DUKE POWER CO.
KEOWEE-TOXAWAY PROJECT
FLOOD STUDIES

8001130036

KEOWEE - TOKAWAY
ALL RESERVOIRS

MAX. FLOOD ROUTING FROM MAJOR FLOOD HYDROGRAPHS

CGR 4-12-66
FGT 9-17-[illegible]

SUMMARY OF STUDY:

RESERVOIR AND RECORD FLOOD	FROM MAX. PROBABLE RAINFALL ON FLOOD HYDROGRAPH - R=22.3		WITH LAKE TOXAWAY VOLUME AS SURCHARGE ON MAX. RAINFALL FLOOD	
	MAX. SPILLWAY DISCHARGE (CFS)	PEAK RESERV. ELEV.	MAX STILLWAY DISCHARGE	PEAK RESERV. ELEV.
JOCASSEE RESERVOIR (FLOOD - OCT 4-5, 1964)	71,500	1115.0	79,500	1117.28
FULL POND = EL. 1110.0 TOP OF DAM = EL. 1125.0	70,500	1114.60	74,800	1116.35
KEOWEE RESERVOIR w/o JOCASSEE (FLOOD - AUG 13-15, 1940)	150,500	808.7	153,000	809.65
FULL POND = EL 800.0 TOP OF DAM = EL 815.0	146,700	807.72	149,500	[illegible]
KEOWEE RESERVOIR WITH JOCASSEE (+ DISCHARGE FROM JOCASSEE) (FLOOD - AUG 13-15, 1940)	147,500	808.3	151,500	[illegible]
TOP OF DAM = EL. 815.0	147,800	807.95	150,500	[illegible]

KEOWEE-TOXAWAY STUDIES
ALL RESERVOIRS
MAX FLOOD ROUTING CRR 3-18-66

PURPOSE: The purpose of this study is to evaluate the design spillway's ability to pass the maximum flood which is probable, within a short period of time, without danger of the other portions of the dam being overtopped.

Method: The study will utilize the most correct inflow records for the maximum flood on record as well as the theoretical storm which is predicted from Corps of Engrs. Design Manuals on both Hartwell & Carters Dam Projects.

The Graphical Method of Flood Routing per TVA will be used.

ASSUMPTIONS:

(1) Each reservoir is at full pond before the flood begins.

(2) The tainter gates are immediately opened fully at the beginning time.

(3) Additional discharge is allowed for through some power units.

(4) Elev. of the top of the dam is 15' above the full pond elev.

(5) The spillway above a certain ELEV is [illegible] to act as an [illegible] when [illegible].

Keowee Studies

SPILLWAY DESIGN FLOOD 3A

CQR 3-16-66

REF: Davis, HANDBOOK OF APPLIED HYDRAULICS - Hydrograph - flow versus time

Inflow = storage + outflow

$$I = (d_1 + d_2)T + S_2 - S_1$$

$$I + S_1 - d_1T = S_2 + d_2T$$

I = inflow, ac-ft

T = time, days

d_1 = discharge at be... (cfs)

d_2 = discharge at e...

S_1 = storage at b...

S_2 = Storage at e...

1 dsf = 2 ac-ft.

REF: CORPS OF ENGINEERS EM 1110-2-1405 31 AUG '59 FLOOD HYDROGRAPH ANALYSIS AND COMPUTATIONS

∴ known flood = 100,000 cfs.

KEOWEE STUDIES
SPILLWAY DESIGN FLOOD 3B
CQR 3-17-66

48 hr

26,700
7.6 x max. known flood

KEOWEE - TOXAWAY STUDIES
JOCASSEE RESERVOIR

CQR 3-25-66

COMPARISON OF MAX. DESIGN FLOODS -

HARTWELL -

D.A. = 2,088 sq. mi. × 640 Ac./sq. mi. = 1,335,000 Ac.
storm duration = 72 HRS.
TOTAL VOL. = 24.8 in
Vol. Run-off = 18.8 in. = 1.57 ft.
Vol. Runoff = 2,093,400 Ac-ft. ← = × 1.57 ft Check

Peak Nat. Flow = 760,000 cfs
Spillway design = 565,000 cfs

CARTERS -

DA = 376 sq. mi. × 640 Ac/sq. mi. = 240,500 Ac.
storm duration = 48 hours
TOTAL VOL = 26.6 in
Vol. Run-off = 22.3 in. = 1.86 ft
Vol Run-off = 447,000 Ac-ft.

Peak Nat. Flow = 194,200 cfs.
Spillway Design = 197,800 cfs.

JOCASSEE -

D.A. = 144 sq. mi. × 640 Ac/sq. mi. = 92,100 Ac.
duration storm = 48 hours
TOTAL VOL. = 26.6 in. (same as CARTER)
Vol. Run-off = 22.3 in = 1.86 ft.
Vol Run-off = 171,500 Ac-ft.

POOR ORIGINAL

Peak Nat. Flow = 75,000
SPILLWAY DESIGN = 45,600 CFS + (16,400 cfs 2 UNITS @)
TOTAL = 62,000 CFS.

FROM: CARTERS DAM
DESIGN MEMO #1
CORPS OF ENGINEERS

5.

DISCHARGE HYDROGRAPHS-FLOODS OF RECORD

25. Estimated discharge rates at Carters dam site. Since records of stage and discharge are not available at the Carters site, it was necessary to estimate discharge hydrographs for the floods of record from data at nearby stations. In order to accomplish this, concurrent records for the gage at Pine Chapel below the site and the Ellijay gage on the Cartecay River above the site were used. The discharges at these stations were modified by applying weighted drainage area ratios to estimate the natural discharges at the site. It was assumed that due to the small reservoir area there would be no appreciable difference between natural and inflow hydrographs and the natural hydrographs were used in routings. The peak discharges and flood volumes as estimated for some of the larger floods were as follows:

Flood	Peak discharge (c.f.s.)	Flood volume (inches)
February, 1946	14,000	4.1
January, 1947	10,400	4.1
March, 1951	21,200	3.7
January, 1954	18,400	4.6

SPILLWAY DESIGN FLOOD

26. Criteria and procedure for computing rainfall volume. The spillway design storm rainfall was developed using the criteria in Hydrometeorological Report No. 33 "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24 and 48 Hours". The month of August was found to have the maximum probable precipitation for the Carters area. This amount of precipitation, as shown on figure 17 and the corresponding depth-area-duration relationships for a drainage area of 376 square miles in zone 7, as shown on figure 18, were used to compute the rainfall volume for the spillway design storm. The resulting amounts were reduced by 10 percent to allow for irregularities in basin shape and the improbability of rainfall patterns conforming exactly with the Carters drainage area. The rainfall volume thus computed amounted to 26.6 inches.

27. Rainfall excess for Carters dam. In computing the rainfall excess it was assumed that the initial loss would be zero and a constant loss of 0.1 inch per hour was adopted, based on losses encountered in studying floods of record in the area. This resulted in a total rainfall-excess of 22.3 inches. The 6-hour rainfall-excess amounts were arranged in a critical pattern of 4-2-1-3-5-6 in order of magnitude.

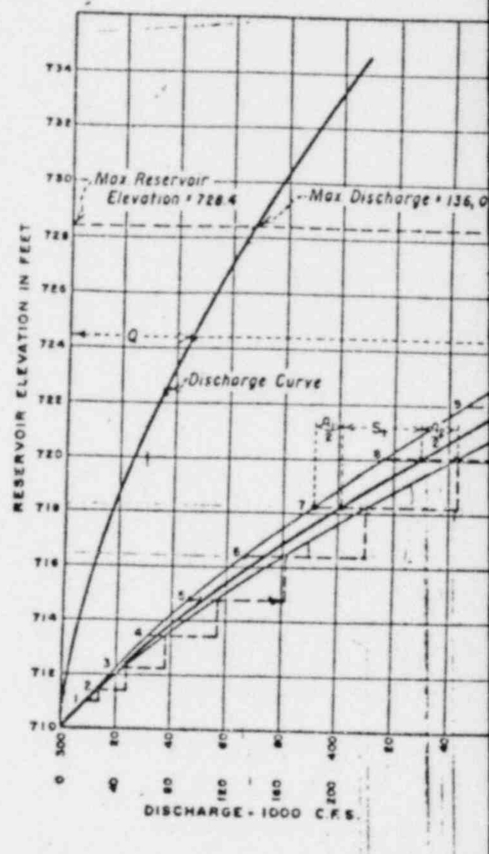
28. Natural discharge hydrograph. The derived unit hydrograph as described in paragraph 23 was applied to the rainfall excess and a

PRINCIPLE

For any time interval, inflow = storage + outflow

Q = Discharge in c.f.s.
T = Time interval in hours.
i_1 = Inflow at start of interval in acre feet/time interval.
i_2 = Inflow at end of interval in acre feet/time interval.
q_1 = Outflow at start of interval in acre feet/time interval.
q_2 = Outflow at end of interval in acre feet/time interval.
S_t = Storage during interval in acre feet.

$$\therefore \frac{i_1 + i_2}{2} = S_t + \frac{q_1 + q_2}{2}, \text{ or } \frac{i_1 + i_2}{2} = S_t + \frac{q_1}{2} + \frac{q_2}{2}$$



6.
1 cfs = 2 AF/day

GRAPHICAL METHOD OF FLOOD ROUTING

CONSTRUCTION

(1) Plot Discharge Curve in c.f.s. for spillway and outlets.

(2) Plot Storage Curve in acre feet for reservoir above elevation of outlets.

(3) Select a time interval.

(4) Plot Work Curves "A" and "B" as follows: At any elevation; Curve "A" = Storage Curve minus one-half the discharge in acre feet for the selected time interval –

$(S_t - (\frac{Q}{2}) = S_t - \frac{QT}{24})$

Curve "B" = Storage Curve plus one-half the discharge –

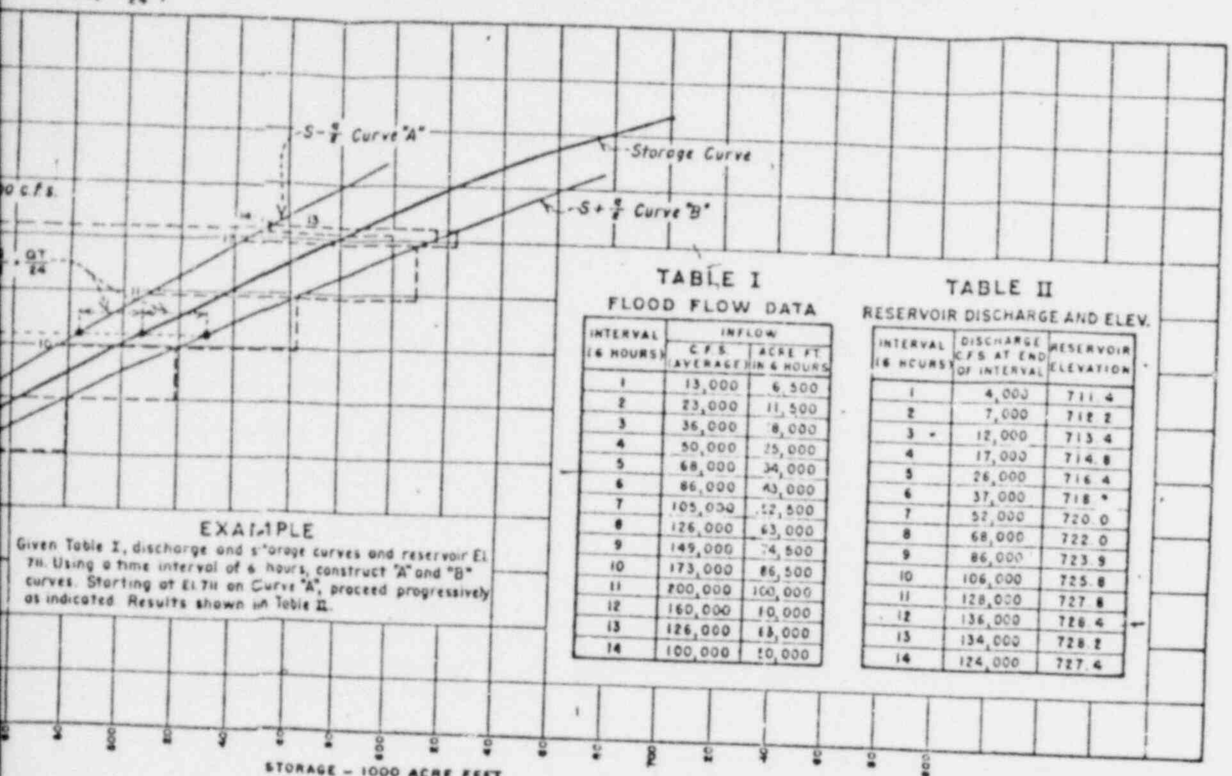
$(S_t + \frac{QT}{24})$

PROCEDURE

Construct Discharge and Storage Curves for given conditions.
Assume a time interval, T, and construct Curves "A" and "B". Two time intervals may be selected for alternate use.
From flood data determine inflow for each interval.
Starting at any desired reservoir elevation, solve graphically as follows:

From the selected initial reservoir elevation on Curve "A", lay off to the right the inflow in acre ft. for the interval. From that point project vertically to Curve "B". Read directly from the chart the discharge and reservoir elevation. Repeat this procedure for each interval starting each time from the "A" curve at the elevation where the vertical from the preceding inflow intersects the "B" curve.

By construction the intercept between Curve "A" and the Storage Curve at the start of the interval = $\frac{Q_1}{2}$.
And the intercept between Curve "B" and the Storage Curve at the end of the interval = $\frac{Q_2}{2}$.
The horizontal projection of the Storage Curve between these intercepts = S_t.
Therefore the equation $\frac{i_1 + i_2}{2} = S_t + \frac{Q_1}{2} + \frac{Q_2}{2}$ is satisfied.



EXAMPLE

Given Table I, discharge and storage curves and reservoir El. 711. Using a time interval of 6 hours, construct "A" and "B" curves. Starting at El. 711 on Curve "A", proceed progressively as indicated. Results shown in Table II.

TABLE I
FLOOD FLOW DATA

INTERVAL (6 HOURS)	INFLOW C.F.S. (AVERAGE)	INFLOW ACRE FT. IN 6 HOURS
1	13,000	6,500
2	23,000	11,500
3	36,000	18,000
4	50,000	25,000
5	68,000	34,000
6	86,000	43,000
7	105,000	52,500
8	126,000	63,000
9	149,000	74,500
10	173,000	86,500
11	200,000	100,000
12	160,000	80,000
13	126,000	63,000
14	100,000	50,000

TABLE II
RESERVOIR DISCHARGE AND ELEV.

INTERVAL (6 HOURS)	DISCHARGE C.F.S. AT END OF INTERVAL	RESERVOIR ELEVATION
1	4,000	711.4
2	7,000	712.2
3	12,000	713.4
4	17,000	714.8
5	26,000	716.4
6	37,000	718.[illegible]
7	52,000	720.0
8	68,000	722.0
9	86,000	723.9
10	106,000	725.8
11	128,000	727.8
12	136,000	728.4
13	134,000	728.2
14	124,000	727.4

REFERENCE: H.R. DOCUMENT NO. 186,- 70TH. CONGRESS. REPORT ON SURVEY OF TENN. RIVER. PAPER ON FLOOD REGULATION OF THE TENN. RIVER BY L.G. PULS.

X-D-2989

P.M.S. 4-20-44

SAVANNAH RIVER BASIN

2-1850, Keowee River near Jocassee, S. C.

[illegible] 34°57'21", long 82°54'41", on right bank 0.6 mile downstream from bridge on State Highway 11, 1.8 miles southeast of [illegible] County, and 2.6 miles upstream from Eastatoe Creek.

[illegible] 148 mi.

[illegible] 1949 to September 1964.

[illegible] recorder. Datum of gage is 737.43 ft above mean sea level, datum of 1929, supplementary adjustment of 1936.

[illegible] 14 years (1950-64), 476 cfs.

[illegible] discharge during year, 17,700 cfs Sept. 29 (gage height, 17.84 ft); minimum 122 cfs Oct. 29, 30, 31, Nov. 1 (gage [illegible])
[illegible] maximum discharge, that of Sept. 29, 1964 (revised); minimum, 57 cfs Oct. 7, 1954.

[illegible] good except those for periods of no gage-height record, which are fair.

Rating table (gage height, in feet, and discharge, in cubic feet per second)
(Stage-discharge relation affected by ice Dec. 18, 20)

1.1	101	3.0	1,500
1.3	166	4.0	2,810
1.5	252	6.0	4,970
2.0	565	8.0	7,340
2.5	980		

Discharge, in cubic feet per second, water year October 1963 to September 1964

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
[illegible]	[illegible]	[illegible]	565	626	543	439	680	1,190	459	220	400	688
[illegible]	[illegible]	[illegible]	466	412	486	572	648	a1,400	473	305	350	536
[illegible]	[illegible]	[illegible]	425	425	459	1,010	625	a1,700	412	503	316	459
[illegible]	[illegible]	[illegible]	339	375	439	769	640	a1,200	387	353	304	419
[illegible]	[illegible]	[illegible]	316	362	455	•1,850	640	a1,100	375	257	316	375
[illegible]	[illegible]	[illegible]	299	345	1,290	1,050	1,940	a930	406	234	288	345
[illegible]	[illegible]	[illegible]	288	588	736	846	2,830	863	412	220	•252	321
[illegible]	[illegible]	[illegible]	299	500	610	752	2,220	819	394	220	289	310
[illegible]	[illegible]	[illegible]	283	•1,700	543	695	1,440	777	356	220	321	299
[illegible]	[illegible]	[illegible]	268	940	515	1,210	1,160	727	333	248	320	283
[illegible]	[illegible]	[illegible]	316	664	500	872	1,020	711	316	299	580	283
[illegible]	[illegible]	[illegible]	633	758	459	760	925	a800	310	278	433	288
[illegible]	[illegible]	[illegible]	452	744	486	680	1,120	a780	333	262	316	288
[illegible]	[illegible]	[illegible]	479	572	486	981	1,390	672	316	•229	278	262
[illegible]	[illegible]	[illegible]	425	536	499	2,150	1,080	625	299	211	278	252
[illegible]	[illegible]	[illegible]	368	507	698	1,250	925	a600	310	220	684	238
[illegible]	[illegible]	[illegible]	299	452	536	999	854	a590	294	206	764	234
[illegible]	[illegible]	[illegible]	270	425	685	819	802	a560	283	252	479	229
[illegible]	[illegible]	[illegible]	262	400	711	777	760	a540	278	917	417	268
[illegible]	[illegible]	[illegible]	250	601	610	872	727	a540	273	339	387	252
[illegible]	[illegible]	[illegible]	243	493	551	863	695	•500	262	294	333	238
[illegible]	[illegible]	[illegible]	247	439	515	736	672	706	268	445	332	229
[illegible]	[illegible]	[illegible]	316	412	486	703	•656	558	310	540	468	229
[illegible]	[illegible]	[illegible]	283	841	466	672	664	565	400	362	339	220
[illegible]	[illegible]	[illegible]	268	2,900	507	767	640	543	382	424	304	206
[illegible]	[illegible]	[illegible]	268	1,050	493	2,340	763	486	283	356	278	202
[illegible]	[illegible]	[illegible]	283	802	473	1,230	a3,500	466	262	299	263	202
[illegible]	[illegible]	[illegible]	273	680	493	990	a2,500	452	247	314	376	254
[illegible]	[illegible]	[illegible]	257	602	452	872	a2,300	432	234	766	320	•a6,900
[illegible]	[illegible]	[illegible]	247	558	------	777	1,420	432	224	690	2,660	a2,000
[illegible]	[illegible]	[illegible]	243	536	-----	719	-----	412	-----	551	1,140	-------
[illegible]	[illegible]	[illegible]	10,230	21,245	16,182	30,022	38,236	22,676	9,891	11,034	14,585	17,309
[illegible]	[illegible]	[illegible]	330	685	558	968	1,208	731	330	356	470	577
[illegible]	[illegible]	[illegible]	2.23	4.63	3.77	6.54	8.16	4.94	2.23	2.41	3.18	3.90
[illegible]	[illegible]	[illegible]	2.57	5.34	4.07	7.54	9.11	5.70	2.49	2.77	3.66	4.35

[illegible] 3,520 Min 122 Mean 378 Cfsm 2.55 In. 34.64
[illegible] 6,900 Min 122 Mean 559 Cfsm 3.78 In. 51.41

[illegible] Discharge (base, 4,000 cfs)

Date	Time	Gage height	Discharge	Date	Time	Gage height	Discharge
[illegible]	[illegible]	[illegible]	4,530	4-27	Unknown	Unknown	Unknown
[illegible]	[illegible]	[illegible]	5,780	8-30	1030	5.34	6,020
[illegible]	[illegible]	[illegible]	4,750	9-29	Unknown	17.84	17,700

• Discharge measurement made on this day.
a No gage-height record.

U.S. WEATHER BUREAU
TECH. PAPER No. 2 8.

Table 6

MAXIMUM RECORDED U.S. POINT RAINFALL (INCHES)

Station	MINUTES 5	10	15	30	60	HOURS 2	3	6	12	24
[illegible] (cont.)										
[illegible]	0.54	0.86	1.10	1.62	1.81	2.31	2.38	2.43	3.41	3.56
	7/9	9/4	9/4	9/4	8/9	8/9	8/9	7/8	10/15	10/15
	1956	1958	1958	1958	1953	1953	1953	1957	1954	1954
	←				1952-1961					→
[illegible]	0.61	1.01	1.41	2.05	2.68	4.89	5.04	5.26	5.75	6.08
	6/25	7/31	8/7	8/7	7/21	7/21	7/21	7/21	11/25	11/25
	1924	1942	1932	1932	1916	1916	1916	1916	1950	1950
	←				1913-1961					→
[illegible]	0.67	0.98	1.18	1.83	2.36	2.67	2.76	3.20	3.60	5.09
	7/28	6/25	6/25	7/24	8/16	7/24	6/20	7/24	7/14	9/29
	1922	1949	1949	1933	1935	1933	1936	1933	1945	1924
	←				1901-1961					→
[illegible]										
[illegible]	0.79	1.02	1.43	2.23	3.48	4.93	5.61	6.24	8.38	10.55
	5/22	5/22	5/25	11/11	11/11	8/15	8/15	11/11	12/14	12/13
	1911	1911	1936	1931	1931	1944	1944	1931	1910	1910
	←				1900-1961				→	99-61
[illegible]	0.61	1.02	1.29	1.68	2.60	2.89	3.03	4.22	4.73	5.08
	2/3	2/3	2/3	2/3	5/29	4/26	4/26	8/6	8/6	8/6
	1950	1950	1950	1950	1960	1959	1959	1955	1955	1955
	←				1950-1961					→
[illegible]										
[illegible]	0.52	0.84	1.08	1.58	2.19	3.20	3.44	4.13	7.08	8.52
	8/8	9/4	8/8	8/8	7/14	8/6	8/6	9/19	9/19	9/19
	1938	1937	1938	1938	1912	1952	1952	1960	1960	1960
	←	1903-1949		→	←	1903-1961		→	←1881-1961→	
[illegible]	0.50	0.90	1.20	1.70	2.46	3.33	3.62	4.69	5.32	6.17
	6/13	6/13	6/13	8/29	8/24	7/23	7/23	9/14	9/16	9/16
	1958	1958	1958	1959	1927	1922	1922	1944	1932	1932
	←				1905-1961					→
[illegible]										
[illegible]	0.73	1.17	1.65	2.79	4.11	6.64	7.42	8.62	9.03	10.57
	5/30	6/20	6/20	6/20	9/6	9/6	9/6	9/6	9/5	9/5
	1949	1947	1947	1947	1933	1933	1933	1933	1933	1933
	←				1897-1961				→	71-61
[illegible]	0.74	1.05	1.39	1.86	2.56	3.84	4.08	4.52	6.77	7.40
	8/20	7/26	7/26	7/30	9/1	6/19	6/19	8/16	8/16	8/16
	1911	1922	1922	1929	1956	1911	1911	1949	1949	1949
	←				1901-1961				→	87-61
[illegible]	0.61	1.16	1.58	2.54	3.46	4.66	4.82	4.95	4.95	6.53
	7/27	7/27	7/27	7/27	7/27	7/27	7/27	7/27	7/27	9/30
	1926	1926	1926	1926	1926	1926	1926	1926	1926	1929
	←				1921-1932					→
[illegible]	0.78	1.05	1.40	1.66	2.11	3.30	3.60	4.64	6.03	9.15
	4/29	4/29	4/29	4/29	7/15	7/29	6/22	9/4	10/15	7/15
	1959	1959	1959	1959	1959	1959	1958	1957	1954	1916
	←				1954-1961				→	00-61
[illegible]	0.80	1.27	1.52	2.30	3.63	4.49	5.29	5.78	6.20	8.20
	7/4	7/4	7/4	7/9	9/6	9/6	9/6	9/6	9/6	5/7
	1956	1956	1956	1928	1951	1951	1951	1951	1951	1910
	←			1918-1932 and 1938-1961					→	93-61
[illegible]	0.50	0.95	1.24	1.85	3.20	3.53	4.42	6.19	6.67	7.00
	9/22	9/22	9/22	9/22	9/22	9/22	10/6	10/6	10/6	8/15
	1951	1951	1951	1951	1951	1951	1949	1949	1949	1928
	←	1951-1961		→	←		1941-1961		→	97-61
[illegible]										
[illegible]	0.83	1.19	1.55	2.03	2.16	2.72	3.08	3.42	3.59	4.20
	8/1	8/1	7/2	7/2	6/27	6/27	6/27	6/27	6/4	10/10
	1959	1959	1958	1958	1905	1905	1905	1905	1914	1961
	←	1905-1961		→	←		1900-1961		→	81-61
[illegible]	0.61	1.06	1.32	1.52	1.93	2.30	2.36	2.47	2.55	3.72
	8/29	8/29	8/29	8/29	8/8	7/30	6/14	6/14	8/20	8/20
	[illegible]	1912	1912	1912	1919	1917	1923	1923	1916	1916
	←				1907-1932					→

POOR ORIGINAL

Table 2-2, cont.

