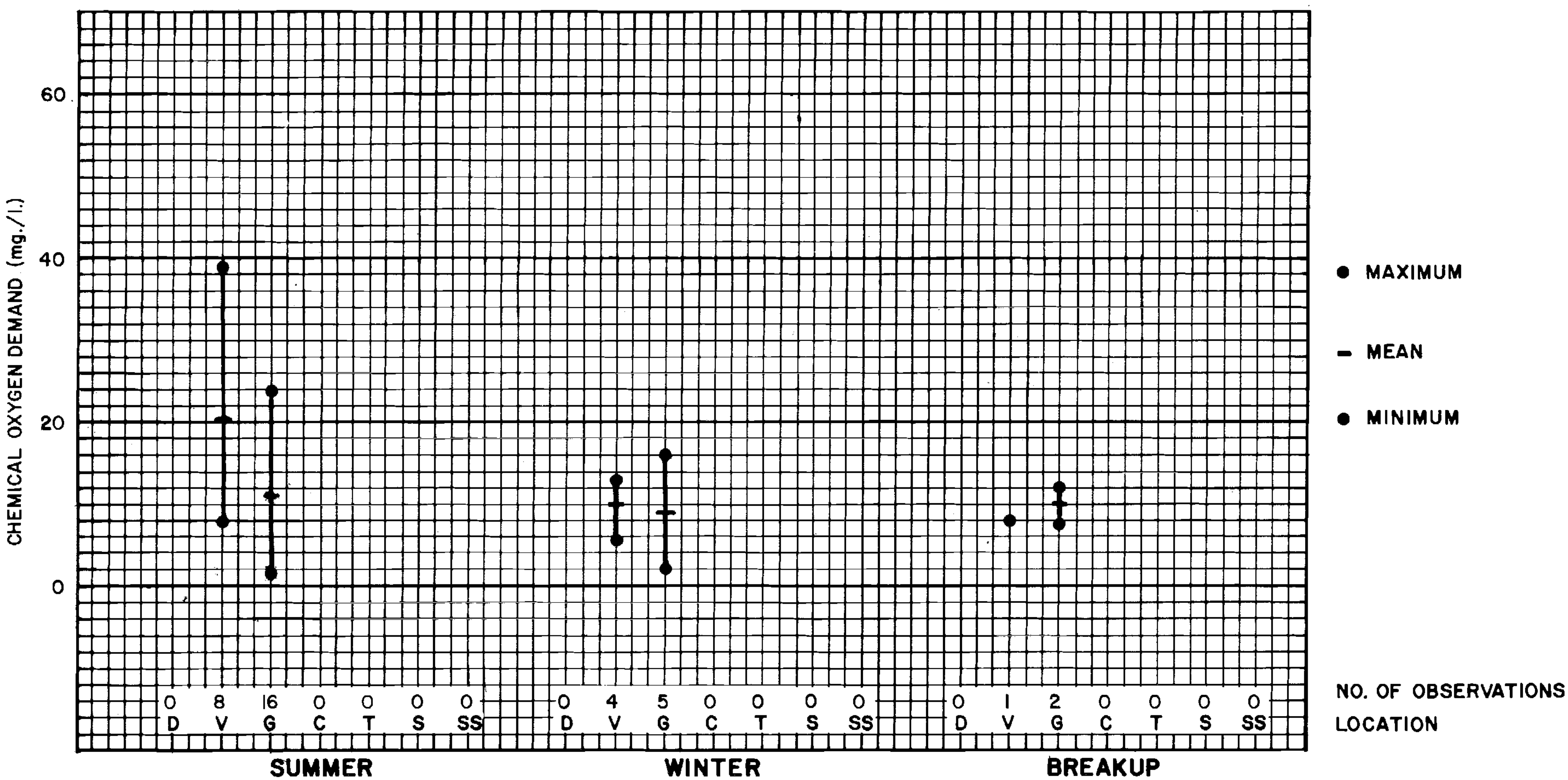
NOTES:

1. NO CRITERION ESTABLISHED.
2. WATERS CONTAINING LESS THAN 3.0 mg./l. HAVE BEEN OBSERVED TO BE RELATIVELY CLEAN (McNEELY et al. 1979).

DATA SUMMARY - TOTAL ORGANIC CARBON

SOURCE: USGS AND R&M

FIGURE E.2.101



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

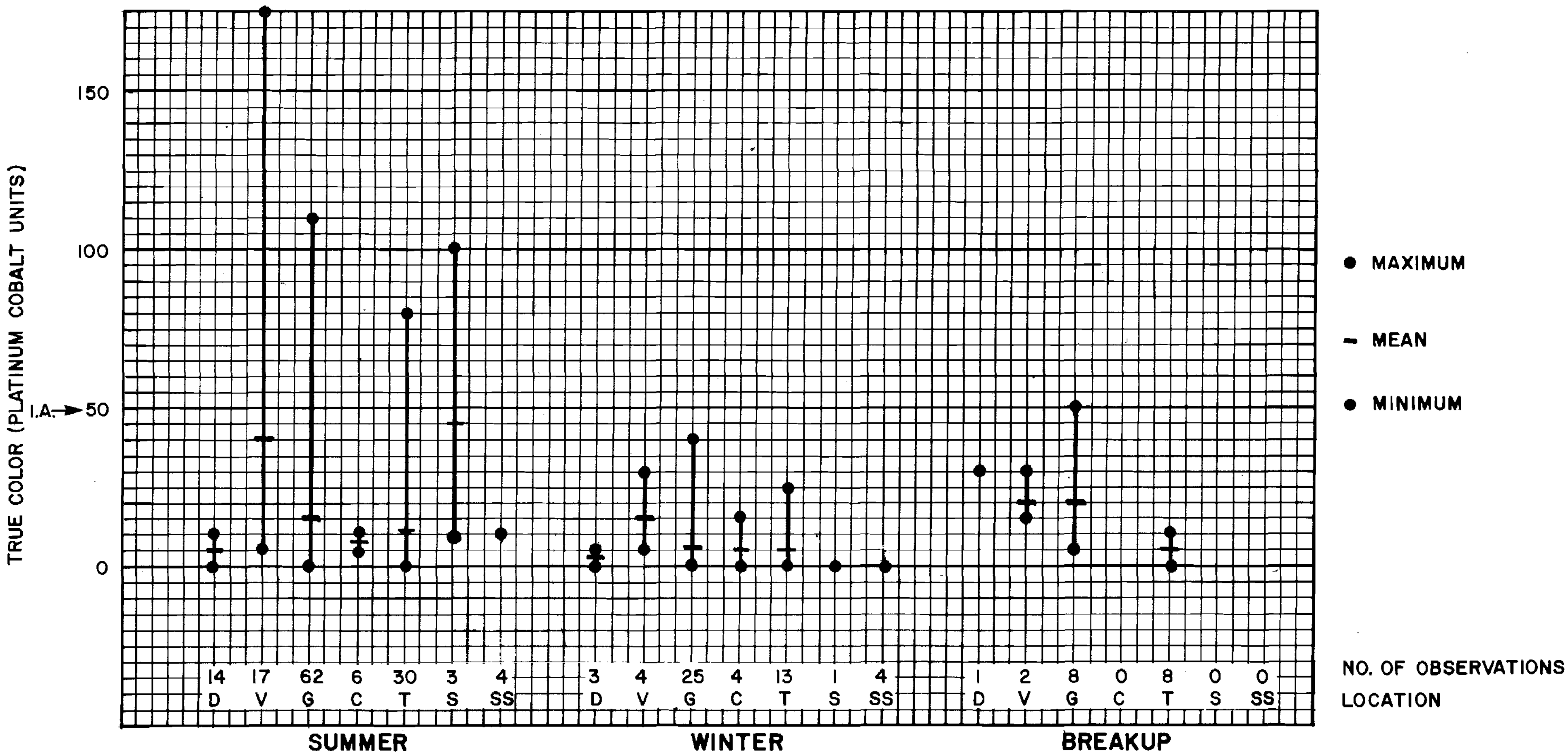
NOTES:

1. NO CRITERION ESTABLISHED.
2. AT GOLD CREEK, 2 SUMMER OBSERVATIONS WERE LESS THAN 1.0 mg./l.

DATA SUMMARY - CHEMICAL OXYGEN DEMAND

SOURCE: R & M

FIGURE E.2.102



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

1.A. CRITERION: SHALL NOT EXCEED 50 UNITS (ADEC 1979).

1.B. ESTABLISHED TO PREVENT THE REDUCTION OF PHOTOSYNTHETIC ACTIVITY WHICH MAY HAVE DELETERIOUS EFFECTS ON AQUATIC LIFE.

2. AT DENALI, 1 SUMMER OBSERVATION WAS LESS THAN 5 UNITS. ONE SUMMER OBSERVATION WAS GREATER THAN 5 UNITS.

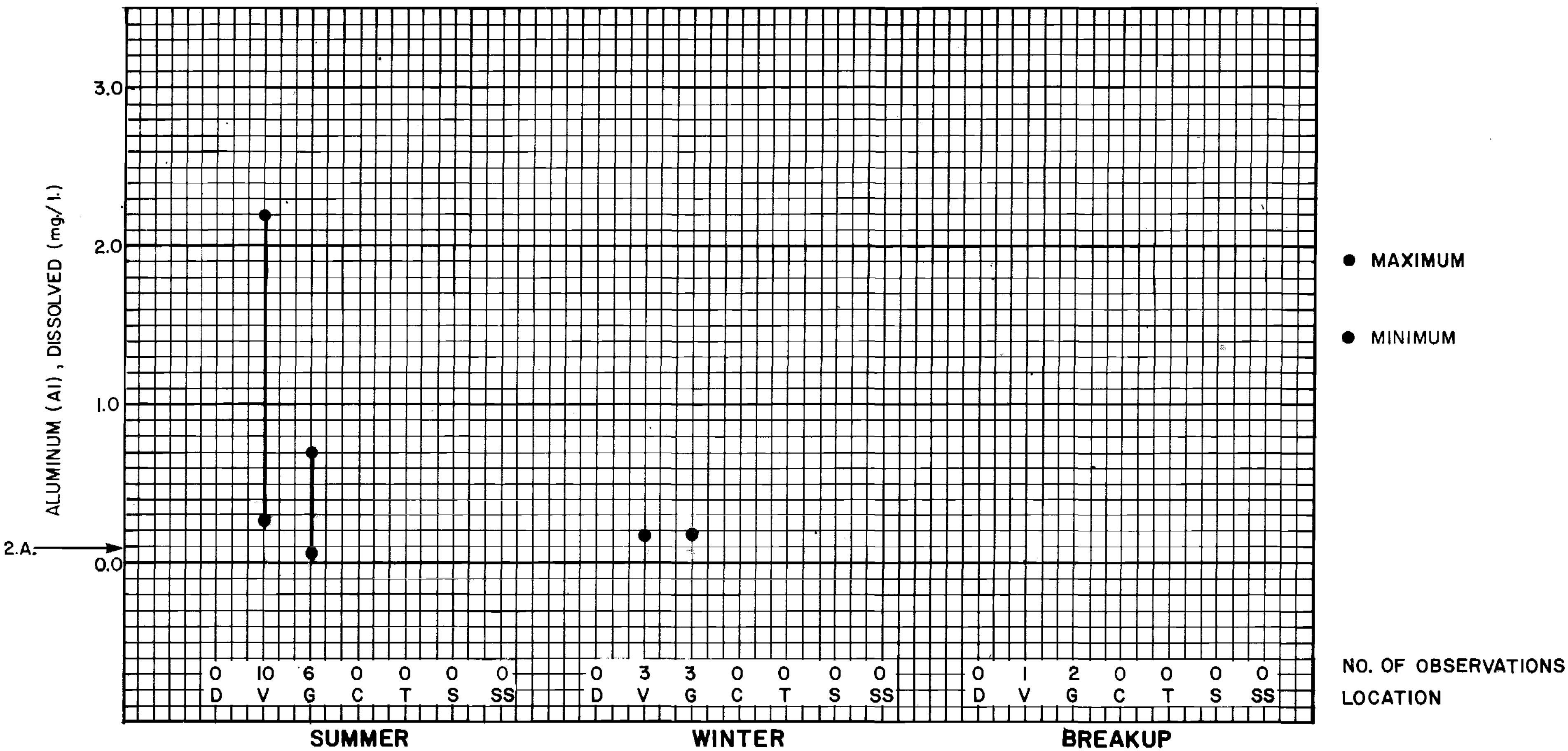
3. AT SUSITNA STATION, 2 SUMMER OBSERVATIONS AND 2 WINTER OBSERVATIONS WERE LESS THAN 5 UNITS.

4. AT TALKEETNA, 1 WINTER OBSERVATION WAS LESS THAN 5 UNITS.

SOURCE: USGS AND R&M

DATA SUMMARY - TRUE COLOR

FIGURE E.2.103



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

1. NO CRITERION ESTABLISHED.

2. A. A LIMIT OF 0.073 mg./l. HAS BEEN SUGGESTED BY EPA (SITTIG 1981).

2. B. THIS SUGGESTED LIMIT IS BASED ON THE EFFECTS OF ALUMINUM ON HUMAN HEALTH.

3. AT VEE CANYON, 7 SUMMER OBSERVATIONS WERE LESS THAN 0.10 mg./l. TWO WINTER OBSERVATIONS AND THE ONE SUMMER OBSERVATION WERE LESS THAN THE DETECTION LIMIT OF 0.05 mg./l.

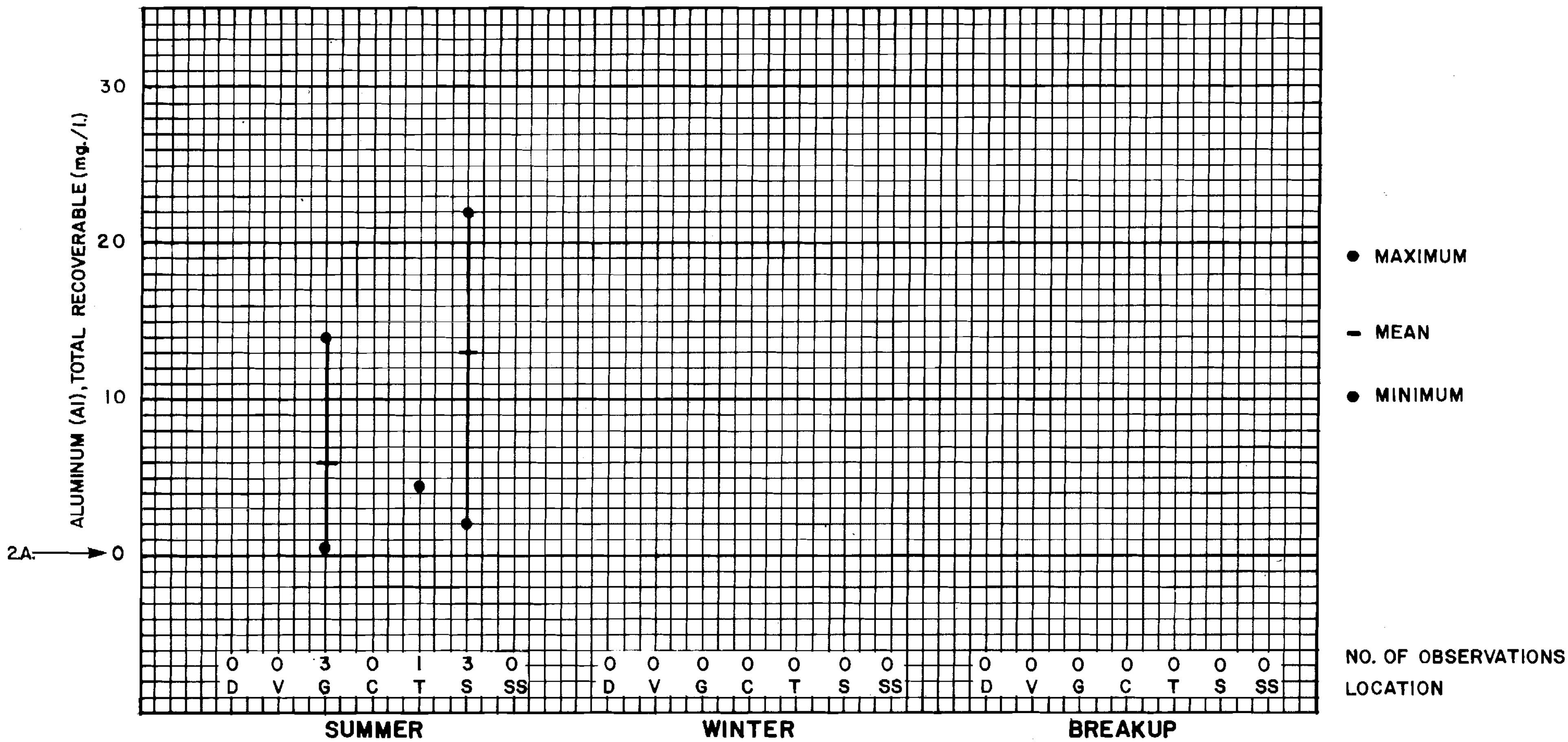
4. AT GOLD CREEK, 4 SUMMER OBSERVATIONS, 2 WINTER OBSERVATIONS AND THE 2 BREAKUP OBSERVATIONS WERE LESS THAN THE DETECTION LIMIT OF 0.05 mg./l.

5. (d) = DISSOLVED.

SOURCE: R&M

DATA SUMMARY - ALUMINUM (d)

FIGURE E.2.104



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

1. NO CRITERION ESTABLISHED.

2.A. A LIMIT OF 0.073 mg./l. HAS BEEN SUGGESTED BY EPA (SITTIG 1981).

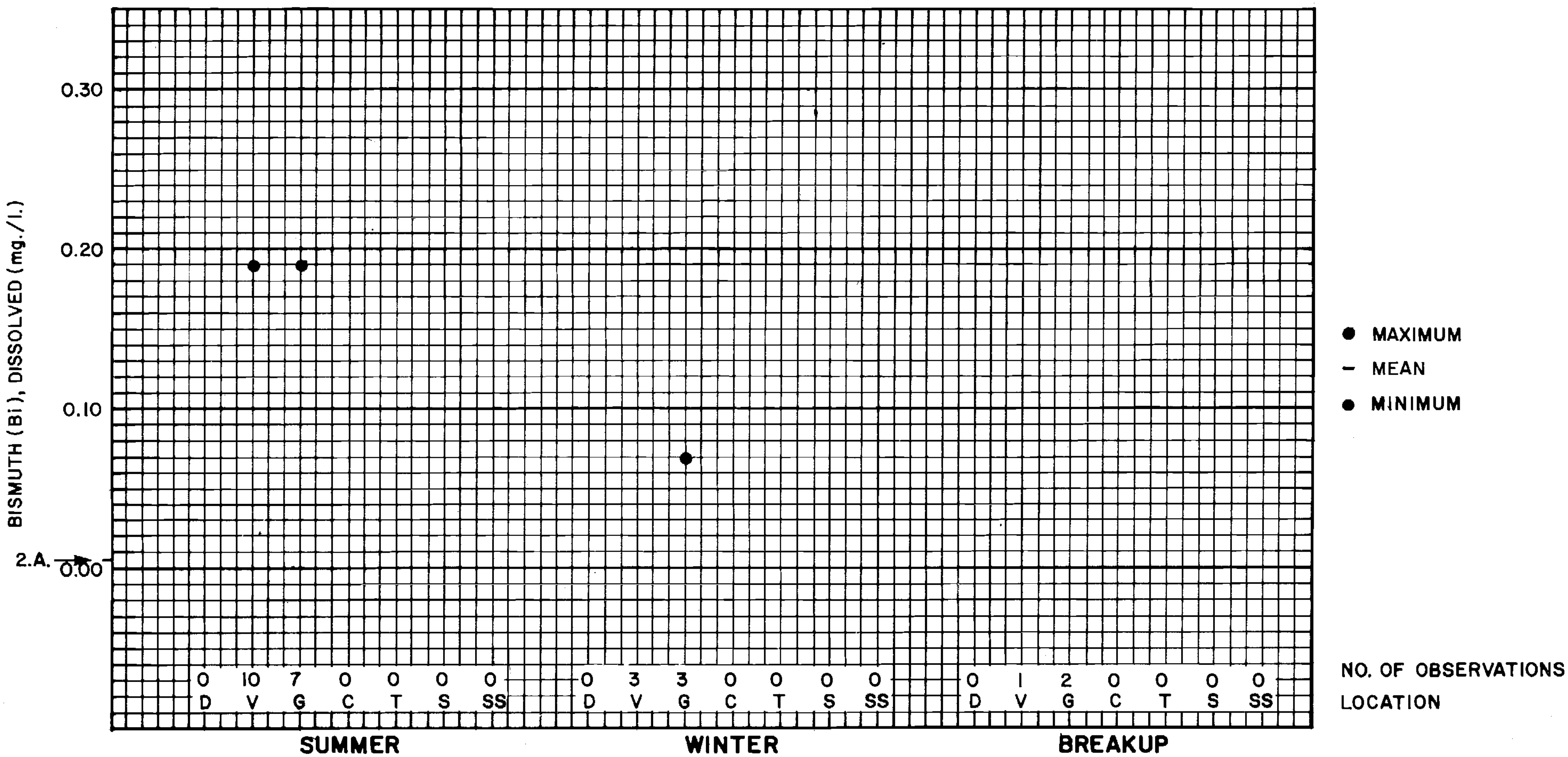
2.B. THIS SUGGESTED LIMIT IS BASED ON THE EFFECTS OF ALUMINUM ON HUMAN HEALTH.

3. (t) = TOTAL RECOVERABLE.

DATA SUMMARY - ALUMINUM (t)

SOURCE: USGS

FIGURE E.2.105



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

1. NO CRITERION ESTABLISHED.

2.A. EPA HAS SUGGESTED AN AMBIENT LIMIT OF 0.0035 mg./l. (SITTIG 1981).

2.B. THIS SUGGESTED LIMIT FOR BISMUTH IS BASED ON HUMAN HEALTH EFFECTS.

3. AT VEE CANYON, 9 SUMMER OBSERVATIONS, THE 3 WINTER OBSERVATIONS, AND THE 1 BREAKUP OBSERVATION WERE LESS THAN 0.05 mg./l.

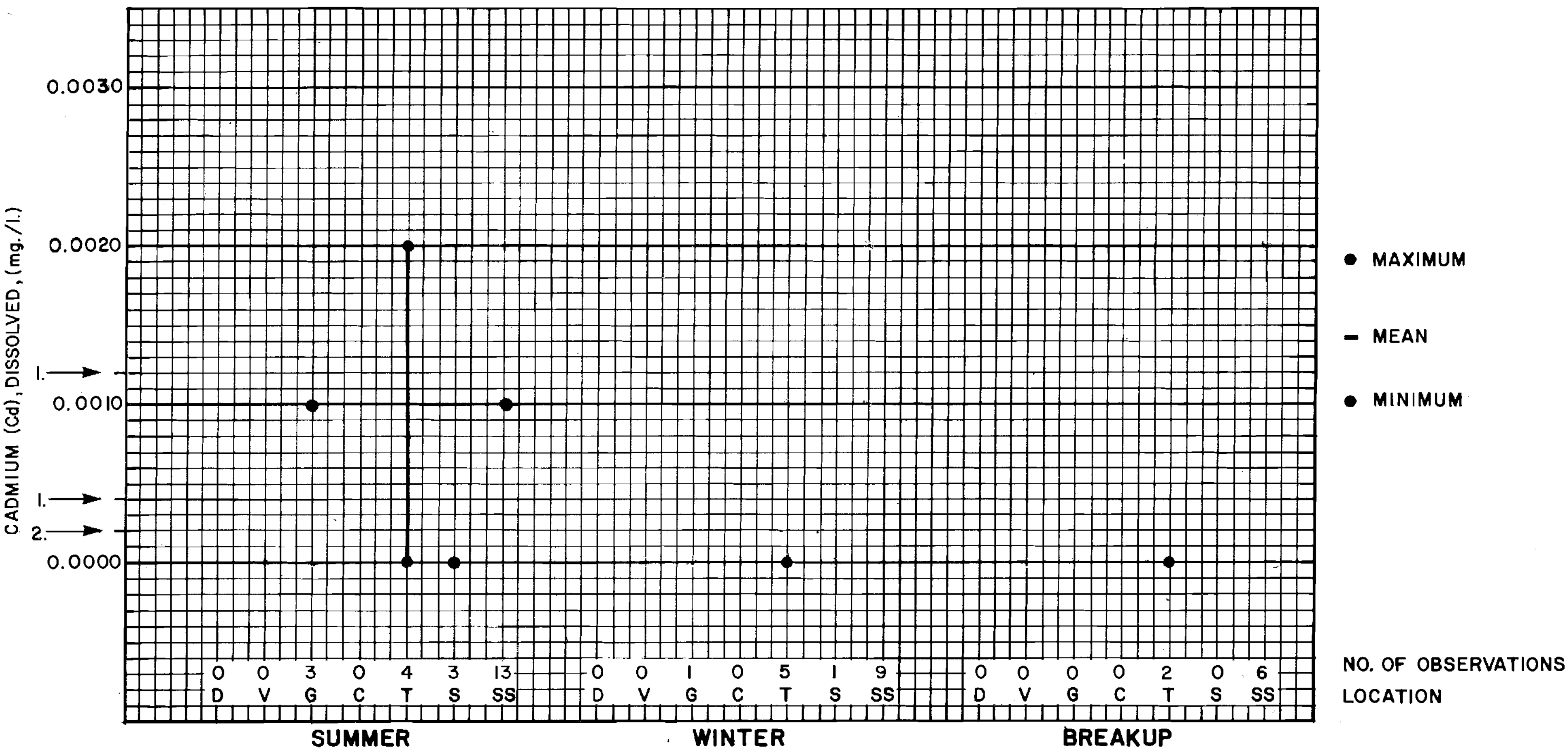
4. AT GOLD CREEK, 6 SUMMER OBSERVATIONS, 2 WINTER OBSERVATIONS, AND THE 2 BREAKUP OBSERVATIONS WERE LESS THAN 0.05 mg./l.

5. (d) = DISSOLVED.

SOURCE: R & M

DATA SUMMARY - BISMUTH (d)

FIGURE E.2.106



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

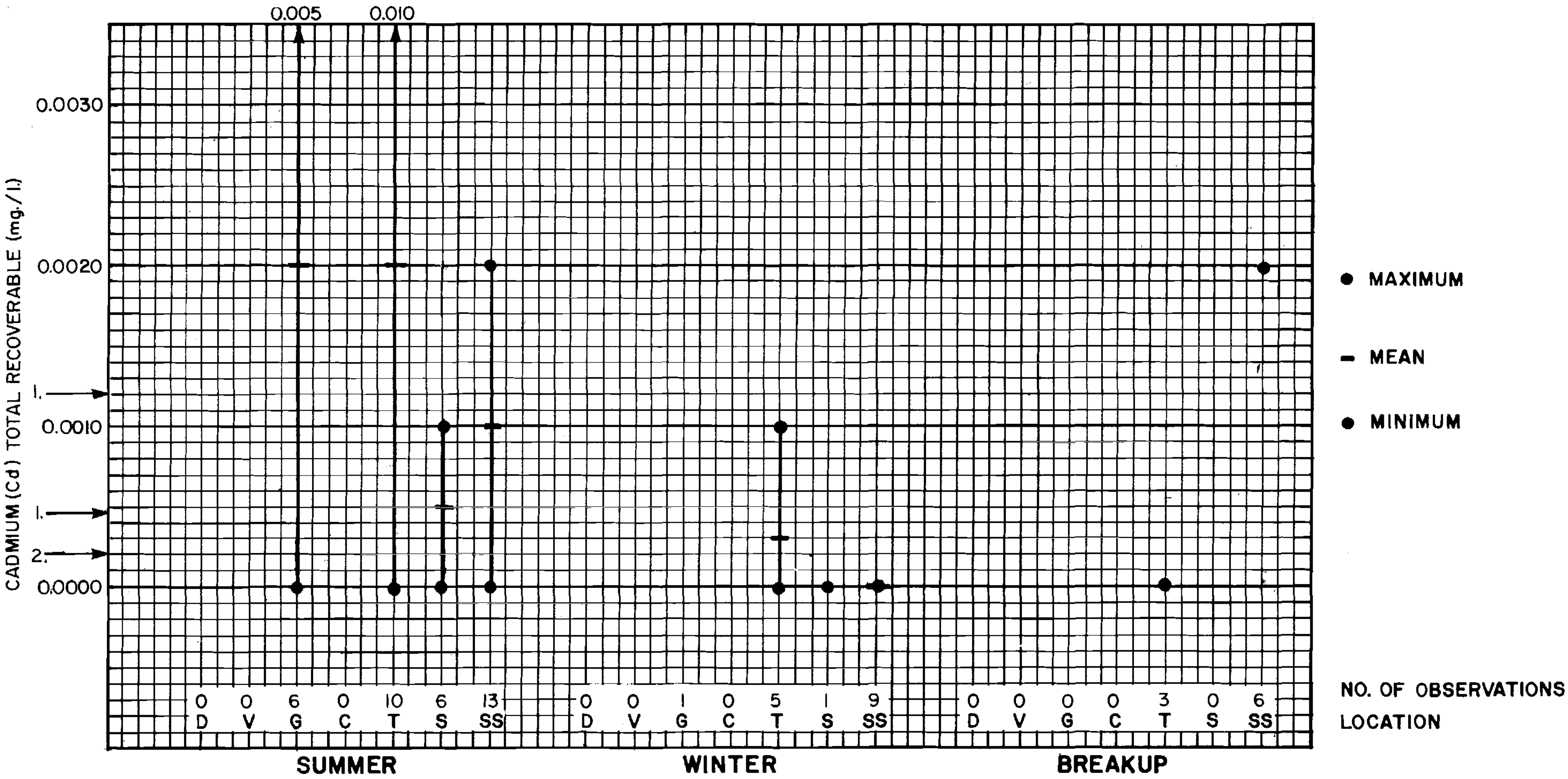
NOTES:

1. CRITERIA: 0.0012 mg./l. IN HARD WATER AND 0.0004 SOFT WATER (EPA 1976).
2. CRITERION: LESS THAN 0.0002 mg./l. (McNEELY et al. 1979).
3. THE ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT GOLD CREEK, I SUMMER OBSERVATION WAS LESS THAN 0.001 mg./l. THE I WINTER OBSERVATION WAS LESS THAN 0.003 mg./l.
5. AT TALKEETNA, 2 SUMMER OBSERVATIONS AND 2 WINTER OBSERVATIONS WERE LESS THAN 0.001 mg./l.
6. AT SUNSHINE, 2 SUMMER OBSERVATIONS AND THE I WINTER OBSERVATION WERE LESS THAN 0.001 mg./l.
7. AT SUSITNA STATION, 12 SUMMER OBSERVATIONS WERE LESS THAN 0.002 mg./l. THE 9 WINTER OBSERVATIONS AND THE 6 BREAKUP OBSERVATIONS WERE LESS THAN 0.003 mg./l.
8. (d) = DISSOLVED

SOURCE: USGS

DATA SUMMARY-CADMIUM (d)

FIGURE E.2.107



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

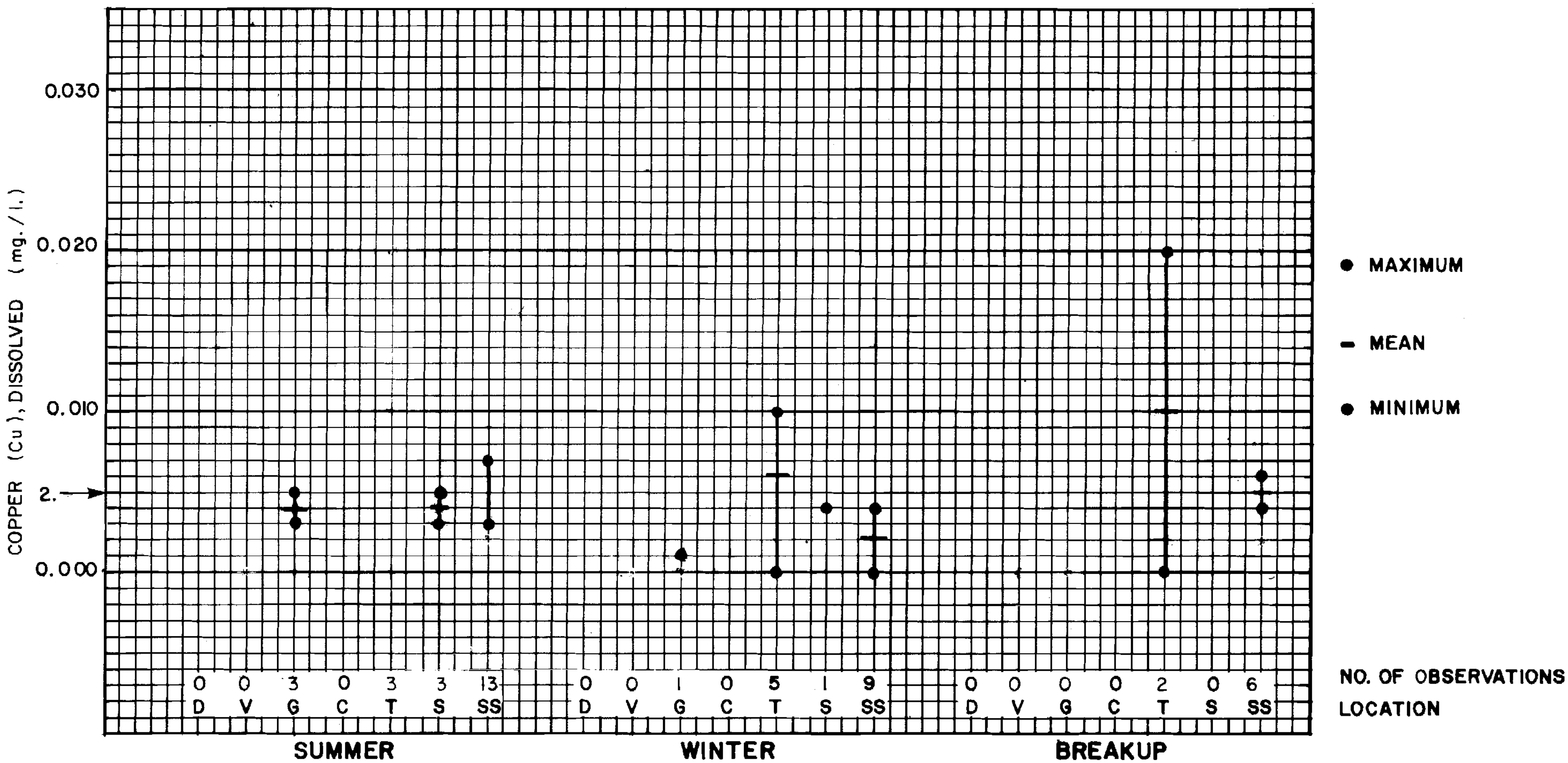
NOTES

1. CRITERIA: 0.0012 IN HARD WATER AND 0.0004 mg/l IN SOFT WATER (EPA 1976).
2. CRITERION: LESS THAN 0.0002 mg./l. (McNEELY et al. 1979).
3. ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT GOLD CREEK, 3 SUMMER OBSERVATIONS WERE LESS THAN 0.010 mg/l. THE 1 WINTER OBSERVATION WAS LESS THAN 0.001 mg./l.
5. AT TALKEETNA, 5 SUMMER OBSERVATIONS, 1 WINTER OBSERVATION AND 2 BREAKUP OBSERVATIONS WERE LESS THAN 0.010 mg./l.
6. AT SUNSHINE, 4 SUMMER OBSERVATIONS WERE LESS THAN 0.010 mg./l.
7. AT SUSITNA STATION, 7 SUMMER OBSERVATIONS, 7 WINTER OBSERVATIONS AND 5 BREAKUP OBSERVATIONS WERE LESS THAN 0.020 mg./l.
8. (t) = TOTAL RECOVERABLE.

DATA SUMMARY - CADMIUM (t)

SOURCE: USGS

FIGURE E.2.108



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

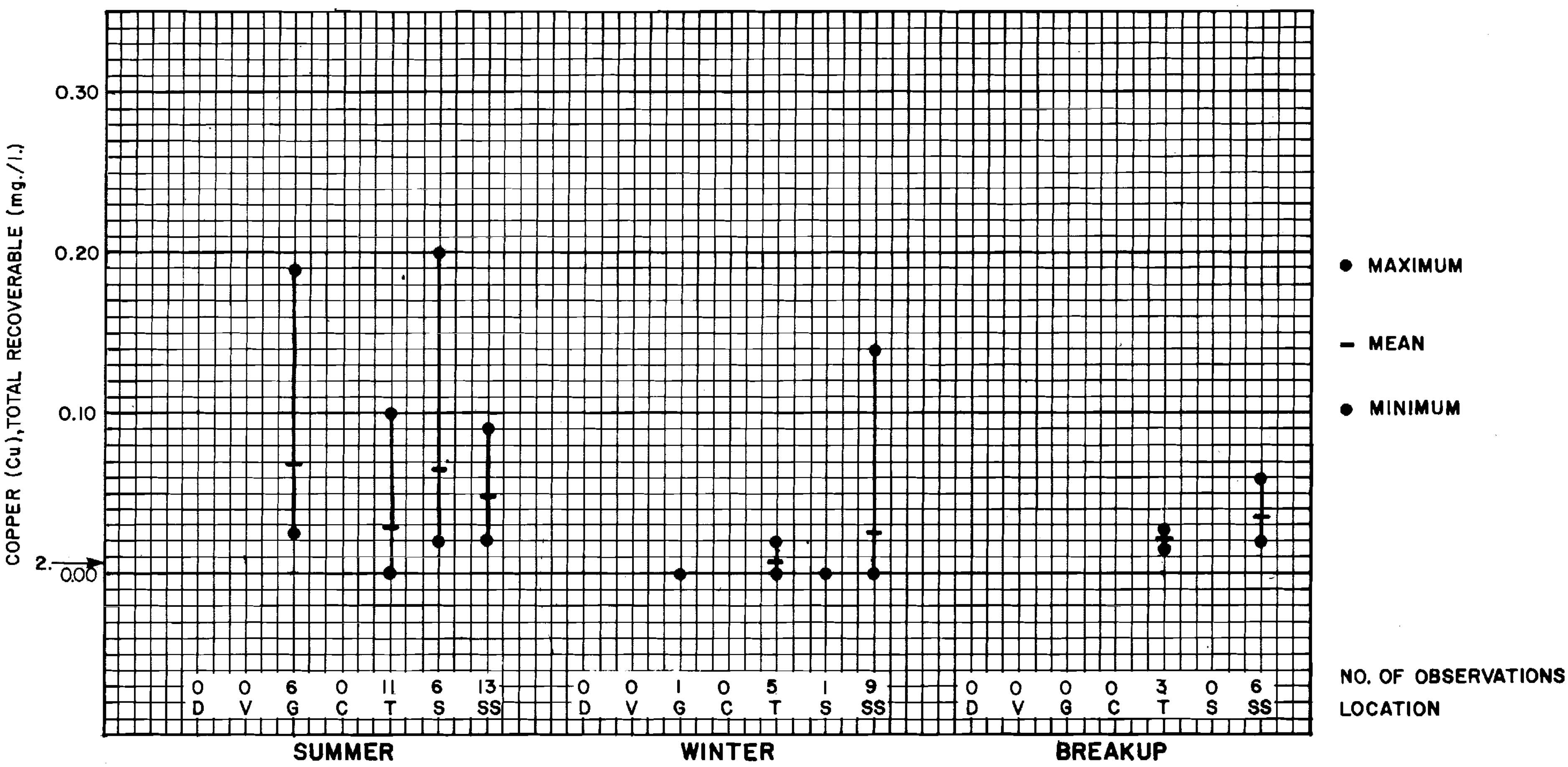
NOTES:

1. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED THROUGH BIOASSAY (EPA 1976).
2. CRITERION: 0.005 mg/l (McNEELY et al. 1979).
3. THE ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT TALKEETNA, THE 3 SUMMER OBSERVATIONS WERE LESS THAN 0.010 mg/l.
5. AT SUSITNA STATION, 6 SUMMER OBSERVATIONS, 2 WINTER OBSERVATIONS AND 2 BREAKUP OBSERVATIONS WERE LESS THAN 0.002 mg/l.
6. (d) = DISSOLVED.

DATA SUMMARY COPPER (d)

SOURCE: USGS

FIGURE E.2.109



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

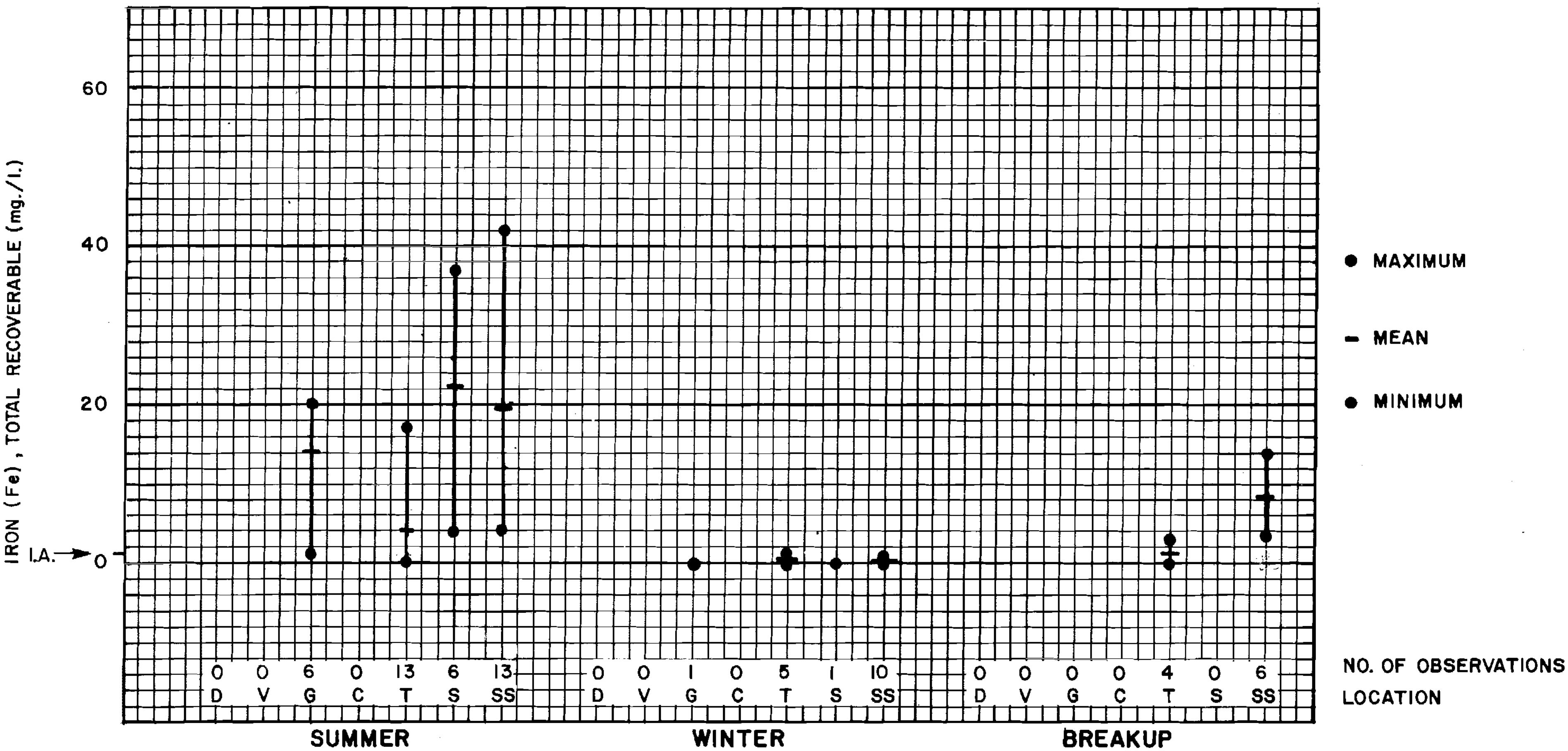
NOTES:

1. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED THROUGH BIOASSAY (EPA 1976).
2. CRITERION: 0.005 mg./l. (McNEELY et al. 1979).
3. THE ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT GOLD CREEK, 1 SUMMER OBSERVATION WAS LESS THAN 0.010 mg./l.
5. AT SUSITNA STATION, 1 SUMMER OBSERVATION AND 2 WINTER OBSERVATIONS WERE LESS THAN 0.020 mg./l.
6. AT TALKEETNA, 1 BREAKUP OBSERVATION WAS LESS THAN 0.020 mg./l.
7. (t) = TOTAL RECOVERABLE.

SOURCE: USGS

DATA SUMMARY-COPPER (t)

FIGURE E.2.110



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

1.A. CRITERION: LESS THAN 1.0 mg./l. (EPA 1976; SITTIG 1981).

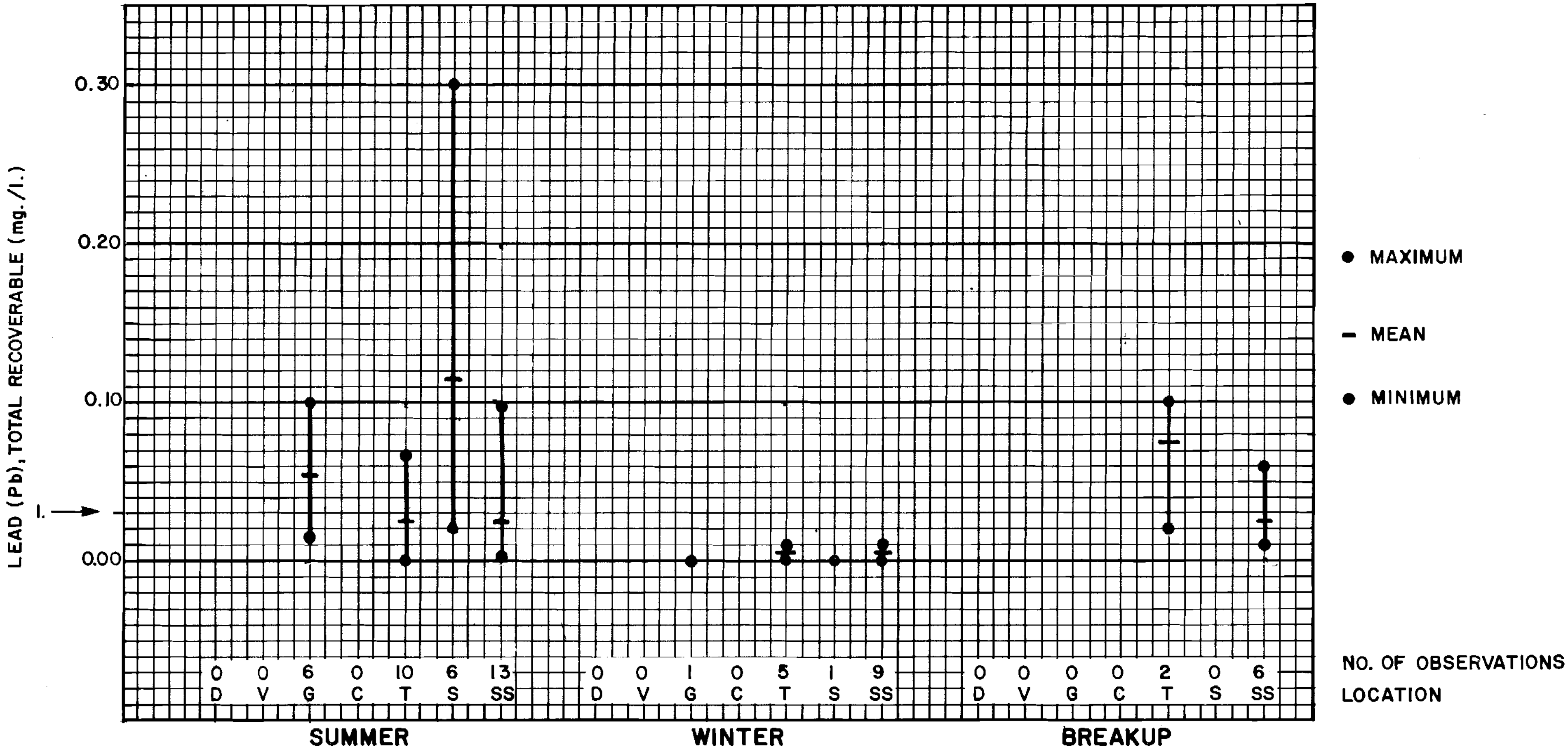
1.B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

2. (t)= TOTAL RECOVERABLE.

DATA SUMMARY - IRON (t)

SOURCE: USGS

FIGURE E.2.111



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

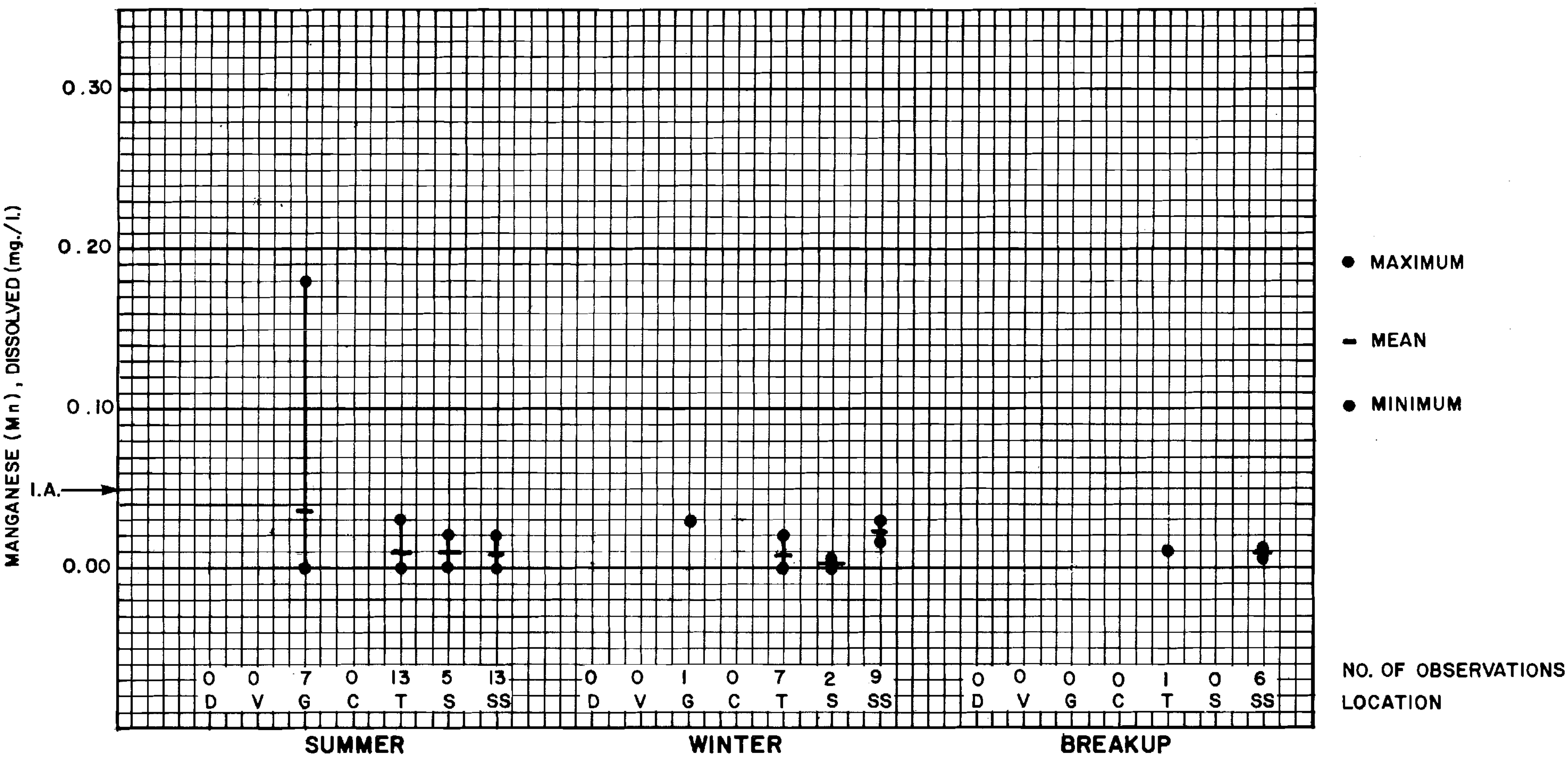
NOTES:

1. CRITERION: LESS THAN 0.03 mg./l. (McNEELY et al. 1979).
2. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED BY BIOASSAY (EPA 1976).
3. ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT GOLD CREEK, 3 SUMMER OBSERVATIONS WERE LESS THAN 0.100 mg./l.
5. AT TALKEETNA, 6 SUMMER OBSERVATIONS AND 1 WINTER OBSERVATION WERE LESS THAN 0.100 mg./l.
6. AT SUNSHINE, 2 SUMMER OBSERVATIONS WERE LESS THAN 0.100 mg./l.
7. AT SUSITNA STATION, 5 SUMMER OBSERVATIONS, 3 WINTER OBSERVATIONS, AND 2 BREAKUP OBSERVATIONS WERE LESS THAN 0.200 mg./l.
8. (t) = TOTAL RECOVERABLE.

SOURCE: USGS

DATA SUMMARY - LEAD (t)

FIGURE E.2.112



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

I.A. CRITERION: LESS THAN 0.05 mg./l. (EPA 1976)

I.B. ESTABLISHED TO PROTECT WATER SUPPLIES.

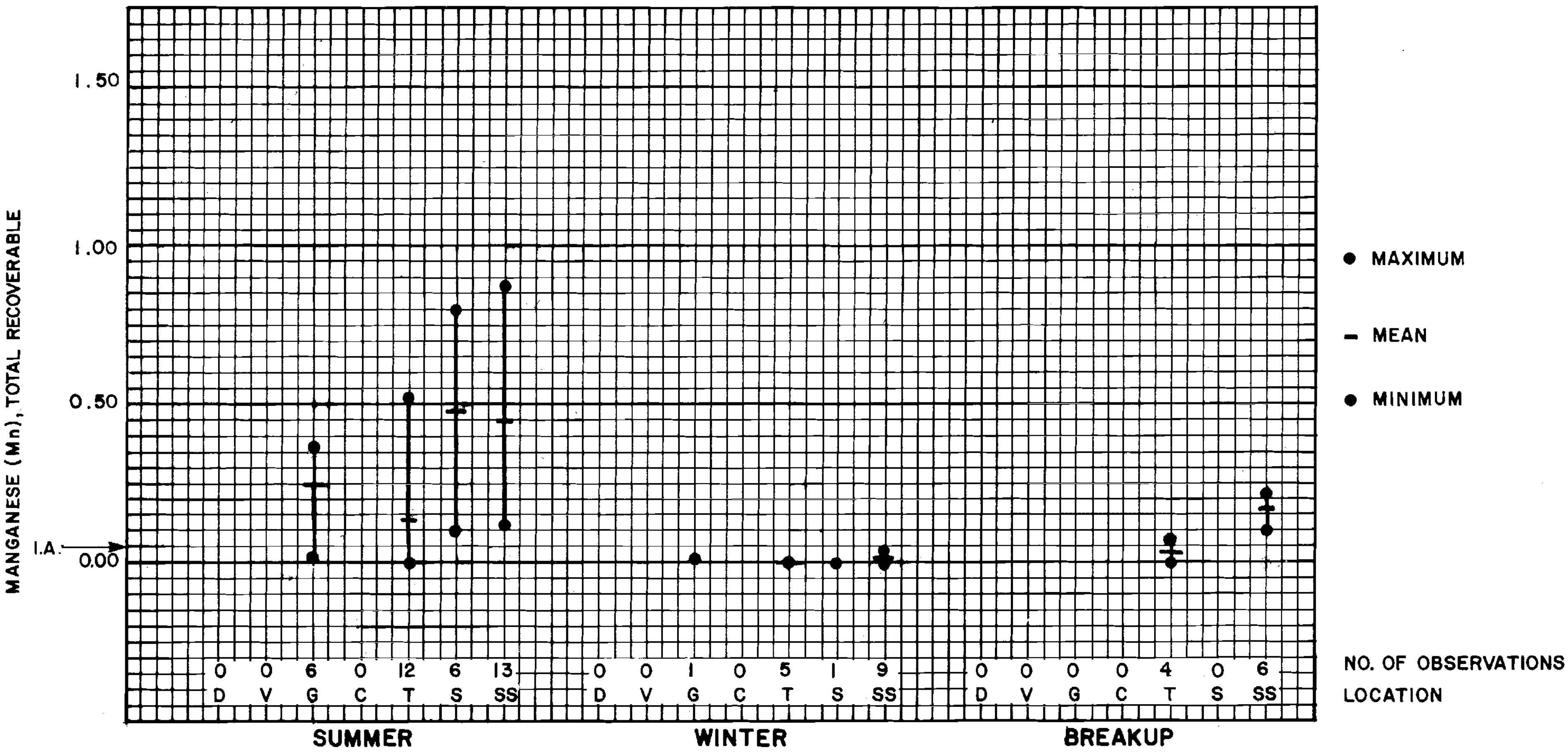
2. AT SUSITNA STATION, 6 SUMMER OBSERVATIONS, 1 WINTER OBSERVATION AND 6 BREAKUP OBSERVATIONS WERE LESS THAN 0.010 mg./l.

3. (d) = DISSOLVED

DATA SUMMARY - MANGANESE (d)

SOURCE: USGS

FIGURE E.2.113



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

I.A. CRITERION: LESS THAN 0.05 mg./l. (EPA 1976).

I.B. ESTABLISHED TO PROTECT WATER SUPPLIES.

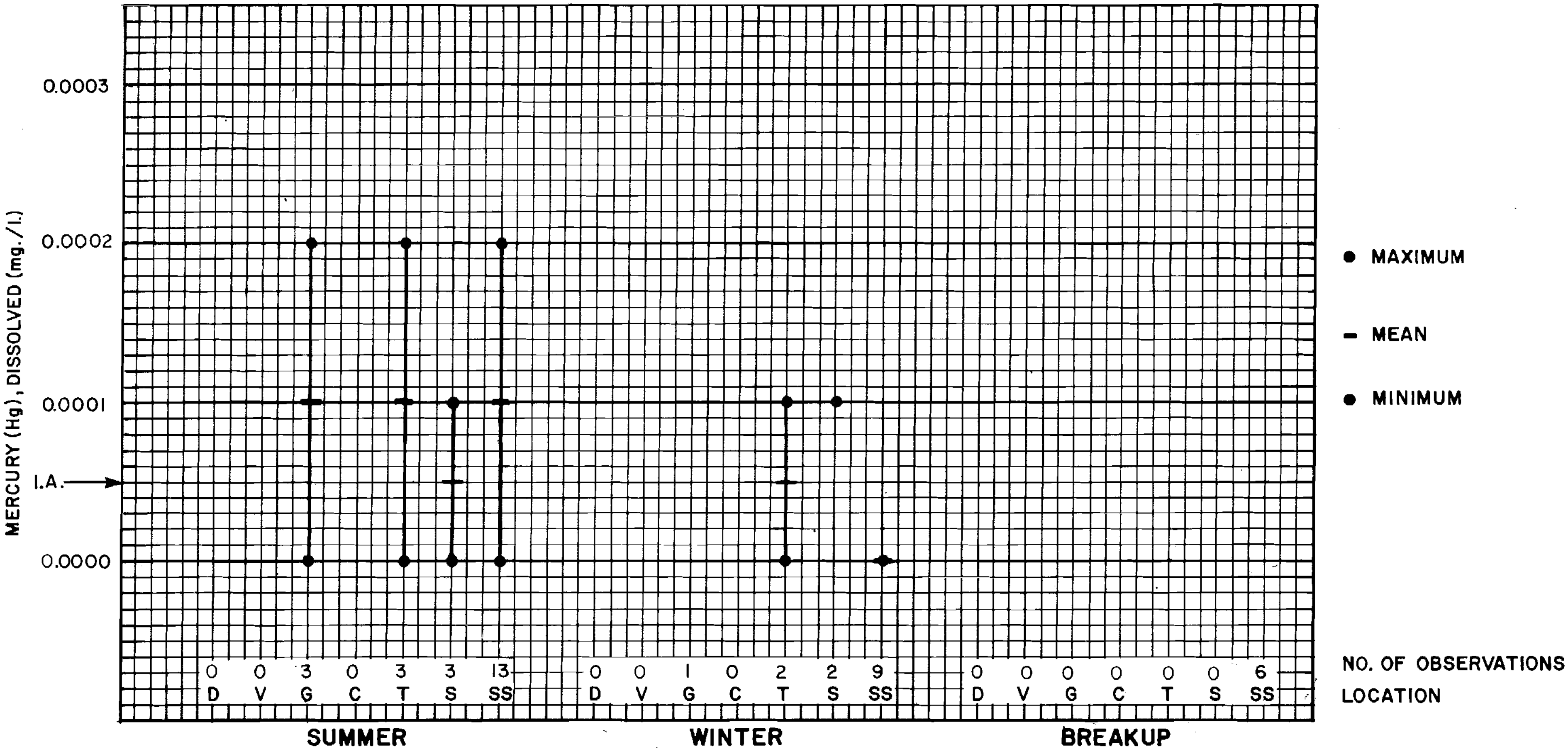
2. AT SUSITNA STATION, 1 BREAKUP OBSERVATION WAS LESS THAN 0.01 mg./l.

3. (t)= TOTAL RECOVERABLE.

DATA SUMMARY - MANGANESE (t)

SOURCE: USGS

FIGURE E.2.114



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

I.A. CRITERION: LESS THAN 0.00005 mg./l. (EPA 1976).

I.B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

2. AT GOLD CREEK, I SUMMER OBSERVATION AND THE I WINTER OBSERVATION WERE LESS THAN 0.001 mg./l.

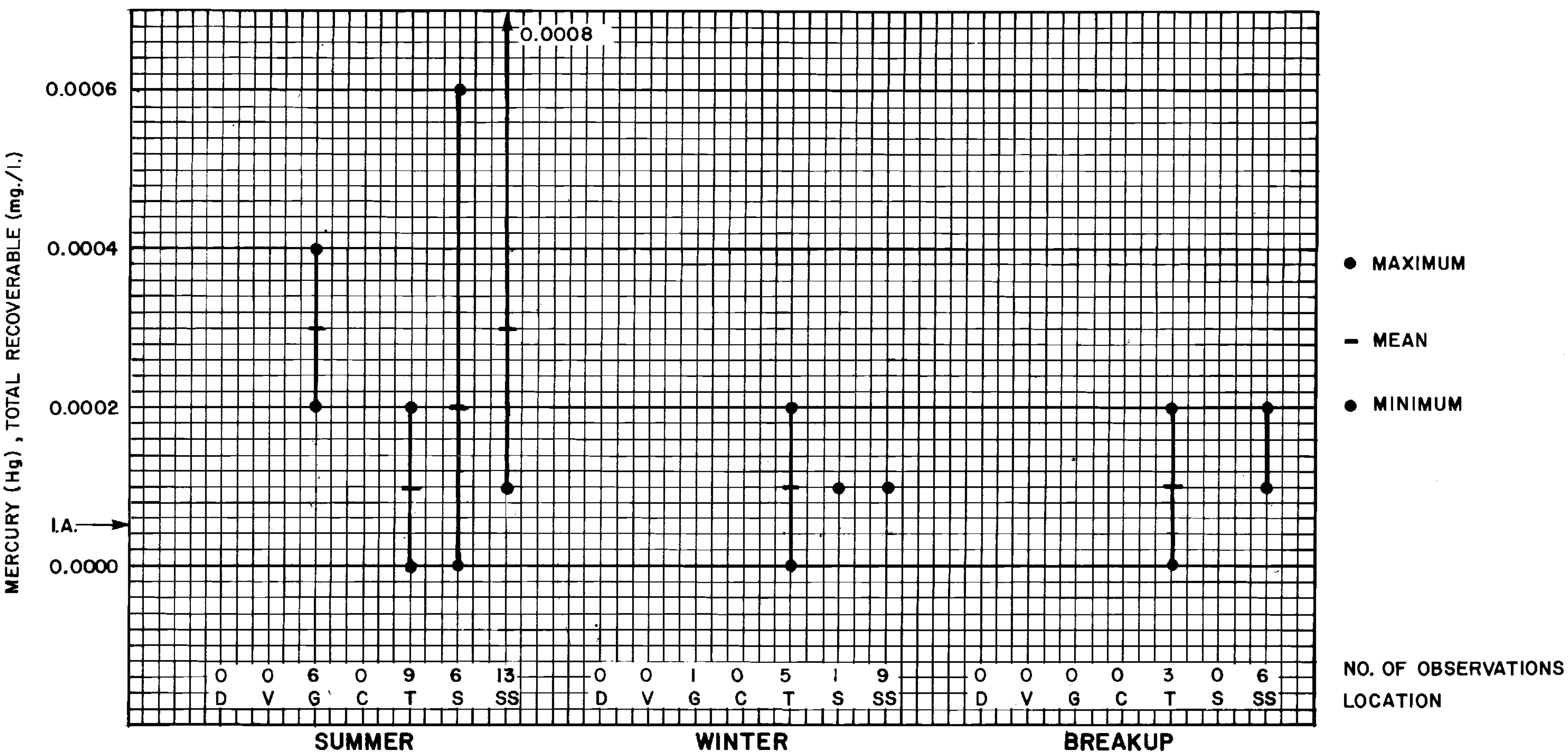
3. AT SUSITNA STATION, 8 SUMMER OBSERVATIONS, 7 WINTER OBSERVATIONS, AND THE 6 BREAKUP OBSERVATIONS WERE LESS THAN 0.0005 mg./l.

4. (d) = DISSOLVED

DATA SUMMARY - MERCURY (d)

SOURCE: USGS

FIGURE E.2.115



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

NOTES:

I.A. CRITERION: LESS THAN 0.00005 mg./l. (EPA 1976).

I.B. ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.

2. AT TALKEETNA, 1 SUMMER OBSERVATION WAS LESS THAN 0.0005 mg./l.

3. AT SUSITNA STATION, 7 SUMMER OBSERVATIONS, 7 WINTER OBSERVATIONS AND 4 BREAKUP OBSERVATIONS WERE LESS THAN 0.0005 mg./l.

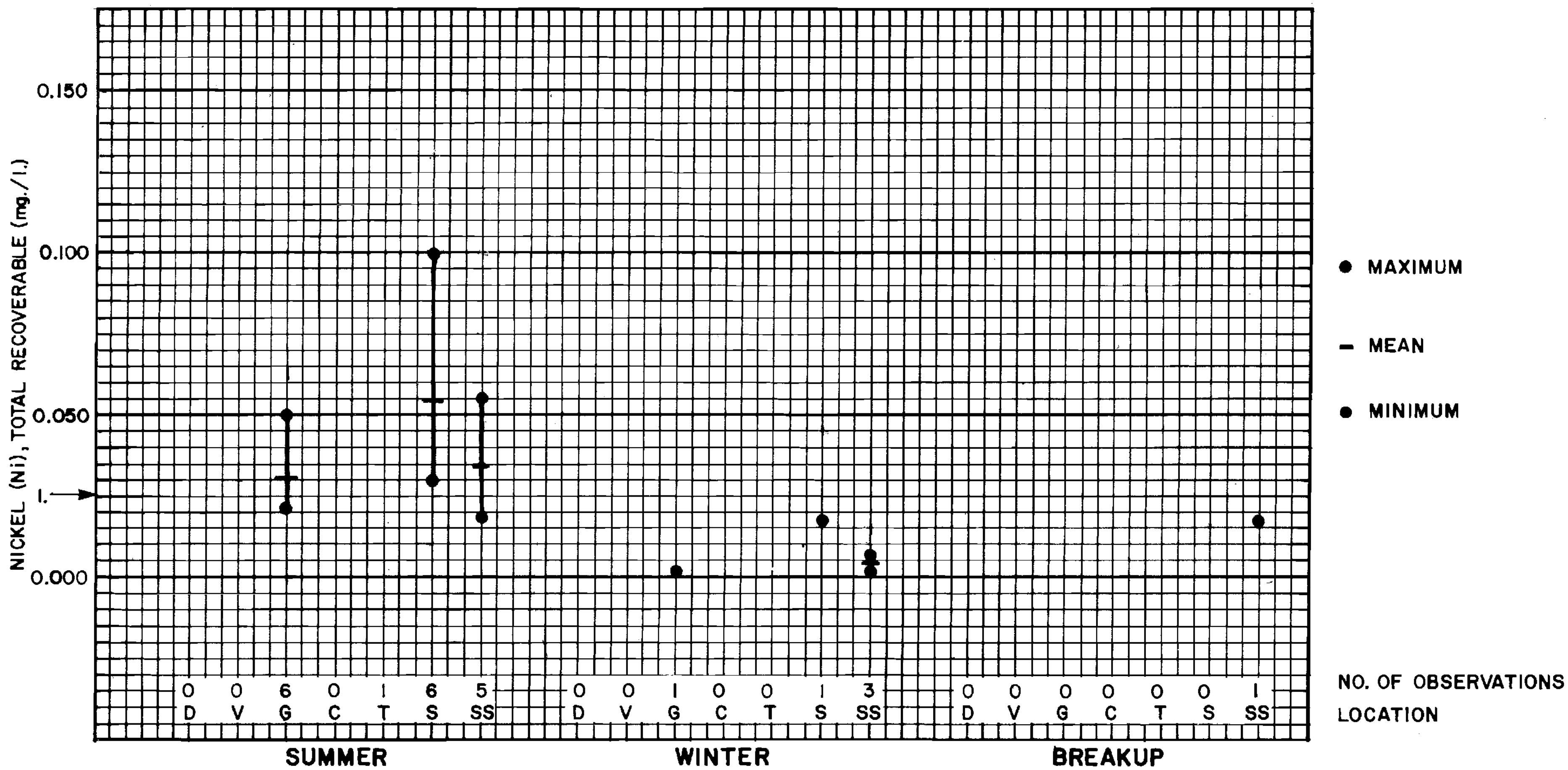
4. AT GOLD CREEK, THE 1 WINTER OBSERVATION WAS LESS THAN 0.0005 mg./l.

5. (t) = TOTAL RECOVERABLE.

DATA SUMMARY - MERCURY (t)

SOURCE: USGS

FIGURE E.2.116



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

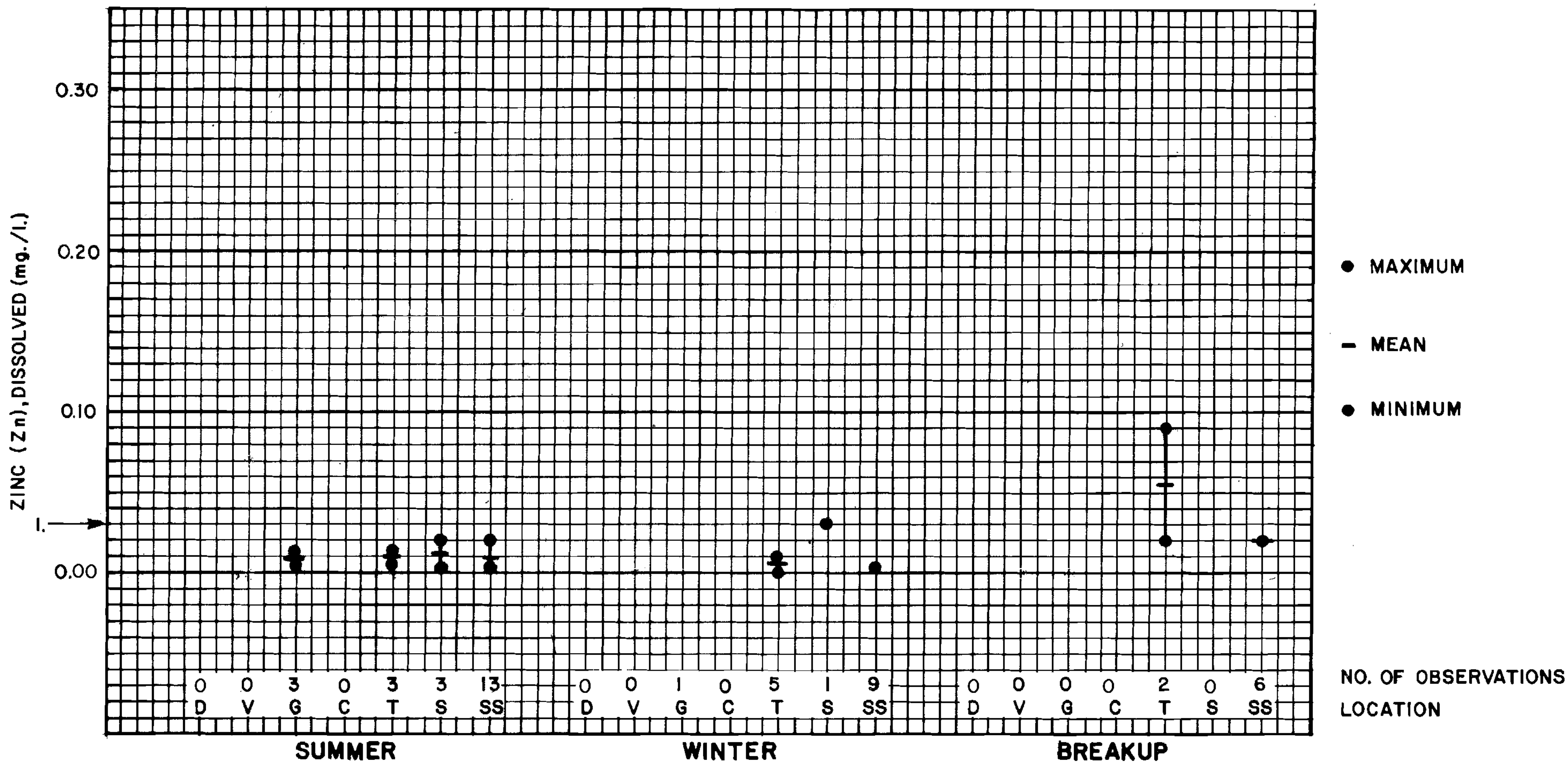
NOTES:

1. CRITERION: LESS THAN 0.025 mg./l. (McNEELY et al. 1979).
2. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED THROUGH BIOASSAY (EPA 1976).
3. THE ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT GOLD CREEK, 2 SUMMER OBSERVATIONS WERE LESS THAN 0.05 mg./l.
5. AT TALKEETNA, THE 1 SUMMER OBSERVATION WAS LESS THAN 0.05 mg./l.
6. AT SUNSHINE, 2 SUMMER OBSERVATIONS WERE LESS THAN 0.05 mg./l.
7. (t) = TOTAL RECOVERABLE.

