1564

FLOODS
ON
FRENCH BROAD RIVER
DAVIDSON RIVER
KING CREEK
NICHOLSON CREEK
TUCKER CREEK

IN VICINITY OF
BREVARD
NORTH CAROLINA

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

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FLOODS
ON
FRENCH BROAD & DAVIDSON RIVERS
AND
KING, NICHOLSON, & TUCKER CREEKS
IN VICINITY OF
BREVARD, NORTH CAROLINA

REPORT NO. 0-6373

KNOXVILLE, TENNESSEE
MAY 1964

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FOREWORD

Tennessee Valley Authority
Division of Water Control Planning

FOREWORD

This report relates to the flood situation along the French Broad River, Davidson River, King Creek, Nicholson Creek, and Tucker Creek in the vicinity of Brevard, North Carolina. It has been prepared at the request of the Town of Brevard through the North Carolina Department of Water Resources to aid (1) in the solution of local flood problems and (2) in the best utilization of land subject to overflow. The report is based upon work TVA has been carrying on since its beginning in connection with its water resources operations throughout the Tennessee Valley. TVA has assembled information on rainfall, runoff, historical and current flood heights, and other technical data bearing upon the occurrence and magnitude of floods in localities throughout the region which provide the basis for preparation of this report.

The report does not include plans for the solution of flood problems. Rather, it is intended to provide the basis for further study and planning on the part of the Town of Brevard in arriving at solutions to minimize vulnerability to flood damages. This might involve (1) the construction of flood protection works, (2) local planning programs to guide developments by controlling the type of use made of the flood plain through zoning and subdivision regulations, or (3) a combination of the two approaches.

The report covers three significant phases of the Brevard flood problem. The first brings together a record of the largest known floods of the past on the French Broad and Davidson Rivers and on King, Nicholson, and Tucker Creeks. The second treats of Regional Floods. These are derived from consideration of the largest floods known to have occurred on streams of similar physical characteristics in the same general geographical region as that of the French Broad River and its tributaries in the vicinity of Brevard and generally within 50 miles of Brevard. The third develops the Maximum Probable Floods for French Broad River, Davidson River, King Creek, Nicholson Creek, and Tucker Creek. Floods of this magnitude on most streams are considerably larger than any that have occurred in the past. They are the floods of infrequent occurrence that are considered in planning protective works, the failure of which might be disastrous.

Such floods are used by TVA in the design of physical features of reservoirs, dams, powerhouses, and some kinds of local flood protection works.

In problems concerned with the control of developments in the flood plains of French Broad River, Davidson River, King Creek, Nicholson Creek, and Tucker Creek, and in reaching decisions on the magnitude of floods to consider for this purpose, appropriate consideration should be given to the possible future occurrence of floods of the magnitude of (1) those that have occurred in the past, (2) the Regional Floods, and (3) the Maximum Probable Floods.

The report contains maps, profiles, and cross sections which indicate the extent of flooding that has been experienced and that might occur in the future in the vicinity of Brevard. This should be useful in planning new developments in the flood plains. From the maps, profiles, and cross sections, the depth of probable flooding by either recurrence of the largest known floods or by occurrence of the Regional or Maximum Probable Floods at any location may be ascertained. By having this information, floor levels for buildings may be planned either high enough to avoid flood damage or at lower elevations with recognition of the chance and hazards of flooding that are being taken.

I.

RESUME

OF

FLOOD SITUATION

I.

RESUME OF FLOOD SITUATION

Brevard, North Carolina, is located on the French Broad River 195 miles above its mouth at Knoxville, Tennessee, and 47 miles above Asheville, North Carolina. Davidson River, one of the principal tributaries of the upper French Broad River, has a drainage area of 47.3 square miles and joins the river at Pisgah Forest, 3 river miles downstream from Brevard. King Creek and Nicholson Creek, with drainage areas of 4.6 and 5.1 square miles, respectively, join the French Broad River at Brevard. Tucker Creek is a tributary of Nicholson Creek with a drainage area of 1.5 square miles. The corporate limits of Brevard extend from Mile 0.58 to Mile 2.06 along King Creek and from Mile 0.27 to Mile 1.32 along Tucker Creek. French Broad River follows a course which is south and east of the Brevard corporate limits and the course of Nicholson Creek is just west and south of the corporate limits. A part of the Brevard development is on the flood plains of the two streams.

This investigation covers the French Broad River from Mile 186.87 to Mile 208.45, Davidson River from the mouth to Mile 4.47, King Creek from the mouth to Mile 2.38, Nicholson Creek from the mouth to Mile 2.18, and Tucker Creek from the mouth to Mile 1.38. The total drainage area of the French Broad River above the lower limit of the reach studied is 291 square miles.

The broad flood plain of the French Broad River is used principally for agriculture, a sizable portion of the land being used each year for the production of truck crops for the fresh produce and process markets and for the raising of gladioli for the commercial flower market. The principal business and residential development of Brevard is on high ground north of the French Broad River, but there are residential and commercial developments at the edge of the French Broad River flood plain and along King, Nicholson, and Tucker Creeks. Some of the buildings of Brevard College are in the King Creek flood plain. Portions of these developments are on land which has been inundated by floods of the past. A substantially larger part is within reach of the larger floods of the future.

Residential and business developments which are on the flood plain at Pisgah Forest are subject to damage by overflow from Davidson River floods and to some extent from floods on the French Broad River. The plant of the Olin Mathieson Chemical Corporation, producing cigarette paper, thin papers for the printing trade, and cellophane film, is on the Davidson River flood plain just above Pisgah Forest.

Records of river stage and discharge have been maintained continuously since 1920 for the French Broad River at Blantyre, 11 miles downstream from Brevard, and for the Davidson River at a stream gage two miles above the mouth. There are no records of streamflow on King Creek, Nicholson Creek, or Tucker Creek. In compiling a record of early floods on the streams, it has been necessary to interview residents along the streams who have knowledge of past floods and to conduct research in newspaper files and historical documents. From these investigations and from studies of possible future floods on French Broad River, Davidson River, King Creek, Nicholson Creek, and Tucker Creek, the flood situation, both past and future, has been developed. The following paragraphs summarize the significant findings with regard to the flood situation which is discussed in more detail in succeeding sections of this report.

THE GREATEST FLOOD of which there is definite knowledge on the French Broad River and one of the greatest on Davidson River, King Creek, Nicholson Creek, and Tucker Creek occurred on July 16, 1916. There was widespread overflow and heavy damage to land, roads, and railroads. The very intense rain caused numerous landslides, and three persons lost their lives in the Brevard vicinity as a result of these slides.

* * *

A GREAT FLOOD in June 1876 was the highest flood known on Davidson River and the second highest on the French Broad River in the memory of the oldest inhabitants. The flood was one to two feet higher than the 1916 flood on Davidson River. On the French Broad River it was about 4 feet lower than the 1916 flood. Although many floods are known to have occurred on King, Nicholson, and Tucker Creeks, no definite information is available concerning their magnitudes.

* * *

ANOTHER GREAT FLOOD occurred on the French Broad River in April 1791, soon after settlement of the region began. The available evidence indicates that this was an unusually high flood on the French Broad River and that it may have been of the magnitude of the flood in 1916.

* * *

OTHER LARGE FLOODS on the French Broad and Davidson Rivers occurred on August 15-16, 1928; October 16-17, 1932; and August 13-14, 1940. The largest of these, the flood of August 1928, was very nearly as high as the 1876 flood. The flood of August 1940 was the largest flood on the French Broad River since 1928, reaching a stage 5.2 feet lower than the 1916 flood at the Blantyre stream gage. On the Davidson River it was 1.1 feet lower than the 1916 flood. It was also a large flood on the smaller streams, King, Nicholson, and Tucker Creeks. Three floods which occurred in the summer of 1949 and the flood on August 26, 1961, were not so great as the 1940 flood, but are particularly noteworthy because of the heavy damage caused to truck crops and commercial flowers which have become an increasingly important part of the region's economy in recent years.

* * *

REGIONAL FLOODS on French Broad and Davidson Rivers and King, Nicholson, and Tucker Creeks in the vicinity of Brevard are based upon floods experienced on streams within 50 miles of the community, a number of which are larger than any known floods on the five streams. This indicates that greater floods than those experienced so far may reasonably be expected in the future. Based upon the magnitude of floods which have occurred on neighboring streams, a Regional Flood may occur on French Broad River that would be generally 4 feet higher than the July 1916 flood. On Davidson River a Regional Flood would be about 6 feet higher than the July 1916 flood. On King, Nicholson, and Tucker Creeks a Regional Flood would be 4 feet, 6 feet, and 5 feet higher, respectively, than the top of the banks.

* * *

MAXIMUM PROBABLE FLOOD determinations indicate that floods could occur on the French Broad River in the vicinity of Brevard about 10 feet higher than the 1916 flood crest. A Maximum Probable Flood on Davidson River would also be about 10 feet higher than the 1916 flood. Maximum Probable Floods on King, Nicholson, and Tucker Creeks would be about 5 feet, 8 feet, and 6 feet higher, respectively, than the top of banks.

* * *

BACKWATER from large floods on French Broad River affects flood heights on the lower reaches of Davidson River, King Creek, and Nicholson Creek. In July 1916 this backwater was higher than the headwater flood on Davidson River

upstream to Mile 0.4. The backwater effect extended upstream on King and Nicholson Creeks about three-fourths of a mile.

* * *

FLOOD DAMAGES that would result from a recurrence of a flood as large as that of July 1916 on French Broad River, Davidson River, and King, Nicholson, and Tucker Creeks would be considerably higher than at the time of the actual flood because of the development now on the flood plains and because of the more intensive agriculture now being practised. The Regional and Maximum Probable Floods, with their greater depths and velocities, would cause even more extensive damages.

* * *

MOST FREQUENT FLOOD OCCURRENCES on the French Broad River have been during the winter and spring months, December through March, and during the hurricane season, August through October. On Davidson River and on King, Nicholson, and Tucker Creeks the most frequent flood occurrences have been in the summer and early fall. Most of the higher floods on all the streams in the Brevard area have been summer floods resulting from very heavy hurricane rainfall or intense thunderstorms. However, large floods may occur at any time.

* * *

PLANS FOR WATERSHED PROTECTION AND FLOOD PREVENTION in the upper French Broad River watershed will be included in a study being made by TVA and the North Carolina State University in cooperation with other state and local organizations. The study is scheduled for completion during the calendar year 1964. A preliminary study has been made by the U. S. Soil Conservation Service to develop plans for watershed protection and flood prevention on that part of the watershed above Penrose. Preparation of a Work Plan was authorized in January 1962 but that plan has not yet been completed.

* * *

VELOCITIES OF WATER during the July 1916 flood ranged up to 10 feet per second in the channel of the French Broad River in the Brevard vicinity and up to 4 feet per second on the flood plain. Along Davidson River, velocities were up to 12 feet per second in the channel and up to 4 feet per second on the flood plain. Along King Creek, Nicholson Creek, and Tucker Creek, velocities during flows at bankfull stages would range up to 12, 5, and 4 feet per second, respectively.

During a Maximum Probable Flood, velocities on the French Broad River would range up to 12 feet per second in the channel and up to 6 feet per second in the flood plain. The corresponding velocities on the Davidson River would be 23 and 8 feet per second. On King Creek, Maximum Probable Flood velocities would range up to 22 feet per second in the channel and 11 feet per second in the flood plain. Corresponding velocities on Nicholson Creek would be 12 and 6 feet per second and on Tucker Creek 15 and 8 feet per second.

* * *

DURATION OF FLOODS is short on Davidson River and on the smaller streams, King Creek, Nicholson Creek, and Tucker Creek at Brevard. The flat channel slope and wide flood plain of the French Broad River results in a slower movement of floodwaters and a correspondingly longer flood duration on that stream. During the flood of August 13, 1940, the French Broad River at Blantyre remained above bankfull stage for 60 hours and had a maximum rate of rise of 1.1 feet per hour. During a Maximum Probable Flood on French Broad River, the stream would rise 20 feet in 25 hours with a maximum rate of rise of 5 feet in 2 hours, remaining out of banks for about 76 hours. Davidson River in the 1940 flood was out of banks for 7.5 hours and had a maximum rate of rise of 1.5 feet per hour. During a Maximum Probable Flood, Davidson River would rise 17 feet in 4 hours and remain out of banks for about 18 hours. On King Creek, the Maximum Probable Flood would rise 8 feet in 1.5 hours with a maximum rate of 5 feet in one-half hour, and the stream would remain out of banks for 4 hours. On Nicholson and Tucker Creeks the Maximum Probable Flood would rise 13 feet in one hour and remain out of banks for 5 hours.

* * *

HAZARDOUS CONDITIONS would occur during very large future floods as a result of the rapidly rising streams, high velocities, and deep flows.

* * *

FUTURE FLOOD HEIGHTS that would be reached if floods of the magnitude of the Regional and Maximum Probable occurred in the vicinity of Brevard are shown for five locations in Table 1. The table compares these heights with the crest of the July 1916 flood on the French Broad and Davidson Rivers, and with bankfull stages on King, Nicholson, and Tucker Creeks.

TABLE 1

RELATIVE FLOOD HEIGHTS

VICINITY OF BREVARD

Flood	Location	Mile	Estimated Peak Discharge cfs	Above July 1916 or Bankfull Stage feet
	French Broad River			
July 16, 1916	U.S. Highway 276	196.51	37,000	0
Regional			42,500	4.5
Maximum Probable			80,800	10.5
	Davidson River			
July 16, 1916	U.S. Highways 64 & 276	2.13	6,500	0
Regional			25,000	6.9
Maximum Probable			48,000	10.6
	King Creek			
Bankfull	U.S. Highways 64 & 276	1.33	2,300	0
Regional			10,700	4.3
Maximum Probable			14,800	5.0
	Nicholson Creek			
Bankfull	U.S. Highway 64	1.60	400	0
Regional			9,600	6.4
Maximum Probable			14,500	7.98
	Tucker Creek			
Bankfull	U.S. Highway 64	0.33	300	0
Regional			6,500	4.8
Maximum Probable			7,800	5.2

II.

PAST FLOODS

II.

PAST FLOODS[1]

This section of the report is a history of floods which have occurred on the French Broad River, Davidson River, King Creek, Nicholson Creek, and Tucker Creek, in the vicinity of Brevard, in Transylvania County, North Carolina. The portion of the French Broad River considered extends from the bridge at Penrose to the mouth of Catheys Creek, a distance of 21.58 river miles. The investigation on Davidson River extends from its mouth upstream 4.47 miles to the mouth of Avery Creek. King Creek is covered from the mouth to a ford at Mile 2.38, Nicholson Creek is covered for a distance of 2.18 miles from the mouth to Cashiers Valley Road, and Tucker Creek is covered from the mouth to Brushy Creek at Mile 1.38. Davidson River joins the French Broad River 3 miles downstream from Brevard. King Creek and Nicholson Creek join the river in the immediate Brevard vicinity, at Miles 194.17 and 198.08, respectively. Tucker Creek, a tributary of Nicholson Creek, joins that stream at Mile 1.33. The study reaches are all within Transylvania County. A small part of the drainage area above the lower limit of the study is in Henderson County; the remainder is in Transylvania County.

The French Broad River flows generally northwestward in the reach covered by this report. Davidson River flows southeastward, then southward to its confluence with French Broad River. King Creek and Nicholson Creek follow a southeastward course through the Brevard development to the river. Tucker Creek flows southward to its junction with Nicholson Creek. Wide bottom lands are found along the entire length of French Broad River which is included in the study. There are moderately wide bottom lands along the upper mile and along the lower two miles of the Davidson River reach and along the full length of the reaches covered on the smaller streams, King, Nicholson, and Tucker Creeks.

A dike at the Olin Mathieson Chemical Corporation plant is designed to protect the plant site against overflow from floods as severe as any which are known to have occurred in the past on Davidson River. The dike will not protect the plant from the higher floods which are possible in the future.

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1. Prepared by Hydraulic Data Branch.

The larger part of the development at Brevard is on high ground above flood danger. Residential developments are at the edge of the French Broad River flood plain along U. S. Highway 276 at the south corporate limit and on the flood plains of King, Nicholson, and Tucker Creeks. Some of the more recent business developments of the town are along Broad Street, where U. S. Highways 64 and 276 cross the King Creek flood plain. At North Brevard, where the former route of U. S. Highway 64 follows the edge of the French Broad flood plain, are a drive-in theater, other businesses, and a number of residences. In Pisgah Forest a number of businesses along Old U. S. Highway 64 and residences on both banks of Davidson River are on land which has been overflowed in the past. The larger floods of the future would affect nearly all of the development now in the vicinity of Pisgah Forest and the Olin Mathieson Chemical Corporation plant.

The first records of streamflow in the vicinity of Brevard date from 1904 when the U. S. Geological Survey began a 5-year period of record at a staff gage on Davidson River at the mouth of Avery Creek, at the upper end of the reach included in this study. On the French Broad River records were maintained at Rosman, 21 miles upstream from Brevard, during the period 1907-1909. Continuous records date from 1920 when staff gages were installed on French Broad River at Blantyre, 11 miles below Brevard, and on Davidson River near the present U. S. Highway 64 and 276 bridge 2 miles above the mouth. The French Broad River gage was converted to a recording gage in 1930 and the Davidson River gage in 1934. Streamflow records have been maintained continuously since 1935 on the French Broad River at Rosman and are available for a gage at Calvert, 2 miles below Rosman, for the period 1924-1955. No records of stage or discharge have been maintained on King Creek, Nicholson Creek, or Tucker Creek.

Flood history investigations which were made by TVA engineers in the period 1935 to 1937 developed information on the French Broad River from Rosman through the reach covered by this report and downstream to the mouth. Investigations which were made after the floods of August 1940 also developed the flood history on the Davidson River. Field investigations have been made after all the important floods on French Broad and Davidson Rivers since 1940. Additional investigations have been made to supplement the early data and to develop the flood history on King, Nicholson, and Tucker Creeks. A search has been made of newspaper files and historical documents, and local residents have been interviewed. From these sources it has been possible to develop a history of known floods on French Broad River covering the past 173 years, and on Davidson River covering the past 88 years.

Information concerning King Creek, Nicholson Creek, and Tucker Creek floods is very limited.

This section of the report discusses separately the flood history of French Broad River, Davidson River, and King Creek. The flood histories of Nicholson Creek and its tributary, Tucker Creek, are discussed jointly.

1. FRENCH BROAD RIVER VALLEY

Settlement

Early historical accounts state that, about 1770, white settlers made an agreement with the Conestee Indians at their village at what is now known as Dunn's Rock, 4 miles south of Brevard, giving them freedom of access in the area. The land which now constitutes Transylvania County, however, was generally considered to be Indian land until 1783, when it was declared open to settlement by the white man by an act of the General Assembly of North Carolina.

One of the earliest recorded grants of land was that made to Ben Davidson in 1797. The stream on which he settled was first called Rolling River, then became known as Ben Davidson's Creek, and later Davidson River. Among the other early settlers in the Brevard area were the Wilson and King families, names which are prominent in the area today. Ben Davidson built a water-powered mill and iron smelter on Davidson River at Mile 2.35 which operated through the period of the Civil War. King's Mill, about Mile 2.38 on King Creek, was one of the early landmarks of Brevard.

The General Assembly created Buncombe County in 1792, to contain originally all the land in North Carolina lying west of the Blue Ridge. As the population of the region increased, divisions and subdivisions were made to form new, smaller counties. Transylvania County came into being in 1861, being formed from parts of Henderson and Jackson Counties.

Brevard was chosen as the county seat and the town was laid out and incorporated in 1867. Brevard was named for Colonel Ephraim Brevard, a resident of Charlotte, North Carolina, and a leader in the independence movement in the colonies which led to the Revolutionary War.

Shortly after the Civil War there was a brief dream of providing cheap transportation for the area by making the French Broad River navigable. The Congress provided $43,000 with which the U. S. Corps of Engineers made studies and built a series of low rock walls, or jetties, along the stream. These extended out from the banks and served to concentrate the flow at midchannel in low-flow periods. A small paddle-wheel steamer, the "Mountain Lily", made one trip upstream from King's Bridge in Henderson County to Elmbend Bridge at Brevard, but that was the end of the enterprise.

The Hendersonville-Brevard Railroad was completed to Brevard in 1894. It was extended to Rosman in 1900, and is now part of the Southern Railway.

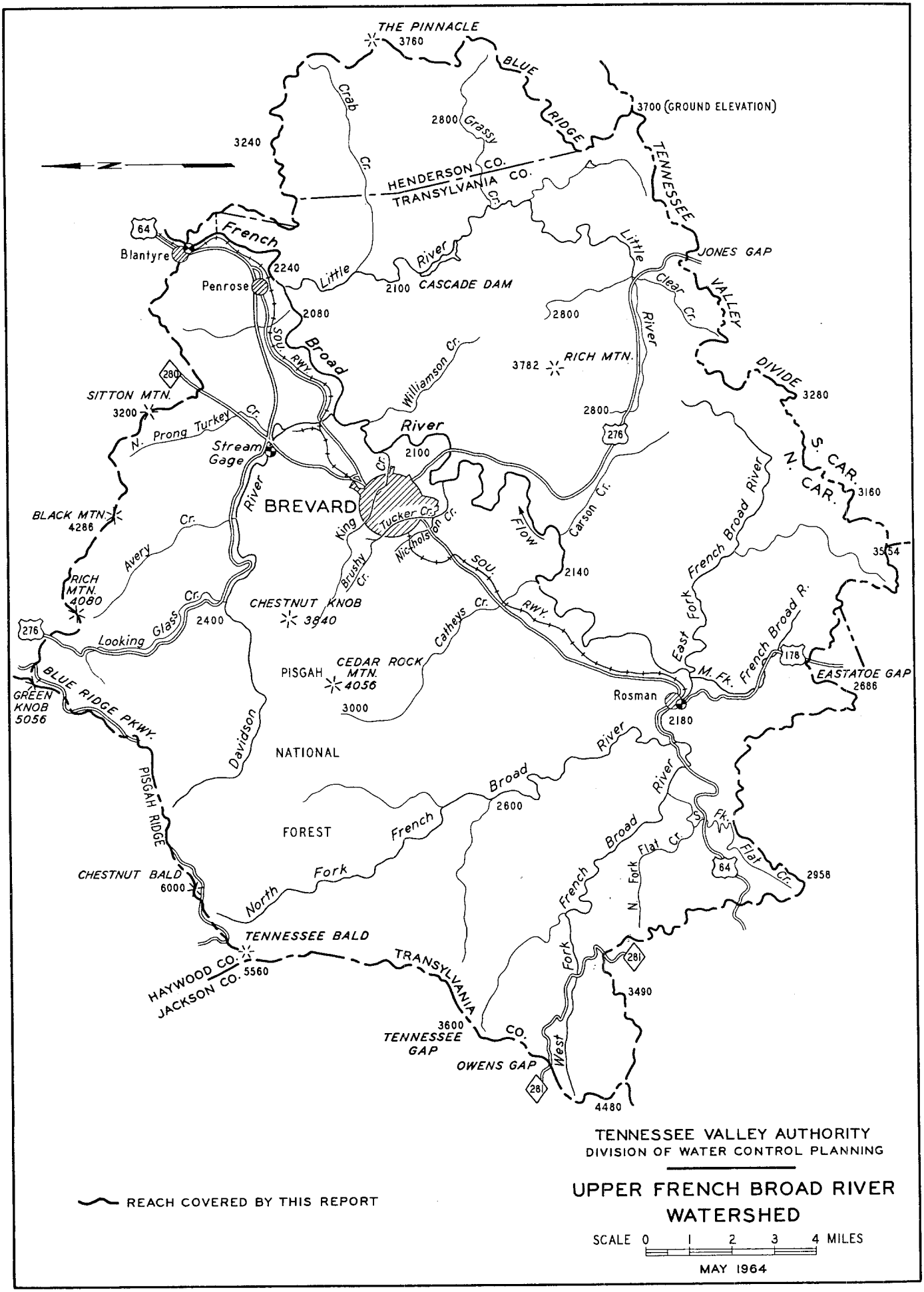
The county is served by U. S. Highway 64 which crosses North Carolina from east to west and by U. S. Highway 276 which links Brevard with Waynesville at the north and the cities of South Carolina at the south. The scenic route of the Blue Ridge Parkway follows the northern boundary of the county.

The population of Brevard according to the 1960 census was 4,857 persons, an increase of 24 percent since 1950. The population of Transylvania County was 16,372, up 8 percent since 1950.

The Stream and Its Valley

The French Broad River watershed covers an area of 5,124 square miles in North Carolina and Tennessee. The watershed above the lower limit of the study reach is roughly square in shape, about 17 miles on a side with the sides oriented in northeast-southwest and northwest-southeast directions. The drainage area lies approximately one-twentieth in Henderson County, the remainder in Transylvania County. The drainage area above the Blantyre stream gage, shown on Plate 1, covers 296 square miles. The river originates on the northern and western slopes of the Blue Ridge, which divides the Tennessee River drainage from that flowing toward the Atlantic Ocean. The watershed in Transylvania County lies entirely within the heavily forested Appalachian Mountain physiographic subregion. Forest cover averages 86 percent in Transylvania County.

The French Broad River begins at Rosman, North Carolina, 8 miles southwest of Brevard, where four tributaries converge. These four streams drop steeply from the watershed rim, where elevations range from 2,700 feet to as much as 6,000 feet.



REACH COVERED BY THIS REPORT

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

UPPER FRENCH BROAD RIVER WATERSHED

SCALE 0 1 2 3 4 MILES

MAY 1964

HD-1311

In the reach of French Broad River from Rosman to the Transylvania-Henderson County line the river follows a meandering course through a broad flood plain, with a channel slope which averages about 3.5 feet per mile, much flatter than is usual for a mountain stream.

In the Brevard vicinity the principal tributary, in addition to the Davidson River which will be discussed later, is the Little River which joins the French Broad River near Penrose Bridge at the lower end of the reach being investigated, and Catheys Creek which joins the French Broad River at the upper end of the reach.

Little River, the largest tributary in Transylvania County, has a drainage area of 60.4 square miles. The stream has its head between Rich Mountain and the Blue Ridge at the North Carolina - South Carolina state line. The stream flows eastward, then northeastward through a broad, flat valley, then turns northward to drop by a series of scenic waterfalls to the French Broad River valley floor.

Cascade Dam, a rock masonry structure 58 feet high, is a private power generating facility which provides some regulation of flows on Little River. A lower, timber-crib dam at this site supplied the first electric power to Brevard in 1909. The present dam was begun in 1919 and completed to a 50-foot height in 1924. It was raised 4 feet in 1945 and another 4 feet to the present height in 1963. The powerhouse contains two turbines, of 625 kv-a and 725 kv-a capacity. The Duke Power Company purchases the power and distributes it over their system.

Catheys Creek drains an area of 13.7 square miles lying between the basins of the North Fork French Broad River and Davidson River. The stream drops steeply from elevations ranging up to 4,056 feet to join the French Broad River at an elevation of 2,129 feet.

A number of smaller tributaries join the French Broad River in the Brevard vicinity. These include King Creek and Nicholson Creek, with its tributary Tucker Creek, all of which will be discussed later.

For the reach covered by this investigation, the channel of the French Broad River falls from elevation 2129 to elevation 2069, an average rate of fall of 2.8 feet per mile. The effect of this flat slope, together with the steep slopes of the tributaries which join French Broad River in this reach, is to produce a rapid concentration of runoff from the surrounding ridges with broad overflow of the bottom lands along the main stream in all large floods. The flood plain varies in

width from 800 feet at the upper end of the reach and at Wilson Bridge to as much as 5000 feet in the vicinity of North Brevard. Over much of the reach it ranges between 2000 and 3000 feet in width. At Penrose, at the lower end of the study reach, the width is about 1300 feet.

The corporate limits of Brevard were originally a circle with a three-quarter-mile radius. There have been some changes in recent years as the limits were revised to take in additional area. Plate 9 and Plates 12 through 22 show the corporate limits in 1964. The channel of French Broad River comes no closer than 1000 feet to the corporate limits of Brevard as the stream follows its course south and east of the town. The flood plain extends inside the corporate boundary at two points, near U. S. Highway 276 south of the business district and along King Creek at the Brevard College property. The principal business, industrial, and residential sections are on high ground, but some business and residential developments are subject to flooding between Miles 194 and 198.

Pertinent drainage areas of the French Broad River and its tributaries in the vicinity of Brevard are given in Table 2.

Developments in the Flood Plain

Plates 9 and 10 show the flood plain of the French Broad River for the reach covered by this report. Except for the few places where highway and railroad locations are found on the flood plain and for the land which is in the immediate Brevard area, the flood-plain land is used for agricultural purposes.

The Toxaway Line of the Southern Railway follows the edge of the left-bank flood plain from the lower end of the study reach at Penrose to Pisgah Forest. From Pisgah Forest to Brevard and over most of its location between Brevard and Rosman the railway is back away from the flood plain.

Former U. S. Highway 64 follows the left-bank flood plain from Penrose through Pisgah Forest to North Brevard. The present route of U. S. Highway 64 from Brevard east is on high ground north of the river. From Brevard west, U. S. Highway 64 closely follows the railway location and is out of the flood plain in the reach covered by this report. U. S. Highway 276, which connects Brevard with the Piedmont section of South Carolina, follows the narrow left-bank flood plain of French Broad River from the Brevard corporate limit to Wilson Bridge where it crosses the flood plain from Mile 198.9 to Mile 199.6 and from Mile 202.8

TABLE 2

DRAINAGE AREAS IN WATERSHED OF FRENCH BROAD RIVER

Stream	Location	Mile above Mouth	Drainage Area sq. mi.
French Broad River	Mouth	0	5124
	N. C. - Tenn. state line	103	1663
	USGS stream gage at Blantyre	183.7	296
	Lower limit of study (Penrose bridge)	186.87	291
	Above Little River	187.21	230
	Below Davidson River	191.74	220
	Above Davidson River	191.74	173
	U. S. Highway 276	196.51	156
	Upper limit of study (below Catheys Creek)	208.45	130
	USGS stream gage at Rosman	216.45	67.9
Little River	Mouth	0	60.4
Davidson River	Mouth	0	47.3
King Creek	Mouth	0	4.60
Nicholson Creek	Mouth	0	5.13
Tucker Creek	Mouth	0	1.50
Catheys Creek	Mouth	0	13.7
E. Fk. French Broad River	Mouth	0	26.4
Mid. Fk. French Broad River	Mouth	0	5.67

to Mile 203.8. The route leaves the flood plain by way of Carson Creek and crosses out of the French Broad watershed at Jones Gap, near Cedar Mountain.

A number of roads which could be classed as principal farm-to-market roads cross the river or follow the flood plain in the reach. The Little River Road crosses the river and flood plain at Penrose Bridge and Everett Road crosses the river at Patton Bridge and follows the right-bank flood plain downstream 2.4 miles. Clough Road crosses the river at Pisgah Forest and follows the right bank upstream to Wilson Bridge. Island Ford Road crosses the river at Mile 206.75, is at the edge of the left-bank flood plain downstream to Mile 205, and is at the edge of the right-bank flood plain from the bridge to Mile 206.3 and from Mile 204.4 to Mile 203.8, where it joins U. S. Highway 276. A number of other roads which would be classed as secondary roads are on the flood plain, as seen on Plates 9 and 10.

Part of the Brevard Golf Course is at the edge of the left-bank flood plain between Miles 201.0 and 201.4. A small section of the course would be inundated by a flood reaching the height of the 1916 flood, and all of the course on the river side of Country Club Road would be under water during a Maximum Probable Flood.

Residential and business developments at Brevard which are subject to French Broad River floods are found along U. S. Highway 276, New School Road, Morningside Drive, and Neely Road, and along old U. S. Highway 64 at North Brevard. On New School Road there are a new apartment building, five residences, and a used auto parts place. The apartment house floor is at the Regional Flood level, but two residences and the auto parts store have floors below that level. Two hangar buildings are along a private airplane landing strip which parallels New School Road. A grocery store and one residence are on U. S. Highway 276 below New School Road. Both would be flooded by a Regional Flood, the store by 3 feet. The basement floor of a church just above New School Road is at elevation 2125.1, 3 feet above the Regional Flood but 3.5 feet under the Maximum Probable Flood. At the Sapphire Manor housing development at the north side of U. S. Highway 276, six housing units have floor levels which are above the Regional Flood level but under the Maximum Probable Flood, the lowest by as much as 5 feet. Two residences on Morningside Drive and two on Neely Road would be affected by a Maximum Probable Flood.

In North Brevard and adjacent Pisgah Forest, a large number of residences and businesses are subject to flooding by large floods on the French Broad River. A flood comparable with that of July 1916 would flood about twenty houses and five businesses with depths up to 5 feet. A Regional Flood would be over the floors of more than fifty homes, ten businesses, and one church, with depths ranging up to 7 feet. A Maximum Probable Flood would be over the floors of about 75 residences, twenty businesses, and four churches with depths ranging up to 11 feet.

A primary substation of the Duke Power Company is on the left bank just below Patton Bridge. Facilities at the substation are on ground at elevation 2098.4, which is about the 1916 flood crest elevation and Regional Flood height at this point, but 5 feet under the elevation that would be reached by a Maximum Probable Flood. Five houses nearby are also in the flood plain and subject to flooding by a Regional Flood.

A bottled gas bulk plant is on the left-bank flood plain at a Southern Railway siding at Penrose. It would be flooded by a flood comparable with that of 1916.

Camp Deerwoode, one of the many summer camps which are operated in the Brevard vicinity, is at the edge of the left-bank flood plain south of the town. Some of the cabins would be flooded to shallow depths by a Maximum Probable Flood.

Brevard obtains its water supply by gravity from two watersheds located about $2\frac{1}{2}$ miles northwest of the business district. The principal supply is at the head of King Creek at a watershed owned partly by the town, but lying mostly within the boundary of Pisgah National Forest. In periods of low flow or high demand an intake on a town-owned watershed on Brushy Creek, also known as Nortons Creek, and a tributary of Tucker Creek, is used to augment the supply. Two reservoirs, of one million gallons each, are located near the town and feed the distribution system. An engineering study has been made which recommends that Catheys Creek be tapped as a further supply to meet future needs. The town is moving toward acquisition of a site for an intake and treatment plant on Catheys Creek just above U. S. Highway 64. Pumping will be required to use water from this site.

Brevard has had a sewage treatment plant since 1952. The plant is located on the left-bank flood plain of King Creek above Neely Road. A principal collecting sewer follows King Creek to the plant. Another follows Tucker Creek through the town and along the edge of the French Broad River flood plain to a pumping station near New School Road, then by a route that roughly follows the corporate limit to a second pumping station on King Creek at Neely Road.

The treatment plant discharges into King Creek. The filter beds at the plant are at elevation 2116.6, which is above the Maximum Probable Flood level. The floor of the King Creek pumping station is at 2109.3 feet, just above the 1916 flood height, but one foot below the Regional Flood and 6 feet below the Maximum Probable Flood. The New School Road pumping station, at French Broad River Mile 197.7, has its floor at elevation 2113.7. Elevations of the 1916, Regional, and Maximum Probable Floods at that point are 2116.0, 2122.5, and 2129.0, respectively.

An intake and pumping station located on the left bank of French Broad River just upstream from the mouth of Davidson River provides the Olin plant with additional water when it is necessary to supplement the Davidson River flow. The pumps and a diesel motor are on a floor at elevation 2094.2 feet. The 1916 flood reached an elevation of 2102.5 at that point, and the Regional and Maximum Probable Floods would reach heights of 2106.3 and 2109.7, respectively. In the event of high water the motor is disconnected and hoisted to the top of the building. The building is shown in Figure 5, on page 49.

Bridges across the Stream

Seven highway bridges cross the French Broad River in the reach near Brevard which is included in this investigation. Table 3 lists pertinent elevations for these bridges and shows their relation to the crest of the flood of July 1916 and the Regional Flood. Plate 23 shows the relation of the floor and underclearance at the bridges to the flood profiles for the reach. Figures 1, 2, and 3 are photographs of the bridges.

The Penrose bridge carries local traffic to the Little River section and a part of the traffic to the plant of E. I. du Pont de Nemours and Company, located in the headwaters of the Little River watershed. This is a 5-span steel-girder, concrete-deck structure, completed in 1955, which replaced a narrow concrete bridge that was located 150 feet upstream. At one time a covered wood bridge crossed the river about one-fourth mile downstream. It was in use at the time of the 1916 flood. A fill blocks the right-bank flood plain up to the elevation of the bridge floor. Approach on the left bank is over a fill which begins at the tracks of the Southern Railway, 600 feet from the bridge, and rises to a height of 12 feet at the bridge. The bridge and fill would cause heading up of about 2 feet during a Regional or Maximum Probable Flood. Access to the bridge is blocked when water overflows the road and railroad at elevation 2087.5. Approaches to the older bridge were at flood-plain levels.

Patton bridge is a steel-girder, concrete-deck bridge of five spans, completed in 1959, to replace a steel truss bridge at the same site. Approach fills cross both banks of the wide flood plain and present a sizable obstruction to flood flows. Heading up of 6 feet would occur during a Regional Flood, and 4 feet during a Maximum Probable Flood. The bridge floor is at elevation 2103.2 feet, but overflow of the left-bank approach begins at elevation 2100. At the time of the 1916 flood the bridge approaches were at the level of the flood plains.

