UNITED STATES GEOLOGICAL SURVEY

BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, BOGUE CHITTO NEAR JOHNSTON STATION, 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 Published by the U.S. Geological Survey, 1978

FLOOD-FLOW DATA, BOGUE CHITTO NEAR JOHNSTON STATION, MISSISSIPPI

Square meter (m2)

Cubic meter (m³)

Cubic meter per

second (m³/s)

Meter per second (m/s) 3.281

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 Bogue Chitto near Johnston Station, Mississippi, one of 22 sites plotted in figure 1.

HYDROLOGIC INVESTIGATIONS ATLAS NUMBER ALABAMA

Buckhorn Creek near Shiloh

Pea Creek near Louisville	608* 609* 610* 611*
LOUISIANA	
Alexander Creek near St. Francisville	-600* 601* 602
Cypress Creek near Downsville	603*
Flagon Bayou near Libuse	604*
Little Bayou de Loutre near Truxno	605*
Tenmile Creek near Elizabeth	606*
MISSISSIPPI	504
Bogue Chitto near Johnston Station	
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*

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 te elevations were determine

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 difference 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

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 sheet 3. Bridge geometry and roadembankment dimensions are shown with brief notations of pier spacing and configuration.

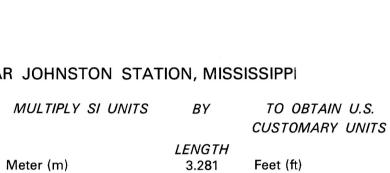
In addition to the data points shown on the maps, discharge

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.

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.



DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

DATA FOR BOGUE CHITTO NEAR JOHNSTON

AREA

10.76

VOLUME

35.31

VELOCITY

FLOW RATE

35.31

Square feet (ft2)

Cubic feet (ft3)

Cubic feet per

Feet per second (ft/s)

second (ft³/s)

STATION, MISSISSIPPI Data for Bogue Chitto near Johnston Station, Miss. obtained in a 6.4 kilometer reach crossed about midway by a county road are presented on five 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 alignment 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 three floods on Bogue Chitto are presented. The first

curred on March 25, 1973 (sheet 3). The third flood occurred April 14, 1974 (sheet 3).

The 1971 flood damaged the left abutment, causing the revetment at the downstream side to collapse. Both the 1973 and 1974 floods overtopped the roadfill to depths less than 0.1 meter. Both of these floods undermined the left abutment sufficiently to cause partial collapse of the roadway but did not breach the fill. The roadway, including the abutment, was repaired after each flood. After the 1974 flood an earthen spurdike extending upstream from the left abutment was constructed to protect the abutment, and to reduce scour at the

flood occurred December 7, 1971 (sheet 3). Nine cross sections

were surveyed after this flood (sheet 2). A second flood oc-

downstream side of the bridge.

A profile of the roadway crown was surveyed after the 1973 flood. Valley cross sections as surveyed are considered valid for all floods.

Manning's roughness coefficient values and the 1973 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 elevation of 102.379 meters at the reference point located on the downstream guardrail 53 meters from the left abutment. The peak discharge was 708 cubic meters per second (m³/a), from a stage-discharge relation developed for the site. A discharge of 620 m³/s was measured on the recession at an elevation of 102.312 meters at the reference point (table 2). The recurrence interval of the

peak discharge is 50 years (Colson and Hudson, 1976). See

FLOOD OF MARCH 25, 1973

Peak water-surface elevations for the flood of March 25, 1973, are shown on sheet 3. The flood crested at an elevation of 102.471 meters at the reference point located on the downstream guardrail. The peak discharge was 892 m³/s from the stage-discharge relation for the site. No discharge measurement was made during this flood. A discharge of 362 m³/s was measured at an elevation of 101.895 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 greater than 100 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 flood crested at an elevation of 102.593 meters at the reference point. The average crest elevation at the downstream bridge abutments was 102.382 meters. The peak discharge was 878 m³/s from the stage-discharge relation. A discharge of 606 m³/s was measured on the recession at an elevation of 102.315 meters at the reference point (table 2). The recurrence interval of the 1974 peak discharge is greater than 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 Johnston Station, Miss. Water depths, velocities, and discharges through bridge openings on Bogue Chitto near Johnston Station, Miss. for floods of December 7, 1971, March 25, 1973, and April 14, 1974, are shown 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 graphs.

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

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

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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 Re-

sources Council Bull. 17A, 163 p.