SOURCE: USGS

DATA SUMMARY- NICKEL (t)

FIGURE E.2.117



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

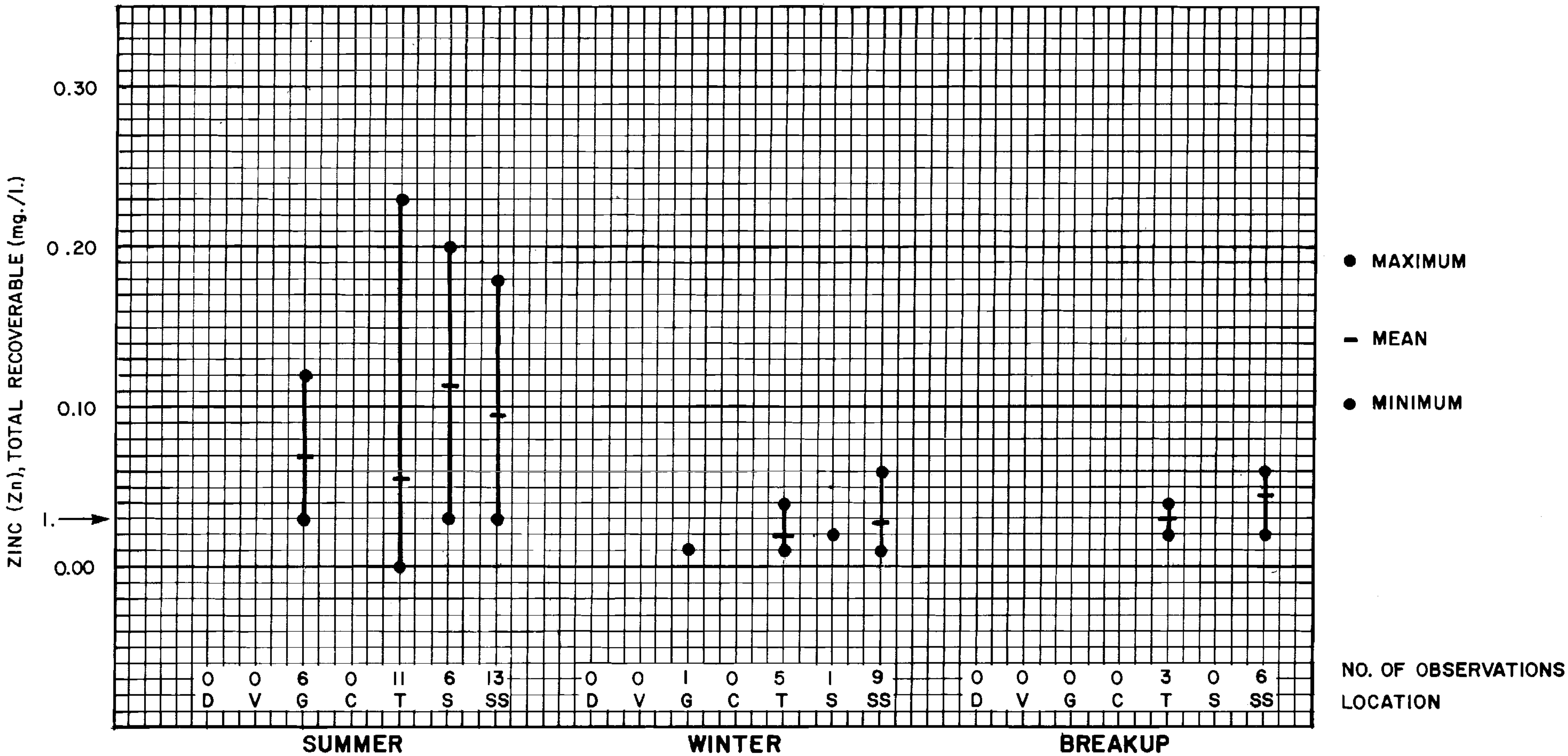
NOTES:

1. CRITERION: LESS THAN 0.03 mg./l. (McNEELY et al. 1979).
2. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED THROUGH BIOASSY (EPA 1976).
3. THE ABOVE CRITERIA BASED ON HUMAN HEALTH EFFECTS.
4. AT SUSITNA STATION, 8 SUMMER OBSERVATIONS, 8 WINTER OBSERVATIONS AND 4 BREAKUP OBSERVATIONS WERE LESS THAN 0.020 mg./l.
5. AT GOLD CREEK THE 1 WINTER OBSERVATION WAS LESS THAN 0.012 mg./l.
6. (d) = DISSOLVED

SOURCE: USGS

DATA SUMMARY - ZINC (d)

FIGURE E.2.118



D-DENALI V-VEE CANYON G-GOLD CREEK C-CHULITNA T-TALKEETNA S-SUNSHINE SS-SUSITNA STATION

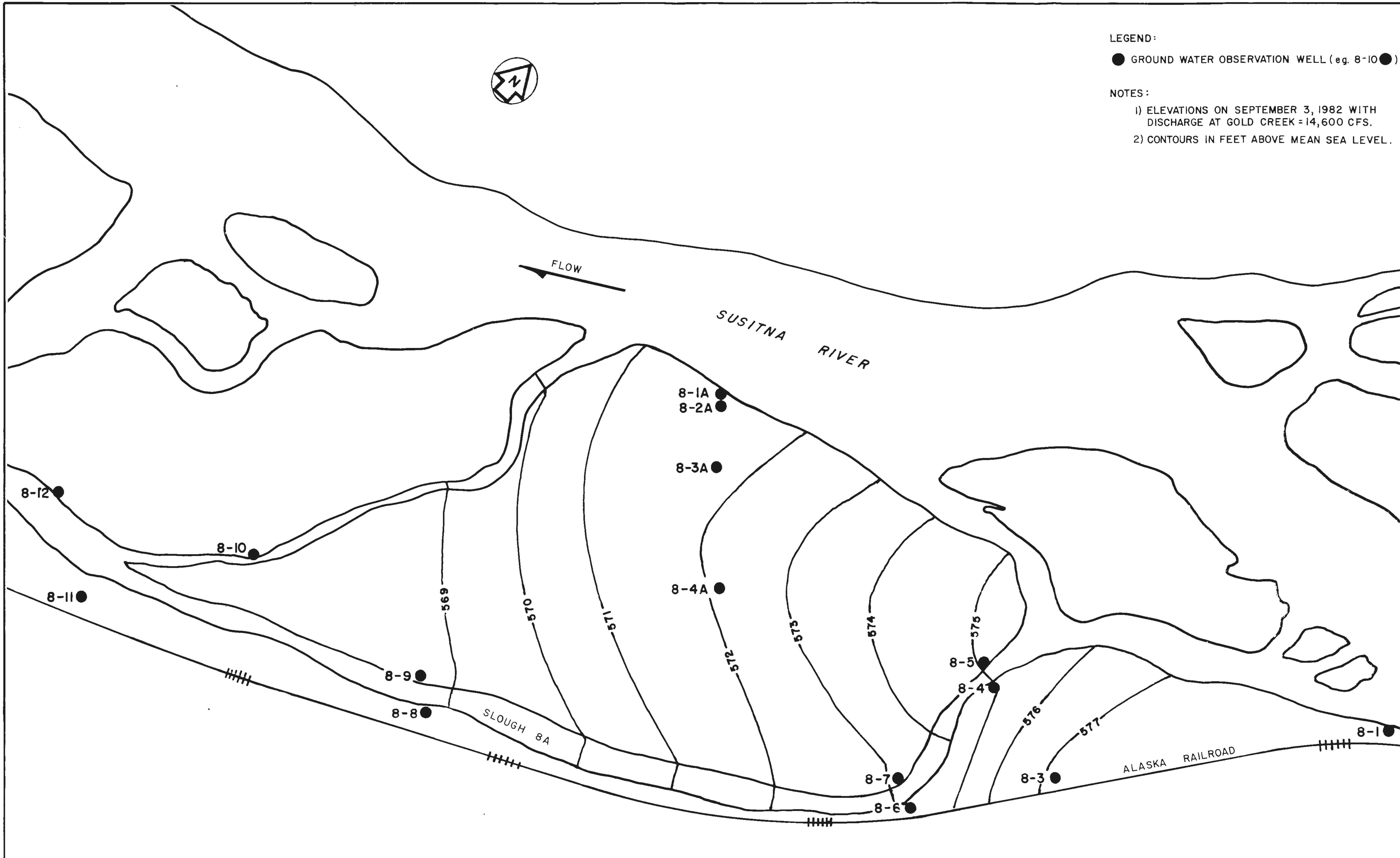
NOTES:

1. CRITERION: LESS THAN 0.03 mg./l. (McNEELY et al. 1979).
2. CRITERION: 0.01 OF THE 96-HOUR LC_{50} DETERMINED THROUGH BIOASSAY (EPA 1976).
3. THE ABOVE CRITERIA ESTABLISHED TO PROTECT FRESHWATER AQUATIC ORGANISMS.
4. AT SUSITNA STATION, 1 SUMMER OBSERVATION AND 2 WINTER OBSERVATIONS WERE LESS THAN 0.020 mg./l.
5. (t) = TOTAL RECOVERABLE.

DATA SUMMARY - ZINC (t)

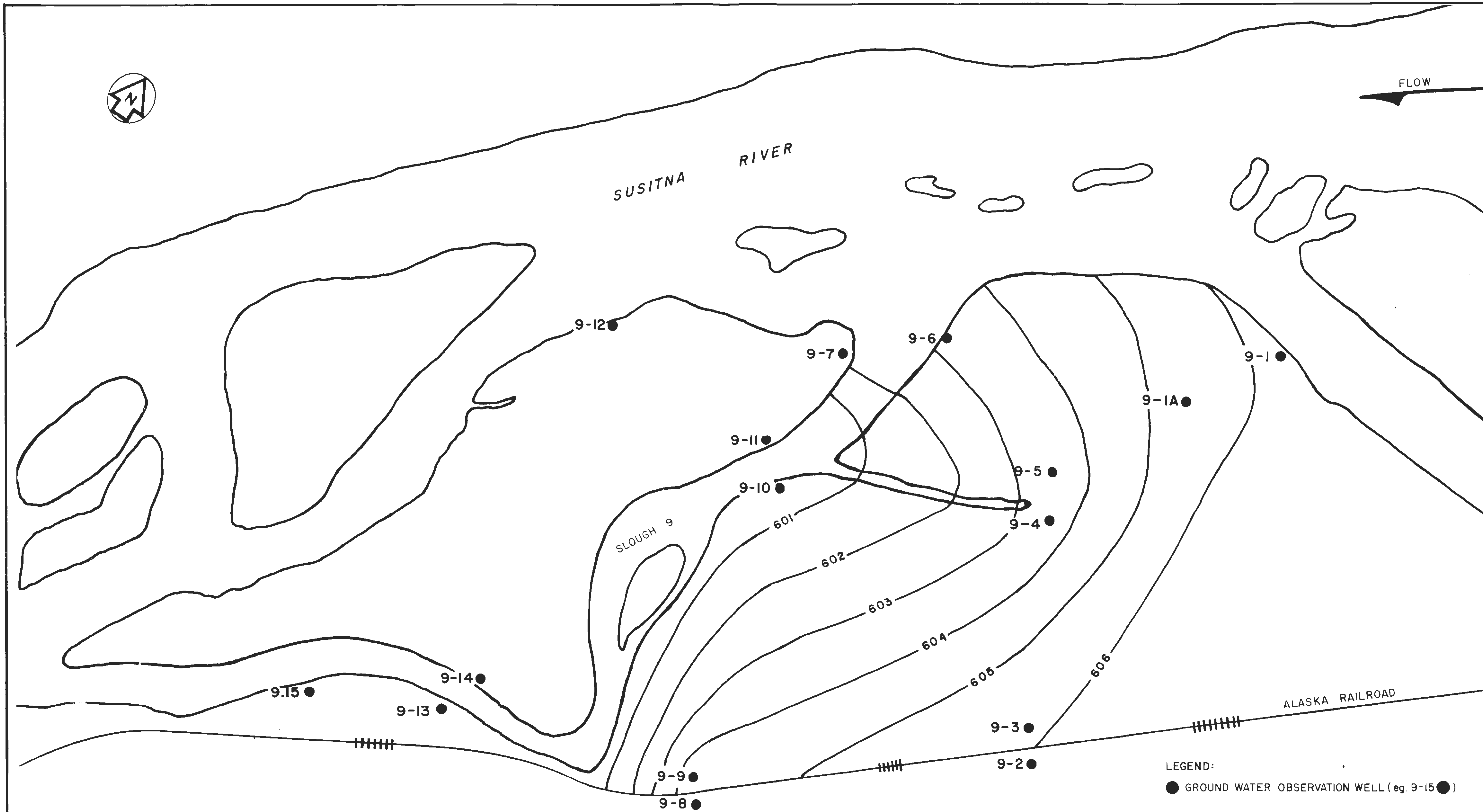
SOURCE: USGS

FIGURE E.2.119



SLOUGH 8A GROUND WATER CONTOURS

FIGURE E.2.120



LEGEND:

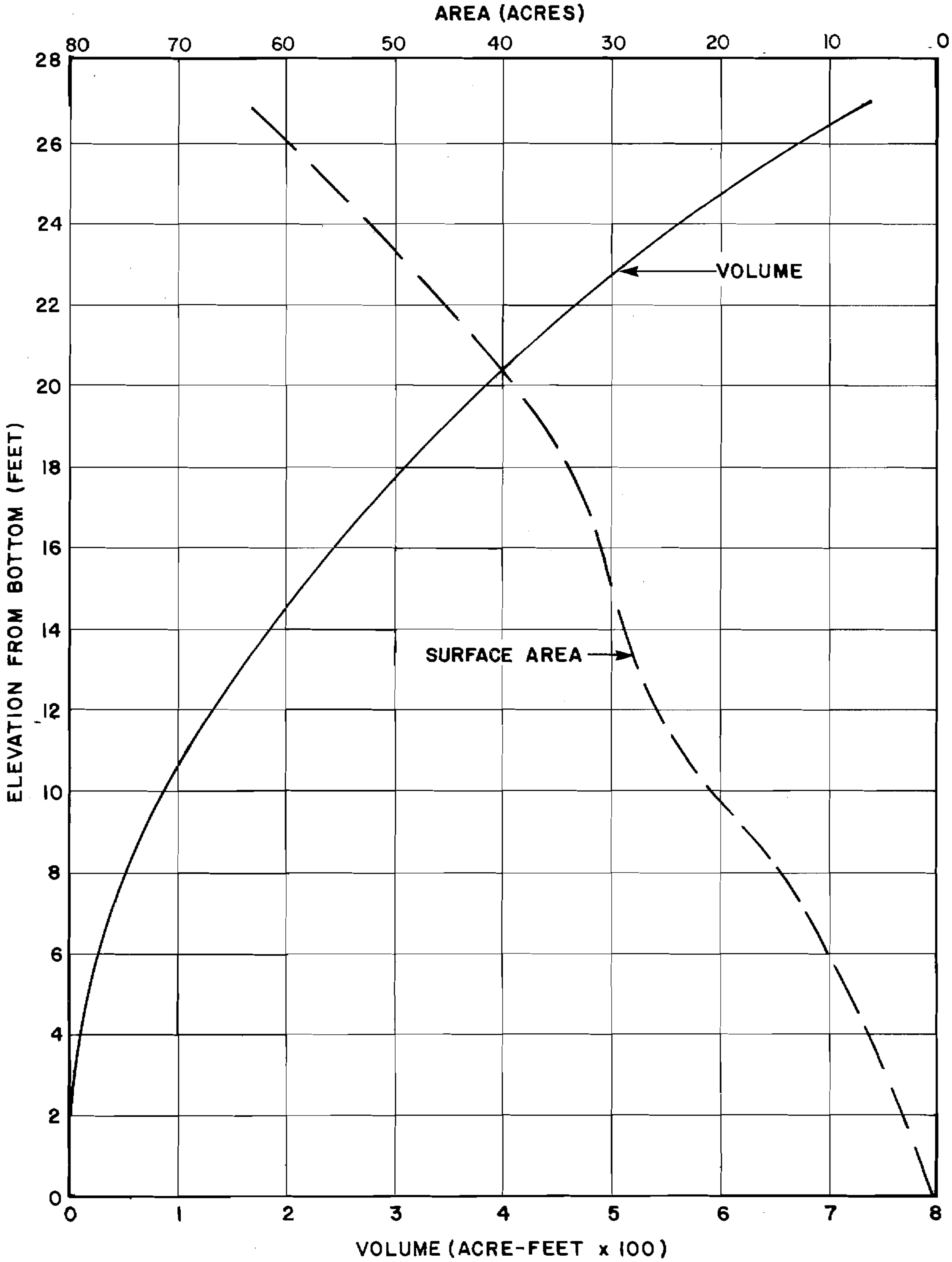
● GROUND WATER OBSERVATION WELL (eg. 9-15●)

NOTES:

1. ELEVATIONS ON SEPTEMBER 6, 1982 WITH DISCHARGE AT GOLD CREEK = 12,200 CFS.
2. CONTOURS IN FEET ABOVE MEAN SEA LEVEL.

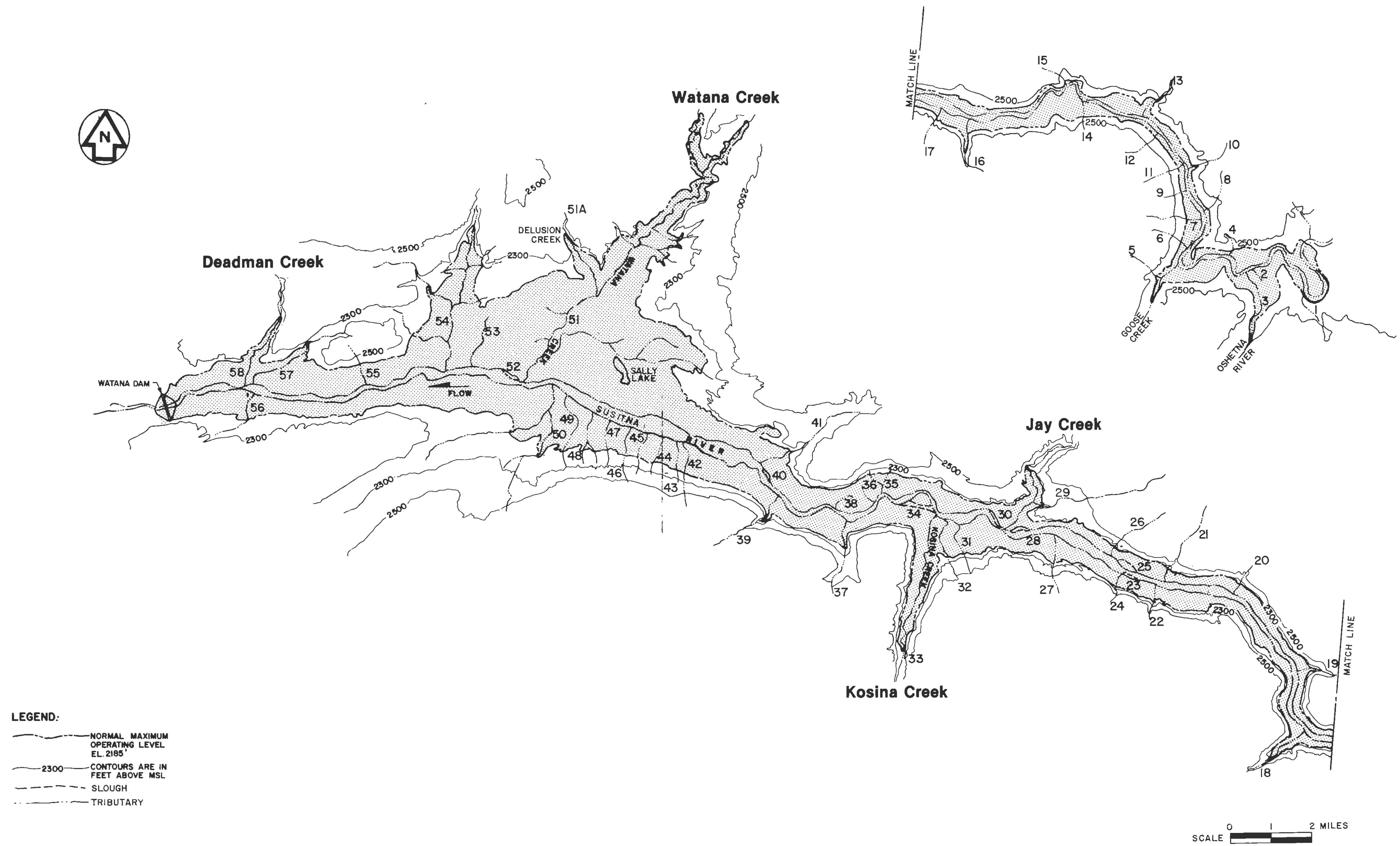
SLOUGH 9 GROUND WATER CONTOURS

FIGURE E.2.121



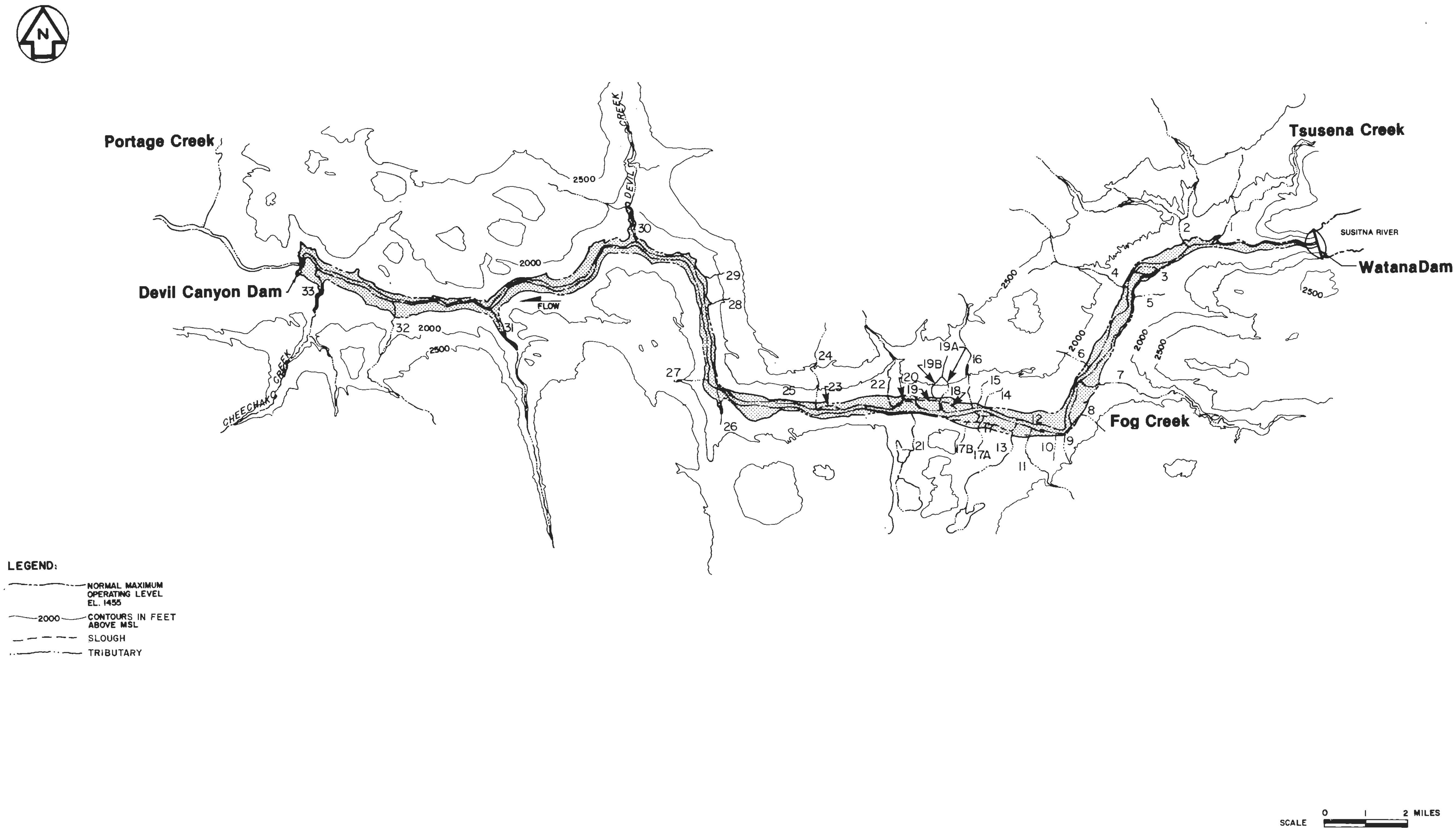
SALLY LAKE
AREA-CAPACITY CURVES

FIGURE E.2.122



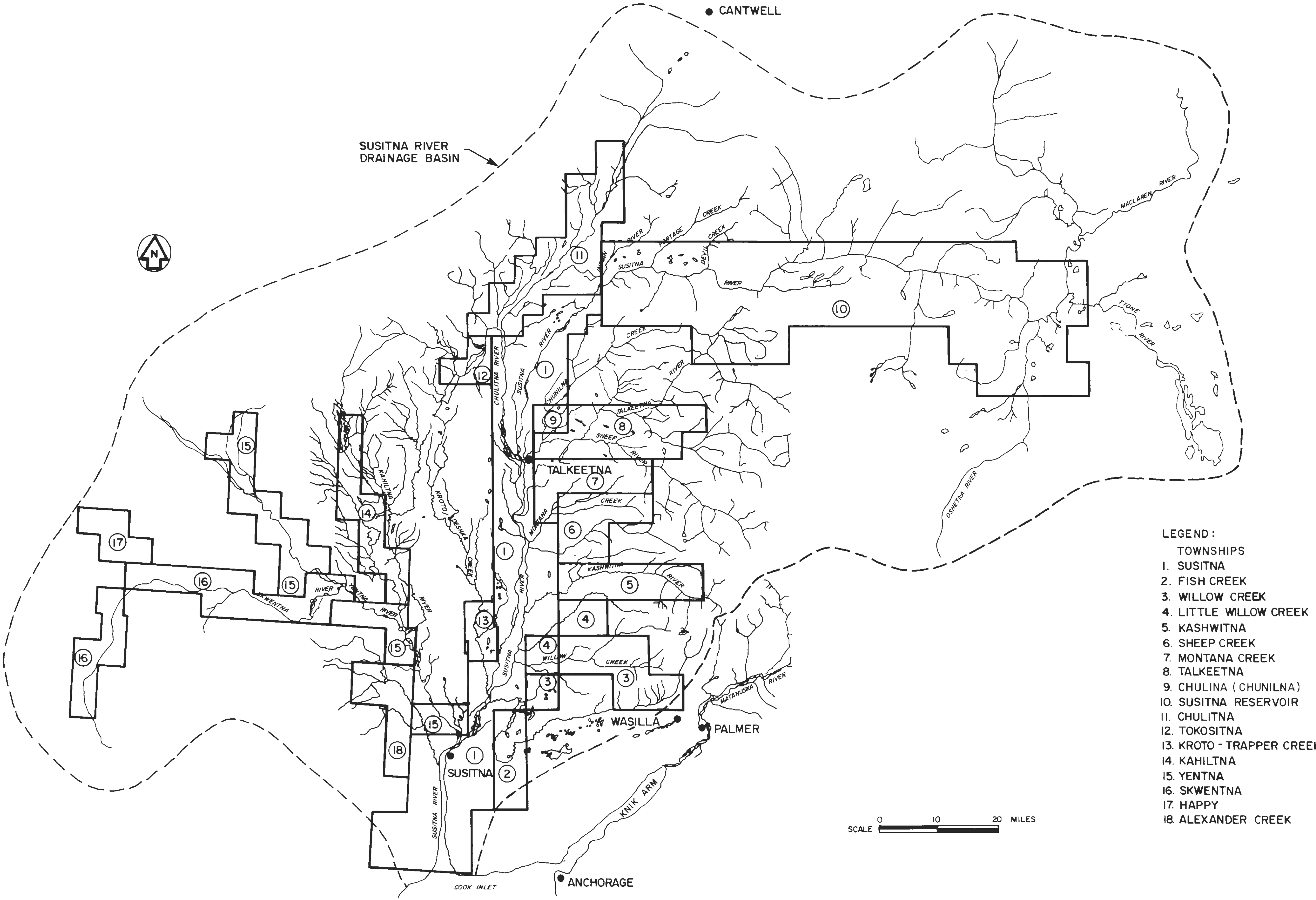
WATER BODIES TO BE INUNDATED BY WATANA RESERVOIR

FIGURE E.2.123



WATER BODIES TO BE INUNDATED BY DEVIL CANYON RESERVOIR

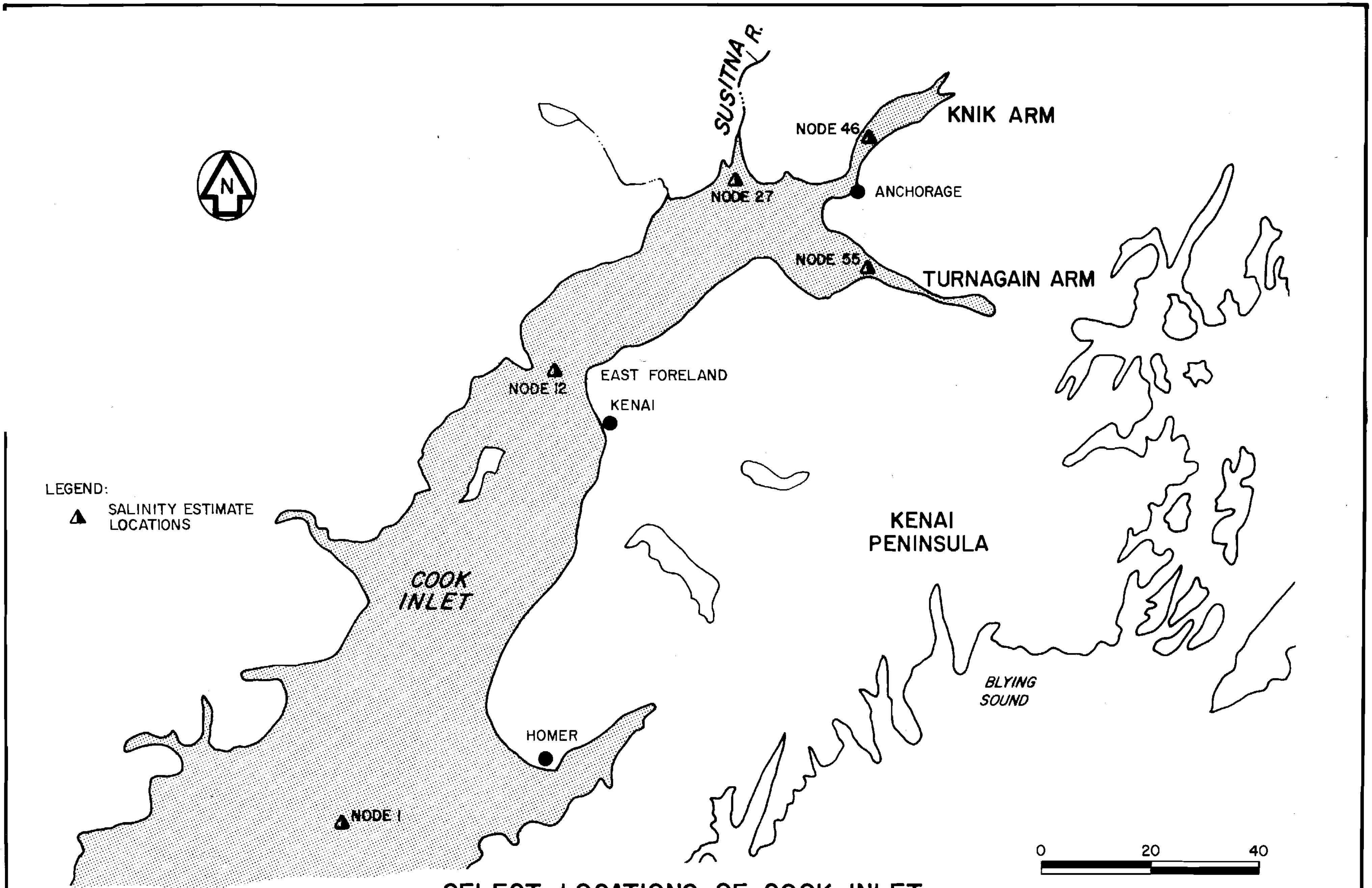
FIGURE E.2.124



TOWNSHIP GRIDS INVESTIGATED FOR WATER RIGHTS IN THE SUSITNA RIVER BASIN

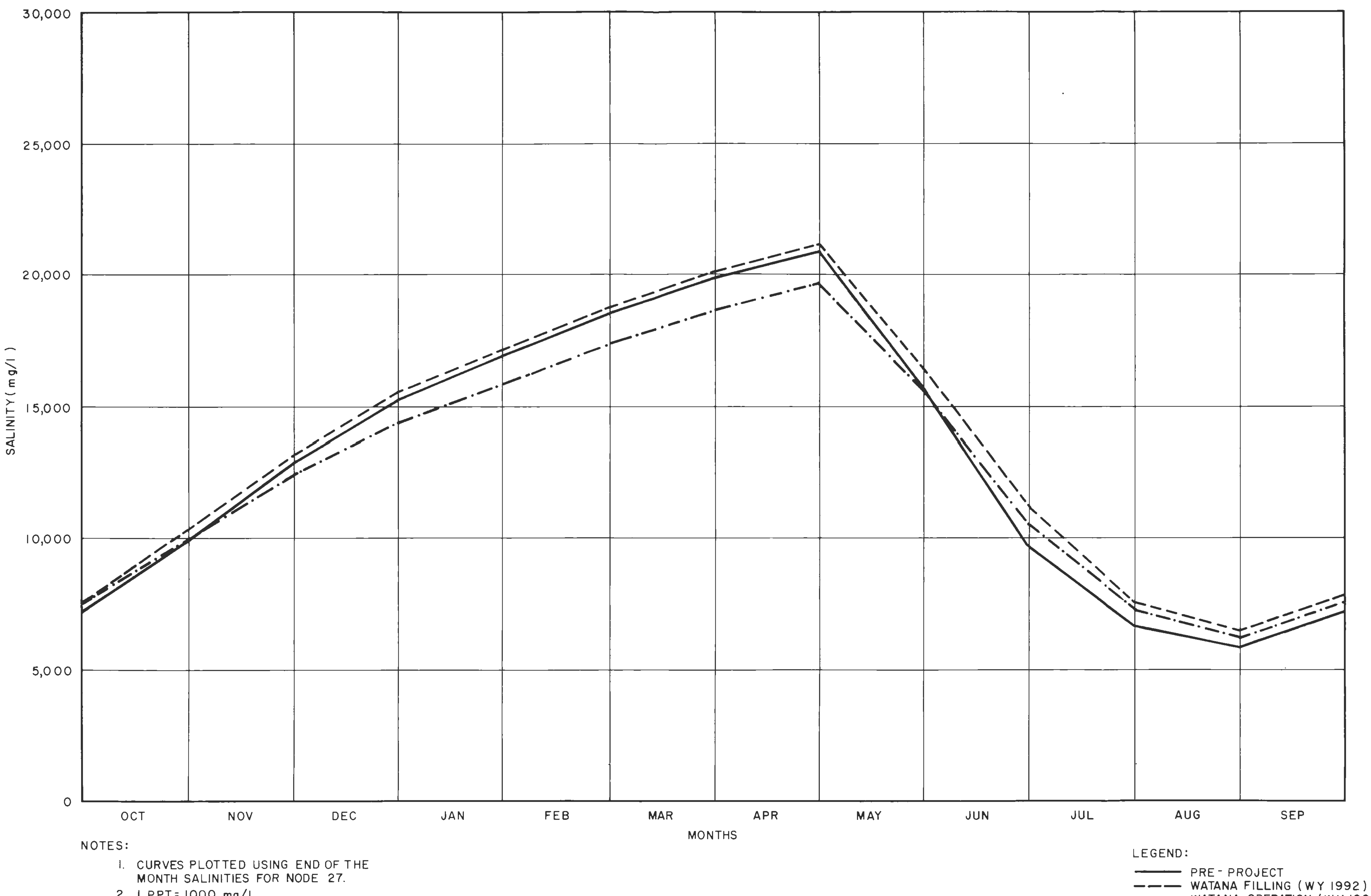
SOURCE: DWIGHT 1981

FIGURE E.2.125



SELECT LOCATIONS OF COOK INLET SALINITY ESTIMATES

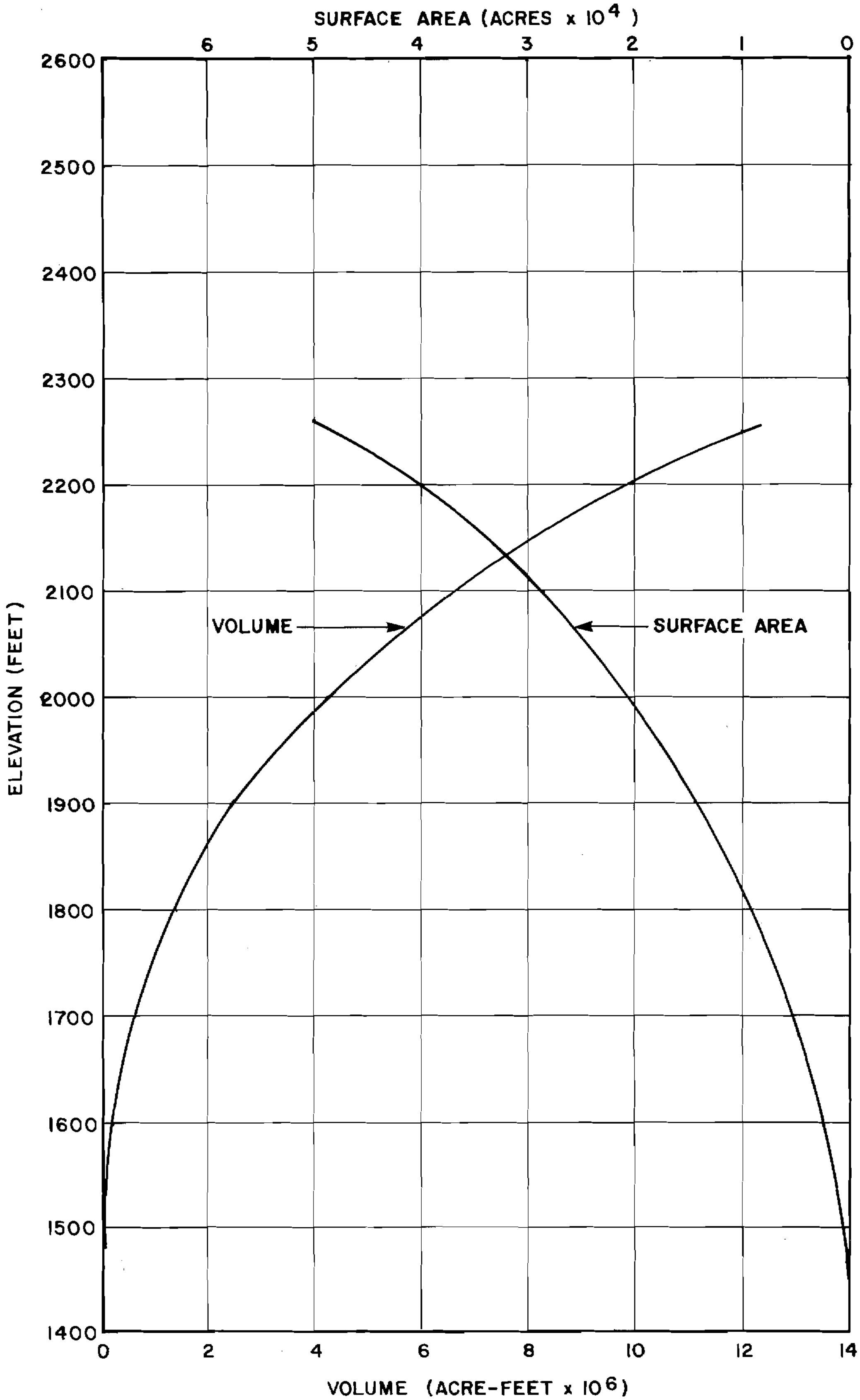
FIGURE E.2.126



TEMPORAL SALINITY ESTIMATES FOR
COOK INLET NEAR THE SUSITNA RIVER MOUTH

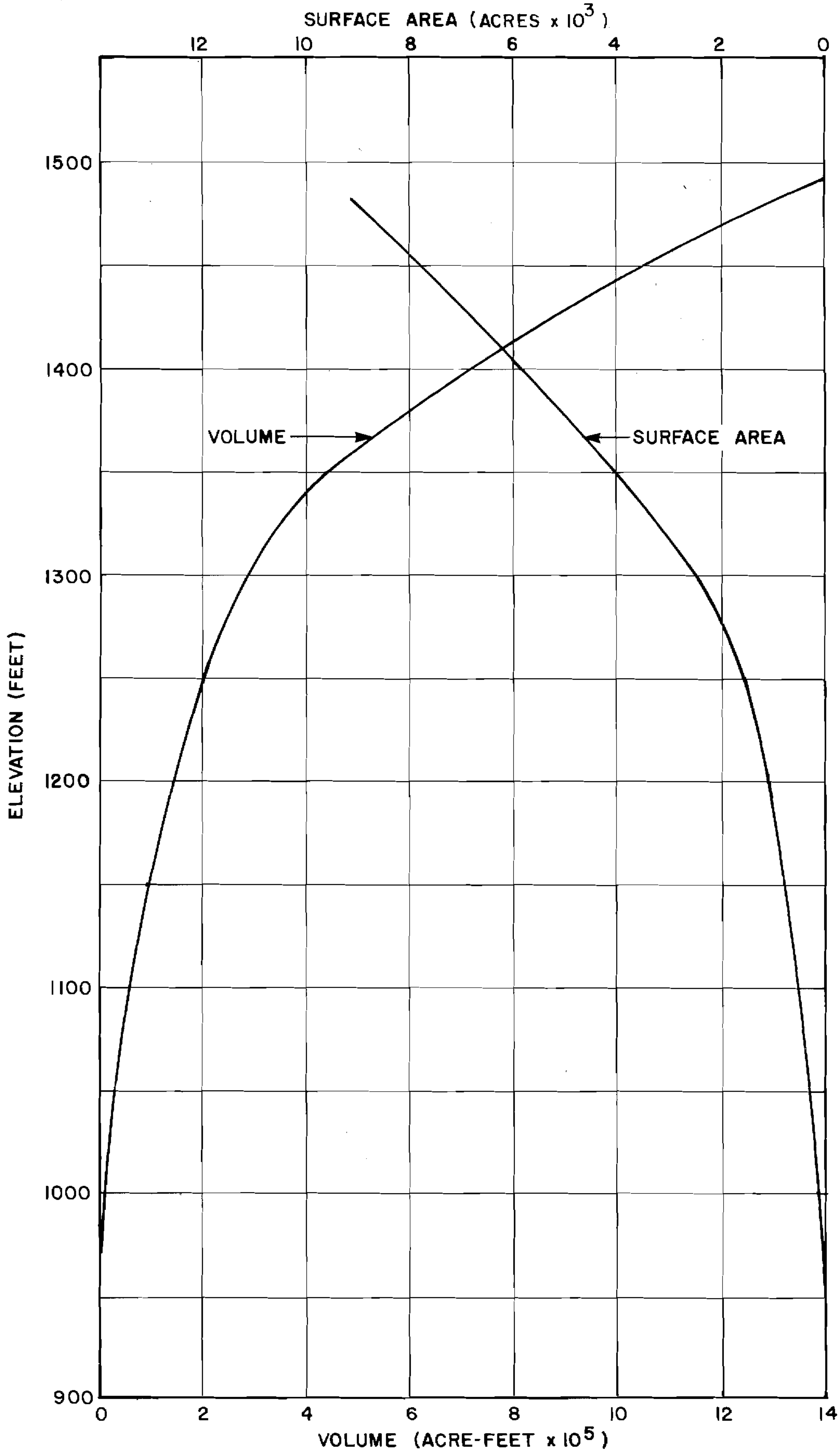
SOURCE: RMA 1983

FIGURE E.2.127



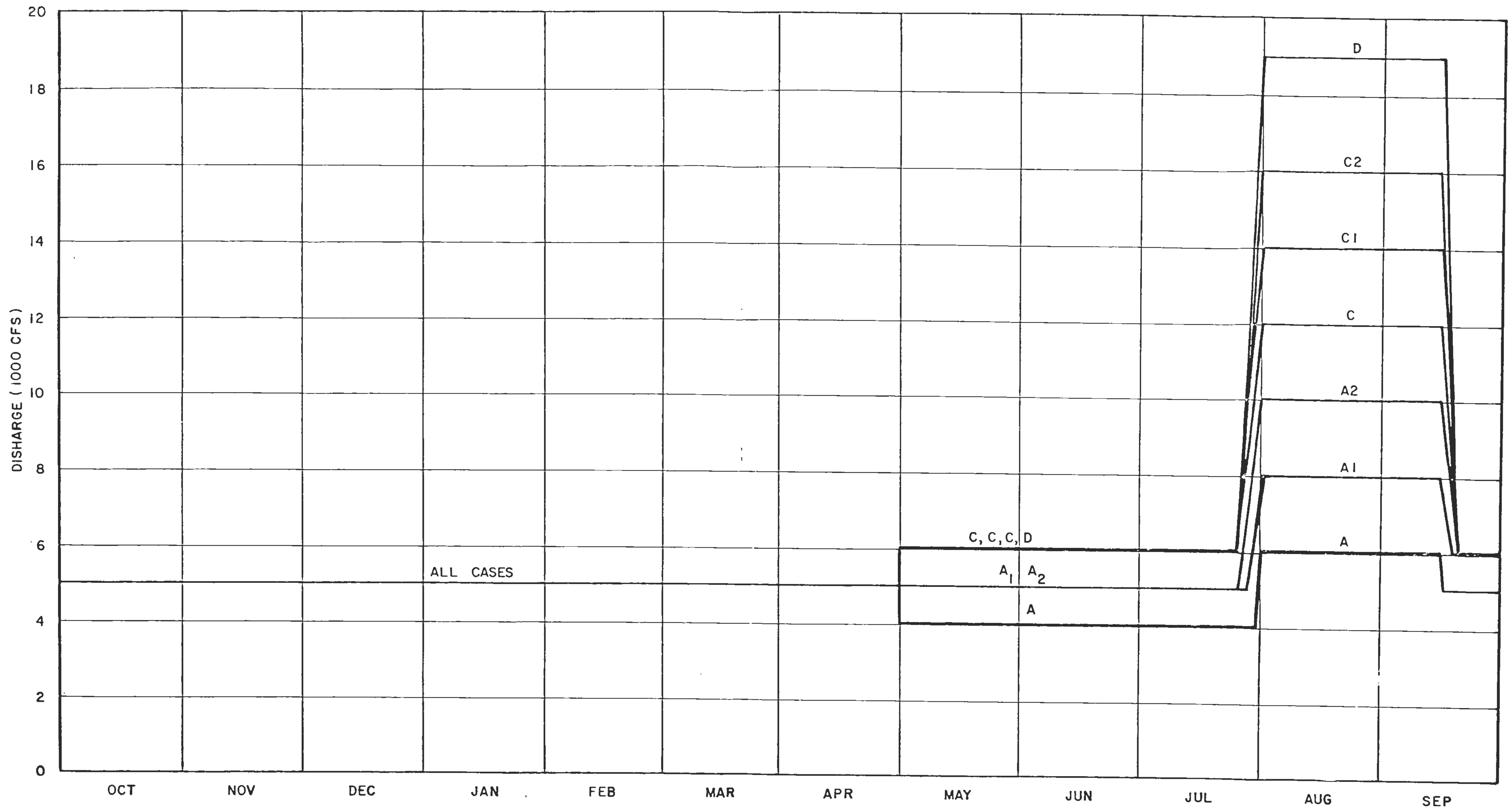
WATANA RESERVOIR VOLUME AND SURFACE AREA

FIGURE E.2.128



DEVIL CANYON RESERVOIR VOLUME AND SURFACE AREA

FIGURE E.2.129



NOTES:

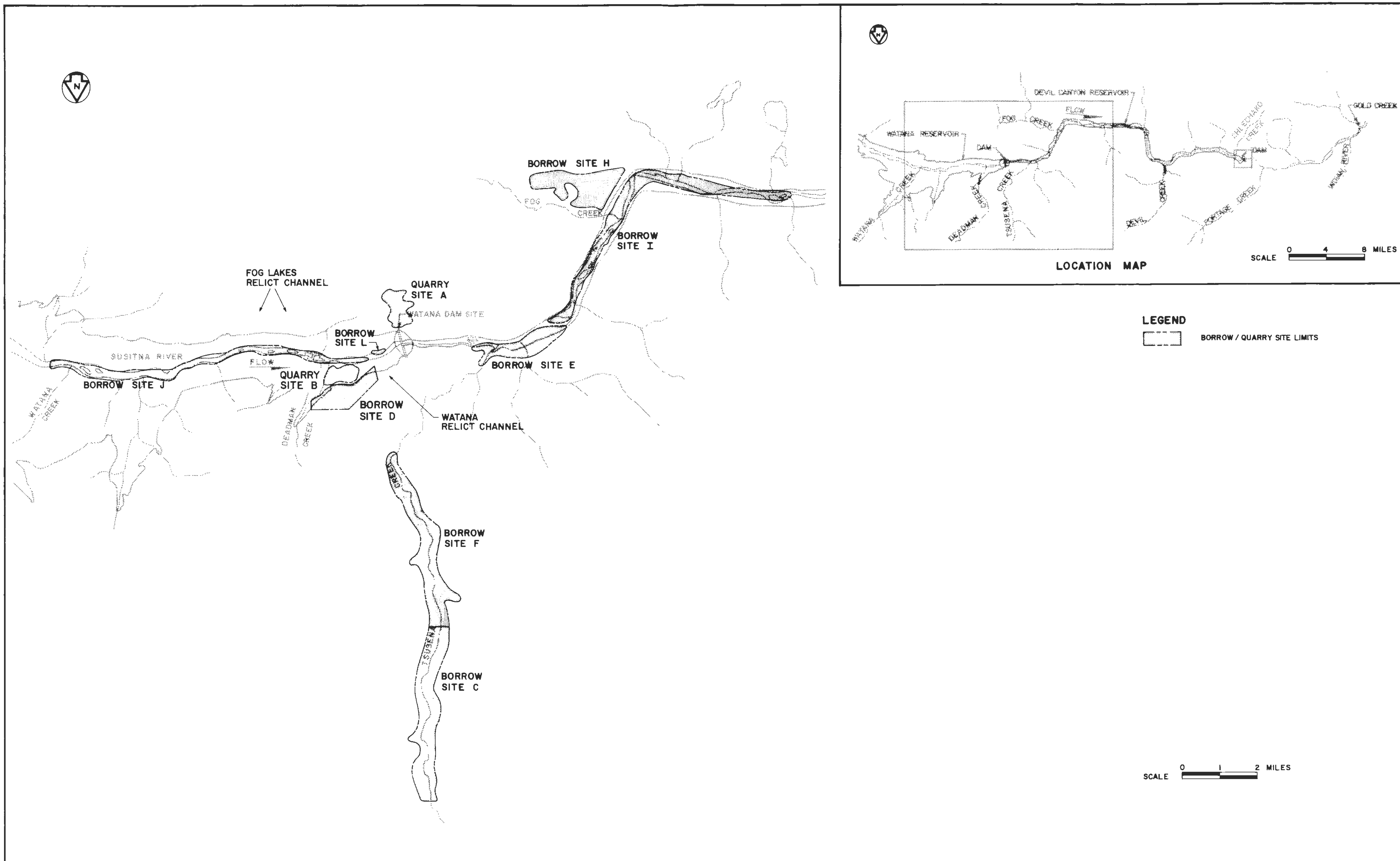
1) LETTERS DESIGNATE THE VARIOUS SCENARIOS CONSIDERED (ie. A=CASE A).

2) FLOW REPRESENTS GOLD CREEK FLOWS.

3) Three additional flow regimes were investigated with respect to project economics. These regimes are discussed in Exhibit B, pages B-2-123 thru B-2-128 & are identified as cases E, F, & G.

MINIMUM OPERATIONAL TARGET FLOW
FOR ALTERNATIVE FLOW SCENARIOS

FIGURE E.2.130



POTENTIAL WATANA BORROW SITES

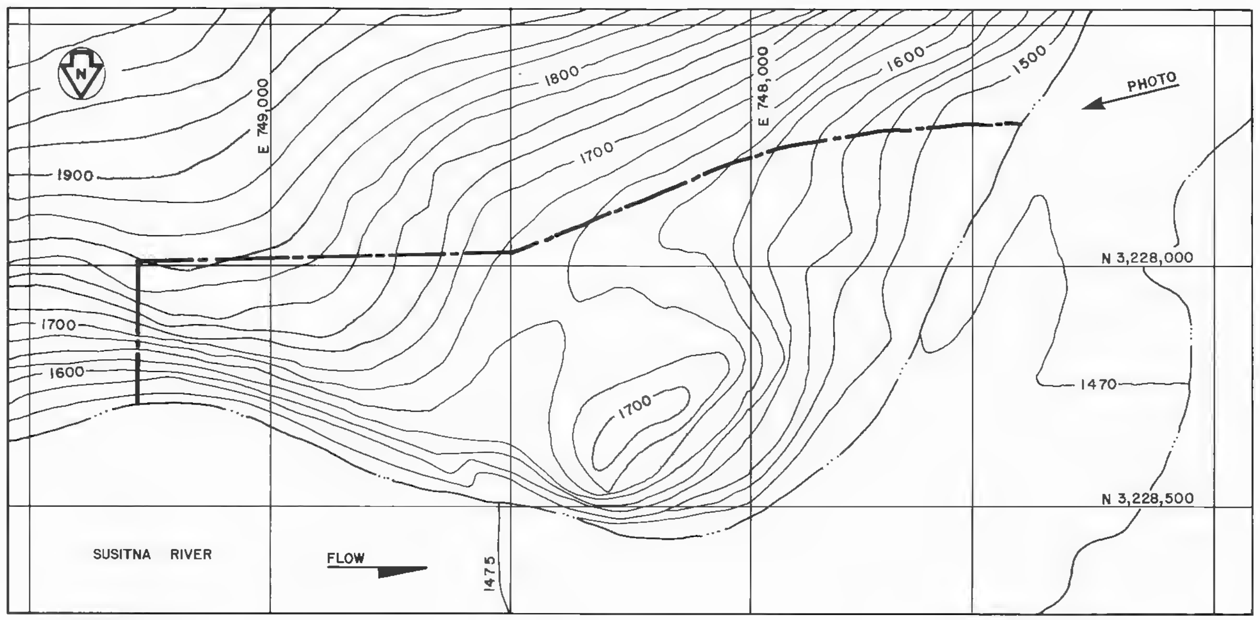
FIGURE E.2.131

LEGEND

— · — BORROW SITE LIMIT

NOTES

1. ENTIRE QUARRY SITE LIES WITHIN PROPOSED WATANA RESERVOIR LIMITS.
2. MATERIAL LIMITS INFERRED FROM PRELIMINARY MAPPING AND ARE SUBJECT TO REFINEMENT AND VERIFICATION IN DESIGN LEVEL INVESTIGATION.
3. SURFACE ELEVATIONS FROM 1"=200' TOPOGRAPHY – COE, 1978, TRACED AT 25' CONTOUR INTERVAL.
4. PHOTO TAKEN AUGUST, 1981.



APPROXIMATE QUARRY SITE LIMIT

QUARRY SITE L

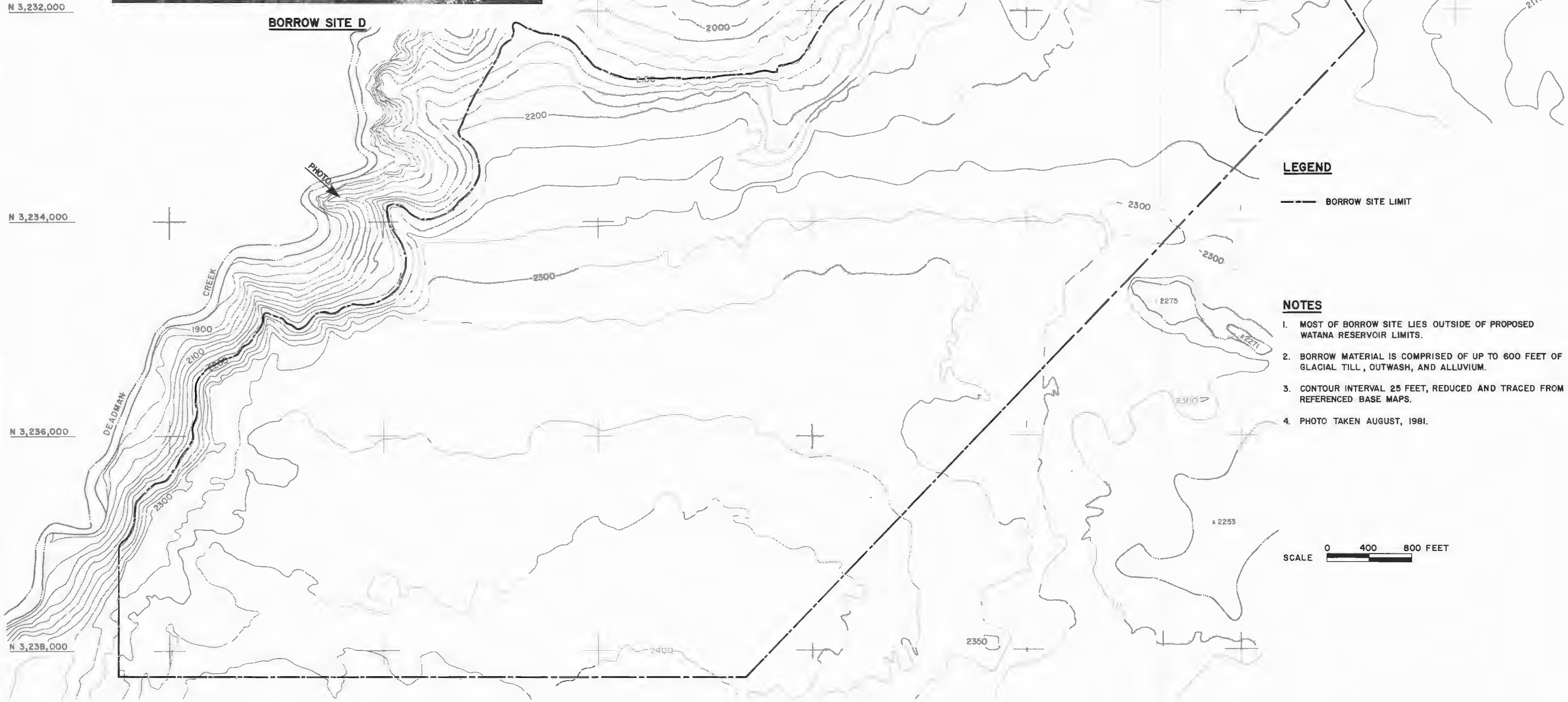
REFERENCE: BASE MAP FROM COE, 1978 1"=200' WATANA TOPOGRAPHY
SHEETS 8 & 9 OF 26, COORDINATES IN FEET, ALASKA STATE PLANE (ZONE 4)

SCALE 0 200 400 FEET

WATANA
QUARRY SITE L

FIGURE E.2.132

BORROW SITE D



LEGEND

—·—·— BORROW SITE LIMIT

NOTES

1. MOST OF BORROW SITE LIES OUTSIDE OF PROPOSED WATANA RESERVOIR LIMITS.
2. BORROW MATERIAL IS COMPRISED OF UP TO 600 FEET OF GLACIAL TILL, OUTWASH, AND ALLUVIUM.
3. CONTOUR INTERVAL 25 FEET, REDUCED AND TRACED FROM REFERENCED BASE MAPS.
4. PHOTO TAKEN AUGUST, 1981.

SCALE 0 400 800 FEET

REFERENCE: BASE MAP FROM 1978, COE - 1" = 200' DAMSITE TOPOGRAPHY, SHEETS 13-15, 18-20 OF 26

WATANA
BORROW SITE D

FIGURE E.2.133

LEGEND

—·—·— BORROW SITE LIMIT

NOTES

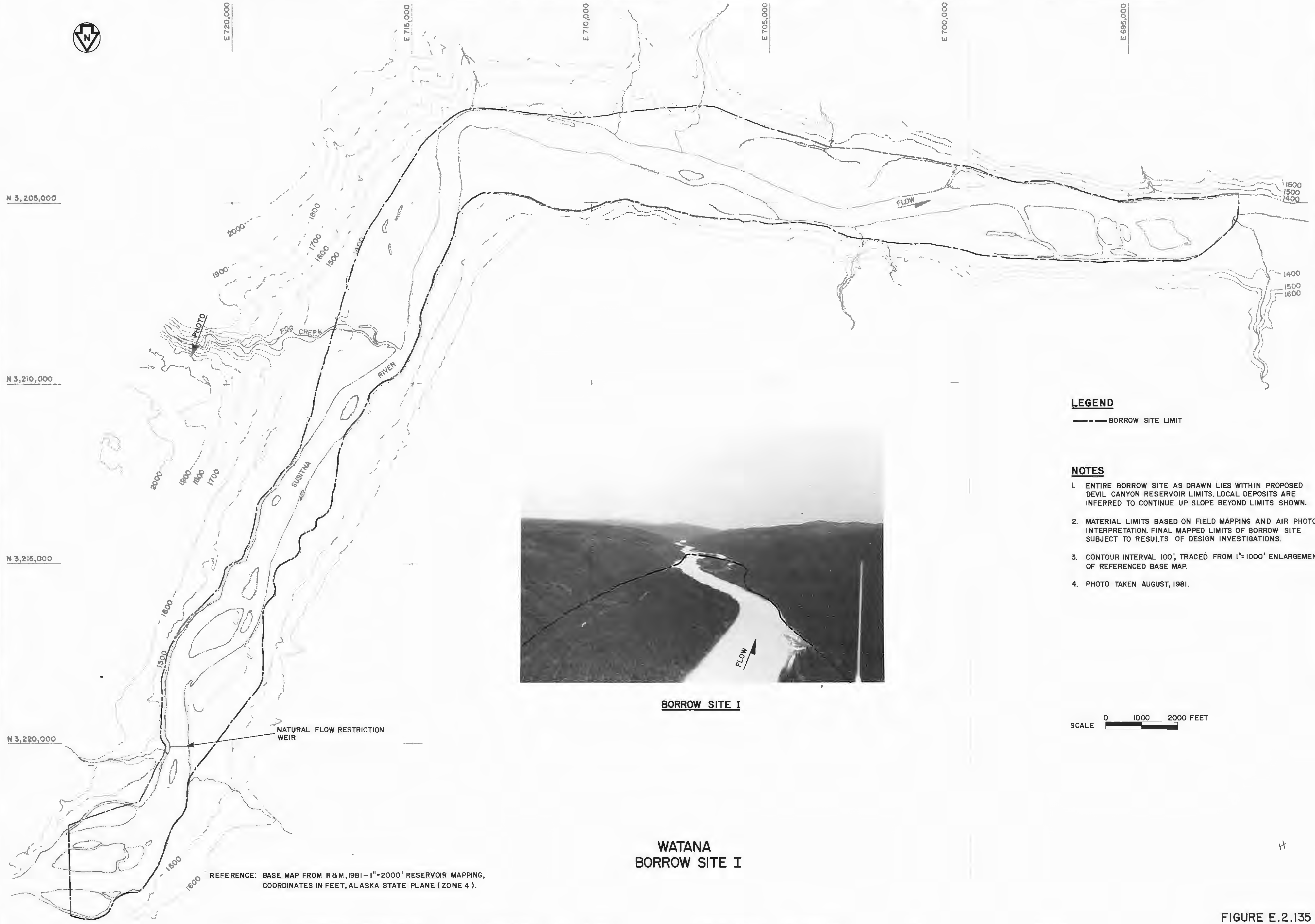
1. PORTIONS OF BORROW SITE LIE WITHIN THE PROPOSED DEVIL CANYON RESERVOIR LIMITS.
2. MATERIAL LIMITS BASED ON FIELD EXPLORATION, MAPPING AND AIR PHOTO INTERPRETATION. FINAL LIMITS OF BORROW MATERIALS SUBJECT TO RESULTS OF DESIGN INVESTIGATIONS.
3. CONTOUR INTERVAL 25', TRACED AND/OR REDUCED FROM REFERENCED BASE MAPS.
4. PHOTO TAKEN AUGUST, 1981.

SCALE 0 400 800 FEET

REFERENCES: BASE MAP FROM COE, 1978 - 1" = 200' WATANA TOPOGRAPHY, SHEET 6 & 11 OF 26
R&M, 1981 - 1" = 400' DEVIL CANYON RESERVOIR MAPPING, FLIGHT 5 (6-8), MANUSCRIPT 2
COORDINATES IN FEET, ALASKA STATE PLANE (ZONE 4)

WATANA
BORROW SITE E

FIGURE E.2.134



BORROW SITE I

LEGEND

—·—·— BORROW SITE LIMIT

NOTES

1. ENTIRE BORROW SITE AS DRAWN LIES WITHIN PROPOSED DEVIL CANYON RESERVOIR LIMITS. LOCAL DEPOSITS ARE INFERRED TO CONTINUE UP SLOPE BEYOND LIMITS SHOWN.
2. MATERIAL LIMITS BASED ON FIELD MAPPING AND AIR PHOTO INTERPRETATION. FINAL MAPPED LIMITS OF BORROW SITE SUBJECT TO RESULTS OF DESIGN INVESTIGATIONS.
3. CONTOUR INTERVAL 100', TRACED FROM 1"=1000' ENLARGEMENT OF REFERENCED BASE MAP.
4. PHOTO TAKEN AUGUST, 1981.

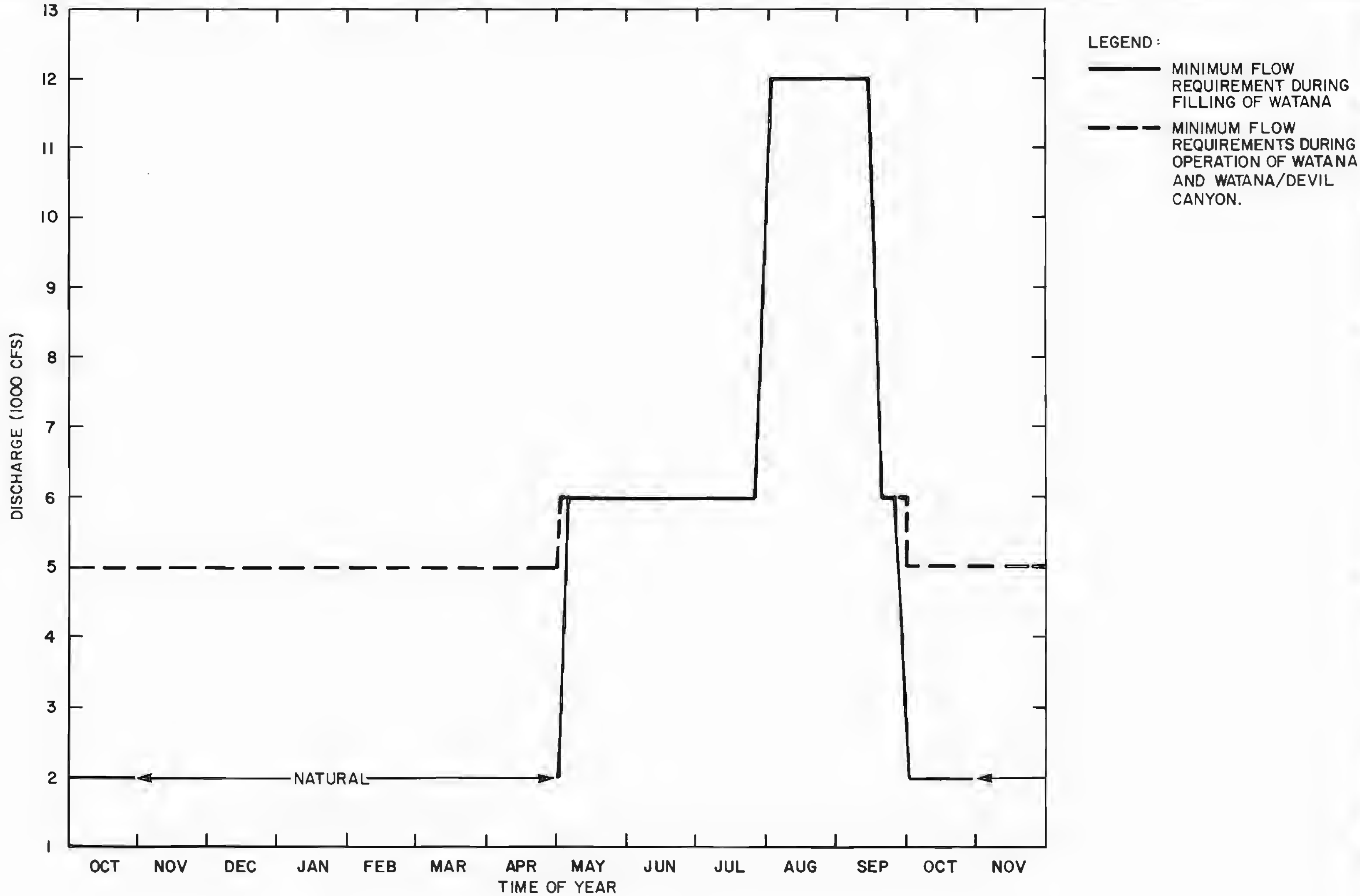
SCALE 0 1000 2000 FEET

REFERENCE: BASE MAP FROM R&M, 1981 – 1"=2000' RESERVOIR MAPPING, COORDINATES IN FEET, ALASKA STATE PLANE (ZONE 4).

