OPEN FILE COPY 56-121
Do not remove from
HYDROLOGIC STUDIES SECTION
SURFACE WATER BRANCH

KANAWHA RIVER, W. VA.

COMPUTED MEAN DAILY DISCHARGE AT SELECTED POINTS

Sept. 20 to Oct. 10, 1949

OPEN-FILE REPORT

APRIL 1956

Kanawha River, W. Va.

Computed Mean Daily Discharge at Selected Points

Sept. 20 to Oct. 10, 1949

GENERAL

The Water Pollution Control Section, Department of Health, Education, and Welfare, Cincinnati, Ohio has requested the District Office, Water Resources Division, Charleston, W. Va., to furnish daily discharge at selected points on the Kanawha River. These data are needed in connection with an analysis of pollutional problems in the Kanawha River. The analysis is being prepared for the Corps of Engineers, U. S. Army.

Records of daily discharge have been collected on the Kanawha River at Kanawha Falls, or comparable site, since March 1877. Those records including momentary minimum discharges have been published through Sept. 30, 1953.

Records of discharge on the Kanawha River at Charleston have been collected since June 1939 and published through Sept. 30, 1953. Generally, only those daily discharges exceeding 10,000 cubic feet per second have been published as such. Discharges below that figure have generally been published as five-day averages, since the stage-slope-discharge relationship becomes indefinite at the lower discharges, due principally to operation of the hydroelectric plants.

Continuous records of stage in the forebay and tailrace at each of the three hydro-electric plants on the Kanawha River are available. In addition, a continuous record of stage on the Ohio River is obtained at a point 0.4 mile upstream from the mouth of Kanawha River. The lock and dam at Gallipolis, Ohio, controls the pool at the above point as well as the pool in the Kanawha River below the lock and dam at Winfield.

The hydro-electric plants are usually operated from a central control station. The plants are operated in a manner to maintain the navigable pools above Winfield and Marmet within a 1-foot range. A 3-foot range is permitted above London. The plants are therefore run-of-the-river within the limitations of storage draw-down mentioned. Consequently, there is relatively small change between the instantaneous pool stages at midnight on successive days when the river discharge is constant. However, there is usually some fluctuation in the pool stages during the day, due principally to operation of the power plants with minor changes caused by operation of the locks.

There are 2,052 square miles of intervening drainage area between the gaging stations at Kanawha Falls and Charleston, the runoff from 1,145 square miles of which is measured at the gaging station on Elk River at Queen Shoals.

There are 1,824 square miles of intervening drainage area between the gaging station at Charleston and the mouth of Kanawha River at Point Pleasant. The gaging stations on Coal River at Ashford, 393 square miles, Little Coal River at Danville, 270 square miles, and Pocatalico River at Sissonville, 238 square miles, measure the runoff from a total of 901 square miles of this intervening area.

Supplemental measurements of the discharge of several ungaged tributaries to the Kanawha River have been made since 1946.

COMPUTATION OF DISCHARGE

Computation of daily mean discharge at selected points on the Kanawha River has been made as the sum of daily mean discharge at Kanawha Falls, plus or minus the change in discharge due to change in storage in the pool above the point, plus the discharge from the intervening gaged area above the point, plus the estimated discharge from the intervening ungaged area above the point.

Discharge at Kanawha Falls was determined from the gaging station record at that point.

Change in the storage in the pool areas was computed as a function of the recorded change in stage in the pool and the average area of the pool as measured from Kanawha River survey charts made by the Corps of Engineers, U. S. Army.

Discharge from the intervening gaged areas was determined from the gaging station records on Elk River at Queen Shoals, Coal River at Ashford, Little Coal River at Danville, and Pocatalico River at Sissonville.

Estimated discharge from the intervening ungaged areas was computed on the basis of discharge from the gaged areas and from curves of relation. The curves of relation were based on the comparison of supplemental discharge measurements of several ungaged areas with the discharge from one of the gaged areas on the same day.

Results of the computation of daily discharge at selected points on the Kanawha River during the period Sept. 20 to Oct. 10, 1949 are shown in the attached table.

Records for the gaging station at lock 6 at Charleston have been published previously in the form of 5-day averages in Water-Supply Papers 1143 and 1173. By use of the figures of daily discharge given herein, the 5-day average discharges will differ slightly from those published in the water-supply papers. However, the effect on the published monthly mean discharges is so small that the published figures will not be considered as revised.

KANAWHA RIVER

Daily Mean Discharge at Selected Points

Sept. 20 - Oct. 10, 1949

Date	Kanawha Falls Disch.cfs	London Dam Disch.cfs.	Chelyan Bridge Disch.cfs.	Marmet Dam Disch.cfs.	Charleston below mouth Elk River Disch. cfs.	Charleston lock 6 Disch.cfs.	Winfield Dam Disch.cfs.	Point Pleasant Disch.cfs.
9/20	5,300	5,320	5,360	5,370	5,480	5,470	5,510	5,310
21	5,700	5,800	5,867	5,900	6,190	6,220	6,400	7,220
22	5,160	5,180	5,200	5,200	5,340	5,320	5,320	4,240
23	4,510	4,520	4,540	4,540	4,780	4,790	4,870	5,710
24	4,900	4,800	4,830	4,840	5,050	5,050	5,140	4,480
25	4,380	4,140	4,160	4,160	4,310	4,310	4,350	4,360
26	3,640	4,150	4,150	4,140	4,260	4,240	4,190	5,070
27	3,190	3,000	3,060	3,090	3,230	3,240	3,350	2,960
28	4,130	4,190	4,200	4,200	4,290	4,280	4,340	4,200
29	4,380	4,480	4,590	4,640	4,800	4,900	5,170	4,930
30	5,970	5,790	5,910	5,910	6,050	6,000	6,550	6,190
10/1	8,540	9,440	9,760	9,920	11,290	11,270	11,680	10,930
2	5,840	5,490	5,610	5,640	7,240	7,290	7,870	8,350
3	5,160	5,240	5,350	5,390	6,370	6,380	6,560	7,020
4	4,640	4,220	4,230	4,210	4,860	4,860	5,080	5,550
5	5,030	5,180	5,280	5,330	5,790	5,780	5,760	5,900
6	4,900	4,920	4,960	4,960	5,420	5,430	5,620	5,350
7	4,640	4,870	4,920	4,940	5,240	5,240	5,380	5,380
8	4,260	4,380	4,450	4,480	4,740	4,740	4,830	4,500
9	4,640	4,370	4,380	4,380	4,700	4,710	4,860	5,210
10	4,000	3,920	3,920	3,910	4,020	3,990	3,900	4,060

Note: The discharge at the selected points was computed as the sum of the discharge at Kanawha Falls, plus or minus the change in discharge due to change in storage in the pool above the point, plus the discharge from the intervening gaged area above the point, plus the estimated discharge from the intervening ungaged area above the point.

KANAWHA RIVER, W. VA.

Daily Mean Discharge at Selected Points

Sept. 20 - Oct. 10, 1949

General.- Method of computing the daily mean discharge for selected points on the Kanawha River.

The gage on Kanawha River at Kanawha Falls, W. Va. is located above the navigation and power pool formed by the London Dam and the records are considered "excellent".

Using the daily mean discharge as the flow entering the head of Reach No. 1, Kanawha Falls to London Dam, the discharge was computed as the flow at Kanawha Falls plus or minus the change in storage in the navigation and power pool above the dam, plus the estimated inflow from the ungaged area. For each succeeding reach the discharge, at the end of the Reach, is the summation of the discharge entering the Reach, plus or minus the discharge represented by the change in storage in the Reach, plus the inflow measured at gaging stations, plus the estimated inflow from ungaged areas.