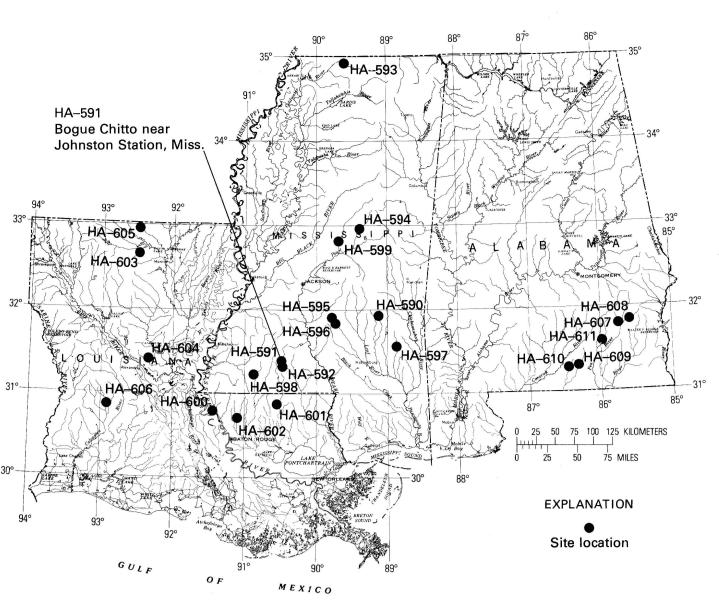


FIGURE 1.—INDEX MAP OF STUDY SITES IN THE BRIDGE BACKWATER INVESTIGATION PROJECT, ALABAMA, LOUISIANA, AND MISSISSIPPI.

