Big Creek near Waynesville, North Carolina

(Also referred to as "near Sunburst," "Burnett Siding," and "above Lake Logan")
(Miscellaneous ungaged site, Big Creek basin, USGS North Carolina Water Science Center)

Review of peak discharge for the flood of August 30, 1940

Location: This flood was located about 1.6 mi northwest of Adako, N.C. at 35.9161N and 81.7292W.

Published peak discharge: A peak discharge of 13,000 ft^3/s is published in Crippen and Bue (1977). A peak discharge of 12,500 ft^3/s is published in Costa (1987a, 1987b). A peak discharge of 12,000 ft^3/s is published in U.S. Geological Survey (1949). The indirect measurement shows the computed and reviewed peak discharge as 12,400 ft^3/s.

Drainage area: The drainage area for this site varies by publication as follows:

Publication	Drainage area (mi^2)
Crippen and Bue, 1977	1.32
Costa, 1987a, 1987b	1.69 (4.38 km^2)
U.S. Geological Survey, 1949	1.69
Indirect measurement notes, 1941	1.69 (planimeter, unknown quad)
Topographic map (7.5 minute) estimate, 2003	1.93 (by planimeter)

The indirect measurement notes do not give a specific location of the surveyed site. The survey site is assumed to be about 700 ft upstream of the mouth. The indirect measurement review states that the Tennessee Valley Authority (TVA) made an indirect computation at a site 500 ft upstream of the USGS miscellaneous site and assigned a drainage area of 1.32 mi^2. This may explain the drainage area of 1.32 mi^2 given by Crippen and Bue (1977).

Data for storm causing flood: The TVA report "Floods of August 1940 in Tennessee River Basin" shows an average rainfall of 9.0 in. for the Big Creek basin. Individual rain gages in the area show rainfall amounts as much as about 12 in., over 20–40 hours. The main storm lasted about 22–27 hours.

U.S. Geological Survey (1949) refers to this storm as the "late-August storm," which was a comparatively local meteorological disturbance in the Little Tennessee and French Broad River basins. That report states that rainfall ranged from 8 to 13 in. for periods of 20 to 30 hours. In Haywood County, where Big Creek is located, published rainfall totals at 12 locations ranged from 3.5 to 11.3 in. Many of these values were obtained from a bucket survey and were furnished by the TVA. Historical photographs taken after the August 30, 1940, flood and during the 2003 review and described herein are provided in figures A145–A148.

Method of peak discharge determination: A three-section slope-area measurement was made on May 6, 1941, more than 8 months after the flood. There is no explanation for the time lapse between the flood and the survey. There is no indication that high-water marks were flagged soon after the flood or if they were located during the May 6 survey. A couple of marks are described as "good," which is hard to believe 8 months after the flood. The plotted high-water profile appears consistent with most marks lining up fairly well.

Another discrepancy is that the front sheet of the indirect measurement shows the date of the flood as August 30, 1941, rather than 1940. This probably is an inadvertent typographical error.

The actual location of the survey is assumed to be about 700 ft upstream of the mouth of Big Creek. The indirect measurement notes do not include a location description.

A number of manual computations originally were made using all three cross sections and also using only two sections. The two-section reach from the upstream to the middle section was expanding and was not used. The two-section reach from the middle to the downstream section was contracting and was used to compute a peak discharge of 12,400 ft^3/s. Although a number of other computations were tried, the discharge of 12,400 ft^3/s was the final discharge selected. This review revealed a minor error of about 5 percent in the cross-sectional area of the middle cross section, which probably has little effect on the final result.

For this review, all three cross sections, the original "*n*" values and the original water-surface elevations were entered in the slope-area computation (SAC) program. A peak discharge of 16,400 ft^3/s was computed using all three sections, but because of the expanding reach from sections 020 to 075, this computation is not acceptable. A peak discharge of 11,800 ft^3/s was computed using only the middle (075) and downstream (125) sections. This is 5 percent less than the original hand-computed discharge.

Froude numbers were not computed in the original hand computations. The SAC computations for the discharge of 11,800 ft^3/s gave Froude numbers of 1.0 for section 075, and 1.2 for section 125. Average velocities ranged from 17 ft/s at section 075 to 21 ft/s at section 125. The water surface fall was 3.55 ft in a distance of 50 ft (water slope = 0.071 ft/ft).

Possible sources of error: The most obvious and significant source of error for this indirect measurement is that it was most probably a debris flow/debris avalanche rather than a water flood. First hand reports, including field observations, notes and photographs document the mountain slides that occurred in the upstream reaches of Big Creek and the resultant scour and deposition of rocks, boulders, and sediment in the downstream reaches. A report, "Mountain Slides on the West Fork of the Pigeon River", by the TVA (HD-1044, no date), provides a detailed description of the mountain slides in the Big Creek basin.

