ATLAS HA-595

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, OKATOMA CREEK EAST OF MAGEE, MISSISSIPPI

By B. E. Colson, George J. Arcement, and C. O. Ming

Prepared in cooperation with the
DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
and the
MISSISSIPPI STATE HIGHWAY DEPARTMENT

HYDROLOGIC INVESTIGATIONS ATLAS
Published by the U.S. Geological Survey, 1978
W

Prepared in cooperation with the
DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION
AND THE MISSISSIPPI STATE HIGHWAY DEPARTMENT

FLOOD-FLOW DATA OKATOMA CREEK EAST OF MAGEE, MISSISSIPPI

INTRODUCTION

New techniques for predicting water-surface profiles, needed in the design of economical, structurally sound, and environmentally compatible stream crossings, are under investigation. The investigation has accelerated with the advent of digital computers capable of analyzing large quantities of data. Among the techniques is the development of two-dimensional (2-D) digital models. Field data are essential for development and evaluation of these techniques for predicting water-surface profiles. This atlas is one of a series that will provide a wide range of field data.

Since 1969 the U.S. Geological Survey has been collecting backwater data where wide, densely vegetated flood plains are crossed by highway embankments and single-opening bridges. This work was done in cooperation with the Federal Highway Administration Department of Transportation, the Alabama State Highway Department, the Louisiana Department of Transportation and Development, and the Mississippi State Highway Department. The objective of this cooperative project is to present the data in a format conducive to the development of improved models for predicting hydraulic responses of flow at highway crossings of streams in complex hydrologic and geographic settings.

Data were collected at the following 22 sites (fig. 1) for 35 floods; that is, 11 sites had 1 flood each; 9 sites, 2 floods each; and 2 sites, 3 floods each. Analysis of the data (Schneider and others, 1976) showed that backwater and discharge at these sites computed by methods presently in use, would be inaccurate. The floodflow data are unique in the range and detail in which information was collected and provide a base for evaluating digital models relating to open-channel flow. This atlas shows flood data obtained on Okatoma Creek east of Magee, Miss., one of 22 sites plotted in figure 1:

HYDROLOGIC INVESTIGATIONS ATLAS NUMBER

ALABAMA

Buckhorn Creek near Shiloh............HA–607*
Pea Creek near Louisville............ 608*
Poley Creek near Sanford............ 609*
Yellow River near Sanford............ 610*
Whitewater Creek near Tarentum............ 611*

LOUISIANA

Alexander Creek near St. Francisville............HA–600*
Beaver Creek near Kentwood............ 601*
Comite River near Olive Branch............ 602
Cypress Creek near Downsville............ 603*
Flagon Bayou near Libuse............ 604*
Little Bayou de Loutre near Truxno............ 605*
Tenmile Creek near Elizabeth............ 606*

MISSISSIPPI

Bogue Chitto near Johnston Station............HA–591*
Bogue Chitto near Summit............ 592*
Coldwater River near Red Banks............ 593*
Lobutcha Creek at Zama............ 594*
Okatoma Creek east of Magee............ 595
Okatoma Creek near Magee............ 596*
Tallahala Creek at Waldrup............ 590
Thompson Creek near Clara............ 597*
West Fork Amite River near Liberty............ 598*
Yockanookany River near Thomastown............ 599*

* In press

DESCRIPTION OF DATA

TYPE OF DATA

Data collected at all study sites consist of (1) depths, velocities, and discharges measured through the bridge openings, and (2) peak water-surface elevations along the highway embankment and along cross sections. A minimum of eight valley cross sections were surveyed at approximately one valley-width intervals in the vicinity of the bridge at each site. Locations of the cross sections were alined perpendicularly to the assumed direction of flow. Cross sections were extended to intersect the edge of the valley at equal water-surface elevations. Surveying procedures described in the U.S. Geological Survey Techniques of Water-Resources Investigations series (Matthai, 1967; Benson and Dalrymple, 1967) were followed.