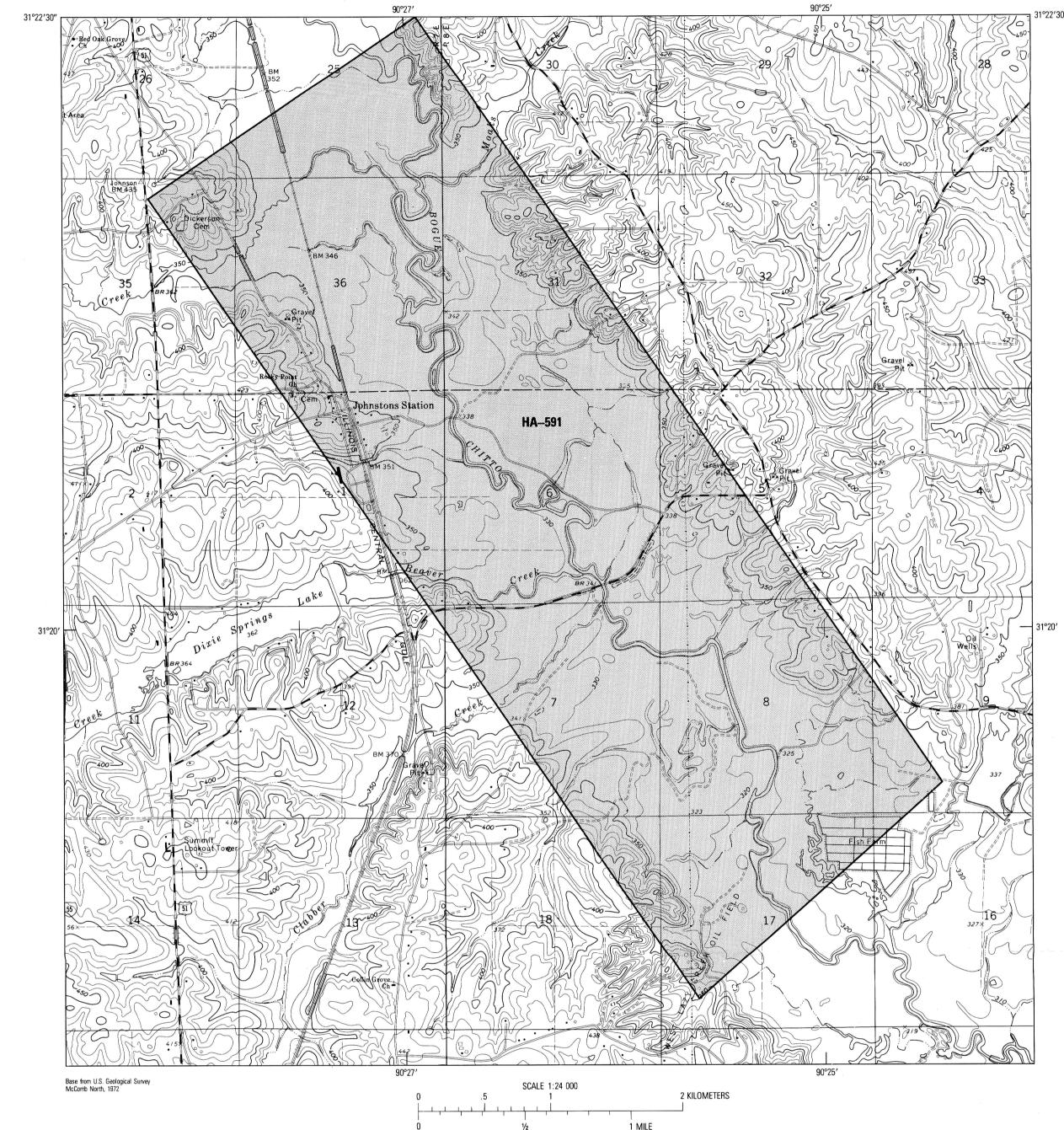


FIGURE 2—INDEX MAP SHOWING STUDY REACH BOGUE CHITTO NEAR JOHNSTON STATION, MISSISSIPP

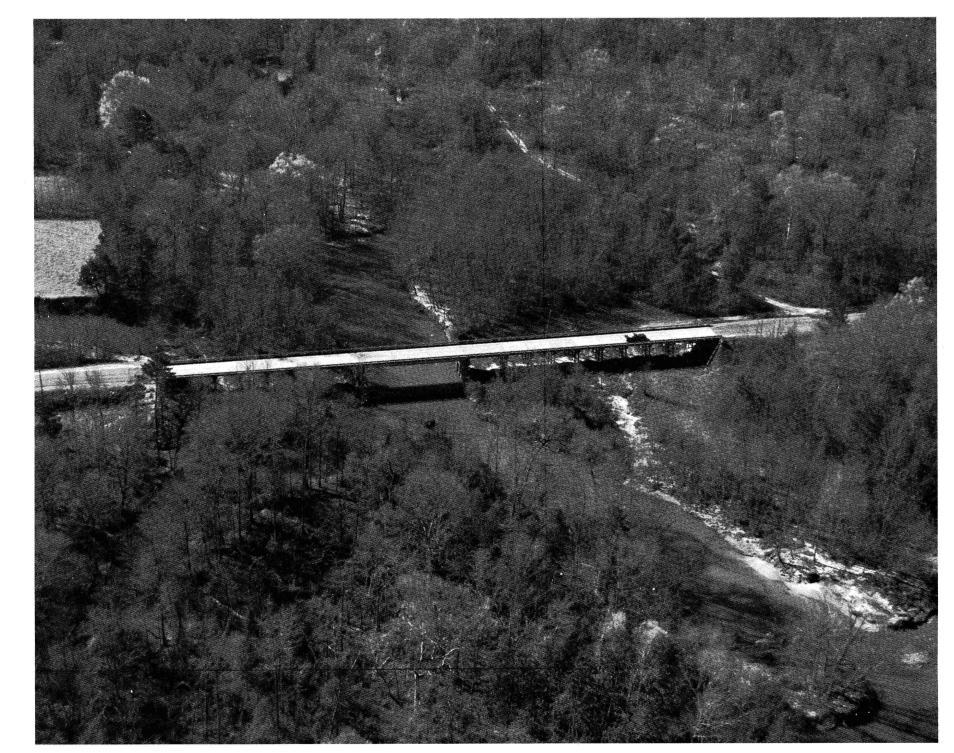
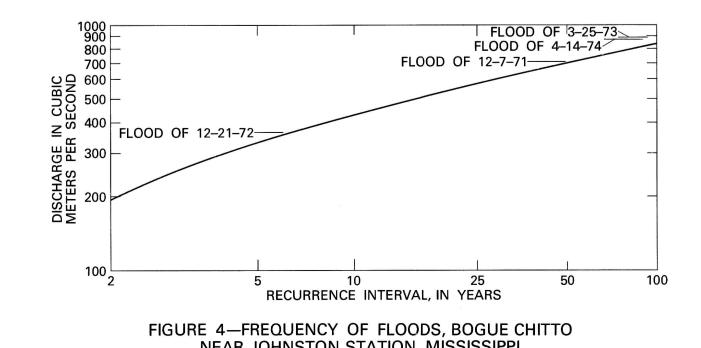