Change in Storage Computations.- There are three dams on the Kanawha River and the Gallipolis Dam on the Ohio River that provide pools for navigation on the Kanawha River.

The three dams on the Kanawha River, in addition to supplying water for navigation and lockages around the dams, also supply water for "Run-of-the-river" hydroelectric plant at each dam. Since the fluctuations of the water surface is controlled within narrow limits, there is relatively small change in stage between the instantaneous midnight gage readings on successive days. (The stages change during the day but tend to be very nearly the same on successive midnights).

Continuous automatic water-stage recorders are located at each end of each pool, with the exception of the head of London pool (Reach No. 1). For the pool from Winfield Dam to Marmet Dam, the water-stage recorders for the slope station at Charleston, W, Va. give intermediate stages in this pool (Reach 4, 4a and 5). For the pool from Gallipolis Dam to Winfield Dam, the water-stage recorder at Pt. Pleasant, located on highway bridge over the Ohio River and just above the mouth of the Kanawha River, records stages at the mouth of the Kanawha River for Reach No. 6.

The water surface area in each reach was determined from Kanawha River survey charts to a scale of one inch equals 200 feet, made by the Corps of Engineers.

The width of the navigation pool was scaled at one tenth (0.1) mile intervals to obtain the average width in the reach, which in turn was multiplied by the length of the reach. To this area the water surface area in the mouths of the tributaries, at pool level, was computed and added to obtain the total water surface area. The flow required to raise the water surface one foot in 24 hours was computed. To obtain the change in storage the average change in stage in the reach was multiplied by the rate of flow required to produce a one-hundredths foot change in the pool.

Computation of inflow.- The three main tributaries of the Kanawha River; Elk River, Coal River and Pocatalico River, are gaged as part of the water-resources program of West Virginia.

The Elk River (Reach 4), with a drainage area of 1,533 square miles, is gaged at Queen Shoals where the drainage area is 1,145 square miles. The Coal River, entering Reach 5, has a total drainage area of 890 square miles of which 393 square miles is above the gaging station on Coal River at Ashford and 270 square miles is above the gaging station on Little Coal River at Danville.

The Pocatalico River, entering Reach No. 5, has a total drainage area of 356 square miles, of which 238 square miles is above the gaging station at Sissonville.

The discharge at the gaging stations was used direct in some instances and the unit flow per square mile was also used in conjunction with supplementary discharge measurements on minor tributaries to estimate the runoff of ungaged areas.

Supplementary discharge measurements have been made on some ungaged tributaries since 1946. On such tributaries, where there were six or more supplementary measurements, curves of relation were constructed between the unit runoff of the tributary stream or streams, and the unit runoff at gaging stations as determined from the daily mean discharge on the date of the supplemental discharge measurement. The procedure is discussed in more detail in the description of each Reach.

Other supplemental discharge measurements have been made on the lesser tributaries but were not used in this study.

KANAWHA RIVER

Change in Storage Study

Kanawha River at Kanawha Falls, W. Va.

Location.- - Lat 38°08'20", long 81°12'45", on right bank 150 feet downstream from toll bridge, three-quarters of a mile downstream from the village of Kanawha Falls, Fayette County, 2 miles downstream from Gauley Bridge, and 2 miles downstream from confluence of New River and Gauley River.

Drainage area.- - 8,367 square miles.

Gage.- - Water-stage recorder. Datum of gage is 623.20 feet above mean sea level, datum of 1929. Prior to October 27, 1928, staff gage at several sites within nine miles of present site at various datums.

Records available.- - March 1877 to Sept. 30, 1955. October 1916 to September 1918 and October 1927 to October 1928 published as "at lock 2, Montgomery".

Remarks.- - Records excellent. Flow partly regulated since 1939 by Claytor Reservoir and since 1949 by Bluestone Reservoir (combined capacity 856,000 acre-feet).

KANAWHA RIVER AT CHARLESTON, W. VA.

A stream gaging station has been maintained on Kanawha River at Charleston, W. Va. from June 1939 to date, utilizing two continuous water-stage recorders to determine the slope of the water surface in the reach. Below a discharge of 10,000 cubic-feet per second, the slope-stage-discharge relation tends to become indefinite and daily discharges are not published; instead five-day averages are published. These five-day averages are computed by the regular slope-stage-discharge method or from records obtained at Kanawha Falls plus the measured inflow at Queen Shoals plus an estimate of the ungaged inflow based on a drainage area ratio (1.4 times the sum of the discharge at Ashford and Sissonville).

KANAWHA RIVER

Computations of Storage Study

Change in Storage Study

Reach No. 1

Location.- - Kanawha Falls to London Dam.

Gages.- - Automatic water-stage recorder, Kanawha River at Kanawha Falls, W. Va. Water-stage recorder on left bank 400 feet above London Dam.

Drainage areas.- -

8368 on diagram

Drainage area at Kanawha Falls	8,367 square miles
Drainage area at London Dam	8,490 square miles
Intervening area	123 square miles

Inflow into Reach.- - There are no gaging stations on tributaries in the reach.

Supplementary gaging points.- Seven discharge measurements have been made on Loop Creek in the vicinity of Kincaid, W. Va. A curve of relation based on the unit runoff indicated by the supplementary measurements and the unit runoff for the daily mean discharge at Coal River at Ashford, W. Va. The inflow was computed by taking the unit runoff at Kincaid from this curve of relation and multiplying it by the intervening ungaged area of 123 square miles.

attached computation sheet shows both 122 and 123. According to the diagram it is 8490 - 8368 = 122 sq mi. CTR

9-330

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

File No. { Washington ..... District .....

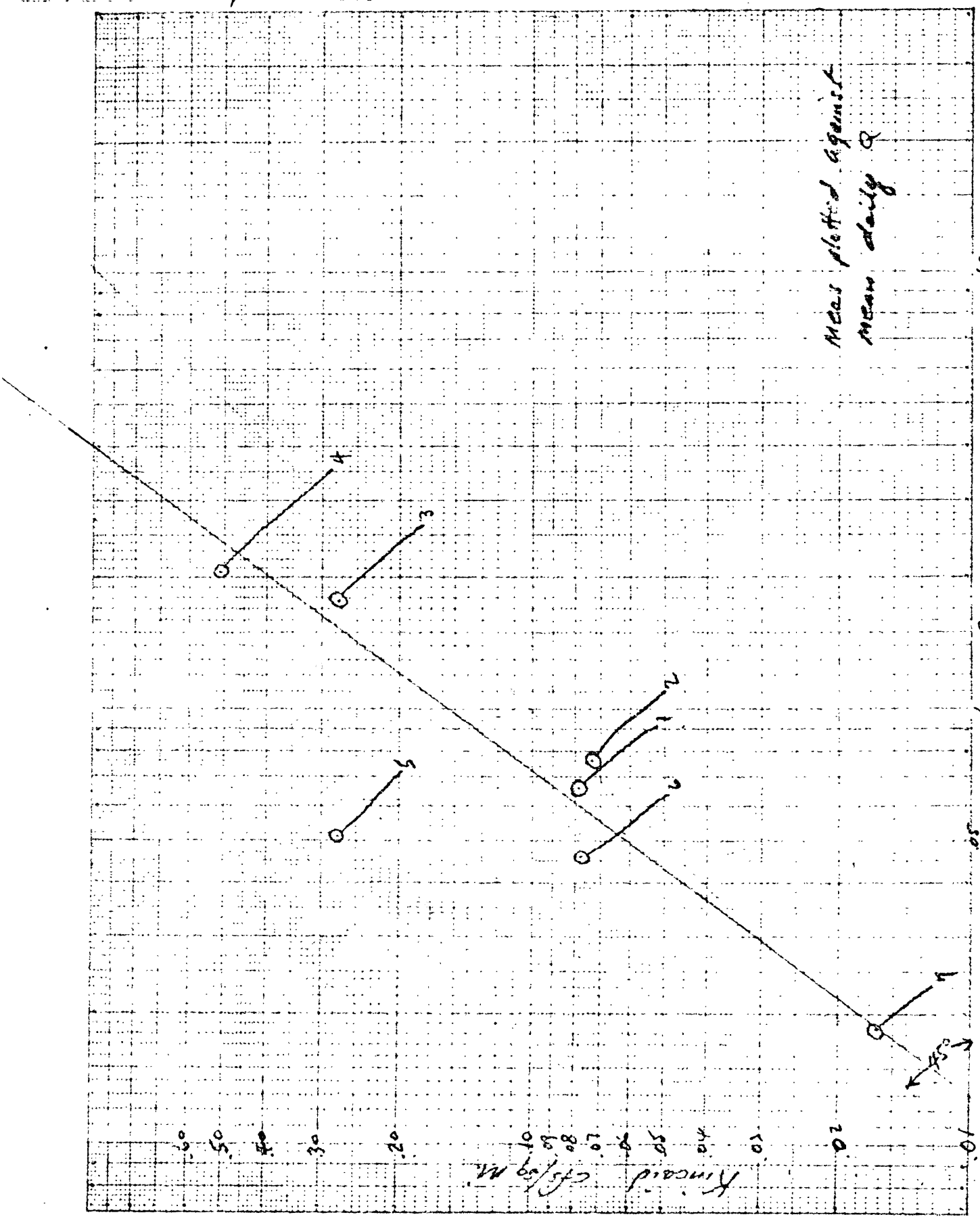
Inflow between Kanawha Falls & London Dam

