# Notable Local Floods of 1942–43

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1134

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1952

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# ugust 4-5, 1943
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H. M. ERSKINE

*h a* Summary of Flood Stages and Discharges in West Virginia

OTABLE LOCAL FLOODS OF 1942-43

EOLOGICAL SURVEY WATER-SUPPLY PAPER 1134-A

*·epared in cooperation with the Corps Engineers and the State of West 'rginia*

ITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1951

UNITED STATES DEPARTMENT OF THE INTERIOR

Oscar L. Chapman, *Secretary*

GEOLOGICAL SURVEY

W. E. Wrather, *Director*

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 40 cents (paper cover)

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# NOTABLE LOCAL FLOODS OF 1942-43

## FLOOD OF AUGUST 4-5, 1943, IN CENTRAL WEST VIRGINIA

By H. M. Erskine

### ABSTRACT

During the night of August 4–5, 1943, a violent thunderstorm of unusual intensity occurred in parts of Braxton, Calhoun, Gilmer, Ritchie, and Wirt Counties in the Little Kanawha River Basin in central West Virginia. Precipitation amounted to as much as 15 inches in 2 hours in some sections. As a result, many small streams and a reach of the Little Kanawha River in the vicinity of Burnsville and Gilmer reached the highest stages known. Computations based on special surveys made at suitable sites on representative small streams in the areas of intense flooding indicate that peak discharges closely approach 50 percent of the Jarvis scale.

Twenty-three lives were lost on the small tributaries as numerous homes were swept away by the flood, which developed with incredible rapidity during the early morning hours. Damage estimated at $1,300,000 resulted to farm buildings, crops, land, livestock, railroads, highways, and gas- and oil-producing facilities. Considerable permanent land damage resulted from erosion and deposition of sand and gravel.

### INTRODUCTION

The flood of August 4–5, 1943, in the Little Kanawha River Basin in central West Virginia was of short duration and high intensity. The area affected (fig. 1) was about 50 miles long and 10 miles wide extending northwest along the major axis of the roughly diamond-shaped Little Kanawha River Basin. Many small streams in Braxton, Calhoun, Gilmer, Ritchie, and Wirt Counties reached stages much higher than previously known as a result of precipitation that amounted to as much as 15 inches in 2 hours. Little Kanawha River reached the highest stages of record in the vicinity of Burnsville and Gilmer, but farther downstream the peak stages were not exceptional. In less than one-fourth of the area of the basin was precipitation during the storm in excess of 4 inches.

Twenty-three lives were lost as a result of the flood. Although there was considerable flooding of residential property in the communities along the Little Kanawha River, all loss of life occurred along relatively small tributaries. There in the small valleys the water rose with great rapidity during the early morning hours, carrying away many homes.

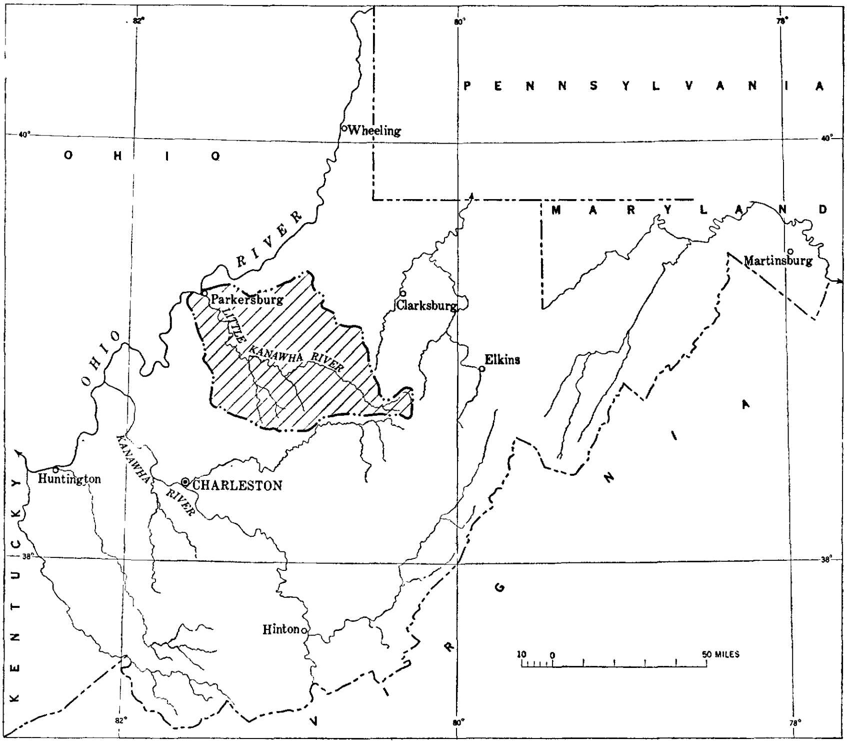


FIGURE 1.—Map of West Virginia showing location of Little Kanawha River basin.

Property damages were high considering the limited extent to which the area is settled. Crops and agricultural land, farm homes and farm buildings, railroads, highways and rural roads, and gas- and oil-producing facilities suffered heavy damages. As a result of a survey conducted by its office at Huntington, W. Va., the Corps of Engineers arrived at the following summary of damages:

| | |
|---|---|
| Agricultural lands, farm buildings, livestock, etc | $511, 750 |
| Urban damages | 29, 500 |
| Baltimore & Ohio Railroad Co | 566, 935 |
| State Road Commission | 158, 950 |
| Gas- and oil-producing companies | 26, 938 |
| Total | 1, 294, 073 |

Severe flash floods, resulting from violent thunderstorms covering relatively small areas, are known to have occurred previously in West Virginia, but little or no factual information is available relative to the maximum rainfall and its intensity or to the maximum rate of discharge from the small areas affected. Notable among previous floods of this general type in West Virginia are the floods on Cabin

Creek and Coal River in Kanawha and Boone Counties during August 1916, when 40 lives were lost and the estimated property damage was $5,000,000, and the floods on Paint Creek and Armstrong Creek in Fayette and Kanawha Counties during July 1932, which caused the loss of 19 lives and property damage estimated at $1,000,000 (Congressional Doc., 1935).

The outstanding features of this flood made it appear highly desirable that factual information relative to it and the storm that produced it be collected and assembled in report form. Accordingly, the Geological Survey undertook to make special determinations of the peak discharges by means of slope-area measurements based on surveys at the most favorable sites available on representative small streams in the most severely flooded areas. The selection of these sites was coordinated closely with the data on rainfall that were assembled soon after the storm.

Although there were several regularly operated precipitation stations in the storm area, none of these were in the localities where the rainfall was intense. The wide variations in rainfall over relatively small areas made it essential that additional records be obtained to define accurately the amount and distribution of precipitation.

Representatives of the Corps of Engineers, the Weather Bureau, and the West Penn Power Co. made a thorough investigation of the area soon after the storm and interviewed many local residents regarding ertinent features of the storm. Numerous miscellaneous records of ainfall were thus obtained from the amount of water collected in ails, tubs, jars, and other containers that were uncovered and in the open during the storm.

It is the aim of this report to bring together in suitable form the data collected during those special investigations and the data collected at regular gaging and precipitation stations.

## ADMINISTRATION AND PERSONNEL

This report was prepared in the Water Resources Division of the Geological Survey under the general administrative direction of G. L. Parker, Chief Hydraulic Engineer, until his death on February 12, 1946, and since that time by his successor, C. G. Paulsen. The field and office work was performed and the original report prepared by H. M. Erskine, district engineer, Charleston district, assisted by his staff. Hollister Johnson, hydraulic engineer, reviewed the computations of peak discharge.

## ACKNOWLEDGMENTS

The general stream-measurement program in West Virginia at the time of the flood and during the subsequent investigation was carried on by the Geological Survey cooperating with the Corps of Engineers,

and with the State of West Virginia through its Geological and Economic Survey, Public Service Commission, Health Department, and Water Commission. Acknowledgment is made to those cooperating agencies and also to the Weather Bureau and to J. E. Stewart, hydraulic engineer, West Penn Power Co., who furnished much valuable material and many helpful suggestions.

## DESCRIPTION OF THE STORM AND FLOOD

The heavy rainfall of August 4 to 5 and the resultant floods were caused by a large supply of convectively unstable, moist, tropical maritime air, transported from the general region of the Gulf of Mexico, which released its potential energy with explosive violence upon interaction with a cold air mass that had moved into the area from the northwest. Storms of this type are limited to the hot summer period and are characterized by intense rainfall, accompanied by thunder and lightning. This general type of storm is described in considerable detail elsewhere (Eisenlohr, 1951).

The U. S. Weather Bureau (1943) has described this storm as follows:

> Thundershowers, mostly of short duration, occurred about dusk on August 4, throughout the Little Kanawha River Basin. However, these showers were locally heavy in the Burnsville-Copen area. They were followed about 3 hours later by record-breaking rains accompanied by one of the worst, if not the worst, electrical storms of record. The excessive rains began to fall in the McFarlan-Girta area about 11 p. m., August 4, and progressed southeastward into the Saltlick Creek Basin where the excessive rains began about 1 a. m., August 5. These rains continued in most places for from 1 to 2 hours and were generally continuous, although quite a number of persons reported brief slackenings of the hard rains. There were two main peaks of excessive rainfall, one over the Burnsville-Copen-Cedarville area and the other over the Nobe-Brohard area.

The resulting flood developed with incredible speed and, coming as it did at night on the tributaries, gave no opportunity for warning the people residing along the normally small streams. The violence of the storm and the roar of the streams awakened many in time for them to seek refuge on higher ground. However, many were either not awakened in time or, if awake, did not realize the danger and remained in their homes, which in many cases were destroyed by the onrushing waters. Eight persons were drowned in the vicinity of Heaters on the O'Brien Fork Saltlick Creek, eight in the vicinity of Copen on Copen Run (fig. 2), five at Girta on Island Run, and two above Tanner on Tanner Creek. Of these 23 who lost their lives more than half were small children.

The area affected by the flood ranges from hilly to mountainous, with elevations varying from about 600 to 1,500 feet except for a few points in the southeastern part where elevations in excess of 2,000

FIGURE 2.—Residence of the Yeager family where six persons perished during the flood. The house was swept ½ mile down Copen Run and came to rest in the creek bed. Courtesy of Corps of Engineers.

feet are reached. The hillsides are generally steep, the valleys narrow, and the profiles of the tributary streams moderately steep. Heavy showers had fallen over most of the area during the week preceding the flood. These circumstances tended to produce a situation favorable to high rates of runoff.

The principal tributaries that had high rates of discharge—the highest stages known to local residents—were Saltlick Creek, Copen Run, Cedar Creek, Tanner Creek, Laurel Fork, Yellow Creek, and Leatherbark Creek. At Burnsville, Little Kanawha River reached a crest stage about 25 feet above extreme low water and 0.5 foot higher than the flood of March 1918, which had been the highest of record. At Gilmer, the 1918 maximum was exceeded by 0.1 foot. At Glenville, the crest stage was 30.73 feet compared to 33.6 feet in November 1926, which is the highest of record. The crest stage became lower as it advanced downstream.

The water-supply system for the town of Burnsville was put out of operation. Other municipal supplies were not affected but two-thirds of the wells in the flood area were reported contaminated by the flood waters. Emergency water-purification measures and public clinics for immunization against typhoid fever were promptly set up under the general direction of the State Health Department. The Red Cross and Civilian Defense workers were active in assisting with relief and rehabilitation work.

Probably the largest single property damaged by the flood was the 10-mile length of Baltimore & Ohio Railroad Co. tracks between Heaters and Burnsville where six railroad bridges in the Saltlick Creek basin were destroyed, much track washed out or moved, and the roadbed generally damaged. (See fig. 3.) About 5 miles of track along Copen Run between Copen and Gilmer were extensively damaged and out of operation for 11 days. (See fig. 4.) The primary State highways in the flood area closed temporarily because of slides and inundations and the washing out of small bridges and fills (fig. 5). Detours were provided where needed soon after the flood

FIGURE 3.—Residence near Heaters, which with its four occupants was washed a mile down O'Brien Fork of Saltlick Creek and lodged on a displaced section of railroad track. Courtesy of Baltimore & Ohio Railroad Co

FIGURE 4.—Washed-out railroad bridge on Copen Run. Courtesy of Corps of Engineers.

FIGURE 5.—Washed-out fill on State Route 5 at Jobs Run about 10 miles below Glenville. Courtesy of Corps of Engineers.

receded. The secondary road system suffered severely with many miles of roadway and dozens of small bridges and culverts completely destroyed.

Agricultural property was heavily damaged. In addition to the many farm homes and buildings demolished or badly damaged, much tillable land in small valleys was permanently damaged by erosion along the creek banks, the washing of topsoil from the cultivated bottom lands, and the depositing of heavy deposits of sand and gravel which came down every small run in great quantities (figs. 6, 7). The

FIGURE 6.—Rock and mud deposit from a hillside wash. This wash drains about 2 acres in Right Fork Saltlick Creek basin. The man is standing at site of five-room house that was swept away by flood. Courtesy of Corps of Engineers.

cleared hillside land, used mostly for grazing purposes, was frequently cut by deep gullies. Large slides and blow-outs were common. (See fig. 8.) There were many instances where hillside pastures lost at least one-third of their cover of sod as a result of these actions.

FIGURE 7.—Typical sand and gravel deposits. Right Fork Saltlick Creek basin.

FIGURE 8.—Typical hillside erosion. Right Fork Saltlick Creek basin.

The crops on the lowlands, particularly corn, hay, and garden truck, were almost a complete loss. (See fig. 9.) Many farmers faced the necessity of selling their livestock owing to the resulting shortage of feed.

Residential and business property in Burnsville and low-lying sections of Glenville suffered materially from inundation, but no lives were lost. Ninety percent of Burnsville was inundated during the crest of the flood. Gas- and oil-producing companies suffered damages to pipe lines, rigs, compressor stations, and company buildings.

FIGURE 9.—Cornfield destroyed by flood. Right Fork Saltlick Creek. Courtesy of Corps of Engineers.

## RAINFALL

Precipitation had been high in central West Virginia during the latter part of July. Heavy rainfall July 28–30 resulted in high stream flows, particularly in the upper reaches of Little Kanawha River. The data of precipitation as recorded at Weather Bureau stations in and adjacent to Little Kanawha River basin during the period July 20 to August 6 are given in table 1, and the locations of the stations are shown in figure 2. Figure 10 also shows, by means of isohyetal lines, the total rainfall during the period July 26–30.

Although light thundershowers occurred generally over the flood area during the late afternoon of August 4, the downpour producing the flood did not begin until several hours later. In the northwestern part of the area the intense rain began about 11 p. m., while in the southeastern section it did not begin until about 1 a. m., August 5. The heavy rain continued for about 2 hours with little slackening. Although there were no recording precipitation gages in the areas where the rainfall was most intense, there were several near by. The

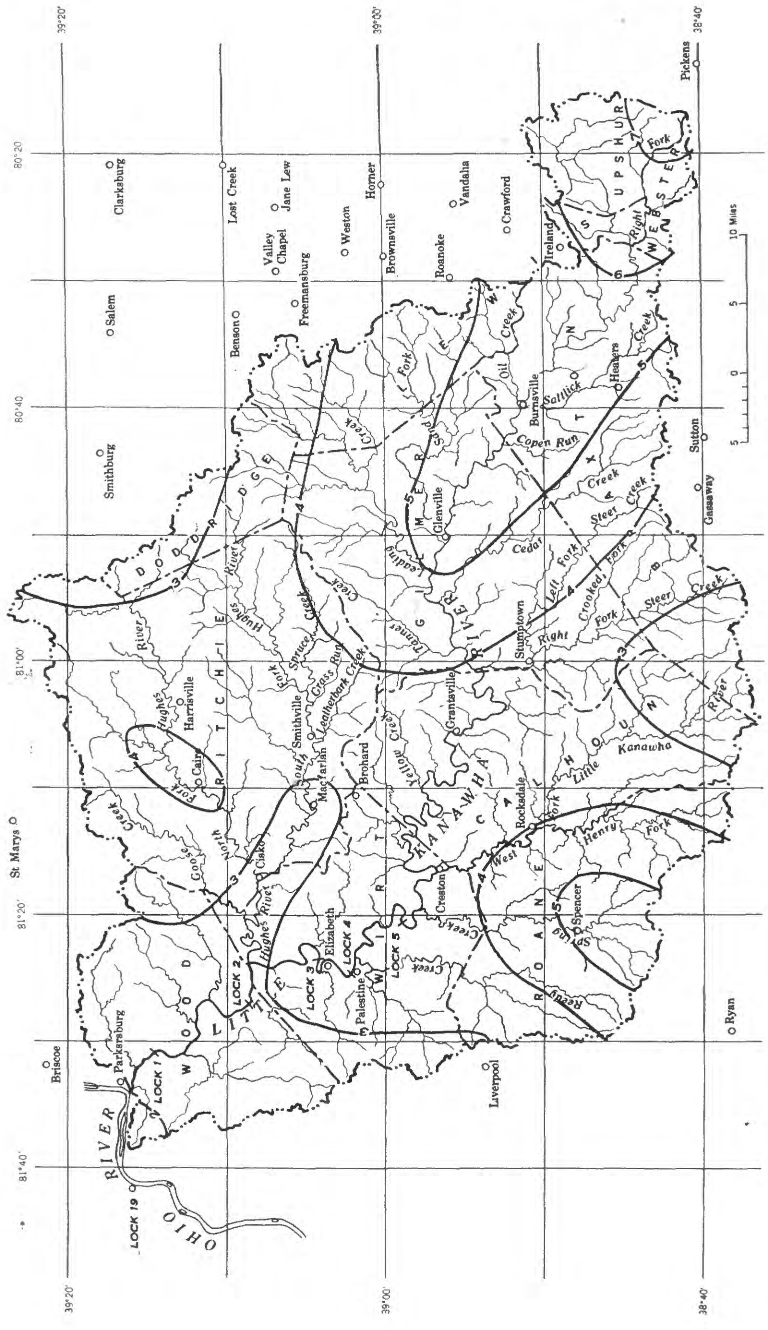


FIGURE 10.—Isohyetal map of Little Kanawha River basin showing total rainfall July 26-30, 1943.

TABLE 1.—*Daily precipitation, in inches, July 20 to Aug. 6, 1943, at stations in and adjacent to Little Kanawha River basin*

[From U. S. Weather Bureau]

| Station (see fig. 10) | July | | | | | | | | | | | | August | | | | | | Totals for storms | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 1 | 2 | 3 | 4 | 5 | 6 | July 25–30 | Aug. 4–5 |
| Cairo [1] | | | 0.44 | | | | 0.39 | | 0.71 | 2.33 | 0.70 | | | | | 1.20 | 2.55 | | 4.13 | 2.55 |
| Creston [2] | | | .52 | | | | .72 | 0.19 | .67 | 1.36 | .25 | | | | | .65 | 2.40 | | 3.19 | 2.40 |
| Elizabeth [2] | | | .95 | | | | .63 | | 1.54 | 1.07 | .22 | | | | | .21 | 1.65 | | 3.46 | 1.65 |
| Freemansburg [3] | | | .52 | | | | .96 | | 1.60 | .68 | .02 | | | | 0.20 | 1.33 | | | 3.26 | .74 |
| Gassaway [3] | | | .65 | | | | 1.10 | | 2.50 | .27 | | | | | .45 | .64 | .97 | | 3.87 | 1.17 |
| Glenville [2] | 0.12 | | .45 | | | | .27 | .13 | 1.76 | 1.68 | 1.52 | | | | | .77 | 3.70 | Tr. | 5.36 | 3.70 |
| Ireland [1] | | Tr. | .60 | | | 0.10 | 1.67 | | 1.31 | 1.15 | 1.46 | | | | Tr. | .80 | 2.45 | | 5.59 | 2.45 |
| Macfarlan [3] | | | .54 | | | .02 | .30 | | 1.77 | .55 | .29 | | | | .55 | 5.15 | .03 | | 2.91 | 5.03 |
| Parkersburg [3] | | | .46 | | | .05 | .15 | | 1.22 | .80 | | | | | .48 | 1.34 | | | 2.17 | .98 |
| Pickens [1] | | 1.11 | | | | .22 | .82 | | 1.95 | 1.58 | 2.90 | | | | .13 | .47 | .03 | | 7.25 | .03 |
| Smithburg [3] | .14 | | .30 | | | | .84 | | .70 | .55 | [4] .02 | | | | .10 | 1.18 | | | 2.11 | .31 |
| Spencer [2] | | | .44 | | | | .33 | .10 | 1.27 | 3.20 | .29 | | | | | .22 | .63 | .01 | 5.19 | .63 |
| St. Marys [2] | | | .42 | | | | .54 | | .12 | 1.21 | .50 | | | | | .94 | 1.61 | | 2.37 | 1.61 |
| Stumptown [3] | | | .32 | | | | .52 | | | | [5] 2.94 | | | | .08 | .93 | .67 | | 3.46 | 1.46 |
| Sutton [1] | | | .63 | | | | 1.31 | | 1.44 | 1.10 | | | | | .16 | .90 | 1.65 | | 3.85 | 1.65 |

[1] Precipitation generally measured in late afternoon; amount recorded is for the 24 hours ending at the time of observation.
[2] Precipitation measured in morning; amount then recorded is for preceding 24 hours.
[3] Precipitation is for the 24-hour period midnight to midnight.
[4] Incomplete; no record 6 a. m. to 2 p. m.
[5] Total for period 3 p. m. 27th to 12 p. m. 30th.

records obtained from them are indicative of the distribution of the rainfall with respect to time and are in substantial agreement with the testimony of local residents in the storm area. The hourly precipitation at the recording gages during the storm period is listed in table 2.

TABLE 2.—*Hourly precipitation, in inches, for storm of Aug. 4–5, 1943, at recording gages*

[From U. S. Weather Bureau. Eastern Standard Time]

| Hour ending | Freemansburg | Gassaway | Macfarlan | Parkersburg | Smithburg | Stumptown |
|---|---|---|---|---|---|---|
| *Aug. 4* | | | | | | |
| 4 p. m | | | | 0.02 | | |
| 5 | 0.02 | | 0.01 | .07 | | |
| 6 | .41 | | .04 | .01 | 0.02 | |
| 7 | .01 | 0.02 | | | | 0.31 |
| 8 | | .43 | | | | .04 |
| 9 | | | | | | |
| 10 | .14 | | .66 | .82 | .29 | |
| 11 | .16 | | 3.70 | .06 | | .02 |
| 12 | | | .59 | | | .42 |
| *Aug. 5* | | | | | | |
| 1 a. m | | .67 | .01 | | | .61 |
| 2 | | .03 | .02 | | | .03 |
| 3 | | .02 | | | | |
| 4 | | | | | | .02 |
| 5 | | | | | | .01 |
| Total | 0.74 | 1.17 | 5.03 | 0.98 | 0.31 | 1.46 |

It was apparent soon after the storm that the areas receiving the most intense rainfall were relatively small and were so scattered that the records for the regular precipitation stations did not give the complete picture. Accordingly, soon after the flood, field parties visited the area where intense rainfall was indicated and made a search for quantitative data. Thus, rainfall measurements were obtained at 118 additional points. The location of these points, amount of rainfall measured, and remarks regarding the reliability of each record are given in table 3. Figure 11 is an isohyetal map based on all available records for the storm.

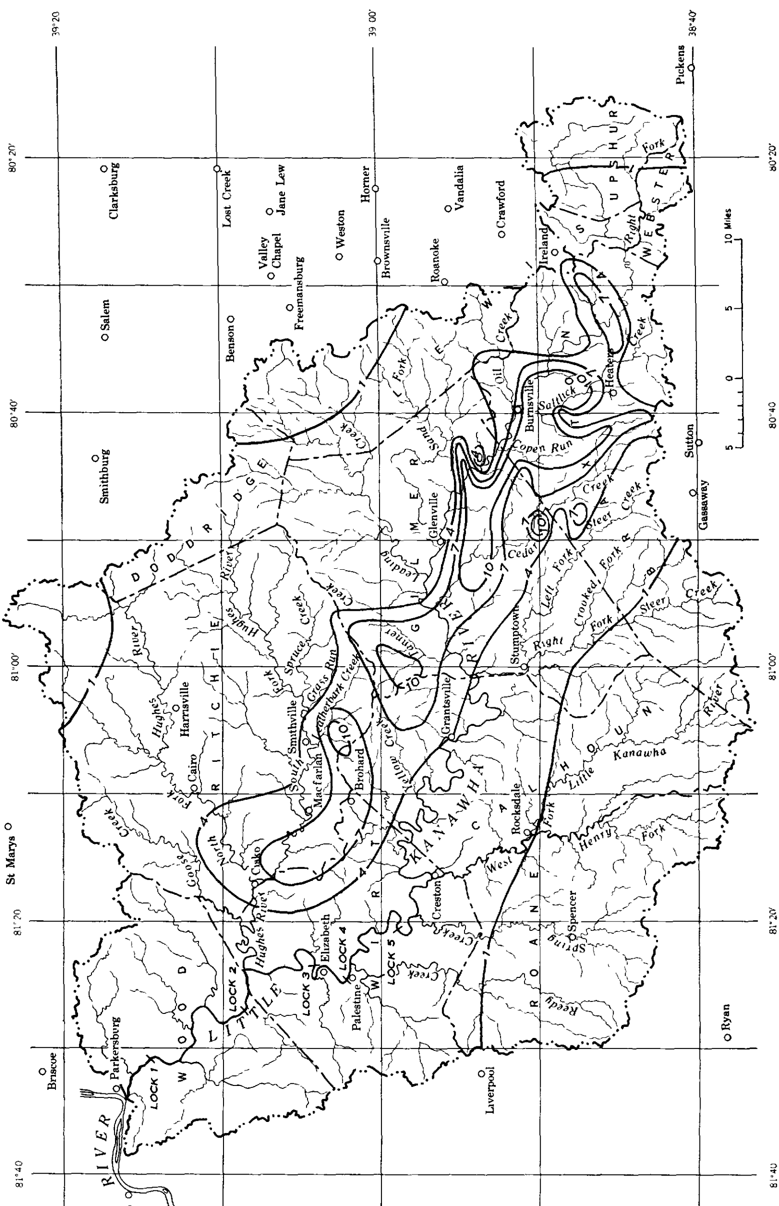


FIGURE 11.—Isohyetal map of Little Kanawha River basin showing total rainfall, August 4-5, 1943.

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TABLE 3.—*Miscellaneous measurements of precipitation during storm of Aug. 4–5, 1943*

[Measurements taken from miscellaneous gages and from containers other than gages]

| Measurement No. | Location: Latitude ° | ′ | ″ | Location: Longitude ° | ′ | ″ | Elevation (feet above msl) | Rainfall (inches) | Estimated accuracy of measurement |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 39 | 01 | 11 | 81 | 13 | 33 | 800 | [1] 5.5 | Fair. |
| 2 | 39 | 02 | 04 | 81 | 10 | 39 | 930 | 9.4 | Good. |
| 3 | 39 | 02 | 08 | 81 | 10 | 34 | 950 | 8.0 | Do. |
| 4 | 39 | 01 | 31 | 81 | 10 | 31 | 880 | 4.5 | Fair. |
| 5 | 39 | 02 | 32 | 81 | 10 | 00 | 800 | [2] 2.0 | Good. |
| 6 | 38 | 55 | 21 | 81 | 07 | 51 | 710 | 5.0 | Do. |
| 7 | 39 | 04 | 32 | 81 | 05 | 42 | 700 | 5.5 | Do. |
| 8 | 39 | 03 | 53 | 81 | 05 | 26 | 840 | 10.4 | Do. |
| 9 | 39 | 00 | 49 | 81 | 05 | 03 | 900 | 6.0+ | Fair. |
| 10 | 38 | 59 | 44 | 81 | 04 | 41 | 1,020 | 5.0 | Do. |
| 11 | 38 | 59 | 36 | 81 | 04 | 17 | 1,020 | [2] 2.0 | Good. |
| 12 | 38 | 58 | 15 | 81 | 03 | 08 | 960 | 9.4+ | Do. |
| 13 | 38 | 57 | 50 | 81 | 02 | 31 | 1,080 | 10.5+ | Do. |
| 14 | 38 | 58 | 43 | 81 | 02 | 23 | 1,100 | 6.8+ | Do. |
| 15 | 38 | 59 | 03 | 81 | 02 | 16 | 1,100 | 9.5 | Do. |
| 16 | 38 | 55 | 30 | 81 | 00 | 44 | 1,100 | [2] 2.0 | Do. |
| 17 | 39 | 01 | 23 | 80 | 59 | 38 | 960 | 6.0 | Do. |
| 18 | 39 | 00 | 38 | 80 | 59 | 07 | 880 | 6.8+ | Do. |
| 19 | 39 | 01 | 12 | 80 | 57 | 38 | 900 | 8.1+ | Fair. |
| 20 | 38 | 59 | 02 | 80 | 56 | 31 | 750 | 5.1 | Good. |
| 21 | 38 | 55 | 05 | 80 | 51 | 50 | 760 | 13.0+ | Do. |
| 22 | 38 | 51 | 31 | 80 | 51 | 05 | 860 | 6.1 | Do. |
| 23 | 38 | 50 | 13 | 80 | 49 | 35 | 800 | 6.0 | Fair. |
| 24 | 38 | 50 | 42 | 80 | 49 | 10 | 820 | 7.0+ | Reliable. |
| 25 | 38 | 50 | 08 | 80 | 49 | 07 | 900 | 10.4 | Good. |
| 26 | 38 | 50 | 08 | 80 | 48 | 54 | 900 | 6.5 | Fair. |
| 27 | 38 | 52 | 15 | 80 | 48 | 44 | 860 | 7.2 | Good. |
| 28 | 38 | 52 | 10 | 80 | 48 | 13 | 860 | 4.5 | Fair. |
| 29 | 38 | 50 | 02 | 80 | 48 | 02 | 840 | 4.9 | Good. |
| 30 | 38 | 47 | 12 | 80 | 48 | 00 | 870 | 6.9+ | Fair. |
| 31 | 38 | 52 | 35 | 80 | 47 | 59 | 920 | 9.2 | Good. |
| 32 | 38 | 47 | 47 | 80 | 47 | 24 | 1,050 | 4.5 | Do. |
| 33 | 38 | 49 | 23 | 80 | 47 | 18 | 800 | 5.3 | Do. |
| 34 | 38 | 47 | 23 | 80 | 46 | 21 | 960 | 6.4 | Fair. |
| 35 | 38 | 49 | 59 | 80 | 46 | 13 | 880 | 7.8+ | Good. |
| 36 | 38 | 52 | 59 | 80 | 46 | 12 | 1,175 | 13.0 | Do. |
| 37 | 38 | 51 | 35 | 80 | 45 | 57 | 830 | 5.3 | Do. |
| 38 | 38 | 51 | 31 | 80 | 45 | 44 | 890 | 5.0 | Do. |
| 39 | 38 | 47 | 52 | 80 | 45 | 42 | 880 | 4.7+ | Fair. |
| 40 | 38 | 48 | 56 | 80 | 45 | 21 | 860 | 6.5+ | Good. |
| 41 | 38 | 54 | 57 | 80 | 45 | 10 | 720 | 10.8 | Do. |
| 42 | 38 | 51 | 36 | 80 | 44 | 59 | 860 | 6.4 | Do. |
| 43 | 38 | 52 | 07 | 80 | 44 | 43 | 830 | 11.0+ | Fair. |
| 44 | 38 | 53 | 07 | 80 | 44 | 41 | 750 | 5.4 | Good. |
| 45 | 38 | 53 | 45 | 80 | 44 | 18 | 850 | 3.1 | Seems too low. |
| 46 | 38 | 54 | 09 | 80 | 44 | 15 | 740 | 3.6 | Questionable. |
| 47 | 38 | 46 | 03 | 80 | 44 | 09 | 890 | 6.1 | Good. |
| 48 | 38 | 54 | 24 | 80 | 44 | 09 | 830 | 15.0+ | Fair. |
| 49 | 38 | 54 | 38 | 80 | 44 | 08 | 770 | 5.2+ | Good. |
| 50 | 38 | 53 | 40 | 80 | 43 | 49 | 760 | 7.6 | Do. |
| 51 | 38 | 50 | 15 | 80 | 43 | 47 | 860 | [3] 9.3 | Do. |
| 52 | 38 | 46 | 00 | 80 | 43 | 46 | 920 | 7.0 | Do. |
| 53 | 38 | 50 | 52 | 80 | 43 | 35 | 830 | 7.1 | Fair. |
| 54 | 38 | 47 | 23 | 80 | 43 | 18 | 1,040 | 8.0 | Good. |
| 55 | 38 | 48 | 24 | 80 | 43 | 13 | 970 | 9.0 | Do. |
| 56 | 38 | 45 | 38 | 80 | 43 | 04 | 940 | 7.7 | Do. |
| 57 | 38 | 50 | 46 | 80 | 43 | 03 | 850 | 9.9 | Do. |
| 58 | 38 | 49 | 49 | 80 | 42 | 33 | 960 | 9.4+ | Do. |
| 59 | 38 | 46 | 22 | 80 | 42 | 31 | 950 | 10.5+ | Do. |
| 60 | 38 | 44 | 31 | 80 | 42 | 28 | 975 | 4.6 | Do. |
| 61 | 38 | 45 | 02 | 80 | 42 | 23 | 950 | [4] 7.0 | Do. |
| 62 | 38 | 44 | 25 | 80 | 42 | 10 | 990 | 5.0 | Do. |
| 63 | 38 | 43 | 21 | 80 | 42 | 07 | 1,075 | 3.8 | Do. |
| 64 | 38 | 47 | 24 | 80 | 41 | 58 | 1,110 | 9.2+ | Do. |
| 65 | 38 | 48 | 33 | 80 | 41 | 54 | 980 | 8.0 | Do. |
| 66 | 38 | 42 | 03 | 80 | 41 | 49 | 975 | 5.0 | Do. |
| 67 | 38 | 45 | 02 | 80 | 41 | 48 | 940 | 8.5 | Do. |
| 68 | 38 | 44 | 54 | 80 | 41 | 44 | 1,020 | 7.0+ | Do. |
| 69 | 38 | 44 | 54 | 80 | 41 | 44 | 1,100 | 6.1+ | Do. |
| 70 | 38 | 51 | 26 | 80 | 41 | 31 | 800 | 10.0+ | Do. |
| 71 | 38 | 47 | 15 | 80 | 41 | 19 | 1,130 | 5.0 | Do. |
| 72 | 38 | 48 | 21 | 80 | 41 | 19 | 950 | 6.9+ | Do. |
| 73 | 38 | 47 | 06 | 80 | 41 | 10 | 1,180 | 4.8 | Do. |
| 74 | 38 | 47 | 59 | 80 | 41 | [illegible] | 1,020 | 9.2+ | D |

TABLE 3.—*Miscellaneous measurements of precipitation during storm of Aug. 4-5, 1943*—Continued

| Measurement No. | Location | | | | | | Elevation (feet above msl) | Rainfall (inches) | Estimated accuracy of measurement |
|---|---|---|---|---|---|---|---|---|---|
| | Latitude | | | Longitude | | | | | |
| | ° | ′ | ″ | ° | ′ | ″ | | | |
| 75 | 38 | 49 | 46 | 80 | 40 | 52 | 790 | 12.5 | Good. |
| 76 | 38 | 43 | 41 | 80 | 40 | 52 | 1,160 | 7.9+ | Do. |
| 77 | 38 | 48 | 39 | 80 | 39 | 56 | 800 | 8.5+ | Fair. |
| 78 | 38 | 51 | 41 | 80 | 39 | 45 | 800 | 5.3 | Good. |
| 79 | 38 | 51 | 36 | 80 | 39 | 46 | 800 | 7.6+ | Do. |
| 80 | 38 | 48 | 10 | 80 | 39 | 37 | 870 | 3.3 | Questionable. |
| 81 | 38 | 47 | 48 | 80 | 39 | 37 | 1,080 | 7.2+ | Good. |
| 82 | 38 | 47 | 54 | 80 | 39 | 28 | 980 | 6.2 | Fair. |
| 83 | 38 | 45 | 21 | 80 | 39 | 18 | 890 | 4.2 | Good. |
| 84 | 38 | 51 | 31 | 80 | 39 | 17 | 780 | 8.9+ | Do. |
| 85 | 38 | 45 | 40 | 80 | 39 | 16 | 910 | 5.5 | Fair. |
| 86 | 38 | 43 | 55 | 80 | 39 | 14 | 980 | 4.6 | Do. |
| 87 | 38 | 51 | 41 | 80 | 39 | 12 | 880 | 14.8 | Do. |
| 88 | 38 | 51 | 03 | 80 | 38 | 56 | 780 | 10.0 | Good. |
| 89 | 38 | 45 | 45 | 80 | 38 | 33 | 880 | 6.0 | Do. |
| 90 | 38 | 46 | 41 | 80 | 38 | 26 | 820 | 6.9+ | Fair. |
| 91 | 38 | 46 | 25 | 80 | 38 | 15 | 950 | 7.7 | Good. |
| 92 | 38 | 48 | 45 | 80 | 38 | 06 | 960 | [3] 12.0 | Do. |
| 93 | 38 | 45 | 43 | 80 | 38 | 04 | 920 | 4.8 | Do. |
| 94 | 38 | 50 | 41 | 80 | 37 | 33 | 780 | 10.3+ | Fair. |
| 95 | 38 | 48 | 23 | 80 | 37 | 07 | 840 | 10.0+ | Good. |
| 96 | 38 | 51 | 18 | 80 | 37 | 02 | 1,010 | 6.5 | Do. |
| 97 | 38 | 52 | 18 | 80 | 36 | 58 | 810 | 4.4 | Fair. |
| 98 | 38 | 49 | 38 | 80 | 36 | 54 | 740 | 3.5+ | Do. |
| 99 | 38 | 49 | 38 | 80 | 36 | 54 | 740 | 5.4 | Do. |
| 100 | 38 | 45 | 51 | 80 | 36 | 48 | 860 | 6.2 | Good. |
| 101 | 38 | 49 | 21 | 80 | 36 | 47 | 820 | 9.6+ | Fair. |
| 102 | 38 | 48 | 57 | 80 | 36 | 46 | 820 | 5.0 | Do. |
| 103 | 38 | 50 | 33 | 80 | 36 | 44 | 790 | 6.4 | Good. |
| 104 | 38 | 50 | 33 | 80 | 36 | 44 | 800 | 5.8+ | Do. |
| 105 | 38 | 49 | 05 | 80 | 36 | 43 | 850 | 9.3+ | Do. |
| 106 | 38 | 52 | 50 | 80 | 36 | 39 | 850 | 4.7 | Do. |
| 107 | 38 | 47 | 00 | 80 | 36 | 34 | 900 | 5.5 | Do. |
| 108 | 38 | 50 | 45 | 80 | 36 | 34 | 820 | 6.1+ | Do. |
| 109 | 38 | 50 | 51 | 80 | 36 | 28 | 825 | 6.7 | Do. |
| 110 | 38 | 45 | 58 | 80 | 36 | 09 | 820 | 6.2 | Do. |
| 111 | 38 | 45 | 53 | 80 | 35 | 53 | 900 | 6.5 | Do. |
| 112 | 38 | 46 | 12 | 80 | 34 | 02 | 785 | 4.9 | Do. |
| 113 | 38 | 46 | 12 | 80 | 34 | 02 | 785 | 4.6 | Do. |
| 114 | 38 | 44 | 56 | 80 | 33 | 44 | 1,225 | 9.5 | Do. |
| 115 | 38 | 46 | 31 | 80 | 32 | 48 | 825 | 7.6 | Do. |
| 116 | 38 | 46 | 02 | 80 | 31 | 31 | 980 | 7.8 | Do. |
| 117 | 38 | 48 | 02 | 80 | 29 | 54 | 1,025 | [3] 8.0 | Do. |
| 118 | 38 | 48 | 02 | 80 | 29 | 54 | 1,025 | 8.0 | Do. |

NOTE.—Where the record is incomplete owing to overflowing of the container, the total amount is followed by +. All measurements include the fall from a shower or showers that occurred about dusk on August 4, 1943, and it is estimated that this fall did not exceed 1 inch at any place.

[1] Approximate.
[2] Considerably plus.
[3] Slightly plus.
[4] Estimated.

# FLOOD DISCHARGE

## MEASUREMENT OF FLOOD DISCHARGE

The usual method of determining stream discharge at gaging stations is by the application of the stage-discharge rating to the stages recorded. The rating is defined by current-meter discharge measurements through as much of the range between the extremes of low and high water as is practicable.

Many difficulties are encountered when attempts are made to obtain current-meter measurements at high stages, particularly at gaging stations on the relatively small and flashy streams. Impass able roads resulting from slides, debris deposits, washouts, and inun dation; washed-out or inaccessible bridges or cableways from whic measurements are usually made; huge quantities of drift in the water and very swift and turbulent flow as well as rapidly changing stag are among the obstacles encountered. When it is impracticable o impossible to obtain current-meter measurements upon which to bas the upper end of a rating, it must be extended upward on the basi of special studies.

Information on flood flows may be desirable at points other tha at the regular gaging stations. This is particularly true of flas floods resulting from intense rainfall over relatively small areas as in the flood of August 1943. Although it is usually impossible t determine the total flood runoff at such points, a reasonably accurat value for the peak discharge may be computed where field condition are favorable. The methods employed in determining the maximun discharges given in this report are: Extension of rating curves at th gaging stations, computation of flow by the critical-depth method computation of flow through contracted openings, and computatio of flow by the slope-area method. A brief statement concernin each of these methods is given below; fuller descriptions are give elsewhere (Corbett and others, 1943, pp. 98–108).

*Extension of rating curves.*—This method is based essentially on th shape of the upper part of the rating curve as defined by current meter measurements and a knowledge of the channel conditions an other pertinent factors that may affect the shape of the rating abov the highest measurements. Logarithmic plotting with suitable ad justments for overflow areas and other factors that may affect th channel capacity at high stages is frequently used.

*Critical-depth method.*—This method has limited usage as it depend on the flow at the selected section being under critical-depth con ditions. Proof that this condition prevailed usually depends upo an independent determination of peak flow by other methods, there fore it is generally used in conjunction with determinations made b some other method.

*Contracted-opening method.*—Computations using this method ar based on the conversion of head into velocity while the flow is passin through a restricted section of the channel such as a narrow openin between bridge abutments.

*Slope-area method.*—This method has the widest application t conditions as they are usually found in natural streams. It was use in computing peak discharges at all but one of the sites where specia discharge determinations were made for this flood. The computations were based on the Manning formula.

The slope, area of cross section, and hydraulic radius were computed from data obtained by field surveys soon after the flood had subsided. Where necessary, owing to the relative difference in conveyance properties, the cross sections were divided into appropriate parts and a value of $n$ assigned to each. Where cross sections were reasonably uniform, one value of $n$ was assigned to the entire section. The value selected for $n$ in each case was arrived at on the basis of the Geological Survey's background of experience gained through flood studies involving channels of various types and through reference to engineering texts and manuals dealing with the subject.

## DISCHARGES AT GAGING STATIONS DURING THE FLOOD PERIOD

Records of stage and discharge for the flood period at the nine gaging stations in operation in the Little Kanawha River Basin are given on succeeding pages. These records consist of a station description, a table giving the daily mean discharge during July and August 1943, and a table showing the gage height and discharge at indicated time in sufficient detail to permit reasonably accurate plotting of the hydrographs during the flood period. The station description gives information regarding the location of the station, the drainage area, the character of the gage height and discharge records, the maximum during the flood of August 1943, and the greatest known flood prior to 1943. The table of gage height and discharge at indicated time is omitted for the stations on Leading and Steer Creeks because complications due to backwater prevented the computation of discharge with sufficient accuracy to warrant this refinement. Where backwater or other factors affected the normal stage-discharge relation, notation of the special methods used is made under "Discharge records."

In nearly all cases the stage-discharge relation is fairly well defined by current-meter measurements, up to the maximum for the August 1943 flood. Slope-area measurements have been used to aid in defining the upper ends of the ratings for the stations in the Hughes River Basin. Water-stage recorders functioned satisfactorily at all stations during the flood period. At nonrecording stations the gage readers rendered excellent service by obtaining special gage readings, which made it possible to construct accurate hydrographs for the flood period. Figures 12 and 13 are hydrographs showing the discharge of Little Kanawha River and its tributaries during the period July 26 to August 9.

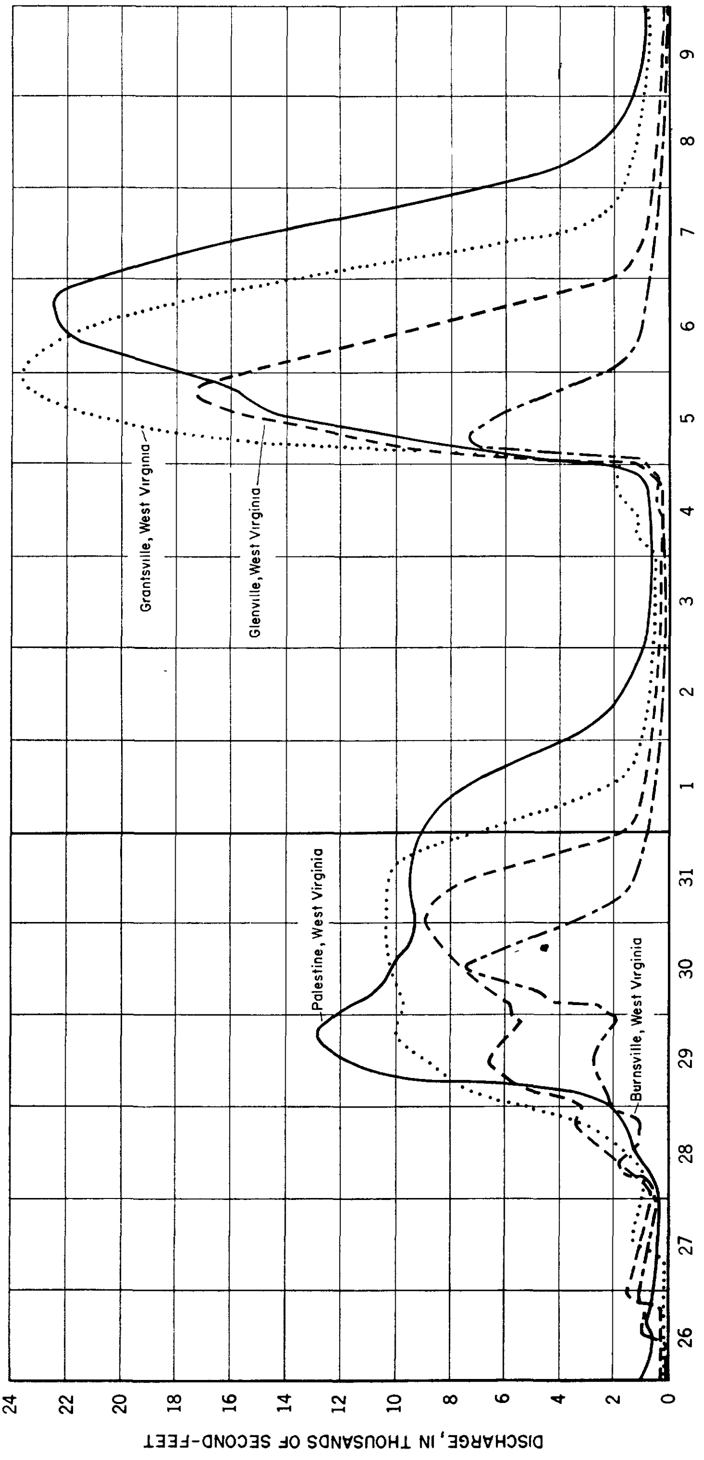



Figure 12.—Discharge hydrographs at stream-gaging stations on Little Kanawha River July 26 to Aug. 9, 1943.

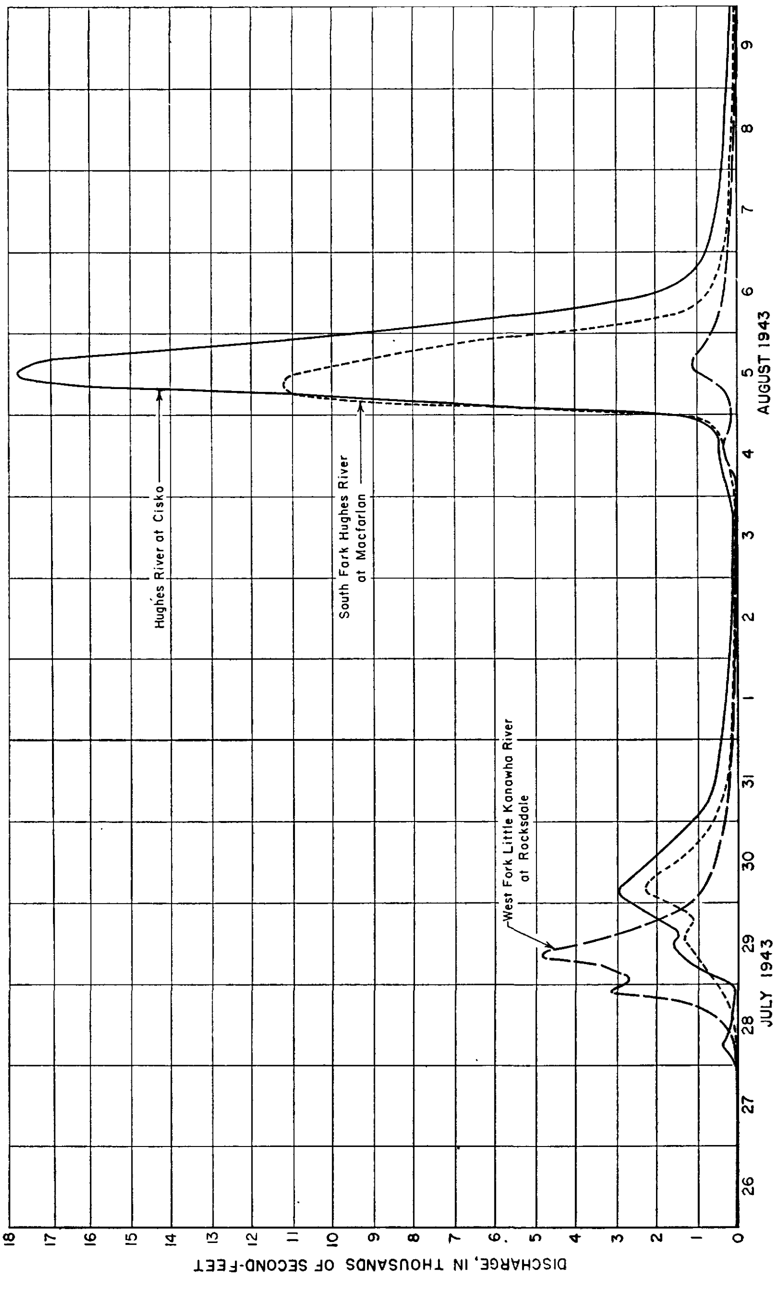



Figure 13.—Discharge hydrographs at stream-gaging stations on tributaries of Little Kanawha River July 26 to Aug. 9, 1943.

## LITTLE KANAWHA RIVER NEAR BURNSVILLE

LOCATION.—Lat. 38°49′25″, long. 80°35′35″, at bridge on State Highway 5, 0.1 mile downstream from Knawl Creek and 4 miles southeast of Burnsville, Braxton County. Datum of gage is 756.09 feet above mean sea level (levels by Corps of Engineers).

DRAINAGE AREA.—155 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph except for period 9 a. m. to 4 p. m. July 30 for which a graph was drawn based on a floodmark.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 6,500 second-feet and extended above. Gage heights used to half-tenths between 3.5 and 4.6 feet; hundredths below and tenths above these limits.

MAXIMA.—1943: Discharge, 7,370 second-feet 1 p. m. July 30 (gage height 17.62 feet from floodmark); 7,290 second-feet 6. a m. Aug. 5 (gage height, 17.46 feet).

1938–42: Discharge, 9,200 second-feet Feb. 3, 1939 (gage height, 19.04 feet, observed at crest).

The flood of Mar. 13, 1918, reached a stage of 19.7 feet, from floodmark (discharge about 9,800 second-feet).

*Mean discharge, in second-feet, 1943*

| Day | July | August | Day | July | August | Day | July | August | Day | July | August |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 69 | 510 | 9 | 146 | 172 | 17 | 42 | 495 | 25 | 36 | 37 |
| 2 | 52 | 288 | 10 | 93 | 121 | 18 | 52 | 300 | 26 | 517 | 33 |
| 3 | 41 | 177 | 11 | 57 | 106 | 19 | 54 | 177 | 27 | 619 | 50 |
| 4 | 38 | 308 | 12 | 44 | 75 | 20 | 45 | 115 | 28 | 1,120 | 147 |
| 5 | 35 | 5,050 | 13 | 76 | 107 | 21 | 34 | 80 | 29 | 2,280 | 104 |
| 6 | 134 | 1,180 | 14 | 93 | 447 | 22 | 38 | 64 | 30 | 5,190 | 61 |
| 7 | 84 | 495 | 15 | 76 | 705 | 23 | 78 | 53 | 31 | 1,560 | 46 |
| 8 | 69 | 282 | 16 | 62 | 408 | 24 | 50 | 44 | | | |
| Monthly mean discharge, in second-feet | | | | | | | | | | 416 | 395 |
| Runoff, in inches | | | | | | | | | | 3.09 | 2.94 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1943*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|
| *July 26:* | | | *July 26*—Con. | | | *July 28*—Con. | | |
| 1 a. m. | 1.58 | 34 | 10 | 5.38 | 1,010 | 8 | 7.78 | 1,810 |
| 2 | 1.58 | 34 | 11 | 5.40 | 1,010 | 9 | 7.94 | 1,840 |
| 3 | 1.57 | 33 | 12 | 5.43 | 1,010 | 10 | 7.80 | 1,810 |
| 4 | 1.57 | 33 | *July 27:* | | | 11 | 7.43 | 1,670 |
| 5 | 1.56 | 33 | 2 a. m. | 5.34 | 980 | Noon | 6.98 | 1,530 |
| 6 | 1.55 | 32 | 4 | 5.00 | 890 | 2 p. m. | 5.82 | 1,130 |
| 7 | 1.55 | 32 | 6 | 4.70 | 800 | 4 | 5.22 | 950 |
| 8 | 1.75 | 44 | 8 | 4.40 | 710 | 6 | 5.41 | 1,010 |
| 9 | 2.12 | 88 | 10 | 4.15 | 635 | 8 | 5.45 | 1,010 |
| 10 | 3.15 | 342 | Noon | 3.95 | 575 | 10 | 7.15 | 1,600 |
| 11 | 4.20 | 650 | 6 p. m. | 3.48 | 435 | 12 | 8.46 | 2,070 |
| Noon | 4.77 | 830 | 12 | 3.17 | 348 | *July 29:* | | |
| 1 p. m. | 5.07 | 920 | *July 28:* | | | 4 a. m | 8.93 | 2,200 |
| 2 | 5.11 | 920 | 1 a. m. | 3.12 | 334 | 8 | 9.30 | 2,360 |
| 3 | 4.90 | 860 | 2 | 3.08 | 323 | Noon | 9.83 | 2,560 |
| 4 | 4.62 | 770 | 3 | 3.05 | 314 | 2. p. m | 9.86 | 2,600 |
| 5 | 4.48 | 740 | 4 | 3.02 | 306 | 4 | 9.63 | 2,480 |
| 6 | 4.75 | 830 | 5 | 3.23 | 364 | 6 | 9.24 | 2,320 |
| 7 | 5.10 | 920 | 6 | 5.50 | 1,040 | 8 | 8.67 | 2,120 |
| 8 | 5.30 | 980 | 7 | 7.15 | 1,600 | 10 | 8.00 | 1,840 |
| 9 | 5.35 | 995 | | | | 12 | 8.87 | 2,200 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1943*—Con.

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|
| *July 30:* | | | *Aug. 3:* | | | *Aug. 5*—Con. | | |
| 2 a. m | 9.70 | 2,520 | Noon | 2.57 | 172 | 5 | 17.40 | 7,210 |
| 4 | 13.78 | 4,620 | 12 p. m | 2.52 | 160 | 6 | 17.46 | 7,290 |
| 6 | 14.32 | 4,940 | *Aug. 4:* | | | 7 | 17.43 | 7,210 |
| 8 | 15.50 | 5,740 | 2 a. m | 2.55 | 167 | 8 | 17.35 | 7,210 |
| 10 | 16.6 | 6,570 | 4 | 2.58 | 174 | 9 | 17.23 | 7,050 |
| Noon | 17.5 | 7,290 | 6 | 2.64 | 189 | 10 | 17.04 | 6,890 |
| 1 p. m | 17.62 | 7,370 | 8 | 2.71 | 208 | 11 | 16.78 | 6,730 |
| 2 | 17.5 | 7,290 | 10 | 2.78 | 227 | Noon | 16.47 | 6,490 |
| 4 | 16.72 | 6,650 | Noon | 3.12 | 323 | 3 p. m | 15.07 | 5,460 |
| 6 | 15.77 | 5,950 | 1 p. m | 3.27 | 366 | 6 | 13.34 | 4,320 |
| 8 | 14.60 | 5,130 | 2 | 3.33 | 384 | 9 | 11.20 | 3,190 |
| 10 | 13.40 | 4,380 | 3 | 3.37 | 395 | 12 | 9.40 | 2,400 |
| 12 | 12.17 | 3,700 | 4 | 3.37 | 395 | *Aug. 6:* | | |
| *July 31:* | | | 5 | 3.32 | 381 | 6 a. m | 6.40 | 1,300 |
| 6 a. m | 8.46 | 2,040 | 6 | 3.27 | 366 | Noon | 5.37 | 1,000 |
| Noon | 6.17 | 1,240 | 7 | 3.24 | 358 | 6 p. m | 4.76 | 825 |
| 6 p. m | 5.22 | 945 | 8 | 3.21 | 349 | 12 | 4.28 | 675 |
| 12 | 4.52 | 735 | 9 | 3.29 | 372 | *Aug. 7:* | | |
| *Aug. 1:* | | | 10 | 3.82 | 525 | 8 a. m | 3.82 | 525 |
| 6 a. m | 4.02 | 585 | 11 | 4.15 | 630 | 4 p. m | 3.55 | 450 |
| Noon | 3.70 | 495 | 12 | 4.52 | 735 | 12 | 3.29 | 372 |
| 6 p. m | 3.49 | 432 | *Aug. 5:* | | | *Aug. 8:* | | |
| 12 | 3.30 | 375 | 1 a. m | 4.74 | 795 | Noon | 2.94 | 271 |
| *Aug. 2:* | | | 2 | 8.10 | 1,880 | 12 p. m | 2.74 | 216 |
| Noon | 2.96 | 277 | 3 | 15.60 | 5,810 | *Aug. 9:* | | |
| 12 p. m | 2.76 | 221 | 4 | 17.08 | 6,970 | Noon | 2.55 | 167 |
| | | | | | | 12 p. m. | 2.40 | 133 |

## LITTLE KANAWHA RIVER AT GLENVILLE

LOCATION.—Lat. 38°56′00″, long. 80°50′20″, at highway bridge at Glenville, Gilmer County, and about 1,000 feet upstream from Sycamore Run. Datum of gage is 697.79 feet above mean sea level, adjustment of 1912. Auxiliary gage on highway bridge at mouth of Leading Creek, 2.7 miles downstream. Datum of auxiliary gage is 700.23 feet above mean sea level, adjustment of 1912.

DRAINAGE AREA.—386 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph at the base gage. Graph drawn based on four readings a day of the auxiliary staff gage from 6 a. m. July 29 to 3 p. m. July 31 and 8 a. m. Aug. 5 to 6 p. m. Aug. 6.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements for entire range of stage. Gage heights used to half-tenths between 3.5 and 5.5 feet; hundredths below and tenths above these limits. Stage-fall-discharge relation defined by current-meter measurements for entire range of stage, used during periods of backwater from Leading Creek 6 a. m. July 29 to 3 p. m. July 31 and 8 a. m. Aug. 5 to 6 p. m. Aug. 6.

MAXIMA.—1943: Discharge, 17,300 second-feet 6 p. m. Aug. 5 (gage height 30.73 feet).

1915–22, 1928–42: Discharge, 20,400 second-feet Apr. 16, 1939, from graph of discharge adjusted for changing stage; gage height, 33.22 feet Apr. 17, 1939, from floodmarks.

The flood of Nov. 16, 1926, reached a stage of 33.6 feet; discharge not determined, but probably less than that of Apr. 16, 1939.