FIGURE 3—AERIAL VIEW LOOKING DOWNSTREAM AT BRIDGE ON COUNTY HIGHWAY,
BOGUE CHITTO NEAR JOHNSTON STATION, MISSISSIPPI



OF THE VALLEY (FACING DOWNSTREAM). BRIDGE SECTION (Cont.) CROSS SECTION 9 (Cont.) CROSS SECTION 4 **CROSS SECTION 7 CROSS SECTION 1 GROUND SURFACE** GROUND SURFACE **GROUND SURFACE** 98.99 STATION **ELEVATION ELEVATION** STATION STATION **ELEVATION** 104.78 99.05 (METERS (METERS) (METERS) 98.90 102.43 105.42 99.99 104.60 97.65 101.43 105.02 104.38 95.40 101.00 103.92 100.60 103.86 96.88 104.75 95.27 100.27 96.88 131 103.10 104.69 94.88 102.83 104.29 94.85 99.38 102.58 104.26 94.85 98.32 224 102.19 1000 95.12 102.16 138 98.41 264 1018 209 100.39 101.58 95.21 104.72 100.66 102.03 242 98.50 268 1077 95.52 104.75 100.72 102.43 1100 104.69 95.58 100.91 101.85 96.19 1122 104.81 101.18 102.13 424 1151 104.81 438 100.72 414 102.22 1164 104.81 98.41 100.91 467 98.04 420 98.75 1198 104.78 100.21 100.75 473 96.09 1218 104.78 98.96 101.18 101.76 479 99.05 100.91 102.16 1231 104.93 97.37 479 99.18 104.78 100.97 102.16 1248 97.43 511 99.18 100.63 102.25 97.92 99.02 1253 103.56 102.25 104.44 99.57 1256 102.07 99.57 1258 106.30 102.13 532 100.60 96.06 SECTION 99.48 100.45 536 98.83 96.49 99.82 GROUND SURFACE 101.21 94.93 99.66 102.00 STATION ELEVATION 93.93 105 99.60 98.93 102.10 (METERS) (METERS) 99.51 108 726 102.16 94.93 103.69 735 101.91 102.01 97.43 99.45 102.28 97.74 101.61 117 99.69 102.52 120 99.63 102.71 123 99.82 97.43 102.55 125 100.76 102.46 97 71 99.05 126 101.61 96.30 876 102.64 99.05 128 102.65 102.89 97.83 909 99.18 130 103.29 102.00 99.08 97.58 103.69 130 100.60 102.83 100.66 102.80 95.88 101.30 102.74 960 95.82 101.18 102.64 1015 101.24 1042 102.19 TABLE 2—DISCHARGE MEASUREMENTS DECEMBER 7, 1971 97.13 101.03 1062 102.52 829 100.36 102.64 834 837 1091 DECEMBER 21, 1972, AND APRIL 14, 1974, AT COUNTY 100.60 1102 102.67 HIGHWAY NEAR JOHNSTON STATION, MISSISSIPPI ZERO 100.11 841 96.88 1124 102.83 STATION IS AT THE EDGE OF THE LEFT ABUTMENT (FACING 100.60 102.89 919 97.98 1148 DOWNSTREAM) 101.36 102.16 97.74 100.75 1162 102.49 98.53 DISCHARGE MEASUREMENT DECEMBER 7, 1971, BOGUE CHITTO 1050 99.08 100.66 1192 102.25 AT COUNTY HIGHWAY NEAR JOHNSTON STATION, 100.63 102.58 1052 99.69 1202 MISSISSIPPI (WATER-SURFACE ELEVATION=102.312 METERS) 100.85 1043 1216 TOTAL DISCHARGE=620 CUBIC METERS PER SECOND 100.79 101.91 CROSS SECTION 2 1059 1236 101.21 1064 100.63 1253 **GROUND SURFACE** VELOCITY 1084 101.27 1263 99.26 **STATION ELEVATION** ANGLE **OBSERVATION** (METERS PER 1104 101.15 97.46 1266 SECOND) STATION (METERS) (DEGREES) 1124 97.43 1280 101.15 1.52 101.21 99.23 1281 101.15 1.750 100.72 1148 102.46 99.93 1.652 100.66 1153 1307 102.55 99.29 1.811 101.06 1338 102.03 1.878 99.63 1365 101.91 99.81 1.323 100.85 