FLOOD-FLOW CHARACTERISTICS OF NANCY CREEK AT GEORGIA HIGHWAY 400 EXTENSION NEAR ATLANTA, GEORGIA

U.S. GEOLOGICAL SURVEY

Open-File Report 87-386

Prepared in cooperation with

DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

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Doraville, Georgia

1987

DEPARTMENT OF THE INTERIOR

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U.S. GEOLOGICAL SURVEY

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CONVERSION FACTORS

The inch-pound units used in this report can be converted to equivalent SI metric (International System) units as follows:

Multiply inch-pound units	By	To obtain metric units
foot (ft)	0.3048	meter (m)
foot per second (ft/s)	0.3048	meter per second (m/s)
cubic foot per second (ft^3/s)	0.2832	cubic meter per second (m^3/s)
square foot (ft^2)	0.0929	square meter (m^2)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.59	square kilometer (km^2)

FLOOD-FLOW CHARACTERISTICS OF NANCY CREEK AT PROPOSED GEORGIA HIGHWAY 400 EXTENSION NEAR ATLANTA, GEORGIA

By McGlone Price and Glen W. Hess

ABSTRACT

The Highway Division, Georgia Department of Transportation, plans the extension of Georgia Highway 400 from Interstate 285 southward to Interstate 85. As part of this extension, the Highway Division plans construction of a bridge crossing Nancy Creek near Atlanta, Georgia.

The U.S. Geological Survey, in cooperation with the Highway Division, determined the flood-flow characteristics of Nancy Creek near the bridge crossing. The flood frequency, elevation-discharge relation, flood profiles, floodway, and flood-flow effects were determined. The maximum backwater effect for the proposed bridge and relocated channel was 0.2 foot for the 100-year flood. The relocated channel will drastically shorten flow length near the proposed State Highway 400 extension and reduce the 100-year flood elevation between 1 and 2 feet from existing conditions between the proposed site and Windsor Parkway.

INTRODUCTION

The Highway Division, Georgia Department of Transportation, plans the extension of Georgia Highway 400 from near Interstate 285, southward to Interstate 85. The plan includes construction of a bridge crossing Nancy Creek near Atlanta. The U.S. Geological Survey, as part of a program of water-resources investigations under the provisions of a cooperative agreement with the Highway Division, studied the flood-flow characteristics and flood-flow effects of Nancy Creek at the proposed bridge site. Nancy Creek drains an area of 21.8 mi^2 at the crossing site.

The purpose of this report is to describe the flood-flow characteristics of Nancy Creek at the proposed bridge site for floods having recurrence intervals at 2, 10, 25, 50, and 100 years for existing and two alternate proposed conditions. The alternate proposed conditions are:

A. Construction of a 390-ft bridge between highway centerline stations 253+15 and 257+05 with abutments skewed 45 degrees to the roadway and parallel to flow and abutment slopes of 2 horizontal to 1 vertical. The main channel of Nancy Creek in the reach from about 600 ft downstream from proposed bridge to about 700 ft upstream would be relocated. The relocated main channel would be 40 ft wide at the bottom and have channel side slopes of 2 horizontal to 1 vertical.

B. Construction of a 380-ft bridge between highway centerline stations 253+20 and 257+00 with abutments the same as alternate A. The channel relocation would be the same as for alternate A, except that channel side slopes would be 1.5 horizontal to 1 vertical.

The report includes computation of flood elevations, area of bridge opening under high-water conditions, average velocity through the bridge, and backwater computations for the proposed bridge for alternate conditions.

The location of the proposed bridge site, cross sections used in flood routing, the relocated channel, the floodway, and the 100-year flood boundary are shown in figure 1.

Available Data

From 1963 to 1965 the U.S. Geological Survey operated a crest-stage gage on Nancy Creek at Rickenbacker Drive, about 7,000 ft downstream from the proposed bridge site. Miscellaneous high-water information has been obtained by the U.S. Geological Survey for all major floods from 1961 to 1987 at several bridge crossings of Nancy Creek from its mouth to Tilly Mill Road.

A field reconnaissance of the study reach was made by U.S. Geological Survey personnel on March 18, 1985, and Manning's "n" values were estimated for use in the step-backwater analyses.

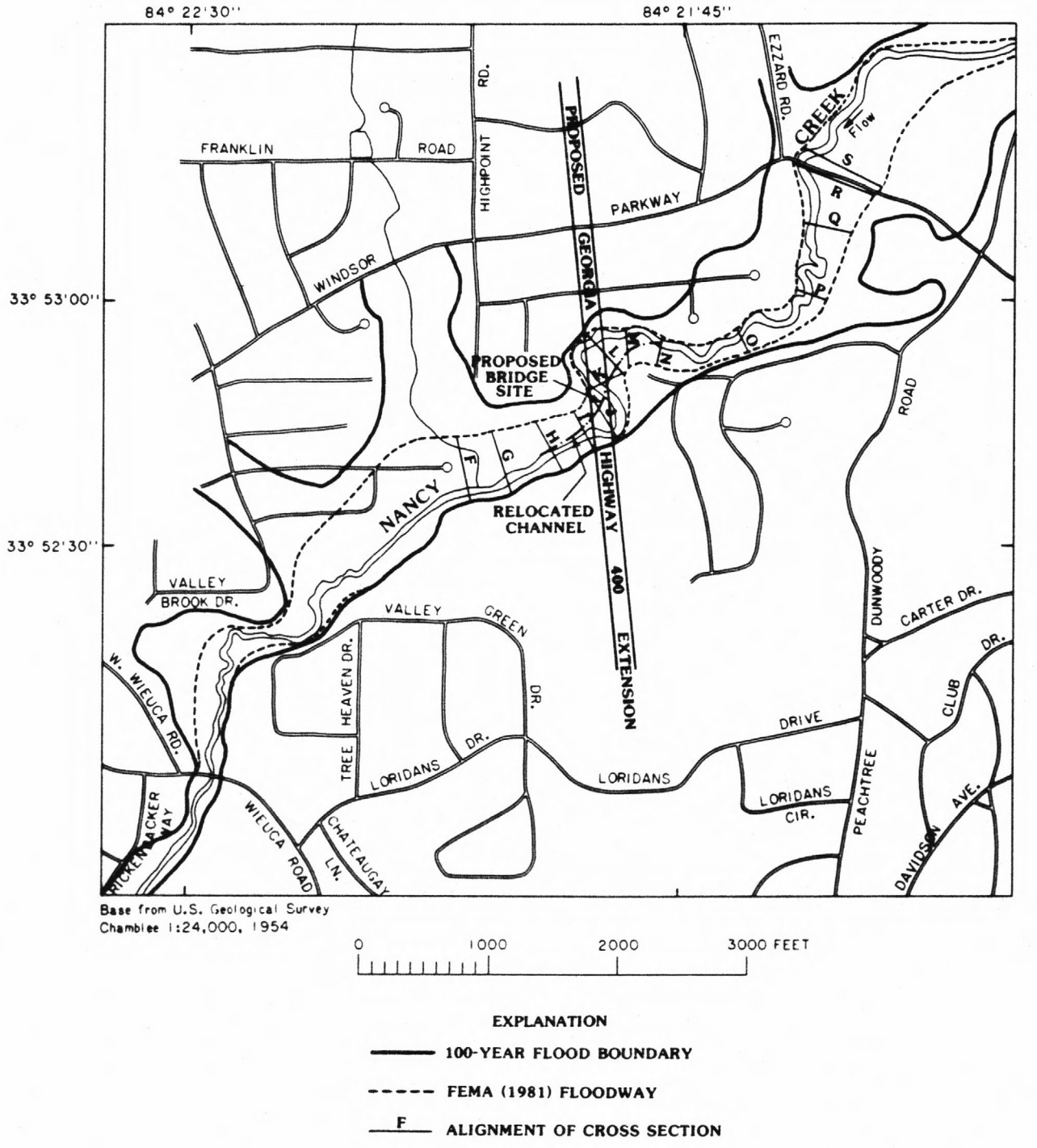
All elevations given in this report are to National Geodetic Vertical Datum of 1929.