*Mean discharge, in second-feet, 1943*

| Day | July | August | Day | July | August | Day | July | August | Day | July | August |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 114 | 911 | 9 | 172 | 296 | 17 | 65 | 1,400 | 25 | 75 | 70 |
| 2 | 83 | 426 | 10 | 136 | 208 | 18 | 69 | 560 | 26 | 333 | 59 |
| 3 | 56 | 262 | 11 | 90 | 167 | 19 | 83 | 308 | 27 | 1,060 | 61 |
| 4 | 44 | 318 | 12 | 70 | 146 | 20 | 75 | 204 | 28 | 1,970 | 215 |
| 5 | 41 | 13,000 | 13 | 88 | 118 | 21 | 65 | 150 | 29 | 5,500 | 229 |
| 6 | 292 | 8,670 | 14 | 132 | 302 | 22 | 56 | 120 | 30 | 7,400 | 142 |
| 7 | 256 | 984 | 15 | 98 | 770 | 23 | 69 | 98 | 31 | 6,090 | 94 |
| 8 | 138 | 474 | 16 | 70 | 578 | 24 | 96 | 80 | | | |
| Monthly mean discharge, in second-feet | | | | | | | | | | 803 | 1,014 |
| Runoff, in inches | | | | | | | | | | 2.40 | 3.03 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1943*

| Honr | Gage height | Discharge |
|---|---|---|
| *July 26:* | | |
| 2 a. m. | 2.24 | 61 |
| 6 | 2.22 | 59 |
| Noon | 2.28 | 66 |
| 2 p. m. | 2.30 | 69 |
| 4 | 2.32 | 72 |
| 6 | 2.95 | 184 |
| 8 | 5.50 | 1,020 |
| 10 | 6.56 | 1,430 |
| 12 | 6.85 | 1,510 |
| *July 27:* | | |
| 6 a. m. | 6.21 | 1,280 |
| Noon | 5.70 | 1,100 |
| 6 p. m. | 4.92 | 805 |
| 12 | 4.32 | 595 |
| *July 28:* | | |
| 2 a. m. | 4.17 | 542 |
| 4 | 4.05 | 508 |
| 6 | 4.80 | 770 |
| 8 | 5.48 | 1,020 |
| 10 | 6.62 | 1,430 |
| Noon | 7.80 | 1,880 |
| 2 p. m. | 9.28 | 2,430 |
| 4 | 10.62 | 2,940 |
| 6 | 11.55 | 3,350 |
| 8 | 11.72 | 3,390 |
| 10 | 11.55 | 3,350 |
| 12 | 11.22 | 3,180 |
| *July 29:* | | |
| 2 a. m. | 11.90 | 3,470 |
| 4 | 13.50 | 4,180 |
| 6 | 14.90 | 5,400 |
| 8 | 15.95 | 5,850 |
| 10 | 16.80 | 6,380 |
| Noon | 17.23 | 6,620 |
| 2 p. m. | 17.48 | 6,600 |
| 4 | 17.37 | 6,400 |
| 6 | 17.00 | 6,120 |
| 8 | 16.45 | 5,770 |
| 10 | 15.73 | 5,270 |
| 12 | 16.19 | 5,700 |

| Hour | Gage height | Discharge |
|---|---|---|
| *July 30:* | | |
| 2 a. m. | 16.30 | 5,720 |
| 4 | 16.82 | 6,050 |
| 6 | 17.40 | 6,480 |
| 8 | 17.98 | 6,850 |
| 10 | 18.50 | 7,250 |
| Noon | 18.95 | 7,580 |
| 2 p. m. | 19.34 | 7,830 |
| 4 | 19.72 | 8,100 |
| 6 | 20.05 | 8,400 |
| 8 | 20.32 | 8,590 |
| 10 | 20.55 | 8,790 |
| 12 | 20.67 | 8,900 |
| *July 31:* | | |
| 2 a. m. | 20.65 | 8,820 |
| 4 | 20.46 | 8,700 |
| 6 | 20.06 | 8,500 |
| 8 | 19.50 | 8,020 |
| 10 | 18.62 | 7,310 |
| Noon | 17.50 | 6,620 |
| 6 p. m. | 12.55 | 3,770 |
| 12 | 7.57 | 1,800 |
| *Aug. 1:* | | |
| 4 a. m. | 6.05 | 1,210 |
| 8 | 5.42 | 988 |
| Noon | 5.00 | 840 |
| 6 p. m. | 4.52 | 665 |
| 12 | 4.20 | 560 |
| *Aug. 2:* | | |
| Noon | 3.76 | 410 |
| 12 p. m. | 3.45 | 320 |
| *Aug. 3:* | | |
| Noon | 3.23 | 256 |
| 12 p. m. | 3.11 | 224 |
| *Aug. 4:* | | |
| 6 a. m. | 3.16 | 237 |
| Noon | 3.40 | 305 |
| 6 p. m. | 3.48 | 329 |
| 12 | 5.53 | 1,020 |
| *Aug. 5:* | | |
| 1 a. m. | 9.39 | 2,470 |
| 2 | 15.66 | 5,310 |
| 3 | 19.22 | 7,440 |

| Hour | Gage height | Discharge |
|---|---|---|
| *Aug. 5*—Con. | | |
| 4 | 21.07 | 8,780 |
| 5 | 22.68 | 10,000 |
| 6 | 23.98 | 11,000 |
| 7 | 24.98 | 11,800 |
| 8 | 25.84 | 12,000 |
| 9 | 26.59 | 12,200 |
| 10 | 27.44 | 13,000 |
| 11 | 28.19 | 13,900 |
| Noon | 28.82 | 14,600 |
| 2 p. m. | 29.85 | 16,200 |
| 4 | 30.51 | 16,900 |
| 6 | 30.73 | 17,300 |
| 8 | 30.68 | 17,200 |
| 10 | 30.25 | 16,400 |
| 12 | 29.73 | 15,700 |
| *Aug. 6:* | | |
| 2 a. m. | 29.00 | 14,600 |
| 4 | 28.05 | 13,500 |
| 6 | 26.90 | 12,200 |
| 8 | 25.51 | 11,000 |
| 10 | 24.00 | 10,100 |
| Noon | 22.17 | 9,030 |
| 2 p. m. | 20.10 | 7,820 |
| 4 | 17.95 | 6,800 |
| 6 | 15.50 | 5,440 |
| 8 | 13.15 | 4,030 |
| 10 | 10.70 | 2,980 |
| 12 | 8.62 | 2,170 |
| *Aug. 7:* | | |
| 6 a. m. | 5.73 | 1,100 |
| Noon | 5.08 | 877 |
| 6 p. m. | 4.62 | 700 |
| 12 | 4.34 | 612 |
| *Aug. 8:* | | |
| 6 a. m. | 4.12 | 525 |
| Noon | 3.91 | 458 |
| 6 p. m. | 3.74 | 410 |
| 12 | 3.60 | 365 |
| *Aug. 9:* | | |
| Noon | 3.37 | 296 |
| 12 p. m. | 3.19 | 245 |
| *Aug. 10:* | | |
| Noon | 3.05 | 208 |
| 12 p. m. | 2.93 | 180 |

## LITTLE KANAWHA RIVER AT GRANTSVILLE

LOCATION.—Lat. 38°55′20″, long. 81°05′50″, at bridge on State Highway 16 at Grantsville, Calhoun County, about 1,200 feet downstream from Philip Run. Datum of gage is 652.83 feet above mean sea level, adjustment of 1912.

DRAINAGE AREA.—913 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements. Gage heights used to half-tenths between 8.0 and 11.0 feet; hundredths below and tenths above these limits.

MAXIMA.—1943: Discharge, 23,700 second-feet 10:30 p. m. Aug. 5 (gage height, 34.95 feet).

1928–42: Discharge, 34,300 second-feet Apr. 17, 1939 (gage height, 43.10 feet).

*Mean discharge, in second-feet, 1943*

| Day | July | August | Day | July | August | Day | July | August | Day | July | August |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 288 | 2,920 | 9 | 367 | 899 | 17 | 110 | 2,800 | 25 | 128 | 148 |
| 2 | 172 | 810 | 10 | 428 | 644 | 18 | 99 | 1,470 | 26 | 119 | 170 |
| 3 | 126 | 530 | 11 | 239 | 512 | 19 | 94 | 776 | 27 | 738 | 343 |
| 4 | 99 | 1,340 | 12 | 156 | 422 | 20 | 108 | 512 | 28 | 1,820 | 467 |
| 5 | 112 | 17,900 | 13 | 126 | 467 | 21 | 106 | 330 | 29 | 8,530 | 593 |
| 6 | 156 | 20,500 | 14 | 158 | 374 | 22 | 101 | 264 | 30 | 9,970 | 422 |
| 7 | 571 | 5,750 | 15 | 184 | 1,070 | 23 | 101 | 201 | 31 | 9,700 | 259 |
| 8 | 380 | 1,330 | 16 | 140 | 1,370 | 24 | 112 | 167 | | | |
| Monthly mean discharge, in second-feet | | | | | | | | | | 1,146 | 2,121 |
| Runoff, in inches | | | | | | | | | | 1.45 | 2.68 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1943*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|
| *July 26:* | | | *July 30*—Con. | | | *Aug. 5*—Con. | | |
| 2 a. m. | 6.96 | 131 | 12 | 21.18 | 10,300 | 9 | 29.55 | 18,300 |
| Noon | 6.93 | 124 | *July 31:* | | | 10 | 30.30 | 19,000 |
| 12 p. m. | 6.87 | 110 | 4 a. m. | 21.23 | 10,300 | 11 | 31.00 | 19,700 |
| *July 27:* | | | 8 | 21.23 | 10,300 | Noon | 31.60 | 20,300 |
| 2 a. m. | 6.87 | 110 | Noon | 21.03 | 10,200 | 1 p. m. | 32.10 | 20,800 |
| 4 | 6.86 | 108 | 4 p. m. | 20.51 | 9,700 | 2 | 32.70 | 21,400 |
| 6 | 6.86 | 108 | 8 | 19.50 | 8,800 | 3 | 33.22 | 21,900 |
| 8 | 6.88 | 112 | 12 | 17.83 | 7,270 | 4 | 33.75 | 22,500 |
| 10 | 8.50 | 565 | *Aug. 1:* | | | 5 | 34.10 | 22,800 |
| Noon | 9.84 | 1,180 | 4 a. m. | 15.66 | 5,380 | 6 | 34.40 | 23,100 |
| 2 p. m. | 10.03 | 1,290 | 8 | 13.35 | 3,500 | 7 | 34.62 | 23,300 |
| 4 | 10.02 | 1,260 | Noon | 11.60 | 2,240 | 8 | 34.80 | 23,500 |
| 6 | 9.96 | 1,240 | 6 p. m. | 10.26 | 1,400 | 9 | 34.90 | 23,600 |
| 8 | 9.86 | 1,180 | 12 | 9.68 | 1,100 | 10 | 34.94 | 23,600 |
| 10 | 9.76 | 1,130 | *Aug. 2:* | | | 11 | 34.95 | 23,700 |
| 12 | 9.63 | 1,080 | Noon | 9.06 | 790 | 12 | 34.91 | 23,600 |
| *July 28:* | | | 12 p. m. | 8.68 | 645 | *Aug. 6:* | | |
| 2 a. m. | 9.50 | 1,000 | *Aug. 3:* | | | 2 a. m. | 34.75 | 23,500 |
| 4 | 9.35 | 925 | Noon | 8.35 | 512 | 4 | 34.50 | 23,200 |
| 6 | 9.48 | 1,000 | 2 p. m. | 8.30 | 495 | 6 | 34.13 | 22,800 |
| 8 | 9.38 | 950 | 4 | 8.25 | 478 | 8 | 33.70 | 22,400 |
| 10 | 9.52 | 1,020 | 6 | 8.20 | 460 | 10 | 33.10 | 21,800 |
| Noon | 10.13 | 1,350 | 8 | 8.28 | 495 | Noon | 32.40 | 21,100 |
| 2 p. m. | 10.71 | 1,670 | 10 | 8.35 | 512 | 4 p. m. | 30.60 | 19,300 |
| 4 | 11.32 | 2,040 | 12 | 8.28 | 495 | 8 | 28.35 | 17,200 |
| 6 | 11.83 | 2,370 | *Aug. 4:* | | | 12 | 25.40 | 14,300 |
| 8 | 12.75 | 3,060 | 2 a. m. | 8.74 | 665 | *Aug. 7:* | | |
| 10 | 13.92 | 3,880 | 4 | 9.58 | 1,050 | 2 a. m. | 23.65 | 12,600 |
| 12 | 15.30 | 5,020 | 6 | 9.87 | 1,180 | 4 | 21.85 | 10,900 |
| *July 29:* | | | 8 | 9.83 | 1,180 | 6 | 19.90 | 9,160 |
| 6 a. m. | 18.20 | 7,630 | 10 | 9.70 | 1,100 | 8 | 17.95 | 7,450 |
| Noon | 19.50 | 8,800 | Noon | 9.85 | 1,180 | 10 | 16.00 | 5,650 |
| 2 p. m. | 19.96 | 9,250 | 2 p. m. | 10.33 | 1,460 | Noon | 14.40 | 4,240 |
| 4 | 20.38 | 9,610 | 4 | 10.78 | 1,730 | 4 p. m. | 12.30 | 2,580 |
| 6 | 20.70 | 9,880 | 6 | 10.94 | 1,820 | 8 | 11.52 | 1,990 |
| 8 | 20.82 | 9,970 | 8 | 10.93 | 1,820 | 12 | 11.15 | 1,790 |
| 10 | 29.80 | 9,970 | 10 | 10.90 | 1,790 | *Aug. 8:* | | |
| 12 | 20.62 | 9,790 | 12 | 10.85 | 1,760 | 2 a. m. | 11.00 | 1,660 |
| *July 30:* | | | *Aug. 5:* | | | Noon | 10.45 | 1,330 |
| 2 a. m. | 20.46 | 9,700 | 1 a. m. | 11.00 | 1,850 | 12 p. m. | 9.93 | 1,080 |
| 4 | 20.46 | 9,700 | 2 | 16.20 | 5,830 | *Aug. 9:* | | |
| 6 | 20.60 | 9,790 | 3 | 17.85 | 7,270 | Noon | 9.51 | 878 |
| 8 | 20.74 | 9,880 | 4 | 20.70 | 9.880 | 12 p. m. | 9.16 | 737 |
| 10 | 20.85 | 9,970 | 5 | 23.70 | 12,700 | *Aug. 10:* | | |
| Noon | 20.91 | 10,100 | 6 | 25.90 | 14,800 | Noon | 8.89 | 644 |
| 4 p. m. | 21.00 | 10,200 | 7 | 27.50 | 16,300 | 12 p. m. | 8.63 | 560 |
| 8 | 21.08 | 10,200 | 8 | 28.70 | 17,500 | | | |

SUPPLEMENTAL RECORD.—Aug. 5, 10:30 p. m., gage height, 34.93 feet; discharge, 23,700 second-feet.

### LITTLE KANAWHA RIVER AT PALESTINE

LOCATION.—Lat. 39°02′00″, long. 81°24′20″, in lower pool at lock 4 at Palestine, Wirt County, 0.9 mile downstream from Reedy Creek. Datum of gage is 596.075 feet above mean sea level, adjustment of 1912. Auxiliary water-stage recorder in upper pool at lock 3, 5.5 miles downstream from lock 4. Datum of gage is 590.51 feet above mean sea level, adjustment of 1912.

DRAINAGE AREA.—1,510 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graphs. Record from auxiliary gage used during periods of no backwater from Ohio River.

DISCHARGE RECORD.—State-discharge relation defined by current-meter measurements up to 18,000 second-feet and extended above. Stage-fall-discharge

*Mean discharge in second-feet, 1943*

| Day | July | August | Day | July | August | Day | July | August | Day | July | August |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 417 | 7,040 | 9 | 624 | 1,320 | 17 | 205 | 2,430 | 25 | 181 | 182 |
| 2 | 375 | 1,900 | 10 | 538 | 968 | 18 | 246 | 2,760 | 26 | 644 | 346 |
| 3 | 326 | 784 | 11 | 481 | 776 | 19 | 222 | 1,400 | 27 | 329 | 475 |
| 4 | 283 | 784 | 12 | 378 | 661 | 20 | 186 | 907 | 28 | 877 | 707 |
| 5 | 276 | 12,200 | 13 | 309 | 651 | 21 | 155 | 466 | 29 | 9,800 | 743 |
| 6 | 464 | 21,600 | 14 | 264 | 820 | 22 | 165 | 363 | 30 | 10,300 | 798 |
| 7 | 1,030 | 14,900 | 15 | 222 | 798 | 23 | 158 | 283 | 31 | 9,400 | 440 |
| 8 | 730 | 3,000 | 16 | 210 | 1,100 | 24 | 141 | 234 | | | |
| Monthly mean discharge, in second-feet | | | | | | | | | | 1,288 | 2,640 |
| Runoff in inches | | | | | | | | | | 0.98 | 2.02 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1943*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|
| *July 25:* | | | *July 29—* | | | *Aug. 5—* | | |
| 4 a.m. | 9.50 | 162 | Con. | | | Con. | | |
| 8 | 9.52 | 172 | 8 | 15.10 | 12,800 | 10 | 15.14 | 12,800 |
| Noon | 9.50 | 162 | 12 | 14.87 | 12,200 | Noon | 15.38 | 13,900 |
| 2 p.m. | 9.48 | 155 | *July 30:* | | | 6 p.m. | 15.77 | 15,300 |
| 4 | 9.47 | 152 | 8 a.m. | 14.43 | 10,600 | 12 | 16.45 | 17,600 |
| 6 | 9.47 | 152 | 4 p.m. | 14.18 | 10,000 | *Aug. 6:* | | |
| 8 | 9.50 | 162 | 12 | 14.01 | 9,400 | 2 a.m. | 16.62 | 18,400 |
| 10 | 9.60 | 210 | *July 31:* | | | 4 | 16.98 | 20,000 |
| 12 | 10.20 | 655 | Noon | 13.95 | 9,400 | 6 | 17.18 | 20,800 |
| *July 26:* | | | 12 p.m. | 13.88 | 9,100 | 8 | 17.34 | 21,200 |
| 2 a.m. | 10.50 | 1,010 | *Aug. 1:* | | | 10 | 17.48 | 22,000 |
| 4 | 10.40 | 880 | 8 a.m. | 13.58 | 8,230 | Noon | 17.56 | 22,400 |
| 6 | 10.24 | 697 | 4 p.m. | 12.90 | 6,340 | 2 p.m. | 17.60 | 22,400 |
| 8 | 10.12 | 581 | 12 | 11.90 | 3,810 | 4 | 17.62 | 22,400 |
| 10 | 10.08 | 547 | *Aug. 2:* | | | 6 | 17.60 | 22,400 |
| Noon | 10.10 | 563 | 8 a.m. | 11.14 | 2,110 | 8 | 17.55 | 22,400 |
| 2 p.m. | 10.20 | 655 | 4 p.m. | 10.74 | 1,370 | 10 | 17.47 | 22,000 |
| 4 | 10.20 | 655 | 12 | 10.50 | 1,010 | 12 | 17.34 | 21,200 |
| 6 | 10.15 | 609 | *Aug. 3:* | | | *Aug. 7:* | | |
| 8 | 10.08 | 547 | Noon | 10.32 | 784 | 8 a.m. | 16.45 | 17,600 |
| 10 | 10.04 | 514 | 12 p.m. | 10.22 | 676 | 4 p.m. | 15.00 | 12,500 |
| 12 | 9.98 | 466 | *Aug. 4:* | | | 12 | 13.22 | 7,130 |
| *July 27:* | | | 4 a.m. | 10.20 | 655 | *Aug. 8:* | | |
| Noon | 9.76 | 309 | 8 | 10.20 | 655 | Noon | 11.32 | 2,490 |
| 12 p.m. | 9.67 | 252 | Noon | 10.26 | 718 | 12 p.m. | 10.70 | 1,300 |
| *July 28:* | | | 2 p.m. | 10.29 | 750 | *Aug. 9:* | | |
| 4 a.m. | 9.66 | 246 | 4 | 10.30 | 760 | Noon | 10.48 | 984 |
| 8 | 9.97 | 458 | 6 | 10.32 | 784 | 12 p.m. | 10.33 | 796 |
| Noon | 10.40 | 880 | 8 | 10.35 | 820 | *Aug. 10:* | | |
| 6 p.m. | 10.72 | 1,330 | 10 | 10.65 | 1.220 | Noon | 10.22 | 676 |
| 12 | 11.07 | 1,970 | 12 | 11.36 | 2,580 | 12 p.m. | 10.12 | 581 |
| *July 29:* | | | *Aug. 5:* | | | *Aug. 11:* | | |
| 4 a.m. | 12.75 | 5,950 | 2 a.m. | 12.63 | 5,690 | Noon | 10.06 | 530 |
| 8 | 13.95 | 9,400 | 4 | 13.37 | 7,670 | 12 p.m. | 9.98 | 466 |
| Noon | 14.68 | 11,500 | 6 | 13.90 | 9,100 | | | |
| 4 p.m. | 14.98 | 12,500 | 8 | 14.65 | 11,200 | | | |

relation defined by current-meter measurements up to 25 feet and extended above. Gage heights used to half-tenths between 11.5 and 13.0 feet; hundredths below and tenths above these limits.

MAXIMA.—1943: Discharge, 22,400 second-feet 4 p. m. Aug. 6 (gage height 17.62 feet).

1939–42: Discharge, 40,500 second-feet Dec. 30, 1942 (gage height, 27.5 feet, from graph based on gage readings).

The flood of April 17, 1939, reached a stage of 32.25 feet, from floodmarks (discharge, about 53,000 second-feet).

### LEADING CREEK NEAR GLENVILLE

LOCATION.—Lat. 38°57′45″, long. 80°52′05″, 200 feet upstream from Big Run, 1.4 miles above mouth, and 2¾ miles northwest of Glenville, Gilmer County. Datum of gage is 700.23 feet above mean sea level, adjustment of 1912. Auxiliary gage is at site of abandoned highway bridge at mouth 1.3 miles downstream. Datum of auxiliary gage is same as base gage.

DRAINAGE AREA.—144 square miles.

GAGE-HEIGHT RECORD.—Base staff gage read twice a day to hundredths. Graphs drawn based on all available gage readings July 5–10, 27–31, Aug. 4–7, 14–15, 27–28. Auxiliary staff gage read four times a day July 29–31 and Aug. 5–6; graphs drawn based on all available readings for these days.

DISCHARGE RECORD.—Stage-discharge relation defined by current meter-measurements up to 5 feet. Gage heights used to half-tenths between 2.5 and 4.0 feet; hundredths below and tenths above these limits. Stage-fall-discharge relation defined by current-meter measurements between 5.0 and 24.0 feet, and used during periods of backwater from Little Kanawha River, July 29–31 and Aug. 5–6.

MAXIMA.—1943: Discharge, about 3,500 second-feet 8:00 p. m. Aug. 5 (gage-height, 24.1 feet, observed at crest).

1938–42: Discharge not determined; gage height, 27.5 feet Apr. 17, 1939.

REMARKS.—Gage heights given in the paragraph on maxima are affected by backwater from Little Kanawha River.

*Mean discharge, in second-feet, 1943*

| Day | July | August | Day | July | August | Day | July | August | Day | July | August |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 18 | 139 | 9 | 202 | 62 | 17 | 7.0 | 65 | 25 | 11 | 11 |
| 2 | 11 | 64 | 10 | 94 | 45 | 18 | 7.3 | 64 | 26 | 8.2 | 9.9 |
| 3 | 6.7 | 34 | 11 | 36 | 34 | 19 | 7.9 | 34 | 27 | 36 | 20 |
| 4 | 6.7 | 456 | 12 | 22 | 26 | 20 | 7.9 | 22 | 28 | 426 | 206 |
| 5 | 21 | 1,420 | 13 | 15 | 24 | 21 | 9.7 | 18 | 29 | 1,170 | 58 |
| 6 | 160 | 2,130 | 14 | 12 | 30 | 22 | 32 | 15 | 30 | 1,150 | 29 |
| 7 | 90 | 323 | 15 | 9.4 | 77 | 23 | 16 | 13 | 31 | 681 | 19 |
| 8 | 104 | 92 | 16 | 7.9 | 43 | 24 | 14 | 12 | | | |
| Monthly mean discharge, in second-feet | | | | | | | | | | 142 | 180 |
| Runoff, in inches | | | | | | | | | | 1.14 | 1.45 |

### STEER CREEK NEAR GRANTSVILLE

LOCATION.—Lat. 38°51′45″, long. 81°02′05″, at highway bridge 500 feet upstream from Rush Run, 2.2 miles above mouth and 5.5 miles southeast of Grantsville, Calhoun County. Datum of gage is 678.00 feet above mean sea level, adjustment of 1912. Auxiliary gage is the water-stage recorder at Grantsville (see page 22).

DRAINAGE AREA.—166 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graphs.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 6,000 second-feet and extended above. Gage heights used to half-tenths between 4.6 and 6.5 feet; hundredths below and tenths above these limits. Stage and discharge ratios of the base and auxiliary gages were used in computing discharge for periods of backwater from Little Kanawha River Aug. 5–7.

MAXIMA.—1943: Discharge, 5,580 second-feet 1 p. m. Aug. 5; gage height 18.72 feet 3 p. m. Aug. 5.

1938–42: Discharge 12,400 second-feet Apr. 16, 1939; gage height 28.15 feet Apr. 16, 1939, from graph based on gage readings.

REMARKS.—All gage heights given in the paragraph on Maxima are affected by backwater from Little Kanawha River.

*Mean discharge, in second-feet, 1943*

| Day | July | August | Day | July | August | Day | July | August | Day | July | August |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 32 | 80 | 9 | 34 | 54 | 17 | 9.1 | 471 | 25 | 10 | 16 |
| 2 | 17 | 49 | 10 | 17 | 42 | 18 | 8.0 | 114 | 26 | 13 | 107 |
| 3 | 11 | 35 | 11 | 11 | 61 | 19 | 9.3 | 56 | 27 | 17 | 150 |
| 4 | 8.6 | 119 | 12 | 8.6 | 50 | 20 | 12 | 40 | 28 | 186 | 143 |
| 5 | 12 | 3,070 | 13 | 32 | 80 | 21 | 8.6 | 32 | 29 | 1,260 | 60 |
| 6 | 34 | 1,060 | 14 | 44 | 148 | 22 | 6.8 | 26 | 30 | 401 | 40 |
| 7 | 50 | 162 | 15 | 22 | 169 | 23 | 17 | 20 | 31 | 169 | 30 |
| 8 | 36 | 84 | 16 | 13 | 193 | 24 | 19 | 17 | | | |
| Monthly mean discharge, in second-feet | | | | | | | | | | 81.5 | 219 |
| Runoff, in inches | | | | | | | | | | 0.57 | 1.52 |

### WEST FORK LITTLE KANAWHA RIVER AT ROCKSDALE

LOCATION.—Lat. 38°50′35″, long. 81°13′20″, at highway bridge about 50 feet downstream from Henrys Fork, 800 feet downstream from Rocksdale, Calhoun County, and 9 miles southwest of Grantsville. Datum of gage is 657.85 feet above mean sea level, adjustment of 1912.

DRAINAGE AREA.—205 square miles.

GAGE-HEIGHT RECORD.—Wire-weight gage read to hundredths twice a day. Graphs drawn based on all available readings July 5–9, 27–31, Aug. 3–8, 12–18, and 26–28.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 12,000 second-feet. Gage heights used to half-tenths between 5.8 and 7.6 feet; hundredths below and tenths above these limits.

MAXIMA.—1943: Discharge, 1,100 second-feet 3 p. m. Aug. 5 (gage height 9.72 feet from graph based on gage readings).

1928–31, 1938–42: Discharge 20,200 second-feet Apr. 16, 1939 (gage height 30.3 feet, from floodmarks), from rating curve extended above 13,000 second-feet.

*Mean discharge, in second-feet, 1943*

| Day | July | August | Day | July | August | Day | July | August | Day | July | August |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 39 | 90 | 9 | 144 | 51 | 17 | 12 | 510 | 25 | 10 | 16 |
| 2 | 24 | 61 | 10 | 57 | 42 | 18 | 11 | 150 | 26 | 9.3 | 55 |
| 3 | 17 | 45 | 11 | 35 | 38 | 19 | 14 | 70 | 27 | 23 | 85 |
| 4 | 15 | 193 | 12 | 26 | 32 | 20 | 11 | 44 | 28 | 831 | 47 |
| 5 | 121 | 640 | 13 | 20 | 182 | 21 | 9.6 | 32 | 29 | 2,980 | 30 |
| 6 | 212 | 348 | 14 | 18 | 115 | 22 | 10 | 25 | 30 | 634 | 21 |
| 7 | 154 | 148 | 15 | 17 | 119 | 23 | 9.3 | 22 | 31 | 210 | 15 |
| 8 | 238 | 80 | 16 | 15 | 170 | 24 | 12 | 19 | | | |
| Monthly mean discharge, in second-feet | | | | | | | | | | 192 | 113 |
| Runoff, in inches | | | | | | | | | | 1.08 | 0.63 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1943*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|
| *July 26* | | | *July 30* | | | *Aug. 5—Con.* | | |
| 1 a. m. | 5.08 | 9.2 | 6 a. m. | 8.75 | 785 | 8 | 7.60 | 390 |
| Noon | 5.05 | 8.0 | Noon | 8.15 | 576 | 10 | 8.40 | 645 |
| | | | 6 p. m. | 7.75 | 448 | Noon | 9.20 | 925 |
| 6 p. m. | 5.09 | 9.6 | 12 | 7.40 | 334 | 2 p. m. | 9.70 | 1,100 |
| 12 | 5.30 | 20 | *July 31:* | | | 4 | 9.70 | 1,100 |
| *July 27:* | | | Noon | 6.90 | 206 | 6 | 9.35 | 995 |
| 6 a. m. | 5.40 | 25 | 12 p. m. | 6.50 | 131 | 8 | 9.00 | 855 |
| Noon | 5.30 | 20 | *Aug. 1:* | | | 10 | 8.60 | 715 |
| 6 p. m. | 5.30 | 20 | Noon | 6.20 | 90 | 12 | 8.30 | 610 |
| 12 | 5.55 | 34 | 12 p. m. | 6.00 | 70 | *Aug. 6:* | | |
| *July 28:* | | | *Aug. 2:* | | | 4 a. m. | 7.90 | 478 |
| 6 a. m. | 6.25 | 96 | Noon | 5.85 | 57 | 8 | 7.60 | 390 |
| Noon | 7.50 | 362 | 12 p. m. | 5.76 | 50 | Noon | 7.40 | 334 |
| 2 p. m. | 8.10 | 543 | *Aug. 3:* | | | 6 p. m. | 7.12 | 254 |
| 4 | 8.80 | 785 | Noon | 5.68 | 44 | 12 | 6.90 | 206 |
| 6 | 9.94 | 1,180 | 6 p. m. | 5.65 | 42 | *Aug. 7:* | | |
| 8 | 12.05 | 2,050 | 12 | 5.73 | 47 | 8 a. m. | 6.70 | 166 |
| 10 | 14.2 | 3,140 | *Aug. 4:* | | | 4 p. m. | 6.45 | 124 |
| 12 | 13.5 | 2,780 | 4 a. m. | 6.10 | 80 | 12 | 6.30 | 102 |
| *July 29:* | | | 8 | 6.75 | 176 | *Aug. 8:* | | |
| 2 a. m. | 13.3 | 2,680 | Noon | 7.35 | 320 | Noon | 6.10 | 80 |
| 4 | 14.2 | 3,140 | 4 p. m. | 7.30 | 307 | 12 p. m. | 5.90 | 61 |
| 6 | 15.4 | 3,480 | 8 | 6.80 | 185 | *Aug. 9:* | | |
| 8 | 16.9 | 4,830 | 12 | 6.70 | 166 | Noon | 5.77 | 51 |
| 10 | 16.7 | 4,690 | *Aug. 5:* | | | 12 p. m. | 5.67 | 43 |
| Noon | 15.6 | 3,960 | 2 a. m. | 6.70 | 166 | | | |
| 6 p. m. | 12.4 | 2,230 | 4 | 6.85 | 196 | | | |
| 12 | 9.8 | 1,140 | 6 | 7.15 | 267 | | | |

Supplemental record.—Aug. 5, 3 p. m., gage height, 9.72 feet; discharge, 1,100 second-feet.

### SOUTH FORK HUGHES RIVER AT MACFARLAN

Location.—Lat. 39°04′40″, long. 81°11′25″, at highway bridge 0.4 mile east of Macfarlan, Ritchie County, 0.5 mile upstream from Dutchman Run and 1.5 miles upstream from Macfarlan Creek. Datum of gage is 635.28 feet above mean sea level, adjustment of 1912.

Drainage area.—210 square miles.

Gage-height record.—Wire-weight gage read to hundredths twice a day, more frequently during high water. Graphs drawn based on all available gage heights on days of fluctuating stage.

Discharge record.—Stage-discharge relation defined by current-meter measurements up to 6,000 second-feet and extended above on basis of slope-area measurements at 21.7 and 27.91 feet. Gage heights used to half-tenths between 4.6 and 5.4 feet; hundredths below and tenths above these limits.

Maxima.—1943: Discharge 11,200 second-feet at 8:45 a. m. Aug. 5 (gage height 27.91 feet, observed at crest).

1915–22, 1938–42: Discharge 11,000 second-feet Jan. 22, 1917 (gage height 25.7 feet).

A flood of unknown date, but prior to 1915, reached a stage of about 29 feet, from information by local residents (discharge about 13,000 second-feet).

*Mean discharge, in second-feet, 1943*

| Day | July | August | Day | July | August | Day | July | August | Day | July | August |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.8 | 104 | 9 | 9.1 | 74 | 17 | 2.8 | 51 | 25 | 3.4 | 13 |
| 2 | 2.2 | 60 | 10 | 7.6 | 56 | 18 | 9.4 | 53 | 26 | 3.7 | 11 |
| 3 | 1.8 | 37 | 11 | 11 | 45 | 19 | 18 | 44 | 27 | 3.2 | 12 |
| 4 | 1.5 | 374 | 12 | 10 | 34 | 20 | 7.9 | 37 | 28 | 140 | 58 |
| 5 | 5.4 | 8,570 | 13 | 11 | 31 | 21 | 4.5 | 29 | 29 | 1,070 | 65 |
| 6 | 14 | 1,190 | 14 | 7.0 | 64 | 22 | 5.0 | 24 | 30 | 1,510 | 44 |
| 7 | 23 | 216 | 15 | 4.5 | 181 | 23 | 5.0 | 19 | 31 | 295 | 30 |
| 8 | 14 | 116 | 16 | 3.2 | 75 | 24 | 4.0 | 15 | | | |
| Monthly mean discharge, in second-feet | | | | | | | | | | 104 | 378 |
| Runoff, in inches | | | | | | | | | | 0.57 | 2.08 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1943*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|
| *July 26:* | | | *July 31:* | | | *Aug. 5—Con.* | | |
| Noon | 3.12 | 3.7 | Noon | 5.00 | 246 | 2 p. m. | 25.90 | 10,100 |
| 12 | 3.11 | 3.6 | 12 | 4.60 | 150 | 4 | 24.50 | 9,380 |
| *July 27:* | | | *Aug. 1:* | | | 6 | 22.90 | 8,500 |
| 6 a. m. | 3.10 | 3.4 | Noon | 4.40 | 108 | 8 | 21.10 | 7,500 |
| Noon | 3.08 | 3.2 | 12 | 4.20 | 74 | 10 | 18.70 | 6,300 |
| 6 p. m. | 3.06 | 2.9 | *Aug. 2:* | | | 12 | 15.70 | 4,800 |
| 12 | 3.20 | 5.0 | Noon | 4.10 | 60 | *Aug. 6:* | | |
| *July 28:* | | | 12 | 4.00 | 48 | 2 a. m. | 12.50 | 3,200 |
| 6 a. m. | 3.48 | 13 | *Aug. 3:* | | | 4 | 10.40 | 2,210 |
| Noon | 4.20 | 74 | Noon | 3.90 | 38 | 6 | 8.40 | 1,390 |
| 6 p. m. | 5.00 | 246 | 6 p. m. | 3.85 | 34 | 8 | 7.50 | 1,060 |
| 12 | 6.00 | 532 | 12 | 4.28 | 87 | 10 | 6.90 | 846 |
| *July 29:* | | | *Aug. 4:* | | | Noon | 6.50 | 710 |
| 6 a. m. | 6.95 | 870 | 6 a. m. | 4.80 | 196 | 4 p. m. | 5.90 | 520 |
| Noon | 8.00 | 1,230 | Noon | 5.20 | 300 | 8 | 5.55 | 430 |
| 4 p. m. | 8.10 | 1,270 | 4 p. m. | 5.45 | 370 | 12 | 5.30 | 342 |
| 8 | 7.85 | 1,150 | 8 | 6.00 | 532 | *Aug 7:* | | |
| 12 | 9.20 | 1,710 | 12 | 10.00 | 2,030 | Noon | 4.80 | 206 |
| *July 30:* | | | *Aug. 5:* | | | 12 p. m. | 4.60 | 156 |
| 4 a. m. | 10.60 | 2,300 | 2 a. m. | 15.50 | 4,700 | *Aug. 8:* | | |
| 8 | 10.00 | 2,030 | 4 | 23.60 | 8,880 | Noon | 4.40 | 112 |
| Noon | 8.80 | 1,550 | 6 | 27.20 | 10,900 | 12 p. m. | 4.30 | 94 |
| 6 p. m. | 7.40 | 1,010 | 8 | 27.90 | 11,200 | *Aug. 9:* | | |
| 12 | 6.30 | 628 | 10 | 27.85 | 11,200 | Noon | 4.18 | 75 |
| | | | Noon | 27.20 | 10,900 | 12 p. m. | 4.10 | 65 |

SUPPLEMENTAL RECORD.—Aug. 5, 8:45 a. m., gage height, 27.91 feet; discharge, 11,200 second-feet.

### HUGHES RIVER AT CISKO

LOCATION.—Lat. 39°07′45″, long. 81°17′10″, 200 feet downstream from county footbridge at Cisko, Ritchie County, and 1 mile downstream from confluence of North and South Forks and 4½ miles south of Petroleum. Datum of gage is 605.35 feet above mean sea level, adjustment of 1912.

DRAINAGE AREA.—453 square miles.

GAGE-HEIGHT RECORD.—Staff gage read to hundredths twice a day, more frequently during high water. Graphs drawn based on gage readings on days of fluctuating stage.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 21 feet, extended to 27.5 feet on the basis of slope-area measurements at 24.5 and 27.5 feet. Gage heights used to half-tenths between 3.5 and 4.8 feet; hundredths below and tenths above these limits.

MAXIMA.—1943: Discharge, 17,800 second-feet noon Aug. 5 (gage height, 24.5 feet, from floodmark).

1915–22, 1929–31, 1939–42: Discharge about 25,700 second-feet Jan. 22, 1917 (gage height, 30.25 feet).

*Mean discharge, in second-feet, 1943*

| Day | July | August | Day | July | August | Day | July | August | Day | July | August |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 307 | 9 | 45 | 196 | 17 | 17 | 133 | 25 | 18 | 31 |
| 2 | 9.4 | 173 | 10 | 85 | 133 | 18 | 215 | 142 | 26 | 16 | 24 |
| 3 | 8.4 | 120 | 11 | 45 | 105 | 19 | 51 | 142 | 27 | 18 | 22 |
| 4 | 9.4 | 537 | 12 | 33 | 85 | 20 | 35 | 93 | 28 | 164 | 29 |
| 5 | 58 | 12,600 | 13 | 18 | 74 | 21 | 22 | 66 | 29 | 1,440 | 104 |
| 6 | 110 | 3,190 | 14 | 23 | 84 | 22 | 24 | 49 | 30 | 2,150 | 94 |
| 7 | 40 | 502 | 15 | 20 | 353 | 23 | 25 | 36 | 31 | 652 | 69 |
| 8 | 41 | 292 | 16 | 16 | 208 | 24 | 22 | 35 | | | |
| Monthly mean discharge, in second-feet | | | | | | | | | | 175 | 646 |
| Runoff, in inches | | | | | | | | | | 0.45 | 1.64 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1943*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|
| *July 26:* | | | *July 30:* | | | *Aug. 5:* | | |
| 1 a.m | 2.52 | 17 | 4 a.m. | 10.10 | 2,920 | 2 a.m. | 13.0 | 4,900 |
| Noon | 2.50 | 16 | 8 | 9.64 | 2,610 | 4 | 16.4 | 7,660 |
| 12 p.m. | 2.62 | 22 | Noon | 8.90 | 2,200 | 6 | 19.6 | 10,900 |
| *July 27:* | | | 6 p.m. | 7.90 | 1,700 | 8 | 23.3 | 15,800 |
| Noon | 2.51 | 16 | 12 | 6.70 | 1,170 | 10 | 24.2 | 17,200 |
| 6 p.m. | 2.47 | 15 | *July 31:* | | | Noon | 24.5 | 17,800 |
| 12 p.m. | 2.90 | 39 | 6 a.m. | 5.60 | 732 | 2 p.m. | 24.4 | 17,600 |
| *July 28:* | | | Noon | 5.20 | 587 | 4 | 24.2 | 17,200 |
| 2 a.m. | 3.65 | 133 | 12 p.m. | 4.74 | 434 | 6 | 23.0 | 15,300 |
| 4 | 4.25 | 277 | *Aug. 1:* | | | 8 | 21.4 | 13,100 |
| 6 | 4.42 | 322 | Noon | 4.35 | 307 | 10 | 19.7 | 11,000 |
| 8 | 4.30 | 292 | 12 p.m. | 4.03 | 221 | 12 | 18.1 | 9,300 |
| 10 | 4.03 | 221 | *Aug. 2:* | | | *Aug. 6:* | | |
| Noon | 3.82 | 162 | Noon | 3.83 | 173 | 6 a.m. | 13.2 | 5,040 |
| 4 p.m. | 3.50 | 108 | 12 p.m. | 3.75 | 152 | Noon | 8.6 | 2,040 |
| 8 | 3.35 | 86 | *Aug. 3:* | | | 6 p.m. | 6.50 | 1,090 |
| 12 | 3.95 | 196 | Noon | 3.50 | 108 | 12 | 5.70 | 770 |
| *July 29:* | | | 6 p.m. | 3.45 | 100 | *Aug. 7:* | | |
| 2 a.m. | 4.80 | 450 | 12 | 3.95 | 196 | 8 a.m. | 5.10 | 552 |
| 4 | 5.80 | 808 | *Aug. 4:* | | | 4 p.m. | 4.75 | 434 |
| 6 | 6.60 | 1,130 | 6 a.m. | 4.60 | 385 | 12 | 4.58 | 385 |
| 8 | 7.20 | 1,380 | Noon | 4.80 | 450 | *Aug. 8:* | | |
| 10 | 7.80 | 1,650 | 2 p.m. | 4.84 | 450 | 8 a.m. | 4.36 | 307 |
| Noon | 7.70 | 1,600 | 4 | 4.88 | 483 | 4 p.m. | 4.20 | 262 |
| 2 p.m. | 7.40 | 1,470 | 6 | 5.00 | 517 | 12 | 4.10 | 234 |
| 4 | 7.50 | 1,520 | 8 | 5.25 | 587 | *Aug. 9:* | | |
| 6 | 8.10 | 1,790 | 10 | 6.20 | 965 | Noon | 3.95 | 196 |
| 8 | 8.70 | 2,100 | 12 | 10.0 | 2,850 | 12 p.m. | 3.80 | 162 |
| 10 | 9.20 | 2,370 | | | | | | |
| 12 | 9.70 | 2,670 | | | | | | |

## SUMMARY OF FLOOD DISCHARGES

Data from all flood measurements made in the flood area are summarized in table 4. The locations of points where the discharges were measured are shown in figure 14, the number shown for each point being the corresponding number in the first column of table 4.

945369—51——4

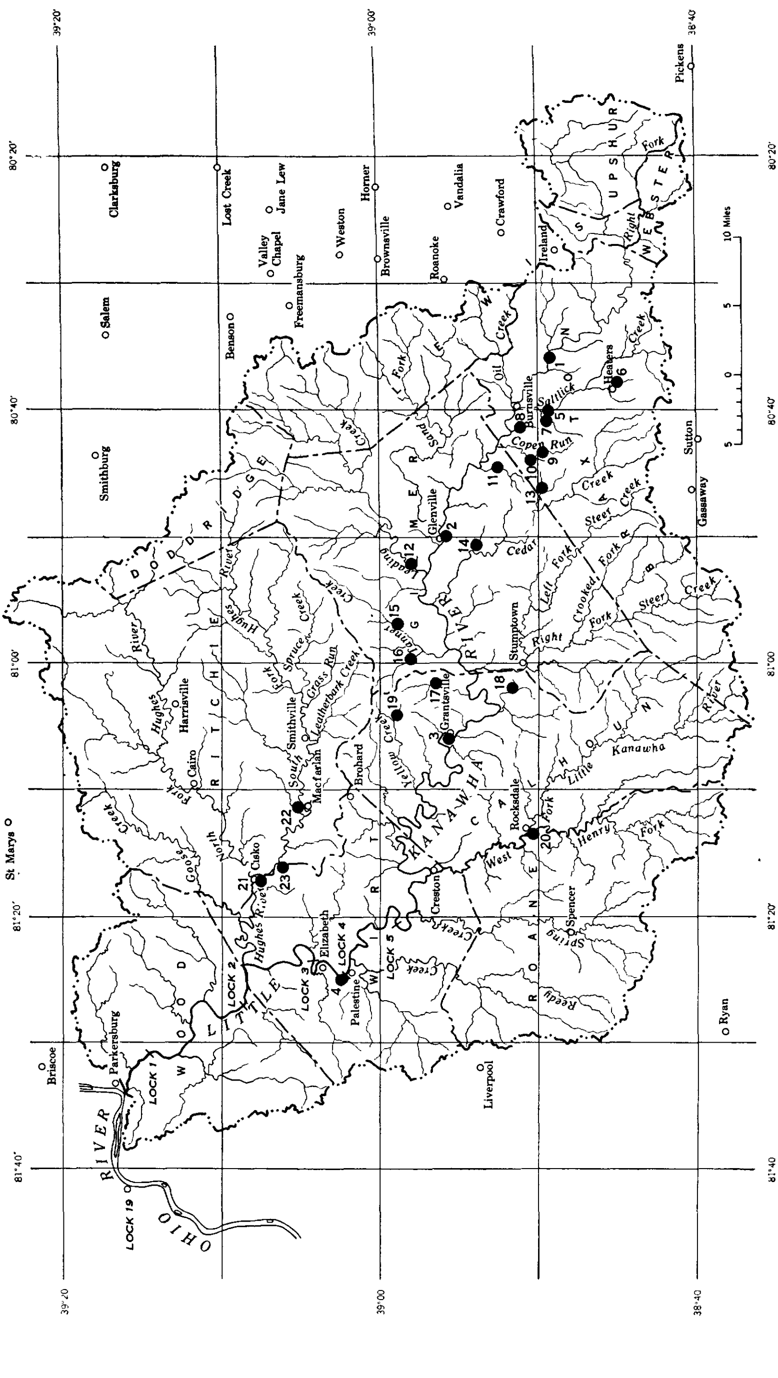



FIGURE 14.—Map of Little Kanawha River basin showing location of flood discharges listed in table 4.

The areal distribution of rainfall during the storm of August 4–5 was such that the maximum amount of rainfall fell on only a small part of the drainage area above any gaging station. In no case did rainfall amounting to 4 inches or more fall on more than half the drainage area above a gaging station. As a result, the gaging-station records do not give a good indication of the peak discharges on the smaller streams whose drainage areas were wholly within the region of heavy rainfall. The general location of each peak-discharge measurement on a small stream was selected after an examination of the region and a study of the rainfall records in order to obtain representative measurements in areas where the peak runoff rates were unusually high. It is believed that the measurements showing the highest unit-runoff rates with respect to a drainage area of given size are very close to the maximum rates that occurred on drainage areas of corresponding size anywhere in the flood area.

The maximum unit discharges, in second-feet per square mile, are plotted against the drainage area in square miles in figure 15. The

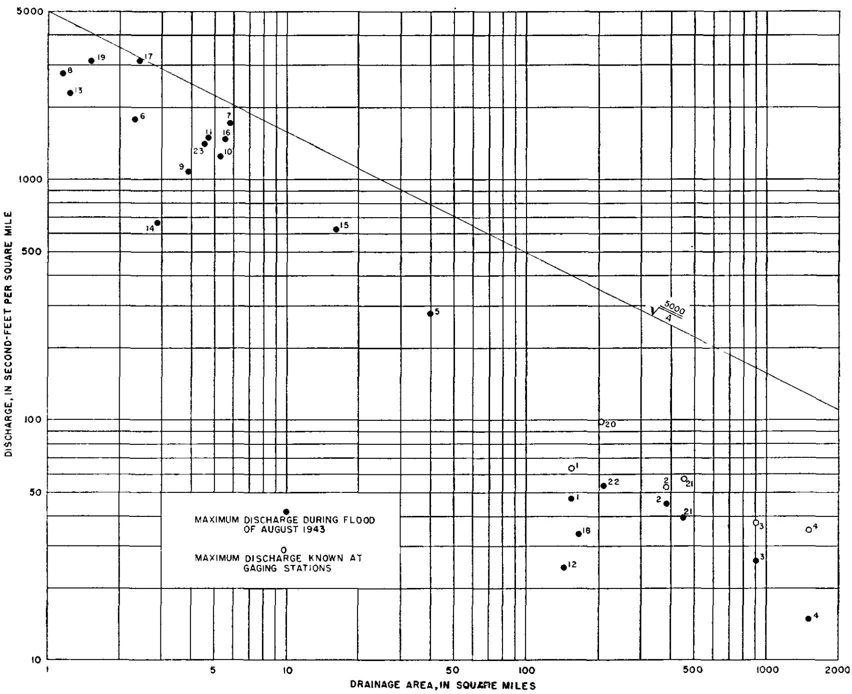



FIGURE 15.—Relation of unit discharges in Little Kanawha River basin to size of drainage basin.

numbers shown near the plotted points correspond to those in the first column of table 4 and on figure 14. At gaging stations where the flood of August 1943 was not the maximum known, the discharge for the maximum flood previously known is also plotted.

TABLE 4.—*Summary of flood discharges in Little Kanawha River basin, for the flood of August 1943*

| No. | Stream and place of determination | Drainage area (square miles) | Period of record | Maximum flood previously known: Date | Maximum flood previously known: Gage height (feet) | Maximum flood previously known: Discharge, Second-feet | Maximum flood previously known: Discharge, Second-feet per square mile | Maximum during present flood: Time | Maximum during present flood: Gage height (feet) | Maximum during present flood: Discharge, Second-feet | Maximum during present flood: Discharge, Second-feet per square mile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Little Kanawha River near Burnsville [1] | 155 | 1938–42 | Mar. 13, 1918 | 19.7 | 9,800 | 63.4 | Aug. 5, 6 a. m. | 17.46 | 7,290 | 47.0 |
| 2 | Little Kanawha River at Glenville [1] | 386 | 1915–22; 1928–43 | Apr. 16, 1939[2] | [3] 33.22 | 20,400 | 52.8 | Aug. 5, 6 p. m. | 30.73 | 17,300 | 44.8 |
| 3 | Little Kanawha River at Grantsville [1] | 913 | 1928–43 | Apr. 17, 1939 | 43.10 | 34,300 | 37.6 | Aug. 5, 10:30 p. m. | 34.95 | 23,700 | 26.0 |
| 4 | Little Kanawha River at Palestine [1] | 1,510 | 1939–43 | do | 32.25 | 53,000 | 35.1 | Aug. 6, 4 p. m. | 17.62 | 22,400 | 14.8 |
| 5 | Saltlick Creek above Gem [4] | 39.8 | | | | | | | | 11,000 | 276 |
| 6 | Berry Fork at Heaters [4] | 2.30 | | | | | | | | 4,100 | 1,780 |
| 7 | Right Fork Saltlick Creek at Gem [4] | 5.74 | | | | | | | | 9,800 | 1,710 |
| 8 | Hyers Run near Burnsville | 1.15 | | | | | | | | 3,200 | 2,780 |
| 9 | Copen Run above Copen [5] | 3.87 | | | | | | | | 4,300 | 1,080 |
| 10 | Copen Run at Copen [6] | 5.27 | | | | | | | | 6,600 | 1,250 |
| 11 | Duskcamp Run near Stouts Mill [4] | 4.67 | | | | | | | | 6,900 | 1,480 |
| 12 | Leading Creek near Glenville [1] | 144 | 1938–43 | Apr. 17, 1939 | 27.5 | | | Aug. 5, 8 p. m. | 24.1 | 3,500 | 24.3 |
| 13 | Walker Fork at Flower [4] | 1.23 | | | | | | | | 2,800 | 2,280 |
| 14 | Spruce Fork near Glenville [4] | 2.87 | | | | | | | | 1,900 | 660 |
| 15 | Tanner Creek at Tanner [4] | 16.1 | | | | | | | | 10,000 | 621 |
| 16 | Trace Fork at Revere [4] | 5.47 | | | | | | | | 8,000 | 1,460 |
| 17 | Laurel Fork above White Pine [4] | 2.42 | | | | | | | | 7,400 | 3,060 |
| 18 | Steer Creek near Grantsville [1] | 166 | 1938–43 | Apr. 16, 1939 | 28.15 | 12,400 | 74.7 | Aug. 5, 1 p. m. | 18.72 | 5,580 | 33.6 |
| 19 | North Fork Yellow Creek near Big Spring [4] | 1.51 | | | | | | | | 4,700 | 3,100 |
| 20 | West Fork Little Kanawha River at Rocksdale [1] | 205 | 1928–31; 1938–43 | Apr. 16, 1939 | 30.3 | 20,200 | 98.5 | Aug. 5, 3 p. m | 9.72 | 1,100 | 5.4 |
| 21 | South Fork Hughes River at Macfarlan [1] | 210 | 1915–22; 1938–43 | (7) | 29.0 | 13,000 | 61.9 | Aug. 5, 8:45 a. m. | 27.91 | 11,200 | 53.3 |
| 22 | Hughes River at Cisko [1] | 453 | 1915–22; 1929–31; 1939–43 | Jan. 22, 1917 | 30.25 | 25,700 | 56.8 | Aug. 5, 12 m. | 24.5 | 17,800 | 39.3 |
| 23 | Island Run at Girta [4] | 4.50 | | | | | | | | 6,300 | 1,400 |

[1] Gaging-station record.
[2] Greater flood occurred Nov. 16, 1926. Gage height, 33.6 feet.
[3] Apr. 17, 1939.
[4] Slope-area method.
[5] Contracted-opening and critical-depth methods.
[6] Slope-area and contracted-opening methods.
[7] Prior to 1915.

## FLOOD CRESTS

The heights reached by great floods are matters of primary importance to be considered in planning many of man's activities. Adequate knowledge of flood heights over long periods of time is essential to the solution of problems involving the design and location of structures and works in the river valleys and also to the control of floods.

Records of the stages reached by floods in recent years are available at a number of gaging stations and at several miscellaneous points where floodmarks recorded by local residents have later been correlated with sea-level datum by surveys. These data are summarized in table 5.

TABLE 5.—*Flood crests reached by major floods at points on Little Kanawha River*

[Feet above mean sea level]

| Location | Miles above mouth | Elevation (in feet) of flood crests on indicated date | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | March 1913 | March 1918 | November 1926 | January 1937 | February 1939 | April 1939 | August 1943 |
| Burnsville, USGS gage near | 127.1 | | 775.8 | 773.7 | | 775.1 | 774.4 | 773.6 |
| Burnsville | 121.5 | | 766.8 | 764.0 | | 764.0 | 765.8 | 767.3 |
| Gilmer—Braxton Co. line | 116.6 | | 755.8 | | | | 755.2 | 755.9 |
| Stouts Mill | 113.5 | | 748.8 | | | | 748.8 | 748.7 |
| Sand Fork | 110.2 | | 741.7 | 741.8 | | | 742.7 | 741.3 |
| Glenville, USGS gage | 103.7 | | 730.4 | 731.4 | 722.9 | 727.4 | 731.0 | 728.5 |
| Leading Creek | 100.9 | | | | | | 727.4 | 724.0 |
| Dekalb | 92.6 | | 721.7 | 721.7 | | | | 717.0 |
| Steer Creek | 83.3 | | 701.5 | | | | 701.5 | 694.4 |
| Grantsville, USGS gage | 78.0 | | 695.5 | 692.7 | 686.2 | 689.8 | 695.9 | 687.8 |
| Creston, USWB gage | 48.7 | 642.1 | 652.5 | 645.4 | 644.5 | | 654.9 | 641.4 |
| Lock and Dam 5, upper gage | 41.2 | 635.0 | 641.5 | 636.6 | 633.6 | | 643.5 | [1] 632.8 |
| Lock and Dam 4, upper gage | 30.7 | 621.7 | 628.7 | 622.8 | 625.4 | | 629.2 | [1] 619.6 |
| Lock and Dam 3, upper gage | 25.3 | 621.3 | 621.7 | 614.6 | 622.1 | | 622.5 | 608.1 |
| Lock and Dam 2, upper gage | 14.9 | 620.9 | 609.9 | 603.6 | 618.4 | | 609.6 | [1] 598.4 |
| Lock and Dam 1, upper gage | 3.8 | 620.5 | 596.9 | 591.6 | 617.0 | | 596.8 | [1] 587.2 |
| Parkersburg, USWB gage | 0 | 620.5 | 596.8 | 588.9 | 616.7 | 595.1 | 596.1 | 575.6 |

[1] Highest gage reading, may not be the peak.

The flood profile in figure 16 was constructed from the data in table 5 supplemented by elevations at a number of other locations where the information was available for only one or two floods.

It is of interest to note in figure 16 that, although the flood of April 1939 was higher over a greater length of river than any other flood, the profile of recorded maximum stages, in the relatively short length of 127 miles, is made of sections of five major floods: March 1913, March 1918, November 1926, April 1939, and August 1943.

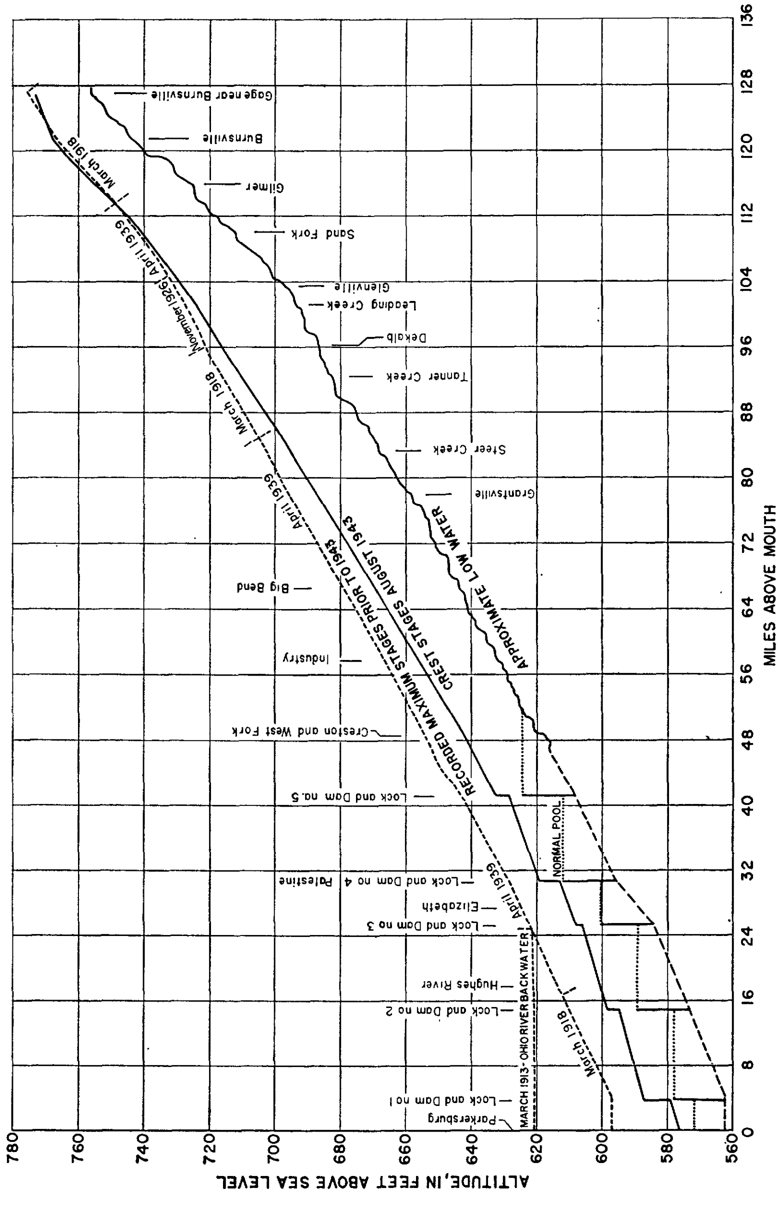



FIGURE 16.—Flood profiles of Little Kanawha River.

## PREVIOUS FLOODS

### FLOODS PRIOR TO APRIL 1939

Several large floods have occurred in the Little Kanawha River Valley since 1900 when systematic records were started. Fairly good information is available for most of these floods but relatively little is known about the floods prior to that time. A brief description of the floods prior to 1943, for which we have some information, is given below.

*April 1852.*—The meager information available indicates that this was probably the greatest flood on Little Kanawha River since white settlers first located in its valley. At Prices Ripple (mile 85) the river rose 38 feet above low water and at Dekalb the peak was 36 feet above low water. These points indicate stages approximately 2 feet higher than were reached in April 1939 in the section of river between Glenville and Grantsville.

*September 1861.*—The only record is one obtained from an aged resident of Burnsville, who stated that the floods of 1861 and 1875 exceeded that of 1918. No doubt this flood in the Little Kanawha River Valley was a great flood as records for Elk River show that the greatest flood known on that river occurred at this time.

*August 1875.*—This flood exceeded the 1918 flood at Burnsville (see above flood of September 1861); it was the greatest flood known on Middle Island Creek at Little, reaching a stage of 33.5 feet. Thus a great flood is on record on the lower reaches of the Little Kanawha River as well as in the headwaters.

*February 1884.*—There is no evidence of particularly high stage in the upper part of the basin during this flood but there were undoubtedly high stages in the lower section owing to backwater from the Ohio River, which reached the highest stage known prior to the great flood of 1913; the stage at Parkersburg reached 53.9 feet.

*July 1888.*—No record of this flood has been found, but the extremely high flood recorded in the West Fork, Tygart, and Elk River Basins indicates that a major flood probably occurred also in the upper part of the Little Kanawha Valley.

*March 1913.*—The lowest 23-mile stretch of Little Kanawha River reached the highest known stage as the result of backwater from the Ohio River that reached a stage of 58.9 feet at Parkersburg, the highest known stage at that place. The flood was relatively small on that part of Little Kanawha River above the effect of backwater.

The Ohio River flood of 1913 is described by Horton and Jackson (1913).

*March 1918.*—This was the greatest flood known in some sections of the Little Kanawha River valley between Grantsville and Glenville and above Burnsville. A rainfall of 4.8 inches in 24 hours was reported at Sutton, a few miles outside the upper end of the Little Kanawha Basin. Probably 2 to 5 inches of rain fell on the basin.

*November 1926.*—This was the highest flood of record at Glenville and in a reach of the river extending about 10 miles downstream. The rainfall for 1 day at Glenville was 3.50 inches. The heaviest rainfall was apparently concentrated near Glenville and in the Leading Creek area. The rise was quick and the runoff high.

*January 1937.*—Moderately high floods occurred all along the river as the result of general heavy rainfall. The most severe part of this flood was in the lower reaches where backwater from the Ohio River was the principal factor, as indicated by the stage of 55.4 feet recorded at Parkersburg.

The 1937 flood is described by Grover (1938).

*February 1939.*—This flood was the result of heavy rainfall in the headwaters of the Little Kanawha, Elk, Gauley, and Tygart River basins. A rainfall of 3.5 inches was recorded at Sutton. Rainfall was less in the middle and lower reaches of the Little Kanawha Valley resulting in a moderate flood in those sections. At the gaging station near Burnsville the stage reached was the highest recorded during the period of continuous records, exceeded, as far as is known, only by the flood of 1918.

## FLOOD OF APRIL 1939

The flood of April 1939 was the greatest flood of record in sections of the river extending about 4 miles above and below Sand Fork and from the mouth of Steer Creek to Lock 3. (See fig. 16.) The maximum flood of record occurred in 70 of the 127 miles between the Burnsville gaging station and Parkersburg. In view of the magnitude of this flood (figs. 17, 18) and the records of precipitation, stage, and discharge available for the period, it is described in greater detail than the previous floods.

Rainfall during the period April 14–18 ranged from about 3 inches along the northern edge of the basin in the headwaters of the North Fork Hughes River to nearly 5 inches along the southwest edge in the headwaters of Spring Creek. The records for the precipitation stations in the basin and adjacent thereto are given in table 6. The isohyetal map (fig. 19) illustrates the areal distribution of the rainfall.

FIGURE 17.—Business section of Burnsville during flood of April 16, 1939. Stage is about 1.5 feet lower than the maximum August 5, 1943. Courtesy of Corps of Engineers.

FIGURE 18.—Part of flooded section of Glenville during flood of April 1939 Stage is about 2 feet below the crest of April 1939 flood.