102.58 1398 100.11 100.91 101.09 1196 102.31 98.86 3.23 2.252 100.94 102.58 1198 1519 1.844 99.60 100.97 101.00 1205 1519 1.719 1208 101.12 101.00 1523 1.612 101.33 1230 1525 102.43 1.652 100.08 1243 101.46 1537 102.46 1.780 1.231 99.54 1263 101.55 1581 102.52 99.14 7.32 1279 101.58 1639 102.77 1.231 1296 103.25 1.106 7.50 1310 101.82 1.155 99.72 101.73 1339 104.14 1.231 99.60 7.62 102.10 1714 99.81 1.539 102.40 1.750 100.11 7.07 CROSS SECTION 8 1.878 CROSS SECTION 5 99.87 GROUND SURFACE 2.252 **GROUND SURFACE** 1.750 100.11 STATION **ELEVATION STATION** ELEVATION 100.05 0.994 (METERS) (METERS) 100.02 (METERS) (METERS) 0.634 105.05 99.23 103.19 105.05 1.692 99.11 101.97 104.14 0.570 1.024 96.15 100.79 103.65 3.32 95.54 100.33 0.344 103.56 1.692 94.87 100.08 102.71 100.33 103.68 1.064 100.94 103.71 1.612 101.03 99.11 103.28 1.231 99.02 102.92 103.38 219 1.411 167 1.042 1.323 99.93 100.85 103.19 99.75 183 99,69 103.16 2.87 99.05 102.34 1.085 98.71 98.35 103.10 1.411 97.89 103.38 1.155 98.96 98.35 103.59 1.442 100.21 103.89 1.353 1.131 99.50 103.83 97.86 101.12 102.13 1.106 99.17 101.09 1.262 103.47 98.99 282 97.31 103.50 572 127.4 0.0 102.55 98.59 96.55 613 97.62 295 97.89 103.47 622 DISCHARGE MEASUREMENT DECEMBER 21, 1972, BOGUE CHITTO, 99.44 103.53 658 MISSISSIPPI (WATER-SURFACE ELEVATION = 101.895 METERS) 99.90 103.44 TOTAL DISCHARGE = 362 CUBIC METERS PER SECOND 99.41 100.02 101.76 99.66 100.39 99.20 98.86 99.99 98.86 ANGLE OBSERVATION (METERS PER 100.11 99.20 SECOND) 98.04 STATION (METERS) (DEGREES) DEPTH1 100.42 97.80 0.283 3.05 0.0 99.75 103.99 0.288 0.893 99.11 100.94 103.89 99.47 475 100.45 103.83 1.521 3.72 1.673 99.32 100.33 102.31 102.22 97.89 103.77 1.094 96.06 103.74 2.62 0.2 0.914 97.86 98.19 103.89 1.164 97.62 103.56 99.20 0.820 103.10 532 98.53 98.04 103.35 0.856 0.2 536 98.99 99.02 103.16 0.506 0.8 578 0.732 99.57 99.84 100.60 0.411 100.11 99.57 101.82 8.0 100.85 103.68 1.006 1014 614 0.957 100.85 103.80 101.27 1.094 97.98 1010 103.41 0.2 0.838 101.67 1029 103.35 1040 0.597 101.61 103.22 97.98 0.2 0.506 98.50 1060 103.50 101.30 1085 102.19 1.457 101.61 1.600 1088 103.07 98.96 802 101.58 1097 103.04 1.396 98.99 823 101.73 1115 103.44 1.338 1.052 98.83 101.00 1120 103.56 0.2 1.052 0.957 101.73 98.71 1130 103.25 101.43 102.74 7.16 101.52 1.119 97.80 1189 103.65 97.77 101.64 1194 102.28 1.423 101.64 1209 1.396 103.16 1.893 1.634 1224 103.25 101.76 101.91 103.50 1.396 102.64 103.65 1.396 103.41 1263 99.63 1322 103.47 0.290 1269 103.83 1.164 98.41 CROSS SECTION 6 1341 1300 1362 0.375 98.80 103.74 **GROUND SURFACE** 1302 1369 1.094 98.38 103.04 0.2 ELEVATION 1374 1307 98.56 103.77 0.421 (METERS) (METERS) 1310 1389 98.68 103.56 0.411 1325 98.65 103.50 0.195 102.64 1342 98.65 103.68 0.838 101.73 1353 98.71 1453 