TABLE 3

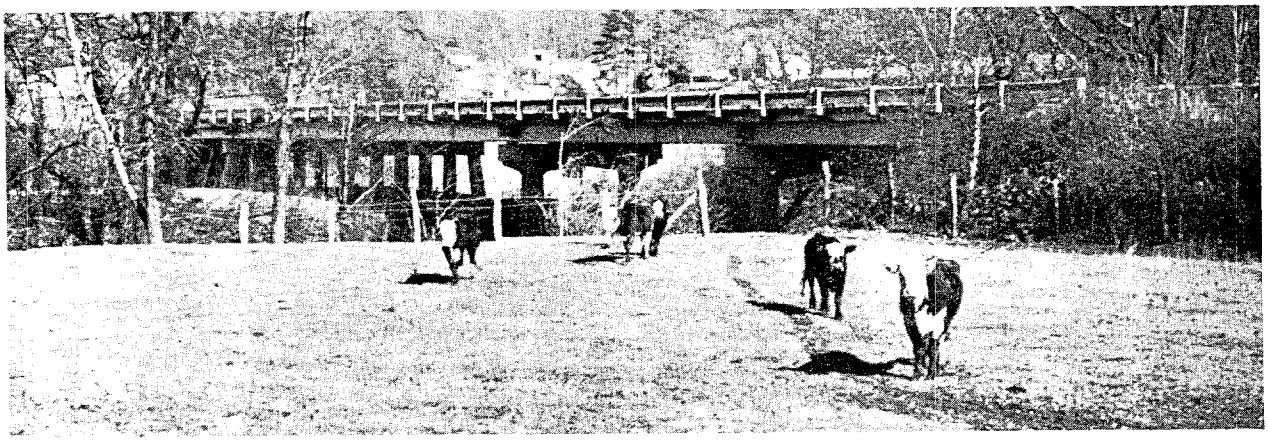
BRIDGES ACROSS FRENCH BROAD RIVER

Mile above Mouth	Identification	Low Water Elev. feet	Floor Elev. feet	Regional Flood Crest Elev. feet	July 1916 Flood Crest Elev. feet	Underclearance Elev. feet	Above 1916 Flood feet	Below 1916 Flood feet
186.87	Little River Road (Penrose Bridge)	2069.0	2094.3	2095.9	2093.3	2091.0		2.3
190.62	Everett Road (Patton Bridge)	2081.6	2103.2	2104.9	2098.8	2099.6	0.8	
192.07	Clough Road	2087.8	2101.4	2106.9	2103.5	2099.0		4.5
195.44	County road (Tom Wilson Bridge)	2094.6	2109.4	2115.7	2111.0	2107.8		3.2
196.51	U.S. Highway 276 (Wilson Bridge)	2095.8	2114.6	2121.0	2115.5	2110.6		4.9
202.27	County road	2109.9	2124.8	2130.7	2126.3	2122.5		3.8
206.75	Island Ford Road	2122.8	2138.6	2140.6	2136.4	2135.8		0.6

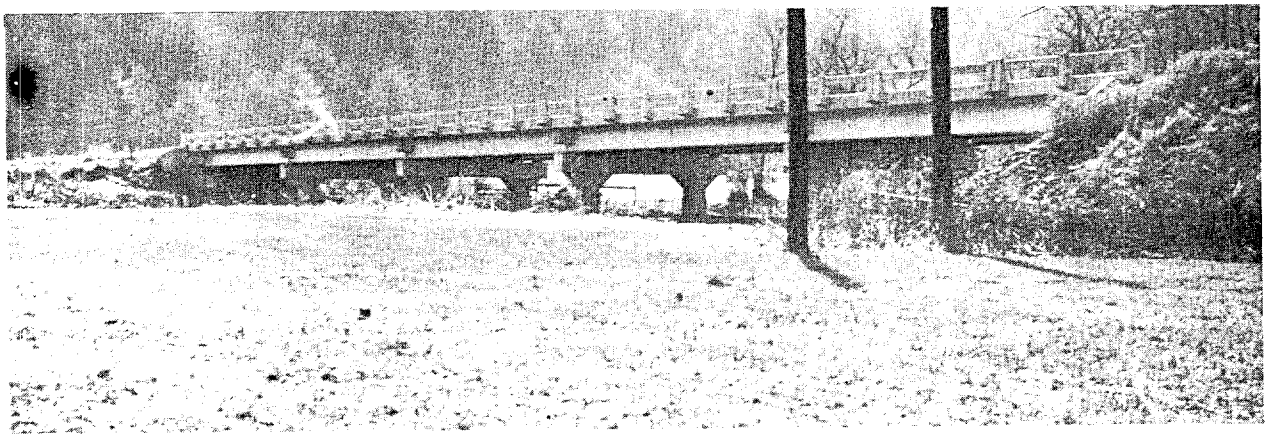
The 3-span bridge at Clough Road is a wood-deck, steel-girder structure. The bridge floor is at elevation 2101.2, but the road approaching the bridge on the right bank is mostly at flood-plain level and use of the bridge is cut off when water overflows this road at elevation 2095.2.

Tom Wilson bridge, also called the Elmbend bridge, consists of a steel-truss span across the channel with a short approach span on the right bank. The road leading to the bridge across the wide flood plain on the right bank is at the natural ground elevation. Use of the bridge is lost when water overflows this road at elevation 2103.

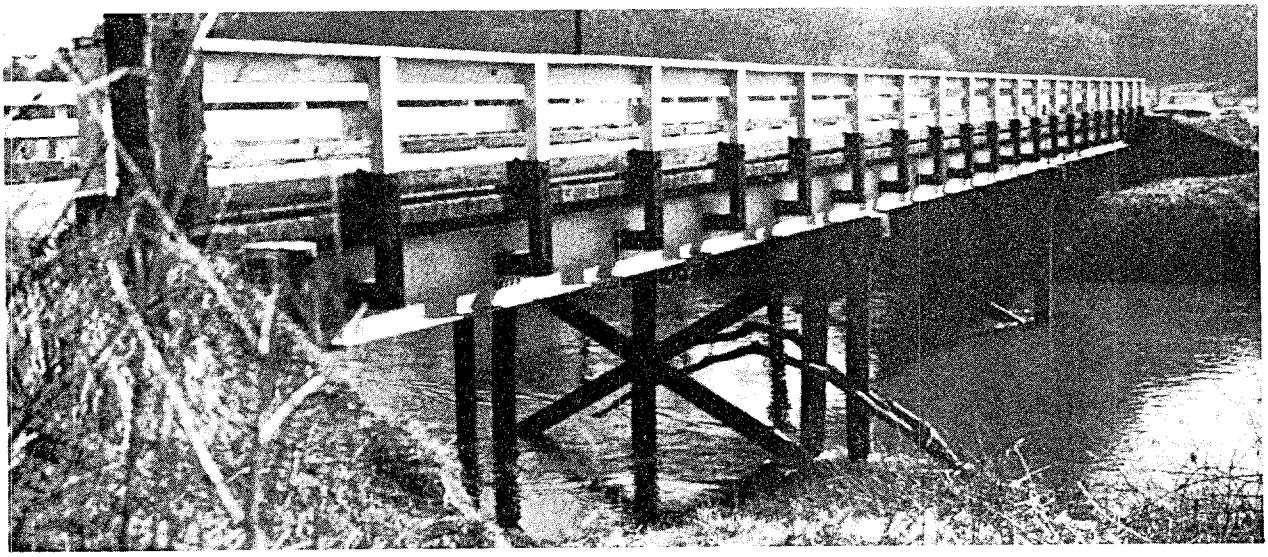
U. S. Highway 276 carries the principal north-south traffic between Brevard and upper South Carolina and local traffic to the Cedar Mountain section and the du Pont Company plant which is nearby. The flood plain narrows at the bridge site to 800 feet and the approach fills on each bank range from 5 to 15 feet in height. The bridge, known locally as Wilson Bridge, was built in 1926 and is a 5-span concrete structure, with a solid guard rail. The natural constriction in the overbank section results in heading up of about 5 feet and the bridge with its approaches increases this heading up by another floot. The bridge floor is at



Penrose Bridge, Mile 186.87, upstream side.

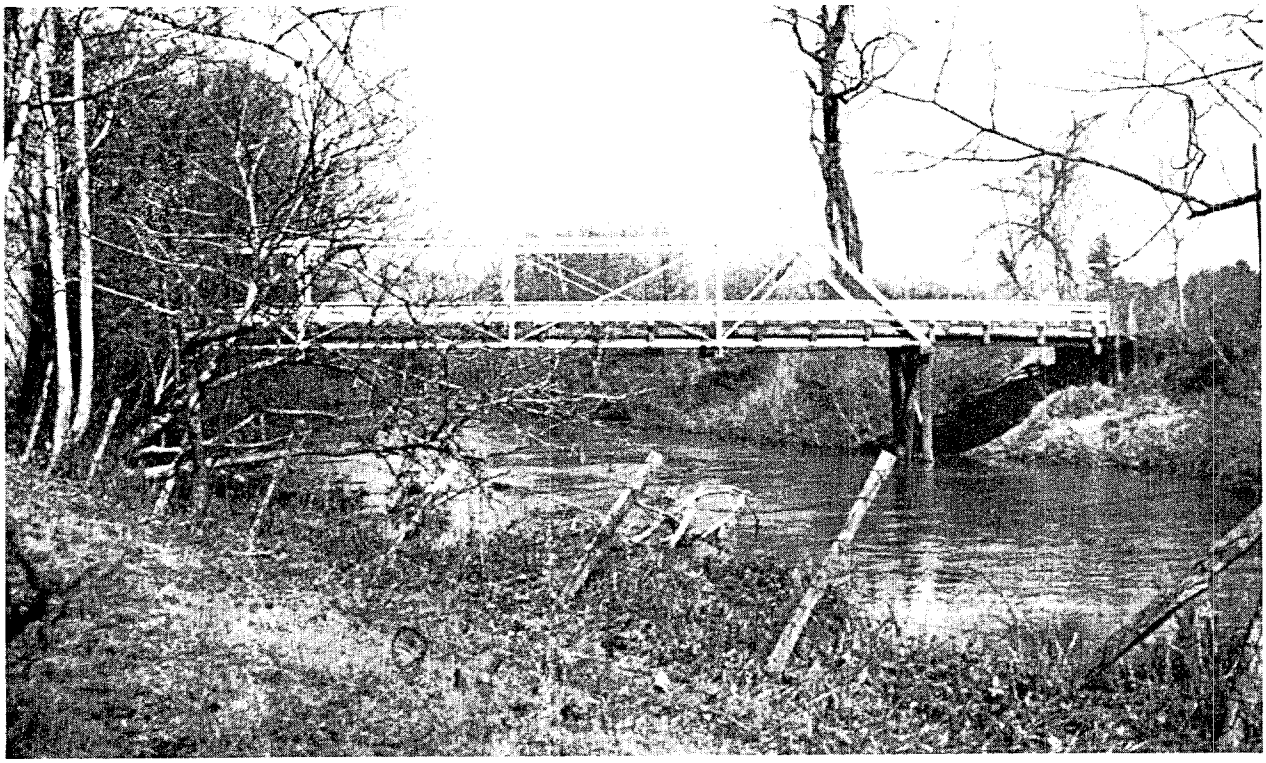


Patton Bridge, downstream side, at Mile 190.62.

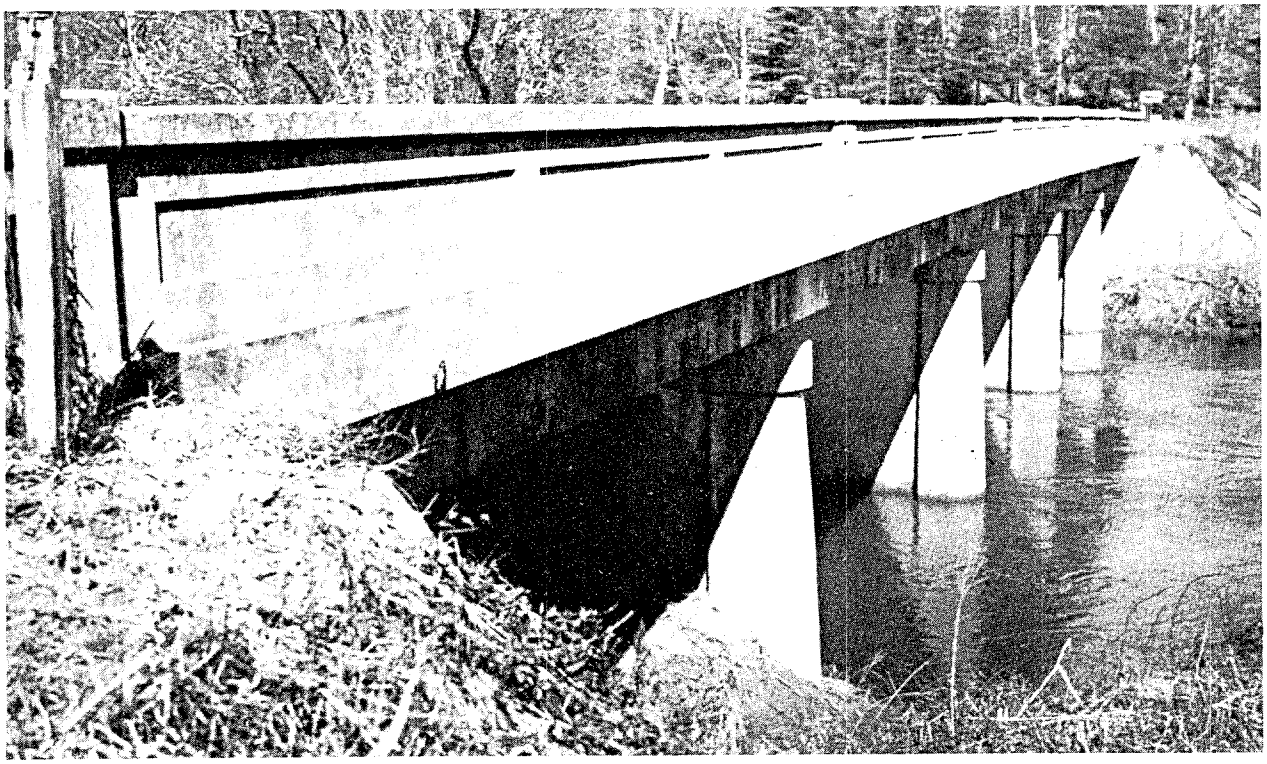


Clough Road bridge at Mile 192.07, upstream side.

Figure 1.--FRENCH BROAD RIVER BRIDGES BELOW PISGAH FOREST



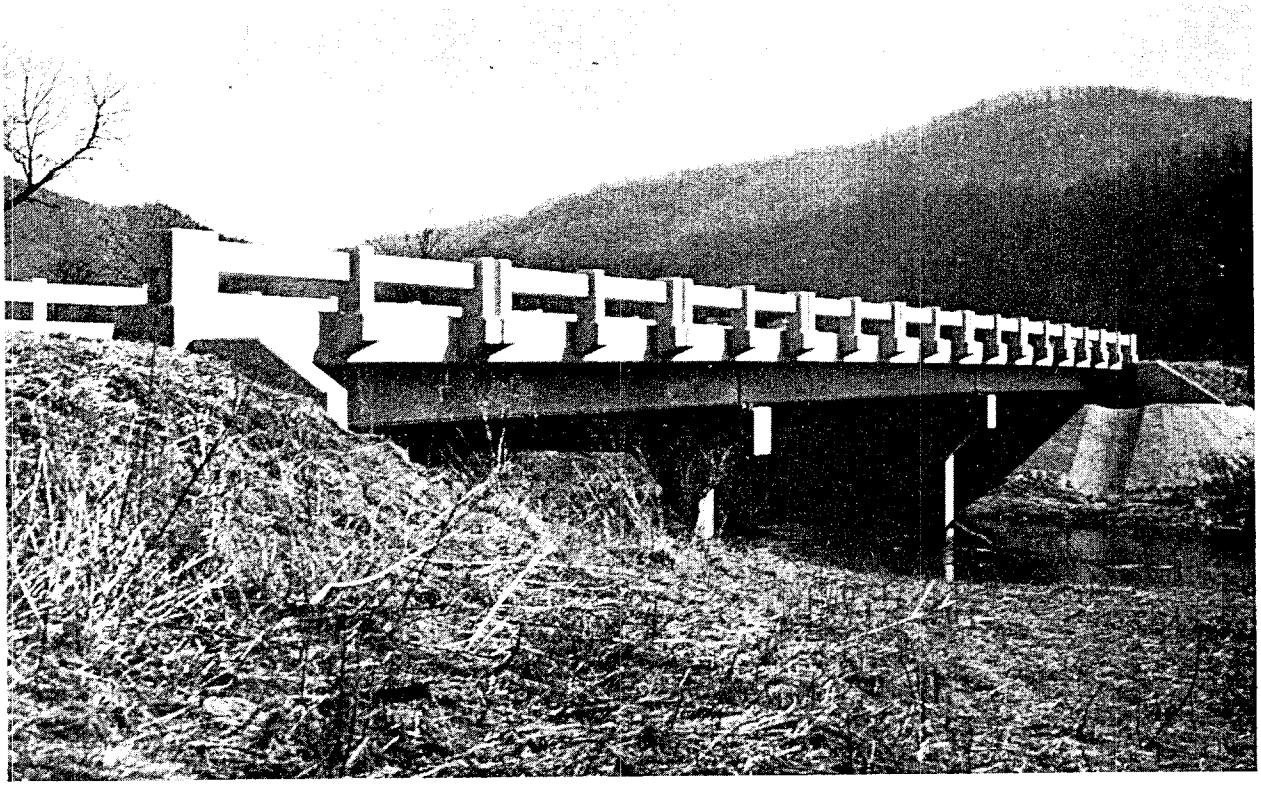
Upstream side of Tom Wilson Bridge over French Broad River at Mile 195.44.



The Wilson Bridge at Mile 196.51 carries U. S. Highway 276 over French Broad River and was built by the State in 1926. The view is from right bank, downstream side.

Figure 2.--TWO WILSON BRIDGES SOUTHEAST OF BREVARD

County bridge at Mile 202.27, upstream side.



Island Ford Road bridge at Mile 206.75, upstream side. This bridge was completed in August 1962.

Figure 3.--FRENCH BROAD RIVER BRIDGES ABOVE BREVARD

elevation 2114.6, but overflow begins at the left-bank approach at elevation 2113.3. Bridges have been located at this site for at least 60 years and, as at the Penrose and Patton bridges, approaches for the early bridges were at the flood-plain level.

Abutments and one pier of a bridge are in place at Mile 200.98, but there has been no bridge in use at the site since about 1947.

A 2-span steel-girder, wood-floor bridge is at Mile 202.27. The floor of the bridge is just above bank level at the site, and the approach road which crosses the wide left-bank flood plain is at natural ground elevation. Any flood which overtops the banks overflows the road.

Island Ford bridge is a 3-span structure with steel girders and a concrete deck, built in 1962 to replace an older bridge at the site. Approach fills block short sections of the flood plain near the bridge on each bank, but the road is at natural ground elevation across most of the wide flood plain on each bank.

Obstructions to Flood Flow

The effect of obstructions due to the bridges and the approach fills at the bridges has been described in the previous section. Farm operators have constructed low levees along the riverbank at a number of points where overflow is known to occur first, as protection for the most vulnerable parts of their fields. Ditching and grading is done periodically to improve drainage. The levees and the spoil banks which are left along the ditches have some effect upon flood flows, particularly for floods which only slightly exceed the bankfull stage. They have little or no effect during larger floods.

In 1950 an inspection was made of the jetties along French Broad River, to ascertain their condition and to evaluate their effect upon flows in the river. These were the loose-piled rock walls, extending out from the stream banks, which were built around 1880 for the purpose of concentrating flows at midchannel to produce a depth sufficient for navigation of the river in periods of low flow. Some 59 jetties were located, many appearing to be in much the same condition as when built. In general, they were found to rise one to two feet above the stream bed and were usually arranged in pairs, one extending out from each bank with 20 to 30 feet of open channel between the ends. The two found farthest upstream were at Elm Bend. Twenty-eight of the jetties were concentrated in a relatively steep reach of about 2000 feet just below the mouth of Davidson River. Another

twelve were in a 0.4-mile reach near Patton Bridge, and ten were located a short distance above the mouth of Little River. The relatively low height of the jetties indicates that they have an effect upon flows in the river at times of low discharge, but that in time of flood their effect is of little or no consequence.

Plans for Water Resources Development, Watershed Protection, and Flood Damage Prevention

A study of the North Carolina part of the French Broad River watershed is being made at the request of the Western North Carolina Regional Planning Commission and the State Department of Water Resources. The study is being conducted by the Tennessee Valley Authority and the North Carolina State University at Raleigh with the assistance and cooperation of the North Carolina Department of Water Resources, other state agencies, the W. N. C. Regional Planning Commission, and local organizations. Five counties--Transylvania, Henderson, Buncombe, Madison, and Haywood--are included. This study will provide the technical base for planning a program of over-all improvement in the economy of the area and the welfare of its citizens. An integral part of such a program will be plans for water resources development including structures and other means of reducing flood damages. The study is scheduled for completion during the calendar year 1964. The rapidity of program planning and the initiation of developmental measures will depend upon the interests and initiative of local residents.

Transylvania County is organized as a Soil Conservation District in accordance with state laws in order to gain the benefits provided by the Watershed Protection and Flood Prevention Act (Public Law 566). The Soil Conservation District and the Board of County Commissioners joined corresponding groups from Henderson County in requesting the Soil Conservation Service to develop a plan for watershed protection and flood prevention for that part of the French Broad watershed above Penrose. The SCS made a field examination in December 1957 and in 1958 prepared a preliminary study identifying 17 sites for small reservoirs. Preparation of a Work Plan was authorized in January 1962 but that plan has not yet been completed. The engineering studies which are the basis for this report by TVA have been made for channel and overbank conditions as they exist at the present time.

FLOOD SITUATION

Flood Records

Records of river stage and discharge have been maintained continuously since 1920 on the French Broad River in the vicinity of Brevard. The first records of streamflow go back to May 7, 1907, when the U. S. Geological Survey established a staff gage on the river at Rosman, 21 miles upstream from Brevard. The gage was discontinued June 30, 1909. It was reestablished as a recording gage December 11, 1935, and has been continued in operation since that date. On December 11, 1920, the Geological Survey began observations on the French Broad River at Blantyre, Mile 183.7, 11 miles downstream from Brevard and 3.2 miles below the lower end of the reach covered in this investigation. The first observations at Blantyre were made on a chain gage on a bridge 20 feet downstream from the present bridge. Records began at a recording gage at the present bridge July 5, 1930, and have been continued without interruption. Observations were made at a gage on the French Broad River located at Calvert, 2 miles downstream from Rosman, during the period October 1924 to September 1955. The gage consisted of a staff gage until July 1932, a chain gage from July 1932 to May 1934, and a recording gage after that date.

From December 1, 1917, through November 30, 1924, the U. S. Weather Bureau operated a chain gage on the old covered bridge at Penrose, which was located about 0.25 mile downstream from the present bridge, and daily observations of stage only are available for the seven-year period.

Streamflow records are available for three of the tributaries which join French Broad River in the reach studied. The records available for Davidson River will be discussed in the following section of this report, which deals with floods on that stream. For Little River records are available from May 1907 to June 1909 for a staff gage at a site 1.2 miles above the mouth, and from October 1942 to September 1955 for a recording stream gage located at a site 4.3 miles above the mouth. For the latter period, also, a recording gage was operated on Crab Creek 1.6 miles above its mouth in Little River. Recording stream gage records were maintained on Catheys Creek from October 1944 to September 1955. The first gage was 1.3 miles above the mouth and 150 feet above U. S. Highway 64. The gage was relocated 250 feet farther upstream in October 1946, and in January 1947 it was moved to a site 0.9 mile above the highway.

To supplement the record obtained from these gaging stations, local residents were interviewed for dates and heights of floods. Files of the Asheville and Brevard newspapers were searched, as were historical documents and records. Valuable data were obtained from reports of field investigations made by TVA engineers after the important floods which have occurred in the last 29 years. These investigations have developed a knowledge of floods on French Broad River covering the past 173 years.

Flood Stages and Discharges

Table 4 lists peak stages and discharges for the known floods exceeding bankfull stage of 16 feet at the Geological Survey gaging station on French Broad River at Blantyre. Table 5 lists the highest ten floods in order of magnitude. For floods since 1920 the flood-crest stages are those observed at the gage. Stages for floods prior to 1920 are from high water marks or are estimated from observed stages at Penrose, newspaper and historical accounts, or from interviews with local residents.

Flood Occurrences

Plate 2 shows crest stages and months of occurrence of known floods since 1875 which have exceeded the bankfull stage of 16 feet on the French Broad River at Blantyre. Table 6 shows the monthly distribution of the 51 known floods occurring since 1920. The record shows that floods have occurred in every month of the year, with the most frequent flooding in the winter and spring months, December through March, and during the hurricane season, August through October.

Duration and Rate of Rise

Plate 3 shows the stage hydrograph on French Broad River for the flood of August 13, 1940, at the stream gage at Blantyre. During the mid-August 1940 flood, the river rose to its crest stage in 48 hours at an average rate of 0.4 foot per hour with a maximum rate of 1.1 feet per hour, and remained above bankfull stage 60 hours.

Velocities

During the July 16, 1916, flood, velocities in the channel of French Broad River in the vicinity of Brevard ranged up to 10 feet per second, and

TABLE 4

FLOOD CREST ELEVATIONS ABOVE BANKFULL STAGE

FRENCH BROAD RIVER AT BLANTYRE, NORTH CAROLINA

1791-1964

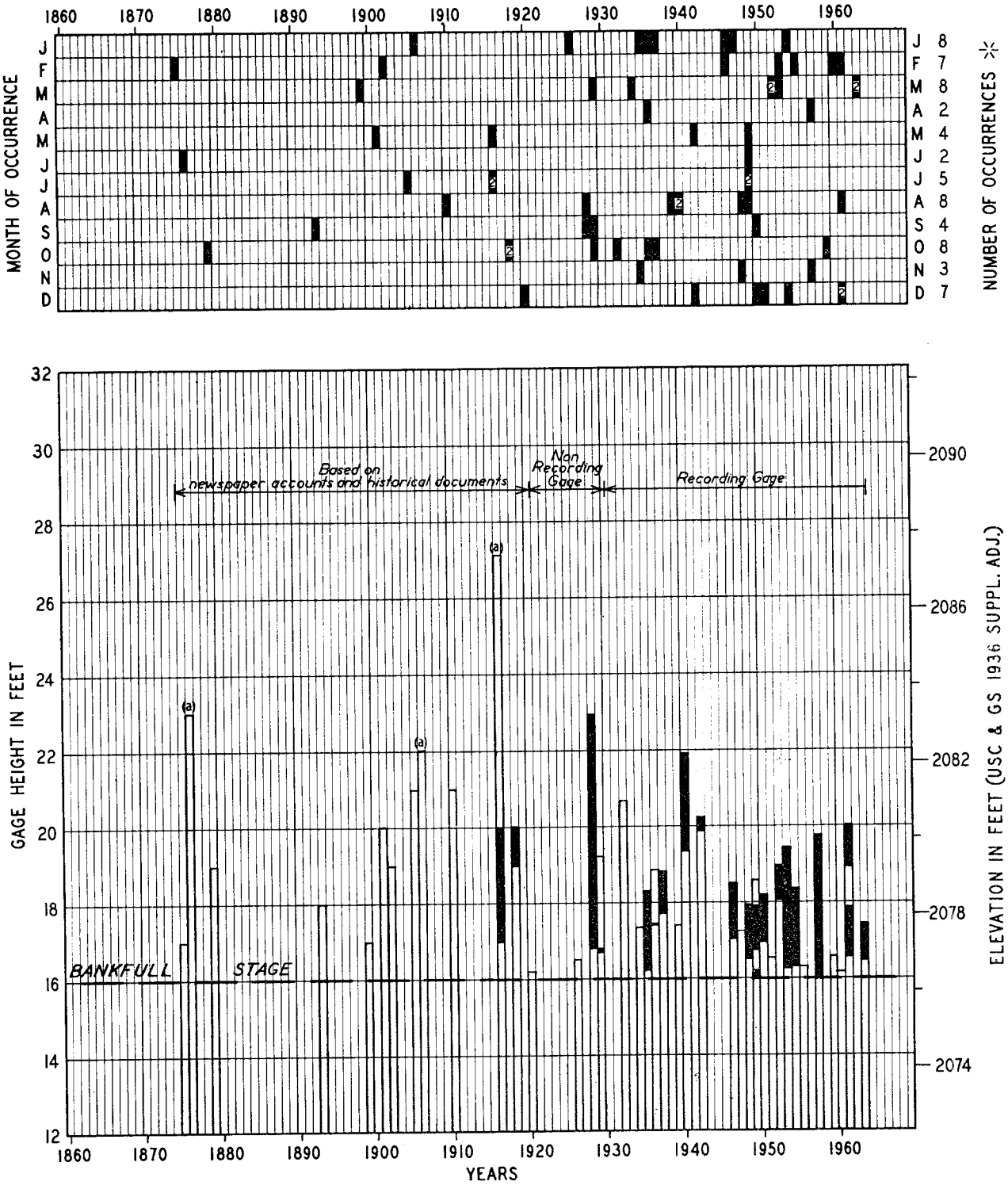
This table includes all known floods above bankfull stage of 16 feet at the U. S. Geological Survey gaging station at Blantyre, Mile 183.7. Drainage area is 296 square miles.

Date of Crest	Gage Heights		Discharge
	Stage feet	Elevation feet	cfs
April 1791			
August 1796	Large floods are believed to		
1810	have occurred on these dates		
May 1840	with probable stages ranging		
August 1850	between 20 and 25 feet.		
August 1852			
February 1875	17(a)	2077	
June 1876	23(b)	2083	
October 17, 1879	19(a)	2079	
September 13, 1893	18(a)	2078	
March 15, 1899	17(a)	2077	
March 19, 1899	17(a)	2077	
May 22, 1901	20(a)	2080	
February 28, 1902	19(a)	2079	
July 1905	21(a)	2081	
January 23, 1906	22(b)	2082	
August 31, 1910	21(a)	2081	
May 23, 1916	17(a)	2077	
July 10, 1916	20(b)	2080	
July 16, 1916	27.1(b)	2087.4	50,700
October 25, 1918	19(c)	2079	
October 29, 1918	20(c)	2080	
December 14, 1920	16.2	2076.5	5,170
January 19, 1926	16.50	2076.8	5,100
August 16, 1928	22.9	2083.2	26,500
September 6, 1928	16.8	2077.1	5,460
March 14, 1929	19.2	2079.5	10,600
September 28, 1929	16.8	2077.1	5,460
October 2, 1929	16.70	2077.02	5,420
October 17, 1932	20.68	2081.00	15,600
March 5, 1934	17.32	2077.64	6,110
January 10, 1935	18.29	2078.61	8,040
November 13, 1935	16.20	2076.52	4,780
January 20, 1936	17.40	2077.72	5,920
April 7, 1936	18.85	2079.17	9,470

TABLE 4 (Continued)

Date of Crest	Gage Heights		Discharge
	Stage feet	Elevation feet	cfs
October 17, 1936	17.44	2077.76	5,920
January 3, 1937	17.70	2078.02	6,560
October 20, 1937	18.83	2079.15	9,470
August 19, 1939	17.40	2077.72	6,180
August 14, 1940	21.89	2082,21	20,800
August 31, 1940	19.32	2079.64	10,900
May 21, 1942	19.86	2080.18	12,800
December 30, 1942	20.21	2080.53	13,800
January 8, 1946	18.50	2078.82	8,720
February 11, 1946	17.05	2077.37	5,030
January 20, 1947	17.24	2077.56	5,400
August 5, 1948	16.53	2076.85	4,720
November 29, 1948	17.96	2078.28	6,550
May 1, 1949	16.00	2076.32	4,420
June 17, 1949	17.94	2078.26	6,580
July 13, 1949	18.56	2078.88	8,010
July 20, 1949	16.20	2076.52	4,550
August 29, 1949	16.74	2077.06	4,970
September 9, 1950	16.96	2077.28	5,180
December 7, 1950	18.20	2078.52	6,880
December 21, 1951	16.53	2076.85	4,710
March 11, 1952	18.97	2079.29	9,730
March 24, 1952	18.05	2078.37	6,550
February 22, 1953	19.44	2079.76	11,300
March 24, 1953	16.23	2076.55	4,580
January 23, 1954	18.32	2078.64	7,290
December 30, 1954	16.29	2076.61	4,570
February 7, 1955	16.30	2076.62	4,550
April 5, 1957	19.75	2080.07	12,800
November 19, 1957	16.06	2076.38	4,270
October 11, 1959	16.58	2076.90	4,660
February 6, 1960	16.17	2076.49	4,350
February 26, 1961	17.87	2078.19	5,410
August 26, 1961	20.01	2080.33	7,830
December 13, 1961	18.94	2079.26	8,500
December 19, 1961	16.57	2076.89	4,540
March 6, 1963	16.47	2076.79	4,490
March 13, 1963	17.42	2077.74	5,330

(a) Estimated from newspaper accounts and flood history investigations.
(b) Estimated from high water mark.
(c) Estimated upon basis of Penrose-Blantyre gage relation.



(a) Stage based on high water mark

⁂ Number of occurrences during period February 1875 to April 1964.

Stream Gage at River Mile 183.7

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

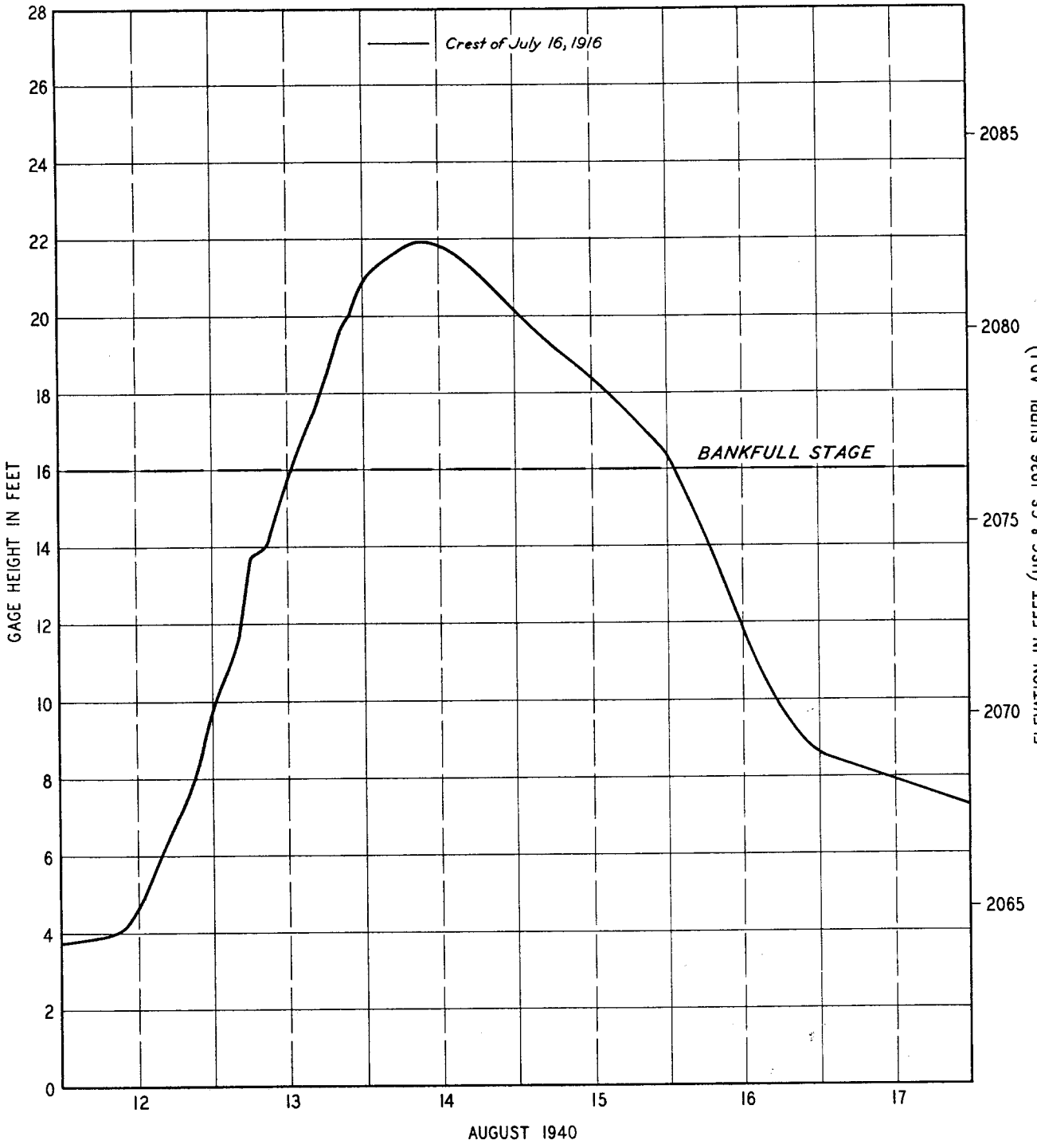
FLOODS ABOVE BANKFULL STAGE

FRENCH BROAD RIVER AT BLANTYRE, N.C.

MAY 1964

HD-1311

PLATE 3



Gage at River Mile 183.7

TENNESSEE VALLEY AUTHORITY

DIVISION OF WATER CONTROL PLANNING

STAGE HYDROGRAPH

FLOOD OF MID-AUGUST 1940
FRENCH BROAD RIVER
AT BLANTYRE, N.C.

MAY 1964

TABLE 5

HIGHEST KNOWN FLOODS IN ORDER OF MAGNITUDE

FRENCH BROAD RIVER AT BLANTYRE, NORTH CAROLINA

Order No.	Date of Crest	Gage Height	
		Stage feet	Elevation feet
1	July 16, 1916	27.1	2087.4
2	June 1876	23	2083
3	August 16, 1928	22.9	2083.2
4	January 23, 1906	22	2082.
5	August 14, 1940	21.89	2082.21
6	July 1905	21	2081
7	August 31, 1910	21	2081.
8	October 17, 1932	20.68	2081.00
9	December 30, 1942	20.21	2080.53
10	August 26, 1961	20.01	2080.33

TABLE 6

MONTHLY FLOOD DISTRIBUTION

FRENCH BROAD RIVER AT BLANTYRE, NORTH CAROLINA

Month	Number of Occurrences	Month	Number of Occurrences
January	7	July	2
February	5	August	7
March	7	September	3
April	2	October	5
May	2	November	3
June	1	December	7
		Total	51

overbank velocities ranged up to 4 feet per second. During larger floods, velocities would be even greater.

Flooded Areas, Flood Profiles, and Cross Sections

Plates 9 and 10 show the approximate areas along the French Broad River in the vicinity of Brevard that would be inundated by the flood of July 1916 under present conditions, and by the Maximum Probable Flood. The actual limits of these overflow areas on the ground may vary somewhat from those shown on the map because the contour interval of the map does not permit precise plotting of the flooded area boundaries. The contour interval of Plates 9 and 10 is 40 feet.