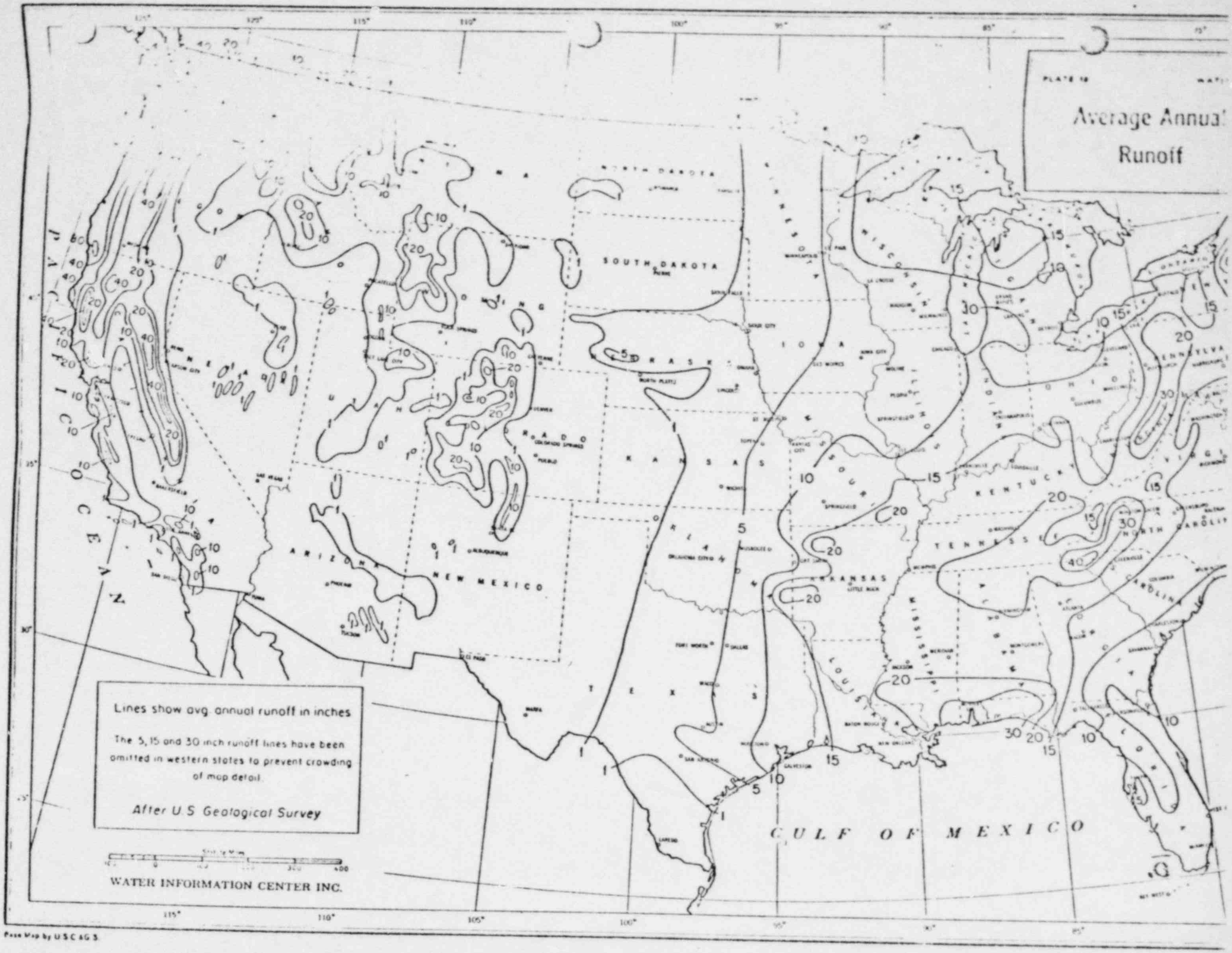
STATION	Lat.	Long.	Period of Record	Length of Record (years)	2-Year 1-Hour Rainfall (inches)	2-Year 6-Hour Rainfall (inches)	2-Year 24-Hour Precipitation (inches)
NORTH CAROLINA							
Monroe 4 SE	34-57	80-31	1939-54	16			3.86
Wadesboro	34-57	80-04	1941-54	14			3.90
SOUTH CAROLINA							
Aiken	33-34	81-44	1902-54*	52			3.53
Anderson	34-31	82-39	1893-54*	55			3.89
Anderson CAA AP	34-30	82-43	1943-54	12			3.95
Batesburg	33-54	81-33	1947-54	8			3.25
Beaufort 7 SW	32-23	80-43	1899-54*	47			4.37
Belton 5 ESE	34-30	82-33	1941-55	15	1.54	2.30	3.28
Bishopville	34-13	80-15	1939-53	15			3.84
Bishopville	34-13	80-15	1941-56	16	1.78	2.85	3.77
Blackstock	34-34	81-09	1941-45	5	2.11	3.45	4.53
Blackville 3 W	33-22	81-19	1899-54	56			3.59
Blaire	34-25	81-24	1939-54	16			4.46
Branchville	33-16	80-49	1947-54	8			4.18
Calhoun Falls	34-05	82-35	1899-54	56			3.74
Camden 2 WSW	34-15	80-39	1899-54	56			4.06
Catawba	34-51	80-48	1939-54	16			3.30
Chappells	34-11	81-52	1939-54	16			3.43
Charleston WB AP	32-54	80-02	1941-54	14			4.19
Chester 2 SW	34-42	81-15	1939-54	16			3.67
Clemson College	34-40	82-50	1940-50	11	1.81	2.70	3.83
Clemson College	34-40	82-50	1939-54	16			3.49
Columbia WB AP	33-57	81-07	1941-54	14			3.30
Columbia WB AP	33-57	81-07	1903-51	49	1.74	2.58	3.37
Crescent	34-46	82-07	1939-54*	15			4.3[illegible]
Due West	34-21	82-22	1921-31	11	1.68	2.88	4.30
Eau Claire	34-01	81-04	1942-46	5			5.48
Edgefield 1 ENE	33-47	81-55	1913-54	42			3.43
Ehrhardt	33-06	81-01	1941-49	9	1.74	2.74	3.98
Eutawville	33-24	80-21	1939-54	16			4.44
Fort Mill 4 NW	35-00	81-00	1949-54	6			2.68
Givhans Ferry	33-02	80-23	1947-54	8			3.73
Great Falls	34-33	80-53	1942-54	13			3.50
Greenville WB AP	34-51	82-21	1918-48*	26	1.70	2.78	4.11
Greenwood	34-12	82-09	1899-54	56			3.52
Hartsville 3 S	34-22	80-02	1948-54	7			4.49
Heath Springs	34-38	80-40	1902-54*	51			3.63
Jocassee 7 WNW	34-59	83-04	1941-56	16	1.96	3.21	5.78
Kershaw	34-33	80-35	1939-54	16			3.85
Lancaster	34-43	80-46	1941-56*	15	1.69	2.57	3.30
Laurens	34-30	82-02	1939-54*	15			3.24
Laurens	34-[illegible]	82-02	1942-50	9	1.82	2.84	3.39
Little Mountain	34-12	81-25	1899-54	56			3.85
Lockhart	34-47	81-28	1951-56	6	1.63	1.77	2.76
Long Creek 1 N	34-47	83-15	1939-54*	15			4.82
McCormick 9 E	33-55	82-09	1943-54	12			3.07
Wiley	32-57	81-02	1939-49	11			5.20
Newberry	34-17	81-37	1939-54	16			3.67
Newberry	34-17	81-37	1941-56	16	1.70	2.68	3.72
Orangeburg 2 SE	33-29	80-50	1939-52	14			4.34
Orangeburg 2	33-29	80-52	1947-54	8			4.62
Paris Mountain Fire Tower	34-57	82-25	1948-54*	5			4.61
Parr	34-16	81-20	1946-54	9			2.68
Parris Island	32-19	80-41	1942-46	5	2.46	4.72	5.85
Pelion	33-46	81-15	1947-54	8			2.87
Pelzer	34-39	82-27	1939-54	16			4.43
Pickens 5 SE	34-51	82-38	1942-54*	12			4.30
Pinopolis	33-18	80-03	1899-43	45			4.22
Pinopolis Dam	33-14	80-00	1944-54	11			4.09
Ridgeland 2 SE	32-28	80-58	1942-54	13			4.73
Rimini	33-40	80-30	1914-54	41			3.90
Rock Hill 5 NE	34-59	80-58	1949-54	6			3.25
Rock Hill 6 SE	34-50	81-00	1944-50*	6	1.62	2.16	3.28
St. George	33-11	80-34	1946-55	10	1.81	2.74	3.67
St. Matthews 2 ESE	33-40	80-44	1941-55*	12	1.85	2.82	4.06
St. Paul 5 S	33-30	80-22	1943-53	11			3.70
Saluda	34-00	81-47	1902-54*	52			3.37
Santuck 4 SE	34-36	81-29	1939-54	16			3.18
Spartanburg WB AP	34-55	81-57	1939-43	5			3.74
Spartanburg WB AP	34-55	81-57	1942-56	15	1.55	2.46	3.58
Springfield	33-30	81-17	1947-54	8			3.61
Summerville 2 WNW	33-02	80-12	1899-54	56			4.38
Sumter	33-56	80-19	1939-54	16			4.46
Trenton 1 WNW	33-45	81-50	1899-54*	53			3.34
Union 7 SW	34-38	81-40	1949-54	6			3.08
Wagener	33-40	81-23	1941-54*	13	1.69	2.51	3.06
Walhalla	34-45	83-05	1899-54*	49			4.68
Walterboro	32-54	80-40	1903-54*	34			4.19
Ware Shoals	34-24	82-14	1939-54	16			3.36

*Breaks in Record

Table 2-3, cont.

STATION	Lat.	Long.	Period of Record	Length of Record (years)	100-Year 1-Hour Rainfall (inches)	100-Year 6-Hour Rainfall (inches)	100-Year 24-Hour Precipitation (inches)
SOUTH CAROLINA (continued)							
Calhoun Falls	34-05	82-35	1899-54	56			8.42
Camden 2 WSW	34-15	80-39	1899-54	56			8.65
Columbia WB AP	33-57	81-07	1903-51	49	3.03	5.16	7.22
Edgefield 1 ENE	33-47	81-55	1913-54	42			6.62
Greenville WB AP	34-51	82-21	1918-48*	26	3.52	5.76	9.06
Greenwood	34-12	82-09	1899-54	56			7.53
Heath Springs	34-38	80-40	1902-54*	51			7.04
Jocassee 2 WNW	34-59	83-04	1941-56	16	3.88	6.55	14.93
Lancaster	34-43	80-46	1941-56*	15	3.72	4.86	6.10
Little Mountain	34-12	81-25	1899-54	56			8.74
Newberry	34-17	81-37	1941-56	16			6.62
Pinopolis	33-18	80-03	1899-43	45	3.82	5.71	10.21
Rimini	33-40	80-30	1914-54	41			8.00
Saluda	34-00	81-47	1902-54*	52			6.17
Spartanburg WB AP	34-55	81-57	1942-56	15	3.18	7.30	7.30
Summerville 2 WNW	33-02	80-12	1899-54	56			10.82
Trenton 1 NNE	33-45	81-50	1899-54*	53			6.11
Walhalla	34-45	83-05	1899-54*	49			10.72
Walterboro	32-54	80-40	1903-54*	34			5.88
Wedgefield	33-54	80-30	1923-51*	27			5.39
Winnsboro	34-23	81-05	1899-54*	53			6.99
Winthrop College	34-57	81-03	1900-54	55			6.46
Yemassee 4 W	32-42	80-55	1899-54	56			10.39

*Breaks in Record

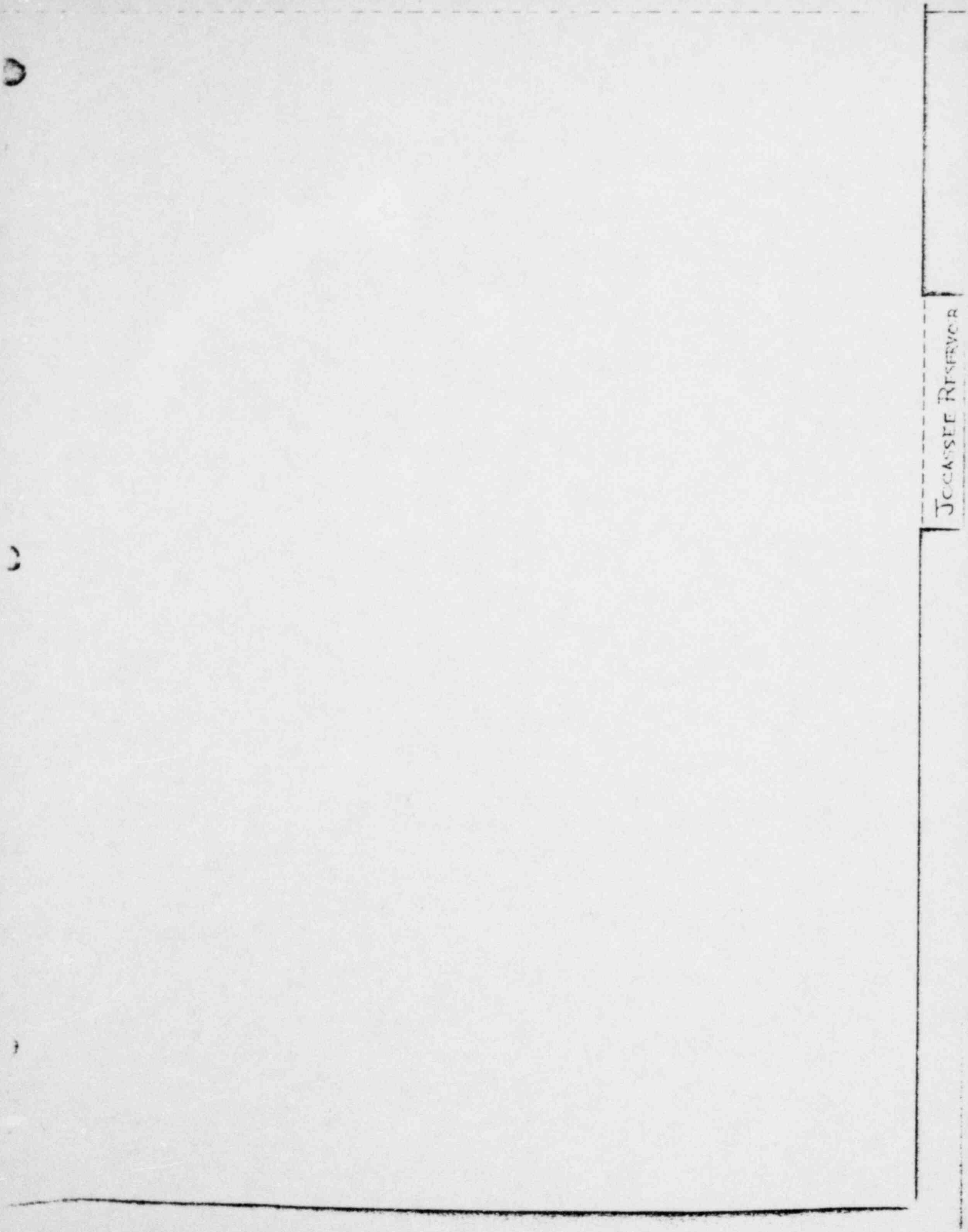


Average Annual
Runoff
Lines show avg. annual runoff in inches
The 5, 15 and 30 inch runoff lines have been omitted in western states to prevent crowding of map detail.
After U.S. Geological Survey
WATER INFORMATION CENTER INC.
Base Map by U.S.C.&G.S.
PACIFIC OCEAN
GULF OF MEXICO
NORTH DAKOTA
SOUTH DAKOTA
IOWA
KANSAS
ARIZONA
NEW MEXICO
TEXAS
ARKANSAS
TENNESSEE
KENTUCKY
MISSISSIPPI
WISCONSIN

Keowee [illegible] Project
[illegible]fall On – [illegible] Evaporation From
Reservoir Surface, [illegible]
[illegible] Energy

	Keowee	Jocassee
D[illegible] Area	39 sq mi. (24 X 10⁵A)	148 sq mi (
[illegible] Avg. Annual Rainfall	— " (4.58')	60 " (5.0')
Vol. Precipitation A. Ft.	1.29 X 10⁶	.47 X 10⁶
Equivalent 100% Runoff	1760 CFS	645 CFS
Avg. Streamflow	1102 CFS	470 CFS
Ratio Runoff: Rainfall	0.63	0.73
Loss by Evap.-Natural State	37%	27%
Avg. Reservoir Area (5' D)	17,000 A.	7000 A.
Direct Rainfall On Reservoir	78,000 A.FT	35,000 A FT
Savings-Elimination of Loss by Evap-Nat. State	28,800 A FT 39.5 CFS *	9450 A FT 13.0 CFS *
Gross Loss by Evap. from Reservoir Surface/Year	42" (3.5') 59,500 A FT	42" (3.5') 24,500 A FT
Net Loss by Evap from Reservoir Surface/year ([illegible])	30,700 A. FT ≈ 22" I / 21"	13,050 A FT ≈ 23" I / 21"
Avg head	Used 120	300
$E = e_t \times e_g = .92 \times .98$	.9	.9
$KWH/_{cfs/yr} = \frac{1\,cfs \times h \times e}{11.8}$. 8760	80,000 KWH	206,000 KWH
* Additional KWH/yr	40 CFS ≈ 3.2 X 10⁶ KWH/yr	13 CFS ≈ 2.7 X 10⁶ KWH/yr

POOR ORIGINAL


JOCASSEE RESERVOIR

KEOWEE - TOXAWAY STUDIES
JOCASSEE RESERVOIR

CQR 4/27 3-25-66 9-19-66

... NAPPE PROFILES @ ℄ OF BAY

... of Engr. ... CHART III-12

$H/H_d = 1.0$ AT CREST AXIS $X/H_d = 0.0$

HT. OF GATE = 32' $Y/H_d = -.805$ ↑

If we assume the tainter gate fully opened at 32' with the gate directly over the crest axis.

if $H/H_d = 1.0$ + $Y/H_d = -.805 = 32'$

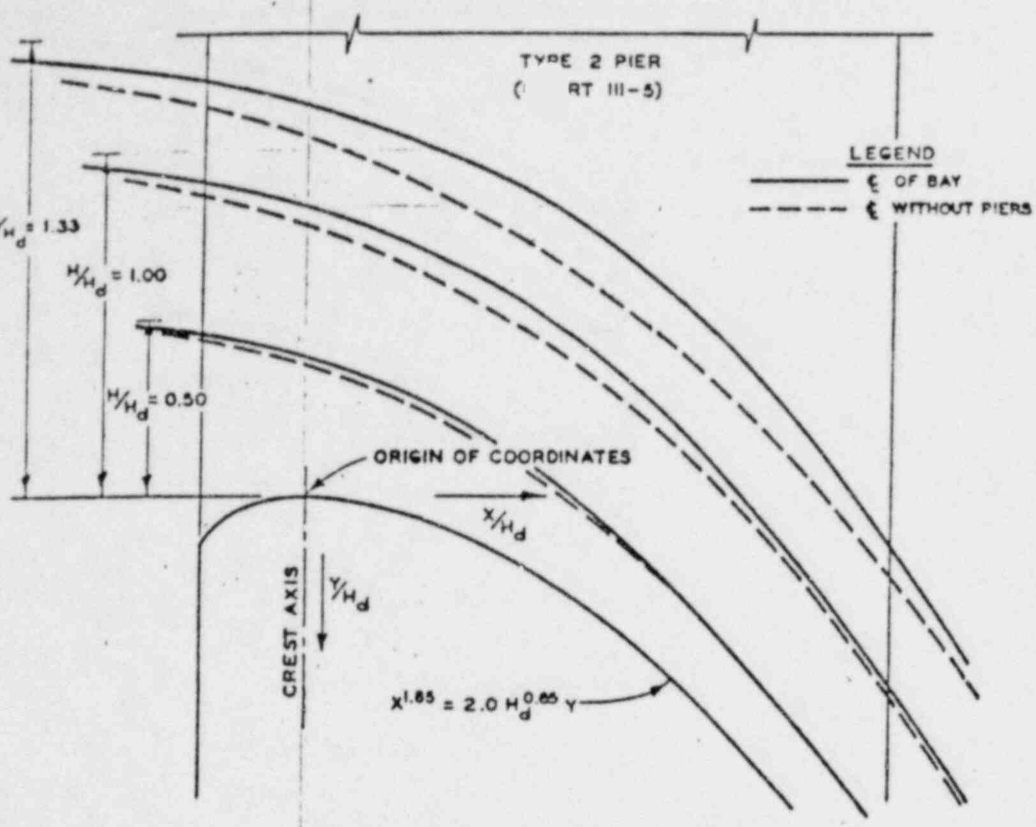
then $\frac{H_d}{32'} = \frac{1.0}{.805}$

or ... 25.8'

$H_d = \frac{1.0 \times 32}{.805} = \underline{39.8'}$

∴ the gated spillway will actually act as a free overflow spillway until the reservoir level is 39.8 above the crest height of the spillway.