HIGH-WATER MARKS

Water-surface elevations were determined from high-water marks identified along the cross sections and the edges of the valley after each flood. During peak discharge measurements, water-surface elevations were marked with standard surveying stakes along the upstream and downstream sides of the highway embankment. For some floods additional high-water marks were identified in the valley adjacent to the bridge to define in detail the water surface in the approach and exit reaches.

BRIDGE GEOMETRY

Detailed bridge geometry was obtained at each site. The bridge cross section was surveyed at the most contracted section. Piers, spur dikes, wingwalls, abutment slopes, and other pertinent geometry were measured.

MANNING'S ROUGHNESS COEFFICIENT

Schneider and others (1976) used composite Manning's roughness coefficient values (n) where frequent changes in roughness occurred. In their study, composite values of (n) were verified by matching step backwater computations of the water surface with actual water-surface profiles for measured discharges. The range of (n) values used in this report is based on values used by Schneider and others (1976). Roughness varies from open fields to dense forests.

Roughness values or ranges of roughness values in different parts of the flood plain are shown on the maps. The values shown are based on water depth. The high value is value where depth is less than 0.6 meter and the low value applies where water depth is greater than 1.0 meter. A linear relation of roughness to water depth is assumed for water depths between 0.6 and 1.0 meter.

PRESENTATION OF DATA

The data are presented on topographic maps enlarged from standard 1:24,000 (or 1:62,500) scale Geological Survey topographic maps which comply with National Map Accuracy Standards. Accuracy limitations of the base maps are retained in the enlargements. Although positions may be scaled closely on the enlargements, they are not defined with greater accuracy than positions on the base maps.

Ground elevations are placed adjacent to solid squares. Elevations of floodmarks are indicated by numerical values adjacent to solid triangles. Floodmark elevations for separate floods are shown on separate sheets. Bridge geometry and road-embankment dimensions are shown with brief notations of pier spacing and configuration.

In addition to the data points shown on the maps, discharge measurements of selected floods, plots of cross sections, and velocity-distribution diagrams are shown. Cross-section elevations are tabulated to define stream channels and flood-plain features in greater detail. Each cross section is referred to a zero station established at the extreme left edge (facing downstream) of the valley.

DATUM

All elevations presented in this report are referred to National Geodetic Vertical Datum of 1929 (NGVD).

FLOOD FREQUENCY

Flood-frequency relations are presented graphically. Techniques for deriving flood-frequency relations are those described by the U.S. Water Resources Council (1977), and by Colson and Hudson (1976).

INTERNATIONAL SYSTEM OF UNITS (SI)

The International System of Units (SI) is used throughout this report. All data were measured in the U.S. customary units and converted to SI units. Ground elevations which were originally determined to the nearest tenth of a foot are rounded to the nearest 0.01 meter. Water-surface elevations which were surveyed to hundredths of a foot are rounded to millimeters. The same criteria apply to all other dimensions, except contour elevations which are shown to the nearest tenth of a meter.

The following factors may be used to convert SI units to the U.S. customary units:

MULTIPLY SI UNITS	*BY*	*TO OBTAIN U.S. CUSTOMARY UNITS*
	LENGTH	
Meter (m)	3.281	Feet (ft)
	AREA	
Square meter (m^2)	10.76	Square feet (ft^2)
	VOLUME	
Cubic meter (m^3)	35.31	Cubic feet (ft^3)
	VELOCITY	
Meter per second (m/s)	3.281	Feet per second (ft/s)
	FLOW RATE	
Cubic meter per second (m^3/s)	35.31	Cubic feet per second (ft^3/s)

DATA FOR OKATOMA CREEK EAST OF MAGEE, MISSISSIPPI

Data for Okatoma Creek near Magee, Miss. obtained in a 3-kilometer reach crossed about midway by a county road, are presented on three sheets (fig. 2). Sheet 1 contains tables showing cross-section data (table 1) and discharge data (table 2). An aerial view of the reach looking downstream in vicinity of the bridge is shown on figure 3. Relative magnitude of the flood is shown on the frequency curve (fig. 4).

The locations of representative ground elevations are shown on sheet 2. These points of significant changes in cross-section elevations or alinement of the axis. Plots of the cross sections are graphic presentations of the tabular data.

