Castle Creek Tributary No. 2 near Rochford, South Dakota

(Miscellaneous ungaged site in the Cheyenne River basin, USGS South Dakota Water Science Center)

Review of peak discharge for the flood of July 28, 1955

Location: This flood was located about 5 mi southwest of Rochford, S.D., at 44.0656N and 103.7994W.

Published peak discharge: The peak discharge occurred on July 28, 1955, and was determined from an indirect measurement to be 98.9 ft^3/s (Wells, 1962). During review in 1955, the culvert computation was increased by 1.2 ft^3/s, but the review recommended no revision. The combination measurement (culvert plus road overflow) was rated fair.

Drainage area: 0.0192 mi^2 (about 12 acres). Because of the small area, the perimeter of the basin was defined by transit/stadia survey at the time the flood was surveyed, and the area was determined by planimeter.

Data for storm causing flood: The flooding in the Rochford area was documented by Wells (1962, p. 110-113). According to Wells (1962, p. 110), as much as 5 in. of rain fell in 2 hours in the storm center 6.5 mi southwest of Rochford. Wells (1962) developed an isohyetal map of the area for July 28 and reported results for indirect measurements at eight miscellaneous sites. The July 29, 1955, edition of the Rapid City Journal featured several stories about the storm and resulting floods. A photograph taken during the 2003 review and described herein is provided in figure A232.

Method of peak discharge determination: The peak discharge is based on the sum of discharges through an 18-in. diameter corrugated-pipe culvert (originally 14.2 ft^3/s) and flow over a county road (84.7 ft^3/s). The computations were reviewed in the USGS Central Region by Howard Matthai (July 6, 1956) and at USGS Headquarters by M.A. Benson (July 18, 1956). During the latter review, the original culvert computation (type IV flow) of 14.2 ft^3/s was recomputed as type VI flow to be 15.4 ft^3/s. However, the review suggested that no revision was needed given that the culvert computation was a small part of the total peak discharge (about 15 percent) and the change itself was minor (about 1 percent).

The original measurement summary noted that the culvert entrance condition was unusual and did not exactly fit standard conditions, and Howard Matthai (USGS) concurred with this assessment. Given that the culvert flow was a small part of the total flow, the culvert computation was deemed acceptable.

The water-surface profiles, and more importantly, the fall over the road embankment were well defined. Those profiles show that the roadway clearly acted as a broad-crested weir (or flow-over-road) with good get-away conditions.

Possible sources of error: The most likely sources of error in the measurement are (1) the assumption that the culvert is free from debris and obstructions at the peak, (2) the determination of the culvert flow type and coefficient, and (3) the assumption that the road embankment acted as a broad-crested weir (critical depth occurred). Normally on a basin of this small size, the size of the basin that produced the flood would be questioned, but that question was removed in 1955 by surveying the perimeter of the basin.

Recommendations of what could have been done differently: This is an excellent example of how large floods should be handled. Multiple measurements were made, which give corroborating evidence of the unusual nature of the flooding. The survey of the basin perimeter removed the normal uncertainty that surrounds drainage-area determination for such small areas. Finally, the measurement received critical review at all levels. Apparent loss of the pictures was unfortunate, but only those for this basin were lost; the photographs for the other seven indirect measurements apparently are available.

Site visit and review: Kenneth Wahl (USGS retired) and R.W. Teller (USGS South Dakota Water Science Center) visited the site on May 29, 2003. The original pictures of the site were misplaced in 1955, but the field-note sketches are fairly definitive.

The original 18-in. culvert has been replaced with a 24-in. diameter culvert with spiraled corrugation. Therefore, the unusual entrance condition noted in the survey could not be examined. The county road also has been raised perhaps 1–2 ft and widened; the present culvert is about 50 ft long, whereas the original culvert length was 24 ft. Ralph Teller spoke to the county road crew chief, Heine Junge, who confirmed that the roadway has changed since 1955. It is unlikely, however, that there have been any significant changes to the basin that produced the flood. That basin, which is about 600 ft wide and extends about 1,000 ft upstream, has grass cover and no trees. Upstream from the roadway, the waterways are grassy swales, and there are no defined channels. Flow during extreme storms would essentially arrive at the roadway as sheet flow that converges at the culvert.

Debris blocking the culvert entrance is highly unlikely given the total absence of any sources of woody debris in the basin. That the culvert flow type was either IV or VI seems indisputable given the profiles that were based on the high-water marks and the field notes made at the time of the survey. Either flow type results in about 15 ft^3/s through the culvert. Because of the unusual entrance condition, the culvert coefficient is subject to debate, and the questions were raised in 1955. However, any reasonable reinterpretation of the coefficient would change the culvert discharge by only 2–3 ft^3/s, thus changing the total flow by only 2–3 percent. Finally, the field notes and profiles leave little doubt that the roadway acted as a broad-crested weir and that get-away conditions were such that there was no submergence.

Kenneth Wahl (USGS retired) checked the original culvert computations and the computations for road overflow and concluded everything was in order. However, today's TWRI on flow over embankments would give C values for the roadway that are about 7 percent greater than those used in 1955.

Recommendations: The original peak discharge of 98.9 ft^3/s should be accepted as published, but rounded to 100 ft^3/s, and rated fair.

There is no doubt that the rain and runoff from this small basin and from the surrounding area were exceptional. The computations are done correctly, and there is little chance that this was something other than a water flood.

Figure A232. View looking upstream at the basin that produced the 1955 flood, Castle Creek Tributary No. 2 near Rochford, South Dakota, May 29, 2002. The basin perimeter is the grassed ridge in the near foreground (perhaps 300 yards away). The 1955 18-in. culvert has been replaced with a 24-in. culvert, and the road fill has been raised and is about twice as wide.