Acknowledgments

The Highway Division furnished the following information needed for the study:

1. Transverse profiles at the channel and floodway of the proposed bridge and location of the proposed bridge,

2. Main channel, bridge, and roadway profiles at Wieuca Road, located about 5,000 ft downstream from the proposed bridge, and at Windsor Parkway, located about 3,500 ft upstream from the proposed bridge,



Base from U.S. Geological Survey
Chamblee 1:24,000, 1954

EXPLANATION

100-YEAR FLOOD BOUNDARY

FEMA (1981) FLOODWAY

F ALIGNMENT OF CROSS SECTION

Figure 1.--Location of proposed bridge site, cross-sections used in flood routing, relocated channel, FEMA (1981) floodway, and 100-year flood boundary.

3. Seventeen cross sections of the main channel in the reach between Wieuca Road and Windsor Parkway,

4. A 2-ft contour map of the study reach, and

5. Input data from U.S. Army Corps of Engineers (1979) step-backwater computer program HEC-2 for the profile and floodway studies used in the Federal Emergency Management Agency (FEMA) (1981) study of unincorporated Fulton County.

FEMA supplied input data for the HEC-2 computer program for the profile and floodway studies of Nancy Creek for their revised, "Flood Insurance Study, City of Atlanta, Fulton and DeKalb Counties, Georgia" (1985).

FLOOD-FLOW CHARACTERISTICS

Flood Frequency

Flood discharges at the proposed site were computed using techniques described by Inman (1983). Discharges computed using estimating equations developed from the U.S. Geological Survey rainfall-runoff (USGS) model (Dawdy and others, 1972) for the 2-, 10-, 25-, 50-, and 100-year floods were 2,620, 5,240, 6,700, 7,760, and 9,680 ft^3/s, respectively. Using the distributed routing rainfall-runoff (DR3M) model (Alley and Smith, 1982) for the 2-, 10-, 25-, 50-, and 100-year floods were 3,270, 6,440, 8,080, 9,890, and 11,700 ft^3/s, respectively. The computations were based on an impervious area of 35 percent and a channel slope of 17.5 ft/mi. Discharges for the two models were computed for the 2-, 10-, 25-, 50-, and 100-year floods were to be 2,950, 5,840, 7,400, 8,900, and 10,700 ft^3/s, respectively. These values were used in all flood analyses, except for the 100-year flood, because the discharges better reflect current land-use conditions than the discharges used by FEMA (1981). However, for the 100-year flood, the discharge of 10,900 ft^3/s from FEMA (1981) was used for the analysis, because the present floodway was computed using this value and it is within 2 percent of that obtained by averaging the discharges computed from the equation described by Inman (1983). Frequency curves for FEMA (1981) and Inman (1983) are shown in figure 2.

Elevation-Discharge Relation

The elevation-discharge relation at the downstream end of the proposed crossing of Nancy Creek (fig. 3) has been computed by the U.S. Geological Survey Step-Backwater Computer Program J635 (Shearman, 1977, written commun.) is an enhanced version of Program E431 (Shearman, 1976). The computations were based on starting elevations from an elevation-discharge relation at Wieuca Road (fig. 4). The elevation-discharge relation was established from high-water elevations for several floods at Wieuca Road and corresponding discharges at the U.S. Geological Survey crest-stage gage at Rickenbacker Drive. The elevation-discharge curve was extended above 4,500 ft^3/s by the slope-conveyance method (Bailey and Ray, 1966). Elevation-discharge relations were computed for existing conditions and alternate conditions A and B.

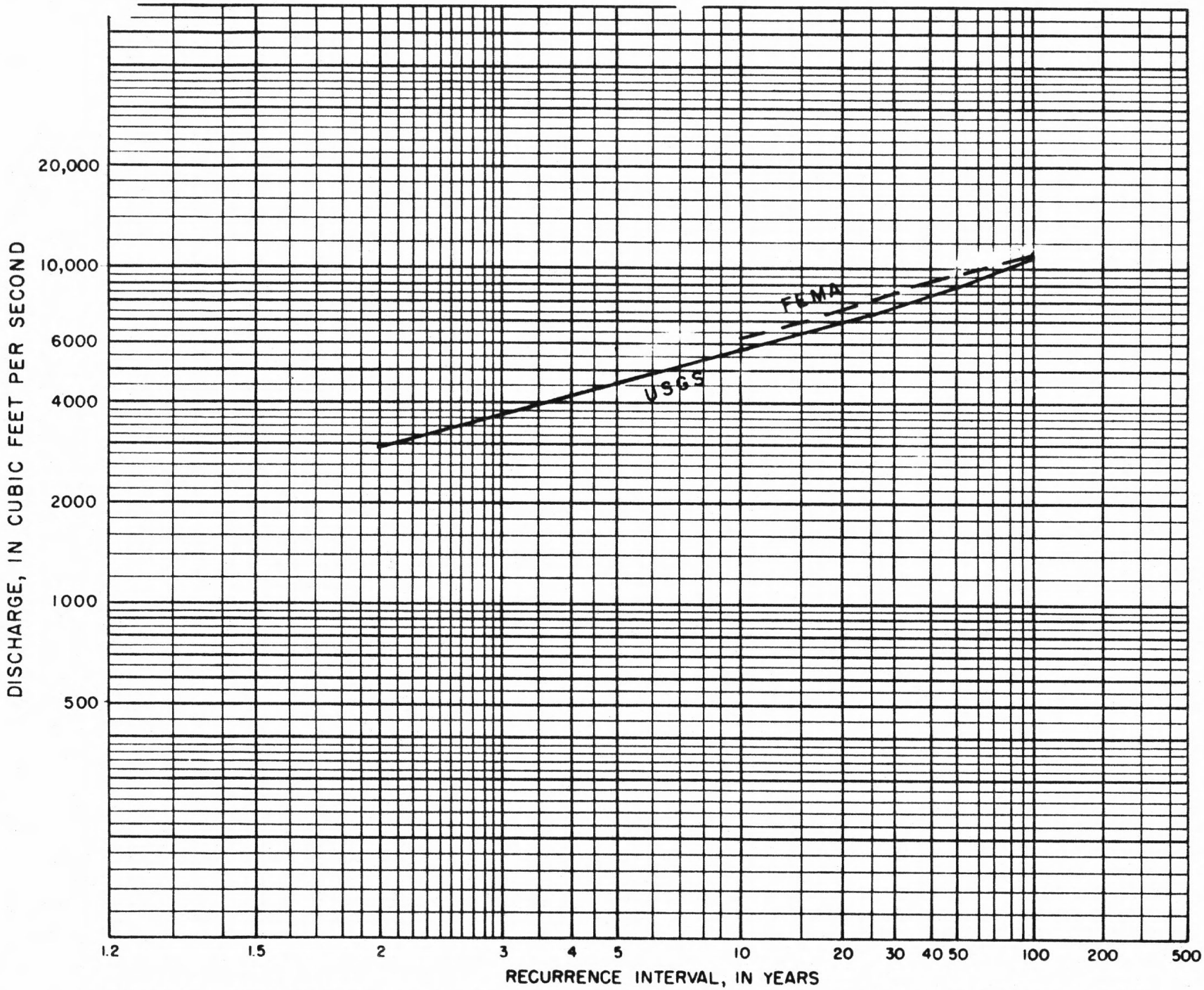


Figure 2.—Flood-frequency curves for Nancy Creek at proposed Georgia Highway 400 Extension near Atlanta, Georgia.

Figure 3.—Elevation-discharge relation at downstream end of proposed Georgia Highway 400 crossing at Nancy Creek near Atlanta, Georgia.