1 Date 1949	2 Q Ashford	3 ②-9.65 K.	4 ③÷ 207 Unit Runoff	5 ④× 122	6 cfs/sq mi Ashford	7 cfs/sq mi Kincaid Curve Relation	⑧ ×122		7 ×123			
Sept 20	19.	14.	.057	16.6	.571	.577	12.1		12.2			
21	15.	15.	.072	9.2	.[illegible]	.[illegible]	.[illegible]		10.4			
22	2.3	16.	.048	5.8	.[illegible]	.[illegible]	11.		7.7			
23	2.2	15.	.052	6.4	.[illegible]	.071	8.7		8.7			
24	2.0	14	.049	5.9	.[illegible]	.[illegible]	7.1		7.7			
25	2.5	14.	.071	8.6	.[illegible]	.[illegible]	[illegible]		10.5			
26	24	14	.068	8.3	.[illegible]	.[illegible]	9.5		9.8			
27	2.2	12	.059	7.1	.[illegible]	.071	8.1		7.7			
28	2.2	15	.059	7.1	.[illegible]	.071	8.7		8.7			
29	1.[illegible]	11	.028	3.[illegible]	.[illegible]	.[illegible]	3.[illegible]		3.4			
30	.[illegible]	234	1.13	13.[illegible]	.[illegible]	1.1	220		221			
Oct 1	1.[illegible]	143	.364	44	.[illegible]	1.37	167		169			
2	.[illegible]	117	.765	1.[illegible]	.[illegible]	.95	92		92			
3	.[illegible]	75	.387	4.[illegible]	.[illegible]	.46	56		57			
4	1.6	56	.270	32.9	.[illegible]	.271	33		38			
5	5.4	44	.212	25.[illegible]	.[illegible]	.24	29		30			
6	4.6	36	.174	21.[illegible]	.117	.192	23		24			
7	3.[illegible]	29	.140	17.0	.[illegible]	.157	19		19			
8	3.[illegible]	26	.126	15.9	.[illegible]	.132	17		17			
9	2.1	21	.[illegible]	12.3	.[illegible]	.111	14		14			
10	2.[illegible]	12	.[illegible]	[illegible]	.[illegible]	.098	12		12.2			

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

File

Loop Creek.



Sheet No. ___ of ___ sheets Prepared by [illegible] Date 3/22/76 Checked by ___ Date ___

GPO 863802

KANAWHA RIVER

Change in Storage Study

Reach No. 2

Location.- - London Dam to Chelyan bridge.

Gages.- - Upper gage is automatic water-stage recorder located 200 ft downstream from the London Dam. Lower gage is a water-stage recorder located 220 feet upstream from the Marmet Dam, and six miles below Chelyan bridge.

Drainage areas.- -

Drainage area at London Dam	8,490 square miles
Drainage area below mouth of Cabin Creek	8,735 square miles
Intervening area	245 square miles

Inflow into Reach.- - There are no gaging stations on tributaries in the reach.

Supplementary gaging points.- Seven discharge measurements have been made on Paint Creek in the vicinity of Kingston, W. Va. and seven discharge measurements have been made on Cabin Creek in the vicinity of Eskdale, W. Va. Curves of relation were drawn for the unit runoff of these two tributaries as indicated by the supplementary measurements and the unit runoff for the daily mean discharge for Coal River at Ashford.

Methods of estimating inflow from ungaged areas.- - The estimated runoff per square mile iwas computed for each of the two tributaries at the miscellaneous measuring sites using the respective curves of relation. The runoff per square mile of the tributaries was then averaged and used as the average runoff per square mile of the intervening drainage

area. The estimated inflow was found by multiplying the average runoff per square mile by the intervening drainage area of 245 square miles. An alternate method was investigated that indicated better results might be obtained by one curve of relation based on the sum of the discharges at the two miscellaneous sites divided by the sum of the drainage areas at the sites, plotted against the unit runoff at Ashford. As there were too few simultaneous measurements on the tributary, the points were considered too few to be conclusive. However, the result of method No. 2 plotted against Method No. 1 showed good consistency and would be less laborious to compute in cases of long periods of summation computations.

9-230

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

File No. { Washington ..... District .....

Kanawha River.

