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WOLF RIVER AT MEMPHIS, TENNESSEE; FLOODFLOW CHARACTERISTICS ALONG PROPOSED INTERSTATE HIGHWAY 240, SHELBY COUNTY. 1973.

# WOLF RIVER AT MEMPHIS, TENNESSEE
## Floodflow Characteristics Along Proposed Interstate Highway 240
## Shelby County

by

U.S. Geological Survey
Nashville, Tennessee
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## INTRODUCTION

This report has been prepared by the U.S. Geological Survey at the request of Mr. Henry Derthick, Engineer of Structures of the Tennessee Department of Transportation, under the authority of a cooperative agreement between the two agencies. It supplements information contained in a report with the same title dated September 1966.

The Department of Transportation proposes to construct a segment of Interstate Highway 240 and several bridges across the Wolf River on the northern side of Memphis, Shelby County. Mr. Derthick has requested an analysis of the 50-year flood or the maximum flood of record to determine the possible effect of the proposed construction on flood profiles along the Wolf River.

All elevations given in this report are to mean sea level datum.

Site description.--General features of the proposed construction are shown in the location sketch on figure 1. The drainage area of Wolf River is 771 square miles at Jackson Avenue (about midway of the channel reach under study).

The valley in the vicinity of the proposed construction consists of a fairly large improved channel with a wide flood plain. Most of the flood plain is thickly wooded. The channel bed is composed of silt and sand. The proposed highway approximately parallels the dredged channel.

Date available.--Principal data and their sources, used in the preparation of this report, are as follows:

1. Report entitled, "Floods in Tennessee, Magnitude and Frequency" (Jenkins, 1960).

2. Report entitled "Magnitude and Frequency of Floods in the United States, Part 7, Lower Mississippi River Basin (USGS WSP 1681, 1964).

3. Preliminary results of recent (1973) flood-frequency analyses for West Tennessee by the Geological Survey.

4. Report entitled "Flood Plain Information Report, Wolf River, Shelby County, Tennessee (Soil Conservation Service, 1969).

5. Plan, profile and cross-section sheets for the proposed highway, tentative bridge plans, and a topographic map of Shelby County (contour interval, 5 feet), furnished by the Department of Transportation.

6. High-water profiles and plans and specifications for channel improvement work on Wolf River, furnished by the Corps of Engineers, Memphis District.

7. Stage and discharge records from the gaging stations on the Wolf River at Rossville for the period 1929 to Jan. 31, 1972, furnished by the Geological Survey, and at Raleigh (State Route 14) for the period 1936 to date, furnished by the Corps of Engineers.

8. Channel roughness coefficients for the various subsections of the valley cross sections as chosen by engineers of the Geological Survey.

## RESULTS OF STUDY

Past floods.--The greatest flood on the Wolf River since at least 1929 occurred Jan. 20, 1935, and reached an elevation of 240.9 feet at the Raleigh gage. Other elevations along Wolf River for the 1935 flood are shown in figure 1. Estimates of the discharge of the 1935 flood range from 54,000 cfs (cubic feet per second) by the Geological Survey to 80,000 cfs by the Corps of Engineers. For design purposes, the Department of Transportation has selected a discharge of 60,000 cfs which appears reason-

able. The second largest flood at the Raleigh gage occurred Jan. 9, 1946, reached an elevation of 237.6 feet and had a peak discharge of 41,400 cfs.

The downstream end of the study reach (section 1) is subject to flooding by backwater from the Mississippi River. The greatest backwater flood known from the Mississippi River occurred Feb. 8, 1937. Static backwater at section 1 during this flood reached an elevation of about 236 feet.

Flood frequency, stage, and discharge.--The discharge-frequency relation at the Raleigh gage was defined from a recent flood-frequency study for West Tennessee. From this relation, the discharge of the 100-year flood is 49,100 cfs. The frequency of the 1935 flood (discharge, 60,000 cfs) though not definitely known, is much greater than 100 years. The frequency of the 1946 flood is about 46 years.

