DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, BOGUE CHITTO NEAR SUMMIT, MISSISSIPPI

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

HYDROLOGIC INVESTIGATIONS ATLAS
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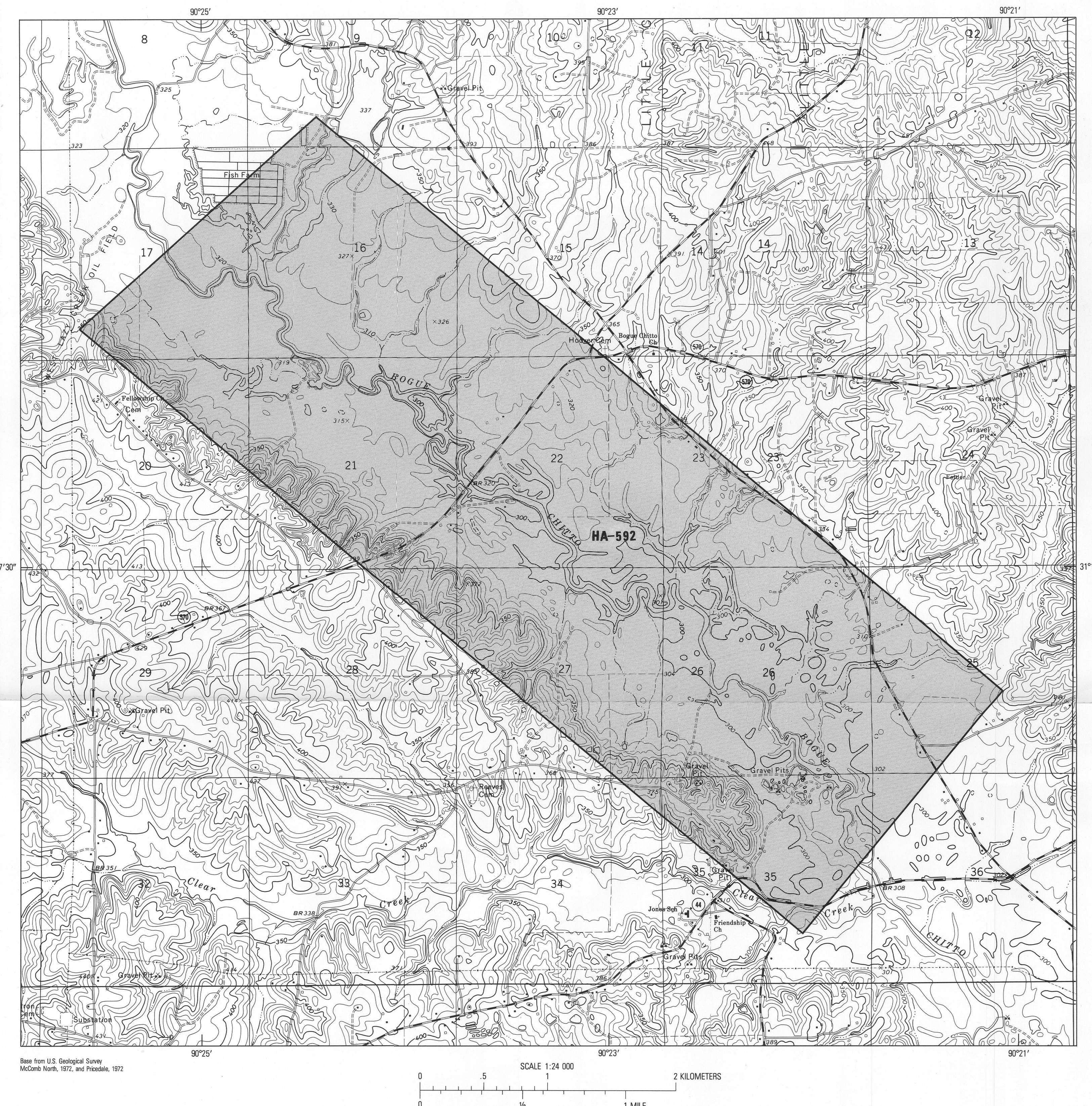