Estimated Inflow between London Dam & Chelyan Bridge, W. Va

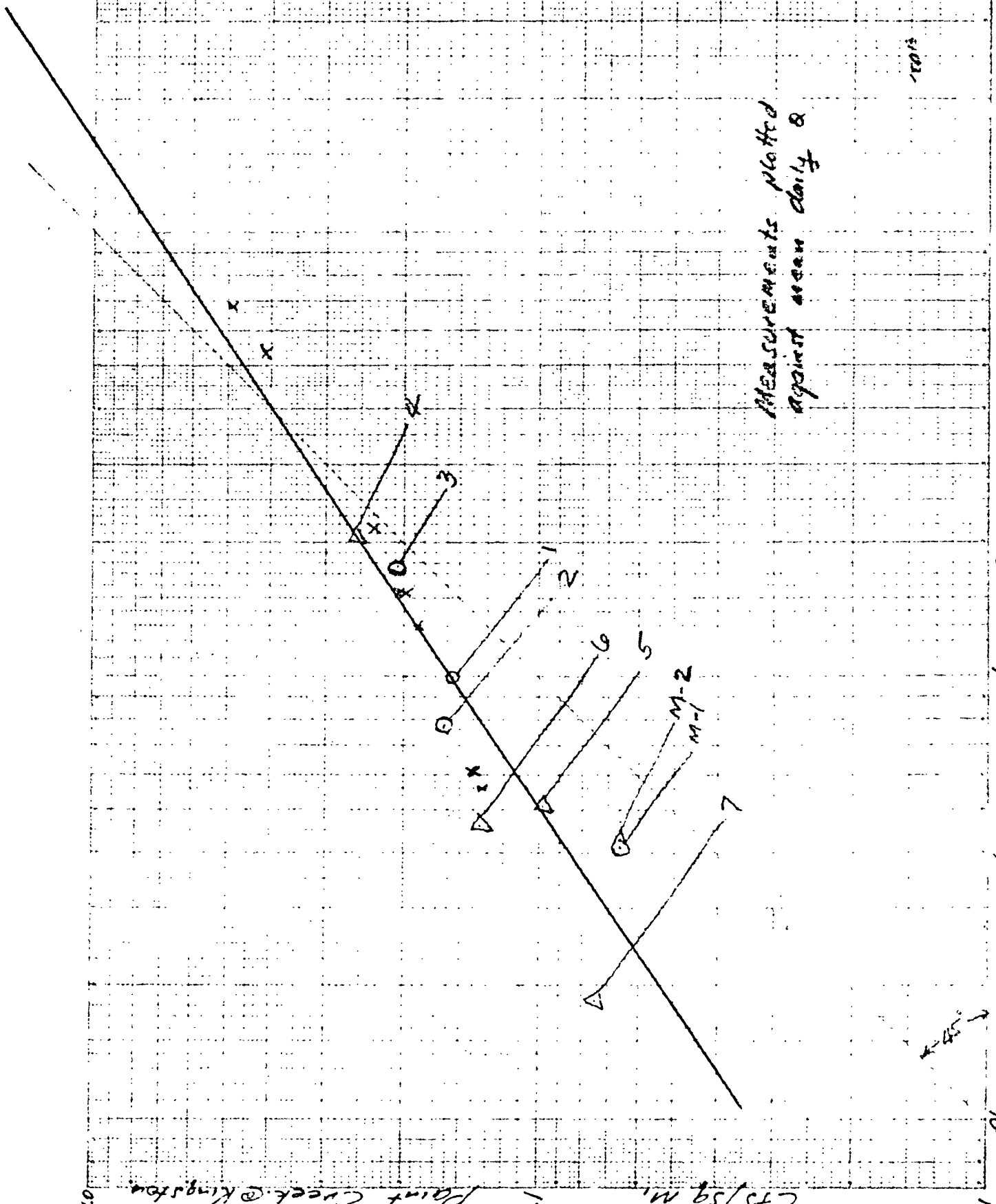
1	2	3	4	5	6	7	8	9	10	11	12	
Date 1929	Discharge Ashford cfs.	Ashford cfs/sq.m. (2)/393	Unit runoff Eskdale cfs/sq.m.	Unit runoff Kingsdale cfs/sq.mi.	Average Eskdale & Kingston (4)(5)÷2	Inflow (6)x245		Curve Eskdale & Kingston cfs/sq.mi.	cfs [illegible] (9)x265			
Sept 20	23	[illegible]	.168	.125	.146	35.8		.152	37			
21	25	[illegible]	[illegible]	.113	.135	33.1		.143	35			
22	20	[illegible]	[illegible]	[illegible]	.112	27.4		.122	30			
23	22	.056	.135	.107	.121	29.6		.130	32			
24	20	.051	.135	.100	.112	27.4		.122	30			
25	25	.064	.152	.118	.135	33.1		.143	35			
26	24	[illegible]	.145	.112	.128	31.4		.138	34			
27	22	.056	.135	.107	.121	29.6		.130	32			
28	22	[illegible]	.135	.107	.121	29.6		.130	32			
29	21	[illegible]	.350	.212	.281	68.8		.259	63			
30	244	.621	1.27	[illegible]	[illegible]	220		.660	162			
Oct 1	198	.504	1.03	.465	.748	183		.575	141			
2	127	[illegible]	.690	[illegible]	.518	127		.423	104			
3	88	[illegible]	[illegible]	.270	[illegible]	93.1		.330	81			
4	66	[illegible]	.372	[illegible]	.297	72.8		.271	66			
5	54	.137	.310	.195	.252	61.7		.237	58			
6	46	.117	.268	.175	.222	54.4		.215	53			
7	39	[illegible]	.230	.155	[illegible]	47.0		.191	47			
8	36	[illegible]	.215	.148	.182	44.6		.182	45			
9	34	[illegible]	[illegible]	.135	[illegible]	39.4		.163	40			
10	28	.071	[illegible]	.125	[illegible]	35.8		.152	37			

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON, D. C.

Cabin Creek at Eskdale, W. Va.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

Point Creek near Kingston, W. Va.



Point Creek @ Kingston

Sheet No. ... of ... sheets Prepared by WLD Date 3-30-56 Checked by ... Date ...

KANAWHA RIVER

Change in Storage Study

Reach No. 3

Location.- - Chelyan bridge to Marmet dam.

Gages.- - Upper gage is automatic water-stage recorder located 200 ft downstream from the London dam. Lower gage is a water-stage recorder located 220 feet upstream from the Marmet dam, and six miles below Chelyan bridge.

Drainage areas.- -

Drainage area to and including mouth of Cabin Creek	8,735 square miles
Drainage area at Marmet dam	8,816 square miles
Intervening area	81 square miles

Inflow into Reach.- - There are no gaging stations on tributaries in the reach.

Supplementary gaging points.- None.

Method of estimating inflow from ungaged areas.- The same unit runoff as computed for Reach No. 2 was assumed to apply in this reach, and the estimated inflow was computed by multiplying the average unit runoff as determined by curve of relation of Eskdale plus Kingston, times the intervening area of 81 square miles.

9-230

Estimated in Acre

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

File No. Washington ..... District .....

Chelyan Bridge & Marmet Dam

1 Date 1949	2	3	4	5	6 Av. Runoff Eskdale Kingston (4+5)÷2	7 CFS Inter. Area Runoff (6) × 81	8	9 Curve Eskdale Kingston CFS	10 CFS Interval Area (9) × 81			
Sept 20					.146	12		.152				
21					.135	11		.143				
22					.112	9		.132				
23					.121	10		.130				
24					.112	9						
25					.135	11						
26					.146	12						
27					.121	10						
28					.121	10						
29					.281	23						
30					.900	73						
Oct 1					.975	79						
2					.498	40						
3					.368	30						
4					.297	24						
5					.252	20						
6					.222	18						
7					.192	16						
8					.182	15						
9					.161	13						
10					.146	12						

KANAWHA RIVER

Change in Storage Study

Reach No. 4

Location.- - Marmet dam to Charleston upper gage (below mouth of Elk River).

Gages.- - Upper gage is water-stage recorder located 50 feet downstream from the Marmet dam. Lower gage is automatic water-stage recorder on left bank 0.5 mile downstream from Elk River and 3 miles upstream from gage at Kanawha River at Charleston (lock 6).

Drainage areas.- -

Drainage area at Marmet dam	8,816 square miles
Drainage area at Charleston gage (upper)	10,419 square miles
Intervening area	1,603 square miles
Gaged area, Elk River at Queen Shoals	1,145 square miles
Ungaged intervening area	458 square miles

Inflow into Reach.- - The station on Elk River at Queen Shoals is the only gaged tributary in this reach.

Supplementary gaging points.- There were no supplementary gaging points made on minor tributaries.

Method of estimating inflow from ungaged area.- The unit runoff of the ungaged area was assumed to be the same as the average unit runoff of the sum of the discharge at Coal River at Ashford plus Pocatalico River at Sissonville divided by the sum of the two drainage areas multiplied by the intervening drainage area of 458 square miles. Coal River at Ashford and Pocatalico River at Sissonville were used as representative records because of their location on opposite banks of the Kanawha River and their relatively small drainage areas.

