FLOODS ON OPEQUON AND TUSCARORA CREEKS IN THE VICINITY OF MARTINSBURG, WEST VIRGINIA

This report was prepared by the U.S. Geological Survey to further the objectives of the Appalachian Regional Commission. It presents hydrologic data concerning the extent, depth, and frequency of flooding that are useful for an appraisal of the hazards involved in occupancy and development of flood plains along Opequon and Tuscarora Creeks in the vicinity of Martinsburg, West Virginia. It will aid those individuals, organizations, and governmental agencies who are responsible for making decisions for the safe and economical use of flood-plain lands along these creeks. The report will be useful for preparing building and zoning regulations, developing recreational areas, and purchasing and developing unoccupied land for various uses. The map and flood data provide a technical basis for making decisions leading to land uses compatible with the degree and frequency of flooding expected.

The approximate boundaries of inundation on Opequon and Tuscarora Creeks by hypothetical floods having recurrence intervals of 5, 25, and 50 years are delineated on an aerial photomosaic map. Greater floods than those whose boundaries are delineated have occurred in the past and probably will recur. Depths of inundation and limits of overflow of floods of various magnitudes can be estimated by using the methods and relations presented.

In general, the procedure used in defining flood boundaries was to construct flood profiles by computing elevations using the step-backwater method for hypothetical floods having recurrence intervals of 5, 25, and 50 years, and from data available in the U.S. Geological Survey files. The flood profiles were used to delineate the extent of flooding on the photomosaic map by interpolation between contours (lines of equal ground elevations).

Flood height.—The height of a flood at a gage usually is stated in terms of gage height or stage, which is the elevation of the water surface above a selected datum plane. Elevations in this report are expressed in feet above mean sea level. Gage heights or stage at gaging stations on Opequon and Tuscarora Creeks can be converted to elevations above mean sea level by adding the gage height to the appropriate datum of gage listed in the following table. Location of the gages, measured downstream along the stream channels from arbitrary starting points, and the period of record also are shown.

Gaging station	Distance along channel (feet)	Datum of gage above mean sea level (feet)	Period of record
Opequon Creek near Martinsburg	2,600	354.89	May 1905 to July 1906, July 1947 to Jan. 1970
Tuscarora Creek at Martinsburg	0	445.74	Oct. 1948 to Sept. 1963, July 1967 to Jan. 1970

Flood history.—The maximum known flood stage at the site of the present gaging station on Opequon Creek near Martinsburg reached an elevation of about 372.4 feet above mean sea level in March 1936. This information was obtained from local residents.

Flood occurrence.—The irregular time distribution of flood events is illustrated by the pattern of flood occurrence at the gaging station on Opequon Creek near Martinsburg during the period 1948-67 (fig. 2). Flood stages above 365-foot elevation (considered flood stage at gaging station) occurred 19 times during the 20-year period, an average of about one flood each year. No flood above 365 feet occurred in 8 of the years, none occurred during the 3-year period 1956-58, and three occurred in each of the years of 1950 and 1952.

Recurrence interval.—Although the distribution of flood occurrences is recognized as erratic, the concept of "recurrence interval" is used to evaluate the probable frequency of flooding. As applied to flood events, recurrence interval is the average interval of time within which a given flood will be equaled or exceeded once. For example, about 20 floods of at least the magnitude of a 5-year flood may be expected to occur in a 100-year period, and about 4 floods of at least the magnitude of a 25-year flood may be expected to occur in a 100-year period. Because of the irregular nature of flood events, recurrence interval cannot be used to predict the time of flood occurrence. It can, however, be used to evaluate the probability of occurrence in any year. A flood with a 5-year recurrence interval would have a 20-percent chance of being equaled or exceeded in any given year, and a flood with a 25-year recurrence interval would have a 4-percent chance of being equaled or exceeded in any given year.