Bridge geometry and road embankments are shown on sheet 2 as they existed at the time of the floods. The cross section surveyed at the downstream side of the bridge is tabulated on sheet 1. The cross section shown for velocity distribution was obtained by sounding from the upstream side of the bridge during the discharge measurement.

Data for the flood of April 12, 1974 on Okatoma Creek are presented. Eleven valley-cross sections were surveyed after this flood (sheet 2).

Manning's roughness coefficient values and the 1974 flood boundaries are shown on sheets 2 and 3.

FLOOD OF APRIL 12, 1974

Peak water-surface elevations, measured cross section, and velocities for the flood of April 12, 1974, are shown on sheet 3. The flood crested at an elevation of 112.797 meters at the reference point located on the downstream guardrail of the bridge. A peak discharge of 343 m^3/s was measured on the recession at an elevation of 112.794 meters at the reference point (table 2). The recurrence interval of the peak discharge is greater than 100 years (Colson and Hudson, 1976, fig. 4)

SUMMARY

Floodflow data that will provide a base for evaluating digital models relating to open-channel flow were obtained at 22 sites on streams in Alabama, Louisiana, and Mississippi. Thirty-five floods were measured. Analysis of the data indicated that backwater and discharges computed by standard indirect methods currently in use would be inaccurate where densely vegetated flood plains are crossed by highway embankments and single-opening bridges. This atlas presents flood information at the site on Okatoma Creek east of Magee, Miss. Water depths, velocities, and discharges through bridge openings on Okatoma Creek east of Magee, Miss. for flood of April 12, 1974, were measured, together with peak water-surface elevations along embankments and along cross sections. Manning's roughness coefficient values in different parts of the flood plain are shown on maps, and flood-frequency relations are shown on a graph.

ADDITIONAL INFORMATION

Other information pertaining to floods in Alabama, Louisiana, and Mississippi may be obtained at the offices of the U.S. Geological Survey listed below:

U.S. Geological Survey
Room 202, Oil and Gas Board Building (P.O. Box V)
University, Alabama 35486

U.S. Geological Survey
6554 Florida Boulevard (P.O. Box 66492)
Baton Rouge, Louisiana 70896

U.S. Geological Survey
430 Bounds Street
Jackson, Mississippi 39206

SELECTED REFERENCES

Barnes, H. H., Jr., 1967, Roughness characteristics of natural channels: U.S. Geol. Survey Water Supply Paper 1849, 213 p.

Benson, M. A., and Dalrymple, T., 1967, General field and office procedures for indirect discharge measurements: U.S. Geological Survey Techniques Water-Resources Inv., book 3, chap. A1, 30 p.

Bradley, J. N., 1970, Hydraulics of bridge waterways: Federal Highway Admin., Hydraulic Design Ser. No. 1, 111 p.

Colson, B. E., and Hudson, J. W., 1976, Flood frequency of Mississippi streams: Mississippi State Highway Dept., 34 p.

Hains, C. F., 1973, Floods in Alabama, magnitude and frequency: Alabama Highway Dept., 37 p.

Hedman, E. R., 1964, Effects of spur dikes on flow through constrictions: Am. Soc. Civil Engineers Proc., Jour. Hydraulics Div., v. 91, no. HY4, July 1965, p. 155–165.

Matthai, H. F., 1967, Measurement of peak discharge at width contractions by indirect methods: U.S. Geol. Survey Techniques Water-Resources Inv., book 3, chap. A4, 44 p.

Neely, B. L., Jr., 1976, Floods in Louisiana, magnitude and frequency, 3d ed.: Louisiana Dept. Highways, 340 p.

Schneider, V. R., Board, J. W., Colson, B. E., Lee, F. N., and Druffel, L., 1976, Computation of backwater and discharge at width constrictions of heavily vegetated flood plains: U.S. Geol. Survey Water-Resources Inv. 76–129, 64 p.

U.S. Water Resources Council, 1977, Guidelines for determining flood flow frequency: Washington, D.C., U.S. Water Resources Council Bull. 17A, 163 p.