FIGURE 2—INDEX MAP SHOWING STUDY REACH, BOGUE CHITTO NEAR SUMMIT, MISSISSIPPI

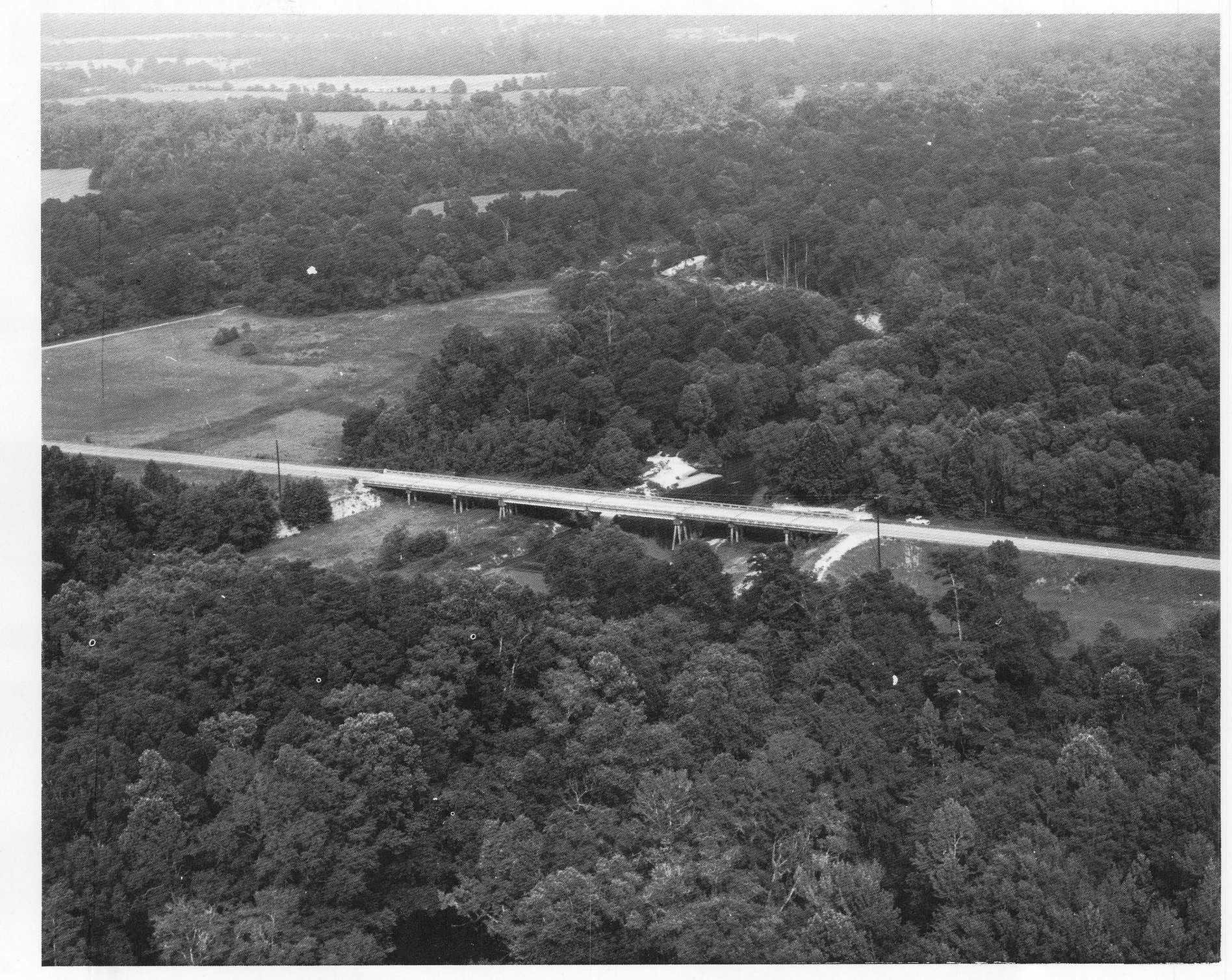

FIGURE 3—AERIAL VIEW LOOKING DOWNSTREAM IN THE VICINITY OF THE BRIDGE ON STATE HIGHWAY 570, BOGUE CHITTO NEAR SUMMIT, MISSISSIPPI