103.92 0.250 1.308 101.43 1398 98.65 1455 103.99 100.91 0.549 1406 98.56 1465 104.53 8.0 99.81 0.936 1412 104.99 99.26 100.27 106.12 0.597 8.0 100.18 0.674 100.02 138 0.296 SECTION 9 **CROSS SECTION 3** 100.05 0.2 0.421 110.3 GROUND SURFACE GROUND SURFACE 101.06 0.539 **STATION** ELEVATION 101.00 ELEVATION 0.405 114.9 (METERS) (METERS) 100 42 (METERS) (METERS) 0.469 100.85 106.15 102.31 221 0.506 101.67 100.85 105.54 8.0 0.494 100.69 104.90 101.09 0.448 100.85 100.82 104.32 0.448 100.75 100.88 104.26 0.384 421 101.12 104.35 100.60 0.338 100.42 101.24 104.26 126.2 0.0 104.53 100.24 458 100.82 463 101.30 104.60 100.02 DISCHARGE MEASUREMENT APRIL 14, 1974, BOGUE CHITTO AT 101.15 104.41 99.41 COUNTY HIGHWAY NEAR JOHNSTON STATION, MISSISSIPP 510 101.03 104.32 99.99 (WATER-SURFACE ELEVATION=102.315 METERS) TOTAL 530 101.18 101.18 100.30 100.11 101.36 100.54 DISCHARGE=606 CUBIC METERS PER SECOND 101.18 100.05 100.14 100.48 100.36 104.81 OBSERVATION (METERS PER 100.57 98.77 104.81 STATION (METERS) DEPTH1 SECOND) (DEGREES) 649 100.36 104.75 100.72 0.0 0.6 100.42 100.88 104.81 2.44 0.0 1.993 0.6 104.75 3.0 3.05 98.68 101.09 734 0.2 101.15 104.50 99.47 2.460 0.8 101.18 104.53 99.44 1.298 104.44 100.48 4.02 97.71 0.573 1.448 100.63 103.41 98.01 12.8 99.38 100.45 103.07 0.8 1.000 103.68 97.83 1.332 0.2 18.9 809 98.13 104.53 98.22 1.113 0.8 811 96.88 104.44 100.82 1.417 0.2 100.72 839 95.70 103.62 1.186 842 98.16 103.35 100.05 1.661 0.2 100.45 104.23 99.87 1.067 8.0 99.23 99.99 104.50 2.265 0.2 99.11 104.56 37.2 3.51 100.05 1.993 99.87 101.24 104.05 0.8 1.158 98.29 101.39 102.80 43.3 3.35 1.213 101.33 102.89 97.46 1.186 101.33 7.07 0.2 99.47 103.96 1.332 1.158 0.8 975 100.30 101.21 104.56 0.2 100.42 1002 104.38 52.4 101.03 1.158 0.8 100.69 1009 100.42 104.56 1.814 0.2 1013 101.18 103.38 100.02 1.548 1031 101.27 103.32 99.63 2.121 1049 7.62 0.2 101.82 101.18 104.23 1056 1.417 100.79 0.8 104.32 101.82 0.933 96.94 1059 99.84 104.47 0.2 0.762 96.34 1064 101.00 104.72 1.585 1075 95.42 101.27 104.53 0.978 0.8 96.43 1090 101.39 103.89 1.548 0.2 73.8 3.20 100.72 1112 101.36 103.89 0.890 0.8 100.75 1135 101.36 104.41 1.213 100.75 1162 101.39 104.44 79.9 0.2 0.835 1183 101.52 105.02 101.00 1.548 101.03 1199 101.70 104.81 1.000 101.03 1227 101.91 104.69 1.512 104.69 1251 102.10 101.12 1.268 101.06 1274 102.22 104.56 1.512 101.15 1309 102.31 104.69 1.268 1335 102.37 101.21 105.08 1.045 102.37 105.30 1.067 1445 101.06 102.10 102.95 1.268 1509 101.30 102.86 101.91 114.9 1.067 101.61 1565 102.77 101.91 1.158 102.95 1397 101.64 1593 102.95 101.94 103.25 104.47 102.43

TABLE 1-VALLEY CROSS SECTION DATA FOR BOGUE CHITTO NEAR JOHNSTON STATION, MISSISSIPPI. ZERO STATION IS AT THE LEFT EDGE

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.,—1978—W78508