It is emphasized that recurrence intervals are average values—the average number of years that will elapse between floods that equal or exceed a specific elevation. Thus, a flood elevation of 371.7 feet at the Opequon Creek gage is said to have a 25-year recurrence interval. However, because of the nature of flood occurrences, the 371.7-foot elevation may not be exceeded in any given 25-year period, or it may be exceeded more than once in the period. It may even be exceeded more than once in any year.

Flood frequency.—Flood-frequency relations were derived from streamflow records, for Opequon Creek near Martinsburg and for Tuscarora Creek at Martinsburg, supplemented by the regional flood-frequency relation of floods in the United States (Tice, 1968). The regional flood-frequency relations are based upon gaging-station records for the region having 5 or more years of record relatively unaffected by artificial regulation or diversion. The results decribe the magnitude and frequency of natural floods within the range and recurrence interval defined by the base data.

The relations between recurrence interval and hypothetical discharge for two sites on Opequon Creek, one just upstream and one just downstream from the mouth of Tuscarora Creek, and one site on Tuscarora Creek at the mouth, were computed from the regional flood-frequency data mentioned above and shown on figure 3. The relations between frequency and flood elevations at the two gaging stations are shown in figure 4. The relation between stage and recurrence interval is dependent on the relation of stage to discharge which is affected by changes in physical conditions of the channel such as scour or fill. The stage-frequency curves shown in figure 4 are based on channel conditions existing in 1968. Longer records and future changes in channel conditions may define somewhat different stage-frequency curves.

Future conditions.—The flood-elevation data in this report are applicable for flood-control and river-channel conditions existing prior to 1968. Changes that affect the water-carrying capacity of the stream channels, such as those to waterway openings at highway and railroad bridges, channel improvement, and changes in runoff characteristics of the stream basins above the report area, could affect the flood height and inundation pattern of future floods of comparable discharge.

Flood profiles.—The given relation between recurrence interval and flood elevation evaluates the flood potential only at the Geological Survey gage sites. The flood profiles in figures 5 and 6 extend this information to all points along Opequon and Tuscarora Creeks in the study area. The profiles for hypothetical floods having recurrence intervals of 5, 25, and 50 years are based on elevations computed at cross sections in the study reach. Elevations were computed by routing discharge values through the cross sections using the step-backwater method.

Distances on the profiles were established from the photomosaic base map and correspond to those shown on the map. The zero point of the channel distances along Opequon Creek is located at an arbitrary point 2,600 feet upstream from the Geological Survey gage near Martinsburg. The zero point of the channel distances along Tuscarora Creek is located at the gaging station at Martinsburg about 3.7 miles upstream from the mouth.

Extent of flooding.—The boundaries of inundation on the map were determined by locating the ground position of the water-surface elevations indicated by the 50-year, 25-year, and 5-year hypothetical-flood profiles in figures 5 and 6.

Owing to the nature of the topography and the scale and contour interval of the map used, it was not practical to distinguish differences in areal extent between the 5-year, 25-year, and 50-year floods in some reaches. At these locations only the 50-year flood boundary is shown.

The primary significance of the 50-year flood is its use as the design flood for many land-use developments and projects. The 25-year and 5-year flood boundaries are shown for comparison.

Depth of flooding.—Depths of flooding by 5-year, 25-year, and 50-year floods at several selected cross sections are shown in figures 7 and 8. Depth of inundation caused by floods of selected magnitudes can be estimated at other points by subtracting ground elevations from the water-surface elevations shown in figures 5 and 6. The approximate ground elevation can be determined from contours on the map; however, more accurate elevations can be obtained by leveling from nearby bench marks. The locations and elevations of several bench marks in the area of this report are given below. These were taken from vertical control data sheets of the U.S. Coast and Geodetic Survey. Elevations are based on sea-level datum of 1929, supplementary adjustment of 1944.

B. M. 72 (B. & O. RR.).—About 1.8 miles northwest along the Baltimore & Ohio Railroad from Van Clevesville, Berkeley County, and about 800 feet west of Milepost B 97, at a culvert, and in the west end of the south coping. The top of a copper bolt. Elevation (ft msl) 404.048.