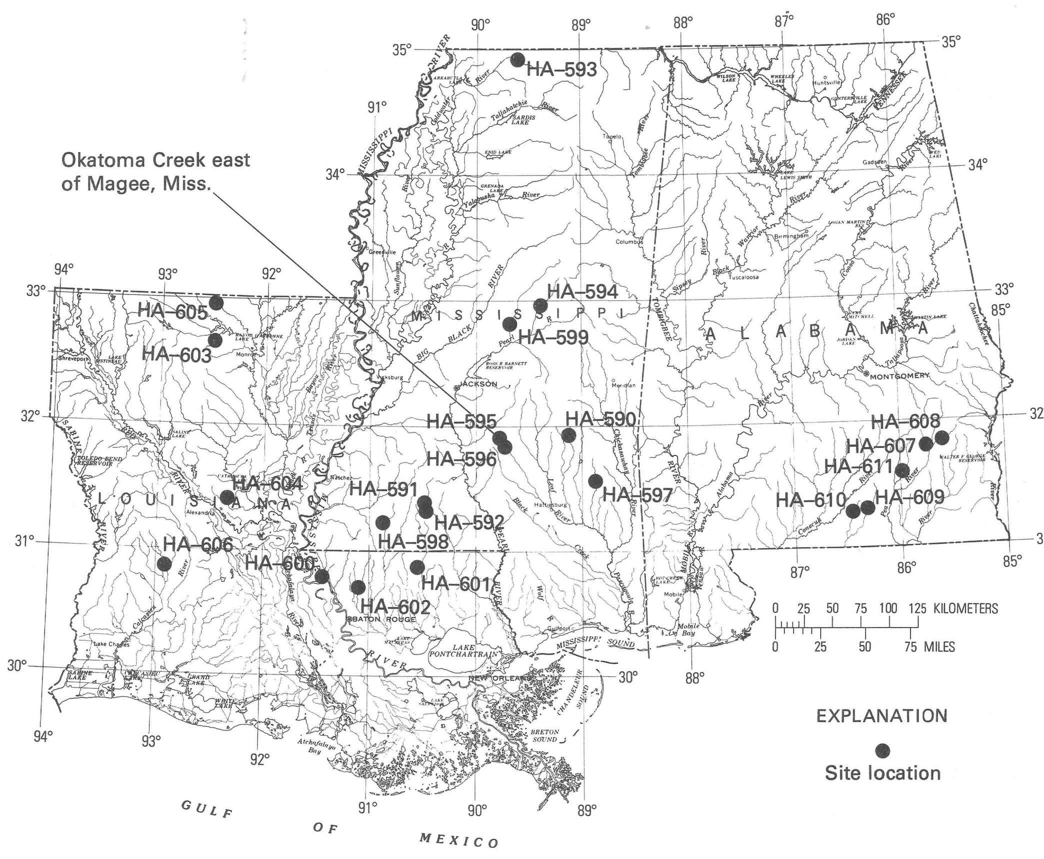

FIGURE 1.—INDEX MAP OF STUDY SITES IN THE BRIDGE BACKWATER INVESTIGATION PROJECT, ALABAMA, LOUISIANA, AND MISSISSIPPI.

