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FLOODFLOW CHARACTERISTICS OF WHITE RIVER AT U.S. HIGHWAY 167 AT BATESVILLE, ARKANSAS

Prepared in cooperation with the

ARKANSAS STATE HIGHWAY COMMISSION

Open-File Report
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INTRODUCTION

The Arkansas State Highway Department plans to build a new two-lane highway bridge, parallel to and approximately 50 feet (15.2 metres) downstream from the centerline of the existing U.S. Highway 167 bridge, over the White River at Batesville. The present bridge will be altered and remain in service, thus providing a four-lane crossing after completion of the new bridge.

The State Highway Department requested a hydraulic analysis of the 50-year flood at the site, considering the effect of upstream flood storage in existing (1974) reservoirs. The purpose of this study was to determine for the regulated 50-year flood: (1) the discharge and elevation of peak flow and resulting backwater with exising bridge in place; (2) the discharge and elevation of peak flow and resulting backwater if an additional bridge of the same length, parallel to and 50 feet (15.2 metres) downstream from the existing bridge, is added; and (3) the reduction in length of relief span of proposed four-lane bridge that could be made without flooding existing buildings on the north bank of the upstream flood plain.

Information is provided in this report to assist the Highway Department in deciding upon the most practical and economical river crossing

within existing limitations. Floodflow characteristics of the design (50-year) flood are summarized in table 1 for (1) existing bridge and embankment, (2) proposed four-lane bridge the same length as present structures, (3) proposed four-lane bridge with length of relief span reduced to 3,000 feet (914 metres), (4) length of relief span reduced to 2,000 feet (610 metres), (5) length of relief span reduced to 1,000 feet (305 metres), and (6) without a relief span.

All elevations listed in this report are referenced to highway datum, which is mean sea level.

For use of those readers who may prefer to use metric units rather than English units, the conversion factors for the terms used in this report are listed below.

Multiply English unit	By	To obtain metric unit
feet (ft)	0.3048	metres (m)
miles (mi)	1.609	kilometres (km)
square miles (mi^2)	2.590	square kilometres (km^2)
cubic feet per second (ft^3/s)	0.02832	cubic metres per second (m^3/s)

DESCRIPTION OF THE AREA

U.S. Highway 167 crosses the White River south of Batesville, Ark. (fig. 1). The site is 0.6 mi (0.97 km) downstream from the mouth of Polk Bayou and 0.3 mi (0.48 km) upstream from Lock and Dam 1. The upper White River flows through the Ozark Mountains in a narrow channel that in many places has eroded vertically through rock to more than 100 ft (30.5 m). The streambed in the upper reach is composed mostly of rocks, boulders, sand, and gravel. Four dams—Beaver, Table Rock, Ozark Beach,

Table 1.—*Summary of floodflow characteristics for 50-year flood on White River at U.S. Highway 167 at Batesville, Ark.*

Bridge	Highway stationing at bridges		Discharge (ft^3/s)	Net area (ft^2)	Mean velocity (ft/s)	Water-surface elevation (ft)	
	Left	Right				Upstream	Downstream
Plan 1: Present two-lane bridge							
Main	71+44	54+45	139,000	29,600	4.7	262.6	262.5
Relief	48+42	10+00	76,000	32,150	2.4	262.6	262.5
Plan 2: Proposed four-lane bridge, same length of present bridge							
Main	71+44	54+45	139,000	29,600	4.7	262.6	262.5
Relief	48+42	10+00	76,000	32,150	2.4	262.6	262.5
Plan 3: Proposed four-lane bridge with 3,000-foot relief span							
Main	71+44	54+45	143,000	29,600	4.8	262.65	262.5
Relief	40+00	10+00	72,000	27,960	2.6	262.65	262.5
Plan 4: Proposed four-lane bridge with 2,000-foot relief span							
Main	71+44	54+45	159,000	29,600	5.4	262.7	262.5
Relief	30+00	10+00	56,000	20,270	2.8	262.7	262.5
Plan 5: Proposed four-lane bridge with 1,000-foot relief span							
Main	71+44	54+45	181,000	29,600	6.1	262.9	262.5
Relief	20+00	10+00	34,000	9,784	3.5	262.9	262.5
Plan 6: Proposed four-lane bridge with no relief span							
Main	71+44	54+45	215,000	29,600	7.3	263.1	262.5