The overflow limits in the immediate area of Brevard are also shown on Plates 12 through 22 which are sections of the Brevard town map compiled by Piedmont Aerial Surveys, Inc., of Greensboro, North Carolina. These maps have a larger scale and show more detail than Plates 9 and 10, and the contour interval is 5 feet. Plate 11 is a key map which shows the relative position of Plates 12 through 22.

Plate 23 shows high water profiles for the floods of July 1916 and February 1946. Also shown are the profiles for the Regional and Maximum Probable Floods discussed in Sections III and IV of this report.

Plate 24 shows typical cross sections of French Broad River in the reach investigated. Some sections were obtained by TVA and others by the Soil Conservation Service. The locations of all sections are shown on the profile, Plate 23. For the sake of clarity, only the TVA sections are located on the map, Plates 9 and 10. The cross sections show the elevation and extent of overflow of the July 1916 flood and the Regional and Maximum Probable Floods.

FLOOD DESCRIPTIONS

Following are descriptions of known large floods that have occurred in the general vicinity of Brevard. They are based upon newspaper accounts, historical records, and investigations by TVA engineers.

Information is sparse on the very early floods on French Broad River and its tributaries in the vicinity of Brevard. A search of early Asheville newspapers gives hints of floods in the headwater reaches of French Broad River but

no clue from which flood heights can be estimated in most cases. On the other hand there are numerous references to floods and flood damages on the river in the immediate vicinity of Asheville. Experience in more recent floods indicates that damaging or near-damaging floods probably occurred on the headwater streams whenever there were overflows on the main river at Asheville, but that the effects close to Asheville crowded out the news from the headwater areas.

It is probable also that floods have occurred in the vicinity of Brevard which were not mentioned in the early Asheville newspapers. Particularly would this be true for floods on the smaller streams, King Creek, Nicholson Creek, and Tucker Creek, which can be affected by local storms of the common thunderstorm type.

April 1791

Many large floods occurred in the early years of settlement in the Asheville vicinity. The earliest known of these floods occurred in April 1791. Since the country was only sparsely settled at the time, information on the flood is naturally meager but still sufficient to establish quite definitely that it was the greatest flood on Swannanoa River of which there is any knowledge and probably one of the greatest on French Broad River. The weight of evidence indicates that on the Swannanoa River the flood exceeded the severe flood of July 1916 by as much as five feet. Since a flood in April is likely to be caused by general rains, it is reasonable to assume that the French Broad River was also unusually high at that time and that it may have been as high as in the flood of July 1916.

1797-1875

Historical reference is found to a flood on both French Broad River and Swannanoa River in August 1796. Another flood in 1810 was said to have been particularly high on the Swannanoa River.

The Asheville "Citizen" of July 27, 1916, quotes Mr. W. J. Alexander, a member of one of the first families to settle near Asheville, as saying that the first notable flood in his lifetime occurred in May 1845, when he was 15 years old. Flood history investigations in the adjoining Tuckasegee River basin have definitely established that a great flood occurred in May 1840, and it is probable that the French Broad flood occurred at that time, rather than in 1845.

Floods occurred in August 1850 and August 1852. According to the Asheville "News" of September 2, 1852, the 1852 flood on the French Broad River "was higher . . . than it has been for many years before, exceeding largely the great flood two years ago."

Great floods occurred throughout the upper half of the Tennessee Valley in March 1867. They were the largest floods ever known on the lower French Broad, Holston, and Little Tennessee Rivers and on the Tennessee River itself from Knoxville through Chattanooga. On the French Broad River at Newport, Tennessee, the flood exceeded by 1.0 to 1.5 feet the floods of 1902 and 1916. Although the storm was most severe in the lower part of the French Broad watershed, it undoubtedly produced a large flood also in the Brevard vicinity.

Intense rainfall produced a flood late in February 1875. The Asheville "Citizen" for March 4, 1875, reported that "the Swannanoa and French Broad Rivers rose so rapidly that persons residing along their banks had to abandon their houses and effects and flee for safety. In many domiciles the water was 3 and 4 feet deep."

June 17, 1876

This flood, often called the "June Freshet", is one of the great floods along the upper reaches of the French Broad River. At Asheville it ranked next below the July 1916 crest among floods of the past 170 or more years, and the same relation probably holds for the reach of the river near Brevard.

Mr. R. L. Gash, an attorney at Brevard and a member of one of the pioneer families of Transylvania County with an avid interest in its early history, was interviewed by TVA engineers in 1937. Mr. Gash stated that at the time of the 1916 flood the oldest residents of the area said the flood was the greatest they had seen or heard of and that the highest known previously was the "June Freshet" of 1876.

The Brevard "Sylvan Valley News", in an article printed on July 21, 1916, had the following to say about the relation of the July 1916 flood to the flood of June 1876:

> P. C. Surrette and E. B. Clayton of the Penrose section say they have high water marks made by the noted June Freshet of 1876 and that the water Sunday was 5 feet higher than at the destructive flood 40 years ago. . . .

May 1901, February 1902

On May 22, 1901, the French Broad River at Asheville rose to a stage of 11 feet and damaged railroads, industries, and other developments and disrupted the city's water supply. It is probable that there was a large flood on the upper reaches of the river also.

A flood occurred on February 28, 1902, that was the highest on the French Broad River at Asheville since June 1876. Evidently the flood was not quite so large in the Brevard vicinity. The "Sylvan Valley News" of March 7, 1902, stated:

> March came in the latter part of last week with a terrific rush and a heavy downpour of rainfall. As a result the various streams in the county were soon out of banks, some footlogs were removed from their resting places and some of the bridges had a narrow escape. Washouts along the railroads prevented trains from running either to Toxaway or Hendersonville from Friday until Tuesday following. Yet our people have not suffered as other sections have.

January 23, 1906

This was a large flood on the French Broad River above Asheville. The following account of the flood is from the "Sylvan Valley News" of January 26, 1906:

> THE FLOOD
>
> Tuesday morning French Broad River was the highest recorded since the great June Freshet of 30 years ago and those who have been watching the high water marks made at that time tell us that it only lacks 3 or 4 inches of the record made in 1876.
>
> But in the present instance it rained. Roofs that were rainproof heretofore let in the water in sluices. The water was hurled into the river from the mountainsides with such force that it cut its way through the bottoms, taking all loose soil with it. It was simply a boiling, seething torrent from hill to hill and the damage done to farming lands is incalculable. . . .
>
> The iron abutment at the south end of Wilson's iron bridge was moved about 18 inches downstream . . . Island Ford bridge is reported all right but the approach to it is washed away. The Luther Hamilton mill dam on Little River is washed away; also the bridge across Little River at the mouth of Laurel Creek. . . .
>
> Our railroad suffered severely by washouts . . . A great amount of damage has been done which we will not hear about in time for this issue of the News.

August 31, 1910

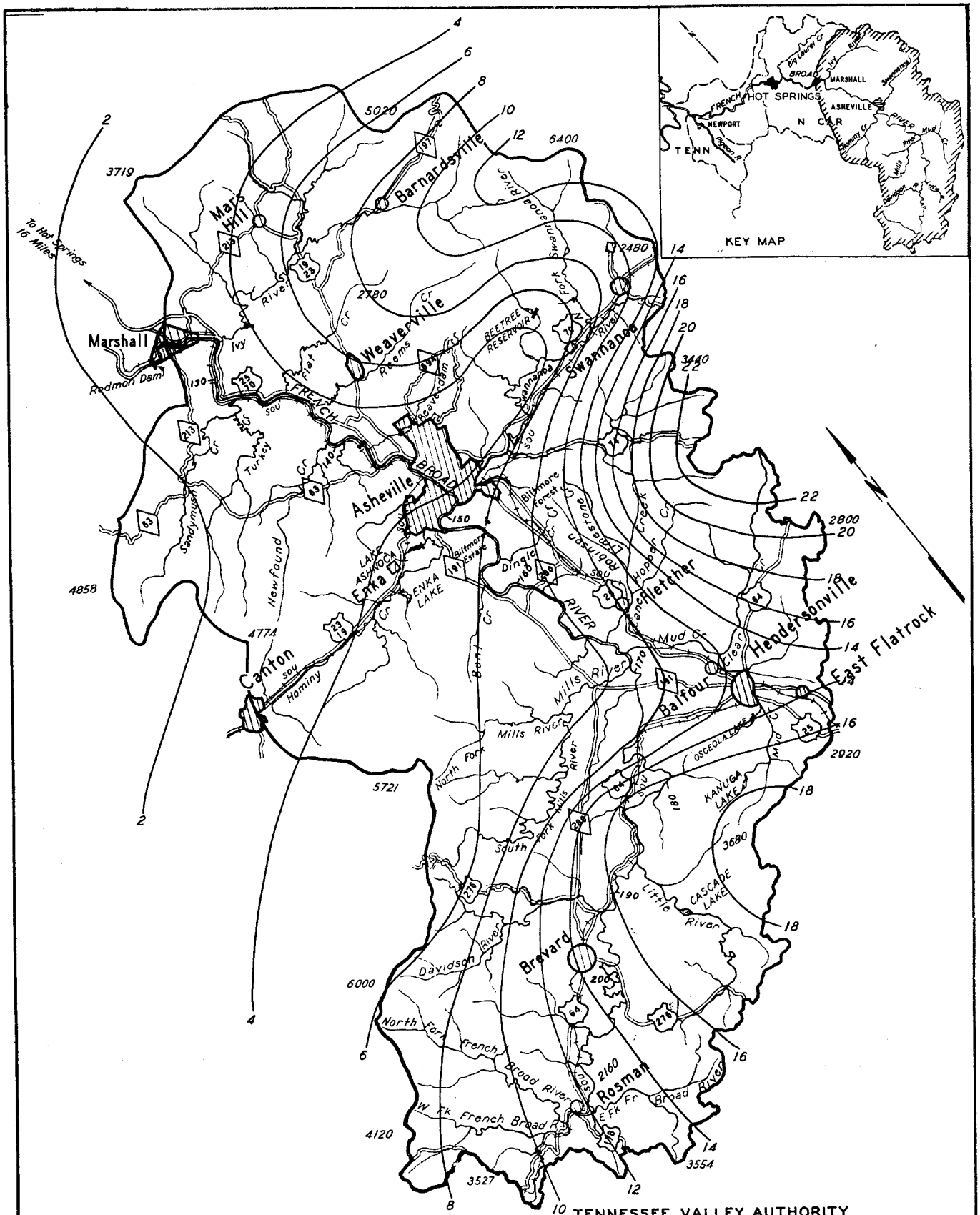
The French Broad River at Asheville reached a stage in this flood which was equal to that of May 1901. There was a heavy loss to crops which were nearing maturity. The "Sylvan Valley News" of September 2, 1910, contained the following account:

> Rainfall from 6 o'clock Monday until 6 o'clock Tuesday a.m. (was) 1.80 inches. From Tuesday to Wednesday morning there was a fall of 5.70 inches according to the rain gage at Major Breese's. Some rain that -- and watercourses made a strenuous effort to prove it.
>
> HIGH WATER
>
> The heavy rains have done much damage to growing crops and to property. The river is reported to be higher than for several years. Cornfields along the banks are inundated and the crop is seriously injured.
>
> The Southern Railway has been a heavy loser, trestles having been washed away, the track torn up, bridges injured, freight and passenger traffic suspended -- no trains for several days and no mail. . . .
>
> Many of the pupils of Brevard Institute could come no further than Hendersonville and thus were unable to be at the opening on Thursday.

July 16, 1916

This is the greatest flood of which there is definite record on the upper French Broad River and its tributaries. It resulted from a tropical hurricane storm that passed inland over Charleston, South Carolina, on July 14 and advanced northwestward across South Carolina. As it moved overland the storm lost much of its surface intensity but maintained its intensity and high moisture content in the upper levels. The presence of a high-pressure area over the northeastern states caused the storm to be directed against the highest portion of the Blue Ridge, which it was unable to cross because of insufficient energy.

The heaviest rainfall during the storm occurred along the Blue Ridge, particularly along the eastern boundary of the French Broad River basin upstream from Asheville. Plate 4 shows the estimated rainfall distribution over the watershed above Marshall, North Carolina. Altapass, North Carolina, located on the crest of the Blue Ridge 60 miles northeast of Brevard, recorded 23.7 inches of rainfall for the storm, 22.2 inches of this falling in 24 hours. As the map shows, rainfall exceeded 14 inches at Brevard and was in excess of 18 inches in the headwaters of Little River. Rainfall amounts decreased rapidly to the north and west



~10~ INCHES RAINFALL

Scale 0 5 10 Miles

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

UPPER FRENCH BROAD AREA SHOWING JULY 1916 ESTIMATED STORM RAINFALL

DECEMBER 1960

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of the Blue Ridge, and Asheville received only 2.85 inches for the storm. Three persons lost their lives in one of the many landslides that resulted from the intense rain in Transylvania County.

General rains had fallen over the upper French Broad watershed a week earlier, putting the river and most of its tributaries out of banks. The streams had been receding only a few days when the great storm of July 15-16 hit. Streams rose rapidly and by early Sunday, July 16, overflow was widespread with severe damage to roads, railroads, crops, and other property.

The flood on the French Broad River near Brevard exceeded the flood of June 1876 by 4 or 5 feet. At Blantyre high water marks indicated the crest to have been at a stage equal to 27.1 feet at the stream gaging station.

Graphic accounts of the flood are contained in the files of newspapers at Brevard and Asheville. The rise that took place a week prior to the main flood overflowed wide areas and caused major damage, as evidenced from the following excerpts from the "Sylvan Valley News" of July 14, 1916:

TRANSYLVANIA GRIPPED BY WORST STORM SINCE JUNE FRESHET OF '76

> THOUSANDS OF ACRES OF RIVER FARMS TRANSFORMED INTO VAST LAKES AND HUNDREDS OF BUSHELS OF RYE WASHED DOWNSTREAM WHILE CROPS STAND SEVERAL FEET UNDER WATER.
>
> RAILROAD TRANSPORTATION SUSPENDED FOR THREE DAYS WITHOUT RAIL AND PASSENGER SERVICE. POWER PLANT OUT OF COMMISSION AND TOWN IN DARKNESS
>
> Transylvania County is emerging from the most destructive overflow it has suffered since the noted June Freshet of 1876.
>
> Rain began Friday and throughout Saturday, Sunday, and Monday there was almost a continual downpour, as a result of which the streams in this county overflowed and took in their sweep thousands of acres of land. . .
>
> The plant which furnishes electric power for Brevard and community was put out of commission Saturday night. . . The operation of trains between Brevard and Hendersonville was suspended by reason of high waters on the French Broad River that covered the tracks to depths of about 5 feet. . .
>
> In addition to the French Broad River bottom lands those on Davidson and Little Rivers, as well as those on the smaller streams, suffered from overflows. . .

The storm brought clearly to mind the frequently mentioned "June Freshet" of 1876 when the waters were said to have been higher and more destructive than they were during the present storm . . .

In the issue of July 21, 1916, the paper describes the even greater flood that occurred on July 16:

FLOOD DESTRUCTION IN FIVE STATES

LANDSLIDES AND HIGH WATERS DESTROY LIVES AND PROPERTY

TORRENTIAL RAINFALL OF SATURDAY NIGHT FOLLOWED ON SUNDAY MORNING BY LANDSLIDES AND UNPRECEDENTED HEIGHT IN RIVERS WHICH TOOK HEAVY ROLL IN LIVES, CROPS, AND OTHER PROPERTY, LEAVING DESTRUCTION IN THE DEATH-DEALING TRAIL OF THE FLOODS

JOHNNY HEATH, MRS. CALDWELL SENTELLE AND DAUGHTER KILLED IN LANDSLIDES

IT BEAT JUNE FRESHET OF '76

P. C. Surrette and E. B. Clayton of the Penrose section say they have high water marks made by the noted June Freshet of 1876 and that the water Sunday was 5 feet higher than at the destructive flood 40 years ago. They say the water was 7 feet higher than it was last week.

NEARLY 15 INCHES OF RAINFALL IN 48 HOURS

The Weather Bureau station on the Institute grounds registered a fall of 14.7 inches from . . . Friday to the same hour Sunday afternoon, just a little over one foot.

Mrs. Caldwell Sentelle and seven-year-old daughter lost their lives on Davidson River Sunday morning when their home was hit by a landslide.

PISGAH FOREST HARD HIT BY FLOODS EARLY SUNDAY

As Davidson River and French Broad began to rise rapidly about 4 o'clock Sunday morning, Pisgah Forest residents near the rivers moved from their homes and, despite rumors of drowning, no lives were lost.

Water was several feet deep over the most of Pisgah Forest. It covered the first floors of some of the stores and residences and is said to have done considerable damage to furniture, lumber, and the plants of the Carr Lumber Company and the Brevard Tanning Company. The bridge at that point over the French Broad was destroyed.

JOHNNY HEATH RECEIVED FATAL INJURIES IN SUNDAY LANDSLIDE

> Johnny Heath of the Dunn's Rock section received fatal injuries in a landslide Sunday morning and his mother is in critical condition with both of her lower limbs broken.
>
> B. Whit Henderson . . . reported 25 slides in that section.

An outstanding feature of the storm was the many landslides that resulted from the very intense rainfall. The same issue of the "News" gives this description of the phenomena:

DESCRIPTION OF LANDSLIDES, THEIR APPEARANCE AND DAMAGE

> From Brevard, scars may be seen in many directions on the mountainsides. These slides were very destructive. In some places they covered acres of ground and ploughed their way to a depth of 20 feet, thus making a deep gorge down the mountainsides.
>
> The formations of some of these slides were intact, coming down in huge bodies of earth with the trees and other vegetation standing erect. In other instances there was a general mixture of water, earth, mud, rock and trees which lumbered down the mountains with a terrific crash. . . .

QUESTION AS TO WHAT CAUSED THE NUMEROUS LANDSLIDES

> There has been considerable discussion as to the direct cause of the numerous landslides that have wrought such destruction to property. . . Some say that the earth became saturated with water and could not hold itself in place. Others say that water spouted from the earth after accumulations through veins and others say spouts from the clouds did the work and others claim cloudbursts set things to moving. O. W. Clayton . . . was in the Penrose section Sunday morning and there were about 14 slides in that vicinity.

Another section of the story tells of damage on King Creek and to the roads and bridges of the county:

CHURCH WASHES AWAY AND KINGS MILL DAMAGED

> C. M. Kilpatrick made a trip up King's Creek beyond the bridge and Mr. Orr's place Monday and found 17 slides.
>
> The church which stood on the bank of the creek was totally destroyed and the church organ was found about half a mile from the site of the building.
>
> Mr. Kilpatrick says that Mr. King's mill on the creek is seriously damaged.

The new flume of Robert Orr, the lumber man, is almost a total loss.

ROADS AND BRIDGES DAMAGED SEVERAL HUNDRED THOUSAND DOLLARS

> In many places tons of earth and rock mixed with forests rest where once there were good roads. In other places the roads have been washed away.
>
> The majority of small bridges in the county were destroyed and many of the major bridges across the rivers have been wrecked.
>
> Island Ford Bridge is standing and the others between Rosman and Wilson Bridge went downstream. . . . Elm Bend bridge is standing. The bridge across the French Broad at Pisgah Forest was destroyed. Patton's bridge is said to have been washed from its foundation. Others along the river suffered greatly from being washed away.

Figure 4 shows a scene of the 1916 flood at Pisgah Forest, and a view of the same locality in May 1964.

October 1918

Not a particularly severe flood on French Broad River, this flood on the upper reaches of Davidson River was about as high as the flood of July 1916.

August 16, 1928

This was a large flood on the upper French Broad River and its tributaries. On the main stream the flood was far under the great flood of July 1916, 4.3 feet lower at the Blantyre stream gaging station; but on Davidson River the flood was slightly higher than the 1916 flood except near the mouth, where backwater from French Broad River affected the flood height. On Little River the flood was about equal to the 1916 flood above the limit of backwater from French Broad River.

The "Brevard News" of August 23, 1928, includes the following account of the flood:

COUNTY RECOVERS FROM FLOOD EFFECT
INDUSTRIES, ROADS, FARMS SUFFER FROM EFFECT OF SWOLLEN STREAMS

COMMUNICATION CUT OFF FOR TWO DAYS
ROSMAN AND PISGAH FOREST GET BRUNT OF RAGING WATERS - BUSINESS GOING ON

> Transylvania County is rapidly recovering from the effects of the flood of last week, when streams in the county left their banks, flooded the highways, covered acres of bottom land, washed bridges and trestles on logging roads away, and had the county isolated for two days. Wednesday of last week was

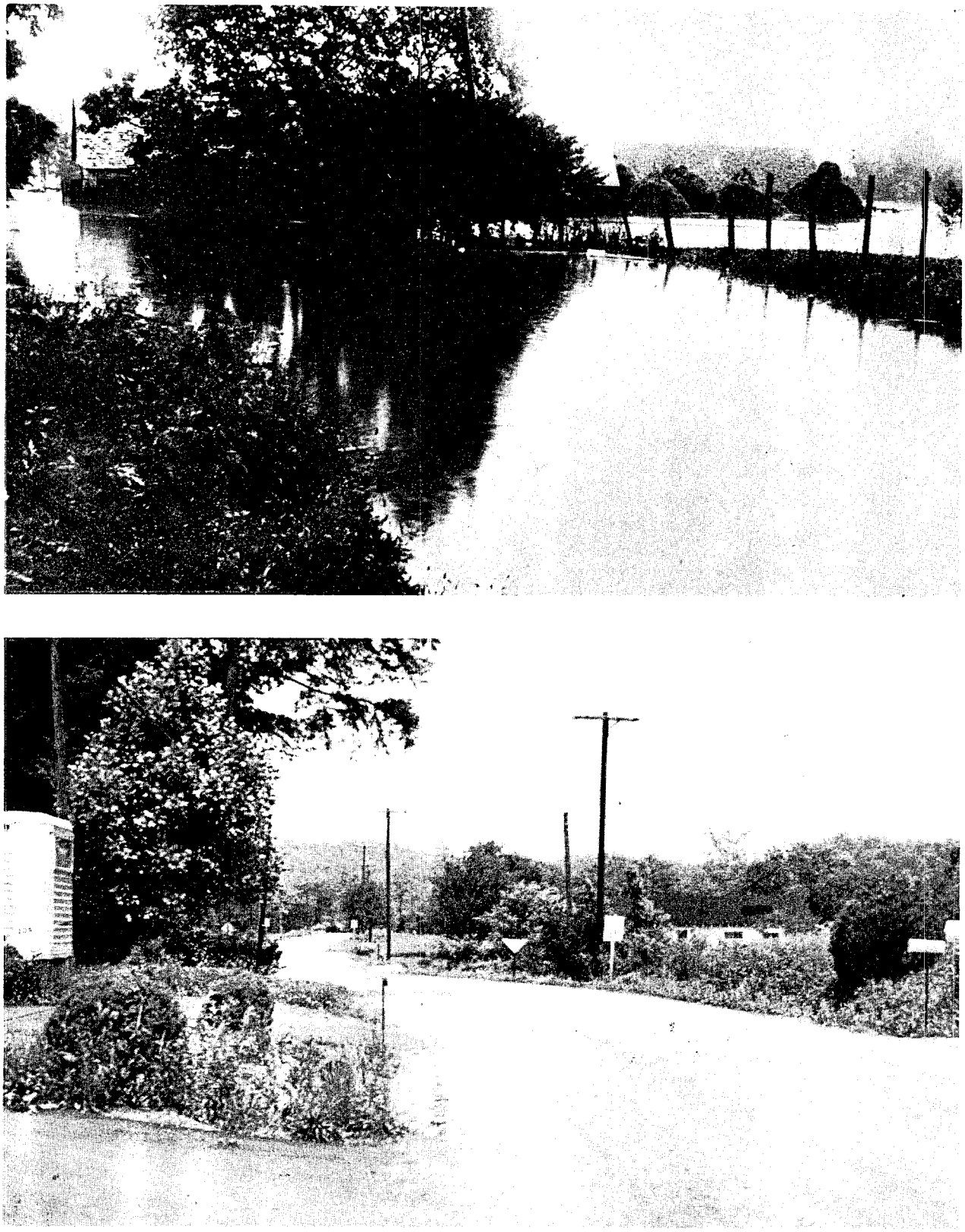


Figure 4.--FLOOD OF JULY 1916 NEAR PISGAH FOREST

Upper view is east along the main road, from a point about 500 feet west of the Davidson River, taken during the flood of July 16-17, 1916. Lower view shows the same stretch of road in 1964. The road is now known as old U. S. Highway 64.

the beginning of the flood conditions when the French Broad River flooded the streets of Rosman and by Thursday morning the high waters had reached a point but little under that which prevailed in the 1916 flood.

Much damage was done to the crops in the county along the French Broad valley. . . County commissioners Wednesday set aside $10,000 for the purpose of replacing bridges that were washed away during the floods last week and to repair roads. . .

POWER PLANT HARD HIT BY THE FLOOD

EXPECT TO HAVE PLANT IN OPERATION BY THE END OF THE WEEK

Last week's flood and storm did considerable damage to the Cascade Power Company's plant on Little River. About 100 feet of the flume was washed away last Wednesday evening. . .

The French Broad was out of banks, the water reaching to the railroad in front of Lyday's store at Davidson River.

CARR LUMBER COMPANY MAKING REPAIRS

Many trestles on the railroad line of the Carr Lumber Company were washed away during the flood last week, causing great loss to the company. . . Comparatively little damage was caused the lumber plant at Pisgah Forest, it is stated.

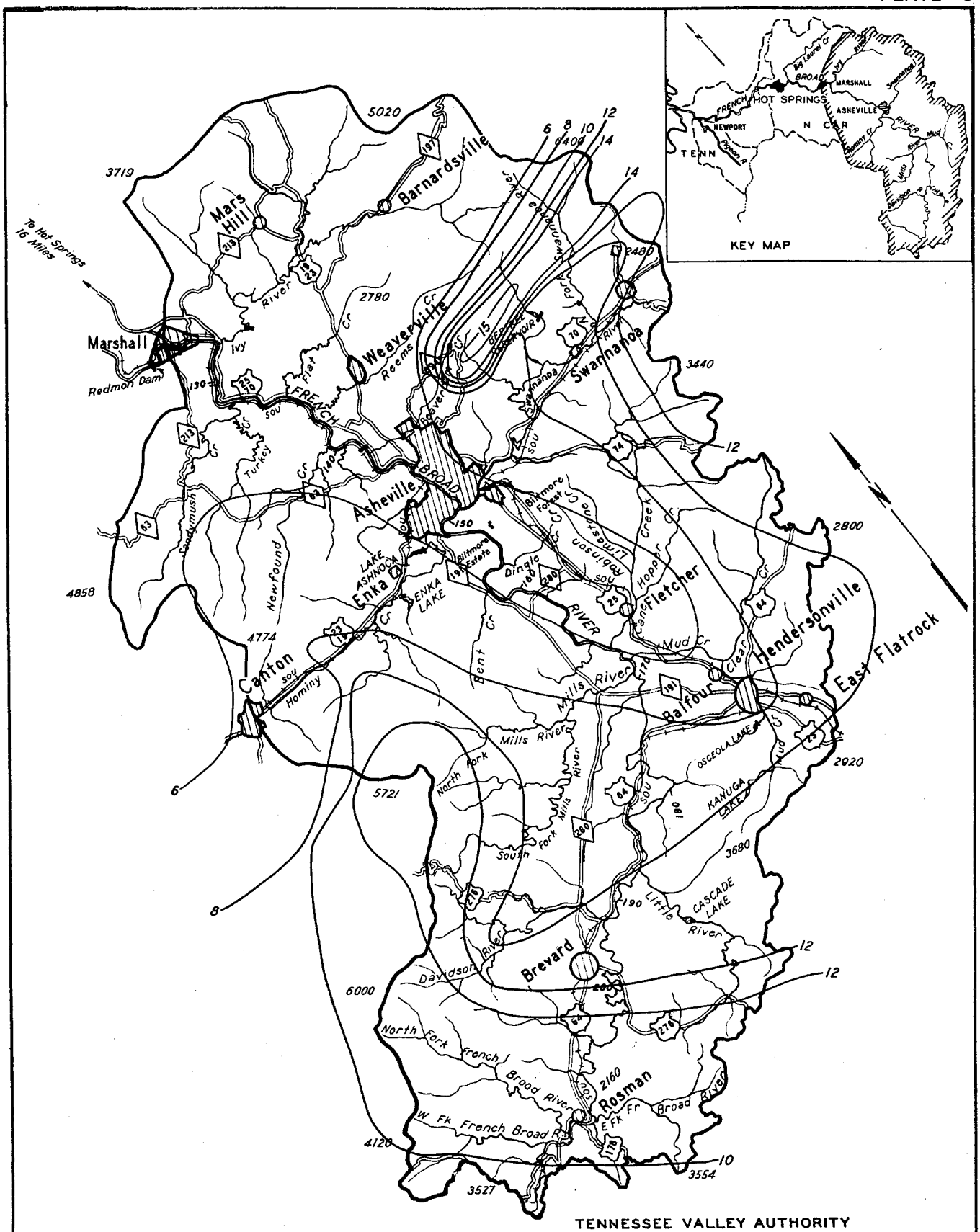
FARMERS SUFFER GREAT LOSSES FROM FLOOD

Farmers of Transylvania County have suffered great losses as a result of the high waters last week. Many farmers report total loss of their crops while others were more fortunate in having much of their crops growing on the uplands.

August 13-14 and August 30, 1940

Two large floods occurred in the upper French Broad River basin in August 1940. Coming at the height of the crop growing season, they caused heavy losses to farmers in the valley. The first flood was the higher of the two on the main stream and on most tributaries, and generally the highest flood since August 1928.

The August 13-14 flood resulted from a tropical storm whose center moved inland at Savannah, Georgia, on August 11, then described a great circle to the west and north of the area, bringing heavy rains to much of the southeast. Plate 5 shows the distribution of rainfall over the upper French Broad River basin. In the vicinity of Brevard and along the basin rim at the head of Davidson River



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UPPER FRENCH BROAD AREA SHOWING MID-AUGUST 1940 STORM RAINFALL

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and North Fork French Broad River, storm totals ranged from 12 to 14 inches. At Beech Gap, at the head of North Fork, an unofficial rainfall catch was found which totaled 16.8 inches for the storm. At Mt. Pisgah, five miles north of the Davidson River divide, the storm rainfall exceeded the 14-inch capacity of the recording rain gage. The French Broad River in the vicinity of Brevard overtopped its banks about midnight Monday, August 12. The water continued to rise at a uniform rate of about 0.5 foot per hour through Tuesday, until some bottom lands had as much as 12 feet of water over them. At the Blantyre stream gage the river crested at 9:00 a.m. on Wednesday, August 14, at 21.89 feet, about one foot lower than the flood of August 1928 and 5.2 feet under the great flood of July 1916. At the Calvert and Rosman stream gages the crest stage was also about one foot lower than the 1928 flood. At the Davidson River gage the crest was 9.2 feet, 2.6 feet lower than the 1928 flood.

French Broad River was not back within banks until early on August 16, so that water was over many fields the greater part of three days, with a resultant heavy loss to crops. Some 4800 acres of corn, hay, and truck crops were flooded in Transylvania County. At The Ecusta Paper Corporation plant, now a part of the Olin Mathieson Chemical Corporation, water from Davidson River carried away coal and building sand in storage.

The Brevard weekly newspaper "The Transylvania Times" reported in its issue dated August 15, 1940, as follows:

PISGAH FOREST WATER HIGH

> In the village of Pisgah Forest, several families in the Mackey Bottoms section were forced to evacuate their homes for several hours, as the water from Davidson River crept steadily up into the first floors.
>
> The broad flood in the Thrash Fields spread to the highway crossing, near the Davidson River Bridge, and at the Patton home cars were barely able to pass through the stream which covered the low places in the highway. Slow traffic was maintained through the long flat in front of the East View Dairy, and two to four inches of water was across the highway near the Jim Mills home, and near Kings Creek inside the town limits of Brevard until noon Tuesday.

The rise on the French Broad River and its tributaries on August 30 followed rainfall originating in a purely local meteorological disturbance which was confined to the North Carolina mountains. Rainfall amounts for the storm over the watershed affecting streams in the Brevard vicinity were quite uniform and generally between 6 and 8 inches.

The French Broad River at Rosman was 0.1 foot higher than in the flood which occurred two weeks earlier, but through the reach covered by this investigation the river was not so high as in the mid-August flood. At the Blantyre stream gage the river crested at 19.32 feet, 2.6 feet lower than on August 14. At the Davidson River gage the crest stage was 7.68 feet, 1.5 feet under the mid-August flood. Some additional damage was done to crops by the second overflow. Bridges, bridge approaches, and roads, repaired after the first flood, were again damaged.

June, July, and August 1949

In the summer of 1949 floods occurred in June, July, and August which resulted in large losses throughout the upper French Broad River basin. The first flood occurred on June 16-17. Two separate floods occurred in July, on July 12-13 and 18-20. A fourth flood took place August 28-29. None of the floods was so high as the mid-August 1940 flood, but damage was much more severe, because of the large increase in the acreage which had been planted to truck crops. Damage to these truck crops alone for the four floods amounted to $373,000 in Transylvania County, and $942,000 for the watershed above Asheville. Investigations which were made by TVA engineers after the floods showed that the total of all damages resulting from the floods amounted to $486,000 for Transylvania County and $1,351,000 for the watershed above Asheville. Of the flood damages which occurred in Transylvania County, the losses along the reach of French Broad River covered by this investigation amounted to some $250,000 in truck crops and some $35,000 for other crops.

The first twelve days of June 1949 were relatively dry, but from June 13 through the end of August the upper French Broad River basin was plagued with almost daily showers. A rain gage at the Davidson River Fish Rearing Station registered 46.2 inches, and a gage at Sassafras Mountain, on the Blue Ridge divide southeast of Rosman, reported 46.0 inches for the three-month period of June, July, and August. A number of other precipitation stations reported more than 30 inches for this period.

Heavy showers, which began about midnight June 13, were almost continuous until late on June 16. Very heavy rain fell during the final 24 hours of the storm period. French Broad River reached overbank stages during the morning of June 16 upstream from Brevard and about 1 p.m. at Blantyre. The

crest stage at the Blantyre stream gage was 17.94 feet, four feet above bankfull stage, but 4.0 feet lower than the crest on August 14, 1940. Above Brevard the river was back in its banks late on June 16, but near Blantyre overflow lasted until 8 p.m. June 18. Although overflow was shallow in many places, there was heavy damage to the truck crops that were flooded.

At the Davidson River stream gage the crest stage was 8.68 feet, 0.5 foot lower than on August 13, 1940. There was only moderate overflow along that stream.

Where it was feasible to work fields after the June flood, farmers planted them to bush beans in an effort to recoup their losses. Many such fields had been replanted by early July, only to be hit by the second flood.

The period July 11-19 was one of daily rainstorms, particularly hard showers falling on July 11, 12, and 18. The ground was thoroughly wet when an intense rain started about 8 p.m. July 11 and continued until midmorning of July 12. At Cedar Mountain, in the headwaters of Little River, 7.06 inches of rain fell in the 12 hours ending at 7 a.m. July 12. Light to moderate showers continued through July 13, 14, and 15. A series of heavier showers began July 16. The most intense of these was a general rain of 7 to 10 hours' duration and ending about noon on July 18, in which 1 to 3 inches of rain fell over the area. Another shower on July 19 terminated the storm period. Two distinct rises occurred on the river and its tributaries, one on July 12-13 and one on July 18-19. Along the French Broad both floods overflowed the banks, but the first was the higher of the two, exceeding the June flood by 0.6 foot at Blantyre. The rise or the overflow was not significant along Davidson River in either of the July floods, but along French Broad River some low fields were under water as much as 11 days.

Truck crop growers, after being hit by two serious floods, made a last effort to recover at least a part of their losses. Bush beans went into the ground as fast as the land could be prepared, and only a shortage of seed kept the replanting from being twice as great as it was.

The storm of August 27-28, 1949, accompanied the passage of a decadent tropical hurricane just east of the Tennessee Valley boundary. The storm center was approaching the Georgia-Florida state line on the late afternoon of August 27 when rain began falling in the upper French Broad River basin. By noon August 28 the center was in northeastern South Carolina, and by 6 p.m.

it had moved across North Carolina into Virginia. Heavy rainfall that had preceded the main storm was important in setting up the conditions which caused the flood. There were scattered showers almost each day during the first half of August. Heavy rains in the period August 16-23 resulted in two rises which were to top of banks on most streams in the watershed. This antecedent rainfall averaged 5 to 6 inches over the watershed and amounted to 9.8 inches at Cedar Mountain. Rainfall as a result of the tropical hurricane began about 4 p.m. August 27 and became heavy about midnight. The steady downpour which followed lasted until early afternoon on August 28. Rainfall for the period ranged from just under 3 inches at Pisgah Forest to 4 and 5 inches around the basin rim. The rise on the French Broad was less than in June and July, but still sufficient to flood most of the fields which had been replanted to beans; and too little time remained in the growing season for another attempt at raising a crop, even if seed had been available for still another try.

August 26, 1961

After their heavy losses in 1949, many truck crop planters said they were going to cut back their operations because of the high flood risks involved in the upper French Broad River basin. Overbank floods continued to occur on an average of about once per year, with stages equal to or exceeding those in 1949, but none of these took place during the growing season. This favorable flood-loss experience, plus continuing good market conditions, served to erase the memory of the early flood losses, and the planters began putting larger and larger acreages into truck crops and into gladioli for the commercial flower market. In the summer of 1961 the acreage which was planted in truck crops was nearly double the acreage which was in the flood plain when the first of the 1949 floods occurred. The acreage of river-bottom land planted in gladioli was several times greater in 1961 than in 1949. The land in use for the usual farm crops of corn, hay, pasture, and small grains was also increased over 1949. Thus the stage was set for high losses when flood conditions developed late in August 1961.