WATANA BORROW SITE I

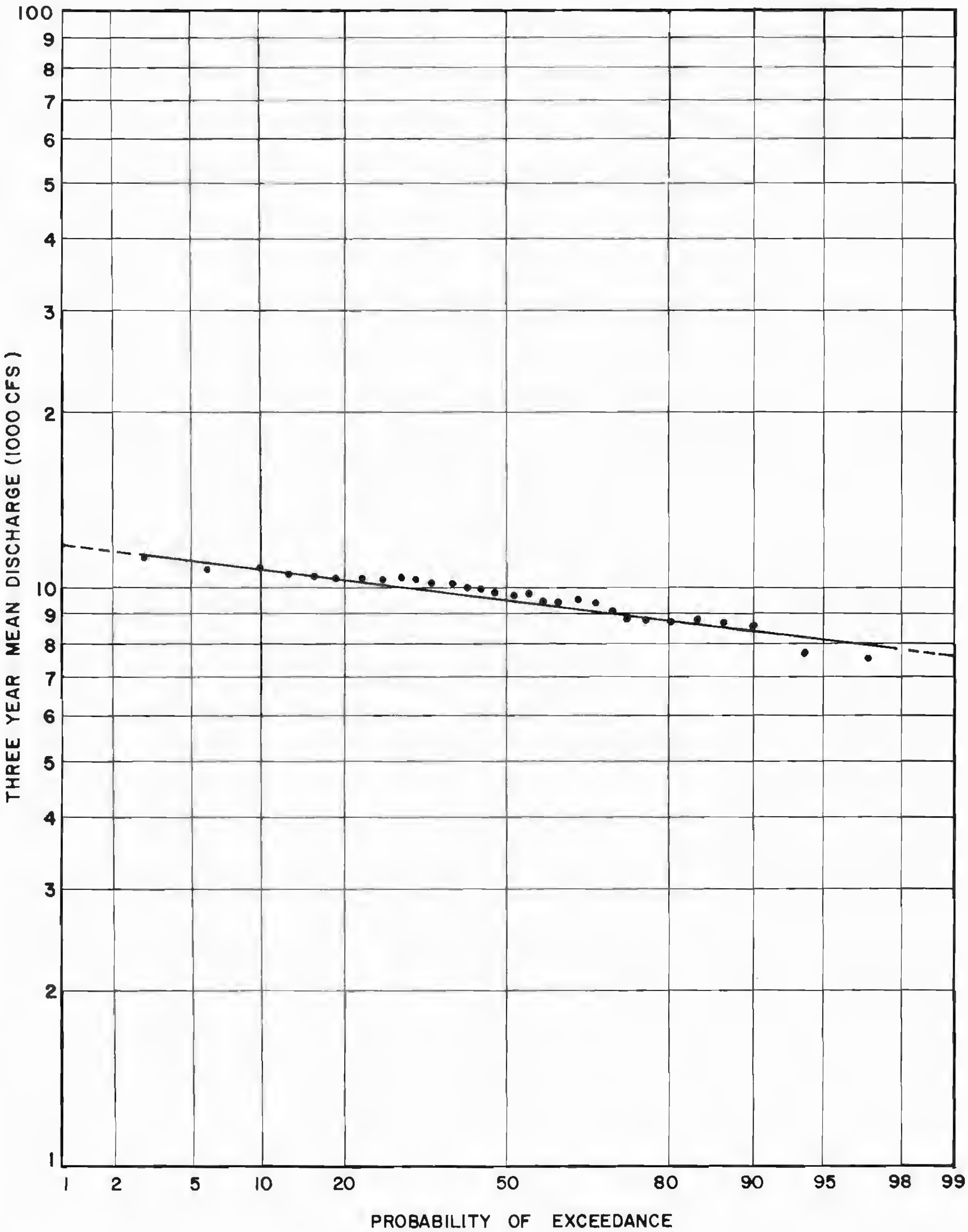
H

FIGURE E.2.135



MINIMUM FLOW REQUIREMENTS AT GOLD CREEK

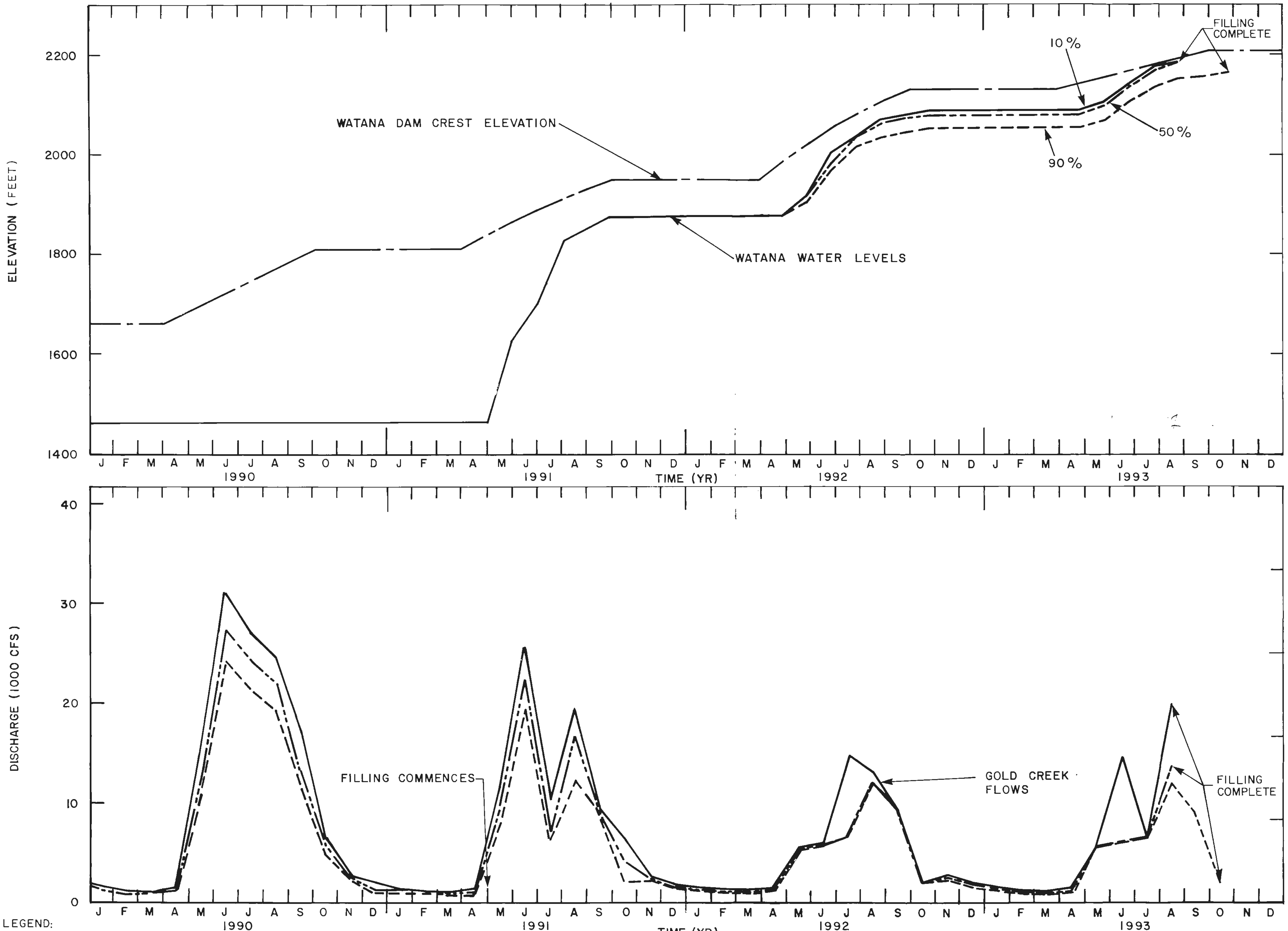
FIGURE E.2.136



NOTE: PERIOD OF RECORD IS WY 1950 - WY 1981.

THREE-YEAR MEAN DISCHARGE AT GOLD CREEK

FIGURE E.2.137



LEGEND:

——— 10% EXCEEDENCE PROBABILITY

– – – 50% EXCEEDENCE PROBABILITY

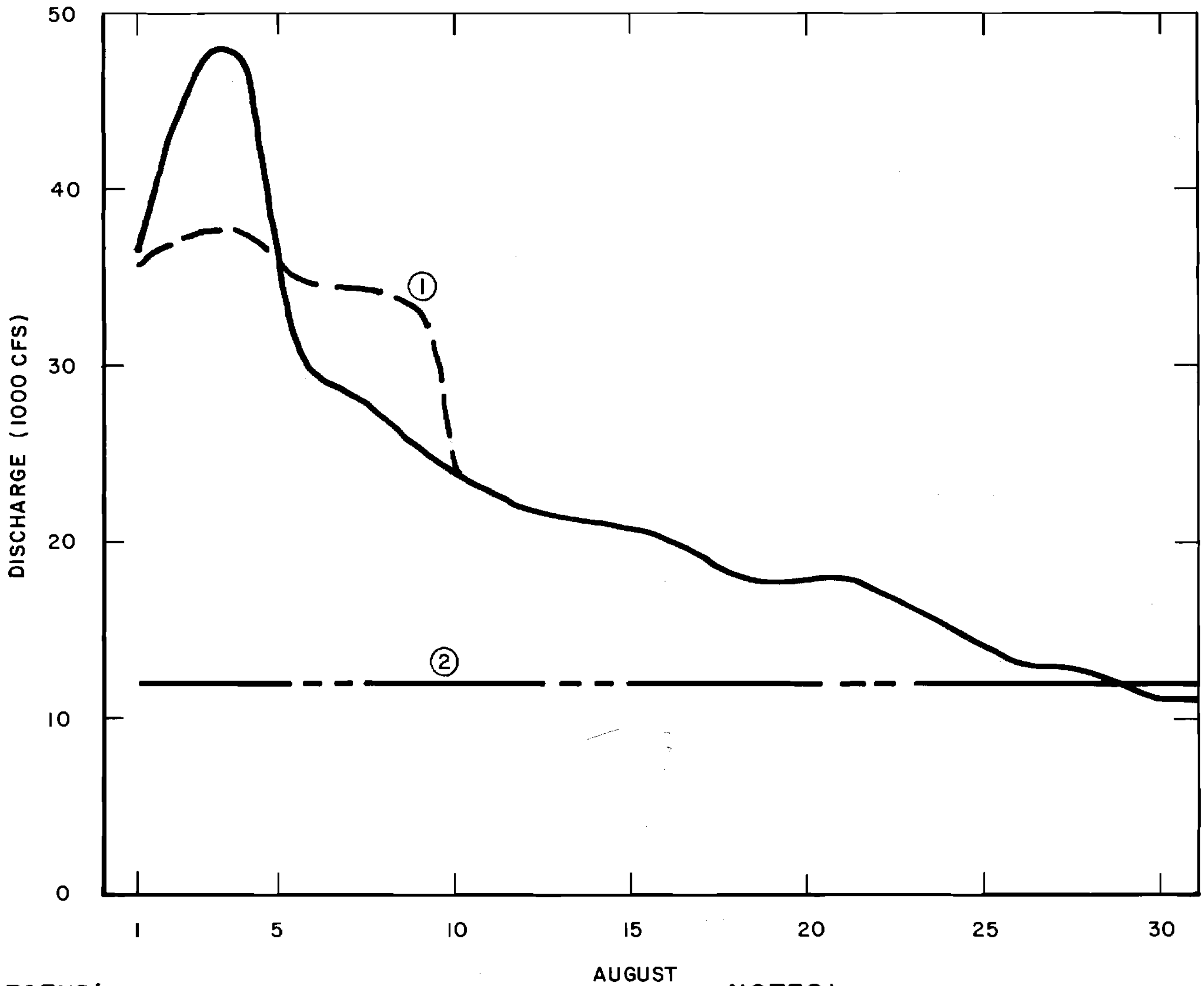
– – – 90% EXCEEDENCE PROBABILITY

WATANA WATER LEVELS AND GOLD CREEK FLOWS DURING RESERVOIR FILLING

NOTES:

1. NATURAL STREAM FLOWS UNTIL MAY 1991 WHEN FILLING BEGINS.
2. AVERAGE MONTHLY VALUES PLOTTED IN MIDDLE OF MONTH.

FIGURE E.2.138



LEGEND:

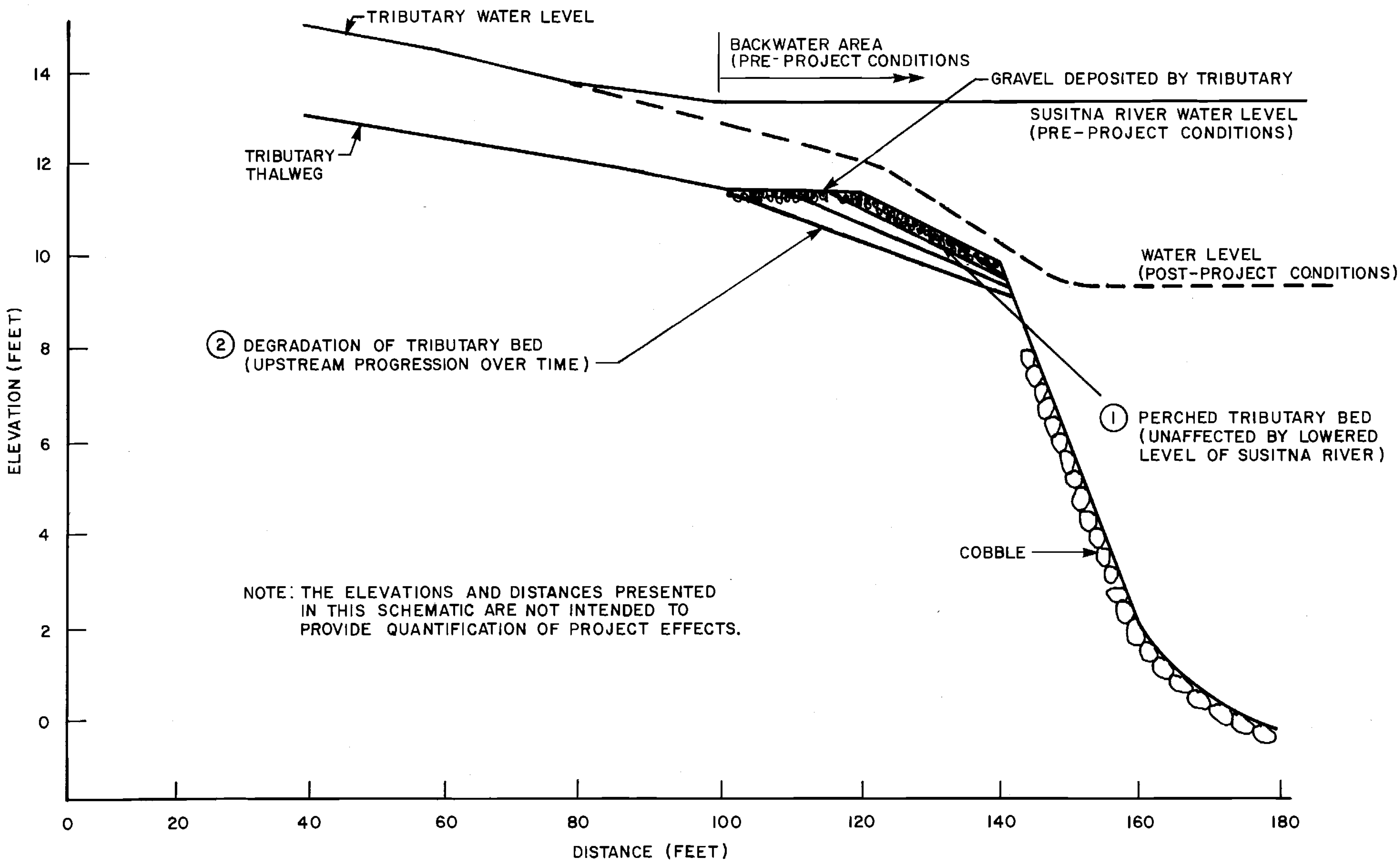
- AUGUST 1958 FLOWS
- ① FILLING SEQUENCE 1, AUGUST 1958 FLOWS – WATANA MINIMUM STORAGE CRITERIA VIOLATED
- ② FILLING SEQUENCE 2, AUGUST 1958 FLOWS – WATANA CAPABLE OF ABSORBING HYDROGRAPH

NOTES:

1. WATANA FLOW ASSUMED TO BE 84 % OF GOLD CREEK FLOW.
2. RESERVOIR FILLING CRITERIA EXCEEDED WITH SEQUENCE ①
3. NEGLIGIBLE CHANGE IN DAM HEIGHT DURING FLOOD EVENT
4. MAXIMUM RELEASE AT WATANA 31,000 CFS (COMBINED POWERHOUSE AND OUTLET FACILITY DISCHARGE).

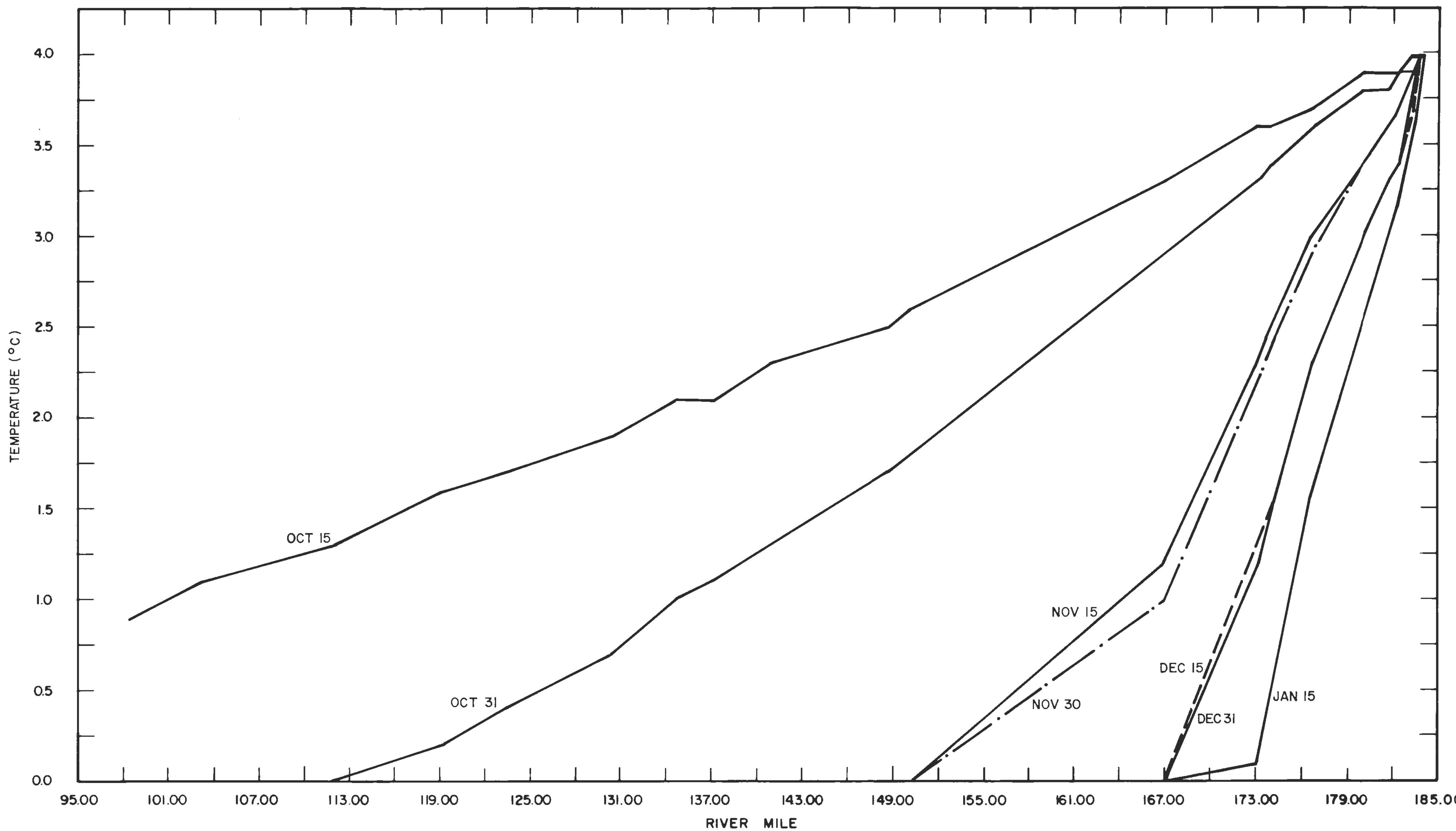
FLOW VARIABILITY AT GOLD CREEK DURING WATANA FILLING

FIGURE E.2.139



SCHEMATIC OF THE POTENTIAL EFFECTS OF THE SUSITNA RIVER ON A TYPICAL TRIBUTARY MOUTH

FIGURE E.2.140



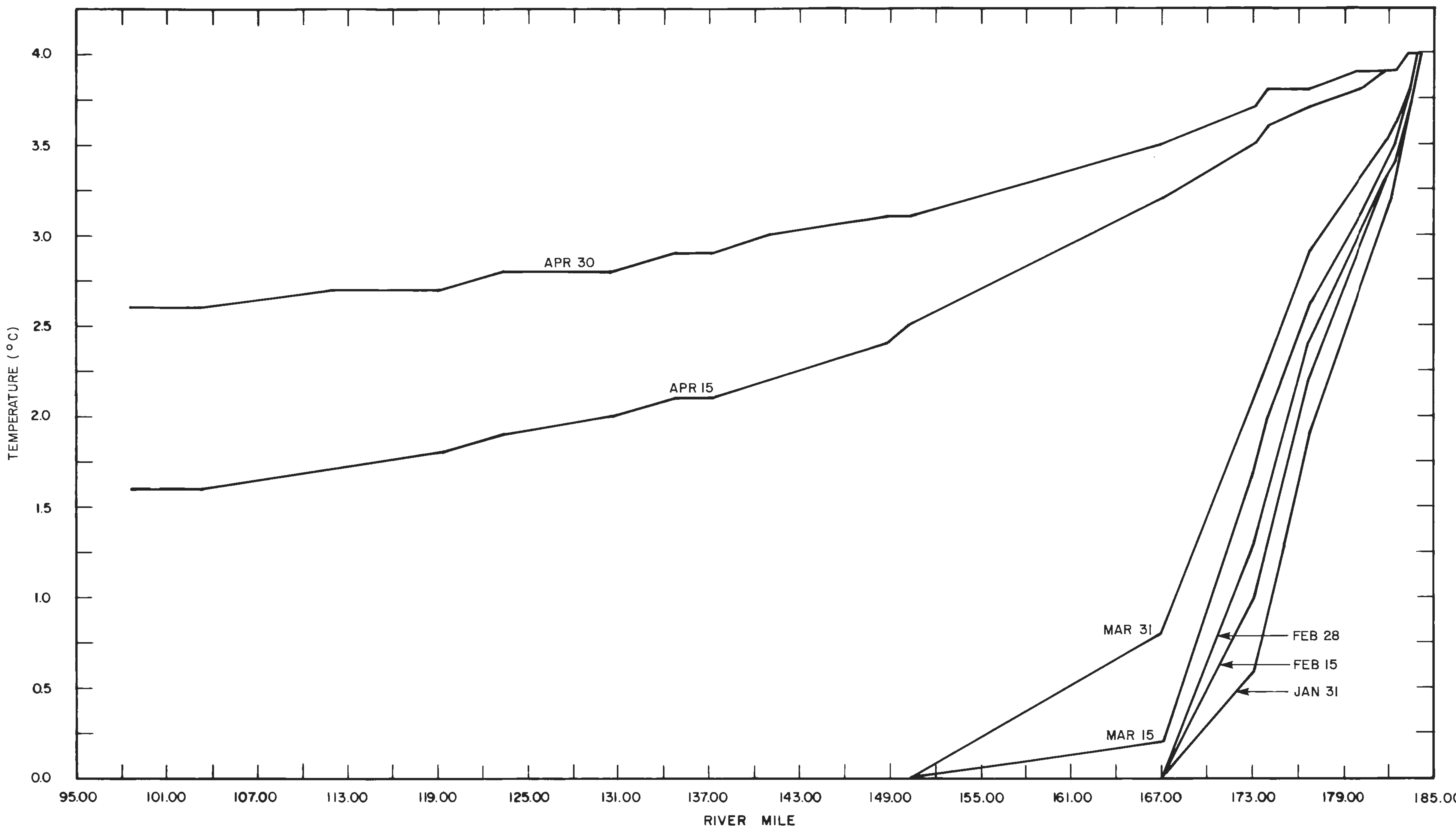
NOTE:

1. MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND MEAN MONTHLY NATURAL FLOWS.

2. GOLD CREEK DISCHARGE (CFS):
   OCT 4280
   NOV 2560
   DEC 1790
   JAN 1460

WATANA FILLING: DOWNSTREAM TEMPERATURES - OCT TO JAN

FIGURE E.2.141

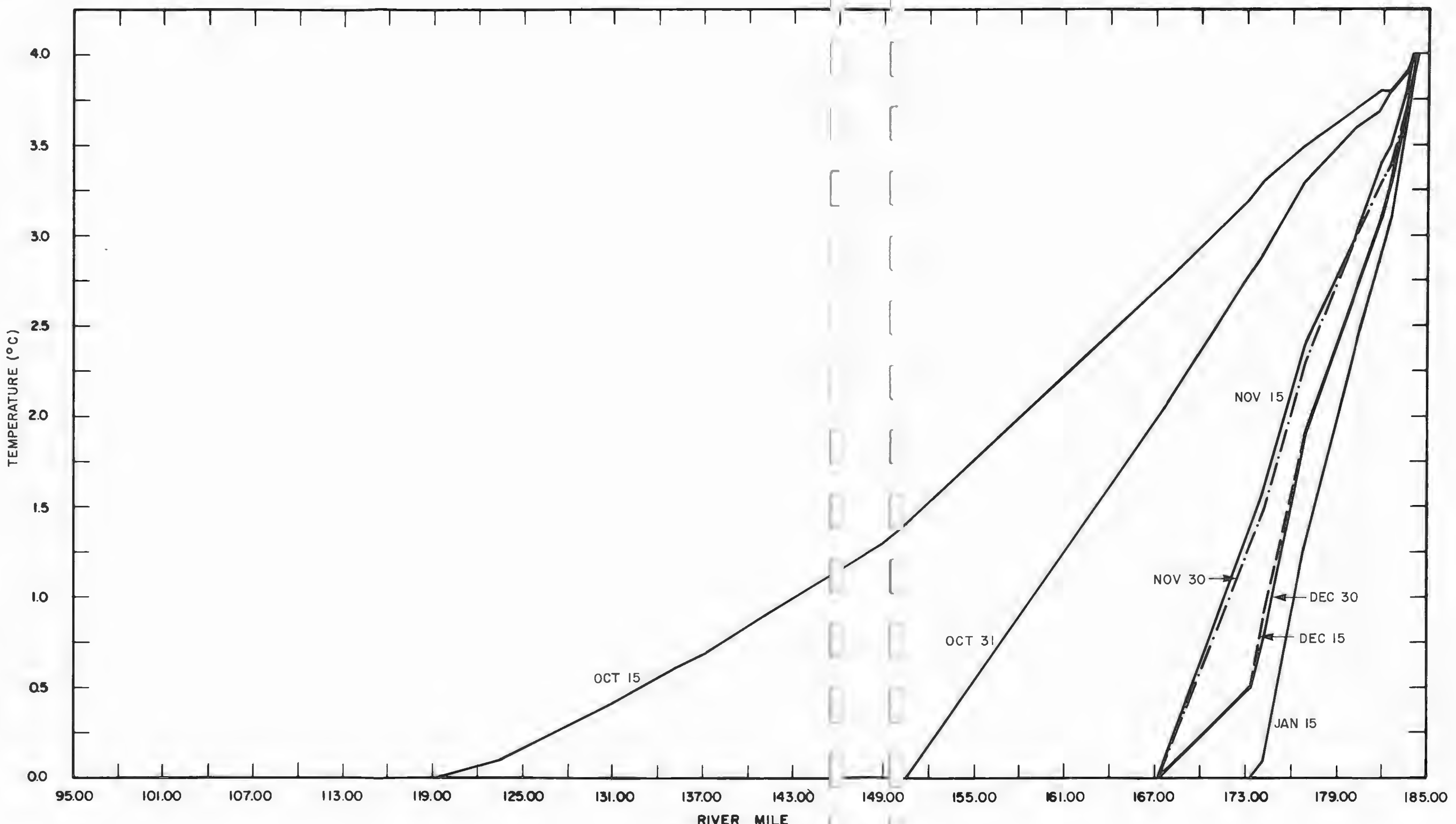


NOTE:

1. MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND MEAN MONTHLY NATURAL FLOWS.
2. GOLD CREEK DISCHARGE (CFS):
   JAN 1460
   FEB 1240
   MAR 1120
   APR 1240

WATANA FILLING: DOWNSTREAM TEMPERATURES - JAN TO APR

FIGURE E.2.142



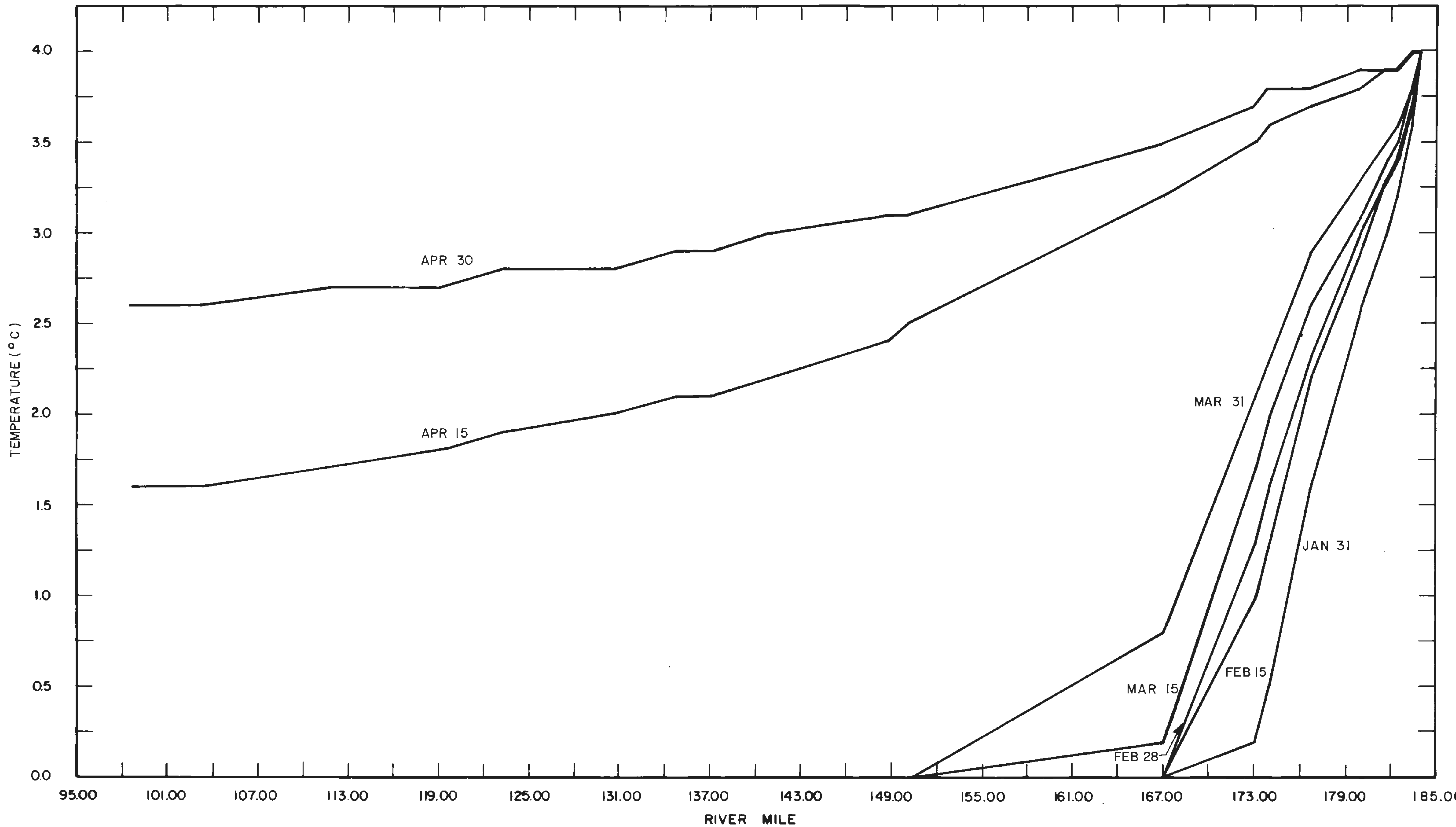
NOTE:

1. MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND LOW FLOW DISCHARGE.

2. GOLD CREEK DISCHARGE (CFS):
OCT 2020
NOV 1460
DEC 1320
JAN 1260

WATANA FILLING: DOWNSTREAM TEMPERATURES-OCT TO JAN
LOW WINTER FLOWS

FIGURE E.2.143



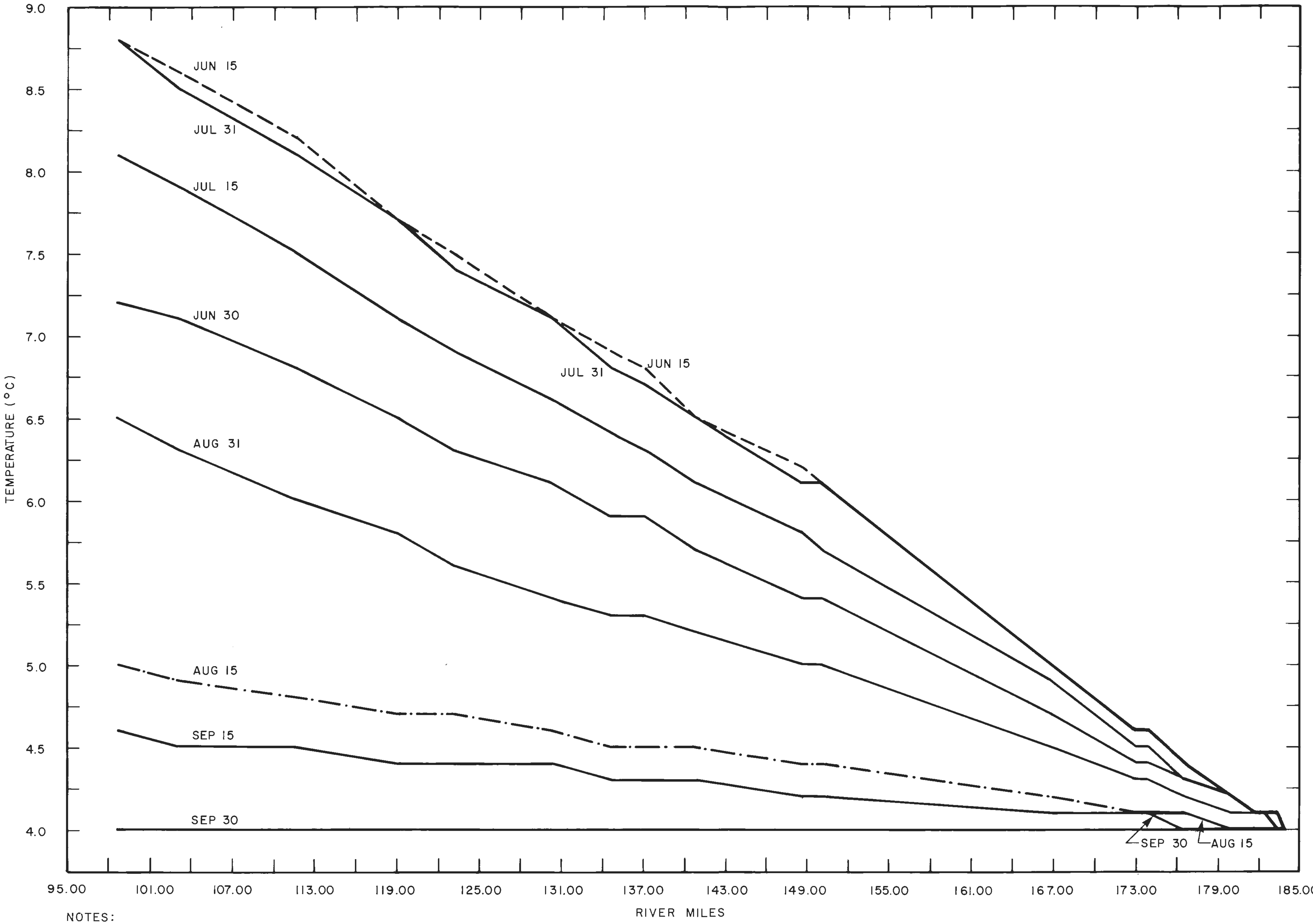
NOTE:

1. MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND LOW FLOW DISCHARGES.

2. GOLD CREEK DISCHARGE (CFS):
   JAN 1260
   FEB 1220
   MAR 1120
   APR 1240

WATANA FILLING : DOWNSTREAM TEMPERATURES - JAN TO APR
LOW WINTER FLOWS

FIGURE E.2.144

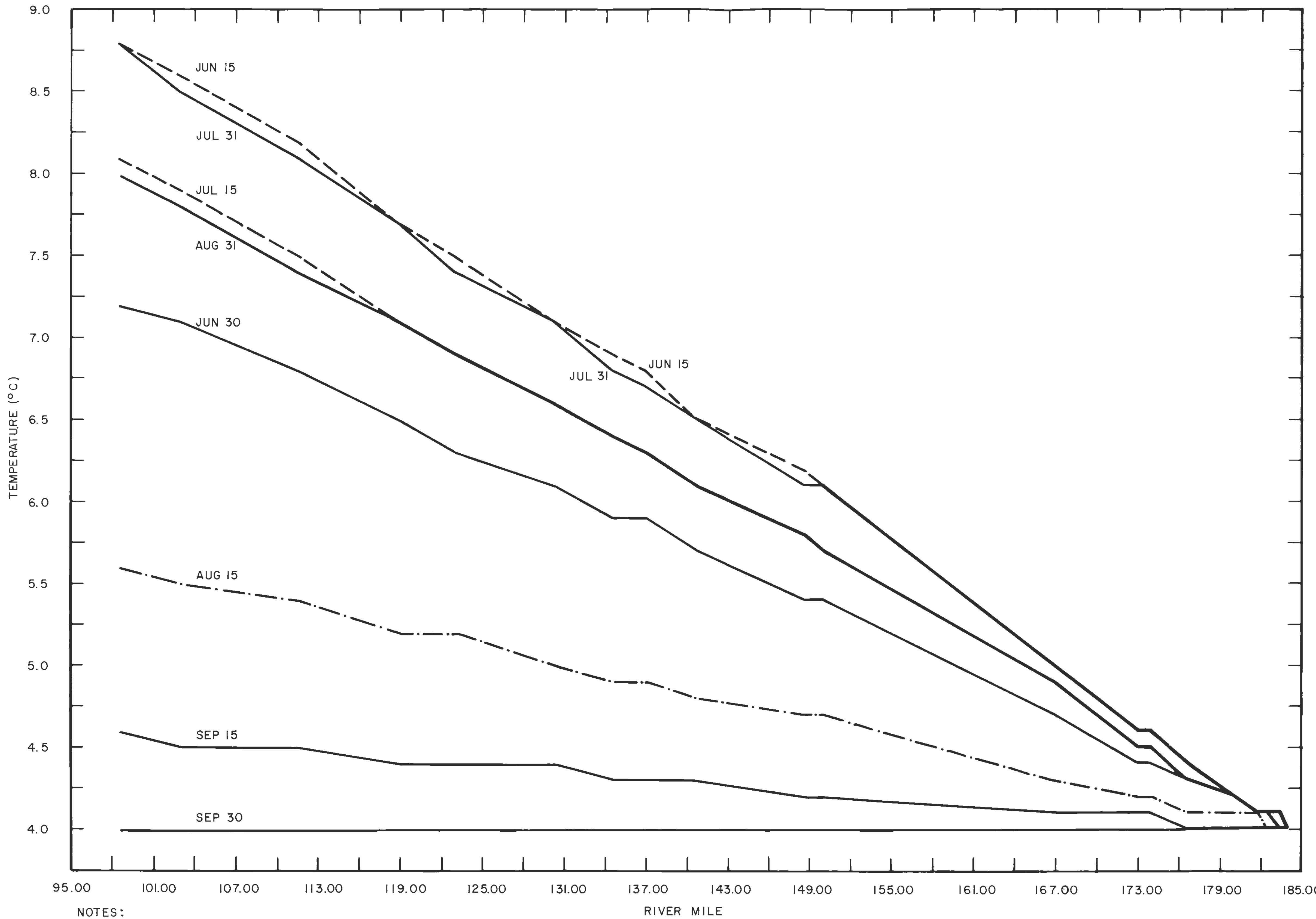


NOTES:

1. MODEL ASSUMES 1981 METEOROLOGICAL DATA RECORDED AT WATANA AND MEDIAN FILLING FLOWS.
2. GOLD CREEK DISCHARGE (CFS):
   JUN 6000 AUG 12000
   JUL 6700 SEP 9000

WATANA: SECOND YEAR OF FILLING DOWNSTREAM TEMPERATURES - SUMMER

FIGURE E.2.145

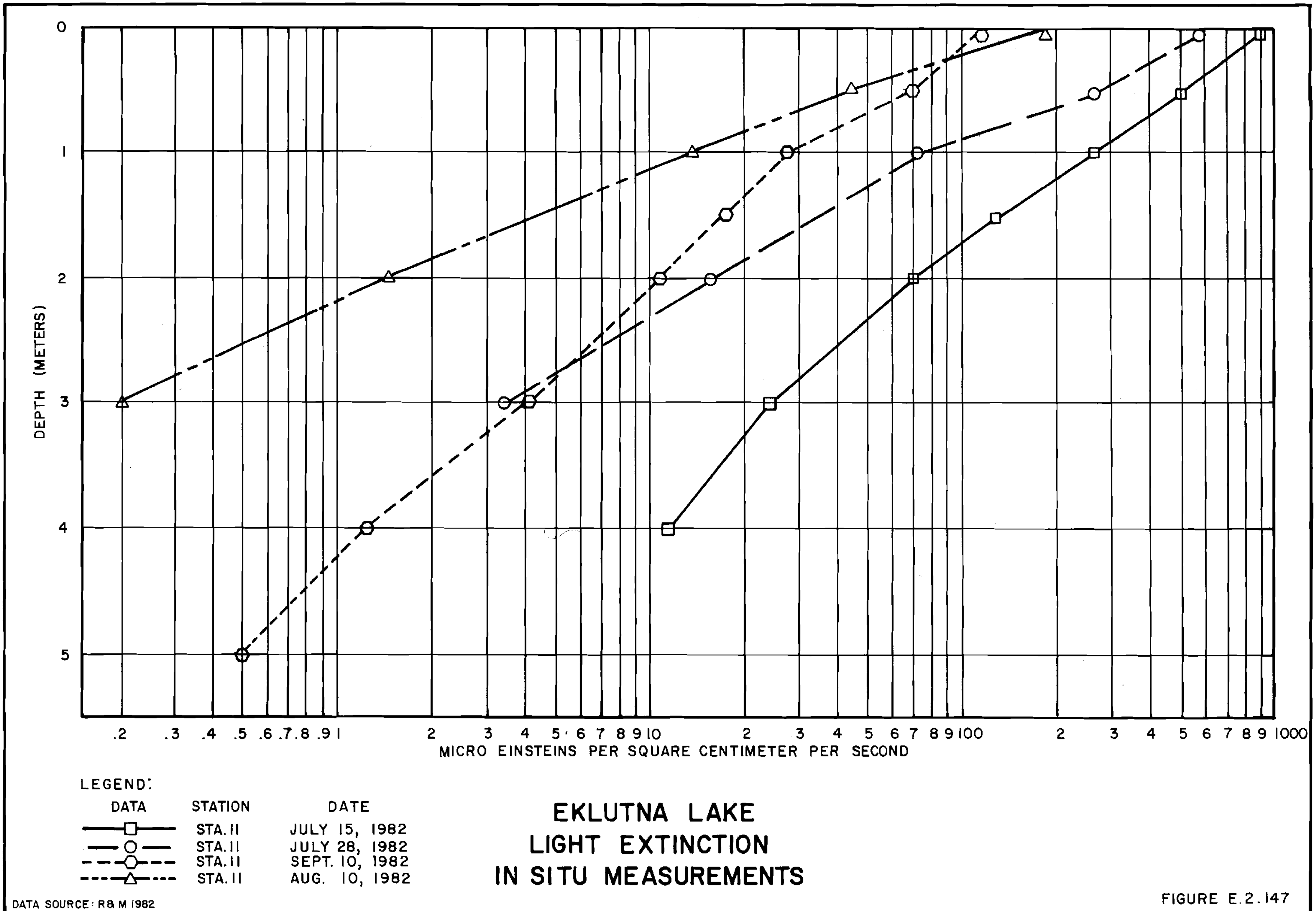


NOTES:

1. MODEL ASSUMES 1981 METEOROLOGICAL DATA RECORDED AT WATANA AND MEDIAN FILLING FLOWS WITH AUGUST FLOW REDUCED TO 6,000 CFS.
2. GOLD CREEK DISCHARGE (CFS):
   JUN 6000 AUG 6000
   JUL 6700 SEP 9100

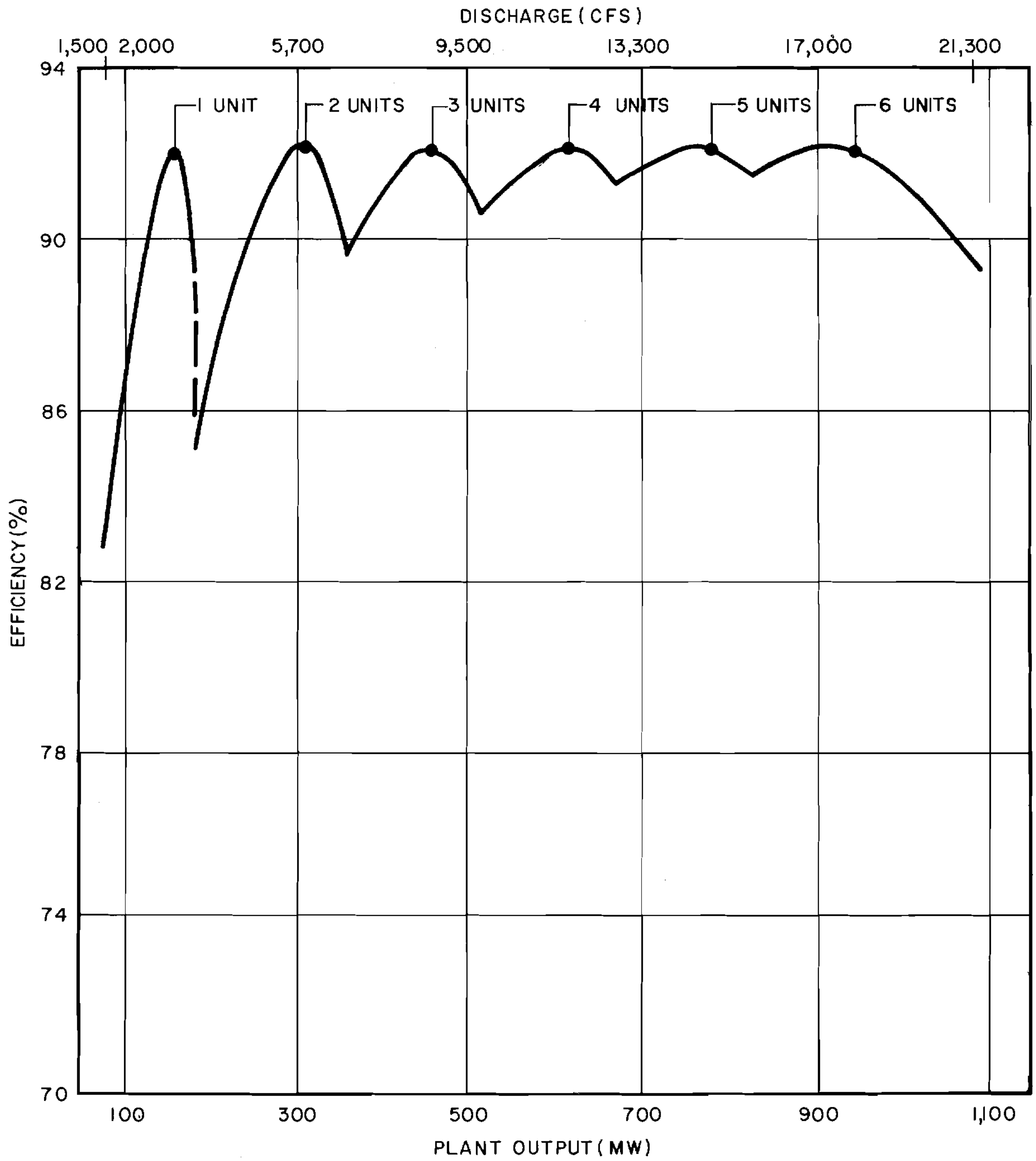
WATANA: SECOND YEAR OF FILLING DOWNSTREAM TEMPERATURES-SUMMER
6,000 CFS IN AUGUST

FIGURE E.2.146



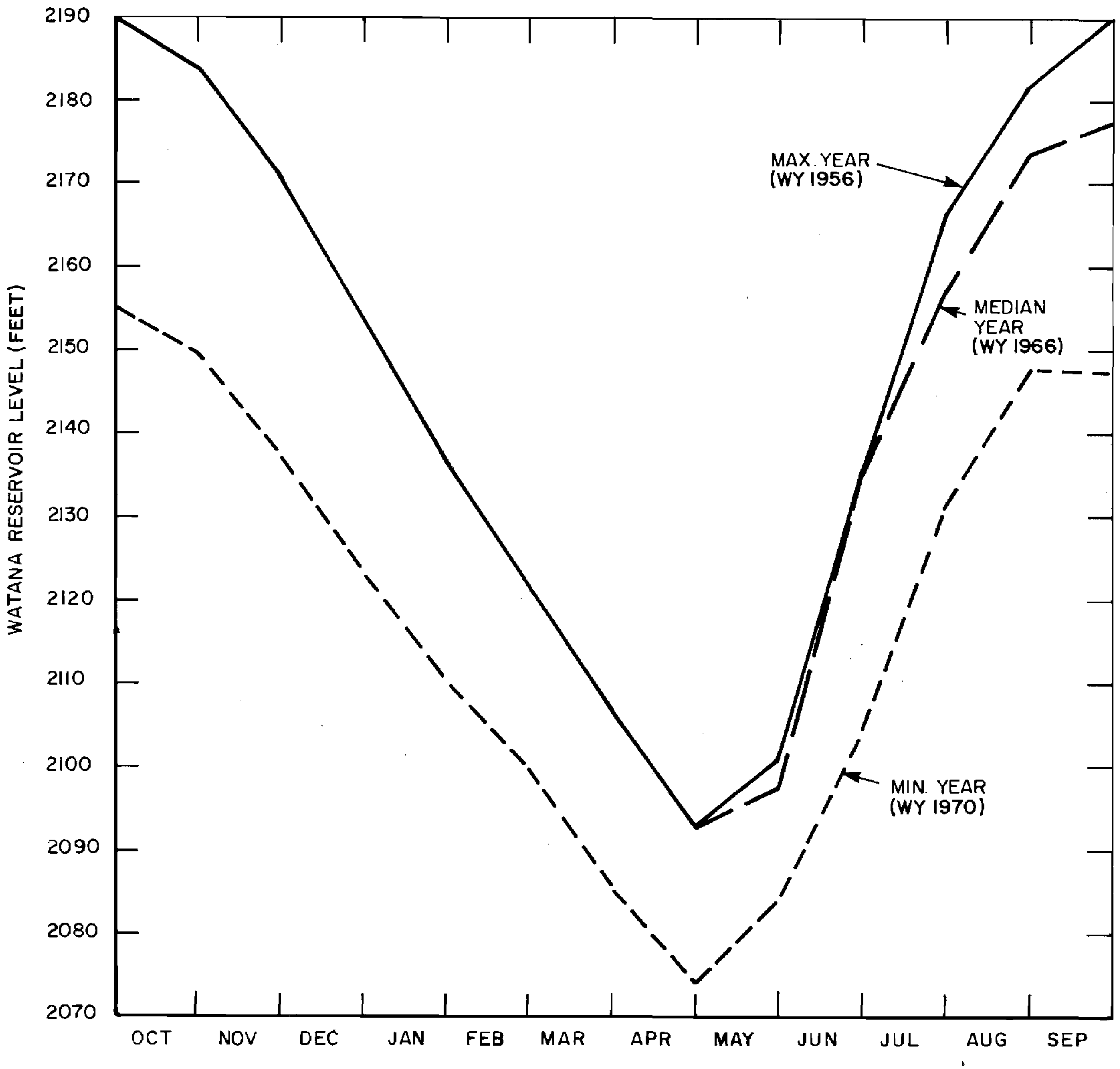
EKLUTNA LAKE
LIGHT EXTINCTION
IN SITU MEASUREMENTS

FIGURE E.2.147



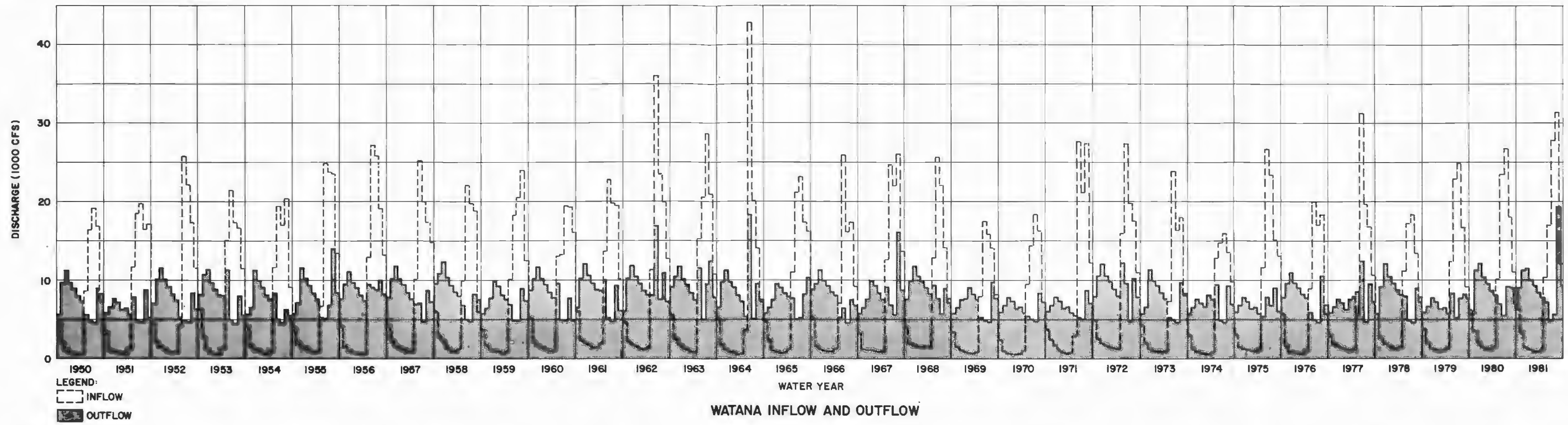
WATANA-UNIT EFFICIENCY AND DISCHARGE OPERATING RANGE (AT RATED HEAD)

FIGURE E.2.148

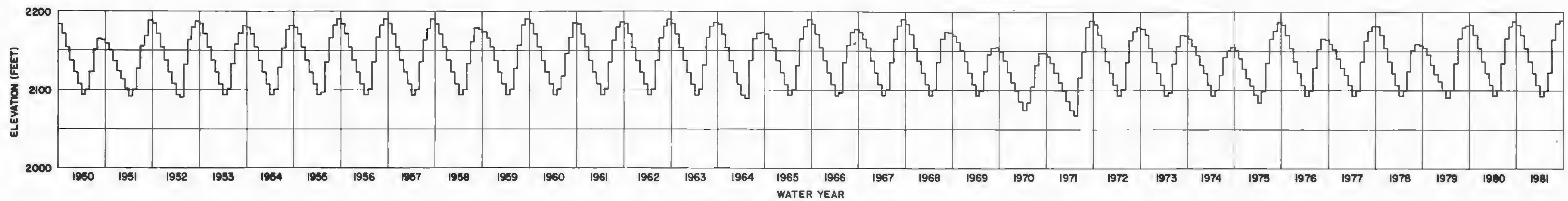


WATANA RESERVOIR WATER LEVELS (WATANA OPERATION)

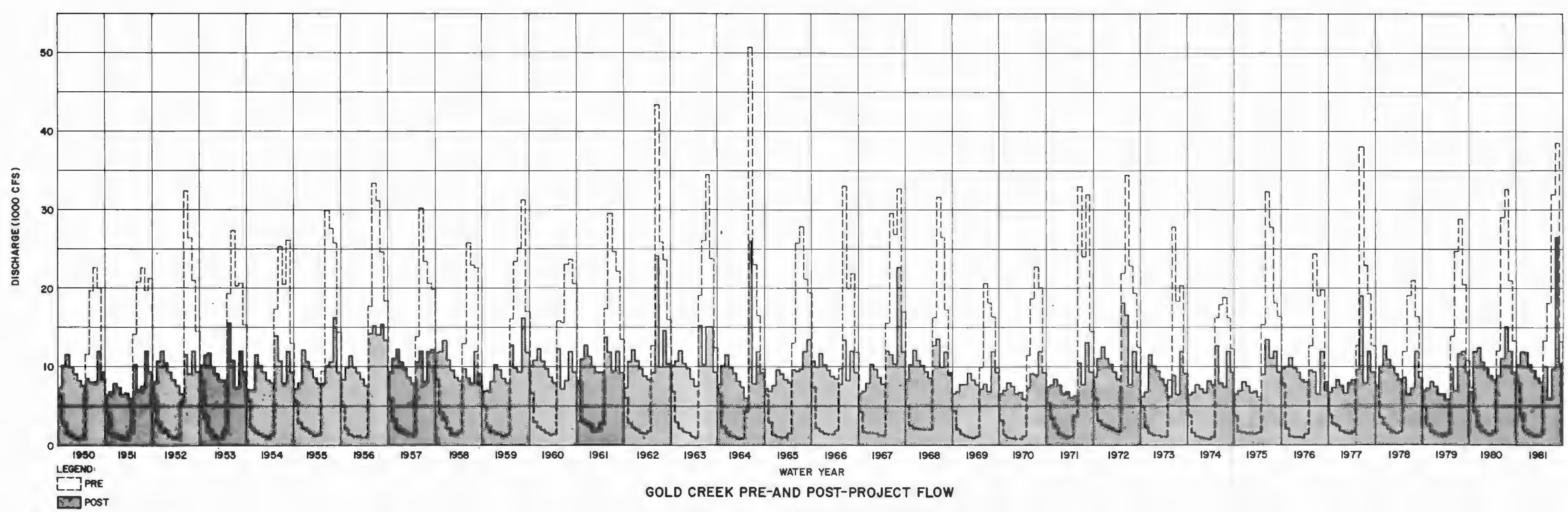
FIGURE E.2.149



WATANA INFLOW AND OUTFLOW



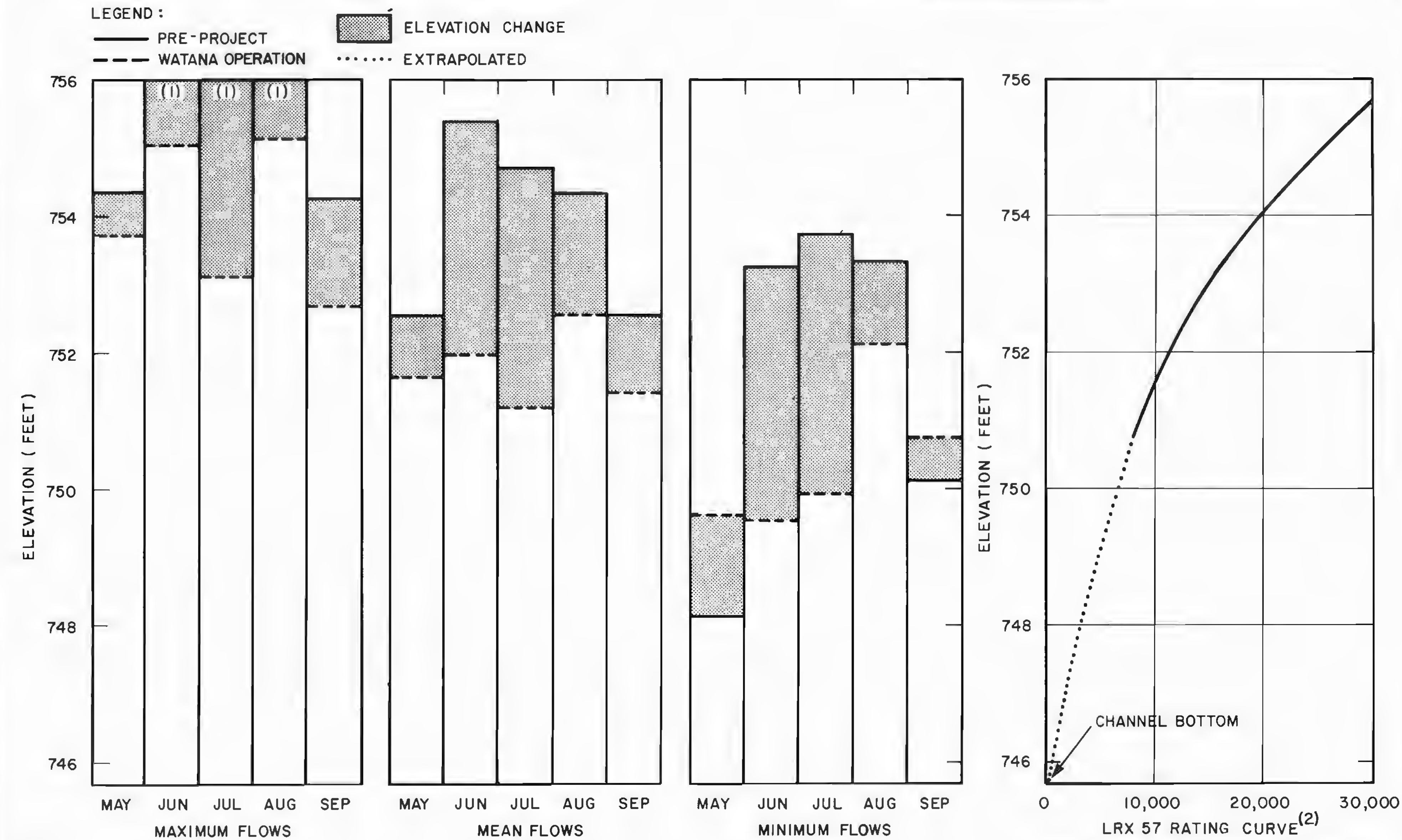
WATANA RESERVOIR ELEVATION



GOLD CREEK PRE-AND POST-PROJECT FLOW

WATANA SIMULATED RESERVOIR OPERATION

FIGURE E.2.150

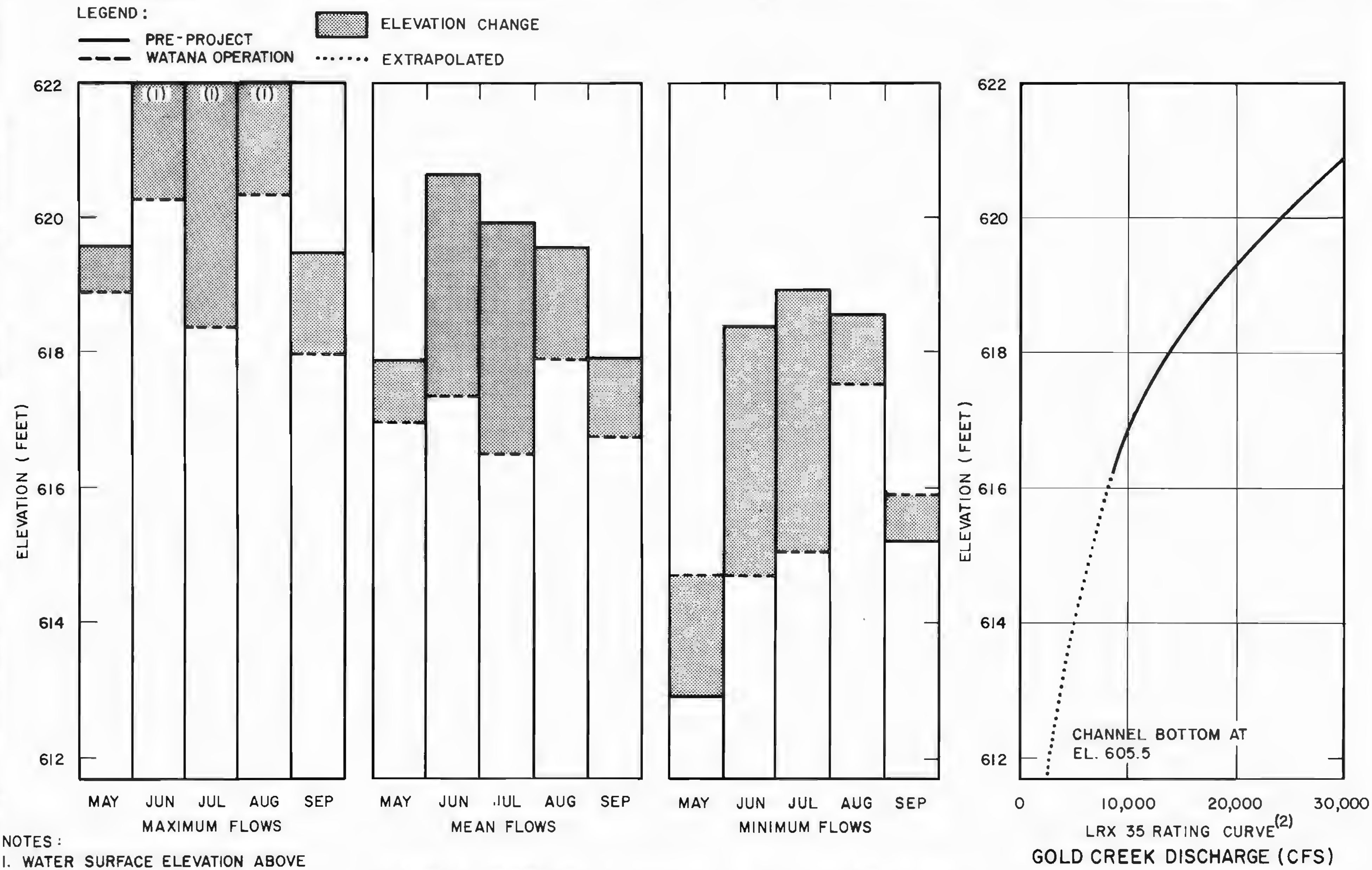


NOTES:

1. WATER SURFACE ELEVATION ABOVE RATING CURVE.
2. RATING CURVE BASED ON GOLD CREEK DISCHARGE AND OBSERVED 1982 WATER LEVELS (ADF & G 1982).

WATANA OPERATION: MONTHLY AVERAGE WATER SURFACE ELEVATIONS AT RIVER MILE 142.3

FIGURE E.2.151

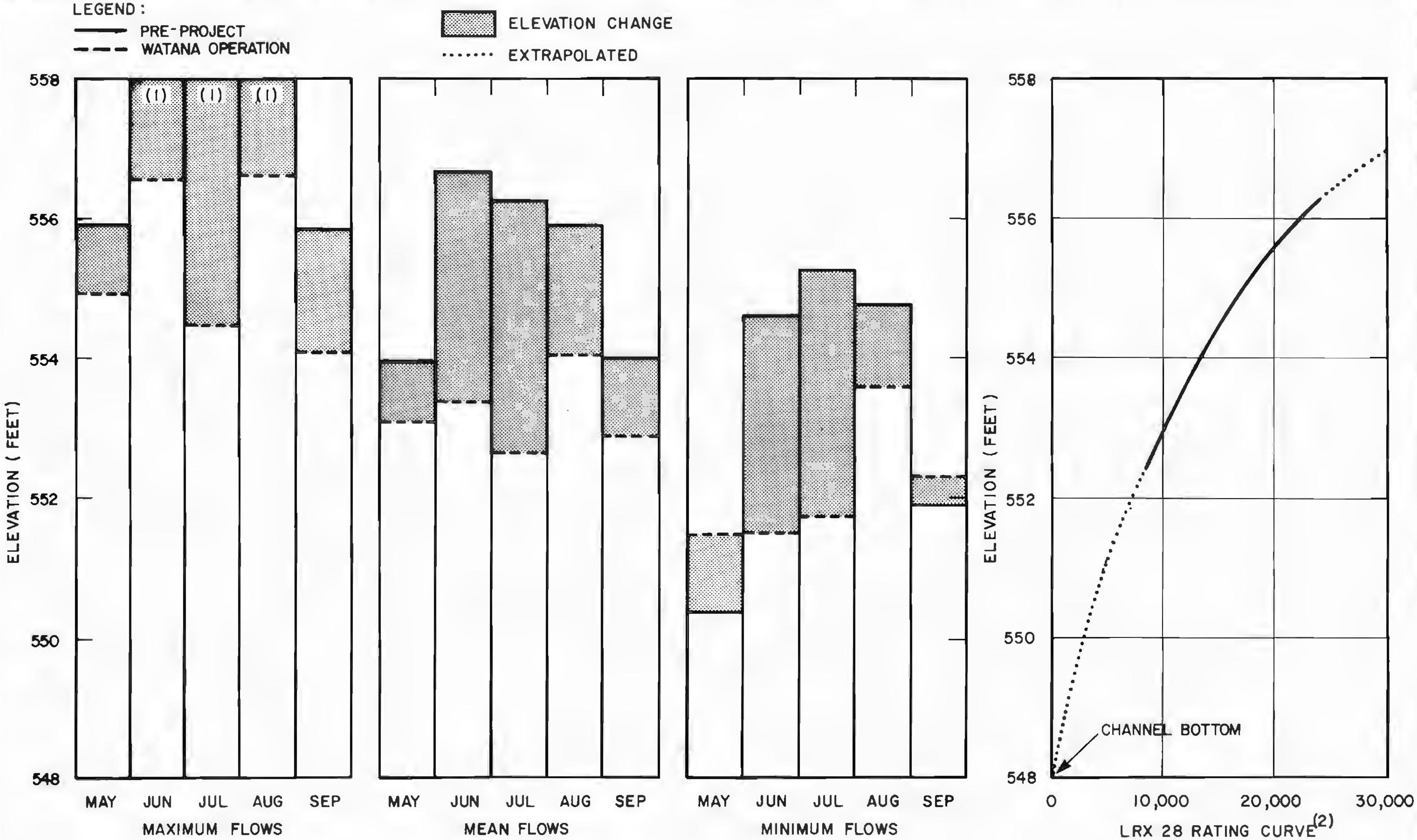


NOTES:

1. WATER SURFACE ELEVATION ABOVE RATING CURVE
2. RATING CURVE BASED ON GOLD CREEK DISCHARGE AND OBSERVED 1982 WATER LEVELS (ADF&G 1982).

WATANA OPERATION: MONTHLY AVERAGE WATER SURFACE ELEVATIONS AT RIVER MILE 130.9

FIGURE E.2.152

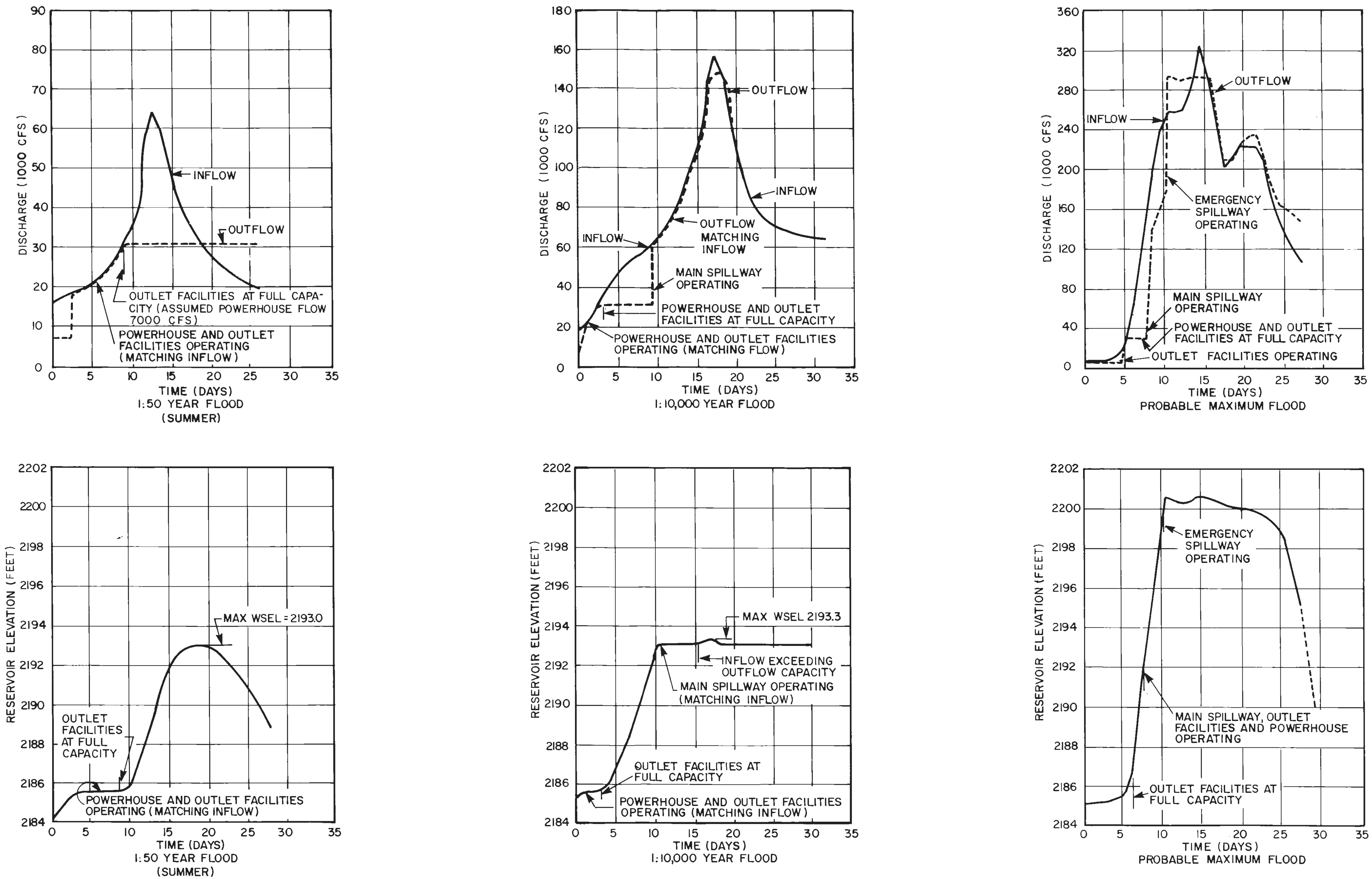


NOTES:

1. WATER SURFACE ELEVATION ABOVE RATING CURVE.
2. RATING CURVE BASED ON GOLD CREEK DISCHARGE AND OBSERVED 1982 WATER LEVELS (ADF&G 1982).