Crest ELEV. = 1078.0
+ 39.8
ELEV. 1117.8 = point where the spillway will act as an orifice
say ELEV. 1118.0



COORDINATES FOR UPPER NAPPE AT ℄ OF BAY WITH TYPE 2 PIERS*

H/H_d = 0.50

X/H_d	Y/H_d
-1.0	-0.482
-0.8	-0.480
-0.6	-0.472
-0.4	-0.457
-0.2	-0.431
0.0	-0.384
0.2	-0.313
0.4	-0.220
0.6	-0.088
0.8	0.075
1.0	0.257
1.2	0.462
1.4	0.705
1.6	0.977
1.8	1.278

H/H_d = 1.00

X/H_d	Y/H_d
-1.0	-0.941
-0.8	-0.932
-0.6	-0.913
-0.4	-0.890
-0.2	-0.855
0.0	-0.805
0.2	-0.735
0.4	-0.647
0.6	-0.539
0.8	-0.389
1.0	-0.202
1.2	0.015
1.4	0.266
1.6	0.521
1.8	0.860

H/H_d = 1.33

X/H_d	Y/H_d
-1.0	-1.230
-0.8	-1.215
-0.6	-1.194
-0.4	-1.165
-0.2	-1.122
0.0	-1.071
0.2	-1.015
0.4	-0.944
0.6	-0.847
0.8	-0.725
1.0	-0.564
1.2	-0.356
1.4	-0.102
1.6	0.172
1.8	0.465

*BASED ON CW 801 TESTS FOR NEGLIGIBLE VELOCITY OF APPROACH

OVERFLOW SPILLWAY CREST

UPPER NAPPE PROFILES

CENTER LINE OF PIER BAY

HYDRAULIC DESIGN CHART III-12

WES 9-54

KEOWEE - TOXAWAY STUDIES
JOCASSEE RESERVOIR
SPILLWAY DISCHARGE

CQR 3-25-66
[illegible] 9-19-66

[illegible] : 2 GATES 32' deep × 40' wide

[illegible] gates fully open at 32', the reservoir [illegible] rise to ELEV 1118.0 before the water will [illegible] touch the bottom of the gate and [illegible] create the orifice effect.

[illegible] from ELEV 1110 to 1117 the spillway will act as an [illegible]

$$Q = C\left[L' - 2(N K_p + K_a) H_e\right] H_e^{3/2}$$

[illegible] of Engr
[illegible] & H&M [illegible] $Q = 3.7\left[80 - 2(1 \times .01 + .175) H_e\right] H_e^{3/2}$

$C = 3.7$
$K_p = .01$
$K_a = .175$
[illegible] 1 pier

GENERAL for any H_e

$$Q = 3.7\left[80 - (.37) H_e\right] H_e^{3/2}$$

H_e (above Crest ELEV 107[illegible])	$H_e^{3/2}$	.37 H_e	[80 - .37 H_e]	DISCHARGE × 3.7 = Q cfs
32	181.0	11.85	68.15	45,600
34	198.2	12.58	67.42	49,500
36	216.0	13.32	66.68	53,400
38	234.2	14.05	65.95	57,200
39	243.5	14.4	65.6	59,000

POOR ORIGINAL

[illegible] reservoir ELEVATIONS above 1117 to 1130, [illegible] spillway will act as an orifice [illegible]
(See next sheet)

FLOW THRU 2 UNITS = 16,200 CFS ADDITIONAL

KEOWEE – TOXAWAY STUDIES
JOCASSEE RESERVOIR
SPILLWAY DISCHARGE (CONT.)

3

CQR 3-25-66
[illegible] 9-19-66

[illegible] RESERVOIR ELEVATIONS 1115 to 1120 the spillway would act as an oriface

BASIC EQUA: $Q = CA\sqrt{2gH}$ EACH GATE 32' W × 40' H

[illegible] Corps of Engr [illegible] Charts 311-1 to 311-5 [illegible] data Chart 311-1

$$Q = C G_o B \sqrt{2gH}$$

C = disc. coeff
G_o = [illegible]
B = gate width
H = Head to Center of Gate opening

[illegible] Calc 12-14-64
[illegible] C = .656
B = 40'
G_o = 0 to 32'
H = 24' to 36'

$Q = .656 \times G_o \times 40' \times \sqrt{64.4 \times H}$

then

$$Q = 26.2\, G_o \sqrt{64.4H}$$

[illegible]

[illegible] 2 UNITS = 16,200 CFS ADDITIONAL
[illegible] ELEV 1110
G_o varying from 0 to 25' : $H = 40' - \frac{G_o}{2}$

	$H = 40' - \frac{G_o}{2}$	$\sqrt{H}$	$Q = 26.2 G_o \sqrt{64.4H}$ one gate	× 2 = or $\{Q = 210.5 G_o \sqrt{H}\}$ two gates
[illegible]	40'	6.32		
5'	37.5	6.12	6,450	12,900
10	35'	5.92	12,450	24,900
20'	30'	5.48	23,000	46,000
25'	27.5'	5.24	27,550	55,100

POOR ORIGINAL

H varying 24' to 36' : G_o = 32'

[illegible]	H	$\sqrt{H}$	$Q = 26.2 \times 32' \times \sqrt{64.4H}$ one gate	× 2 = or $\{Q = [illegible]\sqrt{H}\}$ two gates
[illegible]	24'	4.9	32,900	65,800
[illegible]	26'	5.1	34,300	68,600
[illegible]	28'	5.3	35,600	71,200
[illegible]	30'	5.48	36,800	73,600
[illegible]	32'	5.66	38,100	76,200
[illegible]	34'	5.84	39,300	78,600
[illegible]	36'	6.0	40,300	[illegible]

ice pressures and wave impact are treated in subparagraph 28d. Tainter gates should not be designed for overtopping because of the possibility of gate vibrations induced by nappe flutter during overtopping and possible collection of drift and ice on the downstream side of the gates. Such vibrations were observed by the Bureau of Reclamation[111] on the drum gates at Black Canyon Dam. In this case, the vibration was eliminated by aerating the space under the nappe.

c. Discharge Coefficients. The orifice discharge equation is used in the development of rating curves for partly open gates. The basic equation for a high head orifice with a free falling nappe given by King[11] is

$$Q = CA\sqrt{2gH}$$

where

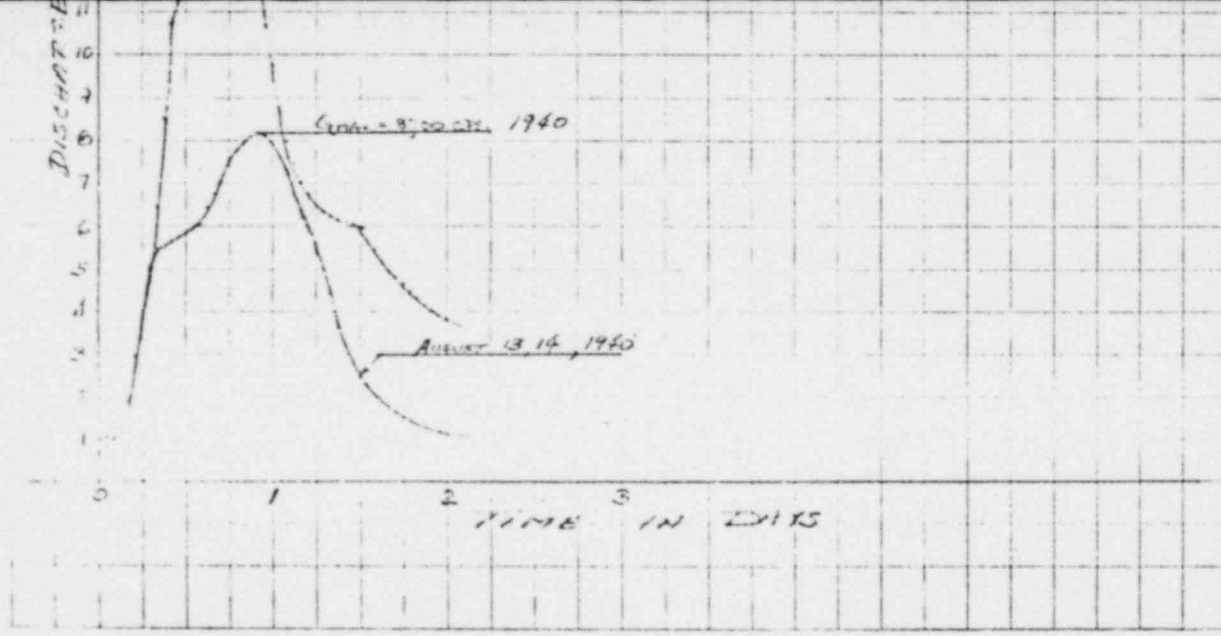
Q = discharge

C = discharge coefficient

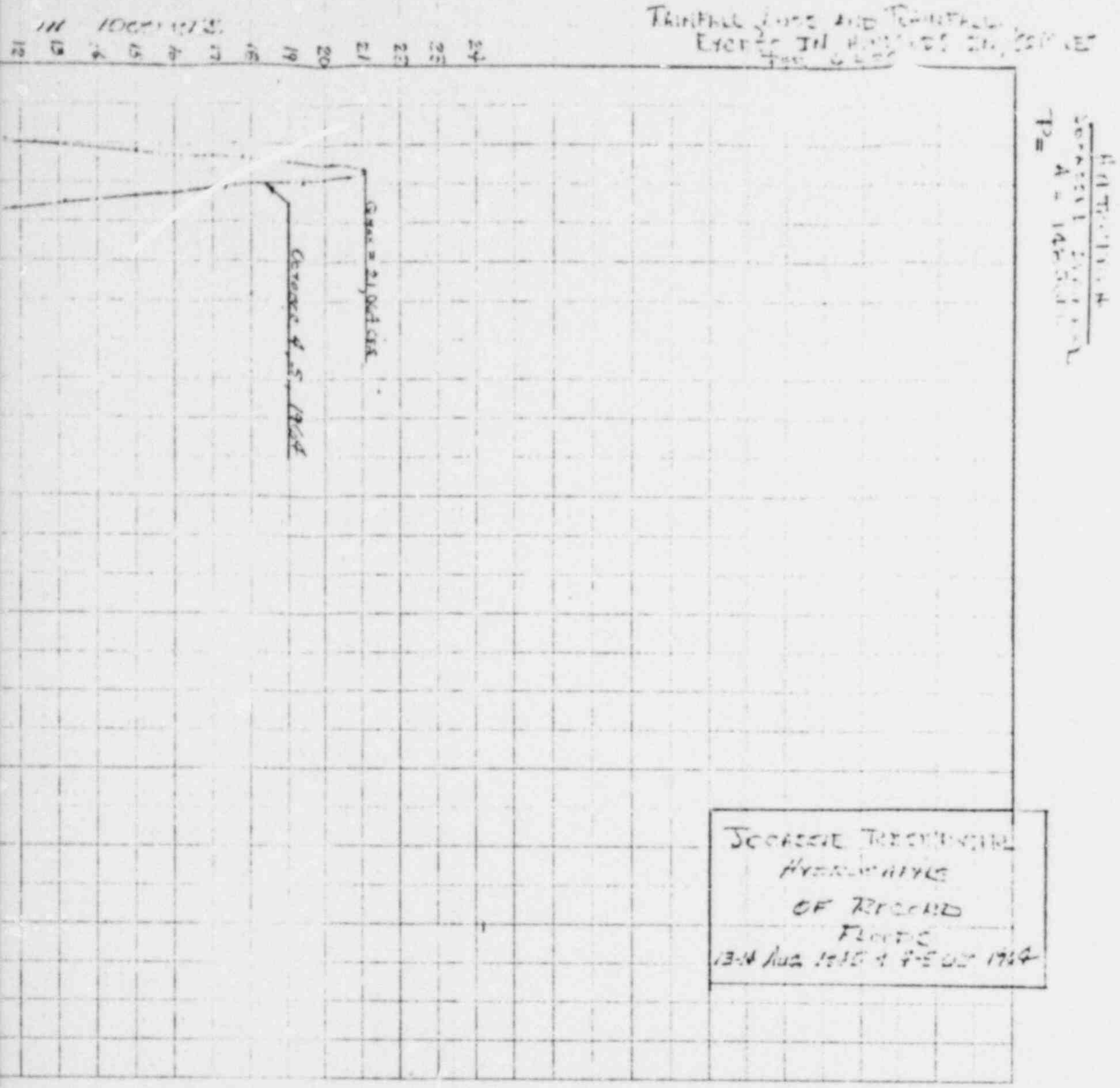
A = orifice area

H = head to center of orifice

Discharge coefficients applicable to tainter gates on the high overflow crest shape described in subparagraph 8b have been published as HDC 311-1 and are included herein as Plate 46. The orifice discharge equation discussed above was used in developing these curves. The head was taken to the center of the gate opening, and the gate opening defined as the minimum distance from the gate lip to the curving crest. The flow boundaries formed by the gate and crest surfaces are comparable to those of a funnel or an orifice formed by converging plane surfaces. Von Mises[62,112] has shown analytically that the contraction coefficient of the jet issuing from converging boundaries is a function of the angle formed by the converging surfaces. The tangents to the gate lip and to the crest curve at the nearest point of the curve to the gate lip are considered comparable to the converging boundaries treated by Von Mises. Therefore, the angle formed by the intersection of these tangents is considered the



DISCHARGE
August 13,14, 1940
0
1
2
3
TIME IN DAYS


20
21
24
OF RECORD

KEOWEE - TOXAWAY STUDIES
JOCASSEE RESERVOIR
MAX. FLOOD ROUTING

6

CQR 3-28-66
[illegible] 9-19-66

[illegible]: FULL POND = EL. 1110
SPILLWAY CREST = EL. 1078
WIDTH = 80 FT. } 2 GATES 40'W × 32'H *

[illegible] DISCHARGE INCLUDES 16,200 CFS THRU TWO UNITS

1 CFS. = 2 AF/DAY ∴ 1 CFS. = 0.5 AF/6 HR

- W/O UNITS -

Time [illegible]	Estimated [illegible] Storage: Total Vol. ([illegible])	Increment for S_T ([illegible])	Max. Discharge Spillway (2 Gates): (CFS)	q/AF/6 HR (= .5 CFS)	Data for Curve "A": $S_T - \frac{q}{2}$	Data for Curve "B": $S_T + \frac{q}{2}$
		- [illegible]				
Spillway [illegible]	[illegible],483	0	0	0	0	0
	[illegible],670	68,187	10,200	5,100		
	[illegible],413	139,930	27,200	13,600		
		Curve "B" ↓	Curve "Q" ↓			
Full Pond	[illegible]		45,200	22,600		
			49,500	24,750		
			53,400	[illegible]		
	[illegible],433				24,310	51,960
			57,200	28,600		
			59,000	29,500		
			65,800	32,900		
	[illegible],250		68,600	34,300	59,802	94,102
			75,600	37,800		
	[illegible],000				98,977	136,427
			76,200	38,[illegible]		
	[illegible],000		80,600	40,300	139,552	179,852

* Size of gate used 38'W × 33'H, Crest el spillway 1077

KEOWEE - TOXAWAY STUDIES

JOCASSEE RESERVOIR

7

MAX. FLOOD ON [illegible]

CQR
[illegible]

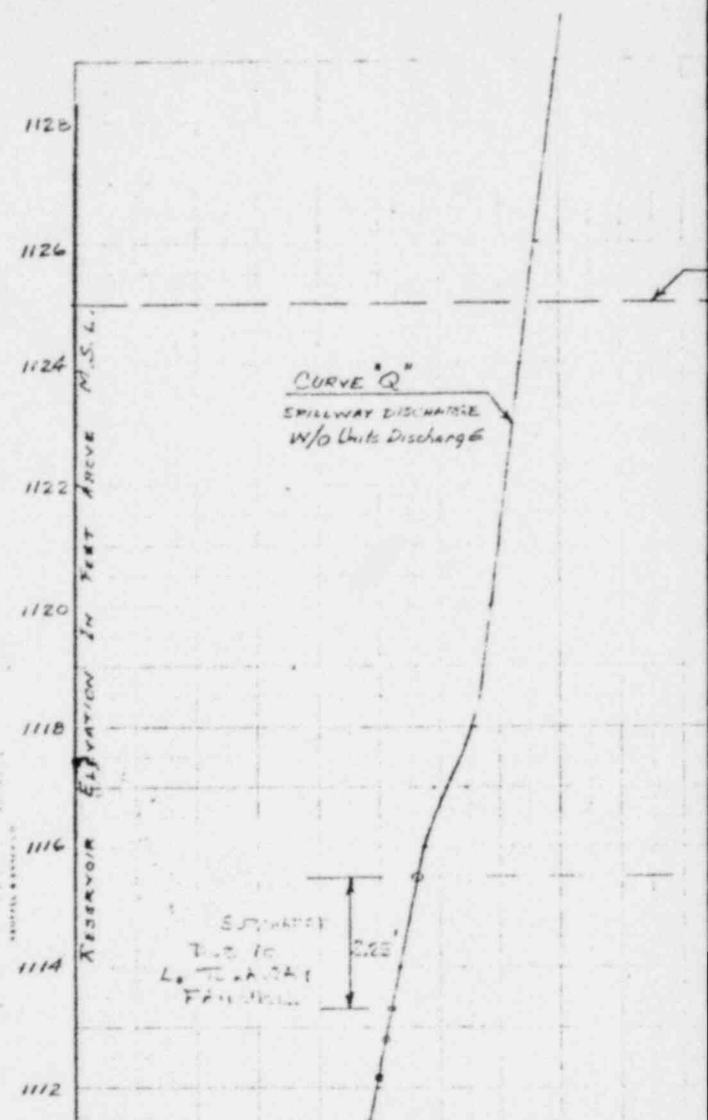
3-23-66
9-[illegible]

MAX Q = 21,024 cfs ([illegible] OCT 4, 1964)

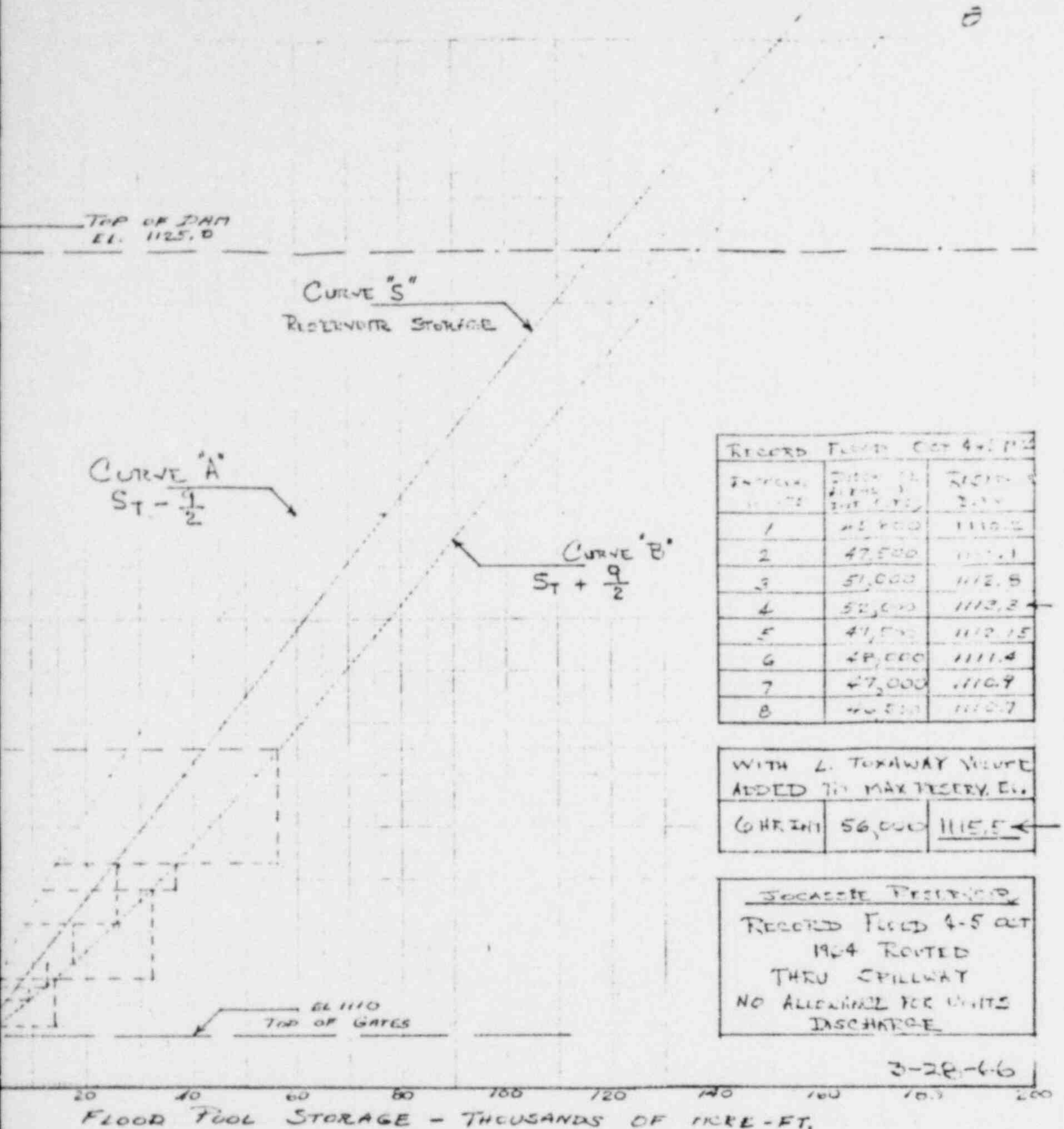
DESIGN Q FOR [illegible] = 61,000 cfs, = 5000 √DA

∴ RATIO = 61,000 / [illegible] = 3.0

Q [illegible]			[illegible]				Q_{2} [illegible]	
1	[illegible]	[illegible]		[illegible]	[illegible]			
2	[illegible]	[illegible]		6.55	[illegible]			
3	[illegible]	1,505	2,043	8.10	7,460	7,400	6,282.9	[illegible] 200
4	3.35	1,[illegible]		7.75	7,040			
5	4.10	2,120		7.50	6,740			
6	4.95	3,850		7.30	6,[illegible]			
7	6.10	5,080		7.18	6,356			
8	7.25	6,440		[illegible]	6,240			
9	[illegible]	[illegible]	9,055.3	7.0[illegible]	6,188	6,148	27,165.9	18,[illegible]20
10	10.65	10,[illegible]		7.00	6,140			
11	[illegible]	11,230		6.92	6,[illegible]44			
12 N	12.40	12,400		6.80	[illegible]			
1	15.00	15,000		6.60	5,[illegible]			
2	18.00	17,[illegible]		6.40	[illegible]			
3	[illegible]1.00	20,200	19,072	6.2[illegible]	5,1[illegible]	5,114.2	57,051.9	15,420
4	[illegible]	21,[illegible]		[illegible]	4,9[illegible]			
5	[illegible]	20,[illegible]		[illegible]	4,805			
6	20.00	17,[illegible]		5.[illegible]	4,690			
7	17.50	17,3[illegible]		5.55	4,475			
8	15.00	15,[illegible]		5.42	4,[illegible]			
9	13.20	13,200	12,[illegible]	[illegible]	4,180	4,1[illegible]	48,902.5	12,410
10	[illegible]	[illegible]		5.18	4,[illegible]			
11	[illegible]	[illegible]		[illegible]	3,960			
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]			



1128
1126
1124
1122
1120
1118
1116
1114
1112
1110
Reservoir Elevation In Feet Above M.S.L.
CURVE "Q"
SPILLWAY DISCHARGE
W/O Units Discharge
0
10
20
30
40
50
60
70
80
90
100
SPILLWAY DISCHARGE, 1000 CFS.