B. M. 73 (B. & O. RR.).—About 1 mile west along the Baltimore & Ohio Railroad from Blairton, Berkeley County, about 1,000 feet east of Milepost B 98, opposite pole 97/34, at a culvert, and in the end of the north coping. The top of a copper bolt. Elevation (ft msl) 384.176.

B. M. 74 (B. & O. RR.).—About 0.7 mile southeast along the Baltimore & Ohio Railroad from Martinsburg, Berkeley County, about 240 feet west of Milepost B 99, at bridge 49, and in the middle of the north coping. The top of a copper bolt. Elevation (ft msl) 399.455.

B. M. 75 (B. & O. RR.).—About 0.2 mile north along the Baltimore & Ohio Railroad from the station at Martinsburg, Berkeley County, about 280 feet south of Milepost B 100 at an arch bridge, in the top of the east coping, and 6 feet south of the north end. The top of a copper bolt. Elevation (ft msl) 433.080.

B. M. 457.7 (U.S.G.S.).—At Martinsburg, set in the top of the east end of the bottom step to the entrance to the Berkeley County Courthouse, at the junction of West King Street and South Queen Street, 16.4 feet north of the north edge of West King Street, 46.4 feet west of the west edge of South Queen Street. A standard USGS disk stamped "457.7". Elevation (ft msl) 456.964.

T. B. M. 467.7.—At Martinsburg about 0.4 mi. W. of courthouse, along King Street, at Pennsylvania R. R. sta., 22 ft. NW. of Baggage-room door, on concrete ring around manhole; chiseled square, painted "T B M 467.7". Elevation (ft msl) 467.66

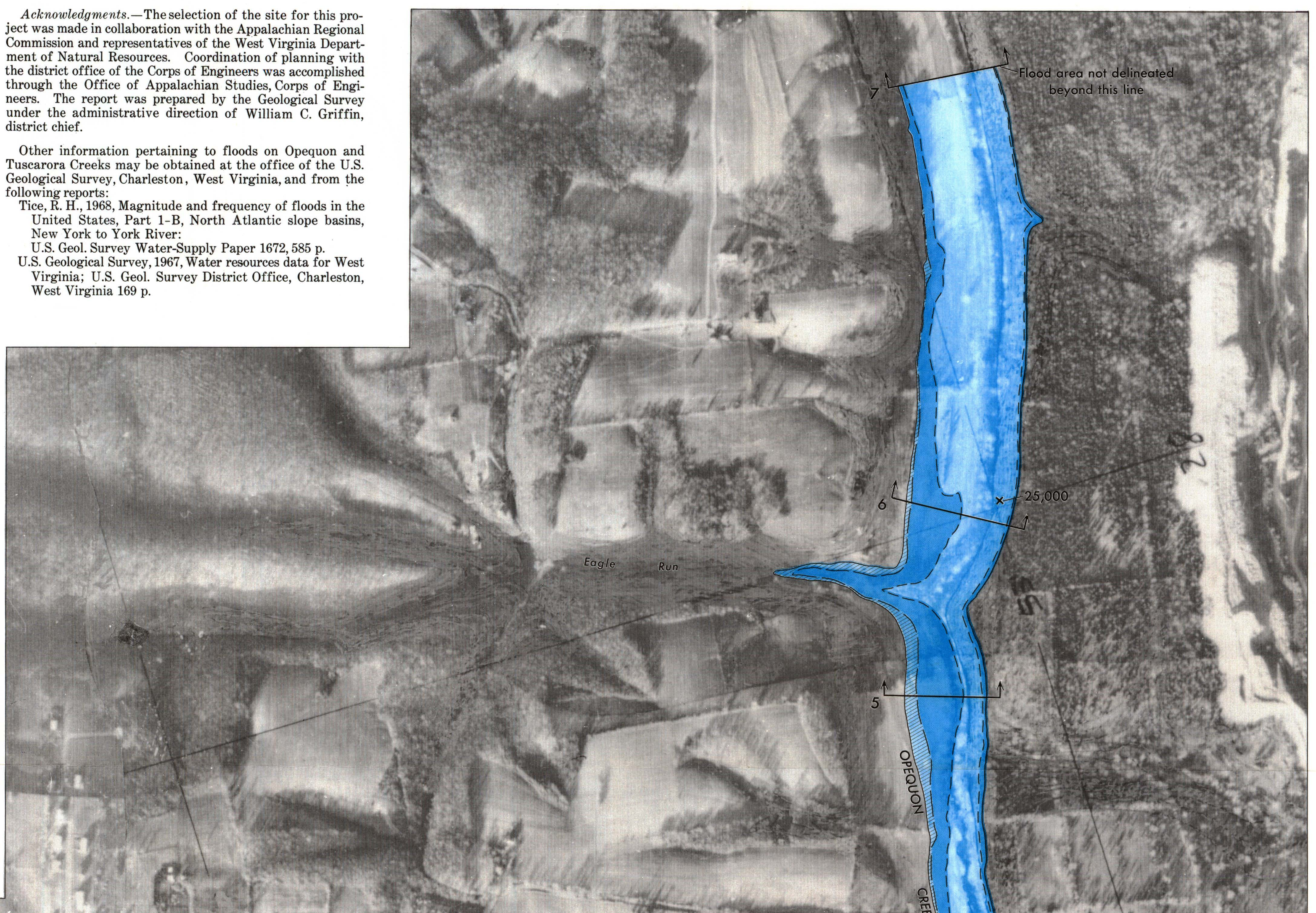
Martin triangulation sta.—U.S.C. & G.S., 1935; located on WNW, side of Martinsburg 0.4 mi. from city limits, about 450 ft. N. of King Street (1.3 mi. W. of county courthouse, on partially developed street (now macadam) called Washington Avenue (not to be confused with Washington Avenue in the town proper), 6 ft. WNW. of E edge of street property line, in concrete post projecting 6 in.; U.S.C. & G.S. standard triangulation-station disk stamped "Martin 1935"). Elevation (ft msl) 558.715.