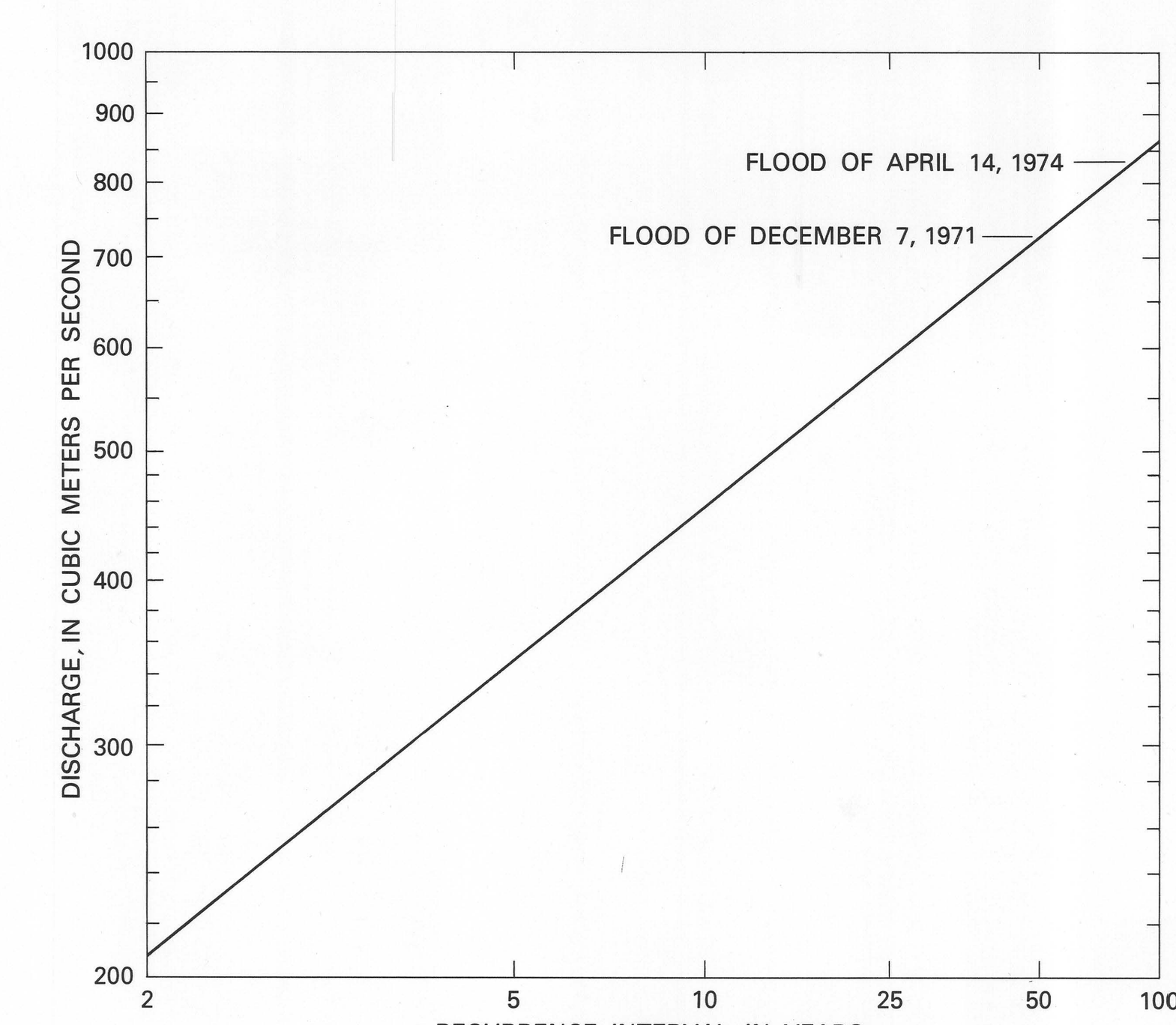

FIGURE 4—FREQUENCY OF FLOODS, BOGUE CHITTO NEAR SUMMIT, MISSISSIPPI

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS BOGUE CHITTO NEAR SUMMIT, 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 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.

Backwater data were obtained at 22 sites for 35 floods; that is, 11 sites had 1 flood each; 9 sites, 2 floods each; and 2 sites, 3 floods each. Analysis of 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.