9-230

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

File No. { Washington _____ District _____

Kanawha River

Estimated Inflow between Marmet Dam and Charleston, W. Va.

1 Date 1949	2 Q Queen Shoals	3 Q Ashford 373	4 Q Sissonville	5 CSM QS	6 CSM Ash	7 CSM Sissonville 2387	8	9	10 Σ Ash + Sissonville 3+4	11 Col 10 / 631	12 Col 11 × 45.8	13 Σ inflow 2+11
Sept 20	143	28	5	129	.071	.0021			28.5	.045	20.6	169
21	14[illegible]	25	5	129	.064	.0021			25.5	.0404	18.5	166
22	159	20	5	148	.051	.0021			20.5	.0324	14.8	184
23	204	22	8	178	.056	.0034			22.5	.0361	16.5	221
24	[illegible]	20	8	[illegible]	.051	.0034			20.8	.033	15.1	193
25	144	25	7	136	.064	.0029			25.7	.0407	18.6	163
26	[illegible]	24	5	107	.061	.0021			24.5	.0388	17.8	140
27	[illegible]	22	4	094	[illegible]	.0017			22.4	.0356	16.2	124
28	[illegible]	22	4	087	.056	.0017			22.4	.0354	16.2	116
29	[illegible]	61	7	103	[illegible]	.0029			61.7	.0977	45	163
30	[illegible]	244	8	214	.021	.0034			244.[illegible]	.388	178	423
Oct 1	1270	198	8	1.11 ~~1.08~~	[illegible]	.0034			198.[illegible]	.315	144	1410
2	1280	127	7	1.12	[illegible]	[illegible]			127.7	.202	93	1370
3	[illegible]	88	6	763	[illegible]	.0025			[illegible]	.140	64	938
4	619	66	5	540	[illegible]	.0021			[illegible]	.105	48	666
5	430	54	4	398	[illegible]	.0017			54.4	.086	39	475
6	[illegible]	46	4	314	[illegible]	[illegible]			46.4	.074	34	393
7	299	39	4	252	[illegible]	.0017			39.4	.062	28	317
8	[illegible]	36	6	217	[illegible]	.0025			36.6	.058	26.6	275
9	[illegible]	31	7	188	[illegible]	.0029			31.7	.050	23.9	238
10	[illegible]	28	6	168	[illegible]	.0025			28.6	.0453	20.7	213

KANAWHA RIVER

Change in Storage Study

Reach No. 4-A

Location.- - Kanawha River at Charleston upper (below mouth of Elk River) and Kanawha River at Charleston, lock 6.

Gages.- - Water-stage recorder. Datum of gage is 548.00 feet above mean sea level, datum of 1929 (levels by Corps of Engineers). Auxiliary water-stage recorder on left bank 0.5 mile downstream from Elk River and 3 miles upstream from base gage.

Drainage area.- - Drainage area at the Charleston gage, 10,419 square miles. As the gages are only 3 miles apart and there is practically no intervening area, the inflow into the reach was disregarded.

KANAWHA RIVER

Change in Storage Study

Reach No. 5

Location.- - Charleston gage to Winfield dam.

Gages.- - Water-stage recorder located at Kanawha River at Charleston (old lock 6) and lower gage is automatic water-stage recorder on left bank 300 feet upstream from Winfield dam.

Drainage area.- -

Drainage area at Charleston gage		10,419 sq mi
Drainage area at Winfield dam		11,810 sq mi
Intervening area		1,391 sq mi
Gaged drainage area		
Coal River at Ashford	393	
Little Coal River at Danville	270	
Pocatalico River at Sissonville	238	901 sq mi
Normally ungaged intervening drainage area		490 sq mi = normally ungaged
Drainage area gaged by supplementary discharge measurements, Coal River at Tornado:		
Coal River at Tornado	861	not counted above
Coal River at Ashford +	663	counted above
Little Coal River at Danville	198	= net not counted
gaged area not counted above		198 sq mi = temporarily gaged
Ungaged intervening drainage area to be estimated		292 sq mi = net ungaged
Drainage area Pocatalico River sources to mouth		356 sq mi

Inflow into reach.- - There are three gaging stations on tributaries entering the reach; namely, Coal River at Ashford, Little Coal River at Danville and Pocatalico River at Sissonville.

Supplementary gaging points.- Twelve discharge measurements have been made on Coal River in the vicinity of Tornado, W. Va. A curve of relation was drawn between the unit discharge indicated by supplementary measurements at Tornado and the sum of the discharge at Ashford plus Danville divided by the sum of the two drainage areas.

The ungaged inflow was estimated as follows: A curve of relation based on the unit runoff indicated by the supplementary measurements for Coal River at Tornado and the unit runoff of the summation of the unit discharge at the gaging stations at Ashford plus Sissonville, divided by the summation of the two drainage areas and multiplied by the ungaged area of 292 square miles. The total inflow into the reach is estimated by the summation of the discharge at Sissonville plus the estimated discharge at Tornado plus the estimated inflow from the intervening area.

9-280

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

File No. { Washington ..... District .....

Kanawha River Charleston Gage to Winfield Dam.