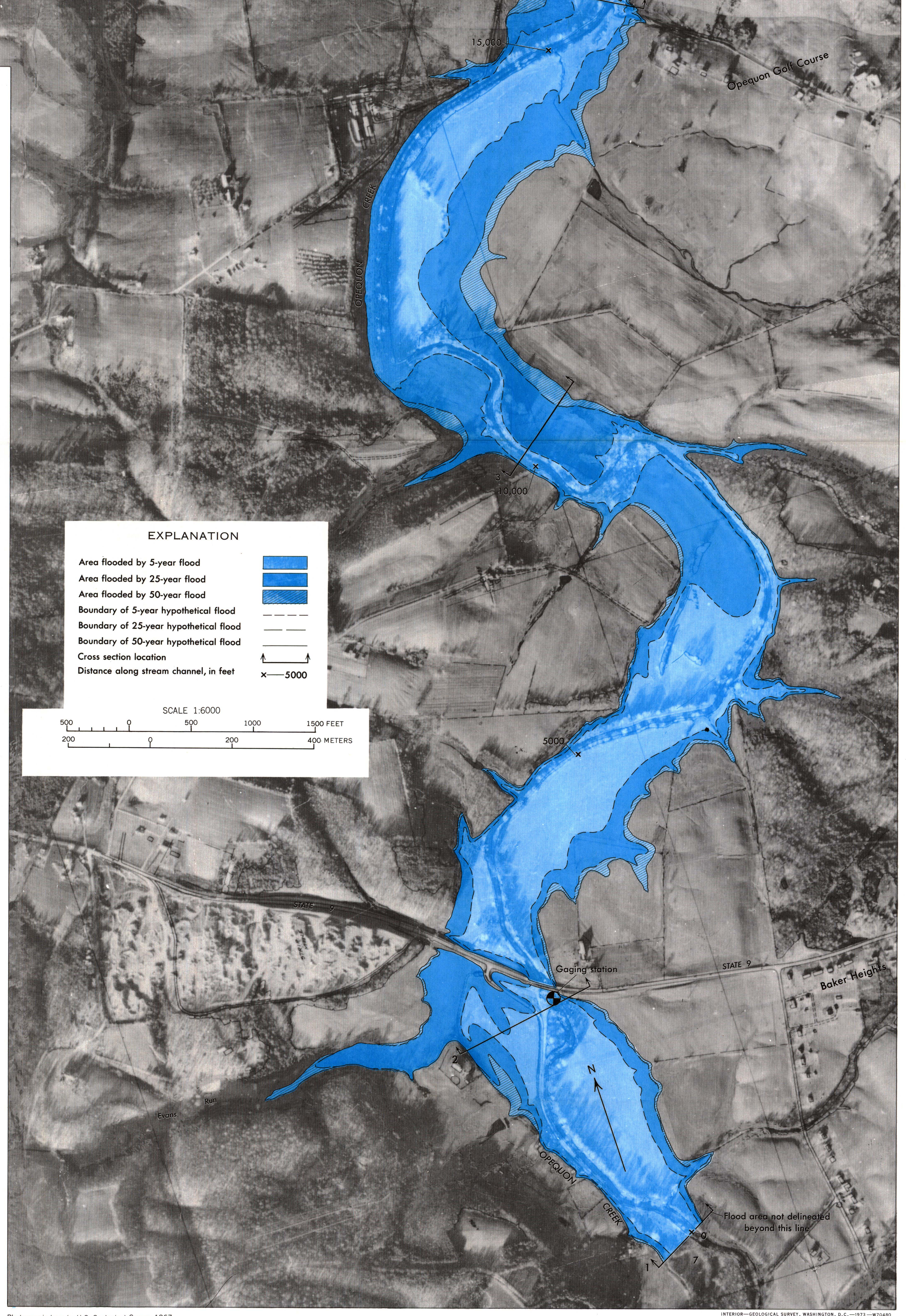
Reference mark.—Location 53.7 ft. WNW. of sta., in slope of cut bank on W. side of street, in concrete post projecting 6 in.; U.S.C. & G.S. standard reference disk stamped "Martin No. 2 1935". Elevation (ft msl) 561.337.