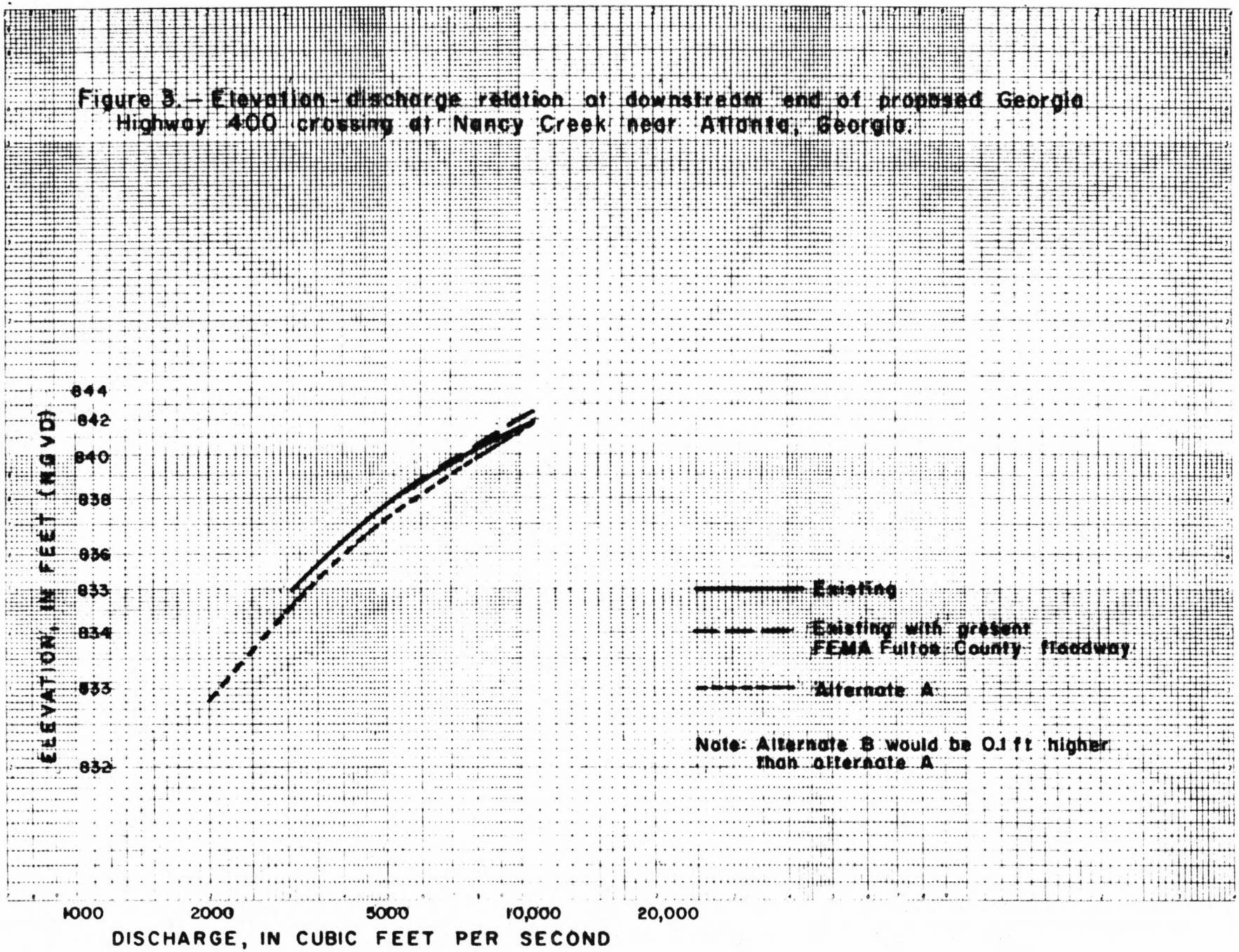
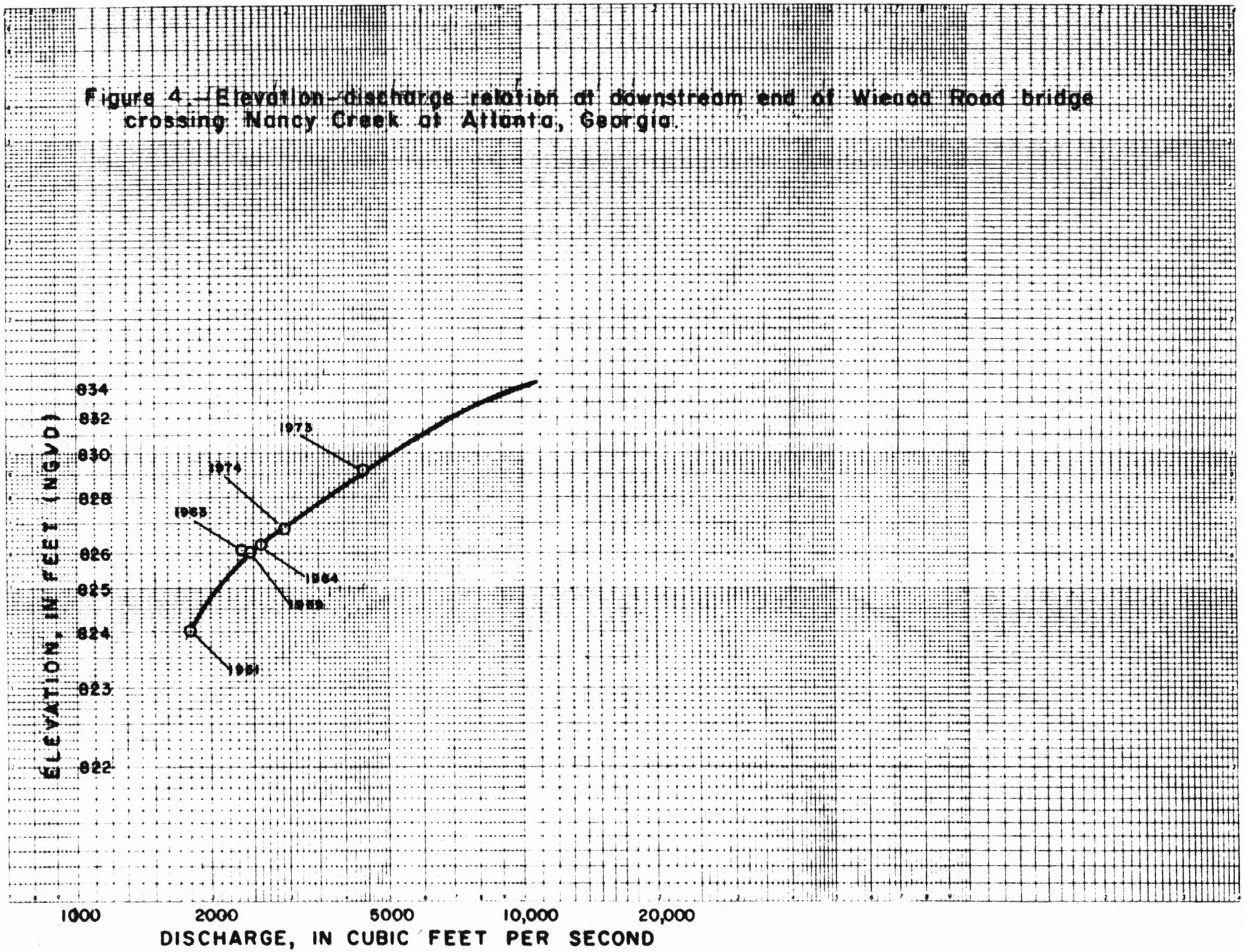


Figure 4.—Elevation-discharge relation at downstream end of Wieuca Road bridge crossing Nancy Creek at Atlanta, Georgia.



The starting elevations for the 100-year flood agree with those for Wieuca Road in the FEMA (1985) report for Atlanta, but are about 3.0 ft higher than those given in the FEMA (1981) report for Fulton County.

The elevation-discharge relations at the downstream end of the proposed crossing of Nancy Creek for existing conditions, for existing conditions using the same floodway given in the FEMA (1981) report, and for alternate condition A are shown in figure 3. The elevation-discharge relation for alternate condition B is not shown because it is only 0.1 ft higher than for alternate condition A throughout the range of discharges.

Flood Profiles

The flood profiles for the 2-, 10-, 25-, 50-, and 100-year floods for Nancy Creek between Wieuca Road and Windsor Parkway are shown in table 1 and figures 5-7. The profiles are shown for existing conditions, existing conditions with the floodway given in FEMA (1981), and for alternate conditions A and B. The profiles were produced by using U.S. Geological Survey Computer Program J635 (Shearman, 1976).

The starting elevations are from the U.S. Geological Survey elevation-discharge relation at Wieuca Road shown in figure 4. The elevation of the 100-year flood agrees with that computed for the downstream end of the Wieuca Road crossing in the FEMA (1985) report for the city of Atlanta.

The elevation-discharge relation at Windsor Parkway shown in figure 8 was computed by using known high-water elevations for several floods obtained at Windsor Parkway and corresponding discharges based on the U.S. Geological Survey crest-stage gage at Rickenbacker Drive. This elevation-discharge curve was extended above 4,300 ft^3/s by the slope-conveyance method (Bailey and Ray, 1966).

The "n" roughness values were adjusted between Wieuca Road and Windsor Parkway to reproduce the Windsor Parkway elevation-discharge relation of figure 8 using the starting elevations obtained from the Wieuca Road elevation-discharge recharge relation of figure 4.