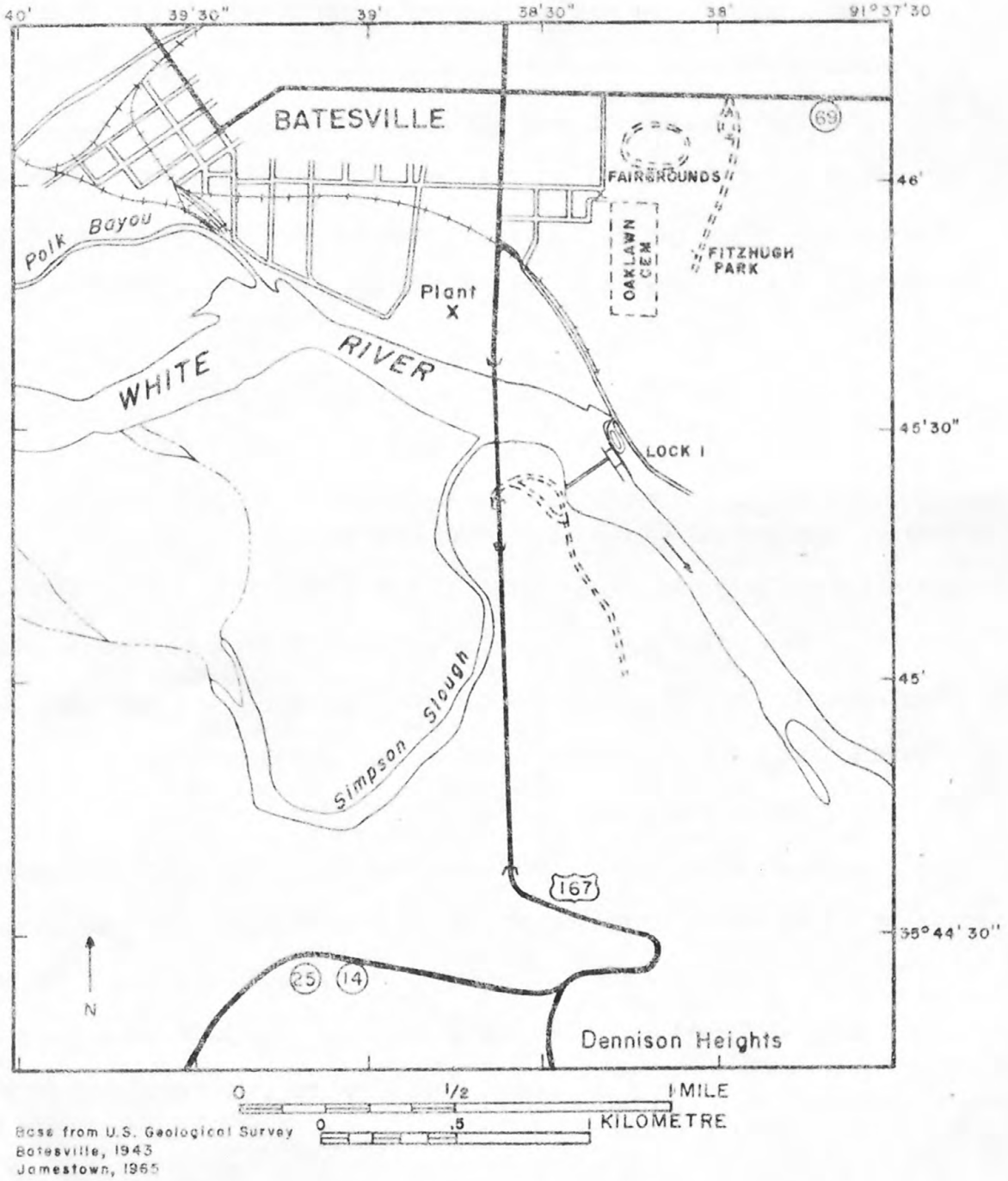

Figure 1.—Location of study site.

and Bull Shoals—form a series of lakes on the upper White River. Norfork Lake on North Fork River also contributes some flood control. The White River in the vicinity of the site is characterized by a meandering channel and flat slopes, and the banks and streambed are composed mostly of fine-grained sand, silt, and clay. The bridge crossing is slightly skewed. Drainage area at the site is 11,070 mi^2 (28,670 km^2).