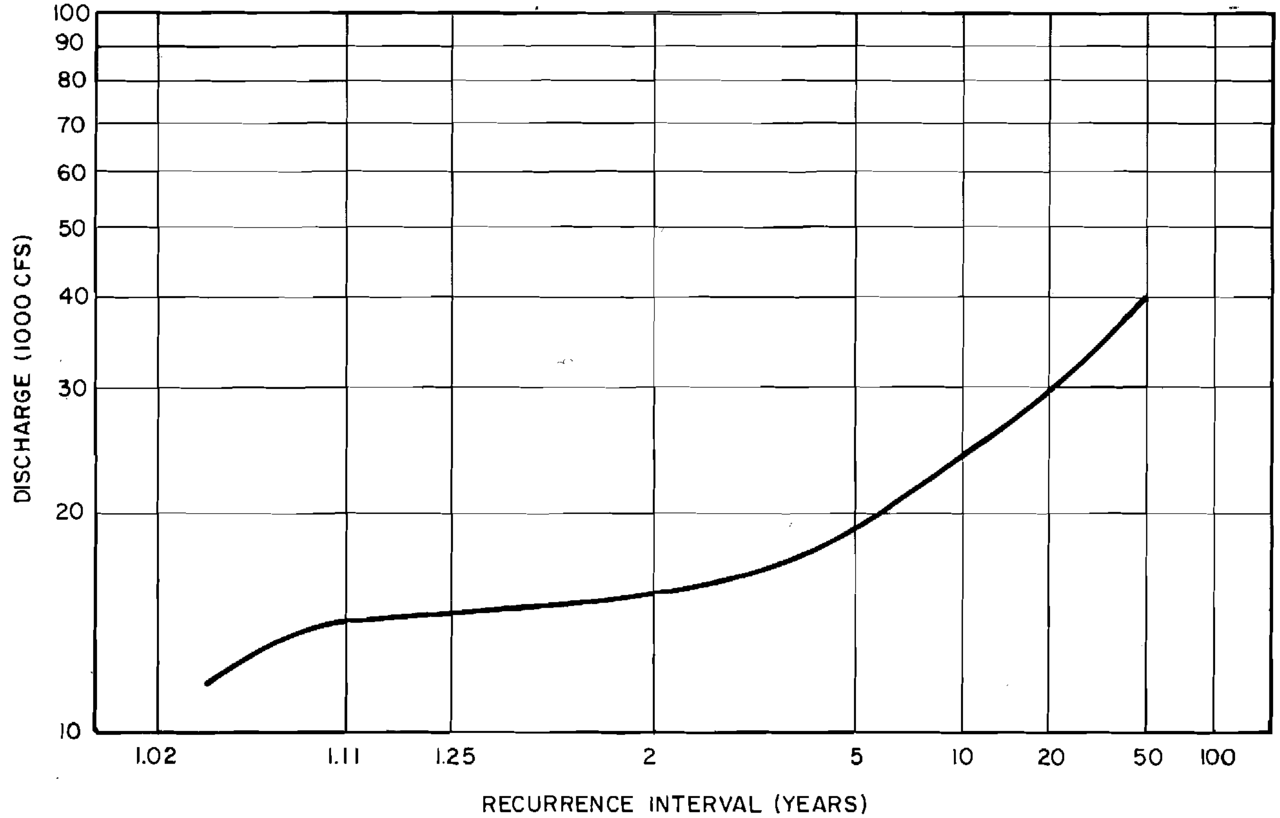
WATANA OPERATION: MONTHLY AVERAGE WATER SURFACE ELEVATIONS AT RIVER MILE 124.4

FIGURE E.2.153



WATANA
FLOOD DISCHARGES AND RESERVOIR SURFACE ELEVATIONS

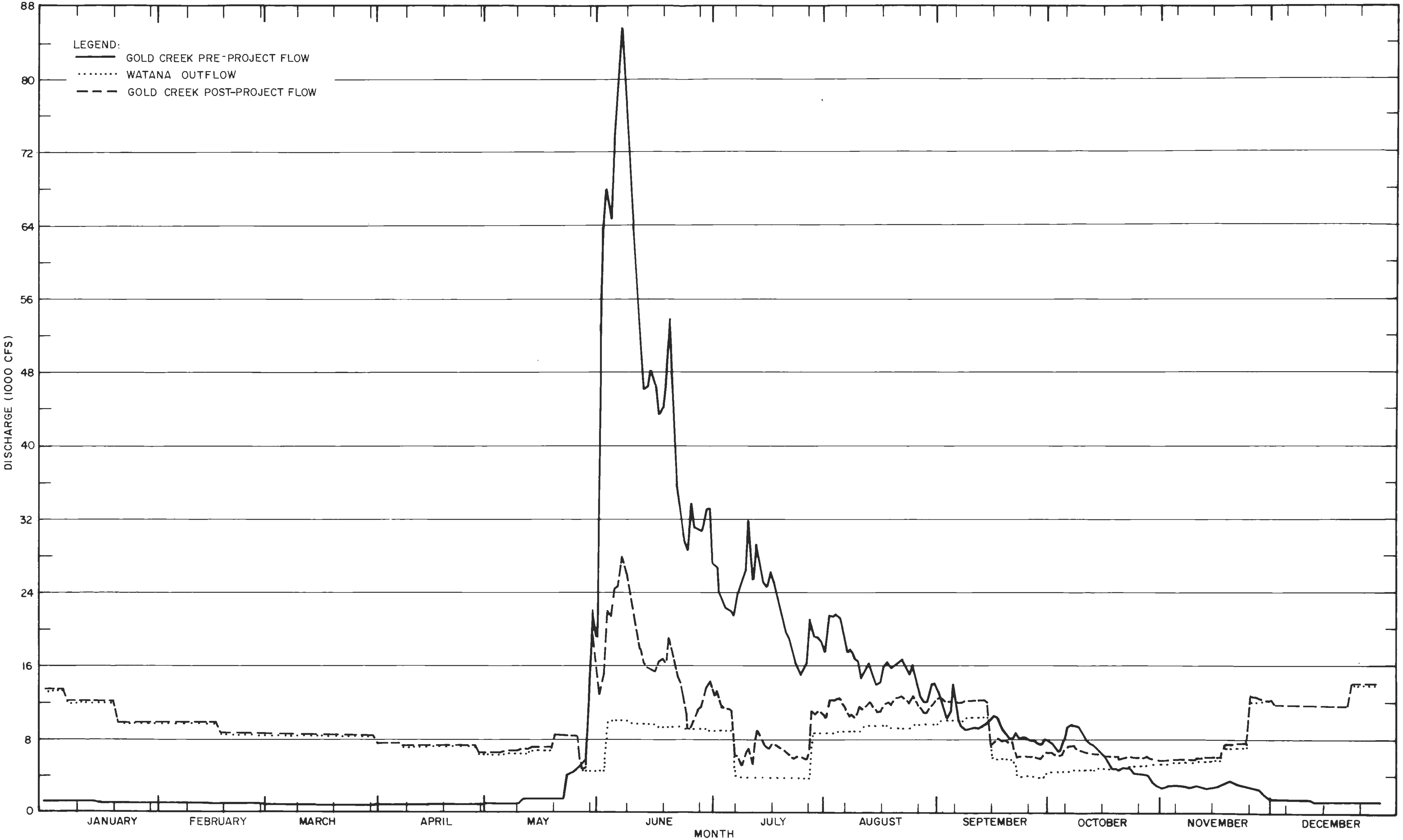
FIGURE E.2.154



NOTE: BASED ON WEEKLY RESERVOIR SIMULATIONS.

GOLD CREEK ANNUAL FLOOD FREQUENCY CURVE WATANA OPERATION

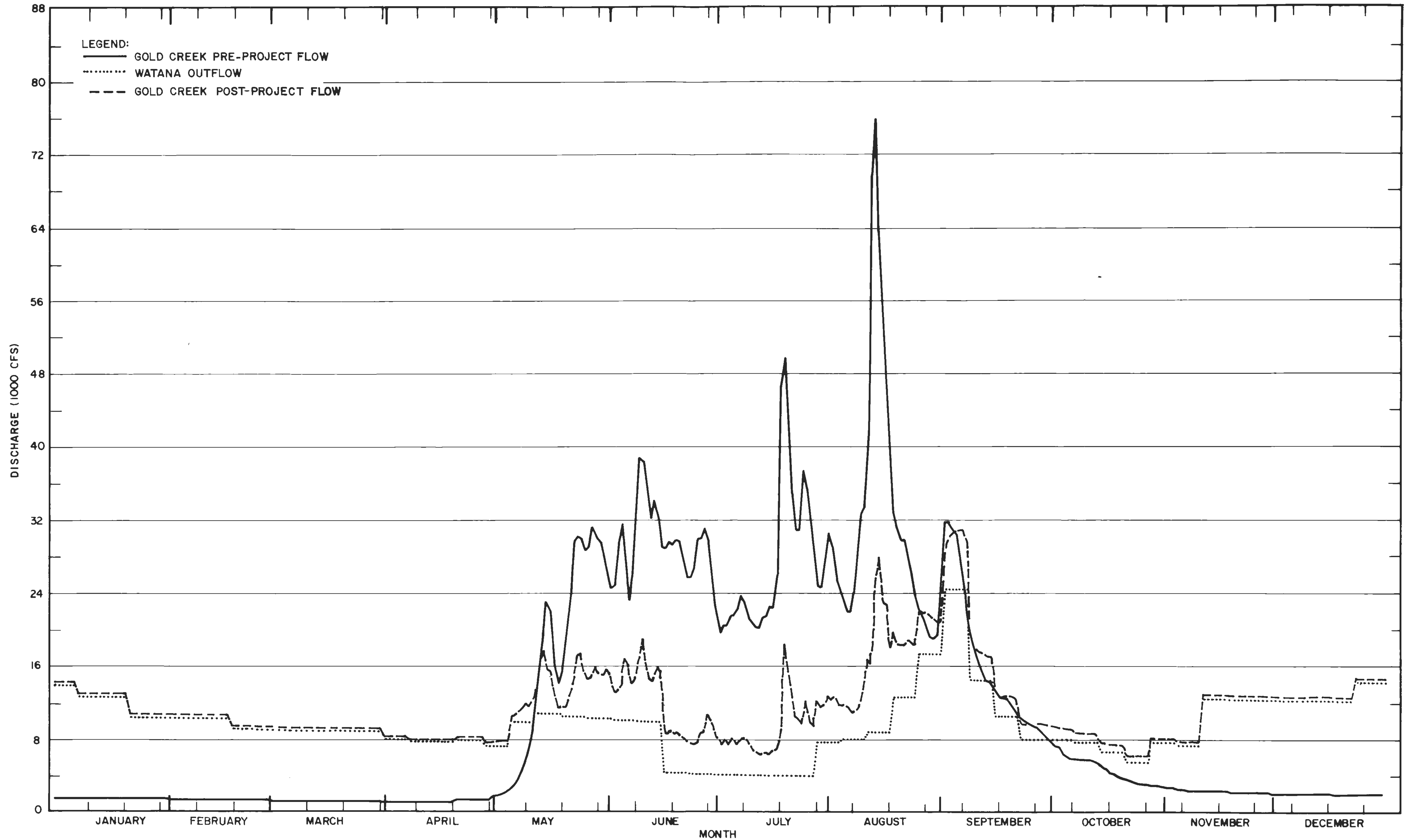
FIGURE E.2.155



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1964 WATANA AND GOLD CREEK FLOW
SIMULATION USING 1995 DEMAND

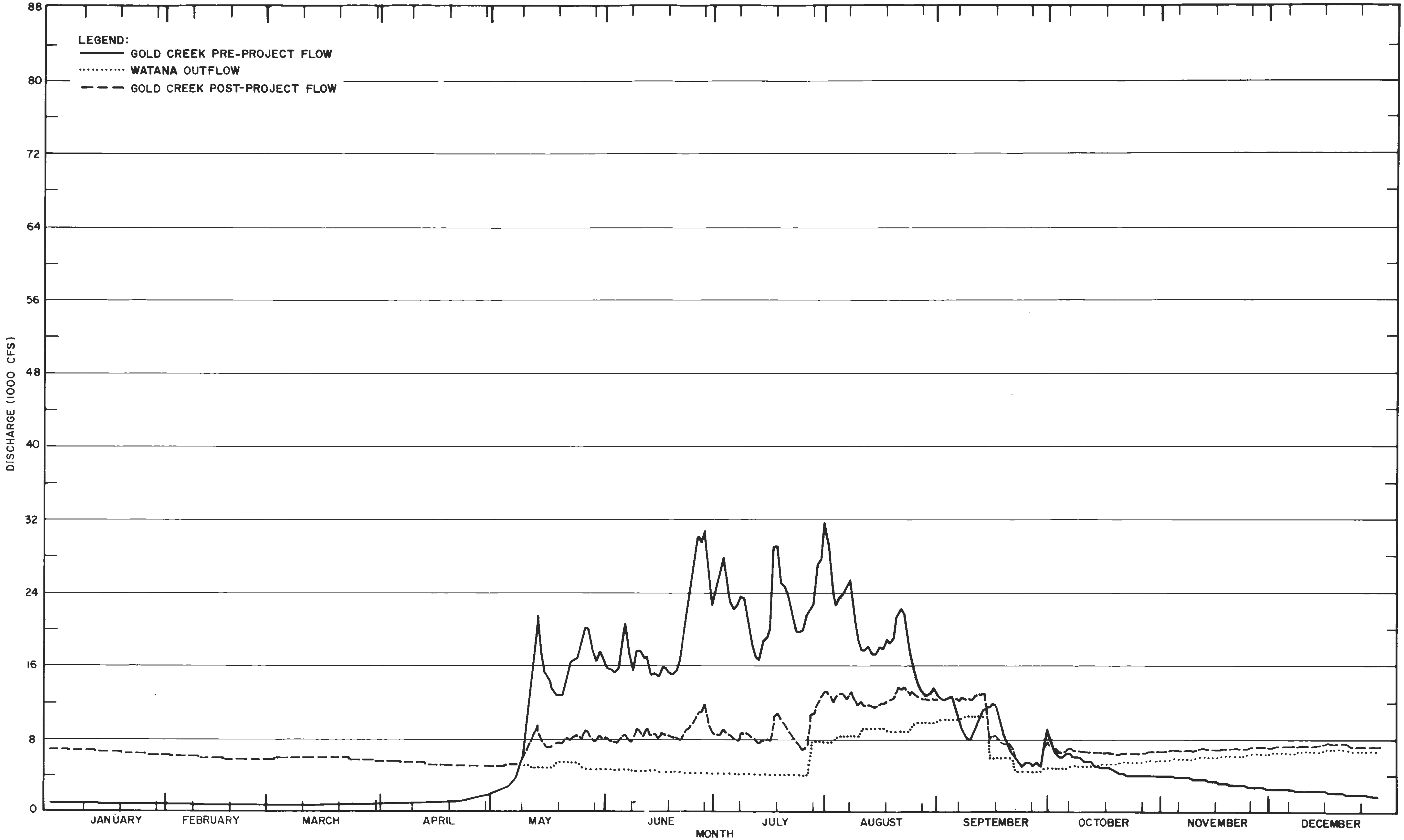
FIGURE E.2.156



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1967 WATANA AND GOLD CREEK FLOW
SIMULATION USING 1995 DEMAND

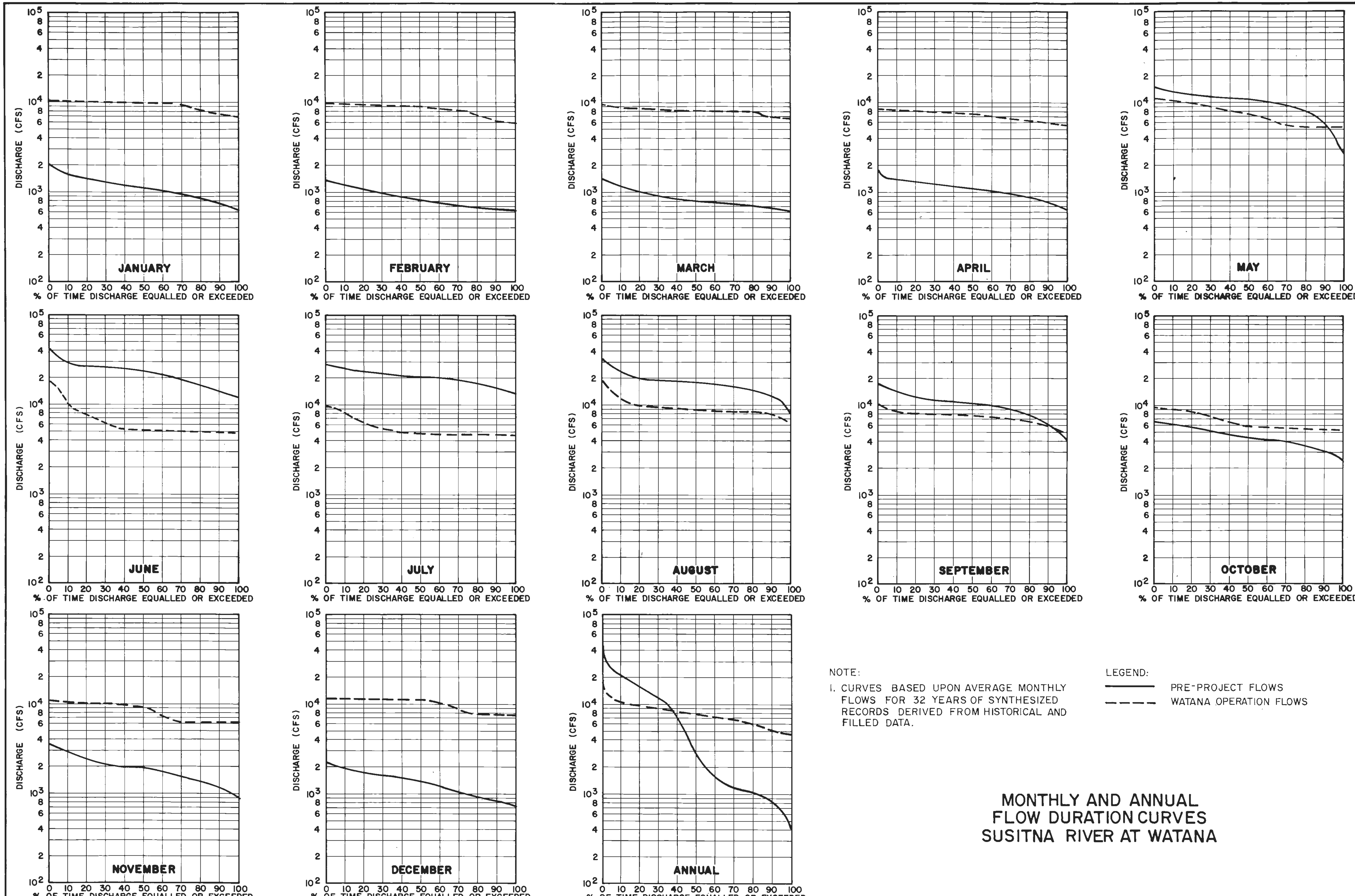
FIGURE E.2.157



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1970 WATANA AND GOLD CREEK FLOW SIMULATION USING 1995 DEMAND

FIGURE E.2.158

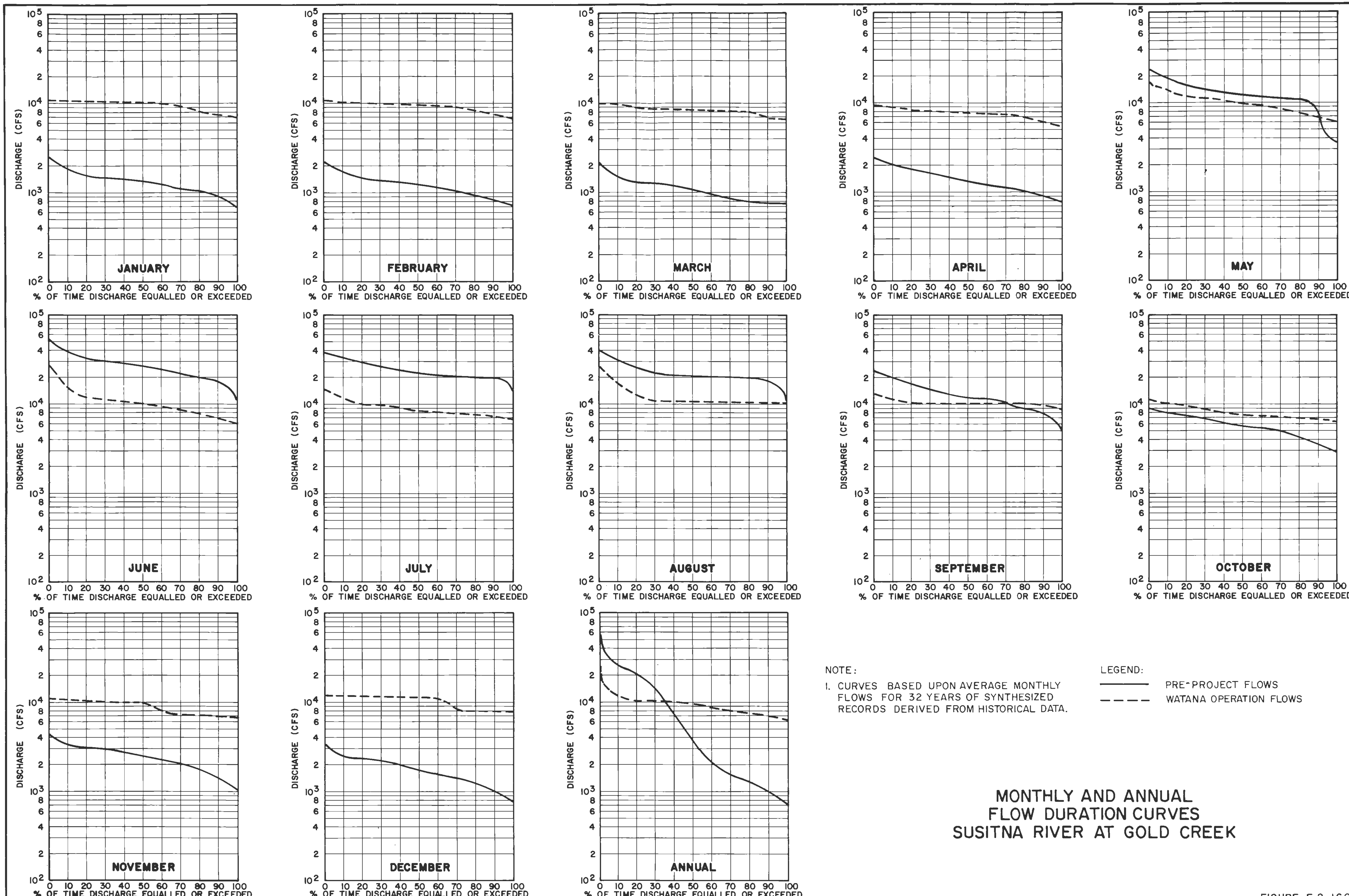


NOTE:

1. CURVES BASED UPON AVERAGE MONTHLY FLOWS FOR 32 YEARS OF SYNTHESIZED RECORDS DERIVED FROM HISTORICAL AND FILLED DATA.

MONTHLY AND ANNUAL FLOW DURATION CURVES SUSITNA RIVER AT WATANA

FIGURE E.2.159

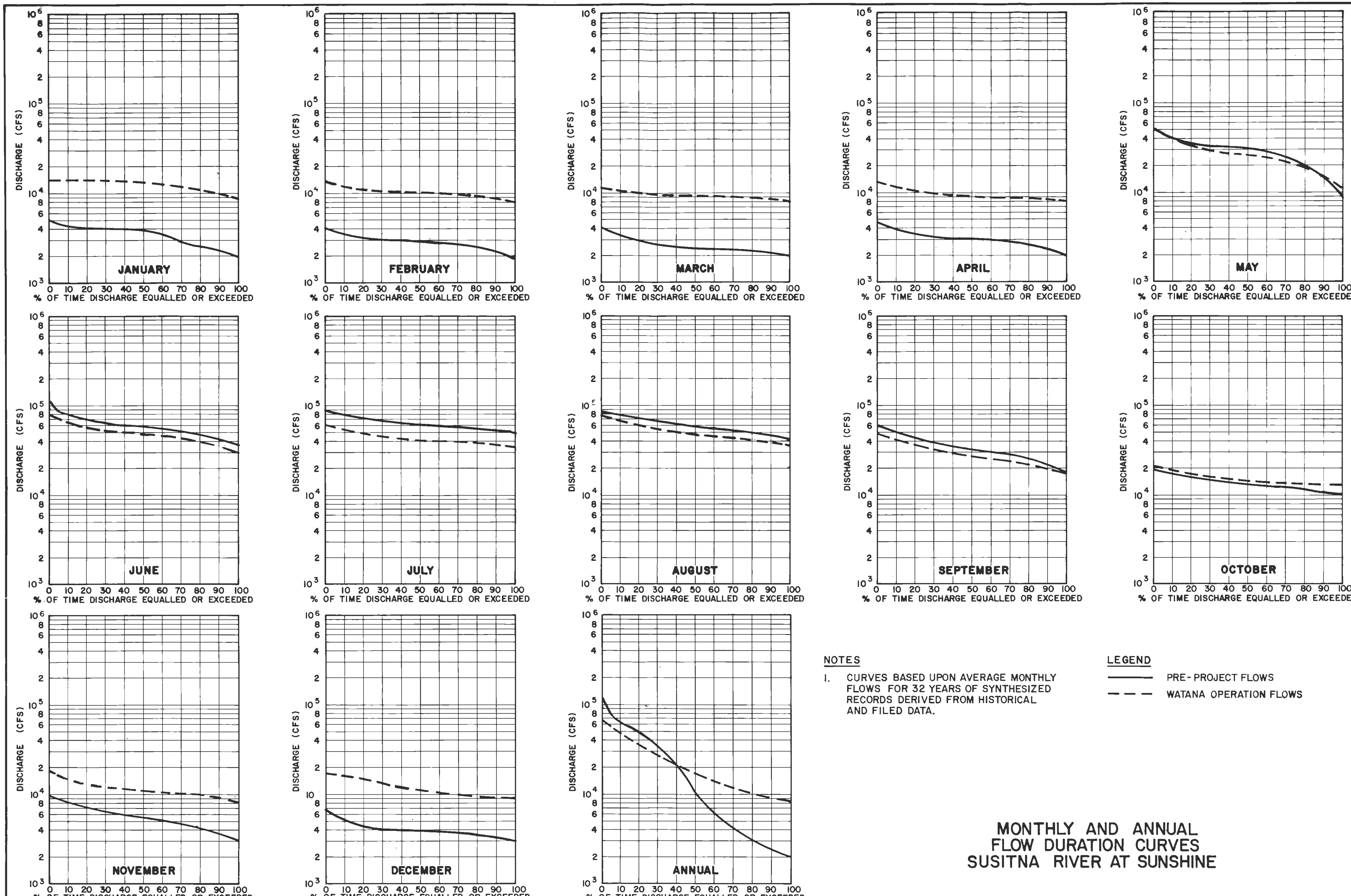


NOTE:

1. CURVES BASED UPON AVERAGE MONTHLY FLOWS FOR 32 YEARS OF SYNTHESIZED RECORDS DERIVED FROM HISTORICAL DATA.

MONTHLY AND ANNUAL
FLOW DURATION CURVES
SUSITNA RIVER AT GOLD CREEK

FIGURE E.2.160



NOTES

1. CURVES BASED UPON AVERAGE MONTHLY FLOWS FOR 32 YEARS OF SYNTHESIZED RECORDS DERIVED FROM HISTORICAL AND FILED DATA.

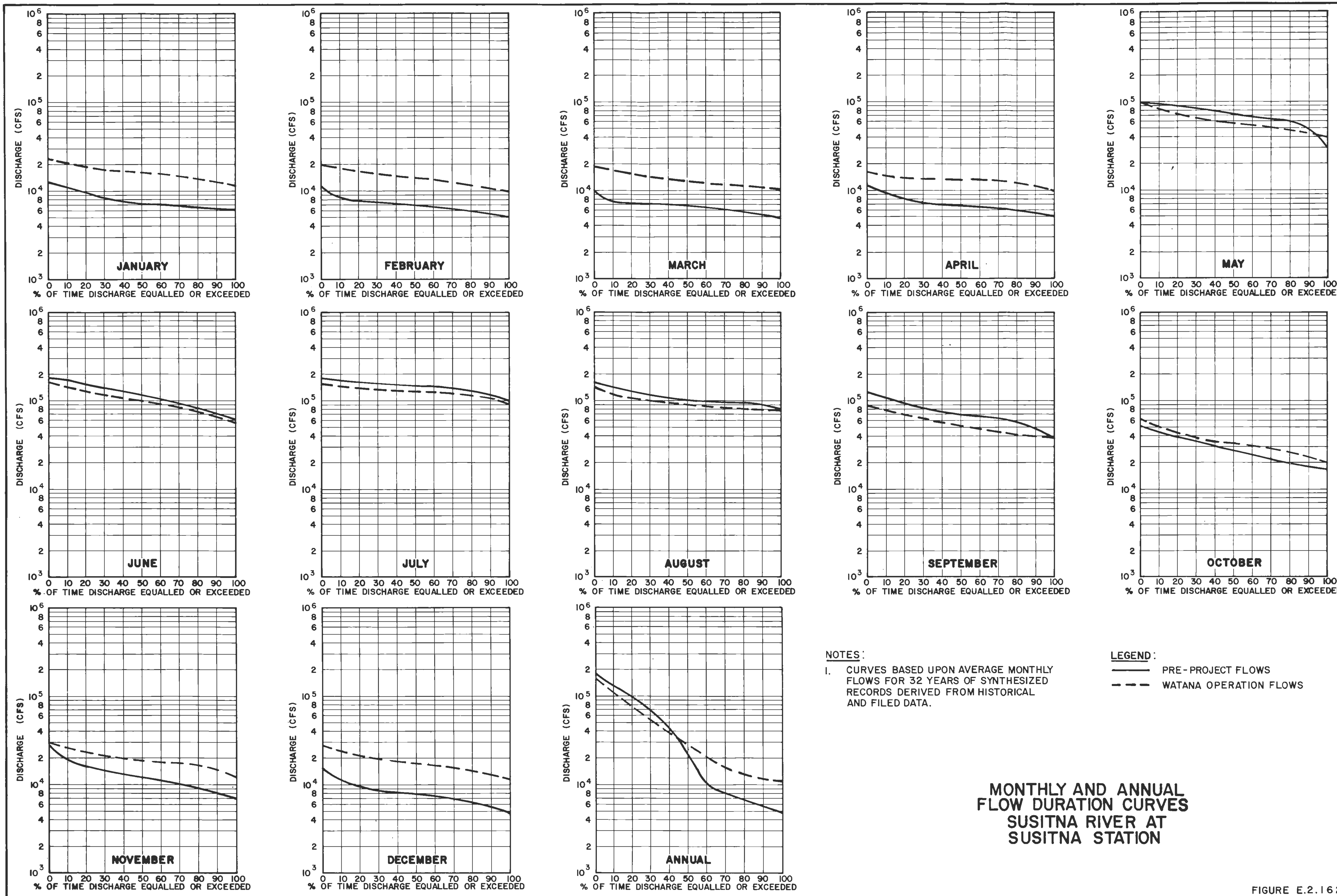
LEGEND

——— PRE-PROJECT FLOWS

– – – WATANA OPERATION FLOWS

MONTHLY AND ANNUAL FLOW DURATION CURVES SUSITNA RIVER AT SUNSHINE

FIGURE E.2.161



NOTES:

1. CURVES BASED UPON AVERAGE MONTHLY FLOWS FOR 32 YEARS OF SYNTHESIZED RECORDS DERIVED FROM HISTORICAL AND FILED DATA.

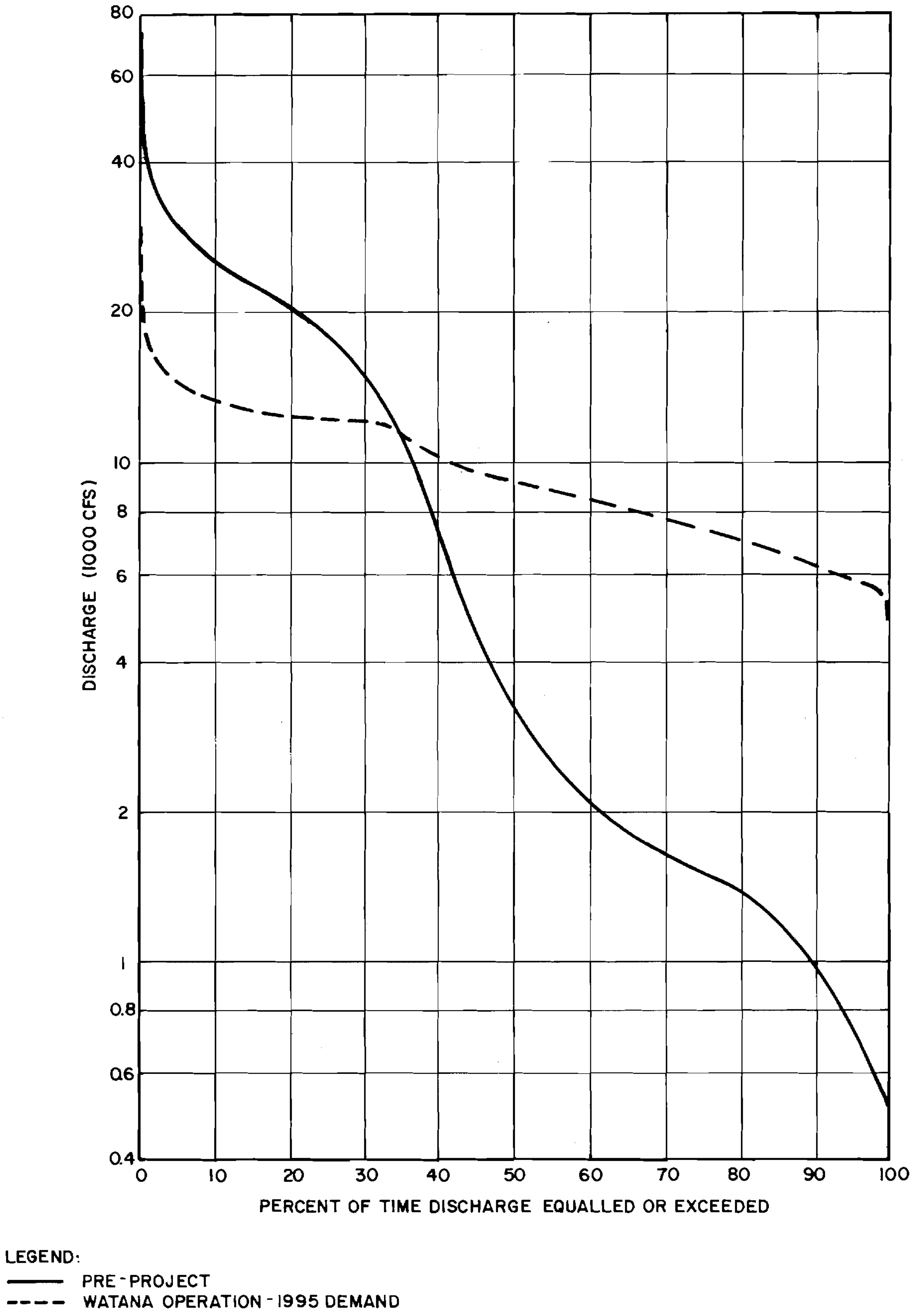
LEGEND:

——— PRE-PROJECT FLOWS

– – – WATANA OPERATION FLOWS

MONTHLY AND ANNUAL FLOW DURATION CURVES SUSITNA RIVER AT SUSITNA STATION

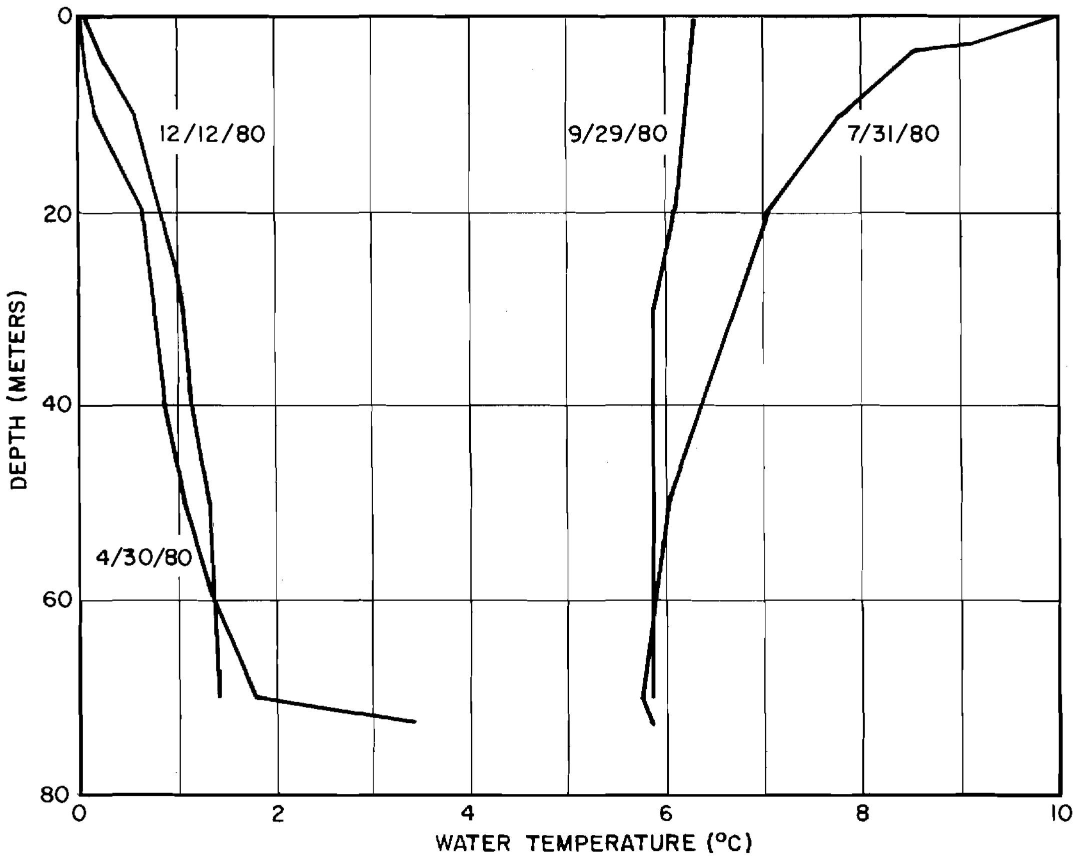
FIGURE E.2.162



NOTE: FLOW DURATION CURVES ARE BASED ON MEAN WEEKLY DISCHARGE.

ANNUAL FLOW DURATION CURVE
SUSITNA RIVER AT GOLD CREEK
PRE-PROJECT AND WATANA OPERATION

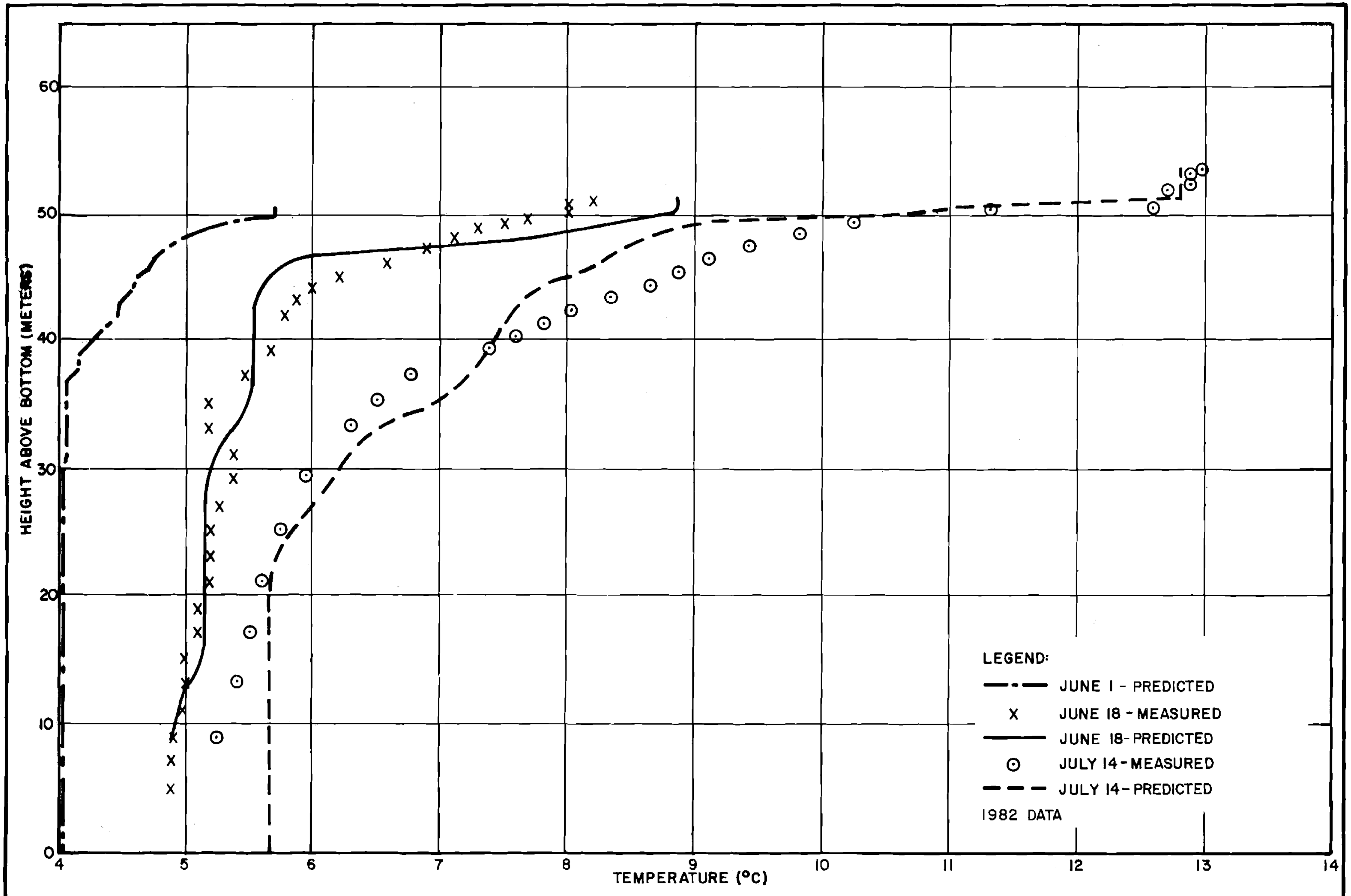
FIGURE E.2.163



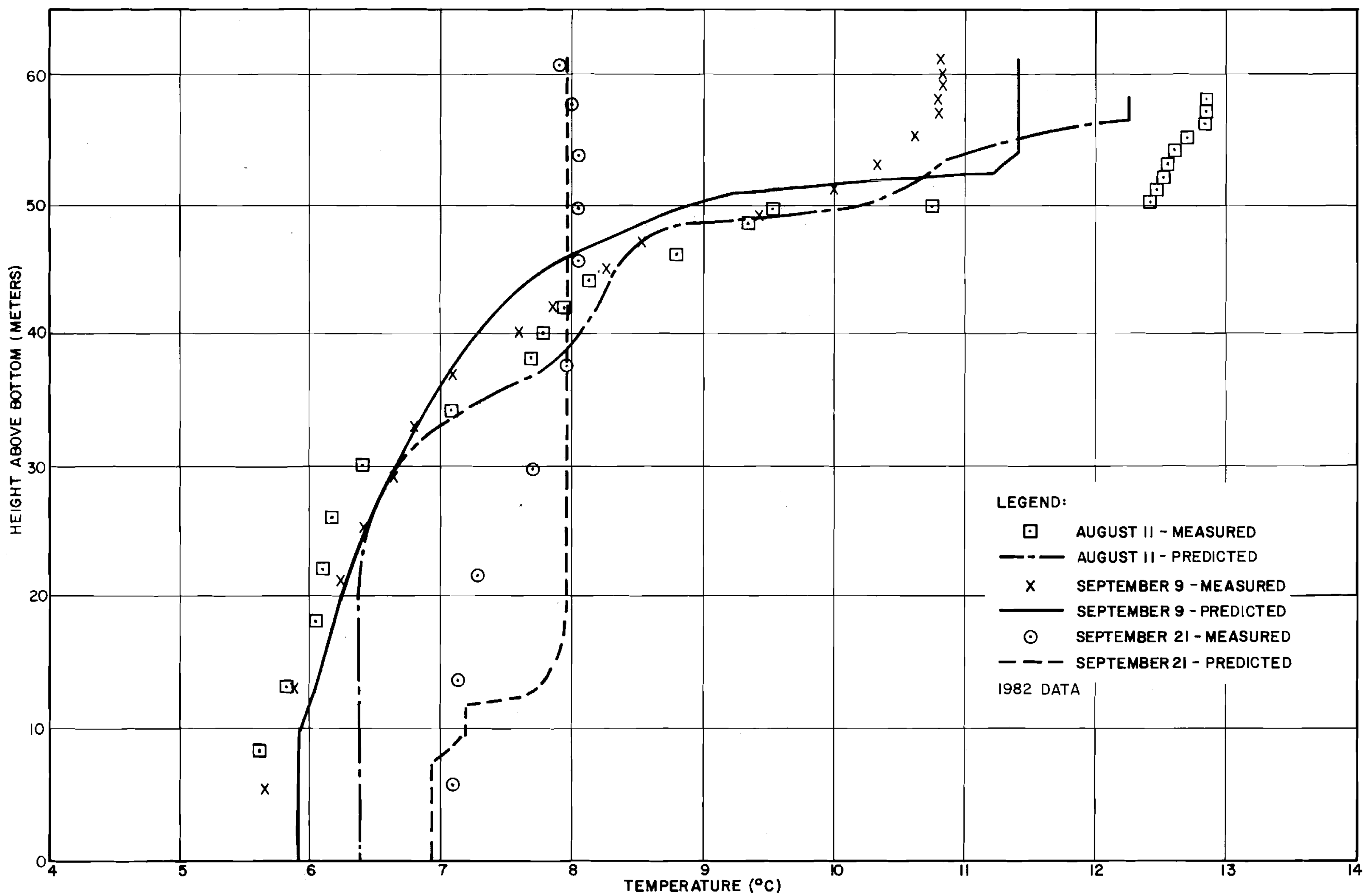
WATER TEMPERATURE PROFILES
BRADLEY LAKE, ALASKA

SOURCE: CORPS OF ENGINEERS 1982

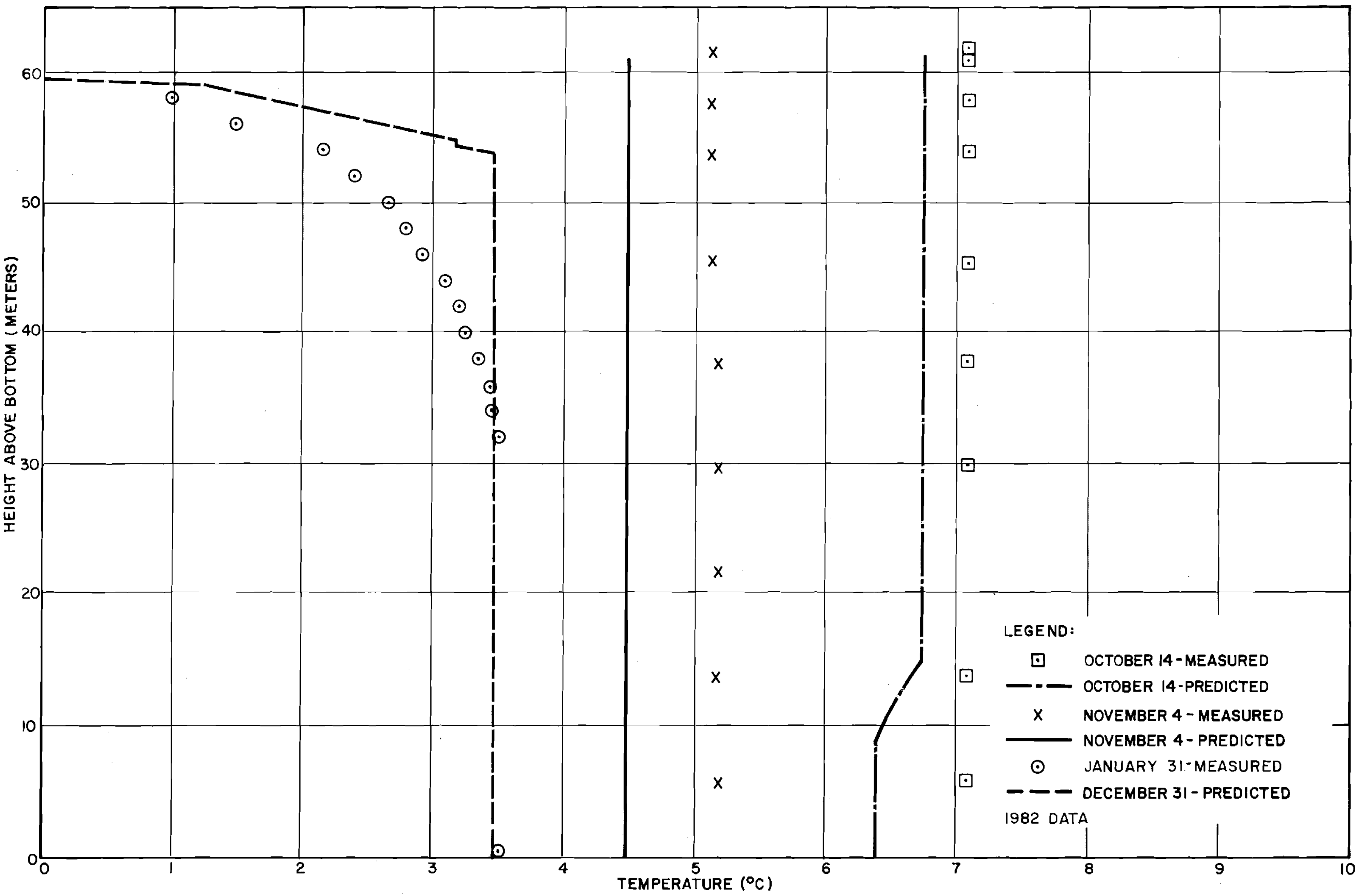
FIGURE E.2.164



EKLUTNA LAKE OBSERVED AND PREDICTED TEMPERATURE PROFILES JUNE-JULY FIGURE E.2.165

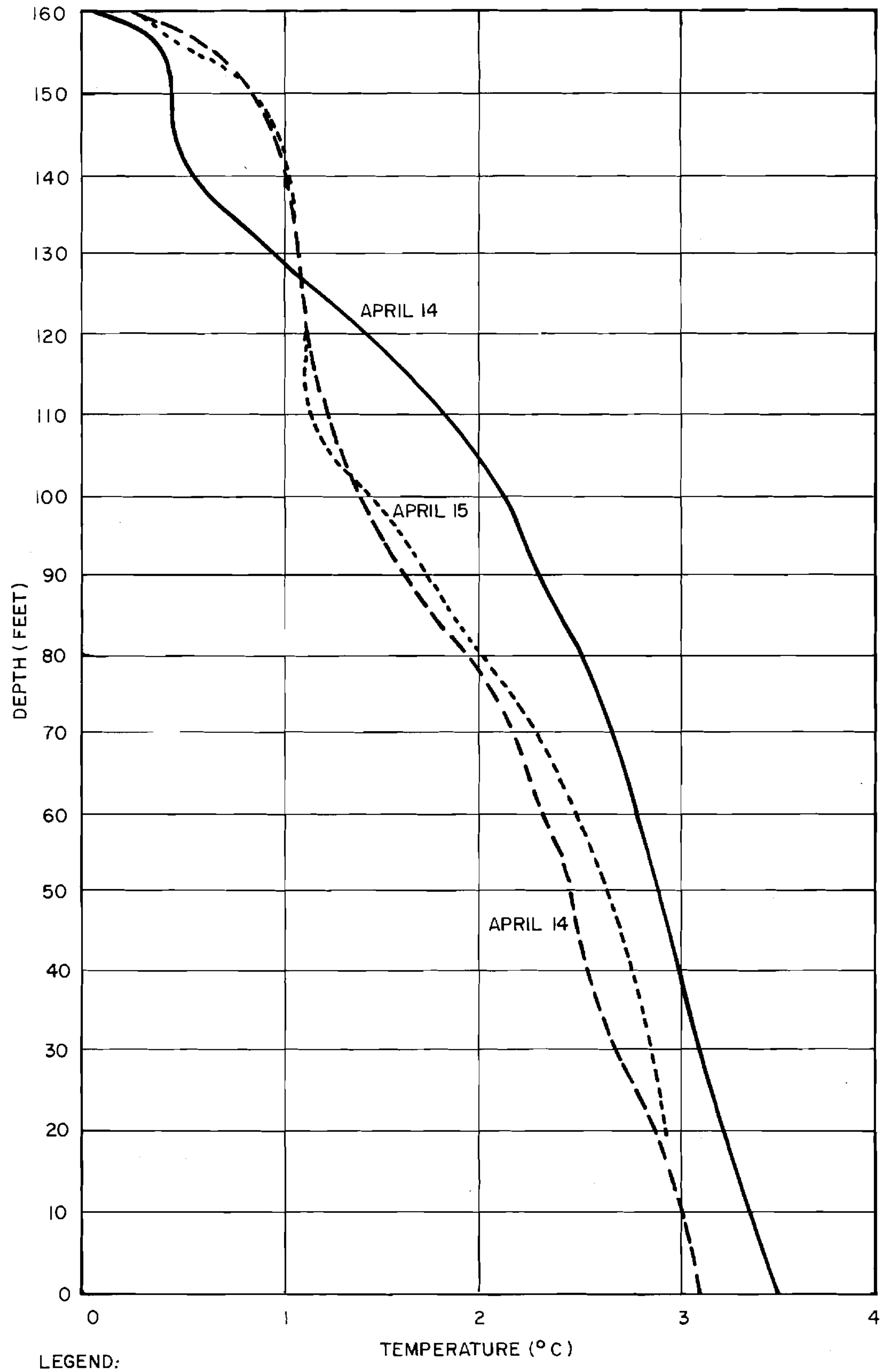


EKLUTNA LAKE OBSERVED AND PREDICTED TEMPERATURE PROFILES AUG - SEP FIGURE E.2.166



EKLUTNA LAKE OBSERVED AND PREDICTED TEMPERATURE PROFILES OCT - DEC

FIGURE E.2.167



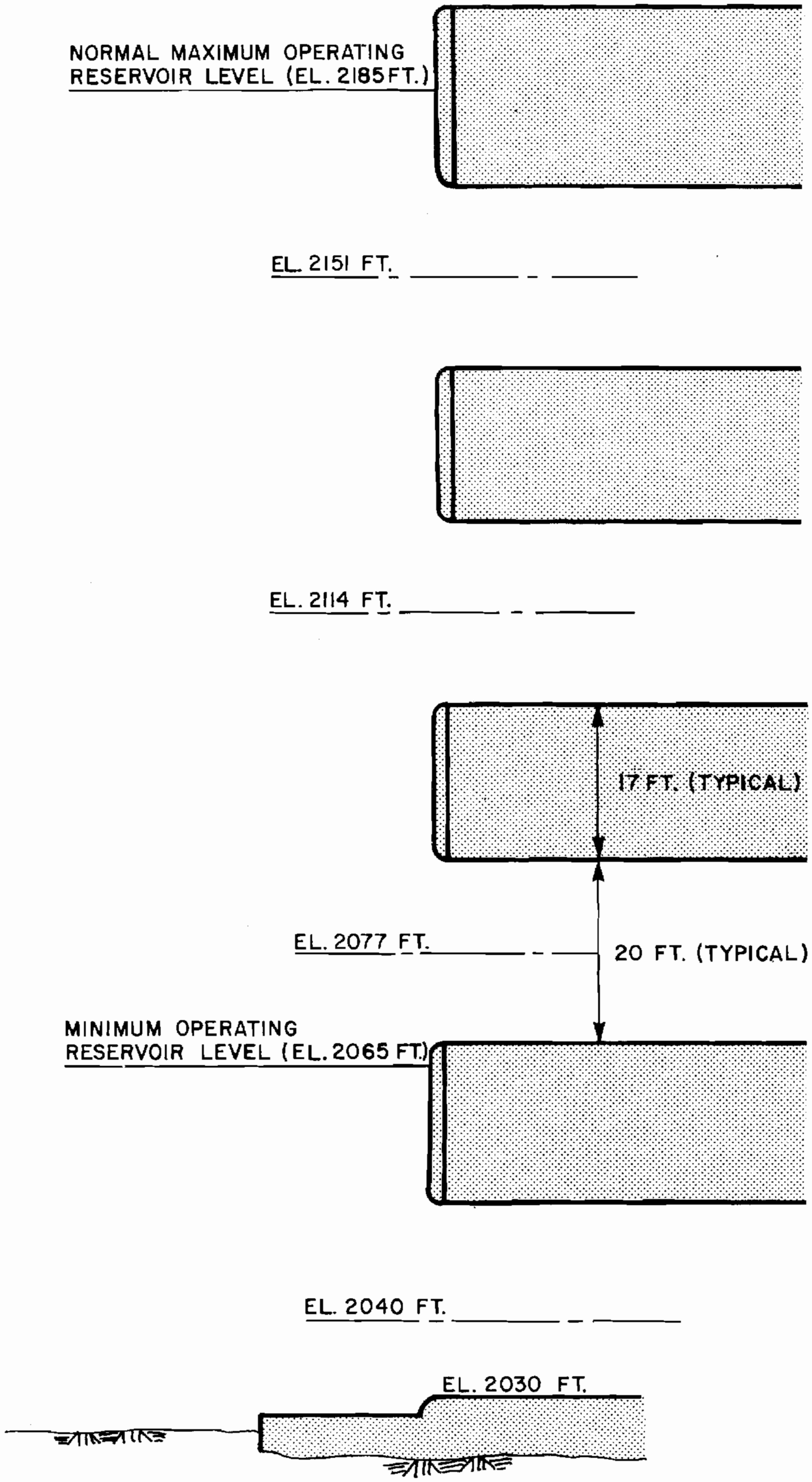
LEGEND:

- SITE 1 FOREBAY
- SITE 2 UPSTREAM OF FOREBAY
- SITE 3 FINDLAY FORKS (APPROXIMATELY 60 MILES UPSTREAM)

LAKE WILLISTON TEMPERATURE PROFILES APRIL 14-15, 1982

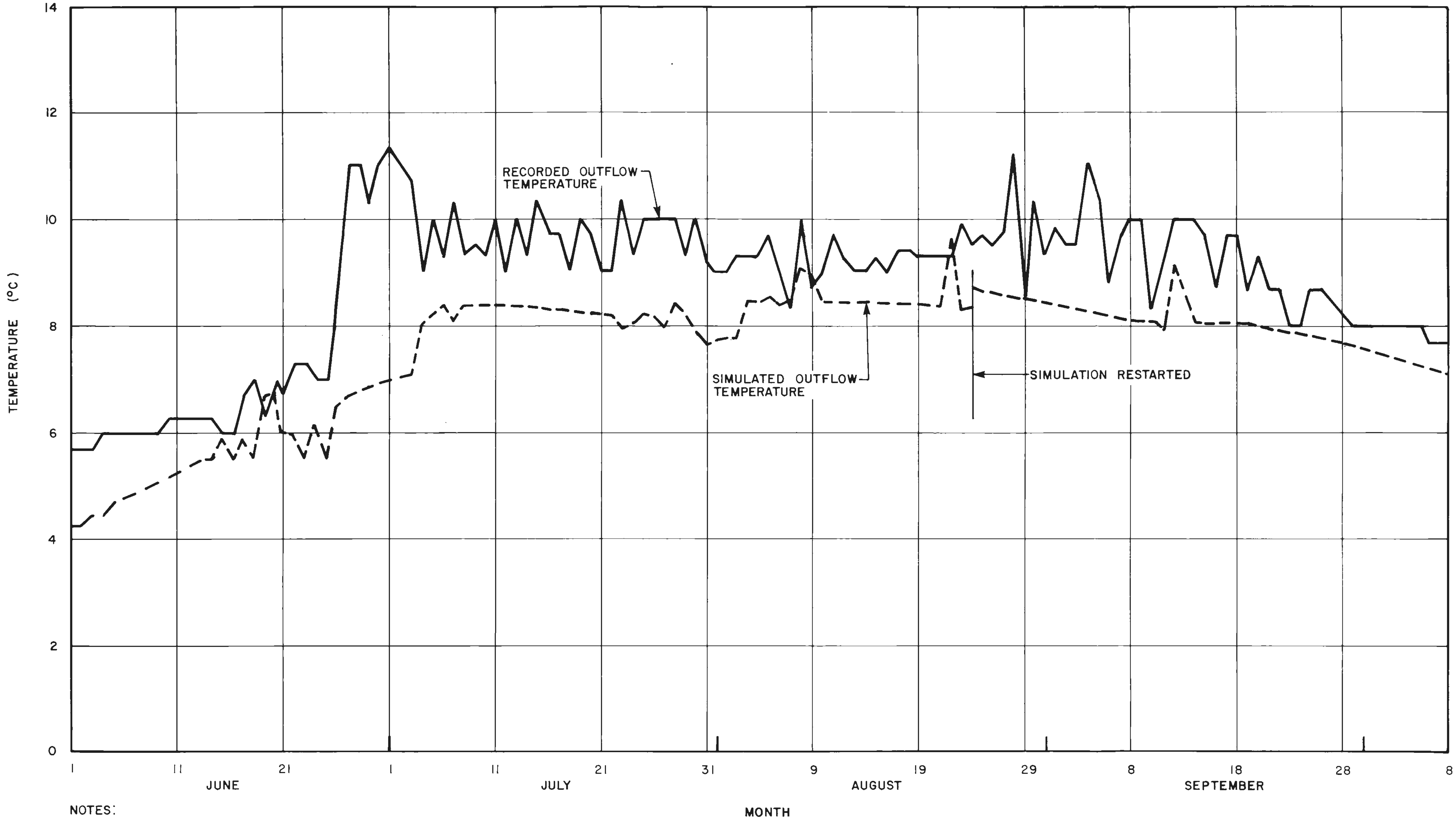
SOURCE: B C HYDRO 1982 UNPUBLISHED DATA

FIGURE E.2.168



WATANA MULTILEVEL INTAKE

FIGURE E.2.169



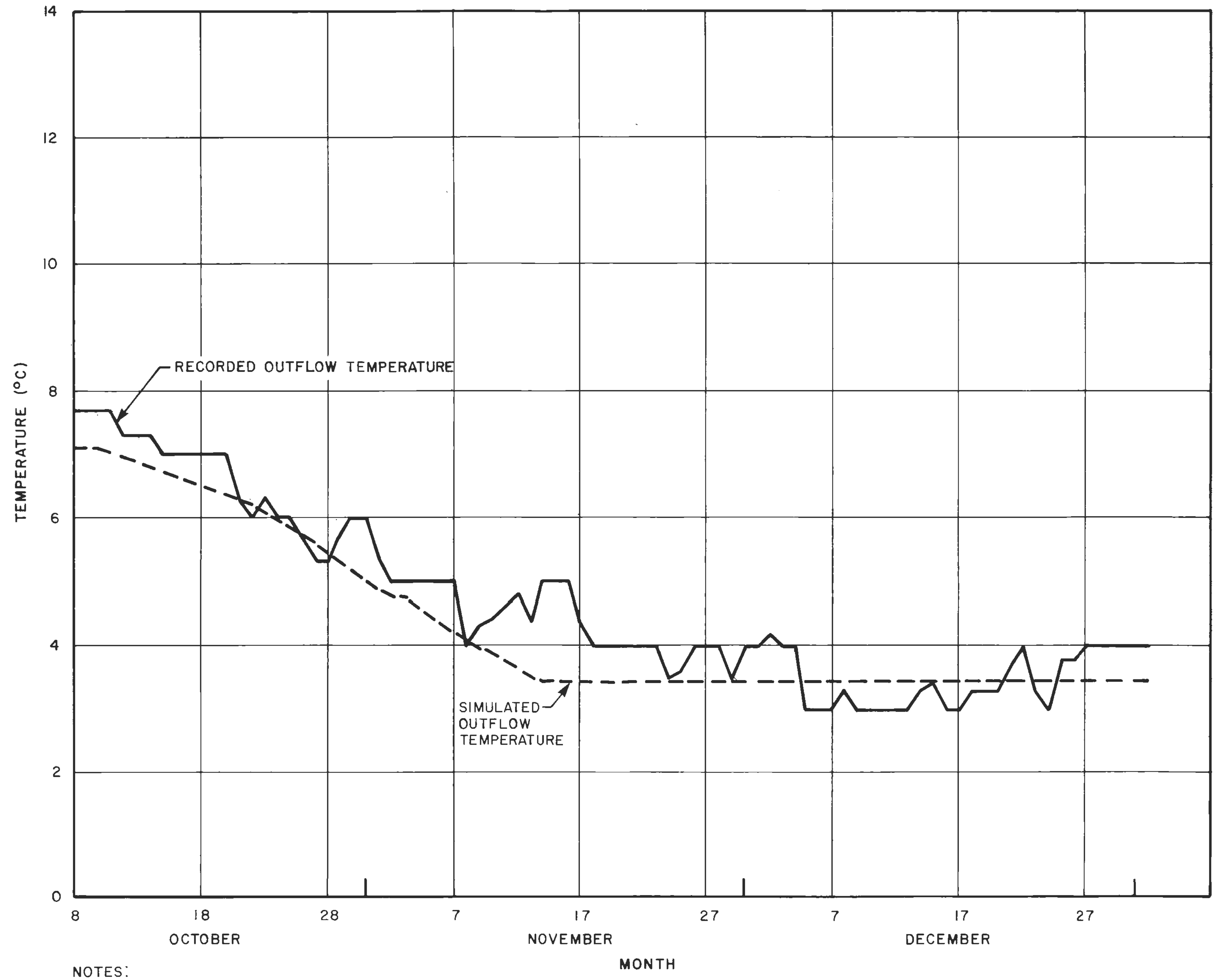
NOTES:

1) TIME SCALE IS IN INCREMENTS OF 10 DAYS.

2) BASED ON 1982 DATA

EKLUTNA LAKE
RESERVOIR TEMPERATURE SIMULATION
JUN TO SEP

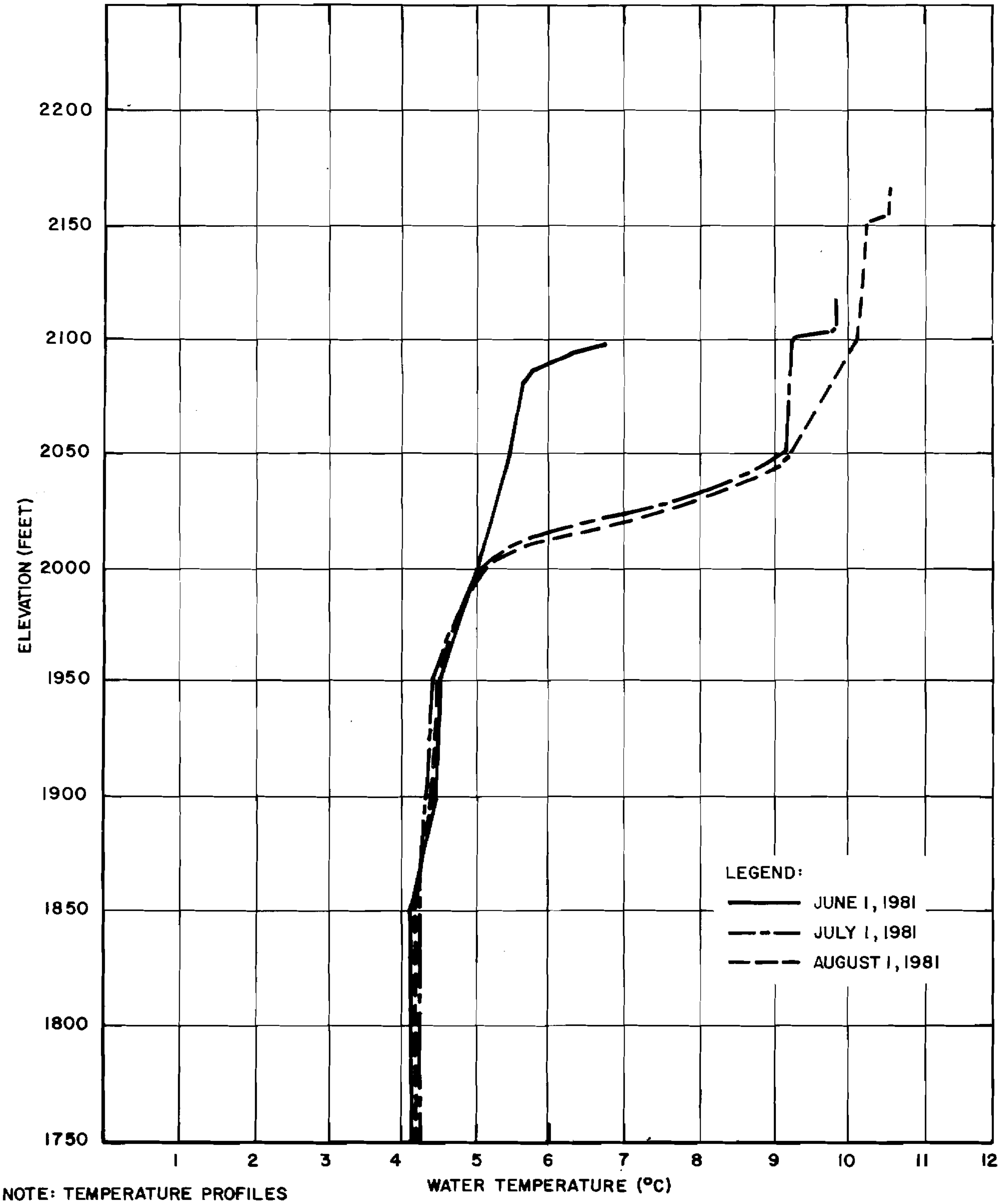
FIGURE E.2.170



NOTES:
1) TIME SCALE IS IN INCREMENTS OF 10 DAYS.
2) BASED ON 1982 DATA.