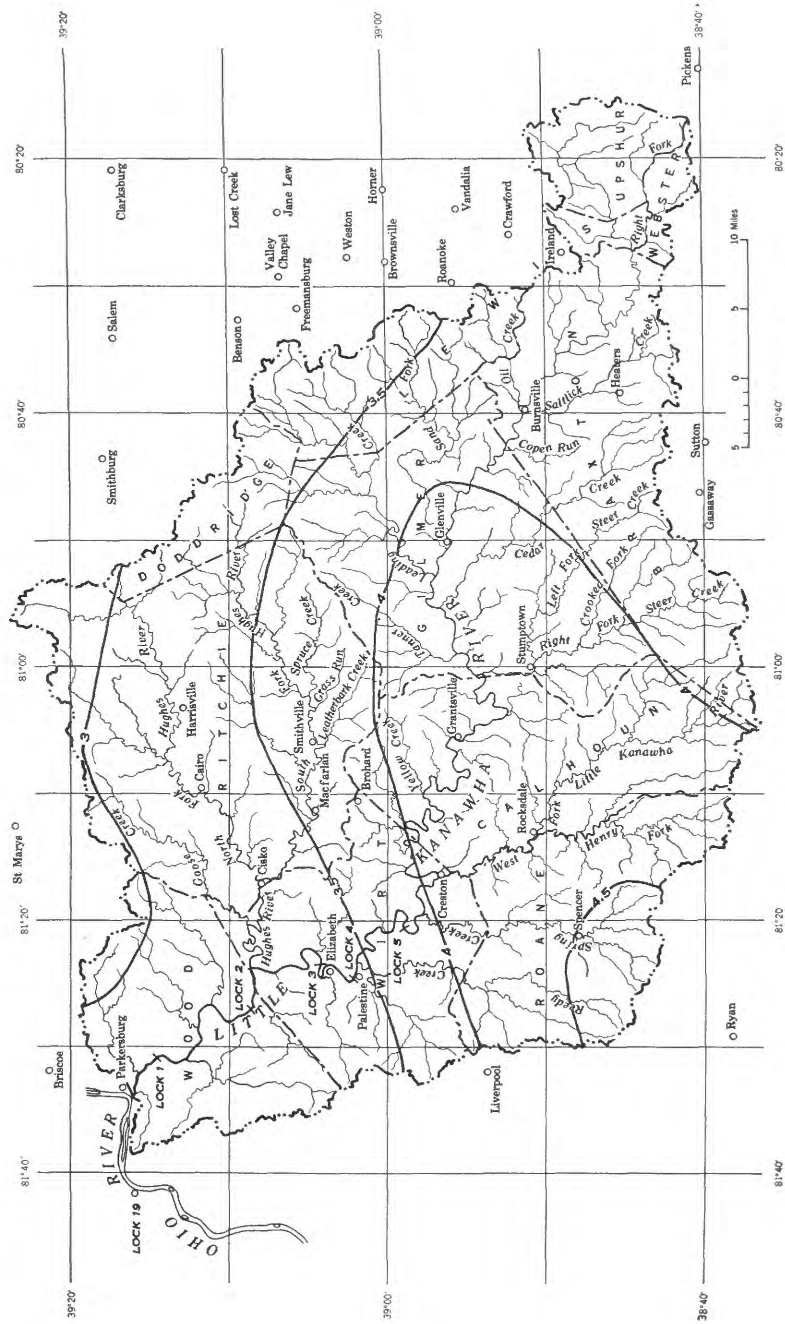



FIGURE 19.—Isohyetal map of Little Kanawha River basin showing total rainfall April 14–18, 1939.

The available recording precipitation gage records and the notes by observers at the standard precipitation gages indicate that the time during which there was rainfall was quite uniform over the basin. Figure 20 shows the hourly rainfall at recording gages in and near Little Kanawha River Basin. The gages at Valley Head and Weston are in the Monongahela River Basin a few miles from the boundary of the Little Kanawha Basin at its southeastern and central eastern edges, respectively. In general, light rain fell over the basin during the afternoon and evening of April 14. About midnight on the 14th steady rain began, continuing with only short interruptions until

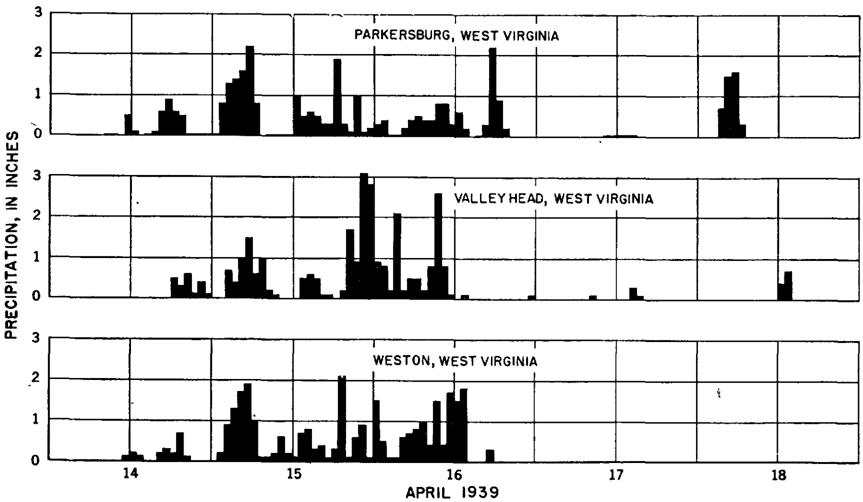



FIGURE 20.—Hourly precipitation at recording rain gages April 14–18, 1939.

the afternoon of the 16th when the period of steady rainfall ended. Light rains were reported at some stations on the 17th and 18th.

Antecedent conditions were favorable for high percentages of runoff. Precipitation at Glenville during March amounted to 5.34 inches, 1.19 inches of which fell March 28–31. An additional 0.69 inch was recorded April 23. It may be seen from table 6 that general rainfall over the basin during the period April 6–12 ranged from about 1.5 to 2 inches with some rainfall reported nearly every day.

The maximum stage and discharge, precipitation, runoff, and retention for each gaging station are summarized in table 7. The rainfall for each drainage area was determined from the isohyetal map (fig. 19) based on all rainfall records in and adjacent to the basin. The direct runoff was computed as the observed discharge during and following the storm minus the base flow. The method is illustrated in figure 21, showing the discharge graph for Grantsville.

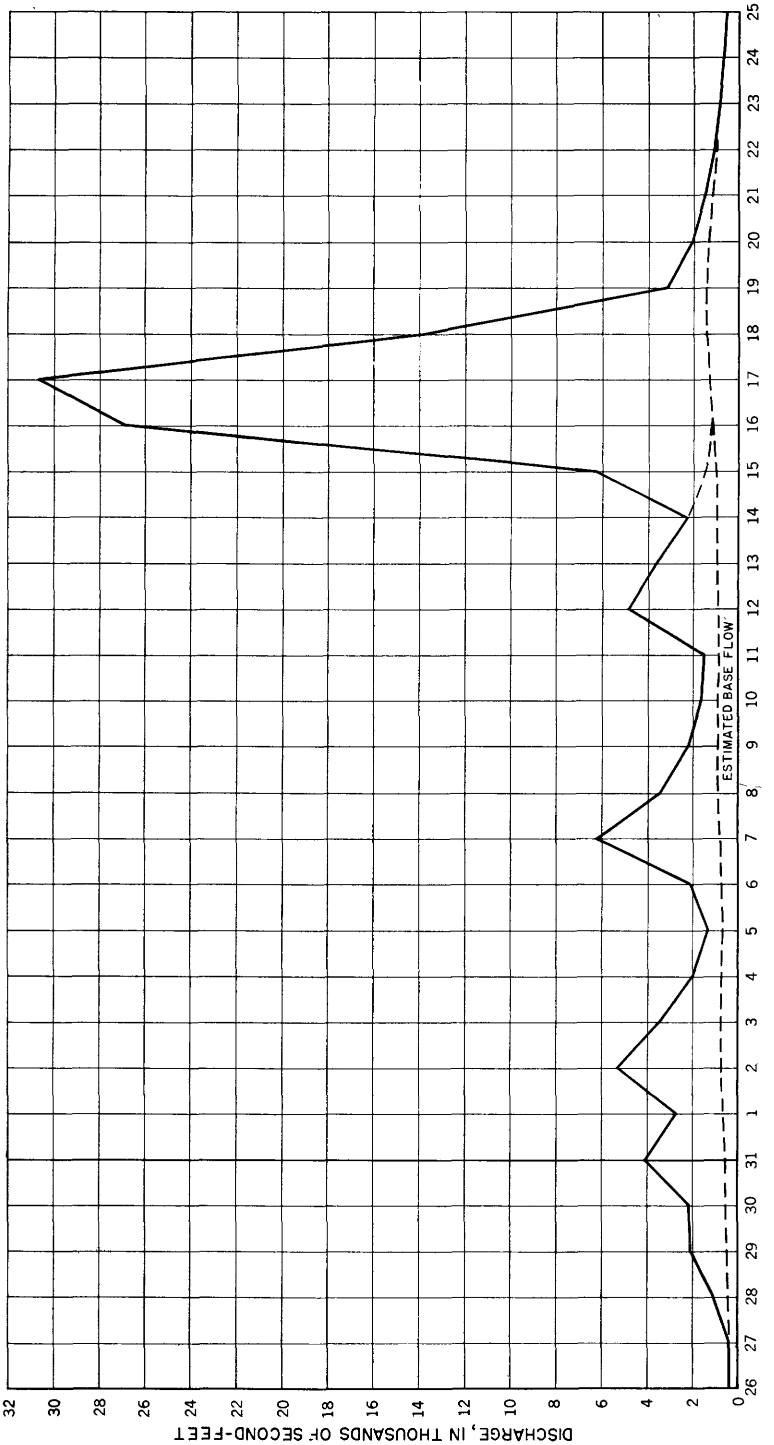



FIGURE 21.—Graph of daily mean discharge of Little Kanawha River at Grantsville, March 26 to April 25, 1939, showing estimated base flow.

TABLE 6.—*Daily precipitation in inches, April 5–20, 1939*

[Data from U. S. Weather Bureau]

| Station | April 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | Storm total, Apr. 14–18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cairo [1] | | 1.13 | 0.02 | | 0.12 | 0.14 | 0.25 | 0.39 | | 0.08 | 1.26 | 1.47 | 0.27 | 0.25 | 0.05 | | 3.33 |
| Creston [2] | | .45 | .50 | | .15 | .05 | .12 | .57 | T | .40 | .75 | 1.80 | .87 | .28 | .10 | T | 4.10 |
| Elizabeth [2] | | .66 | .40 | T | .12 | .08 | .12 | .40 | | | 1.08 | 1.35 | .45 | .36 | | .02 | 3.24 |
| Glenville [2] | | .39 | .44 | | T | .06 | .09 | .71 | | | 1.06 | 1.98 | .86 | .17 | .12 | .04 | 4.07 |
| Ireland [1] | | .77 | | .16 | .32 | .06 | .34 | .11 | | | 1.28 | 2.40 | .01 | | | | 3.69 |
| Parkersburg [3] | 0.08 | .94 | .01 | .03 | .10 | .06 | .28 | .04 | | .33 | 1.49 | .89 | .01 | .41 | T | | 3.13 |
| Pickens [1] | | .06 | .10 | | .40 | | .21 | .02 | | .33 | 1.28 | 2.25 | .06 | T | | | 3.92 |
| Spencer [2] | | .38 | .35 | | .14 | .06 | .15 | .55 | T | | .64 | 2.52 | 1.08 | .25 | .12 | .01 | 4.49 |
| St. Marys [2] | | .75 | .36 | | .09 | .30 | .13 | .41 | | | 1.02 | .86 | .65 | .35 | | | 2.88 |
| Sutton [1] | | .70 | | | .20 | | .55 | | | | .93 | 2.62 | | .15 | | | 3.70 |
| Weston [3] | | .80 | | .15 | .10 | .09 | .62 | .08 | | .18 | 1.47 | 1.29 | | | | | 2.94 |

[1] Precipitation generally measured in late afternoon; amount recorded is for the 24 hours ending at the time of observation.
[2] Precipitation measured in morning; amount then recorded is for preceeding 24 hours.
[3] Precipitation is for the 24-hour period midnight to midnight.

TABLE 7.—*Summary of crest stage and discharge, precipitation, runoff, and retention, at gaging stations for the flood of April 15–17, 1939*

| Stream | Location | Drainage area (square miles) | Crest stage (feet) | Maximum discharge: Second-feet | Maximum discharge: Second-feet per square mile | Precipitation (inches) | Direct runoff (inches) | Retention (inches) |
|---|---|---|---|---|---|---|---|---|
| Little Kanawha River | Near Burnsville | 155 | 18.3 | 8,680 | 56.0 | 3.65 | 2.65 | 1.0 |
| Do | Glenville | 386 | 33.22 | 20,400 | 52.8 | 3.7 | 3.3 | .4 |
| Do | Grantsville | 913 | 43.10 | 34,300 | 37.6 | 3.85 | 3.05 | .8 |
| Do | Palestine | 1,510 | 32.25 | 53,000 | 35.1 | | | |
| West Fork Little Kanawha River | Rocksdale | 205 | 30.3 | 20,200 | 98.5 | 4.2 | 3.25 | .95 |
| Hughes River | Cisko | 453 | 23.5 | 15,900 | 35.1 | 3.4 | 2.75 | .65 |
| South Fork Hughes River | Macfarlan | 210 | 23.97 | 10,200 | 48.5 | 3.55 | 2.65 | .90 |

The base flow, consisting essentially of effluent from ground-water storage, is shown by the dashed line. The area between the dashed and the solid line represents the direct runoff resulting from the storm. The method used in computing the base flow and runoff is explained in detail in previous water-supply papers (Scofield, 1938, p. 488; Youngquist and Langbein, 1941, p. 76).

The retention, computed as the difference between rainfall and runoff, ranged from 0.4 inch at Glenville to 1.0 inch near Burnsville. The average for all stations is 0.8 inch.

## DISTRIBUTION AND FREQUENCY OF FLOOD EVENTS

The recorded annual maximum stage, and floods exceeding the established flood stages at Creston and Glenville, are listed in table 8 for the periods of record for the gages near Burnsville, at Glenville, at Grantsville, and at Creston.

The data collected at Glenville—43 years of gage-height record and 14 years of discharge record—appear to be best suited to illustrate the annual and seasonal distribution of past floods and the frequency with which they have occurred.

The recorded floods exceeding the flood stage of 23 feet at Glenville are shown in figure 22. Probably the relatively few minor floods recorded during the years 1901–12 is due to some extent to the fact that the practice of making special readings of gage height at or near flood crests was not generally in use for minor floods prior to 1913. It may be of some significance that no floods exceeding 30 feet were recorded prior to 1918 but during the years 1918–43 four such floods were recorded.

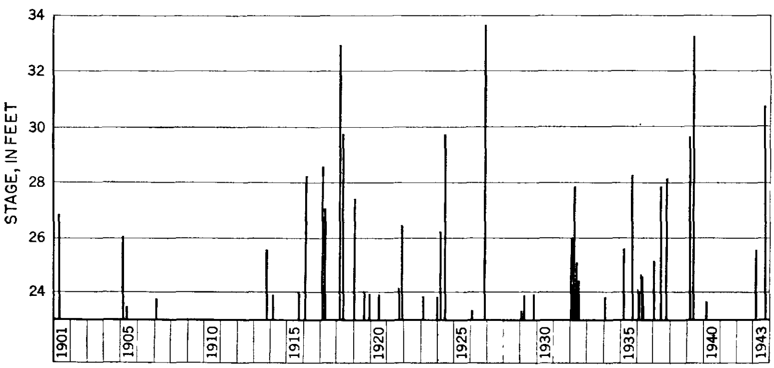



FIGURE 22.—Stages reached by floods exceeding 23 feet at Glenville, 1901–43.

TABLE 8.—*Recorded flood-crest stages, in feet, at stations on Little Kanawha River.*

[For annual maximum flood and other floods for which the gage height was greater then 23 feet at Glenville or 20 feet at Creston]

| Year | Burnsville [1] | | Glenville [2] | | Grantsville [3] | | Creston [4] | |
|---|---|---|---|---|---|---|---|---|
| | Date | Gage height | Date | Gage height | Date | Gage height | Date | Gage height |
| 1901 | | | Apr. 4 | 26.8 | | | Apr. 4 | 23.5 |
| 1901 | | | Apr. 20 | 22.0 | | | Apr. 20 | 25.8 |
| 1902 | | | Jan. 27 | 16.2 | | | Jan. 27 | 21.9 |
| 1902 | | | Feb. 26 | 15.0 | | | Feb. 26 | 21.7 |
| 1903 | | | Feb. 28 | 21.1 | | | Mar. 1 | 21.5 |
| 1904 | | | Mar. 23 | [5] 11.5 | | | Mar. 24 | 13.0 |
| 1904 | | | | | | | Apr. 28 | 16.0 |
| 1905 | | | Feb. 9 | 12.5 | | | Feb. 10 | 20.0 |
| 1905 | | | Mar. 10 | 26.0 | | | Mar. 10 | 23.5 |
| 1905 | | | May 12 | 23.5 | | | May 12 | 20.0 |
| 1906 | | | Mar. 16 | 16.5 | | | Mar. 16 | 19.5 |
| 1906 | | | Dec. 18 | 17.1 | | | Dec. 18 | 18.5 |
| 1907 | | | Jan. 9 | 23.7 | | | Jan. 9 | 16.6 |
| 1907 | | | Jan. 13 | 20.9 | | | Jan. 13 | 22.0 |
| 1907 | | | Jan. 17 | 22.1 | | | Jan. 18 | 21.2 |
| 1908 | | | Feb. 7 | 6.3 | | | Feb. 6 | 16.0 |
| 1908 | | | May 10 | 17.5 | | | May 11 | 12.8 |
| 1909 | | | Feb. 16 | 14.5 | | | Feb. 17 | 15.0 |
| 1909 | | | May 1 | 14.5 | | | May 1 | 18.3 |
| 1910 | | | Jan. 7 | 17.5 | | | Jan. 7 | 13.6 |
| 1910 | | | Jan. 19 | 15.5 | | | Jan. 19 | 16.6 |
| 1911 | | | Jan. 30 | 22.6 | | | Jan. 30 | 19.5 |
| 1912 | | | Feb. 27 | 15.1 | | | Feb. 27 | 16.0 |
| 1912 | | | July 22 | 19.1 | | | July 23 | 12.6 |
| 1913 | | | Mar. 27 | 22.5 | | | Mar. 28 | 20.4 |
| 1913 | | | Nov. 16 | 25.5 | | | Nov. 17 | 23.1 |
| 1914 | | | Feb. 19 | 23.9 | | | Feb. 20 | 22.3 |
| 1915 | | | Oct. 1 | 24.0 | | | Oct. 2 | 19.8 |
| 1915 | | | Dec. 18 | 22.0 | | | Dec. 19 | 20.7 |
| 1916 | | | Jan. 12 | 28.2 | | | Jan. 12 | 24.0 |
| 1916 | | | Feb. 13 | 22.5 | | | Feb. 13 | 20.6 |
| 1917 | | | Jan. 22 | 28.5 | | | Jan. 22 | 24.1 |
| 1917 | | | Mar. 12 | 27.0 | | | Mar. 12 | 23.2 |
| 1917 | | | May 29 | 22.3 | | | May 29 | 24.0 |
| 1918 | | | Jan. 29 | 22.7 | | | Jan. 29 | 32.0 |
| 1918 | Mar. 13 | 19.7 | Mar. 13 | 32.9 | Mar. — | 42.7 | Mar. 14 | 32.0 |
| 1918 | | | May 26 | 29.7 | | | May 26 | 17.5 |
| 1919 | | | Jan. 2 | 27.4 | | | Jan. 2 | 24.6 |
| 1919 | | | June 26 | 23.0 | | | June 27 | 17.5 |
| 1919 | | | July 17 | 24.0 | | | July 17 | 17.0 |
| 1919 | | | Dec. 7 | 23.9 | | | Dec. 7 | 18.6 |
| 1920 | | | Jan. 23 | 22.3 | | | Jan. 23 | 19.7 |
| 1920 | | | July 25 | 23.9 | | | July 26 | 12.0 |
| 1921 | | | Nov. 29 | 24.1 | | | Nov. 29 | 20.3 |
| 1921 | | | Dec. 24 | 26.4 | | | Dec. 24 | 21.0 |
| 1922 | | | Mar. 15 | 22.7 | | | Mar. 16 | 18.3 |
| 1922 | | | June 18 | 22.8 | | | June 19 | 10.3 |
| 1923 | | | Feb. 2 | 23.8 | | | Feb. 2 | 19.4 |
| 1923 | | | Dec. 31 | 23.8 | | | | |
| 1924 | | | | | | | Jan. 1 | 17.8 |
| 1924 | | | Feb. 20 | 26.2 | | | Feb. 20 | 21.8 |
| 1924 | | | May 12 | 29.7 | | | May 13 | 23.8 |

TABLE 8.—*Recorded flood-crest stages, in feet, at stations on Little Kanawha River*—Continued

[For annual maximum flood and other floods for which the gage height was greater then 23 feet at Glenville or 20 feet at Creston]

| Year | Burnsville [1] | | Glenville [2] | | Grantsville [3] | | Creston [4] | |
|---|---|---|---|---|---|---|---|---|
| | Date | Gage height | Date | Gage height | Date | Gage height | Date | Gage height |
| 1925 | | | May 12 | 22.5 | | | May 12 | 15.4 |
| 1925 | | | Oct. 25 | 22.2 | | | Oct. 26 | 15.6 |
| 1926 | | | Jan. 22 | 23.3 | | | Jan. 22 | 17.3 |
| 1926 | Nov. — | 17.6 | Nov. 16 | 33.6 | Nov. — | 39.9 | Nov. 17 | 23.7 |
| 1927 | | | Feb. 19 | 22.8 | | | Feb. 20 | 16.8 |
| 1927 | | | May 1 | 21.5 | | | May 1 | 16.9 |
| 1928 | | | Apr. 30 | 19.5 | | | Apr. 30 | 17.5 |
| 1928 | | | June 30 | 19.6 | | | June 30 | 16.4 |
| 1929 | | | Feb. 26 | 19.2 | Feb. 26 | 28.4 | Feb. 27 | 18.1 |
| 1929 | | | Mar. 6 | 23.9 | Mar. 5 | 27.2 | Mar. 6 | 17.4 |
| 1929 | | | Oct. 3 | 23.9 | Oct. 3 | 24.7 | Oct. 4 | 13.4 |
| 1930 | | | Feb. 5 | 16.8 | Feb. 5 | 23.7 | Feb. 5 | 14.0 |
| 1931 | | | Apr. 1 | 14.6 | Apr. 2 | 21.9 | Apr. 2 | 14.7 |
| 1931 | | | Aug. 22 | 18.0 | Aug. 22 | 22.8 | Aug. 23 | 10.5 |
| 1932 | | | Jan. 30 | 26.0 | Jan. 30 | 35.8 | Jan. 30 | 22.0 |
| 1932 | | | Feb. 5 | 27.8 | Feb. 5 | 31.2 | Feb. 5 | 21.4 |
| 1932 | | | Mar. 17 | 25.0 | Mar. 16 | 28.9 | Mar. 18 | 20.7 |
| 1932 | | | Mar. 28 | 24.4 | Mar. 28 | 30.7 | Mar. 28 | 21.3 |
| 1933 | | | Feb. 15 | 13.8 | Feb. 15 | 30.4 | Feb. 16 | 12.4 |
| 1933 | | | Mar. 19 | 21.7 | Mar. 19 | 28.3 | Mar. 19 | 19.1 |
| 1934 | | | Jan. 7 | 23.8 | Jan. 7 | 29.4 | Jan. 8 | 19.5 |
| 1935 | | | Mar. 12 | 25.5 | Mar. 12 | 33.5 | Mar. 12 | 23.4 |
| 1935 | | | Aug. 8 | 28.2 | Aug. 8 | 34.7 | Aug. 8 | 21.0 |
| 1936 | | | Jan. 3 | 24.1 | Jan. 3 | [6] 28.0 | Jan. 3 | 21.3 |
| 1936 | | | Feb. 15 | 24.0 | Feb. 15 | 30.4 | Feb. 15 | 23.9 |
| 1936 | | | Mar. 17 | 24.6 | Mar. 18 | 31.8 | Mar. 17 | 21.4 |
| 1936 | | | Apr. 6 | 23.4 | Apr. 6 | 31.8 | Apr. 6 | 21.9 |
| 1937 | | | Jan. 23 | 25.1 | Jan. 23 | 33.4 | Jan. 23 | 22.8 |
| 1937 | | | June 22 | 27.8 | June 22 | 30.1 | June 22 | 17.6 |
| 1937 | | | Oct. 28 | 28.1 | Oct. 29 | 32.1 | Oct. 29 | 20.7 |
| 1938 | May 21 | 11.0 | May 20 | 21.5 | May 21 | 30.0 | May 22 | 19.2 |
| 1939 | Feb. 3 | 19.0 | Feb. 4 | 29.6 | Feb. 4 | 37.0 | Feb. 4 | 25.7 |
| 1939 | Apr. 16 | 18.3 | Apr. 16 | 33.2 | Apr. 17 | 43.1 | Apr. 17 | 33.2 |
| 1940 | Mar. 31 | 9.6 | Mar. 31 | 23.6 | Mar. 31 | 30.3 | Mar. 31 | 19.6 |
| 1940 | Apr. 20 | 10.8 | Apr. 20 | 22.5 | Apr. 20 | 31.2 | Apr. 20 | 21.4 |
| 1941 | June 5 | 8.5 | June 4 | 18.6 | June 4 | 25.5 | June 5 | 15.3 |
| 1942 | Dec. 30 | 9.8 | Dec. 30 | 22.2 | Dec. 30 | 31.6 | Dec. 30 | 23.8 |
| 1943 | Mar. 20 | 11.5 | Mar. 20 | 25.5 | Mar. 20 | 34.2 | Mar. 20 | 23.6 |
| 1943 | July 30 | 17.6 | July 31 | 20.7 | July 31 | 21.3 | July 29 | 12.0 |
| 1943 | Aug. 5 | 17.5 | Aug. 5 | 30.7 | Aug. 5 | 35.0 | Aug. 6 | 19.7 |

[1] Records from floodmarks prior to 1938, two or more gage readings daily, 1938, 1939, and water-stage recorder charts beginning Feb. 26, 1940. Gage is 4 miles upstream from Burnsville.

[2] Records from U. S. Weather Bureau prior to 1929 consisting of one daily reading, which was supplemented by special readings during floods beginning in 1913; Weather Bureau records and twice-daily gage readings by Geological Survey 1929-34, water-stage recorder charts beginning Dec. 14, 1934. All records reduced to the present gage datum.

[3] Records from floodmarks prior to 1929; two or more gage readings daily, 1929-34; water-stage recorder charts beginning Nov. 21, 1934.

[4] Records from U. S. Weather Bureau. Gage read once daily supplemented by special readings during floods beginning in 1913. Datum of gage is 612.71 feet above mean sea level, adjustment of 1912.

[5] May not be the maximum for year; no record Apr. 1 to July 11, 1904.

[6] Estimated from records at other stations.

The seasonal distribution of floods recorded at Glenville is shown in figure 23. Eleven of the 48 recorded floods exceeding 23 feet in the 43-year period occurred during March. The next highest in rates of occurrence were January with nine floods and February with seven.

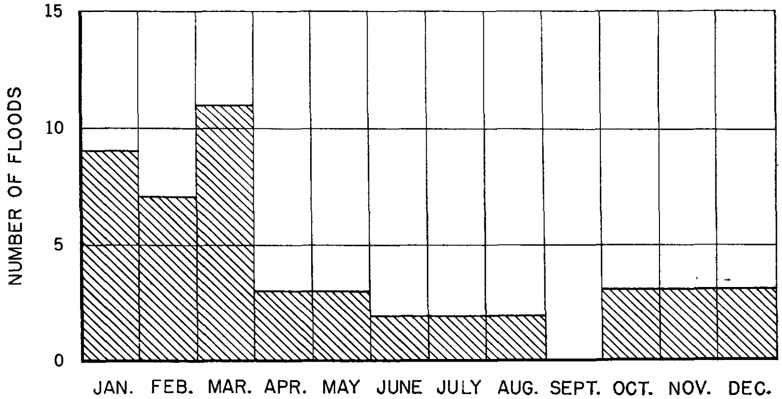



FIGURE 23.—Monthly distribution of floods exceeding 23 feet at Glenville, 1901–43.

No floods have been recorded in September but from two to three occurred in each of the other eight months of the year.

The frequency with which floods of various magnitudes have occurred above a base stage of 23 feet at Glenville during the period of record is shown in figure 24. The recurrence interval was computed

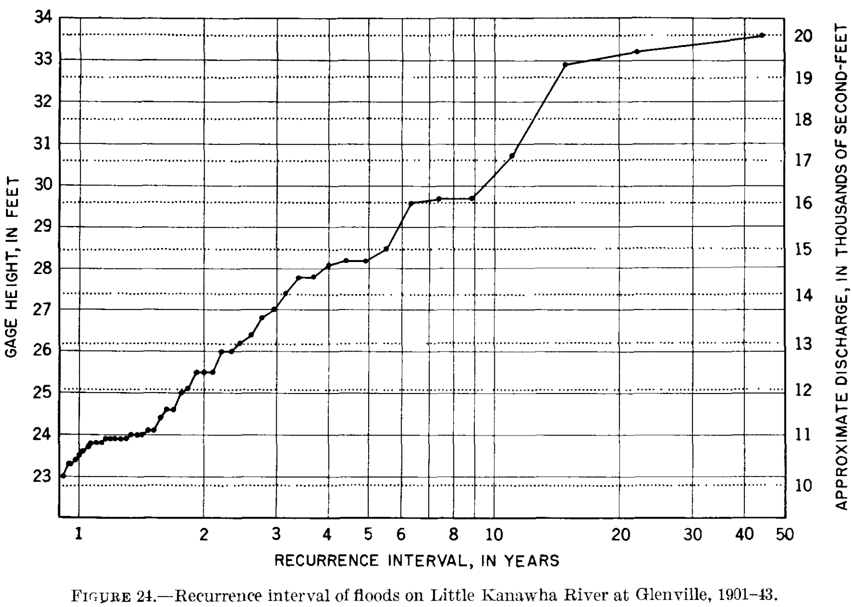



FIGURE 24.—Recurrence interval of floods on Little Kanawha River at Glenville, 1901–43.

from the formula $\frac{N+1}{M}$, in which $N$ is the number of years of record, and $M$ is the relative magnitude of the event beginning with the highest as one. The trend of the plotted points indicates that floods reaching a stage of 23½ feet and discharge of 10,500 second-feet have been equaled or exceeded on an average of once a year during period of record, and floods reaching or exceeding a stage of 28 feet and discharge of 14,500 second-feet have occurred on an average of once every 4 years.

Flood-frequency studies have a very important place in establishing road-bed levels, bridge elevations and clearances, channel capacities, and in other engineering and economic problems where costs of the works must be balanced against probable damages and liabilities that are a function of the frequency of flooding. Anyone attempting to use flood-frequency data should understand its limitations. The relative shortness of the record as well as deficiencies in the application of the statistical theory tend to introduce errors, particularly in the recurrence interval for larger floods.

Much has been written on the subject of flood-frequency analysis, and several methods have been summarized (Jarvis and others, 1936). A more recent approach which is viewed with favor by some students of the subject is that presented by Gumbel (1945, pp. 833–839).

## SUMMARY OF FLOOD STAGES AND DISCHARGES IN WEST VIRGINIA

A summary of the known peak stages and discharges at gaging stations and at certain other points on streams in West Virginia and on its boundaries is given in table 9.

Except as otherwise noted, the discharge data given in this table are from the published reports or from the unpublished data in the files of the Geological Survey. Records of peak stage have been taken from the U. S. Weather Bureau publications in those cases where the gage-height record was collected by that agency. The records of peak stages for most of the gages at locks and dams were taken from the reports of the Corps of Engineers.

The summary includes data for practically all points on West Virginia streams where systematic records of stage and discharge have been collected for periods of a few years or more, with the exception of abandoned navigation locks and dams and certain points on Ohio River. A number of old navigation structures were abandoned and removed from Kanawha and Monongahela Rivers when modern locks and dams were constructed. In these cases the records are given for the present locks but not for those that were removed. Stage and discharge records for Ohio River along the border of West Virginia have been summarized only at stations where discharge records were secured. There are numerous other locations where records of stage are available. Records of flood stages for these points have been summarized in previous water-supply papers (Horton, 1913, Grover, 1937, 1938).

Different gages have been used from time to time at or near the same site at some stations. Insofar as practicable, the records have been reduced to the datum of the gage last used. The datum of the gage in terms of feet above mean sea level is given where this information is available.

The period of known floods is not necessarily the same as the period for which continuous and systematic records have been collected. In many cases records of flood heights have been extended for a number of years prior to the establishment of gages on the basis of reliable floodmarks that were pointed out by local residents.

Wherever practicable, the approximate discharge for great floods outside the period of continuous discharge record have been determined by the extension of rating curves developed in recent years. In some cases this procedure was not applicable because of changes in channel conditions. In others it would have been necessary to extend the rating curve so far beyond the limit to which it was defined that a reasonable degree of accuracy in the result could not be assured. Under these conditions the maximum known stage is given and also the peak discharge for the greatest flood during the period of continuous discharge record.

The reference numbers assigned to the points listed in table 9 may be used in finding its location on the map, plate 1.

Figure 25 shows the peak discharge in second-feet per square mile plotted against the corresponding drainage area for each point where the discharge was given in table 9. Any study attempting to arrive at a probable peak discharge for a drainage basin by comparison with this chart should take into consideration the physical characteristics of the basin such as topography, shape, soil, vegetal cover, and channel conditions, as well as the drainage area.

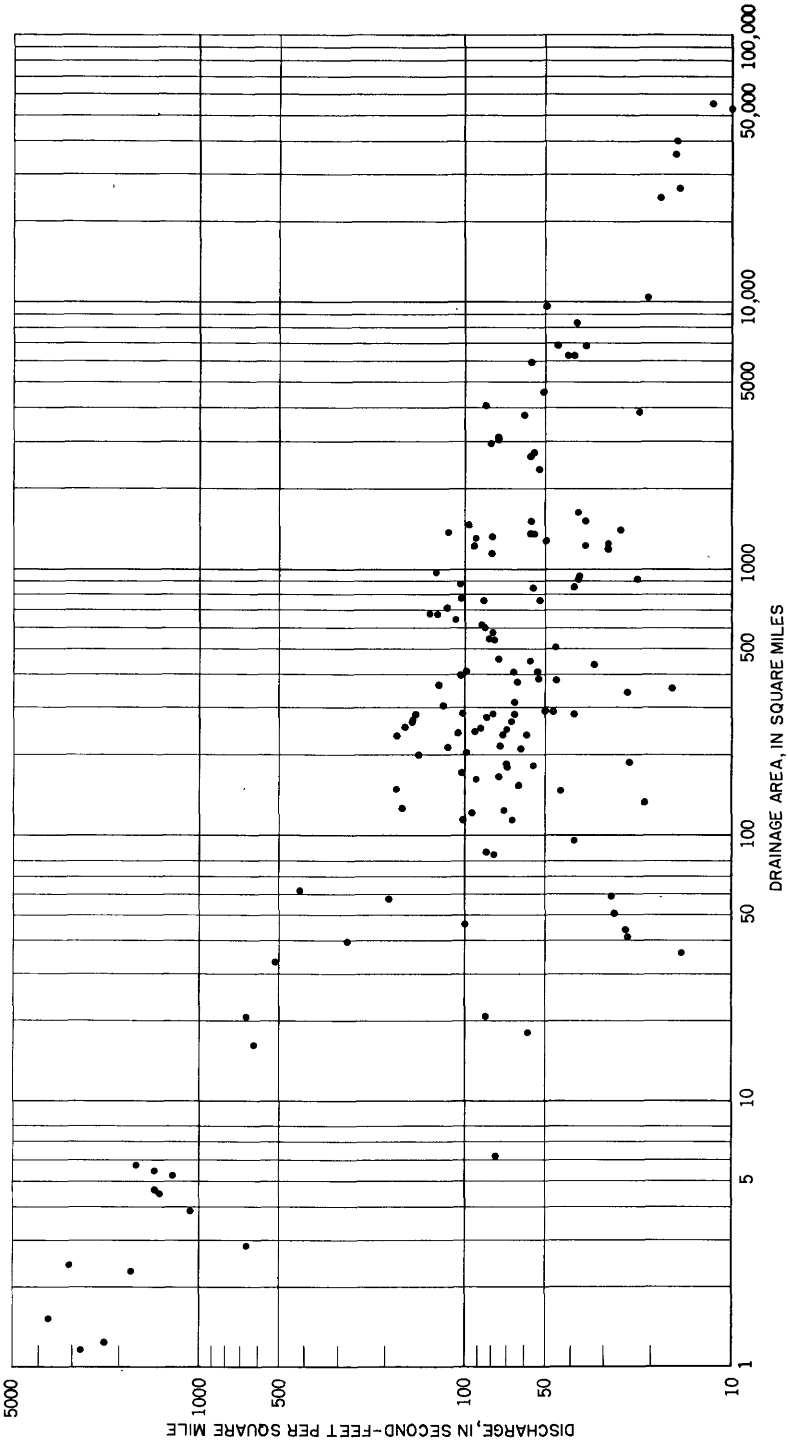
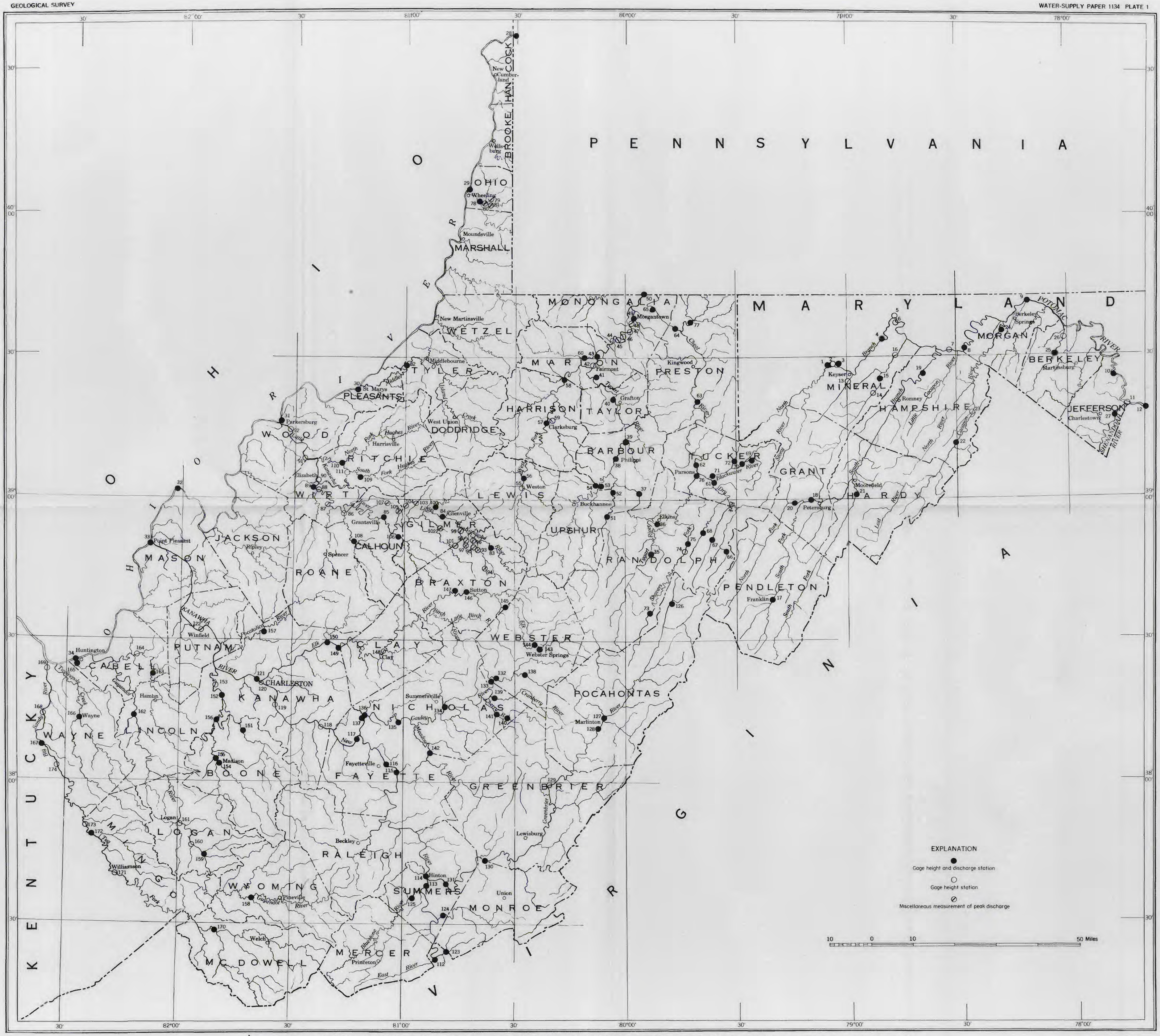



FIGURE 25.—Relation of unit discharges in table 9 to size of drainage basin.




MAP OF WEST VIRGINIA SHOWING LOCATION OF STAGES AND DISCHARGES LISTED IN TABLE 9

945369 O - 51 (Face p. 48)

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TABLE 9.—*Maximum known flood stages and discharges in West Virginia*

| No. | Stream and place of determination | Drainage area (square miles) | Datum of gage in feet above mean sea level | Period of known floods | Peak stage and discharge: Date | Stage in feet | Discharge: Second-feet | Discharge: Second-feet per square mile | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | *Potomac River basin* | | | | | | | | |
| 1 | North Branch Potomac River at Bloomington, Md. | 287 | [1] 951.98 | 1924–43 | Mar. 29, 1924 | [2] 17 | 29,000 | 101 | Gaging-station record. |
| 2 | North Branch Potomac River at Luke, Md. | 402 | | | Mar. 17, 1936 | | 40,000 | 99.5 | Discharge by slope-area method. Flood of Mar. 19, 1924, reached a stage about 1.5 feet higher. |
| 3 | North Branch Potomac River at Piedmont, W. Va. | 410 | | 1899–1906, 1936 | do | | 40,000 | 98.5 | Discharge by slope-area method. |
| 4 | North Branch Potomac River at Pinto, Md. | 596 | [3] 648.23 | 1924–43 | Mar. 29, 1924 | 24 | 55,000 | 92.3 | Gaging-station record. |
| 5 | North Branch Potomac River at Cumberland, Md. | 619 | | | Mar. 18, 1936 | | 53,600 | 86.6 | Discharge by slope-area method. |
| 6 | North Branch Potomac River near Cumberland, Md. | 875 | [3] 585.22 | 1889–1943 | June 1, 1889 | 29.2 | 89,000 | 102 | Gaging-station record. |
| 7 | Potomac River at Okonoko, W. Va. | 2,983 | | | Mar. 18, 1936 | | 239,000 | 80.2 | Discharge by slope-area method. |
| 8 | Potomac River at Paw Paw, W. Va. | 3,109 | [3] 487.88 | 1936–43 | do | 54 | 240,000 | 75.2 | Gaging-station record. |
| 9 | Potomac River at Hancock, Md. | 4,073 | [1] 383.46 | 1889–1943 | do | 47.6 | 340,000 | 83.4 | Do. |
| 10 | Potomac River at Shepherdstown, W. Va. | 5,936 | [1] 281.00 | 1889–1943 | Mar. 19, 1936 | 42.1 | 335,000 | 56.4 | Do. |
| 11 | Potomac River at Harpers Ferry, W. Va. | 9,372 | [4] 245.53 | 1889–1943 | do | 36.53 | | | From U. S. Weather Bureau. |
| 12 | Potomac River at Point of Rocks, Md. | 9,651 | [1] 200.54 | 1889–1943 | do | 41.03 | 480,000 | 49.7 | Gaging-station record. |
| 13 | New Creek at Keyser, W. Va. | 46.4 | | | Mar. 17, 1936 | | 4,600 | 100 | Discharge by slope-area method. |
| 14 | Patterson Creek at Headsville, W. Va. | 161 | | | do | | 14,600 | 90.6 | Do. |
| 15 | Patterson Creek near Headsville, W. Va. | 216 | [3] 631.04 | 1936–43 | do | 17.2 | 16,000 | 74 | Gaging-station record. |
| 16 | Patterson Creek at Alaska, W. Va. | 249 | | | do | | 17,400 | 69.9 | Discharge by slope-area method. |
| 17 | South Branch Potomac River at Franklin, W. Va. | 182 | [3] 1,692.5 | 1936–43 | March 1936 | 13 | | | Discharge not determined. |
| | | | | | May 16, 1942 | 8.69 | 10,100 | 55.5 | Gaging-station record. |
| 18 | South Branch Potomac River near Petersburg, W. Va. | 642 | [1] 692.00 | 1877–1943 | 1877 | 21.2 | 54,000 | 84 | Do. |
| 19 | South Branch Potomac River near Springfield, W. Va. | 1,471 | [1] 562.02 | 1877–1943 | Mar. 18, 1936 | 34.2 | 143,000 | 97.2 | Do. |
| 20 | North Fork of South Branch Potomac River at Cabins, W. Va. | 314 | [3] 1,050.13 | 1936–43 | Mar. 17, 1936 | 12.8 | 20,600 | 65.6 | Do. |
| 21 | South Fork of South Branch Potomac River near Moorefield, W. Va. | 283 | [3] 861.51 | 1928–43 | do | 14.9 | 30,400 | 107 | Do. |
| 22 | Cacapon River at Yellow Springs, W. Va. | 306 | [3] 858.51 | 1936–43 | Oct. 15, 1942 | 22.22 | 36,700 | 120 | Do. |
| 23 | Cacapon River at Cacapon Bridge, W. Va. | 367 | | 1924–36 | Mar. 17, 1936 | 26 | 46,000 | 125 | Discharge by slope-area method. |
| 24 | Cacapon River near Great Cacapon, W. Va. | 677 | [3] 456.78 | 1889–1943 | Mar. 18, 1936 | 30.1 | 87,600 | 128 | Gaging-station record. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Back Creek near Jones Spring, W. Va | 243 | [3] 416.42 | 1928–43 | Oct. 15, 1942 | 25.1 | 22,400 | 92.3 | Do. |
| 26 | Back Creek near Hedgesville, W. Va | 252 | | 1889–1936 | Mar. 18, 1936 | 25 | 22,000 | 87.4 | Discharge by slope-area method. |
| 27 | Shenandoah River at Millville, W. Va | 3,040 | [1] 293.00 | 1870–1943 | Oct. 16, 1942 | 32.4 | 230,000 | 75.6 | Gaging-station record. |
| | *Ohio Main Stem* | | | | | | | | |
| 28 | Ohio River at Montgomery Island Dam, Pa | 22,960 | [1] 653.62 | 1941–43 | Dec. 31, 1942 | 46.8 | 438,000 | 19.1 | Gaging-station record. Lower-pool gage. |
| 29 | Ohio River at Wheeling, W. Va | 24,800 | [5] 610.8 | 1810–1943 | Mar. 19, 1936 | 53.6 | 466,000 | 18.8 | Gaging-station record. Wharf gage. |
| 30 | Ohio River at St. Marys, W. Va | 26,850 | [5] 577.30 | 1884–1943 | Mar. 29, 1913<br>Jan. 1, 1943 | 54.2<br>46.67 | ---<br>421,000 | ---<br>15.7 | From Corps of Engineers, U. S. Army.<br>Gaging-station record. Gage on highway bridge. |
| 31 | Ohio River at Parkersburg, W. Va | 35,600 | [5] 561.97 | 1884–1943 | Mar. 29, 1913 | 58.93 | 577,000 | 16.2 | Gaging-station record. Gage on railroad bridge over Little Kanawha River. Little Kanawha River not included. |
| 32 | Ohio River at Pomeroy, Ohio | 39,950 | [5] 517.50 | 1884–1943 | Mar. 30, 1913 | 65.8 | 633,000 | 15.8 | Gaging-station record. Gage on Pomeroy-Mason City bridge. |
| 33 | Ohio River at Pt. Pleasant, W. Va | 52,760 | [5] 514.10 | 1884–1943 | Mar. 30, 1913<br>Jan. 1, 1943 | 62.8<br>[5a] 54.38 | ---<br>522,000 | ---<br>9.9 | From Corps of Engineers, U. S. Army.<br>Gaging-station record. Gage on highway bridge. Kanawha River included. |
| 34 | Ohio River at Huntington, W. Va | 55,900 | [5] 490.26 | 1884–1943 | Jan. 27-28, 1937 | 69.45 | 654,000 | 11.7 | Gaging-station record. Upper gage at Lock 28. |
| | *Monongahela River basin* | | | | | | | | |
| 35 | Tygart River near Dailey, W. Va | 187 | [1] 1,940.09 | 1915–43 | Feb. 4, 1932 | 17.2 | 13,100 | 70 | Gaging-station record. |
| 36 | Tygart River at Elkins, W. Va | 268 | [3] 1,900.44 | 1913–43 | Mar. 14, 1918<br>Feb. 5, 1932 | 18.5 | 18,000 | 67.2 | From U. S. Weather Bureau. |
| 37 | Tygart River at Belington, W. Va | 408 | [1] 1,679.49 | 1888–1943 | July 1888 | 21.7 | 26,900 | 65.9 | Gaging-station record. |
| 38 | Tygart River at Philippi, W. Va | 916 | [6] 1,280.55 | 1912–43 | July 25, 1912 | 26 | 37,000 | 40.4 | Do. |
| 39 | Tygart River at Arden, W. Va | 945 | [3] 1,220.00 | 1936–40 | Oct. 29, 1937 | 20.6 | 35,000 | 37 | Do. |
| 40 | Tygart River at Fetterman, W. Va | 1,304 | [1] 957.86 | 1888–1939 | July 10, 1888 | 32.5 | 93,000 | 91.2 | Do. |
| 41 | Tygart River at Colfax, W. Va | 1,366 | [7] 855.49 | 1939–43 | Feb. 8, 1940 | 16.56 | --- | --- | Gaging-station record. Due to ice jam. Flow regulated by Tygart Reservoir. |
| 42 | Monongahela River at Fairmont, W. Va | 2,258 | [1] 839.91 | 1888–1921 | July 10, 1888 | 37 | --- | --- | From U. S. Weather Bureau. |
| 43 | Monongahela River at Lock 15, Hoult, W. Va | 2,388 | [8] 849.58 | 1888–1943 | do | 26 | 125,000 | 52.3 | Gaging-station record. Upper-pool gage. |
| 44 | Monongahela River at Lock 14, W. Va | 2,530 | [3] 828.24 | 1888–1943 | do | 34.8 | --- | --- | From Corps of Engineers, U. S. Army. Lower-pool gage. |
| 45 | Monongahela River at Lock 13, W. Va | 2,536 | [3] 817.58 | 1888–1943 | do | 35.9 | --- | --- | Do. |
| 46 | Monongahela River at Lock 12, W. Va | 2,543 | [3] 806.91 | 1888–1943 | do | 37.7 | --- | --- | Do. |
| 47 | Monongahela River at Lock 11, W. Va | 2,571 | [3] 796.2 | 1888–1943 | do | 35.4 | --- | --- | Do. |
| 48 | Monongahela River at Lock 10, W. Va | 2,585 | [3] 785.4 | 1888–1943 | do | 39.1 | --- | --- | Do. |
| 49 | Monongahela River at Morgantown, W. Va | 2,648 | [1] 789.05 | 1888–1943 | do | 34.5 | 150,000 | 57 | Gaging-station record. Gage at highway bridge. |
| 50 | Monongahela River at Lock 8, Pt. Marion, Pa | 2,720 | [3] 782.50 | 1888–1943 | do | 28 | 150,000 | 55.2 | Gaging-station record. Upper-pool gage. |
| 51 | Middle Fork at Midvale, W. Va | 122 | [1] 1,812.63 | 1888–1943 | Feb. 3, 1939 | 18.5 | 11,400 | 93.4 | Gaging-station record. |
| 52 | Middle Fork at Audra, W. Va | 149 | | 1942–43 | Aug. 24, 1942 | 10.29 | 6,540 | 43.9 | Do. |
| 53 | Buckhannon River at Hall, W. Va | 277 | [7] 1,369.15 | 1888–1943 | Mar. 14, 1918<br>Oct. 29, 1937 | 14.7 | 12,200 | 83.0 | Do. |

Footnotes at end of table.

TABLE 9.—*Maximum known flood stages and discharges in West Virginia*—Continued

| No. | Stream and place of determination | Drainage area (square miles) | Datum of gage in feet above mean sea level | Period of known floods | Peak stage and discharge: Date | Peak stage and discharge: Stage in feet | Discharge: Second-feet | Discharge: Second-feet per square mile | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | *Monongahela River basin*—Continued | | | | | | | | |
| 54 | Big Run at Volga, W. Va | 6.19 | [1] 1,387.37 | 1941–43 | Oct. 15, 1942 | 2.38 | 473 | 76.5 | Gaging-station record. |
| 55 | West Fork River at Weston, W. Va | | | 1888–1943 | July 1888 | 22.5 | | | From Treatise on water resources, Scotland G. Highland. |
| | | 133 | [4] 995.6 | 1903–43 | Apr. 16, 1939 | 20.25 | | | From U. S. Weather Bureau. |
| 56 | West Fork River at Butcherville, W. Va | 181 | [9] 993.00 | 1888–1943 | July 1888 | 17 | 12,600 | 69.6 | Gaging-station record. |
| 57 | West Fork River at Clarksburg, W. Va | 384 | | 1888–1943 | July 1888 | 35 | | | From Treatise on water resources, Scotland G. Highland. |
| | | | [6] 931.82 | 1923–43 | Apr. 17, 1939 | 8.22 | 13,500 | 35.2 | Gaging-station record. |
| 58 | West Fork River at Enterprise, W. Va | 759 | [3] 869.45 | 1888–1943 | do | [10] 21.57 | 31,500 | | Do. |
| 59 | Elk Creek near Clarksburg, W. Va | 107 | [11] 955.01 | 1910–18 | July 25, 1912 | 15 | | | Discharge not determined. |
| 60 | Buffalo Creek at Barrackville, W. Va | 115 | [1] 882.42 | 1907–08<br>1912–43 | July 1912 | 18 | 11,600 | 101 | Gaging-station record. |
| 61 | Dry Fork at Hendricks, W. Va | 345 | [1] 1,698.76 | 1940–43 | May 16, 1942 | 6.75 | 8,400 | 24.4 | Do. |
| 62 | Cheat River near Parsons, W. Va | 718 | [12] 1,590.79 | 1888–1943 | July 10, 1888 | 20.5 | 85,000 | 118 | Do. |
| 63 | Cheat River at Rowlesburg, W. Va | 972 | [7] 1,369.8 | 1844–1943 | July 6, 1844 | 16.7 | 125,000 | 129 | Do. |
| 64 | Cheat River near Pisgah, W. Va | 1,354 | [1] 875.68 | 1927–43 | Oct. 28, 1937<br>Feb. 3, 1939 | 24.28 | 74,700 | 55.1 | Do. |
| 65 | Cheat River near Morgantown, W. Va | 1,380 | [13] 822.28 | 1888–1925 | July 10, 1888 | 18.7 | 160,000 | 116 | Do. |
| 66 | Gandy Creek at Horton, W. Va | 36 | | 1924–26 | Sept. 30, 1924 | 2.70 | 550 | 15.3 | Do. |
| 67 | Laurel Fork at Wymer, W. Va | 44 | | 1924–26 | Oct. 25, 1925 | 3.30 | 1,100 | 25.0 | Do. |
| 68 | Glady Fork at Evenwood, W. Va | 41 | | 1924–26 | do | 3.10 | 1,010 | 24.6 | Do. |
| 69 | Blackwater River above Beaver Creek near Davis, W. Va. | 58.7 | | 1929–32 | Feb. 5, 1932 | 5.0 | 1,640 | 28.0 | Do. |
| 70 | Blackwater River at Davis, W. Va | 86.2 | [13] 3,058.87 | 1921–43 | Mar. 29, 1924 | 13.2 | 7,170 | 83.2 | Do. |
| 71 | Blackwater River at Hendricks, W. Va | 148 | | 1911–18 | Mar. 12, 1917 | 8.37 | | | Discharge not determined. |
| 72 | North Fork Blackwater River at Douglas, W. Va. | 17.9 | | 1929–31 | Oct. 2, 1929 | 3.81 | 1,020 | 58.0 | Gaging-station record. |
| 73 | Shavers Fork at Cheat Bridge, W. Va | 57.5 | | 1896–1926 | July 22, 1896 | 14 | 11,000 | 191 | Do. |
| 74 | Shavers Fork at Bemis, W. Va | 115 | | 1918–25 | March 1918 | 15.3 | | | Discharge not determined. |
| | | | | | May 12, 1924 | 11.0 | 7,680 | 66.8 | Gaging-station record. |
| 75 | Shavers Fork at Flint, W. Va | 124 | [13] 2,407.82 | 1924–32 | June 20, 1928 | 9.31 | 8,800 | 71.0 | Do. |
| | | | | | Feb. 4, 1932 | 9.54 | 8,710 | 70.2 | Do. |
| 76 | Shavers Fork at Parsons, W. Va | 214 | [12] 1,631.70 | 1880–1943 | July 10, 1888<br>July 17, 1907 | 12.5 | 25,000 | 117 | Gaging-station record. Datum of gage in use since 1941 is 1634.87 feet above mean sea level. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 77 | Big Sandy Creek at Rockville, W. Va | 200 | | 1888–1943 | July 10, 1888 | 20 to 20.5 | 28,000 to 30,000 | 150 | Gaging-station record. |
| | *Wheeling Creek basin* | | | | | | | | |
| 78 | Wheeling Creek at Elm Grove, W. Va | 282 | [6] 667.59 | 1940–43 | Dec. 30, 1942 | 13.67 | 22,100 | 78.4 | Do. |
| 79 | Little Wheeling Creek above Elm Grove, W. Va. | 20.6 | | | July 10, 1937 | | 13,700 | 665 | Discharge by slope-area method. From Corps of Engineers, U. S. Army. |
| 80 | Little Wheeling Creek at Elm Grove, W. Va | 62.0 | | | do | | 25,900 | 417 | Discharge by slope-area method. From Corps of Engineers, U. S. Army. |
| 81 | Middle Wheeling Creek at Elm Grove, W. Va | 33.5 | | | do | | 17,200 | 513 | Do. |
| | *Middle Island Creek basin* | | | | | | | | |
| 82 | Middle Island Creek at Little, W. Va | 458 | [1] 631.32 | 1875–1943 | August 1875 | 33.5 | 34,000 | 74.3 | Gaging-station record. |
| | *Little Kanawha River basin* | | | | | | | | |
| 83 | Little Kanawha River near Burnsville, W. Va | 155 | [1] 756.09 | 1918–43 | March 1918 | 19.7 | 9,800 | 63.2 | Do. |
| 84 | Little Kanawha River at Glenville, W. Va | 386 | [1] 697.79 | 1901–43 | Nov. 16, 1926 | 33.6 | | | Discharge not determined; probably less than peak discharge Apr. 16, 1939. |
| | | | | | Apr. 16, 1939 | [14] 33.22 | 20,400 | 52.8 | Gaging-station record. |
| 85 | Little Kanawha River at Grantsville, W. Va | 913 | [1] 652.83 | 1918–43 | Apr. 17, 1939 | 43.10 | 34,300 | 37.6 | Gaging-station record. |
| 86 | Little Kanawha River at Creston, W. Va | 1,263 | [1] 621.71 | 1901–43 | do | 33.2 | | | From U. S. Weather Bureau. |
| 87 | Little Kanawha River at Lock 5, W. Va | 1,330 | [1] 616.8 | 1913–43 | April 1939 | 26.7 | | | From Corps of Engineers, U. S. Army. Upper-pool gage. |
| 88 | Little Kanawha River at Lock 4, W. Va | 1,509 | [1] 602.6 | 1913–43 | Apr. 17, 1939 | 26.55 | | | From Corps of Engineers, U. S. Army. Upper-pool gage. |
| 89 | Little Kanawha River at Palestine, W. Va | 1,510 | [1] 596.08 | 1915–43 | do | 32.25 | 53,000 | 35.2 | Gaging-station record. Lock 4, lower-pool gage. |
| 90 | Little Kanawha River at Lock 3, W. Va | 1,536 | [1] 590.51 | 1913–43 | do | 32.0 | | | From Corps of Engineers, U. S. Army. Upper-pool gage. |
| 91 | Little Kanawha River at Lock 2, W. Va | 2,086 | [1] 580.6 | 1913–43 | March 1913 | 40.3 | | | Do. |
| 92 | Little Kanawha River at Lock 1, W. Va | 2,251 | [1] 569.4 | 1913–43 | do | 51.1 | | | Do. |
| 93 | Saltlick Creek above Gem, W. Va | 39.8 | | | Aug. 5, 1943 | | 11,000 | 276 | Discharge by slope-area method. |
| 94 | Berry Fork at Heaters, W. Va | 2.30 | | | do | | 4,100 | 1,780 | Do. |
| 95 | Right Fork Saltlick Creek at Gem, W. Va | 5.74 | | | do | | 9,800 | 1,710 | Do. |
| 96 | Hyers Run near Burnsville, W. Va | 1.15 | | | do | | 3,200 | 2,780 | Do. |
| 97 | Copen Run above Copen, W. Va | 3.87 | | | do | | 4,300 | 1,080 | Discharge by critical-depth and contracted-opening methods. |
| 98 | Copen Run at Copen, W. Va | 5.27 | | | do | | 6,600 | 1,250 | Discharge by slope-area and contracted-opening methods. |
| 99 | Duskcamp Run near Stout's Mill, W. Va | 4.67 | | | do | | 6,900 | 1,480 | Discharge by slope-area method. |
| 100 | Leading Creek near Glenville, W. Va | 144 | [1] 700.23 | 1938–43 | Apr. 17, 1939 | 27.5 | | | Discharge not determined. |
| 101 | Walker Fork at Flower, W. Va | 1.23 | | | Aug. 5, 1943 | | 2,800 | 2,280 | Discharge by slope-area method. |
| 102 | Spruce Run near Glenville, W. Va | 2.87 | | | do | | 1,900 | 660 | Do. |
| 103 | Tanner Creek at Tanner, W. Va | 16.1 | | | do | | 10,000 | 621 | Do. |
| 104 | Trace Fork at Revere, W. Va | 5.47 | | | do | | 8,000 | 1,460 | Do. |
| 105 | Laurel Creek above White Pine, W. Va | 2.42 | | | do | | 7,400 | 3,060 | Do. |
| 106 | Steer Creek near Grantsville, W. Va | 166 | [1] 678.00 | 1938–43 | Apr. 16, 1939 | 28.15 | 12,400 | 74.7 | Gaging-station record. |