RECORD FLOOD OCT 4-5 [illegible]		
[illegible]	[illegible]	[illegible]
1	[illegible]	[illegible]
2	47,500	[illegible]
3	51,000	1112.8
4	52,000	1113.3 ←
5	[illegible]	1112.15
6	48,000	1111.4
7	47,000	1110.9
8	[illegible]	[illegible]

WITH L. TOXAWAY VOLUME ADDED TO MAX RESERV. EL.		
6 HR INT	56,000	1115.5 ←

JOCASSEE RESERVOIR

RECORD FLOOD 4-5 OCT 1964 ROUTED THRU SPILLWAY NO ALLOWANCE FOR UNITS DISCHARGE

3-28-66

KEOWEE-TOXAWAY STUDY

RECORD FLOOD PERIOD

RAINFALL 4-5 OCTOBER 1964 CQR 4-1-66

DAILY [illegible] RECORDS - DATES

JOCASSEE SITE - N.C.	Sept 25	26	27	28	29	30	Oct 1	2	3	4	5	6	7	8	9	10	GREATEST TOTAL [illegible] HR.	6 DAY TOTAL
[illegible]			.06	.41	7.16	8.80	.89	.57	.04	4.08	13.10	.35					17.18	[illegible]
L. [illegible]			.09	.62	7.15	[illegible]	1.13	.33	.07	5.22	4.84	.07					14.64	
KEOWEE [illegible] 5 NW																		
[illegible]																		
CLEMSON [illegible]				T	.23	.27	.02	.48	T	1.01	1.55	.15					2.71	3.71
[illegible] SE			.02	.33	.95		.15	.75	.08	1.59	3.19	.14					4.92	[illegible]
[illegible]					1.60	2.90	—		—		—	—					—	—
WALHALLA [illegible]			.04	1.09	2.48		.12	.46	.02	2.60	2.13	.25					4.98	4.74

[illegible] FLOW @ JOCASSEE = 365 CFS
from SEPT. 1964
[illegible] RECORDS

[illegible] FLOW @ KEOWEE = 500 CFS

2-1850.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

File No. Washington / Field

Rating table for Keowee River near Jocassee, S. C. :

from Oct 1 1963 to , 19 from , 19 to , 19

Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)
.00			2.00	565	75	4.00	2810	120	6.00	4970	110	8.00	7340	120	10.00	9740	120	12.00	12000	100
.10			.10	640	79	.10	2930	120	.10	5080	110	.10	7460		.10	9860		.10	12100	
.20			.20	719	83	.20	3050	120	.20	5190	110	.20	7580		.20	9980		.20	12200	
.30			.30	802	87	.30	3170	110	.30	5300	120	.30	7700		.30	10100		.30	12300	
.40			.40	889	91	.40	3280	110	.40	5420		.40	7820		.40	10220		.40	12400	
.50			.50	980	95	.50	3390	110	.50	5540		.50	7940		.50	10340	120	.50	12500	
.60			.60	1075	100	.60	3500	100	.60	5660		.60	8060		.60	10160	110	.60	12600	
.70			.70	1175	105	.70	3600		.70	5780		.70	8180		.70	10570		.70	12700	
.80			.80	1280	110	.80	3700		.80	5900		.80	8300		.80	10680		.80	12800	
.90	56	20	.90	1390	115	.90	3800		.90	6020		.90	8420		.90	10790		.90	12900	
1.00	76	25	3.00	1505	120	5.00	3900		7.00	6140		9.00	8540		11.00	10900		13.00	13000	
.10	101	30	.10	1625	125	.10	4000		.10	6260		.10	8660		.10	11010		.10	13100	
.20	131	35	.20	1750	130	.20	4100	100	.20	6380		.20	8780		.20	11120		.20	13200	
.30	166	40	.30	1880	135	.30	4200	110	.30	6500		.30	8900		.30	11230		.30	13300	
.40	206	46	.40	2015		.40	4310		.40	6620		.40	9020		.40	11340		.40	13400	
.50	252	52	.50	2150		.50	4420		.50	6740		.50	9140		.50	11450		.50	13500	
.60	304	58	.60	2285	135	.60	4530		.60	6860		.60	9260		.60	11560		.60	13600	
.70	362	63	.70	2420	130	.70	4640		.70	6980		.70	9380		.70	11670		.70	13700	
.80	425	68	.80	2550	130	.80	4750		.80	7100		.80	9500		.80	11780		.80	13800	
.90	493	72	.90	2680	130	.90	4860	110	.90	7220	120	.90	9620	120	.90	11890	110	.90	13900	100

This table is applicable for open-channel conditions. It is based on 12 discharge measurements made during 1963-64 and rating No. 1 and is well defined between 100 cfs and 10000 cfs. Comp by JSS date 3/31/65

and fairly well identified above 10000. Same as rating No. 1 below 9.0 ft. Use to hundredths Ckd by WTU date 3/31/65

throughout beginning Sept. 23, 1964.

Table No. 3

2-1850.

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

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY (WATER RESOURCES DIVISION)

Rating table for Keowee River near Jocassee, S. C.

from Oct. 1, 1963, to ...., 19.... from ...., 19.... to ...., 19....

Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)	Gage height (Feet)	Discharge (Cfs)	Difference (Cfs)
14.00	14000	100	16.00	16000	90	18.00	17800	80	20.00	19400	80	22.00	21000	80	.00			.00		
.10	14100		.10	16090		.10	17880		.10	19480		.10	21080		.10			.10		
.20	14200		.20	16180		.20	17960		.20	19560		.20			.20			.20		
.30	14300		.30	16270		.30	18040		.30	19640		.30			.30			.30		
.40	14400		.40	16360		.40	18120		.40	19720		.40			.40			.40		
.50	14500		.50	16450		.50	18200		.50	19800		.5			.50			.50		
.60	14600		.60	16540		.60	18280		.60	19880		.60			.60			.60		
	14700		.70	16630		.70	18360		.70	19960		.70			.70			.70		
.80	14800		.80	16720		.80	18440		.80	20040		.80			.80			.80		
.90	14900		.90	16810		.90	18520		.90	20120		.90			.90			.90		
15.00	15000		17.00	16900		19.00	18600		21.00	20200		.00			.00			.00		
.10	15100		.10	16990		.10	18680		.10	20280		.10			.10			.10		
.20	15200		.20	17080		.20	18760		.20	20360		.20			.20			.20		
.30	15300		.30	17170		.30	18840		.30	20440		.30			.30			.30		
.40	15400		.40	17260		.40	18920		.40	20520		.40			.40			.40		
.50	15500		.50	17350		.50	19000		.50	20600		.50			.50			.50		
.60	15600		.60	17440		.60	19080		.60	20680		.60			.60			.60		
.70	15700		.70	17530		.70	19160		.70	20760		.70			.70			.70		
.80	15800		.80	17620		.80	19240		.80	20840		80			.80			.80		
.90	15900	100	.90	17710	90	.90	19320	80	.90	20920	80	.90			.90			.90		

This table is applicable for open-channel conditions. It is based on .... discharge measurements made during ....

.... and is .... well defined between .... cfs and .... cfs.

Comp by JSS date 3/31/65

Ckd by WTU date 3/31/65

Table No. 3

10.

U. S. GOVERNMENT PRINTING OFFICE

KEOWEE - TOXAWAY STUDY

JOCASSEE RESERVOIR

FLOOD - 72 HR. READINGS 12

CQR 4-4-66

MAX Q = 21,024 CFS (4:00 PM OCT 4, 1964)

Hour of Day	October 4-6, 1964 Flow (CFS)	Avg. Flow (CFS)	AF/6 HR	Gage Ht	October 7-9 Flow (CFS)	Avg. Flow	AF/6 HR
12M	1,027				2,420		
3	1,505	2,127	[illegible]	3.62	2,312	2,316	[illegible]
6	2,850			3.55	2,217		
9	[illegible]	2,263	[illegible]	3.48		2,117	[illegible]
12N (4th, 24)	[illegible]			3.40	2,015		
3	[illegible]	17,333		3.35		1,947	
6	[illegible]			3.30	1,880		
9	[illegible]	14,113		3.25		1,815	
12M (7th, 96)	[illegible]			3.20	1,750		
3	[illegible]	7,900		3.17		1,706	
6	[illegible]			3.13	1,663		
9	[illegible]	6,196		3.10		1,620	
12N (5th, 48)	[illegible]			3.06	1,577		
3	[illegible]	5,243		3.03		1,541	
6	[illegible]			3.0	1,505		
9	[illegible]	4,213		2.95			
12M (8th, 120)	[illegible]			2.93	1,425	1,465	
3	[illegible]	3,555		2.87		1,380	
6	[illegible]			2.85	1,335		
9	3,170	3,181	[illegible]	2.84		1,308	
12N (6th)	[illegible]			2.80	1,280		
3	[illegible]	2,843	[illegible]	2.79		1,259	
6	[illegible]			2.76	1,238		
9	[illegible]	2,550	[illegible]	2.74		1,217	
12M (9th, 144)	[illegible]			2.72	1,196		

KEOWEE - TOXAWAY STUDIES
JOCASSEE RESERVOIR

13

[illegible] OF MAX. PROBABLE FLOOD CGR 4-6-66
[illegible] 9-19-66

[illegible] ACTUAL VOLUME OF OCT 1964 FLOOD
FROM OBSERVED HYDROGRAPH
48-HOUR PERIOD

Ti[illegible]	[illegible] FLOW [illegible]	AVERAGE AF/6 HR ÷2	
1	[illegible]	[illegible],047	
2	[illegible]	4,528	
3	[illegible]	[illegible],509	
4	[illegible]	[illegible],464	
5	[illegible]	2,700	
6	[illegible]	3,074	
7	[illegible]	2,557	
8	[illegible]	2,[illegible]	

[illegible] 32,970 AF/48 HR TOTAL VOLUME - 48 HR

[illegible] × 2.16 × 10^4 sec = 142,423.92 × 10 CF.

TOTAL VOL. - 48 HR
= 32,970 AF

[illegible] = [illegible] sec.

[illegible] sec. 6 hr. = 21,600. sec. = 2.16 × 10^4 sec

[illegible] × 10[illegible] = 4,126.2[illegible] × 10[illegible] SQ.FT.

640 Ac = 1 sq.mi.

[illegible] = CF / SQ FT = $\frac{1.424 \times 10^9 \text{ CF}}{4.126 \times 10^9 \text{ SF}}$ = .345 10[illegible] FT.

[illegible] FLOW AVG. DEPTH = 0.345 FT. × 12 [illegible] = 4.14 in.

KEOWEE – TOXAWAY STUDIES

JOCASSEE RESERVOIR — 14

[illegible] RAINFALL FOR MAX FLOOD OCT 4-6, 1964 — CEP [illegible] — 4-1-66 / 9-19-[illegible] REVISED 4-[illegible]

[illegible] DEPTH OF FLOW (48 HR.) = 4.14 IN.

LESS [illegible] FLOW AVG. = 500 CFS

$[illegible]\ \frac{CF}{SEC} \times \frac{1.728 \times 10^5\ \frac{SEC}{CF}}{[illegible] \times 10^9\ SF} = 1.53 \times 10^{-2}\ FT \times \frac{12\ IN}{FT}$ } = −0.184

(IN.) AVG. PRECIPITATION RUNOFF = 3.956 IN. = P_E [illegible]

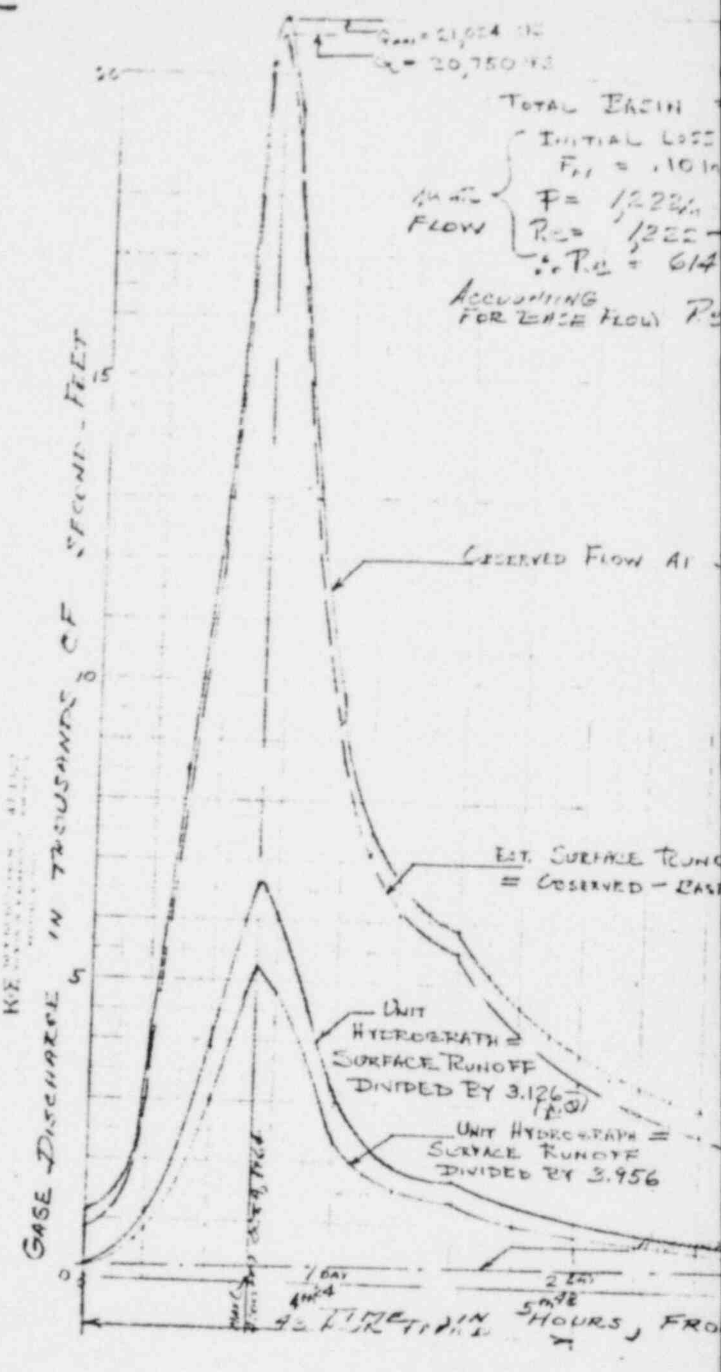
[illegible] BASIN : 148 SQ. MI.

[illegible] LOSS = 0.0

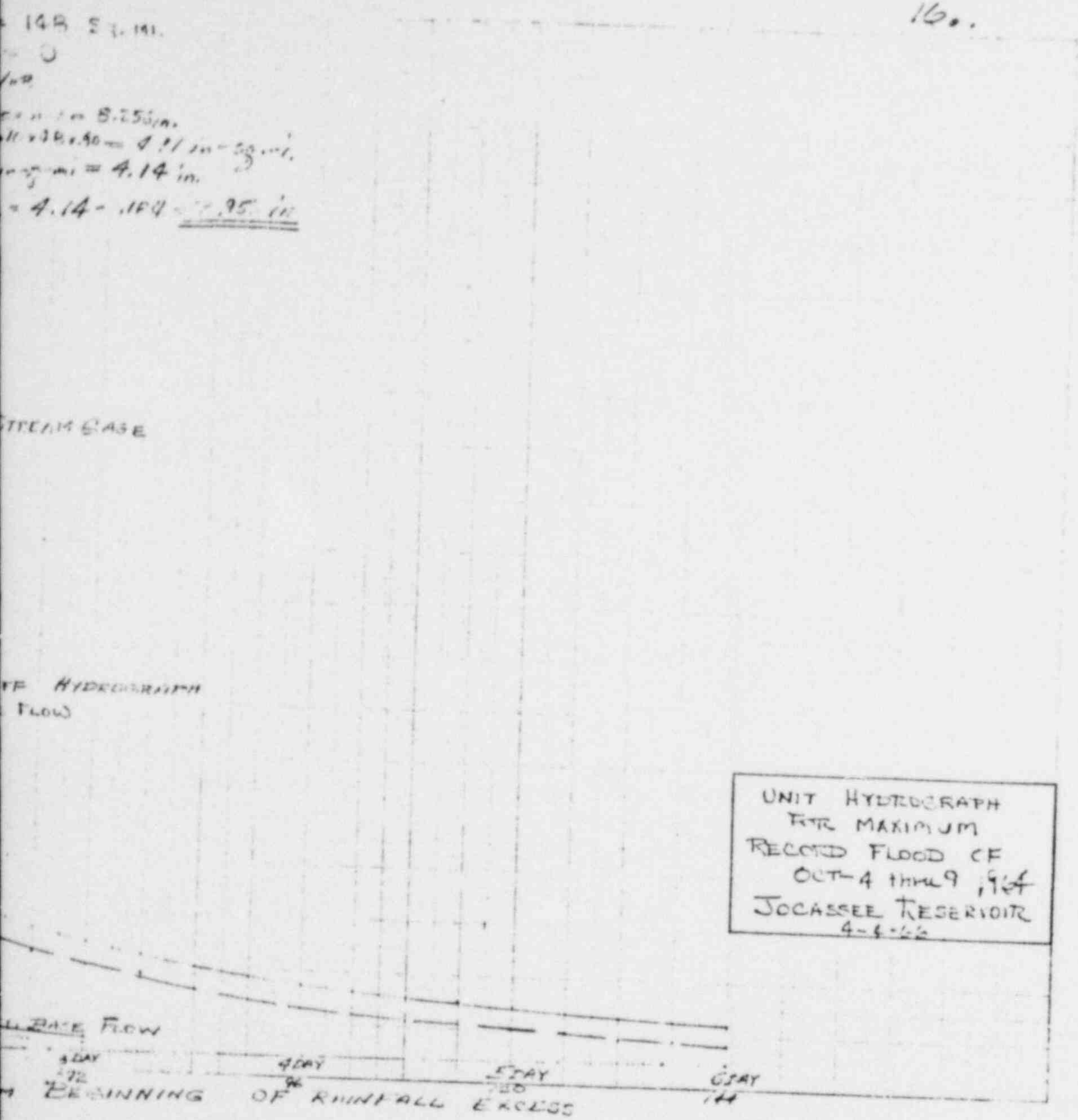
[illegible] = .10 IN/HR × [illegible] HR [illegible] = 4.2 IN

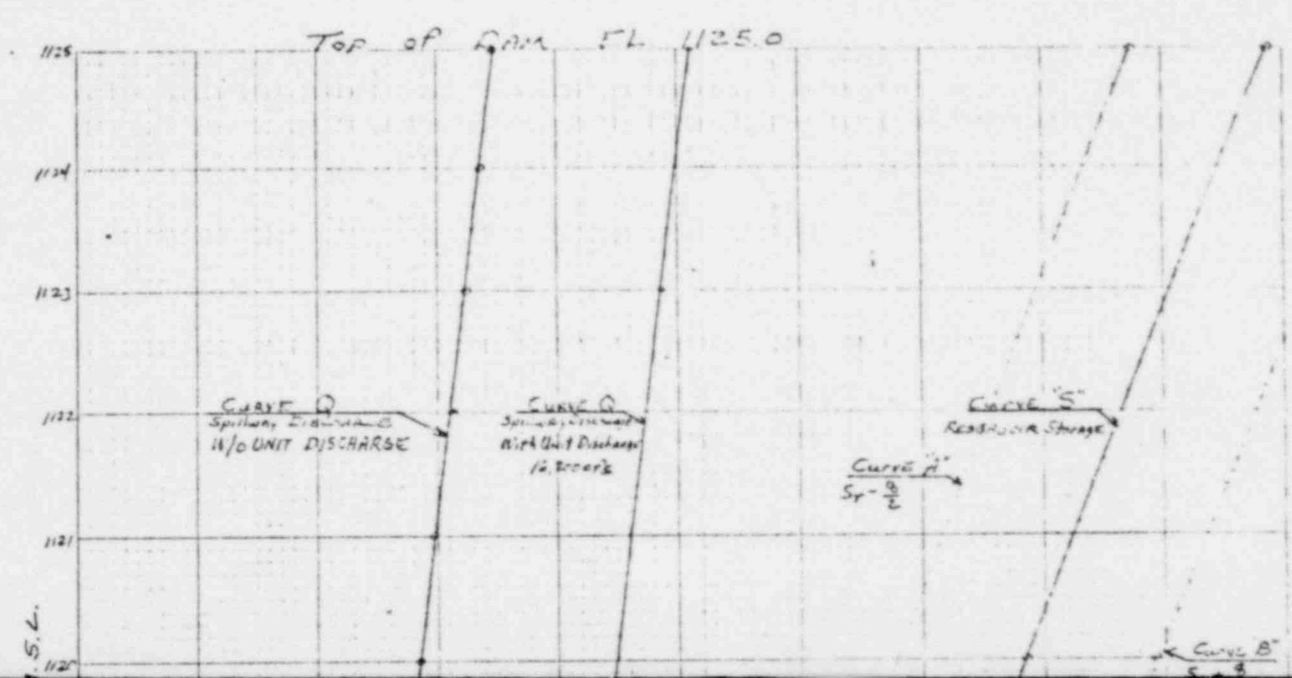
∴ TOTAL P = 3.956" + 4.2" = [illegible] IN.