Because of the channel improvement work during past years on Wolf River, the former stage-discharge relation at the Raleigh gage is no longer applicable. Computations based on the capacity of the former channel and the existing improved channel to carry flow indicates that a flood equal to the 1935 flood (discharge, 60,000 cfs) would now reach an elevation of about 237.0 feet at the Raleigh gage or about 3.9 feet lower than actually occurred in 1935. Elevations along Wolf River for existing channel conditions, determined by methods discussed in the following section, are plotted on figure 1 and are tabulated in table 1.

Because of probable deterioration of the improved channel, probable increase in roughness, future highway crossings, and other factors, the stage-discharge relation will probably be subject to continual change. The future effect of all these factors will be to increase the stage for any given discharge.

Backwater flood stages from the Mississippi River have also been revised downward by the Corps of Engineers. For present conditions, the 100-year flood, which is approximately equal to the 1937 flood as it occurred, will reach an elevation of about 233.2 at the mouth of the Wolf River or about 2.8 feet lower than actually occurred in 1937.

High-water profiles along Wolf River.--The embankments of the proposed construction occupy an appreciable portion of the natural valley flood plain at some locations. These embankments will restrict and reduce to some extent the presently available cross-sectional floodflow area. At other locations, further restrictions of floodflow area will be caused by proposed highway crossings.

The 1935 flood profile for the existing improved valley of Wolf River, including the effect of local constriction from drainage structures, has been computed by the standard-step method using several valley cross sections. In the lower reaches of the study area, backwater from the 100-year flood on the Mississippi River was included in the computations. Data for the cross sections were obtained from topographic maps, plan and profiles of the proposed highway and of the improved channel, and other available data. The locations of the valley cross sections, profile of the 1935 flood (with and without the proposed highway embankment and bridges), and streambed profile are shown on figure 1. Also shown on figure 1 is the 1935 flood profile as it occurred. Pertinent data provided by the step-profile computations for the 1935 flood are summarized in table 1.

Table 1.--Elevations of 1935 flood discharge for existing and proposed conditions.

| ection No. | Distance upstream from mouth (ft) | 1935 flood, discharge, 60,000 cfs, improved valley | | | |
|---|---|---|---|---|---|
| | | Without proposed highway | | With proposed highway | |
| | | Elevation (ft) | Mean velocity (fps) | Elevation (ft) | Mean velocity (fps) |
| 1 | 23,478 | 233.2 | 0.9 | 233.2 | 0.8 |
| 2 | 27,678 | 233.2 | - | 233.3 | 2.5 |
| idge | - | - | - | 233.3 | 3.5 |
| 3 | 28,678 | 233.2 | - | 233.6 | 2.4 |
| 4 | 31,574 | 233.2 | .9 | 234.2 | 1.1 |
| idge | - | - | - | 234.2 | 2.8 |
| 5 | 33,143 | 233.3 | - | 234.7 | 1.1 |
| 6 | 33,893 | - | - | 234.8 | 1.6 |
| idge | - | - | - | 234.8 | 3.9 |
| 7 | 34,863 | - | - | 235.2 | 1.6 |
| 8 | 37,863 | - | - | 235.8 | 1.8 |
| idge | - | - | - | 235.8 | 4.1 |
| 9 | 38,643 | - | - | 236.4 | 1.7 |
| 10 | 39,473 | - | - | 236.6 | 1.5 |
| idge | - | - | - | 236.6 | 3.5 |
| 11 | 41,003 | 234.5 | 1.3 | 237.1 | 1.3 |
| 12 | 46,273 | 236.1 | 1.7 | 237.9 | 1.5 |
| 13 | 50,408 | 238.3 | 2.6 | 239.4 | 2.3 |
| 14 | 57,160 | 241.9 | 1.4 | 242.7 | 1.6 |
| idge | - | 244.1 | 5.0 | 244.8 | 4.7 |
| 15 | 64,230 | 245.4 | 2.1 | 246.2 | 2.4 |