Footnotes at end of table

TABLE 9.—*Maximum known flood stages and discharges in West Virginia*—Continued

| No. | Stream and place of determination | Drainage area (square miles) | Datum of gage in feet above mean sea level | Period of known floods | Peak stage and discharge: Date | Stage in feet | Discharge: Second-feet | Discharge: Second-feet per square mile | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | *Little Kanawha basin*—Continued | | | | | | | | |
| 107 | North Fork Yellow Creek near Big Spring, W. Va. | 1.51 | | | Aug. 5, 1943 | | 4,700 | 3,100 | Discharge by slope-area method. |
| 108 | West Fork Little Kanawha River at Rocksdale, W. Va. | 205 | [1] 657.85 | 1928–43 | Apr. 16, 1939 | 30.3 | 20,200 | 98.5 | Gaging-station record. |
| 109 | South Fork Hughes River at Macfarlan, W. Va. | 210 | [1] 635.28 | 1915–43 | Uncertain | 29 | 13,000 | 61.9 | Gaging-station record. Peak stage sometime prior to 1915. |
| 110 | Hughes River at Cisko, W. Va | 453 | [1] 605.35 | 1915–43 | Jan. 22, 1917 | 30.25 | 25,700 | 56.8 | Gaging-station record. |
| 111 | Island Run at Girta, W. Va | 4.50 | | | Aug. 5, 1943 | | 6,300 | 1,400 | Discharge by slope-area method. |
| | *Kanawha River basin* | | | | | | | | |
| 112 | New River at Glenlyn, Va | 3,768 | [6] 1,489.76 | 1927–43 | Aug. 14, 1940 | 27.5 | 226,000 | 60.0 | Gaging-station record. |
| 113 | New River near Hinton, W. Va | 4,600 | [6] 1,368.49 | 1901–43 | Apr. 21, 1901<br>May 23, 1901 | 24.2 | 234,000 | 50.8 | Do. |
| 114 | New River at Hinton, W. Va | 6,257 | [4] 1,348.2 | 1878–1943 | Sept. 13, 1878 | 20.2 | 260,000 | 41.6 | U. S. Weather Bureau staff gage at site of lower ferry. |
| | | | [6] 1,355.18 | 1936–43 | Aug. 15, 1940 | 18.97 | 246,000 | 39.3 | Gaging-station record. U. S. G. S. recording gage. |
| 115 | New River at Caperton, W. Va | 6,826 | [6] 938.44 | 1928–43 | do | 36.0 | 244,000 | 35.8 | Gaging-station record. |
| 116 | New River at Fayette, W. Va | 6,850 | [1] 838.44 | 1878–1943 | Sept. 13, 1878 | 53 | 310,000 | 45.3 | Do. |
| 117 | Kanawha River at Kanawha Falls, W. Va | 8,367 | [6] 623.20 | 1861–1943 | Sept. 14, 1878 | 37.8 | 320,000 | 38.2 | Do. |
| 118 | Kanawha River at London Dam, W. Va | 8,490 | [3] 600.00 | 1935–43 | Aug. 15, 1940 | 23.3 | | | U. S. G. S. recording gage in forebay. |
| | | | [3] 580.00 | | | 42.9 | | | U. S. G. S. recording gage in afterbay. |
| 119 | Kanawha River at Marmet Dam, W. Va | 8,816 | [3] 580.00 | 1935–43 | do | 21.4 | | | U. S. G. S. recording gage in forebay. |
| | | | [3] 560.00 | | | 40.8 | | | U. S. G. S. recording gage in afterbay. |
| 120 | Kanawha River at Charleston, W. Va | 8,881 | [6] 558.87 | 1822–1943 | Sept. 29, 1861 | 46.9 | | | From Corps of Engineers, U. S. Army. Gage on South Side bridge. |
| 121 | Kanawha River at Charleston, W. Va | 10,420 | [6] 548.00 | 1939–43 | Aug. 15, 1940 | 38.25 | 216,000 | 20.7 | From gaging station record. Recording gage at old Lock 6. |
| | | | | | Dec. 31, 1942 | 38.77 | | | |
| 122 | Kanawha River at Winfield Dam, W. Va | 11,810 | [3] 560.00 | 1939–43 | Dec. 31, 1942 | 15.30 | | | U. S. G. S. recording gage in forebay. |
| | | | [3] 530.00 | | | 45.05 | | | U. S. G. S. recording gage in afterbay |
| 123 | Rich Creek at Peterstown, W. Va | 50.6 | [6] 1,565.94 | 1941–43 | Mar. 13, 1943 | 4.90 | 1,390 | 27.5 | Gaging-station record. |
| 124 | Indian Creek at Indian Mills, W. Va | 189 | [6] 1,472.54 | 1941–43 | do | 9.09 | 4,560 | 24.1 | Do. |
| 125 | Bluestone River at Lilly, W. Va | 438 | [6] 1,433.7 | 1908–16<br>1929–43 | Mar. 25, 1935 | 11.0 | 16,600 | 37.9 | Do. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 126 | Greenbrier River at Durbin, W. Va | 134 | [6] 2,699.71 | 1943 | Mar. 13, 1943 | 5.07 | 2,830 | 21.1 | Do. |
| 127 | Greenbrier River at Marlinton, W. Va | 406 | | 1908-16 | Mar. 27, 1913 | 14.2 | 21,700 | 53.4 | Do. |
| 128 | Greenbrier River at Buckeye, W. Va | 540 | [6] 2,085.89 | 1929-43 | Feb. 5, 1932 | 17.5 | 41,500 | 76.9 | Do. |
| 129 | Greenbrier River at Renick, W. Va | 680 | [1] 1,853.4 | 1889-1943 | 1889 | 21.6 | | | From U. S. Weather Bureau in 1928. |
| 130 | Greenbrier River at Alderson, W. Va | 1,357 | [6] 1,529.42 | 1895-1943 | Mar. 14, 1918 | 22.0 | 77,500 | 57.1 | Gaging-station record. |
| 131 | Greenbrier River at Hilldale, W. Va | 1,625 | [6] 1,388.66 | 1936-43 | Mar. 18, 1936 | 21.85 | 60,800 | 37.4 | From data furnished by U. S. Corps of Engineers. |
| 132 | Gauley River at Camden-on-Gauley, W. Va | 236 | [1] 2,003.28 | 1901-43 | July 4, 1932 | 27.38 | 42,500 | 180 | Gaging-station record. |
| 133 | Gauley River at Allingdale, W. Va | 251 | [1] 2,003.28 | 1908-34 | do | 23.3 | 42,500 | 169 | Do. |
| 134 | Gauley River near Summersville, W. Va | 680 | [1] 1,580.90 | 1908-43 | do | 28.75 | 92,000 | 135 | Do. |
| 135 | Gauley River near Leander, W. Va | 1,210 | [1] 981.17 | 1913-30 | Mar. 13, 1918 | 34.0 | 112,000 | 92.6 | Do. |
| 136 | Gauley River above Belva, W. Va | 1,315 | [1] 669.0 | 1928-43 | July 5, 1932 | 28.60 | 105,000 | 79.8 | Do. |
| 137 | Gauley River at Belva, W. Va | 1,402 | [7] 663.53 | 1908-16 | Jan. 30, 1911 | 19 | 37,000 | 26.4 | Do. |
| 138 | Williams River at Dyer, W. Va | 128 | [1] 2,193.46 | 1929-43 | July 4, 1932 | 18.45 | 22,000 | 172 | Do. |
| 139 | Cranberry River at Woodbine, W. Va | 96 | | 1929-31 | Nov. 18, 1929 | 8.25 | 3,720 | 38.8 | Do. |
| 140 | Cherry River at Richwood, W. Va | 85 | | 1908-16 | Oct. 1, 1915 | 9.0 | 6,600 | 77.7 | Do. |
| 141 | Cherry River at Fenwick, W. Va | 150 | [1] 2,088.94 | 1929-43 | June 27, 1940 | 15.2 | 27,300 | 182 | Do. |
| 142 | Meadow River at Nallen, W. Va | 287 | [1] 1,869.47 | 1908-16; 1928-43 | Mar. 5, 1934 | 15.64 | 11,200 | 39.0 | Do. |
| 143 | Elk River at Webster Springs, W. Va | 171 | | 1908-16 | Jan. 29, 1911 | 11.0 | 17,300 | 101 | Do. |
| 144 | Elk River below Back Fork at Webster Springs, W. Va. | 242 | | 1929-34 | July 4, 1932 | 12.98 | 26,000 | 107 | Do. |
| 145 | Elk River at Centralia, W. Va | 281 | [6] 931.89 | 1934-43 | Feb. 3, 1939 | 14.72 | 18,300 | 65.1 | Do. |
| 146 | Elk River at Sutton, W. Va | 543 | [6] 807.19 | 1918-43 | Mar. 13, 1918 | 37.2 | 44,000 | 81.0 | Do. |
| 147 | Elk River at Gassaway, W. Va | 579 | [1] 796.31 | 1908-18 | do | 44 | 46,000 | 79.4 | Do. |
| 148 | Elk River at Clay, W. Va | 994 | [1] 676.6 | 1916-43 | do | 32.4 | | | From U. S. Weather Bureau. |
| 149 | Elk River at Queen Shoals, W. Va | 1,145 | [6] 604.13 | 1918-43 | July 5, 1932 | 29.2 | 91,300 | 79.7 | Gaging-station record. |
| 150 | Elk River at Clendenin, W. Va | 1,290 | | 1888-16 | 1888 | 32 | 64,000 | 49.6 | Do. |
| 151 | Coal River at Ashford, W. Va | 393 | [6] 622.46 | 1908-16; 1930-43 | Aug. 9, 1916 | 35.0 | 40,700 | 104 | Do. |
| 152 | Coal River at Fuga, W. Va | 849 | | 1911-16 | do | 36.6 | 47,300 | 55.7 | Do. |
| 153 | Coal River at Tornado, W. Va | 857 | [1] 576.9 | 1908-31 | Aug. 1916 | 35 | | | Discharge not determined. |
| | | | | | Nov. 18, 1929 | 16.3 | 33,500 | 39.1 | Gaging-station record. |
| 154 | Little Coal River at Madison, W. Va | 267 | [1] 667.92 | 1930-41 | Feb. 3, 1939 | 27.35 | 42,800 | 160 | Do. |
| 155 | Little Coal River at Danville, W. Va | 270 | [6] 661.12 | 1939-43 | do | 30.2 | 42,800 | 158 | Do. |
| 156 | Little Coal River at McCorkle, W. Va | 375 | | 1915-22 | Aug. 9, 1916 | 28.57 | 24,000 | 64.0 | Do. |
| 157 | Pocatalico River at Sissonville, W. Va | 238 | [1] 594.56 | 1908-43 | June 27, 1910 | 32.4 | 17,000 | 71.4 | Do. |
| | | | | | Apr. 16, 1939 | 34.4 | 14,100 | 59.2 | Datum of gage questionable. |
| | *Guyandot River basin* | | | | | | | | |
| 158 | Guyandot River at Baileysville, W. Va | 354 | | 1929-31 | Nov. 18, 1929 | 13.64 | 5,950 | 16.8 | Gaging-station record. |
| 159 | Guyandot River at Man, W. Va | 762 | [1] 710.88 | 1928-43 | Mar. 3, 1934 | 19.11 | 40,000 | 52.5 | Do. |
| 160 | Guyandot River at Wilber, W. Va | 791 | | 1915-22 | Jan. 28, 1918 | 24.8 | | | Discharge not determined. |
| 161 | Guyandot River at Logan, W. Va | 859 | [4] 639.08 | 1915-43 | do | 27.0 | | | From U. S. Weather Bureau. |
| 162 | Guyandot River at Branchland, W. Va | 1,226 | [1] 547.91 | 1907-43 | 1907 | 44 | 43,500 | 35.5 | Gaging-station record. |
| 163 | Mud River near Milton, W. Va | 291 | [1] 572.64 | 1938-43 | Feb. 3, 1939 | 29.35 | 14,500 | 49.9 | Do. |
| 164 | Mud River at Yates, W. Va | 318 | | 1915-22 | Uncertain | 23.0 | | | Discharge not determined. Peak stage was some time prior to 1915. |

Footnotes at end of table.

TABLE 9.—*Maximum known flood stages and discharges in West Virginia*—Continued

| No. | Stream and place of determination | Drainage area (square miles) | Datum of gage in feet above mean sea level | Period of known floods | Peak stage and discharge | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Date | Stage in feet | Discharge | | |
| | | | | | | | Second-feet | Second-feet per square mile | |
| | *Fourpole Creek basin* | | | | | | | | |
| 165 | Fourpole Creek at Huntington, W. Va | 20.9 | [2] 520.23 | 1940–43 | Apr. 19, 1943 | 7.96 | 1,750 | 83.7 | Gaging-station record. Higher stages recorded as result of backwater from Ohio River. |
| | *Twelvepole Creek basin* | | | | | | | | |
| 166 | Twelvepole Creek at Wayne, W. Va | 291 | [1] 574.92 | 1915–43 | June 30, 1928 | 28.3 | 14,000 | 48.1 | Gaging-station record. |
| | *Big Sandy River basin* | | | | | | | | |
| 167 | Big Sandy River at Louisa, Ky | 3,870 | [5] 516.81 | 1875–1943 | Apr. 3, 1908 | 48.4 | | | Gaging-station record. Lower gage at Lock 3. |
| | | | | | Feb. 5, 1939; Mar. 6, 1899 | 48.0 | 85,000 | 22.2 | |
| 168 | Big Sandy River at Lock 2, Ky | 4,198 | [5] 506.0 | 1908–43 | Jan. 27, 1937 | 51.7 | | | From Corps of Engineers, U. S. Army. Lower-pool gage. |
| 169 | Big Sandy River at Lock 1, Ky | 4,275 | [5] 489.6 | 1908–43 | do | 69.5 | | | Do. |
| 170 | Tug Fork at Litwar, W. Va | 502 | [6] 936.36 | 1930–43 | Mar. 25, 1935 | 19.0 | 23,000 | 45.8 | Gaging-station record. |
| 171 | Tug Fork at Williamson, W. Va | 941 | [4] 620.6 | 1901–43 | Jan. 29, 1918 | 38.1 | | | From U. S. Weather Bureau. |
| 172 | Tug Fork near Kermit, W. Va | 1,185 | [6] 581.82 | 1934–43 | Feb. 3, 1939 | 35.9 | 34,400 | 29.0 | Gaging-station record. |
| 173 | Tug Fork at Kermit, W. Va | 1,240 | [6] 574.44 | 1915–43 | Uncertain | 46.9 | | | Discharge not determined. Peak stage was some time prior to 1915. |
| | | | | | Jan. 29, 1918 | 39.0 | 36,000 | 29.0 | Gaging-station record. |
| 174 | Tug Fork at Lock 1, Ky | 1,514 | [5] 527.6 | 1908–43 | Apr. 3, 1908 | 43.0 | | | From Corps of Engineers, U. S. Army. Lower-pool gage. |

[1] Adjustment of 1912.
[2] About.
[3] From Corps of Engineers, or bench mark of that agency.
[4] From U. S. Weather Bureau.
[5] Sandy Hook datum.
[5a] Occurred January 2, 1943.
[6] Datum of 1929.
[7] Baltimore & Ohio R. R. bench mark.
[8] Adjustment of 1907.
[9] West Virginia State Road Commission bench mark.
[10] Greater flood occurred in 1888 at stage of about 33 feet.
[11] City of Clarksburg bench mark.
[12] Adjustment of 1903.
[13] Level 6 by West Virginia Power and Transmission Co.
[14] Occurred April 17, 1939.

# INDEX

# Floods of July 18, 1942 in North-Central Pennsylvania

*By* W. S. EISENLOHR, JR.

## Notable Local Floods of 1942–43

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1134–B

*Prepared in cooperation with the States of New York and Pennsylvania*

*With a section on*
Descriptive Details of the Storm and Floods

*By* J. E. STEWART

JNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1952

UNITED STATES DEPARTMENT OF THE INTERIOR

Oscar L. Chapman, *Secretary*

GEOLOGICAL SURVEY

W. E. Wrather, *Director*

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Washington 25, D. C. - Price 75 cents (paper cover)

# PREFACE

The floods of July 18, 1942, in north-central Pennsylvania were extraordinary. The enormous volume of rain that fell during the storm and produced these floods seems almost unbelievable. For that reason considerable space has been devoted to descriptions of previous historic storms and floods of the same type. The similarity of the eye-witness accounts is striking. It is hoped that this documentation will contribute to a more reliable knowledge of these extraordinarily great floods.

The field work and collection and tabulation of the basic information on stages and discharges for the flood was done in the Harrisburg, Pa., and Albany, N. Y., districts of the Surface Water Branch under the direction of J. W. Mangan and A. W. Harrington, district engineers, respectively. Hollister Johnson, hydraulic engineer, at that time assigned to the Albany district, had immediate supervision of the miscellaneous measurements of peak discharge made in that district, and reviewed most of those made in Pennsylvania. He also obtained the information about previous floods at Salamanca, N. Y. W. S. Eisenlohr, Jr., assisted in some of the measurements of flood flow and prepared the report in the Technical Coordination Branch under the general direction of R. W. Davenport, chief; he also supplied photographs for the report.

Substantial and important contributions to the collection of field information and to the report were made, as noted, by James E. Stewart, hydraulic engineer, now with the West Penn Power Co., who as a young engineer with the Geological Survey was greatly interested in floods. The great number of miscellaneous rainfall measurements are largely the result of his efforts, and his contributions to this report are gratefully acknowledged. Thanks are also due the West Penn Power Co. for making available the results of Mr. Stewart's work.

The Corps of Engineers and the Weather Bureau cooperated in the collection of meteorologic information and made it available for these reports; the Corps of Engineers also furnished the results of four peak-discharge measurements.

The stream-gaging work in the two districts of the Geological Survey was performed in cooperation with the Pennsylvania Department of Forests and Waters and the New York State Department of Public Works.

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# FLOODS OF JULY 18, 1942, IN NORTH-CENTRAL PENNSYLVANIA

By William S. Eisenlohr, Jr.

### ABSTRACT

The floods of July 1942 in north-central Pennsylvania and adjacent areas in New York were record-breaking on most of the smaller streams. They followed unprecedented rains that amounted to as much as 35 inches at some points during a storm that for the most part lasted less than 12 hours at any point. In the area of heavy rainfall, peak flood discharges were much greater than for the floods of March 1936. The storm was centered over the headwaters of three major drainage basins—Susquehanna, Allegheny, and Genessee—with the result that flood flows in the lower reaches of those streams were not outstanding. The estimated property damage exceeded $10,000,000 and 15 persons lost their lives. Description of previous storms and floods show that quite similar conditions have occurred in other areas in the past. The isohyetal map in the report is based on more than 400 miscellaneous observations of rainfall. Gage heights and discharges during the flood period are given for 14 gaging stations, and peak discharges are given for 47 other points on streams in the flood area. The maximum discharge was 117,000 second-feet in West Branch Susquehanna River at Renovo, and the maximum in relation to drainage area was 2,100 second-feet per square mile from 11.4 square miles in Annin Creek near Turtle Point. The report also contains a table of flood-crest elevations.

## INTRODUCTION

On July 18, 1942, north-central Pennsylvania and adjacent areas in New York were visited by destructive floods of unprecedented magnitude. The principal areas affected were in Elk, Cameron, McKean, and Potter Counties in Pennsylvania, and Cattaraugus, Allegany, and Steuben Counties in New York. (See fig. 26.) Rainfalls of more than 30 inches were reported in several localities, and on about 200 square miles the rainfall was as much as 20 inches. The rainfall was greater than 10 inches on more than 2,000 square miles.

The resulting floods produced the highest crest stages ever recorded on First Fork and Driftwood Branch of Sinnemahoning Creek and on upper Allegheny and Clarion Rivers. Flood discharges on small drainage areas—less than 100 square miles—were as great in relation to drainage area (see fig. 43) as any ever recorded on streams in Pennsylvania and adjacent areas in New York. Allegheny River at Red

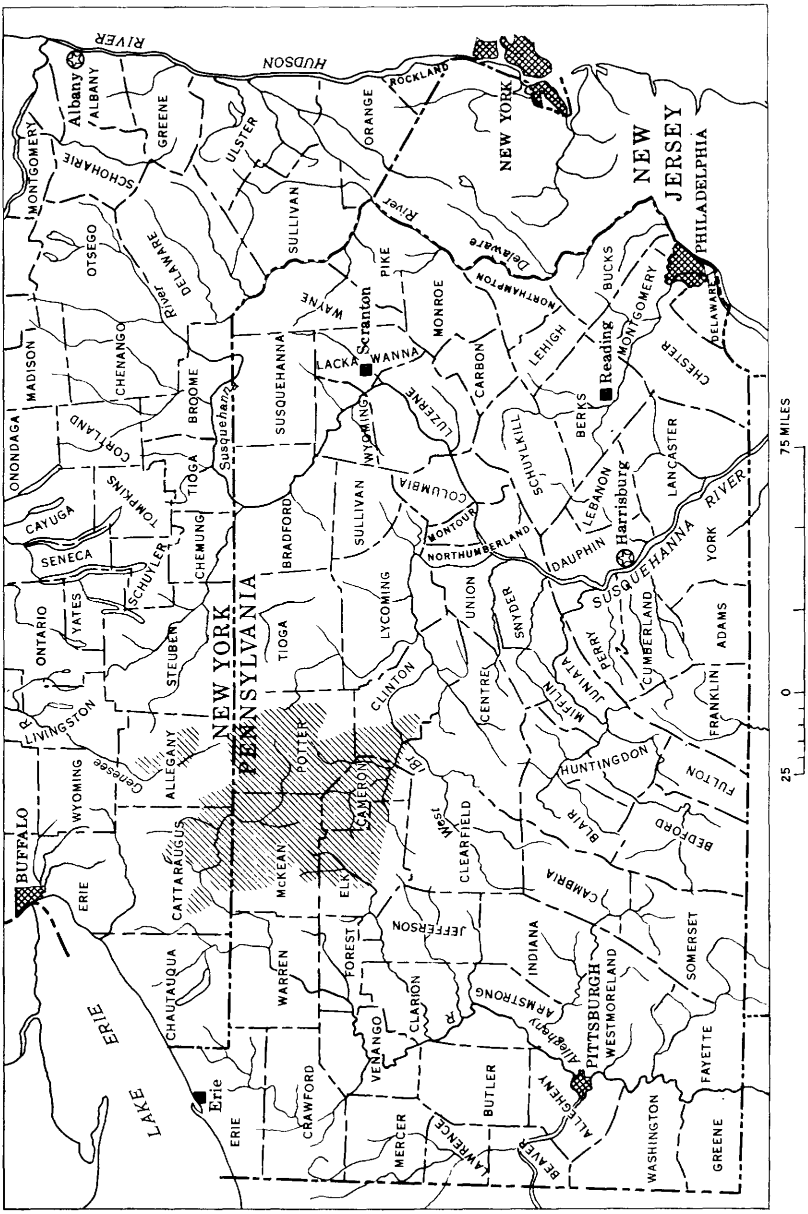


FIGURE 26.—Index map showing location of flood area.

House, N. Y., was nearly a foot higher than the previous maximum in 40 years of record, and at Eldred, Pa., it was more than 9 feet higher than the previous maximum in 27 years of record, with more than four times the discharge. Driftwood Branch Sinnemahoning Creek was nearly 3 feet higher than in March 1936 with more than one and one-half times the maximum discharge.

Practically all the towns along the streams were inundated to a damaging extent. The dikes at Emporium, Pa., were overtopped and about 60 percent of the town was flooded; the water was 5 feet deep in the middle of Broad Street Square. At Austin, Pa., events were reminiscent of the historic flood disaster of September 30, 1911, when the dam broke and 80 people were killed. The dam of the Williamson Pulp & Paper Co.'s reservoir—with a capacity 65,000,000 gallons at spillway crest—was breached (fig. 27), pouring floodwaters upon the

FIGURE 27.—Dam of Williamson Pulp & Paper Co., Austin, Pa., breached by flood.

town of Austin; buildings were knocked off their foundations (fig. 28) and water was 4 to 5 feet deep on the main street. Port Allegany probably suffered the greatest damage per capita of any town in the area. Virtually every business building was flooded 3 to 20 feet. More than 150 people attending a conference in the Free Methodist

FIGURE 28.—Buildings in Austin, Pa., destroyed by flood.

Church were rescued from treetops, roofs, and floating wreckage. The church was washed against a nearby silk mill; it caught fire, and both buildings—as well as others adjacent—were destroyed.

Many other towns were inundated to a considerable extent: Coudersport, Smethport, Eldred, Bradford, and Ridgway, Pa., and Portville, Olean, and Salamanca, N. Y. Above Johnsonburg, Pa., a dam broke, and a wall of water 8 feet high was reported as having swept through the town; 18 families had to be rescued with makeshift rafts, and many houses were moved off their foundations and pushed together (fig. 29). All these communities supported industries that suffered heavily, at a time when capacity production was needed for the war effort.

Public utilities and transportation systems were badly damaged. Water, gas, and electric services were disrupted in many communities. Railroads, highways, and bridges were washed out. A passenger train was marooned by the collapse of a bridge near Ridgway. It was estimated that 75 miles of Pennsylvania Railroad track was damaged. The Coudersport and Port Allegany Railroad between Roulette and Port Allegany, and the Baltimore & Ohio Railroad between Sinnemahoning and Austin were so badly damaged that they were abandoned. (See figs. 30 and 31.). Over all the 27 miles of this stretch of the Baltimore & Ohio Railroad it is doubtful if a section as

FIGURE 29.—Houses in Johnsonburg, Pa., swept off their foundations and pushed together.

FIGURE 30.—Bridge of Coudersport & Port Allegany R. R. damaged by flood.

FIGURE 31.—Baltimore & Ohio R. R. tracks along First Fork Sinnemahoning Creek torn up by flood.

long as a tenth of a mile anywhere was left undamaged; at one place the track was left in the middle of the stream.

Fifteen persons lost their lives in this storm, and many others were made homeless. The damages sustained were extremely large for the size and population of the area. That they were not larger, however, is probably because three separate drainage basins were involved: the Susquehanna, flowing into Chesapeake Bay; the Allegheny, head of the Ohio River system; and the Genesee, tributary to St. Lawrence River. This distribution may explain why the floods were not severe in the lower courses of the major streams. Had the storm that produced these floods been centered over only one major drainage basin, it seems likely that the floods would have been much more severe on the larger streams. The estimated total damage, according to figures compiled by the Weather Bureau, was $10,121,550; this was divided approximately as follows:

| | | | |
|---|---|---|---|
| Railroads | $3, 106, 200 | Communications and power lines | $123, 000 |
| Commercial property | 2, 050, 000 | Agriculture | 750, 000 |
| Residential property | 1, 650, 000 | Relief | 100, 000 |
| Industrial property | 1, 470, 000 | | |
| Highways | 872, 350 | Total | 10, 121, 550 |

Two pictorial booklets describing the flood were published by W. H. Greenhow Co., Hornell, N. Y., and Nelsen Enterprises, Emporium, Pa.

The storm that produced these floods was of less than 24 hours' duration and at many places lasted little, if any, more than 12 hours. Rainfall measured at regular precipitation stations did not exceed 8 inches, except at Coudersport and Emporium where 8.22 and 8.10 inches, respectively, were recorded. From the magnitude of the floods, James E. Stewart, hydraulic engineer of the West Penn Power Co., concluded that rainfalls greatly in excess of these amounts must have fallen within the flood area. Being concerned over the capacity of the spillways designed for power dams of his company, Stewart visited the flood area and obtained evidence that verified his conclusions. A container was found that caught 30.8 inches of rain, and small streams everywhere had moved enormous quantities of rock. This information was brought to the attention of the Corps of Engineers, the Weather Bureau, and the Geological Survey.

At a joint conference held in Pittsburgh, it was agreed that the Corps of Engineers and the West Penn Power Co. would cooperate in a program to obtain all available precipitation data for the storms. This information would be turned over to the Weather Bureau for study in connection with the records for regular weather stations. The Geological Survey would collect additional information on flood runoff to complement the rainfall data. This program was carried out. A detailed meteorological analysis of the storm was made by the Weather Bureau, and a report was prepared as a hydrologic bulletin supplement (U. S. Weather Bureau, 1944).

As soon as field work was completed, the Geological Survey cooperated with the Pennsylvania Department of Forests and Waters in preparing and publishing a report (Pennsylvania Department of Forests and Waters, 1943) on the floods. The purpose of that report was to place in the hands of the public at the earliest practicable time the flood data then available. The present report by the Geological Survey, delayed in preparation owing partly to situations arising from the war emergency, contains additional runoff data as well as records revised since the Pennsylvania report was published. The rainfall records and an isohyetal map also are included so that all base data for rainfall-runoff studies will be contained in a single report. All clock times given are referred to eastern war time; to convert to standard time, subtract 1 hour.

## DESCRIPTIVE DETAILS OF THE STORM AND FLOODS

By James E. Stewart[1]

### DESCRIPTION OF THE STORM

A rainstorm, unusual in the amount of precipitation, and remarkable in its other characteristics, occurred in north-central Pennsylvania and adjacent areas of New York on July 17–18, 1942. The forerunners of the storm may have arrived as early as 6 a. m., Friday, July 17, when there were short, intense showers at such recording rainfall stations as Wellsboro and Jackson Summit, Pa. Nevertheless, the first definite warning of exceptional meteorologic conditions was a 10- or 15-minute hailstorm that occurred about 3 p. m., Friday, in the region of Keating Summit, Pa., to the east of that point, and perhaps at other locations.

At 8:35 p. m., Friday, the rainstorm burst furiously near Cohocton, N. Y. From that time until 8 p. m., Saturday, it raged almost continuously but shifted from place to place and back and forth in the storm area. Generally, however, the areas of heavy precipitation gradually shifted southwestward until, in the main storm area, the last of the storm's explosive energy was expended in the vicinity of Ridgway, Pa. After 8 p. m., Saturday, in this main storm area, there was no overhead evidence of the previous tumult except for some very light, intermittent showery conditions that continued through Sunday, July 19.

The heavy storm rainfall covered a period of slightly less than 24 hours, but at no one location was there more than about 16 hours between the beginning and ending of the heavy rain; in fact, at many places this period was confined to about 14 hours. But even a 14- or 16-hour period gives a false idea of the storm's intensity, because in most locations the rainfall was concentrated in a very few periods of heavy precipitation. It is probably conservative to say that at any given spot more than 50 percent of the rain fell during high-intensity periods, in which the total elapsed time was 6 hours or less. (See fig. 36.) In fact, at many locations more than 80 percent of the rain is known to have fallen in periods of 5 hours or less.

In the area near Cohocton, N. Y., and in the main storm area west of Hornell, N. Y., the heavy rain had stopped by 7 a. m., Saturday. In the main storm area northeast of Coudersport, Pa., most of the rain fell before 7 a. m., Saturday. In much of the remaining, indeed the major part, of the storm area the deluge occurred between 7 a. m. and 1 p. m., Saturday. In a few small sections of this area, however, the rainfall before 7 a. m. was as great or nearly as great as after 7 a. m. From Emporium, Pa., westward and northwestward there was heavy

[1] Hydraulic engineer, West Penn Power Co.

rain after 1 p. m., Saturday, and from the head of Clarion River southwestward to Ridgway, Pa., most of the rain occurred after that hour.

Where the total storm rainfall is known to have exceeded 12 inches, and many times for lesser amounts, people complained of the following:

1. Cellars being filled or partly filled with water—far away from and above streams—where flood water inflow either had never occurred before or had never exceeded the cellars' drainage capacities.
2. Roofs leaking badly that had never leaked before.
3. Water coming out the stovepipe holes in the chimneys.

Generally there was wind at the start of the storm and sometimes at the end, but usually very little or no wind during the storm. Wind directions were erratic; for example, at two different locations they were in exactly opposite directions within a distance of 1 mile. Quite often the wind seemed to be up or down a hollow, irrespective of the direction of cloud travel. There were many reports of thunderstorms coming first from one direction, then returning from another; of storms that traveled perpendicular to the path of previous storms; storms that seemed to mill or circle; and of storms that seemed to come together. As far as lightning was concerned, there was uniform testimony that a much higher percentage of lightning strokes occurred between clouds rather than between cloud and ground as compared with ordinary storms.

In the Austin, Pa., region, many people said that the rain did not come down in drops, and they had the visual impression, at least, that the rain came down in streams which they likened to strings and ropes. This phenomenon appears to be a characteristic of intense cloudburst storms as described in the accounts of previous storms given later. Although it could have been an optical illusion, it seems more likely to have been an actual occurrence. Also, in that region, there were people who had not been able to reach shelter and were afraid they would drown during the downpour through lack of oxygen. One man expressed the effect by saying it was just like breaking water after a long dive, lungs bursting, with water pouring down over his head.

The observer who recorded more than 30.8 inches of rain in 4¾ hours stated that it seemed to fall at a tremendous rate, but quite uniformly, for the greater part of the time. Also, the drops seemed to be exceptionally large and very close together. From her statement and the record of total rainfall at that point, it may be assumed that the rainfall at no time exceeded a rate of about 10 inches per hour and that there was no "streaming" for that rate and for that size of drop.

On the other hand, there were regions, particularly around Austin, where the rainfall rate for very short periods ranged from 15 to nearly 40 inches per hour. For such high rates of rainfall it would appear that the drops would be so close together they would tend to coalesce

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into streams and sheets as a result of mutual mass attraction. If streaming actually occurs at extremely high rainfall rates, then the question arises as to its effect on rainfall catch and the deductions therefrom. It would seem that such streams of water, although moving about, might result in the catch at any given point being materially different from one only a few feet away.

## PREVIOUS EXTRAORDINARY STORMS

### STORM OF JULY 26, 1819

Storms of the intensity of the one that occurred in July 1942 in Pennsylvania are extremely rare. That this storm was not unique, however, is shown by the following quotations from reports of apparently similar storms that have occurred in the past. The earliest record is the account by Dwight (1822) of the storm of July 26, 1819, at Catskill, N. Y., from which the following quotations are taken:

About half past five [p. m.] another dense and black cloud accompanied by a fresh wind arose from the southwest. * * * About the same time, or immediately after, a very thick and dark cloud rose up rapidly from the northeast. They met immediately over the town. At this instant a powerful rain commenced. The air soon became so obscure, that trees and buildings, and other large objects, could not be discerned at the distance of a few yards. The obscurity did not appear to arise from a fog, of the usual kind; but from the abundance of the rain and the low descent of the clouds, which appeared to rest upon the ground or to hang a little above it. After the clouds met, the wind became very variable, and blew for short periods from almost every point of the compass. At times it came with so much force as to drive the rain in a very unusual manner, through the crevices in doors and windows, and the roofs of dwelling houses. Many houses which had never before been known to leak at this time admitted great quantities of water. In several instances the wind suddenly abated, and a calm of a few minutes ensued. The lightning and thunder were unusually severe. The thunder frequently resembled a violent crash, and was as sudden and of as short continuance as the sound occasioned by the firing of a cannon, or by the snapping of a whip. The rain descended at times in very large drops; and at times in streams, and sheets.

During the storm four or five intermissions each of about 8 or 10 minutes occurred, also in the rain. In each instance it excited a hope that the storm was approaching its termination, but this hope was soon dissipated by the appearance of fresh torrents. The extreme violence of the rain terminated before half past six o'clock, though it continued to descend with considerable briskness until about nine; and moderately until about ten, and it did not entirely cease until about eleven. The quantity which fell from the commencement to the termination of the storm is difficult to ascertain with exactness. It seems probably from the facts hereinafter mentioned, that it exceeded 15 inches on a level. Some remarkable phenomena occurred in various places.

At the Point, just before the clouds met, two sloops were observed sailing before the wind, under a full press of sail, one sailing rapidly up stream, and the other more rapidly down. They met near the north end of the island, when the northeast wind prevailed.

Further on, Dwight gives the account of

a gentleman who * * * observed the phenomena of the storm with more exactness than any other person with whom I have conversed. His account is as follows: * * * "The descent of rain was most copius between a quarter before 6 o'clock, and a quarter after 6. In this half hour he estimates the descent of water to have exceeded 12 inches upon a level."

Dwight continues:

The whole quantity of water which fell at the Point, is estimated to have exceeded 15 inches upon a level. * * * Should we then estimate the whole tract, on which the rain descended with peculiar violence, and in quantities never before known, in this section of the country, since its first settlement at 80 square miles, we probably should not be very wide from the truth; and on this tract, I am persuaded that the water fell full 15 inches upon a level. On a considerable part of the tract there is reason to believe that the quantity exceeded 18 inches."

## STORM OF AUGUST 5, 1843

Another storm of similar magnitude occurred August 5, 1843, in Delaware County, Pa. That storm was the subject of a report by a special committee of the Delaware County Institute of Science (1910 pp. 7–18), from which the following descriptions are taken:

No general description of the *heavy rain* which * * * caused the inundation, will exactly apply to any two neighborhoods—much less to the whole extent of the county. In the time of its commencement and termination—in the quantity of rain which fell—in the violence and direction of the wind, there was a remarkable want of correspondence between different parts of the county. It may be observed, however, that comparatively little rain fell along its southern and southeastern borders. * * *

In those sections of the county where its greatest violence was expended, the character of the storm more nearly accorded with that of a tropical hurricane, than with anything which appertained to this region of country. The clouds wore an unusually dark and lowering appearance, of which the whole atmosphere appeared in some degree to partake, which circumstance, no doubt, gave that peculiarly vivid appearance to the incessant flashes of lightning which was observed by every one. The peals of thunder were loud and almost continuous. The clouds appeared to approach from different directions, and to concentrate at a point not very distant from the zenith of the beholder. In many places there was but very little wind, the rain appearing to fall in nearly perpendicular streams; at other places it blew a stiff breeze, first from the east or northeast; and suddenly shifting to the southwest; while at a few points it blew in sudden gusts with great violence, accompanied with whirlwinds, which twisted off and prostrated large trees, and swept every thing before it. * * *

As observed by Joel Evans, at his residence in Springfield * * * the heaviest rain fell between five and six o'clock. The direction of the wind during the day, until the heavy fall of rain commenced, being generally from the S. E., though at some periods throughout the day it was variable, shifting from E. S. E., to S. S. E. The atmosphere at a considerable height above the earth's surface, appeared to be in a very unsettled and agitated state, from 12 o'clock, M. to 5 o'clock P. M., which was indicated by contrary and opposite currents of wind prevailing, carrying with them light clouds, which he observed several times in the afternoon; he being induced to go out to make observations on the state of the weather, from its very unusual and threatening appearance. During the fall of the very heavy rain, and as nearly as he can recollect, about half past five o'clock, the wind suddenly commenced blowing with great force from the east, which soon increased to a violent gale, prostrating fences, and some trees in its course. Its velocity was such that with the immense quantity of water falling (which it carried with it in one continuous sheet, as it were), rendered it impossible to see a distance of more than fifty yards. After blowing in this way for fifteen or twenty minutes, the wind almost as suddenly veered to S. W. (nearly the opposite point of the compass), and for a short time (perhaps not more than from five to ten minutes) blew with equal violence, leveling in that direction on his farm, a number of panels of fence, and one or two apple trees. The wind subsided about six o'clock or very soon after, and was succeeded by a calm. * * *

As observed by Professor John F. Frazer * * * in the upper end of Chester township, the heavy rain commenced late in the afternoon, about half past five or six o'clock, and continued perhaps half an hour or more. During the rain there was no wind, the streams (for it fell more in streams than in drops) were, apparently quite vertical. Professor F. was unprepared to measure the quantity of rain which fell, but it exceeded anything which he had ever witnessed. * * *

Mr. Joseph Edwards, who resides in Middletown township, within half a mile of the center of the county, observed a phenomenon during the last heavy shower of rain, which does not appear to have been noticed in any other part of the county. He remarks that during the last shower which continued, say twenty minutes, and in which there fell a greater quantity of water than during any equal space of time during the afternoon—unlike any other shower he had witnessed—the distant woods and other objects were not obscured in any sensible degree by the falling rain. This extraordinary appearance was a subject of remark by all present, and created considerable surprise. At the time there was an impending mass of dense clouds, without any apparent motion in the air. This particular shower approached from the south, unaccompanied by wind.

### STORM OF JULY 5, 1939

More recently a similar storm occurred July 5, 1939, in eastern Kentucky, which has been described in a special report (Schrader, 1945):

The characteristics of the storm are well defined because its unusual aspects attracted the attention of many people. Although generally considered as a single storm, it actually consisted of a series of thunderstorms accompanied by almost continuous lightning and thunder, which were noticeable for a considerable time before the storm. The lightning was described as continuous lightning and sheet lightning and by several observers as the most persistent they had ever witnessed. The thunder preceding the storm was a low rumble and at the height of the storm is reported to have shaken the earth. The lightning was so continuous that, despite the fact that the storm occurred at night in most localities, the cloud formations could be viewed without difficulty in what is described as a purplish hue. Although in a turbulent state, these cloud formations had a distinct outline and could be seen approaching from the north at a rapid rate.

On the edge of the storm area winds reached gale proportions such that buildings were damaged and in several places were entirely destroyed. Reports indicate that there was relatively little wind outside of the storm area, and observers at the storm centers reported that little or no wind accompanied the rainfall. According to information obtained from weather stations, the prevailing direction of the wind was to the southwest on the northeast side of the storm area, to the northeast on the southwest side, and variable on the northwest and southeast sides. * * *

The rates of precipitation produced by this storm were extremely high and exceeded any known to have occurred previously in the region affected. The rainfall is described by observers as having been so intense that it was impossible to see objects only a few feet away. People caught out in the storm were compelled to stop before reaching shelter because of the lack of visibility. Numerous accounts were given of runoff that covered the sloping ground in sheets. Although the rain did not fall at a continuous high rate throughout the storm, high rates apparently were maintained in some localities for periods as long as an hour. These periods of sustained intensity occurred near the end of the storm. During such periods the rainfall was alternately in the form of large drops and of continuous sheets of water similar to those coming from the eaves of a roof.

The remarkable similarity in the descriptions of each of these storms is most striking. It indicates that they were all of the same general type.

## COLLECTION OF RAINFALL RECORDS

Radio and newspaper reports of the storm of July 17–18, 1942, were exceedingly interesting. Accordingly, as rapidly as they became available, the official records of rainfall were studied. Although those records indicated rainfalls of as much as 8 inches, it did not appear reasonable that even that considerable amount of rain would have sufficed to cause the flood and resulting damage, particularly as it followed a drought. Therefore, the writer asked for and received permission from the West Penn Power Co. to make a preliminary investigation of the rainfalls that had occurred. A field trip was made August 5 to 9, inclusive, and rainfall records were obtained from about 50 amateurs. Among these was one reliable overflow record showing more than 30.8 inches of rainfall. That record, along with many other overflows and three total-storm records of 17.5, 18.5, and 19.0 inches, respectively, indicated that the storm had been one of major intensity and that its rainfall warranted a thorough investigation. On another trip to the storm district August 15 and 16 the writer obtained 23 more records.

Meanwhile in Pittsburgh the original findings were called to the attention of the Weather Bureau, Geological Survey, and Corps of Engineers. It was suggested that interested agencies should meet and plan a thorough field and office rainfall-investigation program that would avoid duplication of work. Also, that other hydrologic phases of the storm and storm damage, already under investigation by one or more of these Federal bureaus, be discussed at the meeting and coordinated with the rainfall program. This suggestion met with approval.

A meeting was held on August 17 in Pittsburgh with representatives of the interested agencies present. Those attending the meeting came to unanimous conclusions as follows:

1. All the subsequent runoff determinations should be made by the Geological Survey, but a close liaison should be established between the Survey and the collectors of precipitation data so that good and sufficient field data on rainfall and runoff would become available for correlation studies.

2. All available miscellaneous precipitation records should be collected by the Corps of Engineers and the West Penn Power Co. through a cooperative and systematic coverage of the storm area.

3. All rainfall data should be pooled and finally turned over to the Weather Bureau.

The Corps of Engineers and the West Penn Power Co. thoroughly searched the main storm area for rainfall records, except for a small region west of Hornell, N. Y., which was only partly covered owing to bad winter weather. The rainfall records obtained through this further investigation, with regular and miscellaneous records previously obtained, resulted in nearly 500 records of precipitation being made available for the storm study.

It is worth while to point out to those who may sometime be interested in collecting miscellaneous rainfall records that the country, rather than the city, is the place to obtain records. This is because the farmer often has empty containers set out in the open, whereas the city inhabitant rarely does. In northern Pennsylvania a record was probably obtained for every 12 or 15 contacts in the country, whereas there might not have been obtained 1 in 200 or 300 contacts in the towns and cities.

It was found necessary to visit every farmer in the storm area, inasmuch as apparently one farmer rarely knew of a record that his neighbor had. In fact, often within a family only one person might know of the record. This was due not to reticence, but to lack of importance of the record to the observer.

At first, no data were obtained except as to the actual rainfall, but later a form was gradually evolved which brought in much pertinent information, such as location of container, direction of wind and clouds, presence or absence of hail and sheet runoff, beginning and ending times for rain periods, time any adjacent stream was highest, etc. A copy of the questionnaire in its final form is shown on figure 32. They were filled out through personal interviews.

The more than 400 records of rainfall thus obtained were used to draw the isohyetal map contained in this report. If the precipitation had not been so great—causing overflows—and the distribution had been somewhat better, it would have been an excellent isohyetal map.

STORM OF JULY 17-18, 1942, IN NORTHERN PENNSYLVANIA

1. Hour and date this questionnaire was made out?

2. Auto mileage and on what stream, or distance and direction to a map location?

3. Did you have out any empty bucket, tub, washboiler, milk can, jar, oil drum, or watering tank during the storm? If so, what was it?

4. Size of container?

5. Location of container and distance from nearest obstacle?

6. Depth of water in container?

7. Was this depth of water for all of storm or only part? If only part, what part?

8. Did container overflow?

9. If it overflowed, how much additional rain is estimated to have fallen?

10. Approximate time that heavy rain began Friday or Friday night and ended Saturday. Also times for any periods that rain was stopped or nearly so?

11. Direction of both storm movement (clouds) and ground wind, if any, at beginning, during, and at end of storm.

12. Was there any hail before or during the storm, and if so when?

13. Time and length of period minor streams were highest on Saturday?

14. Did side-hill streams carry stones, and if so when?

15. Describe electrical features of storm.

16. Describe effects of heavy rainfall on roofs, cellars, chimneys, etc.

17. What was the appearance of the water flowing down the hillsides?

18. Name and Post Office address of person furnishing data?

19. Remarks, estimated accuracy of observations, reliability of observer, etc. Use back of sheet if necessary.

20. Depth of rainfall.

FIGURE 32.—Questionnaire used for recording miscellaneous rainfall information.

As it is, the map should represent fairly well the rainfall centers and isohyetals. There undoubtedly are areas of low rainfall not found, however, because they are in a large and practically uninhabited forest reserve in one section of the storm area. A preliminary isohyetal map made in the offices of the West Penn Power Co. involved months of work in drawing and redrawing isohyetals and in reviewing partial records and other data. The preliminary map was used in the drawing of the map prepared by the United States Weather Bureau.

## FLOOD WAVES

Where the total precipitation was greatest over considerable areas, the intense rains started about 8 a. m. Saturday. They fell on ground completely saturated by 4 inches or more of rain that had fallen the previous night. Not only was the ground saturated, but the streams were very high and in some cases far out of their banks. With such high stages, the streams were overwhelmed by the sudden inrush of water from the tremendous Saturday forenoon rain. As a consequence, flood waves from 1 to 3 feet in height formed on top of the previous flood waters of many streams. These waves swept the full length of streams having drainage areas of less than 100 square miles.

Near Port Allegany and north therefrom to the New York State line, a single rolling wave about 1 to 3 feet high probably occurred in the fairly large streams: Sartwell, Lillibridge, Twomile, Annin, and Newell Creeks, Barden Brook, and Rock, McCrea, Kings, and Bells Runs. Furthermore, for most of these streams the maximum stage set by the wave was at least maintained, and in many cases increased somewhat, during the period of heavy rain.

Where the total rainfall was the greatest in the Port Allegany region, the larger streams seemed to remain near the maximum stage for hours. In some cases, even the outpouring of the small hillside gulches seemed to be at a tremendous but fairly steady rate. On the other hand, near the edges of the heaviest rainfall areas, where there were definite intervals between heavy downpours, there were also definite recessions between flood peaks for small streams such as Taylor Brook—a tributary of Bells Run—and Champion Hollow—a tributary of Kings Run.

Many streams in other sections also had flood waves: Freeman Run, Dexter Run, East Branch Clarion River, Straight Creek, South Fork Straight Creek, and upper Portage Creek. There probably were other streams on which the flood waves were unrecorded. Particularly is this true of smaller streams in the State Forest which flow into First Fork Sinnemahoning Creek and the headwaters of Sinnemahoning Portage. On East Branch Clarion River at Glenn Hazel, where the drainage area is about 80 square miles, there were three rolling waves, each apparently about 1½ feet high and about 100 yards apart. The waves on this particular stream were a result of intense rains Saturday afternoon.

## DEBRIS MOVEMENTS, BLOW-OUTS AND SLIDES

The tremendous rainfalls concentrated into a short period resulted in certain physical and geologic phenomena. For example, all steep-sloped streams did a great deal of eroding and carried along large quantities of detritus. The streams ranged from those in small gulches, with drainage areas less than 0.01 square mile, to mountain rivers, such as First Fork Sinnemahoning Creek, draining several hundred square miles—Allegheny River and some of its tributaries in their middle and lower reaches, such as Oswayo, Potato, and Portage Creeks, are not considered steep-sloped streams. Tremendous quantities of rock and gravel poured out from small gulches and streams with a few square miles of drainage area. From the small gulches these outpourings lodged on the alluvial cone at the mouth of each gulch, whereas along the small streams most of the material was carried to a point near their mouths where backwater from the main stream caused the material to deposit. The largest deposits noted were at the mouths of streams tributary to First Fork Sinnemahoning Creek near Wharton.

In the regions of exceptionally heavy rainfall around Port Allegany, particularly heavy erosion occurred in small side gulches where there was less than a square mile of drainage area. As a consequence, there were tremendous outflows of rock in proportion to the drainage area, but in total volume, outflows could not compare with those from the small streams in First Fork Sinnemahoning Creek district where the slopes and drainage areas were greater.

The erosion and rock movement caused by the flood of July 18, 1942, substantiates the belief that, instead of long time attrition, infrequent but tremendous floods are the principal eroding agents where steep topography, bedrock, and rock detritus are involved. During this flood, peak flows of 100 to 500 second-feet plunged down small gulches where there were irregular slopes of 10 percent or more. Vivid evidence that great forces had been at work was found in small gulches near Port Allegany. There, apparently great quantities of actual bedrock had been ripped out and carried down to the alluvial cones and deposited (fig. 33).

The same process probably occurred on a smaller scale in the larger streams. For example, on First Fork Sinnemahoning Creek there was considerable evidence that during the flood all the channel material down to bedrock had been in motion and in many places the channel itself had shifted. This is the usual process whereby streams erode their channel through rock. Many streams of relatively flat gradient often are not considered as lowering their channels because floods of sufficient magnitude to do the cutting are so extremely rare. That tremendous but infrequent floods are the princi-

FIGURE 33.—Upstream end of debris cone on Taylor farm, formed during flood. Note that stream channel is dry. Photographed August 26, 1942.

pal land-leveling agent is supported by the appearance of the old alluvial cones at the mouth of small gulches.

Inspection of the trenches cut in those old cones by the flood of July 18, 1942, clearly showed that they consisted mainly of great masses of broken-up bedrock, embeded in soil, that could have been brought down only by tremendous floods of the past. However, from the first settlement of that territory until July 18, 1942, the rock detritus cones were covered with grass and soil and a little rivulet coursed across each one in rainy weather; hence they gave no hint to the settler as to their underlying significance. In fact, they blended in with the general topography to such a degree that their true nature would have been apparent only to the trained eye of a geologist. Of course, when trails or roads were built along the valleys of the main streams, those early highways went up and over the alluvial cones. Naturally, the settlers built their homes on the cones in preference to the hillsides between the gulches, and no doubt they congratualted themselves that they had also obtained excellent protection from floods by their increased elevation above the main creek into which the gulches debouched. This sense of security was rudely shaken by the tremendous water and rock outflows from the gulches during the 1942 flood. Fortunately, so far as known, no loss of life resulted from this rather dangerous location for homes, although narrow escapes were common.

An especially interesting effect of the torrential rainfalls was an exceedingly great number of what, for want of a better expression, have been termed "blow-outs." Where the rainfall exceeded 10 inches, these blow-outs, or large holes, were found on most of the hill-sides. The soil from the blow-out holes, mostly in a semiliquid form, had run and slid down to the bottom of the hills but had scarcely disturbed the ground surface or anything thereon. When the first holes were seen, it was thought that perhaps in each case the excessive surface runoff had started a small hole and rapidly enlarged it to the size noted. However, this thought was quickly discarded owing to the fact that there was little or no erosion either at the upper or lower side of the holes (fig. 34), and to the fact that normally they occurred in a series and all in one plane. Examination of individual holes indicated

FIGURE 34.—Blow-out hole near Port Allegany. Note absence of erosion around rim.

that they had been caused by flows of water from within the hillsides, a method of formation confirmed by interrogation of persons who had seen the blow-outs burst forth.

The holes occurred where zones of shattered rock would have formed outcrops on hillsides but for the shallow soil mantle. It is thought that great pressures were built up at this point by the large quantities of water that reached the zone of shattered rock by infiltration from the extremely heavy rainfall on higher ground. The dense ground surface, usually sod-covered, acted as a dam which blew out at the weakest spots when enough pressure developed. Each of these blow-outs acted as a safety valve to protect a considerable length of ground surface in front of the shattered rock layer on either side of that hole. Thus, a series of perhaps only a dozen large holes would occur along a mile or two of hillside. Manifestly, each line of holes clearly defined the location of a shattered rock stratum.

In addition to the blow-outs, there were many true slips and slides. although even those may very well have been due to water from shattered rock strata wetting and lubricating the slipped material. Some of these slides plunged down through forested areas, carrying everything before them. One swept from near the top of a hill to its bottom in Kettle Creek, a distance of probably more than a mile. Although small at the top, the slide appeared from a distance to be nearly a quarter of a mile wide at the bottom. Some of the slides, with the trees upright, moved for hundreds of feet. Some of the trees continued to grow in the new location as though nothing had happened.

## METEOROLOGY OF THE STORM

### DESCRIPTION

The following description is taken from the analysis contained in the Hydrologic Bulletin Supplement (U. S. Weather Bureau, 1944), omitting all references to the detailed charts and diagram used in that analysis as they are beyond the scope of this report.

The phenomenally heavy rains that fell over Elk, Cameron, McKean, and Potter Counties, Pa., and adjoining sections of New York on July 17–18, 1942, resulted from the recurrent thunderstorm activity associated with an atmospheric flow pattern that has been named Type V in Hydrometeorological Report No. 2: "Maximum possible precipitation over the Ohio River basin above Pittsburgh, Pa." Notable among heavy storms of this type are the Newcomerstown, Ohio, storm of August 6–7, 1935 (Showalter, 1941), and the eastern Kentucky storm of July 4–5, 1939 (Schrader, 1945). The July 1942 storm is classed as a 24-hour storm although durations were generally less than 24 hours at any one place. Nevertheless, the point-rainfall measurements of July 17–18, 1942, exceeded by several hundred percent the known 24-hour amounts of May 30–31, 1889 (the Johnstown flood). They also exceeded the all-time Pennsylvania 24-hour record of 16.0 inches at Concord Township, Delaware County, on August 5, 1843 (see p. 148), the United States 12-hour record of 24.0 inches at Ewan, N. J., on September 1, 1940 (see p. 151), and approached the United States 24-hour record of 38.2 inches at Thrall, Tex., on September 9–10, 1921.[2]

It cannot be said, however, that amounts of rainfall like those of July 17–18, 1942, have never occurred before in the United States, even within a narrowly but reasonably defined period of record. The only certainty is that those amounts are among the highest for such durations that have been measured. It is notable, also, that this storm was one in an unusually extended series of excessive rainfalls that occurred in Pennsylvania between early in March and the latter part of August 1942.

Meteorological conditions near the earth's surface on July 17–18 were characterized by a warm anticyclone centered over the Southeastern States and the adjoining ocean. The flood area throughout was south of a quasi-stationary front extending eastward from Minnesota through the Great Lakes and then southward through eastern New York and New Jersey. The frontal system advanced slowly northeastward during the 18th.

The warm anticyclonic circulation extended above 15,000 feet. Around the western and northern periphery of the warm anticyclone there was the usual flow of maritime tropical air. The moist air stream was continuous from the Gulf of Mexico to Buffalo, N. Y. Over Buffalo on July 18 the air was unusually warm and moist even for July 1942, which was not a dry month. Except in the surface layer, where passage over the Great Lakes had induced an inversion, the air showed conditional and convective instability up to 15,000 feet and neutral equilibrium above that level. The precipitable water content up to about 16,000 feet was computed to be 1.95 inches. This is close to the maximum values of long record in the vicinity—for example, 2.13 inches at Cleveland. A concurrent sounding of the upper air at Sault Sainte Marie showed unusual warmth, moisture, and instability extending even that far north.

Soundings of the upper air in the Mississippi Valley region indicated decreasing pressure gradient with altitude and smooth anticyclonic flow without much change in curvature. Over the New York-Pennsylvania region, however, there was an increasing pressure gradient with altitude and a rapid change of curvature in the flow from anticyclonic to cyclonic. This was true at the 5,000-, 10,000-, and 15,000-foot levels, indicating a deep zone of convergence. An

[2] These United States 12-hour and 24-hour records supersede those previously published.

area of saturation coincident with the heavy rainfall zone also was apparent on one of the upper air charts prepared for this analysis.

The persistence of the zone of convergence over the region can be considered the major cause of the heavy rain. Other factors, which of themselves were not entirely effective impulses but which must be given consideration as adding to the effect, were the orographic lift of the unstable air mass from about the 600-foot elevation of Lake Erie to the more than 2,000-foot elevations of the mountain ridges of Pennsylvania and New York and the regenerating influence of the locally formed dense, cold air mass in the zone of heavy rain. The latter effect is an unusual illustration of how a thunderstorm zone maintains its own existence.

In general, the areas of lowest temperature coincided with the heavy-rain zone. Active cooling within the rain zone can be attributed to a combination of causes other than reflection of solar radiation from cloud tops. There was cooling of the air by conduction from cold rain and by melting of hail. Airplane pilots' reports during the period indicated cloud elevations well above the freezing level. In addition, however, the air was cooled by evaporation of rain. This is thought to be the dominant cause of cooling. As a result of such evaporation, the surface air would cool to its wet-bulb temperature, but the temperatures observed in the rain zone were as low as 63° F., a temperature lower than the wet-bulb temperature of any surface air that could have moved into the region horizontally. The indications are that in a process of such convective intensity as the rainfall amounts imply there was a large-scale exchange of air between the surface and aloft. Examination of the radiosondes from Detroit, Mich., and Huntington, W. Va., both representative of some of the air undergoing convergence over the area, shows wet-bulb temperatures aloft such as to produce, by descent of air through heavy rainfall, surface temperatures as low as 63° F.

The cooling thus accomplished produced a mass of cold, dense air at the surface. A slight ridge of high pressure was associated with the cold mass probably as a result of both the denser air and downward accelerations which also contribute to a pressure rise. The demarcation between cold and warm air became, in effect, a frontal zone, the cold air spreading laterally to lift the warm air and also acting as a barrier which the warm air overran, renewing and spreading thunderstorm activity by both methods.

The frontal zone became pronounced at about sunset of July 17, when heavy thunderstorms began over Cohocton, N. Y., and then spread fanwise, reaching Ridgway, Pa., between 2 and 3 a. m., July 18. A careful study of the data available shows that, while the individual thunderstorms moved to the southeast in harmony with the northwest winds aloft, the thunderstorm area was propagated towards the southwest also. Such a propagation—to the right across the mean upper-air current—has been noted in previous thunderstorm studies and has been attributed to the hydrodynamical principle that cyclonic vortices move (or propagate) to the right across the current in which they are imbedded.

Between 3 and 6 a. m. July 18 the major extension of the cold-air mass seemed to be to the northeast. The heavy-rain zone spread with it, diminishing in the southwest. After 6 a. m. the edge of the cold air, acting as a front, moved to the southwest again, bringing a second period of heavy rain to the regions within its path.

Over the area of heavy rainfall the total precipitation resulted from a succession of three downpours coinciding with the oscillations of the cold air mass, the first and last outbursts being the most intense. The greatest amounts were centered between Emporium, Coudersport, Shinglehouse, and Smethport—unfortunately a region containing no official rain gages. The isohyetal map (pl. 2) based largely on miscellaneous records, shows the effect of the persistent, mainly northwesterly, winds in elongating the isohyetal pattern in a southeastward direction. Added to this effect was the southwestward-propagating effect plus the spreading of the cold, dense air-mass formed at the surface. It should be noted that equally plausible interpretations of the miscellaneous rainfall reports could lead to different isohyetal values near the storm center. Material differences in resulting duration-depth data would become negligible for the larger areas but any duration-depth computations for areas under 100 square miles should be classed as doubtful.

## RAINFALL RECORDS

All available rainfall records for this storm, other than those few that were rejected because their accuracy was too uncertain, are given in tables 1 and 2. Table 1 contains the records for regular precipitation stations and is based on the Weather Bureau report (1944). The data have also been plotted in figure 35 to show the storm periods at the different locations and their timing. The data have been revised where necessary to correct known errors. The geographical positions are as accurate as could be determined, but they may still be subject to slight error for a few stations.

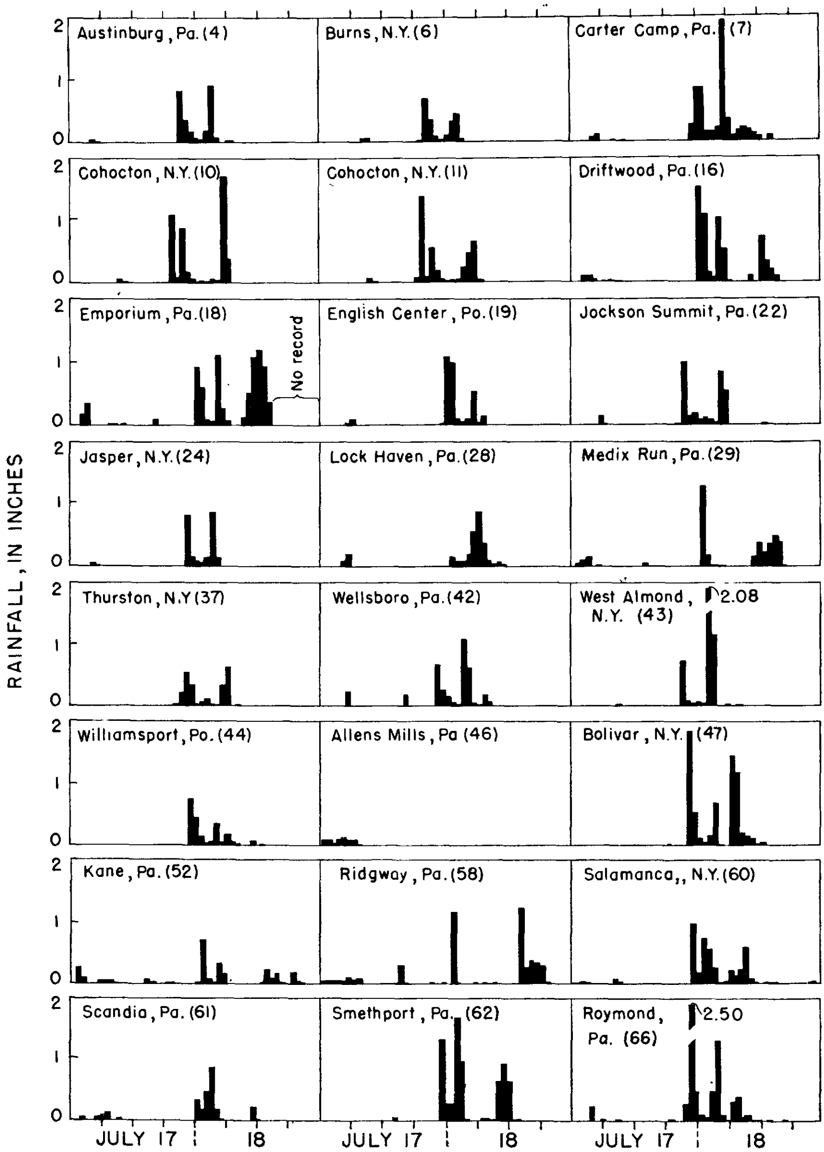


FIGURE 35.—Distribution of rainfall at recording-gage stations.