Acknowledgments.—The selection of the site for this project was made in collaboration with the Appalachian Regional Commission and representatives of the West Virginia Department of Natural Resources. Coordination of planning with the district office of the Corps of Engineers was accomplished through the Office of Appalachian Studies, Corps of Engineers. The report was prepared by the Geological Survey under the administrative direction of William C. Griffin, district chief.

Other information pertaining to floods on Opequon and Tuscarora Creeks may be obtained at the office of the U.S. Geological Survey, Charleston, West Virginia, and from the following reports:

Tice, R. H., 1968, Magnitude and frequency of floods in the United States, Part 1-B, North Atlantic slope basins, New York to York River:
U.S. Geol. Survey Water-Supply Paper 1672, 585 p.
U.S. Geological Survey, 1967, Water resources data for West Virginia; U.S. Geol. Survey District Office, Charleston, West Virginia 169 p.





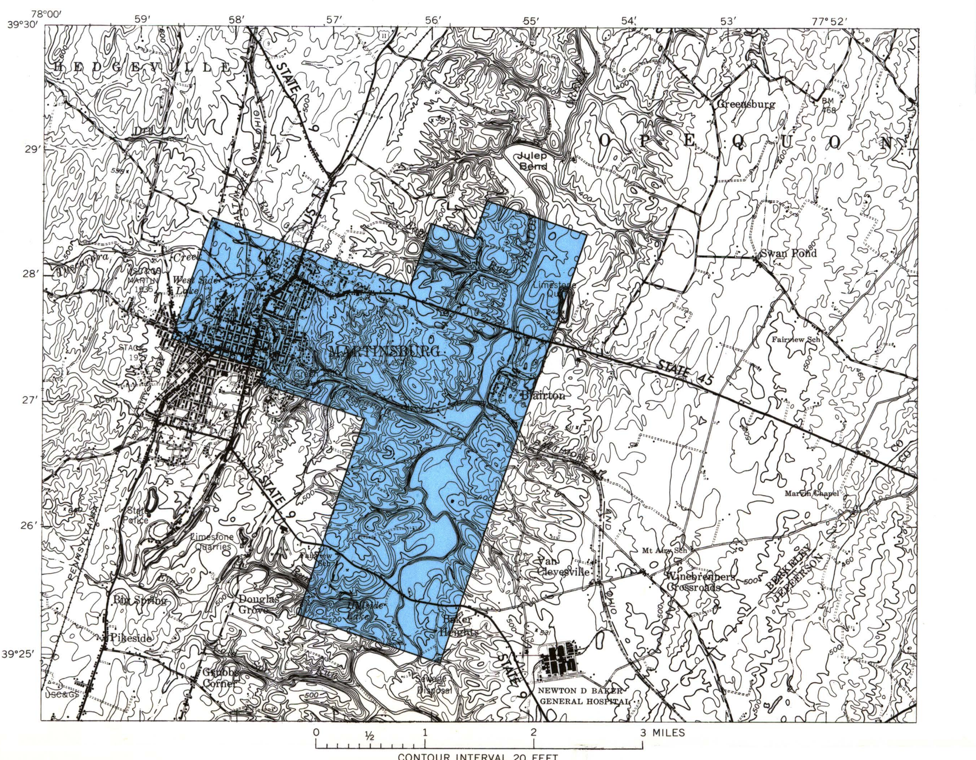


FIGURE 1.—*Index map of Martinsburg area showing location of photomosaic base map.*

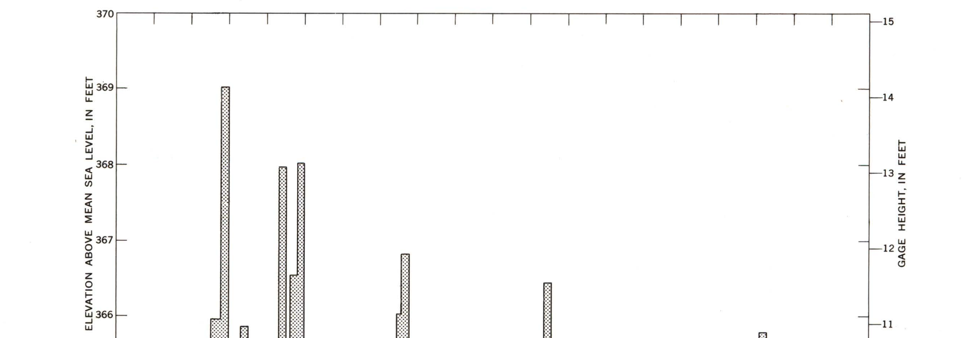


FIGURE 2.—*Floods above 365 foot elevation, Opequon Creek near Martinsburg, 1948-67.*

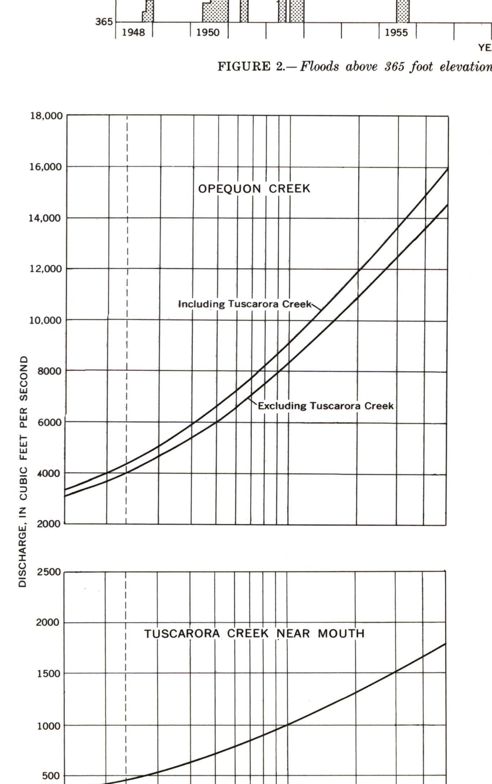


FIGURE 3.—*Frequency of hypothetical flood discharges on Opequon and Tuscarora Creeks.*