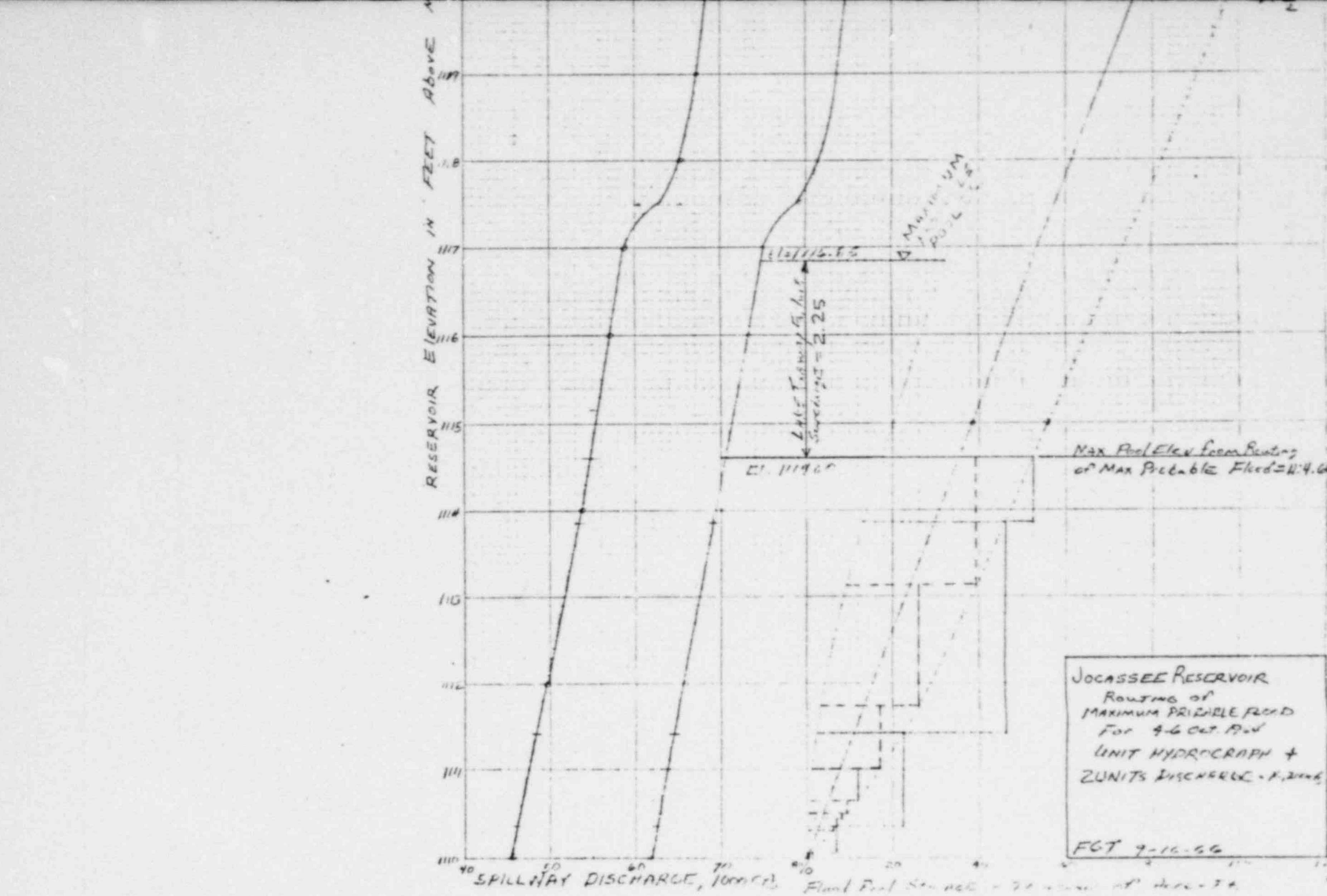
[illegible]ULATION OF UNIT RAINFALL DURATION [illegible]			
	[illegible]	$Q_{UNIT} = Q_{UNIT} / 3.956$ [illegible]	[illegible] P_E = [illegible] IN [illegible]
[illegible]	[illegible] (CFS)	VALUES FOR UNIT HYDROGRAPH [illegible]	MAXIMUM [illegible] FLOODS [illegible]
[illegible]	850	215	4,800
[illegible]	3,500	885	19,700
[illegible]	12,150	3,070	68,500
[illegible]	20,750	5,240	117,000 [illegible]
[illegible]	19,050	4,810	107,000
24	9,300	2,350	52,[illegible]
30	[illegible],100	1,540	34,[illegible]
[illegible]	[illegible],500	1,390	31,[illegible]
[illegible]	[illegible],[illegible]50	1,075	24,000
[illegible]	[illegible],[illegible]00	860	19,200
[illegible]	2,900	734	[illegible]
[illegible]	2,600	658	14,600
[illegible]	2,200	556	12,400
[illegible]	2,000	506	11,200



Q = 20,750
TOTAL BASIN
INITIAL LOSS
FLOW
ACCOUNTING FOR BASE FLOW
OBSERVED FLOW AT
EST. SURFACE RUNOFF
= OBSERVED - BASE
UNIT HYDROGRAPH = SURFACE RUNOFF DIVIDED BY 3.126
UNIT HYDROGRAPH = SURFACE RUNOFF DIVIDED BY 3.956
BASE DISCHARGE IN THOUSANDS OF SECOND - FEET
20
15
10
5
0
1 DAY
2 DAY
HOURS, FROM


148 Sq. mi.
= 4.14 in.
STREAM GAGE
HYDROGRAPH
FLOW
BASE FLOW
BEGINNING OF RAINFALL EXCESS
4 DAY 96
5 DAY 120
6 DAY 144
UNIT HYDROGRAPH FOR MAXIMUM RECORD FLOOD OF OCT 4 thru 9, 1964 JOCASSEE RESERVOIR


Top of Dam EL 1125.0
1125
1124
1123
1122
1121
1120
S.L.
Curve Q
Spillway Discharge
W/O UNIT DISCHARGE
Curve Q
Spillway Discharge
With Unit Discharge
12,200 cfs
Curve "S"
Reservoir Storage
Curve "A"
$S_r - \frac{Q}{2}$
Curve "B"



RESERVOIR ELEVATION IN FEET Above
SPILLWAY DISCHARGE, 1000 cfs
Max Pool Elev from Routing of Max Probable Flood = 1114.60'
El. 1114.60
Maximum Pool
JOCASSEE RESERVOIR
Routing of
MAXIMUM PROBABLE FLOOD
For 4-6 Oct. 19..
UNIT HYDROGRAPH +
2 UNITS DISCHARGE
FGT 9-16-66

KEOWEE-TOXAWAY Studies
JOCASSEE RESERVOIR
Flood Routing

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FGT 9-16-66

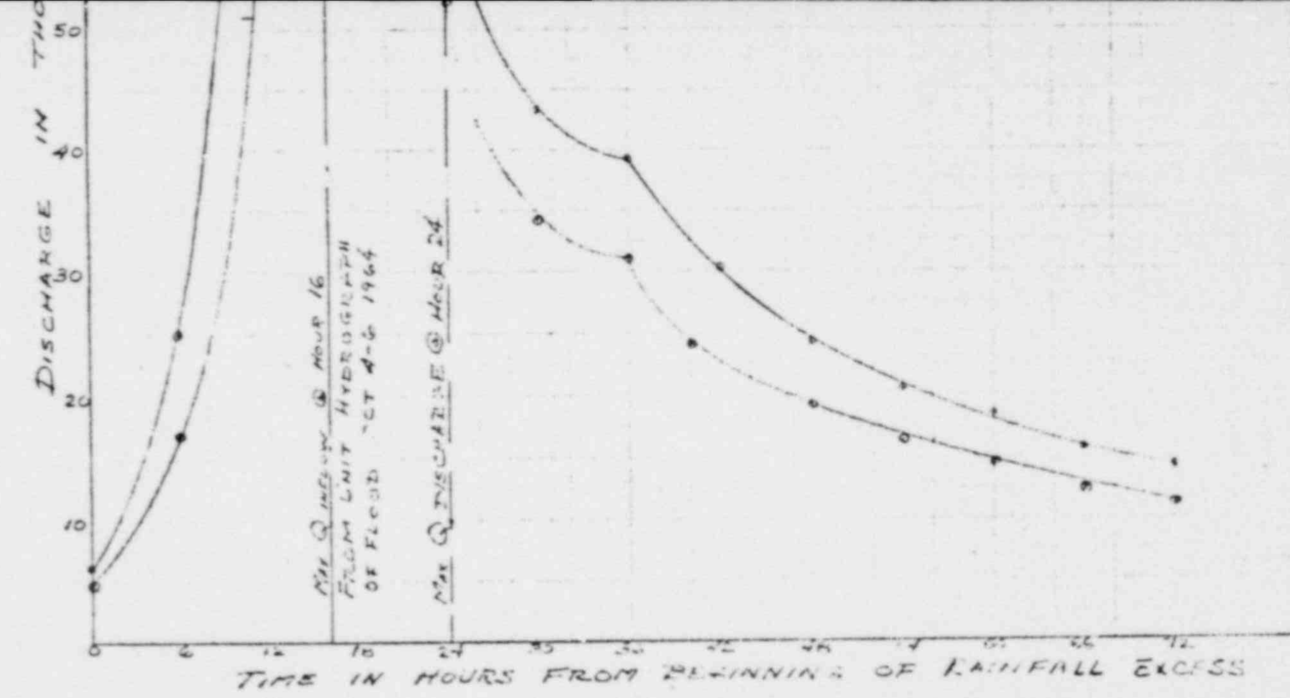
MAXIMUM Flood Probable - Re = 22.3" {CARTER DAM Report

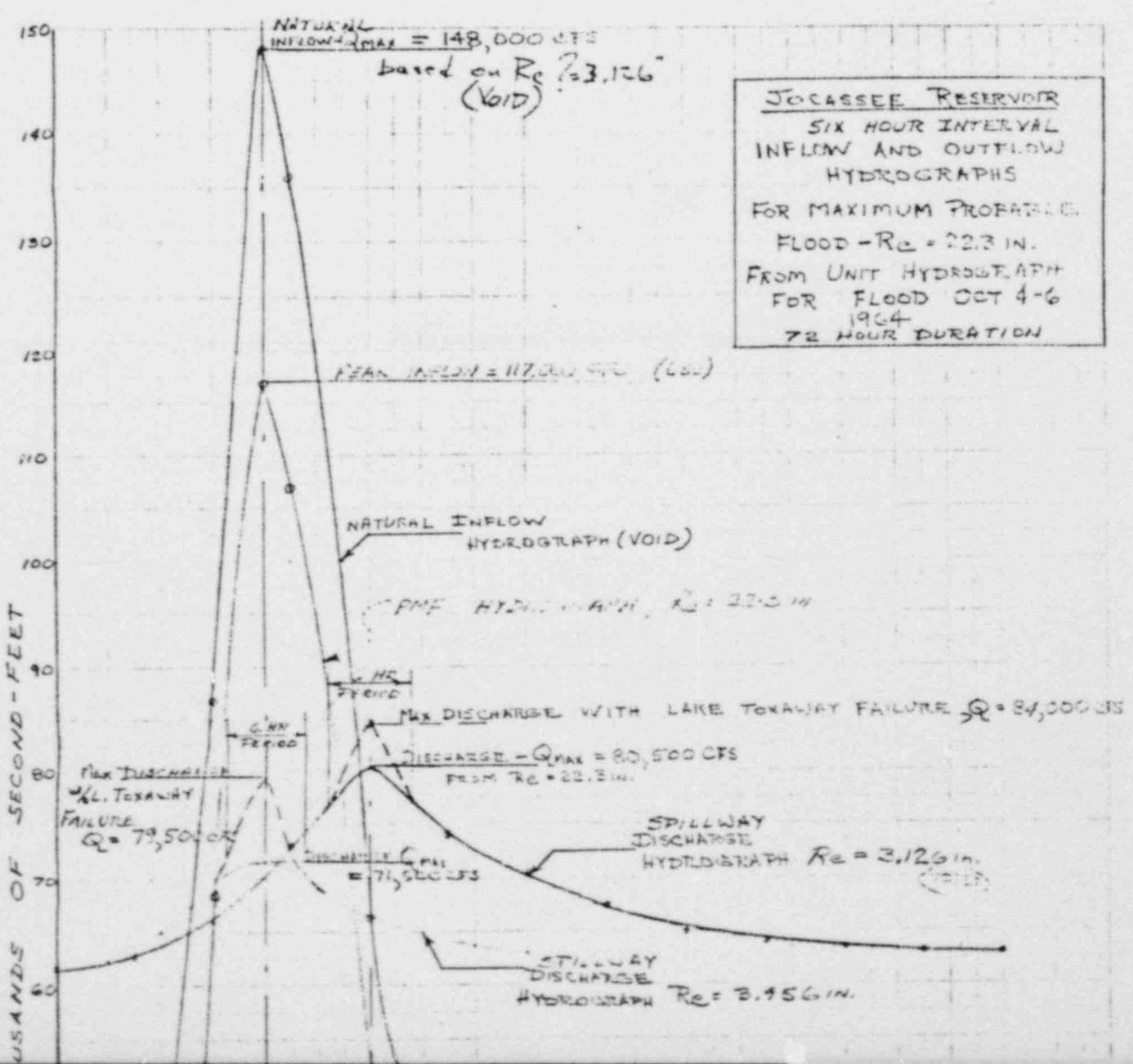
Using UNIT Hydrograph For Oct 4-6, 1964

1 cfs = 0.5 A-F/6 Hr

FLOOD ROUTING COMPUTATIONS

STEP	TIME FROM BEGIN FLOOD	TABLE I: Max FLOOD INSTANTAN. Inflow (cfs)	TABLE I: Sum of Inflow At Begin & End	TABLE I: Vol. of Inflow During Interval ½ cfs	TABLE I: Vol. of Inflow During Interval A-F/6Hr (VALUES USED ON GRAPH STEPS)	TABLE II: W/UNITS FLOW Spillway Discharge	TABLE II: RESERVOIR EL @ End Int.
0	0	4800	4800	2400	1200	62,000	1110.05
1	6	19,700	24,500	12,250	6125	62,800	1110.37
2	12	68,500	88,200	44,100	22,050	64,500	1111.40
Peak		117,000					
3	18	107,000	175,500	87,750	43,875	69,000	1113.55
4	24	52,400	159,400	79,700	39,850	[illegible]	1114.60
5	30	34,300	86,700	43,350	21,625	[illegible]	1113.12
6	36	31,000	65,300	32,650	16,325	65,000	1111.72
7	42	24,000	55,000	27,500	13,750	63,300	1111.00
8	48	19,200	43,200	21,600	10,800	63,000	1110.65
9	54	16,400	35,600	17,800	8900	62,500	1110.50
10	60	14,650	21,050	15,525	7763	62,600	[illegible]
11	66	12,400	27,050	13,525	6763	62,500	1110.37
12	72	11,250	23,650	11,890	5945	62,400	[illegible]


DISCHARGE IN THO
10
20
30
40
50
0
6
12
18
24
MAX Q INFLOW @ HOUR 16
FROM UNIT HYDROGRAPH
OF FLOOD OCT 4-6 1964
MAX Q DISCHARGE @ HOUR 24
TIME IN HOURS FROM BEGINNING OF RAINFALL EXCESS


JOCASSEE RESERVOIR
SIX HOUR INTERVAL
INFLOW AND OUTFLOW
HYDROGRAPHS
FOR MAXIMUM PROBABLE
FLOOD - Re = 22.3 IN.
FROM UNIT HYDROGRAPH
FOR FLOOD OCT 4-6
1964
72 HOUR DURATION
NATURAL INFLOW Qmax = 148,000 CFS
based on Re ?=3.126"
(VOID)
NATURAL INFLOW
HYDROGRAPH (VOID)
MAX DISCHARGE WITH LAKE TOXAWAY FAILURE
DISCHARGE - Qmax = 80,500 CFS
FROM Re = 22.3 IN.
MAX DISCHARGE
W/L. TOXAWAY
FAILURE
Q = 79,500 CFS
SPILLWAY
DISCHARGE
HYDROGRAPH Re = 3.126 in.
SPILLWAY
DISCHARGE
HYDROGRAPH Re = 3.456 IN.
USANDS OF SECOND-FEET
150
140
130
120
110
100
90
80
70
60

KEOWEE – TOXAWAY STUDIES
JOCASSEE RESERVOIR
FLOOD ROUTING

19

CGR
267

4-6-66
9-19-66
(CHECKED [illegible])

MAXIMUM FLOOD PROBABLE – Re = 22.3 IN.
USING UNIT HYDROGRAPH FOR
OCT 4-6, 19[illegible]

1 CFS = .5 AF/6 HR

FLOOD ROUTING COMPUTATIONS

STEP	TIME FROM BEGIN. [illegible]	TABLE II: [illegible] INFLOWS [illegible]	TABLE II: SUM OF INFLOWS [illegible]	TABLE II: VOL. OF [illegible] (2) [illegible]	TABLE II: [illegible]	TABLE III: STORAGE [illegible]	TABLE III: RESERVOIR ELEVATION
0	0	4,800	4,800	2,400	↓ 1,200	62,000	1110.05
1	6	19,700	24,500	12,250	6,125	62,300	1110.35
2	11	68,500	88,200	44,100	22,050	65,000	1111.60
PEAK →		117,000					
3	18	107,000	175,500	87,750	43,875	69,800	1114.05
4	24	52,400	159,400	79,700	39,850	71,500	1115.0 ← MAX
5	30	34,300	86,700	43,350	21,625	[illegible]	1113.70
6	36	31,000	[illegible]	[illegible]	16,325	66,500	1112.40
7	42	24,000	[illegible]	27,500	13,750	65,000	1111.60
8	48	19,200	[illegible]	21,600	10,800	[illegible]	1110.80
9	54	16,400	35,600	17,800	8,900	63,000	1110.65
10	60	14,650	31,050	15,525	7,763	62,500	1110.35
11	[illegible]	12,400	27,050	13,525	6,763	[illegible]	1110.20
12	[illegible]	11,280	23,680	11,890	[illegible]	61,900	1110.05

KEOWEE - TOXAWAY STUDY
JOCASSEE RESERVOIR
MAX. FLOOD ROUTING

CQR 3-29-66
FGT 9-1[illegible]

WITH MAXIMUM FLOOD OF RECORD (OCT 4+5 1964) AT HIGHEST PEAK FOR RESERVOIR, WHAT WOULD HAPPEN IF LAKE TOXAWAY DAM GAVE WAY AND THAT VOLUME OF WATER WERE ADDED TO THE RESERVOIR? HOW HIGH WOULD THE POOL RISE?

LAKE TOXAWAY DATA:

OLD SPILLWAY CREST EL = 2998 NEW CREST = 3010
D.A. = 11.1 sq. mi.
shoreline = 15 miles
MAX. FLOOD FLOW @ EL. 3022 = 16,700 CFS

From Corps of Engr. Area-Capacity Curves:
@ EL. 3016 = 11,500 A-F
@ EL. 3020 = 17,200 A-F

From Graphical Flood Hydrograph Oct 4+5 1964 Re = 3,126 Flood

MAX AT. RESERVOIR = 1113.2
AREA @ ELEV. 1113.2 = 7,640 AC.

ASSUME TOXAWAY AT ELEV. 3020 FAILS AND RESERVOIR AT JOCASSIE IS AT MAX 1113.2

WITH R[illegible]

RISE IN POND = $\frac{17,200 \text{ A-F}}{7,640 \text{ AC}}$ = 2.25 ft.

AREA [illegible] = 7,754 AC.

RISE [illegible] POND = $\frac{17,200 \text{ A-F}}{7,754}$ = 2.22'

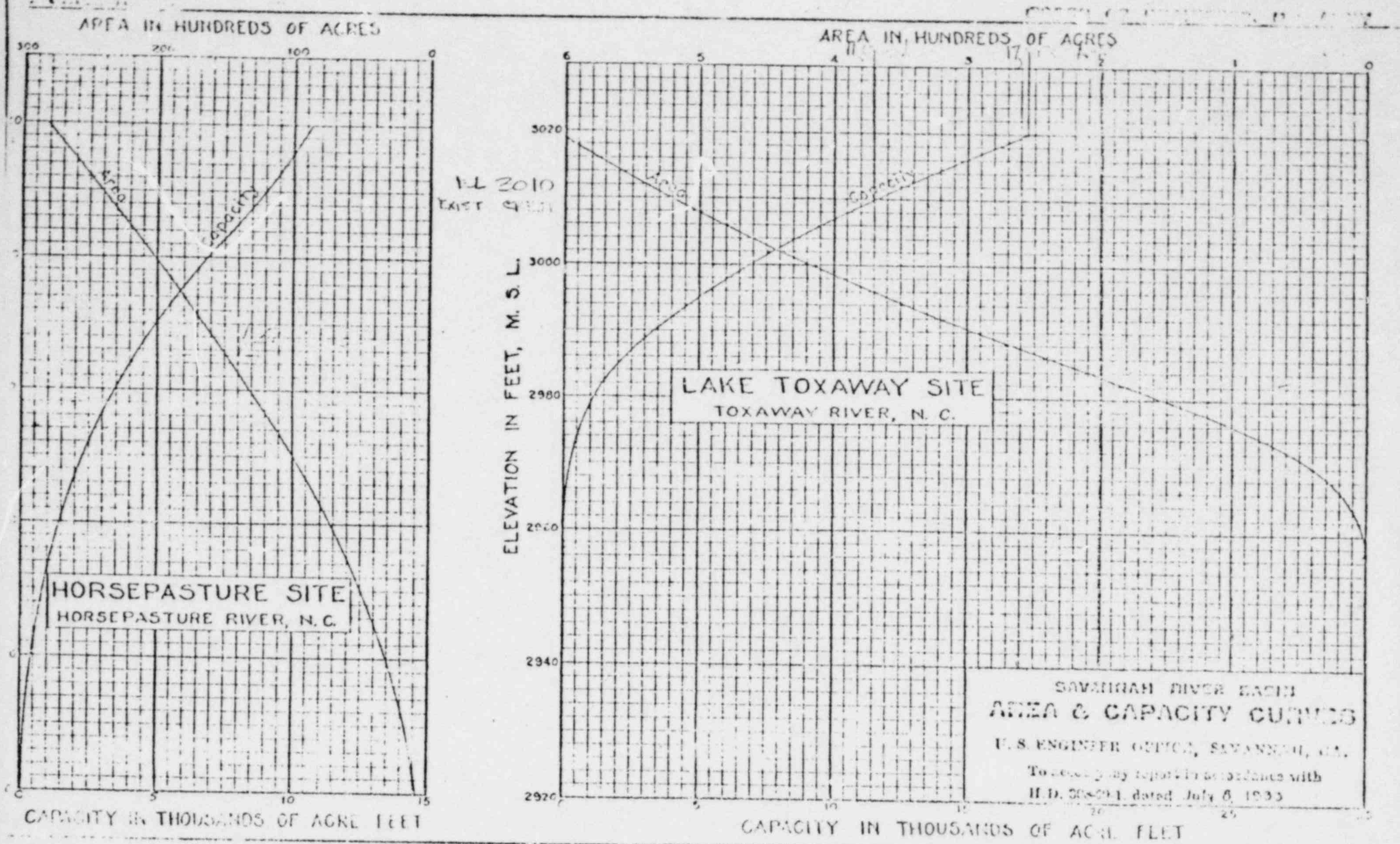
ELEV. = 1113.25
+ 2.25
ELEV = 1115.50 ← MAX RESV. LEVEL POSSIBLE

[illegible] EL [illegible]

@ ELEV. 1115.5
SPILLWAY DISCHARGE = 56,000 CFS
AVG. FLOW DURING 6 HR: 36,100 CFS

MAX [illegible]

@ ELEV 1117.5
SPILLWAY DISCHARGE = 9[illegible],000 CFS
AVG. FLOW DURING 6 HR = [illegible] CFS



AREA IN HUNDREDS OF ACRES
HORSEPASTURE SITE
HORSEPASTURE RIVER, N. C.
CAPACITY IN THOUSANDS OF ACRE FEET
Area
Capacity
ELEVATION IN FEET, M. S. L.
LAKE TOXAWAY SITE
TOXAWAY RIVER, N. C.
SAVANNAH RIVER BASIN
AREA & CAPACITY CURVES
U. S. ENGINEER OFFICE, SAVANNAH, GA.

KEOWEE - TOXAWAY STUDIES
KEOWEE RESERVOIR

CQR 3-29-66
FGT 9-19-66

UPPER NAPPE PROFILES @ ℄ OF BAY

FROM: Corps of Engr.
HDC CHART III-12

$H/H_d = 1.0$ AT CREST AXIS $X/H_d = 0.0$

HT. OF GATE = 35' $Y/H_d = -.805$"

If we assume the tainter gate fully opened at 32'35' with the gate directly over the crest axis.

$H/H_d = 1.0$ + $Y/H_d = -.805$ = 35'

or $\frac{Y}{35} = \frac{.805}{1.0}$ $\frac{H_d}{35} = \frac{1.0}{.805}$

$Y = \frac{35 \times .805}{1.0} = 28.2'$ $H_d = \frac{1.0 \times 35}{.805} = \underline{43.5'}$

∴ the gated spillway will actually act as a free-overflow spillway until the reservoir level is ~~28.5~~ 43.5' above the crest height of the spillway.

CREST ELEV. = 765.0
+ 43.5
ELEV = 808.5 = point where the spillway will act as an oriface

SAY ELEV. 808.0

KEOWEE – TOXAWAY STUDIES
KEOWEE RESERVOIR

CQR 3-29-66
FGT 9-19-66

SPILLWAY DISCHARGE

GIVEN : 4 GATES 38'W x 35'H

WITH gates fully open at 35', the reservoir can rise to ELEV. 809.0 before the water will actually touch the bottom of the gate and create the oriface effect.

A) Therefore from ELEV 800 to 808 the spillway will act as an ~~uncontrolled~~ overflow type

$$Q = C\left[L' - 2(N K_p + K_a) H_e\right] H_e^{3/2}$$

from Corps of Engr:
Data Sheets + HGM calc.
122-1/1 & 2/2

USE: $C = 3.73$
$K_p = .01$
$K_a = .175$
$N = 2$ piers
$L' = 4 \times 38' = 152'$

$$Q = 3.73\left[152 - 2(3 \times .01 + .175) H_e\right] H_e^{3/2}$$

(.03, .205)

GENERAL For Any He

$$Q = 3.73\left[152 - (.410) H_e\right] H_e^{3/2}$$

RES ELEV	He (above Crest EL 765)	* $H_e^{3/2}$	.41 He	[152 - .41 He]*	x 3.73 = * DISCHARGE Q cfs
800	35'	207.1	14.35	137.65	106,300
802	37'	225.1	15.18	136.82	114,900
805	40'	253.0	16.4	135.60	128,000
808	43'	282.0	17.62	134.38	141,350
810	45'	301.9	18.45	133.55	150,400

FOR RESERVOIR ELEVATIONS ABOVE 808 to 820, the spillway will act as an oriface [illegible],

(see next sheet)

KOWEE - TOXAWAY STUDIES
KEOWEE RESERVOIR

SPILLWAY DISCHARGE (cont.) CQR 3-30-66
FGT 9-19-66

B) AT RESERVOIR ELEVATIONS 808 to 820 the spillway would act as an oriface

BASIC EQUA: $Q = CA\sqrt{2gH}$ EACH GATE 38'W x 35'H

FROM CORPS OF ENGR' SHEETS 311-1 to 311-5 & DATA CHART 311-1

$$Q = CG_oB\sqrt{2gH}$$

C = disc. coeff.
G_o = gate opening
B = gate width
H = Head to Center of Gate Opening

From HEM Calc. 12-14-64
Use C = .656
B = 38'
G_o = 0 to 35'
H = 25.5' to 37.5'

$Q = .656 \times G_o \times 38' \times \sqrt{64.4 \times H}$

then $Q = 24.9\, G_o \sqrt{64.4H}$ ONE GATE

NOTE: FLOW THRU 1 UNITS = 6,960 CFS.