EKLUTNA LAKE
RESERVOIR TEMPERATURE SIMULATION
OCT TO DEC

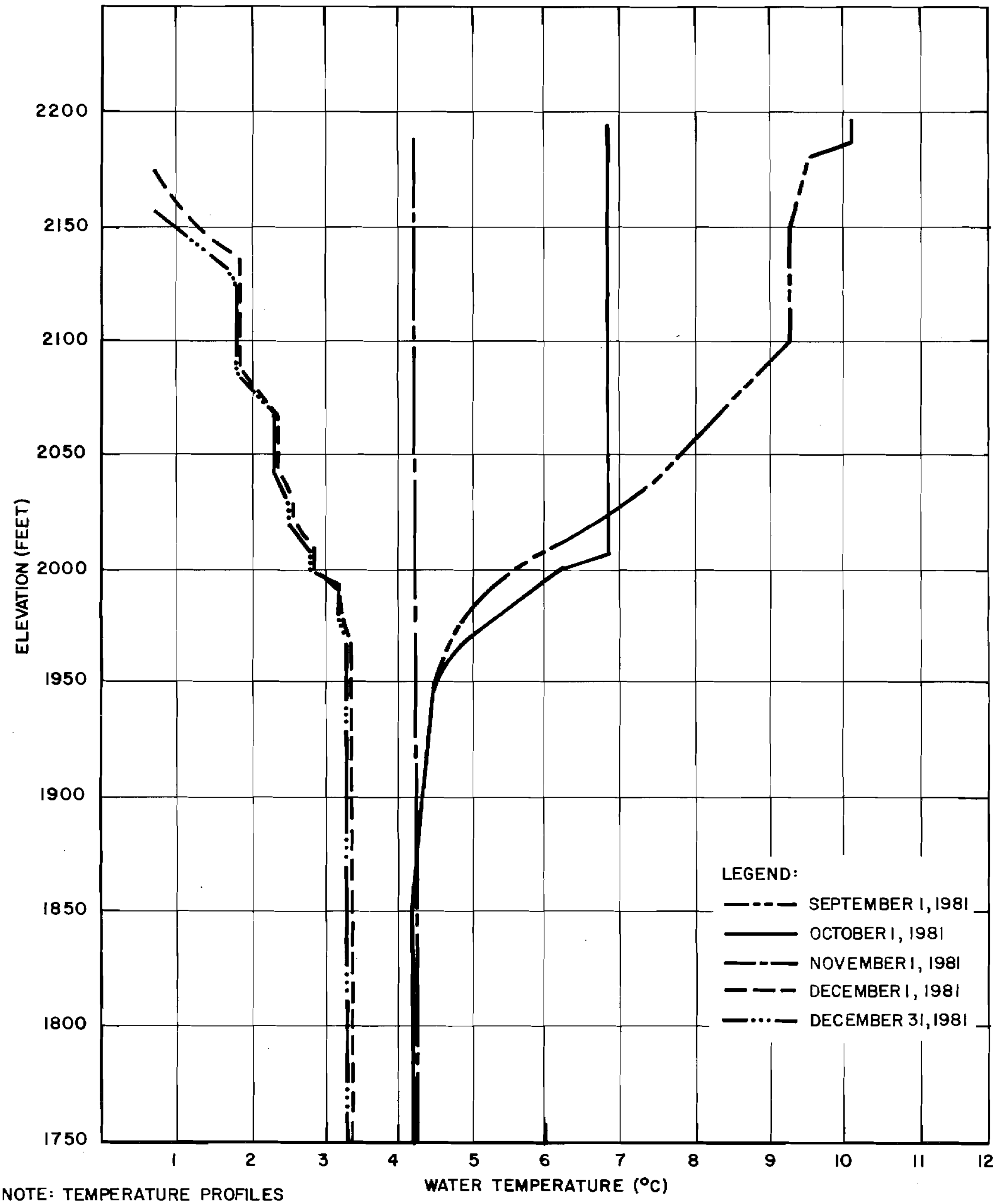
FIGURE E.2.171



NOTE: TEMPERATURE PROFILES SIMULATED USING 1981 DATA.

WATANA RESERVOIR TEMPERATURE PROFILES JUNE TO AUGUST

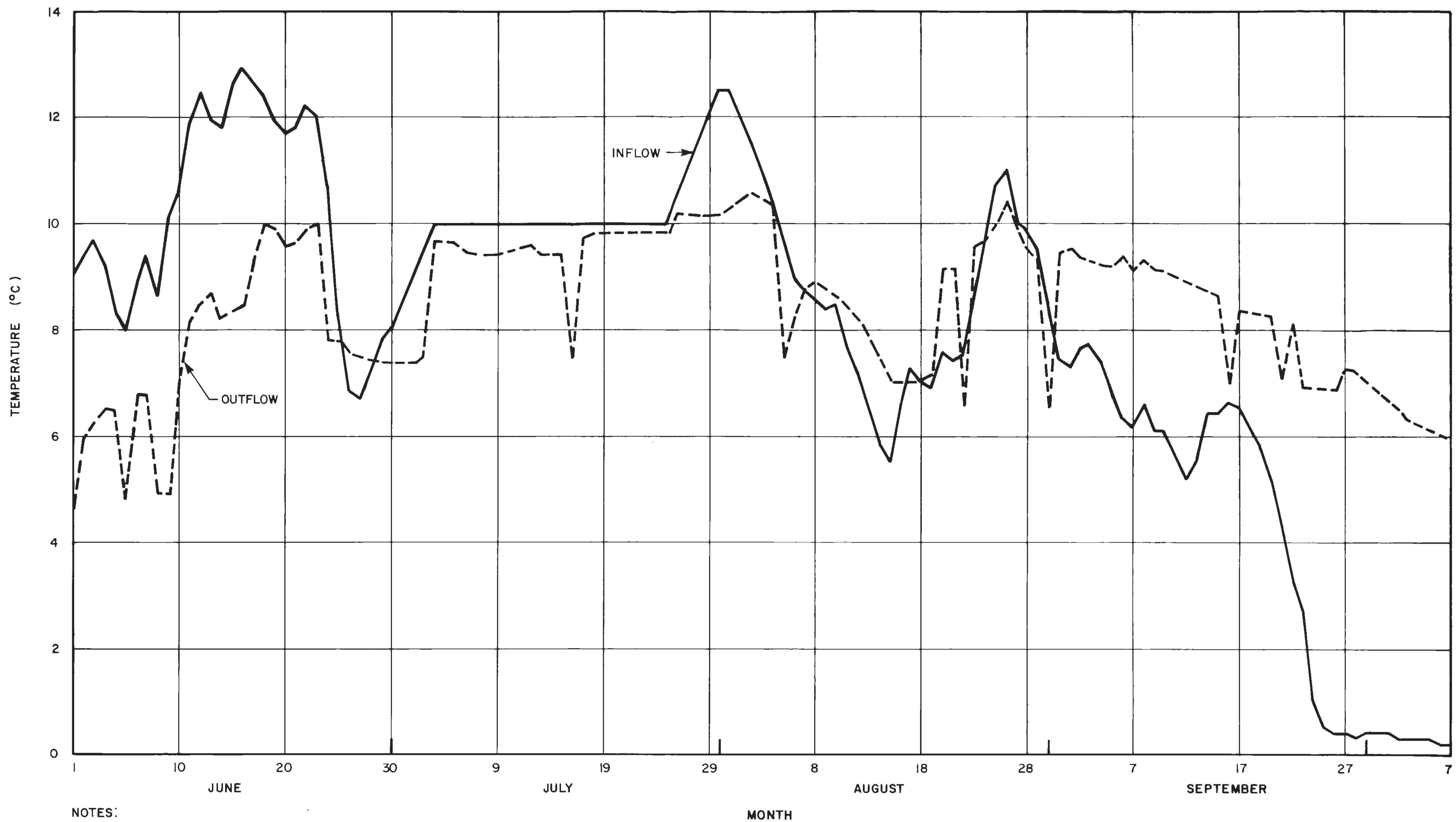
FIGURE E.2.172



NOTE: TEMPERATURE PROFILES SIMULATED USING 1981 DATA.

WATANA RESERVOIR TEMPERATURE PROFILES SEPTEMBER TO DECEMBER

FIGURE E.2.173

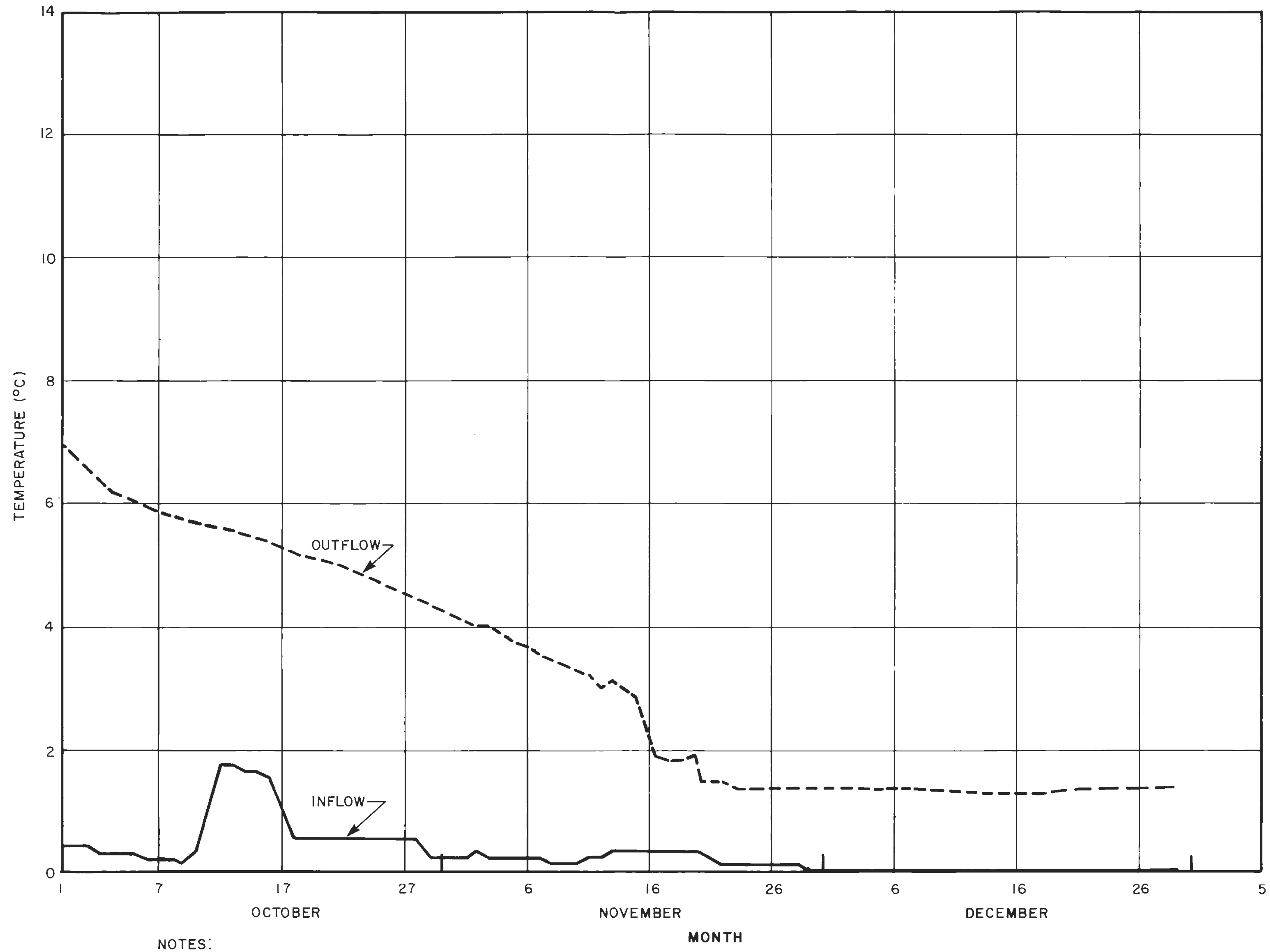


NOTES:

1) TIME SCALE IS IN INCREMENTS OF 10 DAYS.
2) BASED ON 1981 DATA, WATANA OPERATION
3) RUN W4020; WITH OUTFLOW TEMPERATURE FOLLOWING INFLOW TEMPERATURE.
4) JULY INFLOW TEMPERATURES ESTIMATED

WATANA RESERVOIR INFLOW AND OUTFLOW TEMPERATURES
JUN TO SEP

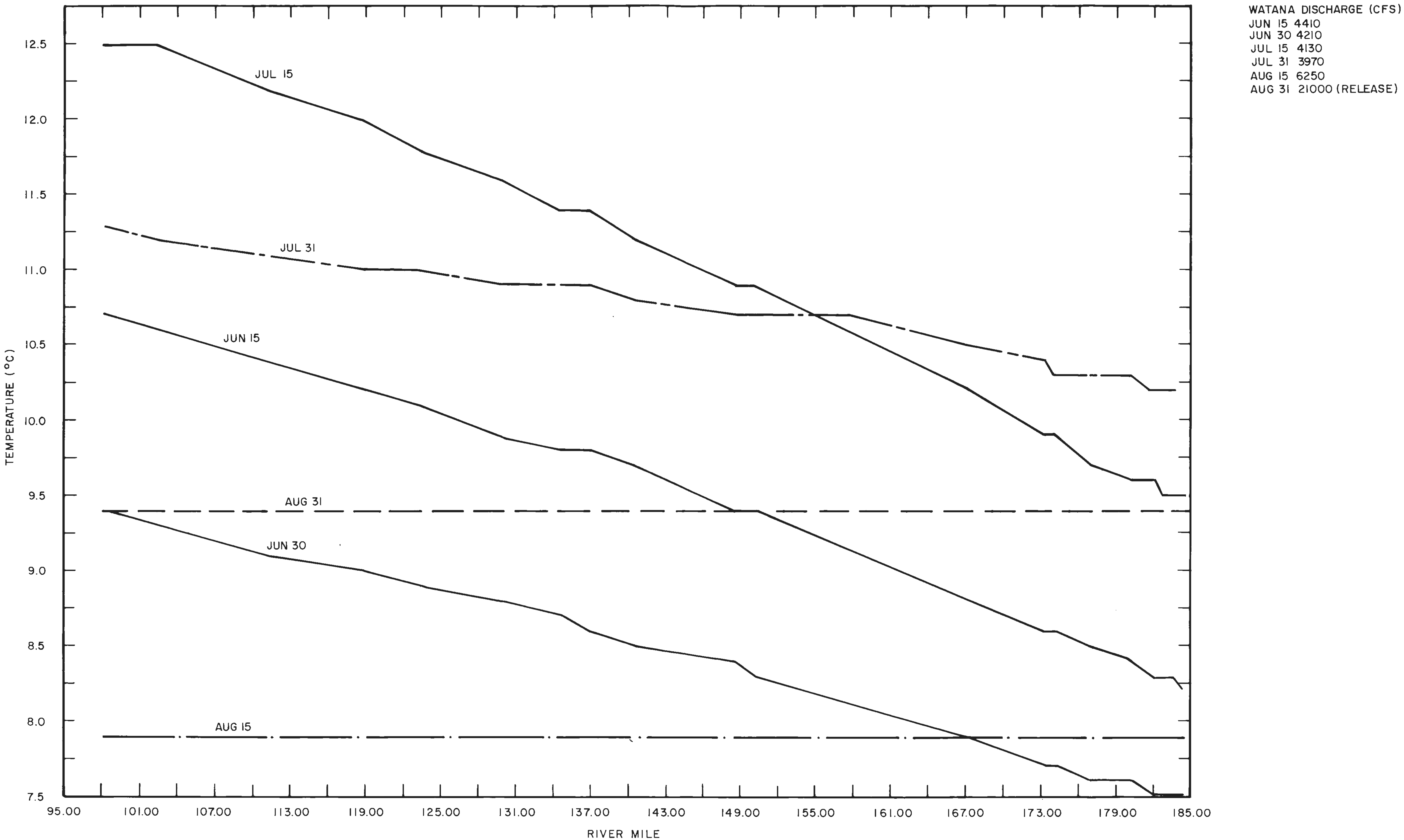
FIGURE E.2.174



NOTES:
1) TIME SCALE IS IN INCREMENTS OF 10 DAYS.
2) BASED ON 1981 DATA, WATANA OPERATION
3) RUN W4020; WITH OUTFLOW TEMPERATURE FOLLOWING INFLOW TEMPERATURE.

WATANA RESERVOIR INFLOW AND OUTFLOW TEMPERATURES OCT TO DEC

FIGURE E.2.175

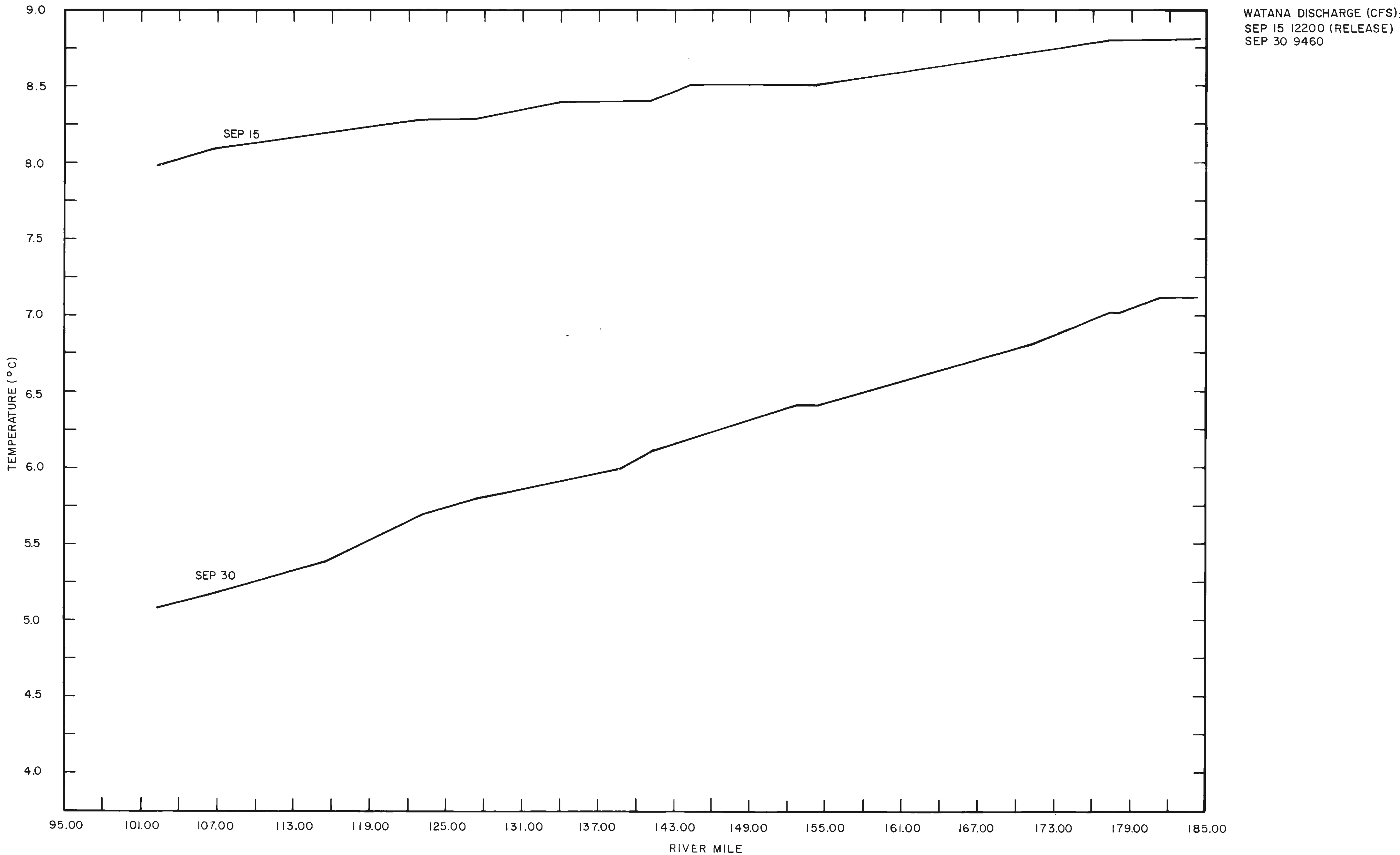


NOTE:

1. MODEL ASSUMES 1981 METEOROLOGICAL DATA RECORDED AT WATANA.
2. WATANA TEMPERATURE AND DISCHARGE FROM DYRESM MODEL. (RUN WA4020)

WATANA OPERATION:
DOWNSTREAM TEMPERATURES - JUN TO AUG

FIGURE E.2.176

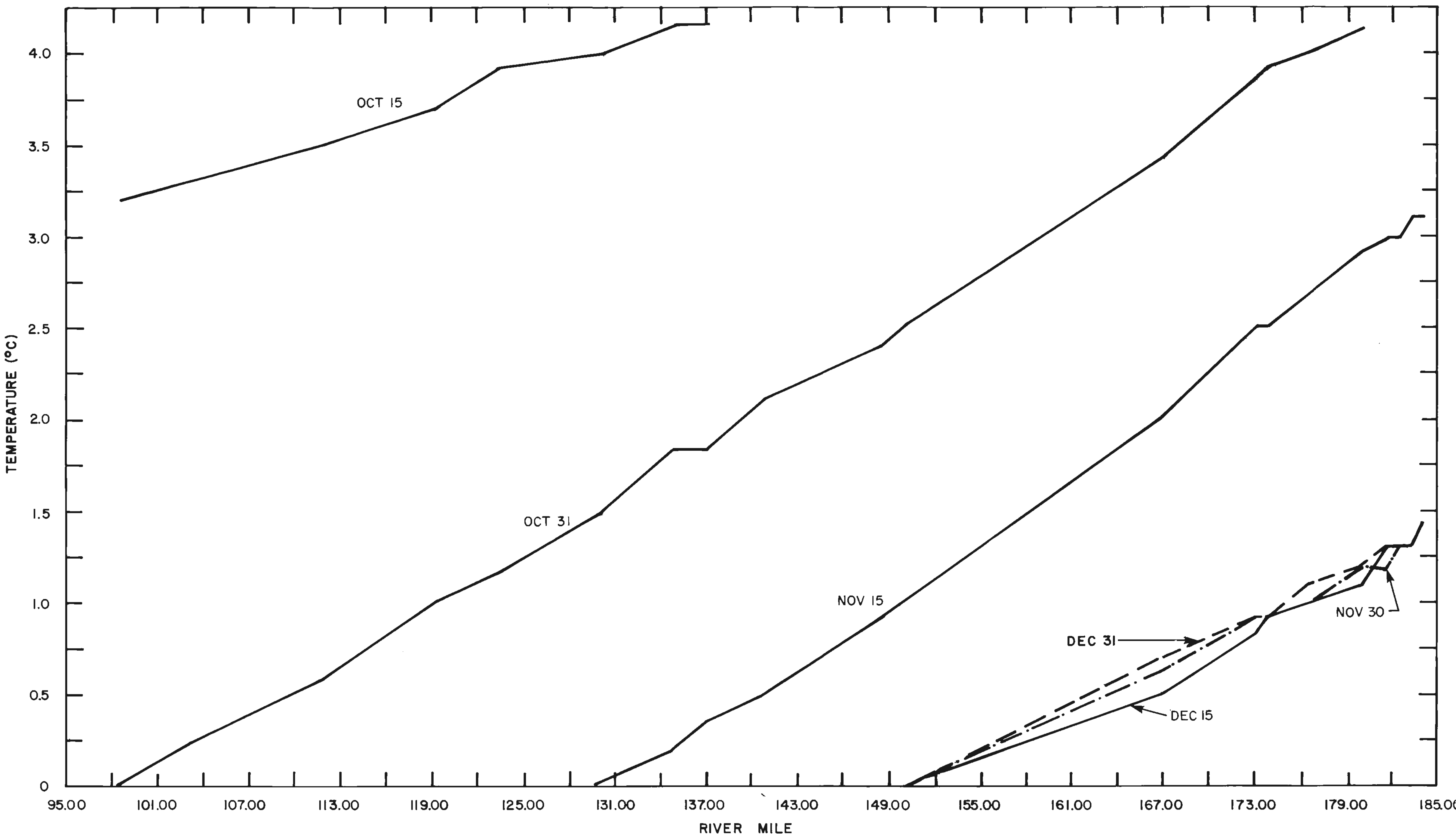


NOTE:

1. MODEL ASSUMES 1981 METEOROLOGICAL DATA RECORDED AT WATANA.
2. WATANA TEMPERATURES AND DISCHARGE FROM DYRESM MODEL. (RUN WA4020)

WATANA OPERATION
DOWNSTREAM TEMPERATURES - SEP

FIGURE E.2.177

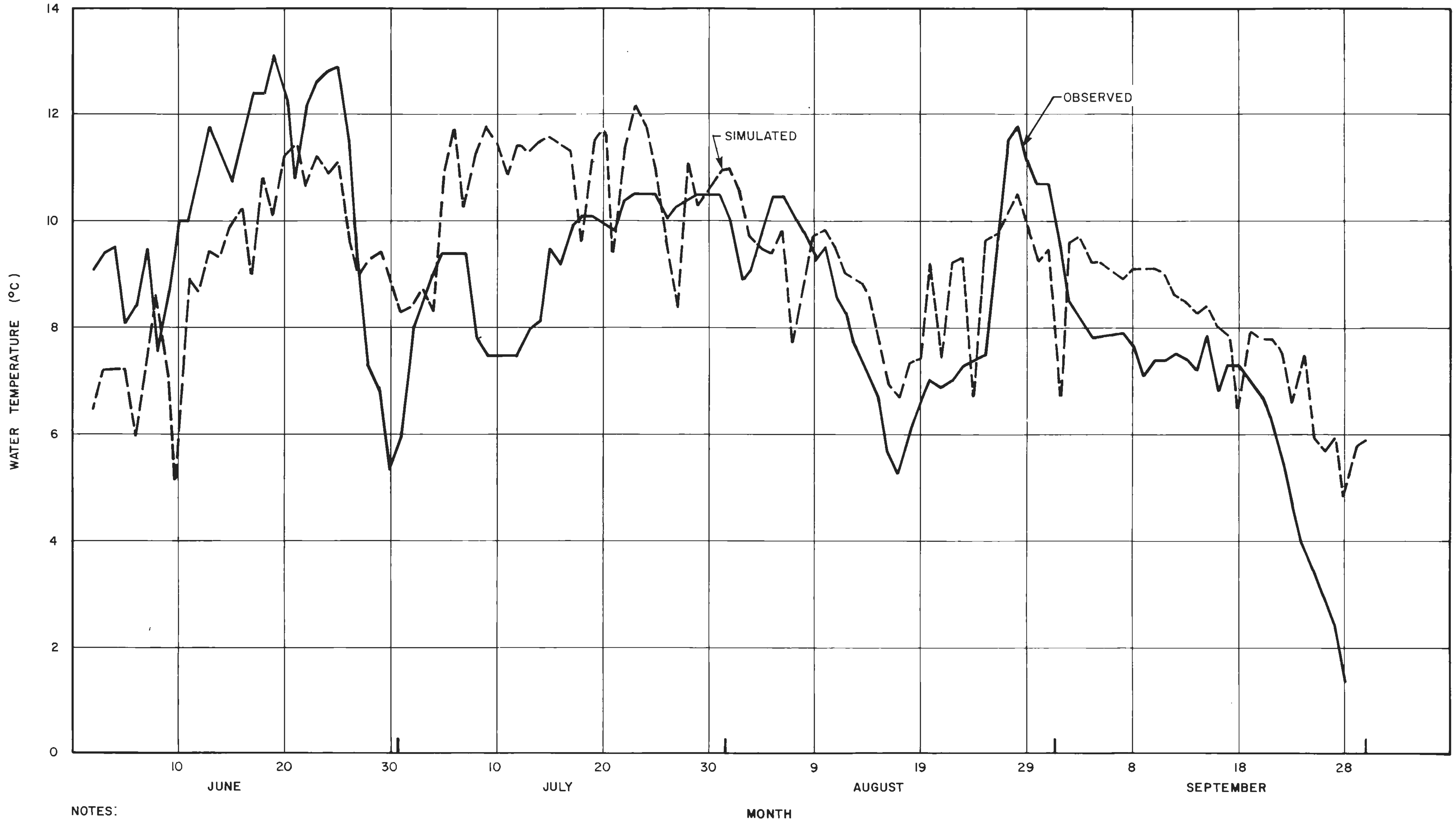


WATANA DISCHARGE (CFS):
OCT 15 6110
OCT 31 5820
NOV 15 6580
NOV 31 10070
DEC 15 10540
DEC 31 12500

NOTES:
1. MODEL ASSUMES 1981 METEOROLOGICAL DATA RECORDED AT WATANA.
2. WATANA TEMPERATURES AND DISCHARGE FROM DYRESM MODEL. (RUN WA4020)

WATANA OPERATION: DOWNSTREAM TEMPERATURES - OCT TO DEC

FIGURE E.2.178

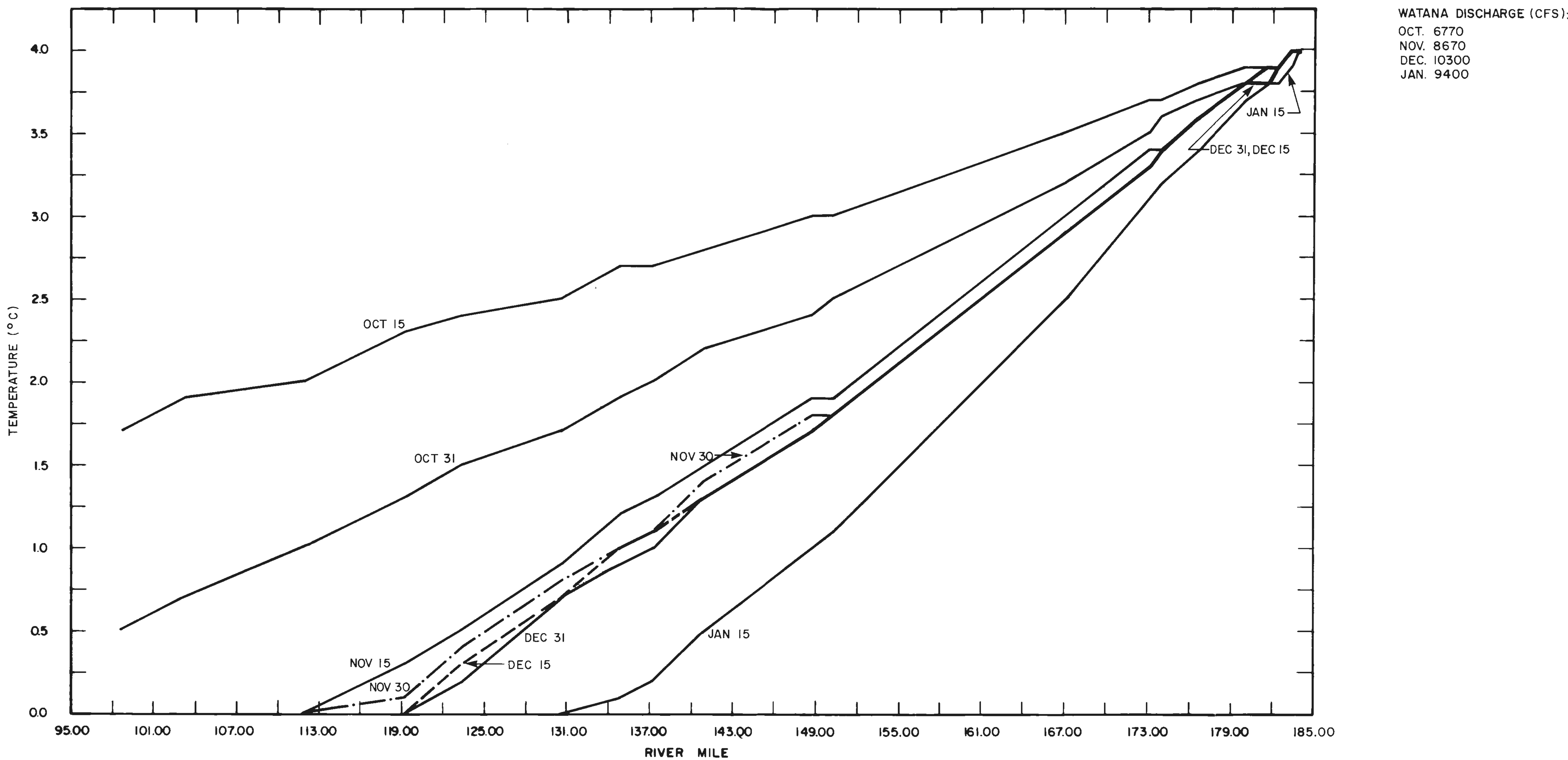


NOTES:

1. TIME SCALE IS IN INCREMENTS OF 10 DAYS.
2. OBSERVED DATA FOR SUSITNA RIVER ABOVE FOURTH OF JULY CREEK (RM 131.3) ADF&G 1982.
3. PREDICTED WATER TEMPERATURES (RM 130.5) DURING WATANA OPERATION USING 1981 DATA.
4. TEMPERATURES REPORTED ARE MEAN DAILY VALUES.

COMPARISON OF 1981 OBSERVED WATER TEMPERATURES NEAR SHERMAN AND 1981 TEMPERATURE SIMULATION OF WATANA OPERATION

FIGURE E.2.179

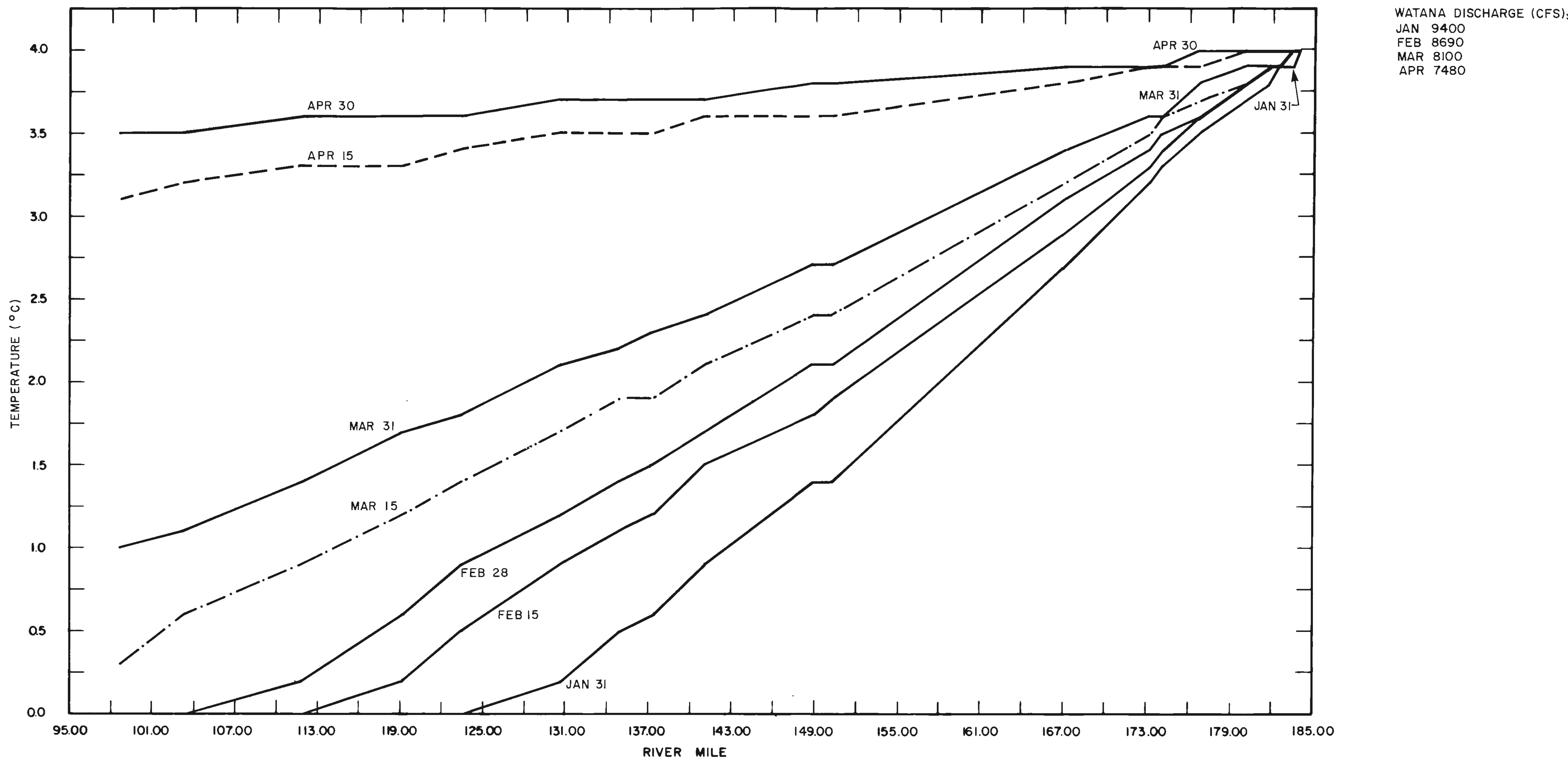


NOTE :

MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND MEAN MONTHLY FLOWS AT WATANA.

WATANA OPERATION:
DOWNSTREAM TEMPERATURES - OCT TO JAN
OUTFLOW TEMPERATURE 4° C

FIGURE E.2.180

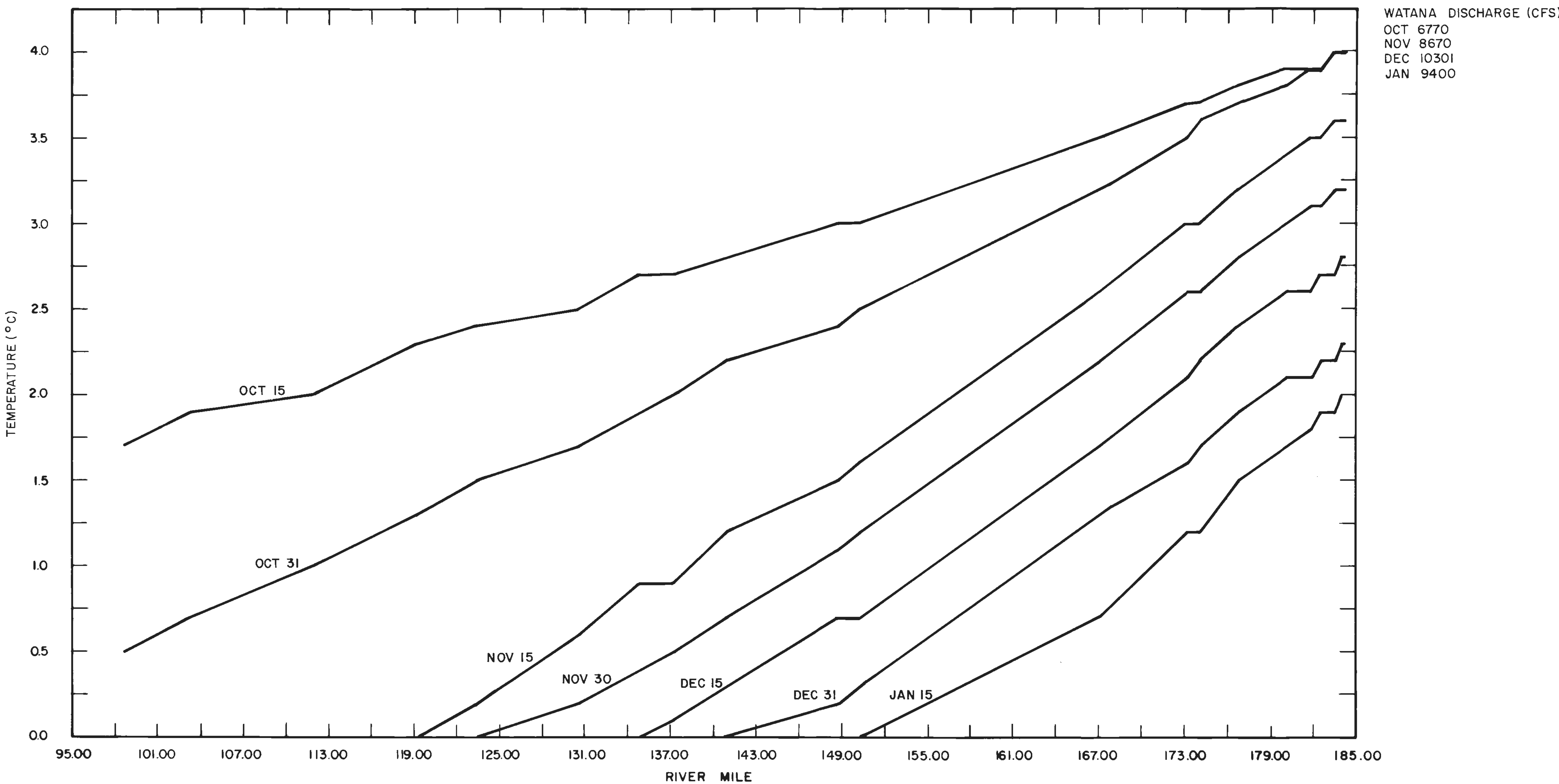


NOTE :

MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND MEAN MONTHLY FLOWS AT WATANA.

WATANA OPERATION:
DOWNSTREAM TEMPERATURES - JAN TO APR
OUTFLOW TEMPERATURE 4°C

FIGURE E.2.181

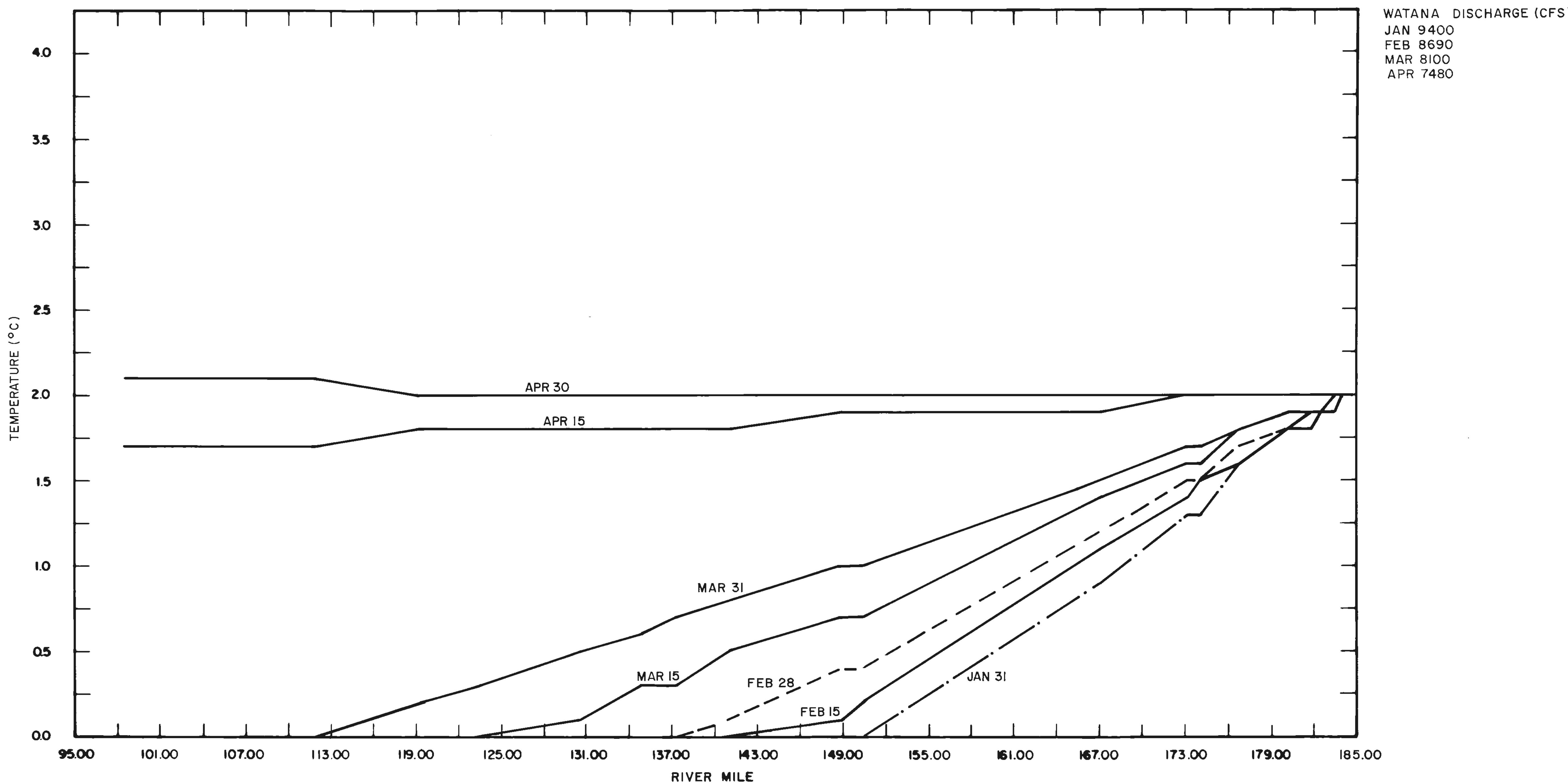


NOTE:

MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND MEAN MONTHLY FLOWS AT WATANA.

WATANA OPERATION: DOWNSTREAM TEMPERATURES - OCT TO JAN
OUTFLOW TEMPERATURE 4 TO 2°C

FIGURE E.2.182

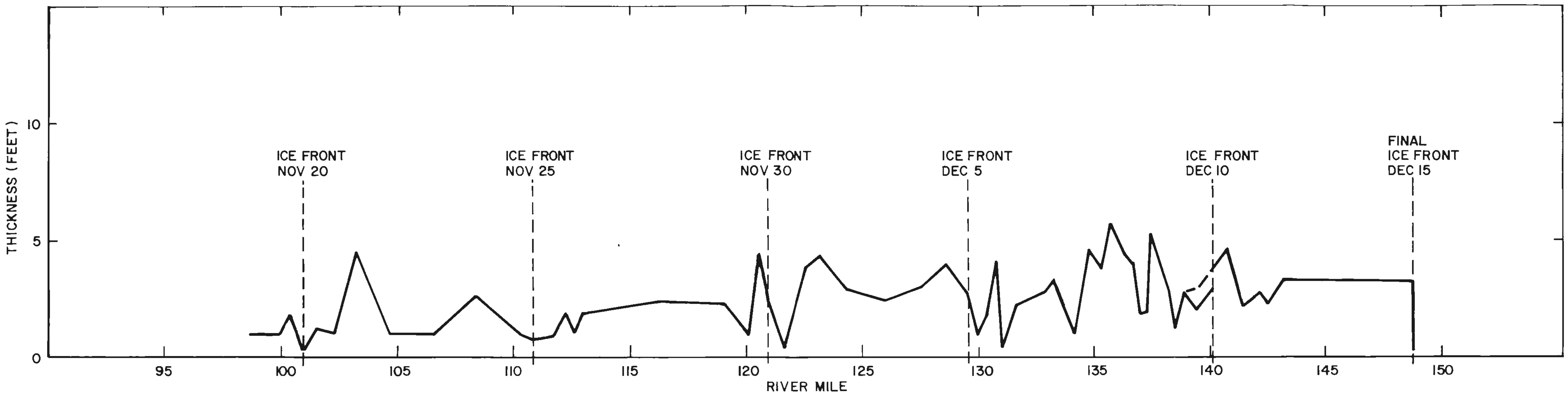


NOTE :

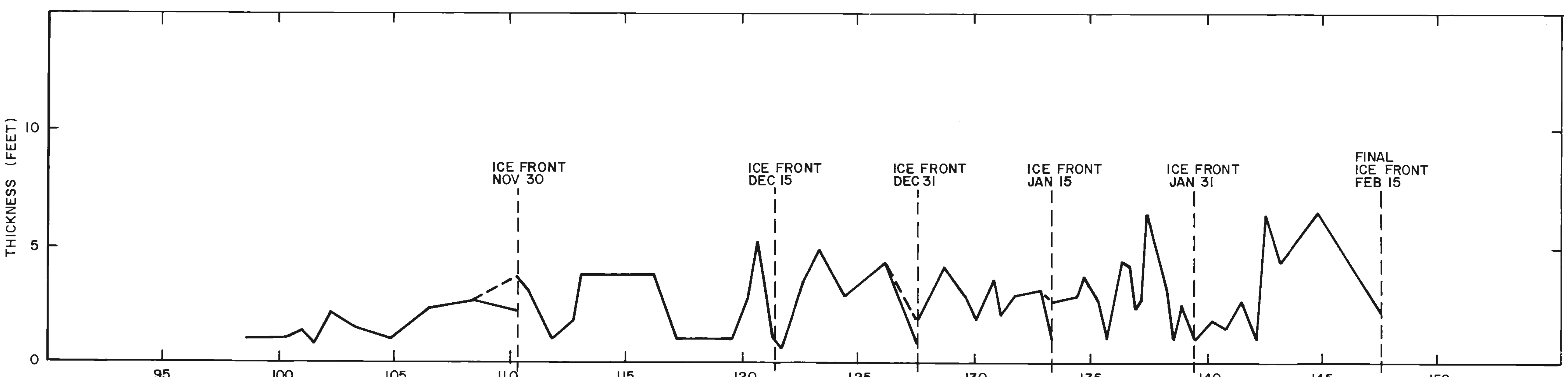
1. MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND MEAN MONTHLY FLOWS AT WATANA.

WATANA OPERATION: DOWNSTREAM TEMPERATURES - JAN TO APR
OUTFLOW TEMPERATURE 4 TO 2°C

FIGURE E.2.183



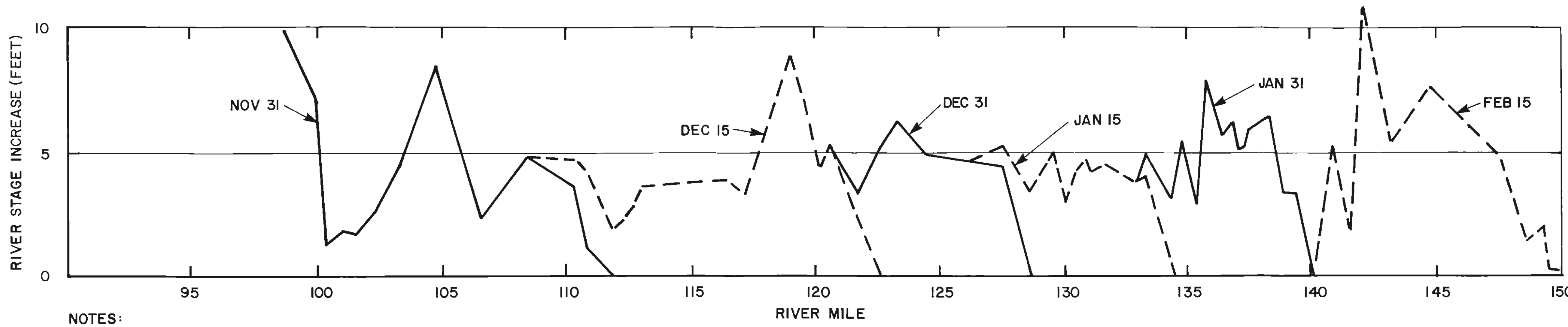
NOTE:
1. BASED ON RESERVOIR OUTFLOW TEMPERATURE MODEL(SEE FIGURE E.2.175).
2. THE DASHED HORIZONTAL LINE OVERLYING SOLID LINE INDICATE THE INCREASED ICE THICKNESS AS SIMULATED. FOR THE NEXT ICE FRONT LOCATION.



NOTES:
1. BASED ON RESERVOIR OUTFLOW TEMPERATURES STARTING AT 4°C ON NOV. 1 AND DROPPING TO 2°C BY JAN 15.
2. THE DASHED HORIZONTAL LINE OVERLYING SOLID LINE INDICATE THE INCREASED ICE THICKNESS AS SIMULATED FOR THE NEXT ICE FRONT LOCATION.

WATANA OPERATION
SIMULATED ICE THICKNESS AND ICE FRONT LOCATION

FIGURE E.2.184

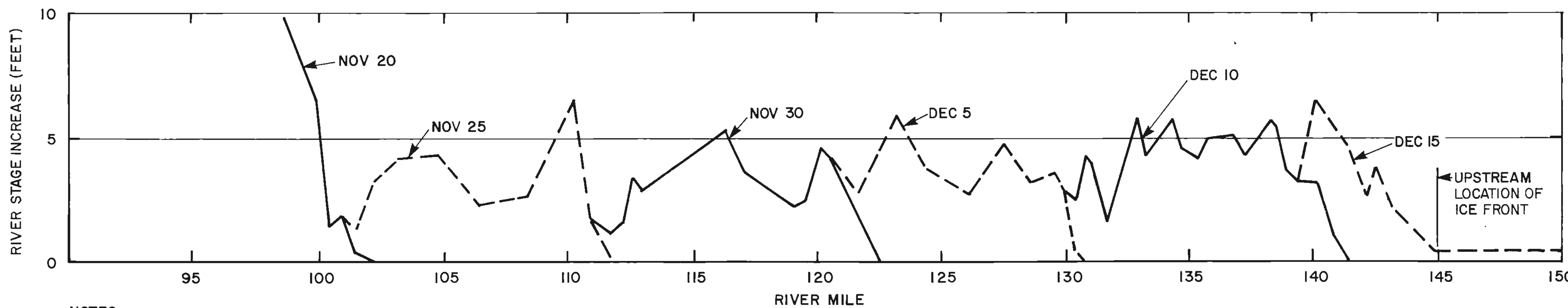


NOTES:

1. BASED ON RESERVOIR OUTFLOW TEMPERATURES STARTING AT 4°C ON NOV 1 AND DROPPING TO 2°C BY JAN 15.
2. CHANGE IN STAGE DURING FREEZEUP BASED ON OPEN WATER DISCHARGE OF 9900 CFS.

WATANA DISCHARGE (CFS)

NOV	8670
DEC	10300
JAN	9400
FEB	8690



NOTES:

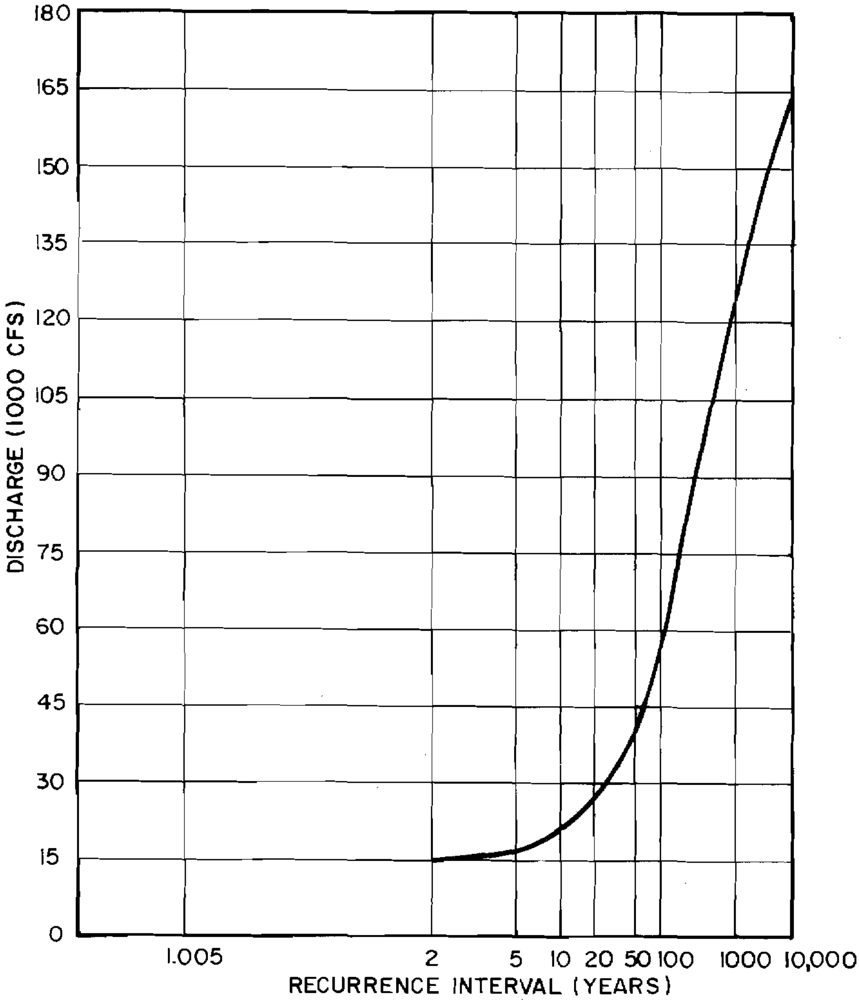
1. BASED ON OUTFLOW TEMPERATURES FROM RESERVOIR TEMPERATURE MODEL.
2. CHANGE IN STAGE DURING FREEZEUP BASED ON OPEN WATER DISCHARGE OF 9900 CFS.

WATANA DISCHARGE (CFS)

NOV 20-26	8890
NOV 27-3	9410
DEC 4-10	10070
DEC 11-18	10300

WATANA OPERATION
RIVER STAGE INCREASE DUE TO ICE COVER

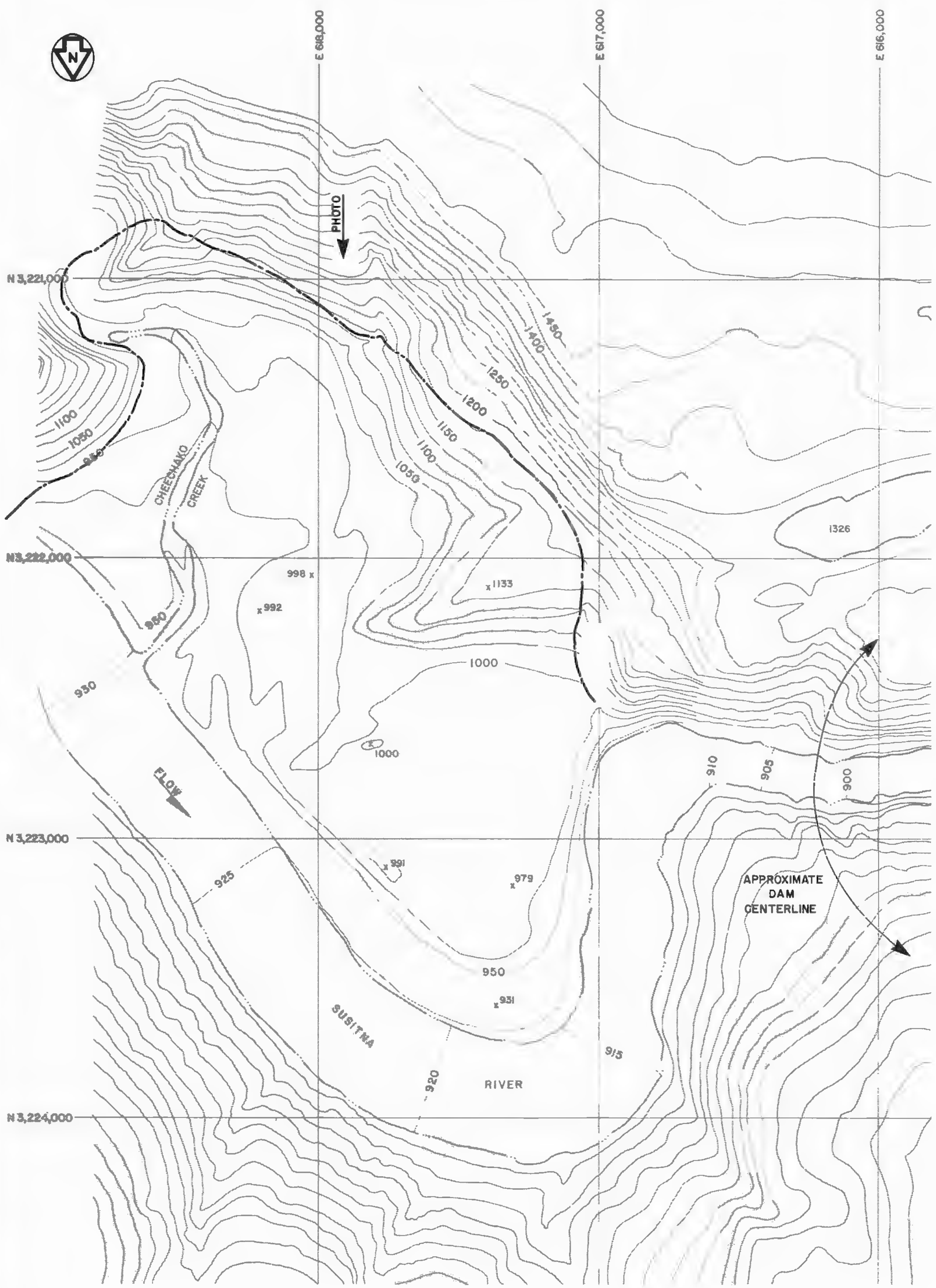
FIGURE E.2.185



NOTE:
FLOWS ROUTED THROUGH
WATANA IMPOUNDMENT.

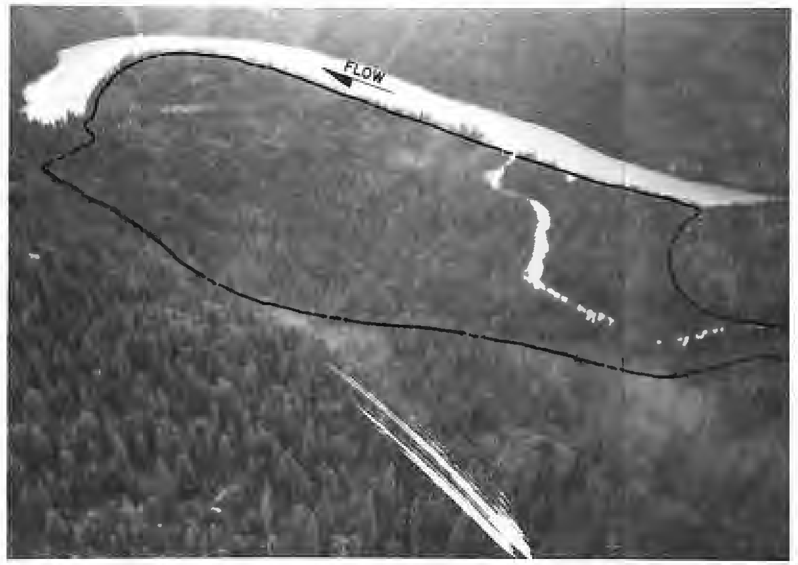
DEVIL CANYON
FLOOD FREQUENCY CURVE

FIGURE E.2.186



LEGEND

—·—·— BORROW SITE LIMIT



BORROW SITE G

NOTES

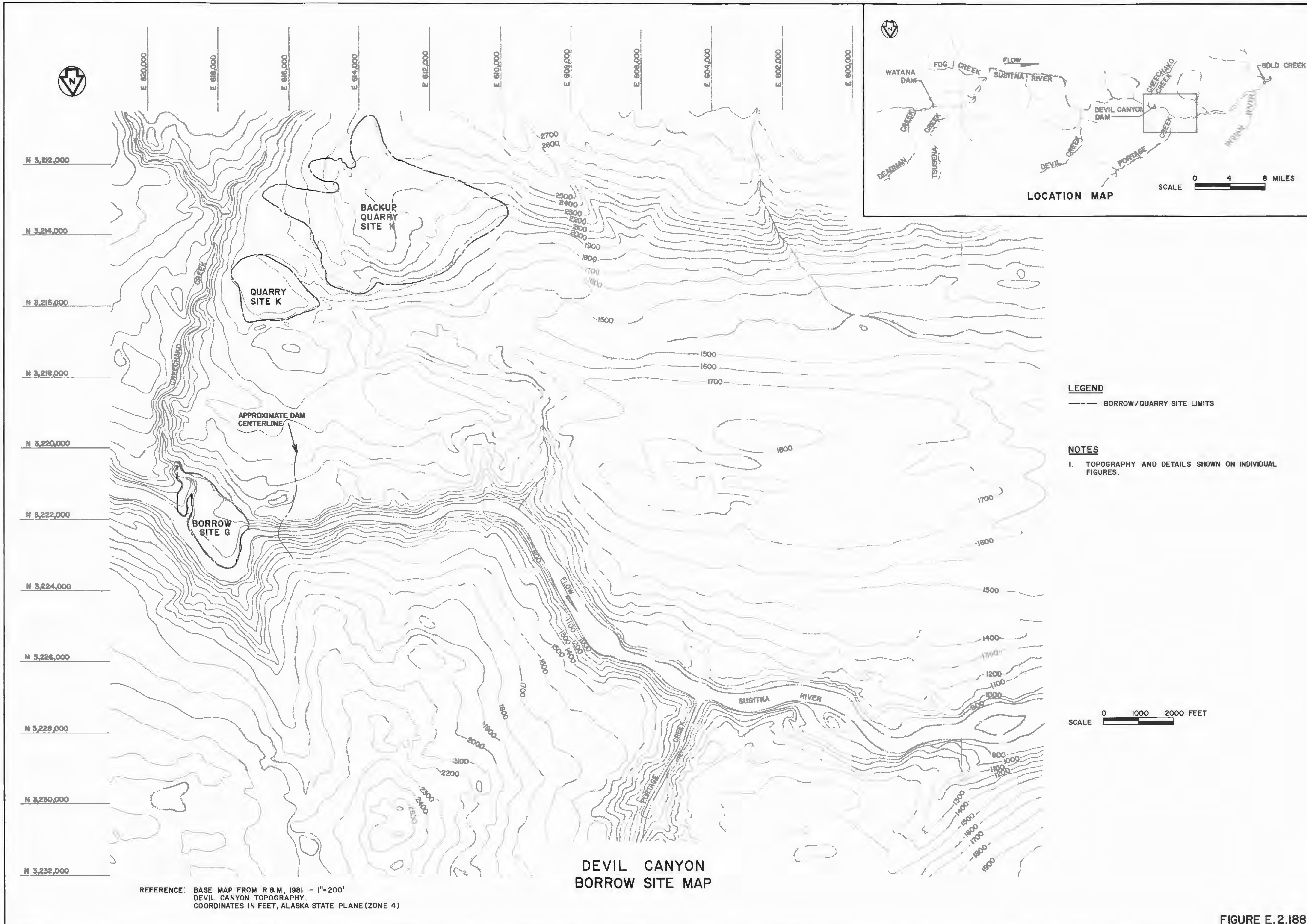
1. ENTIRE BORROW SITE LIES WITHIN PROPOSED DEVIL CANYON RESERVOIR LIMITS.
2. BORROW SITE LIMITS BASED ON FIELD AND AIR PHOTO INTERPRETATION OF BORROW MATERIAL. FINAL LIMITS SUBJECT TO RESULTS OF DESIGN INVESTIGATIONS.
3. 25 FOOT CONTOUR INTERVAL ADDED FROM SOURCE MAP (REFERENCED) IN BORROW SITE ONLY.
4. PHOTO TAKEN AUGUST, 1981.

SCALE 0 200 400 FEET

REFERENCE: BASE MAP FROM R & M, 1981 – 1" = 200' DEVIL CANYON TOPOGRAPHY, RETRACED AT 25' CONTOURS
USBR, 1960
COE, 1978
WCC, 1978

DEVIL CANYON
BORROW SITE G

FIGURE E.2.187



LEGEND

— - — BORROW/QUARRY SITE LIMITS

NOTES

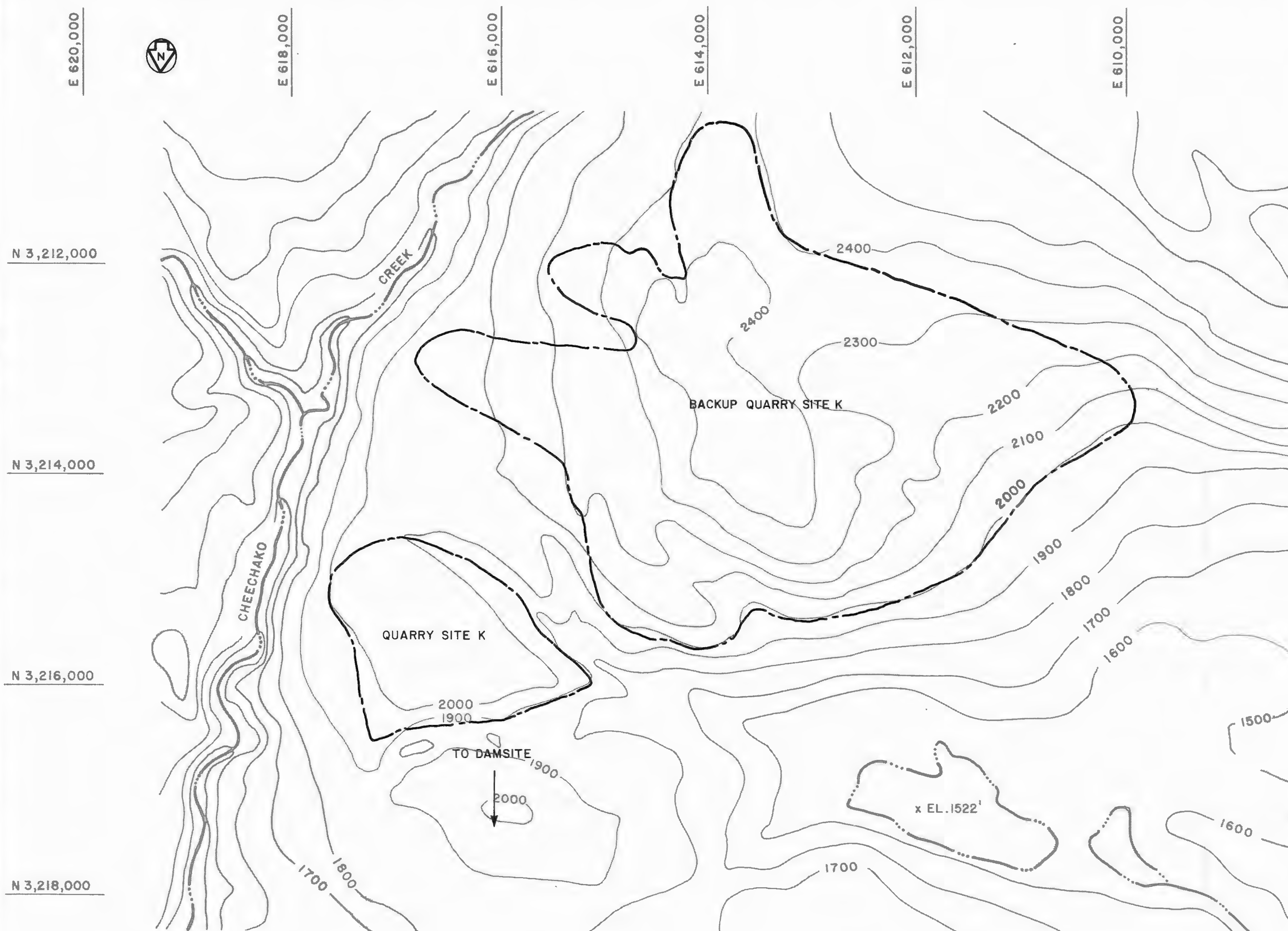
1. TOPOGRAPHY AND DETAILS SHOWN ON INDIVIDUAL FIGURES.

SCALE 0 1000 2000 FEET

REFERENCE: BASE MAP FROM R & M, 1981 - 1"=200' DEVIL CANYON TOPOGRAPHY. COORDINATES IN FEET, ALASKA STATE PLANE (ZONE 4)

DEVIL CANYON
BORROW SITE MAP

FIGURE E.2.188



LEGEND

MATERIAL LIMITS

NOTES

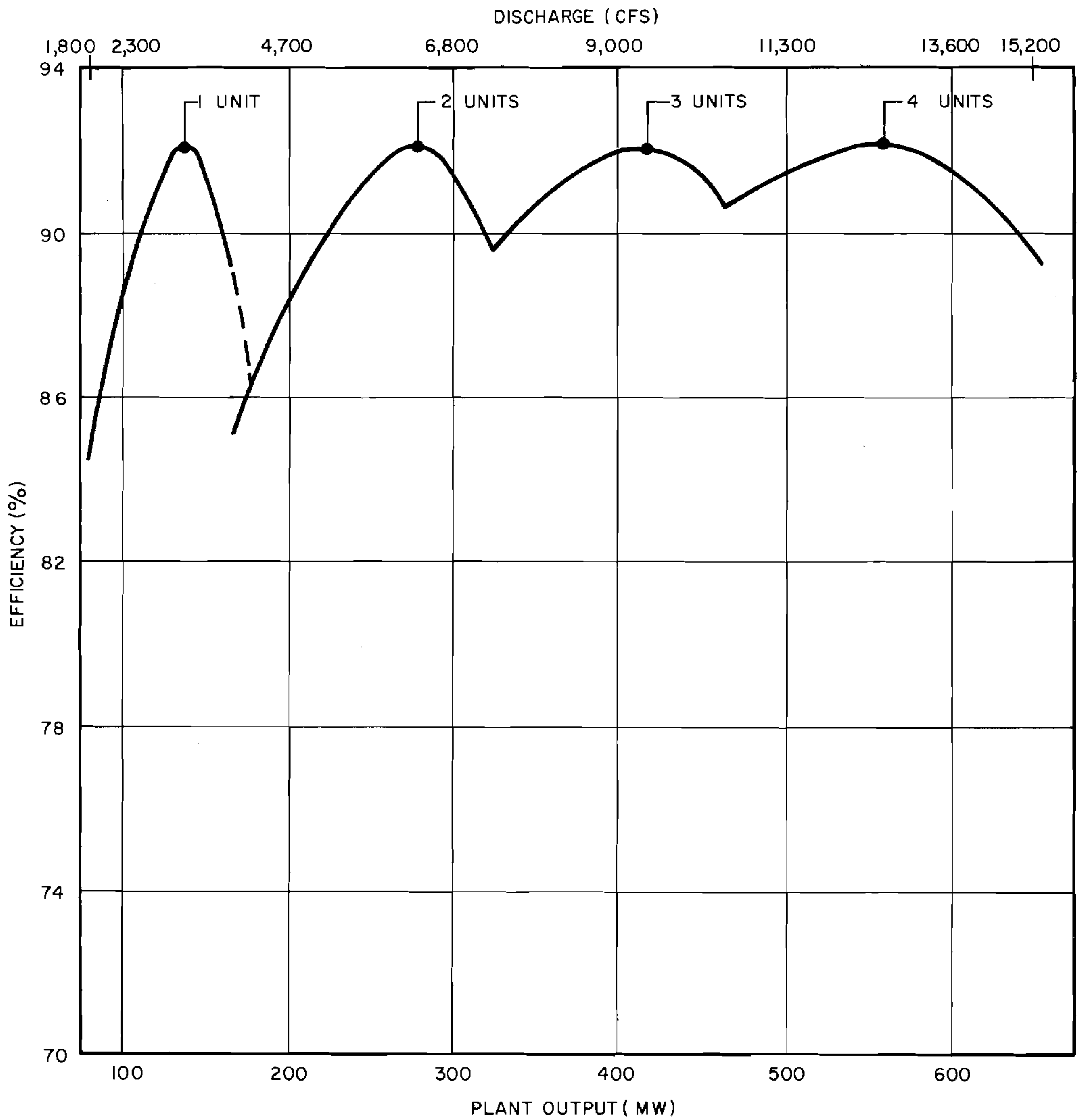
1. ENTIRE QUARRY SITE LIES OUTSIDE OF PROPOSED RESERVOIR LIMITS.
2. MATERIAL LIMIT SHOWN IS OUTCROP LIMIT AS DETERMINED FROM AIR PHOTO INTERPRETATION. NORTH FACES OF SITES ARE EXPOSED ROCK CLIFFS, AND LOCATION OF SAMPLES.
3. CONTOURS TRACED FROM ENLARGED, REFERENCE BASE MAP, AT 100' INTERVALS.