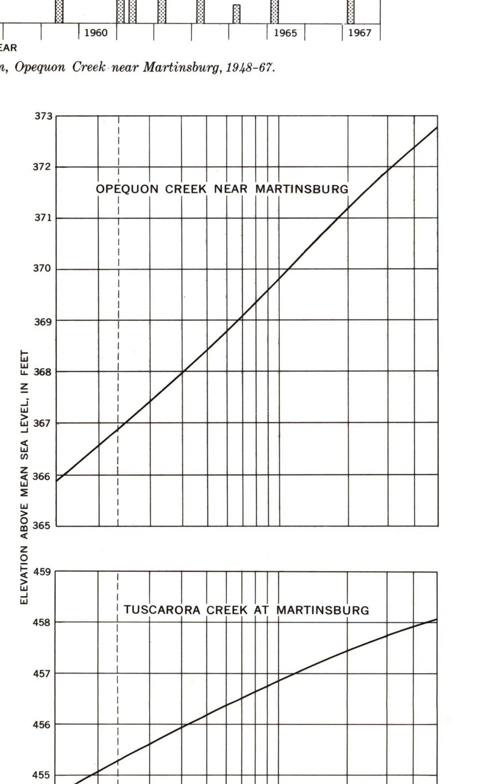


FIGURE 4.—*Frequency of hypothetical flood stages on Opequon and Tuscarora Creeks.*