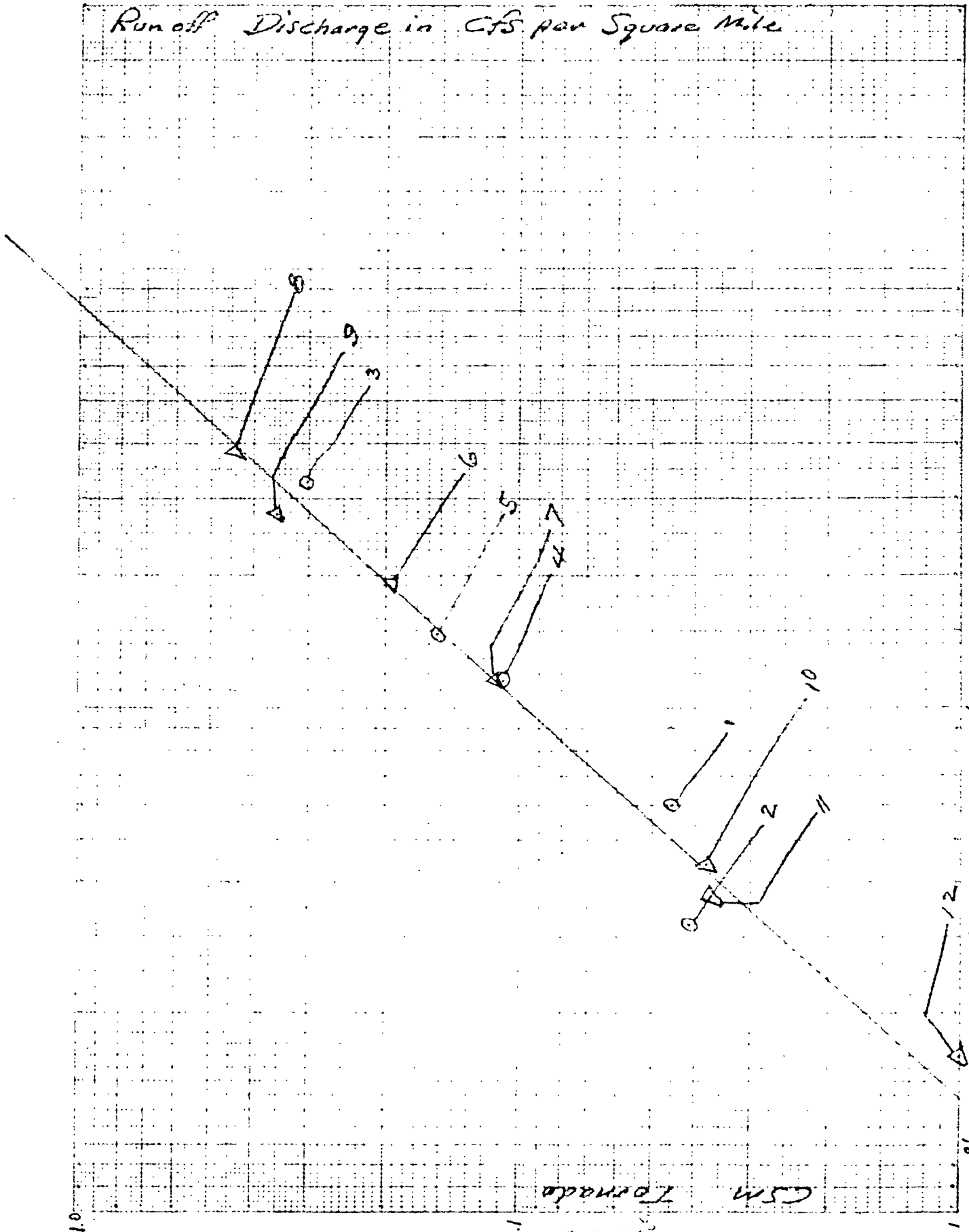
Date 1949	1 Disch. Danville cfs (7)	2	3 Disch Ashford cfs	4	5 Danville + Ashford (1)+(3)	6 Σ/DA 5/663	7 Cfs/Sm. Tornado [illegible]	8 Q [illegible] Z [illegible]	9 Q Sissonville cfs	10 Σ Ashford + Sissonville ÷631	11 Inflow Col (10) x 29.2	12 Total inflow (8)+(9)+(11)
Sept 20	22		28		50	.075	[illegible]	60	.5	.045	[illegible]	74
21	17		25		42	[illegible]	[illegible]	50	.5	.0404	11.8	62
22	13		20		33	.050	.045	37	.5	.0324	[illegible]	49
23	11		22		33	.050	.045	[illegible]	.8	.0361	[illegible]	50
24	13		20		33	.050	.045	37	.8	.033	[illegible]	47
25	14		25		39	.059	.054	40	.7	.0407	[illegible]	[illegible]
26	12		24		36	.054	.049	42	.5	.0388	11.3	[illegible]
27	11		22		33	.050	.045	39	.4	.0354	[illegible]	[illegible]
28	12		22		34	.051	.046	40	.4	.0354	[illegible]	51
29	62		61		123	.186	.191	[illegible]	.7	.0977	[illegible]	[illegible]
30	160		244		404	.607	.71	611	.8	.388	113	725
Oct 1	87		198		285	.430	.43	413	.8	.314	91	505
2	55		127		182	.274	.275	254	.7	.202	59	314
3	40		88		128	.193	.200	172	.6	.140	41	214
4	33		66		99	.149	.150	129	.5	.105	31	160
5	29		54		83	.125	.125	108	.4	.086	25	133
6	26		46		72	.109	.106	91	.4	.074	22	113
7	24		39		63	.095	.091	72	.4	.062	16	96
8	21		36		57	.086	.084	71	.6	.058	16.9	[illegible]
9	18		31		49	.074	.069	59	.7	.050	[illegible]	72
10	18		28		46	.069	.064	[illegible]	.6	.0455	[illegible]	67

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

File

Summation Danville plus Ashford vs Tornado, W. Va.

Run off Discharge in CFS per Square Mile

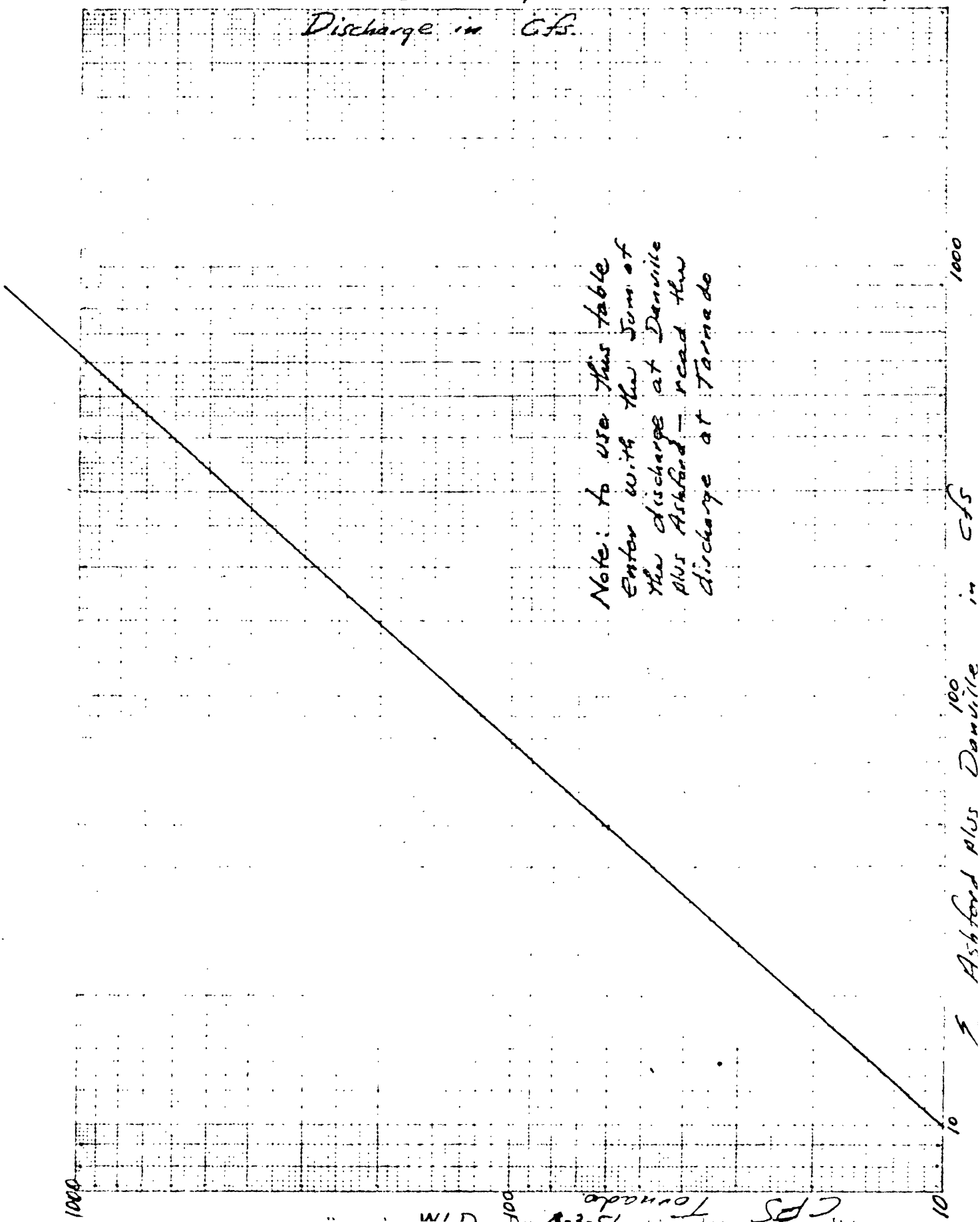


Sheet No. of sheets. Prepared by WLD Date 4-3-56 Checked by Date

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

(5)

Curve of Relation Σ Danville plus Ashford VS Tornado, W. Va.



9-230

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

File No. { Washington ..... District .....