Rainfall over the upper French Broad River basin was in excess of normal in three of the five months preceding August 1961. The cumulative excess amounted to just about one inch, but more important from the viewpoint of the farmers and planters was the fact that there was seldom a period longer than two or three days without rain. This caused planting to be late in many cases. Crops had made excellent progress, but wet grounds had interfered with cultivation and crop treatment.

August was particularly wet. Total rainfall for the month in the watershed above Blantyre ranged from 12.83 inches at Sassafras Mountain, at the southernmost tip of the drainage, to 28.86 inches at Rosman. Rainfall for the month at Pisgah Forest was 18.76 inches and at Brevard 20.85 inches. Showers fell daily from August 1 through 13, with hard showers at many stations on August 4, 5, 8, and 10. Rain fell generally on the 18th and there were showers on August 19, 20, 21, and 22. Heavy rains began to fall at all stations around 9 to 10 p.m. August 23. In the period of some 34 hours up to observation time on the morning of August 25, the rainfall averaged 7.5 inches for ten stations in the French Broad River basin above Blantyre. Pisgah Forest reported 5.67 inches, Brevard 6.14 inches, and Rosman 9.70 inches for the period. The heaviest amounts fell along the Blue Ridge divide at the south edge of the basin, with 9.98 inches at Cedar Mountain and 10.45 inches at Caesars Head, just outside the watershed near Cedar Mountain. Light to heavy showers fell late on August 25 and again on August 26 and 27, serving to keep the streams full and to do further damage to crops in the field.

The French Broad River was above normal in the vicinity of Brevard as a result of the showers in the period August 18-23. The river began to rise rapidly, the general intense rains beginning at 9 or 10 p.m. August 23. This shower ended about 6 a.m. August 24. A second intense rain began about noon and lasted until about 6 p.m. This distribution of rainfall caused the upper river to rise to two separate peaks, but near Brevard and farther downstream at Blantyre the recession between peaks was hardly noticeable. At Blantyre the river was out of banks for about five days, from late morning of August 24 to noon on August 29. The peak stage, 20.01 feet, was the highest since 1940 and 1.5 feet above the July 13, 1949, flood, the highest of the 1949 floods. The discharge at the Blantyre stream gage was slightly less than in July 1949, however, evidently as a result of some change in conditions at the site.

The flood caused damages amounting to $1,380,000 for the upper French Broad River basin, slightly more than that which resulted from the four floods which occurred in the summer of 1949. In Transylvania County the damage to crops of all kinds totaled $532,000. The loss to regular farm crops was $35,000, to gladioli $32,000, and to truck crops $465,000, nearly double the total truck crop loss in 1949.

2. DAVIDSON RIVER VALLEY

The Stream and Its Valley

Davidson River has a watershed of 47.3 square miles, lying wholly within Transylvania County. The watershed, shown on Plate 1, is fan-shaped, 10 miles long by 7 miles at the widest point. The area is for the most part covered with a heavy stand of second-growth timber, and more than 90 percent of the watershed lies within the boundaries of Pisgah National Forest.

The watershed is bounded on the south and southwest by Chestnut Knob, Cedar Rock Mountain, and Chestnut Bald; on the northwest by the Pisgah Ridge; and on the northeast by Rich Mountain, Black Mountain, and Sitton Mountain. Elevations are 4000 feet or more around most of the upper basin rim, near 5000 feet along a large part of Pisgah Ridge, and 6000 feet at the highest point, Chestnut Bald, at the western tip of the watershed. In the lower part of the basin the divide ranges from 4000-foot elevation down to 2200 feet.

The headwater drainage system is made up of three principal streams, Davidson River, Looking Glass Creek, and Avery Creek. Davidson River has its origin in a number of streams which rise at the northwest corner of the watershed and flows eastward to its confluence with the other two streams. Looking Glass Creek rises at Green Knob, on Pisgah Ridge at the north corner of the watershed, and flows southward to join Davidson River near the center of the basin. The Avery Creek drainage adjoins that of Looking Glass Creek on the east. The stream rises on Rich Mountain and flows south-southeastward to enter Davidson River two miles downstream from Looking Glass Creek.

Between the confluence with Avery Creek and the mouth, the reach which is covered by this investigation, Davidson River follows a southeastward course. In this reach the stream channel falls from elevation 2164 to elevation 2085, a fall of 79 feet in 4.47 miles for an average slope of about 18 feet per mile.

Turkey Creek is the largest tributary joining Davidson River in the study reach. The stream rises east of the Avery Creek drainage, between Black Mountain and Sitton Mountain, flows southeastward parallel to Davidson River, then turns southwestward for the last mile of its course to join the main stream just below the U. S. Highway 64 & 276 bridge. Two streams join Davidson River upstream from Turkey Creek; Thrift Cove Branch is on the left and Joel Branch

is on the right. These are small and have little effect upon the flood situation. There are no tributaries of consequence downstream from Turkey Creek.

Pertinent drainage areas of Davidson River are given in Table 7.

The flood-plain width varies from about 300 feet to almost one mile in the study reach. It is widest about one-half mile above the mouth where it joins the flood plain of the French Broad River. From that point upstream, the flood plain gradually narrows to about 1500 feet at the U. S. Highway 64 & 276 bridge. The narrowest section occurs about 0.2 mile upstream from the bridge where steep hills close in on the flood plain at the Pisgah National Forest boundary. Upstream, within the National Forest, the flood plain opens up into a bottom which is 1500 to 2000 feet wide to the upper end of the reach at the mouth of Avery Creek.

Backwater from large floods such as those of 1916, 1928, and 1940 on the French Broad River would have extended about one mile up the Davidson River if there had been no corresponding flood on the latter stream. Major floods on the French Broad River reach their maximum heights later and overflow is of longer duration than for Davidson River. In July 1916 backwater in Davidson River was higher than the headwater flood upstream to about Mile 0.4.

Developments on the Flood Plain

Plate 10 shows the flood plain of Davidson River for the reach covered by this investigation. A relatively small amount of the flood-plain land is used for agriculture, principally that found on the left bank downstream from Mile 1.3. The rest is occupied by business, industrial, and residential developments or is in the Pisgah Ranger District of Pisgah National Forest and reserved for uses under the jurisdiction of the U. S. Forest Service.

The Blue Ridge Parkway follows the Pisgah Ridge along the upper rim of the watershed. U. S. Highway 276, which intersects the parkway at Wagon Road Gap, just outside the northernmost tip of the watershed, enters the basin at the head of Looking Glass Creek and follows that stream to Davidson River. The highway follows the left bank of Davidson River through the upper end of the study reach and downstream to Mile 2.14, where it intersects U. S. Highway 64 and with that route crosses the river toward Brevard. U. S. Highway 64 is on the left-bank flood plain from Mile 2.14 to Mile 1.65, where it leaves the basin en route to Penrose and Hendersonville. Through the study reach U. S. Highways 64

TABLE 7

DRAINAGE AREAS IN WATERSHED OF DAVIDSON RIVER

Stream	Location	Mile above Mouth	Drainage Area sq. mi.
Davidson River	Mouth	0	47.3
	Below Turkey Creek	1.94	46.3
	USGS stream gage	2.19	40.4
	Upper limit of study (Below Avery Creek)	4.47	37.4
Turkey Creek	Mouth	0	5.56
Avery Creek	Mouth	0	6.39
Looking Glass Creek	Mouth	0	8.79

and 276 are 6 or more feet higher than the flood of August 13, 1940. A Regional Flood, however, would cover the highway in some locations with depths up to 6 feet, and a Maximum Probable Flood would reach depths of up to 10 feet.

The Toxaway Line of the Southern Railway crosses the river at Mile 0.49. Old U. S. Highway 64 crosses the river and flood plain at Mile 0.40. This road is now part of the state secondary road system and carries primarily local traffic. Vanderbilt Road and Deaver Road connect old U. S. Highway 64 with the new route farther upstream. Vanderbilt Road is on the right-bank flood plain, and about one mile of Deaver Road on the left bank is in the flood plain. Deaver Road was impassable during the August 13, 1940, flood, and Vanderbilt Road would be impassable during a Regional Flood.

A public picnic area maintained by the U. S. Forest Service is on the right-bank flood plain at the upper end of the Davidson River study reach. English Chapel Church, just below the picnic grounds at Mile 4.14, has its floor at elevation 2169.8. Any flood which breaks overbank would flood the church grounds. A Regional Flood would surround the church, but not quite reach the floor level; but a Maximum Probable Flood would put water to a depth of 4 feet in the building.

The headquarters building for the Pisgah Ranger District of Pisgah National Forest is at the edge of the left-bank flood plain at Mile 3.93. Shop and maintenance buildings are at Mile 3.60. The ranger station building floor is at elevation 2169.1, above the range of the highest floods, but one of the maintenance buildings, with the floor at elevation 2154.8, would be flooded to a depth of more than one foot by a Regional Flood and to a depth of 6 feet in a Maximum Probable Flood. Another maintenance building has a floor 3 feet higher.

The Forest Service is making plans for a recreational development to occupy the approximately 120 acres on the left-bank flood plain downstream from English Chapel Church. Their plans envision an access road from U. S. Highway 276 with a bridge over Davidson River and a system of loop roads giving access to some 250 camping sites in the area. Water and sanitary facilities would be provided convenient to the camp sites. At the center of the area would be located service buildings, a sewage treatment plant, and a 200-car parking area for an amphitheater which is proposed for a sloping site at the edge of the flood plain.

Developments on the left bank near the intersection of U. S. Highway 64 and U. S. Highway 276 include a motel, two service stations, and four residences. Located along U. S. Highway 64 and a road which adjoins it downstream from the intersection are an auto repair shop and six residences. Most of these would be flooded with depths ranging up to 6 feet during a Regional Flood and 10 feet during a Maximum Probable Flood.

The Olin Mathieson Chemical Corporation property includes both banks of the river from a point a short distance upstream from the U. S. Highway 64 & 276 bridge downstream to Mile 0.62. The left-bank property line lies close to the stream, but on the right bank the property extends generally to Vanderbilt Road, with two tracts across the highway. A diversion channel 2000 feet in length cuts across the loop of Davidson River that extends from Mile 1.39 to Mile 2.12. The main plant buildings are located between the river and Vanderbilt Road in the reach which extends from Mile 0.74 upstream to about 500 feet above the lower end of the diversion channel, a distance of about 3/4 mile.

The firm has constructed a levee to provide a measure of flood protection for the plant area. At the upstream end of the building area the levee extends from the bank of the diversion channel to the fill of a road which loops the plant site. The levee extends along the right bank of the diversion channel and the channel of

Davidson River to the plant waste outlet at Mile 0.74. A water pumping station, shown in Figure 5, which is in the levee line at Mile 1.38 is protected against flooding up to the top-of-levee elevation. Grading for a power service substation at Mile 1.28 has cut the levee to elevation 2117 at that point, about 3 feet below the top elevation adjacent to the site. The levee as constructed will protect the plant area against a recurrence of the flood of August 13, 1940. A Regional Flood would overtop the levee and flood most buildings in the plant area with depths up to 2.5 feet. In a Maximum Probable Flood the levee would be overtopped for its entire length and buildings would be flooded to depths ranging up to 6 feet.

The Carr Lumber Company sawmill, kiln, and lumber storage area at the height of their operations had occupied the right-bank flood plain from Mile 0.7 to the railroad bridge. Most of the original buildings have been torn down and part of the area is now included in the Olin plant property. A building and a kiln located just above the railroad bridge are now operated by Alexander Wood Products Company, producers of veneer lumber. The building floor is at elevation 2103.0, about 2 feet under the elevation reached by the 1916 flood. A Regional Flood would be 3 feet deep in the building and a Maximum Probable Flood would be more than 5 feet deep.

The business development of Pisgah Forest is located along Vanderbilt Road and along old U. S. Highway 64 near Vanderbilt Road. On Vanderbilt Road at the Southern Railway is the railway station and two building supply firms. Near the intersection of Vanderbilt Road and old U. S. Highway 64 are two service stations, a dairy bar, a grocery and feed store, and the post office. At old U. S. Highway 64 and Clough Road there are a furniture store, a grocery, a machine shop, and a garage. A few of these would be flooded with depths generally less than one foot during a Regional Flood, but most of them would be flooded by a Maximum Probable Flood with depths up to 4 feet. Two churches, a school, and some 60 residences are also on the right-bank flood plain in the Pisgah Forest vicinity. One church would be flooded to a depth of 4 feet during a Regional Flood and 7 feet during a Maximum Probable Flood, while the other has a floor above the Regional Flood level but 2 feet below the Maximum Probable Flood level. The school floor is almost 7 feet higher than the Maximum Probable Flood, but the basement is about one foot below the Regional Flood level. During a Regional Flood about 35 homes would be flooded with depths up to 6 feet, and during a Maximum Probable Flood an additional 20 homes would be flooded and depths of flooding would be as great as 9 feet.

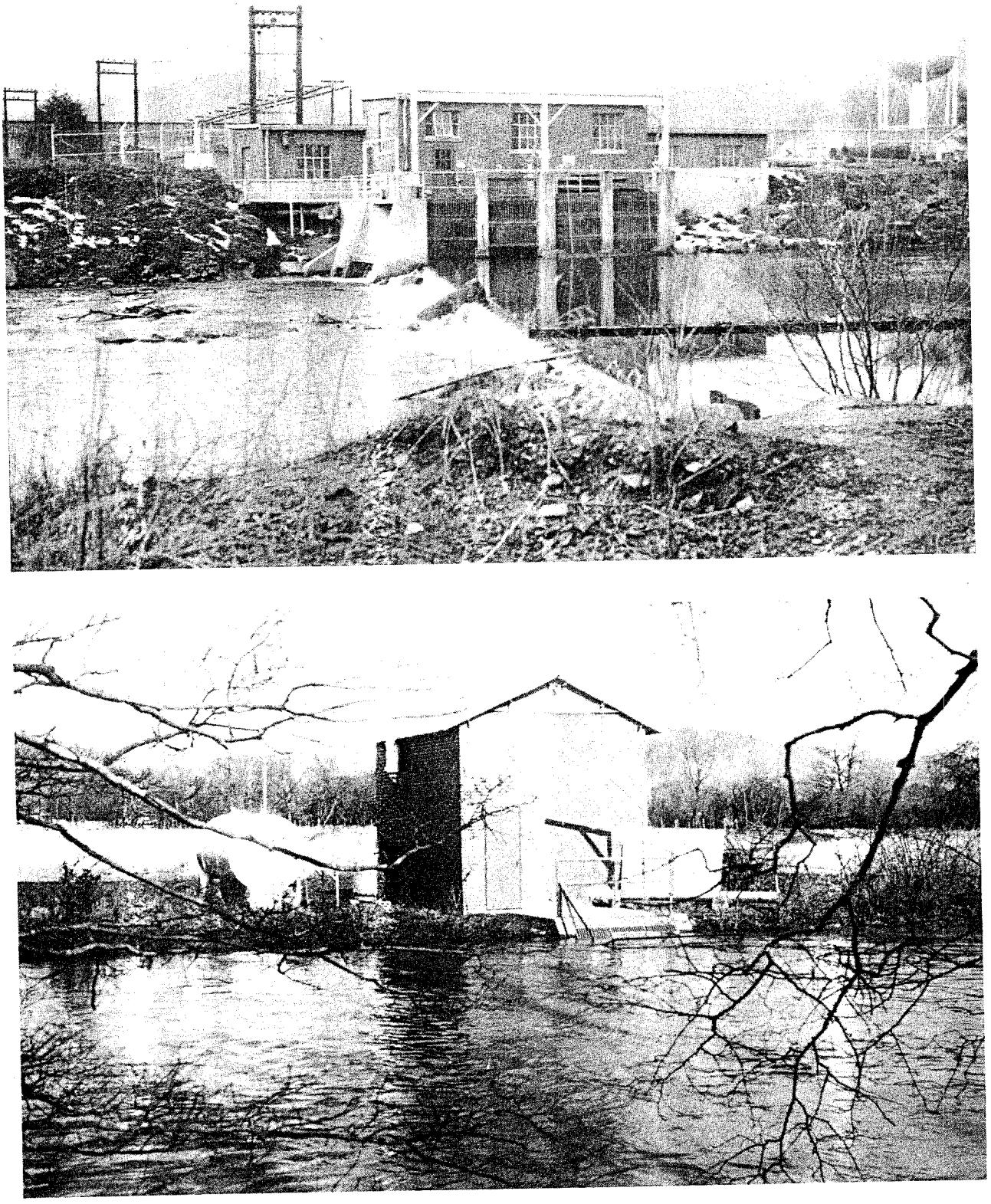


Figure 5.--WATER INTAKES FOR OLIN MATHIESON PLANT

Upper view shows low intake dam on Davidson River at Mile 1.38, as seen from left bank. The intake structure is built in the dike. Lower view is the auxiliary water intake on left bank of French Broad River just upstream from mouth of Davidson River.

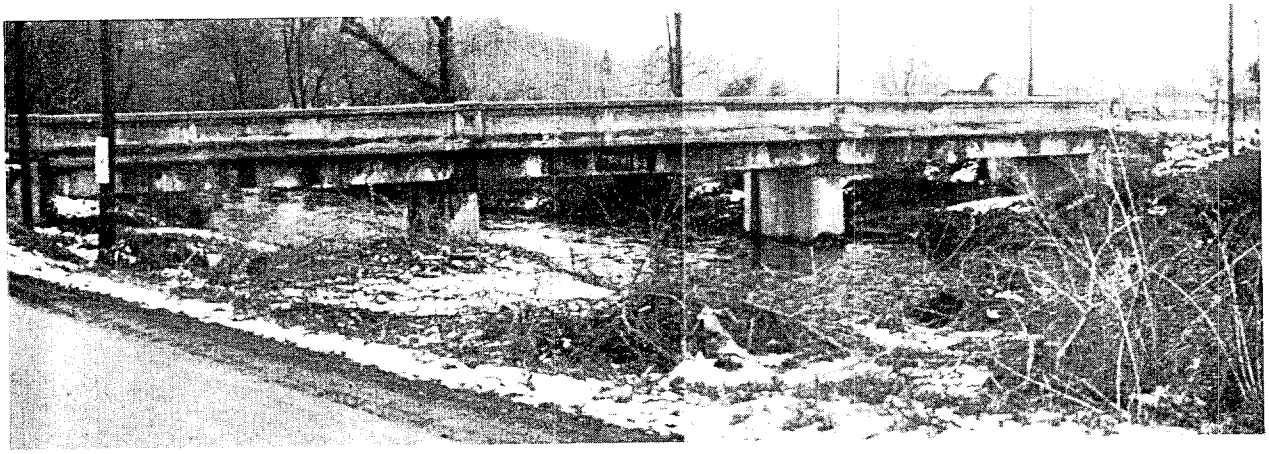
Along Deaver Road and the connecting roads on the left-bank flood plain there are two churches, a grocery store, and 34 residences. All of these would be flooded by a Regional Flood on Davidson River with depths of flooding ranging from less than one foot to nearly 11 feet. During a Maximum Probable Flood, depths of flooding would range from 4 to 14 feet.

Bridges across the Stream

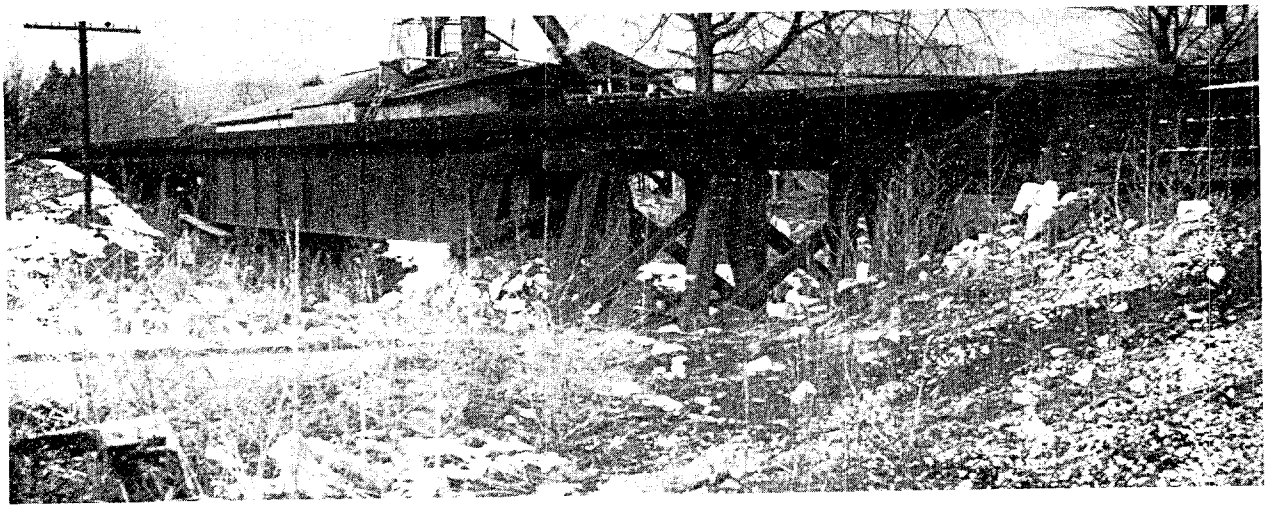
Three highway bridges and a railroad bridge cross Davidson River in the reach covered by this investigation. Table 8 lists pertinent elevations for the bridges and shows their relation to the crest of the flood of July 16, 1916, and the Regional Flood. Plate 25 shows the relation of the floor and underclearance at the bridges to the flood profiles for the reach. Figures 6 and 7 show photographs of the bridges.

Old U. S. Highway 64 bridge is a reinforced concrete structure with three spans and a solid guard rail. A fill extends the full 2100-foot width of the left-bank flood plain and varies from 2 to 6 feet in height. A fill on the right bank extends for about 500 feet from the bridge. Beyond that point the road is at flood-plain level. The bridge floor is at elevation 2103.0, but overflow begins on the right-bank approach at elevation 2098.6. Overflow of the road can begin near the edge of the left-bank flood plain, where overflow follows Thrash Branch, at elevation 2095.3.

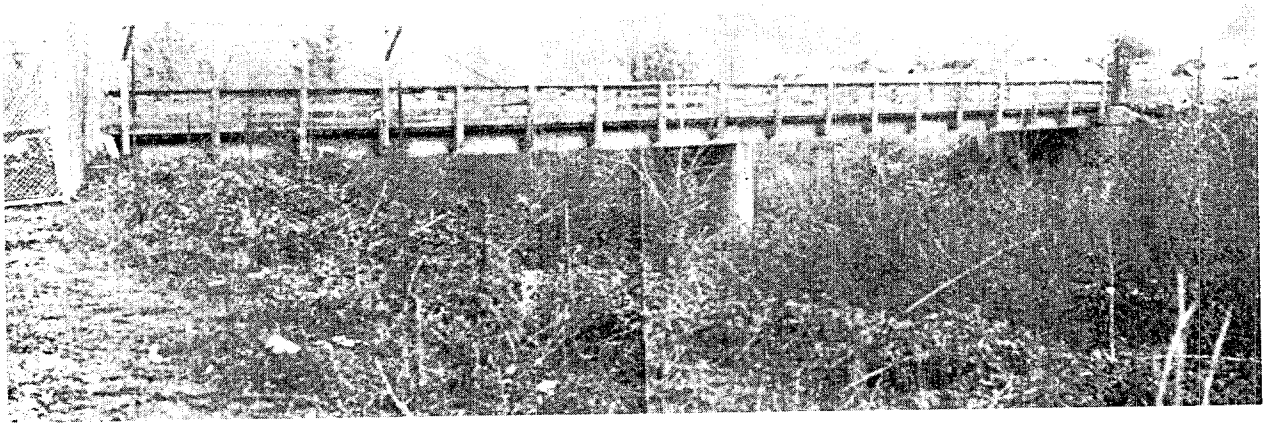
The Toxaway Line of the Southern Railway crosses the river on a steel girder bridge with trestle approach sections extending for 48 feet on the left bank and 68 feet on the right bank. Deaver Road passes under the bridge on the left bank. On the left bank the tracks are on a fill, mostly 6 to 8 feet in height, which extends for a 900-foot distance to an intersection with old U. S. Highway 64. The tracks cross the road at this point and are on the downstream side of the highway and near the highway grade elevation for the rest of the distance across the flood plain. On the right bank the railroad fill extends to Vanderbilt Road and ranges from 8 feet to 2 feet in height. Beyond Vanderbilt Road the railroad crosses the rest of the flood plain and Allison Creek on a fill which averages about 5 feet high. In spite of the fills, heading up is negligible during large floods on Davidson River. A Maximum Probable Flood on the French Broad River would overtop the tracks at the bridge by 2 feet.



Upstream side of old U. S. Highway 64 bridge at Mile 0.40.

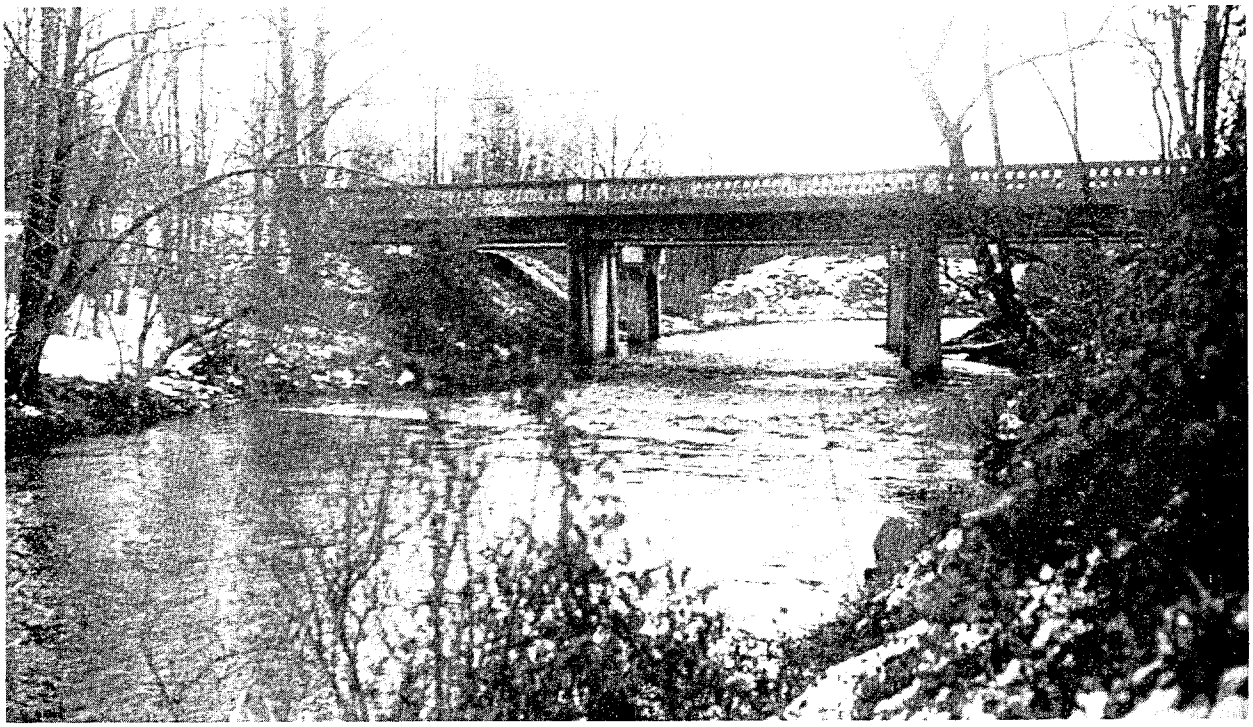


Southern Railway bridge at Mile 0.49, downstream side. The factory in background is the Alexander Wood Products Company.

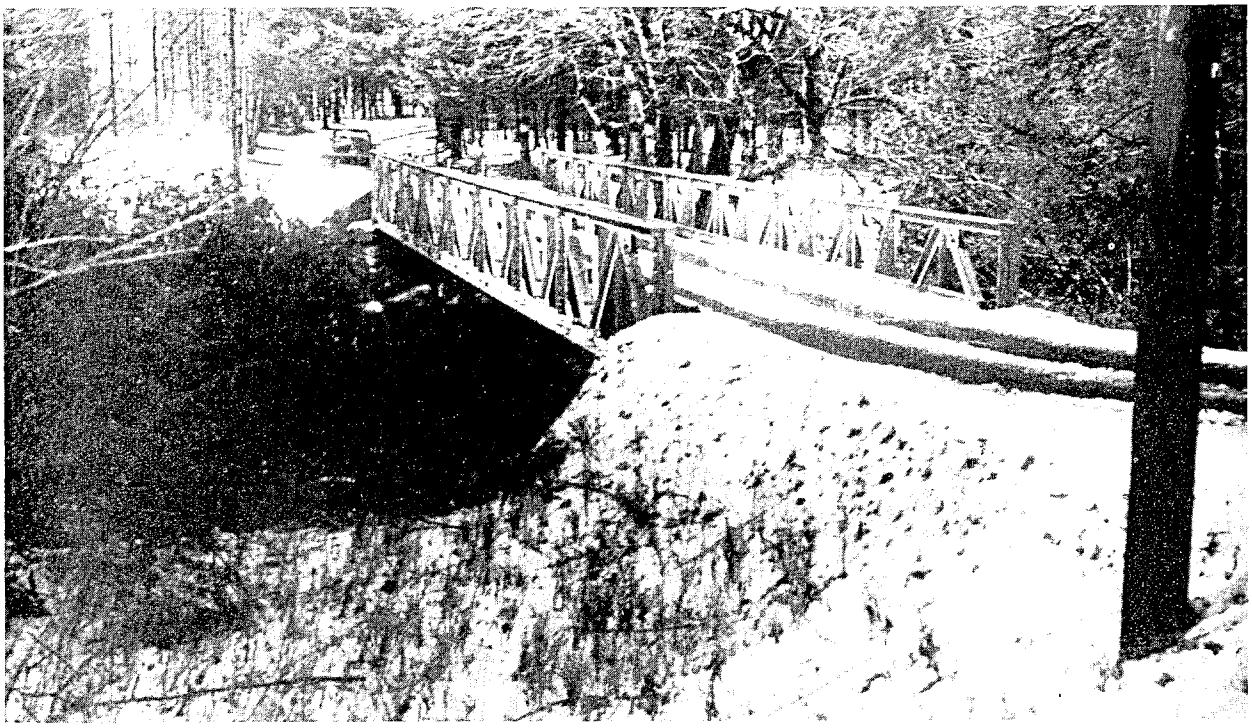


Downstream side of private bridge over diversion channel 380 feet upstream from intake dam on Davidson River, Mile 1.38. The view is upstream on the Olin Mathieson Chemical Corporation property and shows their private dump on the island between river and channel.

Figure 6.--DAVIDSON RIVER BRIDGES BELOW U. S. HIGHWAY 276



U. S. Highways 64 and 276 cross the river on two bridges at Miles 2.13 and 2.14. The view shows upstream side of the southbound bridge, which was built in 1934. The other bridge was built in 1956 and carries a gas pipeline laid in 1963.



English Chapel Bridge at Mile 4.18 as seen from U. S. Highway 276 on left bank, downstream side. The bridge provides access to a church and to a Forest Service recreation area just across bridge at right.

Figure 7.--DAVIDSON RIVER BRIDGES UPSTREAM FROM OLIN MATHIESON PLANT

TABLE 8

BRIDGES ACROSS DAVIDSON RIVER

Mile above Mouth	Identification	Low Water Elev. feet	Floor Elev. feet	Regional Flood Crest Elev. feet	July 16 1916 Flood Crest Elev. feet	Underclearance Elev. feet	Above 1916 Flood feet	Below 1916 Flood feet
0.40	Old U.S. Highway 64	2092.1	2104.3	2104.2	2103.4	2100.8		2.6
0.49	Southern Railway	2092.2	2109.0	2105.6	2104.4	2101.2		3.2
2.13 2.14	U.S. Highways 64 & 276	2114.3	2133.2	2136.8	2124.0	2129.7	5.7	
4.18	English Chapel Bridge	2156.4	2170.4	2175.7	2165±	2168.2	3	

Twin bridges carry the four-lane U. S. Highways 64 & 276 over Davidson River. These are concrete structures of three spans each, with similar openings, and similar floor and underclearance elevations. The upstream bridge was built in 1934. The second structure was built in 1956, when U. S. Highways 64 & 276 became a four-lane dual highway from the intersection of the routes into Brevard. The fill crossing the narrow right-bank flood plain is 5 to 6 feet high. On the left bank the approach fills extend for the 600-foot width of the flood plain with the road grade 4 to 9 feet above natural ground. Bridge floors are at elevation 2133.2, but overflow of the highway on the left bank would begin at elevation 2130.5. Regional and Maximum Probable Floods would overtop the road and bridge, and heading up of about 7 feet would occur during such floods.

The bridge at English Chapel is a one-span steel truss. Short approach fills lead from the bridge to U. S. Highway 276 on the left bank and to the flood plain on the right bank. Use of the bridge would be affected when water overflowed the road on the right bank at elevation 2167.6 feet. During a Regional Flood heading up of over 5 feet would occur; and during a Maximum Probable Flood the heading up would amount to 3.3 feet, the water reaching a depth of almost 8 feet on the bridge.

The Olin Mathieson Chemical Corporation has a bridge which crosses their diversion channel 380 feet upstream from the intake dam, Davidson River Mile 1.38. The bridge, a 2-span, wood-floor, steel-girder structure, provides access from the plant to a refuse disposal area which is between the channel and the loop of Davidson River which the channel bypasses.

Obstructions to Flood Flow

The effect of obstructions due to the bridges and their approach fills has been discussed in the previous section. Flood conditions have been altered by changes made in the stream channel and on the flood plain at the Olin Mathieson Chemical Corporation property. Plant buildings and the flood levee serve to restrict flow sharply on the right-bank flood plain. On the other hand, the construction of the diversion channel and work that the firm has done to enlarge the natural channel of Davidson River past the plant site have served to increase the flood-carrying capacity of the stream at that point.

The natural constriction in the overbank section between Miles 2.3 and 2.5 would become effective during great floods. During a Regional Flood this constriction would cause a rise upstream of about 9 feet, and during a Maximum Probable Flood the rise would be over 14 feet as a result of the narrow overbank channel.

FLOOD SITUATION

Flood Records

Records of river stage and discharge on Davidson River go back to June 1904 when the U. S. Geological Survey began observations on a staff gage near the mouth of Avery Creek, at the upper end of the reach included in this investigation. The gage was discontinued in June 1909. Continuous records date from December 10, 1920, when a staff gage was installed by the Geological Survey on a bridge 100 feet upstream from the present U. S. Highway 64 & 276 bridge. The staff gage was replaced by a chain gage on a new bridge at the same site in April 1929. On May 18, 1934, observations began at the present recording stream gage 200 feet above U. S. Highways 64 & 276. The station is designated by the Geological Survey as Davidson River near Brevard, N. C.

To supplement the streamflow records, local residents were interviewed for dates and heights of floods on Davidson River. Files of the Asheville and Brevard newspapers were searched. TVA engineers have made investigations in the field after the important floods which have occurred in the last 29 years. These investigations have developed a knowledge of floods on Davidson River covering the past 88 years or more.

Flood Stages and Discharges

Table 9 lists peak stages and discharges for the known floods above the bankfull stage of 7 feet at the Geological Survey stream gaging station, Davidson River near Brevard. Table 10 lists the highest 6 floods in order of magnitude. For floods since 1920 the flood crest stages are those observed at the gage. Stages for floods prior to 1920 are from high water marks or are estimated from newspaper and historical accounts or from interviews with local residents.

Flood Occurrences

Plate 6 shows crest stages and months of occurrence of known floods which have exceeded the bankfull stage of 7 feet on the Davidson River near Brevard stream gage. Table 11 shows the monthly distribution of the 14 known floods occurring since 1920. The record shows that floods may occur at any time of the year, and that floods have occurred most frequently in the month of August.

Duration and Rate of Rise

Plate 7 shows the stage hydrograph on Davidson River for the flood of August 13, 1940, at the stream gage above U. S. Highways 64 & 276. During the flood the river rose to its crest stage in 30 hours at an average rate of 0.3 foot per hour with a maximum rate of 1.5 feet per hour, and remained above bankfull stage for $7\frac{1}{2}$ hours.

Velocities

During the flood of July 16, 1916, velocities in the channel of Davidson River in the vicinity of Brevard ranged up to 12 feet per second, and overbank velocities ranged up to 4 feet per second. During larger floods, velocities would be even greater.

Flooded Areas, Flood Profiles, and Cross Sections

Plate 10 shows the approximate areas along Davidson River in the vicinity of Brevard that would be inundated by the flood of August 13, 1940, under present conditions, and by the Maximum Probable Flood. The actual limits of these overflow areas on the ground may vary somewhat from those shown on the map because the contour interval of the map does not permit precise plotting of the flooded area boundaries. The contour interval of Plate 10 is 40 feet.