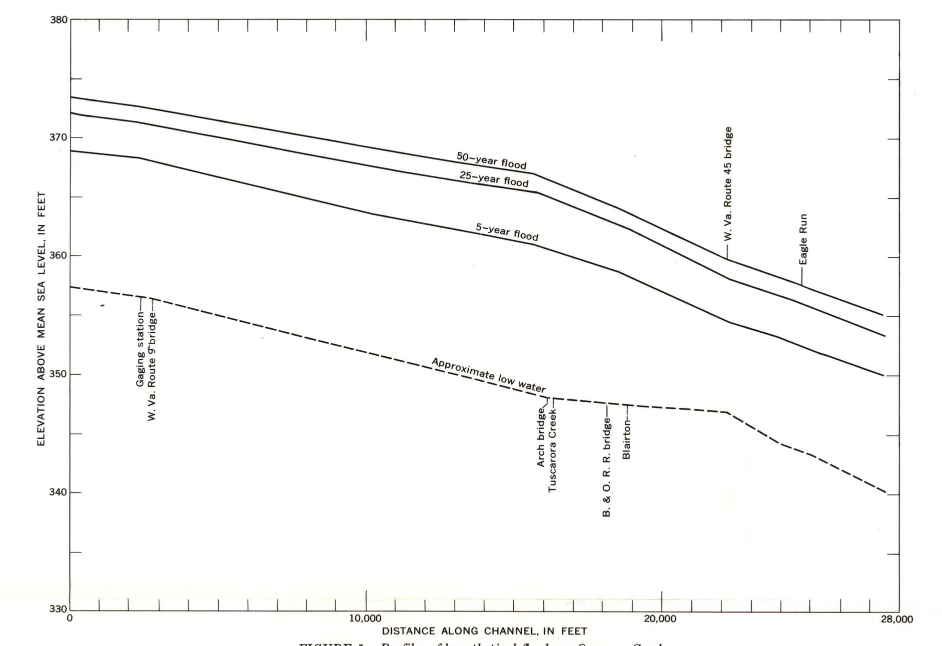


FIGURE 5.—*Profiles of hypothetical floods on Opequon Creek.*

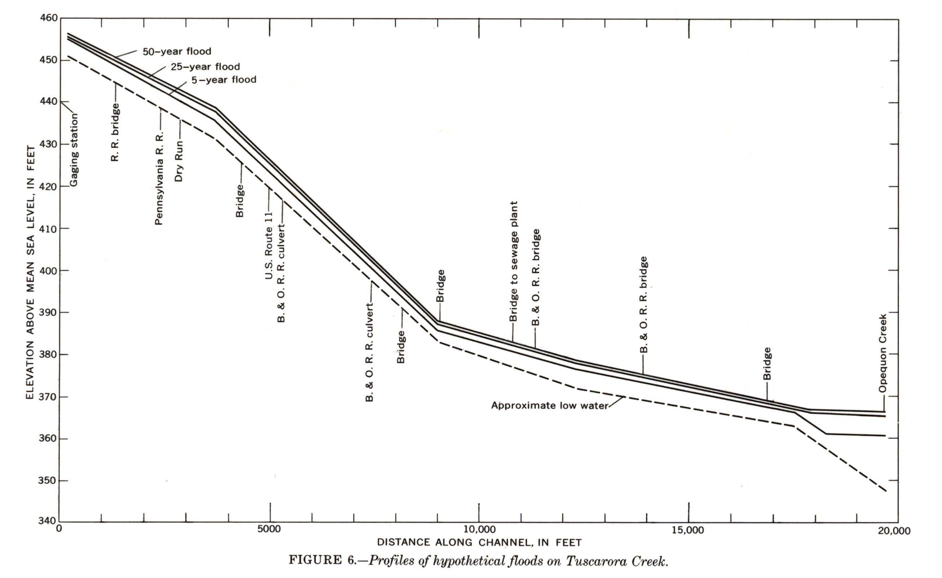


FIGURE 6.—*Profiles of hypothetical floods on Tuscarora Creek.*

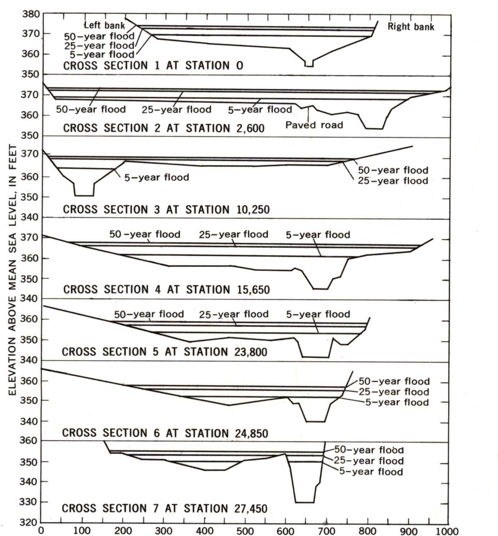


FIGURE 7.—*Cross sections on Opequon Creek and flood plain.*

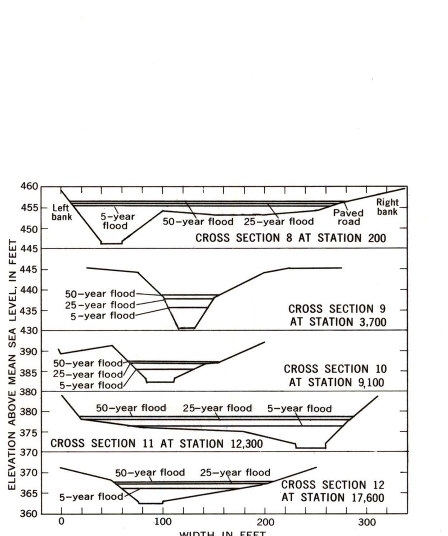


FIGURE 8.—*Cross sections on Tuscarora Creek and flood plain.*

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