The channel between cross sections H and N (fig. 1) was relocated as shown in figure 9 by using either the alternate A or B channel and embankment slopes. This relocation reduces the length of the main channel in this reach from 2,050 ft to 1,300 ft and reduces the elevations of floods as shown in figures 5-7. These reductions in elevation result from the reduced length and lower roughness values of the relocated channel.

Table 1.--Flood-profile data for existing conditions, existing condition with floodway, and alternate conditions A and B

Cross section (See fig. 1)	Distance above Wieuca Road (ft)	Distance above Wieuca Road (ft)	WATER-SURFACE ELEVATION IN FEET (NGVD)							
			2-year flood, 2,950 ft^3/s				10-year flood, 5,840 ft^3/s			
		Alt. A and B	Existing Conditions	Existing floodway	Alt. A	Alt. B	Existing Conditions	Existing floodway	Alt. A	Alt. B
A-Wieuca Rd.	0	0	826.9	826.9	826.9	826.9	830.9	830.9	830.9	830.9
B-Approach	120	120	827.1	827.1	827.1	827.1	831.7	831.7	831.7	831.7
C	790	790	827.7	827.7	827.7	827.7	832.2	832.2	832.2	832.2
D	1,500	1,500	828.8	828.8	828.8	828.8	833.0	833.0	833.0	833.0
E	2,180	2,180	830.1	830.1	830.1	830.1	834.1	834.1	834.1	834.1
F	3,700	3,700	833.0	833.0	833.0	833.0	836.4	836.5	836.5	836.5
G	4,000	4,000	833.6	833.6	833.6	833.6	837.1	837.2	837.2	837.2
H-Start relocated channel	4,400	*4,400	834.4	834.4	834.3	834.3	837.6	837.8	837.6	837.6
I	4,700	4,700	834.8	834.8	834.4	834.4	838.1	838.3	837.8	837.9
J-Proposed Georgia Highway 400 Extension	4,960	4,960	835.0	835.0	834.5	834.5	838.4	838.6	837.9	838.0
K	5,510	5,060	836.3	836.3	--	--	839.5	839.6	--	--
L-Approach	5,910	5,290	836.9	836.9	834.6	834.7	840.3	840.4	838.2	838.3
M	6,180	5,440	837.2	837.2	834.8	834.9	840.6	840.7	838.4	838.5
N-End relocated channel	6,450	*5,700	837.9	837.9	835.0	835.1	841.2	841.4	838.5	838.6
O	7,140	6,390	839.2	839.2	836.6	836.8	842.8	842.9	840.2	840.4
P	7,750	7,000	840.4	840.4	839.4	839.4	844.1	844.2	843.0	843.1
Q	8,250	7,510	841.3	841.3	840.7	840.7	844.9	845.0	844.2	844.2
R-Windsor Parkway	8,780	8,030	841.6	841.7	841.3	841.3	845.1	845.3	844.6	844.7
S	8,900	8,150	842.0	842.1	841.6	841.6	845.2	845.4	844.7	844.8

*Relocated channel between distances 4,400 and 5,700 ft for alternates A and B.

Table 1.--Flood-profile data for existing conditions, existing condition with floodway, and alternate conditions A and B--Continued

Cross section (See fig. 1)	Distance above Wieuca Road (ft)	Distance above Wieuca Road (ft)	WATER-SURFACE ELEVATION IN FEET (NGVD)							
			25-year flood, 7,400 ft^3/s				50-year flood, 8,940 ft^3/s			
		Alt. A and B	Existing Conditions	Existing floodway	Alt. A	Alt. B	Existing Conditions	Existing floodway	Alt. A	Alt. B
A-Wieuca Rd.	0	0	832.5	832.5	832.5	832.5	833.3	833.4	833.4	833.4
B-Approach	120	120	833.6	833.7	833.7	833.7	834.5	834.7	834.7	834.7
C	790	790	834.1	834.2	834.2	834.2	835.0	835.2	835.2	835.2
D	1,500	1,500	834.7	834.8	834.8	834.8	835.7	835.9	835.9	835.9
E	2,180	2,180	835.8	835.9	835.9	835.9	836.8	837.0	837.0	837.0
F	3,700	3,700	837.7	837.9	837.9	837.9	838.7	839.0	839.0	839.0
G	4,000	4,000	838.3	838.5	838.5	838.5	839.2	839.5	839.5	839.5
H-Start relocated channel	4,400	*4,400	838.8	839.1	839.0	839.0	839.7	840.2	840.0	840.0
I	4,700	4,700	839.4	839.6	839.2	839.3	840.4	840.7	840.3	840.3
J-Proposed Georgia Highway 400 Extension	4,960	4,960	839.7	840.0	839.3	839.4	840.7	841.0	840.4	840.5
K	5,510	5,060	840.8	841.0	--	--	841.8	842.1	--	--
L-Approach	5,910	5,290	841.6	841.8	839.6	839.7	842.7	842.9	840.7	840.8
M	6,180	5,440	842.0	842.1	839.6	839.8	843.1	843.2	840.8	840.9
N-End relocated channel	6,450	*5,700	842.5	842.8	839.8	840.0	843.6	843.9	841.0	841.2
O	7,140	6,390	844.2	844.4	841.6	841.9	845.4	845.6	842.8	843.1
P	7,750	7,000	845.5	845.8	844.4	844.5	846.6	847.1	845.6	845.7
Q	8,250	7,510	846.2	846.5	845.6	845.7	847.2	847.8	846.7	846.8
R-Windsor Parkway	8,780	8,030	846.4	846.8	846.0	846.1	847.4	848.2	847.2	847.3
S	8,900	8,150	846.5	846.9	846.1	846.2	847.5	848.3	847.3	847.4

*Relocated channel between distances 4,400 and 5,700 ft for alternates A and B.

Table 1.--Flood-profile data for existing conditions, existing condition with floodway, and alternate conditions A and B--Continued

Cross section (See fig. 1)	Distance above Wieuca Road (ft)	Distance above Wieuca Road (ft)	WATER-SURFACE ELEVATION IN FEET (NGVD)			
			100-year flood, 10,900 ft^3/s			
		Alt. A and B	Existing Conditions	Existing floodway	Alt. A	Alt. B
A-Wieuca Rd.	0	0	834.2	834.3	834.3	834.3
B-Approach	120	120	835.4	835.8	835.8	835.8
C	790	790	836.1	836.5	836.5	836.5
D	1,500	1,500	836.8	837.4	837.4	837.4
E	2,180	2,180	837.9	838.4	838.4	838.4
F	3,700	3,700	839.8	840.4	840.4	840.4
G	4,000	4,000	840.2	840.8	840.8	840.8
H-Start relocated channel	4,400	*4,400	840.8	841.5	841.3	841.3
I	4,700	4,700	841.5	842.1	841.6	841.7
J-Proposed Georgia Highway 400 Extension	4,960	4,960	841.9	842.4	841.7	841.8
K	5,510	5,060	843.1	843.5	-	-
L-Approach	5,910	5,290	844.0	844.3	842.1	842.3
M	6,180	5,440	844.4	844.6	842.1	842.3
N-End relocated channel	6,450	*5,700	844.9	845.4	842.3	842.5
O	7,140	6,390	846.8	847.1	844.2	844.6
P	7,750	7,000	847.9	848.7	847.1	847.3
Q	8,250	7,510	848.4	849.4	848.2	848.3
R-Windsor Parkway	8,780	8,030	848.6	849.7	848.6	848.7
S	8,900	8,150	848.7	849.8	848.7	848.8

*Relocated channel between distances 4,400 and 5,700 ft for alternates A and B.