TABLE 9

FLOOD CREST ELEVATIONS ABOVE BANKFULL STAGE

DAVIDSON RIVER NEAR BREVARD, NORTH CAROLINA

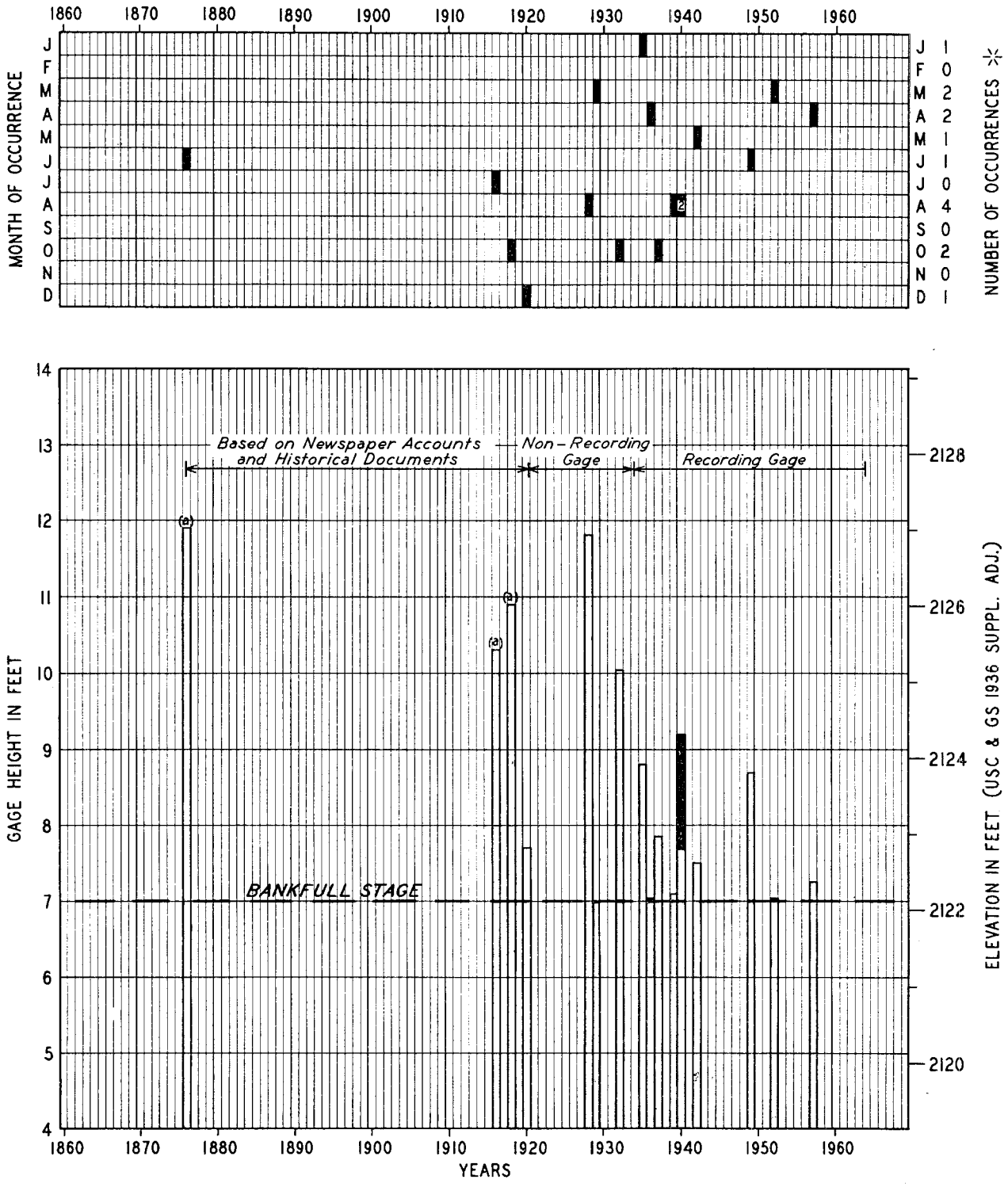
1876-1964

This table includes all known floods above bankfull stage of 7 feet at the U. S. Geological Survey gaging station near Brevard, Mile 2.19. Drainage area is 40.4 square miles.

Date of Crest	Gage Heights		Discharge
	Stage feet	Elevation feet	cfs
June 1876	11.9	2127.0	8,500
July 16, 1916	10.3	2125.4	6,500
October 1918	10.9	2126.0	7,200
December 14, 1920	7.7	2122.8	3,780
August 15, 1928	11.8	2126.9	8,400
March 14, 1929	7.0	2122.1	3,160
October 16, 1932	10.04	2125.17	6,130
January 8, 1935	8.80	2123.93	3,700
April 6, 1936	7.02	2122.15	2,780
October 18, 1937	7.85	2122.98	3,450
August 18, 1939	7.08	2122.21	3,650
August 13, 1940	9.20	2124.33	6,100
August 30, 1940	7.68	2122.81	4,310
May 20, 1942	7.49	2122.62	5,110
June 16, 1949	8.68	2123.81	6,800
March 11, 1952	7.02	2122.15	4,490
April 4, 1957	7.24	2122.37	4,770

Plate 25 shows high water profiles for the floods of July 1916 and August 13, 1940. Also shown are the profiles for the Regional and Maximum Probable Floods discussed in Sections III and IV of this report.

Plate 24 shows typical cross sections of Davidson River in the reach investigated. The locations of the sections are shown on the map and profiles, Plates 10 and 25. The cross sections show the elevation and extent of overflow of the July 1916 flood and the Regional and Maximum Probable Floods.



(a) Stage based on high water mark

✳ Number of occurrences during period of gage record, Dec. 1920 to April 1964.

Stream Gage at River Mile 2.19

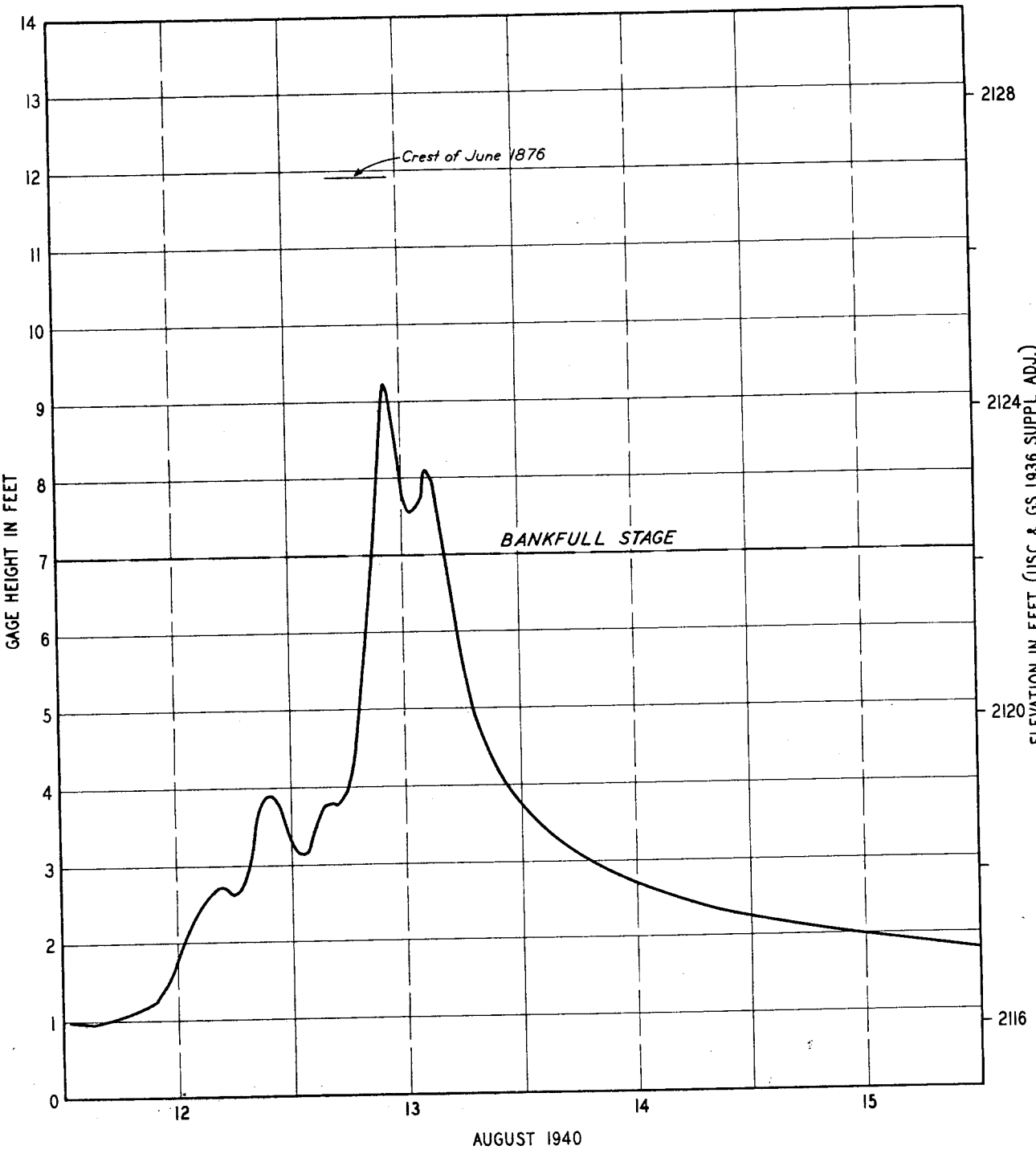
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

FLOODS ABOVE BANKFULL STAGE
DAVIDSON RIVER NEAR BREVARD, N.C.

MAY 1964

HD-1311

PLATE 7



Gage at River Mile 2.19

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

STAGE HYDROGRAPH
FLOOD OF MID-AUGUST 1940
DAVIDSON RIVER
NEAR BREVARD, N.C.

MAY 1964

TABLE 10

HIGHEST KNOWN FLOODS IN ORDER OF MAGNITUDE

DAVIDSON RIVER NEAR BREVARD, NORTH CAROLINA

Order No.	Date of Crest	Gage Height	
		Stage feet	Elevation feet
1	June 1876	11.9	2127.0
2	August 15,, 1928	11.8	2126.9
3	October 1918	10.9	2126.0
4	July 16, 1916	10.3	2125.4
5	October 16, 1932	10.04	2125.17
6	August 13, 1940	9.20	2124.33

TABLE 11

MONTHLY FLOOD DISTRIBUTION

DAVIDSON RIVER NEAR BREVARD, NORTH CAROLINA

Month	Number of Occurrences	Month	Number of Occurrences
January	1	July	0
February	0	August	4
March	2	September	0
April	2	October	2
May	1	November	0
June	1	December	1
		Total	14

FLOOD DESCRIPTIONS

Description of the large floods on Davidson River is included in the description of past floods on French Broad River.

3. KING CREEK VALLEY

The Stream and Its Valley

King Creek drains a long, narrow, mountainous area of 4.6 square miles, which lies to the northwest of Brevard. The watershed, shown on Plate 1, lies wholly within Transylvania County. It is rectangular in shape, 5 miles long, $1\frac{1}{2}$ miles wide at the widest point, but just $\frac{1}{2}$ to 3/4 mile wide over the lower half of its length. The upper half of the drainage area is within the boundary of Pisgah National Forest and covered with a heavy stand of second-growth timber. Steep ridges bound this part of the watershed, dividing it from the Davidson River watershed on the north and Catheys Creek watershed on the west. Elevations range from 3100 to 3850 feet on the Davidson River divide and from 3600 to 3900 feet on the Catheys Creek divide. From these elvations the basin divides decline to about 2200 feet as they near the Brevard development. The northeast half of the incorporated area of Brevard lies within the King Creek watershed.

King Creek rises in the northwest corner of the watershed between Chestnut Knob and Cedar Rock Mountain. The stream flows eastward for about two miles, then southeastward through Brevard to join the French Broad River at Mile 194.17. King Creek is within the corporate limits of Brevard from Mile 0.58 upstream a distance of 1.48 miles. Tinsley Creek, the largest tributary of King Creek, joins the stream in Brevard, just above U. S. Highways 64 & 276.

This investigation covers King Creek from a ford at Mile 2.38 to the mouth. In this reach the stream channel falls from elevation 2236 to 2090 for an average slope of 61 feet per mile; however, the slope is not uniform, ranging from less than 20 feet per mile near the mouth to more than 100 feet per mile in the upper end of the reach. The average slope is three times as great as the slope in the Davidson River reach and 17 times greater than that of the French Broad River at Brevard. The flood-plain width varies from about 200 feet at

the upper end of the reach to 2000 feet near the mouth. Within the corporate limit, the flood plain is 400 to 2000 feet wide. At U. S. Highways 64 & 276, where the greatest development is found, the width is 900 feet. The flood plain widens to 2000 feet above Neely Road in the Brevard College vicinity and below Neely Road, where the valley joins the flood plain of French Broad River.

Pertinent drainage areas of King Creek are given in Table 12.

Backwater from large floods such as that of July 1916 on the French Broad River extends about 3/4 mile up King Creek. Major floods on the French Broad River reach their maximum height much later and have a much longer duration of overflow than do the corresponding floods on King Creek.

Developments on the Flood Plain

Plate 9 and Plates 14, 15, and 16 show the flood plain of King Creek for the reach covered by this investigation. Below Neely Road the flood-plain land is used for agriculture. Above the Southern Railway bridge much of the land is in pasture. The land in the middle portion of the reach is occupied by residential and business developments, the Brevard sewage treatment plant, and Brevard College.

The Southern Railway crosses King Creek on a fill and trestle, and four streets cross the creek and flood plain in the study reach. The most important of these is North Broad Street which is one of the two principal streets of Brevard and carries all through traffic on U. S. Highways 64 & 276, as well as local traffic. Other streets which serve the residential and business developments are Neely Road, Railroad Avenue, and Tinsley Road.

The Brevard College development occupies the flood plain on both banks of King Creek between the college service road at Mile 1.02 and North Broad Street. The principal dormitory and classroom buildings are on the right bank and are above any flood that has occurred in the past as well as above the Maximum Probable Flood. Elevations of the lowest floors of these buildings range from 2130.0 to 2135.6. A new physical education building is on the left-bank flood plain with its main floor at elevation 2126.4, 2.8 feet below the Regional Flood level and 3.4 feet below the Maximum Probable Flood level. Figure 8 shows the building and the portion of the campus in the flood plain. Two faculty residences on the left bank have floors at elevation 2125.3. The downstream building is above flood levels.

TABLE 12

DRAINAGE AREAS IN WATERSHED OF KING CREEK

Stream	Location	Mile above Mouth	Drainage Area sq. mi.
King Creek	Mouth	0.0	4.60
	Neely Road	0.62	4.17
	North Broad Street (U.S. Highways 64 & 276)	1.33	3.69
	Upper limit of study	2.38	2.89

but the upstream building floor is 1.5 and 2 feet, respectively, below the Regional and Maximum Probable Flood levels. A maintenance building on the right bank has a floor at elevation 2119.9, which is just above the Regional Flood height, but 0.4 foot below the Maximum Probable Flood height.

Filter beds of the Brevard sewage treatment plant on the left-bank flood plain at Mile 0.8 are at elevation 2116.6. The elevation of the floor of the pumping station just downstream from Neely Road is 2109.3. A Maximum Probable Flood on the creek would not reach the plant or pumping station.

Business developments in the flood plain along U. S. Highways 64 & 276 on North Broad Street include a large motel, a dairy, an automotive agency, two service stations, three drive-in eating places, and a bowling alley. These are shown in Figure 9. Five of these businesses would be flooded by a Regional Flood with depths up to 6 feet, and seven would be flooded by a Maximum Probable Flood with depths up to 7 feet. Along Railroad Avenue are an oil bulk plant and a garage and materials storage lot for the local telephone company. The oil company office would be flooded to a depth of 4.5 feet during a Regional Flood and 6.5 feet during a Maximum Probable Flood.

Nine residences on the flood plain of King Creek would be flooded during Regional and Maximum Probable Floods with depths ranging from 2 to 7 feet during a Regional Flood and 2 to 9 feet during a Maximum Probable Flood.

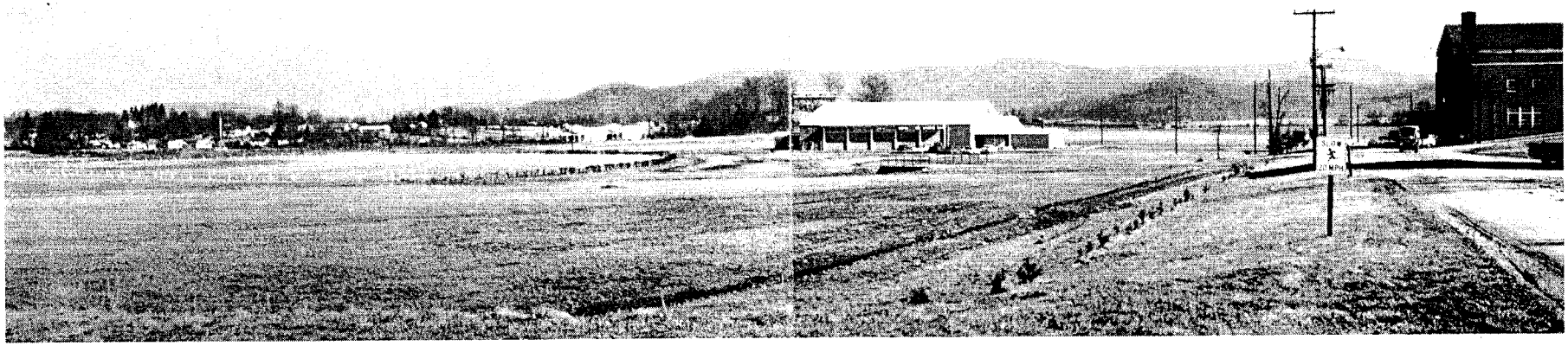


Figure 8.--BREVARD COLLEGE CAMPUS

The new Physical Education Building and athletic field are situated along King Creek. The bridge at right center is at Mile 1.20. In the background at left are new houses and apartments, and the tower of radio station WPNF.

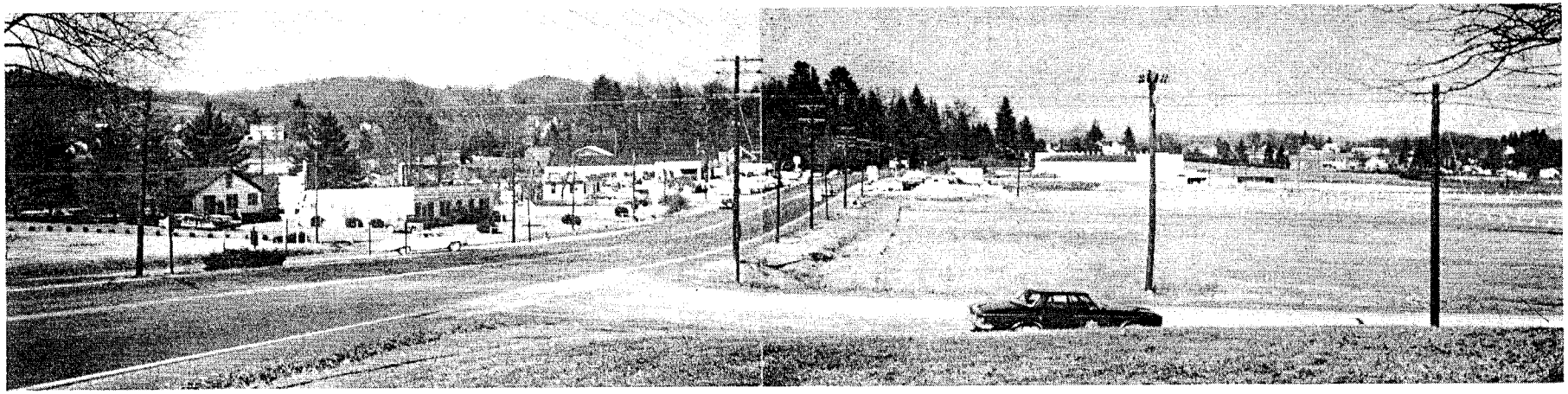


Figure 9.--DEVELOPMENT ALONG U. S. HIGHWAYS 64 & 276 AT BREVARD

The highway crosses King Creek at Mile 1.33. The view is northeast from the Brevard College grounds toward a dairy, auto sales agency, bowling alley, filling station, and several drive-in restaurants. Most of the vacant land at right is college property.

Bridges across the Stream

A railroad bridge, six highway bridges, and a footbridge cross King Creek in the study reach. Table 13 lists pertinent elevations for the bridges and shows the relation to the crest of a flood at bankfull stage and the Regional Flood. A Maximum Probable Flood would overtop all except the railroad bridge. Plate 26 shows the relation of the floor and underclearance at the bridges to the flood profiles for the reach. Figures 10 to 13 show photographs of the bridges.

The bridge at Neely Road is constructed with steel girders and a wood floor. A fill 2 to 3 feet high extends 700 feet from the bridge to the left side of the flood plain, where a culvert carries Lambo Creek under the road. The bridge floor is at elevation 2107.9, but use of the bridge is affected when water overflows the left-bank approach road at elevation 2106.7. The bridge and fill would cause heading up of about one foot during floods.

Two vehicle bridges and a footbridge are on the Brevard College property. The road bridges, at Miles 1.02 and 1.23, are of reinforced concrete construction. The footbridge at Mile 1.17 has a concrete floor on steel beams. All the structures are built with the floors at the top-of-bank elevation and they would be overtopped during any overbank flood. Heading up of one to two feet would occur at each highway bridge during large floods.

The bridge carrying North Broad Street and the traffic of U. S. Highways 64 & 276 is a three-opening box culvert. There are no fills on the bridge approaches, but buildings along the highway block a large part of the flood plain and obstruct the flood-carrying capacity of the overbank area. Overflow of the road and bridge begins at elevation 2137.2. A Maximum Probable Flood would overtop the road by 4.8 feet, and heading up of almost 4 feet would occur during a Regional or Maximum Probable Flood.

A fill blocks the flood plain where the Southern Railway crosses King Creek. Near the left-bank edge of the flood plain the railroad crosses Tinsley Creek on a low trestle. From Tinsley Creek the fill rises as it approaches King Creek and the right-bank flood plain to bring the tracks to the higher ground at the Brevard railroad station at Whitmire Street. The King Creek crossing is made on a trestle 125 feet long, with an underclearance that is 15 to 17 feet above low water. The height of the fill above the flood plain varies from 4 or 5 feet near Tinsley Creek, which is 600 feet from the King Creek trestle, to 10 feet at King Creek and on the

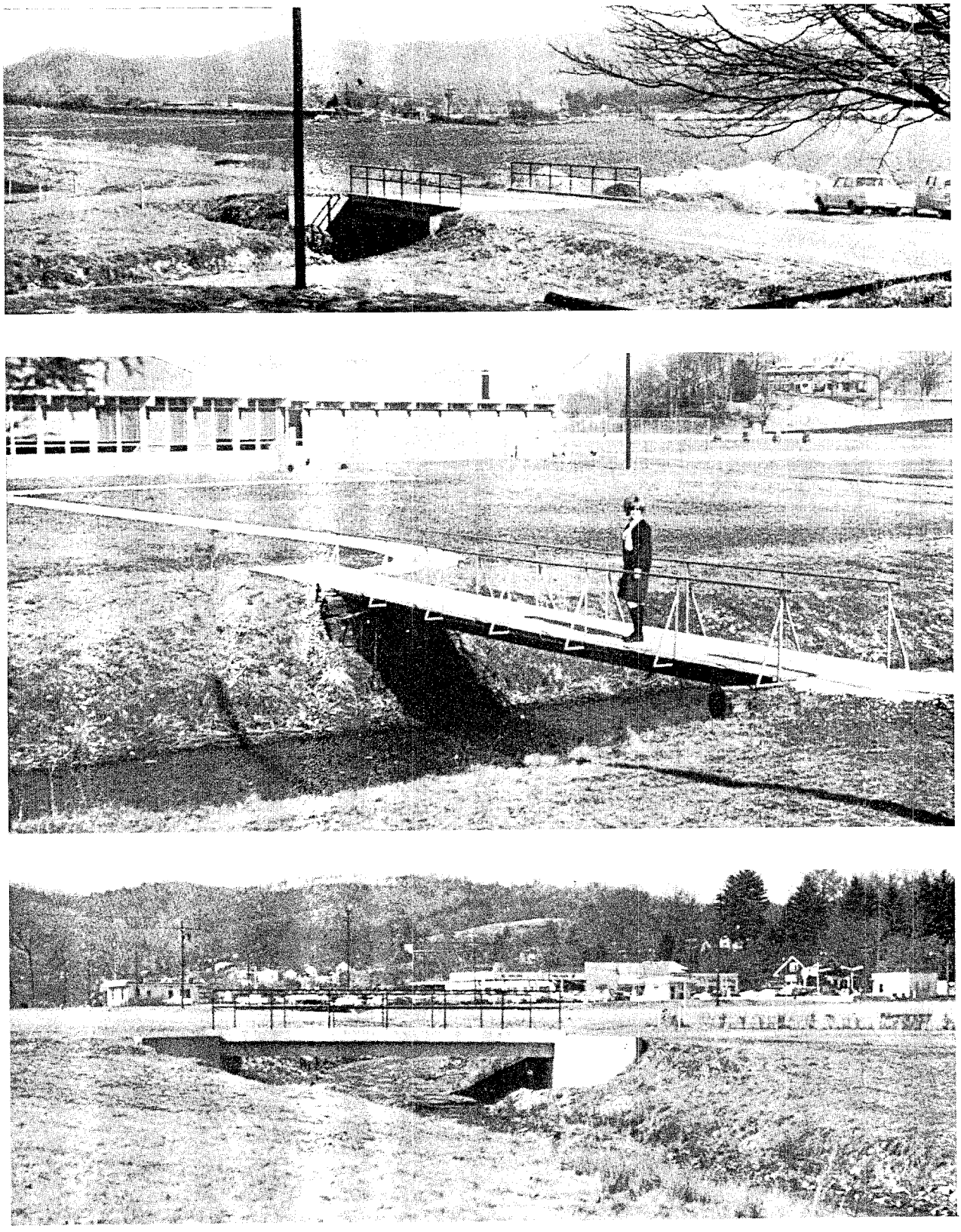


Figure 10.--KING CREEK BRIDGES ON BREVARD COLLEGE CAMPUS

Top view is upstream side of bridge at Mile 1.02. Footbridge at Mile 1.17 in middle view leads to new Physical Education Building on left bank. Bottom view is downstream side of bridge at Mile 1.23 carrying driveway to the same building and to athletic field.

Figure 11.--NEELY ROAD BRIDGE OVER KING CREEK, MILE 0.62

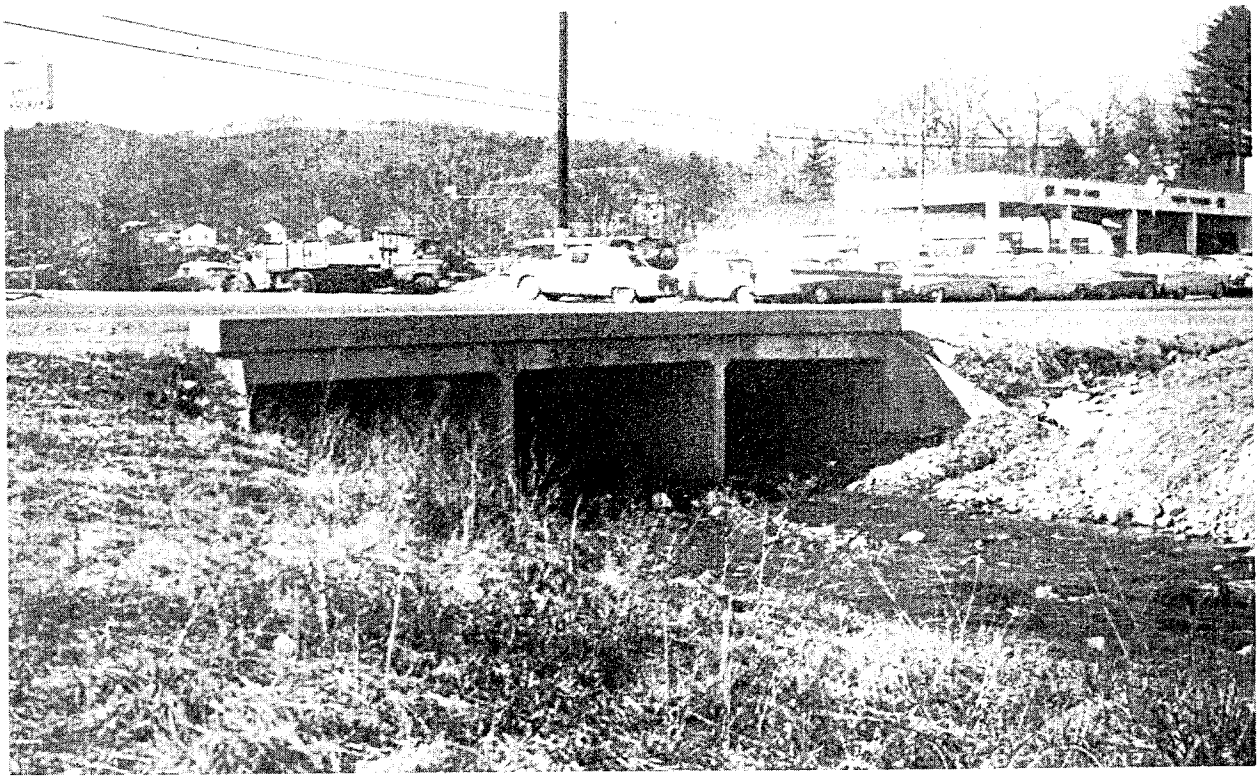


Figure 12.--U. S. HIGHWAYS 64 & 276 CROSSING KING CREEK

This 3-section culvert carries the four-lane highway across King Creek at Mile 1.33. The view shows the downstream side.

This view is downstream toward the Railroad Avenue bridge, at Mile 1.60, and the Southern Railway trestle at Mile 1.58.

Downstream side of Tinsley Road bridge at Mile 1.79.

Figure 13.--KING CREEK BRIDGES ABOVE U. S. HIGHWAY 276

TABLE 13

BRIDGES ACROSS KING CREEK

Mile above Mouth	Identification	Low Water Elev. feet	Floor Elev. feet	Regional Flood Crest Elev. feet	Bankfull Elev. feet	Underclearance Elev. feet	Above Bankfull Stage feet	Below Bankfull Stage feet
0.62	Neely Road	2100.9	2107.9	2108.5	2105.4	2105.2		0.2
1.02	Private road	2111.7	2120.1	2121.9	2120.1	2118.1		2.0
1.17	Footbridge	2119.8	2125.2	2128.2	2125.2	2124.4		0.8
1.23	Private road	2122.4	2129.7	2132.0	2129.6	2127.8		1.8
1.33	U.S. Highways 64 & 276	2130.2	2137.2	2141.3	2136.3	2135.4		0.9
1.58	Southern Railway	2151.8	2169.6	2163.4	2159.5	2167.2	7.7	
1.60	Railroad Avenue	2155.1	2161.0	2163.5	2161.0	2160.2		0.8
1.79	Tinsley Road	2170.9	2178.4	2183.1	2177.2	2176.9		0.3

narrow right-bank flood plain. Overflow of the tracks would begin at the Tinsley Creek crossing at elevation 2156.0. During a Regional Flood the trestle and fill would cause heading up of 2.5 feet, and during a Maximum Probable Flood the heading up would increase to almost 4 feet.

A bridge at Railroad Avenue, just 100 feet above the railroad bridge, is an all-wood structure. The bridge is at top-of-bank elevation. There are no fills on the approaches, and the crossing presents no appreciable obstruction to flood flows.

The bridge at Tinsley Road is of 2-span all-wood construction. The bridge sets a foot or two above top-of-bank elevation at the site, and the road grade is only a little above the flood-plain level. Overflow begins at the bridge at elevation 2178.2. Heading up of one to two feet would occur during large floods.

Obstructions to Flood Flow

The effect of obstructions due to the bridges and their approach fills has been discussed in the previous section. There has been some grading and filling along U. S. Highways 64 & 276 and this has affected flood flows. The buildings along

this road materially reduce the effective area on the flood plain. The net effect of these changes would be to make a major flood, such as that of July 1916, higher than it would be under natural or undisturbed conditions.

FLOOD SITUATION

Flood Records

There are no records of stream stages or discharges available for King Creek. Information on floods was obtained from interviews with the local residents and from a search of newspaper files and historical records. TVA engineers obtained data in the field to establish the flood profile for the minor flood on November 29, 1963.

Flood Occurrences

The investigation indicates that major floods have occurred on King Creek at about the same frequency as on the neighboring stream, Davidson River.

Duration and Rate of Rise

Small, steep mountainous watersheds, such as that of King Creek, produce floods that are characterized by very rapid rates of rise and short duration.

Velocities

Along King Creek in the reach investigated, velocities in the channel during flows at bankfull stage would range up to 12 feet per second. During larger floods, velocities would be greater.

Flooded Areas, Flood Profiles, and Cross Sections

Plate 9 and Plates 14, 15, and 16 show the approximate area along King Creek that was inundated by backwater from the flood of July 1916 on the French Broad River and that would be inundated by the Maximum Probable Flood. The actual limits of the overflow area on the ground may vary somewhat from that shown on the maps because the contour intervals of the maps do not permit precise plotting of the flooded area boundaries. The contour interval on Plate 9 is 40 feet, and the contour interval of Plates 14 to 16 is 5 feet.

Plate 26 shows the high water profile on King Creek for the flood of November 1963. Also shown are the profiles for the Regional and Maximum Probable Floods, which are discussed in Sections III and IV of this report.

Plate 27 shows typical cross sections of King Creek in the reach investigated. The locations of the sections are shown on the map, Plate 9, and the profile, Plate 26. Each cross section shows the elevation and extent of overflow of the Regional and Maximum Probable Floods.

FLOOD DESCRIPTIONS

Descriptions of the large floods on King Creek are included with the discussion of past floods on French Broad River.

4. NICHOLSON AND TUCKER CREEK VALLEYS

The Stream and Its Valley

Nicholson Creek drains a fan-shaped area of 5.1 square miles. Tucker Creek, the largest tributary of Nicholson Creek, drains a long, narrow valley of 1.5 square miles which lies at the east side of the Nicholson Creek basin and adjacent to the watershed of King Creek. The Nicholson and Tucker Creek watersheds, shown on Plate 1, are entirely within Transylvania County and, like the King Creek watershed, have their upper limits in heavily wooded Pisgah National Forest.

Steep ridges bound the upper part of the Nicholson Creek watershed, the highest elevation being about 3650 feet at the northwestern tip of the basin. On the west side, along the divide that separates the Nicholson Creek drainage from that of Catheys Creek, elevations range from the 3650-foot elevation down to 2650 feet at Chestnut Gap and to less than 2400 feet at the southwestern corner of the basin. Along the northern boundary, elevations drop off gradually to less than 2400 feet at the Brevard corporate limit. Included in the watershed is about one-quarter of the incorporated area of Brevard, essentially that part which is bounded by West Main Street and South Broad Street.

The headwaters portion of the watershed is drained by three streams, Brackens Creek, Graham Creek, and Brushy Creek. Nicholson Creek, which has its head in a small cove near the center of the watershed and just west of the Brevard corporate limit, is joined by Graham Creek at Cashiers Valley Road and flows generally southeastward, just outside and roughly parallel to the corporate limits, to the stream's confluence with French Broad River. Brushy Creek rises in a cove adjacent to the one at the head of Brackens Creek. The stream flows southeastward and is joined by Hunts Branch to form Tucker Creek just outside the corporate limit and northwest of the central business district of Brevard. Tucker Creek follows a southward course through the town to join Nicholson Creek at Mile 1.32. The stream is within the corporate limits for 1.05 miles of its course.

This investigation covers Nicholson Creek from Cashiers Valley Road to the mouth. The course of Tucker Creek is included from the confluence of Brushy Creek and Hunts Branch to the mouth at Nicholson Creek, a distance of 1.38 miles. The channel of Nicholson Creek falls from 2145 to 2100 feet on the reach covered, an average slope of 21 feet per mile. Tucker Creek falls from 2174 to 2120 feet, an average fall of 39 feet per mile. These rates of fall are approximately one-third and two-thirds, respectively, of the slope on King Creek for the reach covered.

The flood-plain width of Nicholson Creek varies from about 300 to 2000 feet in the study reach. At the upper end of the reach, at Cashiers Valley Road, the flood plain is 300 feet wide. A short distance below the mouth of Tucker Creek the flood plain is 1200 feet wide, but through most of the reach the width is generally between 500 and 700 feet. Where the stream nears the French Broad River, the width is 2000 feet. Along Tucker Creek the flood plain is generally 300 to 500 feet wide except near U. S. Highway 64, where it is about 800 feet in width.

Pertinent drainage areas in the watersheds of Nicholson and Tucker Creeks are given in Table 14.

Nicholson Creek is subject to backwater effects from large floods on French Broad River similar to those on King Creek. In a flood such as that of 1916, backwater from the river would extend upstream about 3/4 mile on Nicholson Creek.

TABLE 14

DRAINAGE AREAS IN WATERSHED OF NICHOLSON AND TUCKER CREEKS

Stream	Location	Mile above Mouth	Drainage Area sq. mi.
Nicholson Creek	Mouth	0	5.13
	U. S. Highway 64	1.60	2.99
	Upper limit of study (Cashiers Valley Road)	2.18	0.19
Tucker Creek	Mouth	0	1.50
	U. S. Highway 64	0.33	1.48
	Southern Railway	0.95	1.20
	Upper limit of study (Below mouth of Brushy Creek)	1.38	0.98

Developments on the Flood Plain

Plate 9 and Plates 14, 17, 18, and 21 show the flood plains of Nicholson and Tucker Creeks for the reaches included in this investigation. Along Nicholson Creek the flood-plain land is used largely for agriculture, particularly below the mouth of Tucker Creek. Above Tucker Creek some of the land is in agriculture but there are residential and business developments as well. Along Tucker Creek a large part of the flood-plain land is taken up by residential, business, or industrial developments.

U. S. Highway 64, which provides the principal link between Brevard and Rosman and which carries most of the through east-west traffic in the upper French Broad River basin, crosses both Tucker and Nicholson Creeks as does the Southern Railway.

Country Club Road, which carries local traffic to the Island Ford community on the French Broad River upstream from Brevard, and Jordan Road, which serves residents near the mouth of the stream, cross Nicholson Creek as do Lawrence Avenue, Nicholson Creek Road, and Cashiers Valley Road, all of which serve residences along Nicholson Creek in the study reach. Other streets which cross Tucker Creek in the study reach are Silversteen Drive, Cashiers Valley Road, and Mills Avenue.

The Transylvania Tanning Company was established about 1917 on land which took up the right-bank flood plain of Tucker Creek from Mile 0.7 to Mile 0.9. The firm for many years was one of the principal industries at Brevard, but it is no longer in operation and the buildings are being dismantled. A new building at the upper end of the plant property, near Cashiers Valley Road, houses the Weiss Machine Company, established in 1960 to do custom machine work. The plant floor is about 7 feet below the Regional Flood, and 8 feet below the Maximum Probable Flood. Also at Cashiers Valley Road is a ready-mix concrete plant. The ground at the plant is 2 and 3 feet, respectively, lower than the Regional and Maximum Probable Flood elevations.