The data sites (fig. 1) are listed below. This atlas shows flood data obtained on Bogue Chitto near Summit, Mississippi, one of the 22 sites.

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 seven 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, abutments 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 the value where water 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 represented on topographic maps enlarged from standard 1:24,000 or 1:62,500 scale U.S. 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).

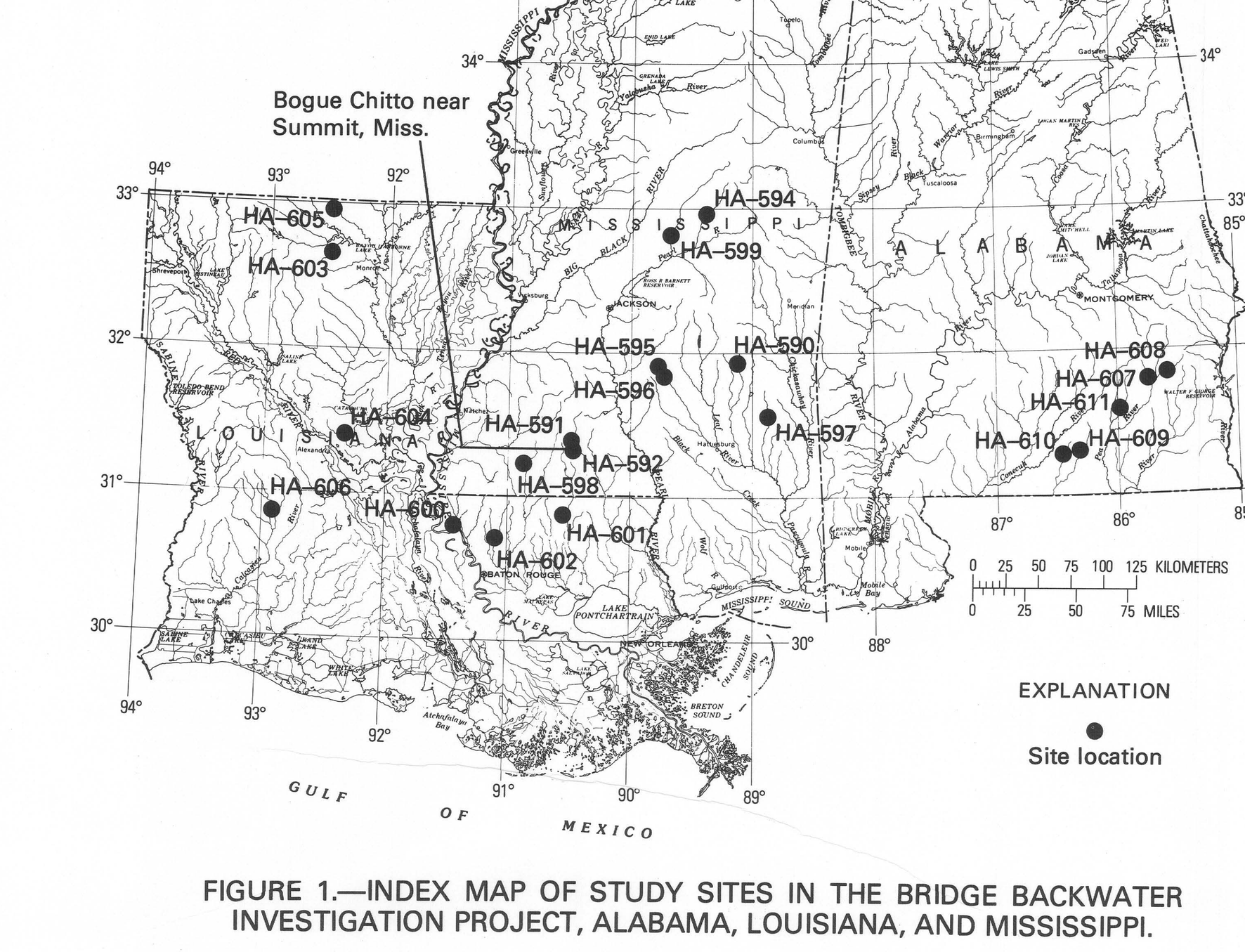

FIGURE 1.—INDEX MAP OF STUDY SITES IN THE BRIDGE BACKWATER INVESTIGATION PROJECT, ALABAMA, LOUISIANA, AND MISSISSIPPI.