MAGNITUDE AND FREQUENCY OF FLOODS

Flood History

Daily records of stage have been collected by the National Weather Service at Batesville since 1904. Daily records of stage and discharge were collected by the U.S. Geological Survey from 1937 to 1958. Annual peak-discharge data are available for the period 1904-58. The maximum stage and discharge during the period of record was 269.6 ft (82.2 m) elevation and 382,000 ft^3/s (10,820 m^3/s), and occurred February 1, 1916. Since regulation by Bull Shoals Dam (1951), the highest stage and discharge were 257.5 ft (78.5 m) elevation and 124,000 ft^3/s (3,510 m^3/s) on April 4, 1957. Regulation upstream from the site is provided by Beaver, Table Rock, and Bull Shoals Reservoir, on the White River, and by Norfork Reservoir, on North Fork River.

Flood Frequency

The 50-year flood of 215,000 ft^3/s (6,090 m^3/s) at the site for present regulated conditions will occur at an elevation of 262.5 ft (80.0 m) at the downstream side of the bridge.

FLOODFLOW CHARACTERISTICS

The floodflow characteristics were determined for the regulated 50-year flood (215,000 ft^3/s (6,090 m^3/s)) which would occur at an elevation of 262.5 ft (80.0 m) at the downstream side of U.S. Highway 167.

Floodflow was analyzed for six conditions: (1) With present two-lane bridge, (2) with proposed four-lane bridge the present length, (3) with proposed four-lane bridge with a 3,000-ft (914-m) relief span, (4) with proposed four-lane bridge with a 2,000-ft (610-m) relief span, (5) with proposed four-lane bridge with a 1,000-ft (305-m) relief span, and (6) with proposed four-lane bridge with no relief span.

Figure 2 shows the valley cross section; the distribution of flow in the approach section, in increments of 4,000 ft^3/s (113.3 m^3/s); and the distribution of flow through the bridges for the conditions described previously. Valley cross-section survey information and details of the bridge were furnished by the Arkansas State Highway Department.

Backwater for present conditions is about 0.1 ft (0.03 m), and the mean velocity is 4.7 ft/s (1.4 m/s) in the main span and 2.4 ft/s (0.73 m/s) in the relief span. Addition of a two-lane bridge downstream from the present bridge would not significantly change the floodflow characteristics at the site.

Reducing the length of the relief span would create additional backwater and increase the velocities under all conditions (table 1). The point of division of flow in the approach would move closer to the relief span with each reduction in length of the span. A scour potential near the right-bank end of the main span would result from reduction in length of the relief span.