TABLE 1.—*Rainfall at precipitation stations, July 17–19, 1942*

[R, recording gage; amount shown is for 24-hour period ending at midnight. Other gages read in the morning except as noted. T, Trace. Records furnished as follows: C of E. Corps of Engineers; SCS, Soil Conservation Service; F-S FFS, Federal-State flood forecasting service of Pennsylvania; all others, Weather Bureau]

| No. on pl. 2 | Station | County | Latitude (deg., min.) | Longitude (deg., min.) | Elevation | July 17 | July 18 | July 19 | Storm total [1] |
|---|---|---|---|---|---|---|---|---|---|
| | **Susquehanna River drainage basin** | | | | | | | | |
| 1 | Addison, N. Y | Steuben | 42 06 | 77 14 | 990 | 0.10 | 2.50 | 1.05 | 3.55 |
| 2 | Alfred, N. Y | Allegany | 42 16 | 77 47 | 1,760 | T | 3.35 | 0. | 3.35 |
| 3 | Ansonia, Pa | Tioga | 41 45 | 77 26 | 1,136 | .20 | 2.44 | .42 | 2.86 |
| 4 | Austinburg, Pa. (C of E, T-3) R | do | 42 00 | 77 32 | 1,790 | 1.35 | 1.26 | .01 | 2.61 |
| 5 | Bradford, N. Y. (C of E, H-26) | Steuben | 42 22 | 77 08 | 1,430 | 0 | 1.67 | 0 | 1.67 |
| 6 | Burns, N. Y. (C of E, N-19) R | Allegany | 42 25 | 77 44 | 1,620 | 1.19 | .80 | .80 | 1.99 |
| 7 | Carter Camp, Pa. (F-S FFS) R | Potter | 41 38 | 77 43 | | .39 | 4.85 | 0 | 5.24 |
| 8 | Cedar Run, Pa | Lycoming | 41 31 | 77 27 | 800 | .38 | 3.20 | .12 | 3.32 |
| 9 | Clearfield, Pa | Clearfield | 41 01 | 78 27 | 1,260 | .28 | .63 | .55 | 1.18 |
| 10 | Cohocton, N. Y. (SCS, R-1) R | Steuben | 42 30 | 77 29 | 1,570 | 2.29 | 2.23 | .07 | 4.52 |
| 11 | Cohocton, N. Y. (SCS-10) R | do | 42 32 | 77 27 | 1,900 | 2.35 | 1.47 | .13 | 3.82 |
| 12 | Cohocton, N. Y. (SCS, S-43) | do | 42 30 | 77 31 | 1,520 | 0 | 2.69 | 0 | 2.69 |
| 13 | Cohocton, N. Y. (SCS, S-60) | do | 42 28 | 77 30 | 1,460 | 0 | 2.83 | .05 | 2.88 |
| 14 | Corning, N. Y | do | 42 08 | 77 03 | 925 | T | 1.58 | .07 | 1.65 |
| 15 | Covington, Pa | Tioga | 41 50 | 77 05 | 1,193 | .80 | 1.45 | 0 | 2.25 |
| 16 | Driftwood, Pa. (F-S FFS) R | Cameron | 41 20 | 78 08 | 820 | .29 | 5.59 | .17 | 5.88 |
| 17 | Du Bois, Pa. (near) [2] | Clearfield | 41 06 | 78 38 | 1,670 | .68 | .27 | .26 | .27 |
| 18 | {Emporium, Pa | Cameron | 41 30 | 78 14 | 1,033 | .59 | 3.44 | 4.23+ | 7.67+ |
| | {Emporium, Pa. (Z) (F-S FFS) R | do | 41 30 | 78 14 | 1,033 | .67 | 7.43 | (3) | [3] 8.10 |
| 19 | English Center, Pa. (F-S FFS) R | Lycoming | 41 26 | 77 17 | 881 | .15 | 3.08 | 0 | 3.23 |
| 20 | Galeton, Pa.[2] | Potter | 41 44 | 77 39 | 1,330 | .46 | 3.78 | 0 | 3.78 |
| 21 | Haskinville, N. Y | Steuben | 42 25 | 77 34 | 1,620 | 0 | 1.88 | .05 | 1.93 |
| 22 | Jackson Summit, Pa. (C of E, G-4) R | Tioga | 41 57 | 77 01 | 1,700 | 1.54 | 1.74 | 0 | 3.28 |
| 23 | Jasper, N. Y. (C of E, N-9) [2] | Steuben | 42 09 | 77 33 | 1,610 | 0 | 1.82 | 0 | 1.82 |
| 24 | Jasper, N. Y. (C of E, N-8) R | do | 42 09 | 77 35 | 2,160 | .97 | 1.20 | 0 | 2.17 |
| 25 | Karthaus, Pa | Clearfield | 41 07 | 78 07 | 860 | .40 | .95 | .83 | 1.78 |
| 26 | Lawrenceville, Pa.[2] | Tioga | 42 00 | 77 08 | 996 | .12 | 3.39 | 0 | 3.39 |
| 27 | Lock Haven, Pa | Clinton | 41 08 | 77 26 | 557 | .30 | 1.82 | .29 | 2.11 |
| 28 | Lock Haven, Pa. (No. 2) (F-S FFS) R | do | 41 07 | 77 27 | 600 | .28 | 2.40 | 0 | 2.68 |
| 29 | Medix Run, Pa. (F-S FFS) R | Elk | 41 17 | 78 23 | | .42 | 3.37 | .08 | 3.79 |

See footnotes at end of table.

971774—52——3

TABLE 1.—*Rainfall at precipitation stations, July 17–19, 1942*—Continued

| No. on pl. 2 | Station | County | Latitude (deg., min.) | Longitude (deg., min.) | Elevation | July 17 | July 18 | July 19 | Storm total [1] |
|---|---|---|---|---|---|---|---|---|---|
| | **Susquehanna River drainage basin**–Continued | | | | | | | | |
| 30 | Middlebury, Pa. (C of E, T–4) | Tioga | 41 54 | 77 20 | 1,780 | 0 | 2.00 | 0.06 | 2.06 |
| 31 | Prattsburg, N. Y. (C of E, H–25) | Steuben | 42 33 | 77 17 | 1,580 | 0 | 2.12 | 0 | 2.12 |
| 32 | Pump Station Tower, Pa. | Lycoming | 41 28 | 77 34 | 2,150 | 0 | 2.70 | .30 | 3.00 |
| 33 | Renovo, Pa. | Clinton | 41 19 | 77 46 | 645 | .31 | 1.90 | 2.69 | 4.59 |
| 34 | Richmond, Pa. (C of E, T–2) | Tioga | 41 50 | 77 04 | 1,580 | 0 | 1.95 | 0 | 1.95 |
| 35 | Smith-Elliot Tower, Pa. | Jefferson | 41 06 | 78 32 | 2,230 | 0 | .62 | 1.08 | 1.70 |
| 36 | Tamarack Tower, Pa. | Clinton | 41 24 | 77 51 | 2,220 | .34 | 2.70 | 3.35 | 6.05 |
| 37 | Thurston, N. Y. (C of E, H–2) R | Steuben | 42 12 | 77 20 | 1,640 | 1.14 | 1.25 | 0 | 2.39 |
| 38 | Troupsburg, N. Y. (C of E, N–16) [2] | do | 42 04 | 77 30 | 1,945 | 0 | 2.26 | 0 | 2.26 |
| 39 | Wallace, N. Y. (SCS, S–49) | do | 42 26 | 77 28 | 1,600 | 0 | 1.89 | 0 | 1.89 |
| 40 | Wayland, N. Y. (SCS, S–52) [2] | Livingston | 42 35 | 77 30 | 1,600 | 0 | 2.92 | 0 | 2.92 |
| 41 | Wellsboro, Pa. | Tioga | 41 45 | 77 17 | 1,319 | .26 | 3.03 | .25 | 3.28 |
| 42 | Wellsboro, Pa. (C of E, T–1) R | do | 41 45 | 77 15 | 1,600 | 1.32 | 2.13 | 0 | 3.45 |
| 43 | {Williamsport, Pa. | Lycoming | 41 15 | 77 00 | 550 | .20 | 1.83 | .32 | 2.15 |
| | {Williamsport, Pa. (Z) (F–S FFS) R | do | 41 15 | 77 00 | 542 | .74 | 1.42 | 0 | 2.16 |
| | **Allegheny River drainage basin** | | | | | | | | |
| 44 | Allegany State Park, N. Y.[2] | Cattaraugus | 42 06 | 78 45 | 1,500 | 0.18 | 3.92 | 0.32 | 3.92 |
| 45 | Allens Mills, Pa. (F–S FFS) R | Jefferson | 41 12 | 78 54 | 1,590 | .70 | 0 | .16 | .70 |
| 46 | Bolivar, N. Y. (near) (F–S FFS) R | Allegany | 42 03 | 78 11 | 1,560 | 2.32 | 4.02 | .52 | 6.34 |
| 47 | Bradford, Pa. (Reservoir No. 1) [2] | McKean | 41 57 | 78 44 | 1,680 | .17 | 4.70 | .02 | 4.70 |
| 48 | Coudersport, Pa. (No. 1) [4] | Potter | 41 46 | 78 01 | 1,653 | .26 | 8.22 | 0 | 8.22 |
| 49 | Franklinville, N. Y.[4] | Cattaraugus | 42 21 | 78 27 | 1,600 | 0 | 3.21 | .28 | 3.21 |
| 50 | Kane, Pa. (near, No. 3) | McKean | 41 41 | 78 48 | 1,800 | 0 | 1.51 | 1.68 | 3.19 |
| 51 | Kane, Pa. (near), (F–S FFS) R | Elk | 41 36 | 78 44 | 1,680 | .62 | 2.95 | .15 | 3.57 |
| 52 | Knapp Creek, N. Y.[5] | Cattaraugus | 42 01 | 78 31 | 2,370 | .54 | 6.32 | .75 | 6.77 |
| 53 | Little Valley, N. Y.[6] | do | 42 15 | 78 48 | 1,575 | .23 | 3.61 | .07 | 3.61 |
| 54 | Mount Alton Airport, Pa.[2] | McKean | 41 48 | 78 38 | 2,155 | 0 | 4.64 | 0 | 4.64 |
| 55 | Olean, N. Y. | Cattaraugus | 42 04 | 78 26 | 1,440 | .17 | 6.00 | 1.70 | 7.70 |
| 56 | Raymond, Pa. (F-S FFS) R | Potter | 41 52 | 77 52 | 2,220 | 3.00 | 3.17 | .04 | 6.17 |
| 57 | Red House, N. Y. | Cattaraugus | 42 07 | 78 48 | 1,382 | 0 | 4.48 | .98 | 5.46 |
| 58 | {Ridgway, Pa. | Elk | 41 26 | 78 44 | 1,393 | .38 | 1.68 | 2.62 | 4.68 |
| | {Ridgway, Pa. (Z) (F–S FFS) R | do | 41 26 | 78 44 | 1,371 | .80 | 3.59 | .31 | 4.39 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 59 | Saint Mary's, Pa. (near) | do | 41 | 24 | 78 | 33 | 1,664 | 0 | 1.70 | 3.63 | 5.33 |
| 60 | Salamanca, N. Y. (F-S FFS) R | Cattaraugus | 42 | 11 | 78 | 43 | 1,750 | 1.15 | 2.95 | .35 | 4.10 |
| 61 | Scandia, Pa. (near) [7] R | Warren | 41 | 55 | 79 | 01 | 2,040 | .28 | 2.21 | .39 | 2.49 |
| 62 | Smethport, Pa | McKean | 41 | 48 | 78 | 27 | 1,510 | T | 4.35 | 2.41 | 6.76 |
| | Smethport, Pa. (Z) (F-S FFS) R | do | 41 | 48 | 78 | 27 | 1,510 | 1.34 | 5.35 | .30 | 6.69 |
| | **Genesee River drainage basin** | | | | | | | | | | |
| 63 | Andover, N. Y.[2] | Allegany | 42 | 10 | 77 | 47 | 1,670 | 0 | 4.10 | 0 | 4.10 |
| 64 | Angelica, N. Y.[4] | do | 42 | 18 | 78 | 01 | 1,420 | .05 | 4.00 | .11 | 4.00 |
| 65 | Dansville, N. Y.[2] | Livingston | 42 | 34 | 77 | 42 | 700 | .13 | 2.44 | 0 | 2.44 |
| 66 | Scio, N. Y.[2] | Allegany | 42 | 10 | 77 | 59 | 1,440 | .16 | 4.56 | 0 | 4.56 |
| 67 | West Almond, N. Y. (C of E) R | do | 42 | 18 | 77 | 53 | 1,960 | .84 | 3.31 | .11 | 4.15 |
| 68 | Wiscoy, N. Y.[2] | do | 42 | 30 | 78 | 05 | 1,200 | .06 | 3.37 | .10 | 3.37 |

[1] Does not include rainfall measured by recording gages July 19.
[2] Measured in the afternoon, 4 to 6 p. m.
[3] No record 3 p. m. July 18 to 6 a. m. July 20.
[4] Measured in the evening, 7 to 8 p. m.
[5] Observations at 1:30 and 7:30 by Airway observer; amount given is for 24 hours ending at 1:30 a. m.
[6] Measured at 2 p. m.
[7] Observations by L. D. Anderson.

Table 2 contains the rainfall records that J. E. Stewart, with the Corps of Engineers cooperating, was instrumental in collecting, as described on pages 71 to 74. They are arranged in order from north to south by major drainage basins. The geographical positions were checked thoroughly and should be as accurate as the maps available. Unfortunately, much of the area is sparsely settled, and topographic maps, based on surveys using modern methods and with the culture reasonably up to date, were available for only very small parts of the area. The quadrangle designation is given only for purposes of cross reference to the Weather Bureau report. For that reason the quadrangle designation for each record is the same in both reports, except for obvious typographical errors such as for No. 398, even though some designations were found to be incorrect. The rainfall measured represents the volume of the catch divided by the area of the opening through which it was caught. At many locations, the reporter or resident furnished information concerning more than one container. The rainfall caught in each one is listed separately in table 2. When several measurements were made using the same container, the rainfall measured each time is given in italics in table 2. The total amount measured in each of these containers is then given immediately below in roman type; the time period for the total is not given as it is merely the sum of the elapsed time for the separate measurements. Under Remarks is given information on the intensity of precipitation and factors that affected the accuracy of the catch.

Many of the records in table 2 were for parts of the storm period only. They are useful to some extent in that they show an amount by which the total precipitation is known to have been exceeded. They would be more useful if they could be used as a basis for estimating the total rainfall at that point. Several methods were investigated by Stewart, who finally adopted the relation shown in figure 36. The maximum rainfall for various intervals of time was picked off the charts for several representative recording gages. These amounts were expressed in percent of total storm rainfall and plotted in figure 36. The heavy line in that figure represents a weighted average that was used to estimate the storm rainfall from the partial records. The procedure was to assume that the amount of rainfall measured was the maximum that occurred during the storm for that length of time. The measured rainfall was divided by the percentage of the total rainfall occurring during the same length of time, obtained from the average curve in figure 36. More than 50 estimates of total rainfall given in table 2 were obtained by this method.

Records of rainfall of less than 1 hour duration were not used to estimate total rainfall. The estimates were interpreted as the minimum amount that could be expected for the total rainfall; the assumption that the measured rainfall was the maximum was considered

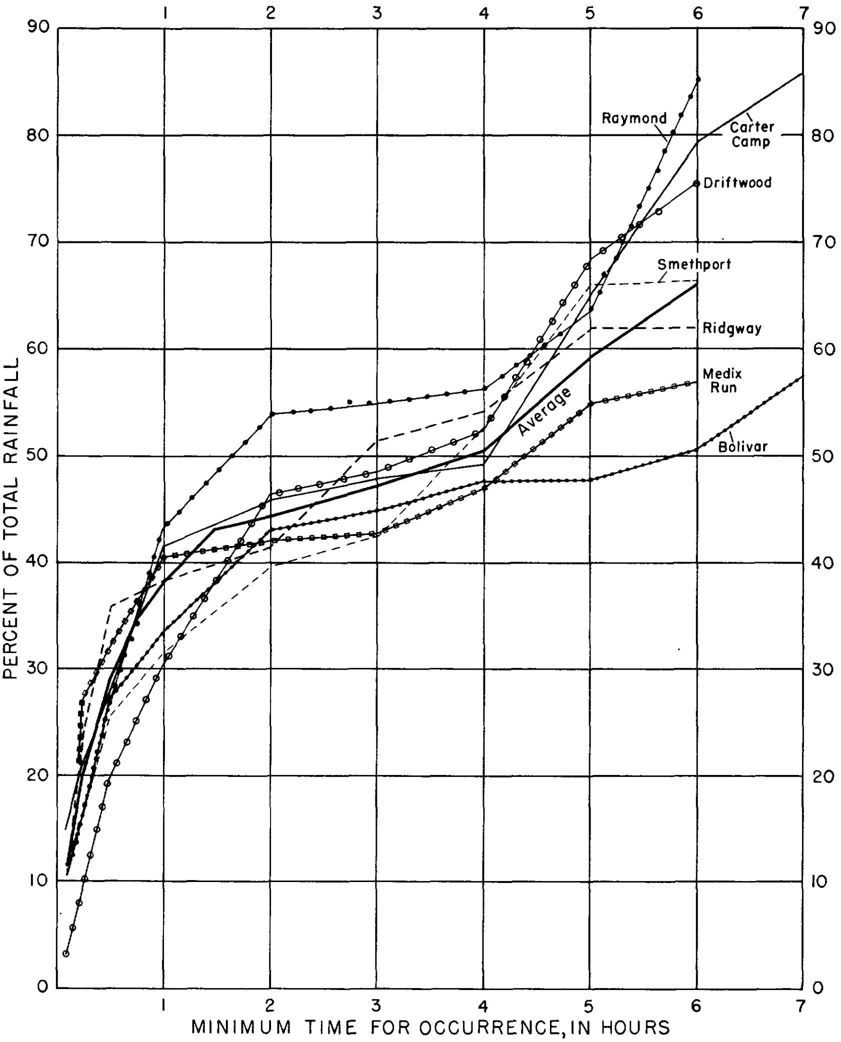


FIGURE 36.—Relation between percent of total rainfall and minimum time required for its occurrence.

unlikely in many instances. The method was tested by comparing the estimated total rainfall, computed from a partial catch and figure 36, with the observed total catch in the same container. The results were reasonably satisfactory. Admittedly the process is somewhat crude, but with the tests made and the relatively small variations shown by the observed data in figure 36, it was concluded that the estimates obtained were of sufficient accuracy to be given weight in drawing the isohyetal map (pl. 2).

Table 2 in manuscript form was checked by Mr. Stewart against the original field notes so as to eliminate all errors in compiling the table, insofar as possible. Several errors in previous work were eliminated in that way.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*

[DN, During night; *, container overflowed at unknown time or leaked badly; E. estimated on basis of rainfall measured; + or − with time of rain indicates a variation from time shown up to 15 minutes. Italic figures indicate more than one measurement in the same container; total for the container is given immediately below in roman type]

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall between times shown: July 18 A. m. | Rainfall between times shown: July 18 P. m. | Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period between times shown: July 18 A. m. | Storm period between times shown: July 18 P. m. | Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **West Branch Susquehanna River drainage basin** | | | | | | | | | | | | | |
| | | | *Pennsylvania* | | | | | | | | | | |
| 1 | 41 51 36 | 77 49 18 | Genesee 6a | W. Cutler | 11:30 | 12 m. | | 8.6 | 11:30 | 12 m. | | 8.6 | Very heavy rain 11:30 p. m. 17 to 9 a. m. 18. |
| 2 | 41 50 22 | 77 50 33 | 5c | L. Hawkes | 12 | 12 m. | | 9.5 | 12 | 12 m. | | 9.5 | Very heavy rain 12 p. m. 17 to 7 a. m. 18. |
| 3 | 41 49 51 | 77 48 20 | 9a | J. Griffins | 11 | 10:30 | | 6.8 | 11 | 10:30 | | 6.8 | Heavy rain 11 p. m. 17 to 6:30 a. m. 18. |
| 4 | 41 47 35 | 77 45 52 | 9b | P. Bowen | 12 | 9 | | 6.5 | 12 | 9 | | 6.5 | Hard rain 12 p. m. 17 to 8 a. m. 18. |
| 5 | 41 47 05 | 77 53 11 | 8h | Blough | 11 | | | *7.4 | 11 | | | | Heavy rain 11 p. m. 17 to 10:30 a. m. 18. |
| 6 | 41 45 56 | 77 52 43 | 8j | Dr. Nixon | 11:30 | | 1:30 | 17.5 | 11:30 | | 1:30 | 17.5 | Hard rain 11:30 p. m. 17 to 7 a. m. 18 and 8 a. m. to 1:30 p. m. 18. |
| 7 | 41 44 49 | 78 00 06 | Emporium 3a | F. Kellnor | 9 | 6 | | 4.1 | 9 | | | | |
| 8 | 41 44 14 | 78 02 00 | 3b | Grumm | 11 | | 12:30 | 11.4 | 11 | | 12:30 | 11.4 | 11.4 inches catch probably small as container leaned to south with wind from northwest. Reporter estimated as much rain fell after 9 a. m. 18 as before. |
| | | | | | 11 | 9 | | 7.8 | | | | | |
| 9 | 41 44 04 | 77 48 56 | Short Run 3a | J. O'Neill | | | | *17.2 | | | | | Container 2 feet from house with eaves extending 8 inches and probably reducing catch. |
| 10 | 41 44 03 | 77 59 17 | 1b | Weiss | 10 | 4 | | *13.9 | 10 | | 2 | E21.2 | A little hail about 10 p. m. 17. No rain 8 to 9 a. m. 18. |
| 11 | 41 43 49 | 77 58 54 | 1e | L. Littlefield | 11 | 4 | | *10.0 | 11 | | 2 | E>15.1 | |
| 12 | 41 43 36 | 77 59 15 | 1e | Evjen | 10 | 11:30 | | *10.0 | 10 | 11:30 | | | Very hard rain 10 p. m. 17 to 8 a. m. 18. No rain 8 to 9 a. m. 18. |
| | | | | | 10 | 6 | | **5.4* | | | | | |
| | | | | | | 6 to 11:30 | | **5.4* | | | | | |
| | | | | | | | | *10.8 | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 41 | 43 | 33 | 77 | 57 | 45 | 1f | Pritt | | | | 12.8+ | | | | 12.8+ | Container leaked slightly. |
| 14 | 41 | 43 | 20 | 77 | 58 | 06 | 1g | U. Buttnen | | 6–12 | | 4.2 | 8:30 | 12 m. | | | Hail 2 to 2:10 p. m. 17. |
| 15 | 41 | 43 | 17 | 78 | 00 | 49 | Emporium 3d | S. Kelly | 12 | | 3 | 16.0 | 12 | | 3 | 16.0 | Short thunderstorm about 4 p. m. 17. Heaviest rain 7:15 a. m. to 1:30 p. m. 18. |
| 16 | 41 | 42 | 27 | 78 | 05 | 00 | 3e | A. Hackett | DN | 11 | | 21.2 | DN | | 5? | | Heaviest rain 8:30 a. m. to 3:30 p. m. 18. |
| 17 | 41 | 42 | 21 | 78 | 05 | 35 | 2b | J. Smith | | | | 19.0 | | | | 19.0 | Container empty 17; emptied a few days after storm. |
| 18 | 41 | 42 | 19 | 77 | 57 | 46 | Short Run 1h | E. Vergason | 11:45 | | 12:30 | *9.1 | 11:45 | | 12:30 | | |
| 19 | 41 | 42 | 15 | 78 | 05 | 14 | Emporium 2c | R. Hackett | 11:30 | 7 | | _*8.1_ | 11:30 | | 1:30 | E18.3 | About 4 hours heavy rain after container filled the second time. |
| | | | | | | | | | | 7:15 to 9:15 | | _8.1_ | | | | | |
| | | | | | | | | | | | | *16.2 | | | | | |
| 20 | 41 | 42 | 10 | 77 | 58 | 28 | Short Run 1i | G. Girardin | 11 | 12 m. | | *12.7 | 11 | 12 m. | | | Amount of rain may include that for hailstorm 3 to 3:15 p. m. 17. |
| | | | | | | | | | 11 | 11 | | _*7.9_ | | | | | |
| | | | | | | | | | | 11–12 | | _3.7_ | | | | | |
| | | | | | | | | | | | | *11.6 | | | | | |
| 21 | 41 | 42 | 04 | 78 | 05 | 40 | Emporium 2d | Mitcheltree | | | | *10.2 | 12 | | 12:30 | | Heaviest rain 12 p. m. 17 to 6:30 a. m. 18. Reporter estimated rain enough to fill container 2 more times. |
| 22 | 41 | 41 | 53 | 77 | 56 | 15 | Short Run 1j | O. Watson | 7:30 | 6 | | *1.7 | 7:30 | | 2 | | Shower with hail 3 to 3:10 p. m. 17. |
| 23 | 41 | 41 | 31 | 78 | 05 | 20 | Emporium 2f | L. Tyler | 12 | | 3 | *9.6 | 12 | | 3 | | Downpour started 9 a. m. 18. |
| 24 | 41 | 41 | 30 | 78 | 07 | 11 | 2e | R. Kio | 11:30 | 6 | | _5.6_ | 11:30 | | 3:30 | | Hailed 4 to 4:30 p. m. and about 11:30 p. m. 17. Heavy rain 8:30 a. m. to 12 m. and 12:30 to 3:30 p. m. 18. Reporter estimated container would have filled again after 10 a. m. |
| | | | | | | | | | | 6–10 | | _*3.3_ | | | | | |
| | | | | | | | | | | | | *8.9 | | | | | |
| 25 | 41 | 40 | 55 | 78 | 07 | 33 | 2g | J. MacMartin | 11:30 | | 3:30 | 4.1 | 11:30 | | 3:30 | 4.1 | Some hail 3:45 to 4:05 p. m., 11:30 to 11:45 p. m. 17, and 2 to 2:15 p. m. 18. Continuous heavy rain 11:30 p. m. 17 to 3:30 p. m. 18. Container sheltered by dense foliage of maple tree. |
| 26 | 41 | 40 | 43 | 77 | 56 | 23 | Short Run 1k | M. Kio | 8 | | 9 | 5.7 | 8 | | 9 | 5.7 | Hailed about 1 minute at beginning of storm; heaviest rain 3 a. m. to 5:30 p. m. 18. |
| 27 | 41 | 40 | 39 | 78 | 11 | 19 | Emporium 1g | E. Sebring | 9 | | 4 | *10.0 | 9 | | 4 | | No rain to 8 a. m.; very heavy rain 8 a. m. to 2 p. m. 18. |
| 28 | 41 | 40 | 30 | 78 | 02 | 15 | 3f | Stephens | | 2–8 | | _*6.0_ | | 2 | 4 | E15.0 | Reporter estimated at least 3″ rain after 12 m. 18. Very little rain 9 to 9:30 a. m. |
| | | | | | | | | | | 8–12 | | _6.0_ | | | | | |
| | | | | | | | | | | | | *12.0 | | | | | |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall between times shown: July 18 A. m. | Rainfall between times shown: July 18 P. m. | Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period: July 18 A. m. | Storm period: July 18 P. m. | Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **West Branch Susquehanna River drainage basin**—Continued | | | | | | | | | | |
| | | | *Pennsylvania*—Con. | | | | | | | | | | |
| 29 | 41 40 02 | 78 12 06 | Emporium 1h | C. Perrigo | | 8–12 | | 11.0 | DN | | P. m. | E21.7 | Reporter estimated that container would have filled again 5.5″ more had it been emptied at noon 18. |
| 30 | 41 39 32 | 78 08 28 | 5b | L. Goodwin | 11 | 12 m. | | *8.8 | 11 | | P. m. | | Heaviest rain 8 a. m. to 1 p. m. 18. |
| 31 | 41 39 31 | 78 09 10 | 5a | E. Ludwig | 10 | | 3:30 | *12.5 | 10 | | 3:30 | | Some hail p. m. 17; heavy rain 10 p. m. 17 to 6 a. m. 18; no rain 6:30 to 7:45 a. m.; and very heavy rain 10:30 a. m. to 12 m. 18. |
| 32 | 41 39 11 | 78 09 21 | 5c | H. Andrews | DN | 10 | | *9.6 | DN | | P. m. | | Heavy hail storm about 3 p. m. 17; heaviest rain about 12 m. 18. |
| 33 | 41 39 06 | 78 09 19 | 5d | G. Earl | DN | 8 | | *7.1 | DN | | 1 | | A little hail on 18. Reporter estimated more rain after 8 a. m. 18 than before. |
| 34 | 41 38 57 | 77 58 03 | Short Run 4a | E. Reed | | 8–12 | | *6.0 | | 1 | 1:30 | E11.8 | Heavy rain 1 to 7 a. m. and 8 a. m. to 12 m. 18. No rain 7 to 8 a. m. 18. |
| 35 | 41 38 18 | 77 59 10 | 4b | Pierce | 9:30 | 8<br>8 | <br>P. m. | *10.1*<br>*3.1<br>*13.2 | 9:30 | | P. m. | | |
| 36 | 41 37 27 | 77 42 43 | Galeton 4a | C. Heuser | 10:30 | 9:30 | | 3.6 | 10:30 | 12 m. | | | Hard rain period 10:30 p. m. 17 to 10:30 a. m. 18. |
| 37 | 41 37 17 | 78 02 53 | Emporium 6a | D. Rees | | 1–12 | | *9.4 | | 1 | P. m. | | Hailed about 1 a. m. 18. |
| 38 | 41 36 50 | 78 04 02 | 6b | C. Cooney | | 1–11 | | 18.0 | | 1 | P. m. | | Reporter estimated 25% more rain after 11 a. m. Container carried away by flood about 12 m. 18. |
| 39 | 41 36 35 | 77 53 28 | Short Run 5a | A. Walker | DN | | | *12.4 | DN | | 5 | | Heaviest rain 8:30 a. m. to 12 m. 18. Catch measured Sept. 8 probably small. |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 41 36 04 | 78 12 50 | Emporium 4b | V. Cannon | 11:15 | A. m. | | *7.2 | 11:15 | | 4:30 | | Container nearly full early a. m. 18. Reporter estimated enough rain to fill container twice. |
| 41 | 41 35 34 | 77 53 57 | Short Run 5b | C. Lloyd | | 1 | 1:30 | 8.5 | | 1 | 1:30 | 8.5 | Some hail about 1 a. m. 18, heaviest rain 8:30 a. m. to 1:30 p. m. 18. Container at end of house with 10-inch eaves. |
| 42 | 41 35 14 | 77 54 08 | 5c | Williams | | 1 | P. m. | 6.5 | | 1 | P. m. | 6.5 | Heavy rain 1 to 6:15 and 6:30 to 11:30 a. m. 18. Container may have been emptied about 10 a. m. as usual but probably not. |
| 43 | 41 34 45 | 77 54 20 | | Casbear | 12 | | 2 | 6.0 | 12 | | 2 | 6.0 | Container under tree. |
| 44 | 41 34 43 | 78 13 22 | Emporium 7a | C. Dodge | | | | 6.5 | | | | | Heaviest rain started between 10:30 and 11 a. m. 18. Reporter states container filled in about 5 minutes and then overflowed, but time may have been longer. |
| 45 | 41 34 22 | 78 12 05 | 7b | C. Howard | | 11:30 | 4 | 5.4 | DN | | 4 | | Heaviest rain on 18 started about 11 a. m. |
| 46 | 41 33 54 | 77 55 56 | Short Run 7a | G. McFall | DN | | 5 | 4.0 | DN | | 5 | 4.0 | Light shower at 5 p. m. 17. |
| 47 | 41 33 51 | 77 56 18 | 7b | Berglund | | | 12:30 to 1:30 | 6.2 | DN | | 4 | E 16.3 | Heavy rain 8:15 a. m. to 2 p. m. 18; heaviest 12 m. to 2 p. m. |
| 48 | 41 33 35 | 78 02 03 | Emporium 9a | Card | | 9:30 to 9:55 | | 9.5 | | 12:30 | 1 | | Heaviest rain with steady intensity 9 a. m. to 12 m. 18. |
| 49 | 41 33 31 | 78 01 45 | 9b | D. Williams | | 1-8 8 | 2 | 2.9 *6.4 *9.3 | | 1 | 2 | | Intermittent heavy downpours 8:30 a. m. to 2 p. m. 18. |
| 50 | 41 33 24 | 77 57 26 | Short Run 7c | F. Decker | | 9 to 9:20 | | 4.4 | 12 | | 4 | | Very heavy rain 8 a. m. to 1 p. m. 18. |
| 51 | 41 33 03 | 78 01 21 | Emporium 9c | Greely | DN | 8 | | *7.1 | | | | | |
| 52 | 41 32 47 | 77 47 14 | Short Run 8a | Knickerbocker | 11 | 7 | | *1.7 | 11 | | 2 | | Heavy rain 7 a. m. to 2 p. m. 18. |
| 53 | 41 32 26 | 77 58 51 | 7d | J. Foster | 12 | 6 | | 5.4 | 12 | 12 m. | | | |
| 54 | 41 32 00 | 78 00 52 | Emporium 9d | T. Mancuso | 12 | | 2:30 | 20.4 | 12 | | 2:30 | 20.4 | Hard rain 12 to 5 a. m. 18. and 12 m. to 2:30 p. m. 18. Downpour 10 a. m. to 12 m. 18. |
| 55 | 41 31 57 | 78 17 59 | Colegrove 9a | F. Lockwood | 11:30 | | P. m. | *6.7 | 11:30 | | P. m. | | Hard rain 11:30 p. m. 17 to 3 a. m. 18. Downpour 11 a. m. to 12 m. 18. |
| 56 | 41 31 53 | 78 18 00 | 9b | W. Timblin | | | | *8.7 | | | | | Container set out DN 17 and found full on 19. |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall between times shown: July 18 A. m. | Rainfall between times shown: July 18 P. m. | Rainfall between times shown: Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period between times shown: July 18 A. m. | Storm period between times shown: July 18 P. m. | Storm period between times shown: Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **West Branch Susquehanna River drainage basin**—Continued | | | | | | | | | |
| | | | *Pennsylvania*—Con. | | | | | | | | | | |
| 57 | 41 31 34 | 78 03 55 | Emporium 9e | B. Abel | ---- | 9:50 to 10 | ---- | 6.5 | 12 | ---- | 5 | ---- | Container, set out 8 feet from house about 10 a. m. 18, overflowed in 10 min. Cloudburst from about 10 a. m. to 12 m. 18. No rain 6 to 8 a. m. 18. |
| 58 | 41 30 02 | 78 02 07 | 9f | J. Lewis | ---- | ---- | ---- | *11.9 | ---- | ---- | ---- | ---- | |
| 59 | 41 29 57 | 78 02 15 | Driftwood 3a | W. Deibler | ---- | 7 | 1 | 7.8 | DN | ---- | 2.30 | E 12.8 | |
| 60 | 41 29 29 | 78 02 53 | 3b | C. Logue | 11 | A. m. | ---- | *7.4 | 11 | ---- | 2:30 | ---- | Hailed about 5 min. about 10 a. m. 18; heaviest rain 8:30 a. m. to 2:30 p. m. 18. |
| 61 | 41 29 14 | 78 26 08 | Caledonia 1a | G. Mahoulich, Jr. | DN | ---- | 4:30 | *9.3 | DN | ---- | 4:30 | ---- | Very hard rain 12 m. to 4:30 p. m. 18. |
| 62 | 41 29 08 | 78 17 14 | 3b | M. Judd | 12 | 9<br>9 | ----<br>6 | *2.4*<br>**7.1*<br>*9.5 | 12 | ---- | 6 | E>12.5 | Downpour 10 a. m. to 3 p. m. 18; container only 3¾ feet from eaves of house. No rain 7 to 8 a. m. 18. |
| 63 | 41 29 07 | 78 13 42 | Driftwood 1a | J. Sage | 8 | ---- | 6 | *6.5 | 8 | ---- | 6 | ---- | Heaviest rain 8 a. m. to 12 m. 18. |
| 64 | 41 29 05 | 78 17 35 | Caledonia 3a | S. Crawford | ---- | 8 | 3 | 10.5 | ---- | ---- | ---- | ---- | Accuracy of record in doubt. Hail 1:45 to 2 p. m. 18. |
| 65 | 41 29 00 | 78 27 42 | 1b | P. Herzing | 11 | ---- | 4:30 | 5.3 | 11 | ---- | 4:30 | 5.3 | Container 15 feet from lee side of barn. Downpour 2:30 to 4:30 p. m. 18. |
| 66 | 41 28 57 | 78 13 47 | Driftwood 1b | J. Ostrum | 12 | 6<br>12 m. | ----<br>6 | 3.4<br>3.3 | 12 | ---- | 8 | ---- | Very heavy rain 12 m. to about 6 p. m. 18. |
| 67 | 41 28 53 | 77 49 22 | Bitumen 3a | S. Jones | 10 | 8 | ---- | 4.9 | 10 | ---- | 2:30 | ---- | |
| 68 | 41 28 51 | 78 25 12 | Caledonia 1c | I. Carter | DN | ---- | 3 | *7.8 | DN | ---- | 3 | ---- | Container 14 feet from porch, under dense evergreen. Heavy rain between 10 a. m. and 3 p. m. 18. |
| 69 | 41 28 40 | 78 15 39 | 3c | C. Lyon | 12 | ---- | 3:30 | 7.2 | 12 | ---- | 3:30 | 7.2 | No rain 7 to 8 a. m.; heavy rain 8 a. m. to 3:30 p. m. 18; downpour 12 m. to 3:30 p. m. It is possible that container overflowed. |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70 | 41 | 28 | 34 | 78 | 11 | 03 | Driftwood 1c | H. Hicks | 10:30<br>10:30 | | 4:30<br>3 | 7.6<br>*6.9 | 10:30 | | 4:30 | 7.6 | |
| 71 | 41 | 28 | 04 | 78 | 16 | 35 | Caledonia 3d | E. Mumford | | | | 4.7 | | | | 4.7 | Container under maple tree with thin foliage. |
| 72 | 41 | 28 | 03 | 78 | 29 | 26 | 1d | J. Brentel | | 12 m. | 6 | 4.4 | 12 | | 6 | | Heavy rain 1 to 5 p. m.; very heavy rain 5 to 6 p. m. 18. |
| 73 | 41 | 28 | 00 | 78 | 61 | 51 | 3e | P. Lyon | | 1–7<br>8 | <br>5:30 | 3.9<br>3.9<br>7.8 | | 1 | 6 | 8.1± | Very hard rain 12 m. to 4 p. m. 18. Moderate rain 7 to 8 a. m. and light rain 5:30 to 6 p. m. estimated as 0.3 in. |
| 74 | 41 | 27 | 48 | 77 | 50 | 42 | Bitumen 2a | F. Caldwell | DN | | P. m. | *9.8 | DN | | P. m. | | Heavy rain 6 to 8 a. m. 18. |
| 75 | 41 | 27 | 42 | 78 | 03 | 28 | Driftwood 3c | R. Keller | 11 | 11 | | *12.1 | 11 | | 3 | | May include rain from previous storms. Heavy rain to 6 a. m. and 6:40 a. m. to 2 p. m. 18. |
| 76 | 41 | 27 | 33 | 78 | 17 | 30 | Caledonia 3f | J. Reed | 12 | | 7 | 16.5 | 12 | | 7 | 16.5 | Downpour 3:30 to 4:30 p. m. 18. |
| 77 | 41 | 26 | 08 | 77 | 53 | 17 | Bitumen 2b | Peters | 10 | 7 | | *7.3 | 10 | | 3 | E14.3 | Heavy rain 5 a. m. to 12 m. 18. |
| 78 | 41 | 25 | 52 | 78 | 22 | 34 | Caledonia 2a | G. Sprankle | | 7:30<br>11 | 6<br>6 | *8.2<br>2.9 | 10 | | 6 | | Heaviest rain between 10 a. m. and 12 m. 18. |
| 79 | 41 | 25 | 45 | 77 | 54 | 50 | Bitumen 2c | D. Crane | | 9 to<br>10 | | 3.6 | 10 | | 2:30 | | Heaviest rain DN 17. Container filled in 20 min. |
| 80 | 41 | 25 | 42 | 77 | 54 | 48 | 2d | H. Cramer | | 11 | 1 | *7.5 | 12 | | 2 | E16.9 | Very heavy rain 11 a. m. to 1 p. m. 18. |
| 81 | 41 | 25 | 32 | 77 | 54 | 04 | 2e | Summerson | | 8 | 3 | 8.0 | | 1 | 3 | E11.4 | Container 6" from end eaves. Poor location due to sheltering. |
| 82 | 41 | 25 | 19 | 77 | 54 | 05 | 2f | C. Calhoun | 10 | | 3 | 8.6 | 10 | | 3 | 8.6 | |
| 83 | 41 | 24 | 46 | 78 | 02 | 12 | Driftwood 6a | C. Peno | | 12:30 | 2 | *8.9 | | 12:30 | 2 | | Very heavy rain 8:30 a. m. to 2 p. m. 18. |
| 84 | 41 | 24 | 35 | 78 | 11 | 56 | 4a | S. Barr | DN | | 4 | *7.3 | DN | | 4 | | Heavy rain 12 m. to 4 p. m. 18. Container overflowed 3 times. Emptied 6 a. m. and 12 m. 18. |
| 85 | 41 | 24 | 17 | 77 | 55 | 14 | Bitumen 4a | McCoy | | | 12:30<br>to<br>3:15 | 3.3 | 11 | | 3:15 | E6.5 | Very heavy rain 12:30 to 3:15 p. m. 18. |
| 86 | 41 | 24 | 04 | 78 | 14 | 44 | Caledonia 6a | J. Mix | 9 | 5:30 | | 3.9 | 9 | | P. m. | | Heaviest rain about 11 p. m. 17. |
| | | | | | | | | | 9 | | P. m. | *8.2 | | | | | Container overflowed near end of storm. |
| 87 | 41 | 23 | 46 | 78 | 01 | 10 | Driftwood 6b | P. Johnson | | 12:30 | 2 | 9.7 | | 12:30 | 4 | | Downpour 11 a. m. to 3 p. m. 18. |
| 88 | 41 | 22 | 53 | 78 | 01 | 29 | 6c | S. Kuppelweiser | 9 | 7<br>8 to<br>10:30 | | 6.9<br>8.6 | 9 | | 5 | E19.0 | No rain 7 to 8 and 10:30 to 11 a. m. 18. Very heavy rain 9 to 10:30 a. m. and 11 a. m. to 3:30 p. m. 18. |
| | 41 | 22 | 43 | 77 | 55 | 28 | Bitumen 4b | D. Schoonover | | | 4–5 | 15.5<br>3.5 | | | | E9.2 | |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall between times shown: July 18 A. m. | Rainfall between times shown: July 18 P. m. | Rainfall between times shown: Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period between times shown: July 18 A. m. | Storm period between times shown: July 18 P. m. | Storm period between times shown: Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **West Branch Susquehanna River drainage basin**—Continued | | | | | | | | | | |
| | | | *Pennsylvania*—Con. | | | | | | | | | | |
| 90 | 41 22 22 | 78 09 10 | Driftwood 5a | H. Jordan | DN | 8 | ---- | *7.9 | DN | ---- | 3 | ---- | Container in poor location. Very hard rain 1 to 3 p. m. 18. |
| | | | | | DN | ---- | 3 | *5.4 | | | | | |
| 91 | 41 21 39 | 78 08 17 | 5b | J. Johnson | ---- | 1–7 | ---- | *5.2* | ---- | 1 | P. m. | 9.5 | Very heavy rain 7:30 a. m. to 2 p. m. 18. |
| | | | | | | 7 | P. m. | *.3* | | | | | |
| | | | | | | | | 9.5 | | | | | |
| 92 | 41 21 23 | 78 03 12 | 6d | Miller | ---- | 1–7 | ---- | 3.1 | ---- | 1 | P. m. | ---- | Very hard rain 10:30 a. m. to 2 p. m. 18. |
| 93 | 41 20 25 | 77 50 33 | Bitumen 5b | Desmond Mine | ---- | ---- | ---- | *11.8 | ---- | ---- | ---- | ---- | |
| | | | | | | | | *9.2 | | | | | |
| 94 | 41 20 20 | 77 52 22 | 5a | Janet Mine | ---- | ---- | ---- | *7.4 | ---- | ---- | ---- | ---- | |
| | | | | | | | | *10.0 | | | | | |
| 95 | 41 18 05 | 78 03 06 | Driftwood 9a | C. Pitts | 10 | 5:30 | ---- | *3.1 | 10 | ---- | 3 | ---- | Heavy rain 2:30 to 3 p. m. 18. |
| 96 | 41 17 52 | 77 50 46 | Bitumen 8a | F. Morton | 11 | 10:30 | ---- | 8.3 | 11 | ---- | 3 | ---- | Heaviest rain between 5 and 6 a. m. 18; drizzled after 3 p. m. to 8 p. m. 18. |
| 97 | 41 16 49 | 77 53 14 | 8b | H. Anderson | ---- | 1:45 to 6:30 | ---- | *1.5* | ---- | 1:45 | 2 | 3.0 | Hard rain 6 to 7 a. m. and 11 a. m. to 2 p. m. 18. No rain 7 to 9 a. m.; light rain 2 to 9 p. m. 18. |
| | | | | | | 6:30 | 9 | *1.5* | | | | | |
| | | | | | | | | 3.0 | | | | | |
| 98 | 41 15 31 | 77 54 32 | 8c | A. Stimson | ---- | 2 | 2 | 4.2 | ---- | 2 | 2 | 4.2 | Very hard rain noon to 2 p. m. 18. |
| | | | | | ---- | 2 | 2 | 4.0 | ---- | 2 | 2 | 4.0 | Container under big limbs of a tree. |
| | | | **Allegheny River drainage basin** | | | | | | | | | | |
| | | | *New York* | | | | | | | | | | |
| 99 | 42 11 48 | 78 33 28 | Salamanca 3a | J. Wiley | 9 | 11 | ---- | 8.0 | 9 | 11 | ---- | 8.0 | Heavy downpours 7 to 11 a. m. 18. |
| 100 | 42 11 36 | 78 28 16 | Olean 1a | G. Wilber | DN | 11 | ---- | 6.8 | DN | 11 | ---- | 6.8 | 1 cloudburst after another 6:30 to 11 a. m. 18. Very little rain after 11 a. m. 18. |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 42 | 11 | 25 | 78 | 33 | 25 | Salamanca 3b | B. Potter | DN | 12 m.<br>12 m. | <br>4 | 4.7<br>2.8<br>7.5 | DN | | 4 | 7.5 | Downpour 5 to 9 a. m. 18. |
| 102 | 42 | 11 | 22 | 78 | 29 | 38 | Olean 1b | J. Whitcher | 11 | A. m. | | *8.7 | 11 | A. m. | | | Heavy rain 11 p. m. 17 to about 7:30 a. m. 18. |
| 103 | 42 | 10 | 45 | 78 | 26 | 26 | 1c | R. Rogers | DN | 8 | | *7.6 | DN | 10 | | | Downpour 6:30 to 8 and hard rain 8 to 10 a. m. 18. |
| 104 | 42 | 10 | 45 | 78 | 24 | 29 | 2a | F. Gile | | 6:30 to 10 | | *5.3 | 11:30 | 10 | | E>12.6 | Very heavy rain 11:30 p. m. 17 to 1:30 a. m. 18, downpour 6:30 to 9 a. m. 18. |
| | | | | | | | | | | 6:30 to 10 | | *5.8 | | | | | |
| 105 | 42 | 10 | 30 | 78 | 28 | 57 | 1d | M. Hitchcock | 7 | | 1 | *9.4 | 7 | | 1 | | Heavy rain 5 to 11 a. m. and downpour 11 a. m. to 1 p. m. 18. |
| 106 | 42 | 10 | 27 | 78 | 22 | 24 | 2b | D. Wing | 10:30 | | | *8.1 | 10:30 | | | | Downpour 7:30 to 9 a. m.; not much rain after 9 a. m. 18. |
| 107 | 42 | 10 | 19 | 78 | 21 | 58 | | C. Wagner | 11:30 | 9 | | 4.7 | 11:30 | 9 | | 4.7 | A little hail DN 17. Hard rain 11:30 p. m. 17 to 12:30 a. m. 18. Downpour 8 to 9 a. m. 18. Container sheltered by tree. |
| 108 | 42 | 09 | 54 | 78 | 23 | 12 | Olean 5a | G. Bell | DN | | 1 | 14.1 | DN | | 1 | 14.1 | Downpour 8:30 to 9:30 a. m. 18. |
| 109 | 42 | 09 | 32 | 78 | 23 | 45 | 5b | E. Saylor | 12 | 12 m. | | 6.0 | 12 | 12 m. | | 6.0 | Hard rain 12 to 7:30 a. m. and downpour 7:30 to 9:30 a. m. 18. |
| 110 | 42 | 09 | 27 | 78 | 26 | 36 | 4a | C. Adams | 10 | 12 m. | | *2.5 | 10 | 12 m. | | | A little hail and downpour for ½ hour shortly after 8 a. m. 18. |
| 111 | 42 | 09 | 24 | 78 | 30 | 12 | Salamanca 6a | G. Wood | | 7 to 11 | | 6.0+ | Before 12 | 11 | | E9.6 | No rain 5 to 7 a. m. 18. ¾ hr. downpour between 7 and 8 a. m. 18. Hard bursts of rain 8 to 11 a. m. 18. Slight leak in container. |
| 112 | 42 | 09 | 23 | 78 | 25 | 20 | Olean 4b | A. Swart | 10 | 11 | | *6.6 | 10 | 11 | | | No rain 5 to 7:30 a. m. 18. Downpour started 7:30 a. m.; thereafter heavy bursts of rain until 11 a. m. 18. |
| 113 | 42 | 09 | 10 | 78 | 17 | 38 | 6a | C. Kratts | 10 | 9 | | *4.8 | 10 | 10 | | | Excessive rain 7:30 to 8:30 a. m. 18. |
| 114 | 42 | 09 | 03 | 78 | 17 | 45 | 6b | A. Subject | 10:45 | | 2:30 | 5.4 | 10:45 | | 2:30 | 5.4 | Excessive rain 7 to 8:30 a. m. 18. |
| 115 | 42 | 08 | 40 | 78 | 21 | 16 | 5c | J. Bump | 9 | 10 | | 5.9 | 9 | 10 | | 5.9 | No rain 5 to 7 a. m.; downpour 8 to 10 a. m. 18. |
| 116 | 42 | 08 | 24 | 78 | 24 | 30 | 5d | E. Hurlburt | 11 | 11 | | *9.2 | 11 | 11 | | | Downpour 8:45 to 11 a. m. 18. |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall: July 18 A. m. | Rainfall: July 18 P. m. | Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period: July 18 A. m. | Storm period: July 18 P. m. | Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| **Allegheny River drainage basin**—Continued | | | | | | | | | | | | | |
| | | | *New York*—Con. | | | | | | | | | | |
| 117 | 42 08 20 | 78 21 05 | Olean 5e | F. Miller | | 6:30 to 10 | | *1.7 | 11 | 12 | | | Downpour 7 to 11 a. m. 18. |
| 118 | 42 08 06 | 78 20 21 | 5g | A. Dehnkam | | 10 | | *6.6 | | | | | Downpour 8 to 8:30 a. m. 18. Container noticed overflowing 9:30 or 10 a. m. 18. |
| 119 | 42 08 04 | 78 20 50 | 5f | C. Shaffer | 9 | 11 | | *7.9 | 9 | 11 | | | Very hard rain 6 or 7 to 9:30 a. m. 18. |
| 120 | 42 07 57 | 78 28 52 | 4c | F. Miller | DN | | 2 | *7.0 | DN | | 2 | | Downpour 7:30 to 8:30 a. m. 18, followed by another slightly later. |
| 121 | 42 07 56 | 78 18 11 | 6c | M. Manley | 11 | 9 | | 3.5 | 11 | 9 | | 3.5 | Excessive rain 7:30 to 9 a. m. 18. |
| 122 | 42 07 46 | 78 28 35 | | A. Hansel | | 8:30 to 12 | | 2.6 | DN | 12 m. | | E6.0 | Steady hard rain 5:30 to 10 a. m.; heaviest rain 6 to 9:30 a. m. 18. Good record of amount of rainfall after 8:30 a. m. |
| 123 | 42 07 46 | 78 22 44 | Olean 5h | W. Alexander | DN | 10 | | *7.4 | DN | 10 | | | Heavy rain 12 to 8 a. m. and downpour 8 to 8:30 a. m. 18. |
| 124 | 42 07 40 | 78 24 48 | 5i | F. Phelps | DN | 12 m. | | 9.5 | DN | 12 m. | | 9.5 | Downpour 6:30 to 8:30 a. m. and hard rain 8:30 until nearly noon 18. |
| 125 | 42 07 38 | 78 14 33 | Belmont 4a | C. Congdon | DN | 10<br>10 to 12 m. | | *4.5*<br>*3.5*<br>8.0 | DN | 12 m. | | 8.0 | Hard bursts of rain 8 to 12 noon 18. |
| 126 | 42 07 20 | 78 20 50 | Olean 5j | E. Miller | 8:30 | 9 | | *9.9 | 8:30 | 11 | | | Heavy rain for an hour about 9 p. m. 17; excessive rain 8:30 to 11 a. m. 18. |
| 127 | 42 07 08 | 78 18 56 | | A. Forsythe | 11:30<br>11:30 | 11:30<br>11:30 | | *7.3<br>*7.2 | 11:30 | 11:30 | | | Heavy rain 11:30 p. m. 17 to 12:30 a. m. 18. Downpour 7:45 to 10 and hard rain 10 to 11:30 a. m. 18. |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 128 | 42 07 07 | 78 23 01 | Olean 5l | J. Zink | DN | 12 m. | | 11.2 | DN | 12 m. | | 11.2 | Hard rain 4 to 8 and excessive rain 8:30 to 9 a. m. 18. Container may have leaked at beginning of storm. |
| 129 | 42 07 05 | 78 18 58 | 6d | D. Wagner | 11:30 | 11:30 | | *7.4 | 11:30 | 11:30 | | | Excessive rain 7:45 to 10 a. m. 18. |
| 130 | 42 07 00 | 78 24 08 | 5k | F. Smith | 10:30 | | | 13.4 | 10:30 | | | 13.4 | Excessive rain 8 to 8:30 and hard rain 8:30 to 10:30 a. m. 18. |
| 131 | 42 06 53 | 78 15 01 | 6e | H. Higby | 10:45 | 7 | | 3.8 | 10:45 | | P. m. | | Succession of heavy thunderstorms 7:30–12 a. m. 18. |
| 132 | 42 06 49 | 78 14 57 | Belmont 4b | F. Walbur | | 7 | 1:30 | 5.7 | 10:45 | | 1:30 | E12.5 | Downpour 7:30 a. m. to 10 a. m. 18. |
| 133 | 42 06 44 | 78 23 15 | Olean 5m | Bush | | | | *6.0 | | | | | |
| 134 | 42 06 40 | 78 19 53 | 6f | O. Crawforth | 11 | 8<br>8–11 | | *6.5*<br>**2.6*<br>*9.1 | 11 | 11 | | | Hard showers 11 p. m. 17 to 6:30 a. m. 18. Downpour 6:30 to 7:30 and hard rain 7:30 to 11 a. m. 18. |
| 135 | 42 06 40 | 78 12 58 | Belmont 4e | C. Fisk | 11 | 12 m. | | 3.4 | 11 | 12 m. | | 3.4 | Downpour 7:30 to 10:30 a. m. 18. |
| 136 | 42 06 39 | 78 22 36 | Olean 5n | C. Brown | 9:45 | 7<br>7 to 11:30 | | **3.6*<br>**10.9*<br>*14.5 | 9:45 | 11:30 | | E>22.1 | Intermittent heavy rain DN 17. No rain 7 to 7:30, excessive rain 7:30 to 9:30, and hard rain 9:45 to 11:30 a. m. 18. |
| 137 | 42 06 38 | 78 14 26 | Belmont 4c | J. Aud | DN | 6<br>6–11 | | *7.0*<br>*7.0*<br>14.0 | DN | 11 | | 14.0 | Hardest rain about 8 a. m. 18. |
| 138 | 42 06 36 | 78 13 30 | 4d | C. Foster | 11 | 12 m. | | 8.9 | 11 | 12 m. | | 8.9 | Downpour 8 to 9 a. m. 18. |
| 139 | 42 06 12 | 78 14 00 | 4f | C. Beckwith | 10:15 | 10 | | 11.2 | 10:15 | 10 | | 11.2 | Succession of heavy rains DN 17 to 5:45 a. m. 18. Cloudburst 8 to 10 a. m. 18. |
| 140 | 42 05 54 | 78 15 14 | Olean 6h | H. Robinson | DN | 5:30 | | 2.8 | DN | 11 | | | Downpour 7 to 8 a. m. 18. |
| 141 | 42 05 53 | 78 14 20 | Belmont 4g | F. Barber | | | | 6.0 | | | | | Amount measured is night rain only. |
| 142 | 42 05 49 | 78 19 07 | Olean 6g | C. Willover | 4 | 12 m. | | *9.1 | 4 | 12 m. | | | Excessive rain 7:30–12 a. m. 18. A little hail within this period. |
| 143 | 42 05 29 | 78 14 53 | Belmont 4h | F. Foster | | | | *6.9 | | | | | Most of rain came in cloudburst between 8 and 9 a. m. 18 |
| 144 | 42 05 27 | 78 21 35 | Olean 5o | C. Fredrick | DN | 10:30 | | *7.9 | DN | 10:30 | | | Excessive rain 8 to 10 or 10:30 a. m. 18. |
| 145 | 42 05 14 | 78 21 34 | 5p | D. Kayes | | 7 to 8 | | *8.2 | DN | 8 | | E>21.6 | Time container was in use is somewhat indefinite; reporter estimated enough rain fell to fill container two more times. |
| 146 | 42 05 14 | 78 14 31 | Belmont 4i | L. Childs | | | | *4.0 | | | | | |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall: July 18 A. m. | Rainfall: July 18 P. m. | Rainfall: Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period: July 18 A. m. | Storm period: July 18 P. m. | Storm period: Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Allegheny River drainage basin**—Continued | | | | | | | | | | |
| | | | *New York*—Con. | | | | | | | | | | |
| 147 | 42 05 06 | 78 17 44 | Olean 6i | J. Hewitt | DN | 9:30 | | 6.4 | DN | 9:30 | | 6.4 | Downpour 7 to 9:30 a. m. 18 |
| 148 | 42 04 55 | 78 15 41 | 9b | H. Burgett | 7 | 12 m. | | 8.3 | 7 | 12 m. | | 8.3 | Heavy rain 7 to 9 and down pour 9 to 11 a. m. 18. |
| 149 | 42 04 50 | 78 19 50 | 9a | R. Blakeslee | 10:30 | 12 m. | | *8.9 | 10:30 | 12 m. | | | Downpour 7:30 to 12 m. 18; some hail in this period. |
| 150 | 42 04 47 | 78 25 56 | | Times Herald | DN | 11:30 | | 6.5 | | | | | |
| 151 | 42 04 46 | 78 11 59 | Belmont 7a | P. Hoffman | 10:30 | | | 8.0 | 10:30 | | | 8.0 | Hardest rain about 11 a. m. 18 when it was almost as dark as night. |
| 152 | 42 04 42 | 78 15 04 | Olean 9c | M. Neu | 11 | 9 | | 8.0 | 11 | 9 | | 8.0 | Cloudburst 6:30 to 8 a. m. 18. |
| 153 | 42 04 37 | 78 12 26 | Belmont 7b | B. Frost | DN | 6 | | *5.1* | | | | | |
| | | | | | | 6–8 | | **2.7* | | | | | |
| | | | | | | | | *7.8 | | | | | |
| 154 | 42 04 30 | 78 16 17 | Olean 9f | L. Lewis | 11 | 12 m. | | 6.1 | 11 | 12 m. | | 6.1 | Downpour 7 to 9 a. m. 18. |
| 155 | 42 04 24 | 78 16 37 | 9e | F. Payne | 11 | 6 | | *2.9* | 11 | 12 m. | | 9.3 | Downpour 7:30 to 11 a. m. 18. |
| | | | | | | 6–12 | | *6.4* | | | | | |
| | | | | | | | | 9.3 | | | | | |
| 156 | 42 04 23 | 78 17 48 | 9d | O. Merrick | | 7:45 to 9 | | 6.1 | DN | 10 | | E15.0 | Downpour 7:45 to 9 a. m. 18. |
| 157 | 42 04 19 | 78 14 56 | Belmont 7c | W. Keller | 7 | 11 | | 7.5 | 7 | 11 | | 7.5 | Hard rain 7 p. m. 17 to 9 a. m. 18. |
| 158 | 42 04 13 | 78 16 58 | Olean 9g | O. Ecker | 9:30 | 10 | | 6.0+ | 9:30 | 10 | | 6.0+ | Catch small, owing to some leakage and end of catch trough being sheltered. Hard rain all night; downpour 6:30 to 8:30 a. m. 18. |
| 159 | 42 04 10 | 78 13 43 | Belmont 7d | A. Chaffee | | | | 6.7 | | | | 6.7 | |
| 160 | 42 03 44 | 78 22 04 | Olean 8a | F. Witherell | 9 | 11 | | *1.5 | 9 | 11 | | | Very heavy rain 7:20 to 8 and downpour 8 to 10 a. m. 18. |
| 161 | 42 03 37 | 78 18 25 | 9h | E. Bradford | 10:30 | 12 m. | | 8.7 | 10:30 | 12 m. | | 8.7 | Downpour started about 8 a. m. 18. |
| 162 | 42 03 33 | 78 14 45 | Belmont 7e | H. Woodard | 11:15 | 12 m. | | 9.5 | 11:15 | 12 m. | | 9.5 | Heavy rain 11:15 p. m. 17 to 11 a. m. 18; heaviest 7:30 to 9 a. m. 18. |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 163 | 42 | 03 | 25 | 78 | 15 | 02 | Olean 9i | J. Coffey | DN | 11 | | *9.5 | DN | 11 | | | Downpour 8:30 to 9:30 and hard rain 9:30 to 11 a. m. 18. |
| 164 | 42 | 03 | 14 | 78 | 21 | 48 | 8c | W. Boxer | 8 | 12 m. | | *13.1 | 8 | 12 m. | | | 5 cloudbursts forenoon of 18. |
| 165 | 42 | 03 | 09 | 78 | 21 | 52 | 8b | B. Martin | DN | 12 m. | | *5.0 | DN | 12 m. | | | Downpour 8-9 and hard rain 9-12 a. m. 18. |
| 166 | 42 | 03 | 03 | 78 | 12 | 37 | Belmont 7f | G. Hulbert | 10 | 12 m. | | 4.8 | 10 | 12 m. | | 4.8 | Hard rain 10 p. m. 17 to 8 a. m. 18; heaviest between 7 and 8 a. m. |
| 167 | 42 | 02 | 35 | 78 | 10 | 22 | 7h | C. Rigby | 11 | 11 | | 1.3 | 11 | 11 | | 1.3 | |
| 168 | 42 | 02 | 27 | 78 | 11 | 22 | 7g | J. Cartwright | 7 | 5 | | 6.3 | 7 | 10 | | | Cloudburst 8 to 10 a. m. 18. |
| 169 | 42 | 02 | 18 | 78 | 22 | 39 | Olean 8d | F. Vanyo | DN | 12 m. | | *6.6 | DN | 12 m. | | | Cloudburst before 9 a. m. 18. |
| 170 | 42 | 02 | 01 | 78 | 10 | 25 | Belmont 7i | M. Burrows | 9 | 11 | | 3.0 | 9 | 11 | | 3.0 | Hard rain 9 p. m. 17 to 11 a. m. 18. |
| 171 | 42 | 01 | 41 | 78 | 09 | 10 | | F. Bates | | | | *8.2 | DN | 12 m. | | | Hardest rain 6:30 to 8 a. m. 18. Container in poor location. |
| 172 | 42 | 01 | 24 | 78 | 13 | 20 | Belmont 7j | M. Lamphere | DN | 8 | | 6.4 | DN | 9 | | | Downpour 7 to 8 a. m. 18. |
| 173 | 42 | 01 | 12 | 78 | 21 | 48 | Olean 8e | M. Coleman | 10:45 | 12 m. | | 5.6 | 10:45 | 12 m. | | 5.6 | Heavy rain all night 17. Excessive rain 8-12 a. m. 18. |
| 174 | 42 | 00 | 52 | 78 | 12 | 54 | Belmont 7k | C. Giddings | | | | 6.8 | | | | 6.8 | Hard rain all night 17. |
| 175 | 42 | 00 | 50 | 78 | 09 | 23 | 8a | D. Grimes | 11 | 11 | | 3.6 | 11 | 11 | | 3.6 | Hard rain 11 p. m. 17 to 4:30 a. m. 18 and 8:30 to 11 a. m. 18. Downpour 5:30 to 8:30 a. m. 18. |
| 176 | 42 | 00 | 34 | 78 | 15 | 52 | Olean 9j | R. Loucks | <br>DN | 8-12<br>12 m. | | 5.0<br>*5.0 | DN | 12 m. | | E9.4 | Hardest part of rain between 8 and 9 a. m. 18. Reporter estimated that 0.5″ fell between 7:30 and 8 a. m. 18, making a total of 5.5″ from 7:30 to noon 18. |
| | | | | | | | *Pennsylvania* | | | | | | | | | | |
| 177 | 41 | 59 | 59 | 78 | 16 | 45 | Smethport 3a | F. Pitzrick | DN | 11:30 | | *9.3 | DN | 11:30 | | | No rain 6 to 8 a. m.; heavy rain 8 to 11:30 a. m. 18. Reporter estimated total rain as about 15 inches. |
| 178 | 41 | 59 | 57 | 78 | 16 | 16 | 3b | L. Shaw | 11:30 | A. m. | | 4.3 | | | | | |
| 179 | 41 | 59 | 57 | 78 | 10 | 55 | Coudersport 1a | P. Gillmer | 12 | 10 | | *7.4 | 12 | 8+ | | | Downpour 6 to 8 a. m. 18. |
| 180 | 41 | 59 | 50 | 78 | 20 | 55 | Smethport 2a | L. Evens | 11:30 | 12 m. | | 6.7 | 11:30 | 12 m. | | 6.7 | Succession of downpours 5-12 a. m. 18. |
| 181 | 41 | 59 | 50 | 78 | 11 | 18 | Coudersport 1b | D. Green | 11 | 10+ | | *8.3<br>*8.7 | 11 | 10+ | | | Downpour 5:30 to 10 a. m. 18. |
| 182 | 41 | 59 | 27 | 78 | 15 | 09 | Smethport 3c | E. Turner | 10:30 | 10+ | | *7.8 | 10:30 | 10+ | | | Downpour 7 to 10 a. m. 18. |
| 183 | 41 | 59 | 22 | 78 | 20 | 58 | 2b | C. Baldwin | 12 | 12 m. | | *10.6 | 12 | 12 m. | | | |
| 184 | 41 | 59 | 18 | 78 | 11 | 08 | Coudersport 1c | R. James | 11:45 | 12 m. | | 23.0 | 11:45 | 12 m. | | 23.0 | Downpour 7:45 to 10 a. m. 18. Container may have held rain from previous storms, but probably not more than 2 inches. Reporter stated no water in container prior to 17. |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall between times shown: July 18 A. m. | Rainfall between times shown: July 18 P. m. | Rainfall between times shown: Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period between times shown: July 18 A. m. | Storm period between times shown: July 18 P. m. | Storm period between times shown: Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Allegheny River drainage basin**—Continued | | | | | | | | |
| | | | *Pennsylvania*—Con. | | | | | | | | | | |
| 185 | 41 59 17 | 78 17 52 | Smethport 3d | E. Mills | 10 | | 2 | *5.6 | 10 | | 2 | | Downpour by "bursts" 7 a. m. to 2 p. m. 18. |
| 186 | 41 59 09 | 78 21 03 | 2c | D. Buffun | 12 | 8 | | *5.8 | 12 | 12 m. | | E17.7 | Downpour 8–12 a. m. 18. |
| | | | | | | 8–12 | | 9.0 | | | | | |
| | | | | | | | | *14.8 | | | | | |
| 187 | 41 58 47 | 78 13 02 | Coudersport 1d | H. Blanchard | DN | 11+ | | 10.5 | DN | 11+ | | 10.5 | Heavy rain 7:30 to 11 a. m. 18. |
| 188 | 41 58 44 | 78 19 28 | Smethport 3 e | Shoemaker | DN | | 1 | 8.5 | DN | | 1 | 8.5 | Downpour about 11:30 a. m. 18. |
| 189 | 41 58 43 | 78 22 22 | 2d | Mason | DN | | 1 | 10.5 | DN | | 1 | 10.5 | Heavy rain 8:15 a. m. to 1 p. m. 18. |
| 190 | 41 58 41 | 78 17 05 | 3h | A. Scutt | 11 | 10+ | | *7.2 | 11 | 10+ | | | Container nearly full before heavy storm of 18. |
| 191 | 41 58 36 | 78 20 13 | 2e | J. Soules | 11 | | 2 | 9.5+ | 11 | | 2 | 9.5+ | Container for 9.5-inch catch 1 foot from end of house, probably leaked at beginning of catch. Hard rain 11 p. m. 17 to 3 a. m. 18; downpour 7:30 to 11 or 11:30 a. m. 18. |
| | | | | | | 7:30 or 8 | 2 | *7.2 | 11 | | 2 | E>14.1 | |
| 192 | 41 58 36 | 78 08 39 | Coudersport 2a | L. Drake | 11 | 5 | | *2.3 | | | | | Container overflowed before 5 a. m. 18. |
| 193 | 41 58 34 | 78 19 20 | Smethport 3f | S. Peasley | 11:30 | 12 m. | | *7.1 | 11:30 | 12 m. | | | Heavy rain 7 to 8 a. m. 18. |
| 194 | 41 58 34 | 77 59 24 | Genesee 1a | F. Walker | 10 | 7 | | 5.0 | 10 | 9 | | | Hard rain 10 p. m. 17 to 6 a. m. 18 and 7 to 8 a. m. 18. |
| 195 | 41 58 33 | 78 14 32 | Coudersport 1e | L. Holly | | 1–9 | | *4.5 | | 1 | 1:30 | | Heavy rain 9 a. m. to 1:30 p. m. 18. |
| 196 | 41 58 33 | 78 12 15 | 1f | P. Baker | 9 | | 2 | *9.9 | 9 | | 2 | | Downpour 8 a. m. to 2 p. m. 18. |
| 197 | 41 58 32 | 78 19 14 | Smethport 3g | A. Cole | | | | 6.5 | | | | 6.5 | |
| 198 | 41 58 31 | 78 23 01 | 2f | McNaughton | | 9 | 1 | 6.3 | 11 | | 4 | E>10.7 | Container (wood-stave barrel) probably leaked materially at beginning of catch. Heavy rain 8 a. m. to 1 p. m. 18. |
| 199 | 41 58 22 | 78 23 08 | 2g | F. Johnson | DN | 12 m. | | *6.1 | DN | 12 m. | | | Rained 1" 11 to 11:40 a. m. 18. |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 200 | 41 | 58 | 03 | 78 | 14 | 25 | Coudersport 1g | M. Maxson | | 2 to 11 | | *7.3 | | 2 to 12 m. | | | Downpour period 8 to 10:30 a. m. 18. |
| 201 | 41 | 57 | 58 | 78 | 16 | 34 | Smethport 3i | G. Taylor | 11:30 | 9:30 | | 9.7 | 11:30 | 12 m. | | | Downpour 7:45 to 11 a. m. 18. The reporter estimated that the rainfall for that period alone was enough to fill the container, which overflowed. |
| 202 | 41 | 57 | 50 | 78 | 12 | 35 | Coudersport 1h | J. Kemp | 10 | | 1 | 12.5 | 10 | | 1 | 12.5 | Downpour 7:30 to 10 a. m. 18. |
| 203 | 41 | 57 | 45 | 78 | 20 | 48 | Smethport 2i | R. Leet | | 6:30 to 9:30 | | 8.0 | | | | E21.1 | Heavy rain 8:30 to 11 a. m. 18. Container overflowed 9:30 a. m. 18 or before. Presumably no rain between 6:30 and 8:30 a. m. 18. |
| 204 | 41 | 57 | 44 | 78 | 08 | 31 | Coudersport 2b | A. Cronk | Before 12 | 6;30 | | *3.0* | Before 12 | 12 m.+ | | E8.2 | Downpour 7–12 a. m. 18. Container lacked 0.5″ of being full at noon. Reporter stated that there may have been enough rain after noon to finish filling the container. |
| | | | | | | | | | | 6:30 to 12 | | *4.9* | | | | | |
| | | | | | | | | | | | | 7.9 | | | | | |
| 205 | 41 | 57 | 43 | 78 | 20 | 06 | Smethport 2j | Ewing | | 8:30 to 9 | | 3.1 | | | | | Heavy rain 8:30–12 a. m. 18. |
| 206 | 41 | 57 | 42 | 78 | 22 | 00 | 2h | G. Eastman | | 8:15 to 9:30 | | 9.2 | 10 | 11:15 | | E22.7 | No rain 5:30 to 8:15 and heavy rain 8:15 to 11:15 a. m. 18. |
| 207 | 41 | 57 | 30 | 78 | 16 | 10 | 3j | | | | | *7.9 | | | | | Container set out during a. m. storm of 18. |
| 208 | 41 | 57 | 24 | 78 | 10 | 37 | Coudersport 1i | J. Rupert | | 7:30 to 11 | | *7.7 | DN | 11 | | E>15.8 | Cloudburst 7:30 to 8:30 a. m. 18. No rain 6 to 7:30 a. m. 18. |
| 209 | 41 | 56 | 56 | 78 | 14 | 12 | Coudersport 1j | D. Stannard | | 8:30 to 9+ | | *7.7 | 6 | | 2 | E20.3 | Downpour started 7:30 a. m.; heaviest rain 9 to 10 a. m. 18. Reporter estimated that there was enough rain to fill container almost 4 times. A very little hail night of 17. |
| 210 | 41 | 56 | 50 | 78 | 10 | 43 | 1k | E. Salisbury | 11 | 7 | | 3.4 | 11 | 11 | | | Hard rain 8 to 11 a. m. 18 of which the heaviest was 8 to 9 a. m. |
| 211 | 41 | 56 | 47 | 78 | 09 | 35 | 2c | W. Bliss | | 12:30 | About 12 m. | 12.8 | | | | | Downpour 8 to 12 a. m. 18. |
| | | | | | | | | | | 12:30 | 12 m.+ 9 | 13.8 | | 12:30 | 12 m.+ 9 | 13.8 | |
| 212 | 41 | 56 | 44 | 78 | 35 | 50 | Bradford 2a | E. O'mara | 5 | | | *14.0 | 5 | | | | Heavy rain 2 to 5:30 and 9 to 11 a. m. 18. |
| 213 | 41 | 56 | 43 | 78 | 23 | 35 | Smethport 2k | O. Ward | DN | | 12:30 | 12.2 | DN | | 12:30 | 12.2 | Very heavy rain 8:30 to 9:30 a. m. 18. |
| 214 | 41 | 56 | 35 | 78 | 10 | 43 | Coudersport 1l | T. Elliot | 11 | 9 | | *9.6 | 11 | 11:30 | | | Downpour period 8 to 11:30 a. m. 18 (5 cloudbursts). |
| 215 | 41 | 56 | 34 | 77 | 56 | 24 | Genesee 1b | F. Kenyon | | | | 18.0 | | | | 18.0 | |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall between times shown: July 18 A. m. | Rainfall between times shown: July 18 P. m. | Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period: July 18 A. m. | Storm period: July 18 P. m. | Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| **Allegheny River drainage basin—Continued** | | | | | | | | | | | | | |
| | | | *Pennsylvania*—Con. | | | | | | | | | | |
| 216 | 41 56 27 | 78 08 45 | Coudersport 2d | E. McGuirl | 11<br>11 | 12 m.<br>12 m. | | *12.5<br>*10.5 | 11 | 12 m. | | | Downpour 7:30 to 11:30 a. m. 18. |
| 217 | 41 56 26 | 78 10 35 | 1m | B. Kellog | DN | 12 m. | | 9.8 | DN | 12 m. | | 9.8 | Heavy rain 8 to 12 a. m. 18. |
| 218 | 41 56 17 | 78 13 59 | 1n | L. Chase | 11:45 | 9 | | 9.2 | 11:45 | 10 | | | Downpour 6:30 to 10 a. m. 18. Observer estimated that about 2″ of rain fell after container was full at 9 a. m. 18. |
| 219 | 41 56 15 | 78 05 35 | 2c | F. Dunshie | 12 | | 4 | 2.8 | 12 | | 4 | 2.8 | Very hard rain 9 a. m. to 1:30 p. m. 18. |
| 220 | 41 56 07 | 78 14 46 | 1o | L. Bridge | 10 | | P. m. | *8.1 | 10 | | P. m. | | Downpour 7:30 a. m. to 1 p. m. 18. |
| 221 | 41 56 04 | 78 13 30 | 1p | A. Blanchard | 11 | | 1 | *9.4 | 11 | | 1+ | | Downpour period 8:30 a. m. to 12 m. 18. A little hail a. m. 18. |
| 222 | 41 56 00 | 78 15 22 | Smethport 3k | F. Matthews | 11:30 | 7:30<br>7:30 | <br>P. m. | *6.7<br>*6.7<br>*13.4 | 11:30 | About 12 m. | | | Extremely heavy rain from shortly after 8 to 9:30 a. m. 18. |
| 223 | 41 55 51 | 78 15 51 | 3l | Woodward | 11:30<br>10 | 12 m.<br>8 | | *13.2<br>*9.4 | 10 | | P. m. | | Reporter estimated enough rain fell to have filled container again. |
| 224 | 41 55 36 | 78 20 56 | 2n | R. Kelley | | 5:30 to 11 | | *3.9 | DN | 11 | | E>6.3 | A little hail about 9 a. m. 18. |
| 225 | 41 55 33 | 78 21 24 | 2m | W. Barnes | 11:45 | 12 m. | | 8.5 | 11:45 | 12 m. | | 8.5 | |
| 226 | 41 55 28 | 78 22 30 | 2l | Smith | DN | 9:15 | | 6.1 | DN | | 12:30 | | Heavy rain 9 a. m. to 12:30 p. m. 18. Container (capacity 6.1 inches) filled in a 15- or 20-minute period beginning 9 a. m. 18 except for estimated 1 in. remaining from previous night's storms. |
| 227 | 41 55 02 | 78 06 48 | | Keir | | 8 to 8:30 | | 3.0 | | | | | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 228 | 41 | 54 | 55 | 78 | 17 | 58 | Smethport 6a | L. Jordan | ---- | 8:30 | 1 | *9.6 | 12 | ---- | 3 | ---- | No rain 7 to 8:30 a. m. 18. |
| 229 | 41 | 54 | 46 | 78 | 18 | 03 | 6b | C. Hubble | 11 | 8:30<br>8:30 | ----<br>12:30 | 3.8<br>*15.0<br>*18.8 | 11 | ---- | 12:30 | ---- | Heavy rain started 8:30 a. m. 18. |
| 230 | 41 | 54 | 45 | 78 | 06 | 16 | Coudersport 5a | P. Fisk | DN | 7<br>7–10 | ----<br>---- | 5.2<br>*3.9<br>*9.1 | DN | ---- | 2 or 3 | ---- | |
| 231 | 41 | 54 | 38 | 78 | 13 | 36 | 4a | N. Austin | DN | ---- | 2:30 | *7.3 | DN | ---- | 2:30 | ---- | Very heavy rain 8 a. m. to 2:30 p. m. 18. Light hail just before heavy rain. |
| 232 | 41 | 54 | 27 | 78 | 23 | 45 | Smethport 5a | A. Rice | ---- | 11:30 | 12:30 | *2.9 | 11:30 | ---- | 2 | E>7.6 | Heaviest rain 10 a. m. to 12:30 p. m. 18. |
| 233 | 41 | 54 | 18 | 78 | 03 | 45 | Coudersport 6c | R. Haskins | DN | 10 | ---- | *8.4 | ---- | ---- | ---- | ---- | Reporter believed there was enough rain to have filled container again. |
| 234 | 41 | 54 | 14 | 78 | 03 | 45 | 6a | A. Swift | 10 | ---- | P. m. | 10.0 | 10 | ---- | P. m. | 10.0 | |
| 235 | 41 | 54 | 12 | 78 | 07 | 18 | 5b | W. Stephenson | DN | ---- | 1 | *7.0 | DN | ---- | 1 | ---- | No rain 6 to 8 a. m. 18. |
| 236 | 41 | 54 | 08 | 78 | 01 | 06 | 6d | F. Amidon | 12 | 5:30<br>7 to 9:30 | ----<br>---- | 6.8<br>6.4 | 12 | 9:30 | ---- | E14.0 | Very heavy rain 12 to 5:30 and 6:30 to 8:30 a. m. 18. |
| 237 | 41 | 54 | 07 | 78 | 04 | 18 | 6b | F. Rachick | 9:30 | ---- | 2 | 8.4 | 9:30 | ---- | 2 | 8.4 | Container may have leaked a little at beginning of storm. |
| 238 | 41 | 53 | 48 | 78 | 19 | 42 | Smethport 6c | Lewis | 10 | ---- | P. m. | *9.7 | 10 | ---- | P. m. | ---- | Heavy rain 8:30 a. m. to 12:30 p. m. 18. |
| 239 | 41 | 53 | 45 | 78 | 20 | 40 | 5b | J. Cooney | ---- | ---- | ---- | *8.8 | ---- | ---- | ---- | ---- | Hard rain 7:30–12 a. m. 18. A little hail about 10:45 a. m. 18. |
| 240 | 41 | 53 | 35 | 78 | 15 | 29 | 6d | H. Evans | ---- | 7:45 to 10:15 | ---- | 7.7 | ---- | ---- | ---- | ---- | Heavy rain beginning between 7:30 and 8:15 a. m. 18 and ending about 12:30 p. m. 18. Reporter stated more rain fell, during heavy rain, after container was full than before (7.7 inches). |
| 241 | 41 | 53 | 31 | 78 | 20 | 57 | 5c | Glover | ---- | 8:45 to 9:30 | ---- | 5 8 | 11 | ---- | 2 | ---- | Heavy rain started 8:30 a. m. 18. |
| 242 | 41 | 53 | 24 | 78 | 06 | 28 | Coudersport 5c | L. Shattuck | DN | 10 | ---- | *8.3 | ---- | ---- | ---- | ---- | Heavy rain 8 to 11:30 a. m. 18. |
| 243 | 41 | 53 | 23 | 78 | 19 | 02 | Smethport 6e | Cantwell | DN | ---- | 4 | *8.1 | DN | ---- | 4 | ---- | Heavy rain started 8:30 a. m. 18. |
| 244 | 41 | 53 | 12 | 78 | 16 | 30 | 6f | A. McNeil | ---- | 8 to 8:20 | ---- | 1.8 | DN | 12 m. | ---- | ---- | Heavy rain about 8–12 a. m. 18. Container sheltered. |
| 245 | 41 | 53 | 09 | 77 | 59 | 31 | Genesee 4c | J. Hemple | DN | 8<br>8 | ----<br>1 | *6.6<br>1.9<br>*8.5 | DN | ---- | 1 | ---- | |
| 246 | 41 | 53 | 07 | 78 | 06 | 44 | Coudersport 5d | E. Fosmer | DN | 8<br>8 to 9:30 | ----<br>---- | 6.3<br>3.4<br>9.7 | DN | ---- | P. m. | ---- | Heaviest rain from 8:30–12 a. m. 18. Reporter estimated nearly as much rain after 9:30 a. m. 18 as before. |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall between times shown: July 18 A. m. | Rainfall between times shown: July 18 P. m. | Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period between times shown: July 18 A. m. | Storm period between times shown: July 18 P. m. | Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Allegheny River drainage basin**—Continued | | | | | | | | |
| | | | *Pennsylvania*—Con. | | | | | | | | | | |
| 247 | 41 52 51 | 77 55 14 | Genesee 4d | R. Conable | DN | 6 | -------- | *7.0 | -------- | -------- | -------- | -------- | Reporter estimated total rainfall to be 10.5″. |
| 248 | 41 52 35 | 78 06 17 | Coudersport 5e | M. Sperl | 10:30 | 6:30<br>6:30 | --------<br>P. m. | *7.2<br>3.9<br>*11.1 | 10:30 | -------- | P. m. | -------- | Very heavy rain 10:30 p. m. 17 to 7 a. m. 18. |
| 249 | 41 52 33 | 78 14 10 | 4b | F. Van Nater | -------- | 8–11 | -------- | 7.5 | 12 | 12 | -------- | E>15.9 | Very hard rain 12 to 2 a. m. and downpour 7–12 a. m. 18. Reporter estimated there was enough rain to fill container again. |
| 250 | 41 52 27 | 77 56 24 | Genesee 4e | W. Leet | 11:30 | -------- | 1+ | 8.8 | 11:30 | -------- | 1+ | 8.8 | Very hard rain 11:30 p. m. 17 to 6:30 a. m. 18 and 8 a. m. to 1 p. m. 18. |
| 251 | 41 52 20 | 78 20 15 | Smethport 5c | E. Hultz | -------- | 12:15 | 3 | 34.5 | -------- | 12:15 | 3 | 34.5 | Downpour 8 to 11:30 a. m. 18. |
| 252 | 41 52 17 | 78 23 44 | 5d | W. Finley | -------- | A. m. | P. m. | *5.5 | -------- | -------- | -------- | -------- | The wood-stave bucket leaked badly until soaked up; therefore there must have been more than 5.5″ rain for the period of catch. |
| 253 | 41 52 13 | 78 25 55 | 4a | W. Brown | 11 | -------- | 5 | 12.5 | 11 | -------- | 5 | 12.5 | Heavy rain 11 p. m. 17 to 6:30 a. m. 18 and 8:30–12 a. m. 18. A little hail about 11 p. m. 17. |
| 254 | 41 52 12 | 78 24 02 | 5f | Bickford | -------- | 12:30 | P. m. | 9.1 | -------- | 12:30 | P. m. | 9.1 | Heavy rain 9:45–12 a. m. 18. |
| 255 | 41 52 12 | 78 17 10 | 6g | Sigward | -------- | 8:30 | 1:30 | 7.3 | DN | -------- | 1:30 | -------- | Heavy rain 12 to 2 and 4 to 6:30 a. m. 18; downpour 9:30 to 11:30 a. m. 18. |
| 256 | 41 52 03 | 78 24 22 | 5g | A. Stratton | -------- | -------- | -------- | 2.8 | -------- | -------- | -------- | -------- | Amount for night of 17 only. Heavy rain 7–12 a. m. 18. |
| 257 | 41 52 03 | 78 13 09 | Coudersport 4c | T. Robbins | -------- | 10 | 2 | *7.5 | 11:30 | -------- | 2 | E>14.7 | A little hail about 11:30 p. m. 17. Reporter estimated there was enough rain to fill container 2 more times. |
| 258 | 41 51 59 | 78 24 30 | Smethport 5h | Stratton | -------- | -------- | -------- | *5.6 | -------- | -------- | -------- | -------- | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 259 | 41 51 59 | 78 11 45 | Coudersport 4d | C. Baum | 12 | 6<br>6 | <br>12:30 | 3.3<br>5.3<br>8.6 | 12 | | 12:30 | 8.6 | Downpour 8 a. m. to 12:30 p. m. 18. |
| 260 | 41 51 46 | 78 19 36 | Smethport 6h | R. Simar | | | | 14.2 | | | | 14.2 | Downpour 7 to after 10 a. m. 18. |
| 261 | 41 51 45 | 78 00 11 | Coudersport 6e | A. Sturdevant | 12 | 6:30<br>6:30 to 9<br>9–11 | | 3.1<br>1.9<br>1.9<br>6.9 | 12 | | 2 | | Very hard rain 12 to 2, 4:30 to 7, and 9 to 11 a. m. 18. Nearly all of storm rainfall measured. |
| 262 | 41 51 38 | 78 15 14 | Smethport 6i | G. Scott | | 11 to 11:20 | | 1.8 | 12 | | 12:30 | | Heavy rain 12 to 5 a. m. 18. A few large hail stones about 9:30 a. m. 18. Downpour period 9:30 to 11:30 a. m. 18. |
| 263 | 41 51 11 | 78 24 50 | 5i | Harris | | | | *11.5 | | | | | Amount is for part of downpour period on 18. |
| 264 | 41 51 04 | 78 13 20 | Coudersport 4e | M. Thornshelley | | | | 6.7 | | | | | Container may have overflowed and children dipped out part of catch. Downpour started at 9 a. m. 18. |
| 265 | 41 51 02 | 77 56 28 | Genesee 4f | Aheara | 2:30 | | P. m. | 10.0 | 2:30 | | P. m. | 10.0 | Hard showers 2:30 to 3 p. m. 17, also hail. Very heavy rain 11 p. m. 17 to 9 a. m. 18 and hard rain 10–12 a. m. 18. |
| 266 | 41 51 01 | 78 21 47 | Smethport 5j | R. Teeter | | | | 17.2 | | | | 17.2 | Amount small owing to small leak in container. |
| 267 | 41 50 55 | 78 01 03 | Coudersport 6g | F. Kenyon | | | | *12.5 | | | | | |
| 268 | 41 50 54 | 78 13 47 | 4g | A. Burr | DN | 12 m. | | *13.8 | DN | | P. m. | | Very hard rain from before 8 a. m. to 12 m. 18. Reporter estimated there was nearly enough rainfall to have half-filled container again. |
| 269 | 41 50 44 | 78 03 52 | 6f | R. Brock | 11:20 | 6 | | 5.7 | 11:20 | | 12:30 | | Heaviest part of rain on 18 was over by 10:30 a. m. |
| 270 | 41 50 42 | 78 18 23 | Smethport 6j | S. Carlson | 12 | 7 | | *7.3 | 12 | | 1 | | Hard rain 12 to 4 a. m. 18. Downpour period 6 a. m. to 1 p. m. 18. Reporter estimated there was enough rain to have filled container again. |
| 271 | 41 50 42 | 78 06 05 | Coudersport 5f | J. Birosh | 10 | | 3:45 | 6.4 | 10 | | 3:45 | 6.4 | Excessive rain 7:30 a. m. to some time in p. m. 18. |
| 272 | 41 50 32 | 78 14 40 | 4h | K. Cooke | 12 | | 3:30 | *12.7 | 12 | | 3:30 | | Downpour 7:30 a. m. to 2:30 p. m. 18. A little hail about noon 18. |
| 273 | 41 50 28 | 78 04 03 | 6h | F. Snyder | | 9:30 to 10:30 | | 2.5 | DN | 12 m. | | | |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall between times shown: July 18 A. m. | Rainfall between times shown: July 18 P. m. | Rainfall between times shown: Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period between times shown: July 18 A. m. | Storm period between times shown: July 18 P. m. | Storm period between times shown: Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| **Allegheny River drainage basin**—Continued | | | | | | | | | | | | | |
| | | | *Pennsylvania*—Con. | | | | | | | | | | |
| 274 | 41 50 27 | 78 24 13 | Smethport 5k | A. Austin | | 8 | P. m. | 3.3 | | 12:30 | P. m. | E7.1 | No rain 4 to 9 a. m. 18. Heavy rain 12:30–4 a. m. and 9-12 a. m. 18. |
| 275 | 41 50 24 | 78 17 09 | 6k | G. Appolt | | 7:45 | About 1 | *30.8 | 11 | | About 1 | | Heavy rain 7:45 a. m. to 12:30 p. m. 18. The heaviest rain was around noon. |
| 276 | 41 50 22 | 78 24 11 | 5l | F. Wilcox | | 7:30 | P. m. | *9.8 | DN | | | E>22.4 | Hard rain 9 to 10:45 a. m. 18. |
| 277 | 41 50 17 | 78 03 22 | Coudersport 6j | M. Peet | 11 | | 2:30 | *6.7 | 11 | | 2:30 | | Very heavy rain 7 to 11:30 a. m. 18. |
| 278 | 41 50 15 | 78 03 42 | 6i | A. Thompson | 11 | | 1 | *6.8 | 11 | | 1 | | Amount greater than 6.1 inches by 8 a. m. 18. Reporter believed as much or more rain fell after 8 a. m. 18 as before. |
| 279 | 41 50 06 | 78 23 30 | Smethport 5m | K. Austin | 12 | | 1:30 | *13.1 | 12 | | 1:30 | | Heavy rain 9 a. m. to 1:30 p. m. 18. |
| 280 | 41 49 59 | 78 17 39 | 9a | R. Hardes | DN | 6 | | 4.5 | | | | | |
| 281 | 41 49 57 | 78 21 33 | 8a | C. Strang | 11 | | 4:30 | *12.1 | 11 | | 4:30 | | Heaviest rain 12:30 to 4:30 p. m. 18. |
| 282 | 41 49 54 | 78 15 06 | 9c | H. Brown | | 12:30 | 12:30 | *10.8 | | 12:30 | 12:30 | | Hard rain 12:30 to 5:30 a. m.; downpour 8 a. m. to 12:30 p. m. 18. A little hail a. m. 18. |
| 283 | 41 49 53 | 78 19 17 | 9b | E. Strang | | 7 | P. m. | 6.5 | | | | E11.9 | |
| 284 | 41 49 52 | 77 51 05 | Genesee 8a | G. Harvey | 12 | 5:30 | | *12.5 | 12 | 12 m. | | | Very heavy rain 12 to 6:30 a. m. 18. |
| | | | | | 12 | 12 m. | | 18.5 | 12 | 12 m. | | 18.5 | |
| 285 | 41 49 48 | 78 24 56 | Smethport 8b | P. Olson | 9:30 | A. m. | | 4.4 | 9:30 | | 3 | | Amount for night of 17 only. Hard rain 9:30 to 10:30 a. m. 18. |
| 286 | 41 49 35 | 78 19 56 | 9d | G. Stoker | DN | 11:30 | | *9.3 | DN | | 3 | | Heavy rain 8:15 to 10:15 a. m. 18. |
| 287 | 41 49 34 | 78 08 17 | Coudersport 8a | E. Harned | DN | | 1:30 | 8.5 | DN | | 1:30 | 8.5 | Rained some about 6:30 p. m. 17. |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 288 | 41 | 49 | 19 | 78 | 00 | 40 | 9a | W. Perry | 11<br>11 | | 2<br>2 | *13.5<br>*9.9 | 11 | | 2 | | Very hard rain 11 p. m. 17 to 3:30 a. m. and 6 to 9 a. m. 18. The 13.5 inches record was obtained at a poor location and therefore is somewhat questionable. |
| 289 | 41 | 49 | 13 | 78 | 03 | 23 | 9b | W. Scott | DN | | 3 | *6.5 | DN | | 3 | | Very hard rain 9 to 12 a. m. 18. |
| 290 | 41 | 49 | 08 | 78 | 11 | 20 | 7a | H. Baker | 12 | 11 | | 11.5 | 12 | | P. m. | | Downpour 8 a. m. to 12 m. 18. Container full by or before 11 a. m. |
| 291 | 41 | 49 | 08 | 78 | 08 | 36 | 8e | R. Green | | | | *8.3 | | | | | |
| 292 | 41 | 49 | 07 | 78 | 15 | 48 | Smethport 9g | M. Manning | 11 | 10 | | *8.0 | 11 | | 2 | | Reporter estimated there was enough rain to have filled container again. |
| 293 | 41 | 49 | 06 | 78 | 08 | 35 | Coudersport 8c | T. Gross | | 7:30 | P. m. | *9.0 | | | | E15.1 | |
| 294 | 41 | 49 | 04 | 78 | 25 | 09 | Smethport 7a | W. Raymer | | | | 9.0 | | | | 9.0 | |
| 295 | 41 | 49 | 02 | 78 | 17 | 56 | 9k | L. Scherer | | 12:30<br>to<br>8:30<br>8:30 | <br><br><br>12 m.+ | *5.0*<br><br><br>*5.0*<br>10.0 | | 12:30 | 12 m.+ | 10.0 | |
| 296 | 41 | 49 | 02 | 78 | 22 | 54 | 8c | G. Smith | | | | 6.4 | | | | 6.4 | |
| 297 | 41 | 49 | 00 | 78 | 17 | 13 | | O. Crossman | | | | *12.0 | | | | | |
| 298 | 41 | 49 | 00 | 78 | 16 | 52 | Smethport 9f | E. Dolaway | | 8 | 12:30<br>12:30<br>to end<br>of storm | **9.5*<br>*1.7* | DN | | P. m. | E>18.9 | |
| 299 | 41 | 48 | 55 | 78 | 25 | 09 | 7b | E. Kibble | | | | *11.2<br>8.0<br>5.8 | | | | 8.0<br>5.8 | Container may have been sheltered by house. |
| 300 | 41 | 48 | 53 | 77 | 53 | 10 | Genesee 8b | A. Gleason | 11:30 | | P. m. | *15.4 | 11:30 | | P. m. | | Very heavy rain 11:30 p. m. 17 to 8 a. m. 18 and hard rain 8:30 a. m. to 1:30 p. m. 18. |
| 301 | 41 | 48 | 47 | 78 | 17 | 02 | Smethport 9h | Minnier | | 9:50 | P. m. | 18.2 | | | | E35.8 | |
| 302 | 41 | 48 | 44 | 77 | 54 | 36 | Genesee 8c | Butler | 11:30 | | P. m. | 11.0 | 11:30 | | P. m. | 11.0 | Very heavy rain 11:30 p. m. 17 to 4:30 a. m. 18 and hard rain 4:30–12 a. m. 18. |
| 303 | 41 | 48 | 15 | 77 | 53 | 30 | 8d | Abbey | 11 | | 7:30 | *24.2 | 11 | | 7:30 | | Heavy rain 11 p. m. 17 to 10:30 a. m. 18. |
| 304 | 41 | 48 | 13 | 78 | 17 | 11 | Smethport 9i | J. Carlson | | 12:15 | 1 | *14.6 | | 12:15 | 1 | | Hard rain 7 to 8:30 and downpour 8:30 to 10 a. m. 18. |
| 305 | 41 | 48 | 09 | 77 | 54 | 10 | Genesee 8e | E. Boucher | 12 | | | 14.0 | | | | 14.0 | Very heavy rain 12 to 6 a. m. and 7 a. m. to 1 p. m. 18. |
| 306 | 41 | 47 | 56 | 78 | 25 | 10 | Smethport 7c | A. Moser | | | | 2.8 | 12:30 | | 4:30+ | | Amount for night of 17 only. |
| 307 | 41 | 47 | 44 | 77 | 56 | 45 | Genesee 7a | R. Yentzer | 11 | 12 m. | | 6.5 | 11 | 12 m. | | 6.5 | Very heavy rain 11 p. m. 17 to 9 a. m. 18. |
| 308 | 41 | 47 | 38 | 78 | 14 | 58 | Coudersport 7b | E. Johnson | | 12:15<br>to 11 | | *9.2 | | 12:15 | 1 | | Downpour 8 to 11 a. m. 18. |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall between times shown: July 18 A. m. | Rainfall between times shown: July 18 P. m. | Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period between times shown: July 18 A. m. | Storm period between times shown: July 18 P. m. | Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Allegheny River drainage basin**—Continued | | | | | | | | | | |
| | | | *Pennsylvania*—Con. | | | | | | | | | | |
| 309 | 41 47 34 | 78 12 57 | Coudersport 7d | F. Fuller | | 1 to 9:30 | | *7.7 | | 1 | 12 m. | | Downpour 5 to 10 a. m. 18. Reporter estimated there was enough rain to have filled container again. |
| 310 | 41 47 34 | 77 53 31 | Genesee 8f | O. Knickerbocker | 6 | | P. m. | 24.0 | 6 | | P. m. | 24.0 | Heavy rain 8 p. m. 17 to 9:45 a. m. 18. |
| 311 | 41 47 33 | 78 08 56 | Coudersport 8d | T. Fitzsimmons | 12<br>12 | 8<br>11:30 | | 1.8<br>*8.7 | 12 | | P. m. | E>16.0 | Heavy rain started 10 a. m. 18. Reporter estimated there was enough rain to have filled container again. |
| 312 | 41 47 27 | 78 13 39 | 7c | V. Tyler | 10:30 | 4<br>4–6<br>7:30 to 9:30 | | *1.2*<br>*5.5<br>*8.0 | 10:30 | | 8 | E>18.1 | Downpour 4:30 to 5 a. m. and cloudburst 7:30 to 9:30 a. m. 18. |
| 313 | 41 47 19 | 78 16 32 | Smethport 9j | T. Fitzsimmons | | 8:30 to 10:45 | | *14.7<br>*15.9 | | 1 to 12 m. | | | |
| 314 | 41 47 13 | 77 54 21 | Genesee 8g | Blough | 6 | 5:30 | | *6.2 | 6 | | 1 | | Heavy rain 11 p. m. 17 to 6:30 a. m. 18. |
| 315 | 41 47 09 | 78 07 09 | Coudersport 8b | C. Clark | | 1 | 2:30 | *8.3 | 1 | | 2:30 | | |
| 316 | 41 47 07 | 78 18 45 | Smethport 9e | Moss | | 8 | P. m. | 10.0 | DN | | P. m. | E18.2 | |
| 317 | 41 47 06 | 78 01 42 | | Water Co | | | | 7.7 | | | | 7.7 | Standard rain gage operated Coudersport Water Co. |
| 318 | 41 47 05 | 78 11 28 | Coudersport 7g | O. Saiers | 11:40 | | P. m. | 14.3 | 11:40 | | P. m. | 14.3 | Downpour period 8–12 a. m. 18. |
| 319 | 41 47 04 | 78 14 43 | 7e | E. Anderson | | A. m. after 8:30 | | *7.2 | DN | | 2 | | Hard rain 12 to 4:15 a. m. and 8:30 a. m. to 2 p. m. 18. |
| 320 | 41 46 56 | 78 03 42 | 9d | O. Senak | 11 | 9 | | *9.6 | | | | | Very hard rain 5 to 9 a. m. 18. |
| 321 | 41 46 52 | 78 12 21 | 7f | R. McAlpine | DN | 7 | | *11.9 | DN | | 3:30 | | No rain 8 to 8:30 a. m. 18. |
| 322 | 41 46 50 | 78 16 00 | Smethport 9l | M. Turner | | 4 | 2 | *12.5 | 4 | | 2 | | Downpour started 9 a. m. 18. |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 323 | 41 46 48 | 78 09 04 | Coudersport 8f | G. Amthor | 12 | | P. m. | *13.5 | 12 | | P. m. | | Downpour 8 a. m. to 1 p. m. 18. |
| 324 | 41 46 46 | 78 25 09 | Smethport 7d | C. Haven | 11 | | P. m. | 6.1 | 11 | | P. m. | 6.1 | |
| 325 | 41 46 39 | 78 12 54 | Coudersport 7h | McKervey | | 12:30 | 1 | 15.6 | | 12:30 | 1 | 15.6 | Heavy rain 9:30-12 a. m. 18. |
| 326 | 41 46 37 | 78 09 29 | 8h | A. Lyman | | | | *1.8 | | | | | Record for night of 17 only. |
| 327 | 41 46 35 | 78 09 42 | 8i | C. Lute | | | | *7.8 | | | | | |
| 328 | 41 46 32 | 78 10 54 | 7i | C. Marshner | | | | *14.1 | | | | | |
| 329 | 41 46 19 | 78 08 13 | 8j | P. Seymour | 11 | 9:30 | | 7.2 | 11 | 11 | | | |
| 330 | 41 46 01 | 78 01 53 | 9c | J. Colcord | 11 | 10<br>10 | <br>2<br>2-3 | *3.9*<br>*3.7*<br>Est. 1<br>7.7 | 11 | | 3 | 7.7 | Downpour 7:45-12 a. m.; heaviest 9-12 a. m. 18. |
| 331 | 41 45 56 | 78 09 28 | 8k | O. Bly | DN | 8 | 2 | 4.0 | DN | | 2 | 4.0 | |
| 332 | 41 45 56 | 77 54 50 | Genesee 8i | A. Lyman | 12 | 8 to 11:15 | | *8.1<br>*8.1 | 12 | 11:15 | | | Heavy rain 12 to 11:15 a. m. 18; heaviest 3 to 9 a. m. |
| 333 | 41 45 53 | 78 07 01 | Coudersport 8m | Reed | | 8-10 | | *16.2<br>*8.1 | 11 | 12 m. + | | E>18.3 | Downpour period 8 to 12 a. m. 18. |
| 334 | 41 45 47 | 78 07 50 | 8l | L. Brown | 11:30 | 10 | | 9.3 | | | | | Heavy rain 9:15 to 10:45 a. m. 18. |
| 335 | 41 45 30 | 78 00 33 | 9e | Harris | 10 | 7 | | 8.6 | | | | | Reporter estimated there was enough rain to have filled container ⅔ full after 7 a. m. 18. |
| 336 | 41 45 26 | 78 24 10 | Smethport 8d | F. Coleman | | 12:30 | 3:30 | *6.9 | | 12:30 | 3:30 | | |
| 337 | 41 45 08 | 78 14 51 | Coudersport 7j | B. Sawyer | 9:30 | | 2 | *9.5 | 9:30 | | 2 | | Downpour period 9:30 a. m. to 1 p. m. 18. |
| 338 | 41 45 06 | 78 01 34 | 9f | E. Vater | | | | *9.5 | | | | | Some hail for about 15 minutes about 4 p. m. 17. |
| 339 | 41 44 54 | 78 14 25 | | H. Wasmer | | 8:30 | P. m. | *4.9 | About 12 | | Before 5 | | |
| 340 | 41 44 37 | 78 14 17 | Emporium 1a | D. Fortner | | 10 | 3:30 | 10.0 | 12:30 | | 3:30 | | Downpour 9-12 a. m. 18. |
| 341 | 41 44 31 | 78 30 23 | Mount Jewett 3a | P. Bloomster | | 11:30 | 4:30 | 1.4 | 12:30 | | 4:30 | E3.4 | No rain 6:30 a. m. to 1 p. m., heavy rain 1 to 2:50 p. m. 18. |
| 342 | 41 44 30 | 78 09 29 | Emporium 2a | M. Obliski | | | | 5.6 | | | | 5.6 | Reporter not certain that top of jar was unbroken. Record therefore is maximum possible. |
| 343 | 41 44 28 | 78 17 46 | Colegrove 3a | Zlobec | 9 | 5:30<br>7 to 8:45 | | *5.9*<br>*5.9*<br>*11.8 | | | | E>14.6 | Very heavy rain 12 to 5:30, 7 to 8:45, and 9-12 a. m. 18. No rain 5:30 to 7 and 8:45 to 9 a. m. 18. Container too close to eaves during first filling, and that part of record may be too great. |