Summation Danville & Ashford vs Tornado, W. Va

Date	1 Disch Danville cfs	2 Disch Ashford cfs.	3 Σ Danville Ashford (1)+(2)	4 cfs/sqm. (3)/663	5 Misc Meas Tornado	6 Disch Tornado	7 cfs/sqm. Tornado (6)/861	8				
11-1-43	13	20	33	.060	1	39.1	.045					
8-3-44	10	11	21	.032	2	35.2	.041					
8-20-47	93	123	216	.326	3	259	.301					
6-9-49	21	56	77	.116	4	94.1	.109					
10-4-49	33	66	99	.149	5	131	.152					
9-15-50	35	92	127	.192	6	167	.194					
9-19-50	30	47	77	.116	7	97	.113					
9-29-50	94	159	253	.382	8	382	.444					
10-13-50	68	115	183	.276	9	306	.355					
10-12-51	13	16	29	.044	10	328	.038					
11-7-52	7.5	17	24.5	.037	11	31.5	.037					
9-29-53	2.8	7.6	10.4	.016	12	8.9	.010					

KANAWHA RIVER

Change in Storage Study

Reach No. 6

Location.- - Winfield Dam to mouth of Kanawha River.

Gages.- - The upper gage is automatic water-stage recorder located 50 feet downstream from the Winfield dam. The lower gage is automatic water-stage recorder at bridge on U. S. highway 35 over the Ohio River at Pt. Pleasant, W. Va., 0.4 mile upstream from Kanawha River. Datum of gage is 1,514.10 feet above mean sea level, Sandy Hook datum (levels by Corps of Engineers).

Drainage areas.- -

Drainage area at Winfield dam	11,810 square miles
Drainage area at mouth of Kanawha River	12,243 square miles
Intervening area	433 square miles

Inflow into reach.- - There are no gaging stations on tributaries in the reach.

Supplementary gaging points.- None.

Method of estimating inflow for ungaged areas.- - Since the topography and characteristics of the small tributaries in this reach are most nearly similar to Pocatalico River at Sissonville or Mud River near Milton, the inflow into the reach was estimated by multiplying the unit runoff at Sissonville by the total intervening area of 433 square miles.

9-880

(6)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

File No. { Washington ____ District ____

Estimated inflow

Winfield Dam and Mouth of Kanawha River

1 Date 1949	2 Mud R. M.Hon cfs	3 Mud R. M.Hon CSM (2)÷291	4 Inflow (18 mile) cfs from Curve Relation	5 Inflow cfs (4)x432	6	7 cfs Sissonville	8 Unit Runoff Sissonville (2)8	9 total Inflow (8)x[illegible]				
Sept 20	1.3	.0045					.0021	.9				
21	6.5	.022					.0021	.9				
22	3.9	.013					.0021	.9				
23	2.5	.0086					.0034	1.5				
24	1.1	.0038					.0034	1.5				
25	.9	.0031					.0029	1.3				
26	.8	.0027					.0021	.9				
27	.8	.0027					.0017	.7				
28	1.1	.0038					.0017	.7				
29	2.3	.0079					.0029	1.3				
30	3.9	.013					.0034	1.5				
Oct 1	10	.034					.0034	1.5				
2	8.4	.029					.0029	1.3				
3	6.8	.023					.0025	1.1				
4	5.4	.019					.0021	.9				
5	4.2	.014					.0017	.7				
6	3.0	.010					.0017	.7				
7	1.9	.0065					.0017	.7				
8	1.5	.0052					.0025	1.1				
9	1.1	.0038					.0029	1.3				
10	1.1	.0038					.0025	1.1				

Kanawha River at Charleston Lock 6

September 21 to October 10, 1949

Sept. 21-25	Sept. 26-30	Oct. 1-5	Oct. 6-10
6220	4240	11270	5430
5320	3240	7290	5240
4790	4280	6380	4740
5050	4900	4860	4710
4310	6000	5780	3990
25690	22660	35580	24110
5140 +9.4%	4530 00	7120 +9.6%	4820 -3.2%
4700	4540	6500	5060

5140
4530
7120
4820
21610
5400 +3.8%

9-330-a
(October 1947)
COMPUTATION FORM—DOUBLE

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

File .....