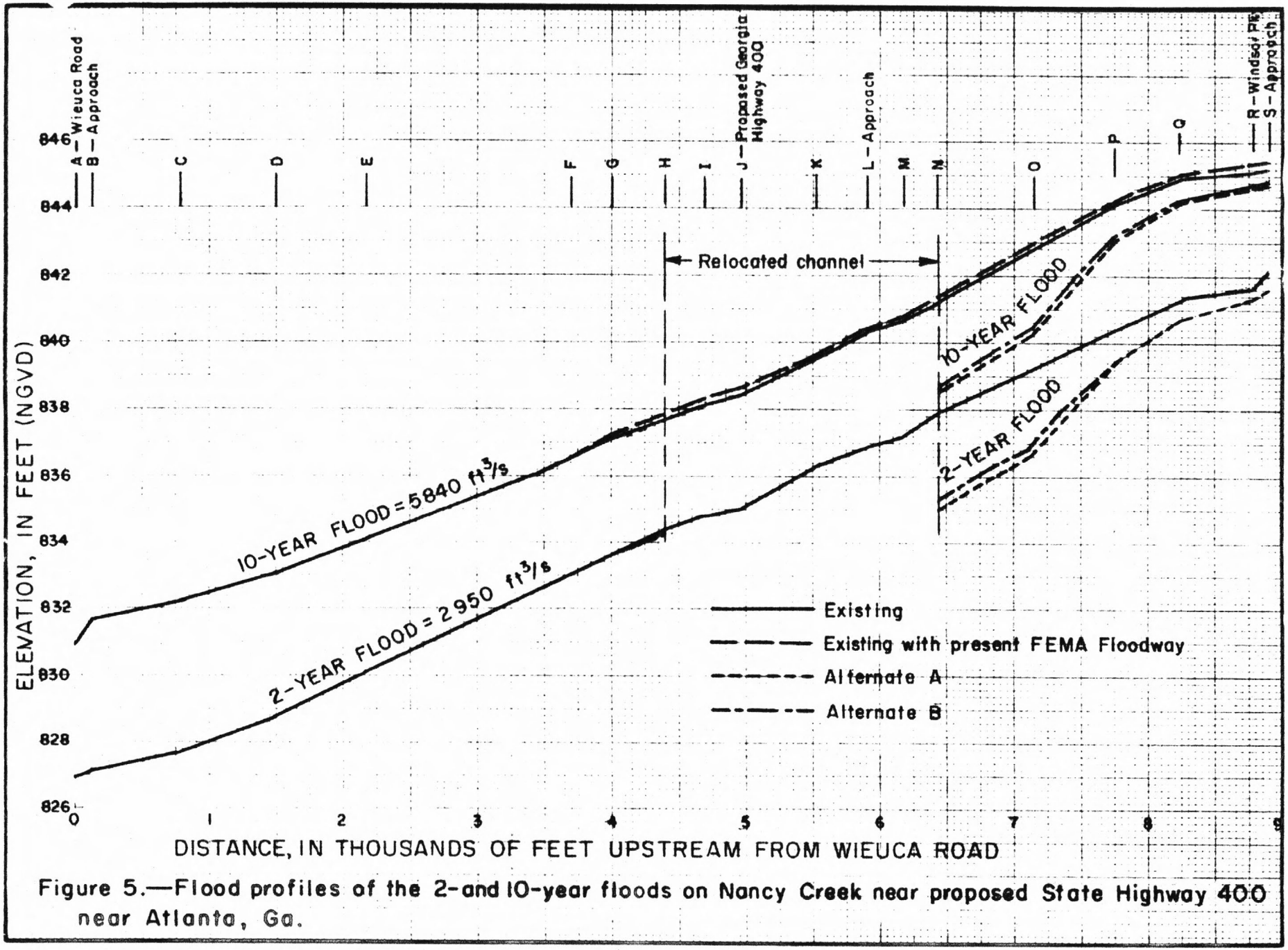


Figure 5.—Flood profiles of the 2-and 10-year floods on Nancy Creek near proposed State Highway 400 near Atlanta, Ga.

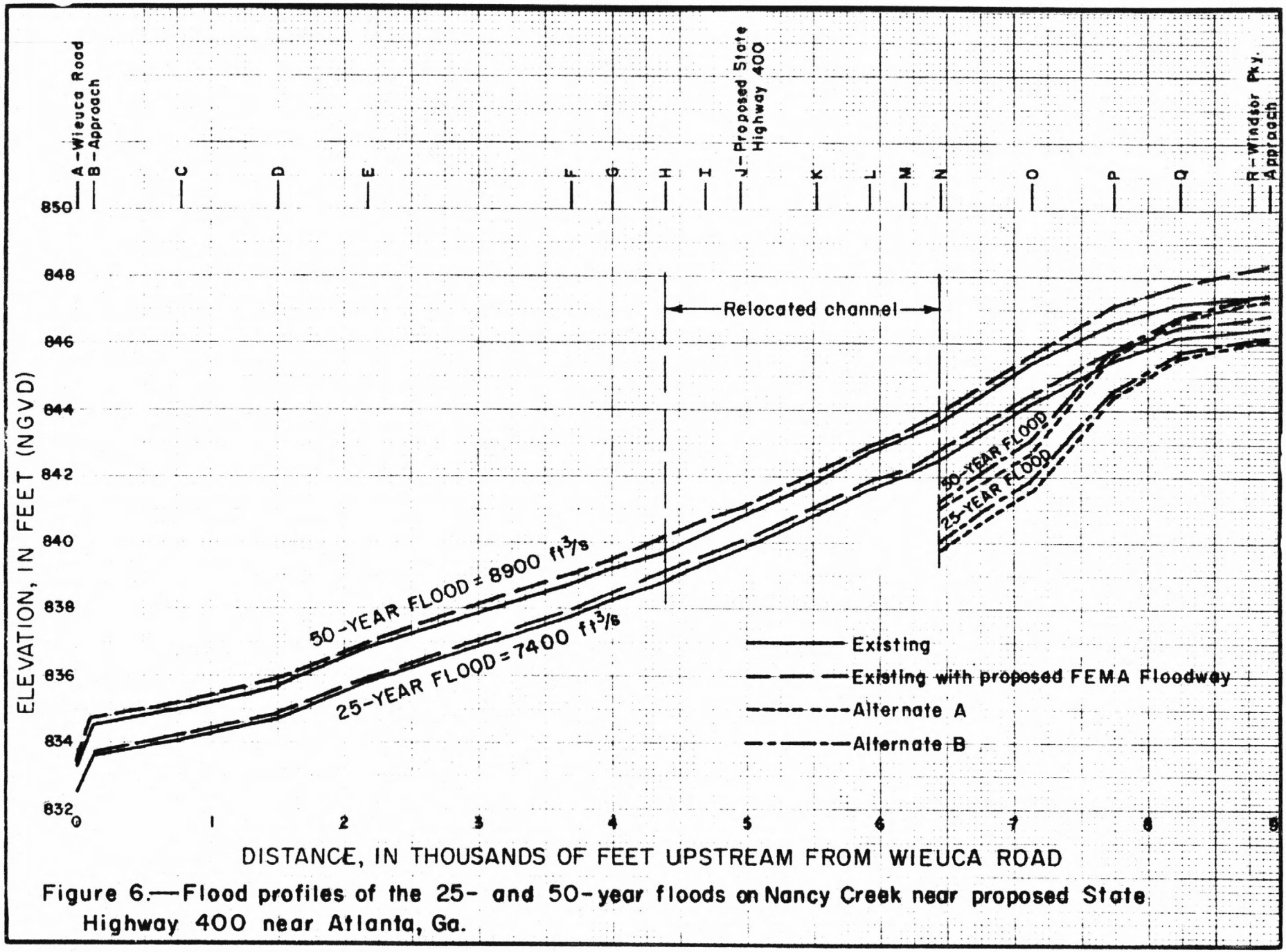


Figure 6.—Flood profiles of the 25- and 50-year floods on Nancy Creek near proposed State Highway 400 near Atlanta, Ga.