See footnote at end of table.

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall between times shown: July 18 A. m. | Rainfall between times shown: July 18 P. m. | Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period between times shown: July 18 A. m. | Storm period between times shown: July 18 P. m. | Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Allegheny River drainage basin**—Continued | | | | | | | | | | |
| | | | *Pennsylvania*—Con. | | | | | | | | | | |
| 344 | 41 44 26 | 77 56 33 | Short Run 1a | Klesa | 11:55 | 8<br>8 to short time after | | 8.8<br>2.5 | 11:55 | | 3 | | Very hard rain 6:30 a. m. to 1 p. m. 18. Reporter estimated container would have more than filled again after 8 a. m. |
| 345 | 41 44 23 | 78 13 08 | Emporium 1b | F. Fortner | DN | 5:40<br>8 to 11:30 | | 11.3<br>*8.2<br>*7.8 | DN | | 4 | E18.1 | Downpour 10 a. m. to 3:30 p. m. 18. |
| | | | | | | 11:30 | 4 | 5.2<br>*13.0 | | | | | |
| 346 | 41 44 15 | 78 21 38 | Colegrove 2b | H. Williams | DN | 9 | | *5.5 | | | | | Container nearly full early in morning of 18. |
| 347 | 41 44 00 | 78 23 46 | 2a | McDowell | 11:30 | | 4 | 5.7 | 11:30 | | 4 | 5.7 | |
| 348 | 41 43 51 | 77 57 07 | Short Run 1d | H. Predmore | | 6 to 6:15 | | 1.5 | DN | | 2 | | Extremely heavy rain 5:45 to 6:15 a. m. 18. Catch period may have been less than 15 minutes. |
| 349 | 41 43 29 | 78 04 35 | Emporium 3c | W. Buchsenschutz | 12 | 12 m. | | 26.6 | 12 m. | 12 m. | | 26.6 | Shower 4 to 4:20 p. m. 17. Heavy rain 12–8 a. m. and 8:30–12 a. m. 18. Small stream carried along boulders weighing 4 to 5 tons. |
| 350 | 41 43 11 | 78 33 19 | Mount Jewett 3b | A. Capwell | 11:30 | A. m. | | 4.6 | 11:30 | | | | Some hail about 11:30 p. m. 17. Heavy rain 12 to 4:30 p. m. 18. |
| 351 | 41 42 53 | 78 39 10 | 2a | A. Johnson | | | | *9.4 | | | | E>21.1 | Amount for p. m. 18 only. Heavy rain 2:15 to 4:15 p. m. 18. |
| 352 | 41 42 46 | 78 12 50 | Emporium 1c | W. Clark | 11:30 | | 2:30 or 3 | 25.6 | 11:30 | | 2:30 or 3 | 25.6 | Very hard rain at 4 a. m. and cloudburst 9 a. m. to 1:30 p. m. 18. |
| 353 | 41 42 26 | 78 11 29 | 1d | V. Mantz | DN | | 2:30 | *8.2 | DN | | 2:30 | E>15.0 | Downpour 12:30 to 3 a. m. and 9 a. m. to 2:30 p. m. 18. |
| 354 | 41 42 18 | 78 29 18 | Colegrove 1a | C. Silfius | | | | *7.1 | | | | | Container overflowed before noon 18. |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 355 | 41 | 42 | 00 | 78 | 30 | 00 | Mount Jewett 3c | F. Anderson | | | | 8.0 | | | | 8.0 | Heavy rain 8:30 a. m. to 2 p. m. 18. |
| 356 | 41 | 41 | 11 | 78 | 23 | 30 | Colegrove 2c | J. Ashby | DN | | 3:30 | 7.1 | DN | | 3:30 | 7.1 | Container 6 or 8 feet from side of house, which may have decreased catch. |
| 357 | 41 | 41 | 08 | 78 | 10 | 20 | Emporium 1e | J. Barth | | | | 1.2 | | | | | Amount caught in 30 minutes a. m. 18. |
| 358 | 41 | 40 | 56 | 78 | 10 | 47 | 1f | H. McCloud | | 1–12 | | *9.7 | | 1 | 3 | | |
| 359 | 41 | 40 | 34 | 78 | 40 | 47 | Mount Jewett 1a | G. Jeffords | | 12:45 | 4 | 9.0+ | | 12:45 | 4 | 9.0+ | Downpour 2 to 4 p. m. 18. Rain probably more than 9.0″ as container had a pin hole leak when examined over 1 month later. |
| 360 | 41 | 40 | 22 | 78 | 40 | 52 | 1b | C. Weaver | | A. m. | P. m. | *5.5 | | | | | Hard rain 2 to 5 a. m. and 2 to 4 p. m. 18. Amount is for daytime 18 only and is small as container was wood-stave keg that leaked while being soaked up. |
| 361 | 41 | 40 | 20 | 78 | 25 | 00 | Colegrove 1b | H. Minnier | | | | *12.0 | | | | | |
| 362 | 41 | 40 | 17 | 78 | 23 | 14 | 2d | F. Oviatt | | | 12:30 to 3 | 3.9 | 10 | | 3 | E8.5 | |
| 363 | 41 | 40 | 14 | 78 | 24 | 47 | 1c | G. Rawley | | | | *4.2 | | | | | Amount measured early a. m. 18. Reporter estimated as much rain fell p. m. 18. as in two other periods of which only the first was measured. |
| 364 | 41 | 39 | 27 | 78 | 27 | 27 | 4a | B. Hertzog | | | | *8.1 | | | | | Heavy rain 1 to 4:30 p. m. 18. |
| 365 | 41 | 38 | 57 | 78 | 34 | 04 | Mount Jewett 6a | R. Howard | | | 1 to 4:30 | *4.2 | | 12:30 | 4:30 | | No rain 5 a. m. to 1 p. m., hail as large as marbles for 10 minutes about 3 p. m. 18. |
| 366 | 41 | 37 | 10 | 78 | 34 | 45 | 6b | J. Szymanski | | | | 8.0 | 12 | | 3:30 | E17.6 | Amount for p. m. 18 only. |
| 367 | 41 | 37 | 07 | 78 | 34 | 59 | 5a | L. Allegretto | | | 1:20 to 6 | 4.6 | DN | | 6 | E7.8 | Container may have overflowed. A little hail just before 1 p. m. 18. Reporter stated it rained as much before 1:20 p. m. as after. |
| 368 | 41 | 36 | 14 | 78 | 34 | 34 | 6c | Bodistow | DN | | P. m. | 18.5 | DN | | P. m. | 18.5 | |
| 369 | 41 | 36 | 11 | 78 | 37 | 30 | 5c | J. Surman | DN | | P. m. | *9.0 | DN | | P. m. | | Heaviest rain 2 to 4 p. m. 18. |
| 370 | 41 | 36 | 08 | 78 | 38 | 18 | 5b | J. Clopp | DN | A. m.<br>A. m. | <br>6 | *2.4*<br>*5.7*<br>8.1 | DN | | 6 | 8.1 | Hard rain 2:30 to 6 p. m. 18; both containers under apple tree with dense foliage. |
| 371 | 41 | 36 | 00 | 78 | 37 | 02 | 5d | R. Market | DN | A. m.<br>A. m. | <br>P. m. | *3.2*<br>*4.0*<br>7.2 | DN | | P. m. | 7.2 | |
| 372 | 41 | 35 | 56 | 78 | 34 | 27 | 6d | A. Smith | | | | *8.3 | | | | | |

TABLE 2.—*Miscellaneous measurements of rainfall, July 18, 1942*—Continued

| No. on pl. 2 | Latitude (deg., min., sec.) | Longitude (deg., min., sec.) | Quadrangle designation [1] | Reporter or resident | Rainfall between times shown: July 17 p. m. | Rainfall: July 18 A. m. | Rainfall: July 18 P. m. | Rainfall: Amount measured (inches) | Storm period between times shown: July 17 p. m. | Storm period: July 18 A. m. | Storm period: July 18 P. m. | Storm period: Total rainfall measured (inches) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Allegheny River drainage basin**—Continued | | | | | | | | | | |
| | | | *Pennsylvania*—Con. | | | | | | | | | | |
| 373 | 41 35 43 | 78 34 30 | Mount Jewett 6e | M. Wolf | | | | *12.4 | | | | | Container exposed 16 to 18. |
| 374 | 41 35 30 | 78 36 08 | 5e | J. Krollcyzk | | 11:30 | 6 | 6.6 | DN | | 6 | E13.7 | Heavy rain 2:30 to nearly 6 p. m. 18. |
| 375 | 41 34 55 | 78 42 06 | | | | | | 11.0 | | | | 11.0 | |
| 376 | 41 34 50 | 78 38 46 | Mount Jewett 5f | W. Elmquist | DN | | P. m. | *9.5 | DN | | P. m. | | |
| 377 | 41 34 38 | 78 37 48 | 8a | A. Zimmerman | | | | *9.9 | | | | | |
| 378 | 41 34 25 | 78 41 16 | | | | | | 11.6 | | | | 11.6 | Most of rain fell between 4:30 and 7:30 p. m. 18. |
| 379 | 41 32 59 | 78 35 51 | Mount Jewett 8b | L. Rosencrans | | | | 9.0 | | | | 9.0 | Container 6 feet from building. |
| | | | **Genesee River drainage basin** | | | | | | | | | | |
| | | | *New York* | | | | | | | | | | |
| 380 | 42 25 58 | 78 00 14 | Angelica 3a | L. Aylor | 9 | 6 | | 6.5 | 9 | 6 | | 6.5 | Very heavy rain about 4 a. m. 18. |
| 381 | 42 25 58 | 77 59 42 | | C. White | 6 | 10:30 | | 3.0 | 6 | 10:30 | | | Container sheltered by house. |
| 382 | 42 25 12 | 77 58 15 | Canaseraga 1a | S. Jones | 9 | 5 | | 5.8 | 9 | 5 | | 5.8 | |
| 383 | 42 24 50 | 77 58 13 | 4a | M. Closser | | | | 4.6 | | | | 4.6 | Heaviest rain early 18. |
| 384 | 42 24 31 | 78 01 06 | Angelica 6a | J. Bentley | | | | 5.7 | | | | 5.7 | Heavy rain about 3 a. m. 18. |
| 385 | 42 22 09 | 77 57 28 | Canaseraga 4b | M. Amidon | 6 | 5:30 | | 2.9 | 6 | 5:30 | | 2.9 | Heavy rain 8 to 10 p. m. 17 and 12 to 3 a. m. 18. |
| 386 | 42 21 15 | 77 56 48 | 4c | F. Watkins | 9 | 6:30 | | *25.0 | 9 | 6:30 | | | Very heavy rain about 11 p. m. 17 and 2:30 a. m. 18. |
| | | | | | 9 | 6:30 | | *11.7 | | | | | |
| 387 | 42 20 45 | 78 00 55 | Angelica 6b | W. Breneka | 10 | 4:30 | | 7.0 | 10 | 4:30 | | 7.0 | Very heavy rain 10 to 11 p. m. 17; also later in night. |
| 388 | 42 20 40 | 77 59 42 | Canaseraga 4d | T. Link | | | | 3.5 | | | | 3.5 | |
| 389 | 42 20 27 | 77 54 26 | 5a | K. George | 10:30 | 5 | | *9.3 | 10:30 | 10 | | | Heavy rain 2 to 6 a. m. 18. |
| 390 | 42 20 19 | 78 02 28 | Angelica 6c | J. Shafer, Sr. | 10+ | 7 | | *4.4 | 10+ | 10 | | | Heavy rain from about 1 a. m. 18 through night. Amount for 7 to 10 a. m. 18 considered unreliable. |
| | | | | | | 7–10 | | *4.4 | | | | | |
| | | | | | | | | *8.8 | | | | | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 391 | 42 | 20 | 01 | 77 | 53 | 22 | Canaseraga 5b | C. Almeter | 10 | 6:30 | | 5.0 | 10 | 6:30 | | 5.0 | Very heavy rain 4 to 5 a. m. 18. |
| 392 | 42 | 19 | 58 | 77 | 55 | 11 | 7a | J. Herdman | | | | 5.1 | | | | 5.1 | |
| 393 | 42 | 19 | 58 | 77 | 54 | 19 | 8a | J. Almeter | 10 | 5:30 | | 7.9 | 10 | 5:30 | | 7.9 | Heaviest rain 3 to 4 a. m. 18. |
| 394 | 42 | 19 | 30 | 78 | 02 | 19 | Angelica 9a | J. Shafer | 9 | 6 | | 5.3 | 9 | 6 | | 5.3 | |
| 395 | 42 | 19 | 23 | 78 | 00 | 51 | 9b | L. Graham | 8 | A. m. | | 6.9 | 8 | A. m. | | 6.9 | Heavy rain started about 10 p. m. 17; heaviest rain 3 to 4 a. m. 18. |
| 396 | 42 | 19 | 18 | 77 | 56 | 51 | Canaseraga 7b | J. Young | | 2 to 4 | | *4.9 | | | | | Reporter estimated that total storm rainfall did not exceed 6″ or 7″. |
| 397 | 42 | 19 | 13 | 77 | 57 | 06 | 7c | R. Jennings | 11 | 8 | | 5.1 | 11 | 8 | | 5.1 | Very heavy rain 4 to 5 a. m. 18. |
| 398 | 42 | 17 | 33 | 77 | 55 | 05 | 7d | L. Ives | 11 | 5 | | *8.2 | 11 | 5:45 | | | Heaviest rain 4 to 5 a. m. 18. |
| 399 | 42 | 15 | 29 | 77 | 53 | 48 | 8b | F. Lonsbery | | | | 6.8 | | | | 6.8 | |
| 400 | 42 | 14 | 45 | 77 | 57 | 35 | Wellsville 1a | W. Keenan | 12 | 5:30 | | 3.8 | 12 | 5:30 | | 3.8 | Heaviest rain about 3 a. m. 18. |
| 401 | 42 | 13 | 59 | 77 | 56 | 07 | 1b | R. Day | 8:30 | 5 | | *15.5 | 8:30 | 5 | | | Heaviest rain 3 to 4 a. m. 18. |
| 402 | 42 | 13 | 10 | 78 | 03 | 39 | Belmont 3a | R. Stowell | 10 | 6 | | 5.0 | | | | | Heaviest rain about 4 a. m.; very little rain after 6. a. m. 18. |
| 403 | 42 | 12 | 45 | 77 | 49 | 22 | Wellsville 3a | L. Snyder | | | | 4.0 | | | | 4.0 | |
| 404 | 42 | 10 | 28 | 77 | 51 | 15 | 2a | H. Beckwith | 10:45 | 6 | | *14.1 | 10:45 | 6 | | | Heaviest rain about 3 a. m. 18. |
| 405 | 42 | 09 | 38 | 77 | 51 | 26 | 5a | F. Mead | 10 | | P. m. | 9.0 | 10 | | P. m. | 9.0 | |
| 406 | 42 | 08 | 20 | 77 | 54 | 02 | 5b | C. Burdick | 6+ | 6+ | | 4.0 | 6 | 6+ | | 4.0 | |
| 407 | 42 | 07 | 04 | 77 | 56 | 53 | 4a | E. Rowe | 5:30 | 7 | | 3.5 | 5:30 | 7 | | 3.5 | Standard rain gage located near buildings. Heaviest rain about 1 a. m. 18. |
| | | | | | | | *Pennsylvania* | | | | | | | | | | |
| 408 | 41 | 55 | 04 | 77 | 54 | 09 | Genesee 2a | R. Storey | 9:30 | 12 m. | | 32.7 | 9:30 | 12 m. | | 32.7 | Downpour 5 to 6 a. m. 18. |
| 409 | 41 | 54 | 44 | 77 | 55 | 17 | 4a | T. Trebik | 10 | | 1+ | 3.6 | 10 | | 1+ | 3.6 | Light hail for 10 or 15 minutes 3 p. m. 17. |
| 410 | 41 | 54 | 10 | 77 | 54 | 16 | 5a | James | | | | 8.8 | | | | 8.8 | Container held 6.2″ at 8:30 a. m. 18. |
| 411 | 41 | 54 | 02 | 77 | 55 | 50 | 4b | E. Burch | | | | 5.6 | | | | | Heavy thundershowers 12 to 3 a. m. and heavy rain 8:30 to 9:30 a. m. 18. |
| 412 | 41 | 50 | 54 | 77 | 50 | 40 | 5b | A. Torok | 12 | 6 | | *5.8 | 12 | 12 m. | | | Heavy rain 12 to 7 a. m. 18. |

[1] See, Storm of July 17–18, 1942, New York-Pennsylvania, supplement to Daily and Hourly Precipitation compiled by Hydrologic Unit, U. S. Weather Bureau Office, Albany, N. Y.

## THE ISOHYETAL MAP

The drawing of an isohyetal map is anything but an accurate procedure. The best precipitation gage can catch only the rain that falls at that particular spot. It is generally assumed that rainfall varies rather uniformly between points of measurement, except for possible topographic considerations. Such an assumption may not be true. An intermediate gage as little as a hundred feet from one of the points of measurement might have caught a rainfall significantly different from that indicated by the adjacent points of measurement for the same storm, especially if the rainfall were spotty, as during the storm of July 18, 1942. When an isohyetal map is to be based on miscellaneous observations of rainfall, such as given in table 2, the task of drawing the isohyetal lines is exceedingly difficult. Did a container that overflowed, barely overflow, or would it have been filled two or three times more if it had been emptied? Do two containers quite close together, but apparently catching radically different amounts of rainfall, represent an actual variation in rainfall, a poor location for a catch, or inaccurate information supplied by one or both reporters? In using miscellaneous observations of rainfall, the most satisfactory procedure is to accept all data at face value—and this was done. There are usually several ways of interpreting the same data, however, and it is frequently impossible to show that any one interpretation is better than another.

The center of greatest precipitation shown on plate 2 is at Port Allegany. There an isohyetal line was drawn to indicate a precipitation of 35 inches. That amount of rainfall is based on miscellaneous measurements 275 and 301. The rain at measurement point 275 was caught in the glass jar shown in figure 37, which shows also the exposure conditions of the jar as well as could be reenacted about a month after the rain. This jar was set out about 7:45 a. m.; it filled with rain for a catch of 30.8 inches, and then overflowed. Considering the unmeasured rainfall prior to 7:45 a. m. and the unknown amount lost by overflow, it would appear that the rainfall at this point was at least 35 inches. That a tremendous rainfall occurred is further indicated by the runoff conditions described under Flood Flows. Measurement 301 showed 18.2 inches of rain after 9:50 a. m. The latest that any rain was reported in the vicinity was at 2 p. m., for measurement 292. That would mean that the 18.2 inches fell in less than 4 hours and 10 minutes. The curve in figure 36 shows that 50.8 percent of the total rainfall occurred in that time, from which an estimated total rainfall of 35.8 inches was obtained for measurement point 301. If the 18.2 inches fell in less than 4 hours, the computation procedure would indicate an amount much greater than 35 inches. At the recording gage in Smethport, about 8 miles away, only 32 percent of the storm

FIGURE 37.—Glass jar (table 2, No. 275), on Appolt farm, that overflowed after catching 30.8 inches of rain. Scene was enacted about a month after the rain to show that nearby objects probably had little effect on the catch.

rainfall occurred after 10 a. m., and practically no rain fell after 1 p. m. That record thus indicates also that measurement 301 should be greater than 35 inches for the storm total. For computations of average rainfall the maximum precipitation was assumed to be 36 inches.

In addition to the precipitation center of more than 35 inches at Port Allegany, there are two centers of more than 30 inches at Turtlepoint and northeast of Coudersport. These centers are based on measurements 251 (34.5 inches) and 408 (32.7 inches), respectively. All three centers are within the main area of heavy precipitation. Off to the northeast, at Angelica, N. Y., there is an area of heavy precipitation that, from the appearance of the map, one might think was a separate storm. It should be noted, however, that the lowest isohyetal line drawn is for 4 inches. The two areas of heavy precipitation are in reality part of a general storm that covered practically the entire region shown on the map with precipitation of at least an inch.