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.

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 BOGUE CHITTO NEAR SUMMIT, MISSISSIPPI

Data for Bogue Chitto near Summit, Miss. obtained in a 7-kilometer reach crossed about midway by State Highway 570 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 looking downstream in the vicinity of the bridge is shown in figure 3. Relative magnitudes of the floods are shown on the frequency curve (fig. 4).

The locations of representative ground elevations are shown on sheet 2. These are points of significant changes in cross section elevation and 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 two floods on Bogue Chitto are presented. The first flood occurred December 7, 1971 (sheet 3). Nine cross sections were surveyed after this flood (sheet 2). A second flood occurred on April 14, 1974 (sheet 3).

A profile of the roadway crown was surveyed after the 1971 flood. Valley cross sections as surveyed are considered valid for both floods.

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

FLOOD OF DECEMBER 7, 1971

Peak water-surface elevations, the measured cross section, and velocities for the flood of December 7, 1971, are shown on sheet 3. The flood crested at an elvation of 95.747 meters at the reference point located on the downstream guardrail 65 meters from the left abutment. The peak discharge was 725 cubic meters per second (m^3/s), from a stage-discharge relation developed for the site. A discharge of 651 m^3/s was measured on the recession at an elevation of 95.555 meters at the reference point (table 2). The recurrence interval of the peak discharge is 50 years (Colson and Hudson, 1976). See figure 4.

FLOOD OF APRIL 14, 1974

Peak water-surface elevations for the flood of April 14, 1974, are shown on sheet 3. The average crest elevation at the downstream bridge abutments was 95.610 meters. The peak discharge was 835 m^3/s from the stage-discharge relation for the site. No discharge measurement was made during this flood. A discharge of 416 m^3/s was measured at an elevation of 94.845 meters at the reference point on December 21, 1972 (table 2). The measured cross section and velocity distribution for the measurement of December 21, 1972 are shown on sheet 3. The recurrence interval of the peak discharge is 100 years (Colson and Hudson, 1976). See figure 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 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 Bogue Chitto near Summit, Miss. Water depths, velocities, and discharges through bridge openings on Bogue Chitto near Summit, Miss. for floods of December 7, 1971, and December 21, 1972, are shown, together with peak water-surface elevations along embankments and along cross sections for floods of December 7, 1971, and April 14, 1974. 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. Geol. Survey Techniques Water-Resources Inv., book 3, chap. Al, 30 p.

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

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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.

TABLE 1—VALLEY CROSS-SECTION DATA FOR BOGUE CHITTO NEAR SUMMIT, MISSISSIPPI. ZERO STATION IS AT THE LEFT EDGE OF THE VALLEY (FACING DOWNSTREAM)

CROSS SECTION 1

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	91.92
119	91.95
158	90.64
166	90.51
170	88.50
201	88 44
221	88.44
238	88.32
241	88.65
247	88.65
252	87.04
256	86.95
257	85.51
262	84.81
273	85.27
274	85.51
283	86.03
299	87.25
311	87.56
321	87.37
324	85.85
326	84.97
357	85.61
358	85.85
365	88.53
366	88.50
370	88.99
378	87.47
380	87.65
385	87.34
388	89.11
397	89.08
411	88.84
435	89.11
441	88.78
448	88.93
461	88.75
473	88.53
481	88.59
486	87.59
487	87.71
493	89.48
512	89.66
528	89.63
530	89.63
584	89.63
601	89.36
678	89.84
714	90.15
759	90.06
787	91.58
792	92.98