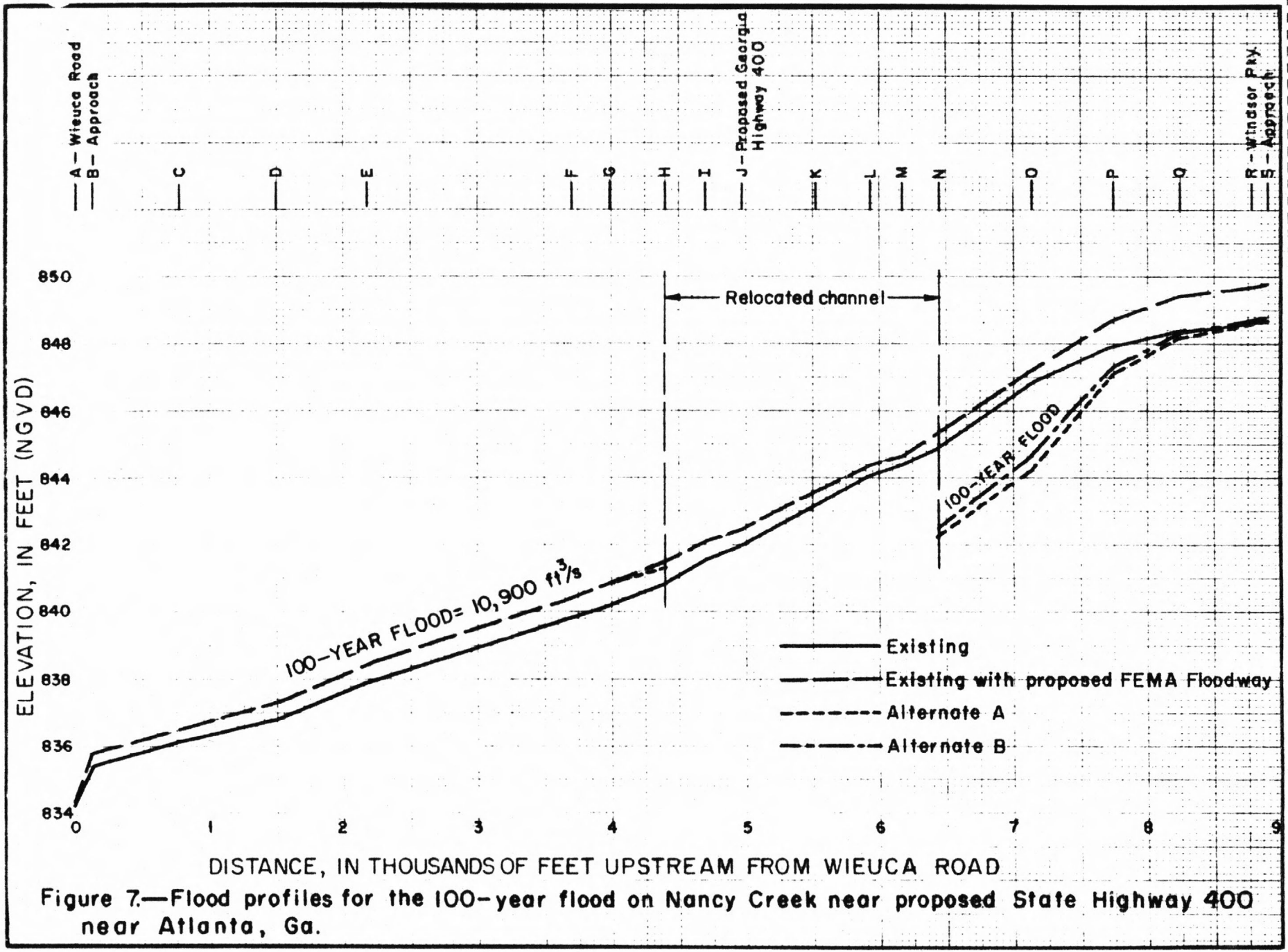


Figure 7.—Flood profiles for the 100-year flood on Nancy Creek near proposed State Highway 400 near Atlanta, Ga.

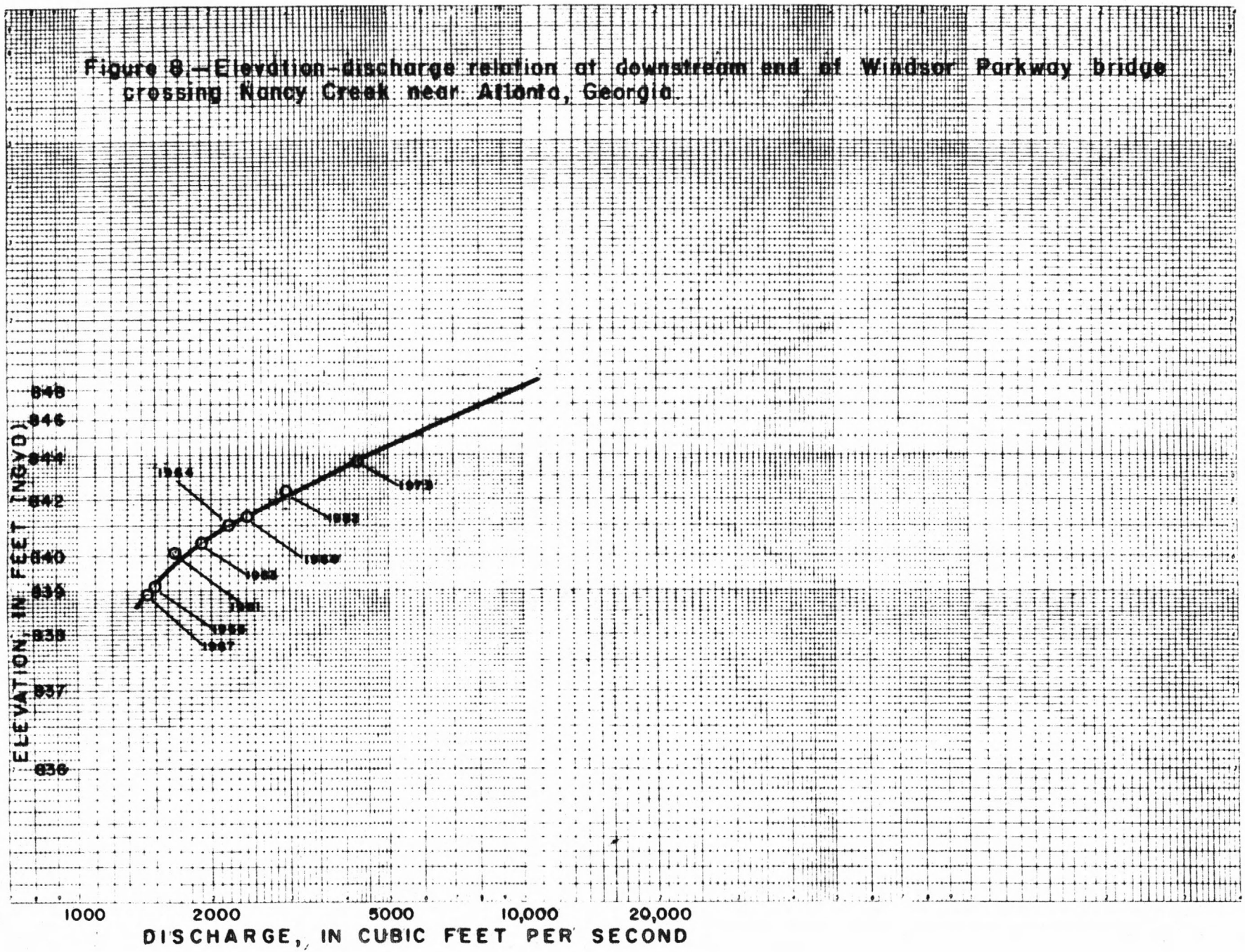


Figure 8.--Elevation-discharge relation at downstream end of Windsor Parkway bridge crossing Nancy Creek near Atlanta, Georgia.