SCALE 0 1000 2000 FEET

REFERENCE: BASE MAP FROM USGS 1:63,360 ALASKA QUADRANGLE TALKEETNA MOUNTAINS (D-5). COORDINATES IN FEET, ALASKA STATE PLANE (ZONE 4)

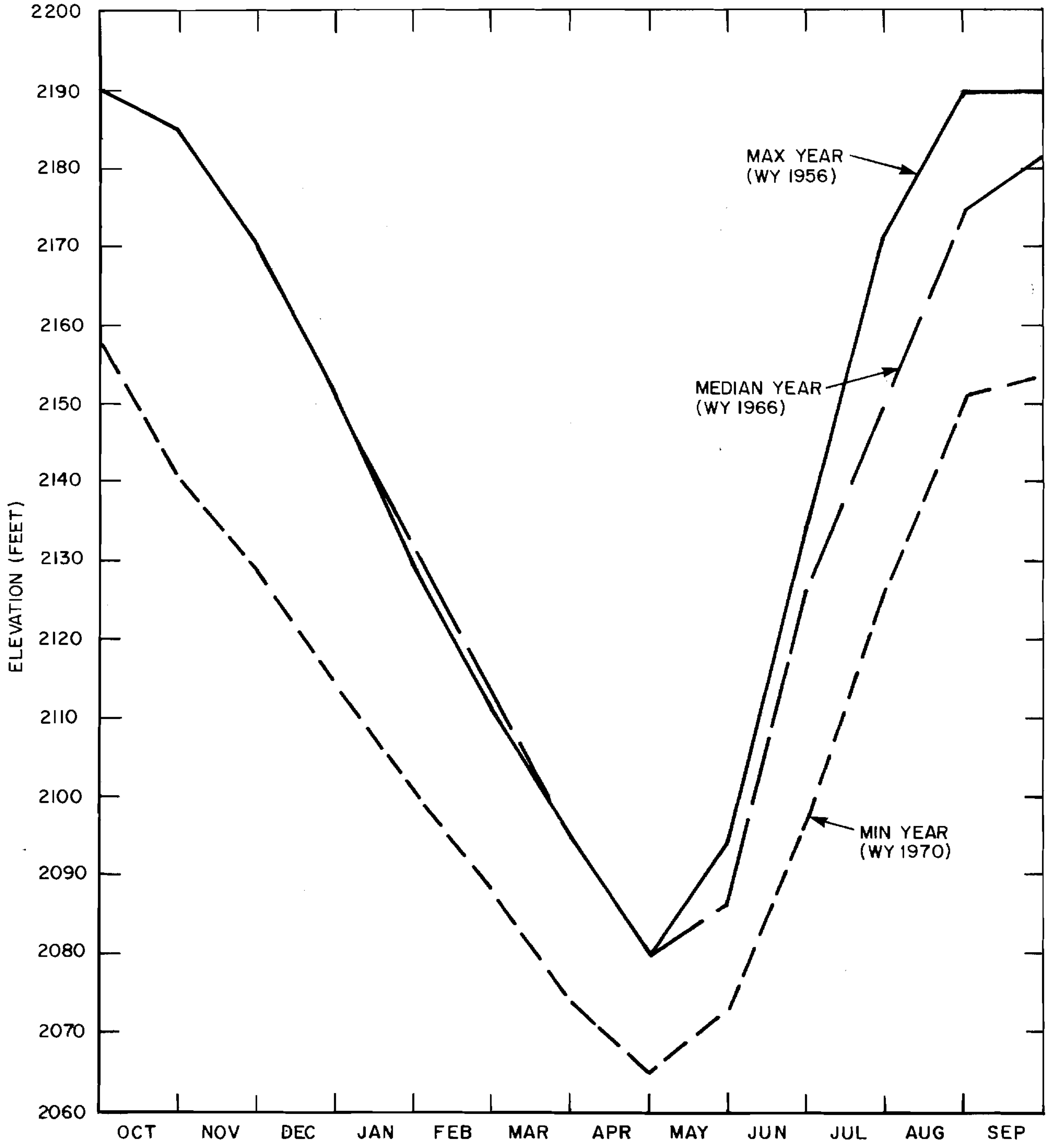
DEVIL CANYON
QUARRY SITE K

FIGURE E.2.189



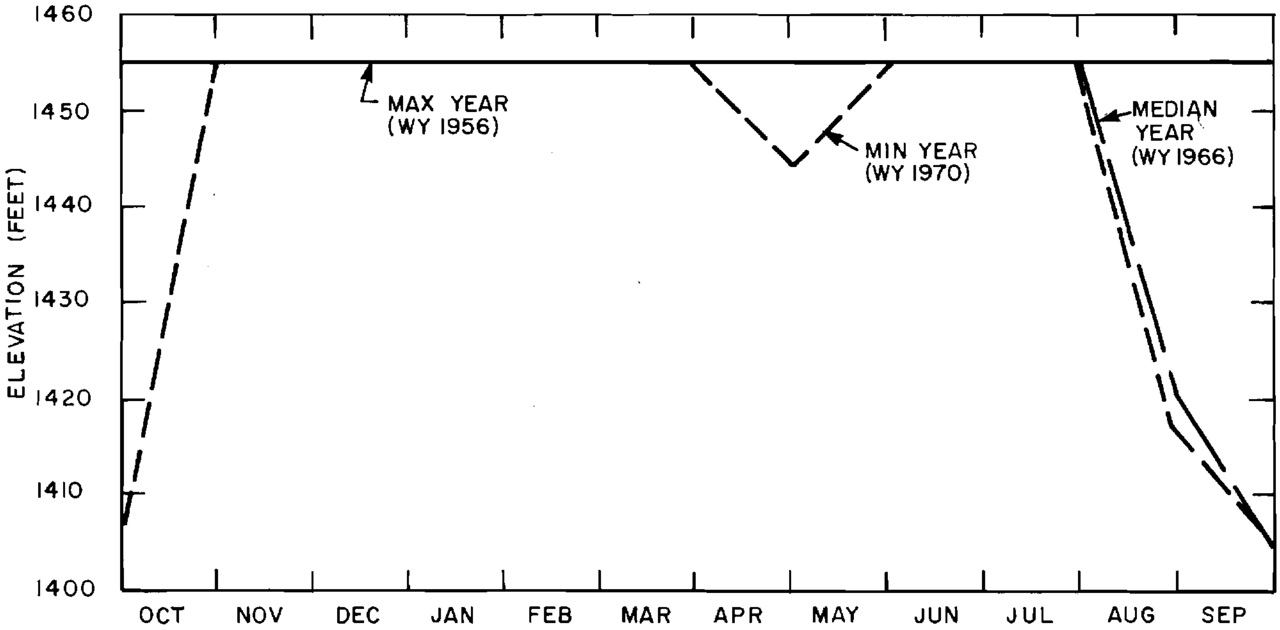
DEVIL CANYON-UNIT EFFICIENCY AND DISCHARGE OPERATING RANGE (AT RATED HEAD)

FIGURE E.2.190



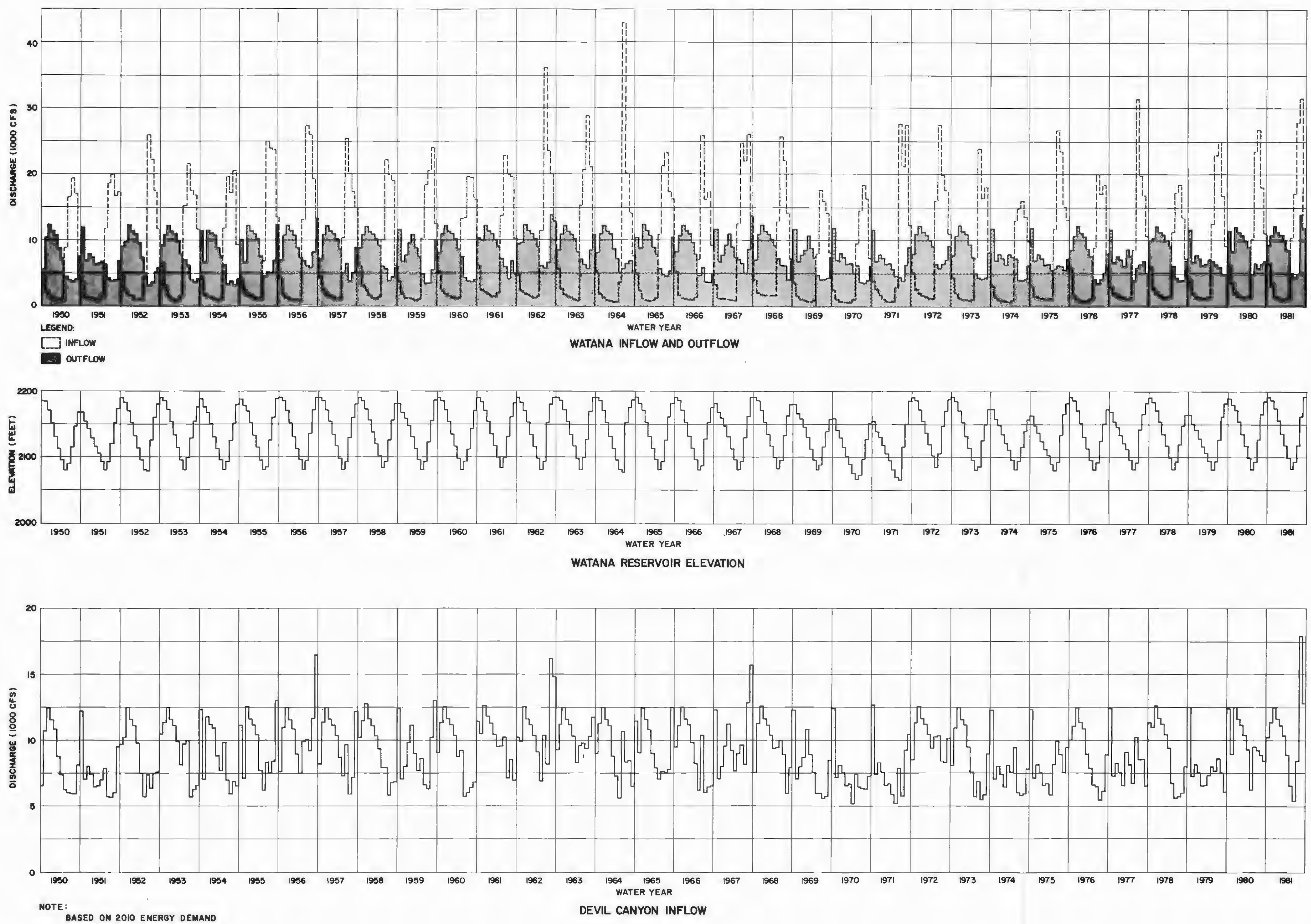
WATANA RESERVOIR WATER LEVELS
(WATANA AND DEVIL CANYON IN OPERATION)

FIGURE E.2.191



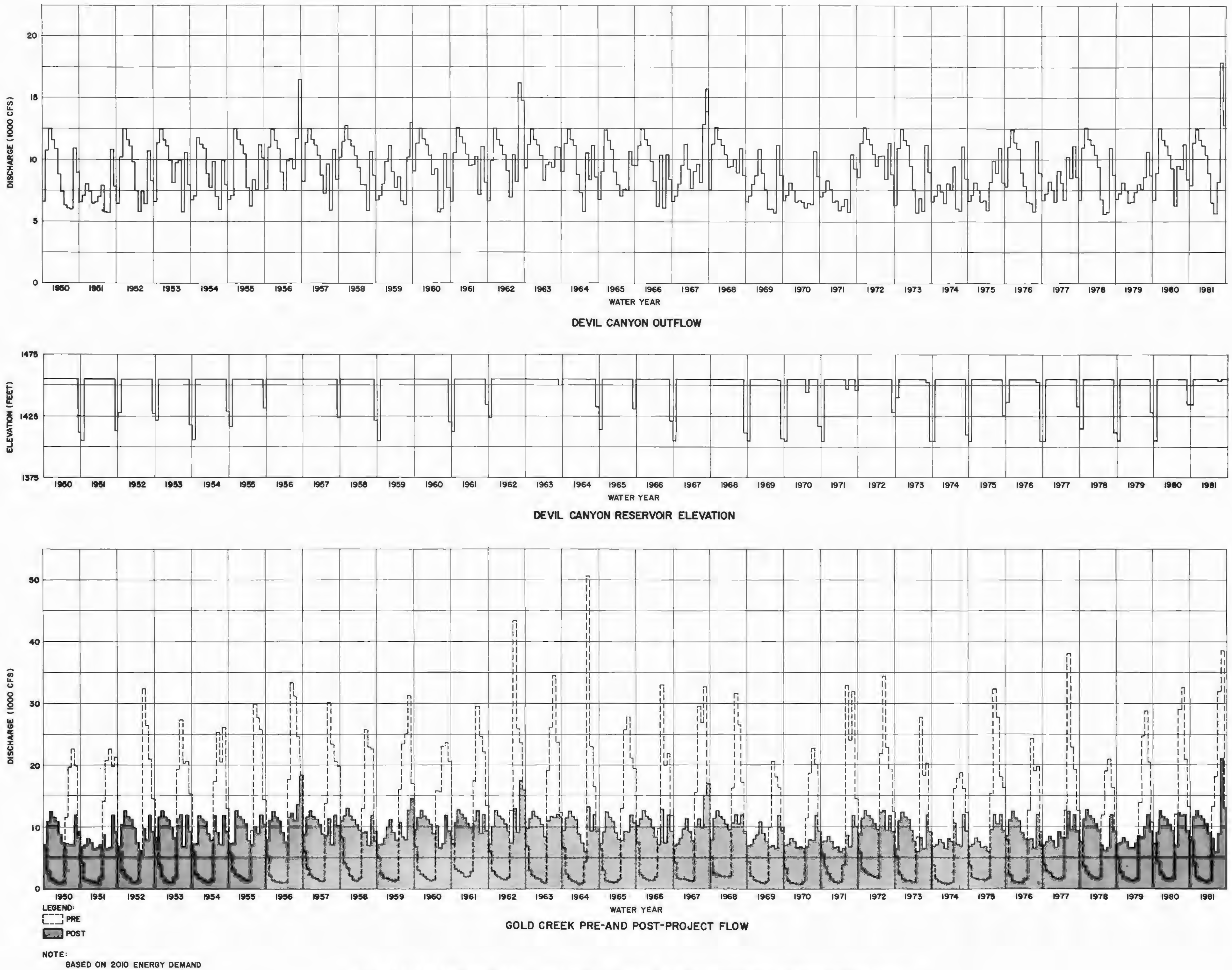
DEVIL CANYON RESERVOIR WATER LEVELS

FIGURE E.2.192



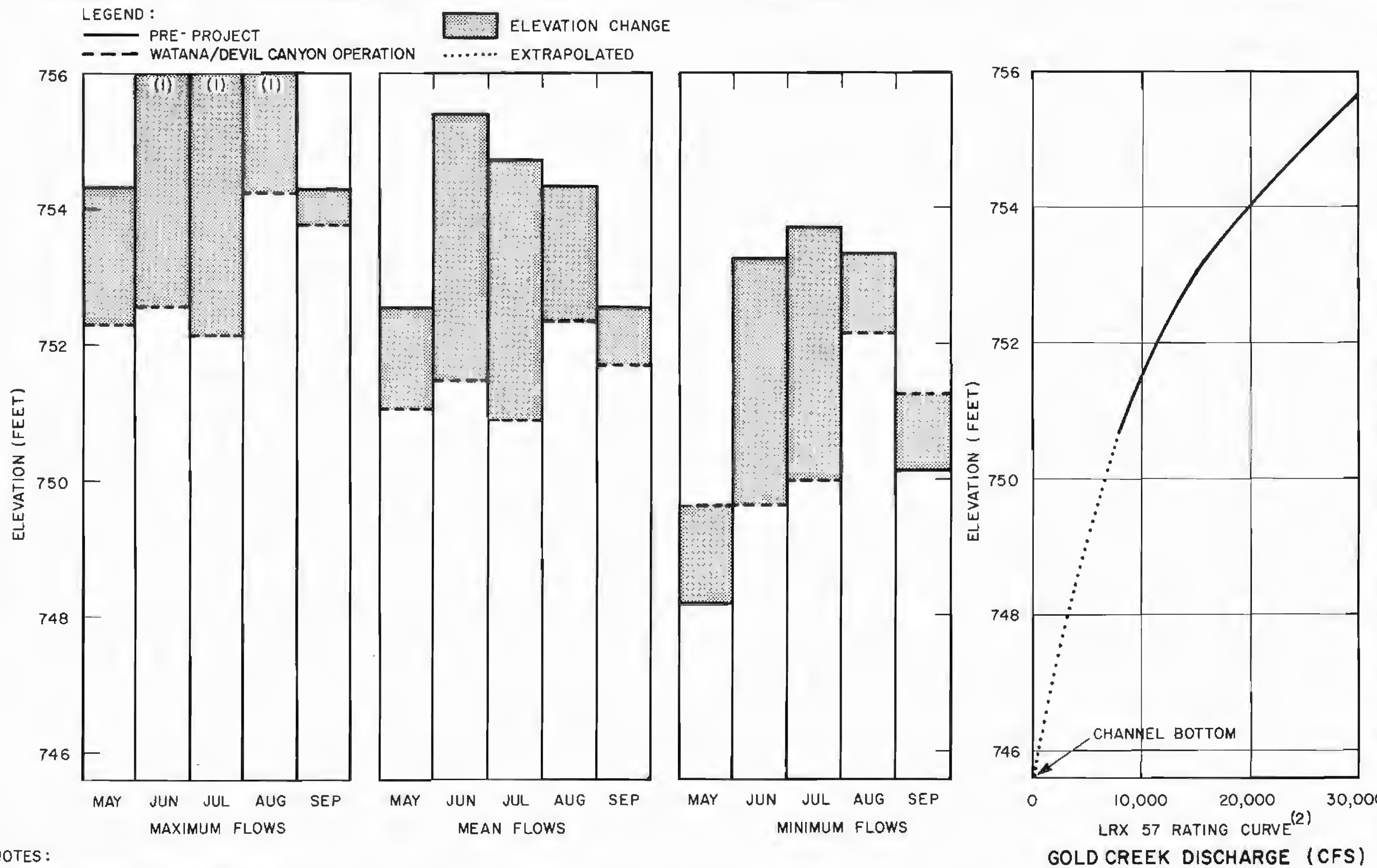
WATANA AND DEVIL CANYON SIMULATED RESERVOIR OPERATION

FIGURE E.2.193



WATANA AND DEVIL CANYON SIMULATED RESERVOIR OPERATION

FIGURE E.2.194

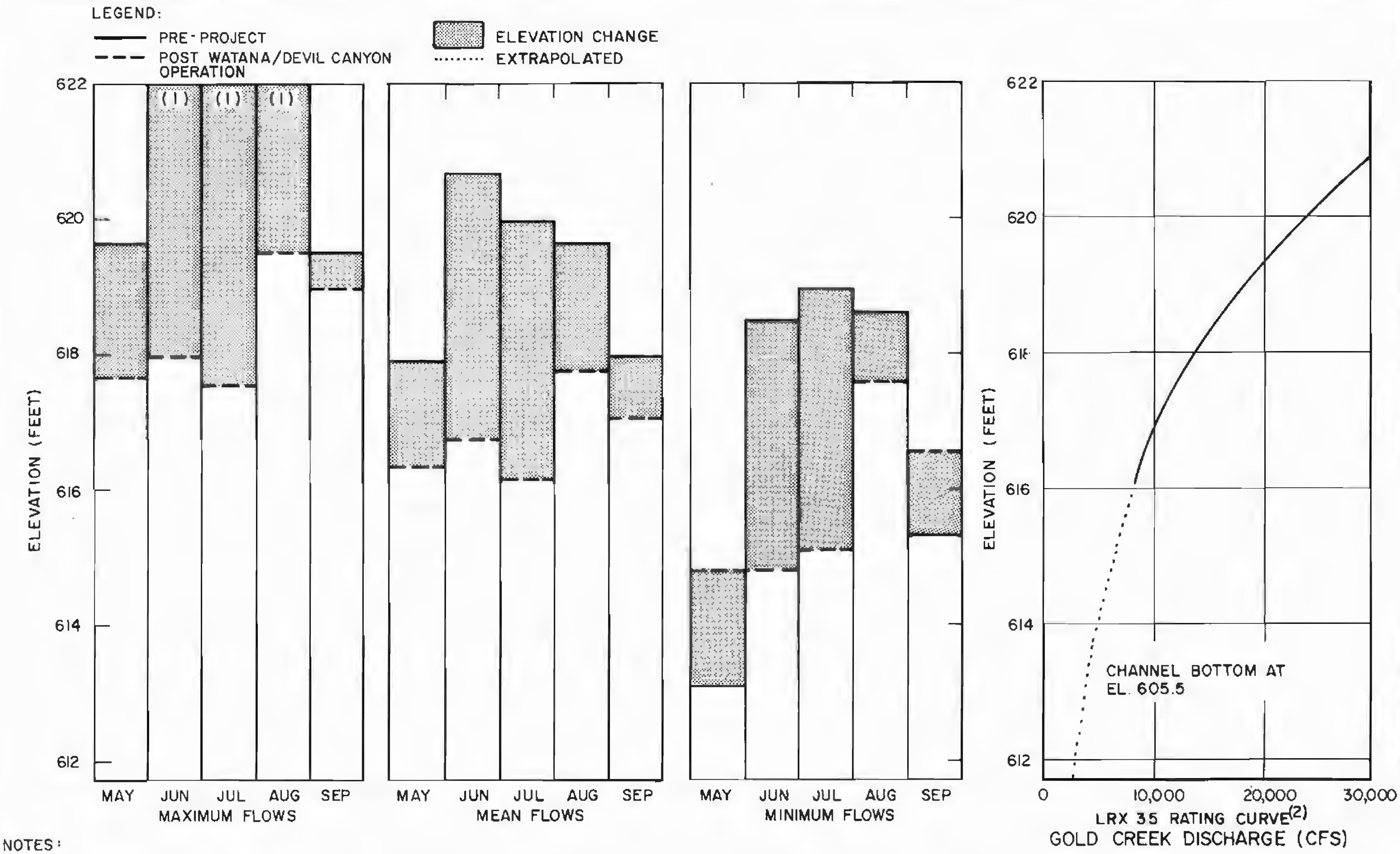


NOTES:

1. WATER SURFACE ELEVATION ABOVE RATING CURVE
2. RATING CURVE BASED ON GOLD CREEK DISCHARGE AND OBSERVED 1982 WATER LEVELS (ADF & G 1982)

WATANA/DEVIL CANYON OPERATION: MONTHLY AVERAGE WATER SURFACE ELEVATIONS AT RIVER MILE 142.3

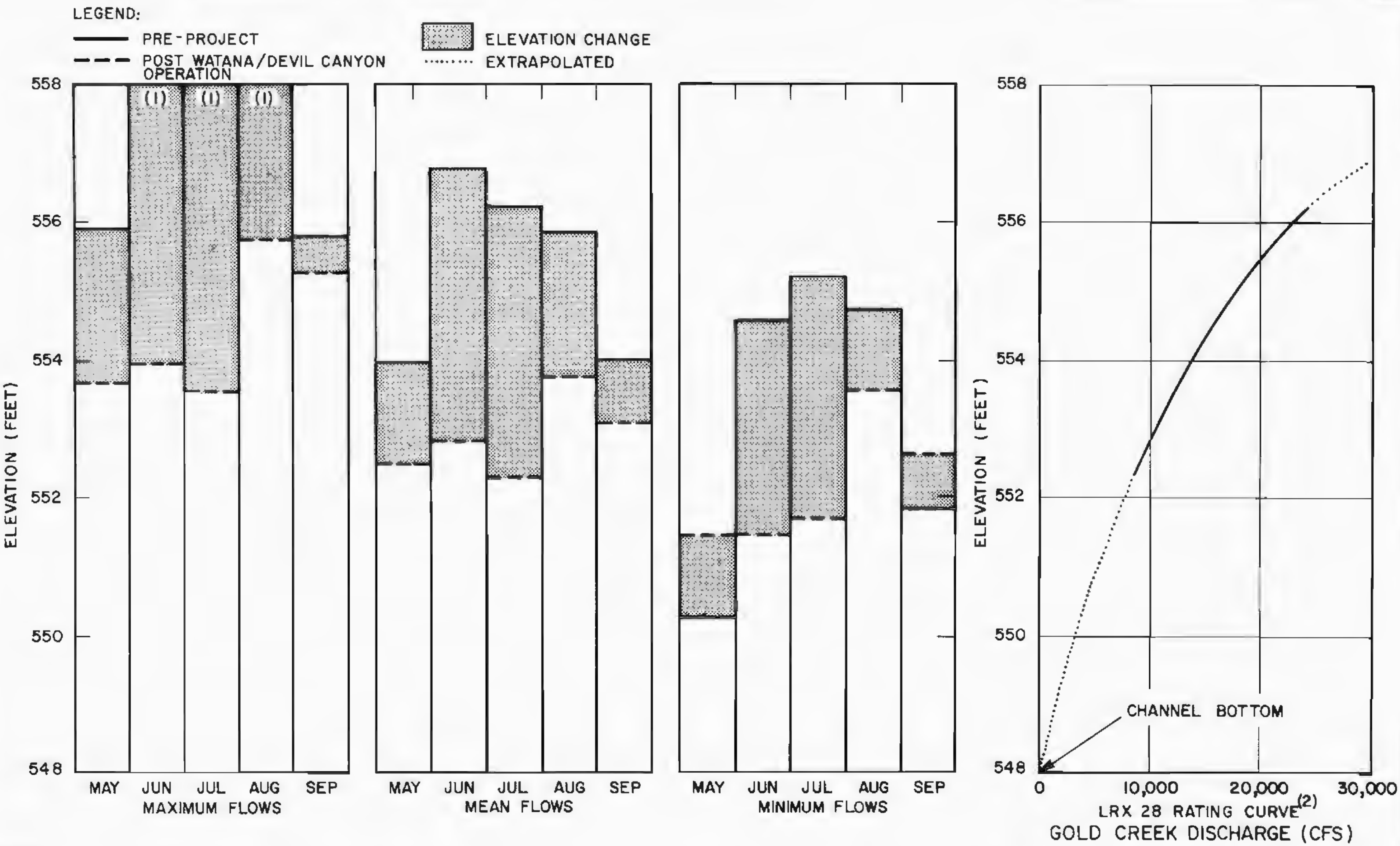
FIGURE E.2.195



NOTES:
1. WATER SURFACE ELEVATION ABOVE RATING CURVE
2. RATING CURVE BASED ON GOLD CREEK DISCHARGE AND OBSERVED 1982 WATER LEVELS (ADF&G 1981).

WATANA/DEVIL CANYON OPERATION: MONTHLY AVERAGE WATER SURFACE ELEVATIONS AT RIVER MILE 130.9

FIGURE E.2.196

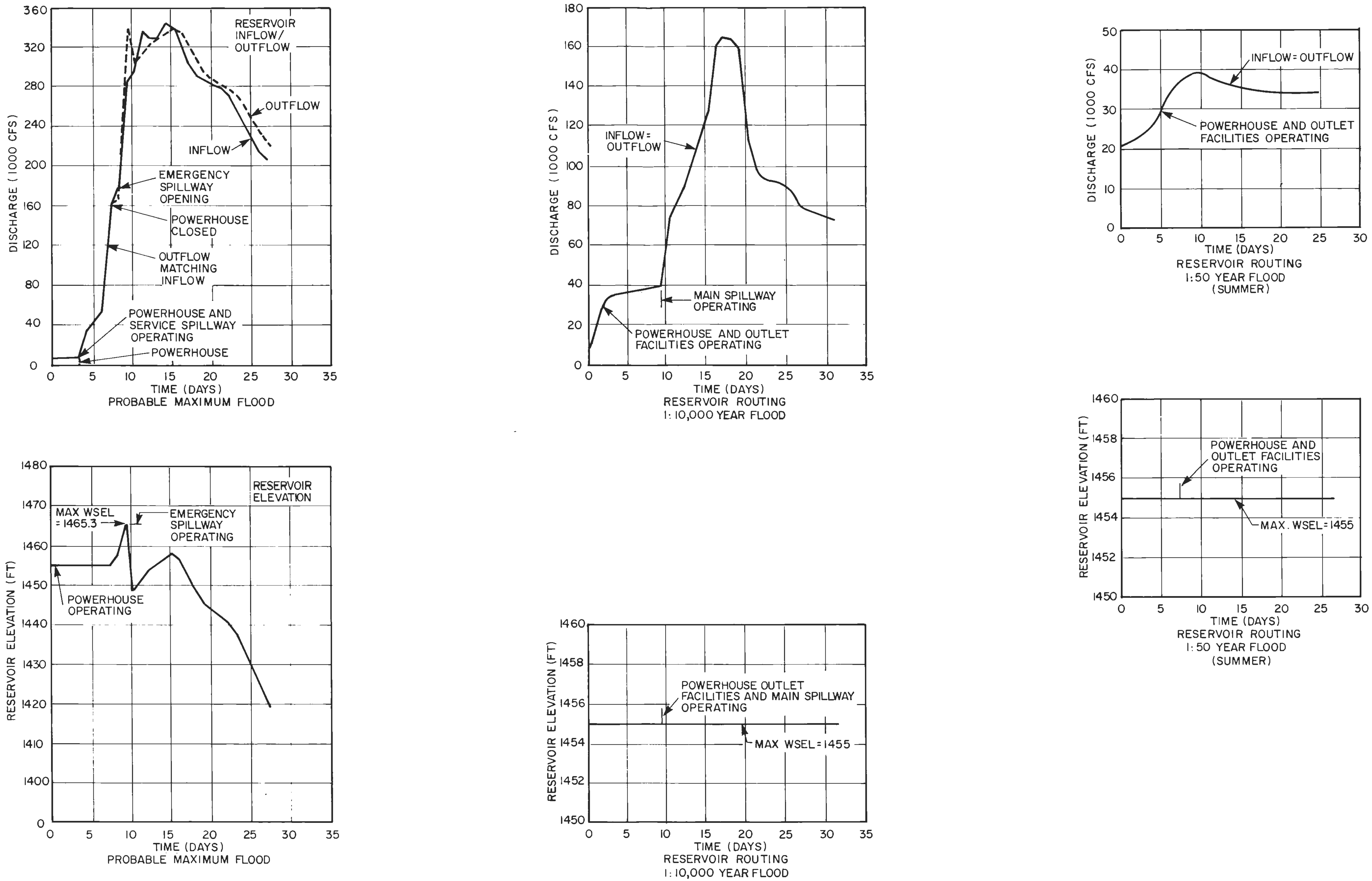


NOTES:

1. WATER SURFACE ELEVATION ABOVE RATING CURVE.
2. RATING CURVE BASED ON GOLD CREEK DISCHARGE AND OBSERVED 1982 WATER LEVELS (ADF&G 1982).

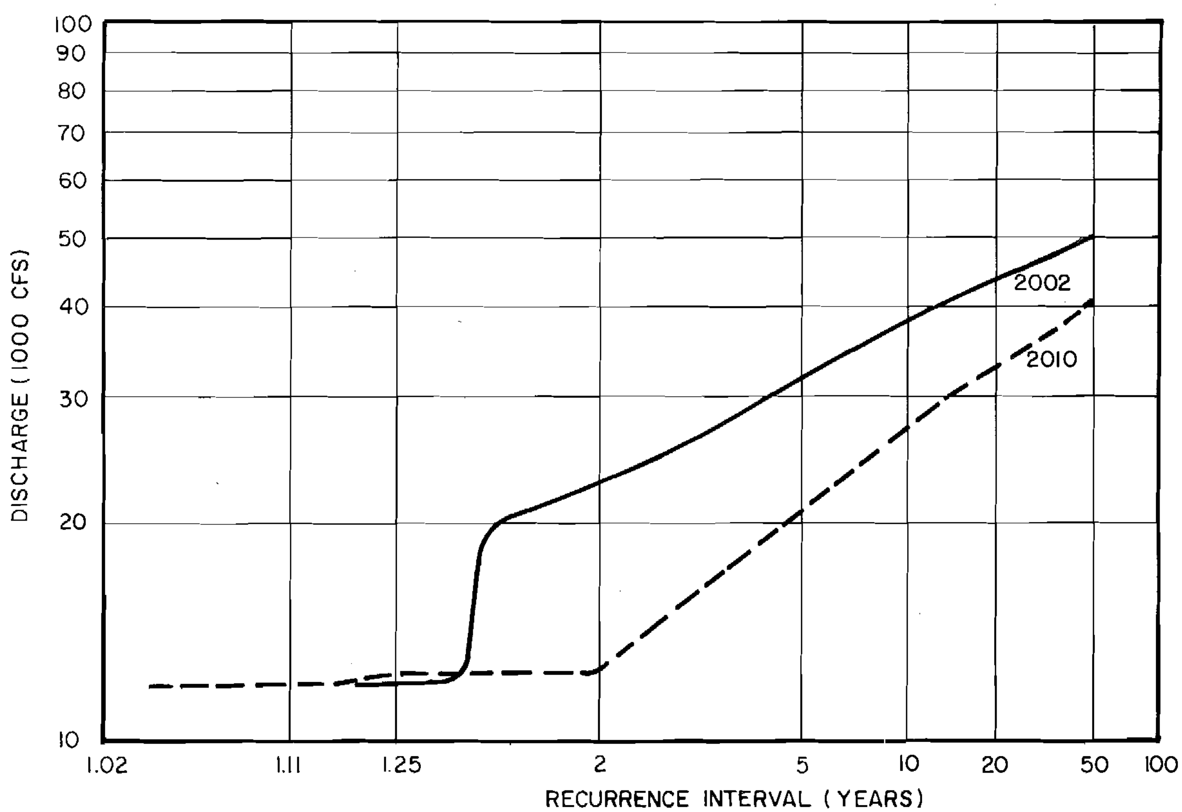
WATANA/DEVIL CANYON OPERATION: MONTHLY AVERAGE WATER SURFACE ELEVATIONS AT RIVER MILE 124.4

FIGURE E.2.197



DEVIL CANYON
FLOOD DISCHARGES AND RESERVOIR
SURFACE ELEVATIONS

FIGURE E.2.198

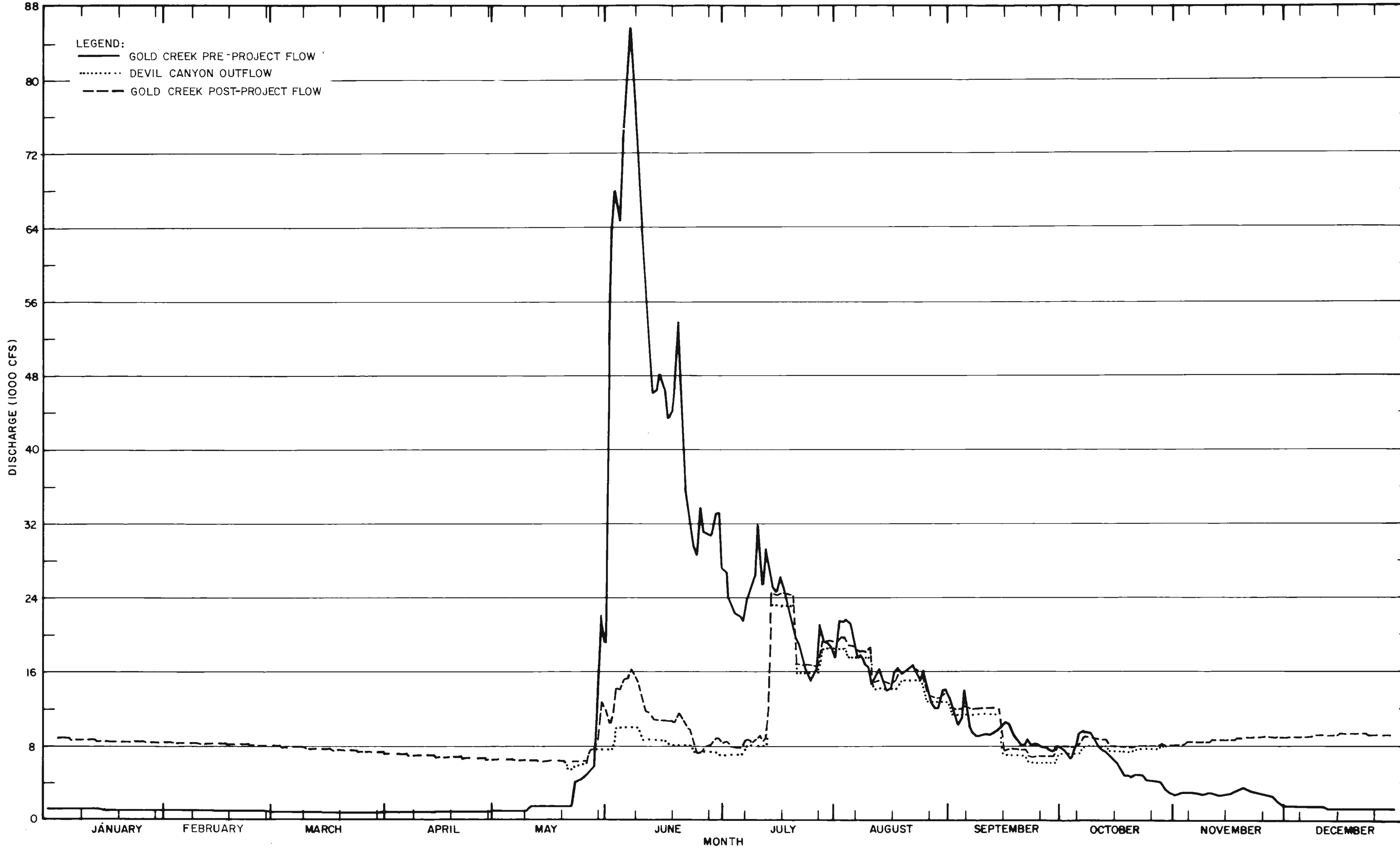


NOTES:

1. BASED ON WEEKLY RESERVOIR SIMULATIONS FOR 2002 AND 2010 DEMAND.

GOLD CREEK ANNUAL FLOOD FREQUENCY CURVES
WATANA/DEVIL CANYON OPERATION

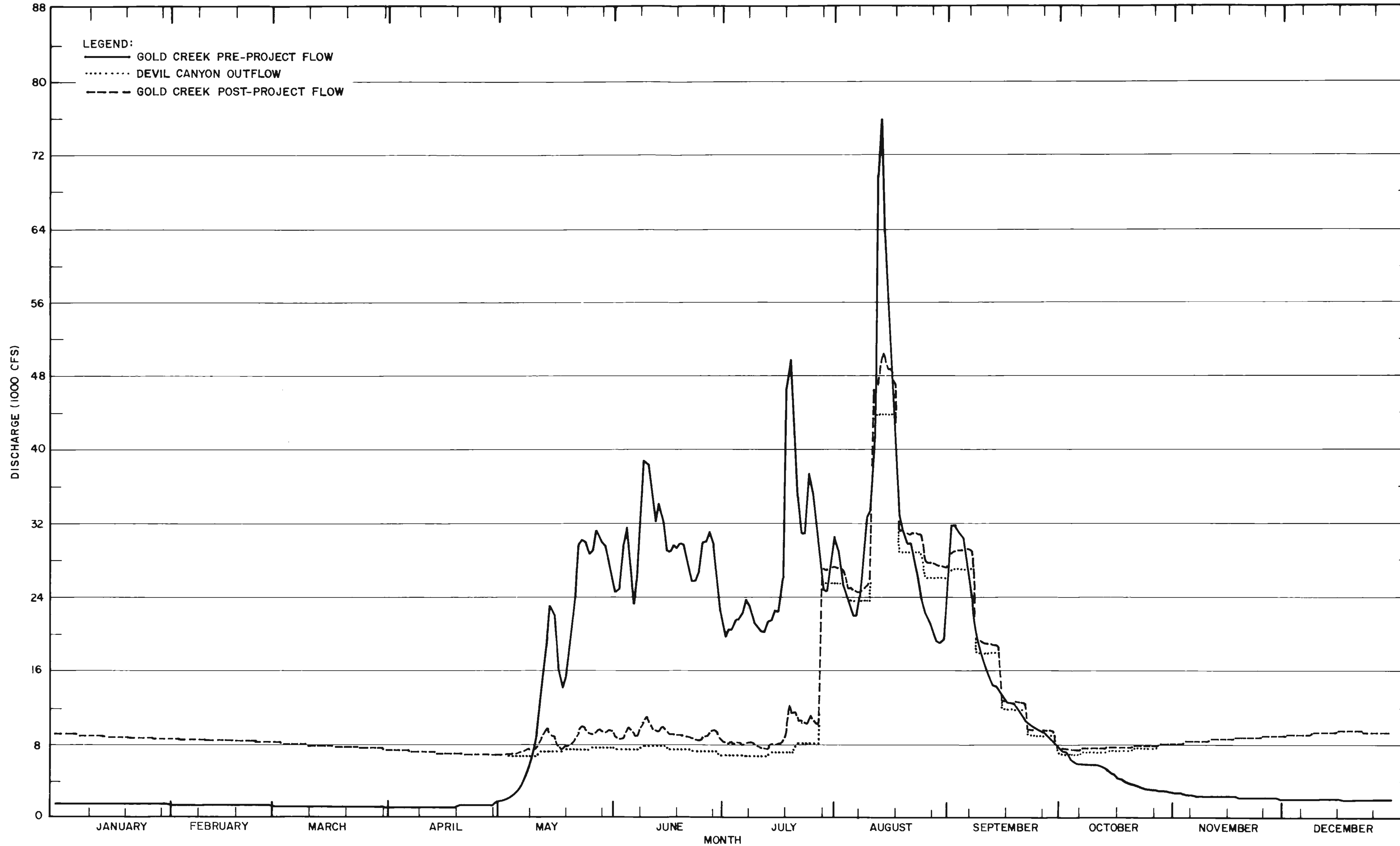
FIGURE E.2.199



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1964 DEVIL CANYON AND GOLD CREEK FLOW
SIMULATION USING 2002 DEMAND

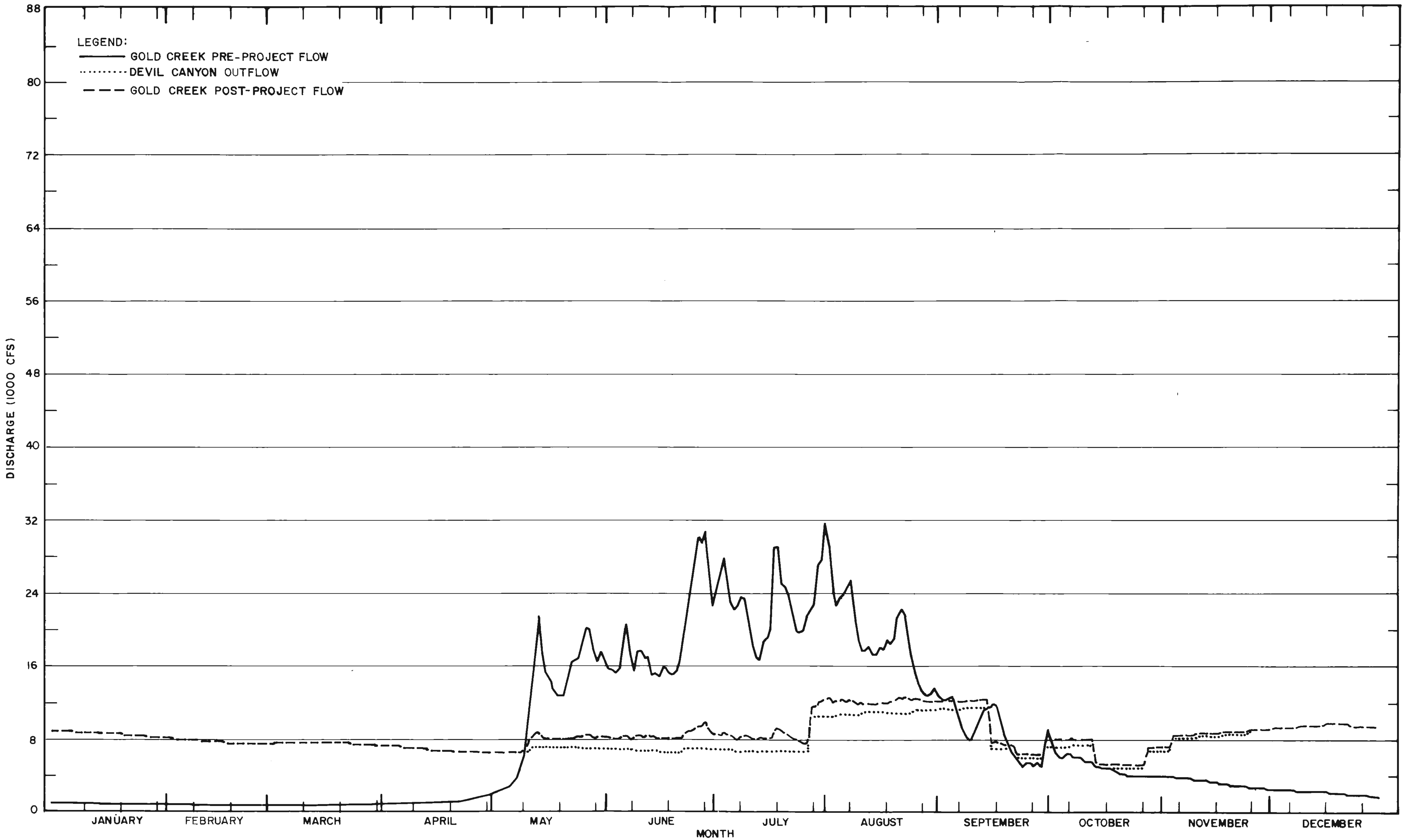
FIGURE E.2.200



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1967 DEVIL CANYON AND GOLD CREEK FLOW
SIMULATION USING 2002 DEMAND

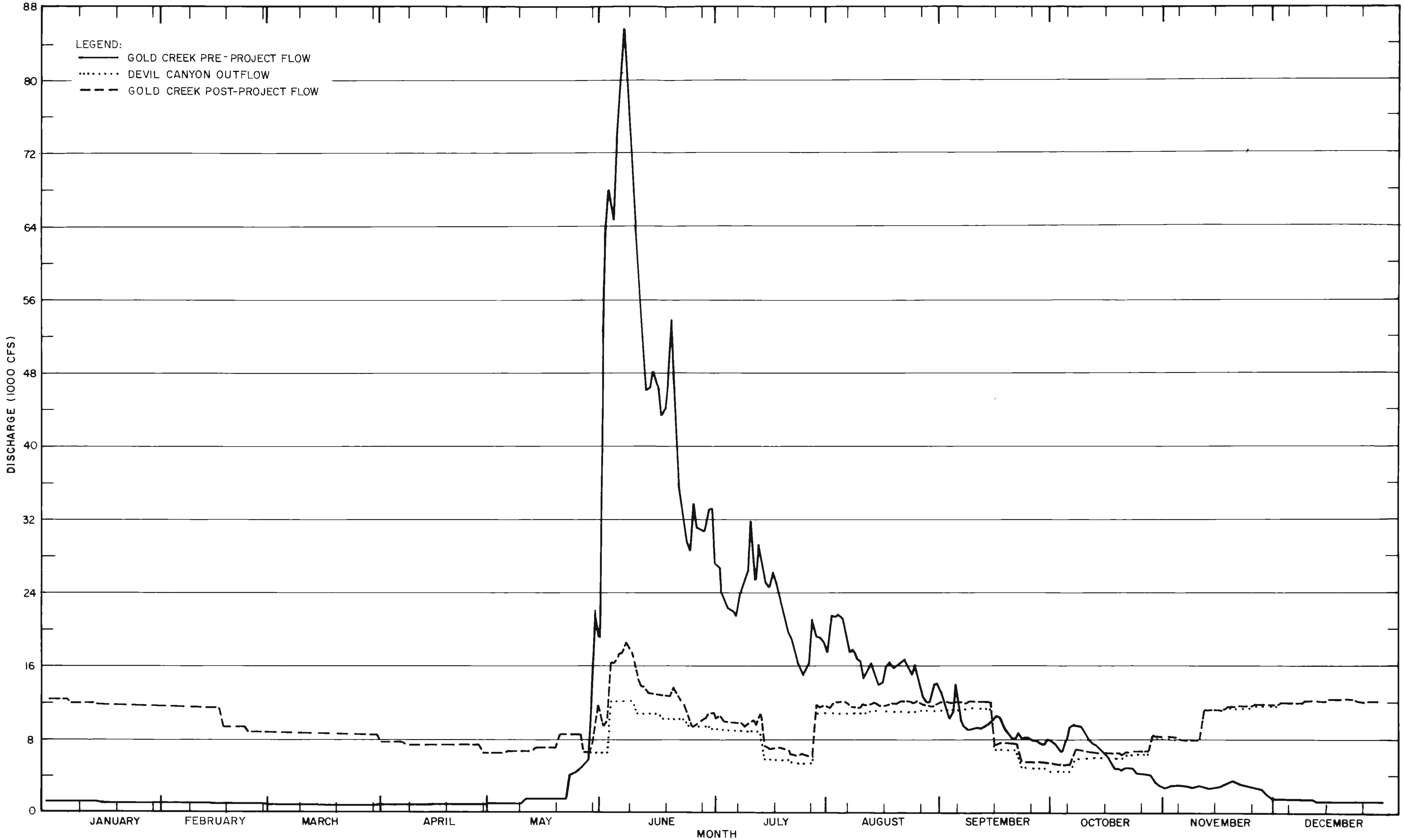
FIGURE E.2.201



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1970 DEVIL CANYON AND GOLD CREEK FLOW
SIMULATION USING 2002 DEMAND

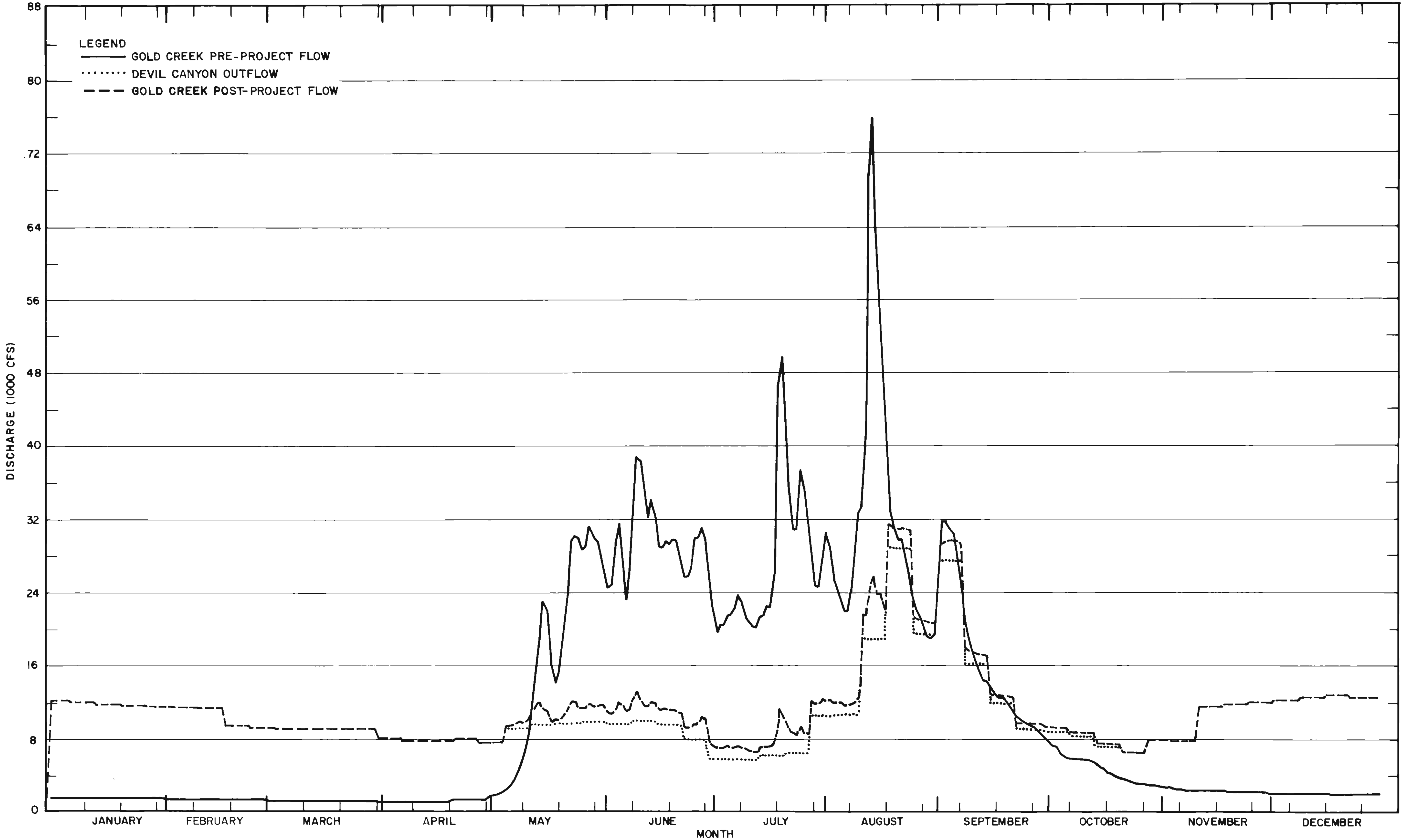
FIGURE E.2.202



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1964 DEVIL CANYON AND GOLD CREEK FLOW
SIMULATION USING 2010 DEMAND

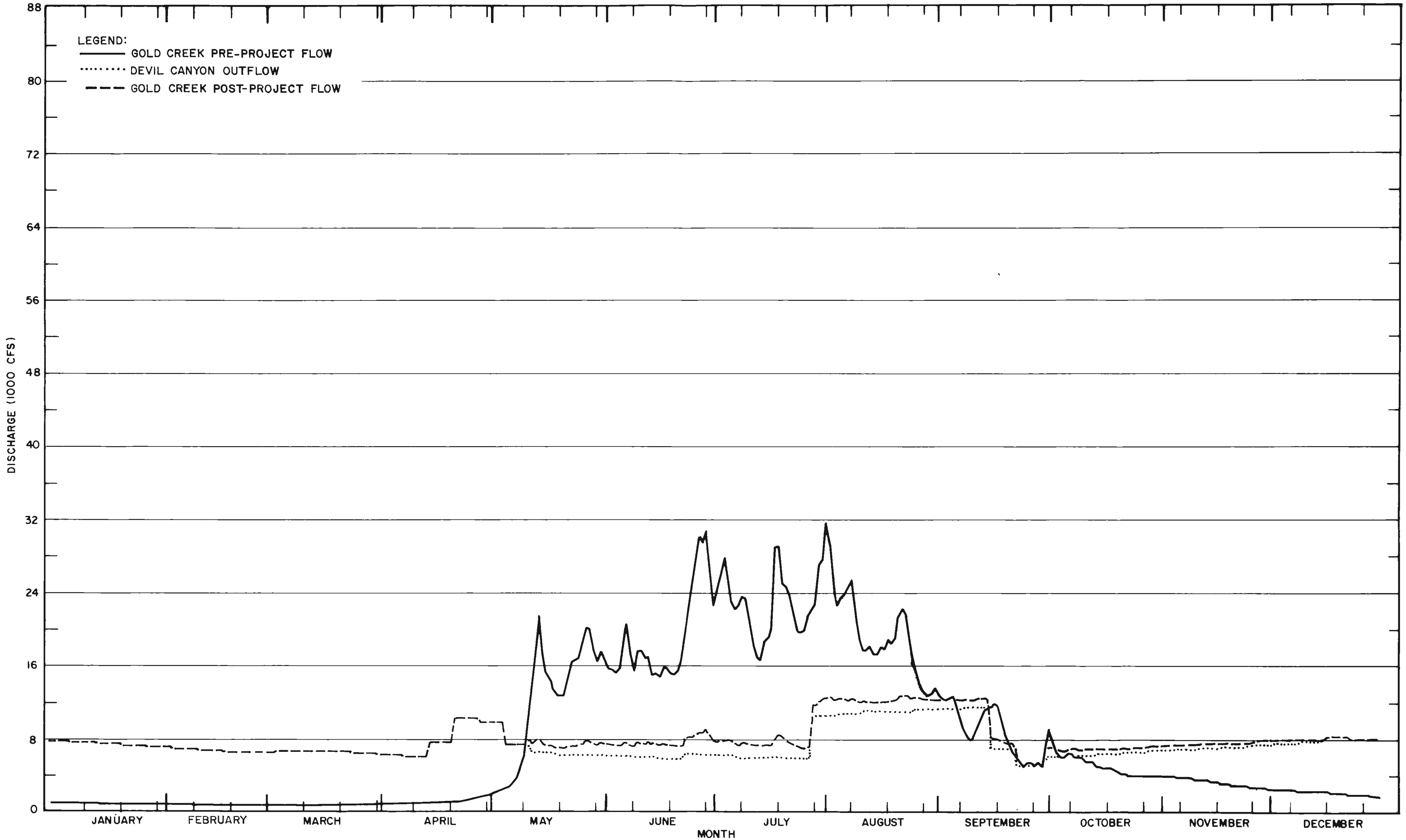
FIGURE E.2.203



NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1967 DEVIL CANYON AND GOLD CREEK FLOW
SIMULATION USING 2010 DEMAND

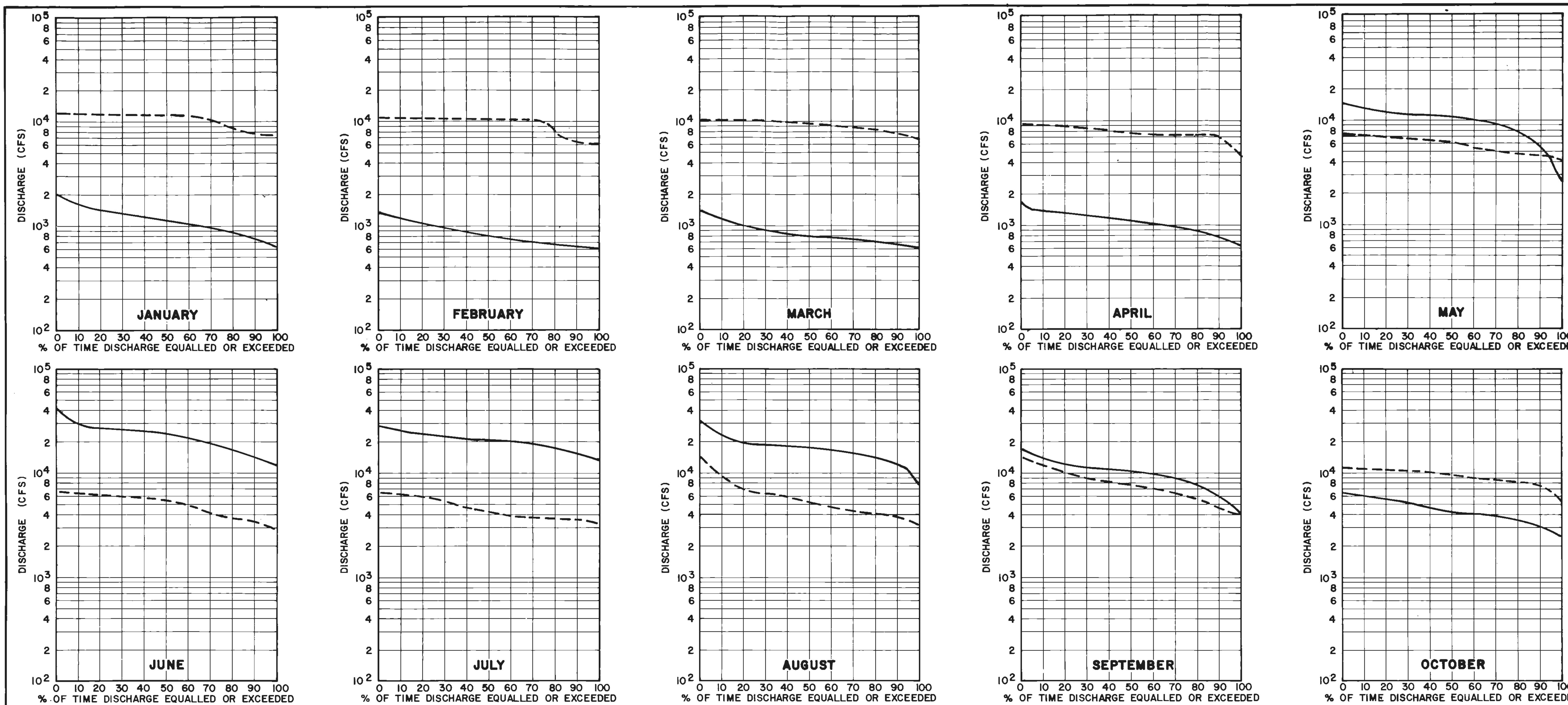
FIGURE E.2.204

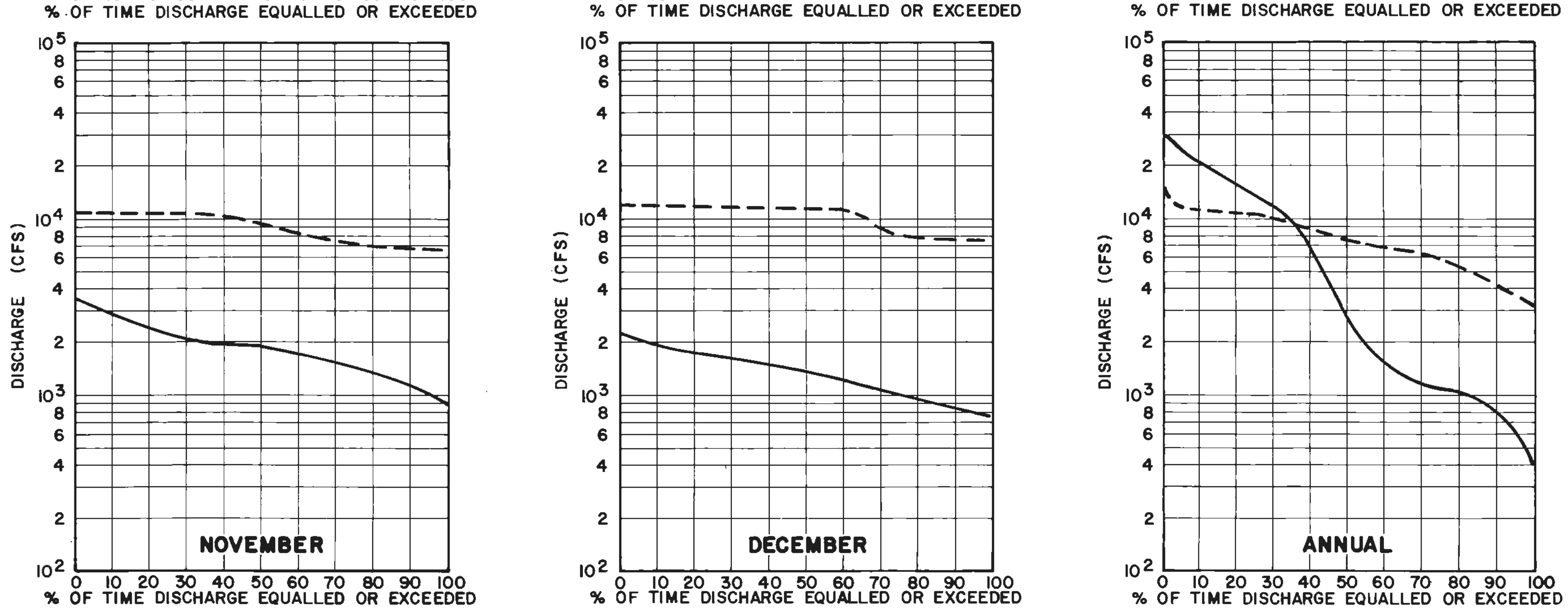


NOTE:
TIME SCALE IS IN INCREMENTS OF 10 DAYS.