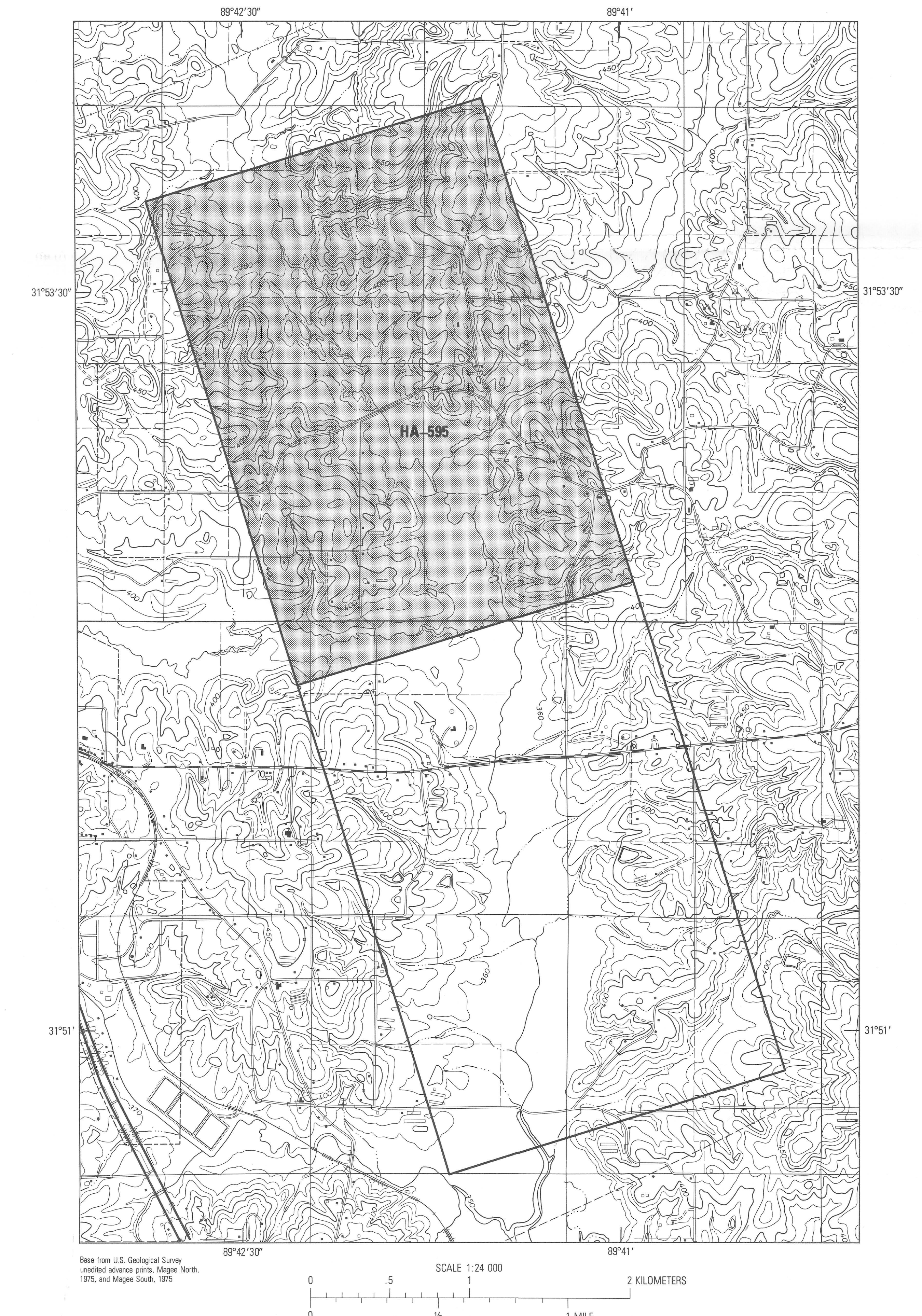

FIGURE 2—INDEX MAP SHOWING STUDY REACH, OKATOMA CREEK EAST OF MAGEE, MISSISSIPPI

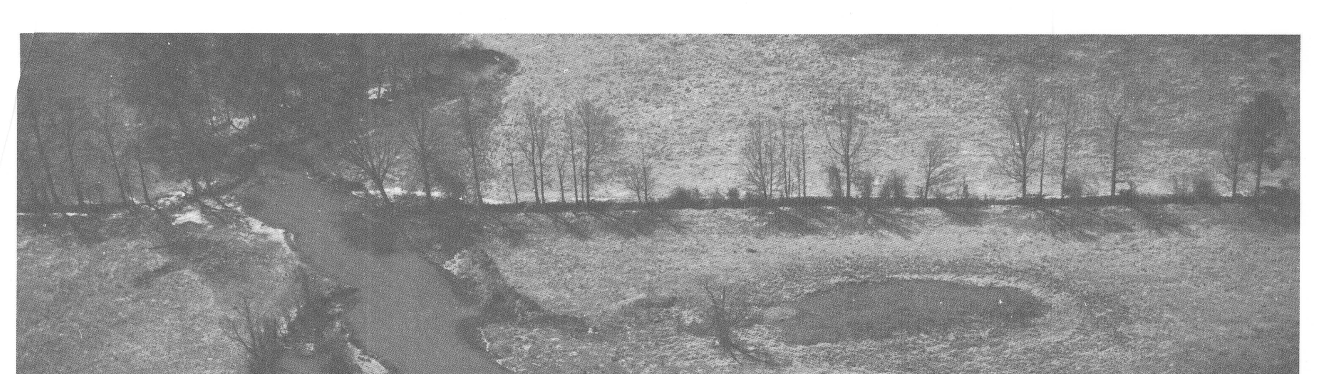

FIGURE 3—AERIAL VIEW LOOKING DOWNSTREAM AT BRIDGE EAST OF MAGEE, MISSISSIPPI

FIGURE 4—FREQUENCY OF FLOODS, OKATOMA CREEK EAST OF MAGEE, MISSISSIPPI

TABLE 1—VALLEY CROSS-SECTION DATA FOR OKATOMA CREEK EAST OF MAGEE, MISSISSIPPI. ZERO STATION IS AT THE LEFT EDGE OF THE VALLEY (FACING DOWNSTREAM)

CROSS SECTION 1

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	112.68
12	111.74
36	109.91
60	109.03
75	109.70
92	109.51
107	109.21
109	108.42
113	107.90
119	107.72
121	108.97
126	109.33
141	109.70
172	109.70
196	109.70
216	109.61
246	109.42
319	109.67
350	110.00
395	110.25
475	111.83
490	113.66

CROSS SECTION 2

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	112.75
5	112.44
23	111.16
89	110.15
137	110.22
149	109.27
175	109.79
178	108.42
186	108.48
187	109.61
190	110.12
204	110.40
265	109.94
309	110.00
335	110.06
395	110.06
432	109.79
444	109.55
465	110.09
485	110.22
519	110.73
529	110.79
547	111.43
567	113.66

CROSS SECTION 3

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	112.87
48	110.98