The isohyetal map for the storm of July 18, 1942, given in plate 2, is the fourth such map to be compiled. It was drawn by the author using the other three maps as basic references. The first map, drawn by Stewart, was based on precipitation records, topography, and relative erosion in small streams. For the last-mentioned, Stewart used an arbitrary scale of 0 to 10 to compare the relative amounts of eroded material at the mouths of the smaller streams. These data were helpful, particularly in the areas where rainfall measurements could not be obtained. Stewart's map was reviewed by the Weather Bureau and modified slightly to take into account the meteorologic characteristics of the storm. The map was reproduced in the Weather Bureau report. Subsequently, the Corps of Engineers made an extensive hydrologic analysis of the storm. As a result of that analysis, it was concluded by the Corps of Engineers that the Weather Bureau map showed too much total precipitation over the storm area for the runoff observed. The Corps of Engineers therefore prepared a new map, for use in the studies being made, that shows considerably less precipitation. The map for this report (pl. 2) is basically the Weather Bureau map redrawn in such a manner that wherever an acceptable interpretation of the data could be made showing less precipitation than the Weather Bureau map, that one was used. The resulting map is quite similar to the one prepared by the Corps of Engineers. The isohyetal lines were drawn to be fully consistent with the data in tables 1 and 2.

## AREA-DEPTH RELATIONS

The areas enclosed within the several isohyetal lines on plate 2 were measured with a planimeter. The total area within the heavier lines, 25- and 8-inch, is 14 and 1,215 square miles, respectively. The 4-inch lines enclose a total area of 3,100 square miles. The greatest average precipitation over areas of various sizes is given in table 3. Differences between these values and similar ones based on the isohyetal map drawn by the Corps of Engineers are believed to be insignificant. No attempt was made to distribute the precipitation with respect to time; only the total storm was studied.

TABLE 3.—*Maximum average precipitation over indicated areas for storm of July 17–18, 1942*

| Area (square miles) | Precipitation (inches) | Area (square miles) | Precipitation (inches) | Area (square miles) | Precipitation (inches) |
|---|---|---|---|---|---|
| 1 | 35.8 | 50 | 25.1 | 500 | 16.4 |
| 5 | 32.6 | 100 | 22.6 | 1,000 | 13.5 |
| 10 | 30.5 | 200 | 20.0 | 2,000 | 10.5 |
| 20 | 28.3 | | | | |

## FLOOD FLOWS

Flood flows within the storm area were the greatest ever recorded on many of the streams, including those in Allegheny River basin above Kinzua, in the upper part of Clarion River drainage basin, Driftwood Branch Sinnemahoning Creek, and First Fork Sinnemahoning Creek (Pa.), and Karr Valley Creek (N. Y.). In the major stream channels leaving the area, however, the flood flows diminished rapidly in relation to previous maximum flows. The absence of outstanding floods in the lower reaches of the streams outside the storm area probably was because the heavy rainfall was divided among three major drainage basins.

Peak flows in the smaller streams in the area of intense precipitation must have been tremendous, as evidenced by the enormous erosion that took place. On the Appolt farm near Port Allegany, the only channel for draining the hillside before the storm was a worn place in the meadow hardly more than a foot wide (figure 38). The runoff from this storm cut a new channel about 5 feet deep and more than 10 feet wide. It was here that rainfall measurement 275 was obtained, as discussed on page 114. On the neighboring Taylor farm much the same events took place. The road between the two farms was blocked in several places by mud flows and slides. A view of the upper end of the debris cone formed as a result of the tremendous erosion is shown in figure 33.

The drainage basins for the channels on the Appolt and Taylor farms extend only a short distance on each side and to the top of the hill shown in figures 33 and 38. Although the hill had dense forest cover, it was evident that overland flow occurred under the trees. The forest litter had been cut up by a myriad of channels as the water from the intense rain flowed away. An attempt was made to estimate the maximum discharge in the channels draining these two areas. Both channels were scoured out to bedrock in many places and at several points the ledge of bedrock formed the head of a falls. At one of these places on the Appolt farm and at two on the Taylor farm, the channel was surveyed for computation of the flow by the critical-depth method. This method assumes that critical flow occurred at the brink of the falls where the cross-sectional area was surveyed. The discharge is then given by the formula (King, 1939, p. 373):

$$Q=5.67\sqrt{\frac{A^3}{T}}$$

in which $Q$=discharge in second-feet,
$A$=cross-sectional area in square feet,
and $T$=top width of cross section in feet.

FIGURE 38.—Old and new drainage channels on Appolt farm near Port Allegany, Pa. Man in dark suit points to previous channel, while man with cap aloft stands in channel cut July 18, 1942. Note party surveying critical-depth section, circled in right background.

The upper critical-depth section on the Taylor farm is shown in figure 39. The highwater marks used to obtain the depth of water in the channel were quite well defined. This indicates that they were made late in the storm and after the channel had been scoured out,

FIGURE 39.—Upper critical-depth section on Taylor farm. Photographed by R. C. Culler.

otherwise they would have been obliterated by the tremendous inflow. It is more than likely that velocities were much greater than critical and that the computed discharge is too small. These three measurements indicate the highest discharge in second-feet per square mile of any in the flood area. It should be realized however that the drainage areas are extremely small, and that the errors in measuring them on the small-scale map available may be quite large. Both channels were dry at the time of the author's visit on August 26.

Several parties searched the flood area to locate streams in which outstanding flood flows occurred. Wherever possible, slope-area, contracted-opening, and flow-over-dam measurement sites were chosen and surveyed for the computation of discharge. The slope-area reach on Nelson Run—a tributary of First Fork Sinnemahoning Creek in the area of high precipitation—is shown in the foreground of figure 40. This slope-area reach is about average for those used. Slope-area and other measurements of flow of these small streams made after the flood and under conditions that existed are not regarded as precise

FIGURE 40.—Slope-area reach on Nelson Run. (No. 789.60 in table 4.)

observations in any sense. They do provide, however, the best method of evaluating the discharge. The contracted opening at the new highway bridge at Port Allegany—destroyed by the flood just 3 days after it was opened to traffic—provided a site where a peak discharge of 77,000 second-feet was measured, the largest in Allegheny River drainage basin. (See fig. 41.) In addition to those made at gaging stations and the critical-depth measurements described above, about 50 miscellaneous measurements were made, including several by the Corps of Engineers. The results of those measurements are summarized in table 4. The methods and procedures used are described by Corbett and others (1943, pp. 98–109).

On many streams where flood flows are known to have been quite large, no sites for measurements could be found. Thus, the fact that a stream is shown on plate 2 with no point of measurement indicated does not mean that the flood flow in that stream was not excessive. On the other hand, some streams that produced little flood runoff were measured to show that they did not contribute to the excessive runoff in the larger streams to which they are tributary.

Following are some of the streams in which excessive flood flow occurred that were examined for measuring sites without success: Norcross, Loque, and Muley Runs tributary to First Fork Sinnema-

FIGURE 41.—Bridge opening on Allegheny River at Port Allegany, Pa., used for contracted-opening measurement. (No. 000.7 in table 4.)

honing Creek; Sevenmile Creek tributary to East Fork Clarion River; Dodge Creek, and Haskell Creek (Pa.), and the upper tributaries of Fivemile Creek in the vicinity of Olean, N. Y.; and Baker Creek near Angelica, N. Y.

In the headwaters of the larger streams, Driftwood Branch Sinnemahoning Creek, Allegheny River, and Clarion River, the flood of July 1942 was the largest known. As the floods progressed downstream and left the storm area they rapidly became smaller in relation to previous floods. That was true also in Genesee River although at the uppermost gaging station at Scio, N. Y., the peak discharge approached, but did not exceed, that for the flood of May 1919, the maximum in 26 years of record.

It is interesting to note the effect of the shape of the river valleys on the shape of the flood wave as it progressed downstream, as illustrated in figure 42. The streams in the Susquehanna River drainage basin flow through narrow valleys with very small flood plains. Consequently very little of the flood waters was held in channel storage, and the flood wave passed down the valley with little change in form. On the other hand, Allegheny River above Red House, N. Y., flows through a broad valley with large flood plains. During the flood of July 1942, those flood plains were inundated to a considerable depth with correspondingly large amounts of channel storage. As a result,

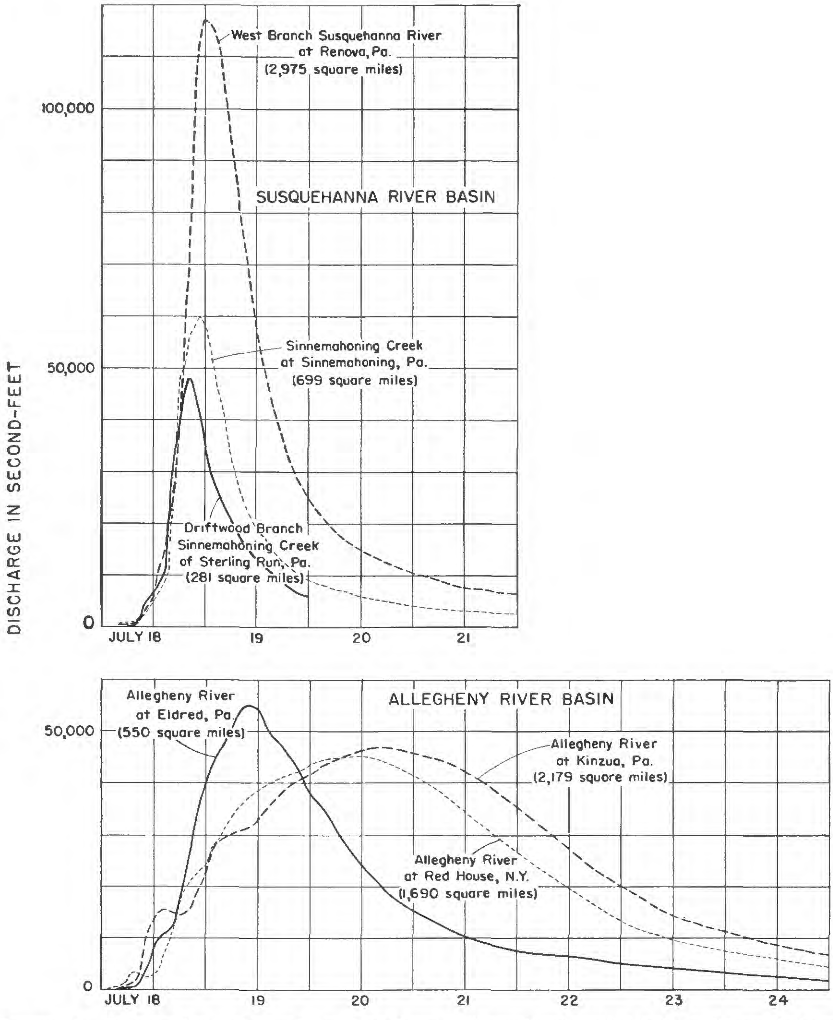


FIGURE 42.—Comparative hydrographs of flood flows in Susquehanna and Allegheny Rivers drainage basins.

the hydrograph of the flood wave at Red House was much flatter and broader than at Eldred. Below Red House, however, the valley of Allegheny River becomes much narrower, which probably accounts for the lack of change in the shape of the hydrograph between Red House and Kinzua. Other factors such as amount and distribution of precipitation have important effects on the size and shape of a flood hydrograph, but computations of channel storage for the flood of July 1942 between Eldred and Red House indicate that this factor alone could account for the diminution of the peak discharge between those two points.

## STAGES AND DISCHARGES AT STEAM-GAGING STATIONS

Stage and discharge records at stream-gaging stations within and adjacent to the flood area are given on the following pages. For each station there is given a station description, a table of daily mean discharge for July and August 1942, and a table of gage heights and discharges at indicated times for use in plotting hydrographs of the flood. Daily mean discharges at these stations for the entire water year 1942 have been published in Water-Supply Papers 951, 953, and 954, Surface Water Supply of the United States 1942: Part 1, North Atlantic slope basins (includes Susquehanna River drainage basin); Part 3, Ohio River basin (includes Allegheny River drainage basin); and Part 4, St. Lawrence River basin (includes Genesee River drainage basin), respectively. Methods of obtaining the records are described briefly in those reports and at greater length in the manual, Stream-Gaging Procedure (Corbett and others, 1943).

Records of daily mean discharge alone are usually inadequate for making any detailed studies of a flood such as that of July 1942. To supply the data for the detailed studies necessary in connection with flood control and forecasting, channel improvement, bridge openings, and the design of hydraulic structures in relation to the flood channels of streams is the object of this report. The table of stages and discharges at indicated times has been included for that purpose. Some of the gage heights in those tables, and the discharges based on them, were not obtained from an actual gage-height record, perhaps because the gage used was a nonrecording one, because the recording-gage record was destroyed by the flood, or for some other reason. It is often possible to obtain a fair record of gage height and discharge by drawing a hydrograph through the plotted points representing observed data, using other available information such as observers' notes, meteorological information, studies of runoff at other gaging stations on the same or adjacent streams, interpreted in the light of intimate knowledge of the peculiar local conditions inherent to a particular gaging station. As Geological Survey engineers usually have access to more of such information than would normally be available to other users of the records, and to complete the report where it could be done with reasonable accuracy, they have made estimates of detailed records wherever necessary.

The station description and the tables are largely self-explanatory. The section headed "maxima" may need additional explanation: The first paragraph gives the maximum stage and discharge during the flood of July 1942; the second paragraph gives the maxima during the preceding period of stream-flow record; and the third paragraph gives the maxima known outside the period of record, usually restricted to those greater than within the period of record.

The gaging-station records are arranged by parts in the order used in the annual reports on Surface Water Supply of the United States referred to previously. The stations are grouped by parts in numerical order of the parts and within each part are arranged in downstream order, the stations on the main stem being given first followed by each tributary in turn.

## SUSQUEHANNA RIVER DRAINAGE BASIN

### CANACADEA CREEK NEAR HORNELL, N. Y.

LOCATION.—Lat. 42°20′05″, long. 77°41′00″, 35 feet downstream from Morris Bridge, near city limits of Hornell, Steuben County, and 2 miles upstream from mouth.

DRAINAGE AREA.—58.7 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph, except for period 4 p. m. July 31 to 11 p. m. August 3.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 3,200 second-feet and extended to crest stage by logarithmic plotting. Discharge July 31 to August 3 computed on basis of records for nearby stations. Shifting-control method used August 4–31.

MAXIMA.—July 1942: Discharge, 6,080 second-feet 6:40 a. m. July 18 (gage height, 7.07 feet).

1924–29, 1938 to June 1942: Discharge, 6,600 second-feet Mar. 17, 1942 (gage height, 7.35 feet).

The flood of July 1935 reached a stage of about 12.3 feet at present site, obtained in 1940 from floodmarks (discharge, 21,000 second-feet by slope-area method).

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.9 | 35 | 9 | 6.6 | 16 | 17 | 7.9 | 16 | 25 | 15 | 10 |
| 2 | 11 | 26 | 10 | 7.4 | 23 | 18 | 712 | 14 | 26 | 16 | 9.8 |
| 3 | 7.0 | 20 | 11 | 43 | 16 | 19 | 81 | 13 | 27 | 17 | 9.2 |
| 4 | 7.0 | 16 | 12 | 16 | 14 | 20 | 49 | 12 | 28 | 42 | 9.2 |
| 5 | 7.4 | 15 | 13 | 11 | 22 | 21 | 24 | 10 | 29 | 49 | 9.8 |
| 6 | 7.9 | 14 | 14 | 9.2 | 39 | 22 | 19 | 11 | 30 | 37 | 9.2 |
| 7 | 7.4 | 13 | 15 | 7.9 | 18 | 23 | 17 | 14 | 31 | 44 | 8.6 |
| 8 | 6.6 | 14 | 16 | 7.9 | 16 | 24 | 16 | 13 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 42.5 | 15.7 |
| Runoff, in inches | 0.83 | 0.31 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 18—Con.* | | | *July 18—Con.* | | | *July 19—Con.* | | |
| 6 | 1.11 | 7.0 | 3 | 1.18 | 14 | 2 | 2.28 | 352 | 6 | 1.53 | 99 |
| 11 | 1.12 | 7.9 | 4 | 1.28 | 26 | 3 | 2.18 | 309 | N | 1.43 | 77 |
| 6 | 1.12 | 7.9 | 5 | 1.40 | 44 | 4 | 2.10 | 276 | 6 | 1.35 | 60 |
| 8 | 1.11 | 7.0 | 6 | 5.95 | 4,170 | 5 | 2.01 | 242 | 12 | 1.29 | 48 |
| 10 | 1.11 | 7.0 | 7 | 6.20 | 4,570 | 6 | 1.94 | 217 | *July 20* | | |
| 12 | 1.16 | 12 | 8 | 4.50 | 2,190 | 9 | 1.79 | 168 | 3 | 1.45 | 81 |
| *July 18* | | | 9 | 3.67 | 1,320 | 12 | 1.68 | 137 | 6 | 1.36 | 62 |
| | | | 10 | 3.25 | 954 | *July 19* | | | N | 1.29 | 48 |
| 1 | 1.16 | 12 | 11 | 2.88 | 681 | | | | 6 | 1.22 | 36 |
| 2 | 1.16 | 12 | N | 2.61 | 517 | 3 | 1.59 | 114 | 12 | 1.17 | 28 |
| | | | 1 | 2.42 | 418 | | | | | | |

SUPPLEMENTAL RECORD.—July 18, 6:40 a. m., gage height 7.07 feet, discharge 6,080 second-feet.

### KARR VALLEY CREEK AT ALMOND, N. Y.

LOCATION.—Lat. 42°18′40″, long. 77°45′05″, 500 feet downstream from McHenry Valley Creek, three-quarters of a mile upstream from mouth, and 1 mile upstream from Almond, Allegany County. Datum of gage is 1,353.68 feet above mean sea level (levels by Corps of Engineers).

DRAINAGE AREA.—27.6 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph except for period 5 a. m. July 18 to 3 a. m. July 20 for which a graph was drawn based on floodmarks and frequent readings of staff gage.

DISCHARGE RECORD.—Artificial control of concrete. Stage-discharge relation defined by current-meter measurements up to 1,600 second-feet and extended to slope-area measurement for crest gage height.

MAXIMA.—1942: Discharge, 5,900 second-feet 5:45 a. m. July 18 (gage height, 8.8 feet from floodmarks).

1937–41: Discharge, 3,800 second-feet March 31, 1940 (gage height, 5.8 feet, from floodmark) from rating curve extended above 1,600 second-feet by logarithmic plotting.

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.1 | 11 | 9 | 0.8 | 3.0 | 17 | 1.4 | 4.0 | 25 | 2.6 | 1.6 |
| 2 | 1.0 | 6.3 | 10 | 1.2 | 6.8 | 18 | 513 | 3.2 | 26 | 2.9 | 1.5 |
| 3 | .9 | 4.7 | 11 | 18 | 4.4 | 19 | 51 | 2.6 | 27 | 4.0 | 1.4 |
| 4 | .9 | 3.4 | 12 | 5.7 | 3.4 | 20 | 28 | 2.1 | 28 | 10 | 1.4 |
| 5 | .9 | 2.8 | 13 | 3.0 | 11 | 21 | 14 | 1.8 | 29 | 15 | 1.3 |
| 6 | 1.0 | 2.4 | 14 | 2.0 | 15 | 22 | 7.9 | 1.6 | 30 | 12 | 1.2 |
| 7 | 1.0 | 2.1 | 15 | 1.6 | 5.8 | 23 | 5.2 | 1.7 | 31 | 16 | 1.1 |
| 8 | .9 | 2.5 | 16 | 1.4 | 4.2 | 24 | 3.6 | 1.6 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 23.5 | 3.77 |
| Runoff, in inches | .98 | .16 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Dis-charge | Hour | Gage height | Dis-charge | Hour | Gage height | Dis-charge | Hour | Gage height | Dis-charge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 18—Con.* | | | *July 18—Con.* | | | *July 19* | | |
| N | 1.73 | 1.3 | 6 | 8.13 | 4,980 | 4 | 3.20 | 201 | 3 | 2.72 | 70 |
| 12 | 1.82 | 2.8 | 7 | 5.70 | 2,120 | 5 | 3.13 | 176 | 6 | 2.68 | 63 |
| | | | 8 | 4.90 | 1,350 | 6 | 3.06 | 154 | 9 | 2.63 | 54 |
| *July 18* | | | 9 | 4.40 | 910 | 7 | 3.01 | 139 | N | 2.59 | 48 |
| | | | 10 | 4.06 | 658 | 8 | 2.96 | 126 | 6 | 2.52 | 38 |
| 1 | 1.89 | 4.7 | 11 | 3.77 | 479 | 9 | 2.92 | 115 | 12 | 2.48 | 33 |
| 2 | 1.91 | 5.4 | N | 3.58 | 376 | 10 | 2.88 | 105 | | | |
| 3 | 1.92 | 5.7 | 1 | 3.46 | 315 | 11 | 2.84 | 96 | | | |
| 4 | 1.98 | 8.1 | 2 | 3.36 | 268 | 12 | 2.80 | 87 | | | |
| 5 | 3.00 | 180 | 3 | 3.28 | 233 | | | | | | |

SUPPLEMENTAL RECORD.—July 18, 5:45 a. m., gage height 8.80 feet, discharge 5,900 second-feet.

## WEST BRANCH SUSQUEHANNA RIVER AT KARTHAUS, PA.

LOCATION.—At mouth of Mosquito Creek at Karthaus, Clearfield County. Gage is at lat. 41°06′55″, long. 78°06′40″, 900 feet upstream from highway bridge, 1,200 feet upstream from Mosquito Creek, and 3.3 miles downstream from Moshannon Creek. Datum of gage is 830.59 feet above mean sea level, datum of 1929, New York-Pennsylvania supplementary adjustment of 1943.

DRAINAGE AREA.—1,462 square miles, including that of Mosquito Creek.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Includes flow of Mosquito Creek. Stage-discharge relation defined by current-meter measurements up to 52,000 second-feet.

MAXIMA.—July 1942: Discharge during flood period, 1,120 second-feet 2 a. m. July 19 (gage-height, 2.15 feet).

1918–20, 1940 to June 1942: Discharge, 50,900 second-feet Apr. 1, 1940 (gage-height, about 13.9 feet).

1889–1917, 1921–39: Discharge, about 135,000 second-feet March 18, 1936 (gage-height, about 24.5 feet, from floodmark at highway bridge).

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 633 | 386 | 9 | 410 | 312 | 17 | 308 | 527 | 25 | 348 | 701 |
| 2 | 786 | 441 | 10 | 379 | 431 | 18 | 550 | 481 | 26 | 317 | 576 |
| 3 | 930 | 416 | 11 | 384 | 481 | 19 | 874 | 420 | 27 | 316 | 453 |
| 4 | 722 | 415 | 12 | 379 | 400 | 20 | 588 | 359 | 28 | 311 | 390 |
| 5 | 594 | 359 | 13 | 350 | 359 | 21 | 457 | 321 | 29 | 290 | 354 |
| 6 | 521 | 326 | 14 | 335 | 447 | 22 | 407 | 316 | 30 | 301 | 326 |
| 7 | 510 | 280 | 15 | 321 | 405 | 23 | 372 | 552 | 31 | 348 | 298 |
| 8 | 458 | 263 | 16 | 289 | 359 | 24 | 346 | 800 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 456 | 418 |
| Runoff, in inches | 0.36 | 0.33 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 18*—Con. | | | *July 19*—Con. | | | *July 20*—Con. | | |
| 6 | 0.97 | 302 | 4 | 1.60 | 652 | 2 | 1.71 | 730 | N | 1.48 | 576 |
| N | 1.00 | 316 | 6 | 1.68 | 708 | 4 | 1.76 | 769 | 4 | 1.43 | 545 |
| 6 | 1.00 | 316 | 8 | 1.82 | 817 | 6 | 1.84 | 834 | 8 | 1.38 | 515 |
| 12 | 1.00 | 316 | 10 | 1.93 | 912 | 8 | 1.82 | 817 | 12 | 1.34 | 492 |
| | | | 12 | 2.08 | 1,050 | 10 | 1.77 | 777 | | | |
| *July 18* | | | | | | 12 | 1.72 | 738 | *July 21* | | |
| | | | *July 19* | | | | | | | | |
| 2 | 1.00 | 316 | | | | *July 20* | | | N | 1.28 | 458 |
| 4 | 1.07 | 350 | 2 | 2.15 | 1,120 | | | | 12 | 1.22 | 426 |
| 6 | 1.08 | 354 | 4 | 2.07 | 1,040 | 2 | 1.67 | 701 | | | |
| 8 | 1.13 | 379 | 6 | 2.01 | 984 | 4 | 1.62 | 666 | *July 22* | | |
| 10 | 1.17 | 400 | 8 | 1.93 | 912 | 6 | 1.57 | 633 | | | |
| N | 1.27 | 453 | 10 | 1.84 | 834 | 8 | 1.53 | 607 | N | 1.18 | 405 |
| 2 | 1.47 | 570 | N | 1.77 | 777 | 10 | 1.51 | 594 | 12 | 1.15 | 390 |

## WEST BRANCH SUSQUEHANNA RIVER AT RENOVO, PA.

Location.—Lat. 41°18′50″, long. 77°44′45″, at highway bridge at Renovo, Clinton County, 1 mile upstream from Paddy Run. Datum of gage is 633.99 feet above mean sea level, unadjusted.

Drainage area.—2,975 square miles.

Gage-height record.—Water-stage recorder graph.

Discharge record.—Stage-discharge relation defined by current-meter measurements up to 90,000 second-feet and extended to slope-area measurement for crest gage height of flood of Mar. 18, 1936.

Maxima.—1942: Discharge, 117,000 second-feet 11:55 p. m. July 18 (gage height, 18.92 feet).

1895–1903, 1905–42: Discharge, 236,000 second-feet March 18, 1936 (gage height, 29.39 feet, from floodmark in gage shelter).

1846–94, 1904: Discharge, about 211,000 second-feet June 1, 1889 (gage height, 27.3 feet, from floodmark).

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 870 | 1,510 | 9 | 860 | 780 | 17 | 445 | 2,130 | 25 | 2,460 | 1,540 |
| 2 | 880 | 1,370 | 10 | 683 | 840 | 18 | 26,800 | 2,300 | 26 | 2,130 | 1,220 |
| 3 | 1,050 | 1,330 | 11 | 683 | 1,100 | 19 | 64,800 | 1,910 | 27 | 1,890 | 990 |
| 4 | 1,040 | 1,150 | 12 | 691 | 957 | 20 | 15,800 | 1,540 | 28 | 1,980 | 820 |
| 5 | 860 | 990 | 13 | 651 | 830 | 21 | 8,010 | 1,250 | 29 | 1,650 | 744 |
| 6 | 806 | 850 | 14 | 566 | 2,180 | 22 | 5,180 | 1,080 | 30 | 1,440 | 700 |
| 7 | 1,620 | 762 | 15 | 500 | 2,380 | 23 | 3,820 | 1,070 | 31 | 1,330 | 643 |
| 8 | 1,280 | 736 | 16 | 465 | 1,910 | 24 | 2,960 | 1,500 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 4,974 | 1,262 |
| Runoff, in inches | 1.93 | 0.49 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 19* | | | *July 20—Con.* | | | *July 22—Con.* | | |
| 4 | 0.16 | 438 | 2 | 18.70 | 115,000 | 2 | 5.92 | 14,200 | 4 | 2.91 | 4,800 |
| 8 | .18 | 452 | 4 | 17.93 | 107,000 | 4 | 5.72 | 13,400 | 8 | 2.80 | 4,560 |
| N | .18 | 452 | 6 | 16.65 | 93,900 | 6 | 5.51 | 12,600 | 12 | 2.70 | 4,320 |
| 4 | .18 | 452 | 8 | 15.15 | 80,700 | 8 | 5.31 | 11,800 | | | |
| 8 | .16 | 438 | 10 | 13.75 | 68,100 | 10 | 5.10 | 11,000 | *July 23* | | |
| 12 | .16 | 438 | N | 15.50 | 57,400 | 12 | 4.92 | 10,400 | | | |
| | | | 2 | 11.38 | 48,600 | | | | 4 | 2.60 | 4,080 |
| *July 18* | | | 4 | 10.50 | 41,400 | *July 21* | | | 8 | 2.52 | 3,850 |
| | | | 6 | 9.77 | 36,300 | | | | N | 2.44 | 3,740 |
| 2 | .18 | 452 | 8 | 9.05 | 30,700 | 4 | 4.57 | 9,500 | 4 | 2.43 | 3,740 |
| 4 | .27 | 515 | 10 | 8.47 | 27,700 | 8 | 4.28 | 8,600 | 8 | 2.40 | 3,630 |
| 6 | .37 | 588 | 12 | 7.97 | 24,700 | N | 4.05 | 7,700 | 12 | 2.31 | 3,420 |
| 8 | .78 | 968 | | | | 4 | 3.85 | 7,250 | | | |
| 10 | 2.17 | 3,120 | *July 20* | | | 8 | 3.67 | 6,680 | *July 24* | | |
| N | 3.06 | 5,180 | | | | 12 | 3.50 | 6,300 | | | |
| 2 | 5.64 | 13,000 | 2 | 7.56 | 22,300 | | | | N | 2.06 | 2,920 |
| 4 | 7.40 | 21,300 | 4 | 7.19 | 20,300 | *July 22* | | | 12 | 1.88 | 2,650 |
| 6 | 10.12 | 38,400 | 6 | 6.84 | 18,300 | | | | | | |
| 8 | 14.10 | 70,800 | 8 | 6.58 | 17,300 | 4 | 3.32 | 5,800 | | | |
| 10 | 18.10 | 109,000 | 10 | 6.35 | 16,300 | 8 | 3.16 | 5,420 | | | |
| 12 | 18.92 | 117,000 | N | 6.12 | 15,000 | N | 3.03 | 5,180 | | | |

SUPPLEMENTAL RECORD.—July 18, 11:55 p. m., gage height 18.92 feet, discharge 117,000 second-feet.

## SINNEMAHONING CREEK AT SINNEMAHONING, PA.

LOCATION.—Lat. 41°18′45″, long. 78°05′30″, a quarter of a mile upstream from Grove Run and 3,500 feet upstream from Pennsylvania Railroad bridge at Sinnemahoning, Cameron County. Datum of gage is 769.36 feet above mean sea level, datum of 1929, New York-Pennsylvania supplementary adjustment of 1943.

DRAINAGE AREA.—699 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 17,000 second-feet and extended to slope-area measurement for crest gage height.

MAXIMA.—1942: Discharge, 59,800 second-feet 10:45 p. m. July 18 (gage height, 21.58 feet).

1938–41: Discharge, 19,100 second-feet March 31, 1940 (gage height, 10.57 feet). Maximum stage known, 21.94 feet March 18, 1936, from floodmark (discharge, 61,200 second-feet).

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 155 | 518 | 9 | 246 | 217 | 17 | 116 | 502 | 25 | 951 | 288 |
| 2 | 170 | 416 | 10 | 196 | 362 | 18 | 18,400 | 437 | 26 | 729 | 221 |
| 3 | 149 | 422 | 11 | 200 | 333 | 19 | 24,400 | 339 | 27 | 768 | 177 |
| 4 | 133 | 316 | 12 | 233 | 231 | 20 | 6,250 | 277 | 28 | 721 | 158 |
| 5 | 126 | 256 | 13 | 177 | 212 | 21 | 3,150 | 241 | 29 | 588 | 150 |
| 6 | 236 | 221 | 14 | 149 | 486 | 22 | 1,920 | 217 | 30 | 516 | 147 |
| 7 | 934 | 199 | 15 | 133 | 370 | 23 | 1,500 | 284 | 31 | 481 | 129 |
| 8 | 382 | 190 | 16 | 118 | 437 | 24 | 1,040 | 383 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 2,105 | 295 |
| Runoff, in inches | 3.47 | 0.49 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 18—Con.* | | | *July 19—Con.* | | | *July 21* | | |
| 6 | 1.66 | 113 | 4 | 9.28 | 14,800 | 2 | 10.10 | 17,200 | 6 | 4.74 | 3,520 |
| N | 1.68 | 118 | 6 | 18.22 | 46,200 | 4 | 9.19 | 14,500 | N | 4.53 | 3,160 |
| 6 | 1.68 | 118 | 8 | 20.32 | 54,600 | 6 | 8.59 | 12,700 | 6 | 4.33 | 2,800 |
| 12 | 1.69 | 120 | 10 | 21.32 | 58,600 | 8 | 8.07 | 11,300 | 12 | 4.09 | 2,370 |
| | | | 12 | 21.12 | 57,800 | 10 | 7.62 | 9,930 | | | |
| *July 18* | | | | | | 12 | 7.28 | 9,150 | | | |
| | | | *July 19* | | | | | | *July 22* | | |
| 2 | 1.77 | 145 | | | | *July 20* | | | | | |
| 4 | 2.06 | 260 | 2 | 19.02 | 49,400 | | | | N | 3.81 | 1,900 |
| 6 | 2.47 | 485 | 4 | 17.22 | 42,200 | 6 | 6.60 | 7,410 | 12 | 3.63 | 1,620 |
| 8 | 3.26 | 1,210 | 6 | 14.77 | 33,200 | N | 6.05 | 6,020 | | | |
| 10 | 4.26 | 2,640 | 8 | 12.97 | 26,900 | 6 | 5.55 | 5,060 | | | |
| N | 5.73 | 5,480 | 10 | 11.75 | 22,700 | 12 | 5.06 | 4,080 | | | |
| 2 | 6.61 | 7,410 | N | 10.72 | 19,000 | | | | | | |

SUPPLEMENTAL RECORD.—July 18, 10:45 p. m., gage height 21.58 feet, discharge 59,800 second-feet.

## DRIFTWOOD BRANCH SINNEMAHONING CREEK AT STERLING RUN, PA.

LOCATION.—Lat. 41°24′25″, long. 78°11′35″, at highway bridge at village of Sterling Run, Cameron County, 300 feet upstream from Sterling Run. Datum of gages is 894.84 feet above mean sea level, datum of 1929, New York-Pennsylvania supplementary adjustment of 1943.

DRAINAGE AREA.—281 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph from recording gage at highway bridge, July 1–19, and thereafter twice-daily readings on staff gage, 800 feet upstream.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 800 second-feet and extended to slope-area measurement for crest gage height.

MAXIMA.—1942: Discharge, 47,800 second-feet 8:45 p. m. July 18 (gage height, 14.7 feet at recording-gage site and 15.0 feet at staff gage; both from floodmarks).

1913–41: Discharge, 28,400 second-feet Mar. 17, 1936 (gage height, 12.0 feet from graph based on staff-gage readings).

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 69 | 230 | 9 | 47 | 115 | 17 | 31 | 300 | 25 | 442 | 99 |
| 2 | 45 | 208 | 10 | 26 | 204 | 18 | 16,300 | 219 | 26 | 313 | 75 |
| 3 | 28 | 183 | 11 | 71 | 132 | 19 | 15,300 | 170 | 27 | 395 | 64 |
| 4 | 19 | 138 | 12 | 76 | 99 | 20 | 2,870 | 144 | 28 | 317 | 57 |
| 5 | 18 | 118 | 13 | 30 | 102 | 21 | 1,240 | 121 | 29 | 278 | 57 |
| 6 | 61 | 104 | 14 | 19 | 270 | 22 | 725 | 107 | 30 | 246 | 53 |
| 7 | 186 | 89 | 15 | 13 | 163 | 23 | 622 | 132 | 31 | 242 | 46 |
| 8 | 98 | 89 | 16 | 8.3 | 170 | 24 | 410 | 132 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 1,308 | 135 |
| Runoff, in inches | 5.37 | 0.55 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 18*—Con. | | | *July 19*—Con. | | | *July 21* | | |
| 4 | 0.28 | 7.6 | 2 | 6.64 | 9,250 | 2 | 7.36 | 11,600 | 6 | 3.91 | 1,550 |
| 8 | .33 | 12 | 4 | 10.94 | 26,400 | 4 | 6.86 | 10,100 | N | 3.70 | 1,340 |
| N | .33 | 12 | 6 | 13.25 | 38,700 | 6 | 6.41 | 8,750 | 6 | 3.48 | 1,140 |
| 4 | .39 | 19 | 8 | 14.63 | 47,200 | 8 | 5.94 | 7,510 | 12 | 3.28 | 960 |
| 8 | .72 | 84 | 10 | 13.89 | 42,900 | 10 | 5.51 | 6,570 | | | |
| 12 | .77 | 98 | 12 | 12.40 | 34,200 | 12 | 5.21 | 5,900 | *July 22* | | |
| *July 18* | | | *July 19* | | | *July 20* | | | 6 | 3.14 | 840 |
| | | | | | | | | | N | 3.02 | 725 |
| 2 | .74 | 90 | 2 | 11.34 | 28,400 | 6 | 5.44 | 3,660 | 6 | 2.92 | 655 |
| 4 | .87 | 126 | 4 | 10.44 | 23,900 | N | 4.84 | 2,720 | 12 | 2.86 | 622 |
| 6 | 1.09 | 194 | 6 | 9.66 | 20,600 | 6 | 4.42 | 2,170 | | | |
| 8 | 2.14 | 750 | 8 | 9.01 | 17,600 | 12 | 4.12 | 1,790 | | | |
| 10 | 4.54 | 4,550 | 10 | 8.42 | 15,200 | | | | | | |
| N | 5.72 | 7,030 | N | 7.85 | 13,000 | | | | | | |

Supplemental record.—July 18, 8:45 p. m., gage height 14.70 feet, discharge 47,800 second-feet.

## KETTLE CREEK AT CROSS FORK, PA.

Location.—Lat. 41°28′15″, long. 77°49′50″, at bridge on State Highway 144, 0.2 mile downstream from Potter-Clinton County line, and 0.9 mile downstream from Cross Fork, Potter County. Datum of gage is 1,027.12 feet above mean sea level, adjustment of 1912.

Drainage area.—136 square miles.

Gage-height record.—Water-stage recorder graph.

Discharge record.—Stage-discharge relation defined by current-meter measurements up to 2,000 second-feet and extended above.

Maxima.—July 1942: Discharge, 2,960 second-feet 11:45 a. m. July 18 (gage height, 5.97 feet).

1940 to June 1942: Discharge, 6,100 second-feet May 22, 1942 (gage height, 7.98 feet).

Maximum stage known, about 14.0 feet March 18, 1936, from information by local residents (discharge, about 20,000 second-feet).

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 37 | 100 | 9 | 27 | 66 | 17 | 25 | 410 | 25 | 140 | 98 |
| 2 | 33 | 84 | 10 | 25 | 62 | 18 | 1,720 | 353 | 26 | 119 | 82 |
| 3 | 29 | 79 | 11 | 40 | 50 | 19 | 1,400 | 288 | 27 | 130 | 73 |
| 4 | 26 | 66 | 12 | 30 | 44 | 20 | 703 | 230 | 28 | 102 | 65 |
| 5 | 25 | 60 | 13 | 24 | 146 | 21 | 436 | 184 | 29 | 106 | 64 |
| 6 | 44 | 58 | 14 | 21 | 320 | 22 | 302 | 150 | 30 | 96 | 58 |
| 7 | 57 | 52 | 15 | 18 | 265 | 23 | 227 | 147 | 31 | 109 | 56 |
| 8 | 33 | 60 | 16 | 16 | 278 | 24 | 178 | 124 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 203 | 135 |
| Runoff, in inches | 1.72 | 1.14 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 18*—Con. | | | *July 19*—Con. | | | *July 21* | | |
| N | 1.17 | 26 | 3 | 5.63 | 2,640 | 8 | 4.58 | 1,600 | 6 | 2.87 | 486 |
| 12 | 1.20 | 29 | 4 | 5.62 | 2,580 | 10 | 4.47 | 1,460 | N | 2.77 | 445 |
| | | | 5 | 5.60 | 2,580 | N | 4.35 | 1,380 | 6 | 2.63 | 388 |
| *July 18* | | | 6 | 5.53 | 2,520 | 2 | 4.23 | 1,300 | 12 | 2.52 | 342 |
| | | | 7 | 5.48 | 2,470 | 4 | 4.11 | 1,180 | | | |
| 2 | 1.25 | 34 | 8 | 5.38 | 2,370 | 6 | 3.99 | 1,110 | *July 22* | | |
| 4 | 1.28 | 38 | 9 | 5.31 | 2,270 | 8 | 3.88 | 1,040 | | | |
| 6 | 1.58 | 82 | 10 | 5.24 | 2,220 | 10 | 3.79 | 970 | 6 | 2.47 | 327 |
| 7 | 4.50 | 1,510 | 11 | 5.17 | 2,120 | 12 | 3.72 | 910 | N | 2.40 | 302 |
| 8 | 4.88 | 1,870 | 12 | 5.10 | 2,070 | | | | 6 | 2.32 | 275 |
| 9 | 4.75 | 1,740 | | | | *July 20* | | | 12 | 2.25 | 252 |
| 10 | 5.24 | 2,220 | *July 19* | | | | | | | | |
| 11 | 5.73 | 2,740 | | | | 6 | 3.52 | 793 | | | |
| N | 5.95 | 2,960 | 2 | 4.97 | 1,920 | N | 3.33 | 703 | | | |
| 1 | 5.82 | 2,800 | 4 | 4.83 | 1,820 | 6 | 3.12 | 599 | | | |
| 2 | 5.65 | 2,640 | 6 | 4.71 | 1,690 | 12 | 2.97 | 530 | | | |

SUPPLEMENTAL RECORD.—July 18, 11:45 a. m., gage height 5.97 feet, discharge 2,960 second-feet.

## PINE CREEK AT CEDAR RUN, PA.

LOCATION.—Lat. 41°31′20″, long. 77°26′55″, at highway bridge at village of Cedar Run, Lycoming County, 2,000 feet downstream from Cedar Run. Datum of gage is 781.96 feet above mean sea level (New York Central Railroad bench mark).

DRAINAGE AREA.—604 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 10,000 second-feet and extended to slope-area measurement for crest gage height of flood of March 18, 1936.

MAXIMA.—July 1942: Discharge, 10,200 second-feet 7 p. m. July 18 (gage height, 6.50 feet).

1918–41: Discharge, 30,900 second-feet March 18, 1936 (gage height, 11.39 feet).

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 123 | 522 | 9 | 117 | 209 | 17 | 69 | 1,030 | 25 | 454 | 263 |
| 2 | 119 | 383 | 10 | 100 | 199 | 18 | 4,940 | 802 | 26 | 376 | 224 |
| 3 | 104 | 330 | 11 | 104 | 189 | 19 | 5,570 | 637 | 27 | 412 | 189 |
| 4 | 93 | 274 | 12 | 143 | 156 | 20 | 2,320 | 522 | 28 | 474 | 170 |
| 5 | 90 | 235 | 13 | 105 | 148 | 21 | 1,310 | 417 | 29 | 476 | 373 |
| 6 | 112 | 209 | 14 | 80 | 1,400 | 22 | 882 | 356 | 30 | 454 | 272 |
| 7 | 223 | 184 | 15 | 75 | 792 | 23 | 654 | 330 | 31 | 449 | 194 |
| 8 | 166 | 189 | 16 | 69 | 620 | 24 | 522 | 311 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 683 | 391 |
| Runoff, in inches | 1.30 | 0.75 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 19—Con.* | | | *July 20—Con.* | | | *July 23* | | |
| N | 1.12 | 69 | 4 | 5.63 | 7,520 | 6 | 3.19 | 1,970 | 6 | 2.15 | 690 |
| 12 | 1.14 | 75 | 6 | 5.43 | 7,090 | 8 | 3.13 | 1,880 | N | 2.11 | 654 |
| | | | 8 | 5.23 | 6,530 | 10 | 3.06 | 1,770 | 6 | 2.08 | 628 |
| *July 18* | | | 10 | 5.00 | 5,850 | 12 | 2.99 | 1,670 | 12 | 2.04 | 595 |
| | | | N | 4.82 | 5,330 | | | | | | |
| 2 | 1.47 | 209 | 2 | 4.62 | 4,830 | *July 21* | | | *July 24* | | |
| 4 | 1.86 | 454 | 4 | 4.46 | 4,470 | | | | | | |
| 6 | 2.02 | 578 | 6 | 4.32 | 4,120 | 6 | 2.83 | 1,440 | 6 | 1.98 | 545 |
| 8 | 2.27 | 802 | 8 | 4.17 | 3,780 | N | 2.72 | 1,300 | N | 1.93 | 506 |
| 10 | 3.00 | 1,680 | 10 | 4.03 | 3,560 | 6 | 2.62 | 1,170 | 6 | 1.90 | 483 |
| N | 4.92 | 5,590 | 12 | 3.89 | 3,250 | 12 | 2.52 | 1,060 | 12 | 1.88 | 468 |
| 2 | 5.78 | 8,100 | | | | | | | | | |
| 4 | 5.97 | 8,700 | *July 20* | | | *July 22* | | | *July 25* | | |
| 6 | 6.42 | 9,900 | | | | | | | | | |
| 7 | 6.50 | 10,200 | 2 | 3.78 | 3,050 | 6 | 2.42 | 952 | 6 | 1.84 | 439 |
| 8 | 6.43 | 9,900 | 4 | 3.68 | 2,860 | N | 2.34 | 870 | N | 1.88 | 468 |
| 10 | 6.23 | 9,300 | 6 | 3.58 | 2,670 | 6 | 2.28 | 811 | 6 | 1.84 | 439 |
| 12 | 6.05 | 8,700 | 8 | 3.52 | 2,490 | 12 | 2.22 | 754 | 12 | 1.81 | 417 |
| | | | 10 | 3.44 | 2,390 | | | | | | |
| *July 19* | | | N | 3.38 | 2,290 | | | | | | |
| | | | 2 | 3.32 | 2,180 | | | | | | |
| 2 | 5.83 | 8,100 | 4 | 3.24 | 2,050 | | | | | | |

## ALLEGHENY RIVER DRAINAGE BASIN

### ALLEGHENY RIVER AT ELDRED, PA.

LOCATION.—Lat. 41°57′50″, long. 78°23′10″, at site of former highway bridge, 1,000 feet upstream from Knapp Creek, and half a mile north of Eldred, McKean County. Datum of gage is 1,416.20 feet above mean sea level, unadjusted.

DRAINAGE AREA.—550 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph, except for period 10:30 p. m. July 18 to 11:30 a. m. July 26 for which a graph was drawn based on floodmark, twice-daily readings of inside gage July 21–25, information from local residents, and records for station at Red House, N. Y.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 12,000 second-feet and extended to crest gage height on the basis of slope-area measurement at Bullis Mills, 4.2 miles downstream.

MAXIMA.—1942: Discharge, 55,000 second-feet 9:30 a. m. July 19 (gage height, 27.60 feet, from floodmark).

1915–41: Discharge, 12,900 second-feet Apr. 5, 1940 (gage height, 18.48 feet).

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 126 | 1,240 | 9 | 159 | 604 | 17 | 96 | 493 | 25 | 1,840 | 304 |
| 2 | 140 | 930 | 10 | 130 | 556 | 18 | 11,400 | 524 | 26 | 1,240 | 257 |
| 3 | 120 | 842 | 11 | 439 | 508 | 19 | 48,100 | 406 | 27 | 1,260 | 228 |
| 4 | 109 | 652 | 12 | 349 | 379 | 20 | 24,600 | 353 | 28 | 1,560 | 210 |
| 5 | 111 | 540 | 13 | 208 | 366 | 21 | 10,500 | 316 | 29 | 1,320 | 203 |
| 6 | 263 | 463 | 14 | 151 | 540 | 22 | 6,150 | 304 | 30 | 1,320 | 199 |
| 7 | 392 | 406 | 15 | 125 | 463 | 23 | 4,180 | 392 | 31 | 1,180 | 183 |
| 8 | 242 | 406 | 16 | 105 | 379 | 24 | 2,770 | 392 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 3,893 | 453 |
| Runoff, in inches | 8.16 | 0.95 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 18—Con.* | | | *July 19—Con.* | | | *July 20—Con.* | | |
| 4 | 2.32 | 96 | 4 | 18.00 | 11,900 | 6 | 26.35 | 47,000 | 8 | 20.65 | 17,600 |
| 8 | 2.32 | 96 | 6 | 19.80 | 16,400 | 8 | 26.00 | 44,600 | 10 | 20.30 | 16,600 |
| N | 2.32 | 96 | 8 | 22.00 | 24,000 | 10 | 25.55 | 42,200 | 12 | 20.00 | 15,600 |
| 4 | 2.31 | 95 | 10 | 24.15 | 34,200 | 12 | 25.05 | 38,600 | | | |
| 8 | 2.30 | 94 | 12 | 25.20 | 39,800 | | | | *July 21* | | |
| 12 | 2.39 | 105 | | | | *July 20* | | | | | |
| | | | *July 19* | | | | | | 6 | 19.10 | 12,800 |
| *July 18* | | | | | | 2 | 24.60 | 36,200 | N | 18.15 | 10,600 |
| | | | 2 | 25.90 | 44,000 | 4 | 24.15 | 34,200 | 6 | 17.20 | 8,680 |
| 2 | 2.50 | 119 | 4 | 26.40 | 47,000 | 6 | 23.70 | 31,700 | 12 | 16.30 | 7,600 |
| 4 | 2.83 | 169 | 6 | 26.90 | 50,100 | 8 | 23.25 | 29,200 | | | |
| 6 | 3.70 | 353 | 8 | 27.45 | 53,600 | 10 | 22.80 | 27,200 | *July 22* | | |
| 8 | 4.72 | 652 | 10 | 27.60 | 55,000 | N | 22.30 | 24,800 | | | |
| 10 | 9.65 | 2,600 | N | 27.50 | 54,300 | 2 | 21.85 | 22,600 | N | 14.95 | 6,240 |
| N | 15.10 | 7,080 | 2 | 27.10 | 51,500 | 4 | 21.40 | 20,800 | 12 | 13.65 | 5,120 |
| 2 | 17.10 | 10,200 | 4 | 26.70 | 48,800 | 6 | 20.95 | 19,200 | | | |

SUPPLEMENTAL RECORD.—July 19, 9:30 a. m., gage height 27.6 feet, discharge 55,000 second-feet.

## ALLEGHENY RIVER AT RED HOUSE, N. Y.

LOCATION.—Lat. 42°06′50″, long. 78°48′15″, at site of old highway bridge in Red House, Cattaraugus County, and 0.7 mile upstream from Meetinghouse Run. Datum of gage is 1,327.68 feet above mean sea level, datum of 1929.

DRAINAGE AREA.—1,690 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements.

MAXIMA.—1942: Discharge, 45,300 second-feet 8:30 a. m. July 20 (gage height, 14.55 feet).

1903–41: Discharge observed, 41,000 second-feet March 2, 1910 (gage height, 13.6 feet); gage height, 13.78 feet March 4, 1934 (ice jam).

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 392 | 2,650 | 9 | 506 | 1,170 | 17 | 324 | 936 | 25 | 3,720 | 872 |
| 2 | 401 | 2,180 | 10 | 392 | 1,360 | 18 | 8,210 | 1,030 | 26 | 2,970 | 726 |
| 3 | 366 | 1,840 | 11 | 866 | 1,360 | 19 | 36,800 | 975 | 27 | 2,530 | 636 |
| 4 | 348 | 1,620 | 12 | 1,140 | 1,120 | 20 | 44,200 | 846 | 28 | 2,570 | 576 |
| 5 | 324 | 1,360 | 13 | 726 | 962 | 21 | 34,700 | 774 | 29 | 2,610 | 558 |
| 6 | 348 | 1,170 | 14 | 515 | 1,030 | 22 | 20,000 | 726 | 30 | 2,710 | 548 |
| 7 | 589 | 1,030 | 15 | 410 | 1,120 | 23 | 10,000 | 910 | 31 | 2,550 | 529 |
| 8 | 690 | 949 | 16 | 357 | 949 | 24 | 6,040 | 1,030 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 6,074 | 1,082 |
| Runoff, in inches | 4.14 | 0.74 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 18* | | | *July 19*—Con. | | | *July 20*—Con. | | | *July 23*—Con. | | |
| 2 | 3.56 | 401 | 10 | 13.13 | 37,200 | 6 | 14.33 | 43,900 | 6 | 8.23 | 11,200 |
| 4 | 3.75 | 589 | N | 13.35 | 38,400 | 8 | 14.23 | 43,200 | N | 7.81 | 9,680 |
| 6 | 4.53 | 1,730 | 2 | 13.54 | 39,500 | 10 | 14.12 | 42,500 | 6 | 7.52 | 8,690 |
| 8 | 5.29 | 3,300 | 4 | 13.72 | 40,500 | 12 | 14.00 | 41,800 | 12 | 7.22 | 7,710 |
| 10 | 4.97 | 2,590 | 6 | 13.86 | 41,200 | | | | | | |
| N | 5.08 | 2,830 | 8 | 13.98 | 41,900 | *July 21* | | | *July 24* | | |
| 2 | 6.03 | 5,180 | 10 | 14.11 | 42,700 | | | | | | |
| 4 | 7.65 | 10,400 | 12 | 14.24 | 43,400 | 6 | 13.51 | 38,600 | N | 6.65 | 6,000 |
| 6 | 9.17 | 16,900 | | | | N | 12.93 | 34,800 | 12 | 6.13 | 4,590 |
| 8 | 9.87 | 20,200 | *July 20* | | | 6 | 12.26 | 30,800 | | | |
| 10 | 10.31 | 22,400 | | | | 12 | 11.58 | 26,900 | *July 25* | | |
| 12 | 10.73 | 24,400 | 2 | 14.35 | 44,100 | | | | | | |
| | | | 4 | 14.44 | 44,600 | *July 22* | | | N | 5.75 | 3,650 |
| *July 19* | | | 6 | 14.49 | 44,900 | | | | 12 | 5.52 | 3,120 |
| | | | 8 | 14.53 | 45,200 | 6 | 10.91 | 23,200 | | | |
| 2 | 11.26 | 27,100 | 10 | 14.54 | 45,200 | N | 10.24 | 19,900 | | | |
| 4 | 11.90 | 30,400 | N | 14.52 | 45,100 | 6 | 9.53 | 16,700 | | | |
| 6 | 12.42 | 33,300 | 2 | 14.48 | 44,900 | 12 | 8.80 | 13,500 | | | |
| 8 | 12.81 | 35,500 | 4 | 14.42 | 44,500 | | | | | | |

SUPPLEMENTAL RECORD.—July 20, 8:30 a. m., gage height 14.55 feet, discharge 45,300 second-feet.

## ALLEGHENY RIVER NEAR KINZUA, PA.

LOCATION.—Lat. 41°50′50″, long. 78°59′30″, at Pennsylvania Railroad bridge, half a mile upstream from Bent Run, 2 miles southwest of Kinzua, Warren County, and 2.3 miles downstream from Kinzua Creek. Datum of gage is 1,200.00 feet above mean sea level (Corps of Engineers, U. S. Army, bench mark).

DRAINAGE AREA.—2,179 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements. Shifting-control method used July 1–17.

MAXIMA.—1942: Discharge, 46,800 second-feet 5 p. m. July 20 (gage height, 17.70 feet).

1935–41: Discharge, 42,000 second-feet March 28, 1936 (gage height, 16.69 feet).

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 563 | 3,290 | 9 | 775 | 1,420 | 17 | 486 | 1,220 | 25 | 5,260 | 1,200 |
| 2 | 556 | 2,960 | 10 | 612 | 1,760 | 18 | 10,500 | 1,220 | 26 | 3,980 | 1,010 |
| 3 | 510 | 2,480 | 11 | 947 | 1,700 | 19 | 34,300 | 1,250 | 27 | 3,400 | 870 |
| 4 | 510 | 2,160 | 12 | 1,480 | 1,510 | 20 | 45,300 | 1,100 | 28 | 3,180 | 784 |
| 5 | 486 | 1,830 | 13 | 1,140 | 1,290 | 21 | 41,500 | 997 | 29 | 3,290 | 748 |
| 6 | 849 | 1,570 | 14 | 811 | 1,250 | 22 | 26,700 | 1,010 | 30 | 3,290 | 714 |
| 7 | 802 | 1,380 | 15 | 612 | 1,380 | 23 | 14,500 | 1,200 | 31 | 3,290 | 681 |
| 8 | 900 | 1,240 | 16 | 517 | 1,310 | 24 | 8,630 | 1,310 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 7,086 | 1,414 |
| Runoff, in inches | 3.75 | 0.75 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge |
|---|---|---|
| *July 17* | | |
| 4 | 5.31 | 468 |
| 8 | 5.33 | 480 |
| N | 5.35 | 492 |
| 4 | 5.35 | 492 |
| 8 | 5.35 | 492 |
| 12 | 5.34 | 486 |
| *July 18* | | |
| 2 | 5.33 | 480 |
| 4 | 5.42 | 543 |
| 6 | 5.76 | 840 |
| 8 | 6.36 | 1,670 |
| 10 | 9.05 | 8,300 |
| N | 10.41 | 13,800 |
| 2 | 10.89 | 15,400 |
| 4 | 10.76 | 15,000 |
| 6 | 10.66 | 14,600 |
| 8 | 10.81 | 15,000 |
| 10 | 11.63 | 18,400 |
| 12 | 12.65 | 22,700 |
| *July 19* | | |
| 2 | 13.55 | 27,300 |
| 4 | 14.01 | 29,100 |
| 6 | 14.22 | 30,000 |
| 8 | 14.35 | 31,000 |

| Hour | Gage height | Discharge |
|---|---|---|
| *July 19—Con.* | | |
| 10 | 14.51 | 31,400 |
| N | 14.76 | 32,900 |
| 2 | 15.10 | 34,300 |
| 4 | 15.50 | 36,200 |
| 6 | 15.87 | 38,100 |
| 8 | 16.17 | 39,600 |
| 10 | 16.43 | 40,500 |
| 12 | 16.65 | 41,500 |
| *July 20* | | |
| 2 | 16.85 | 42,400 |
| 4 | 17.06 | 43,900 |
| 6 | 17.25 | 44,400 |
| 8 | 17.41 | 45,300 |
| 10 | 17.52 | 45,800 |
| N | 17.61 | 46,300 |
| 2 | 17.67 | 46,800 |
| 4 | 17.69 | 46,800 |
| 6 | 17.69 | 46,800 |
| 8 | 17.65 | 46,300 |
| 10 | 17.59 | 46,300 |
| 12 | 17.51 | 45,800 |
| *July 21* | | |
| 2 | 17.42 | 45,300 |
| 4 | 17.32 | 44,800 |

| Hour | Gage height | Discharge |
|---|---|---|
| *July 21—Con.* | | |
| 6 | 17.21 | 44,400 |
| 8 | 17.06 | 43,900 |
| 10 | 16.90 | 42,900 |
| N | 16.71 | 42,000 |
| 2 | 16.51 | 41,000 |
| 4 | 16.28 | 40,000 |
| 6 | 16.06 | 39,100 |
| 8 | 15.79 | 37,600 |
| 10 | 15.52 | 36,200 |
| 12 | 15.25 | 34,800 |
| *July 22* | | |
| 4 | 14.70 | 32,400 |
| 8 | 14.14 | 29,600 |
| N | 13.56 | 27,300 |
| 4 | 13.01 | 24,500 |
| 8 | 12.51 | 22,300 |
| 12 | 12.01 | 20,100 |
| *July 23* | | |
| 4 | 11.56 | 18,400 |
| 8 | 11.10 | 16,200 |
| N | 10.67 | 14,600 |
| 4 | 10.30 | 13,000 |
| 8 | 10.00 | 11,800 |
| 12 | 9.75 | 11,100 |

| Hour | Gage height | Discharge |
|---|---|---|
| *July 24* | | |
| 4 | 9.54 | 9,990 |
| 8 | 9.32 | 9,300 |
| N | 9.11 | 8,630 |
| 4 | 8.89 | 7,970 |
| 8 | 8.69 | 7,330 |
| 12 | 8.49 | 6,710 |
| *July 25* | | |
| N | 8.00 | 5,260 |
| 12 | 7.66 | 4,340 |
| *July 26* | | |
| N | 7.46 | 3,860 |
| 12 | 7.41 | 3,740 |

SUPPLEMENTAL RECORD.—July 20, 5:00 p. m., gage height 17.70 feet, discharge 46,800 second-feet.

## CLARION RIVER AT RIDGWAY, PA.

LOCATION.—Lat. 41°25′, long. 78°44′, at bridge on Main Street in Ridgway, Elk County, 50 feet downstream from Elk Creek. Datum of gage is 1,361.62 feet above mean sea level, unadjusted.

DRAINAGE AREA.—303 square miles.

GAGE-HEIGHT RECORD.—From graph based on floodmark, twice daily readings of chain gage, and local information.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements up to 12,000 second-feet and extended to slope-area measurement for crest gage height. Shifting-control method used except July 16–25.

MAXIMA.—July 1942: Discharge, 34,000 second-feet 1 a. m. July 19 (gage height, 16.4 feet).

1940 to June 1942: Discharge, 6,940 second-feet March 9, 1942 (gage height, 8.0 feet). The flood of March 1936 reached a stage of 14 feet (discharge, 24,000 second-feet).

*Daily mean discharge, in second-feet 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 158 | 444 | 9 | 88 | 326 | 17 | 86 | 412 | 25 | 792 | 191 |
| 2 | 93 | 326 | 10 | 73 | 326 | 18 | 4,550 | 276 | 26 | 545 | 165 |
| 3 | 73 | 326 | 11 | 183 | 235 | 19 | 12,100 | 227 | 27 | 1,210 | 148 |
| 4 | 75 | 280 | 12 | 117 | 187 | 20 | 3,020 | 199 | 28 | 905 | 135 |
| 5 | 77 | 244 | 13 | 83 | 327 | 21 | 1,620 | 180 | 29 | 615 | 141 |
| 6 | 207 | 218 | 14 | 73 | 448 | 22 | 1,060 | 176 | 30 | 545 | 126 |
| 7 | 288 | 195 | 15 | 61 | 252 | 23 | 1,620 | 326 | 31 | 511 | 120 |
| 8 | 117 | 231 | 16 | 58 | 280 | 24 | 980 | 257 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 1,032 | 249 |
| Runoff, in inches | 3.93 | 0.95 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 18—Con.* | | | *July 19—Con.* | | | *July 21—Con.* | | |
| 4 | 0.80 | 63 | 6 | 6.50 | 4,720 | 8 | 6.50 | 4,720 | N | 3.30 | 1,620 |
| 8 | .82 | 67 | 8 | 8.60 | 8,080 | 10 | 6.20 | 4,370 | 4 | 3.20 | 1,540 |
| N | .88 | 79 | 10 | 13.40 | 21,200 | 12 | 6.00 | 4,150 | 8 | 3.10 | 1,460 |
| 4 | .98 | 103 | 12 | 16.10 | 32,600 | | | | 12 | 3.00 | 1,380 |
| 8 | 1.06 | 126 | | | | *July 20* | | | | | |
| 12 | 1.20 | 172 | *July 19* | | | | | | *July 22* | | |
| | | | | | | 4 | 5.60 | 3,710 | 4 | 2.90 | 1,300 |
| *July 18* | | | 1 | 16.4 | 34,000 | 8 | 5.30 | 3,400 | 8 | 2.70 | 1,140 |
| | | | 2 | 16.10 | 32,600 | N | 4.90 | 3,020 | N | 2.50 | 980 |
| 2 | 1.32 | 218 | 4 | 13.70 | 22,400 | 4 | 4.60 | 2,750 | 4 | 2.50 | 980 |
| 4 | 1.48 | 290 | 6 | 11.30 | 14,500 | 8 | 4.30 | 2,480 | 8 | 2.70 | 1,140 |
| 6 | 1.68 | 412 | 8 | 10.20 | 11,600 | 12 | 4.00 | 2,220 | 12 | 3.00 | 1,380 |
| 8 | 1.98 | 615 | 10 | 9.30 | 9,560 | | | | | | |
| 10 | 2.45 | 942 | N | 8.50 | 7,880 | *July 21* | | | | | |
| N | 3.00 | 1,380 | 2 | 7.80 | 6,580 | | | | | | |
| 2 | 3.90 | 2,130 | 4 | 7.30 | 5,780 | 4 | 3.80 | 2,040 | | | |
| 4 | 5.00 | 3,110 | 6 | 6.80 | 5,080 | 8 | 3.50 | 1,790 | | | |

## GENESEE RIVER DRAINAGE BASIN

### GENESEE RIVER AT SCIO, N. Y.

LOCATION.—Lat. 42°09′50″, long. 77°58′50″, at highway bridge, 0.4 mile upstream from Vandermark Creek, and three-quarters of a mile upstream from Scio, Allegany County.