CROSS SECTION 2

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	93.17
7	93.10
29	91.03
83	90.82
134	90.60
171	91.37
262	91.95
267	92.07
277	90.15
284	89.39
292	89.84
310	90.64
324	90.94
329	90.45
333	89.42
344	89.39
347	88.17
351	88.53
358	89.29
374	89.66
390	89.60
411	89.93
417	90.15
444	89.81
449	89.48
453	89.02
457	88.87
461	89.54
485	89.75
499	90.24
502	89.75
504	88.04
507	87.95
510	89.60
533	90.09
554	90.06
557	89.66
560	86.86
562	85.94
571	85.64
582	86.86
588	89.51
597	89.48
601	89.48
611	88.20
613	89.87
621	89.72
632	89.36
647	89.42
652	89.08
655	90.27
661	90.21
674	90.36
689	90.15
697	89.36
701	89.87
723	89.42
727	90.54
729	91.09
743	90.57
757	90.33
760	88.53
775	88.35
778	89.42
794	90.79
798	91.34
807	91.31
813	89.96
828	90.60
829	88.75
832	88.75
834	90.60
852	91.40
861	92.25
916	92.28
992	92.31
1084	92.40
1114	92.65
1173	92.98
1183	94.51

CROSS SECTION 3

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	94.93
40	94.02
47	89.93
53	89.87
54	90.91
82	91.34
137	91.70
148	91.15
156	90.88
178	91.76
188	92.13
202	92.16
211	92.19
221	91.15
225	91.46
234	91.37
239	90.60
249	91.28

CROSS SECTION 3 (Cont.)

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
249	91.37
268	91.52
286	91.70
304	91.67
312	91.34
324	91.21
330	91.18
345	90.73
356	90.64
366	91.70
380	91.95
384	91.82
396	92.10
408	92.22
425	92.22
427	92.22
443	92.28
485	91.92
489	91.76
504	92.04
519	92.56
536	92.59
546	90.91
548	91.61
553	91.40
558	92.25
574	92.68
600	93.10
608	88.26
630	88.53
633	89.08
646	89.84
650	92.53
653	92.37
664	92.31
668	92.31
689	92.56
697	93.96
767	93.74
840	93.32
863	93.81
952	94.14
984	94.75

CROSS SECTION 4

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	95.02
3	93.84
7	91.67
17	91.40
28	91.70
33	93.04
33	93.10
94	92.71
166	92.53
176	93.20
188	93.26
194	92.59
201	89.72
202	88.68
216	87.80
233	88.87
235	89.72
242	93.87
252	93.84
271	93.35
283	93.32
312	92.89
327	92.43
332	92.65
339	92.74
433	92.71
439	91.09
450	90.85
461	91.06
465	93.93
475	94.66
495	94.72
505	94.96
523	94.26
536	93.84
552	94.45
564	94.78
588	93.55
606	93.71
640	94.41
673	94.78
739	94.45
747	96.03

CROSS SECTION 5

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	95.36
21	95.27
30	95.21
57	95.15
99	95.18
128	94.75
133	94.72
162	94.93
171	94.93
187	94.57
192	94.48
195	93.23
208	92.74
216	93.38
219	93.93
222	93.87
228	93.53
237	93.74
248	93.56
254	92.98
278	93.56
280	93.01
283	93.71
334	91.95
455	92.68
468	92.62
473	91.03
478	91.03
479	92.28
482	92.62
517	92.56
522	92.86
526	93.38
529	92.89
532	92.62
536	90.00
536	89.17
567	89.95
575	90.79
581	90.27
583	90.27
586	92.77
588	92.77
604	92.59
614	93.17
617	92.86
619	93.13
621	93.65
626	94.54
638	94.51
647	93.65
653	93.74
655	94.11
661	94.99
682	94.99
710	94.93
739	94.75
777	94.05
802	94.63
822	95.05
860	95.24
867	95.30
879	93.96
884	93.96
894	94.99
909	95.24

CROSS SECTION 5 (Cont.)

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
920	95.36
933	95.30
935	95.30
948	96.00

CROSS SECTION 6

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	96.70
38	95.60
83	95.51
152	95.12
180	95.42
212	95.54
226	94.99
226	94.99
226	94.99
226	94.99
240	93.65
284	94.05
334	94.23
355	94.45
360	93.47
378	93.90
397	93.90
408	92.01
412	92.68
421	92.37
440	93.44
468	93.32
473	90.67
474	90.15
487	90.54
497	92.74
512	92.13
514	90.57
514	89.96
533	90.21
534	91.95
537	93.47
542	93.62
565	93.17
590	92.65
608	92.16
636	93.07
638	93.17
640	92.95
647	90.64
648	89.29
665	89.93
665	90.60
670	93.87
681	93.29
684	93.84
685	91.21
692	92.80
717	94.32
727	94.54
757	95.15
757	95.12
774	94.48
784	95.09
814	95.24
824	95.30
854	95.36
941	95.60
971	95.66
983	96.12