(1) G_o varying from 0 to 30' : $H = 35 - \frac{G_o}{2}$

G_o	RES. ELEV.	$H = 35' - \frac{G_o}{2}$	$\sqrt{H}$	$Q = 24.9\, G_o\sqrt{64.4 \times H}$ ONE GATE	or $\{Q = 200 G_o\sqrt{H}$ x 4 = FOUR GATES
0	800 ↑	35'	5.92	0	0
5'		32.5	5.7	5,700	22,800
10'		30.0	5.48	10,950	43,800
20'		25.0	5.0	20,000	80,000
25'	↓ 800	22.5	4.74	23,700	94,800

(2) H varying 25.5' to 37.5 : G_o = 35'

G_o	RES. ELEV.	H	$\sqrt{H}$	$Q = 24.9 \times 35' \times \sqrt{64.4 \times H}$ ONE GATE	or $\{Q = 7,000\sqrt{H}$ x 4 = FOUR GATES
35' ↑	808	25.5'	5.05	35,350	141,400
	810	27.5	5.24	36,700	146,800
	812	29.5	5.43	38,000	152,000
	815	32.5	5.70	39,900	159,600
	818	35.5	5.96	41,700	166,800
↓ 35'	820	37.5	6.12	42,800	171,200

KEOWEE - TOXAWAY STUDIES
KEOWEE RESERVOIR
MAX. FLOOD ROUTING

4

CQR 3-30-66
FGT 9-19-66

GIVEN:
FULL POND = EL. 800
SPILLWAY CREST = EL. 765 } 4 GATES 38' WIDE
TOTAL WIDTH = 152 FT.

TOTAL DISCHARGE INCLUDES 6,960 CFS THRU ONE UNIT
1 CFS = 2 AF/DAY ∴ 1 CFS = .5 AF/6 HR

— W/O UNIT DISCHARGE — [illegible]

RESERVOIR ELEVATION ABOVE FULL POND	ESTIMATED [illegible] TOTAL VOL. (AC-FT.)	ESTIMATED [illegible] INCREM. STOR. S_T (AC-FT.)	MAX DISCHARGE SPILLWAY (4 GATES) (CFS)	MAX DISCHARGE SPILLWAY (4 GATES) q (AF/6 HR)	DATA FOR CURVE A $S_T - \frac{q}{2}$	DATA FOR CURVE B $S_T + \frac{q}{2}$
SPILLWAY CREST - 765	445,303	BELOW FULL POND 0	0	0		
775	563,907	118,604	43,800	21,600	107,804	129,404
785	704,158	258,855	80,000	40,000	238,855	278,855
FULL POND - 800	955,586	CURVE F ABOVE FULL POND 0	CURVE G 106,300	53,150	0	0
802			114,900	57,450		
805	1,050,191	94,605	128,000	64,000	62,605	126,605
808			141,350	70,675		
810	1,150,300	194,714	146,800	73,400	158,014	231,414
812			152,000	76,000		
815	1,240,000	284,414	159,600	79,600	244,614	324,214
815			166,800	83,800		
820	1,332,000	374,414	171,200	85,600	331,614	417,214

KEOWEE - TOXAWAY
KEOWEE RESERVOIR
MAX. FLOOD ROUTING

5B

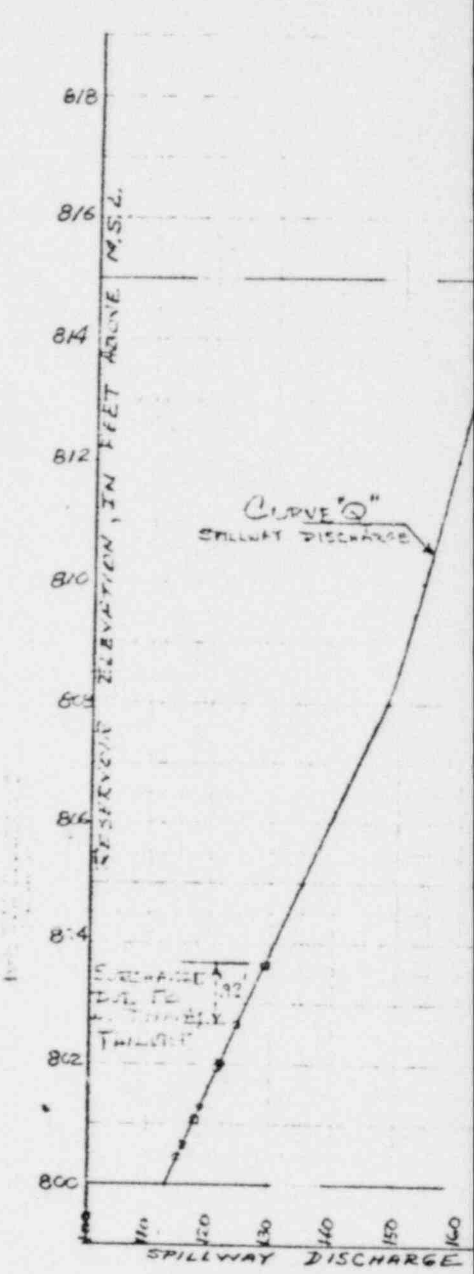
CQR 3-30-66
FGT 9-15-66

AT DAM SITE-MAX. Q = 25,200 CFS (10:00 A.M. AUG 13, 1940)

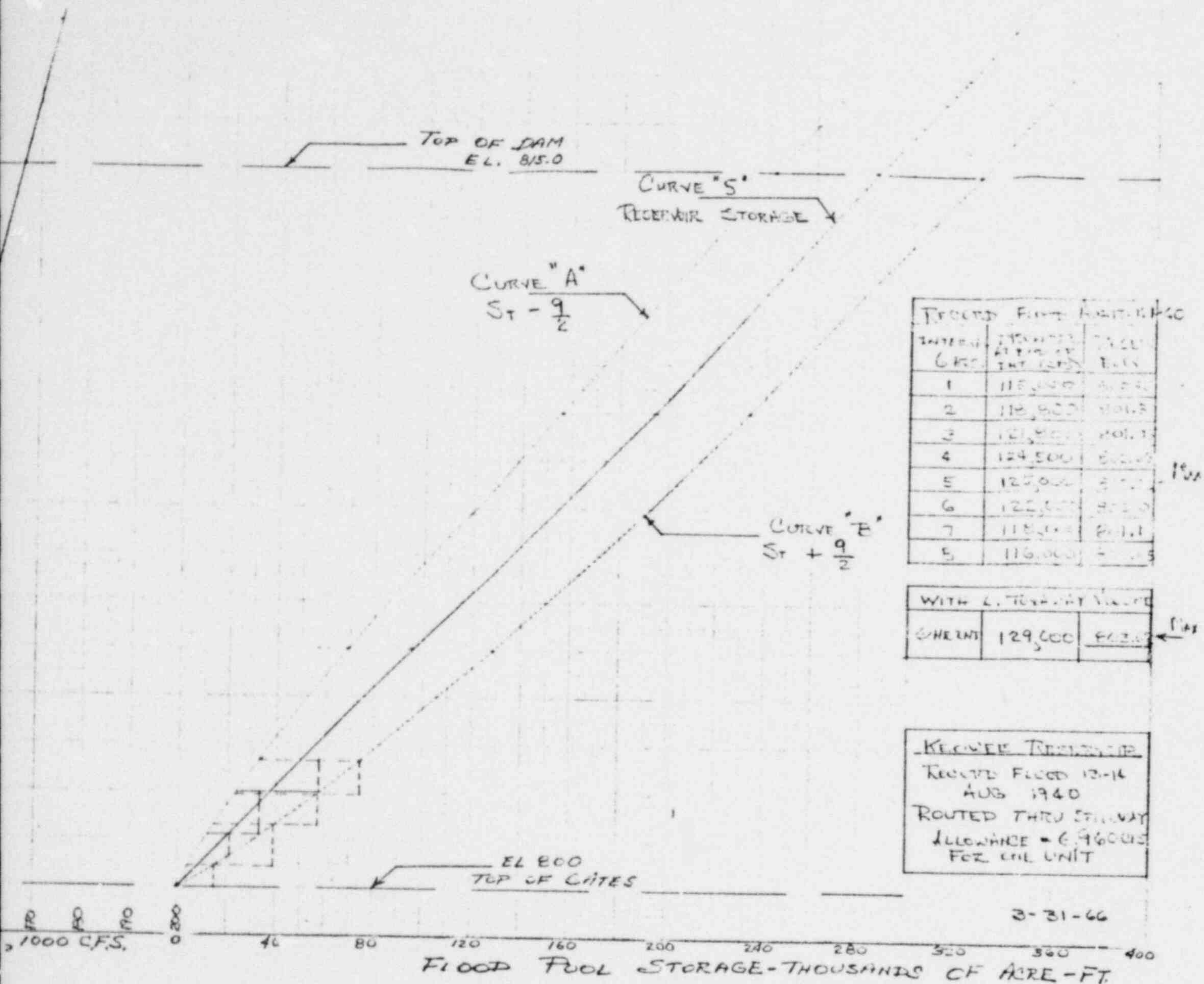
DESIGN Q FOR SPILLWAY = 106,500 CFS = 5000√DA

∴ RATIO = $\frac{106,500}{25,200}$ = 4.2

Hour Ending	Q cfs @ Keowee Dam Site taken from Newry Gage Records 12-14 Aug 1940 at Keowee River: August 13, 1940 Flow (cfs)	August 13, 1940 6 HR Avg	August 14, 1940 Flow (cfs)	August 14, 1940 6 HR Avg	Q cfs (Design Inflow) @ Keowee based 4.2 × Q stream record: Aug 13, 1940 — cfs (Period No.)	August 14, 1940 — cfs (Period No.)
1	2,570		23,400			
2	3,060		22,600			
3	4,130	6,842	20,800	20,217	(1) 28,736	(5) 84,911
4	5,880		19,400			
5	8,310		18,300			
6	11,100		16,800			
7	14,700		15,600			
8	16,800		13,600			
9	16,900	16,917	11,600	11,247	(2) 71,051	(6) 47,237
10	17,400		9,970			
11	17,700		8,840			
12 N	18,000		7,870			
1	18,900		6,980			
2	19,000		6,130			
3	19,800	20,467	5,840	5,655	(3) 85,961	(7) 23,751
4	20,800		5,260			
5	21,900		4,960			
6	22,900		4,760			
7	23,900		4,480			
8	24,400		4,190			
9	24,900	24,650	4,070	3,978	(4) 103,530	(8) 16,608
10	25,200		3,850			
11	25,000		3,720			
12 M	24,500		3,560			



818
816
814
812
810
800
RESERVOIR ELEVATION, IN FEET ABOVE M.S.L.
CURVE "Q"
SPILLWAY DISCHARGE
110
120
130
140
150
160
SPILLWAY DISCHARGE



Record Flood Routing [illegible]		
Interval 6 Hrs.	[illegible] at [illegible] of Int. (CFS)	[illegible] Elev.
1	115,[illegible]	[illegible]
2	118,800	[illegible]
3	121,[illegible]	[illegible]
4	124,500	[illegible]
5	125,[illegible]	[illegible]
6	122,[illegible]	[illegible]
7	118,[illegible]	801.1
8	116,[illegible]	[illegible]

Max

With [illegible]		
6 Hr. Int.	129,000	[illegible]

Max

KEOWEE RESERVOIR
RECORD FLOOD 13-14 AUG 1940
ROUTED THRU SPILLWAY
ALLOWANCE = 6,960 CFS FOR ONE UNIT

KEOWEE – TOXAWAY

KEOWEE RESERVOIR

MAX FLOOD – 72 HOUR READINGS

MAX Q = 23,800

CQR 4-7-66

FGT 9-19-66

DATE Mo.	HOUR DAY	AUG 29 - SEPT 1, 1940 INSTAN FLOW	AVG. FLOW CFS	AF/6 HR
AUG 29	12N	850		
	3	1,020	2,413	
	6	5,370		
	9	15,300	12,790	
	12M	17,700		
			18,833	
AUG 30	3	18,800		
	6	20,000		
	9	22,300	22,033	
	12N	23,800		
	3	22,700	21,933	
	6	19,300		
	9	14,900	14,800	
	12M	10,200		
			7,743	
AUG 31	3	7,110		
	6	5,920		
	9	5,410	5,407	
	12N	4,880		
	3	4,590	4,583	
	6	4,280		
	9	4,060	4,066	
	12M	3,860		
			3,670	
SEPT 1	3			
	6	3,480		
	9		3,375	
	12N	3,270		

ACTUAL 48 HOUR VOLUME OF FLOOD FROM GAGE READINGS

INT. NO.	HR.	AVG. 6 HR. FLOW
	0	
1		2,413
	6	
2		12,790
	12	
3		18,833
	18	
4		22,033
	24	
5		21,933
	30	
6		14,800
	36	
7		7,743
	42	
8		5,407
	48	

48 HOUR TOTAL AVG. CFS = 105,952

LESS THAN FLOOD AUG 13-14, 1940

∴ GO NO FURTHER

BUT DRAW HYDROGRAPH TO COMPARE

KEOWEE - TOXAWAY
KEOWEE RESERVOIR

8

MAX FLOOD - 72 HOUR READINGS — CQR 4-7-66
MAX Q = 25,200 — FGT 9-17-66

DATE MO.	HOUR DAY	AUG 13-15 1940 INSTAN. FLOW (CFS)	AVG. FLOW (CFS)	AF/6 HR
	12M	2,300		
	3	4,130	5,843	2,922
	6	11,100		
	9	16,900	15,333	7,667
Aug 13th	12N	18,000		
	3	19,800	20,233	10,117
	6	22,900		
	9	24,900		
* PEAK →	10	25,200	24,385	12,192
	12M	24,500		
	3	20,800	20,700	10,350
	6	16,800		
	9	11,600	12,090	6,045
	12N	7,[illegible]		
Aug 14th	3	5,[illegible]40	6,157	3,079
	6	4,760		
	9	4,[illegible]70	4,130	2,060
	12M	3,560		
	4	3,170	3,345	1,673
	8	2,800	2,680	1,340
	12N	2,560	2,485	1,243
Aug 15th	4	2,410		
	8	2,240	2,175	1,088
	12M	2,110		

ACTUAL 48 HOUR VOLUME OF FLOOD FROM GAGE READINGS

INT. NO.	HR	AVG. 6 HR FLOW	NO. INT.
	0		
1		5,843	①
	6		
2		15,333	②
	12		
3		20,233	③
	18		
4		24,385	④
	24		
5		20,700	⑤
	30		
6		12,090	⑥
	36		
7		6,157	⑦
	42		
8		4,130	⑧
	48		

48 HOUR TOTAL AVG. CFS = 108,871 CFS

EA. 6 HR = 2.16×10^4 SEC

∴ TOTAL VOL. = 108,871 CF/SEC $\times 2.16 \times 10^4$

(48-HOUR (8-6 HR PERIODS)) VOL. = $235,161 \times 10^4$ CF

D.A. = 455 SQ.MI. $\times$ 27.88 $\times 10^6$ SQ.FT./SQ.MI.

= $12,685.4 \times 10^6$ SQ.FT.

AVG DEPTH RAINFALL = $\frac{CF}{SQ\,FT} = \frac{2.352 \times 10^9}{12.685 \times 10^9}$

TOTAL FLOW AVG. DEPTH = $0.1854\ FT \times 10^0 \times 12$ in.

= 2.22 in.

KEOWEE – TOXAWAY

KEOWEE RESERVOIR

CER 4-8-66
FGT 9-17-[illegible]

AVG. RAINFALL FOR MAX. FLOOD PERIOD
AUG 13-15, 1940

AVG DEPTH OF TOTAL FLOW = 2.225 IN.

LESS BASE FLOW AVG = 500 CFS

$48\ HR = 3600 \frac{SEC}{HR} \times 48\ HR = 1.728 \times 10^5\ SEC$

$\therefore \frac{500\ CF \times 1.728 \times 10^5\ SEC}{12.685 \times 10^9\ SF} = \ \ FT \times 12 \frac{IN}{FT}$ = − 0.082

(NET) AVG. PRECIPITATION RUNOFF = 2.143 IN. = Re (AVG. RAINFALL EXCESS)

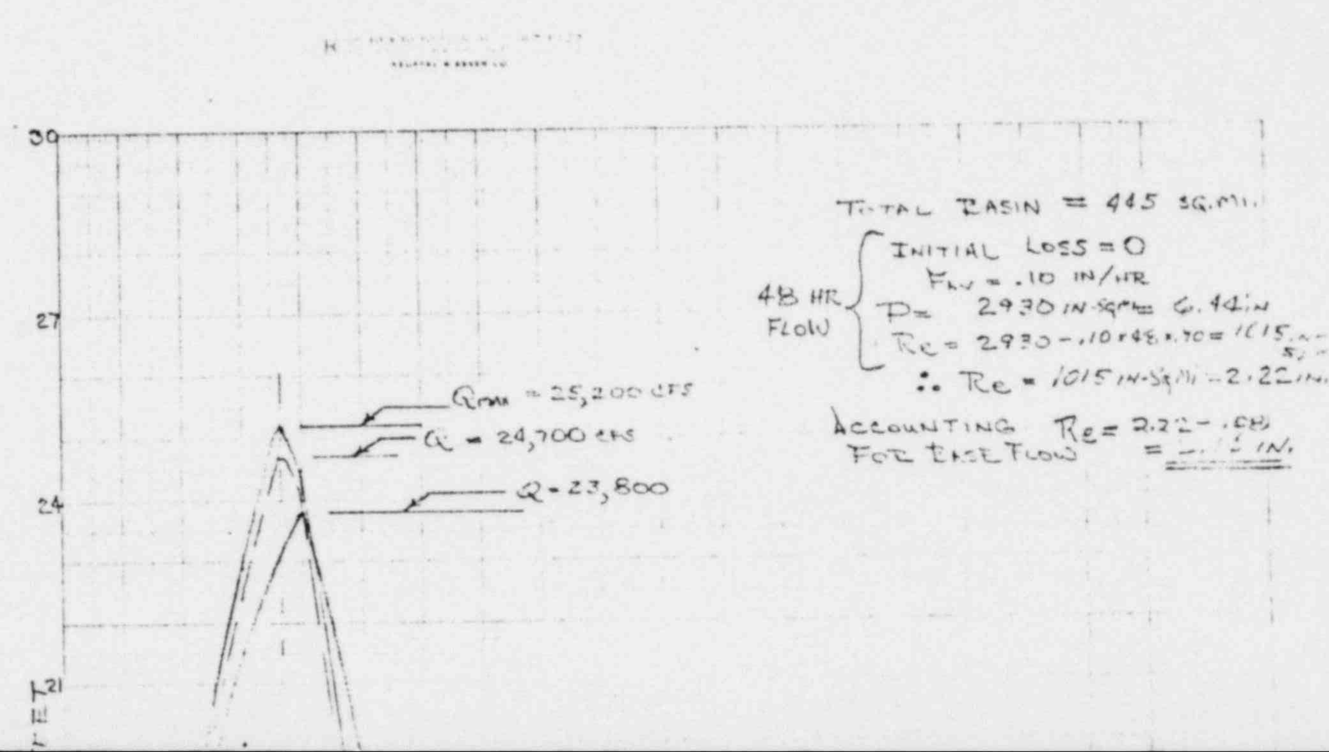
TOTAL BASIN : 455 SQ MI.

INITIAL LOSS = 0.0

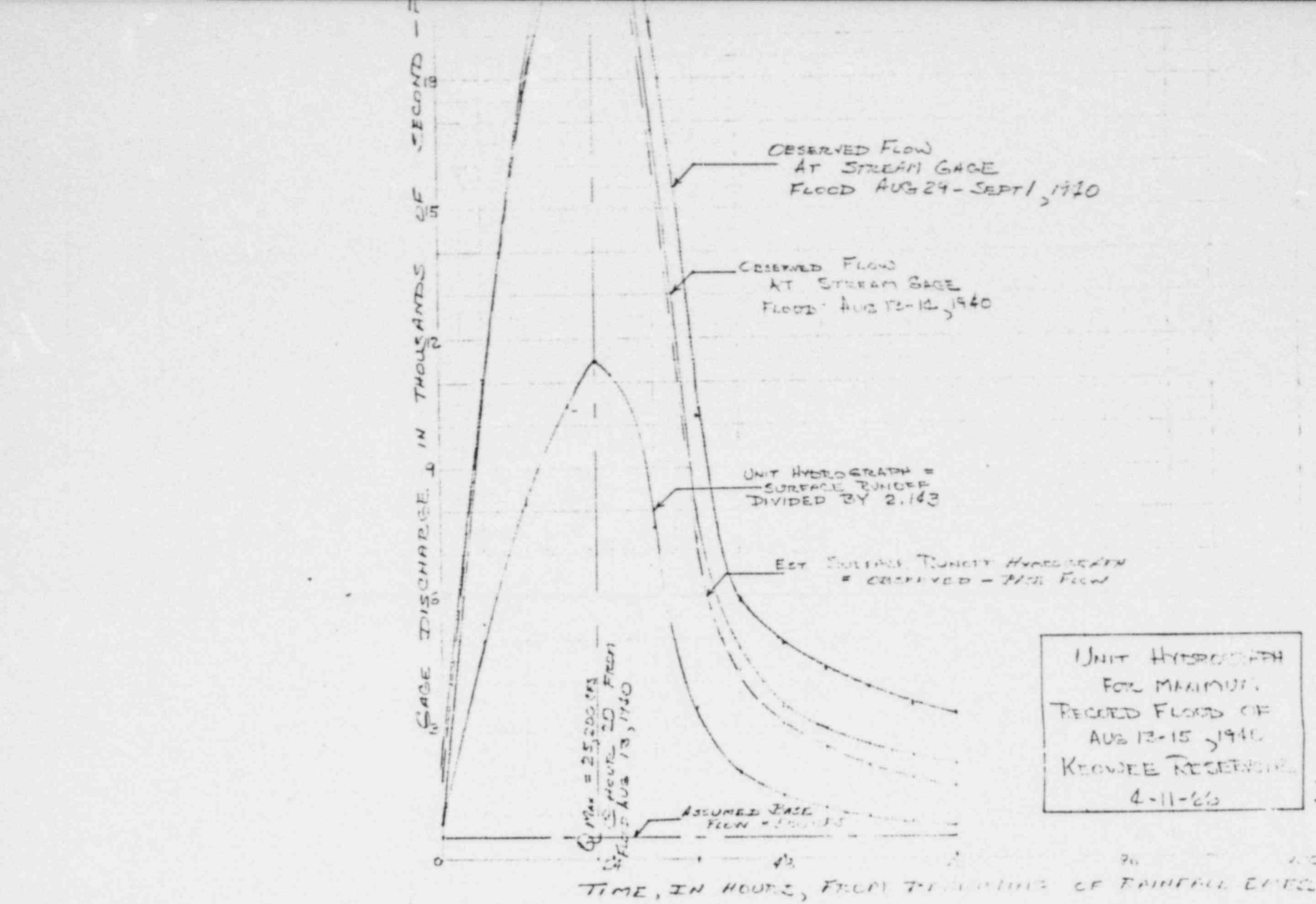
INFILTRATION [illegible] .1[illegible] IN/HR × 48 HR − 10% = 4.3 IN.