DRAINAGE AREA.—309 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph except for period August 15–21.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements. Discharge for period August 15–21 computed on basis of records for nearby stations.

MAXIMA.—1942: Discharge, 9,740 second-feet 12:30 p. m. July 18 (gage height, 9.74 feet).

1916–41: Discharge observed, 10,600 second-feet May 22, 1919 (gage height, 10.1 feet, present datum) from rating curve extended above 3,600 second-feet by logarithmic plotting.

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 104 | 539 | 9 | 60 | 194 | 17 | 44 | 161 | 25 | 266 | 161 |
| 2 | 82 | 363 | 10 | 58 | 378 | 18 | 5,830 | 206 | 26 | 233 | 136 |
| 3 | 67 | 311 | 11 | 166 | 221 | 19 | 3,100 | 209 | 27 | 331 | 119 |
| 4 | 60 | 249 | 12 | 112 | 180 | 20 | 1,190 | 180 | 28 | 955 | 112 |
| 5 | 60 | 212 | 13 | 76 | 185 | 21 | 686 | 161 | 29 | 1,050 | 115 |
| 6 | 73 | 180 | 14 | 64 | 364 | 22 | 500 | 235 | 30 | 634 | 106 |
| 7 | 107 | 159 | 15 | 52 | 209 | 23 | 420 | 276 | 31 | 616 | 95 |
| 8 | 74 | 159 | 16 | 44 | 183 | 24 | 318 | 212 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 562 | 212 |
| Runoff, in inches | 2.10 | 0.79 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 18—Con.* | | | *July 19—Con.* | | | *July 21* | | |
| 4 | 1.19 | 43 | 11 | 9.41 | 9,000 | 8 | 5.95 | 3,340 | 6 | 3.07 | 734 |
| 8 | 1.19 | 43 | N | 9.71 | 9,670 | 10 | 5.57 | 2,900 | N | 2.98 | 684 |
| N | 1.19 | 43 | 1 | 9.58 | 9,380 | N | 5.29 | 2,590 | 6 | 2.89 | 637 |
| 6 | 1.19 | 43 | 2 | 9.38 | 8,940 | 2 | 5.01 | 2,300 | 12 | 2.74 | 562 |
| 10 | 1.19 | 43 | 3 | 9.02 | 8,190 | 4 | 4.82 | 2,110 | | | |
| 11 | 1.33 | 65 | 4 | 8.81 | 7,770 | 6 | 4.59 | 1,890 | *July 22* | | |
| 12 | 1.46 | 90 | 5 | 8.73 | 7,620 | 8 | 4.37 | 1,690 | | | |
| | | | 6 | 8.72 | 7,600 | 10 | 4.18 | 1,520 | 6 | 2.64 | 514 |
| *July 18* | | | 7 | 8.75 | 7,660 | 12 | 4.01 | 1,390 | N | 2.60 | 495 |
| | | | 8 | 8.77 | 7,690 | | | | 6 | 2.54 | 468 |
| 1 | 1.90 | 201 | 9 | 8.73 | 7,620 | *July 20* | | | 12 | 2.59 | 490 |
| 2 | 2.84 | 588 | 10 | 8.67 | 7,500 | | | | | | |
| 3 | 3.29 | 856 | 11 | 8.53 | 7,240 | 2 | 3.92 | 1,320 | *July 23* | | |
| 4 | 3.83 | 1,240 | 12 | 8.33 | 6,870 | 4 | 3.91 | 1,310 | N | 2.44 | 424 |
| 5 | 4.64 | 1,940 | | | | 6 | 3.94 | 1,330 | 12 | 2.27 | 356 |
| 6 | 5.68 | 3,020 | *July 19* | | | 8 | 3.95 | 1,340 | | | |
| 7 | 6.67 | 4,260 | | | | 10 | 3.94 | 1,330 | *July 24* | | |
| 8 | 7.30 | 5,170 | 2 | 7.79 | 5,940 | N | 3.88 | 1,280 | | | |
| 9 | 7.89 | 6,110 | 4 | 7.11 | 4,880 | 6 | 3.57 | 1,050 | N | 2.17 | 318 |
| 10 | 8.58 | 7,330 | 6 | 6.46 | 3,980 | 12 | 3.25 | 838 | 12 | 2.08 | 286 |

SUPPLEMENTAL RECORD.—July 18, 12:30 p. m., gage height 9.74 feet, discharge 9,740 second-feet.

## GENESEE RIVER AT ST. HELENA, N. Y.

LOCATION.—Lat. 42°37′20″, long. 77°59′20″, at highway bridge in St. Helena, Wyoming County, 1½ miles downstream from Wolf Creek, and 3 miles east of Castile.

DRAINAGE AREA.—1,017 square miles.

GAGE-HEIGHT RECORD.—Water-stage recorder graph.

DISCHARGE RECORD.—Stage-discharge relation defined by current-meter measurements.

MAXIMA.—July 1942: Discharge, 18,900 second-feet 12:15 a. m. July 19 (gage height, 10.06 feet).

1908–41: Discharge, 44,400 second-feet May 17, 1916 (gage height, 12.8 feet), from rating curve extended above 29,000 second-feet by logarithmic plotting.

*Daily mean discharge, in second-feet, 1942*

| Day | July | Aug. | Day | July | Aug. | Day | July | Aug. | Day | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 221 | 1,330 | 9 | 185 | 400 | 17 | 167 | 438 | 25 | 695 | 600 |
| 2 | 242 | 1,020 | 10 | 160 | 586 | 18 | 8,820 | 586 | 26 | 605 | 552 |
| 3 | 220 | 775 | 11 | 310 | 783 | 19 | 11,200 | 446 | 27 | 636 | 359 |
| 4 | 184 | 720 | 12 | 533 | 604 | 20 | 4,070 | 376 | 28 | 700 | 242 |
| 5 | 158 | 602 | 13 | 348 | 448 | 21 | 2,030 | 336 | 29 | 1,700 | 354 |
| 6 | 156 | 487 | 14 | 268 | 529 | 22 | 1,260 | 308 | 30 | 1,740 | 446 |
| 7 | 184 | 411 | 15 | 195 | 694 | 23 | 1,010 | 334 | 31 | 1,310 | 440 |
| 8 | 184 | 368 | 16 | 173 | 472 | 24 | 874 | 439 | | | |

| | July | Aug. |
|---|---|---|
| Monthly mean discharge, in second-feet | 1,308 | 532 |
| Runoff, in inches | 1.49 | 0.60 |

*Gage height, in feet, and discharge, in second-feet, at indicated time, 1942*

| Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge | Hour | Gage height | Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *July 17* | | | *July 18—Con.* | | | *July 19—Con.* | | | *July 21* | | |
| 4 | 2.55 | 163 | 7 | 9.61 | 16,600 | 8 | 6.75 | 6,060 | 6 | 4.80 | 2,290 |
| 8 | 2.54 | 159 | 8 | 9.72 | 17,200 | 9 | 6.61 | 5,700 | N | 4.53 | 1,930 |
| N | 2.60 | 182 | 9 | 9.83 | 17,800 | 10 | 6.51 | 5,460 | 6 | 4.37 | 1,730 |
| 4 | 2.53 | 155 | 10 | 9.92 | 18,200 | 11 | 6.40 | 5,200 | 12 | 4.19 | 1,530 |
| 8 | 2.48 | 137 | 11 | 10.00 | 18,600 | 12 | 6.29 | 4,950 | | | |
| 10 | 2.50 | 144 | 12 | 10.05 | 18,800 | | | | *July 22* | | |
| 12 | 2.74 | 245 | | | | *July 20* | | | | | |
| | | | *July 19* | | | | | | N | 3.90 | 1,210 |
| *July 18* | | | | | | 1 | 6.20 | 4,750 | 12 | 3.75 | 1,060 |
| | | | 1 | 10.03 | 18,800 | 2 | 6.13 | 4,600 | | | |
| 1 | 2.86 | 307 | 2 | 9.96 | 18,400 | 3 | 6.07 | 4,480 | *July 23* | | |
| 2 | 2.84 | 296 | 3 | 9.84 | 17,800 | 4 | 6.04 | 4,410 | | | |
| 3 | 2.82 | 285 | 4 | 9.69 | 17,000 | 5 | 6.06 | 4,460 | 6 | 3.74 | 1,050 |
| 4 | 2.91 | 335 | 5 | 9.55 | 16,300 | 6 | 6.09 | 4,520 | N | 3.65 | 960 |
| 5 | 3.29 | 614 | 6 | 9.37 | 15,500 | 7 | 6.09 | 4,520 | 6 | 3.72 | 1,030 |
| 6 | 3.45 | 762 | 7 | 9.17 | 14,600 | 8 | 6.13 | 4,600 | 12 | 3.68 | 990 |
| 7 | 3.49 | 800 | 8 | 8.95 | 13,600 | 9 | 6.15 | 4,640 | | | |
| 8 | 3.45 | 762 | 9 | 8.73 | 12,600 | 10 | 6.12 | 4,580 | *July 24* | | |
| 9 | 3.48 | 791 | 10 | 8.56 | 11,900 | 11 | 6.09 | 4,520 | | | |
| 10 | 7.38 | 7,740 | 11 | 8.35 | 11,100 | N | 6.04 | 4,410 | 6 | 3.67 | 980 |
| 11 | 8.24 | 10,700 | N | 8.21 | 10,500 | 2 | 5.92 | 4,170 | N | 3.52 | 830 |
| N | 8.21 | 10,500 | 1 | 8.06 | 9,950 | 4 | 5.74 | 3,830 | 6 | 3.53 | 840 |
| 1 | 8.30 | 10,900 | 2 | 7.87 | 9,260 | 6 | 5.53 | 3,440 | 12 | 3.44 | 752 |
| 2 | 8.56 | 11,900 | 3 | 7.68 | 8,640 | 8 | 5.35 | 3,140 | | | |
| 3 | 8.81 | 12,900 | 4 | 7.48 | 8,030 | 10 | 5.22 | 2,920 | | | |
| 4 | 9.05 | 14,000 | 5 | 7.26 | 7,410 | 12 | 5.12 | 2,760 | | | |
| 5 | 9.26 | 15,000 | 6 | 7.07 | 6,890 | | | | | | |
| 6 | 9.46 | 15,900 | 7 | 6.91 | 6,470 | | | | | | |

SUPPLEMENTAL RECORD.—July 19, 12:15 a. m., gage height 10.06 feet, discharge 18,900 second-feet.

## SUMMARY OF FLOOD DISCHARGES

The maximum discharges at gaging stations in and adjacent to the flood area, together with the miscellaneous measurements of peak discharge by slope-area, contracted-opening, and similar methods, are summarized in table 4. The gaging stations are indicated in the proper column by the period of record available, to and including 1942. The places of miscellaneous measurement are indicated in the same column by the method of measuring. When slope-area and similar methods of measuring the peak discharge are used at a gaging station, there is usually additional information available so that the peak discharge given for the gaging-station record is not based on the measurement alone. There is, therefore, no particular point in indicating, in table 4, slope-area and similar measurements made at gaging stations, especially as they are discussed in the station descriptions in the preceding section.

The index numbers used in table 4 are those used for the same points in tables 1, 3, 4, 1–A, 3–A, and 4–A of Water-Supply Paper 847, Maximum discharges at stream-measurement stations through December 31, 1937, with a supplement including additions and changes through September 30, 1938. For those places not given in Water-Supply Paper 847, new index numbers were assigned using the same decimal system. The places of measurement also are identified on plate 2 by these index numbers.

The maximum flood previously known may include a flood outside the period of record, the general aim being to list the highest flood for which the discharge is known. The gage heights of all floods listed are the gage heights of the maximum discharge unless qualified otherwise. Other information in table 4 is considered self-explanatory.

TABLE 4.—*Summary of flood discharges in north-central Pennsylvania for the flood of July 1942*

| No. on pl. 2 | Stream and place of determination | Drainage area (square miles) | Period of record or method of measuring | Maximum flood previously known: Date | Gage height (feet) | Discharge: Second-feet | Discharge: Second-feet per square mile | Maximum during present flood: Time | Gage height (feet) | Discharge: Second-feet | Discharge: Second-feet per square mile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SUSQUEHANNA RIVER DRAINAGE BASIN | | | | | | | | | | |
| 753 | Canacadea Creek near Hornell, N. Y. | 58.7 | 1924–29; 1938–42 | July 1935 | [1] 12.3 | 21,000 | 358 | 6:40 a. m. July 18 | 7.07 | 6,080 | 104 |
| 754 | Karr Valley Creek at Almond, N. Y. | 27.6 | 1937–42 | Mar. 31, 1940 | [1] 5.8 | 3,800 | 143 | 5:45 a. m. July 18 | [1] 8.8 | 5,900 | 214 |
| 781.5 | West Branch Susquehanna River at Karthaus, Pa. | 1,462 | 1918–20; 1940–42 | Mar. 18, 1936 | [1] 23.0 | [2] 135,000 | 92 | 2 a. m. July 19 | 2.15 | 1,120 | .8 |
| 783 | West Branch Susquehanna River at Renovo, Pa. | 2,975 | 1895–1903; 1905–42 | do | [1] 29.39 | 236,000 | 79 | 11:55 p. m. July 18 | 18.92 | 117,000 | 39 |
| 784 | West Branch Susquehanna River at Williamsport, Pa. | 5,682 | 1895–1942 | do | [1] 33.57 | 264,000 | 46.5 | 2:30 p. m. July 19 | 18.76 | 110,000 | 19.4 |
| 787.5 | Sinnemahoning Creek at Sinnemahoning, Pa. | 699 | 1938–42 | do | 21.94 | 61,200 | 88 | 10:45 p. m. July 18 | 21.58 | 59,800 | 86 |
| 787.8 | Driftwood Branch Sinnemahoning Creek at Emporium, Pa. | 91.7 | Slope area | | | | | 6:30 p. m. July 18 | | 28,000 | 310 |
| 789 | Driftwood Branch Sinnemahoning Creek at Sterling Run, Pa. | 281 | 1913–42 | Mar. 17, 1936 | 12.0 | 28,400 | 101 | 8:45 p. m. July 18 | [3] 15.00 | 47,800 | 170 |
| 789.1 | North Creek near Lockwood, Pa. | 20.3 | Contracted opening | | | | | 5 p. m. July 18 | | 4,700 | 230 |
| 789.2 | West Creek near Emporium, Pa. | 55.9 | do | | | | | July 18 | | 11,000 | 200 |
| 789.3 | Sinnemahoning Portage near Emporium, Pa. | 63.8 | Slope area | | | | | do | | 18,000 | 280 |
| 789.4 | Salt Run near Emporium, Pa. | 7.67 | Dam | | | | | do | | 1,900 | 250 |
| 789.50 | First Fork Sinnemahoning Creek near Costello, Pa. | 103 | Slope area | | | | | 1 p. m. July 18 | | 31,000 | 300 |
| 789.52 | First Fork Sinnemahoning Creek near mouth, near Sinnemahoning, Pa. | 250 | 2 slope area | | | | | 4 p. m. July 18 | | 81,000 | 324 |
| 789.54 | South Fork of First Fork Sinnemahoning Creek near Costello, Pa. | 17.8 | Slope area | | | | | July 18 | | 7,500 | 420 |
| 789.56 | Freeman Run above Austin Dam, near Odin, Pa. | 12.1 | do | | | | | do | | 9,800 | 810 |
| 789.58 | Freeman Run below Austin Dam, near Austin, Pa. | 14.3 | 2 slope area and a dam | | | | | 11 a. m. July 18 | | 17,000 | 1,200 |
| 789.60 | Nelson Run near Wharton, Pa. | 10.2 | Slope area | | | | | July 18 | | 6,600 | 650 |
| 789.62 | East Fork of First Fork Sinnemahoning Creek, near Wharton, Pa. | 49.1 | Contracted opening | | | | | do | | 6,100 | 120 |
| 789.64 | Bailey Run near Wharton, Pa. | 11.7 | Slope area | | | | | do | | 5,300 | 450 |
| 789.66 | Rattlesnake Run near First Fork, Pa. | 4.43 | do | | | | | do | | 1,300 | 290 |
| 789.68 | Brooks Run at Lushbaugh, Pa. | 4.73 | do | | | | | do | | 1,600 | 340 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 789.8 | Kettle Creek at Cross Fork, Pa | 136 | 1940–42 | May 22, 1942 | [4] 7.98 | 6,100 | 44.9 | 11:45 a. m. July 18 | 5.97 | 2,960 | 22 |
| 792 | Pine Creek at Cedar Run, Pa | 604 | 1918–42 | Mar. 18, 1936 | 11.39 | 30,900 | 51.2 | 7 p. m. July 18 | 6.50 | 10,200 | 16.9 |
| | ALLEGHENY RIVER DRAINAGE BASIN | | | | | | | | | | |
| 000.3 | Allegheny River above Roulette, Pa.[5] | 114 | Slope area | | | | | 2 p. m. July 18 | | 25,000 | 220 |
| 000.7 | Allegheny River at Port Allegany, Pa | 249 | Contracted opening | | | | | 3:30 p. m. July 18 | | 77,000 | 310 |
| 001 | Allegheny River at Eldred, Pa | 550 | 1915–42 | Apr. 5, 1940 | 18.48 | 12,900 | 23 | 9:30 a. m. July 19 | [1] 27.60 | 55,000 | 100 |
| 001.5 | Allegheny River at Bullis Mills, Pa | 608 | Slope area | | | | | July 19 | | 52,000 | 86 |
| 002 | Allegheny River at Red House, N. Y | 1,690 | 1903–42 | Mar. 2, 1910 | 13.6 | [6] 41,000 | 24 | 8:30 a. m. July 20 | 14.55 | 45,300 | 27 |
| 002.5 | Allegheny River near Kinzua, Pa | 2,179 | 1935–42 | Mar. 28, 1936 | 16.69 | 42,000 | 19.3 | 5 p. m. July 20 | 17.70 | 46,800 | 21 |
| 002.8 | Allegheny River at West Hickory, Pa. | 3,660 | 1941–42 | Mar. 18, 1942 | 13.44 | 58,000 | 15.8 | 1 a. m. July 21 | 12.82 | 50,000 | 14 |
| 003 | Allegheny River at Franklin, Pa | 5,982 | 1905–42 | Mar. 17, 1865 | 25.0 | 196,000 | 32.8 | 8 a. m. July 21 | 12.78 | 58,300 | 10 |
| 004 | Allegheny River at Parkers Landing, Pa. | 7,671 | 1932–42 | do | 29.0 | 250,000 | 33 | 10 a. m. July 21 | 11.79 | 58,600 | 8 |
| 016.02 | Run 2.5 miles north of Coudersport, Pa | [2] .82 | Slope area | | | | | July 18 | | 190 | 230 |
| 016.05 | Laninger Creek near Roulette, Pa | .45 | Dam | | | | | do | | 850 | 1,900 |
| 016.08 | Sartwell Creek near Burtville, Pa | 9.86 | Slope area | | | | | do | | 11,000 | 1,100 |
| 016.10 | Run tributary to Sartwell Creek above Meachum Hollow, 1¾ miles north of Burtville, Pa. | [2] .094 | Critical depth | | | | | do | | 310 | 3,300 |
| 016.12 | Dexter Run near Burtville, Pa | .83 | Slope area | | | | | do | | 840 | 1,000 |
| 016.14 | Lillibridge Creek at Port Allegany, Pa | 6.7 | 2 slope area [7] | | | | | 11 a. m.[2] July 18 | | 16,000 | 2,400 |
| 016.16 | Run at north city limit of Port Allegany, Pa. | [2] .39 | Slope area | | | | | July 18 | | 1,400 | 3,600 |
| 016.18 | Twomile Creek near Port Allegany, Pa. | 7.06 | do | | | | | 11 a. m.[2] July 18 | | 15,000 | 2,100 |
| 016.20 | Hollow tributary to Twomile Creek at Taylor farm, near Port Allegany, Pa. | [2] .032 | Critical depth | | | | | July 18 | | 200 | 6,200 |
| 016.21 | do | .053 | do | | | | | do | | 640 | 12,000 |
| 016.22 | Hollow tributary to Twomile Creek at Appolt farm, near Port Allegany, Pa. | [2] .087 | do | | | | | do | | 400 | 4,600 |
| 016.25 | Annin Creek near Turtlepoint, Pa.[5] | 11.4 | Slope area | | | | | 11 a. m.[2] July 18 | | 24,000 | 2,100 |
| 016.28 | Rock Run near Turtlepoint, Pa | 1.82 | do | | | | | July 18 | | 2,300 | 1,300 |
| 016.30 | East Branch Open Brook near Smethport, Pa. | [2] .32 | Contracted opening | | | | | do | | 410 | 1,300 |
| 016.32 | Newell Creek near Larabee, Pa | 2.14 | Slope area | | | | | 11 a. m.[2] July 18 | | 5,200 | 2,400 |
| 016.34 | Marvin Creek near Hazelhurst, Pa | 5.82 | do | | | | | July 18 | | 2,200 | 380 |
| 016.36 | Sherman Run at Hazelhurst, Pa | [2] .24 | Dam | | | | | do | | 70 | 290 |
| 016.38 | Blacksmith Run near Smethport, Pa | 2.03 | do | | | | | do | | 590 | 290 |
| 016.40 | Ice Pond Brook at Smethport, Pa | [2] .56 | do | | | | | do | | 140 | 250 |
| 016.42 | Kent Run near Farmers Valley, Pa | 1.35 | Slope area | | | | | do | | 2,000 | 1,500 |
| 016.45 | Marilla Brook near Bradford, Pa | 4.73 | Dam | | | | | do | | 640 | 140 |
| 016.48 | Hubert Run at Kane, Pa | 2.53 | do | | | | | do | | 110 | 43 |
| 028.2 | East Branch Clarion River at Instanter, Pa. | 19.9 | Contracted opening | | | | | 3:30 p. m. July 18 | | 9,500 | 480 |
| 028.3 | East Branch Clarion River near Johnsonburg, Pa. | 104 | Contracted opening,[5] and slope area. | | | | | 9 p. m. July 18 | | 27,000 | 260 |
| 028.4 | Clarion River at Ridgway, Pa | 303 | 1940–42 | March 1936 | 14.0 | 24,000 | 79 | 1 a. m. July 19 | 16.4 | 34,000 | 112 |
| 028.5 | Clarion River at Cooksburg, Pa | 807 | 1938–42 | Mar. 17, 1936 | 19.0 | 56,000 | 69 | 9:30 a. m. July 19 | 14.96 | 32,700 | 41 |
| 030.3 | Fivemile Run near Rasselas, Pa | 6.20 | Contracted opening | | | | | July 18 | | 1,900 | 310 |

See footnote at end of table.

TABLE 4.—*Summary of flood discharges in north-central Pennsylvania for the flood of July 1942*—Continued

| No. on pl. 2 | Stream and place of determination | Drainage area (square miles) | Period of record or method of measuring | Maximum flood previously known: Date | Maximum flood previously known: Gage height (feet) | Maximum flood previously known: Discharge: Second-feet | Maximum flood previously known: Discharge: Second-feet per square mile | Maximum during present flood: Time | Maximum during present flood: Gage height (feet) | Maximum during present flood: Discharge: Second-feet | Maximum during present flood: Discharge: Second-feet per square mile |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALLEGHENY RIVER DRAINAGE BASIN—Continued | | | | | | | | | | |
| 030.4 | Straight Creek near Instanter, Pa. | 21.7 | Slope area | | | | | July 18 | | 15,000 | 690 |
| 030.5 | South Fork Straight Creek near Instanter, Pa. | 8.41 | do | | | | | do | | 5,300 | 630 |
| 030.6 | Johnson Run at Ketner Dam, near Johnsonburg, Pa. | 7.78 | Dam | | | | | do | | 2,500 | 320 |
| 030.8 | Windfall Run at Halsey Dam, near Mount Jewett, Pa. | 1.61 | do | | | | | do | | 410 | 250 |
| | GENESEE RIVER DRAINAGE BASIN | | | | | | | | | | |
| 143 | Genesee River at Scio, N. Y. | 309 | 1916–42 | May 22, 1919 | [6] 10.1 | 10,600 | 34.3 | 12:30 p. m. July 18 | 9.74 | 9,740 | 31.5 |
| 144 | Genesee River at St. Helena, N. Y. | 1,017 | 1908–42 | May 17, 1916 | 12.8 | 44,400 | 43.7 | 12:15 a. m. July 19 | 10.06 | 18,900 | 18.6 |
| 147.5 | Angelica Creek at Angelica, N. Y. | 61.0 | Slope area | | | | | July 18 | | 14,000 | 230 |

1 From floodmark.
2 About.
3 From floodmark at staff gage.
4 Greater flood occurred Mar. 18, 1936; discharge not determined.
5 Furnished by Corps of Engineers.
6 Observed.
7 One furnished by Corps of Engineers.

The maximum discharges, in second-feet per square mile, for the flood of July 1942 as given in table 4 are plotted with respect to the drainage area, in figure 43. Such a diagram is helpful in comparing the relative size of the flood in streams draining basins of different size. The size of a drainage basin, though important, is only one of many factors that influence the magnitude of the runoff. Some of the other factors are slope and shape of drainage basin, vegetative cover, and underlying rocks. As an aid to those who use a flood formula expressing the discharge in terms of the square root of the drainage area, a guide line representing $5{,}000/\sqrt{\text{drainage area}}$ has been drawn on figure 43. All measurements of drainage areas of less than 1 square mile and especially those less than 0.1 square mile are subject to errors that may be quite large owing to the small-scale maps on which they were measured.

## RAINFALL AND RUNOFF STUDIES

Studies of the volume of flood runoff and the precipitation required to produce it are often made to obtain basic information useful in other flood studies and in estimating floods produced by other storms. To obtain such basic information requires that both the data on rainfall and the data on runoff be complete in themselves and reasonably free of error.

There were only six gaging stations with drainage basins lying within, or mostly within, the 4-inch isohyetal lines on plate 2. At one of the gaging stations there was a staff gage only, and at two others staff-gage readings were used to fill in some of the gaps in the record from water-stage recorders. In preparing flood hydrographs for periods not based on continuous records of gage height, rainfall information was used as a matter of course as an aid in their definition. Thus at three gaging stations the runoff cannot be considered as having been obtained independently of the rainfall. With only three gaging stations at which the runoff was computed independently of the rainfall, and a total of six gaging stations in the storm area, it would seem that little basic rainfall-runoff information could be obtained for this flood. This conclusion is supported by the fact that, as explained on page 116, the interpretations made in drawing the isohyetal map were influenced strongly by the runoff as computed for the stream-gaging stations.

The rainfall-runoff studies made for this report are considered as a test of the reasonableness of the data given. They also show what is believed to be the actual relationship between the two quantities. The data are not considered good enough for use in other flood studies.

The results of the rainfall-runoff studies are given in table 5. The average depth of rainfall on each drainage basin was obtained by planimetering the isohyetal map (pl. 2). The direct storm runoff and

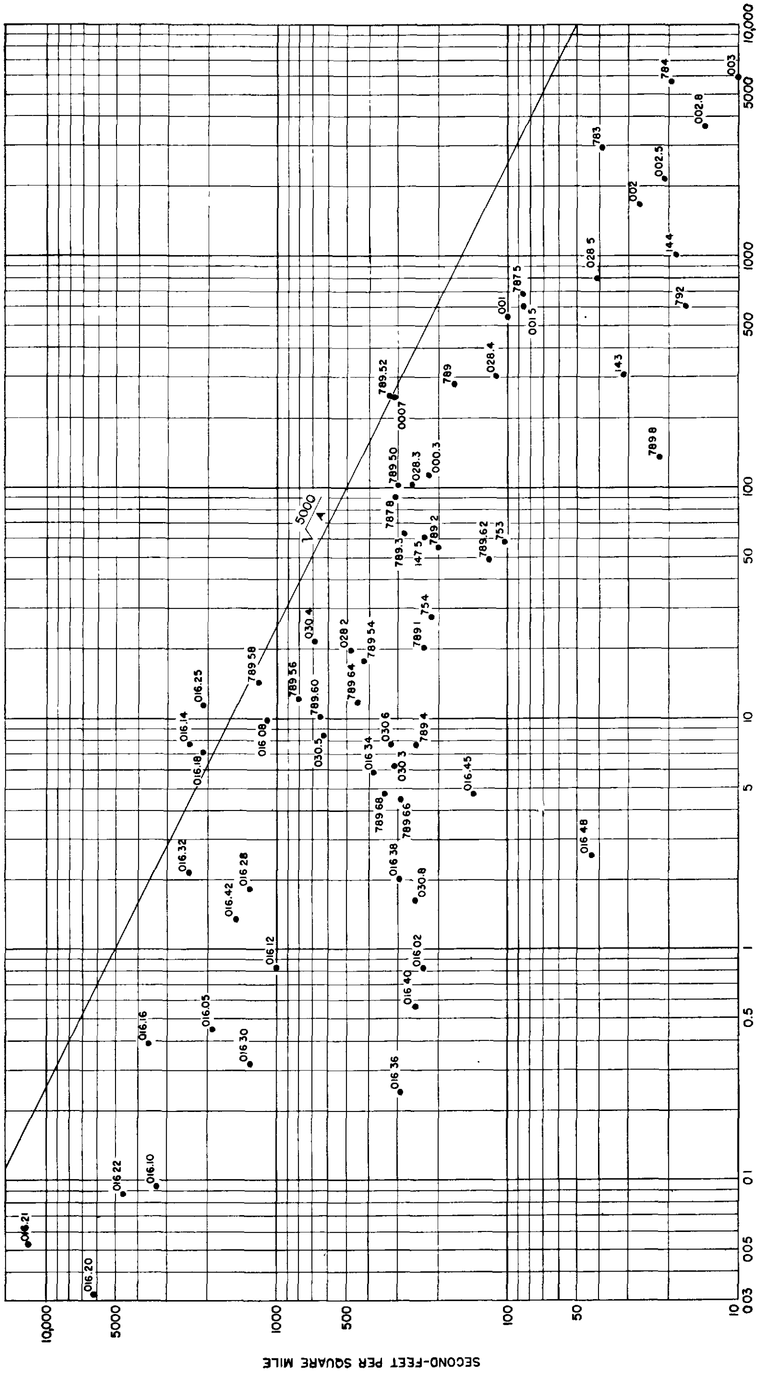


FIGURE 43.—Flood discharge, in second-feet per square mile, in relation to drainage area.

apparent ground-water recharge were obtained from the discharge hydrograph in the following manner: The recession curve, for flow before the flood, was extended through the flood period. The recession curve for the flood was drawn to exclude runoff from subsequent storms and was extended until it approached the recession curve of antecedent flow closely enough that the volume of runoff between the two curves beyond that point could be neglected without appreciable error. The volume of runoff represented by the flood hydrograph and recession curve, in excess of the recession curve of antecedent flow, was taken as the total storm runoff—the sum of the volume of direct storm runoff and the volume of apparent ground-water recharge. The separation between these last two quantities was obtained by arbitrarily drawing a straight line connecting the antecedent-flow recession curve, at about the time of the flood-peak discharge, with the point on the flood recession curve representing the end of direct runoff. This point was taken at the break in slope of the hydrograph when plotted semilogarithmically. The principles involved in this type of analysis are discussed in modern texts on hydrology and in previous flood reports of the Geological Survey (Langbein and others, 1947).

TABLE 5.—*Rainfall and associated direct runoff in selected drainage basins*

| No. on pl. 2 | Stream and point of measurement | Drainage area (square miles) | Rainfall (inches) | Direct storm runoff (inches) | Apparent ground-water recharge (inches) | Basin retention (inches) | Infiltration index |
|---|---|---|---|---|---|---|---|
| 789 | Driftwood Branch Sinnemahoning Creek at Sterling Run, Pa | 281 | 9.5 | 4.2 | 0.7 | 4.6 | 0.8 |
| 789.8 | Kettle Creek at Cross Fork, Pa | 136 | 4.0 | 1.0 | .5 | 2.5 | .6 |
| 001 | Allegheny River at Eldred, Pa | 550 | 11.5 | 5.6 | 2.0 | 3.9 | .9 |
| 002 | Allegheny River at Red House, N. Y | 1,690 | 7.8 | 2.8 | .8 | 4.2 | .9 |
| 028.4 | Clarion River at Ridgway, Pa | 303 | 6.7 | 2.3 | .4 | 4.0 | .8 |
| 143 | Genesee River at Scio, N. Y | 309 | 4.7 | 1.1 | .2 | 3.4 | .7 |

The ground-water recharge could be measured either as the volume of water in the ground represented by a rise in the water table, or it can be computed as the volume reaching the streams as ground-water seepage in excess of the ground-water seepage that would have reached them had there been no recharge. The latter method was used in this report. The overly simplified way in which it was obtained, however, makes it necessary to label it apparent ground-water recharge. As computed it is sufficiently accurate for the purpose of this study but for use in studies of ground-water supplies it may be appreciably in error.

The basin retention is the rainfall minus direct runoff and apparent ground-water recharge. It represents initial basin losses, replenishment of soil moisture, water stored in perched water tables and other forms of temporary storage. For the most part the basin retention probably will become part of the water loss from the basin. Some of the retention may be expected eventually to reach the zone of saturation. As used in this study, however, it is significant only as the difference between rainfall and runoff.

The infiltration index was computed in the usual manner (Langbein and others, 1947). It is given in table 5 to show the general agreement among the several drainage basins.

## FLOOD CRESTS

Records of available flood-crest elevations and the time of their occurrence are given in table 6. These data are basic for the study of time of travel of flood crests, amount of valley and channel storage, and of the limit of future development along a river.

The elevations given are referred to mean sea level, Sandy Hook datum, using the latest adjustment to the precise level net that was available at the time of the surveys in 1942. In a few instances the elevations given for gaging stations are slightly different from the ones that would be computed from information given in the station description, because the gage datum is referred to a later adjustment in the description.

Flood-crest elevations are never precise observations. The water surface of a stream during flood is wavy and frequently is higher on one bank than on the other. Crest elevations for points far back from the main channel must always be used with caution.

TABLE 6.—*Flood-crest elevations*

| Stream and location | Miles above month | Day and hour (July) | Elevation (feet) |
|---|---|---|---|
| SUSQUEHANNA RIVER DRAINAGE BASIN | | | |
| Bennett Branch Sinnemahoning Creek: | | | |
| Caledonia, Pa | 23.2 | | 1,108.4 |
| Medix Run, mouth of | 19.5 | | 1,043.2 |
| Benezette Run, mouth of | 16.1 | | 989.1 |
| Dents Run, mouth of | 9.0 | | 898.2 |
| Hicks Run, mouth of | 7.8 | | 891.7 |
| Pennsylvania R. R. bridge | 1.2 | | 810.6 |
| Sinnemahoning Creek: | | | |
| Driftwood, Pa., confluence of Bennett Branch and Driftwood Branch. | 15.5 | | |
| Sinnemahoning, Pa., USGS gage | 12.9 | 18, 10:45 p. m. | 790.6 |
| Sinnemahoning, Pa., Baltimore & Ohio R. R. bridge—upstream, right bank. | 12.6 | | 787.2 |
| R. R. bridge—upstream, left bank | 12.5 | | 786.8 |
| R. R. bridge—downstream, left bank | 12.5 | | 786.8 |
| First Fork Sinnemahoning Creek, mouth of | 11.8 | | 786.6 |
| Mouth, Keating, Pa | 0 | 18, 11:30 p. m. | 711.3 |
| Driftwood Branch Sinnemahoning Creek: | | | |
| Lockwood, Pa., mouth of North Creek | 22.0 | 18, 5 p. m. | 1,076.7 |
| Emporium, Pa | 20.3 | 18, 6:30 p. m. | 1,034.3 |
| Emporium Junction, Pa., mouth of Sinnemahoning Portage. | 19.3 | | 1,017.2 |
| Cameron, Pa., highway bridge | 14.0 | | 957.4 |
| Sterling Run, Pa., USGS staff gage | 10.1 | | 909.6 |
| Sterling Run, Pa., highway bridge, USGS recording gage | 9.9 | 18, 8:45 p. m. | 909.3 |
| Driftwood, Pa., Pennsylvania R. R. bridge | .05 | | 808.0 |

TABLE 6.—*Flood-crest elevations*—Continued

| Stream and location | Miles above month | Day and hour (July) | Elevation (feet) |
|---|---|---|---|
| SUSQUEHANNA RIVER DRAINAGE BASIN—Continued | | | |
| First Fork Sinnemahoning Creek: | | | |
| Costello, Pa.. mouth of Freeman Run | 25.2 | 18, 1 p. m. | 1,195.4 |
| Nelson Run, 0.6 mile below mouth of | 21.4 | | 1,132.7 |
| Wharton, Pa., mouth of East Fork | 19.7 | 18, 2 p. m. | 1,094.5 |
| Bailey Run, mouth of | 17.2 | | 1,063.5 |
| First Fork, Pa | 12.0 | 18, 3 p. m. | |
| Lushbaugh, Pa., 1.1 miles downstream at mouth of Short Bend Run. | 8.1 | | 907.4 |
| Lick Island | 4.3 | 18, 4 p. m. | 844.7 |
| Mouth | 0 | 18, 5 p. m. | |
| Freeman Run: | | | |
| Austin, Pa., above, at dam that failed | 5.6 | 18, 11 a. m. | |
| Austin, Pa., Ford garage | 3.3 | 18, 11:30 a. m. | 1,353.5 |
| Highway bridge | .6 | | 1,223.4 |
| East Fork Sinnemahoning Creek: Highway bridge | 2.5 | | 1,172.8 |
| ALLEGHENY RIVER DRAINAGE BASIN | | | |
| Allegheny River: [1] | | | |
| Seven Bridges, Pa., Dunn farm | 317.9 | 18, 7:30 a. m. | 1,930.9 |
| Coudersport, Pa., highway bridge | 308.6 | 18, 1:30 p. m. | 1,646.7 |
| Roulette, Pa., highway bridge | 298.3 | 18, 2 p. m. | 1,535.1 |
| Burtville, Pa., highway bridge | 295.1 | | 1,505.4 |
| Port Allegany, Pa., State Highway 155, bridge | 289.6 | | 1,482.1 |
| Port Allegany, Pa., U. S. Highway 6, old bridge | 288.9 | 18, 3:30 p. m. | 1,479.0 |
| Port Allegany, Pa., U. S. Highway 6, new bridge (destroyed by flood). | 288.0 | | 1,477.4 |
| Turtlepoint, Pa., highway bridge | 281.7 | | 1,453.7 |
| Larabee, Pa., highway bridge, USGS gage (discontinued) | 276.4 | 19, 1 a. m. | 1,447.4 |
| Eldred, Pa., highway bridge, USGS gage | 269.0 | 19, 9:30 a. m. | 1,443.8 |
| Mill Grove, N. Y., highway bridge | 262.9 | | 1,434.5 |
| Portville, N. Y., fire department building | 261.4 | 19, 3 p. m. | 1,434.5 |
| Olean, N. Y., highway bridge | 255.5 | 19, 6:30 p. m. | 1,423.3 |
| North Allegany, N. Y., highway bridge | 250.7 | | 1,413.9 |
| Vandalia, N. Y., highway bridge | 246.4 | 19, 11:30 p. m. | 1,404.7 |
| Riverside Junction, N. Y., Erie R. R. bridge | 242.1 | | 1,393.5 |
| South Carrollton, N. Y., railroad bridge | 240.4 | | 1,388.6 |
| Salamanca, N. Y., highway bridge | 233.7 | 20, 5 a. m. | 1,374.2 |
| Red House, N. Y., highway bridge, USGS gage | 226.0 | 20, 8:30 a. m. | 1,342.2 |
| Quaker Bridge, N. Y., highway bridge | 220.4 | | 1,320.2 |
| Onoville, N. Y., highway bridge | 214.0 | | 1,290.6 |
| Kinzua, Pa., railroad bridge, USGS gage | 200.0 | 20, 5 p. m. | 1,217.7 |
| Clarion River: | | | |
| Instanter | 109.4 | 18, 3:30 p. m. | |
| Johnsonburg, Pa., lower highway bridge | 94.0 | 18, 9 p. m. | 1,439.8 |
| Ridgway, Pa., West Penn power station | 88.4 | | 1,390.0 |
| Ridgway, Pa., Main Street bridge, USGS gage | 87.4 | 19, 1 a. m. | 1,378.0 |
| Carman, Pa., highway bridge | 80.1 | | 1,330.4 |
| Bell Town, Pa., highway bridge | 62.2 | | 1,225.2 |
| Cooksburg, Pa., dam site gage | 49.3 | | 1,170.6 |
| Cooksburg, Pa., highway bridge, USGS gage | 47.6 | 19, 9:30 a. m. | 1,161.4 |
| Clarion, Pa., Piney Dam, upper pool | 25.1 | | 1,093.1 |
| St. Petersburg, Pa., highway bridge, USGS gage | 4.5 | 19, 2 p. m. | 891.0 |

[1] Data other than for gaging stations furnished by Corps of Engineers.

## RECORDS OF PREVIOUS FLOODS

The floods of July 18, 1942, were unprecedented in the area of heaviest rainfall. That such extreme floods have occurred in the past in other parts of Pennsylvania and adjoining States is shown by the following descriptions of earlier floods. Perhaps the earliest flood from the cloudburst type of storm in Pennsylvania of which there is accurate record is that of August 5, 1843, in Delaware County. In view of the description of the storm given in an earlier section of this report it seems appropriate to include a description of the flood flows also. Following that description are short descriptions of recent

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floods caused by intense local rains in Pennsylvania and New Jersey. The section closes with a few notes on previous floods in Allegheny River at Salamanca, N. Y.

## FLOOD OF AUGUST 5, 1843, IN DELAWARE COUNTY, PA.

Although confined to a smaller area, the flood of August 5, 1843, in Delaware County was every bit as large as the flood of July 1942 in the north-central part of the State. The following description of that flood is included in this report so that comparisons between the two can be made and to emphasize the fact that previous floods of this magnitude have occurred. Descriptive details of the storm have been given in a previous section by Mr. Stewart. The measured amounts of rainfall given in the original report (Delaware County Inst. Sci., 1910) on that flood have been summarized in table 7.

TABLE 7.—*Rainfall records for storm of August 5, 1843, in Delaware County*

| Place | Amount (inches) | Remarks |
|---|---|---|
| Haverford School | 5.82 | Measured in a rain gage. |
| Upper Darby | 3.75 | 0.5 inch before 12 m., heavy rain 3 to 7 p. m., 1 inch in 15 minutes just before 7 p. m. |
| Newtown Township | Between 11 and 13 | 2 to 5 p. m. |
| Newtown Square | 5.5 | 4:20 to 5 p. m. |
| Concord Township | 16 | 2:45 to 5:45 p. m. |
| Brandywine Hundred, Del | 10 | 2 to 4 p. m. |

NOTE.—"The amount of rain which fell on that part of the County which borders on the Delaware River and embraces the mouths and lower parts of the inundated creeks was not sufficient to produce even an ordinary rise in the stream" (Delaware County Inst. Sci., 1910, p. 9).

The heavy rainfall apparently did not last more than about 3 hours, but the time of its occurrence varied throughout the county. The area covered by the cloudburst was less than the area of Delaware County although small areas of adjacent counties were affected. It followed on the heels of a general storm that extended much beyond the limits of Delaware County in every direction. The total rain prior to the cloudburst probably did not exceed three-quarters of an inch and little rise was noted in the streams. As a result of the general rain, however, the ground was soaked, thus reducing the infiltration and increasing the direct runoff from the cloudburst storm that followed. The heavy rain occurred near the headwaters of the streams unknown to residents of the lower valleys. The floods burst on them with devastating suddenness, causing the loss of 12 lives. The rapid rise of water is attested to by the many accounts of an almost instantaneous rise in the water from 5 to 8 or 10 feet. At one point on Crum Creek the water rose 7 or 8 feet in 10 minutes. Farther downstream at Avondale it was observed that (Delaware County Inst. Sci., 1910, p. 28):

* * * the water at this place rose 19 feet—6 feet higher than the great ice freshet of 1839. The rise in the creek commenced at about half past seven o'clock. The water rose very suddenly as well as unexpectedly, and was at its highest point a little after eight o'clock.

The fall of the flood waters was equally rapid; in Chester Creek at Flower's Mill the waters fell 10 feet in 50 minutes.

The maximum stages above low water reached by the major streams in the County were: Darby Creek, 17.5 feet; Crum Creek, 20 feet; Ridley Creek, 21 feet; and Chester Creek, 33 feet. There is little quantitative information available on peak discharges in these streams other than the description of a cross section on each:

*Darby Creek*, a short distance below the West Chester Road (Delaware County Inst. Sci., 1910, p. 22):

The flood attained a height of 15 feet at this place, with a cross section of 80 yards, which with proper allowances, would give an area of 2,800 feet.

*Crum Creek* (Delaware County Inst. Sci., 1910, p. 26):

Immediately below the point where the road from Newtown Square crosses the creek, the flood reached the height of 9 feet upon a cross section at the surface of 330 feet.

*Ridley Creek* (Delaware County Inst. Sci., 1910, p. 29):

* * * on the farm of George Howard, in Edgmont. At this place the water attained a height of 12 feet 6 inches, which was 6 feet 6 inches higher than the great freshet of 1839, and 6 feet 4 inches higher than that of 1795; this last being the highest which had previously occurred at the same place during a period of at least 90 years. * * * A cross section of the flood of 1795 gives but 900 square feet, while that of 1843 gives upwards of 2,500 square feet.

*Chester Creek.* A detailed description of a cross section on this stream is given by John F. Frazer of Philadelphia, who was visiting at the farm of Samuel West (Delaware County Inst. Sci., 1910, p. 43).

The height of the flood I measured with as much accuracy as my means would permit, and am confident that my measures are correct within one or two inches, at the same time I must observe that the elevations are taken above the level of the creek, a day or two after the flood, when from the continuance of wet weather, the creek was still above its ordinary level; how much it is impossible for me to say. At the position where I first measured it (upon Mr. West's upper meadow) the creek was sixty feet wide, and averaged about six feet in depth (it is the upper end of the backwater from Flower's dam). The vertical height of the flood was 20.58 feet above the water line, or 26.5 feet above the bottom of the channel of the creek. The breadth of the water line at the highest point of the flood (measured at right angles to the direction of the creek) was 534.8 feet (say 535 feet). The meadows overflowed, on either side, are quite flat, and appear to have been at some former time, the banks of the stream or current, so that I think we may assume the area of the cross section as at least two-thirds of the rectangular area given by multiplying the breadth by the height. Assuming then the number 535 and 21 are representing these (neglecting the channel actually occupied by the creek) we shall have the area of the cross section 7,490 square feet. Assuming the creek to be sixty feet wide and six feet deep, and its cross section a rectangle (as it is very nearly) we have an area of 360 square feet for the creek at its ordinary high water, by which we see that the cross section was increased twenty times. The increase of velocity I had no means of ascertaining, as the greater breadth at this point give rise to the formation of extensive eddies. * * * Professor Frazer is of the opinion that at Mr. West's (judging from the motion of the cotton bales) the velocity of the middle of the stream was not less than from fifteen to twenty miles per hour.

The cross section described by Professor Frazer is about a mile below the present Geological Survey gaging station at Dutton Mill Bridge.

For the four cross sections just described, I. E. Houk (1922) estimated velocities after a personal field inspection of the locations and a study of the channel slopes. The results of his calculations are as follows:

TABLE 8.—*Summary of flood discharges in Delaware County, Aug. 5, 1843*

| Stream | Drainage area (square miles) | Runoff | |
|---|---|---|---|
| | | Cubic feet per second per square mile | Inches per hour |
| Darby Creek | [1] 32 | 880 | 1.36 |
| Crum Creek | 22 | 410 | .64 |
| Ridley Creek | 20 | 750 | 1.16 |
| Chester Creek | 62 | 1,000 | 1.55 |

[1] Careful investigation indicates that 32 square miles is a better figure for this location than 48 square miles as given by Houk. Other figures have been revised based on the same peak discharge.

The destruction caused by the storm and flood was calamitous, the losses in Delaware County being estimated at nearly a quarter of a million dollars. This amount of damage is not surprising when one reads of the dams and bridges destroyed and stone buildings being knocked down "stone by stone." The force of the flood is shown in the accounts of a rock weighing 2½ tons that was carried 200 yards, a meadow that was excavated to depths of 4 and 5 feet, and a rock weighing between 10 and 12 tons that was moved about 75 feet.

## FLOOD OF SEPTEMBER 1, 1940, IN SOUTHERN NEW JERSEY

Peak flood discharges in southern New Jersey streams Sept. 1, 1940, were as great as many of those in the flood of July 1942 in Pennsylvania from drainage basins of comparable size. The greatest discharge, both in actual amount and in relation to size of drainage area, was the flow of 26,100 second-feet in Salem Creek below Woodstown. The floods resulted primarily from extraordinary rainfalls associated with the passing of a hurricane off the New Jersey coast. Contributing factors were the breaching of many small dams and the week of antecedent rainfall that soaked the ground and weakened earth dams.

The rainfalls that produced these floods included the maximum 12-hour rainfall in the United States—24 inches in 9 hours at Ewan. The average rainfall on 2,000 square miles was 7.8 inches according to the Corps of Engineers. The flood caused the death of four persons and damage amounting to $1,000,000 according to the Weather Bureau. In addition many thousands of persons were seriously inconvenienced by washed out railroad and highway bridges and flooded highways during Labor Day week-end. Some communities were virtually isolated. A large part of the damage was caused by the breaking of many small dams.

Miscellaneous measurements of peak discharge were made by the Geological Survey and the New Jersey State Water Policy Commission. The results of these measurements are given in table 9 together with peak discharges at stream-gaging stations. Daily discharges at the stream-gaging stations are published in Water-Supply Paper 891, Surface-water supply of the United States, part 1, north Atlantic slope basins.

TABLE 9.—*Summary of flood discharges in southern New Jersey for the flood of September 1, 1940*

| Stream and place of determination | Drainage area (square miles) | Period of record or method of measuring | Maximum flood previously known: Date | Maximum flood previously known: Gage height (feet) | Maximum flood previously known: Discharge: Second-feet | Maximum flood previously known: Discharge: Second-feet per square mile | Maximum during present flood: Time | Maximum during present flood: Gage height (feet) | Maximum during present flood: Discharge: Second-feet | Maximum during present flood: Discharge: Second-feet per square mile |
|---|---|---|---|---|---|---|---|---|---|---|
| **GREAT EGG HARBOR RIVER DRAINAGE BASIN** | | | | | | | | | | |
| Great Egg Harbor River at Folsom | 56.3 | 1925–40 | Sept. 23, 1938 | 6.59 | 718 | 12.8 | Sept. 3 | 9.09 | 1,440 | 25.6 |
| **MAURICE RIVER BASIN** | | | | | | | | | | |
| Maurice River at Norma | 113 | 1932–40 | Sept. 8, 1935 | 5.30 | 1,090 | 9.6 | Sept. 2, 1 p. m. | 8.72 | 7,360 | 65.1 |
| Maurice River at Millville [1] | 218 | Dam | | | | | Sept. 2 | | 6,500 | 29.8 |
| Manantico Creek, near Millville | 22.3 | 1931–40 | Aug. 20, 1939 | 6.21 | 1,050 | 47.1 | Sept. 2, 2 p. m. | 3.88 | 363 | 16.3 |
| **COHANSEY CREEK BASIN** | | | | | | | | | | |
| Cohansey Creek at Bostwick Dam, at Beals Mill.[1] | 8.3 | Dam | | | | | Sept. 1 | | 2,100 | 253 |
| Barrett Run at Mary Elmer Dam at, Bridgeton [1] | 7.5 | do | | | | | do | | 1,850 | 247 |
| **DELAWARE RIVER DRAINAGE BASIN** | | | | | | | | | | |
| Assunpink Creek at Trenton | 89.4 | 1923–40 | Sept. 22, 1938 | 10.74 | 3,320 | 37.1 | Sept. 3, 3–4 a. m. | 6.00 | 1,230 | 13.8 |
| Crosswicks Creek at Extonville | 83.6 | 1940 | | | | | Sept. 1 | 12.05 | 3,360 | 40.2 |
| North Branch Rancocas Creek at Pemberton | 111 | 1921–40 | Aug. 21, 1939 | 10.77 | 1,730 | 15.6 | Sept. 1, about 3 p. m. | 9.65 | 1,480 | 13.3 |
| Haynes Creek at Medford Lakes [1] | 3.3 | Orifice | | | | | Sept. 1 | | 223 | 67.6 |
| Kettle Run at Taunton [1] | 7.3 | do | | | | | do | | 500 | 68.5 |
| Sharps Run at Pa. R. R. culvert at Medford [1] | 4.9 | do | | | | | do | | 700 | 143 |
| Big Timber Creek at Clementon Park Dam, at Clementon.[1] | 2.8 | Critical depth | | | | | do | | 800 | 286 |
| Mantua Creek at Pitman | 6.75 | Dam | | | | | do | | 4,200 | 622 |
| Racoon Creek at State Highway 45, at Mullica Hill.[1] | 14.0 | Critical depth | | | | | do | | 2,900 | 207 |
| Oldmans Creek at Jessups Mills | 4.15 | Contracted opening | | | | | do | | 2,950 | 711 |
| Oldmans Creek near Woodstown | 19.3 | 1931–40 | June 27, 1938 | 9.08 | 1,190 | 61.6 | do | 20.3 | 8,100 | 420 |
| Salem Creek at Woods Mill | 4.3 | Dam | | | | | do | | 7,090 | 1,650 |
| Salem Creek below Woodstown | 17.5 | Slope area | | | | | do | | 26,100 | 1,490 |
| Branch of Salem Creek 3 miles east of Woodstown. | 3.2 | do | | | | | do | | 3,880 | 1,210 |
| Branch of Alloway Creek 1½ miles northeast of Alloway. | 8.7 | do | | | | | do | | 10,800 | 1,240 |
| Branch of Alloway Creek east of Alloway | 5.5 | Contracted opening | | | | | do | | 3,300 | 600 |

[1] Furnished by New Jersey State Water Policy Commission.

## FLOODS OF JUNE 4–5, 1941, IN SOUTHWESTERN PENNSYLVANIA

Outstanding floods occurred in many small streams in Monongahela River Basin as a result of heavy rains June 3 and 4. The flood discharge of Castile Run at Riggle Farm, Pa., was comparable with the higher discharges in the 1942 flood in the north-central part of the State.

The flood-producing rains were preceded by showers that began on May 30. The heavy rains occurred in the afternoon and night of June 3 and again in the afternoon of June 4. They were described by the official in charge, Weather Bureau office, Pittsburgh (Monthly Weather Review, June 1941):

> The rains were unprecedented for several of the southwestern counties in Pennsylvania, and adjacent counties in West Virginia, being in excess of 6 inches for the 24 hours ending at 7 a. m. of the 5th. At Brownsville, Pa., Government lock No. 5, the precipitation on the morning of the 5th measured 6.27 inches.

The Geological Survey made an extensive investigation of the flood area to obtain the peak discharges of the small streams. The results of that investigation are given in table 10. Also given in table 10 are the peak discharges at the stream-gaging stations in the area; daily discharges at these stations are published in Water-Supply Paper 923, Surface-water supply of the United States, 1941, part 3, Ohio River Basin.

TABLE 10.—*Summary of flood discharges in southwestern Pennsylvania for the floods of June 4–5, 1941*

| Stream and place of determination | Drainage area (square miles) | Period of record or method of measuring | Maximum flood previously known | | | | Maximum during present flood | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Date | Gage height (feet) | Discharge | | Time | Gage height (feet) | Discharge | |
| | | | | | Second-feet | Second-feet per square mile | | | Second-feet | Second-feet per square mile |
| Ohio River at Sewickley | 19,500 | 1933–41 | Mar. 18, 1936 | 34.75 | 574,000 | 29 | June 5 | 16.68 | 234,000 | 12 |
| Monongahela River at Greensboro | 4,407 | 1939–41 | Mar. 18, 1936 | 28.4 | 147,000 | 33 | June 4 | 24.28 | [1] 117,000 | |
| Monongahela River at Charleroi | 5,213 | 1886–1905, 1933–41 | July 11, 1888 | 26.1 | [2] 156,000 | 30 | June 5 | 20.85 | [1] 133,000 | |
| Monongahela River at Braddock | 7,337 | 1939–41 | Mar. 18, 1936 | 38.8 | ([3]) | | June 5 | 31.20 | [1] 201,000 | |
| Dunkard Creek at Shannopin | 229 | 1941 | | | | | June 4, 12 p. m. | 14.02 | 16,800 | 73 |
| South Fork Tenmile Creek at Jefferson | 180 | 1931–41 | Nov. 4, 1936 | 13.8 | 8,100 | 45 | June 4 | 18.45 | 13,800 | 77 |
| Tenmile Creek in West Bethlehem Township [4] | 99.3 | Dam | | | | | June 4 or 5 | | 7,800 | 79 |
| Wisecarver Run near Waynesburg | 3.91 | do | | | | | do | | [5] 827 | |
| Ruff Creek at Grimes School | 21.1 | Slope area | | | | | do | | 8,900 | 422 |
| Ruff Creek at Lippincott School | 23.8 | do | | | | | do | | 9,490 | 399 |
| Castile Run at Old Castile School | 1.76 | do | | | | | do | | 2,320 | 1,320 |
| Castile Run at Riggle Farm | 4.25 | do | | | | | do | | 10,000 | 2,350 |
| Twomile Run near Brownsville | 2.68 | do | | | | | do | | 3,650 | 1,360 |
| Tributary to Monongahela River in East Pike Run Township.[4] | .17 | Dam | | | | | do | | 286 | 1,680 |
| Dunlap Creek at Dunlap | 36.0 | Slope area | | | | | do | | 3,560 | 99 |
| Branch of Dunlap Creek in Redstone Township [4] | .19 | Dam | | | | | do | | 45 | 237 |
| Fourmile Run in Redstone Township [4] | .24 | do | | | | | do | | 58 | 242 |
| Redstone Creek at Braznell [6] | 105 | Slope area | | | | | do | | 12,800 | 122 |
| Allen Run, near Smock | 3.17 | Dam | | | | | do | | 3,070 | 968 |
| Crabapple Run at Spillway Lake | 1.33 | do | | | | | do | | [5] 860 | |
| Washwater Run in Jefferson Township [4] | 1.58 | do | | | | | do | | 1,320 | 835 |
| Colvin Run at Grindstone | 2.68 | do | | | | | do | | 2,000 | 746 |
| Pike Run at Daisytown | 20.1 | Contracted opening | | | | | do | | 7,710 | 384 |
| Pike Run near Coal Center | 20.7 | Slope area | | | | | do | | 7,860 | 380 |
| North Branch Little Redstone Creek in Jefferson Township.[4] | .28 | Dam | | | | | do | | 154 | 550 |
| Youghiogheny River below Confluence | 1,029 | 1940–41 | | | | | June 4 | 16.42 | 43,800 | 43 |
| Youghiogheny River at Connellsville | 1,326 | 1908–41 | Mar. 18, 1936 | 20.28 | [1] 92,500 | | June 5 | 17.02 | [1] 63,600 | |
| Youghiogheny River at Sutersville | 1,715 | 1915–29, 1931–36, 1938–41 | do | 30.65 | 100,000 | 58 | June 5 | 27.34 | 78,000 | 45 |
| Casselman River at Markleton | 382 | 1913–41 | Mar. 17, 1936 | 16.4 | 35,800 | 94 | June 5, 12:30 a. m. | 10.24 | 18,700 | 49 |
| Laurel Hill Creek at Ursina | 121 | do | do | 10.28 | 10,300 | 85 | June 4, 10:30 p. m. | 7.98 | 9,400 | 78 |
| Indian Creek at Indian Run Dam | 110 | Dam | | | | | June 4 or 5 | | 6,430 | 58 |
| Branch of Washington Run at Upper Dam, at Star Junction. | .65 | do | | | | | do | | 730 | 1,120 |
| Branch of Washington Run at Lower Dam, at Star Junction. | 1.02 | do | | | | | do | | [5] 620 | |
| Jacobs Creek at Upper Dam, at Bridgeport | 31.8 | do | | | | | do | | [5] 1,970 | |

[1] [illegible]. [2] About. [3] Discharge not determined. [4] Furnished by Pennsylvania Department of Forests and Waters. [5] Affected by storage. [6] Furnished by Corps of Engineers.

## PREVIOUS FLOODS AT SALAMANCA, N. Y.

In the course of his investigation of the flood of July 1942, Hollister Johnson obtained interesting information concerning previous floods in Allegheny River at Salamanca, N. Y. Although the information may not be very accurate owing to the lapse of time and the changes that have taken place in the river channel, they are reported for possible future use.

*Floods of June 1889 and June 1892.*—Although there is some doubt as to which of these two floods was the higher, there is little doubt that both were higher than the flood of 1942. Mr. A. R. Eaton remembered that the flood of 1889 reached the bottom of the floor boards in the basement of the Eaton Department Store on Broad St. (now the S and S store) in which he was living. (Flood elevation was 1,374.3 feet compared with 1,373.7 feet in 1942.) Mr. Fred F. Nies has photographs presumably taken during the flood of 1892. From one of these photographs, the flood elevation at the Shultz Bros. tailoring shop, about 200 feet above the highway bridge, was found to be 1,375.7 feet. Mr. Nies also stated that the flood of 1892 just covered plumbing benches in the basement of Andrews Hardware Store, just downstream from the highway bridge, at elevation 1,374.9 feet. The 1942 flood at these locations was 1,374.9 and 1,374.0 feet, respectively. The significance of these old flood elevations is largely dissipated by the statement of Mr. Eaton that there have been important changes in the river channel since then. There used to be a mill race on the left bank, about three-quarters of a mile long, with a dam for diverting water into it.

*Flood of March 1913.*—Mr. Fred F. Nies built his garage and plumbing shop on the right bank of the river about 100 feet below the highway bridge. Although the flood of 1913 was about 18 inches below the floor of this garage, according to Mr. Nies, no flood prior to 1942 ever reached the floor. (Flood elevations, 1,371.2 and 1,373.9 feet, respectively.)

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