1949

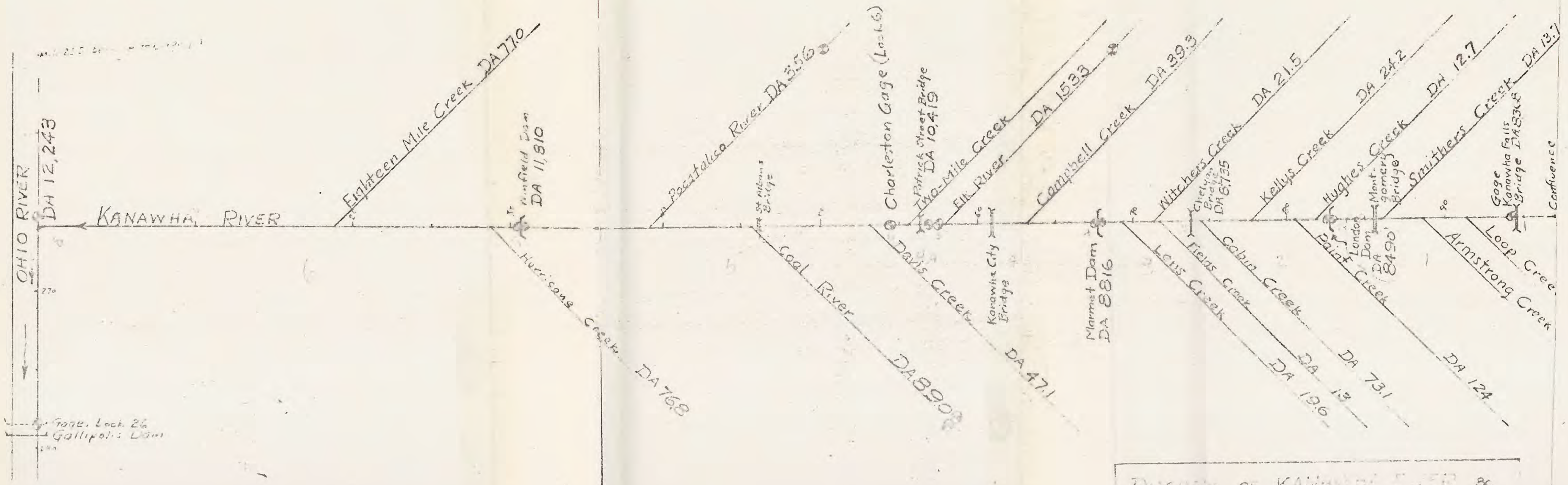
KANAWHA FALLS			LONDON DAM				CHELYAN BRIDGE						TO MARMET 3			MARMET TO CHARLESTON UPPER					CHAS. UPPER TO CHAS. (LOWER)					CHARLESTON (LOWER) TO WINFIELD					WINFIELD TO POINT PLEASANT					
Date 1949 TIME	G.H.	DISCH.	CHG. IN LOCK LONDON UPPER	4.87/.01 CORR.	INFLOW	DISCH	CHG. LONDON LOWER	IN POOL AV. MARMET UPPER	CHG. LONDON TO CHELYAN	3.99/.01 CORR.	INFLOW	DISCH	2.91/.01 CORR.	INFLOW	DISCH	CHG. IN MARMET LOWER	CHG. IN CHAS. UPPER	MEAN	4.64/.01 CORR.	INFLOW	DISCH.	Change IN CHAS. LOWER	MEAN	1.63/.01 CORR.	INFLOW	DISCH	CHG IN WINFLD	MEAN	12.17/.01 CORR.	INFLOW	DISCH	CHG IN WINFLD LOWER	CHANGE IN PT. PL.	MEAN	4.43/.01 CORR.	INFLOW	DISCH.
Sept 19	1.71	4210	+.1	-.5	—		+.07	.00	+.016	-.1	—					+.26	+.25	+.255	—	—							+.06	+.14	0	—	—	-.58	-.2	-.39	—	—	
20	1.71	5230	-.2	+1.0	12	5320	+.04	-.08	-.040	0	12	5270	3	16	5270	+.21	+.06	+.135	-.61	16	5410						.00	+.25	-.30	74	5510	+.18	+.16	+.17	-.26	1	5210
21	1.63	5210	-.3	+.33	10	5250	-.25	+.08	-.095	+.36	33	5360	-.15	11	5260	-.36	-.15	-.255	+.12	166	5420	-.16	-.14	-.15	+.28	166	-.64	-1.00	+.124	62	5400	-.75	-.29	-.520	+.228	1	7200
22	1.63	5140	-.2	+.1	8	5150	+.11	-.06	+.045	-.10	27	5200	-.7	7	5200	+.10	+.10	+.10	+.04	193	5390	+.08	+.22	+.15	-.36	193	.00	+.06	-.07	47	5330	+1.03	+.47	+.750	-.184	1	4240
23	1.69	4.90			9	4.50	-.02	+.08	+.030	-.12	32	4.90	-.1	7	4.90	-.05	-.07	-.060	+.03	221	4.90	-.13	-.04	-.09	+.23	221	-.02	-.05	+.03	50	4270	-.99	-.62	-.805	+.345	2	5110
24	1.76	4.80	+.1	-.12	8	4.80	-.03	+.02	-.005	+.02	27	4.80	-.1	7	4.80	-.03	-.03	-.030	+.01	193	4.80	-.01	-.01	-.01	+.02	193	-.03	-.03	+.37	44	5.05	+.48	+.43	+.455	-.195	2	4470
25	1.72	4.25	+.5	-.253	10	4.14	+.04	+.01	+.025	-.10	33	4160	-.7	11	4160	+.05	-.01	+.020	-.09	162	4.30	-.12	-.15	-.13	+.32	162	+.05	+.015	-.18	58	4.50	+.16	-.20	-.020	+.009	1	4360
26	1.13	3.60	-1.2	-.40	10	4.150	+.03	+.07	+.050	-.32	31	4.150	-.23	10	4.140	+.01	+.28	+.245	-.21	126	4.20	.16	+.20	.18	-.46	126	.07	+.005	-.104	54	4.110	-.82	-.40	-.610	+.281	1	5010
27	1.68	3.12	+.41	-1.00	9	3.00	-.07	-.09	-.080	+.32	30	2.85	+.23	10	3.010	.00	-.05	-.04	-.12	126	3.30	-.05	-.15	-.13	+.34	126	-.05	-.50	+.61	50	3.35	-1.32	+.24	-.540	+.249	1	3765
28	1.87	4.12	-.1	+.49	9	4.190	+.08	+.02	+.050	-.20	30	4.20	-.1	10	4.200	.00	+.16	+.105	-.23	116	4.20	.00	+.05	+.03	-.08	116	-.04	-.10	+.14	51	4.240	-1.14	+.03	-.555	+.256	1	4200
29	1.15	4.35	-.13	+.60	24	4.465	-.15	+.05	-.100	+.48	67	4.590	+.27	23	4.600	-.13	-.12	-.160	+.14	163	4.30	-.11	-.150	+.20	-.48	163	-.02	-.06	+.37	193	5.170	+.14	+.19	+.165	-.076	1	4730
30	2.69	5.05	+.83	-.414	22.0	5.790	+.53	-.01	+.260	-.104	220	5.810	-.76	72	5.110	+.36	+.33	+.345	-.245	423	6.05	+.33	+.230	-.54	-.23	423	-.05	+.145	-.171	725	7.55	+.50	+.61	+.550	-.253	2	6170
Oct 1	2.30	8.00	-1.50	+.720	167	9.60	-.76	+.06	-.350	+.140	183	9.760	+.102	61	9.920	+.01	+.07	+.040	-.02	1410	11.20	+.11	+.140	-.23	-.32	1410	+.05	+.280	-.32	565	11.60	+.82	+.42	+.620	-.285	2	10930
2	1.80	5.60	+.30	-.432	92	5.470	+.24	-.21	+.035	-.10	127	5.610	-.7	42	5.640	+.09	-.34	-.125	+.05	1370	9.40	-.30	-.300	+.53	-.23	1370	-.13	-2.15	+.262	314	7.570	-.41	-.19	-.300	+.138	1	8350
3	1.66	5.05	-.05	+.28	56	5.240	-.16	+.09	-.035	+.14	93	5.350	+.10	31	5.390	-.12	-.055	-.085	+.04	933	1.270	-.01	-.030	+.04	-.01	933	+.07	+.030	-.37	214	6.560	-.59	-.06	-.330	+.152	1	7020
4	1.46	4.60	+.33	-.259	36	4.220	+.13	+.08	+.155	-.62	73	4.320	-.115	24	4.210	+.08	-.01	+.030	-.10	666	4.80	-.03	-.020	-.03	+.08	666	-.07	-.050	+.61	161	5.180	-.42	-.23	-.325	+.150	1	5550
5	1.70	5.20	-.25	+.122	29	5.180	-.18	-.03	-.105	+.42	62	5.320	+.31	20	5.230	+.03	-.05	+.010	-.04	495	6.05	+.04	+.045	-.07	+.18	495	+.24	+.170	-.158	122	5.760	-.01	-.10	-.055	+.025	1	5900
6	1.72	4.90	.00	0	22	4.920	+.15	-.06	+.045	-.18	54	4.960	-.13	18	4.700	-.20	-.08	-.140	+.06	393	5.00	-.06	-.07	+.11	-.08	393	-.27	-.025	+.71	113	5.80	+.13	+.25	+.190	-.090	1	5350
7	1.66	4.11	-.48	+.214	18	4.870	-.09	+.06	-.015	+.6	47	4.920	+.61	16	4.740	+.03	+.03	+.030	-.14	317	5.240	+.02	+.025	-.04	-.03	317	+.05	-.035	+.43	96	5.280	-.03	+.03	.000	.000	1	5380
8	1.65	4.20	-.22	+.107	17	4.330	-.05	-.06	-.055	+.22	45	4.450	+.16	15	4.420	+.05	+.01	+.030	-.14	275	4.760	.00	+.005	-.01	-.04	275	.00	.00	0	0	4.330	+.13	+.31	+.220	-.102	1	4500
9	1.72	4.60	+.58	-.282	14	4.370	+.02	+.10	+.060	-.24	39	4.430	+.17	13	4.420	-.27	-.16	-.215	+.11	234	4.700	-.01	-.005	+.01	-.04	234	-.05	-.23	+.73	74	4.760	-.32	-.14	-.240	+.116	1	5210
10	1.65	4.10	+.19	-.93	12	3.920	+.14	+.02	+.080	-.36	36	3.920	-.23	12	3.910	+.30	-.16	+.070	-.17	213	4.020	+.10	+.115	-.15	-.36	213	+.10	+.175	-.158	67	3.900	-.01	-.11	-.116	+.054	1	4260

Charleston, W. Va.
April 10, 1956

W&D

FOLD

16—63822-1 U. S. GOVERNMENT PRINTING OFFICE



Legend
Continuous Water-Stage Recording Gage

DIAGRAM OF KANAWHA RIVER 8c
TRIBUTARIES

U.S. GEOLOGICAL SURVEY
CHARLESTON, [illegible]
Scale along Kanawha River 1 inch = 5 miles
WLD 4-10-56