Photographs taken at or near the indirect measurement site show many large rocks and boulders in the channel. There is also evidence of significant scour of the banks, which contributes to uncertainty in cross-sectional area at the flood peak.

Another source of error is the delayed time (more than 8 months) between the flood and the indirect measurement survey. The accuracy of high-water marks is questionable. Very high velocities (20 ft/s or more) are indicated by the computations, and Froude numbers slightly exceed 1 (critical to supercritical flow). The reach length is only 50 ft.

Recommendations of what could have been done differently: The site should have been visited soon after the flood rather than 8 months later. This may have revealed more definitively that a debris flow occurred and that a standard indirect measurement would not be reliable. However, debris-flow processes were poorly understood in 1940; hence, recognition and identification of a debris flow likely would have been unrealistic. Photographs immediately after the flow would have been useful. There probably is no reliable way to determine the water discharge for this flood.

Site visit and review: The site was visited on August 25, 2003, by V.B. Sauer and Gene Barker (USGS). Although the exact location of the slope-area survey is uncertain, the channel near the slope-area survey (about 700 ft upstream of the mouth of Big Creek) is extremely overgrown with weeds, brush, and trees. The channel has a steep gradient (0.071 ft/ft) with large rocks and small boulders throughout. Photographs are included for the point where Big Creek enters West Fork Pigeon River, which shows a very rocky channel with large rocks along the right bank. A USGS gaging station on the right bank of West Fork Pigeon River, about 600 ft upstream of the mouth of Big Creek, has been operated since February 26, 1954. The station description for this gaging station does not mention the 1940 flood. The largest discharge for this site since 1954 is 9,740 ft^3/s. Drainage area is 27.6 mi^2.

Recommendations: The original peak discharge should not be used and should be removed from the record because the peak discharge is unreliable. However, the fact that a large and extraordinary flood occurred should be retained and documented in some way.

The peak discharge for this site is unreliable because of the very strong evidence that this was a debris flow and not a water flood. Conditions are such that it would be incorrect to recompute, or determine using other methods, a reliable peak discharge.

In addition, an indirect measurement for the August 1940 flood for a stream named "Big Branch" was found (but not reviewed for this study). This indirect measurement is named "Tributary to Little East Fork Pigeon River (near High Top) near Sunburst, N.C."-This was likely a debris flow as well on the basis of the geomorphic setting, and this indirect measurement should be reviewed.

Figure A145. Debris avalanche scar in headwaters of Big Creek, Big Creek near Waynesville, North Carolina, August 1940.

Figure A146. View looking downstream of slope-area reach, Big Creek near Waynesville, North Carolina, August 1940.

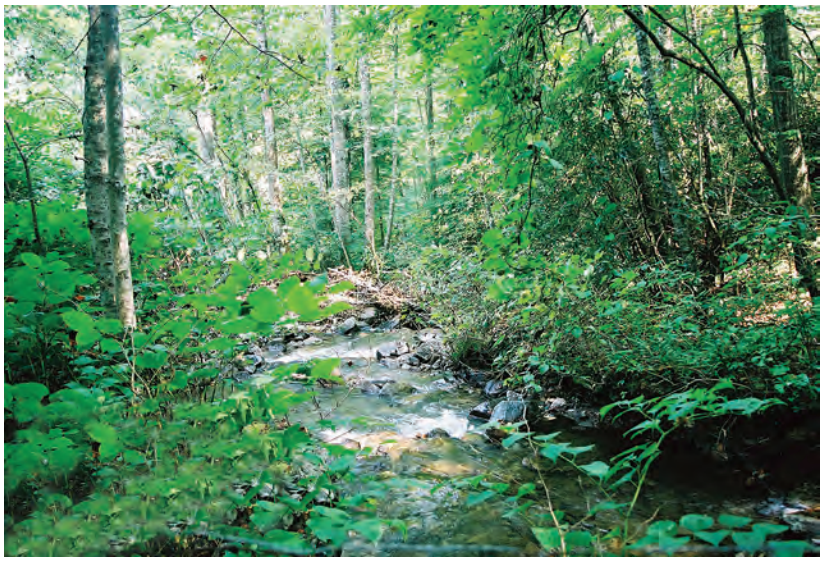

Figure A147. View looking downstream about 700 feet upstream of mouth, Big Creek near Waynesville, North Carolina, August 25, 2003.

Figure A148. View looking downstream along right bank opposite mouth of Big Creek, likely source of coarse boulders, West Fork Pigeon River near Waynesville, North Carolina, August 25, 2003.