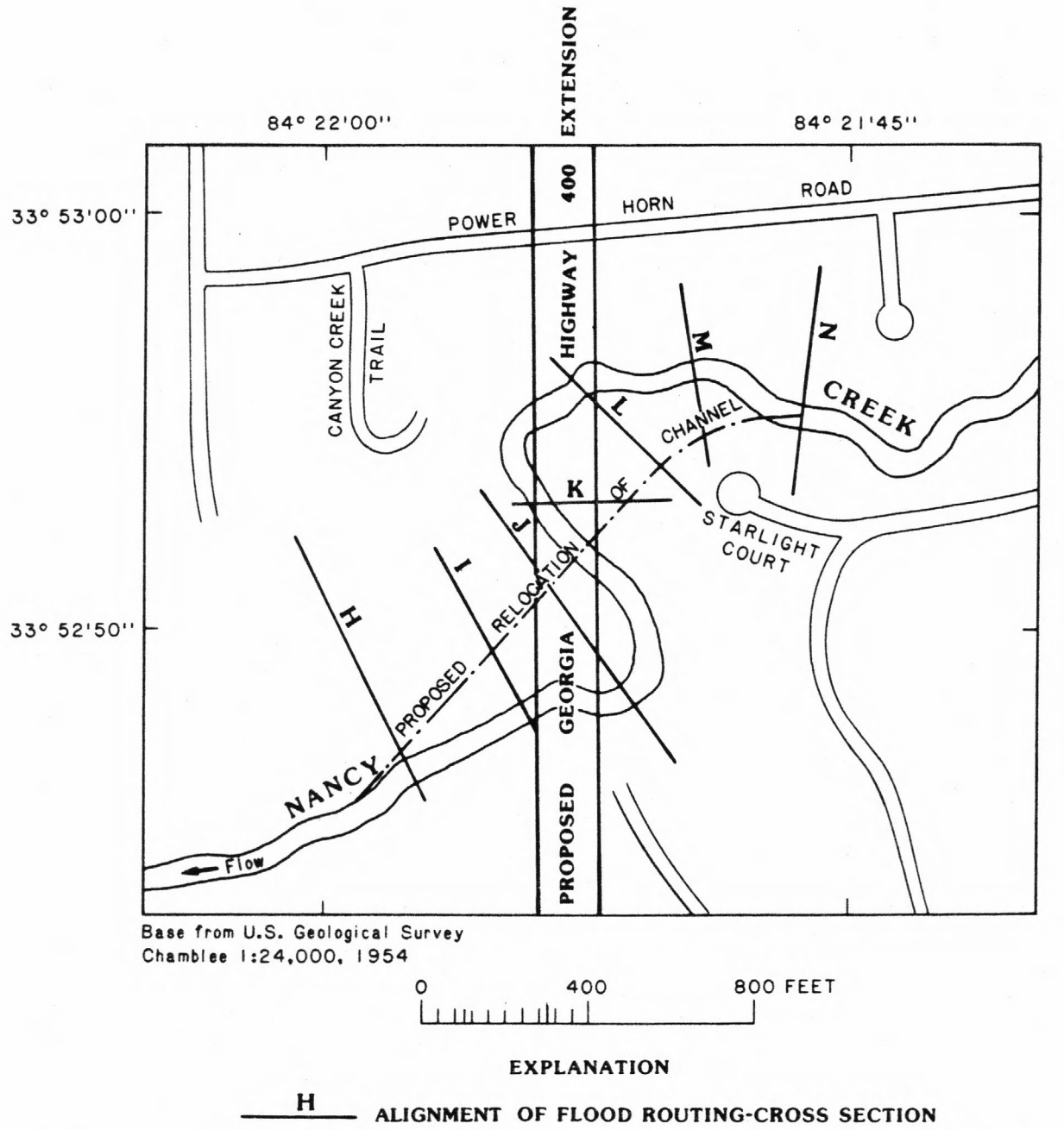


Figure 9.--Location of relocated channel, proposed Georgia Highway 400 extension, and cross sections used in flood routing for Nancy Creek near Atlanta, Ga.

Floodway Computations

The floodway elevations for Nancy Creek used in the FEMA (1981) report for Fulton County were adjusted to agree with the FEMA (1985) report for the city of Atlanta by using the same starting elevations at the downstream end of Wieuca Road. The floodway used in FEMA (1981) has been retained and 18 new cross sections have been added between Wieuca Road and Windsor Parkway.

The revised floodway computations were made by using the U.S. Army Corps of Engineers step-backwater computer program HEC-2 (U.S. Army Corps of Engineers, 1979). Floodway computations include the addition of the proposed bridge on Nancy Creek and the relocated channel in the vicinity of the crossing. Floodway computations were made for alternate conditions A and B and are listed in table 2. The maximum surcharge in the reach of Nancy Creek from Wieuca Road to Windsor Parkway was 0.9 ft as indicated in table 2.

FLOOD FLOW EFFECTS

Backwater Effect

The computed flood elevation, area of opening under high-water conditions, average velocity, and backwater for the 2-, 10-, 25-, 50-, and 100-year floods for existing conditions, existing conditions with floodway, and alternates A and B, with and without floodway, are listed in table 3. These computations were made with U.S. Geological Survey Step-Backwater Computer Program J635 (Shearman, 1976).

The proposed bridge (both alternates A and B) and relocated channel would create a maximum backwater of 0.2 ft for the 100-year flood. The relocated channel will drastically shorten flow length in the vicinity of the proposed extension thus reducing the 100-year flood elevation between 1 and 2 ft between the proposed bridge site and Windsor Parkway (fig. 7).

The distribution of flow through the proposed bridge and flow over the roadway at Windsor Parkway are only estimates, because fall in vicinity of the proposed bridge is insufficient for accurate flow division (table 3).

Table 2.--Floodway computations for Nancy Creek at proposed State Highway 400 extension near Atlanta, Georgia, using floodway with revised starting elevations

Flooding source		Floodway			Base flood water-surface elevation (NGVD)			
Cross sections (See fig. 1)	Distance above Wieuca Road	Width (ft)	Section area (ft^2)	Mean velocity (ft/s)	With floodway (ft)	Without floodway (ft)	Difference (ft)	Condition
B	120	250	3,780	2.9	835.8	835.4	0.4	Alt. A & B
C	790	380	4,400	2.5	836.4	835.9	.5	Do.
D	1,500	303	3,190	3.4	837.4	836.8	.6	Do.
E	2,180	382	4,140	2.6	838.5	837.7	.8	Do.
F	3,700	550	3,890	2.8	840.4	839.6	.8	Do.
G	4,000	500	4,570	2.4	840.9	840.1	.8	Do.
H	4,400	380	3,500	3.1	841.2	840.4	.8	Alt. A
		380	3,580	3.0	841.7	840.8	.9	Alt. B
I	4,700	350	4,040	2.7	841.7	841.0	.7	Alt. A
		350	4,010	2.7	841.8	840.9	.9	Alt. B
J	4,900	390	4,330	2.5	841.8	841.1	.7	Alt. A
		390	4,280	2.5	841.8	841.0	.8	Alt. B
					842.4	841.9	.5	Existing
K	N/A	--	--	--	--	--	--	--
L	5,290	360	3,530	2.6	842.8	842.2	.6	Alt. A
		360	3,590	2.5	843.1	842.4	.7	Alt. B
					844.3	844.0	.3	Existing
M	5,440	262	2,500	3.6	842.8	842.2	.6	Alt. A
		265	2,520	3.6	843.0	842.4	.6	Alt. B
N	5,700	220	1,980	4.5	842.9	842.3	.6	Alt. A
		222	1,980	4.5	843.2	842.5	.7	Alt. B
O	6,390	193	1,760	5.1	843.9	843.5	.4	Alt. A
		193	1,790	5.0	844.1	843.6	.5	Alt. B
P	7,000	338	2,550	3.5	846.1	845.6	.5	Alt. A
		339	2,580	3.5	846.2	845.6	.6	Alt. B
Q	7,510	435	4,300	2.1	847.1	846.4	.7	Alt. A
		435	4,330	2.1	847.1	846.4	.7	Alt. B
R	8,030	610	6,160	1.5	847.5	846.7	.8	Alt. A
		613	6,200	1.5	847.5	846.6	.9	Alt. B
*S	8,456	616	7,070	1.3	847.7	846.8	.9	Alt. A
		616	7,110	1.3	847.7	846.8	.9	Alt. B

Table 3.--Hydraulic comparisons of drainage structures for Nancy Creek near proposed State Highway 400 extension near Atlanta, Georgia

Conditions	Discharge ft^3/s		Downstream elevation ft (NGVD)	Area (ft^2)	Average velocity (ft/s)	Backwater (ft)
	Bridge	Overflow				
WIEUCA ROAD - 68-ft bridge						
Existing conditions - no floodway						
2-year flood	2,950	0	826.9	751	3.9	<0.1
10-year flood	5,840	0	830.9	929	6.3	.5
25-year flood	6,590	810	832.5	929	7.1	.7
50-year flood	6,750	2,150	833.4	929	7.3	.7
100-year flood	6,620	4,280	834.2	929	7.1	.5
Existing conditions - with floodway						
2-year flood	2,950	0	826.9	751	3.9	<0.1
10-year flood	5,840	0	830.9	929	6.3	.5
25-year flood	6,720	580	832.5	929	7.3	.8
50-year flood	7,340	1,560	833.4	929	7.9	1.0
100-year flood	7,750	3,150	834.3	929	8.3	.9
Alternate A and B same as existing conditions with proposed floodway.						
STATE HIGHWAY 400						
Existing conditions - no floodway - no bridge						
2-year flood	2,950	0	835.0	1,220	2.4	--
10-year flood	5,840	0	838.4	2,520	2.3	--
25-year flood	7,400	0	839.7	3,030	2.4	--
50-year flood	8,900	0	840.7	3,450	2.6	--
100-year flood	10,900	0	841.9	3,950	2.8	--
Existing conditions - with floodway - no bridge						
2-year flood	2,950	0	835.1	1,240	2.4	--
10-year flood	5,840	0	838.6	2,560	2.3	--
25-year flood	7,400	0	839.9	3,110	2.4	--
50-year flood	8,900	0	841.0	3,550	2.5	--
100-year flood	10,900	0	842.4	4,080	2.7	--