∴ TOTAL P = 2.143" + 4.3" = [illegible] IN.

[illegible]			
	[illegible] Re = 2.143	[illegible]	[illegible]
TIME FROM BEGIN. OF Re IN HRS	Q_{NET} = INSTAN DISCHARGE (LESS BASE FLOW)	VALUES FOR UNIT HYDROGRAPH	MAXIMUM FLOOD [illegible] {[illegible] DATA}
0	1,800	840	18,700
6	10,600	4,940	110,000
12	17,500	8,160	182,000
18	22,400	10,420	233,000 {100,000+ ← YEAR FLOOD}
* [illegible]	24,700	11,500	256,500
24	24,000	11,180	219,000
30	16,300	7,600	169,500
36	7,370	3,430	76,500
42	4,260	1,980	44,100
48	3,060	1,425	31,800
54	2,500	1,165	26,000
60	2,060	960	21,400
[illegible]	1,200	638	18,700



30
27
24
21
Qmax = 25,200 CFS
Q = 24,700 CFS
Q = 23,800
TOTAL BASIN = 445 SQ.MI.
INITIAL LOSS = 0
FAV = .10 IN/HR
48 HR FLOW
P = 2930 IN-SQMI = 6.44 IN
Re = 2930 - .10 x 48 x .70 = 1015
∴ Re = 1015 IN-SQMI = 2.22 IN.
ACCOUNTING FOR BASE FLOW
Re = 2.22 - .08



OBSERVED FLOW
AT STREAM GAGE
FLOOD AUG 29 - SEPT 1, 1940
OBSERVED FLOW
AT STREAM GAGE
FLOOD AUG 13-14, 1940
UNIT HYDROGRAPH = SURFACE RUNOFF DIVIDED BY 2.143
ASSUMED BASE FLOW
UNIT HYDROGRAPH
FOR MAXIMUM
RECORD FLOOD OF
AUG 13-15, 1940
KEOWEE RESERVOIR
4-11-66
GAGE DISCHARGE, IN THOUSANDS OF SECOND
TIME, IN HOURS, FROM
OF RAINFALL EXCESS

KEOWEE - TOXAWAY STUDIES
KEOWEE RESERVOIR
FLOOD ROUTING

11

CQR 4-11-[illegible]
FGT 9-19-[illegible]

MAXIMUM FLOOD PROBABLE - R_e = 22.3 IN. {CARTER DAM}
USING UNIT HYDROGRAPH FOR
AUG 13-15, 1940

1 CFS = .5 AF/6 HR.

(W/O JOCASSEE)

Step	Time from Begin of Flood	Mean Instantaneous Inflow (cfs) (I)	Sum of the Average Inflow (cfs)	½(I) - CFS	AF/6 hr	Storage	Reservoir Elevation
0	0	18,700	18,700	9,350	4,675	113,500	800.1
1	6	110,000	128,700	54,350	27,175	116,500	800.8
2	12	182,000	292,000	146,000	73,000	125,500	802.8
*3	18	233,000	415,000	207,500	103,750	134,500	804.8
PEAK →		256,500					
4	24	249,000	479,000	239,500	119,750	145,500	807.3
5	30	169,500	408,000	204,000	102,000	150,500	808.7 (MAX.)
6	36	76,500	246,000	123,000	61,500	148,500	808.0
7	42	44,100	120,600	60,300	30,150	139,500	805.9
8	48	31,500	75,900	37,950	18,975	129,000	803.6
9	54	26,000	57,800	28,900	14,450	121,500	801.9
10	60	21,400	47,400	23,700	11,850	[illegible]	[illegible]
11	66	18,700	40,100	20,050	10,025	[illegible]	[illegible]
12	72	16,750	35,450	17,725	[illegible]	[illegible]	[illegible]

KEOWEE - TOXAWAY
KEOWEE RESERVOIR

12

CGR
FGT

4-12-66
9-19-66

FLOOD ROUTING COMPUTATIONS

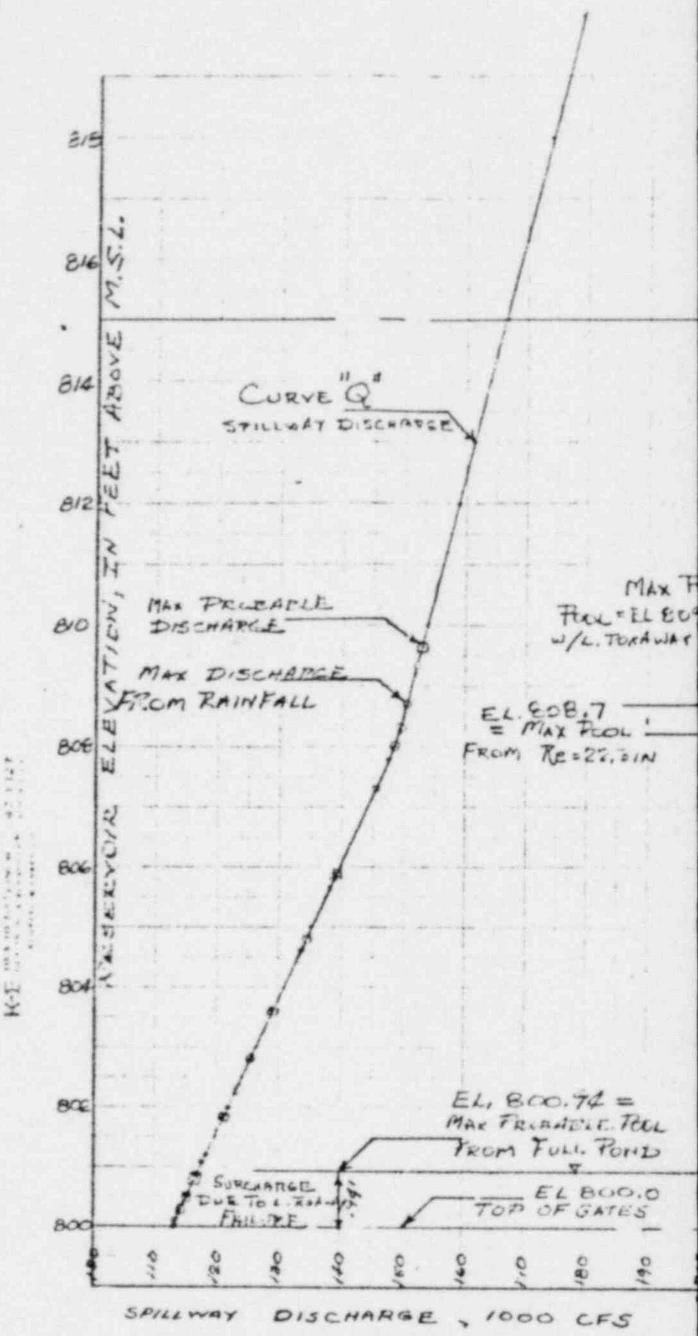
MAXIMUM FLOOD PROBABLE AT KEOWEE WITH JOCASSEE AT MAXIMUM DISCHARGE

1 CFS = .5 [illegible]

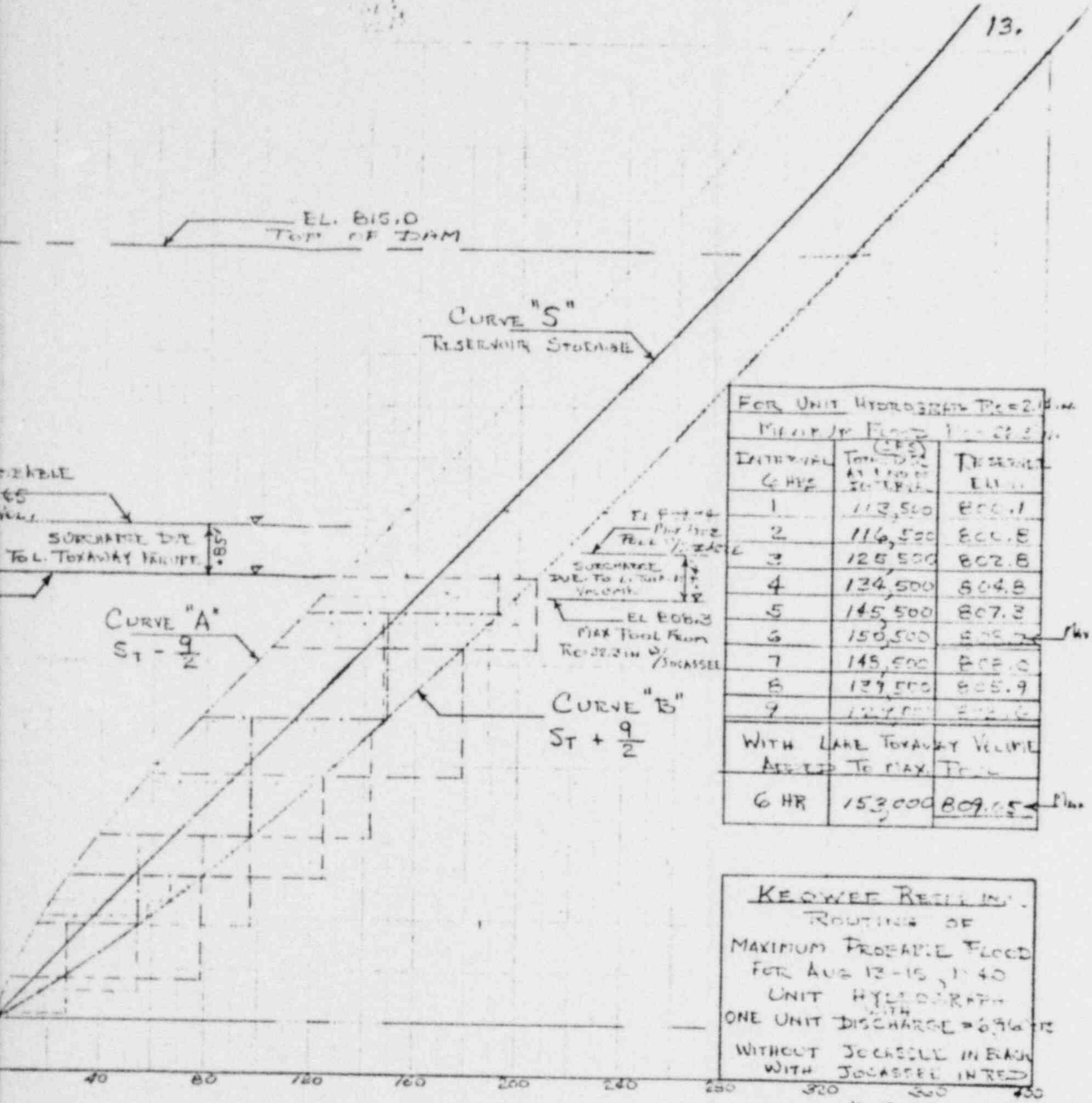
(W/ JOCASSEE)

FLOOD ROUTING COMPUTATIONS

STEP	TIME FROM [illegible] OF FLOOD	[illegible]	[illegible] DISCHARGE	SUM OF INFLOWS	SUM OF INFLOWS [illegible]	RATE OF INFLOW [illegible]	[illegible]	SPILLWAY DISCHARGE	RESERVOIR [illegible]
0	0	12,610	62,000	74,610	74,610	37,305	18,652	115,500	800.55
1	6	74,200	62,300	136,500	211,110	105,555	52,778	121,500	801.65
2	12	122,800	65,000	187,800	324,300	162,150	81,075	129,000	803.60
3	18	157,000	69,800	226,800	414,600	207,300	103,650	138,000	805.65
* PEAK		173,000							
4	24	166,500	71,500	237,500	464,300	232,150	116,075	147,500	807.8
5	[illegible]	115,[illegible]	[illegible]	187,300	422,700	211,350	105,675	147,500	[illegible]
6	[illegible]	51,[illegible]	66,[illegible]	118,100	301,300	150,650	75,325	147,500	807.3
7	[illegible]	29,700	65,000	94,700	212,800	106,400	53,200	139,000	805.9
8	[illegible]	1,1[illegible]	67,800	85,[illegible]	179,950	89,975	44,988	133,700	804.65
9	[illegible]	17,500	[illegible]	70,500	165,750	82,875	41,438	129,000	803.6
10	[illegible]	14,400	60,500	74,9[illegible]	157,400	78,700	39,350	125,500	802.8
11	[illegible]	13,[illegible]	[illegible]	75,[illegible]	151,500	75,750	37,875	123,200	802.3
12	[illegible]	11,[illegible]	[illegible]	72,[illegible]	147,9[illegible]	73,950	36,975	122,000	[illegible]



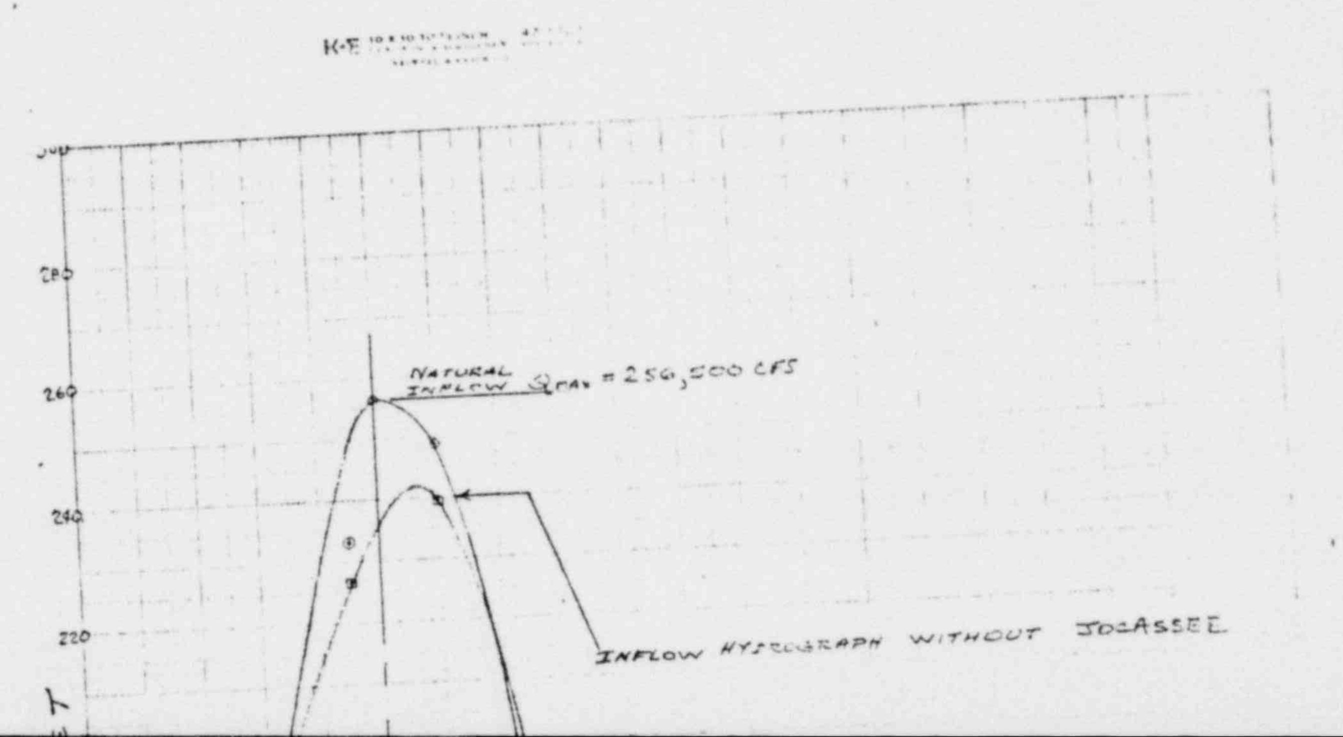
RESERVOIR ELEVATION, IN FEET ABOVE M.S.L.
SPILLWAY DISCHARGE, 1000 CFS
CURVE "Q"
SPILLWAY DISCHARGE
MAX PROBABLE DISCHARGE
MAX DISCHARGE FROM RAINFALL
EL. 800.74 =
MAX PROBABLE POOL
FROM FULL POND
EL 800.0
TOP OF GATES
SURCHARGE
800
802
804
806
808
810
812
814
816

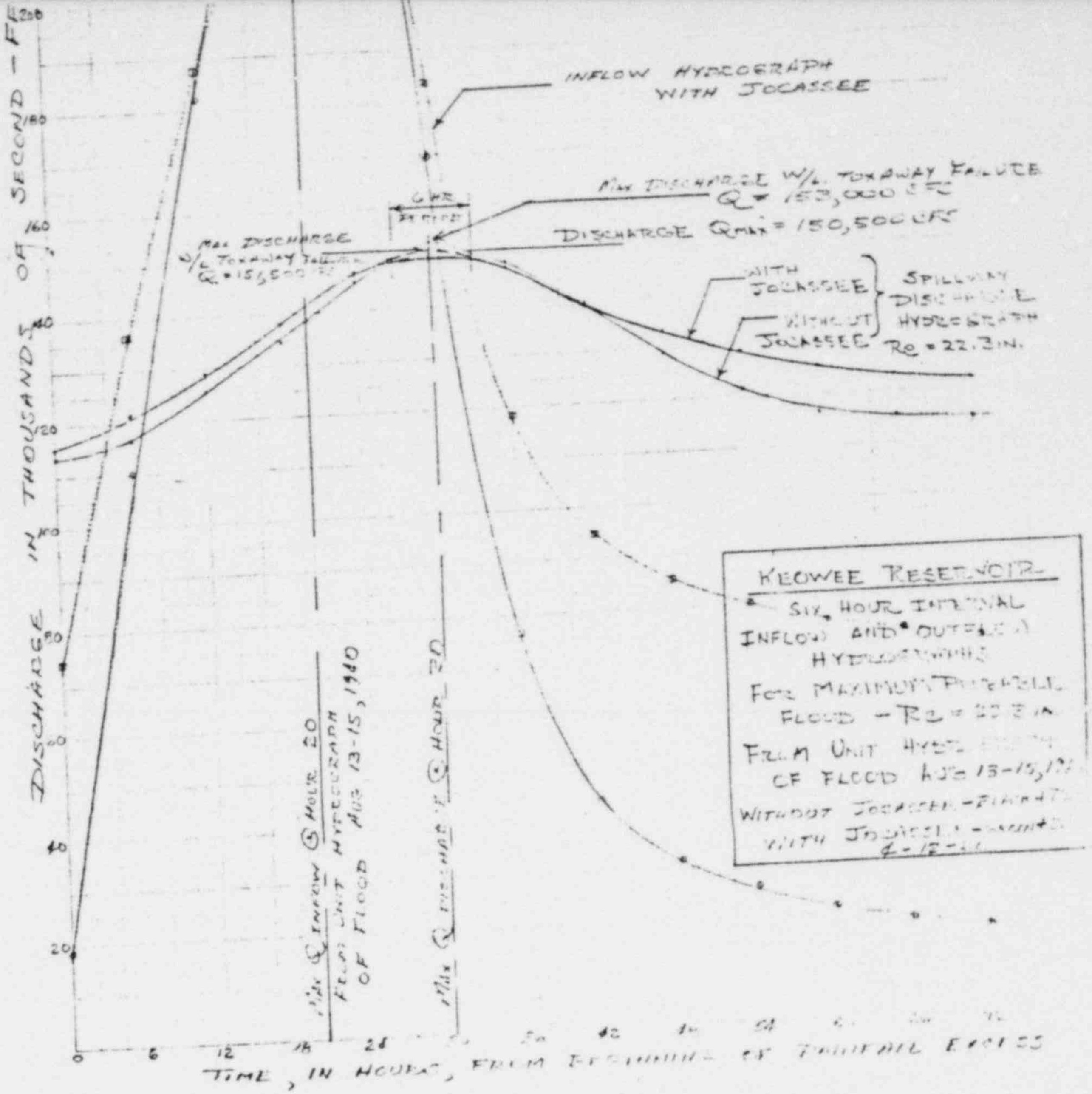


FOR UNIT HYDROGRAPH		
INTERVAL 6 HRS	TOTAL DIS. (CFS) AT END OF INTERVAL	RESERVOIR EL.
1	113,500	800.1
2	116,500	800.8
3	125,500	802.8
4	134,500	804.8
5	145,500	807.3
6	150,500	[illegible]
7	145,500	808.0
8	137,500	805.9
9	[illegible]	[illegible]
WITH LAKE TOXAWAY VOLUME ADDED TO MAX.		
6 HR	153,000	809.65

KEOWEE RESERVOIR
ROUTING OF
MAXIMUM PROBABLE FLOOD
FOR AUG 13-15, 1940
UNIT HYDROGRAPH
WITH
ONE UNIT DISCHARGE = 6.96 FT
WITHOUT JOCASSEE IN BLACK
WITH JOCASSEE IN RED

4-12-66


K-E
300
280
260
240
220
NATURAL INFLOW Q_{MAX} = 256,500 CFS
INFLOW HYDROGRAPH WITHOUT JOCASSEE



INFLOW HYDROGRAPH WITH JOCASSEE
MAX DISCHARGE W/ TOXAWAY FAILURE Q = 153,000 CFS
DISCHARGE QMAX = 150,500 CFS
MAX DISCHARGE W/ TOXAWAY FAILURE Q = 151,500 CFS
6 HR PERIOD
WITH JOCASSEE
WITHOUT JOCASSEE
SPILLWAY DISCHARGE HYDROGRAPH Re = 22.3 IN.
MAX Q INFLOW @ HOUR 20
FROM UNIT HYDROGRAPH OF FLOOD AUG 13-15, 1940
MAX Q DISCHARGE @ HOUR 20
KEOWEE RESERVOIR
SIX HOUR INTERVAL
INFLOW AND OUTFLOW
HYDROGRAPHS
FOR MAXIMUM PROBABLE
FLOOD
FROM UNIT HYDROGRAPH
OF FLOOD
DISCHARGE IN THOUSANDS OF SECOND - FT
TIME, IN HOURS, FROM BEGINNING OF RAINFALL EXCESS

KEOWEE - TOXAWAY STUDY

KEOWEE RESERVOIR

MAXIMUM FLOOD ROUTING

CQR 4-12-66

FGT 9-19-66

WITH MAXIMUM FLOOD OF RECORD (AUG 13-15, 1940) AT HIGHEST PEAK FOR RESERVOIR, WHAT WOULD HAPPEN IF LAKE TOXAWAY DAM GAVE WAY AND THAT VOLUME OF WATER WERE ADDED TO THE RESERVOIR?

HOW HIGH WOULD THE POOL RISE?

LAKE TOXAWAY DATA:

DA = 11.1 SQ.MI. NEW SPILLWAY CREST EL 2010

from Corps of Engr Area vs. Capacity Curves

@ EL 2010 = 11,500 AF

@ EL 2020 = 17,200 AF

FROM GRAPHICAL FLOOD HYDROGRAPH ROUTING OF AUG 13-15, 1940 FLOOD

MAX. HT. RESERVOIR POOL = EL 808.7

AREA @ EL. 808.7 = 20,274 Ac.

ASSUME L. TOXAWAY @ EL. 2020 FAILS AND RESERVOIR @ KEOWEE IS @ MAX EL. 808.7

$$\text{RISE IN POND} = \frac{17,200 \text{ A-F}}{20,274 \text{ Ac}} = 0.85 \text{ Ft.}$$

FLOOD FULL POND EL = 808.8

SURCHARGE = .85

FINAL ELEV = 809.65 ← MAX RESERV. LEVEL POSSIBLE

SPILLWAY DISCHARGE = 153,000 CFS

AVG. FLOW DURING 6 HR = 94,000 CFS.