85	110.61
141	110.55
178	110.46
242	110.55
294	110.55
352	110.64
382	110.64
384	109.30
394	108.90
396	109.58
399	110.34
404	110.43
453	110.28
497	110.34
526	110.31
549	110.46
568	112.59
570	113.78

CROSS SECTION 4

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	112.96
7	112.14
32	111.04
52	111.01
105	110.95
161	110.86
190	111.01
206	111.16
221	111.01
223	109.91
234	109.64
236	111.01
307	111.19
324	110.67
365	111.07
411	111.28
451	112.68
459	113.87

CROSS SECTION 5

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	113.39
9	111.31
9	111.56
47	111.34
102	110.40
116	110.28
120	109.42
136	109.85
141	110.28
148	111.28
187	110.40
220	111.19
260	111.31
314	112.20
372	113.39
395	113.84

CROSS SECTION 6

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	113.69
8	112.84
13	112.47
19	111.65
65	111.53
68	110.25
75	110.06
79	110.95
81	111.53
115	111.40
178	110.67
178	109.97
180	109.58
183	110.46
210	111.19
273	111.07
377	111.22
402	112.11
413	114.09

CROSS SECTION 7

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	113.75
40	111.65
49	110.95
89	110.95
98	111.10
134	111.37
172	111.50
189	110.79
193	111.56
207	110.67
207	110.03

CROSS SECTION 7 (Cont.)