Located along the Rosman Highway, U. S. Highway 64, on the flood plain of Nicholson Creek, are a grocery store, a service station, a radio and TV repair service, and a mobile homes sales lot. Regional Flood depths in these buildings would range up to 3.7 feet, and the Maximum Probable Flood would be one foot higher. Just above the highway is a trailer park which would be flooded to depths of 9 feet by a Regional Flood and 10 feet by a Maximum Probable Flood. Along U. S. Highway 64 where it crosses the Tucker Creek flood plain is a bulk oil plant and a cloth shop. These are respectively 3 and 1 feet below the Regional Flood height. The Maximum Probable Flood would be about one-half foot higher.

The Brevard High School is located on high ground on the left bank of Nicholson Creek just below Country Club Road.

Residences which are along Nicholson and Tucker Creeks are mostly back at the edge of the flood plains and are above the elevations reached by the floods of the past. Some 20 houses would be affected in a flood of the magnitude of the Maximum Probable Flood.

Bridges across the Streams

A railroad bridge and six highway bridges cross Nicholson Creek in the reach investigated. One railroad bridge, four highway bridges, and one private bridge cross Tucker Creek in the study reach. Table 15 lists pertinent elevations for the bridges and shows the relation to the crest of a flood reaching bankfull stages and the Regional Flood. Plate 26 shows the relation of the floor and underclearance at the bridges to the flood profiles for the reaches. Figures 14, 15, and 16 show photographs of the bridges on Nicholson Creek, and Figures 17, 18, and 19 show photographs of the bridges on Tucker Creek.

TABLE 15

BRIDGES ACROSS NICHOLSON AND TUCKER CREEKS

Mile above Mouth	Identification	Low Water Elev. feet	Floor Elev. feet	Regional Flood Crest Elev. feet	Bankfull Elev. feet	Underclearance Elev. feet	Above Bankfull Elev. feet	Below Bankfull Elev. feet
	Nicholson Creek							
0.26	Jordan Road	2101.8	2112.8	2112.1	2109.0	2110.7	1.7	
0.86	Country Club Road	2112.9	2123.6	2126.1	2116.8	2121.9	5.1	
1.41	Lawrence Avenue	2122.3	2127.8	2132.4	2125.4	2126.2	0.8	
1.60	U. S. Highway 64	2126.3	2135.5	2139.8	2130.0	2132.7	2.7	
1.96	Nicholson Creek Road	2134.8	2140.4	2144.4	2138.5	2139.0	0.5	
2.17	Southern Railway	2145.0	2152.2	2154.8	2147.8	2149.8	2.0	
2.18	Cashiers Valley Road	2145.2	2149.8	2154.8	2148.2	2147.7		0.5
	Tucker Creek							
0.33	U. S. Highway 64	2127.4	2137.4	2135.8	2131.0	2135.3	4.3	
0.48	Private road	2130.1	2136.1	2141.2	2136.1	2135.1		1.0
0.58	Silversteen Drive	2134.7	2141.1	2144.8	2140.9	2140.3		0.6
0.94	Cashiers Valley Road	2148.7	2155.0	2161.0	2153.8	2153.5		0.3
0.95	Southern Railway	2149.6	2167.2	2162.9	2154.3	2164.8	10.5	
0.96	Mills Avenue	2149.7	2156.2	2163.4	2155.0	2154.5		0.5

The Jordan Road bridge over Nicholson Creek is a steel-girder, wood-floor structure. The floor of the bridge is about 4 feet above the natural bank elevation of the stream. The approach road is at flood-plain level except near the bridge. Floods on Nicholson Creek or backwater from floods on the French Broad River begin to overflow the road at elevation 2198. A lightly constructed wood bridge which is just below the highway bridge is used for a cattle crossing.

Country Club Road crosses Nicholson Creek on a steel-girder, wood-floor bridge. The flood plain, which is about 600 feet wide at the point, is blocked by a fill which is 8 feet high at the bridge and averages about 5 feet in height. Use of the road and bridge is affected when water overflows the road at elevation 2121.0. Heading up of 2 to 3 feet would occur during large floods.

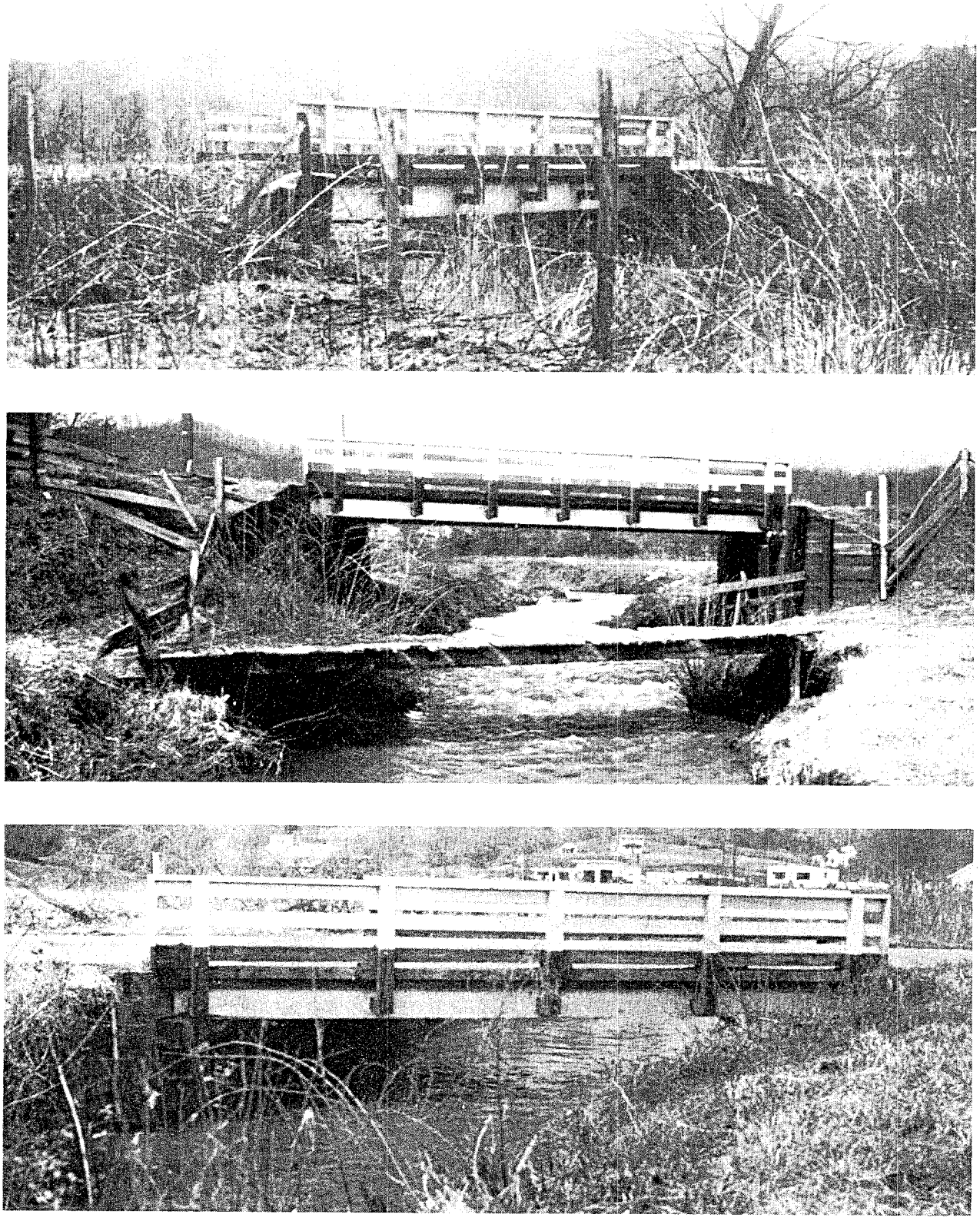


Figure 14.--NICHOLSON CREEK BRIDGES BELOW U. S. HIGHWAY 64

Top view shows upstream side of Jordan Road bridge at Mile 0.26. Middle view shows the Country Club Road bridge at Mile 0.86 and an old private bridge just downstream from it. Bottom view shows downstream side of Lawrence Avenue bridge, Mile 1.41, and buildings along U. S. Highway 64 in background.

Figure 15.--U. S. HIGHWAY 64 BRIDGE OVER NICHOLSON CREEK

This is the upstream side of box culvert at Mile 1.60 under the main highway to the west.

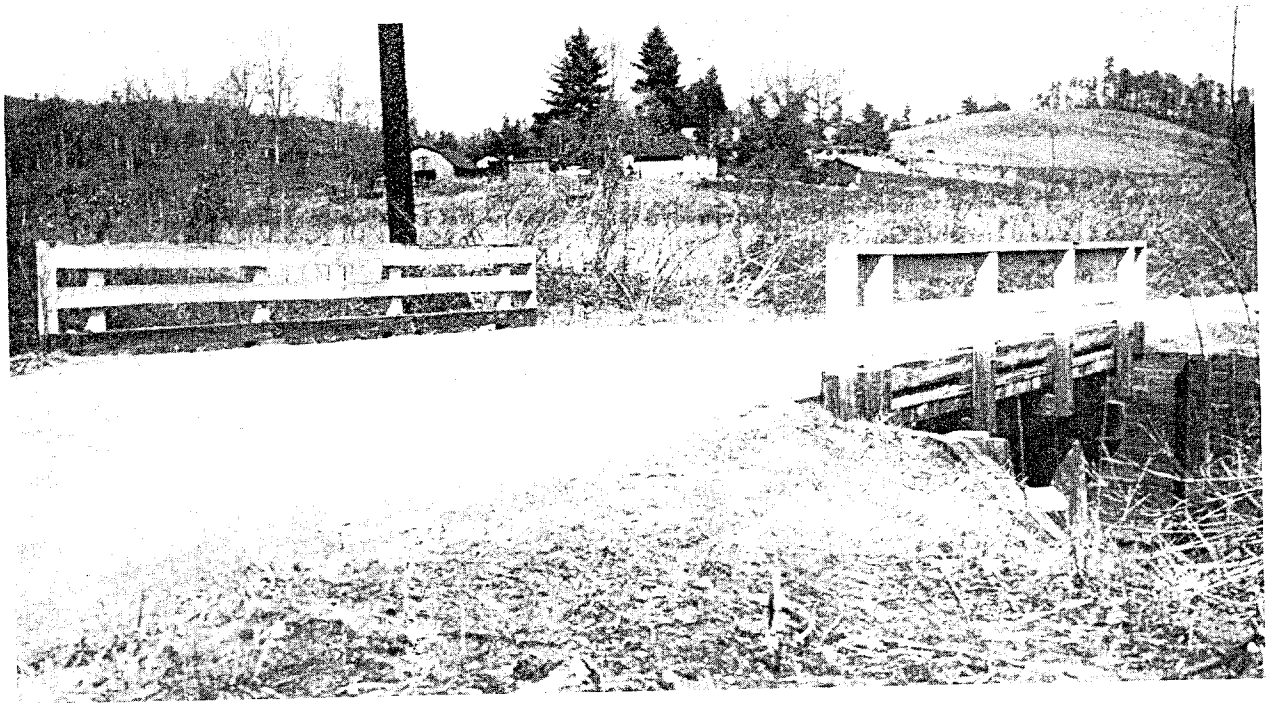


Figure 16.--NICHOLSON CREEK ROAD BRIDGE OVER CREEK

The view is from right bank at Mile 1.96.

Figure 17.--U. S. HIGHWAY 64 CROSSING TUCKER CREEK

This is the downstream end of box culvert carrying the main highway at Mile 0.33.

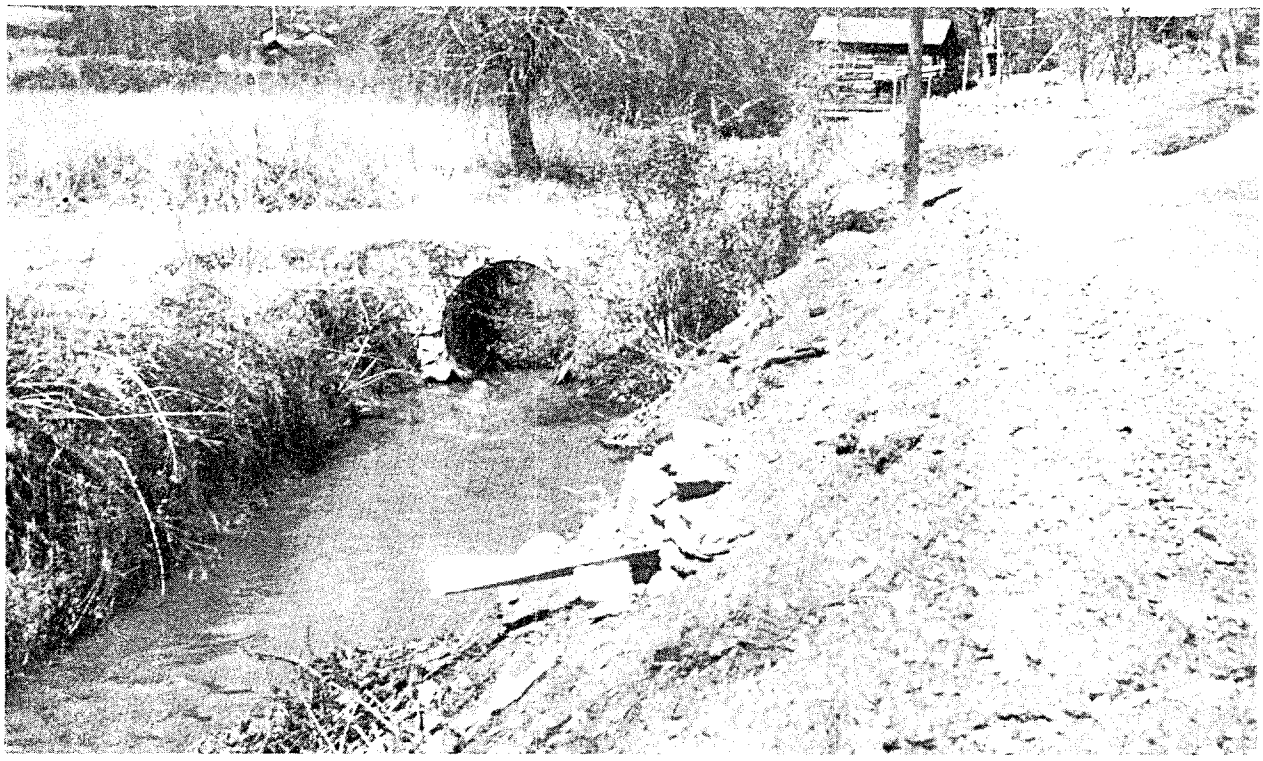


Figure 18.--SILVERSTEEN DRIVE CROSSING TUCKER CREEK

Downstream side of culvert, 72 inches in diameter, at Mile 0.58.

Figure 19.--TUCKER CREEK BRIDGES NEAR RAILWAY CROSSING

Top view is downstream side of Cashiers Valley Road bridge at Mile 0.94 and the Southern Railway trestle at Mile 0.95. Middle view shows upstream side of trestle. Bottom view is downstream side of the Mills Avenue culvert at Mile 0.96.

The bridge at Lawrence Avenue is a steel-girder structure. The street crosses the flood plain on a fill which is 1 to 3 feet high, but heading up is negligible during floods.

U. S. Highway 64 crosses Nicholson Creek on a reinforced concrete bridge. The 500-foot-wide flood plain is blocked by a fill which is about the level of the bridge floor, elevation 2135.5, on the right bank, and slightly higher on the left bank. These fills would cause heading up of about 3 feet during large floods. A Maximum Probable Flood would reach an elevation of 2140.7 feet at the bridge, 5.2 feet above the floor.

The bridge at Nicholson Creek Road is an all-wood structure, set just above the top of banks. It would be flooded in any rise which overtopped the banks at the site and would cause no heading up.

The Southern Railway crosses Nicholson Creek on a fill which is 3 to 4 feet high over the 400-foot-wide flood plain. The bridge is a low wood trestle-type structure, which would be overtopped at elevation 2152.2.

Cashiers Valley Road, just above the railroad bridge, crosses the stream at a 36-inch culvert. The road is at flood-plain level.

U. S. Highway 64 crosses Tucker Creek on a reinforced concrete bridge. A fill which carries the highway is 3 to 6 feet high over the 900-foot width of the flood plain. The floor at the bridge is at elevation 2137.4, but overflow of the road on the right bank begins at elevation 2132.3. Heading up of more than one foot would occur during floods as great as a Regional Flood.

A lightly built private wood bridge at Mile 0.48 sets at the top-of-bank elevation.

A 72-inch culvert carries Tucker Creek under Silversteen Drive. The street grade is at flood-plain level and heading up is negligible during floods.

Three bridges are grouped close together near Cashiers Valley Road. The main road bridge is all-wood construction, with two spans. The bridge sets just above the natural bank elevation and the road is at flood-plain level. The Southern Railway bridge, just above Cashiers Valley Road, is a trestle with its underclearance 15 to 17 feet above the normal water level of Tucker Creek. A fill which is 8 to 10 feet high carries the railroad across the valley and blocks the flood plain at the point. Just above the railroad, Mills Avenue crosses the creek

on a 72-inch culvert to provide access to a group of houses on the right bank. The three bridges cause a heading up of almost 3 feet during large floods on the creek.

Obstructions to Flood Flow

The effect of obstructions due to the bridges and the approach fills on Nicholson and Tucker Creeks has been discussed in the previous section. A small dam at Mile 0.76 on Tucker Creek was built as a water-supply source for the Transylvania Tannery. The dam is just 3 to 4 feet high and has little or no effect upon flood heights on the stream. Grading for the athletic field and a physical education building at Brevard High School has affected the left-bank flood plain of Nicholson Creek below Country Club Road.

FLOOD SITUATION

Flood Records

There are no records of stream stages or discharges available for Nicholson Creek or Tucker Creek at Brevard. Information on floods on the two streams was obtained from interviews with the local residents and from a search of newspaper files and historical records. TVA engineers obtained data in the field to establish the profile for the minor flood on November 29, 1963.

Flood Occurrences

The investigation indicates that major floods have occurred on Nicholson Creek and Tucker Creek at about the same frequency as on the nearby stream, Davidson River.

Duration and Rate of Rise

Small, steep mountainous watersheds, such as those of Nicholson and Tucker Creeks, produce floods that are marked by very rapid rates of rise and short duration.

Velocities

In the reach investigated along Nicholson Creek, velocities in the channel during flows at bankfull stage would range up to 5 feet per second. On Tucker Creek velocities in the channel would range up to 4 feet per second. In larger floods the velocities would be even greater.

Flooded Areas, Flood Profiles, and Cross Sections

Plate 9 and Plates 14, 17, 18, and 21 show the approximate area along Nicholson and Tucker Creeks that would be inundated by backwater from the flood of July 1916 on the French Broad River and that would be inundated by the Maximum Probable Flood. The actual limits of the overflow area on the ground may vary somewhat from that shown on the map because the contour interval of the map does not permit precise plotting of the flooded area boundaries. The contour interval of Plate 9 is 40 feet, and the contour interval of the other plates is 5 feet.

Plate 26 shows the high water profiles on Nicholson and Tucker Creeks for the flood of November 1963. Also shown are the profiles for the Regional and Maximum Probable Floods, which are discussed in Sections III and IV of this report.

Plate 27 shows typical cross sections on Nicholson and Tucker Creeks in the reaches investigated. The locations of the sections are shown on the map, Plate 9, and the profile, Plate 26. Each cross section shows the elevation and extent of overflow of the Regional and Maximum Probable Floods.

FLOOD DESCRIPTIONS

Descriptions of the large floods on Nicholson and Tucker Creeks are included with the discussion of past floods on French Broad River.

III.

REGIONAL FLOODS

III.

REGIONAL FLOODS[1]

This section of the report relates particularly to floods on streams whose watersheds are comparable with those of the upper French Broad River, Davidson River, and King, Nicholson, and Tucker Creeks.

Large floods have been experienced in the past on streams in the general geographical and physiographical region of Brevard, North Carolina. Heavy storms similar to those that caused these floods could occur over the watersheds of the upper French Broad River and its tributaries. In this event, floods would result on these streams comparable in magnitude with those that were experienced on neighboring streams. Floods of this size are designated as Regional Floods. It is therefore desirable, in connection with any determination of future floods that may occur on the upper French Broad River, Davidson River, King, Nicholson, and Tucker Creeks, to consider floods that have occurred in the region on watersheds whose topography, watershed cover, and physical characteristics are similar to those of these five streams.

Maximum Known Floods in the Region

Storm rainfall over watersheds in the southern Appalachian Mountains, including the upper French Broad River watershed, is influenced considerably by the topography of the region. This is true of the occasional tropical summer hurricanes as well as the large cyclonic storms more typical of the winter months. Moist air moving northward and westward from the Gulf and Atlantic Coasts is forced upward by the gradually sloping ground rising to the crest of the Tennessee Valley Divide. As a result, the easterly slopes of the Divide and the area immediately beyond the crest within the Valley are subject to heavy orographic rainfall. The distribution of this rainfall, however, is different over the watersheds to the east and south of the Tennessee Valley Divide than over the watersheds within the valley. On the coastward slopes the heavy precipitation that results when the moist air is lifted over the mountains is widespread, covering entire river basins. Within the Tennessee Valley the heavy precipitation is confined largely to a narrow band along the top and immediately beyond the Divide. Characteristically, the rainfall diminishes on the downstream slopes within the Valley, although

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1. Prepared by Hydraulic Data Branch.

occasionally tongues or cells of heavy rainfall have been experienced for considerable distances within the Valley.

Table 16 lists the maximum known floods experienced on watersheds comparable with those of the upper French Broad River, Davidson River, King Creek, Nicholson Creek, and Tucker Creek which lie within 50 miles of Brevard. Because of the distribution of rainfall during heavy storms, the floods that occurred on watersheds that lie to the east outside the Tennessee Valley have not been considered in the determination of Regional Floods on the upper French Broad River watershed. The largest known floods in the past in the Brevard region have been caused by the storms of May 1840, July 1916, August 1940, and June 1949. Very little is known about the storm of May 1840 except it caused record flooding along the lower Tuckasegee River; however, the other storms are well documented.

The storm of July 15-16, 1916, was the second of two tropical hurricanes that moved inland over the southeastern part of the country during July 1916. The first hurricane dissipated over southern Alabama but brought sufficient rainfall to western North Carolina on July 8-10 to saturate the ground. The second hurricane that followed brought heavy rainfall along the Blue Ridge Mountain Divide between the Atlantic and Tennessee River drainage. Particularly devastating floods resulted on the upper French Broad River and its headwater tributaries from an estimated maximum of 16 to 18 inches of rain that fell on the watersheds of some of these tributaries.

In August 1940 two severe storms caused extensive flooding in the Brevard region. The first, which occurred in mid-August, originated as a tropical hurricane and released heavy rainfall along the eastern Tennessee Valley Divide from the Hiwassee River basin northeast to the Watauga River headwaters. Centers of high rainfall reaching 14 to 16 inches were experienced in the Tuckasegee River watershed, while along the rim of the upper French Broad region rainfall varied from 12 inches to the south and west to about 10 inches to the east. Extensive flooding occurred throughout the area, but in the Brevard region flood discharges were generally lower than those of July 1916. This same area was again deluged by heavy rains about two weeks later on August 29-30. Unlike the first storm, the second one resulted from thunderstorm activity rather than a hurricane and lasted approximately one day. The heaviest rainfall of the storm occurred over the headwaters of the Tuckasegee River and averaged over 10 inches on some of the tributaries. Record flooding occurred along the upper Tuckasegee River and in the Pigeon River watershed.

TABLE 16

MAXIMUM KNOWN FLOOD DISCHARGES ON STREAMS

IN THE REGION OF BREVARD, NORTH CAROLINA

No.	Stream	Location	Drainage Area sq. mi.	Date	Peak Discharge Amount cfs	Peak Discharge Per Sq. Mi. cfs
1	Pigeon River	at Hepco, N. C.	350	February 1902	41,000	117
2	Tuckasegee River	at Dillsboro, N. C.	347	May 1840	53,000	153
3	Little Tennessee River	at Iotla, N. C.	323	February 28, 1902	38,000	118
4	French Broad River	at Blantyre, N. C.	296	July 16, 1916	50,700	171
5	Tuckasegee River	nr East LaPort, N. C.	200	August 30, 1940	45,000	225
6	Tuckasegee River	at Tuckasegee, N. C.	143	August 30, 1940	40,800	285
7	Swannanoa River	at Biltmore, N. C.	130	April 1791	40,000	308
8	Mud Creek	at Naples, N. C.	109	July 1916	40,000	367
9	French Broad River	at Calvert, N. C.	103	July 1916	22,000	214
10	East Fork Tuckasegee River	nr Tuckasegee, N. C.	80.3	August 30, 1940	30,000	374
11	French Broad River	at Rosman, N. C.	67.9	July 1916	18,200	268
12	Cane Creek	nr Fletcher, N. C.	63.1	July 16, 1916	23,000	366
13	Mud Creek	nr Hendersonville, N. C.	52.7	July 16, 1916	20,000	380
14	Clear Creek	nr Hendersonville, N. C.	44.6	July 16, 1916	20,600	462
15	Davidson River	nr Brevard, N. C.	40.4	June 1876	8,500	210
16	Caney Fork	above Cowarts, N. C.	39.4	August 30, 1940	21,700	551
17	North Fork Swannanoa River	nr Black Mountain, N. C.	23.8	June 16, 1949	16,500	693
18	West Fork Pigeon River	at Spruce, nr Waynesville, N. C.	12.2	August 30, 1940	16,500	1,350
19	Devils Fork	nr Hendersonville, N. C.	9.3	July 16, 1916	7,500	806
20	Middle Prong, West Fork Pigeon River	ab Spruce, nr Waynesville, N. C.	8.4	August 30, 1940	16,400	1,950
21	North Hominy Creek	nr Canton, N. C.	7.8	August 30, 1940	5,000	641
22	Right Fork Swannanoa River	nr Black Mountain, N. C.	5.1	June 16, 1949	4,500	882
23	Holcombe Branch	nr Ivy, N. C.	2.41	June 2, 1937	3,400	1,400
24	Big Creek	nr Waynesville, N. C.	1.32	August 30, 1940	12,900	9,770
25	Big Branch	nr Waynesville, N. C.	0.4	August 30, 1940	4,500	11,200

The June 14-16, 1949, storm was part of a widespread disturbance that produced floods of considerable magnitude throughout much of the southeastern part of the Tennessee Valley. Record or near-record flooding was experienced on the North Fork Swannanoa River at Black Mountain, North Carolina, where 8.50 inches of rainfall were recorded in 21 hours. Approximately 2.5 inches of rain had fallen during the two days prior to this intense burst of rainfall.

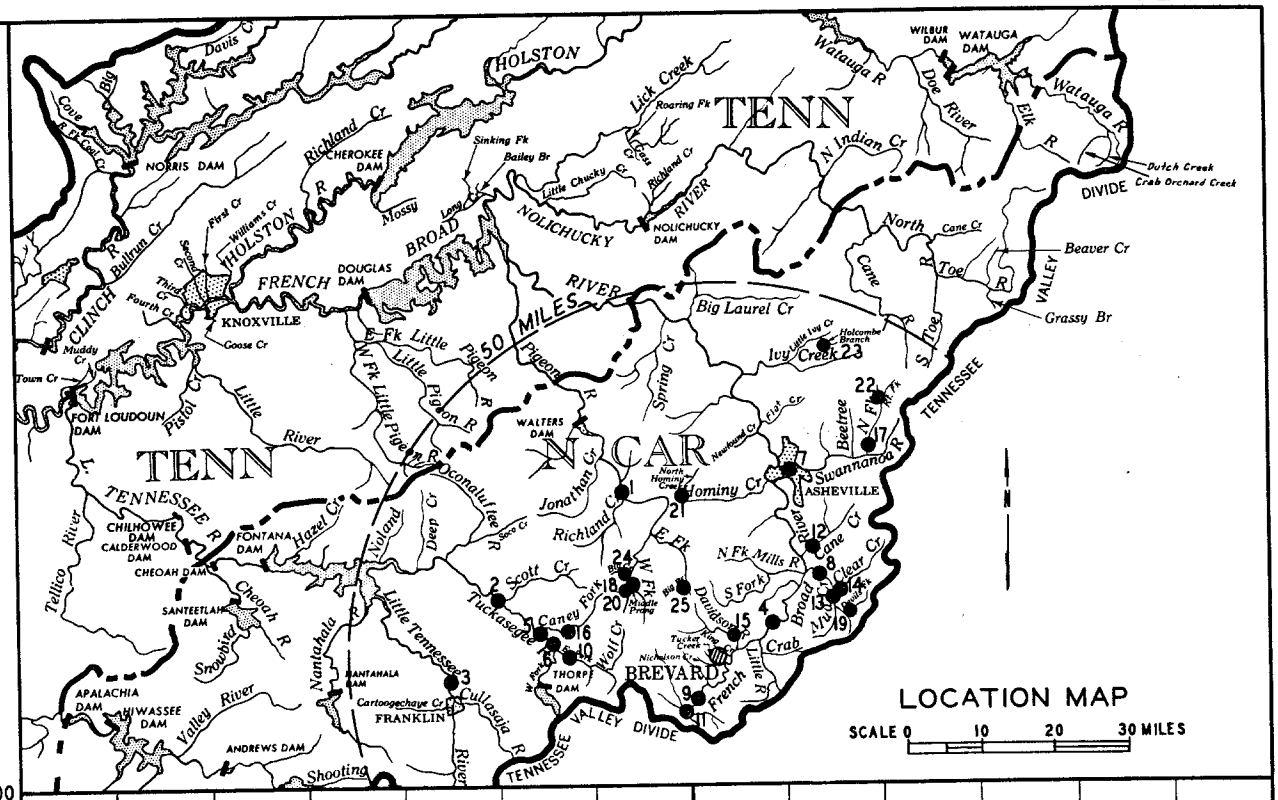
All of the floods listed in Table 16 have occurred on watersheds in the region of Brevard that are similar in physical characteristics. This indicates that floods of like magnitude, modified to take into account differences in drainage area characteristics, could occur in the future on the upper French Broad River and its tributaries.

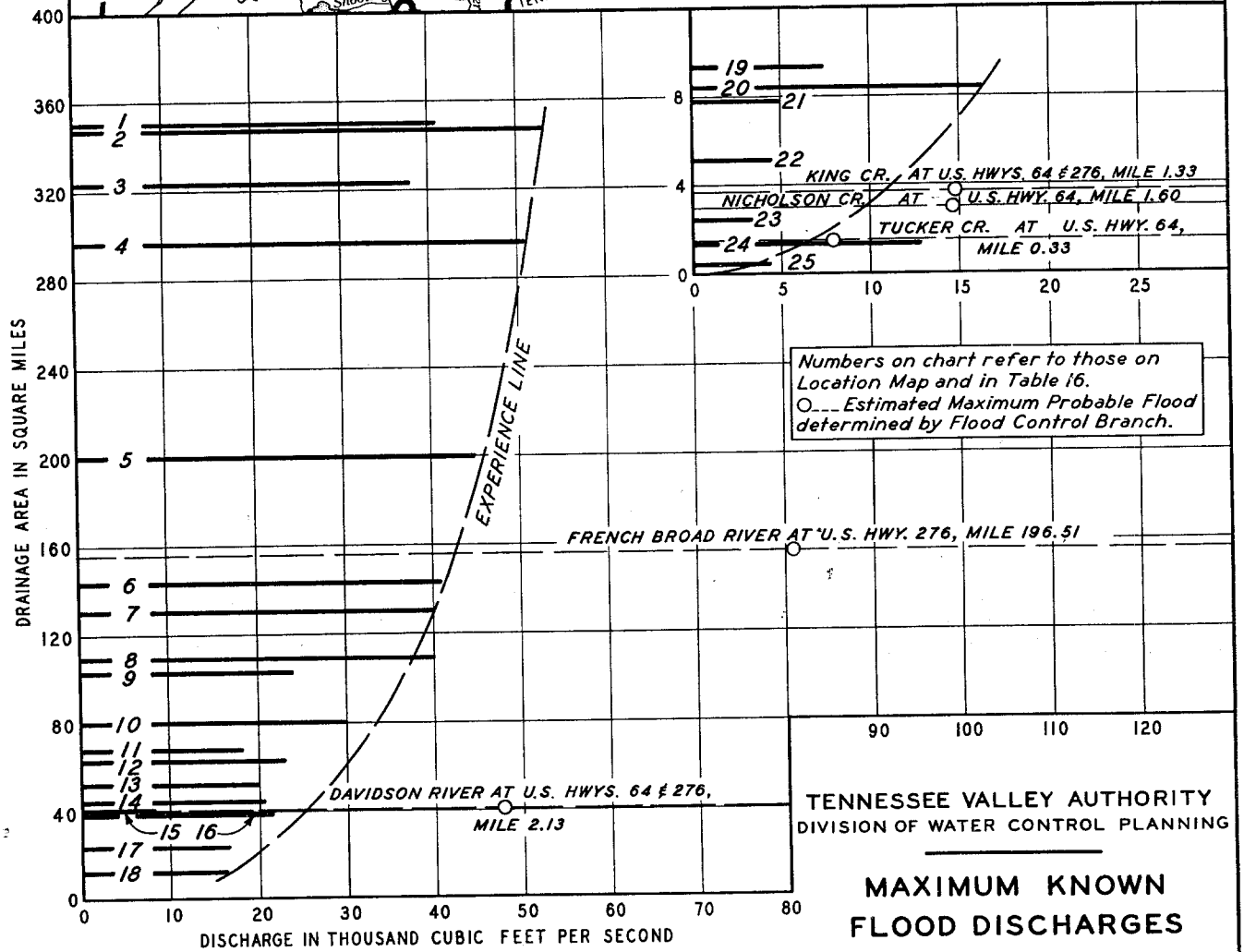
Determination of Regional Floods

Plate 8 is a diagram of the discharges tabulated in Table 16 together with a map showing the locations of the discharge measurements.

The floods listed in Table 16 and shown on Plate 8 occurred from several different types of storms. Although little is known about the May 1840 flood, it was probably caused by heavy rainfall which was widespread over the area. This type of storm could occur during any part of the year although it would more likely occur in winter or early spring months. The July 1916 flood resulted from a hurricane while both the late August 1940 flood and the June 1949 flood resulted from general thunderstorm activity with intense rainfall over a localized area. Each of these three storm types could cause large floods on the upper French Broad River. Although the Davidson River, King Creek, Nicholson Creek, and Tucker Creek are far enough to the west of the Blue Ridge Divide to be sheltered from heavy hurricane rainfall, they could still receive enough rain to saturate the ground thoroughly. This, followed by heavy rains from another source, could cause very large floods on these watersheds. King Creek, Nicholson Creek, and Tucker Creek are particularly susceptible to the type of floods caused by the late August 1940 and June 1949 storms. Undoubtedly storms of this type occur quite often in the mountain regions, but because of the limited size and remoteness of the area affected, very little damage is sustained and the storm is not recorded.

Based upon the maximum flood discharges experienced in the region it is reasonable to expect future flood discharges on the upper French Broad River





TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

MAXIMUM KNOWN FLOOD DISCHARGES

REGION OF
BREVARD, N.C.

MAY 1964

HD-1311

Figure 20.--FLOOD HEIGHTS ALONG FRENCH BROAD RIVER

Upper view shows the sewage pumping station on New School Road, at Mile 197.7. Lower view shows Patton's Store in Pisgah Forest, in the French Broad River flood plain but 0.4 mile up the Davidson River. Arrows show heights of the Regional and Maximum Probable Floods on the French Broad River. The Maximum Probable Flood on the Davidson River would be substantially the same in the lower view as the Regional Flood on the main stream, and the Regional Flood on the Davidson River would be one-half foot above the floor of the store.

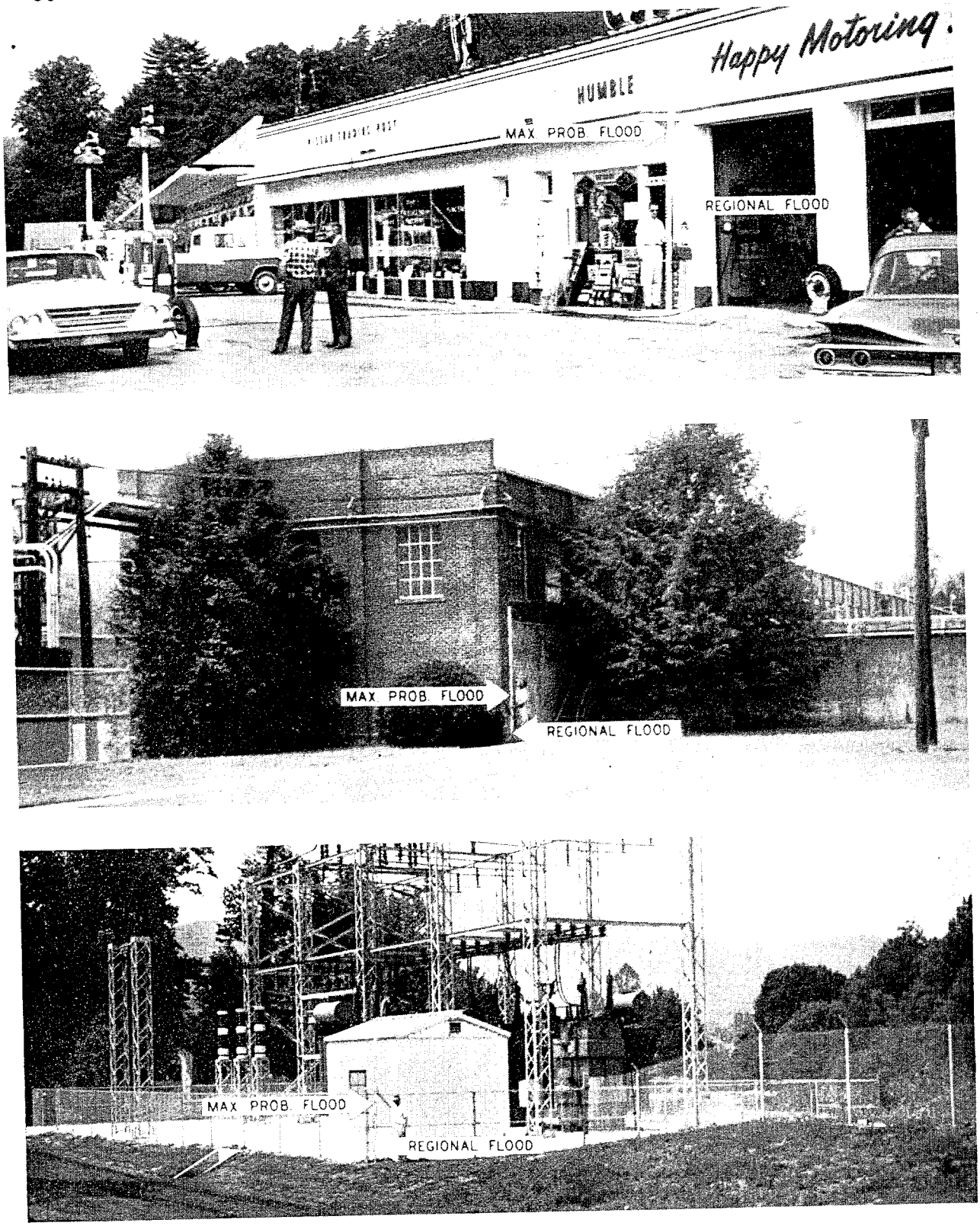


Figure 21.--FLOOD HEIGHTS ALONG DAVIDSON RIVER

Top view is the Pisgah Trading Post at Mile 2.15, on U. S. Highways 64 & 276. Middle view is the filter plant of the Olin Mathieson Chemical Corporation at Mile 1.4. Bottom view is the Duke Power Company substation serving the Olin plant, at Mile 1.29. Arrows show heights of the Regional and Maximum Probable Floods.