1970 DEVIL CANYON AND GOLD CREEK FLOW
SIMULATION USING 2010 DEMAND

FIGURE E.2.205





NOTE:

1. CURVES BASED UPON AVERAGE MONTHLY FLOWS FOR 32 YEARS OF SYNTHESIZED RECORDS DERIVED FROM HISTORICAL AND FILLED DATA.

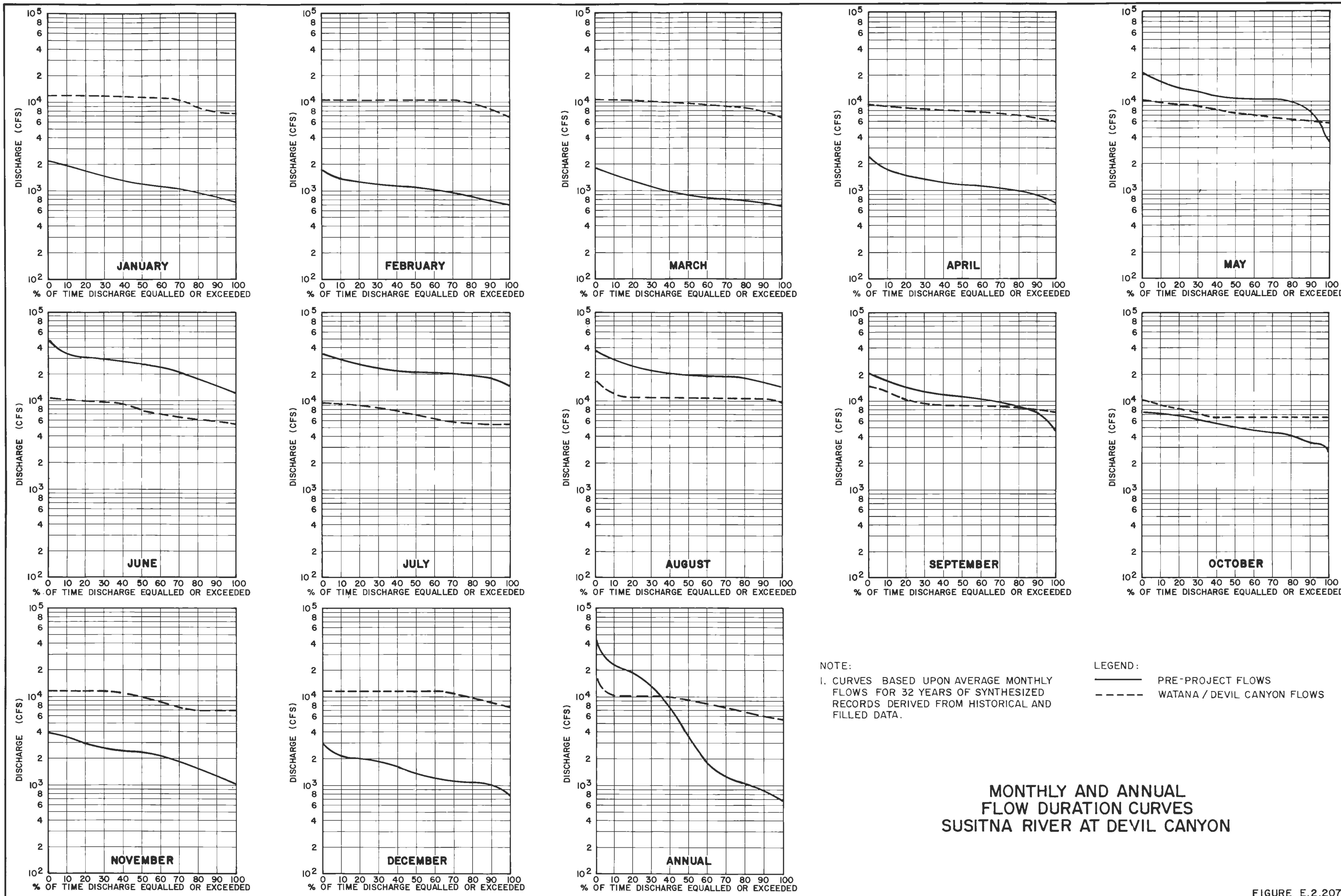
LEGEND:

——— PRE-PROJECT FLOWS

– – – – WATANA / DEVIL CANYON FLOWS

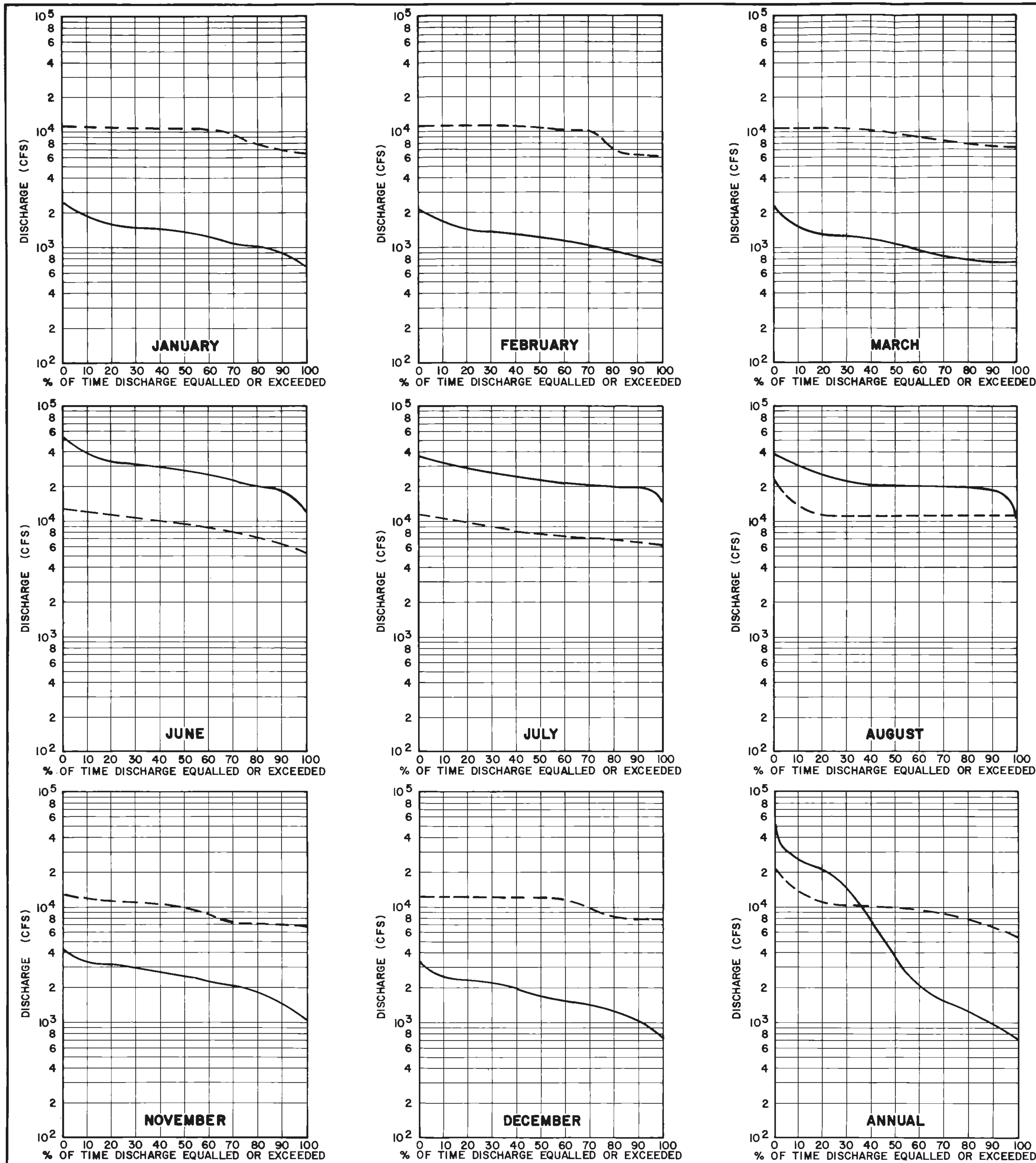
MONTHLY AND ANNUAL FLOW DURATION CURVES SUSITNA RIVER AT WATANA

FIGURE E.2.206



MONTHLY AND ANNUAL
FLOW DURATION CURVES
SUSITNA RIVER AT DEVIL CANYON

FIGURE E.2.207



NOTE:

1. CURVES BASED UPON AVERAGE MONTHLY FLOWS FOR 32 YEARS OF SYNTHESIZED RECORDS DERIVED FROM HISTORICAL DATA.

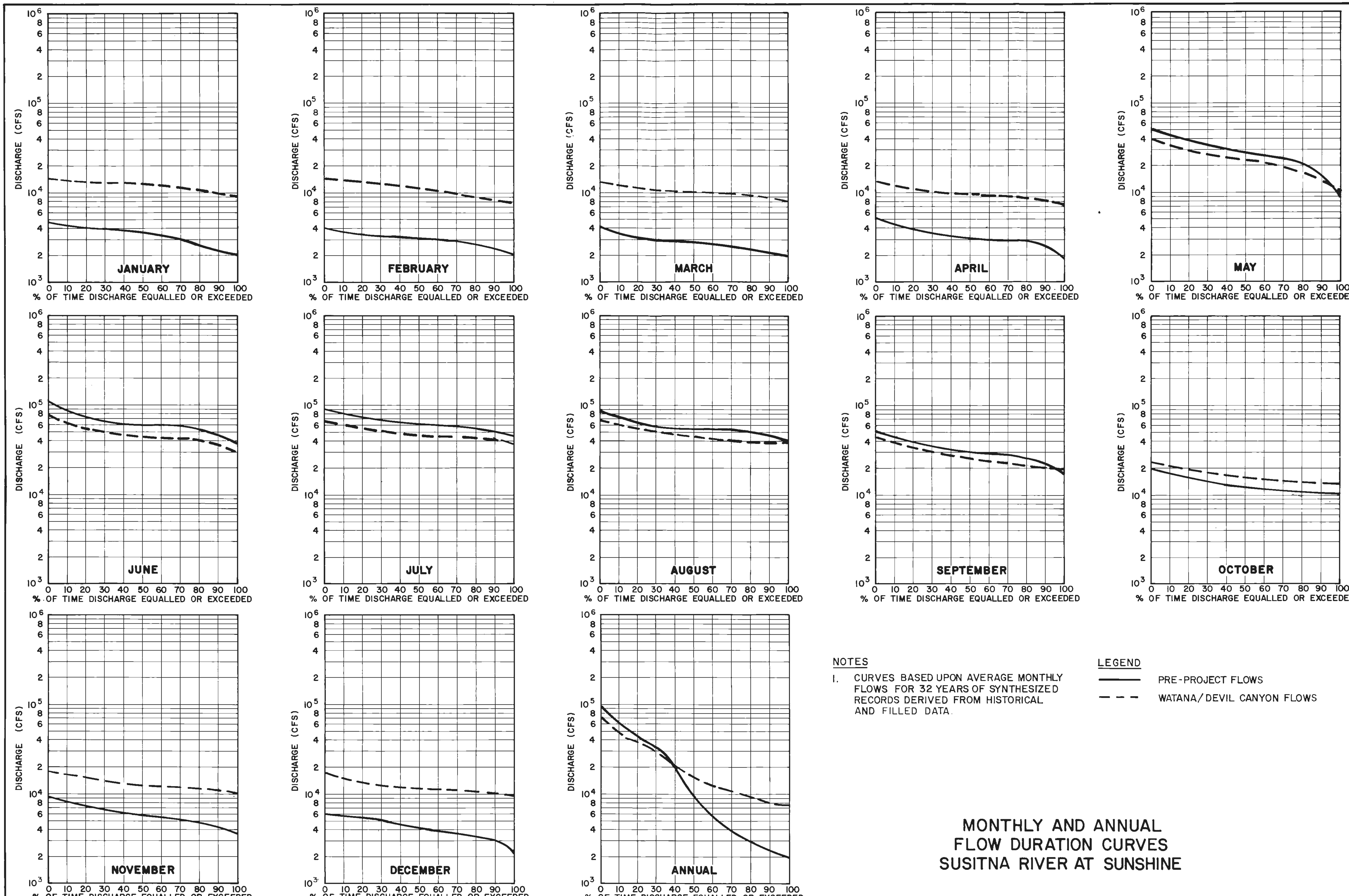
LEGEND:

——— PRE-PROJECT FLOWS

– – – WATANA / DEVIL CANYON FLOWS

MONTHLY AND ANNUAL FLOW DURATION CURVES SUSITNA RIVER AT GOLD CREEK

FIGURE E.2.208



NOTES

1. CURVES BASED UPON AVERAGE MONTHLY FLOWS FOR 32 YEARS OF SYNTHESIZED RECORDS DERIVED FROM HISTORICAL AND FILLED DATA.

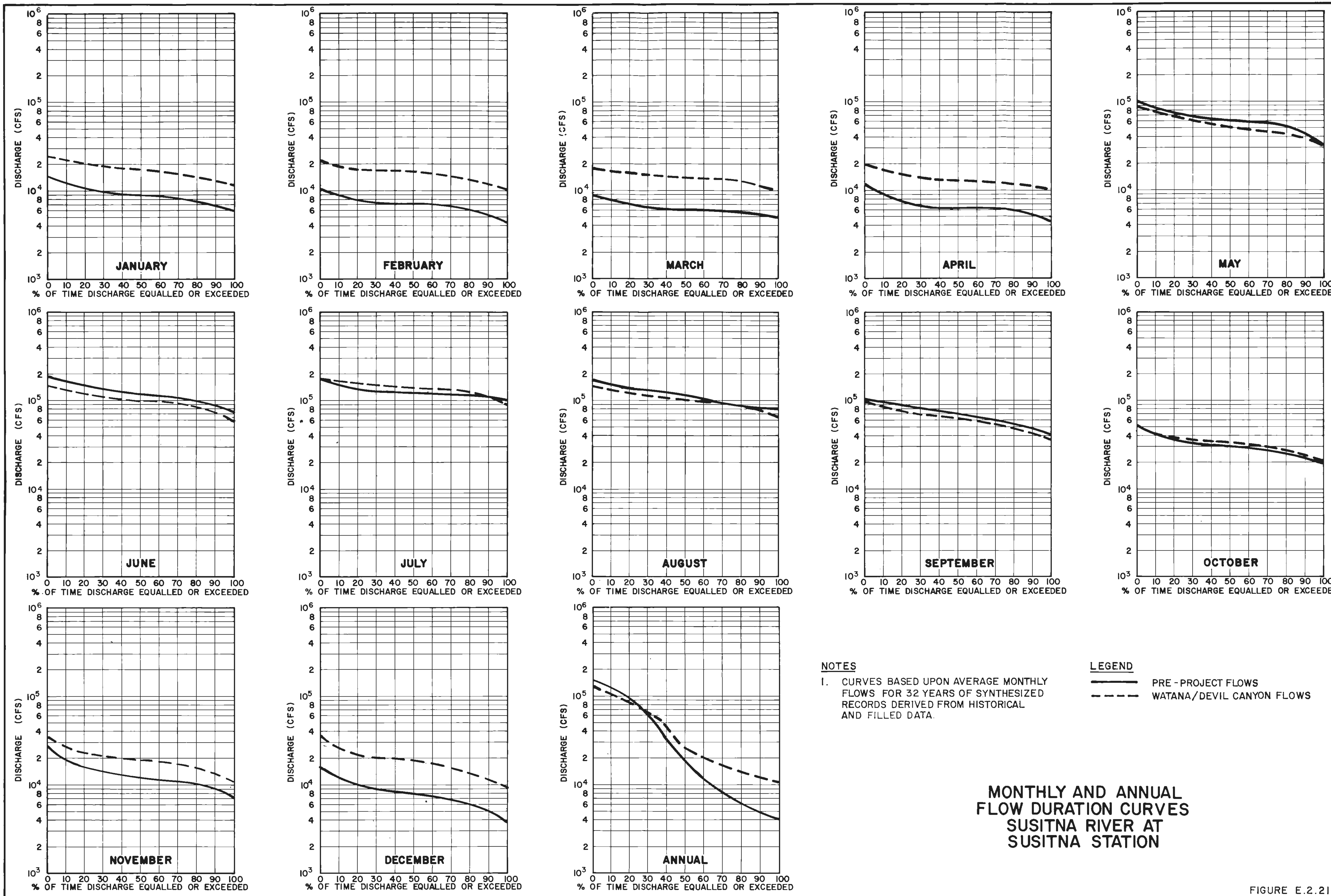
LEGEND

——— PRE-PROJECT FLOWS

– – – WATANA/DEVIL CANYON FLOWS

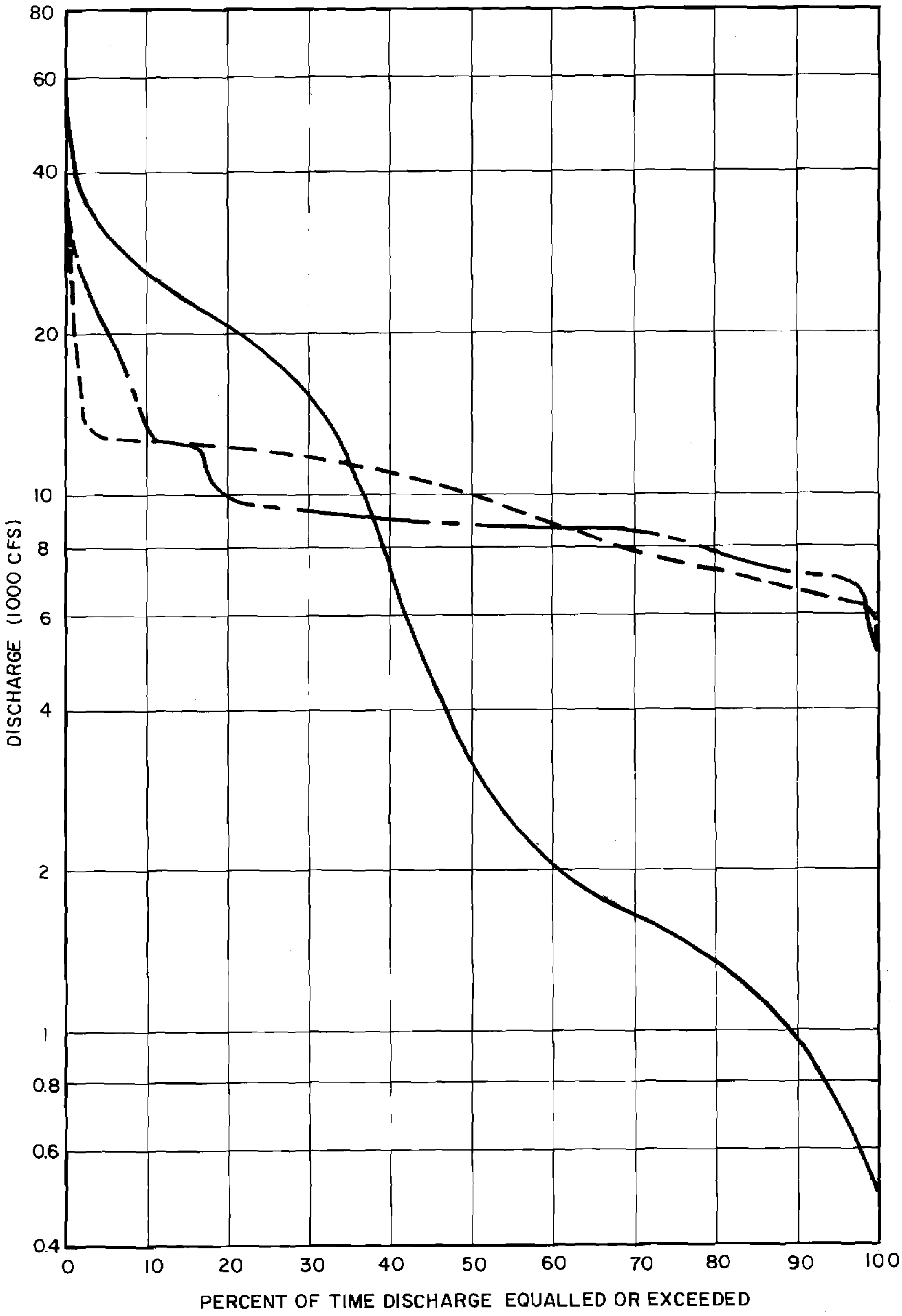
MONTHLY AND ANNUAL
FLOW DURATION CURVES
SUSITNA RIVER AT SUNSHINE

FIGURE E.2.209



MONTHLY AND ANNUAL FLOW DURATION CURVES SUSITNA RIVER AT SUSITNA STATION

FIGURE E.2.210



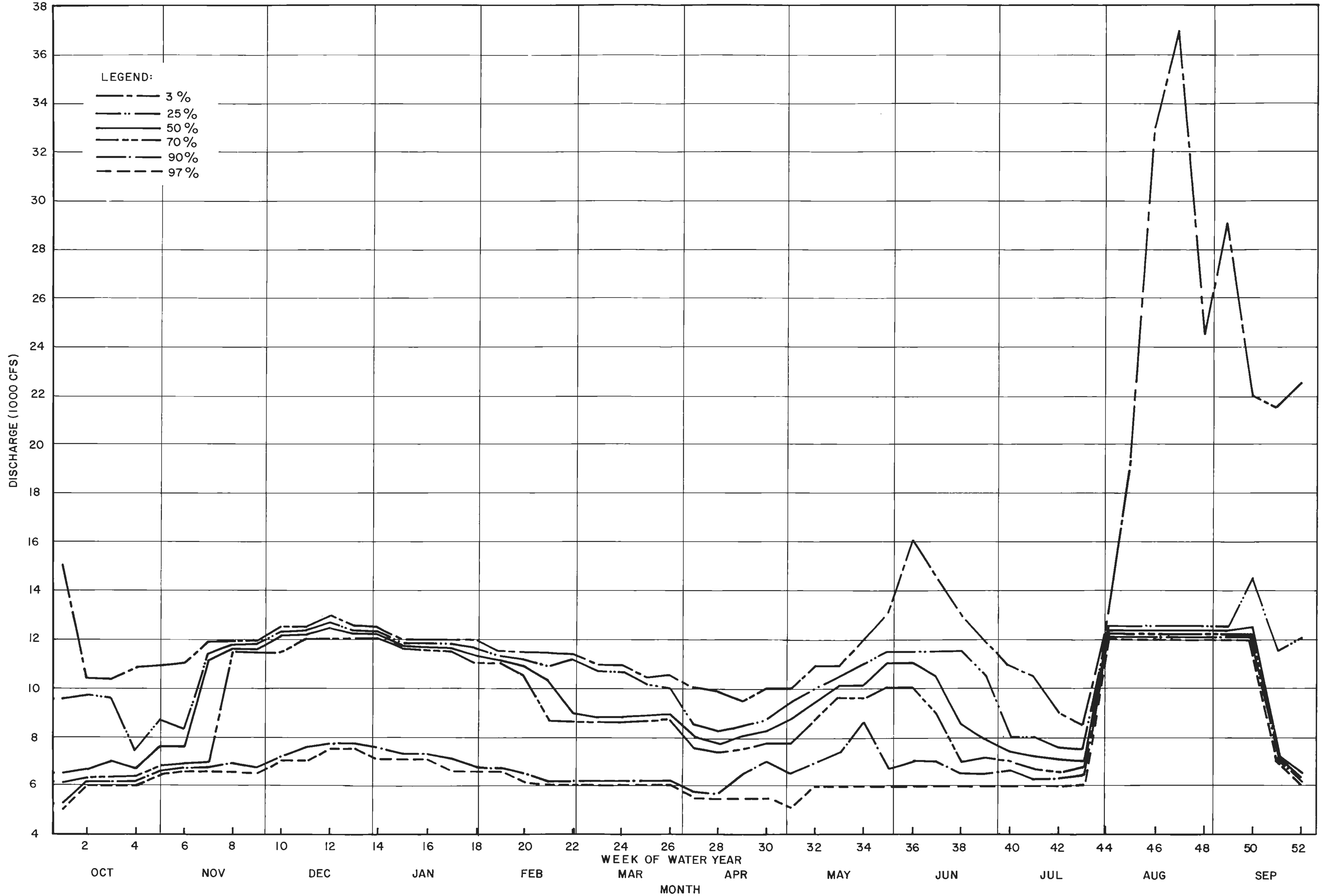
LEGEND:

- PRE-PROJECT
- WATANA / DEVIL CANYON OPERATION - 2002 DEMAND
- WATANA / DEVIL CANYON OPERATION - 2010 DEMAND

NOTE: FLOW DURATION CURVES ARE BASED ON MEAN WEEKLY DISCHARGE.

ANNUAL FLOW DURATION CURVE
SUSITNA RIVER AT GOLD CREEK
PRE-PROJECT AND WATANA / DEVIL CANYON OPERATION

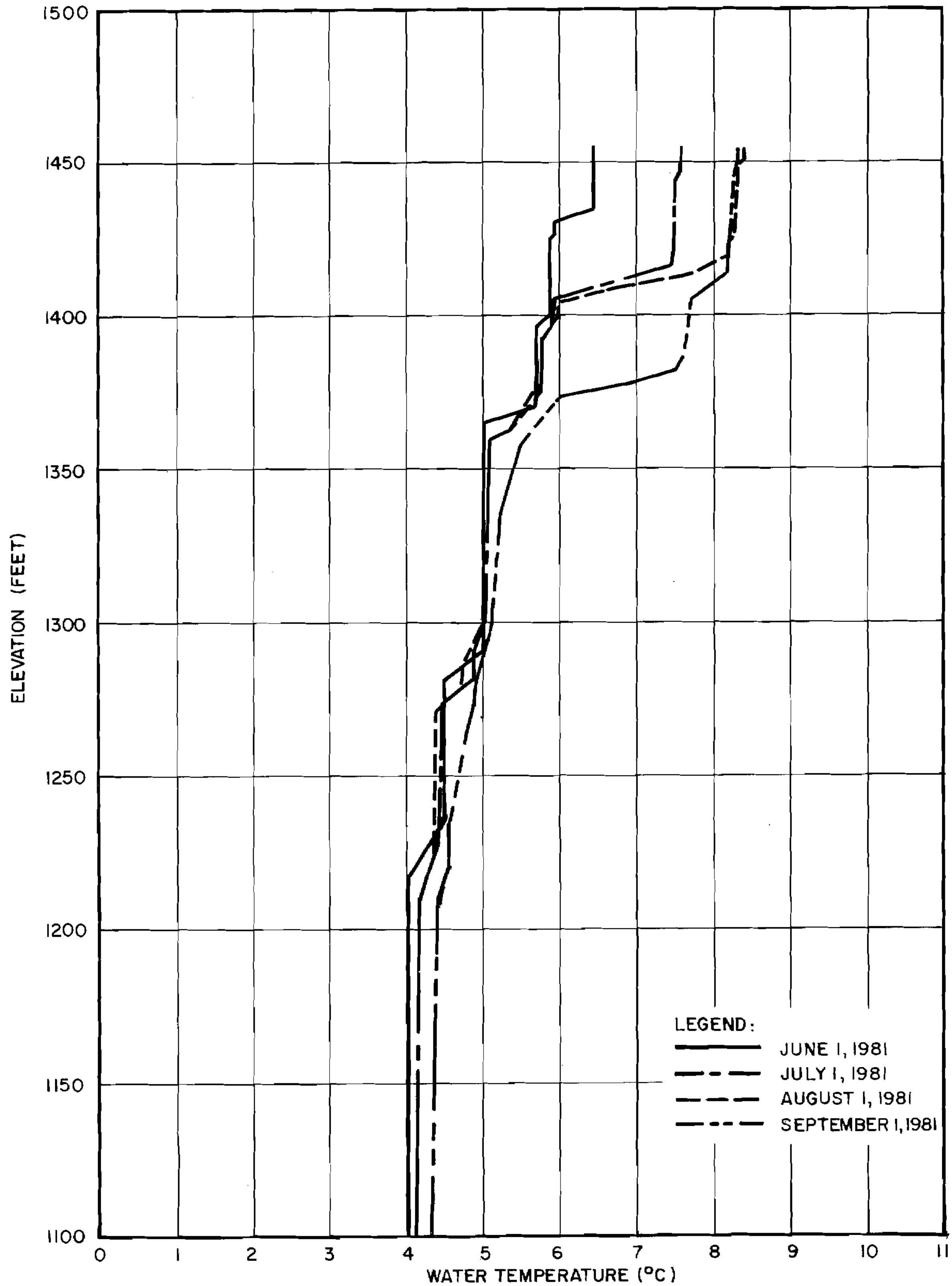
FIGURE E.2.211



NOTE: ASSUMES 2010 ENERGY DEMAND.

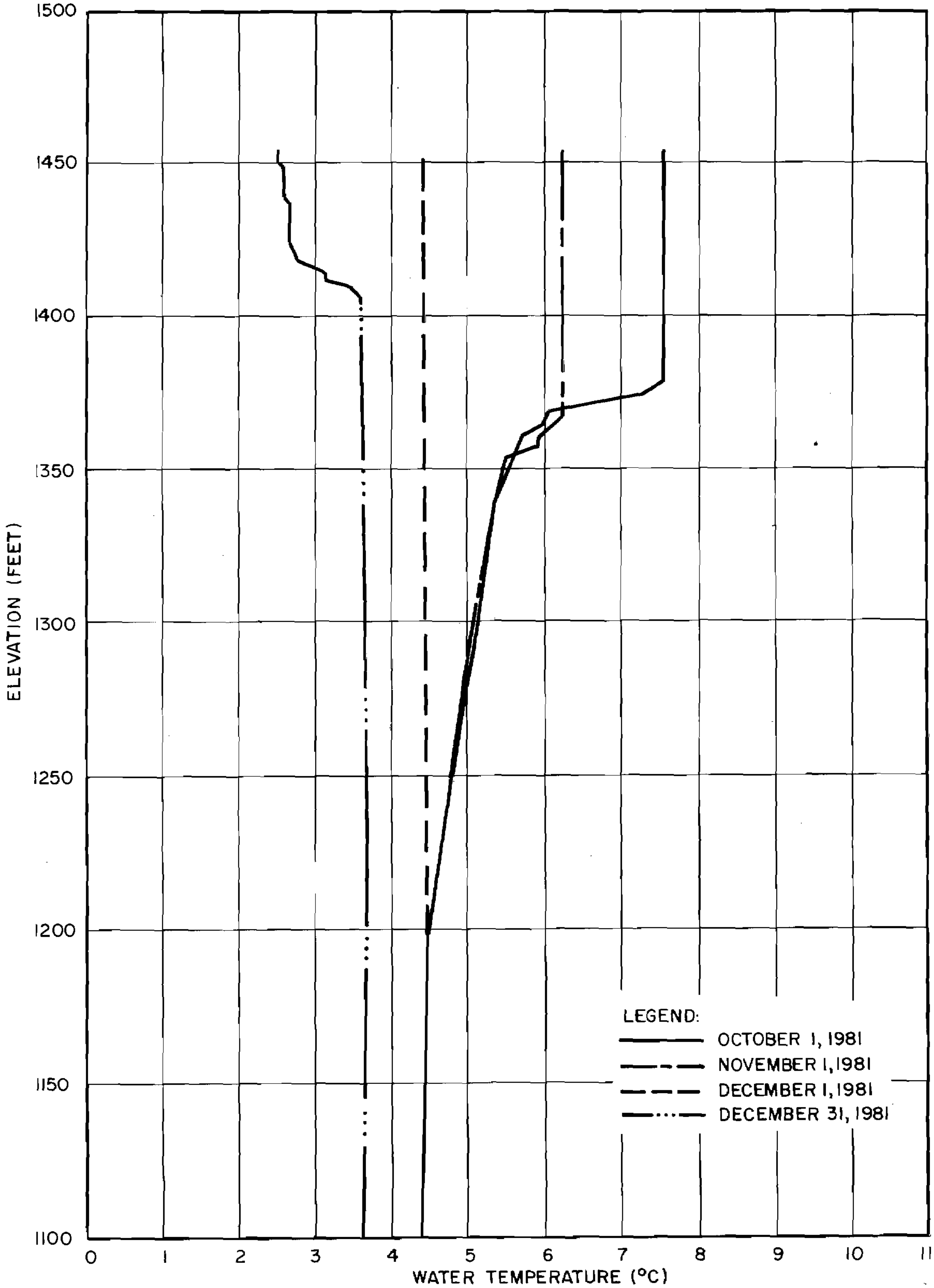
WATANA / DEVIL CANYON OPERATION
GOLD CREEK DISCHARGES FOR VARIOUS
PROBABILITIES OF EXCEEDANCE

FIGURE E.2.212



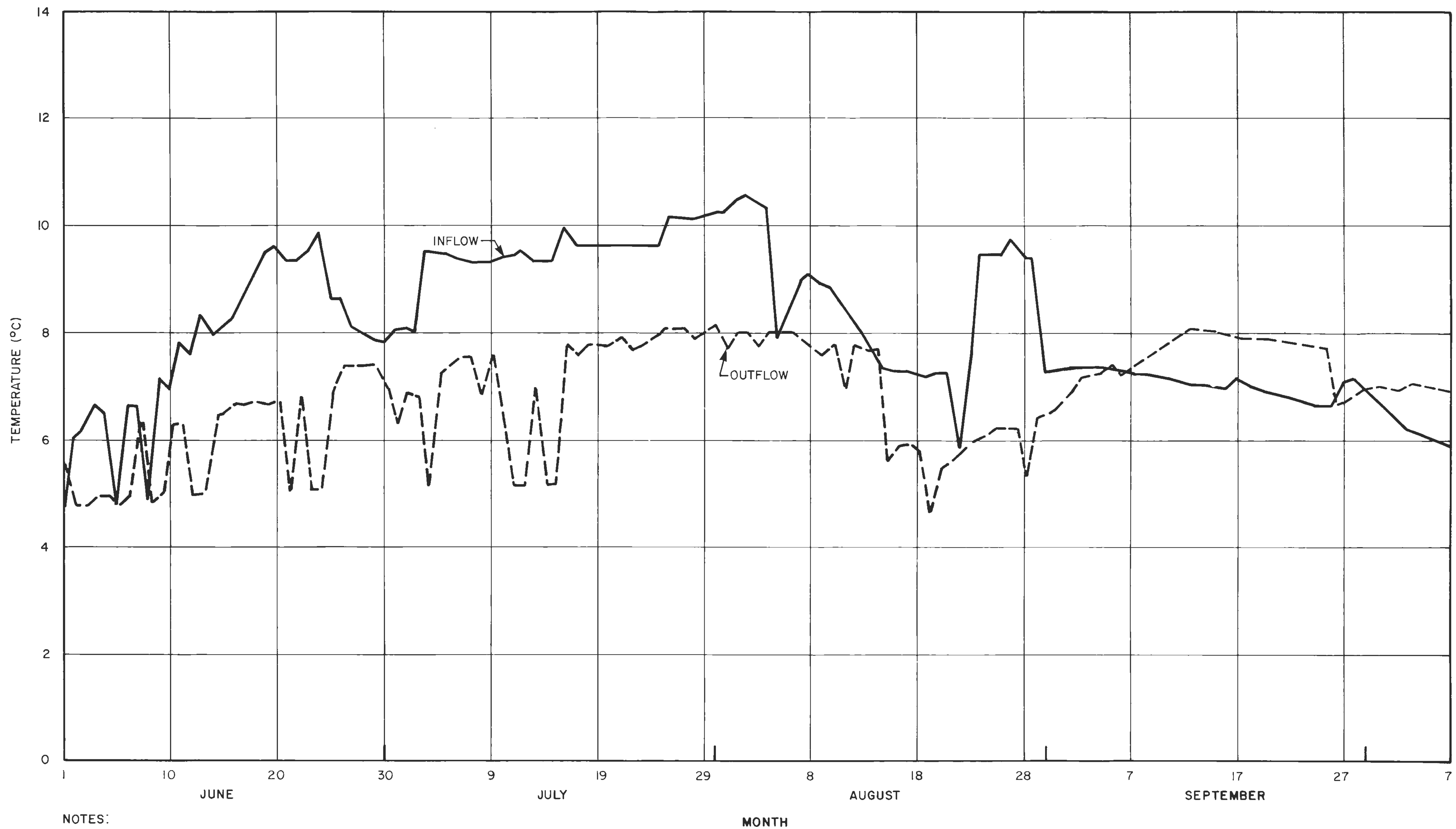
DEVIL CANYON RESERVOIR TEMPERATURE PROFILES
JUNE TO SEPTEMBER

FIGURE E.2.213



DEVIL CANYON RESERVOIR TEMPERATURE PROFILES OCTOBER TO DECEMBER

FIGURE E.2.214

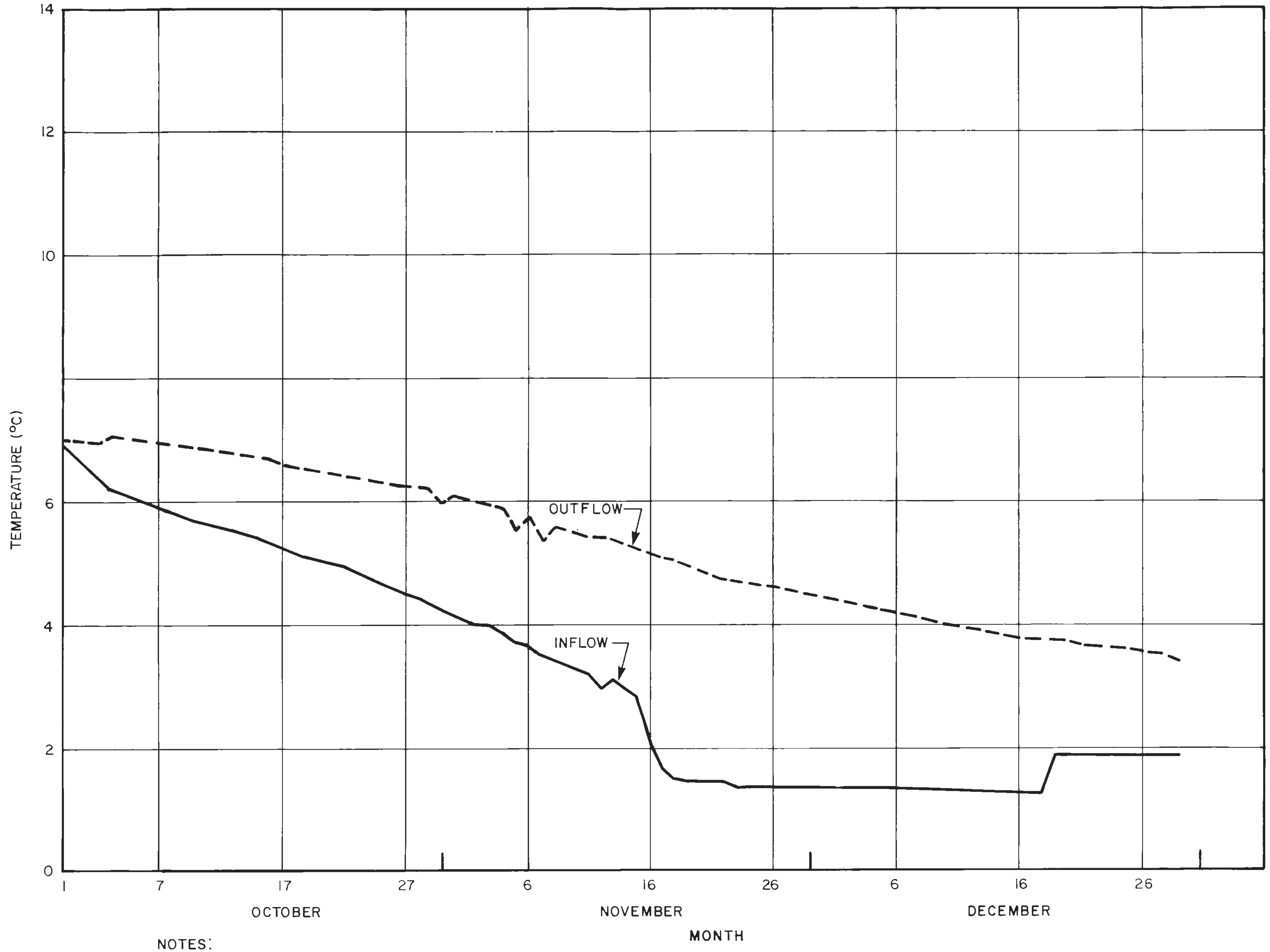


NOTES:

1. TIME SCALE IS IN INCREMENTS OF 10 DAYS.
2. BASED ON 1981 DATA.
3. WATANA ASSUMED UPSTREAM. (DYRESM RUN W4010)
4. OUTFLOW TEMPERATURES ARE BASED ON DYRESM RUNS DC1020, DC1021 AND DC1022.

DEVIL CANYON RESERVOIR INFLOW AND OUTFLOW TEMPERATURES
JUNE TO SEPTEMBER

FIGURE E.2.215

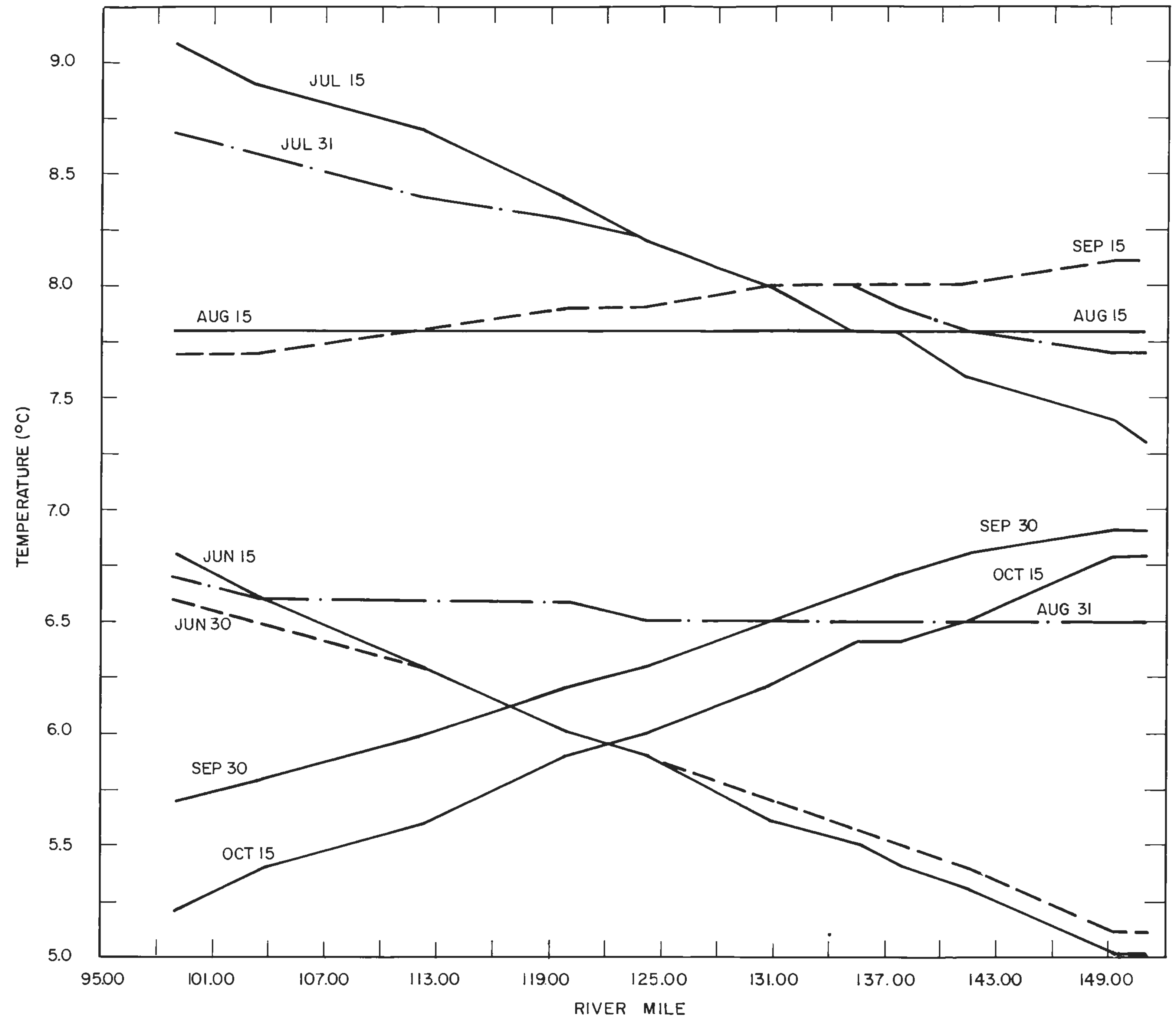


NOTES:

1) TIME SCALE IS IN INCREMENTS OF 10 DAYS.
2) BASED ON 1981 DATA.
3) WATANA ASSUMED UPSTREAM. (DYRESM RUN W4010)
4) OUTFLOW TEMPERATURES ARE BASED ON DYRESM RUN DC1022.

DEVIL CANYON RESERVOIR INFLOW AND OUTFLOW TEMPERATURES
OCTOBER TO DECEMBER

FIGURE E.2.216

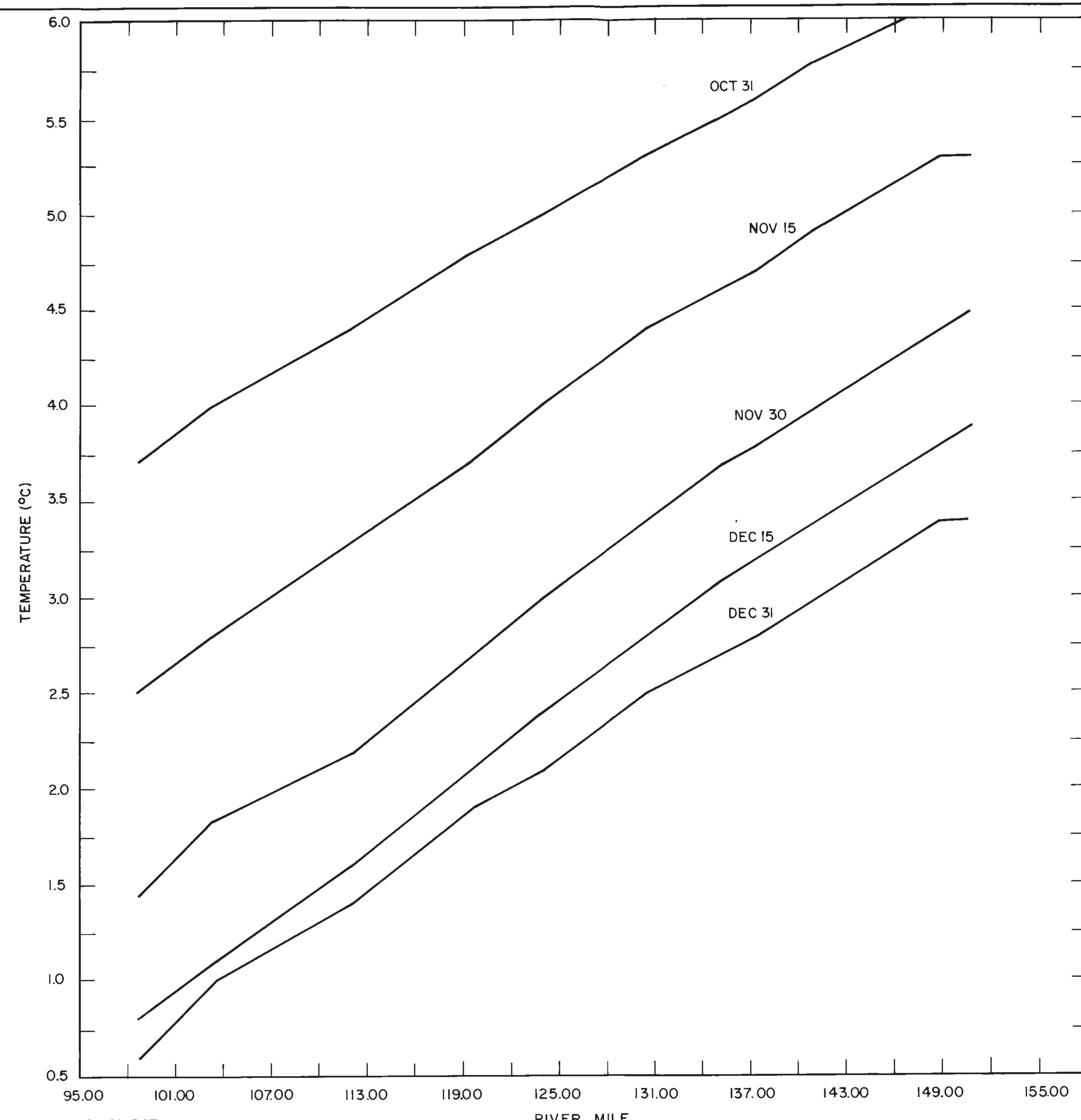


DEVIL CANYON DISCHARGE (CFS):
JUN 15 7920
JUN 30 5740
JUL 15 6830
JUL 31 6480
AUG 15 9940
AUG 31 24100 (RELEASE)
SEP 15 13750
SEP 30 10600
OCT 15 7450

NOTE:
1. MODEL ASSUMES 1981 METEOROLOGICAL DATA RECORDED AT WATANA.
2. DEVIL CANYON TEMPERATURE AND DISCHARGE FROM DYRESM MODEL. (RUNS DC1020 AND DC1021)

WATANA / DEVIL CANYON OPERATION
DOWNSTREAM TEMPERATURES - JUN TO OCT

FIGURE E.2.217



DEVIL CANYON DISCHARGE (CFS):

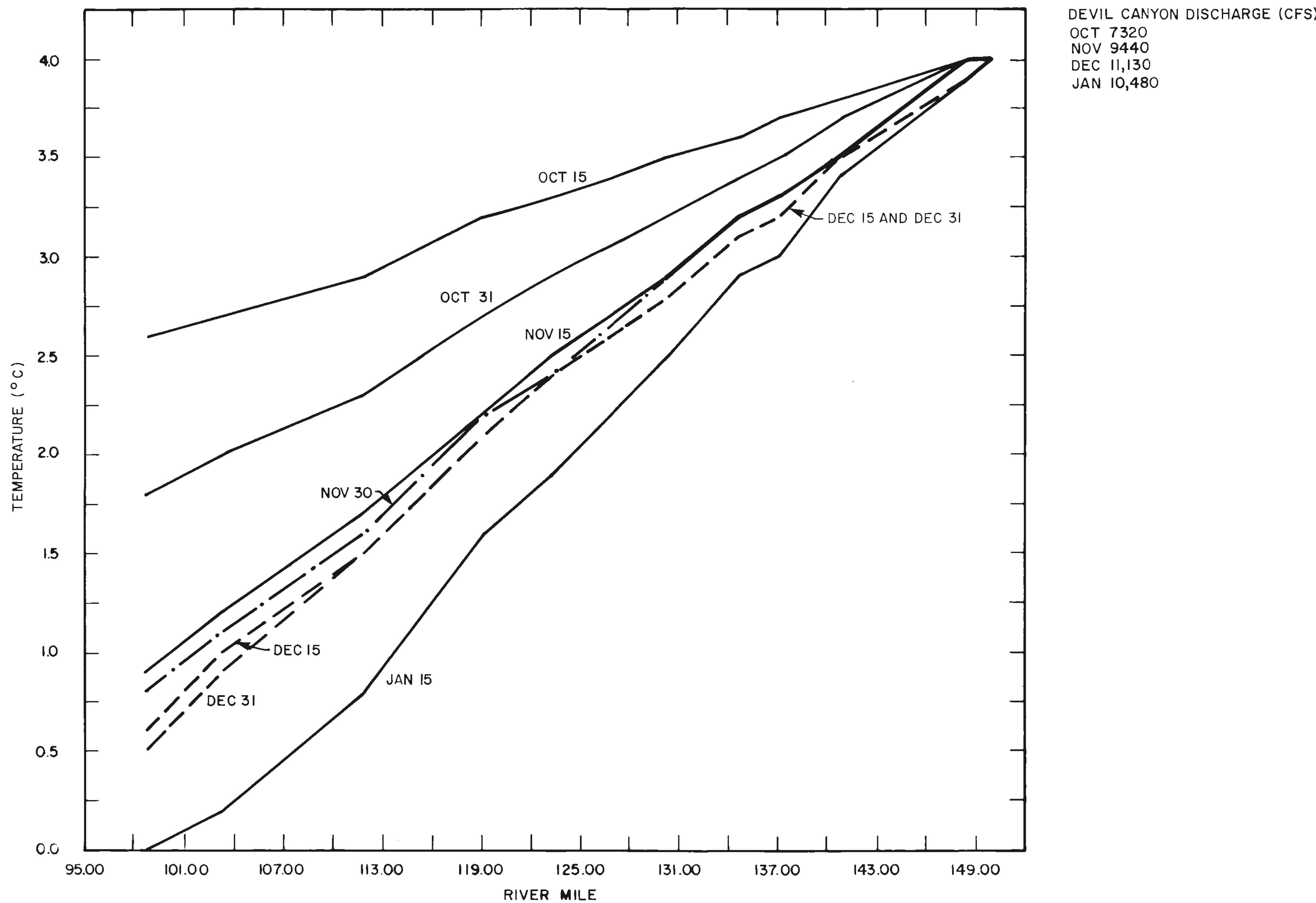
OCT 31 8690
NOV 15 10300
NOV 30 10500
DEC 15 10900
DEC 31 11100

NOTE:

1. MODEL ASSUMES 1981 METEOROLOGICAL DATA RECORDED AT WATANA.
2. DEVIL CANYON TEMPERATURE AND DISCHARGE FROM DYRESM MODEL. (RUN DC1022)

WATANA / DEVIL CANYON OPERATION
DOWNSTREAM TEMPERATURES - OCT TO DEC

FIGURE E.2.218

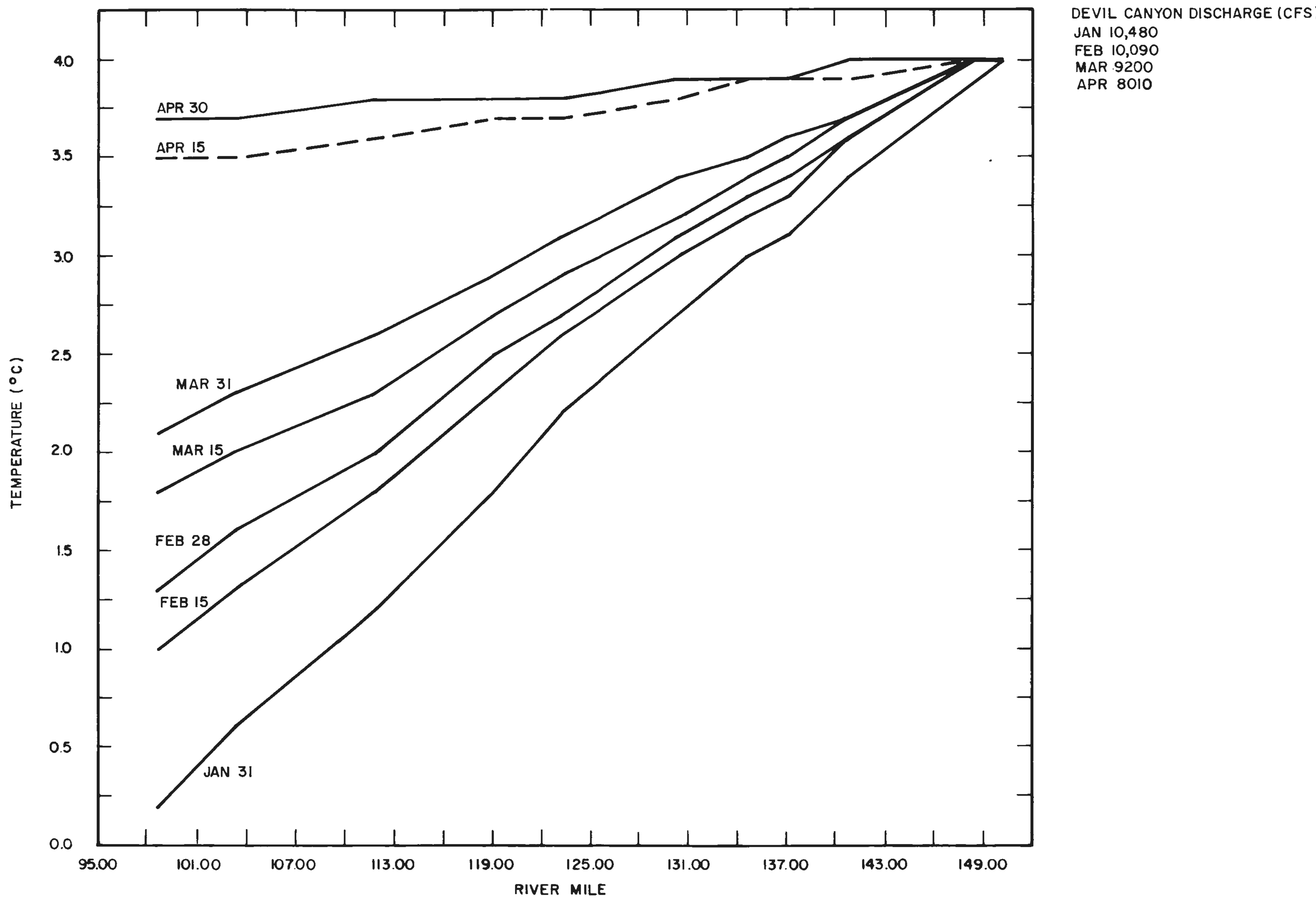


NOTE:

MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND MEAN MONTHLY FLOWS AT DEVIL CANYON.

WATANA/DEVIL CANYON OPERATION DOWNSTREAM TEMPERATURES - OCT TO JAN
OUTFLOW TEMPERATURE 4°

FIGURE E.2.219

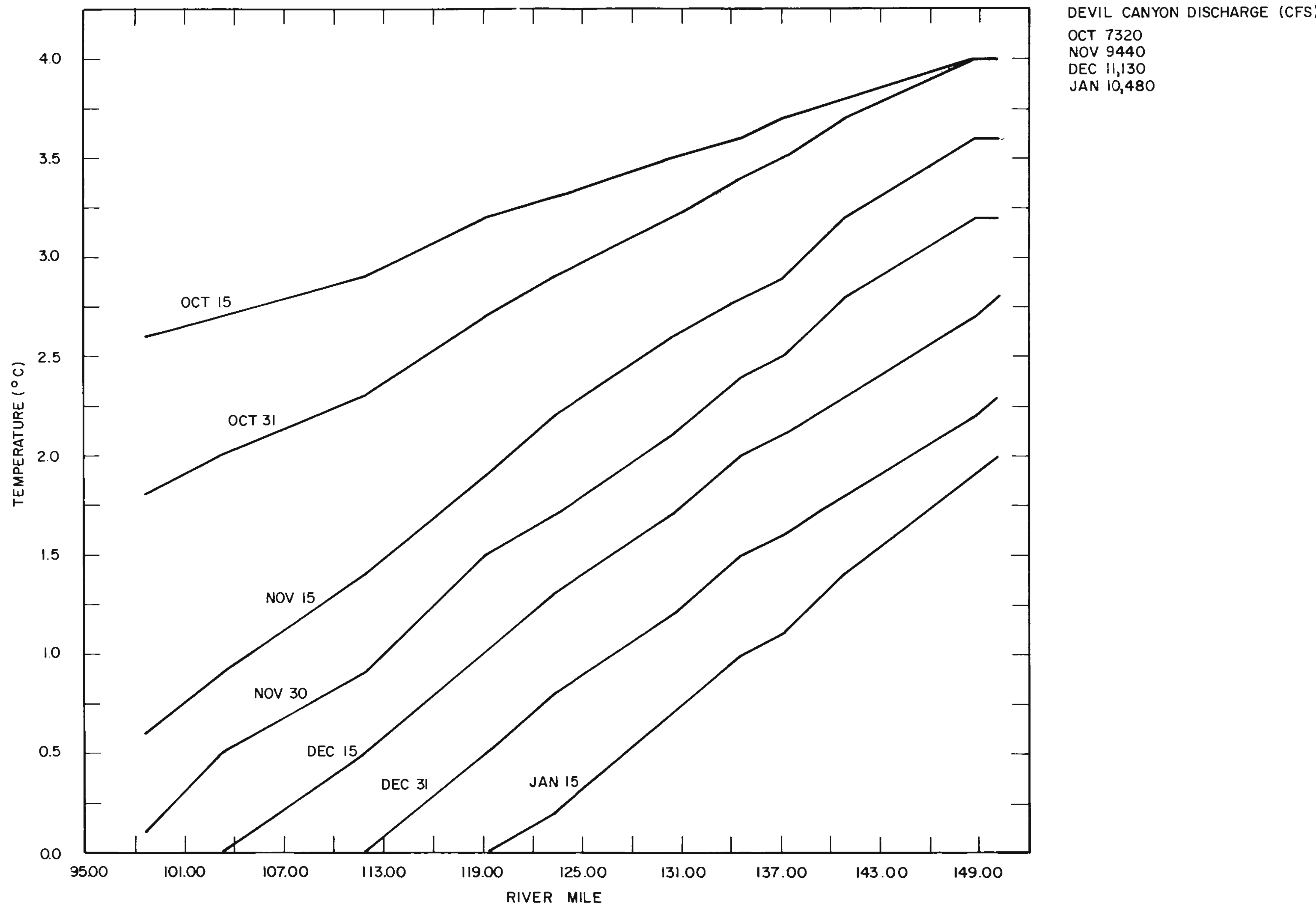


NOTE:

MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND MEAN MONTHLY FLOWS AT DEVIL CANYON.

WATANA / DEVIL CANYON OPERATION DOWNSTREAM TEMPERATURES - JAN TO APR
OUTFLOW TEMPERATURE 4°C

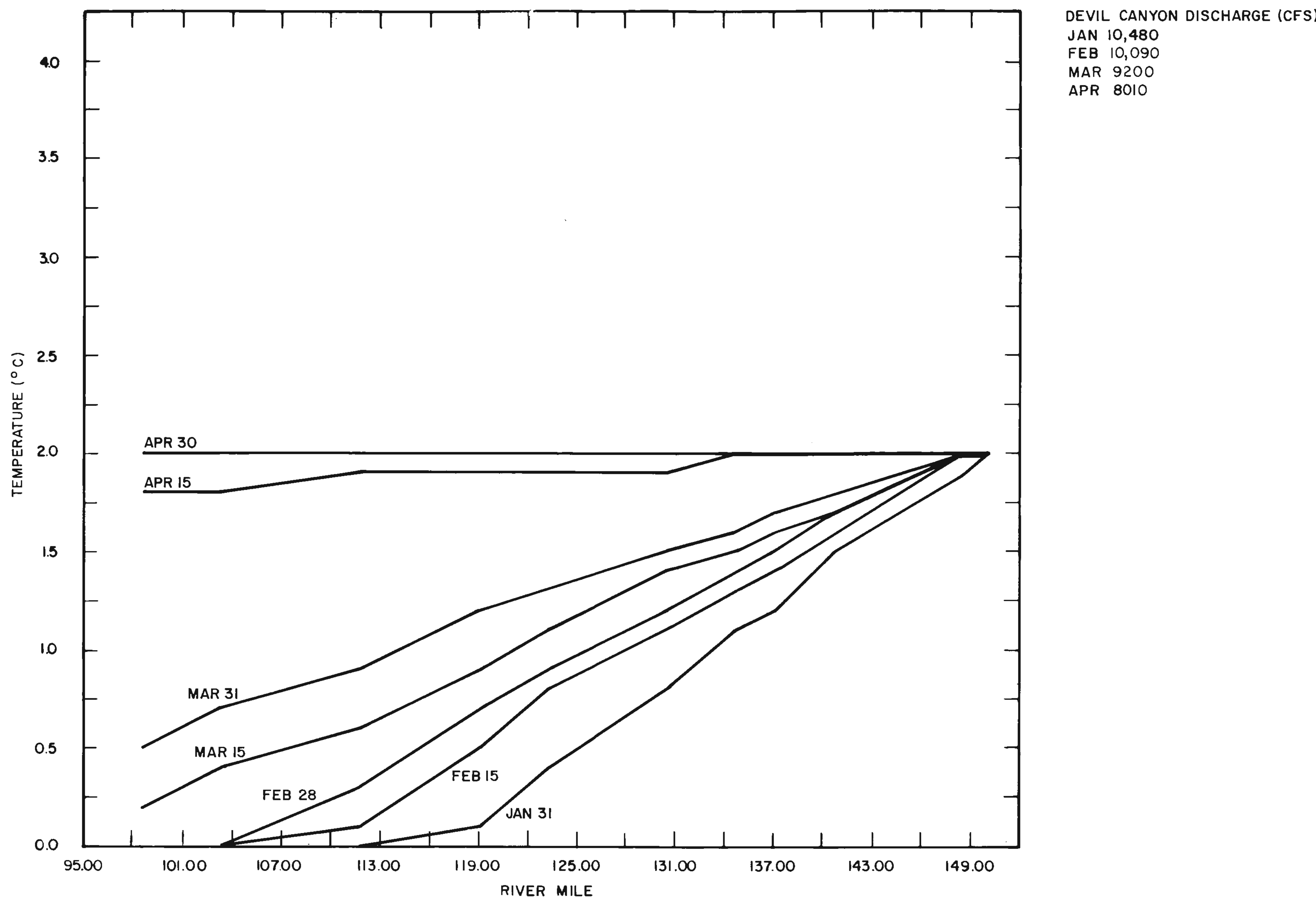
FIGURE E. 2.220



NOTE:
MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND MEAN MONTHLY FLOWS AT DEVIL CANYON.

WATANA/DEVIL CANYON OPERATION DOWNSTREAM TEMPERATURES - OCT TO JAN
OUTFLOW TEMPERATURES 4 TO 2°C

FIGURE E.2.221



NOTE:
MODEL ASSUMES DAILY BASED LONG TERM AVERAGE METEOROLOGICAL DATA AND MEAN MONTHLY FLOWS AT DEVIL CANYON.

WATANA/DEVIL CANYON OPERATION DOWNSTREAM TEMPERATURES-JAN TO APR
OUTFLOW TEMPERATURE 4 TO 2°C

FIGURE E.2.222

PHOTO E.2.1 FRAZIL ICE UPSTREAM FROM WATANA

PHOTO E.2.2 ICE COVER DOWNSTREAM FROM WATANA SHOWING NATURAL LODGEMENT POINT

PHOTO E.2.3 SLOUGH 9 APPROXIMATELY 3500 FEET UPSTREAM FROM SLOUGH MOUTH, DECEMBER 1982

PHOTO E.2.4 SLOUGH 8A FREEZEUP, DECEMBER 1982

PHOTO E.2.6

PHOTO E.2.5 SLOUGH 8A NEAR LRX-29 LOOKING UPSTREAM

PHOTO E.2.7

PHOTO E.2.6 SLOUGH 8A

FIGURE E.2.8

PHOTO E.2.7 SLOUGH 8A SHOWING FLOODING DURING FREEZEUP

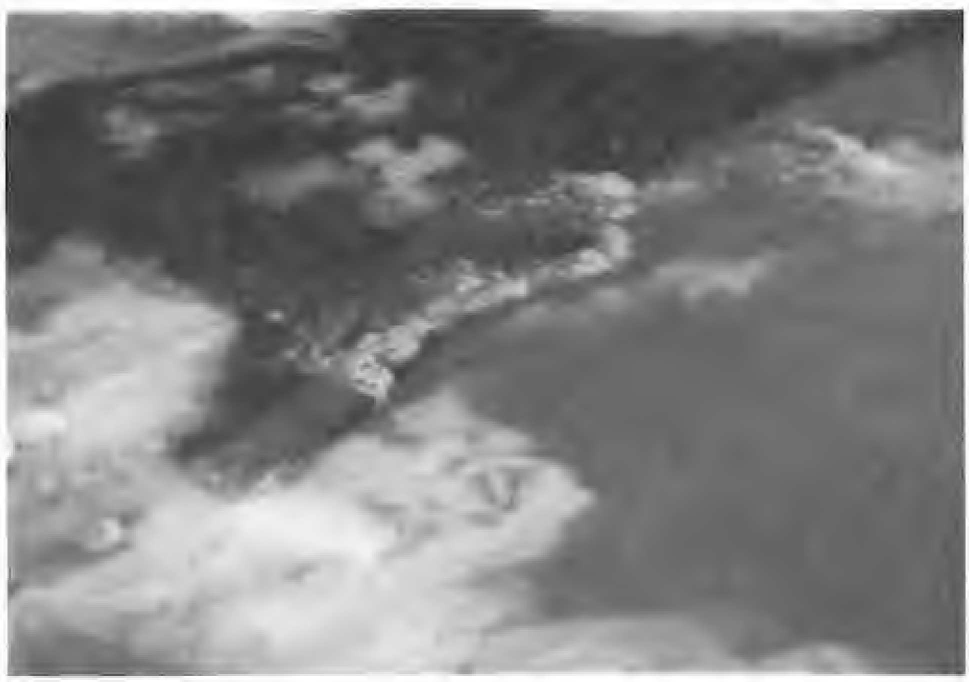


PHOTO E.2.8 ENLARGEMENT OF PHOTO E.2.7 SHOWING TURBULENT FLOW

APPENDIX E.2.A

RELATIONSHIP BETWEEN MAIN CHANNEL FLOW AND SLOUGH PHYSICAL HABITAT VARIABLES

Table of Contents

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List of Figures

A.1 Introduction

Side sloughs of the Susitna River consist of springfed overflow channels between the mainstem Susitna and its side channels and the edge of the floodplain. The side sloughs are generally separated from the mainstem by well-vegetated gravel bars. Exposed alluvial berms at the heads of the sloughs normally separate the sloughs from mainstem or side channel flows. The controlling berms at the upstream end of the side sloughs are approximately at the water surface elevations of the mainstem for mean monthly flows observed during June, July, and August. At intermediate and low-flow periods in the mainstem, the side sloughs convey clear water from small tributaries and/or upwelling groundwater which is essential to the existence of this habitat type. At intermediate mainstem flows, the water surface elevation of the Susitna River causes a backwater to extend well up into the sloughs from their lower end. Even though substantial backwater often exists, the sloughs function hydraulically very much like small stream systems and there is a net discharge from the sloughs. At high flows the water surface elevation of the mainstem river is sufficient to overtop the upper end of the slough.

Over thirty sloughs have been identified in the reach of the Susitna River between Devil Canyon and Talkeetna. These slough habitats have been identified by the Alaska Department of Fish and Game (ADF&G) as the main producers of chum salmon in this reach of the river. This reach will be impacted most by the regulated flows from the proposed Susitna Hydroelectric Project. Numerous additional sloughs have been identified between Talkeetna and Cook Inlet.

Incremental flow analyses have been prepared for three sloughs in the reach from Talkeetna to Devil Canyon and for one slough in the reach from Cook Inlet to Talkeetna. The analyses performed for these four sloughs consist strictly of hydrologic and hydraulic relationships between the sloughs and the mainstem of the Susitna. The analyses describe the effects of mainstem flow on slough discharge, water surface elevation, flow depth and velocity, wetted surface area wetted perimeter and water table elevations. These relationships provide the hydraulic boundary conditions throughout a range of flows in the Susitna River within which fishery habitats can be defined.

A.2 Selection of Sloughs

The ADF&G and R & M Consultants, Inc. (R&M) began collecting hydraulic and hydrologic data in the Susitna River sloughs to describe the relationships between mainstem flow and slough physical characteristics. Although hydraulic data is currently being collected as part of the ongoing studies, data collected primarily in 1981 and 1982 were utilized for this analysis. For the incremental analysis, three sloughs upstream of Talkeetna and one slough downstream of Talkeetna have been selected. These sloughs were selected on the basis of location (representative reach of river), salmon productivity (the three sloughs upstream from Talkeetna provide spawning habitat for 60 to 80 percent of the adult salmon spawning in side sloughs), susceptibility to mainstem flow (changes in mainstem flow under present conditions affect the physical characteristics of the slough), and data availability (detailed studies have been conducted in these sloughs). The representative selected sloughs are:

Above Talkeetna:

- Slough 8A (approximate River Mile 126)
- Slough 9 (approximate River Mile 129)
- Slough 21 (approximate River Mile 142)

Below Talkeetna:

- Rabideux Slough (approximate River Mile 84)

Rabideux Slough is located in the upper portion of the Talkeetna to Cook Inlet reach of the Susitna River and is, therefore, more likely to be affected by altered flows from the proposed project than are sloughs located further downstream.

The locations of the sloughs selected for these analyses are shown on Figure A-1. Maps of each of the sloughs are presented in Figures A-2, A-3, A-4, and A-5, respectively.

A.3 Definition of Flow Regimes

As the flow in the Susitna mainstem changes, several characteristic flow regimes are evident in each slough. These regimes are defined as follows:

- Regime I - This flow regime is characterized by a slough flow which is essentially independent of flow in the mainstem (i.e., there is no backwater effect into the mouth of the slough from the mainstem). In this flow regime, the slough acts as a minor tributary to the mainstem.

- Regime II - This regime is characterized by mainstem backwater extending into the mouth of the slough because the mainstem water level acts as a hydraulic control. However, the discharge from the slough is largely independent of the mainstem discharge since the upstream berms at the heads of the sloughs are not overtopped.

- Regime III - At sufficiently high flows in the mainstem, the upstream berms of the sloughs are overtopped. Under these conditions, the slough hydrologic and hydraulic characteristics are nearly entirely dependent on the mainstem flows.

A factor which complicates the distinction of these regimes is that in several cases the sloughs may have two or more channels and associated upstream berms which overtop at different mainstem flows. Therefore,

Figure A-1

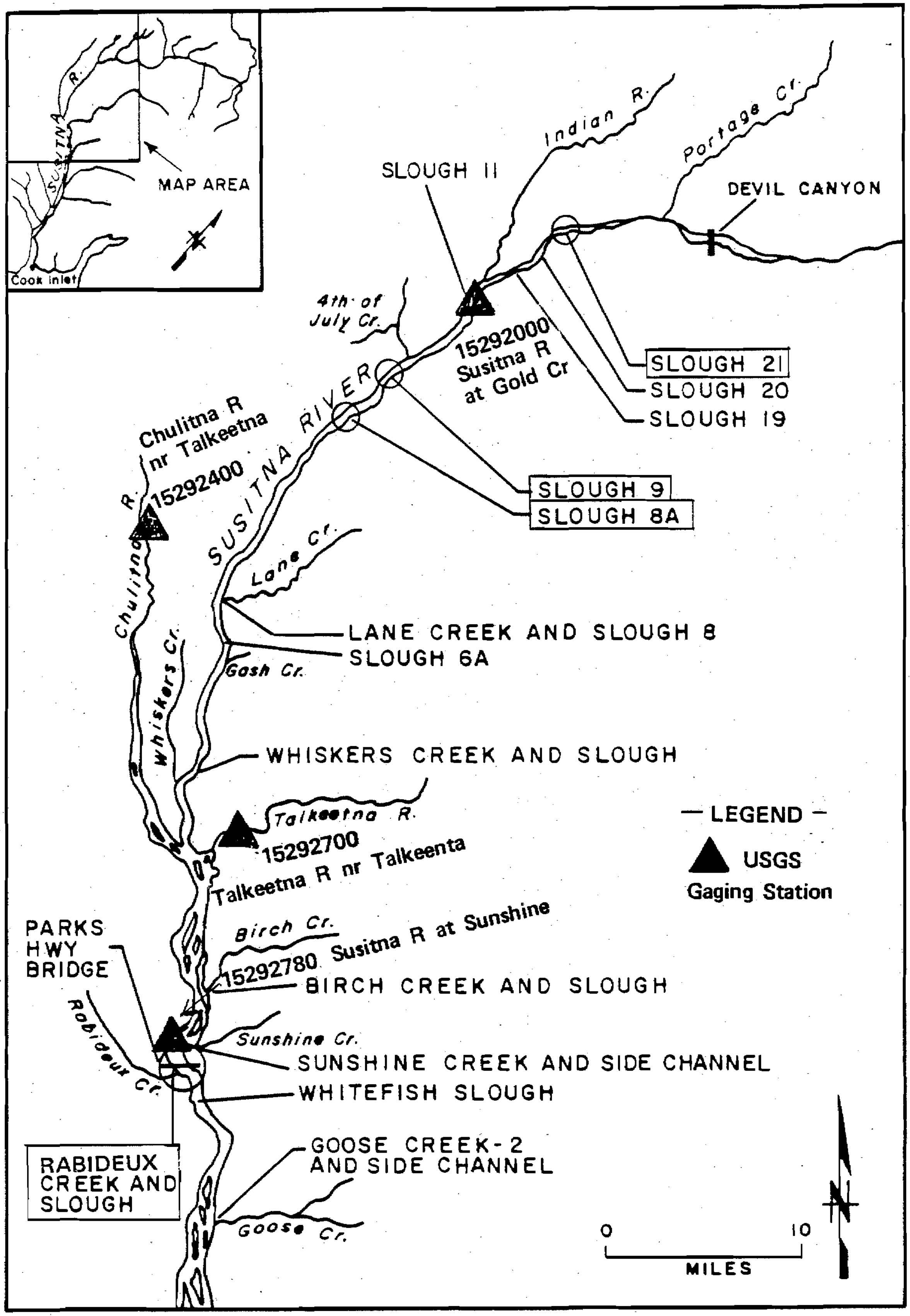
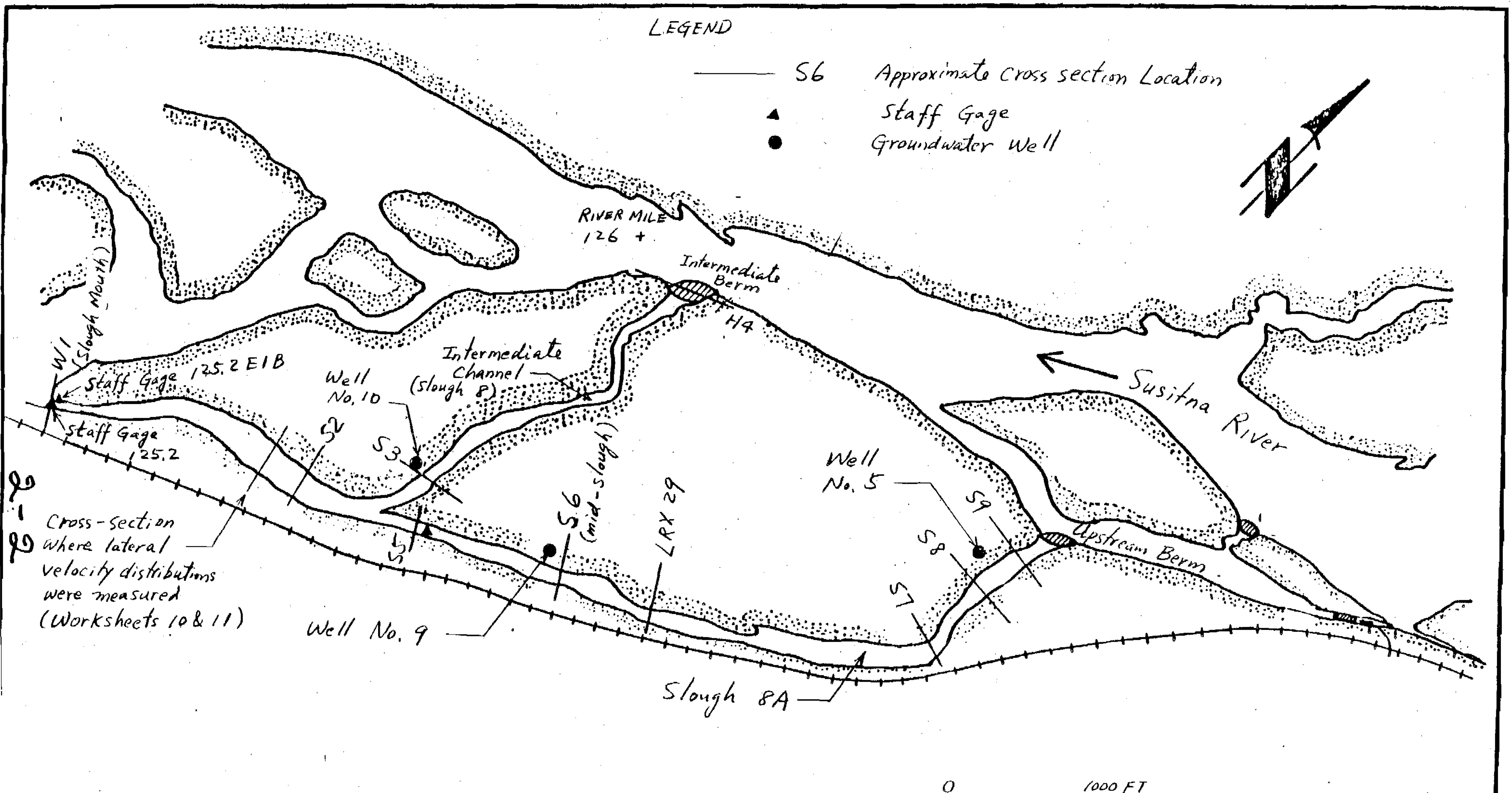


Figure A-1 Slough Location Map

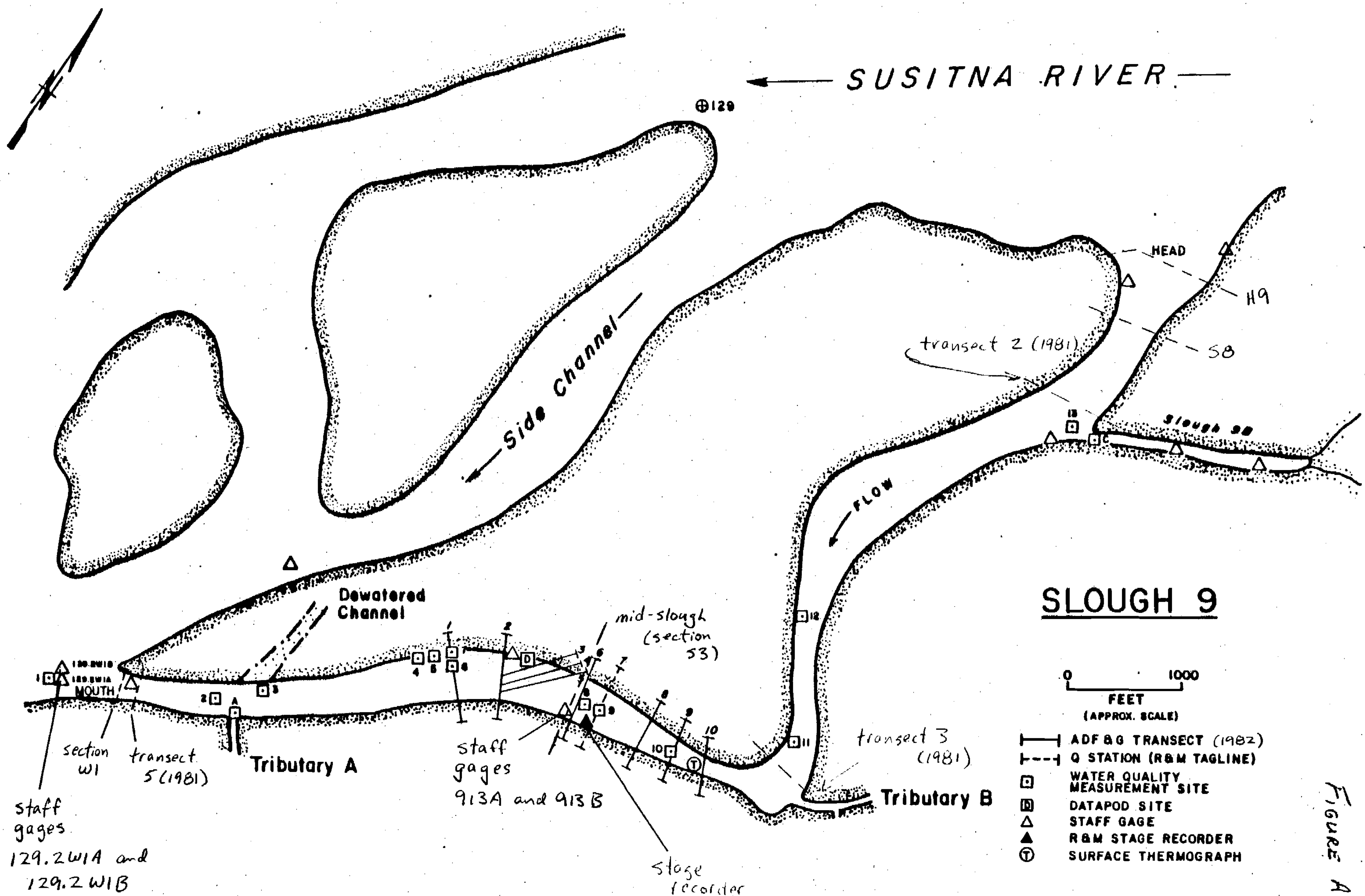


Source: "Slough Hydrology Interim Report," Dec. 1982

PREPARED BY:

R&M CONSULTANTS, INC.