CROSS SECTION 7

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	96.58
6	96.24
136	95.36
146	95.39
151	93.59
189	94.14
204	94.14
210	91.49
212	91.09
227	91.49
241	93.17
241	93.74
328	93.93
344	94.38
387	94.26
477	94.45
487	94.99
505	94.87
512	93.84
523	94.26
525	95.12
529	94.51
566	94.57
573	94.60
618	95.60
675	95.05
691	94.96
714	95.51
725	95.60
731	95.69
757	95.45
768	95.57
818	95.66
829	95.76
830	95.73
896	95.69
932	95.66
982	95.82
999	95.88
1021	95.94
1056	95.57
1065	94.90
1072	94.90
1089	95.42
1096	95.63
1109	95.94
1123	96.52
1138	98.04

CROSS SECTION 8

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	98.13
13	96.46
24	96.34
37	96.85
72	97.13
85	96.40
95	95.76
96	94.63
101	94.63
102	95.66
116	95.82
134	96.55
138	95.63
160	95.66
169	95.82
189	95.63
220	95.54
256	95.66
262	95.69
304	95.24
339	95.39
377	95.42
407	95.54
415	93.26
422	94.78
436	94.32
445	95.02
455	95.63
482	95.66
501	95.60
502	95.60
506	92.25
509	91.52
517	92.25
527	94.51

CROSS SECTION 8 (Cont.)

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
547	95.02
578	95.15
645	94.66
650	94.29
657	92.10
667	92.10
669	93.84
681	94.69
700	95.09
716	95.21
721	94.54
722	92.43
724	91.67
733	89.32
739	92.46
741	92.43
747	94.84
749	95.12
771	95.24
777	94.87
788	95.05
816	95.48
859	94.81
887	94.20
909	93.29
913	93.71
919	96.03
925	94.51
929	94.38
932	94.51
948	96.24
956	96.27
974	95.91
1006	96.37
1030	96.37
1093	96.34
1171	96.37
1287	96.15
1463	96.64
1478	98.16

CROSS SECTION 9

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	98.19
7	98.29
17	93.59
23	93.59
29	96.15
63	96.15
79	96.55
84	94.14
86	93.65
87	93.90
91	95.57
97	95.63
116	95.85
137	95.73
146	93.10
147	92.77
165	92.56
166	93.10
169	95.69
175	95.69
193	94.96
200	93.23
211	94.48
236	95.27
254	93.20
268	93.23
279	96.82
286	97.04
295	97.16
305	95.73
311	95.39
314	95.51
320	97.04
333	97.19
337	97.07
340	96.79
344	94.41
353	94.41
359	96.37
371	96.85
408	97.07
451	97.37
453	97.40
458	97.71
468	98.04
471	98.83
588	99.60
595	97.86
614	97.19
630	97.19
631	96.67
635	96.37
641	96.67
644	97.28
661	97.40
668	97.37
673	96.21
678	96.18
682	96.40
689	96.03
690	95.82
694	96.03
698	96.76
730	96.52
744	96.03
771	96.09
775	96.88
794	96.82
801	96.09
811	96.06
821	97.43
824	97.49
920	97.62
938	97.98
993	98.32

BRIDGE SECTION

STATION (METERS)	GROUND SURFACE ELEVATION (METERS)
0	96.73
2	95.66
3	94.90
5	94.08
6	93.47
8	93.20
11	93.07
17	93.04
20	92.28
23	92.83
29	92.95
32	92.86
35	92.86
38	92.16
41	91.52
45	91.21
48	90.97
50	90.06
53	90.00
57	90.21
63	90.06
66	89.69
71	89.66
75	90.18
78	91.52
81	91.76
84	91.67
87	91.95
90	91.92
93	91.98
99	91.64
102	91.98
105	92.37
107	92.71
109	93.50
110	94.54
112	95.27
113	96.06
115	96.73