Table 3.--Hydraulic comparisons of drainage structures for Nancy Creek near proposed State Highway 400 extension near Atlanta, Georgia--Continued

Conditions	Discharge ft^3/s		Downstream elevation ft (NGVD)	Area (ft^2)	Average velocity (ft/s)	Backwater (ft)
	Bridge	Overflow				
Alternate A--390-ft bridge skewed 45 degrees to roadway with abutment slope 2 to 1, and relocated channel 40 ft wide with 2 to 1 embankment slopes						
With floodway						
2-year flood	2,950	0	834.5	702	4.2	<0.1
10-year flood	5,840	0	837.9	1,130	5.2	.1
25-year flood	7,400	0	839.3	1,310	5.7	.1
50-year flood	8,900	0	840.4	1,460	6.1	.1
100-year flood	10,900	0	841.7	1,650	6.6	.2
No floodway						
2-year flood	2,950	0	834.5	700	4.2	<0.1
10-year flood	5,840	0	837.9	1,120	5.2	<.1
25-year flood	7,400	0	839.1	1,280	5.8	.1
50-year flood	8,900	0	840.1	1,410	6.3	.1
100-year flood	10,900	0	841.2	1,570	6.9	.1
Alternate B--380-ft bridge skewed 45 degrees to roadway with abutment slope 2 to 1, and relocated channel 40 ft wide with 1.5 to 1 embankment slopes						
With floodway						
2-year flood	2,950	0	834.5	664	4.4	<0.1
10-year flood	5,840	0	838.0	1,070	5.5	.1
25-year flood	7,400	0	839.4	1,240	6.0	.1
50-year flood	8,900	0	840.5	1,380	6.4	.1
100-year flood	10,900	0	841.8	1,560	7.0	.2
No floodway						
2-year flood	2,950	0	834.5	656	4.5	<0.1
10-year flood	5,840	0	837.9	1,050	5.6	.1
25-year flood	7,400	0	839.1	1,200	6.2	.1
50-year flood	8,900	0	840.1	1,330	6.7	.1
100-year flood	10,900	0	841.2	1,480	7.4	.2

Table 3.--Hydraulic comparisons of drainage structures for Nancy Creek near proposed State Highway 400 extension near Atlanta, Georgia--Continued

Conditions	Discharge ft^3/s		Downstream elevation ft (NGVD)	Area (ft^2)	Average velocity (ft/s)	Backwater (ft)
	Bridge	Overflow				
WINDSOR PARKWAY - 58-ft bridge						
Existing conditions - no floodway						
2-year flood	2,950	0	841.6	607	4.9	0.3
10-year flood	1,900	3,940	845.1	607	3.1	<.1
25-year flood	*1,200	*6,200	846.4	607	2.0	<.1
50-year flood	*1,000	*7,900	847.4	607	1.6	<.1
100-year flood	*1,000	*9,900	848.6	607	1.6	<.1
Existing conditions - with floodway						
2-year flood	2,950	0	841.7	607	4.9	0.3
10-year flood	*2,000	*3,840	845.3	607	3.2	<.1
25-year flood	*1,400	*6,000	846.8	607	2.3	<.1
50-year flood	*1,200	*7,700	848.2	607	2.0	<.1
100-year flood	*1,200	*9,700	849.7	607	2.0	<.1
Alternate A - with floodway						
2-year flood	2,950	0	841.3	607	4.9	0.3
10-year flood	*2,850	*2,590	844.6	607	4.7	.1
25-year flood	*2,200	*5,200	846.0	607	3.6	<.1
50-year flood	*1,900	*7,000	847.2	607	3.1	<.1
100-year flood	*1,900	*9,000	848.6	607	3.1	<.1
Alternate A - no floodway						
2-year flood	2,950	0	841.2	607	4.9	0.2
10-year flood	*2,850	*2,590	844.5	607	4.7	.1
25-year flood	*2,300	*5,100	845.8	607	3.8	<.1
50-year flood	*2,100	*6,800	846.7	607	3.5	<.1
100-year flood	*2,100	*8,800	847.7	607	3.5	<.1

Table 3.--Hydraulic comparisons of drainage structures for Nancy Creek near proposed State Highway 400 extension near Atlanta, Georgia--Continued

Conditions	Discharge ft^3/s		Downstream elevation ft (NGVD)	Area (ft^2)	Average velocity (ft/s)	Backwater (ft)
	Bridge	Overflow				
WINDSOR PARKWAY - 58-ft bridge--Continued						
Alternate B - with floodway						
(same as Alternate A within accuracy of estimates.)						
Alternate B - no floodway						
(same as Alternate A--within accuracy of estimates.)						

*Rough estimate--Fall-through bridge not sufficient for accurate determination.

Channel Relocation Effects

Three analyses were used to determine the effect that channel relocation (reduction in channel length) and the loss in storage in the floodplain (from filling the original channel and bridge fill approaches) will have on the magnitude of the 100-year flood.

The first analysis was based on a technique of Inman (1986), which uses a dimensionless hydrograph requiring lagtime and magnitude of peak discharges. For existing conditions a lagtime of 4.39 hours was computed by the equation

$$T_L = 161\ A^{\cdot 22}\ S^{-\cdot 66}\ IA^{-\cdot 67}, \qquad (1)$$

where

T_L = lagtime in hours,
A = drainage area in square miles,
S = slope of the main channel in feet per mile, and
IA = the percentage of impervious area in the basin.

For proposed conditions the lag time was reduced 5 minutes from 4.39 hours to 4.30 hours based on a decrease in channel length of 750 ft (2,050 to 1,300 ft) and an estimated velocity of about 3 ft/s. Using this recomputed lag time and the same volume of flow for the 100-year flood, the peak discharge was computed to be 11,100 ft^3/s, an increase of 200 ft^3/s from 10,900 ft^3/s.

The second analysis used the diffusion analogy routing method of Doyle and others (1983). The input for existing conditions was (1) a routing interval of 1.0 hour, (2) a reach length of 0.39 mile, (3) a wave celerity of 4 ft/s, and (4) a wave dispersion coefficient of 7,570 ft^2/s. For proposed conditions the reach length was 0.25 mile, the wave celerity 4.5 ft/s, and the wave dispersion coefficient 6,280 ft^2/s. This routing indicated that with the proposed construction and the reduction in channel length and reduced floodplain storage, the 100-year discharge of 10,900 ft^3/s would be increased by 130 ft^3/s.

The third analysis, based on U.S. Geological Survey Computer Program A697, "Downstream-upstream reservoir routing" (Jennings, 1977), assumed that Nancy Creek acts as a reservoir at cross section H, the downstream end of the relocated channel. This analysis requires (1) an inflow hydrograph, (2) an outflow rating curve, and (3) a reservoir-capacity curve. The inflow hydrograph was computed using techniques described in the first analysis. The outflow elevation-discharge rating curve at cross section H (downstream end of relocated channel) was computed by step-backwater routing as given in the FEMA (1985) report. The computation of the elevation-capacity storage curve at cross section H was based on cross sections upstream. This analysis indicated that with the proposed construction the 100-year discharge of 10,900 would be increased by 170 ft^3/s.

All the analyses indicated that the 100-year discharge would be increased by about 200 ft^3/s, or 2 percent, by the proposed construction and the reduction of the channel length and floodplain storage. This calculated increase in flow is insignificant because the method used to calculate the 100-year flood is accurate only within about ±20 percent. Moreover, an increase in discharge of 200 ft^3/s would increase the elevation of the 100-year flood in the reach only about 0.2 ft.

SUMMARY

The Highway Division, Georgia Department of Transportation, plans the extension of Georgia Highway 400 from Interstate 285, southward to Interstate 85. The plan includes construction of a bridge crossing Nancy Creek, and relocating the main channel, near Atlanta. The U.S. Geological Survey, as part of a program of water-resources investigations in cooperation with the Highway Division, studied the flood-flow characteristics and flood-flow effects of Nancy Creek at the proposed bridge site. The flood-frequency, elevation-discharge relation, flood profiles, and floodway were determined. The maximum backwater effect for the proposed bridge and relocated channel was 0.2 foot for the 100-year flood. The relocated channel will drastically shorten flow length near the proposed State Highway 400 extension and reduce the 100-year flood elevation between 1 and 2 feet from existing conditions between the proposed site and Windsor Parkway. Analyses indicated that the proposed construction and reduction of the channel length and flood-plain storage would increase the 100-year discharge and flood elevation an insignificant amount.

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