VICINITY MAP
OF SLOUGH 8A



Slough 9 Vicinity Map

FIGURE A-3

2-3

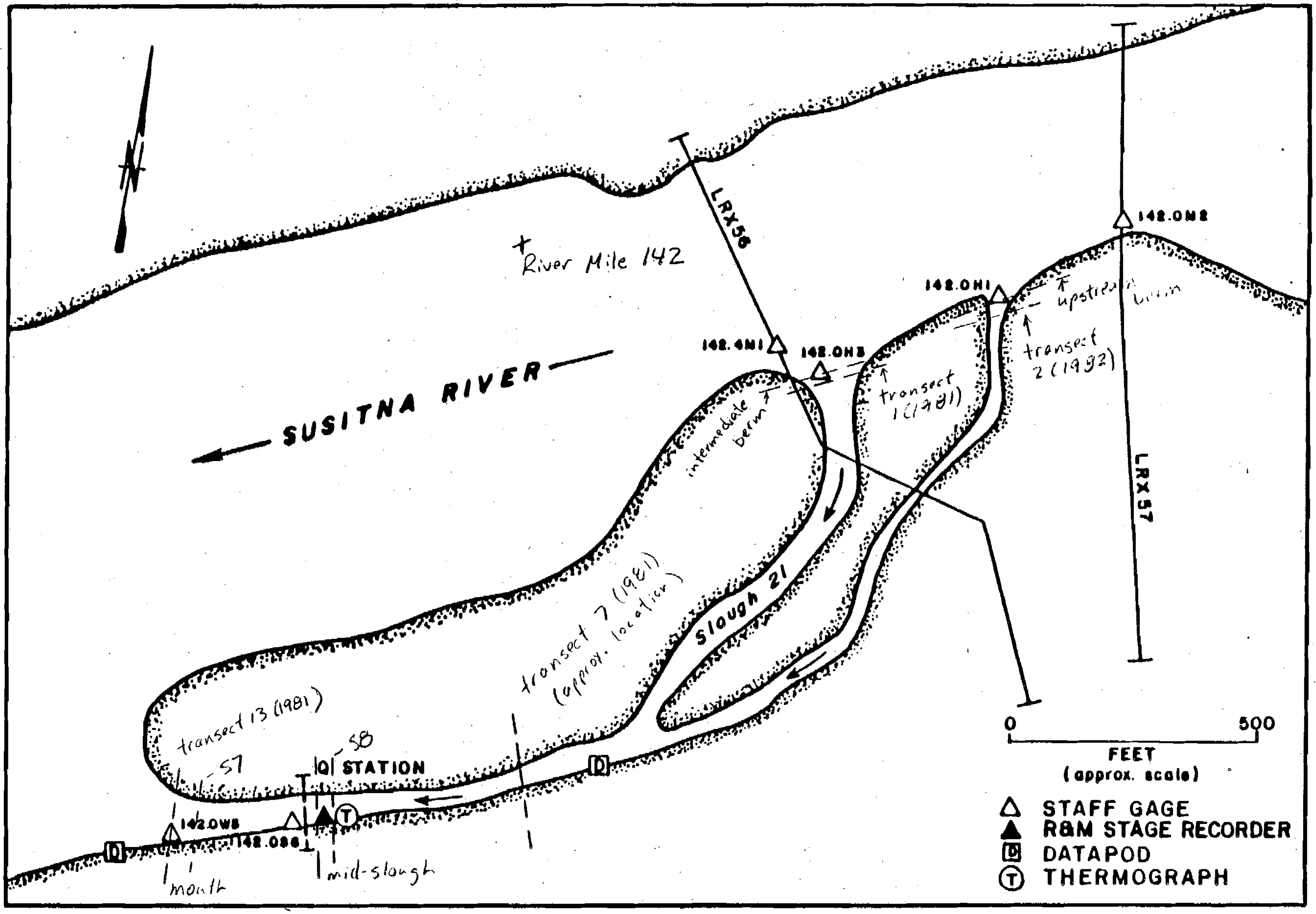
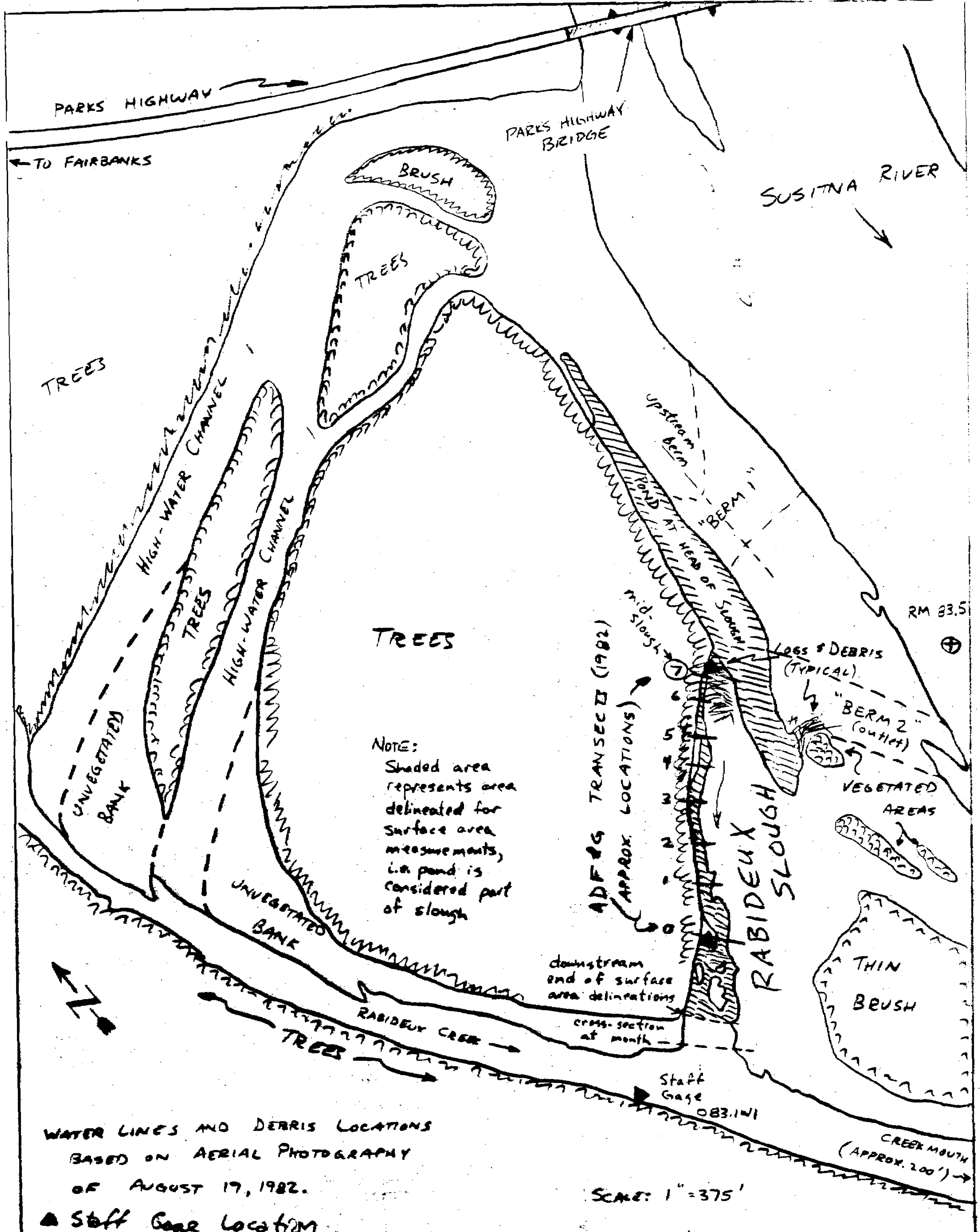


Figure A-4

WORKSHEET 1 : SLOUGH 21 VICINITY MAP

FIGURE A-5



WORKSHEET 1 RABIDEUX SLOUGH VICINITY MAP

subsets of Regime II occur when one or more upstream berms are overtopped by mainstem flow, but the berm with the highest thalweg elevation is not overtopped. These intermediate regimes are defined as Regimes II-A, II-B, etc.

Mainstem discharges which distinguish the hydraulic regimes in the slough are referred to as threshold discharges. For each of the four sloughs analyzed, threshold discharge estimates are presented in Table A-1 along with the ranges of mainstem flows which encompass the flow regimes described above. Determination of these threshold values were based on computations from available data, field observations, and aerial photographs.

Descriptions of these distinct flow regimes are necessary to describe how mainstem flow and slough physical habitat variables are interrelated. The relationships within each regime can then be used to estimate the physical habitat variables within and beyond the range of observed values through interpolation and extrapolation for each regime. The methods and information used to define the relationships between mainstem flow and physical habitat characteristics in the sloughs are presented in the Attachment to this Appendix.

A.4 Main Channel Flow and Physical Habitat Variables Of Sloughs

The following slough physical habitat variables were analyzed with respect to mainstem discharges:

- slough discharge
- water surface elevations at the mouth, near mid-slough, and near the upstream berms
- water depths at the mouth, near mid-slough, and near all upstream berms
- average velocities at cross-sections at the mouth, near mid-slough, and near the upstream berms of the sloughs.[1/]
- total wetted surface area
- wetted perimeters at cross-sections at the mouth, near mid-slough and near the upstream berms of the sloughs
- water table elevations in the vicinity of the sloughs.

[1/] Observed lateral velocity distributions and velocity ranges are provided in the Attachment for selected cross-sections (transects).

Table A-1

THRESHOLD DISCHARGE ESTIMATES

	Susitna River Discharge at Gold Creek			Susitna River Discharge at Sunshine
	Slough 8A (cfs)	Slough 9 (cfs)	Slough 21 (cfs)	Rabideux Slough (cfs)
Discharge at which mainstem acts as a hydraulic control of slough water-surface elevation at mouth (Regime II flow begins)	10,000 1/	11,000 5/	21,400 7/	<10,000 9/
Discharge at which intermediate berm is overtopped (Regime II-A flow begins)	26,000 2/ 3/	N/A 6/	24,800 7/	N/A 6/
Discharge at which highest berm is overtopped (Regime III flow begins)	30,000 3/ 32,000 4/	20,500 5/ 23,000 3/	26,000 8/	65,000 10/

N/A - Not applicable

1/ Field estimate.
2/ Based on field observations on June 29, 1982.
3/ "Slough Hydrology, Interim Report," R&M, Dec. 1982, p. 2-1.
4/ Based on aerial photo.
5/ Based upon data in "Preliminary Assessment of Access of Spawning Salmon to Side-Slough Habitat above Talkeetna," E.W. Trihey, Nov. 1982.
6/ Slough 9 and Rabideux Slough do not have intermediate berms.
7/ Based on staff gage data in "Susitna Hydro Aquatic Studies, Phase II Base Data Report, Volume 4: Aquatic Habitat and Instream Flow Studies 1982, Appendix A, Alaska Department of Fish and Game, 1983," Table 4-A-3, p. 4-A-67.
8/ "Susitna Hydro Aquatic Studies, Phase II Basic Data Report, Volume 4: Aquatic Habitat and Instream Flow Studies, Part I, ADF&G, 1983," Table 4I-3-2, p.43.
9/ Aerial photos indicate Regime II flow exists during very low mainstem flows of 15,000 cfs. Regime II assumed to occur for discharges between 10,000 cfs and 15,000 cfs.
10/ Based on aerial photos.

TABLE A-1 (Cont'd)

REGIME DISCHARGE ESTIMATES

	Susitna River Discharge at Gold Creek			Susitna River Discharge at Sunshine
	Slough 8A (cfs)	Slough 9 (cfs)	Slough 21 (cfs)	Rabideux Slough (cfs)
Regime I	<10,000	<11,000	<21,400	N/A
Regime II	10,000-26,000	11,000-20,500[2/]	21,400-24,800	10,000-65,000
Regime II-A to II-n	26,000-30,000[1/]	N/A	24,800-26,000	N/A
Regime III	>30,000	>23,000	>26,000	>65,000

1/ "Slough Hydrology, Interim Report." R&M, December 1982, P. 2-1 Based on aerial photography this flow is estimated to be 32,000 cfs.

2/ "Preliminary Assessment of Access of Spawning Salmon to Side-Slough Habitat above Talkeetna," E.W. Trihey, November, 1982. Based on data in "Slouth Hydrology, Interim Report", R&M Consultants, December, 1982. p. 2-1, this flow is 23,000 cfs.

For the reach from Talkeetna to Devil Canyon, the relationships between mainstem flows and the slough physical habitat variables were analyzed for average daily discharges of the Susitna River at Gold Creek (USGS gage no. 15292000) for ice-free conditions. Physical characteristics of the sloughs are presented for mainstem flows ranging from 1000 cfs to 31,000 cfs in increments of 2000 cfs and at 12,000 cfs.

Tables A-2, A-3, and A-4 present tabulated results of the effects of the mainstem discharges on physical habitat variables for Sloughs 8A, 9, and 21, respectively. The methods of analysis and the information used in preparing the tables are presented in the Attachment, Parts 1, 2, and 3.

For analyzing the effects of mainstem flow on Rabideux Slough, located downstream from Talkeetna, it was necessary to expand the range of flows considered. Contributions from the Chulitna and Talkeetna Rivers constitute approximately 40 and 20 percent, respectively, of the natural flows in the Susitna River at the Sunshine Gaging Station. The Chulitna and Talkeetna flow contributions, therefore, reduce the influence of Susitna River flows measured at Gold Creek on the physical characteristics of Rabideux Slough. Mainstem flows at Gold Creek of 1000 to 31,000 cfs encompass only the low flow conditions downstream from Talkeetna as measured at the Sunshine Gaging Station (USGS Gage No. 15292780). In order to account for the wider range and higher average flows encountered at Rabideux Slough, three flow conditions at the Sunshine Gage Station were defined based on the Chulitna and Talkeetna River flows. The incremental flows of the Susitna River at Gold Creek were added to the sum of flows from the Chulitna and Talkeetna Rivers. In this way the majority of pre- and post-project flow conditions and the effects on Rabideux Slough physical characteristics could be analyzed. The three flow conditions used for the analysis were:

Condition 1: Sum of the mean daily low flow for the Chulitna and Talkeetna Rivers during September, typically the lowest flow month during the ice-free season. The low flow contribution from each river consists of the 90 percent exceedance flow. Flows at Gold Creek were added incrementally to the sum of these flows to define the lower third of the potential range of flows observed at Rabideux Slough.

Condition 2: A medium flow range at Rabideux Slough was derived from the fifty percent exceedance flows in the Chulitna and Talkeetna Rivers using the mean monthly flow in August. August flows were selected because of the salmon migration activity which occurs in August. Gold Creek flows ranging from 1,000 to 31,000 cfs were incrementally added to the sum of the mean August monthly flows from the Chulitna and Talkeetna Rivers to provide a medium flow range at Rabideux Slough.

Table A-2

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
SLOUGH 8A

Susitna River Discharge at Gold Creek (cfs)	Slough Discharge at Mouth (cfs)	Water Surface Elevation				Flow Depth			
		Mouth (ft,msl)	Mid-Slough (ft,msl)	Inter-mediate Berm (ft,msl)	Upstream Berm (ft,msl)	Mouth (ft)	Mid-Slough (ft)	Inter-mediate Berm (ft)	Upstream Berm (ft)
1,000	3	559.4	568.6	N/A	N/A	1.1	0.2	0	0
3,000	3	559.4	568.6	N/A	N/A	1.1	0.2	0	0
5,000	3	559.4	568.6	N/A	N/A	1.1	0.2	0	0
7,000	3	559.4	568.6	N/A	N/A	1.1	0.2	0	0
9,000	3	559.4	568.6	N/A	N/A	1.1	0.2	0	0
11,000	8	561.4	568.8	N/A	N/A	3.1	0.4	0	0
12,000	8	561.8	568.8	N/A	N/A	3.5	0.4	0	0
13,000	8	562.1	568.8	N/A	N/A	3.8	0.4	0	0
15,000	8	562.5	568.8	N/A	N/A	4.2	0.4	0	0
17,000	8	562.8	568.8	N/A	N/A	4.5	0.4	0	0
19,000	8	563.0	568.8	N/A	N/A	4.7	0.4	0	0
21,000	8	563.2	568.8	N/A	N/A	4.9	0.4	0	0
23,000	8	563.3	568.8	N/A	N/A	5.1	0.4	0	0
25,000	8	563.4	568.8	N/A	N/A	5.2	0.4	0	0
27,000	8	563.5	568.8	573.2	N/A	5.3	0.4	0.1	0
29,000	11	563.5	568.8	573.3	N/A	5.4	0.4	0.2	0
31,000	43	563.6	569.8	573.4	N/A	5.5	0.4	0.3	0

N/A - Not Applicable

Note: See Figure A-2 for location of mouth, mid-slough, intermediate berm, and upstream berm.
See Attachment, Part 1, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-2 (Cont'd)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
SLOUGH 8A

Susitna River Discharge at Gold Creek (cfs)	Average Velocity: Mouth (ft/sec)	Average Velocity: Mid-Slough (ft/sec)	Average Velocity: Intermediate Berm (ft/sec)	Average Velocity: Upstream Berm (ft/sec)	Wetted Surface Area (ft2)	Wetted Perimeter: Mouth (ft)	Wetted Perimeter: Mid-Slough (ft)	Wetted Perimeter: Intermediate Berm (ft)	Wetted Perimeter: Upstream Berm (ft)
1,000	0.06	0.3	N/A	N/A	305,000	62	54	0	0
3,000	0.06	0.3	N/A	N/A	305,000	62	54	0	0
5,000	0.06	0.3	N/A	N/A	305,000	62	54	0	0
7,000	0.06	0.3	N/A	N/A	305,000	62	54	0	0
9,000	0.06	0.3	N/A	N/A	305,000	62	54	0	0
11,000	0.03	0.4	N/A	N/A	480,000	147	59	0	0
12,000	0.03	0.4	N/A	N/A	500,000	152	59	0	0
13,000	0.02	0.4	N/A	N/A	520,000	155	59	0	0
15,000	0.02	0.4	N/A	N/A	570,000	160	59	0	0
17,000	0.02	0.4	N/A	N/A	610,000	163	59	0	0
19,000	0.02	0.4	N/A	N/A	650,000	165	59	0	0
21,000	0.01	0.4	N/A	N/A	700,000	166	59	0	0
23,000	0.01	0.4	N/A	N/A	740,000	167	59	0	0
25,000	0.01	0.4	N/A	N/A	780,000	167	59	0	0
27,000	0.01	0.4	0.5	N/A	830,000	168	59	7	0
29,000	0.02	0.4	2.5	N/A	870,000	169	59	15	0
31,000	0.07	0.4	7.0	N/A	910,000	170	59	81	0

N/A - Not Applicable

Note: See Figure A-2 for location of mouth, mid-slough, intermediate berm, and upstream berm.
See Attachment, Part 1, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-2 (Cont'd)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
SLOUGH 8A

Susitna River Discharge at Gold Creek (cfs)	Water Table Elevation: Mid-Slough Well A (ft,msl)	Mid-Slough Well B (ft,msl)	Upstream Well (ft,msl)
1,000	565.6	568.0	574.7
3,000	565.6	568.0	574.7
5,000	565.6	568.1	574.8
7,000	565.6	568.2	574.8
9,000	565.6	568.3	574.8
11,000	565.6	568.3	574.9
12,000	565.6	568.4	574.9
13,000	565.6	568.4	574.9
15,000	565.6	568.5	574.9
17,000	565.6	568.5	575.0
19,000	565.6	568.6	575.0
21,000	565.6	568.6	575.0
23,000	565.6	568.7	575.0
25,000	565.7	568.7	575.0
27,000	565.7	568.8	575.1
29,000	565.7	568.8	575.1
31,000	565.7	568.9	575.2

N/A - Not Applicable

Note: See Figure 2 for well locations.
See Attachment, Part 1, for narrative and worksheets explaining method of determining water table elevations

Table A-3

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
SLOUGH 9

Susitna River Discharge at Gold Creek (cfs)	Slough Discharge at Mouth (cfs)	Water Surface Elevation: Mouth (ft,msl)	Water Surface Elevation: Mid-Slough (ft,msl)	Water Surface Elevation: Upstream End (ft,msl)	Flow Depth: Mouth (ft)	Flow Depth: Mid-Slough (ft)	Flow Depth: Upstream End (ft)
1,000	3	589.6	593.3	N/A	0.1	0.9	0
3,000	3	589.6	593.3	N/A	0.1	0.9	0
5,000	3	589.6	593.3	N/A	0.1	0.9	0
7,000	3	589.6	593.3	N/A	0.1	0.9	0
9,000	3	589.6	593.3	N/A	0.1	0.9	0
11,000	3	589.6	593.3	N/A	0.1	0.9	0
12,000	6	589.9	593.3	N/A	0.4	0.9	0
13,000	6	590.1	593.3	N/A	0.6	0.9	0
15,000	6	590.5	593.3	N/A	1.0	0.9	0
17,000	6	591.0	593.3	N/A	1.5	0.9	0
19,000	6	591.4	593.3	N/A	1.9	0.9	0
21,000	22	591.7	593.4	602.8	2.2	1.0	1.8
23,000	80	592.1	593.9	603.4	2.6	1.5	2.7
25,000	152	592.6	594.3	603.9	3.0	1.9	3.1
27,000	232	592.9	594.5	604.2	3.4	2.1	3.4
29,000	320	593.3	594.8	604.5	3.8	2.4	3.7
31,000	405	593.7	595.2	604.6	4.2	2.8	3.9

N/A - Not Applicable

Note: See Figure A-3 for location of mouth, mid-slough, and upstream berm.
See Attachment, Part 2, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-3 (Cont'd)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
SLOUGH 9

Susitna River Discharge at Gold Creek (cfs)	Average Velocity Mouth (ft/sec)	Average Velocity Mid-Slough (ft/sec)	Average Velocity Upstream End (ft/sec)	Wetted Surface Area (ft2)	Wetted Perimeter Mouth (ft)	Wetted Perimeter Mid-Slough (ft)	Wetted Perimeter Upstream End (ft)
1,000	0.8	0.1	N/A	130,000	27	89	0
3,000	0.8	0.1	N/A	130,000	27	89	0
5,000	0.8	0.1	N/A	130,000	27	89	0
7,000	0.8	0.1	N/A	130,000	27	89	0
9,000	0.8	0.1	N/A	130,000	27	89	0
11,000	0.8	0.1	N/A	130,000	27	89	0
12,000	0.8	0.1	N/A	230,000	29	89	0
13,000	0.5	0.1	N/A	300,000	33	89	0
15,000	0.2	0.1	N/A	390,000	48	89	0
17,000	0.1	0.1	N/A	470,000	78	89	0
19,000	0.1	0.1	N/A	530,000	145	89	0
21,000	0.1	0.4	0.4	590,000	185	96	50
23,000	0.3	0.8	1.0	640,000	193	117	80
25,000	0.5	1.0	1.4	690,000	193	136	100
27,000	0.6	1.3	1.5	740,000	194	148	150
29,000	0.7	1.4	1.5	780,000	195	150	220
31,000	0.7	1.4	1.5	820,000	195	152	290

N/A - Not Applicable

Note: See Figure A-3 for location of mouth, mid-slough, and upstream berm.
See Attachment, Part 2, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-3 (Cont'd)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
SLOUGH 9

Susitna River Discharge at Gold Creek (cfs)	Water Table Elevation: Mid-Slough Well (ft,msl)	Upstream Well A (ft,msl)	Upstream Well B (ft,msl)
1,000	593.3	599.3	602.9
3,000	593.3	599.5	603.1
5,000	593.5	599.6	603.2
7,000	593.6	599.8	603.3
9,000	593.7	600.0	603.5
11,000	593.8	600.2	603.5
12,000	593.9	600.3	603.6
13,000	594.0	600.4	603.7
15,000	594.1	600.5	603.8
17,000	594.2	600.6	603.9
19,000	594.3	600.8	604.0
21,000	594.5	601.0	604.1
23,000	594.6	601.2	604.3
25,000	594.7	601.5	604.4
27,000	594.9	601.6	604.5
29,000	595.0	601.8	604.6
31,000	595.1	602.0	604.8

N/A - Not Applicable

Note: See Figure A-3 for well locations.
See Attachment, Part 2, for narrative and worksheets explaining method of determining water table elevations.

Table A-4

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
SLOUGH 21

		Water Surface Elevation				Flow Depth			
Susitna River Discharge at Gold Creek (cfs)	Slough Discharge at Mouth (cfs)	Mouth (ft,msl)	Mid-Slough (ft,msl)	Intermediate Berm (ft,msl)	Highest Berm (ft,msl)	Mouth (ft)	Mid-Slough (ft)	Intermediate Berm (ft)	Upstream Berm (ft)
1,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
3,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
5,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
7,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
9,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
11,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
12,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
13,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
15,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
17,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
19,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
21,000	5	744.7	744.9	N/A	N/A	1.6	0.6	0	0
23,000	9	744.8	745.1	N/A	N/A	1.6	0.7	0	0
25,000	9	745.0	745.1	754.6	N/A	1.9	0.7	0.0[1/]	0
27,000	12	745.3	745.3	754.8	755.5	2.2	0.9	0.2	0.0[1/]
29,000	19	745.6	745.8	755.1	755.6	2.5	1.4	0.5	0.1
31,000	34	746.0	746.3	755.5	755.6	2.9	2.0	0.9	0.1

N/A - Not Applicable

Note: See Figure A-4 for location of mouth, mid-slough, intermediate berm, and upstream berm.
See Attachment, Part 3, for narrative and worksheets explaining method of determining slough physical habitat variables.

[1/] Flow depth is less than 0.05 ft.

Table A-4 (Cont'd)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
SLOUGH 21

Susitna River Discharge at Gold Creek (cfs)	Average Velocity: Mouth (ft/sec)	Average Velocity: Mid-Slough (ft/sec)	Average Velocity: Intermediate Berm (ft/sec)	Average Velocity: Upstream Berm (ft/sec)	Wetted Surface Area (ft2)	Wetted Perimeter: Mouth (ft)	Wetted Perimeter: Mid-Slough (ft)	Wetted Perimeter: Intermediate Berm (ft)	Wetted Perimeter: Upstream Berm (ft)
1,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
3,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
5,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
7,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
9,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
11,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
12,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
13,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
15,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
17,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
19,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
21,000	0.1	0.5	N/A	N/A	46,000	50	25	0	0
23,000	0.2	0.7	N/A	N/A	115,000	98	26	0	0
25,000	0.1	0.7	0.0[1/]	N/A	155,000	101	26	3	0
27,000	0.1	0.7	1.4	-	180,000	103	36	24	4
29,000	0.2	0.7	1.4	-	200,000	105	45	44	12
31,000	0.2	0.8	1.0	-	220,000	108	55	65	20

N/A - Not Applicable

Note: See Figure A-4 for location of mouth, mid-slough, intermediate berm, and upstream berm.
See Attachment, Part 3, for narrative and worksheets explaining method of determining slough physical habitat variables.

[1/] Velocity is less than 0.05 ft/sec.

Table A-4 (Cont'd)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
SLOUGH 21

Susitna River Discharge at Gold Creek	Water Table Elevation		
(cfs)	(ft,msl)	(ft,msl)	(ft,msl)
1,000			
3,000			
5,000			
7,000			
9,000			
11,000			
12,000			
13,000			
15,000		1/	
17,000			
19,000			
21,000			
23,000			
25,000			
27,000			
29,000			
31,000			

1/ No well data available for Slough 21; for a description of expected water table conditions in Slough 21, see Attachment, Part 3.

Condition 3: A high flow range at Rabideux Slough was derived from the sum of the 10 percent exceedance flows from the Chulitna and Talkeetna Rivers on a daily basis during the month of June, which is typically the high flow month of the year. The range of flows at Gold Creek were added incrementally to this sum to provide the high range of flows at Rabideux Slough.

The results of the analyses of the effects of mainstem flow on the hydraulic characteristics of Rabideux Slough are presented in Table A-5 for the three flow conditions and result in a total range of flows at Rabideux Slough from 10,000 cfs to 85,000 cfs. Discussion of the methods used in the analyses for Rabideux Slough are presented in the Attachment, Part 4.

A.5 Summary of Methods of Analyses

This section contains a summary of the methods used to derive the following parameters:

- slough discharge
- threshold discharges
- water surface elevation
- flow depth
- velocity
- wetted surface area
- wetted perimeter
- water table elevation.

Since the methods vary among the sloughs, a separate summary is given for each. More detailed descriptions are found in the attachment for Sloughs 8A, 9, and 21 and Rabideux Slough.

The slough physical parameters given in Tables A-2 through A-5 should be considered estimates of the average values. Slough discharge is influenced by mainstem water level effects on groundwater upwelling, local runoff, and regional groundwater. For this reason field measurements of the relations between slough discharges and Susitna River mainstem discharges showed considerable variability in all Regimes but especially in Regimes I and II. To simplify the analyses a constant slough discharge was assumed for each slough for each of Regimes I and II.

A.5.1 Slough 8A

A map of Slough 8A is shown on Figure A-2. Methods of analyses are given in the Attachment, Part 1.

Threshold Discharges

The threshold Susitna River discharge for overtopping the upstream berm (30,000 cfs to 32,000 cfs) was estimated from aerial photography of the

Table A-5

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

Susitna River Discharge at Gold Creek (cfs)	Condition 1[1/]		Condition 2[1/]		Condition 3[1/]	
	Mainstem Discharge (cfs)	Slough Discharge (cfs)	Mainstem Discharge (cfs)	Slough Discharge (cfs)	Mainstem Discharge (cfs)	Slough Discharge (cfs)
1,000	10,000	0	31,000	0	55,000	0
3,000	12,000	0	33,000	0	57,000	0
5,000	14,000	0	35,000	0	59,000	0
7,000	16,000	0	37,000	0	61,000	0
9,000	18,000	0	39,000	0	63,000	0
11,000	20,000	0	41,000	0	65,000	0
12,000	21,000	0	42,000	0	66,000	8
13,000	22,000	0	43,000	0	67,000	20
15,000	24,000	0	45,000	0	69,000	60
17,000	26,000	0	47,000	0	71,000	108
19,000	28,000	0	49,000	0	73,000	165
21,000	30,000	0	51,000	0	75,000	230
23,000	32,000	0	53,000	0	77,000	300
25,000	34,000	0	55,000	0	79,000	380
27,000	36,000	0	57,000	0	81,000	468
29,000	38,000	0	59,000	0	83,000	560
31,000	40,000	0	61,000	0	85,000	660

1/ See last page of this table for explanation of conditions.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

	Condition 1 1/		Condition 2 1/		Condition 3 1/	
Susitna River Discharge at Gold Creek (cfs)	Mainstem Discharge (cfs)	Water-Surface Elevation at Mouth (ft,msl)	Mainstem Discharge (cfs)	Water-Surface Elevation at Mouth (ft,msl)	Mainstem Discharge (cfs)	Water-Surface Elevation at Mouth (ft,msl)
1,000	10,000	255.3	31,000	257.8	55,000	260.5
3,000	12,000	255.5	33,000	258.2	57,000	260.7
5,000	14,000	255.8	35,000	258.4	59,000	260.9
7,000	16,000	256.0	37,000	258.7	61,000	261.0
9,000	18,000	256.3	39,000	258.9	63,000	261.2
11,000	20,000	256.5	41,000	259.1	65,000	261.4
12,000	21,000	256.6	42,000	259.2	66,000	261.5
13,000	22,000	256.8	43,000	259.3	67,000	261.6
15,000	24,000	257.0	45,000	259.5	69,000	261.7
17,000	26,000	257.3	47,000	259.8	71,000	261.9
19,000	28,000	257.5	49,000	260.0	73,000	262.1
21,000	30,000	257.8	51,000	260.1	75,000	262.3
23,000	32,000	258.0	53,000	260.3	77,000	262.5
25,000	34,000	258.3	55,000	260.5	79,000	262.7
27,000	36,000	258.5	57,000	260.7	81,000	262.8
29,000	38,000	258.8	59,000	260.9	83,000	263.0
31,000	40,000	259.0	61,000	261.0	85,000	263.2

1/ See last page of this table for explanation of conditions.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

	Condition 1[1/]		Condition 2[1/]		Condition 3[1/]	
Susitna River Discharge at Gold Creek (cfs)	Mainstem Discharge (cfs)	Water-Surface Elevation at Mid-Slough (ft,msl)	Mainstem Discharge (cfs)	Water-Surface Elevation at Mid-Slough (ft,msl)	Mainstem Discharge (cfs)	Water-Surface Elevation at Mid-Slough (ft,msl)
1,000	10,000	N/A[2/]	31,000	260.3	55,000	260.6
3,000	12,000	N/A	33,000	260.3	57,000	260.7
5,000	14,000	N/A	35,000	260.3	59,000	260.9
7,000	16,000	N/A	37,000	260.3	61,000	261.0
9,000	18,000	N/A	39,000	260.3	63,000	261.2
11,000	20,000	N/A	41,000	260.3	65,000	261.4
12,000	21,000	N/A	42,000	260.3	66,000	261.5
13,000	22,000	N/A	43,000	260.3	67,000	261.6
15,000	24,000	N/A	45,000	260.3	69,000	261.7
17,000	26,000	260.3	47,000	260.3	71,000	261.9
19,000	28,000	260.3	49,000	260.3	73,000	262.1
21,000	30,000	260.3	51,000	260.3	75,000	262.3
23,000	32,000	260.3	53,000	260.3	77,000	262.6
25,000	34,000	260.3	55,000	260.5	79,000	262.9
27,000	36,000	260.3	57,000	260.7	81,000	263.2
29,000	38,000	260.3	59,000	260.9	83,000	263.4
31,000	40,000	260.3	61,000	261.0	85,000	263.7

1/ See last page of this table for explanation of conditions.
2/ Transect 7 reported as dry at discharge of 25,800 cfs (ADF&G 1982)

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

	Condition 1[1/]		Condition 2[1/]		Condition 3[1/]	
Susitna River Discharge at Gold Creek (cfs)	Mainstem Discharge (cfs)	Water-Surface Elevation at Upstream Berm (ft,msl)	Mainstem Discharge (cfs)	Water-Surface Elevation at Upstream Berm (ft,msl)	Mainstem Discharge (cfs)	Water-Surface Elevation at Upstream Berm (ft,msl)
1,000	10,000	N/A	31,000	N/A	55,000	N/A
3,000	12,000	N/A	33,000	N/A	57,000	N/A
5,000	14,000	N/A	35,000	N/A	59,000	N/A
7,000	16,000	N/A	37,000	N/A	61,000	N/A
9,000	18,000	N/A	39,000	N/A	63,000	N/A
11,000	20,000	N/A	41,000	N/A	65,000	N/A
12,000	21,000	N/A	42,000	N/A	66,000	262.8
13,000	22,000	N/A	43,000	N/A	67,000	262.9
15,000	24,000	N/A	45,000	N/A	69,000	263.0
17,000	26,000	N/A	47,000	N/A	71,000	263.1
19,000	28,000	N/A	49,000	N/A	73,000	263.1
21,000	30,000	N/A	51,000	N/A	75,000	263.2
23,000	32,000	N/A	53,000	N/A	77,000	263.2
25,000	34,000	N/A	55,000	N/A	79,000	263.3
27,000	36,000	N/A	57,000	N/A	81,000	263.4
29,000	38,000	N/A	59,000	N/A	83,000	263.5
31,000	40,000	N/A	61,000	N/A	85,000	263.8

N/A - Not Applicable.

1/ See last page of this table for explanation of conditions.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm.
See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

Susitna River Discharge at Gold Creek (cfs)	Condition 1[1/] Mainstem Discharge (cfs)	Condition 1[1/] Flow Depth at Mouth (ft)	Condition 2[1/] Mainstem Discharge (cfs)	Condition 2[1/] Flow Depth at Mouth (ft)	Condition 3[1/] Mainstem Discharge (cfs)	Condition 3[1/] Flow Depth at Mouth (ft)
1,000	10,000	0.4	31,000	2.9	55,000	5.6
3,000	12,000	0.6	33,000	3.3	57,000	5.8
5,000	14,000	0.9	35,000	3.5	59,000	6.0
7,000	16,000	1.1	37,000	3.8	61,000	6.1
9,000	18,000	1.4	39,000	4.0	63,000	6.3
11,000	20,000	1.6	41,000	4.2	65,000	6.5
12,000	21,000	1.7	42,000	4.3	66,000	6.6
13,000	22,000	1.9	43,000	4.4	67,000	6.7
15,000	24,000	2.1	45,000	4.6	69,000	6.8
17,000	26,000	2.4	47,000	4.9	71,000	7.0
19,000	28,000	2.6	49,000	5.1	73,000	7.2
21,000	30,000	2.9	51,000	5.2	75,000	7.4
23,000	32,000	3.1	53,000	5.4	77,000	7.6
25,000	34,000	3.4	55,000	5.6	79,000	7.8
27,000	36,000	3.6	57,000	5.8	81,000	7.9
29,000	38,000	3.9	59,000	6.0	83,000	8.0
31,000	40,000	4.1	61,000	6.1	85,000	8.3

1/ See last page of this table for explanation of conditions.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

Susitna River Discharge at Gold Creek (cfs)	Condition 1 1/ Mainstem Discharge (cfs)	Condition 1 1/ Flow Depth at Mid-slough (ft)	Condition 2 1/ Mainstem Discharge (cfs)	Condition 2 1/ Flow Depth at Mid-slough (ft)	Condition 3 1/ Mainstem Discharge (cfs)	Condition 3 1/ Flow Depth at Mid-slough (ft)
1,000	10,000	0 2/	31,000	0.3	55,000	0.5
3,000	12,000	0	33,000	0.3	57,000	0.7
5,000	14,000	0	35,000	0.3	59,000	0.9
7,000	16,000	0	37,000	0.3	61,000	1.0
9,000	18,000	0	39,000	0.3	63,000	1.2
11,000	20,000	0	41,000	0.3	65,000	1.4
12,000	21,000	0	42,000	0.3	66,000	1.5
13,000	22,000	0	43,000	0.3	67,000	1.6
15,000	24,000	0	45,000	0.3	69,000	1.7
17,000	26,000	0.3	47,000	0.3	71,000	1.9
19,000	28,000	0.3	49,000	0.3	73,000	2.1
21,000	30,000	0.3	51,000	0.3	75,000	2.3
23,000	32,000	0.3	53,000	0.3	77,000	2.6
25,000	34,000	0.3	55,000	0.5	79,000	2.9
27,000	36,000	0.3	57,000	0.7	81,000	3.2
29,000	38,000	0.3	59,000	0.9	83,000	3.4
31,000	40,000	0.3	61,000	1.0	85,000	3.7

1/ See last page of this table for explanation of conditions.
2/Transect 7 reported as dry for discharge of 25,800 cfs (ADF&G, 1982).

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm.
See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

Susitna River Discharge at Gold Creek (cfs)	Condition 1[1/] Mainstem Discharge (cfs)	Condition 1[1/] Flow Depth at Upstream Berm (ft)	Condition 2[1/] Mainstem Discharge (cfs)	Condition 2[1/] Flow Depth at Upstream Berm (ft)	Condition 3[1/] Mainstem Discharge (cfs)	Condition 3[1/] Flow Depth at Upstream Berm (ft)
1,000	10,000	0	31,000	0	55,000	0
3,000	12,000	0	33,000	0	57,000	0
5,000	14,000	0	35,000	0	59,000	0
7,000	16,000	0	37,000	0	61,000	0
9,000	18,000	0	39,000	0	63,000	0
11,000	20,000	0	41,000	0	65,000	0
12,000	21,000	0	42,000	0	66,000	0.3
13,000	22,000	0	43,000	0	67,000	0.4
15,000	24,000	0	45,000	0	69,000	0.5
17,000	26,000	0	47,000	0	71,000	0.6
19,000	28,000	0	49,000	0	73,000	0.6
21,000	30,000	0	51,000	0	75,000	0.7
23,000	32,000	0	53,000	0	77,000	0.7
25,000	34,000	0	55,000	0	79,000	0.8
27,000	36,000	0	57,000	0	81,000	0.9
29,000	38,000	0	59,000	0	83,000	1.0
31,000	40,000	0	61,000	0	85,000	1.3

1/ See last page of this table for explanation of conditions.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

Susitna River Discharge at Gold Creek (cfs)	Condition 1[1/] Mainstem Discharge (cfs)	Condition 1[1/] Average Velocity at Mouth (ft/sec)	Condition 2[1/] Mainstem Discharge (cfs)	Condition 2[1/] Average Velocity at Mouth (ft/sec)	Condition 3[1/] Mainstem Discharge (cfs)	Condition 3[1/] Average Velocity at Mouth (ft/sec)
1,000	10,000	0	31,000	0	55,000	0
3,000	12,000	0	33,000	0	57,000	0
5,000	14,000	0	35,000	0	59,000	0
7,000	16,000	0	37,000	0	61,000	0
9,000	18,000	0	39,000	0	63,000	0
11,000	20,000	0	41,000	0	65,000	0
12,000	21,000	0	42,000	0	66,000	0.0[2/]
13,000	22,000	0	43,000	0	67,000	0.0[2/]
15,000	24,000	0	45,000	0	69,000	0.1
17,000	26,000	0	47,000	0	71,000	0.2
19,000	28,000	0	49,000	0	73,000	0.2
21,000	30,000	0	51,000	0	75,000	0.3
23,000	32,000	0	53,000	0	77,000	0.4
25,000	34,000	0	55,000	0	79,000	0.5
27,000	36,000	0	57,000	0	81,000	0.6
29,000	38,000	0	59,000	0	83,000	0.7
31,000	40,000	0	61,000	0	85,000	0.8

1/ See last page of this table for explanation of conditions.
2/ Velocity is less than 0.05 ft/sec.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

	Condition 1 1/		Condition 2 1/		Condition 3 1/	
Susitna River Discharge at Gold Creek (cfs)	Mainstem Discharge (cfs)	Average Velocity at Mid-Slough (ft/sec)	Mainstem Discharge (cfs)	Average Velocity at Mid-Slough (ft/sec)	Mainstem Discharge (cfs)	Average Velocity at Mid-Slough (ft/sec)
1,000	10,000	0	31,000	0	55,000	0
3,000	12,000	0	33,000	0	57,000	0
5,000	14,000	0	35,000	0	59,000	0
7,000	16,000	0	37,000	0	61,000	0
9,000	18,000	0	39,000	0	63,000	0
11,000	20,000	0	41,000	0	65,000	0
12,000	21,000	0	42,000	0	66,000	0.3
13,000	22,000	0	43,000	0	67,000	0.5
15,000	24,000	0	45,000	0	69,000	0.9
17,000	26,000	0	47,000	0	71,000	1.1
19,000	28,000	0	49,000	0	73,000	1.3
21,000	30,000	0	51,000	0	75,000	1.3
23,000	32,000	0	53,000	0	77,000	1.3
25,000	34,000	0	55,000	0	79,000	1.2
27,000	36,000	0	57,000	0	81,000	1.2
29,000	38,000	0	59,000	0	83,000	1.2
31,000	40,000	0	61,000	0	85,000	1.2

1/ See last page of this table for explanation of conditions.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

	Condition 1 1/		Condition 2 1/		Condition 3 1/	
Susitna River Discharge at Gold Creek (cfs)	Mainstem Discharge (cfs)	Average Velocity at Upstream Berm (ft/sec)	Mainstem Discharge (cfs)	Average Velocity at Upstream Berm (ft/sec)	Mainstem Discharge (cfs)	Average Velocity at Upstream Berm (ft/sec)
1,000	10,000	N/A	31,000	N/A	55,000	N/A
3,000	12,000	N/A	33,000	N/A	57,000	N/A
5,000	14,000	N/A	35,000	N/A	59,000	N/A
7,000	16,000	N/A	37,000	N/A	61,000	N/A
9,000	18,000	N/A	39,000	N/A	63,000	N/A
11,000	20,000	N/A	41,000	N/A	65,000	N/A
12,000	21,000	N/A	42,000	N/A	66,000	1.3
13,000	22,000	N/A	43,000	N/A	67,000	1.4
15,000	24,000	N/A	45,000	N/A	69,000	1.6
17,000	26,000	N/A	47,000	N/A	71,000	1.7
19,000	28,000	N/A	49,000	N/A	73,000	1.7
21,000	30,000	N/A	51,000	N/A	75,000	1.8
23,000	32,000	N/A	53,000	N/A	77,000	1.9
25,000	34,000	N/A	55,000	N/A	79,000	1.9
27,000	36,000	N/A	57,000	N/A	81,000	1.8
29,000	38,000	N/A	59,000	N/A	83,000	1.6
31,000	40,000	N/A	61,000	N/A	85,000	1.4

N/A - Not Applicable

1/ See last page of this table for explanation of conditions.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm.
See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

	Condition 1 1/		Condition 2 1/		Condition 3 1/	
Susitna River Discharge at Gold Creek (cfs)	Mainstem Discharge (cfs)	Total Wetted Surface Area (ft2)	Mainstem Discharge (cfs)	Total Wetted Surface Area (ft2)	Mainstem Discharge (cfs)	Total Wetted Surface Area (ft2)
1,000	10,000	120,000	31,000	160,000	55,000	210,000
3,000	12,000	130,000	33,000	170,000	57,000	220,000
5,000	14,000	130,000	35,000	170,000	59,000	230,000
7,000	16,000	140,000	37,000	180,000	61,000	240,000
9,000	18,000	140,000	39,000	180,000	63,000	250,000
11,000	20,000	140,000	41,000	180,000	65,000	260,000
12,000	21,000	140,000	42,000	190,000	66,000	270,000
13,000	22,000	150,000	43,000	190,000	67,000	280,000
15,000	24,000	150,000	45,000	190,000	69,000	300,000
17,000	26,000	150,000	47,000	200,000	71,000	320,000
19,000	28,000	160,000	49,000	200,000	73,000	340,000
21,000	30,000	160,000	51,000	200,000	75,000	360,000
23,000	32,000	170,000	53,000	210,000	77,000	380,000
25,000	34,000	170,000	55,000	210,000	79,000	400,000
27,000	36,000	180,000	57,000	220,000	81,000	420,000
29,000	38,000	180,000	59,000	230,000	83,000	450,000
31,000	40,000	180,000	61,000	240,000	85,000	470,000

1/ See last page of this table for explanation of conditions.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm.
See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

	Condition 1[1/]		Condition 2[1/]		Condition 3[1/]	
Susitna River Discharge at Gold Creek (cfs)	Mainstem Discharge (cfs)	Wetted Perimeter at Mouth (ft)	Mainstem Discharge (cfs)	Wetted Perimeter at Mouth (ft)	Mainstem Discharge (cfs)	Wetted Perimeter at Mouth (ft)
1,000	10,000	10	31,000	28	55,000	70
3,000	12,000	10	33,000	32	57,000	70
5,000	14,000	12	35,000	35	59,000	71
7,000	16,000	13	37,000	37	61,000	71
9,000	18,000	15	39,000	56	63,000	72
11,000	20,000	16	41,000	61	65,000	72
12,000	21,000	18	42,000	63	66,000	73
13,000	22,000	18	43,000	66	67,000	73
15,000	24,000	20	45,000	68	69,000	74
17,000	26,000	23	47,000	69	71,000	74
19,000	28,000	25	49,000	69	73,000	75
21,000	30,000	28	51,000	69	75,000	76
23,000	32,000	30	53,000	70	77,000	110
25,000	34,000	35	55,000	70	79,000	150
27,000	36,000	36	57,000	70	81,000	180
29,000	38,000	43	59,000	71	83,000	185
31,000	40,000	60	61,000	71	85,000	190

1/ See last page of this table for explanation of conditions.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

	Condition 1 1/		Condition 2 1/		Condition 3 1/	
Susitna River Discharge at Gold Creek	Mainstem Discharge	Wetted Perimeter at Mid-Slough	Mainstem Discharge	Wetted Perimeter at Mid-Slough	Mainstem Discharge	Wetted Perimeter at Mid-Slough
1,000	10,000	0 2/	31,000	12	55,000	16
3,000	12,000	0 2/	33,000	12	57,000	22
5,000	14,000	0 2/	35,000	12	59,000	24
7,000	16,000	0 2/	37,000	12	61,000	25
9,000	18,000	0 2/	39,000	12	63,000	26
11,000	20,000	0 2/	41,000	12	65,000	28
12,000	21,000	0 2/	42,000	12	66,000	29
13,000	22,000	0 2/	43,000	12	67,000	30
15,000	24,000	0 2/	45,000	12	69,000	30
17,000	26,000	12	47,000	12	71,000	31
19,000	28,000	12	49,000	12	73,000	32
21,000	30,000	12	51,000	12	75,000	33
23,000	32,000	12	53,000	12	77,000	35
25,000	34,000	12	55,000	16	79,000	210
27,000	36,000	12	57,000	22	81,000	300
29,000	38,000	12	59,000	24	83,000	310
31,000	40,000	12	61,000	25	85,000	310

1/ See last page of this table for explanation of conditions.
2/ Transect 7 reported as dry at discharge of 25,800 cfs (ADF&G, 1982).

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

	Condition 1[1/]		Condition 2[1/]		Condition 3[1/]	
Susitna River Discharge at Gold Creek (cfs)	Mainstem Discharge (cfs)	Wetted Perimeter at Upstream Berm (ft)	Mainstem Discharge (cfs)	Wetted Perimeter at Upstream Berm (ft)	Mainstem Discharge (cfs)	Wetted Perimeter at Upstream Berm (ft)
1,000	10,000	0	31,000	0	55,000	0
3,000	12,000	0	33,000	0	57,000	0
5,000	14,000	0	35,000	0	59,000	0
7,000	16,000	0	37,000	0	61,000	0
9,000	18,000	0	39,000	0	63,000	0
11,000	20,000	0	41,000	0	65,000	0
12,000	21,000	0	42,000	0	66,000	40
13,000	22,000	0	43,000	0	67,000	75
15,000	24,000	0	45,000	0	69,000	150
17,000	26,000	0	47,000	0	71,000	230
19,000	28,000	0	49,000	0	73,000	305
21,000	30,000	0	51,000	0	75,000	380
23,000	32,000	0	53,000	0	77,000	455
25,000	34,000	0	55,000	0	79,000	530
27,000	36,000	0	57,000	0	81,000	610
29,000	38,000	0	59,000	0	83,000	685
31,000	40,000	0	61,000	0	85,000	760

1/ See last page of this table for explanation of conditions.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

Susitna River Discharge at Gold Creek (cfs)	Condition 1[1/] Mainstem Discharge (cfs)	Condition 1[1/] Water Table Elevation (ft,msl)	Condition 2[1/] Mainstem Discharge (cfs)	Condition 2[1/] Water Table Elevation (ft,msl)	Condition 3[1/] Mainstem Discharge (cfs)	Condition 3[1/] Water Table Elevation (ft,msl)
1,000	10,000		31,000		55,000	
3,000	12,000		33,000		57,000	
5,000	14,000		35,000		59,000	
7,000	16,000		37,000		61,000	
9,000	18,000		39,000		63,000	
11,000	20,000		41,000		65,000	
12,000	21,000		42,000		66,000	
13,000	22,000	2/	43,000	2/	67,000	2/
15,000	24,000		45,000		69,000	
17,000	26,000		47,000		71,000	
19,000	28,000		49,000		73,000	
21,000	30,000		51,000		75,000	
23,000	32,000		53,000		77,000	
25,000	34,000		55,000		79,000	
27,000	36,000		57,000		81,000	
29,000	38,000		59,000		83,000	
31,000	40,000		61,000		85,000	

1/ See last page of this table for explanation of conditions.
2/ No well data avaible for Rabideux Slough; for a description of expected water table conditions, see Attachment A-4.

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

Table A-5 (con't)

MAINSTEM DISCHARGE VS. PHYSICAL HABITAT VARIABLES
RABIDEUX SLOUGH

Mainstem Discharge = $Q_{GC} + Q_C + Q_T$

in which,

Q_{GC} = Susitna River at Gold Creek (USGS Gage No. 15292000) discharge
Q_C = Chulitna River near Talkeetna (USGS Gage No. 15292400) discharge
Q_T = Talkeetna River near Talkeetna (USGS Gage No. 15292700) discharge

Condition 1:

Q_{GC} = 1,000 to 31,000 cfs in 2000 cfs increments
Q_C = 90% exceeded flow during the month of September
Q_T = 90% exceeded flow during the month of September

Condition 2:

Q_{GC} = 1,000 to 31,000 cfs in 2000 cfs increments
Q_C = average monthly flow in August
Q_T = average monthly flow in August

Condition 3:

Q_{GC} = 1,000 to 31,000 cfs in 2000 cfs increments
Q_C = 10% exceeded flow during the month of June
Q_T = 10% exceeded flow during the month of June

Note: See Figure A-5 for location of mouth, mid-slough, and upstream berm. See Attachment, Part 4, for narrative and worksheets explaining method of determining slough physical habitat variables.

slough at a Susitna River discharge (measured at Gold Creek) of 31,100 cfs. The threshold discharge for overtopping the intermediate berm (29,000 cfs) was estimated by comparing computed and observed Susitna River water surface elevations with the berm crest elevation. The threshold discharge between Regimes I and II (10,000 cfs) was estimated from field observations.

Slough Discharge

Slough discharges were estimated to be 3 cfs for Regime I and 8 cfs in Regime II based on field measurements (ADF&G, 1982). Slough discharge for Regime IIA was estimated by computing discharge over the intermediate berm and adding this to Regime II discharge.

Water Surface Elevation

Water surface elevations at the slough mouth are based on a rating curve developed from staff gage readings between 11,500 cfs and 26,500 cfs. Between 10,000 cfs and 11,500 cfs, and between 26,500 cfs and 31,000 cfs, the rating curve was extrapolated. Hydraulic computations, assuming uniform flow, were made to estimate slough mouth water surface elevations for discharges less than 10,000 cfs.

Mid-slough water surface elevations are based on in-field measurements for mainstem discharges which exceed 10,000 cfs. For mainstem discharges less than 10,000 cfs, hydraulic computations were made.

Water surface elevations at the intermediate and upstream berms were estimated using broad crested weir computations.

Flow Depth

Flow depths were computed by subtracting thalweg elevations from water surface elevations, determined as described above.

Velocity

Average slough flow velocities were computed by dividing the slough discharges by flow cross-sectional areas. Lateral distributions of velocity were measured at cross sections about 1600 feet upstream of the slough mouth and are shown in the Attachment.

Wetted Surface Area

For mainstem discharges greater than 10,000 cfs, wetted surface areas were estimated using aerial photographs for mainstem discharges greater than 10,000 cfs. For mainstem discharges less than 10,000 cfs the wetted surface area was estimated using computed slough water surface profiles and surveyed cross sections.

Wetted Perimeter

Wetted perimeters at the slough mouth, mid-slough, and the intermediate berm were measured from the surveyed cross sections and the water surface elevations determined as described previously.

Water Table Elevations

Water table elevations were derived from data collected at observation wells in the slough.

A.5.2 Slough 9

A map of Slough 9 is shown on Figure A-3. Methods of analyses are given in the Attachment, Part 2.

Threshold Discharges

The threshold Susitna River mainstem discharges between Regime I and Regime II (11,000 cfs) and between Regime II and Regime III (20,500 cfs) are based on plots of measured mainstem and slough discharges.

Slough Discharge

The slough discharges are based on the same field measurements as for Threshold Discharges.

Water Surface Elevation

Slough mouth water surface elevations are based on staff gage readings for mainstem discharges greater than 11,000 cfs. For mainstem discharges less than 11,000 cfs, the slough mouth water surface elevation was assumed constant. This water surface elevation reflects an estimate of flow depth at staff gage 129.0 for a mainstem discharge of 10,000 cfs and a slough discharge of 3 cfs (Trihey, 1982, Table 4, p. 21).

All mid-slough water surface elevations are based on a rating curve derived from staff gage readings. Upstream end water surface elevations are based on water surface profiles computed with the U.S. Army Corps of Engineers computer program for water surface profiles, HEC-2.

Flow Depth

Flow depths were computed by subtracting the thalweg elevations from water surface elevations determined as described above.

Velocity

Average slough flow velocites were determined by dividing slough discharge by the flow cross sectional areas. Lateral and longitudinal distributions of velocities obtained in the field are shown in the Attachment.

Wetted Surface Area

For mainstem discharges greater than 11,000 cfs, wetted surface areas were estimated from aerial photography. For mainstem discharges less than 11,000 cfs, the wetted surface area was estimated using computed slough water surface profiles and surveyed cross sections.

Wetted Perimeter

Wetted perimeters were estimated to be equal to wetted surface widths (top widths) for the slough mouth and the upstream end of this slough. Top widths were estimated from aerial photos and computed slough water surface profiles and surveyed cross sections. Wetted perimeters were computed from surveyed cross sections for mid-slough.

Water Table Elevations

Water table elevations were derived from data collected at observation wells in the slough.

A.5.3 Slough 21

A map of Slough 21 is shown on Figure A-4. Methods of analyses are given in the Attachment, Part 3.

Threshold Discharges

The threshold Susitna River mainstem discharges between Regimes II-A and III (26,000 cfs) and between Regimes I and II (21,300 cfs) are based on field measurements of slough and mainstem discharge.

Slough Discharges

Slough discharge estimates are based on the same field measurements indicated in the preceding paragraph.

Water Surface Elevation

For mainstem discharges greater than 21,300 cfs, water surface elevations at the slough mouth are based on a rating curve derived from staff gage readings. A constant water surface elevation at the slough mouth was assumed for all mainstem discharges less than 21,300 cfs.

Mid-slough water surface elevations were estimated from staff gage readings and average daily elevations from a stage recorder. Constant water levels were assumed for Regimes I, II, and II-A.

Intermediate and upstream berm water levels were estimated from staff gage readings.

Flow Depths

Slough flow depths were estimated by subtracting the thalweg elevation from water surface elevations determined as described above.

Velocity

Average slough flow velocities were estimated by dividing slough discharges by flow cross sectional areas. Average velocities for four measured flows are shown in the Attachment. Lateral and longitudinal distributions of velocities obtained in the field are shown in the Attachment.

Wetted Surface Area

Slough wetted surface areas were estimated from aerial photography.

Wetted Perimeter

Slough wetted perimeters were assumed to be equal to wetted surface width (top widths) based on aerial photography and field measurements.

Water Table Elevations

There is not sufficient information to estimate the water table level at this slough since wells have not been installed. Geologic materials are expected to be similar to sloughs 8A and 9.

A.5.4 Rabideux Slough

A map of Rabideux Slough is shown on Figure A-5. Methods of analyses for this slough are presented in the Attachment, Part 4.

Threshold Discharges

There is very little flow in this slough until the upstream berm is overtopped (Susitna River mainstem discharge 66,000 cfs).

Slough Discharges

Slough discharge estimates are based on four field observations. Two observations of slough discharge when the upstream berm was not overtopped (Regime II) indicated negligible flow in this slough. Two observations of slough discharge when the upstream berm was overtopped were used to estimate slough discharge in Regime III.

Water Surface Elevations

Water surface elevations at the slough mouth are based on staff gage readings and a surveyed water surface level. Mid-slough water surface levels are based on surveyed water levels and measurements of top widths from aerial photography projected on surveyed cross sections. The transect at mid-slough has been observed to be dry at a mainstem discharge of 25,800 cfs. Mid-slough water levels are influenced by water levels at the mouth for mainstem discharges greater than 53,000 cfs. Upstream berm water surface levels were estimated from hydraulic computations assuming a triangular broad crested weir.

Flow Depths

Slough flow depths were determined by subtracting the slough thalweg elevations from water surface elevations derived as described above.

Velocity

Average slough flow velocity was computed by dividing slough discharge by the slough cross sectional area. Lateral and longitudinal distributions of velocities as measured in the field are shown in the Attachment.

Wetted Surface Area

Wetted surface areas were estimated from aerial photography.

Wetted Perimeter

Wetted perimeters were estimated from field surveyed cross sections at the slough mouth and mid-slough. Wetted perimeters were estimated to be equal to wetted surface widths (top widths) measured from aerial photography at the upstream berm.

Water Table Elevations

There is not enough information to estimate water table levels at this slough since wells have not been installed. However, groundwater levels are expected to respond in a manner similar to sloughs upstream of Talkeetna (Sloughs 8A and 9).

A.6 Discussion of Results

The following discussion refers to the results presented in Tables A-1 through A-5.

A.6.1 Slough 8A

A summary of the results for Slough 8A is presented in Table A-2.

Regime II occurs over a mainstem flow range of 10,000 to 26,000 cfs, and thus is the dominant regime characterizing Slough 8A in the range of incremental flows analyzed. Intermediate and upstream berms are not overtopped until mainstem flows have reached 26,000 and 30,000-32,000 cfs, respectively (Table A-1).

Slough discharges are generally low at mainstem flows less than the overtopping discharge and vary between 3 and 20 cfs. A correlation of slough flows with mainstem flows at less than overtopping discharges is not apparent at this level of analysis, perhaps because of local runoff and groundwater inflow from upland areas. Therefore, constant slough flows of 3 and 8 cfs were assumed for Regimes I and II, respectively.

In Regime I, water surface elevations at the slough mouth are controlled by a berm downstream of the mouth. Hence, for the 3 cfs discharge the water surface elevation at the mouth remains constant. In Regime II, water surface elevations and depth at the slough mouth increase as Susitna River flows increase because of a backwater effect. The depths presented in Table A-2 represent maximum depths at cross-section W1 (see Figure A-2). For Regime I, the depth at the controlling berm downstream of cross-section W1 is estimated to be 0.1 ft.

For all regimes, the water surface elevations and depths at mid-slough are dependent on slough discharge. At the upstream berms, depths are zero until the berms are overtopped.

At mainstem flows less than 29,000 cfs, average velocities in the slough are low because of the low slough discharges.

Wetted surface area is constant for all mainstem flows in Regime I. As higher mainstem flows increase the backwater effect of Regime II, wetted surface area increases. Wetted perimeter at the mouth also increases as mainstem flows in Regime II increase.

Groundwater elevations at mid-slough, Well A, do not appear to be significantly correlated with mainstem discharge. At mid-slough, Well B, and the upstream well, there is a direct relationship with mainstem discharge. This relationship is depicted on Sheet 3 of Table A-2.

Slough 9

Summary information for Slough 9 is presented in Table A-3.

For Regime I (mainstem flow less than 11,000 cfs) and Regime II (11,000 to 20,500 cfs), there is little variation in slough discharge. Hence, based on observed data, constant slough discharges of 3 cfs and 6 cfs were assumed for Regimes I and II, respectively. At discharges greater than the upstream berm overtopping discharge (Regime III), slough discharge increases with mainstem discharge. Regime III slough discharges presented in Table A-3 represent values estimated from a plot of the observed data.

In Regime I, water surface elevations at the mouth of Slough 9 are controlled by a berm downstream of the mouth. For the assumed 3 cfs slough discharge, the water surface elevation remains constant. At 3 cfs, the depth over the berm is computed to be 0.1 feet. In Regimes II and III, the water surface elevations and depths at the mouth of the slough increase with increasing mainstem discharge.

The mid-slough water surface elevations and depths shown in Table A-3 are at a mid-slough pool. The water surface elevations and depths are essentially independent of mainstem discharges for Regime I and II. However, when the upstream berm is overtopped, the increase in slough discharge results in an increase in water surface elevation and depth.

Once overtopped, the water surface elevations at the upstream berm increase directly with mainstem Susitna water surface elevations.

The average velocities presented for the mouth of Slough 9 are the velocities over the berm at the slough mouth. Since the cross sectional area at the berm is a minimum, velocities are higher than for any other cross section near the mouth. Mid-slough velocities are low throughout Regimes I and II but increase when the upstream berm is overtopped.

The wetted surface area remains constant throughout Regime I. However, in Regime II, as the backwater from the mainstem increases with increasing Susitna River discharge, the wetted surface area increases.

The wetted perimeter at the mouth is constant through Regime I and increases through Regimes II and III. Mid-slough and upstream berm wetted perimeters do not change until overtopping occurs.

Water table elevations at Slough 9 presented in Table A-3 exhibit considerably more change with mainstem discharge than do those presented for Slough 8A (see Table A-2).

Slough 21

Summary information for Slough 21 is contained in Table A-4.

Regime I flow at Slough 21 includes flows up to a mainstem discharge of 21,400 cfs. Regime II flow occurs over a range of discharges from 21,400 cfs to 24,800 cfs. Regime II-A, resulting from overtopping of the intermediate berm, occurs during mainstem flows of 24,800 cfs to 26,000 cfs and Regime III occurs when the highest berm is overtopped at 26,000 cfs.

Slough discharges measured during Regime I flows were low, varying between 2 and 12 cfs. Since there is no apparent correlation with mainstem discharge, a constant slough flow of 5 cfs was assumed (see Table A-4). For Regime II, at mainstem flows between 23,000 and 25,000 cfs, a slough discharge of 9 cfs was assumed. For Regime III, a relationship based on observed data was used to estimate slough discharge.

As a result of the assumed constant slough flow for Regime I, the water surface elevation and slough depth at the mouth are constant. The depths presented reflect a pool depth upstream from the controlling berm and not the depths over the berm. As backwater effects and overtopping of the upstream berms begin, the water surface elevations and depths increase.

At mid-slough, the water surface elevation (and depth) is constant throughout Regime I. As slough discharge increases from 5 to 9 cfs, (Regime I to Regime II), there is a slight increase in water surface elevation (and depth). The increase at mid-slough is attributable to the increase in discharge since the backwater effects do not extend upstream to the mid-slough location.

Average velocities throughout all flow regimes and for all locations analyzed, remain low. As illustrated in Table A-4, velocities at the slough mouth do not exceed 0.2 feet per second for the range of flows considered.

In Table A-4, wetted surface area begins to increase due to backwater (Regime II) at a mainstem flow of 21,400 cfs. At flows higher than 26,000 cfs, the increases in wetted surface area are the result of both backwater and upstream berm overtopping.

Wetted perimeter at the mouth responds to mainstem flow in a manner similar to wetted surface area. The wetted perimeter at the mid-slough is essentially constant until the upstream berm is overtopped.

No groundwater elevation data is available for Slough 21.

<u>Rabideux Slough</u>

Summary information for Rabideux Slough is contained in Table A-5 (Sheets 1 through 16).

Rabideux Slough is affected by the backwater from the Susitna River (Regime II) at mainstem flow conditions (at the slough) as low as approximately 10,000 cfs. This regime persists until the upstream berm is overtopped at a mainstem flow of approximately 65,000 cfs.

Measured slough discharges at flows less than the overtopping discharge were either not measurable or were less than 1 cfs. Therefore, slough discharge was assumed to be zero for Regime II. However, once overtopped, Rabideux Slough discharge increases significantly.

Water surface elevation (Table A-5, Sheet 2) and depth (Table A-5, Sheet 5) at the slough mouth increase with mainstem discharge over the range of flows considered.

The selected mid-slough location is dewatered at flows less than 26,000 cfs (Table A-5, Sheets 3 and 6). At higher flows, isolated ponded water has been observed. Therefore, from flows of 26,000 cfs to 53,000 cfs a constant water surface elevation and a depth of 0.3 feet were assumed. At flows greater than 53,000 cfs, water levels and depths increase as the result of backwater from the mainstem. Once overtopping of the upstream berm occurs, the water level at mid-slough increases at a greater rate than during Regime II. The water surface elevation (Table A-5, Sheet 4) and depth (Table A-5, Sheet 7) at the upstream berm change only after the berm is overtopped. At the higher overtopping discharges, the upstream berm becomes submerged because of backwater.

Velocities at the mouth (Table A-5, Sheet 8) are zero until overtopping occurs. However, because the cross sectional area is relatively large, velocities at the slough mouth remain low even during an overtopped condition. At mid-slough (Table A-5, Sheet 9), velocities remain low during overtopping because of the backwater effect. Velocities at the upstream berm (Table A-5, Sheet 10) during overtopping also remain low because of backwater.

Total wetted surface area (Table A-5, Sheet 11) increases with increasing mainstem discharge as a result of backwater up to the overtopping discharge of 65,000 cfs, and as a result of both backwater and overtopping once overtopping occurs. The wetted surface area includes the areas of both the pond at the upstream end of the slough and the lower slough even though they are not hydraulically connected at lower flows.

The wetted perimeter at the slough mouth (Table A-5, Sheet 12) increases because of the backwater effect. The wetted perimeter responds to the shape of the cross section, increasing quickly at first and then remaining relatively constant. At high flows, the wetted perimeter exhibits a large increase because of overtopping of the flood plain.

The wetted perimeter at mid-slough (Table A-5, Sheet 13) is 12 feet or less until backwater effects occur at a mainstem flow of 53,000 cfs. At a discharge of 79,000 cfs, the water surface encroaches on the flood plain resulting in a large increase in wetted perimeter.

The wetted perimeter at the upstream berm (Table A-5, Sheet 14) is zero until the upstream berm is overtopped.

A.7 References

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