TABLE 2—DISCHARGE MEASUREMENTS DECEMBER 7, 1971, AND DECEMBER 21, 1972, BOGUE CHITTO NEAR SUMMIT, MISSISSIPPI. ZERO STATION IS AT THE EDGE OF THE LEFT ABUTMENT (FACING DOWNSTREAM)

DISCHARGE MEASUREMENT DECEMBER 7, 1971, BOGUE CHITTO AT STATE HIGHWAY 570 NEAR SUMMIT, MISSISSIPPI (WATER-SURFACE ELEVATION=95.555 METERS) TOTAL DISCHARGE=651 CUBIC METERS PER SECOND

STATION (METERS)	DEPTH (METERS)	ANGLE (DEGREES)	OBSERVATION DEPTH[1]	VELOCITY (METERS PER SECOND)
3.4	0.0	0	0.0	0.000
6.1	1.13	0	0.6	0.408
12.2	2.13	0	0.2	1.442
			0.8	1.384
18.3	2.44	0	0.2	2.414
			0.8	1.844
24.4	2.65	0	0.2	2.356
			0.8	1.750
30.5	2.59	0	0.2	2.204
			0.8	1.573
36.6	3.26	0	0.2	1.442
			0.8	1.384
42.7	4.39	0	0.2	1.692
			0.8	1.506
48.8	4.57	0	0.2	2.030
			0.8	1.353
51.8	5.03	0	0.2	2.252
			0.8	2.030
54.9	5.64	0	0.2	2.112
			0.8	1.987
57.9	5.39	0	0.2	1.780
			0.8	1.878
61.0	5.39	0	0.2	1.844
			0.8	1.914
64.0	5.52	0	0.2	2.030
			0.8	2.112
67.1	5.85	0	0.2	2.356
			0.8	1.914
70.1	5.94	0	0.2	1.878
			0.8	1.811
73.2	6.10	0	0.2	1.652
			0.8	1.652
79.2	4.72	0	0.2	1.155
			0.8	0.774
85.3	3.23	0	0.2	1.353
			0.8	1.353
91.4	3.17	0	0.2	1.018
			0.8	0.905
97.5	3.72	0	0.2	1.844
			0.8	1.652
103.6	3.54	8	0.2	1.472
			0.8	1.442
109.7	2.01	0	0.2	0.219
			0.8	0.0
113.4	0.0	0	0.0	0.0

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

DISCHARGE MEASUREMENT DECEMBER 21, 1972, BOGUE CHITTO AT STATE HIGHWAY 570 NEAR SUMMIT, MISSISSIPPI (WATER-SURFACE ELEVATION=94.845 METERS) TOTAL DISCHARGE=416 CUBIC METERS PER SECOND

STATION (METERS)	DEPTH (METERS)	ANGLE (DEGREES)	OBSERVATION DEPTH[1]	VELOCITY (METERS PER SECOND)
4.9	0.0	0	0.0	0.0
9.1	1.49	0	0.6	0.460
15.2	1.83	0	0.2	1.338
			0.8	1.119
21.3	21.3	0	0.2	1.893
			0.8	1.521
27.4	1.95	0	0.2	1.762
			0.8	1.219
33.5	2.04	0	0.6	1.338
39.6	3.35	0	0.2	1.277
			0.8	1.247
44.2	3.57	0	0.2	1.247
			0.8	1.073
48.8	3.81	0	0.2	1.423
			0.8	1.247
53.3	4.39	0	0.2	1.826
			0.8	1.396
57.9	4.51	0	0.2	1.893
			0.8	1.673
61.0	4.42	0	0.2	1.859
			0.8	1.673
64.0	4.54	0	0.2	1.929
			0.8	1.594
67.1	4.94	0	0.2	1.893
			0.8	1.673
70.1	5.18	0	0.2	1.673
			0.8	1.594
73.2	5.36	0	0.2	1.457
			0.8	1.423
79.2	3.72	0	0.2	0.838
			0.8	0.893
85.3	2.59	0	0.2	0.914
			0.8	0.732
91.4	2.56	0	0.2	0.875
			0.8	0.674
97.5	2.96	0	0.2	1.247
			0.8	1.006
103.6	2.68	0	0.2	1.094
			0.8	0.838
108.2	1.83	0	0.6	0.085
111.3	0.0	0	0.0	0.0

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

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