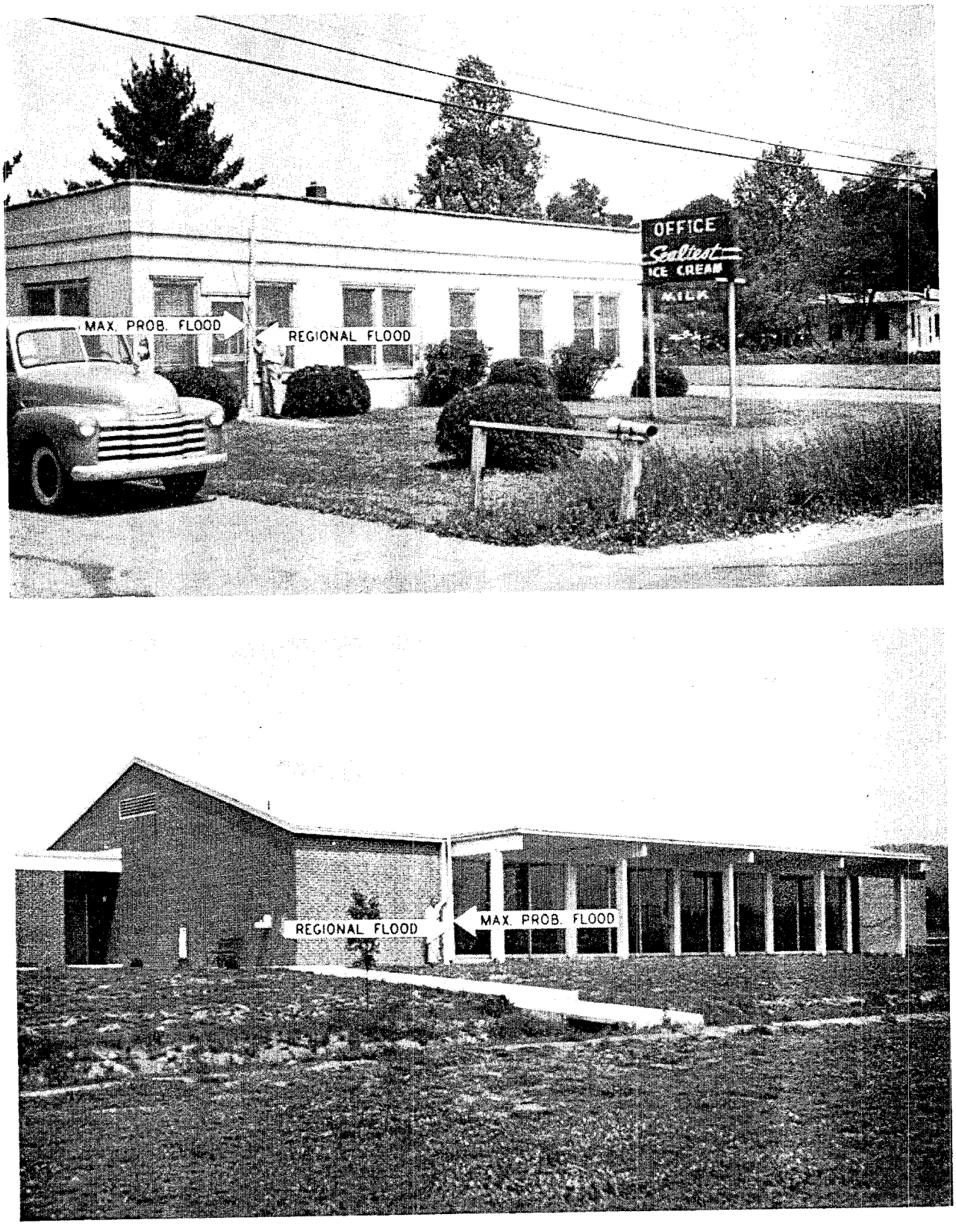


Figure 22.--FLOOD HEIGHTS ALONG KING CREEK

Upper view is the Sealtest office and salesroom at Mile 1.35, on U. S. Highways 64 & 276. Lower view is the Physical Education Building of Brevard College, at Mile 1.17. Arrows show the Regional and Maximum Probable Flood heights.

Figure 23.--FLOOD HEIGHTS ALONG NICHOLSON CREEK

This service station is located at Mile 1.61 of the creek, on U. S. Highway 64. Arrows show the heights of the Regional and Maximum Probable Floods.

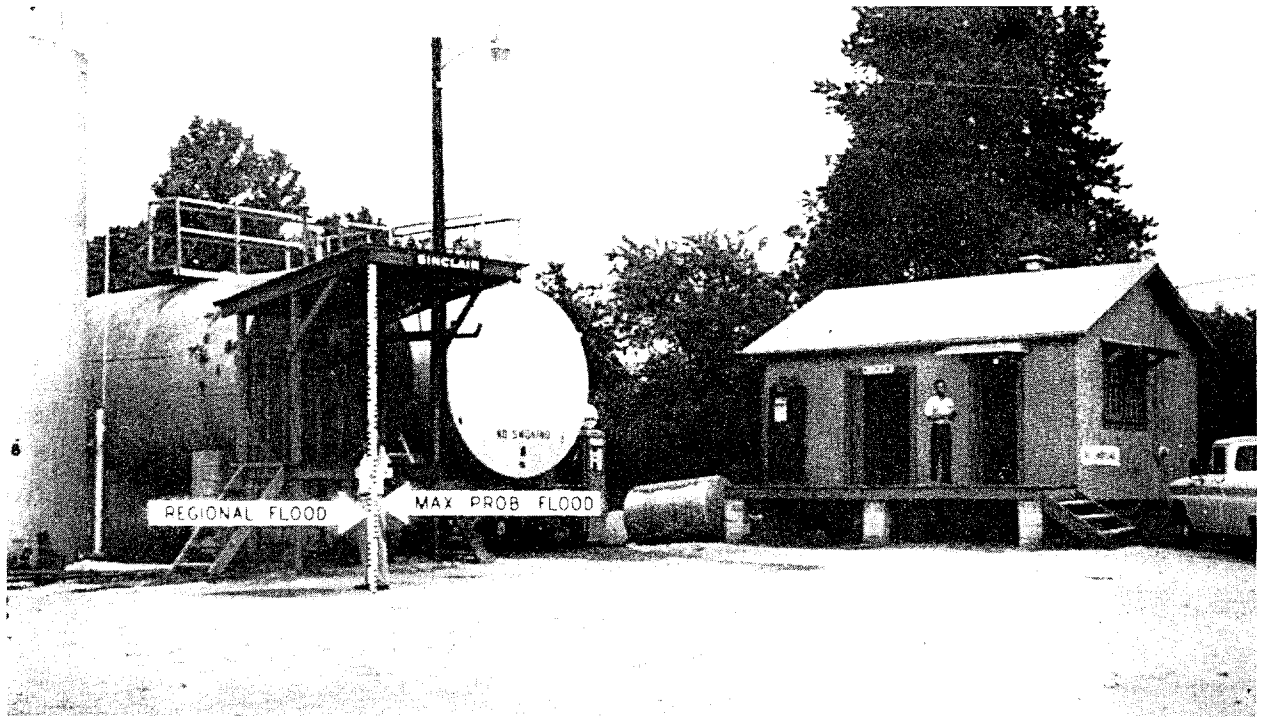


Figure 24.--FLOOD HEIGHTS ALONG TUCKER CREEK

The Sinclair bulk oil station is at Mile 0.35, on U. S. Highway 64. Arrows show Regional and Maximum Probable Flood heights.

TABLE 17

REGIONAL FLOOD PEAK DISCHARGES

Stream	Location	River Mile	Drainage Area sq. mi.	Discharge cfs
French Broad River	U. S. Highway 276	196.51	156	42,500
Davidson River	U. S. Highways 64 & 276	2.13	40.4	24,800
King Creek	U. S. Highways 64 & 276	1.33	3.69	10,700
Nicholson Creek	U. S. Highway 64	1.60	2.99	9,600
Tucker Creek	U. S. Highway 64	0.33	1.48	6,500

and its tributaries to be in the order of those given in Table 17. For the purposes of this report, floods of this magnitude are designated as Regional Floods.

A Regional Flood may occur on the French Broad River in the reach investigated that would be from 0 to 6 feet higher than the July 1916 flood but about 4 feet higher in the immediate vicinity of Brevard. On Davidson River a Regional Flood may occur about 2 to 12 feet higher than the July 16, 1916, flood, being about 6 feet higher over most of the reach. A Regional Flood may occur on King Creek about 1 to 8 feet higher than the top of the banks, being about 4 feet higher over most of the reach. On Nicholson Creek a Regional Flood may occur about 3 to 10 feet higher than the top of banks, but generally about 6 feet higher. A Regional Flood on Tucker Creek may occur which would be from 3 to 8 feet higher than the top of banks, being about 5 feet higher over most of the reach.

The profile of the Regional Flood on French Broad River is shown on Plate 23. Plate 25 shows the Regional Flood profile on Davidson River, and Plate 26 shows the Regional Flood profiles on King, Nicholson, and Tucker Creeks. Figures 20 to 24 show the height that would be reached by the Regional Flood at several locations in the vicinity of Brevard.

IV.

MAXIMUM PROBABLE FLOODS

IV.

MAXIMUM PROBABLE FLOODS[1]

This section discusses the Maximum Probable Floods on the streams involved in this study and some of the hazards of great floods. Floods of the magnitude of the Maximum Probable Flood are the kind considered in planning construction and operation of protective works, the failure of which might be disastrous. They represent reasonable upper limits of expected flooding.

Drainage areas of the streams involved in this study are as follows:

Stream	From mile	To mile	Drainage Area: Downstream Limit sq. mi.	Drainage Area: Upstream Limit sq. mi.
French Broad River	186.9	208.4	291	130
Davidson River	0	4.47	47.3	37.4
King Creek	0	2.38	4.60	2.89
Nicholson Creek	0	2.18	5.13	0.19
Tucker Creek	0	1.38	1.50	0.98

Extreme floods on these streams are most likely to result from either of two types of storms--intense periods of rainfall during winter storms of fairly long duration, or short-duration storms of the cloudburst or hurricane type usually occurring during summer or early fall. Infiltration and other losses are generally low in winter and generally high in summer.

DETERMINATION OF FLOOD DISCHARGES

In determining the Maximum Probable Floods on the five streams involved in this study, consideration was given to great storms and floods that have already occurred on these watersheds and to those which have occurred elsewhere but could have occurred in this area. This procedure provides information about possible floods and storms additional to that which can be gained from the short-term local hydrologic records alone.

---

1. Prepared by Flood Control Branch.

There are no known flood records for King, Nicholson, and Tucker Creeks from which a maximum known flood can be determined.

The maximum known flood on the French Broad River in the vicinity of Brevard occurred on July 16, 1916. The peak discharge is estimated to have been 50,700 cubic feet per second at the Blantyre gage site, Mile 183.7, near the downstream limit of the study.

On the Davidson River in the vicinity of Brevard, the maximum known flood occurred in June 1876 with a peak discharge estimated to have been 8,500 cfs.

It is reasonable to expect that greater floods will occur on these streams.

Observed Storms

Observed storms are meteorologically transposable to the Brevard area from within a broad region extending generally from the Atlantic Ocean to the Appalachian Divide and from Florida through Pennsylvania. The moisture source for storms in this region is the warm, moist air flowing northward from the tropical Atlantic Ocean. In general, the moisture potential for a given region decreases with its increased distance from the moisture source. Transposition of storms from within the broad region includes adjustments for the particular meteorological conditions to be expected at Brevard. Table 18 lists known rainfall depths for several large storms transposable to this area.

TABLE 18

SELECTED MAXIMUM OBSERVED STORMS TRANSPOSABLE TO THE REGION OF BREVARD, NORTH CAROLINA

Date	Location	Area sq. mi.	Rainfall Duration hours	Rainfall Depth inches
July 1916	North Carolina	10	6	8.0
		50	6	7.5
		130	8	8.7
		290	8	8.3
July 1938	North Carolina	4.0	1	6.0
August 1939	New Jersey	10	6	9.7
		50	6	9.3
		130	8	11.6
		290	8	10.7
September 1940	New Jersey	10	6	20.1
		50	6	18.6
		130	8	17.6
		290	8	14.8
July 1960	Georgia	Point	3	12.5
June 1961	North Carolina	3.49	2.5	8.5

IV.

MAXIMUM PROBABLE FLOODS[1]

This section discusses the Maximum Probable Floods on the streams involved in this study and some of the hazards of great floods. Floods of the magnitude of the Maximum Probable Flood are the kind considered in planning construction and operation of protective works, the failure of which might be disastrous. They represent reasonable upper limits of expected flooding.

Drainage areas of the streams involved in this study are as follows:

Stream	From mile	To mile	Drainage Area: Downstream Limit sq. mi.	Drainage Area: Upstream Limit sq. mi.
French Broad River	186.9	208.4	291	130
Davidson River	0	4.47	47.3	37.4
King Creek	0	2.38	4.60	2.89
Nicholson Creek	0	2.18	5.13	0.19
Tucker Creek	0	1.38	1.50	0.98

Extreme floods on these streams are most likely to result from either of two types of storms--intense periods of rainfall during winter storms of fairly long duration, or short-duration storms of the cloudburst or hurricane type usually occurring during summer or early fall. Infiltration and other losses are generally low in winter and generally high in summer.

DETERMINATION OF FLOOD DISCHARGES

In determining the Maximum Probable Floods on the five streams involved in this study, consideration was given to great storms and floods that have already occurred on these watersheds and to those which have occurred elsewhere but could have occurred in this area. This procedure provides information about possible floods and storms additional to that which can be gained from the short-term local hydrologic records alone.

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On the Davidson River in the vicinity of Brevard, the maximum known flood occurred in June 1876 with a peak discharge estimated to have been 8,500 cfs.

It is reasonable to expect that greater floods will occur on these streams.

Observed Storms

Observed storms are meteorologically transposable to the Brevard area from within a broad region extending generally from the Atlantic Ocean to the Appalachian Divide and from Florida through Pennsylvania. The moisture source for storms in this region is the warm, moist air flowing northward from the tropical Atlantic Ocean. In general, the moisture potential for a given region decreases with its increased distance from the moisture source. Transposition of storms from within the broad region includes adjustments for the particular meteorological conditions to be expected at Brevard. Table 18 lists known rainfall depths for several large storms transposable to this area.

TABLE 18

SELECTED MAXIMUM OBSERVED STORMS TRANSPOSABLE TO THE REGION OF BREVARD, NORTH CAROLINA

Date	Location	Area	Rainfall	
			Duration	Depth
		sq. mi.	hours	inches
July 1916	North Carolina	10	6	8.0
		50	6	7.5
		130	8	8.7
		290	8	8.3
July 1938	North Carolina	4.0	1	6.0
August 1939	New Jersey	10	6	9.7
		50	6	9.3
		130	8	11.6
		290	8	10.7
September 1940	New Jersey	10	6	20.1
		50	6	18.6
		130	8	17.6
		290	8	14.8
July 1960	Georgia	Point	3	12.5
June 1961	North Carolina	3.49	2.5	8.5

Upon the basis of these and other data as adjusted for conditions at Brevard, the following rainstorms were adopted for computing the Maximum Probable Floods.

Location	Drainage Area sq. mi.	Rainfall Duration hours	Rainfall Depth inches
French Broad River			
Upper limit	130	4	13.1
Lower limit	291	8	15.8
Davidson River			
Upper limit	37.4	2	10.5
Lower limit	47.3	4	14.9
King Creek			
Upper limit	2.89	0.7	8.4
Lower limit	4.60	1.3	11.6
Nicholson Creek			
Mile 2.12	2.61	0.6	8.1
Lower limit	5.13	1.0	8.9
Tucker Creek			
Upper limit	0.98	0.4	7.4
Lower limit	1.50	1.0	10.5

From a meteorological standpoint, storms as much as 45 percent greater than these can occur.

Observed Floods

Factors such as the meteorology of the region and flood-producing characteristics of the watershed were given consideration in determining whether peak discharges on other streams are applicable. Tables 16 and 19 list peak discharges for observed floods on streams of approximately the size of those discussed in this report. For comparison, the discharges of the maximum known floods on the French Broad and Davidson Rivers are listed.

TABLE 19

SELECTED MAXIMUM OBSERVED FLOODS

Stream	Location	Drainage Area sq. mi.	Year	Peak Discharge Amount cfs	Peak Discharge Per Sq. Mi. cfs
Dutch Creek	Valle Crucis, N. C.	2.42	1940	9,200	3,800
N. F. Catawba R.	Asheford, N. C.	5.2	1940	15,000	2,900
Steels Creek	Tablerock, N. C.	16.0	1940	24,000	1,500
Cane Creek	Bakersville, N. C.	22	1901	29,500	1,340
Stony Fork	Hendrix, N. C.	27.1	1940	37,000	1,370
Watauga River	Valle Crucis, N. C.	33.1	1940	38,000	1,150
N. F. Catawba R.	Woodlawn, N. C.	41.8	1940	55,000	1,320
Elk Creek	Elkville, N. C.	50	1940	70,000	1,400
Wilson Creek	Adako, N. C.	66	1940	99,000	1,500
Catawba River	Marion, N. C.	170	1940	71,000	418
N. F. Catawba R. Dam	Bridgewater, N. C.	380	1940	141,760	373
Davidson River	Brevard, N. C.	40.4	1876	8,500	210
French Broad R.	Calvert, N. C.	103	1916	22,000	214
French Broad R.	Blantyre, N. C.	296	1916	50,700	172

Maximum Probable Flood Discharge

From consideration of the flood discharges in Table 19 and of the transposition to the Brevard area of outstanding storms, the peak discharge of the Maximum Probable Flood at selected locations was determined to be as shown in Table 20.

The adopted discharges, while considerably greater than any known past floods on these streams, are well supported by observed floods which have occurred in similar nearby watersheds.

Frequency

It is not possible to assign a probability of occurrence or frequency to the Maximum Probable Flood. The occurrence of such a flood would be a rare event; however, it could occur in any year.

TABLE 20

MAXIMUM PROBABLE FLOOD PEAK DISCHARGES

Location	Drainage Area sq. mi.	Peak Discharge cfs
French Broad River		
Upper limit	130	79,000
Lower limit	291	87,000
Davidson River		
Upper limit	37.4	45,000
Lower limit	47.3	52,000
King Creek		
Upper limit	2.89	13,500
Lower limit	4.60	16,500
Nicholson Creek		
Mile 2.12	2.61	14,000
Lower limit	5.13	17,500
Tucker Creek		
Upper limit	0.77	6,800
Lower limit	1.50	8,100

Possible Larger Floods

Floods larger than the Maximum Probable are hydrologically possible; however, the combination of factors that would be necessary to produce such floods would seldom occur. That such floods can occur is shown in Table 16, which includes an observed flood on Big Creek near Waynesville, North Carolina, on August 30, 1940. The peak discharge was 12,900 cubic feet per second from a drainage area of 1.32 square miles. This discharge is greater than the Maximum Probable Flood on Tucker Creek, as shown graphically on Plate 8. The consideration of floods of this magnitude is of greater importance in some problems than in others but should not be overlooked in the study of any problem.

HAZARDS OF GREAT FLOODS

The amount and extent of damage caused by any flood depend in general upon how much area is flooded, the height of flooding, the velocity of flow, the rate of rise, and the duration of flooding.

Areas and Heights of Flooding

The areas flooded by the Maximum Probable and maximum known floods are shown on Plates 9 through 22. Depths of flow can be estimated from the crest profiles which are shown on Plates 23, 25, and 26.

The profiles for the five streams were computed by using stream characteristics for selected reaches as determined from available observed flood profiles, topographic maps, and valley cross sections which were surveyed in 1963. The elevations shown on Plates 23, 25, and 26 and the overflow area shown on Plates 9 through 22 have been determined with an accuracy consistent with the purposes of this study and the accuracy of the basic data. More precision would require costly surveys not warranted by this study.

The profiles of the Maximum Probable Flood depend in part upon the degree of destruction or clogging of various bridges during the floods. Because it is impossible to forecast these events, it was assumed that all bridge structures would stand and that no clogging would occur.

The Maximum Probable Flood profile on the French Broad River is from about 5 to 13 feet higher than the July 1916 flood.

On the Davidson River the Maximum Probable Flood is from 3 to 22 feet above the July 1916 flood, the maximum difference occurring at Mile 2.7, and is the result of heading up at the constricted valley section at Mile 2.37.

Because there are no observed flood profiles available on King, Nicholson, and Tucker Creeks the Maximum Probable Flood profile is referred to the average top-of-bank elevation in order to show the magnitude of flooding. On King, Nicholson, and Tucker Creeks the Maximum Probable Flood is respectively from 1 to 8, 4 to 10, and 4 to 8 feet above the average top-of-bank elevation.

Figures 20 to 24 on pages 85 to 88 show the height that would be reached by the Maximum Probable Flood at several locations in the vicinity of Brevard.

TABLE 21

MAXIMUM PROBABLE FLOOD VELOCITIES

Stream	Feet Per Second			
	Main Channel		Overflow Plain	
	From	To	From	To
French Broad River	2	12	Less than 1	6
Davidson River	2	23	Less than 1	8
King Creek	2	22	Less than 1	11
Nicholson Creek	4	12	Less than 1	6
Tucker Creek	3	15	Less than 1	8

Velocities, Rate of Rise, and Duration

Water velocities during the Maximum Probable Flood depend largely upon the size and shape of the cross section, the condition of the stream, and the bed slope, all of which vary on different streams and at different locations on the same stream.

During the Maximum Probable Flood the range of velocities in the main channel and in the overflow plain of the five streams of this study would be as shown in Table 21.

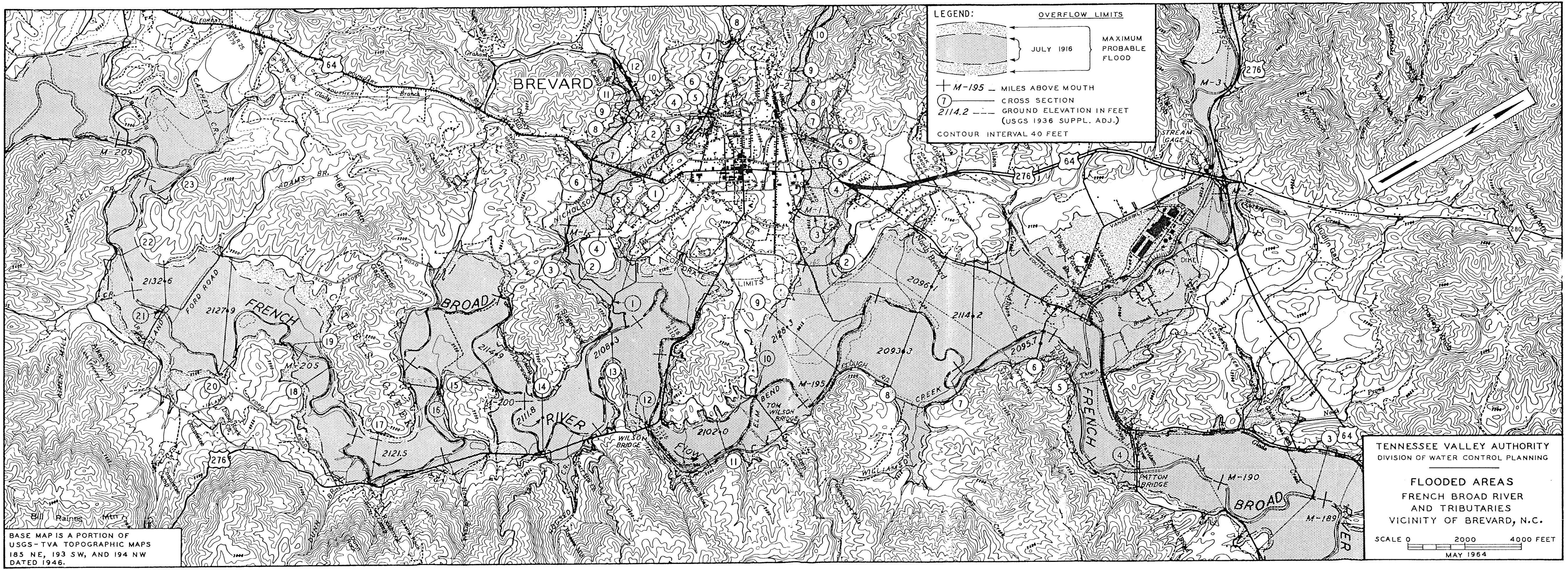
The total rise above low water to the crest stage, the maximum rate of rise, and the duration above bankfull stage of the Maximum Probable Flood on each of these five streams would be as shown in Table 22.

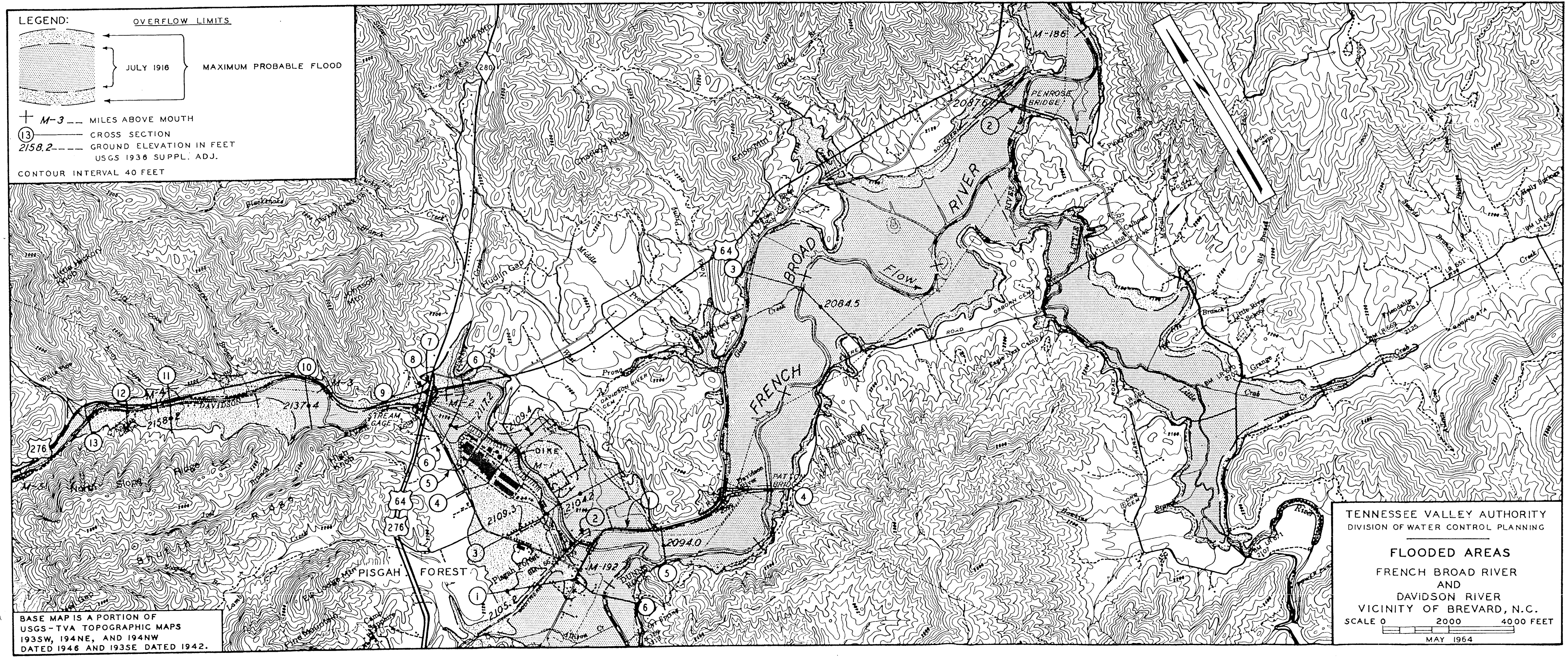
These rapid rates and high stream velocities in combination with deep, long-duration flooding would create a hazardous situation in developed areas.

TABLE 22

MAXIMUM PROBABLE FLOODS - RATE OF RISE AND DURATION

Stream	Location	Total Rise above Low Water	Maximum Rate of Rise	Duration above Bankfull Stage
French Broad River	Mouth of King Creek Mile 194.17	20 feet in 25 hours	5 feet in 2 hours	76 hours
Davidson River	Olin Mathieson plant	17 feet in 4 hours	12 feet in 1 hour	18 hours
King Creek	Below highway bridge Mile 1.36	8 feet in 1.5 hours	5 feet in 0.5 hour	4 hours
Nicholson Creek	Below Country Club Road Mile 0.86	13 feet in 1 hour	8 feet in 0.5 hour	5 hours
Tucker Creek	Below Cashiers Valley Road Mile 0.94	13 feet in 1 hour	10 feet in 0.5 hour	5 hours


LEGEND:
OVERFLOW LIMITS
JULY 1916
MAXIMUM PROBABLE FLOOD
M-195 — MILES ABOVE MOUTH
7 — CROSS SECTION
2114.2 — GROUND ELEVATION IN FEET (USGS 1936 SUPPL. ADJ.)
CONTOUR INTERVAL 40 FEET
BREVARD
FRENCH BROAD RIVER
CORPORATE LIMITS
STREAM GAGE
DIKE
PATTON BRIDGE
TON WILSON BRIDGE
WILSON BRIDGE
M-1
M-2
M-3
M-190
M-189
M-205
M-200
M-195
64
276
280
BASE MAP IS A PORTION OF USGS-TVA TOPOGRAPHIC MAPS 185 NE, 193 SW, AND 194 NW DATED 1946.
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
FLOODED AREAS
FRENCH BROAD RIVER AND TRIBUTARIES
VICINITY OF BREVARD, N.C.
SCALE 0 2000 4000 FEET
MAY 1964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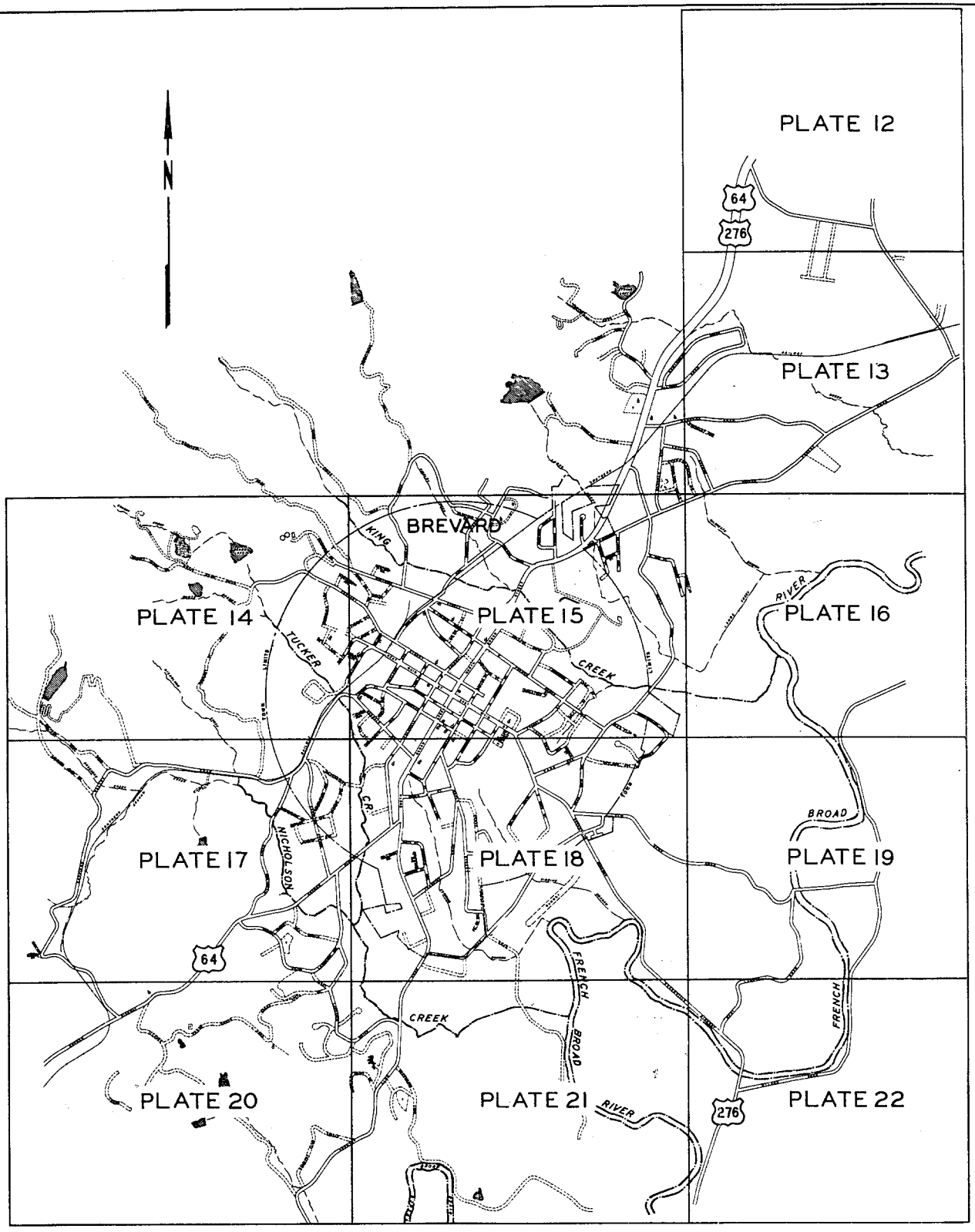
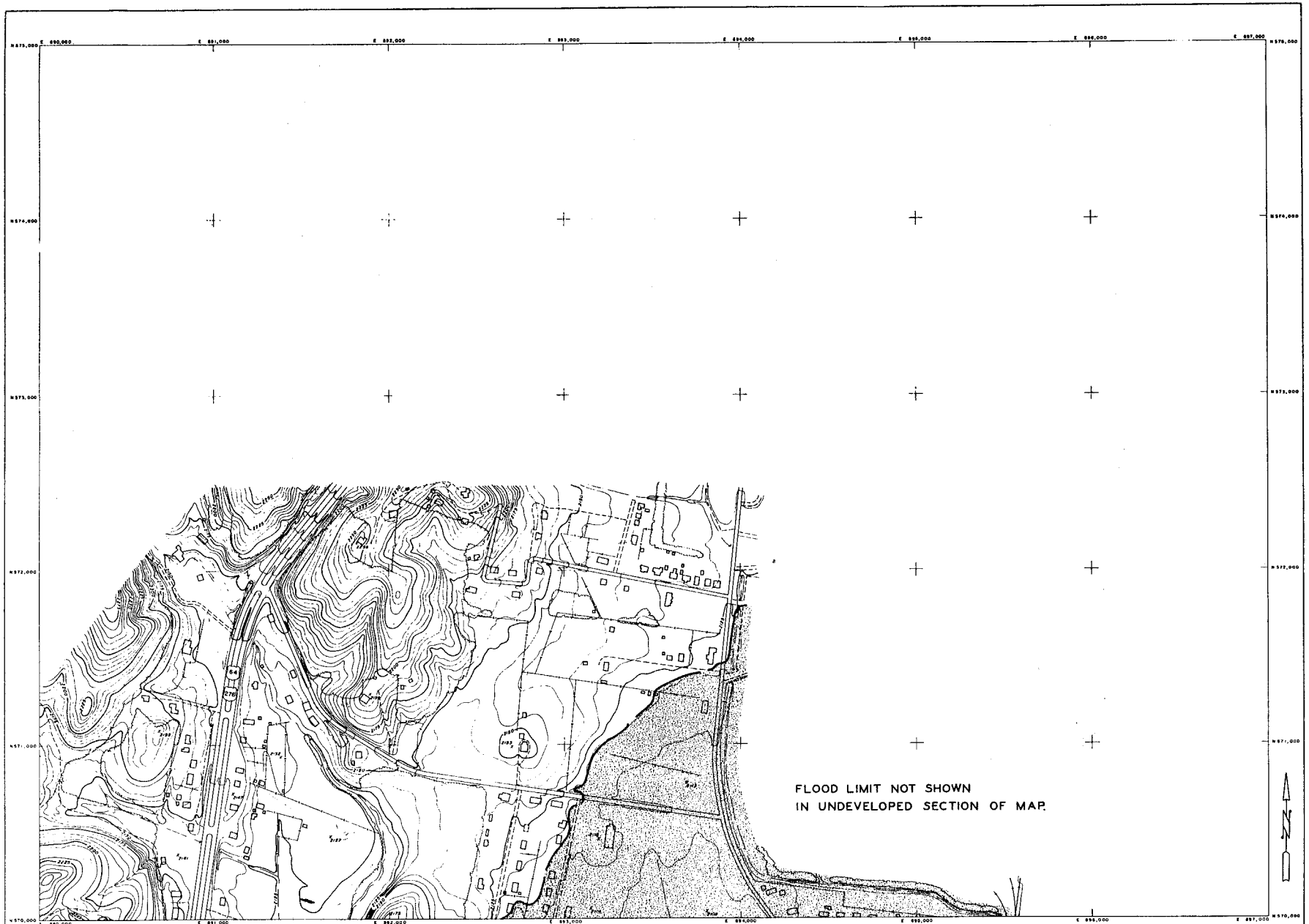
OVERFLOW LIMITS
JULY 1916
MAXIMUM PROBABLE FLOOD
M-3 MILES ABOVE MOUTH
CROSS SECTION
2158.2 GROUND ELEVATION IN FEET USGS 1936 SUPPL. ADJ.
CONTOUR INTERVAL 40 FEET
BASE MAP IS A PORTION OF USGS-TVA TOPOGRAPHIC MAPS 193SW, 194NE, AND 194NW DATED 1946 AND 193SE DATED 1942.
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
FLOODED AREAS
FRENCH BROAD RIVER AND DAVIDSON RIVER VICINITY OF BREVARD, N.C.
SCALE 0 2000 4000 FEET
MAY 1964
FRENCH BROAD RIVER
DAVIDSON RIVER
PISGAH FOREST
PENROSE BRIDGE
DIKE
STREAM GAGE
M-1
M-2
M-3
M-4
M-186
M-192
2087.0
2084.5
2094.0
2137.4
2158.2
2117.2
2109.4
2104.2
2109.3
2105.2
276
64