213	109.76
216	110.46
234	110.83
234	111.28
328	111.37
379	110.76
403	111.53
471	111.31
487	111.37
522	111.50
542	111.86
576	112.44
592	114.67

BRIDGE SECTION

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	113.08
0	111.53
6	110.40
9	110.12
12	110.31
15	110.00
18	109.03
21	109.18
24	109.18
27	109.45
30	109.55
34	110.31
37	110.22
40	110.19
43	110.52
46	110.89
48	111.07
49	111.43
49	113.08

CROSS SECTION 8

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	113.78
8	113.57
19	113.36
38	112.87
58	112.53
86	112.35
117	112.29
137	111.92
178	111.86
197	112.01
215	111.74
215	110.46
216	109.55
222	109.82
223	110.46
224	111.77
280	111.92
295	111.89
325	111.71
347	111.28
372	111.40
376	111.89
384	111.68
403	111.22
422	111.77
443	111.65
452	111.31
457	111.50
461	111.74
491	111.65
515	111.68
596	112.26
625	112.38
641	112.75
650	113.78

CROSS SECTION 9

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	114.24
2	113.96
11	111.56
20	111.56
23	112.78
35	112.90
65	112.84
68	110.92
72	109.91
77	112.96
89	112.87
103	112.75
123	112.59
162	112.62
178	112.26
193	112.41
212	112.38
222	111.95
232	111.89
248	112.35
259	112.38
268	112.29
272	111.65
276	111.68
280	111.83
298	112.38
312	112.29
341	112.26
376	112.20
411	112.53
425	113.93
436	114.21

CROSS SECTION 10

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	114.85
14	113.20
38	113.02
53	113.26
94	113.05
126	113.20
154	112.99
156	112.32
197	113.11
207	112.20
208	111.25
211	111.04
214	111.34
215	112.56
244	112.35
268	113.14
283	112.35
306	112.62
317	113.84
330	115.03

CROSS SECTION 11

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	115.70
14	114.54
31	113.93
52	113.81
71	113.32
79	113.11
81	111.95
86	111.83
87	112.20
89	113.51
103	113.51
115	113.75
127	113.48
135	112.71
141	112.41
146	113.81
173	113.[illegible]6
220	113.9[illegible]
258	113.96
304	113.45
344	113.69
432	113.93
439	114.88
442	116.25

TABLE 2—DISCHARGE MEASUREMENT OF APRIL 12, 1974, ON OKATOMA CREEK EAST OF MAGEE, MISSISSIPPI. (WATER SURFACE ELEVATION=12.994 METERS. TOTAL DISCHARGE=343 CUBIC METERS PER SECOND)

STATION (METERS)	DEPTH (METERS)	ANGLE (COEFFICIENT)	OBSERVATION DEPTH[1]	VELOCITY (METERS PER SECOND)
0.0	0.91	[illegible]	—	1.158
1.2	1.10	[illegible]	0.6	1.158
3.7	1.46	[illegible]	0.6	2.947
6.1	1.89	[illegible]	0.2	2.490
			0.8	1.814
8.5	2.44		0.2	3.158
			0.8	3.316
11.0	2.59	[illegible]	0.2	3.158
			0.8	3.158
13.4	2.59	0	0.2	3.158
			0.8	3.237
15.8	2.80	0	0.2	3.316
			0.8	3.237
18.3	3.35	0	0.2	1.661
			0.8	1.847
20.1	3.66	0	0.2	3.316
			0.8	2.822
21.9	3.72	0	0.2	3.158
			0.8	3.085
23.8	3.51	0	0.2	3.158
			0.8	2.883
25.6	3.51	0	0.2	3.158
			0.8	2.765
27.4	3.23	0	0.2	2.490
			0.8	2.655
29.3	3.20	0	0.2	1.780
			0.8	2.167
31.1	2.90	0	0.2	3.316
			0.8	3.316
33.5	2.56	8	0.2	3.316
			0.8	3.316
36.0	2.44	8	0.2	3.085
			0.8	3.014
38.4	2.44	11	0.2	2.655
			0.8	3.316
40.8	2.44	11	0.2	1.780
			0.8	2.655
43.3	1.89	0	0.2	3.316
			0.8	3.237
45.7	1.58	0	0.2	2.655
			0.8	2.603
48.2	1.52	0	—	1.314

[1]Observation depth is the ratio of the velocity observation depth to the total depth at the station.

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1978—W78460

For sale by Branch of Distribution, U.S. Geological Survey 1200 South Eads Street, Arlington, VA 22202 and Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225