POOL @ EL 800.0

AREA = 18,372 Ac.

$$\text{RISE IN POND} = \frac{17,200 \text{ Ac-Ft}}{18,372 \text{ Ac}} = .94 \text{ FT.}$$

EL. 800.0

+ SURCHARGE = .94

= FINAL ELEV.

KEOWEE - TOXAWAY
KEOWEE RESERVOIR 16
MAX. FLOOD PROBABLE CWR 6-12-66
AT FGT 9-17-66
KEOWEE RESERVOIR WITH JOCASSEE ABOVE

INFLOW = DISCH. from JOCASSEE @ FLOOD FLOWS
+ RAINFALL ON REMAINING KEOWEE D.A.
(D.A. = 455 - 148 = 307 SQ MI.)

∴ USE FLOOD DISCHARGE OF 4-6 OCT, 1964 HYDROGRAPH @ JOCASSEE

USE MODIFIED FLOOD RECORDS OF 12-13 AUG, 1940

MULTIPLIED BY FACTOR $\frac{307 \text{ sq mi}}{455 \text{ sq mi}}$ = .675

FLOOD FLOW @ KEOWEE FROM UNIT HYDROGRAPH OF AUG 12-13 [illegible]			
STEP	HOURS FROM BEGIN. OF STORM	MAX FLOOD INST. [illegible] INFLOW (CFS)	TIMES D.A. MULT. FACTOR 307/455 = .675
0	0	18,700	12,610
1	6	110,000	74,200
2	12	182,000	122,800
3	18	233,000	157,000
PEAK →		256,500	173,000
4	24	249,000	168,000
5	30	169,500	114,200
6	36	76,500	51,600
7	42	44,100	29,700
8	48	31,800	21,450
9	54	26,000	17,500
10	60	21,400	14,400
11	66	18,700	12,600
12	72	16,750	11,300

REVISED

17.

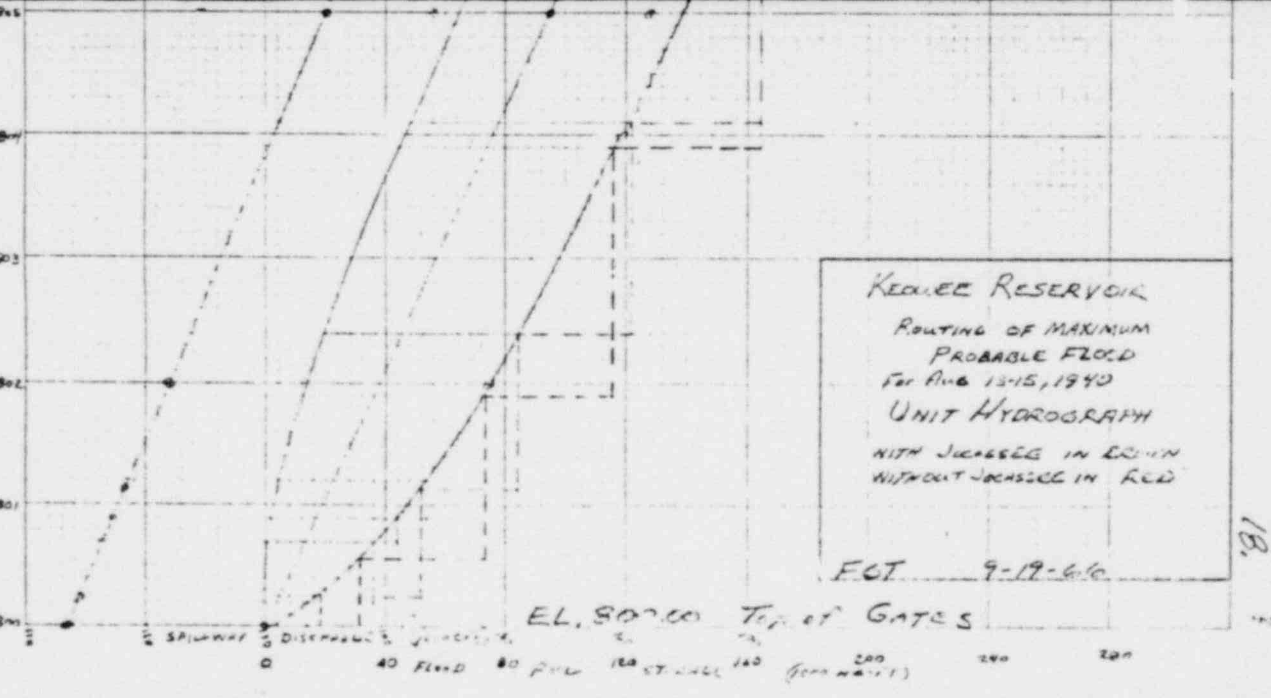
KEOWEE-TOXAWAY Studies
KEOWEE RESERVOIR Flood Routing
COMPARISON DATA for Unit Hydrograph ZRT 9-19-66

MAXIMUM Flood Probable Using Re = 22.3" {CARTER DAM}

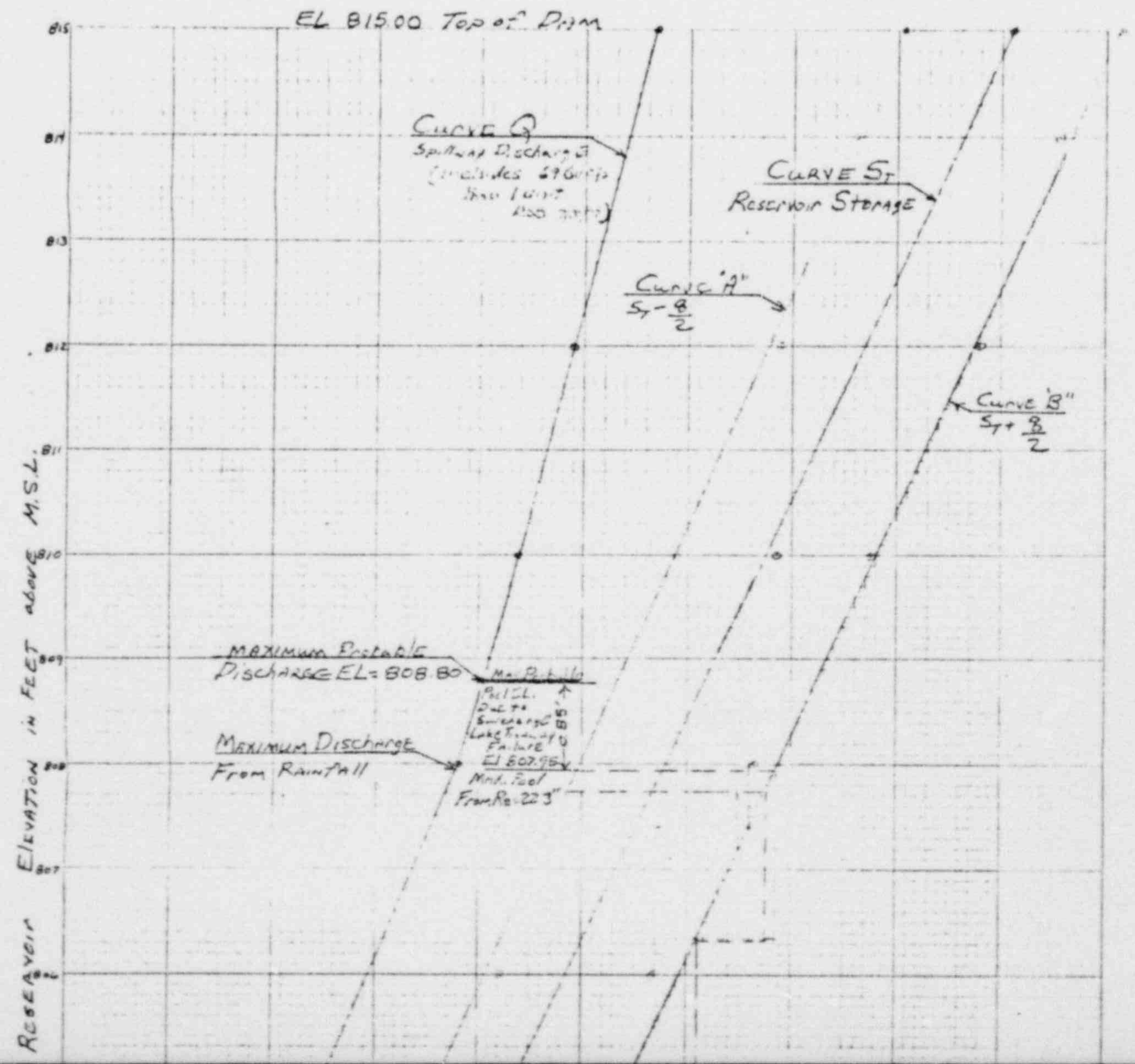
Using Unit Hydrograph For:
August 13-15, 1940
1 cfs = 0.5 AF/6HR

FOR UNIT HYDROGRAPH Re = 2.14"
MAXIMUM FLOOD Re = 22.3"

MAXIMUM FLOOD PROBABLE @ KEOWEE WITHOUT JOCASSEE DAM IN PLACE.				MAXIMUM FLOOD PROBABLE @ KEOWEE WITH JOCASSEE @ MAXIMUM DISCHARGE			
STEP	RATE OF INFLOW During Interval	SPILLWAY DISCHARGE	RESERVOIR ELEV	STEP	RATE OF INFLOW During Interval	SPILLWAY DISCHARGE	RESERVOIR ELEV.
	A-F/6HR	CFS	FT		A-F/6Hr	CFS	FT
0	4375.0	113,600	800.1	0	18,352	114,500	800.[illegible]
1	27,175.0	115,800	800.58	1	52,775	118,200	801.15
2	73,000.0	121,600	801.90	2	81,075	123,800	802.4
3	103,750.0	130,200	803.90	3	1[illegible]3,[illegible]00	131,000	804.12
4	119,750.0	140,900	806.35	4	11[illegible],575	140,900	806.35
5	102,000.0	146,700	[illegible] MAX.	5	105,675	147,900	807.75 MAX.
6	61,500.0		DECREASING ↓	6	75,325	147,900	807.95
7				7	53,200		DECREASING ↓
8							
9							
10							


KEOWEE RESERVOIR
ROUTING OF MAXIMUM PROBABLE FLOOD
FOR AUG 13-15, 1940
UNIT HYDROGRAPH
WITH JOCASSEE IN GREEN
WITHOUT JOCASSEE IN RED
EGT 9-19-66
EL. 800.00 Top of Gates
0
40
80
120
160
200
240
280

18.


EL 815.00 Top of Dam
Curve Q
Spillway Discharge Q
Curve ST
Reservoir Storage
Curve "A"
$S_T - \frac{Q}{2}$
Curve "B"
$S_T + \frac{Q}{2}$
Maximum Probable
Discharge EL = 808.80
Maximum Discharge
From Rainfall
El 807.95
Reservoir Elevation in Feet above M.S.L.
815
814
813
812
811
810
809
808
807
806

Form 184

Development: *Keowee - Toxaway* See Dwg. File No.

Subject: *Flood - Routing of Max. Probable Flood* Sheet No. 1

By TLB Date 7-14-70

(3 hr. intervals)

Aug. 13-15 1940

Hour / Day	Instan. Flow cfs	Avg. flow cfs	AF/day	AF/3 hr
12 M	2,300	3,215	6,370	796
3	4,130	7,615	15,070	1,884
6	11,100	14,000	27,700	3,460
9	16,900	17,450	34,550	4,320
12 N	18,000			
		18,900	37,400	4,680
3	19,800	21,350	42,300	5,290
6	22,900	23,900	47,400	5,920
9	24,900			
(peak) → 10	25,200	24,700	48,900	6,110
12 M	24,500			
		22,650	44,800	5,610
3	20,800	18,800	37,200	4,650
6	16,800	14,200	28,100	3,510
9	11,600	9,735	19,300	2,420
12 N	7,870			
		6,855	13,600	1,700
3	5,840	5,360	10,500	1,314
6	4,760	4,415	8,740	1,090
9	4,070	3,815	7,550	944
12 M	3,560			
	adjusted linearly to 3 hr. interval →	3,399	6,730	841
3	3,238			
4	3,130			
6	2,882	3,007	5,970	746
8	2,800			
9	2,620	2,710	5,370	672
12 N	2,560			
12 N	2,448	2,504	4,960	620
4	2,410			
3	2,283	2,346	4,660	582
6	2,240			
6	2,142	2,191	4,340	542
12 M	2,110			
9				

$1\ \text{CFS} \times \frac{1.98\ \text{a-f/day}}{\text{CFS}} \Rightarrow \frac{\text{a-f}}{\text{day}}$

24 HR = 8 - 3 HR PERIODS

$\therefore \text{AF/day} \div 8 = \text{AF/3 HR}$

Actual Instantaneous Flows

Form 184

Development: Keowee – Toxaway See Dwg. ____ File No. ____

Subject: Flood Routing of Max. Probable Flood Sheet No. 2

By TLB Date 7-14-70

Calculation of Unit hydrograph:

Continued from Keowee - Toxaway Project Flood studies For Check of Design Spillway Capacities – 4-12-66

Page 9 – CQR

R_e = 2.143, Max. Rain = 22.3 in.

Time from Begin of R_e in hrs.	Q_{net} = Instan. Dis. (less base flow)	$Q_{unit} = \frac{Q_{net}}{2.143}$ values for Unit Hydro.	$Q_{max} = Q_{unit} \times 22.3$ Max. Flood Probable
0	1,800	840	18,700
3	3,630	1,693	37,800
6	10,600	4,940	110,000
9	16,400	7,660	171,000
12	17,500	8,160	182,000
15	19,300	9,000	200,000
18	22,400	10,450	233,000
21	24,400	11,400	254,000
Peak @ [illegible]	24,700	11,500	256,500
24	[illegible]	11,180	250,000
27	20,300	9,480	212,000
30	16,300	7,600	169,500
33	11,100	5,180	116,000
36	7,370	3,430	76,500
39	5,340	2,380	53,000
42	4,260	1,985	44,300
45	3,570	1,665	37,100
48	3,060	1,430	31,900
51	2,738	1,275	28,400
54	2,382	1,110	24,800
57	2,120	988	22,000
60	1,948	908	20,200
63	1,783	830	18,500

Form 184

Development: Keowee-Toxaway
Subject: Flood Routing of Max. Probable Flood

Sheet No. 3

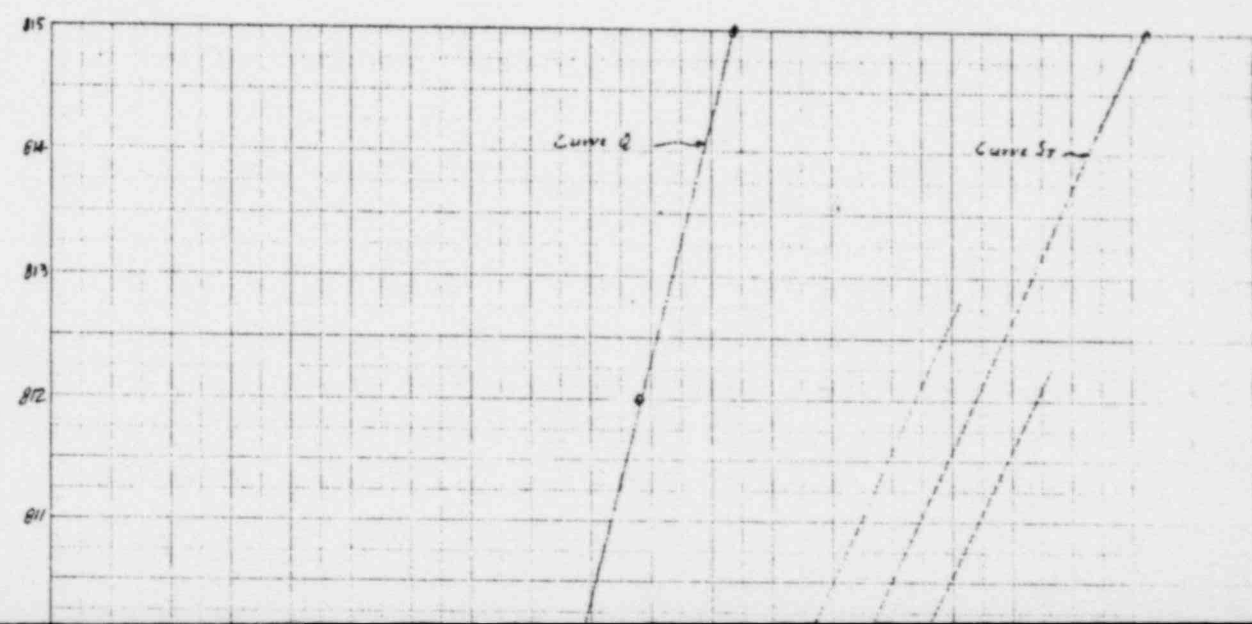
By: T.C.O. 7-14-70

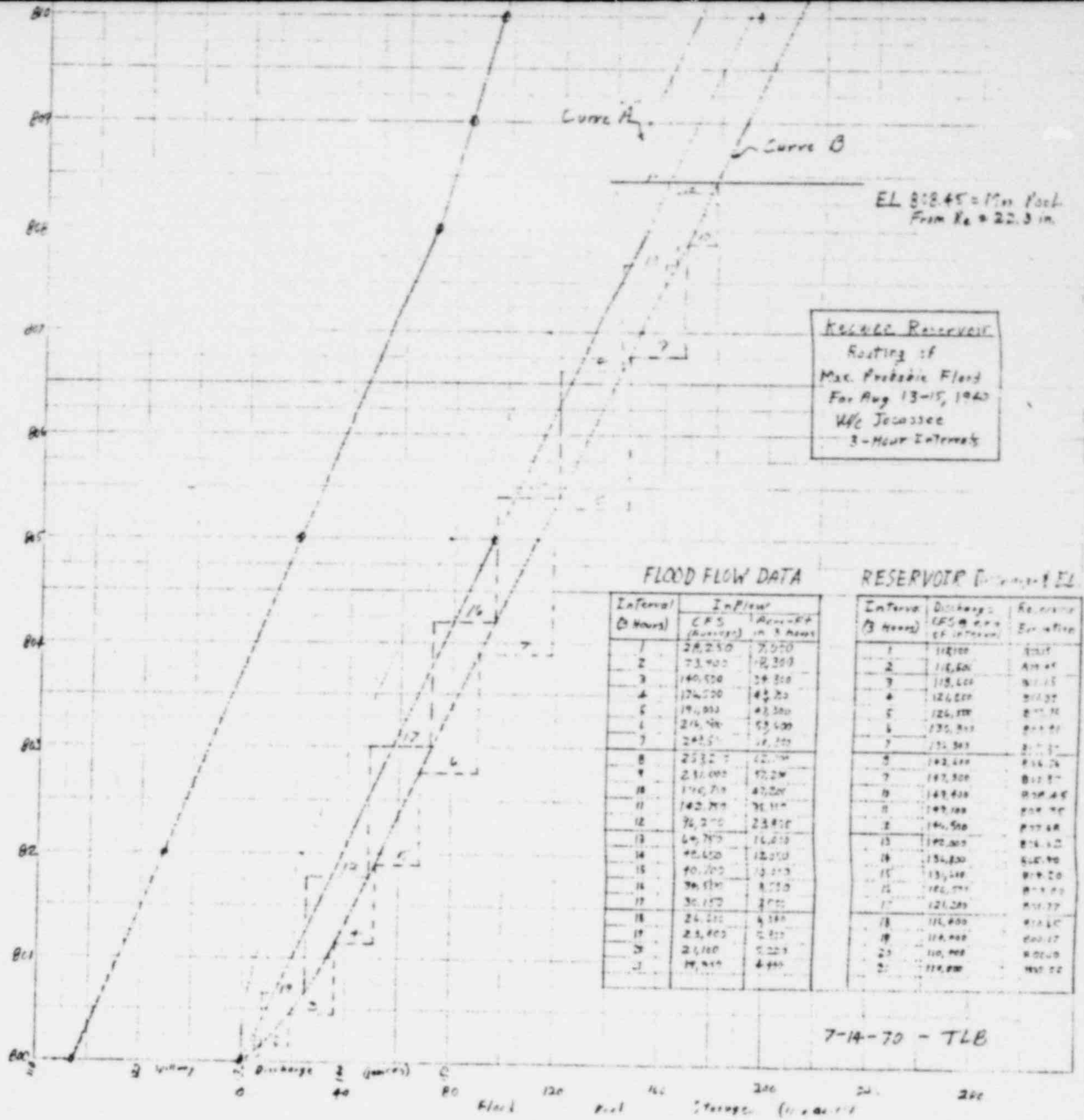
STEP	Time from Begin of Flood	Max. Flood Instan. Inflow (cfs) ①	Sum of Inflow @ Begin & End (cfs) ②	Rate of Inflow During Interval: ½ ② cfs	Rate of Inflow During Interval: AF/3hr
0	0	18,700	18,700	9,350	2,315
1	3	37,800	56,500	28,250	7,000
2	6	110,000	147,800	73,900	18,300
3	9	171,000	281,000	140,500	34,800
4	12	182,000	353,000	176,500	43,700
5	15	[illegible]	[illegible]	191,000	47,300

1 cfs = 1.98 a-f/day × ⅛ day

= 1.98/8 = .2475

6	18	233,000	433,000	216,500	53,600
7	21	254,000	487,000	243,500	60,300
Peak		256,500	510,500	255,250	63,200
8	24	250,000	506,500	253,250	62,700
9	27	212,000	462,000	231,000	57,200
10	30	167,500	381,500	190,750	47,200
11	33	116,000	285,500	142,750	35,350
12	36	76,500	192,500	96,250	23,850
13	39	53,000	129,500	64,750	16,000
14	42	44,300	97,300	48,650	12,050
15	45	37,100	81,400	40,700	10,050
16	48	31,900	69,000	34,500	8,550
17	51	28,400	60,300	30,150	7,500
18	54	24,800	53,200	26,600	6,340
19	57	22,010	46,800	23,400	5,800
20	60	20,200	42,200	21,100	5,220
21	63	18,500	38,700	19,350	4,800


815
814
813
812
811
Curve Q
Curve ST



FLOOD FLOW DATA

Interval (3 Hours)	Inflow CFS (Average)	Inflow Acre-Ft in 3 Hours
1	28,250	7,050
2	73,900	18,300
3	140,550	34,810
4	174,550	43,300
5	191,000	47,300
6	216,400	53,600
7	243,5[illegible]	[illegible]
8	253,2[illegible]	[illegible]
9	231,000	57,200
10	190,710	47,200
11	142,700	35,3[illegible]
12	96,2[illegible]	23,8[illegible]
13	64,7[illegible]	16,0[illegible]
14	48,650	12,0[illegible]
15	40,[illegible]	10,[illegible]
16	34,5[illegible]	8,5[illegible]
17	30,150	7,[illegible]
18	26,[illegible]	6,5[illegible]
19	23,[illegible]	5,[illegible]
20	21,100	5,22[illegible]
21	19,[illegible]	4,[illegible]

RESERVOIR Discharge & EL

Interval (3 Hours)	Discharge CFS @ end of interval	Reservoir Elevation
1	118,100	[illegible]
2	116,600	[illegible]
3	118,600	[illegible]
4	124,[illegible]	[illegible]
5	126,[illegible]	[illegible]
6	135,[illegible]	[illegible]
7	15[illegible]	[illegible]
8	142,[illegible]	816.[illegible]
9	147,300	817.[illegible]
10	149,400	818.45
11	149,100	818.[illegible]
12	146,500	817.[illegible]
13	142,[illegible]	816.[illegible]
14	134,850	815.90
15	13[illegible]	814.20
16	126,[illegible]	[illegible]
17	121,200	[illegible]
18	115,[illegible]	[illegible]
19	114,[illegible]	[illegible]
20	110,[illegible]	[illegible]
21	1[illegible]	[illegible]

7-14-70 - TLB