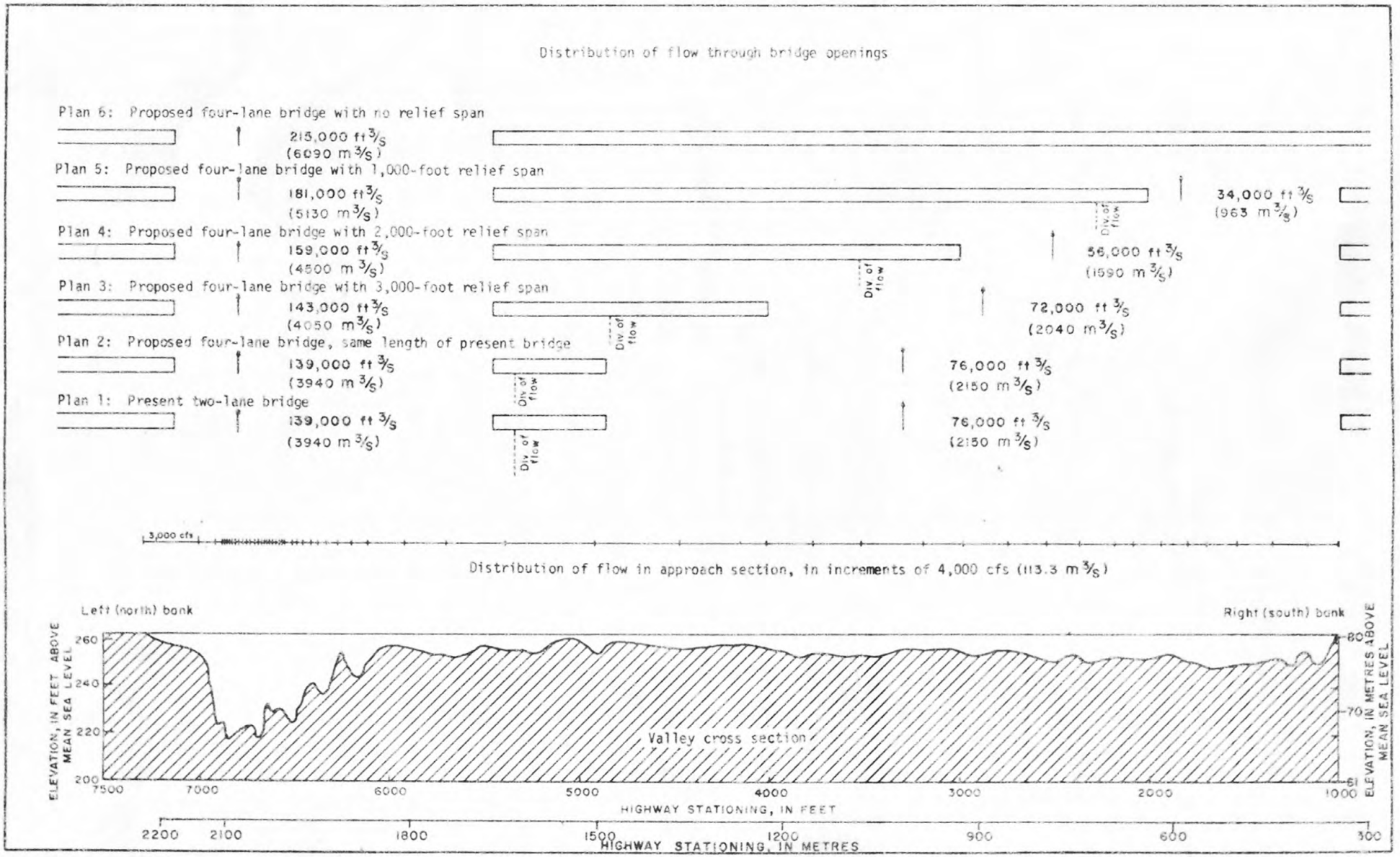

Figure 2.—Valley cross section and distribution of flow.

Maximum backwater and velocities would exist if the relief bridge is eliminated. In addition, water in the right flood plain would have to travel a long distance to reach the main span, and would create a scour potential near the right-bank end of the main span.

Elevations at the building on the north (left) bank of the upstream flood plain are (1) paved lot at loading dock at the back of the building, 262.4 ft (80 m); and (2) main-floor elevation, 266.4 ft (81.2 m). The lot at the back of the building, with present highway conditions, would be inundated to a depth of 0.2 ft (0.06 m) during the 50-year flood. Maximum inundation of the lot for any of the six conditions analyzed would be 0.7 ft (0.21 m) if the relief span is eliminated. The main floor of the building would be 3.3 ft (1.0 m) above this maximum backwater.

Discharge measurements made at the site indicate that the maximum point velocity at the bridge is about twice the mean velocity. The maximum-allowable point velocities probably would be the determining factor in the selection of a relief-span length. The division of flow between the main and relief spans would also be a deciding factor.