SCALE 0 1 2 3 4 5000 FEET

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

INDEX MAP
OF
FLOODED AREA MAPS
PLATE 12 THROUGH PLATE 22
MAY 1964



LEGEND: OVERFLOW LIMITS

MAXIMUM PROBABLE FLOOD

SCALE 0 400 800 FEET

Grid Based on N.C. State Plane Coordinate System, N.A. 1927
Elevations Refer to 1929 Mean Sea Level Datum

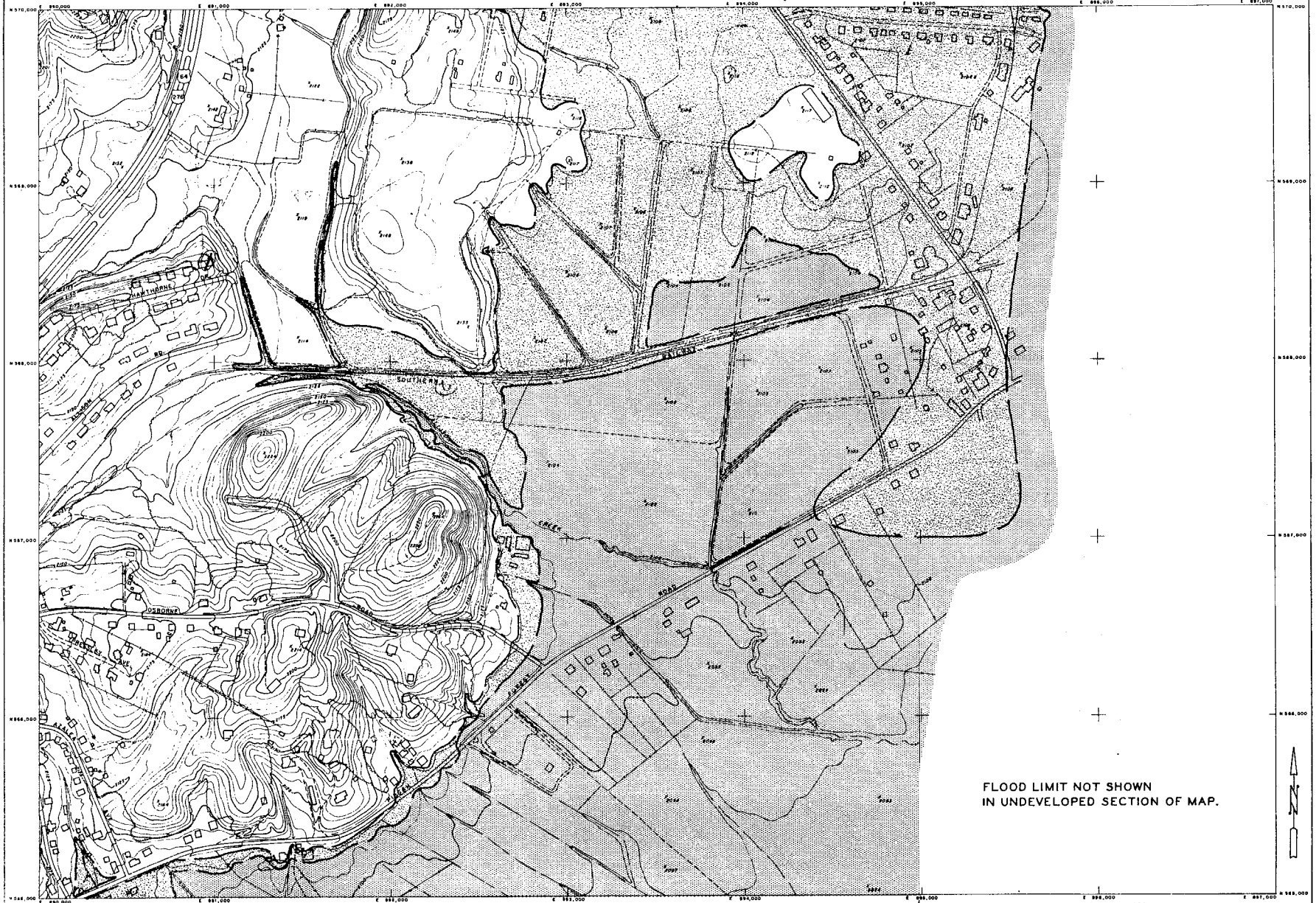
Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
PIEDMONT AERIAL SURVEYS, Inc
PHOTOGRAMMETRIC ENGINEERS
GREENSBORO, N.C.

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

FLOODED AREAS
FRENCH BROAD RIVER
BREVARD, N. C.
MAY 1964

KEY TO PLATES

PLATE 12



LEGEND:

OVERFLOW LIMITS

JULY 1916 — MAXIMUM PROBABLE FLOOD

SCALE 0 400 800 FEET

Grid Based on N.C. State Plane Coordinate ... N.A. 1927
Elevations Refer to 1929 Mean Sea Level Datum

Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
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GREENSBORO, N C

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

FLOODED AREAS
FRENCH BROAD RIVER
BREVARD, N. C.
MAY 1964

KEY TO PLATES

PLATE 13

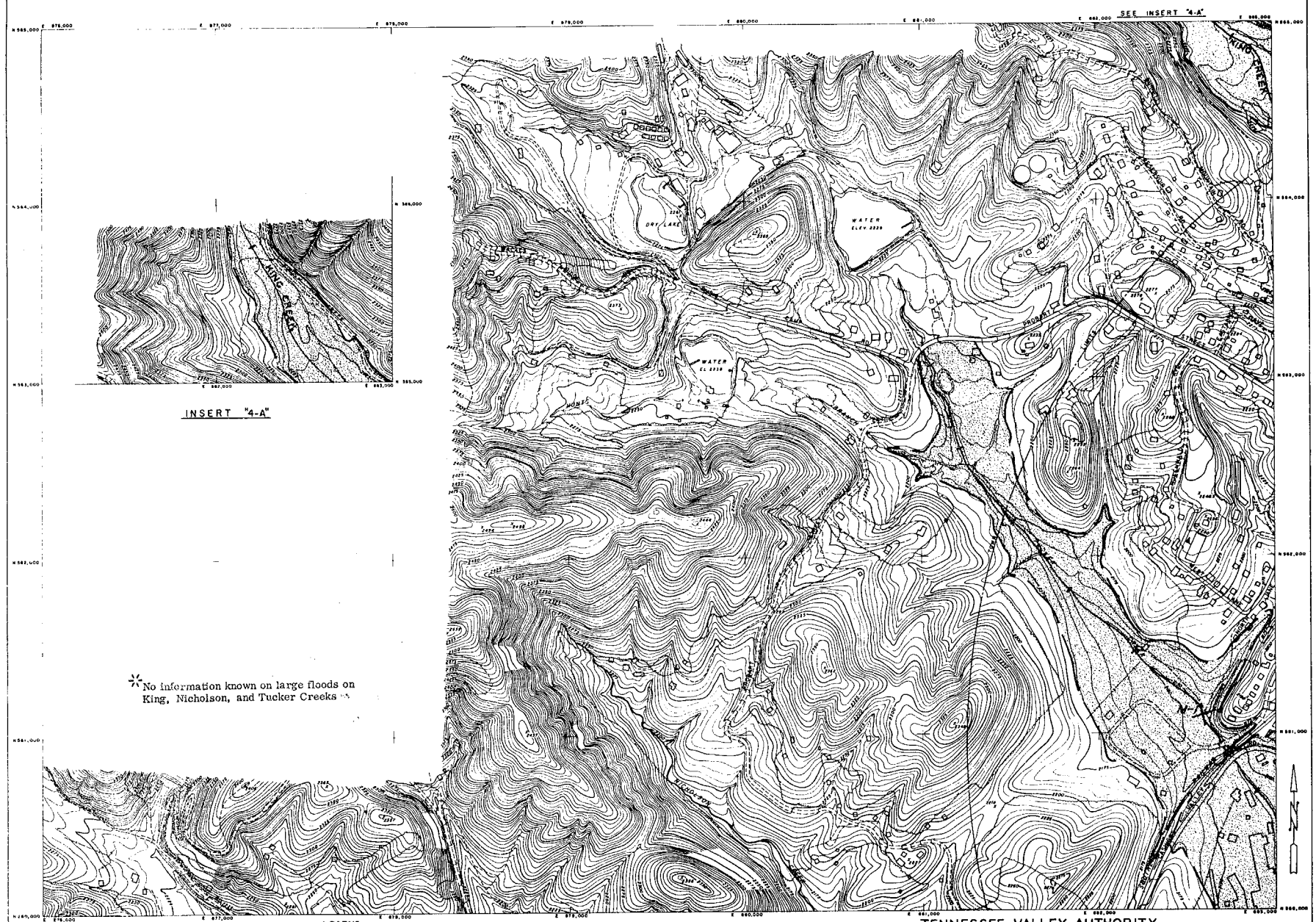
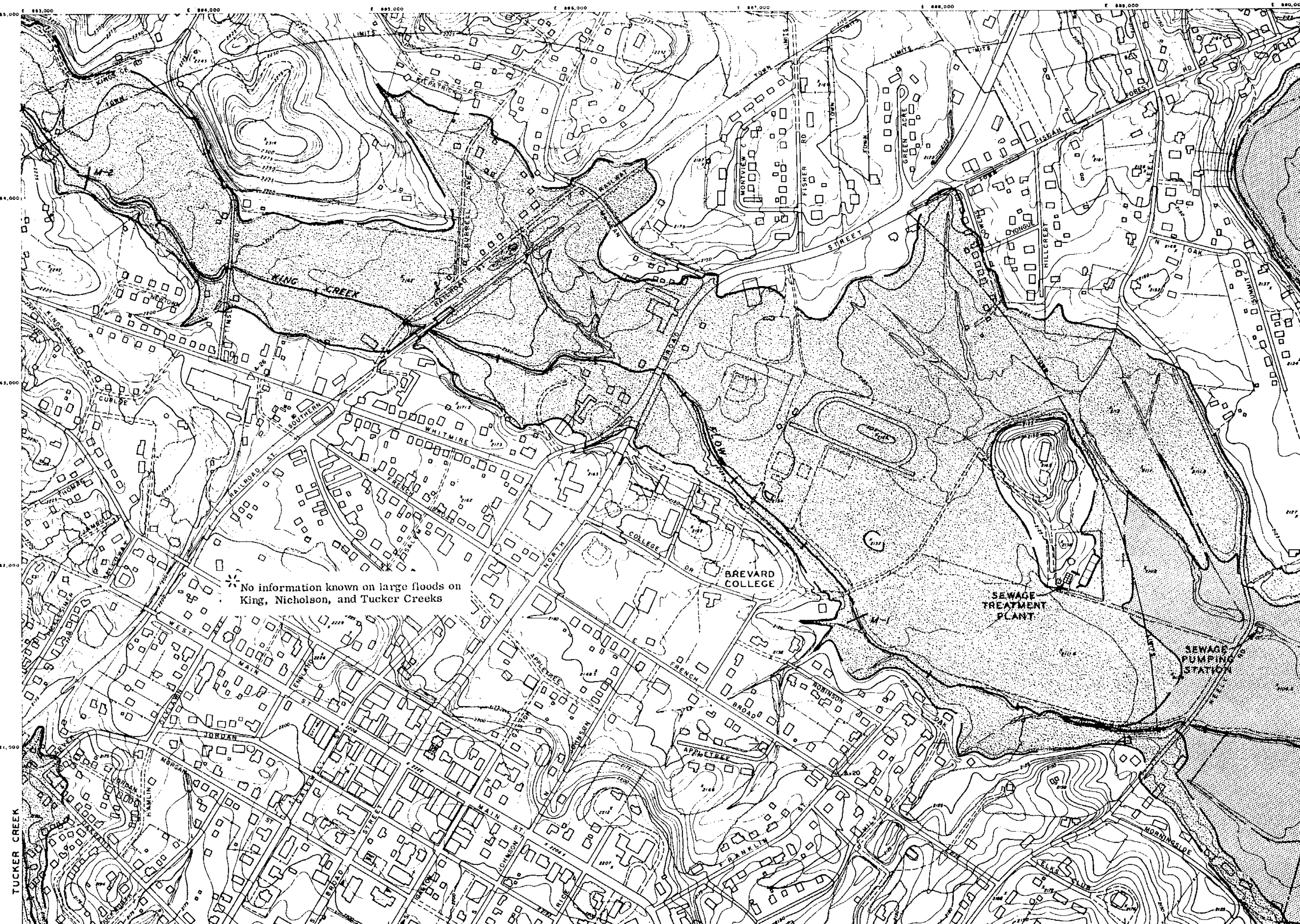

SEE INSERT "4-A"
KING CREEK
DRY LAKE
WATER ELEV 2220
WATER EL 2230
INSERT "4-A"
No information known on large floods on King, Nicholson, and Tucker Creeks
LEGEND: OVERFLOW LIMITS
MAXIMUM PROBABLE FLOOD
SCALE 0 400 800 FEET
Grid Based on N.C. State Plane Coordinate System, N.A. 1927
Elevations Refer to 1929 Mean Sea Level Datum
Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
PIEDMONT AERIAL SURVEYS, Inc.
PHOTOGRAMMETRIC ENGINEERS
GREENSBORO, N.C.
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
FLOODED AREAS
KING AND TUCKER CREEKS
BREVARD, N. C.
MAY 1964
KEY TO PLATES

PLATE 14



Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
PIEDMONT AERIAL SURVEYS, Inc.
PHOTOGRAMMETRIC ENGINEERS
GREENSBORO, N. C.

LEGEND:

OVERFLOW LIMITS

JULY 1916 *

MAXIMUM PROBABLE FLOOD

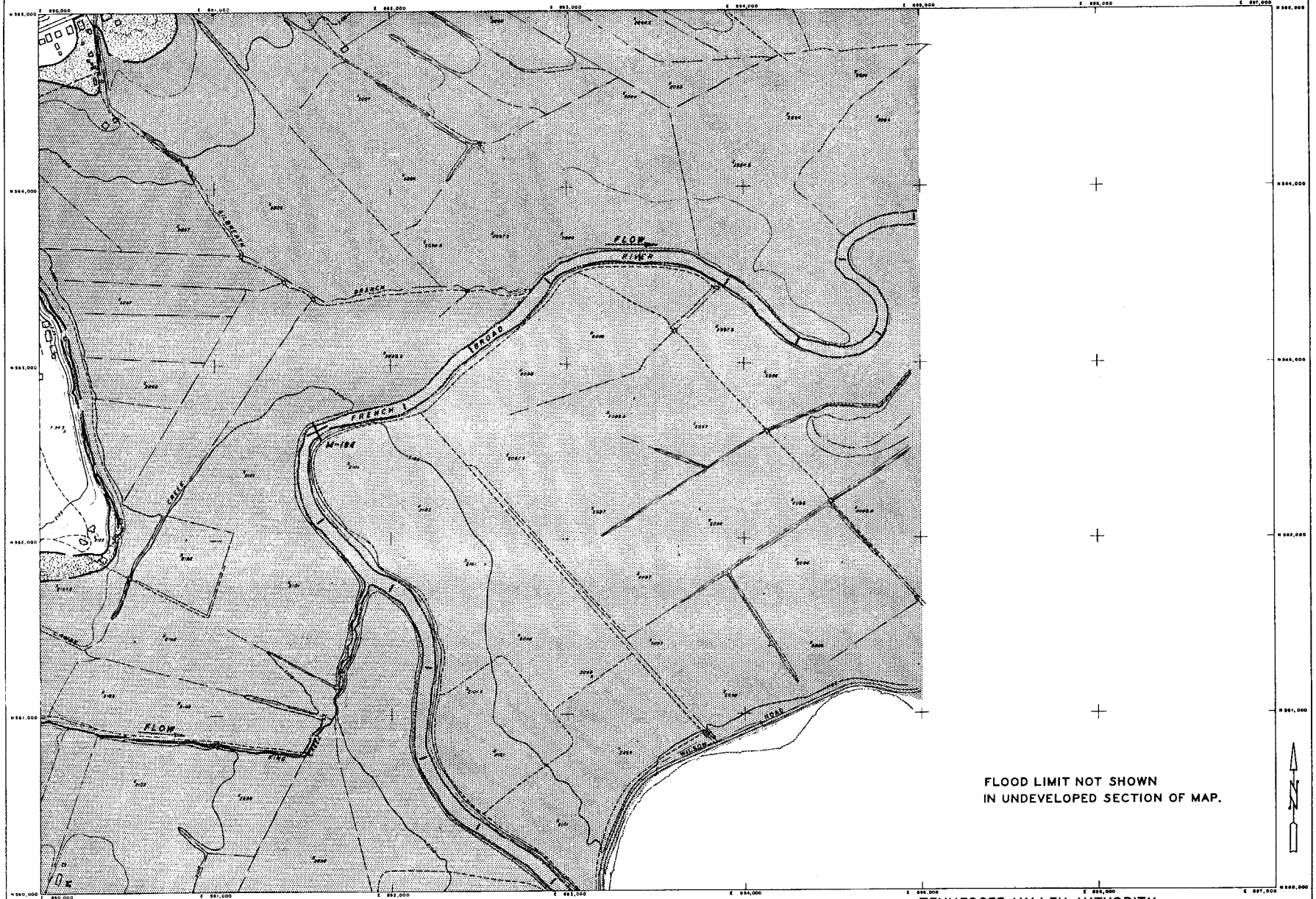
SCALE 0 400 800 FEET

Grid Based on N. C. State Plane Coordinate System, N. A. 1927
Elevations Refer to 1929 Mean Sea Level Datum

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

FLOODED AREAS
KING CREEK
BREVARD, N. C.
MAY 1964

KEY TO PLATES



LEGEND: OVERFLOW LIMITS

JULY 1916 — MAXIMUM PROBABLE FLOOD

SCALE 0 400 800 FEET

Grid Based on N.C. State Plane Coordinate System, N.A. 1927
Elevations Refer to 1929 Mean Sea Level Datum

Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
PIEDMONT AERIAL SURVEYS, Inc.
PHOTOGRAMMETRIC ENGINEERS
GREENSBORO, N.C.

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

FLOODED AREAS
FRENCH BROAD RIVER
BREVARD, N.C.
MAY 1964

KEY TO PLATES

PLATE 16

LEGEND: OVERFLOW LIMITS

MAXIMUM PROBABLE FLOOD

SCALE 0 400 800 FEET

Grid Based on N.C. State Plane Coordinate System, North Zone (1927)
Elevations Refer to 1929 Mean Sea Level Datum

Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
PIEDMONT AERIAL SURVEYS, Inc.
PHOTOGRAMMETRIC ENGINEERS
GREENSBORO, N.C.

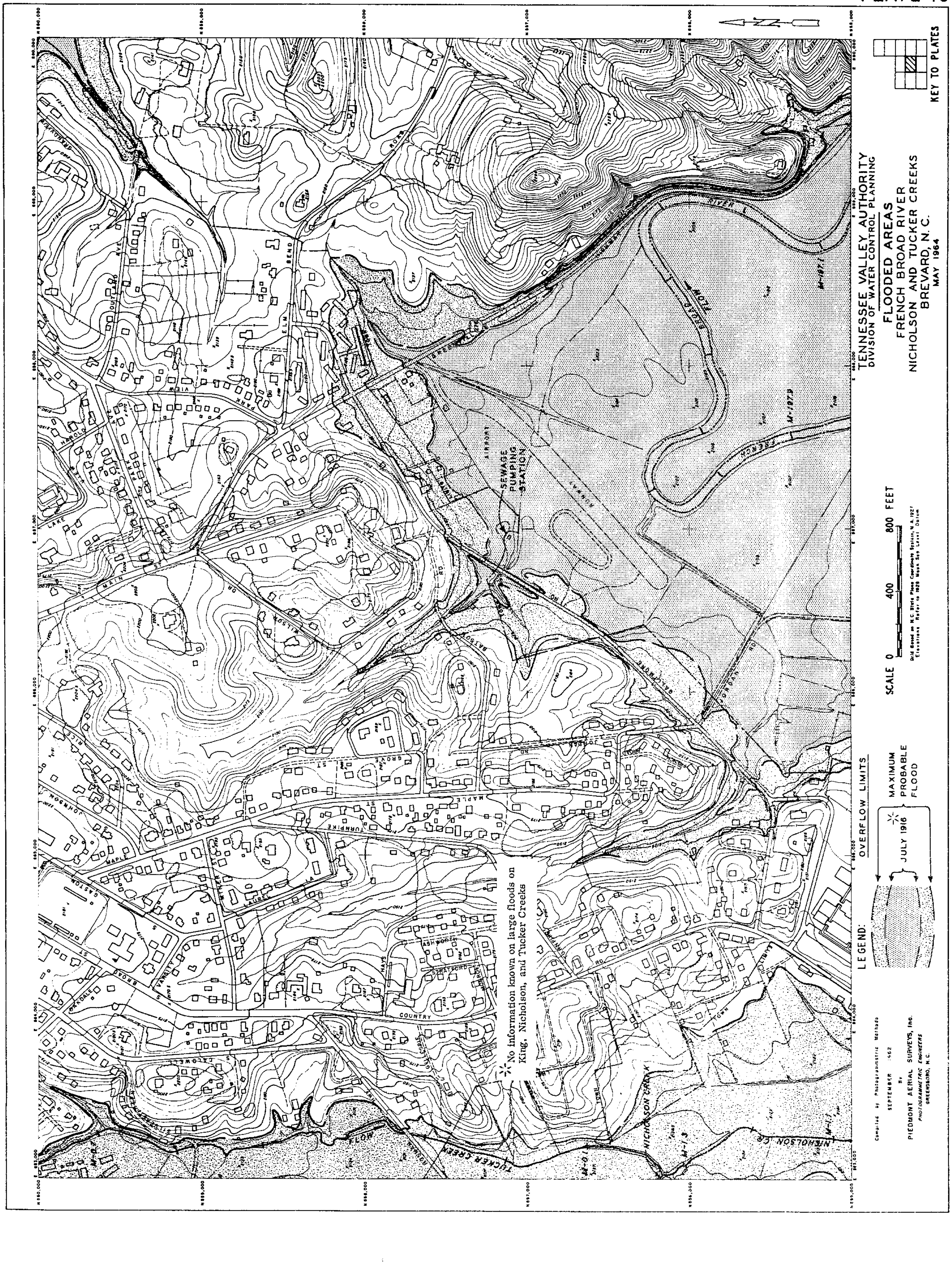
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

FLOODED AREAS
NICHOLSON AND TUCKER CREEKS
BREVARD, N. C.
MAY 1964

KEY TO PLATES

PLATE 17

PLATE 18



TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
FLOODED AREAS
FRENCH BROAD RIVER
NICHOLSON AND TUCKER CREEKS
BREVARD, N.C.
MAY 1964
KEY TO PLATES
SCALE 0 400 800 FEET
LEGEND:
OVERFLOW LIMITS
JULY 1916
MAXIMUM PROBABLE FLOOD
* No information known on large floods on King, Nicholson, and Tucker Creeks
SEWAGE PUMPING STATION
Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
PIEDMONT AERIAL SURVEYS, INC.
PHOTOGRAMMETRIC ENGINEERS
GREENSBORO, N.C.
FRENCH BROAD RIVER
TUCKER CREEK
NICHOLSON CREEK
MAPLE
TURNPIKE
COUNTRY
MAIN
AIRPORT
RUNWAY
ELM
PARK

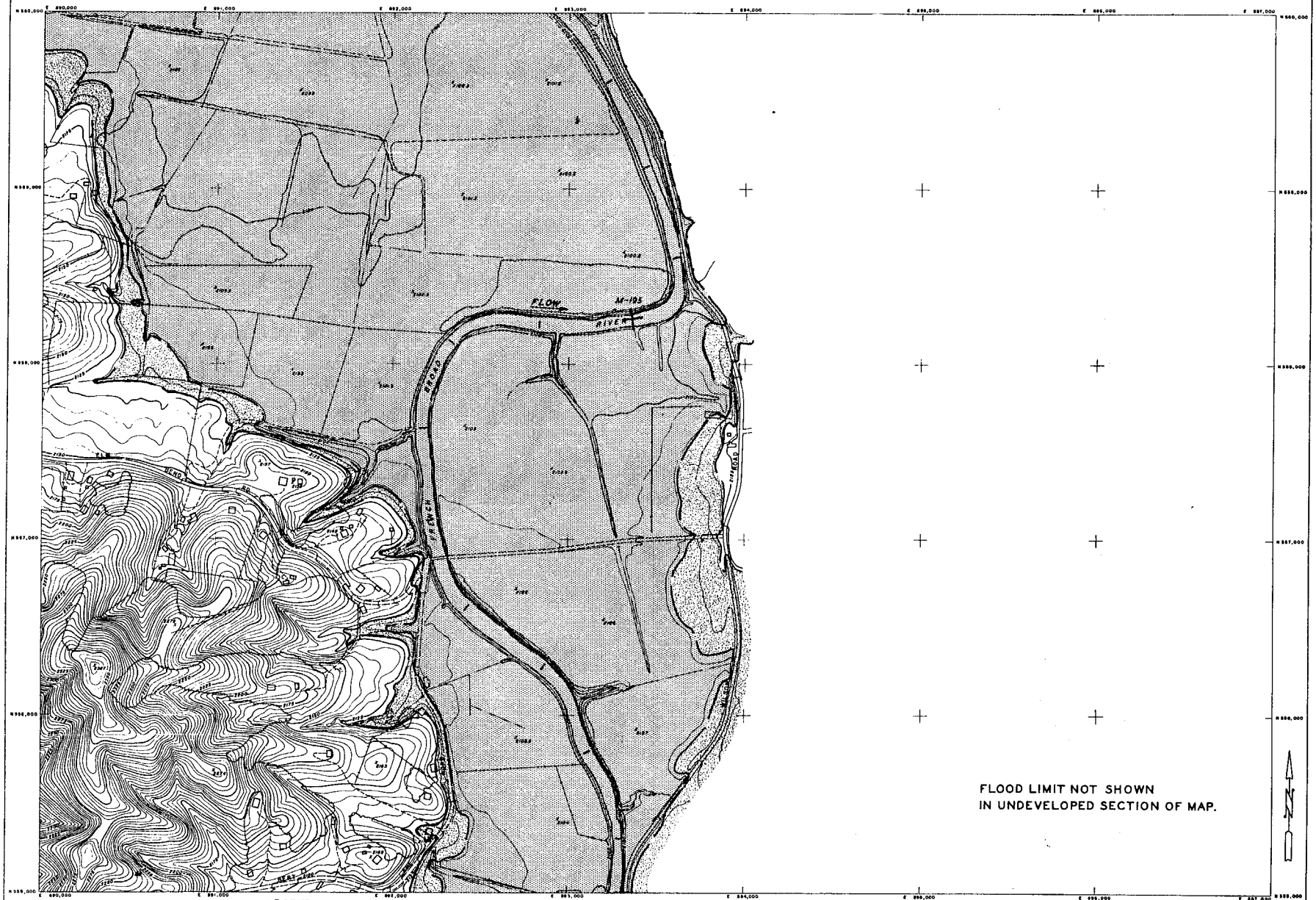
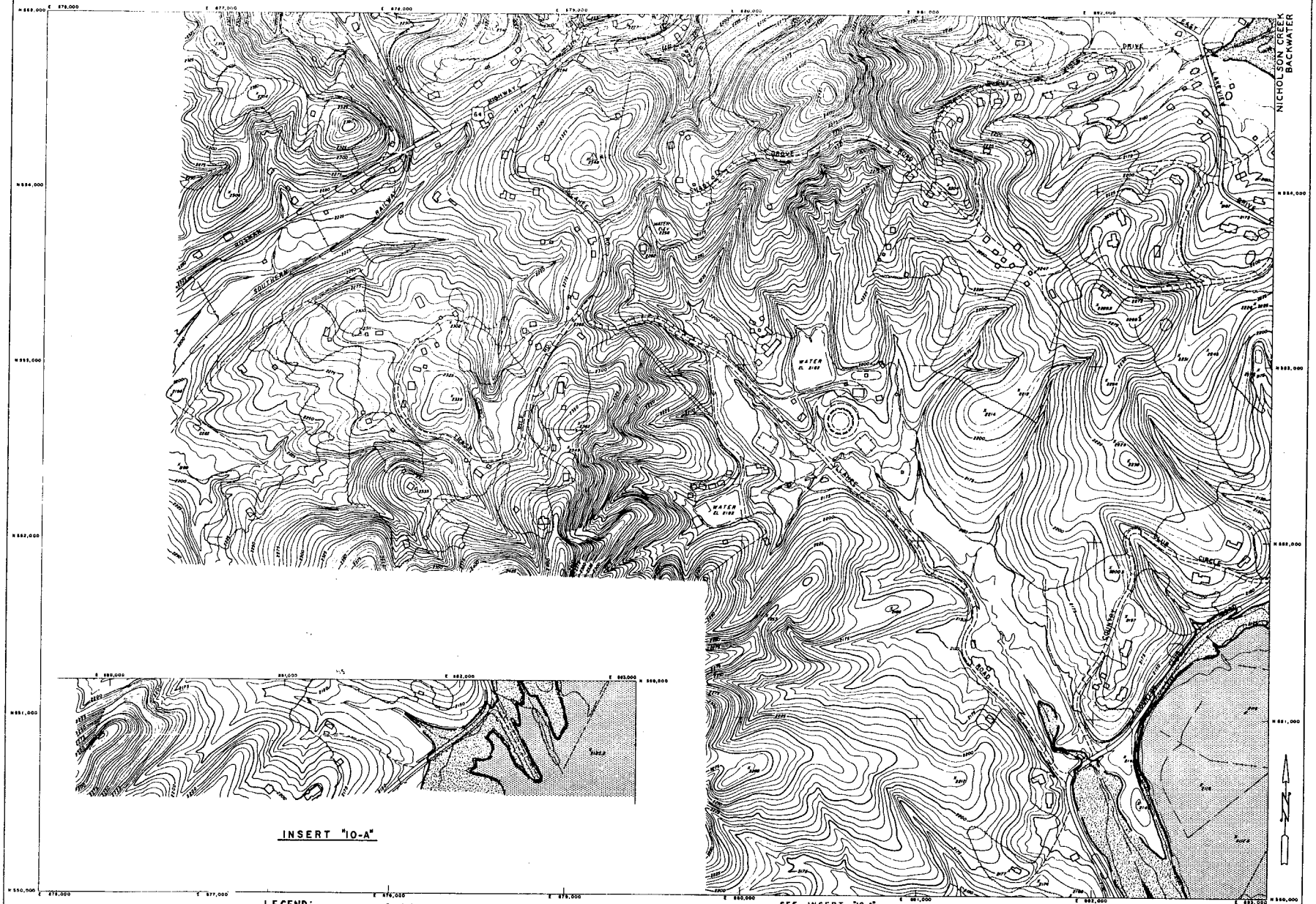

FLOOD LIMIT NOT SHOWN
IN UNDEVELOPED SECTION OF MAP.
N
LEGEND:
OVERFLOW LIMITS
JULY 1916
MAXIMUM
PROBABLE
FLOOD
SCALE 0 400 800 FEET
Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
PIEDMONT AERIAL SURVEYS, Inc.
PHOTOGRAMMETRIC ENGINEERS
GREENSBORO, N. C.
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
FLOODED AREAS
FRENCH BROAD RIVER
BREVARD, N. C.
MAY 1964
KEY TO PLATES

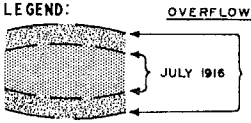
PLATE 19



INSERT "10-A"

Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
PIEDMONT AERIAL SURVEYS, Inc.
PHOTOGRAMMETRIC ENGINEERS
GREENSBORO, N. C.

LEGEND:



OVERFLOW LIMITS
JULY 1916
MAXIMUM PROBABLE FLOOD

SCALE 0 400 800 FEET

Grid Based on N.C. State Plane Coordinate System, N.A. 1927
Elevations Refer to 1929 Mean Sea Level Datum

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

FLOODED AREAS
FRENCH BROAD RIVER
BREVARD, N. C.
MAY 1964

KEY TO PLATES

PLATE 20

Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
PIEDMONT AERIAL SURVEYS, Inc.
PHOTOGRAMMETRIC ENGINEERS
GREENSBORO, N. C.

LEGEND: OVERFLOW LIMITS

JULY 1916 * MAXIMUM PROBABLE FLOOD

SCALE 0 400 800 FEET

Grid Based on N.C. State Plane Coordinate System, N.A.D. 1927
Elevations Refer to 1929 Mean Sea Level Datum

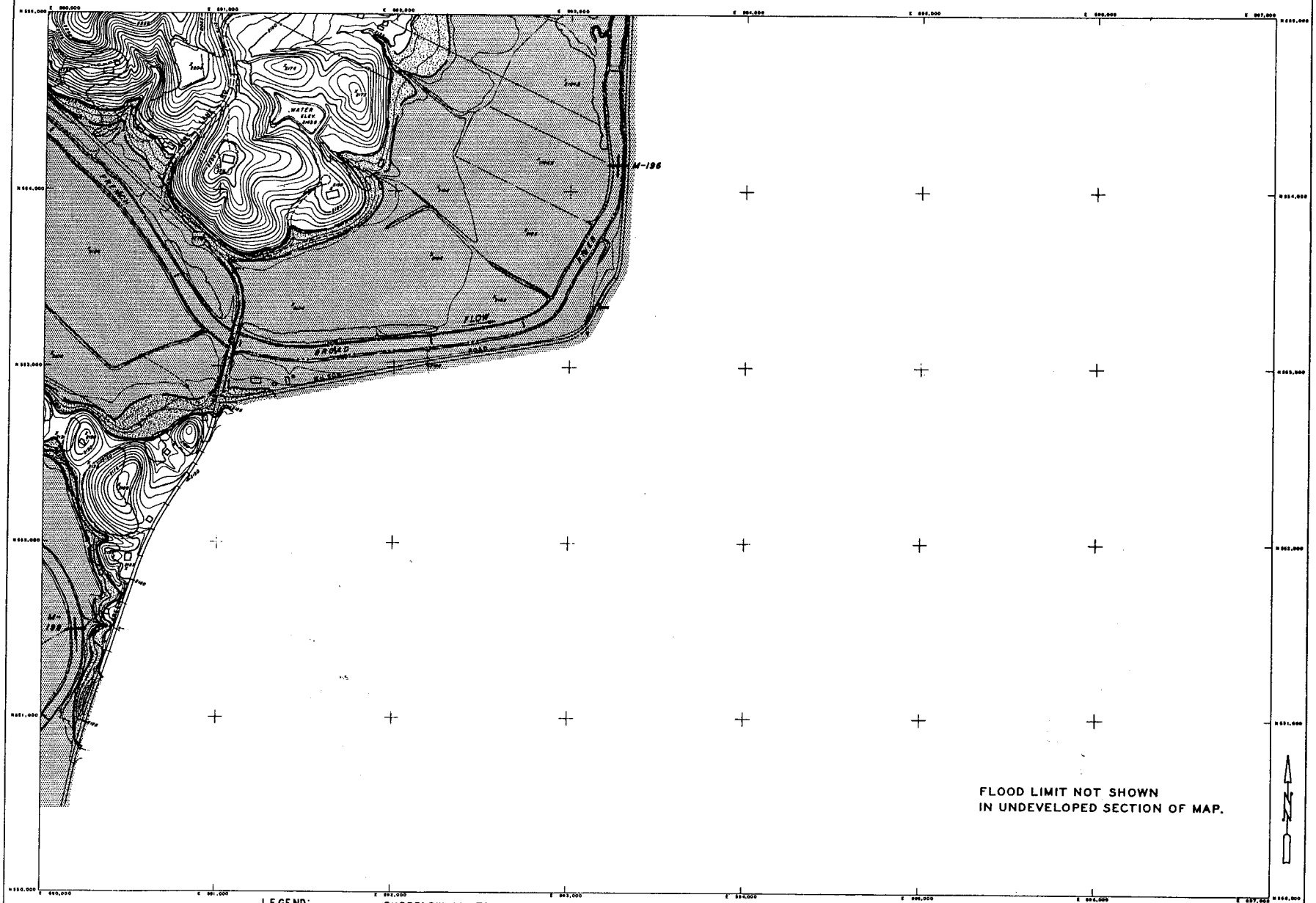
* BACKWATER FROM FRENCH BROAD RIVER ON NICHOLSON CREEK

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

FLOODED AREAS
FRENCH BROAD RIVER
AND NICHOLSON CREEK
BREVARD, N. C.
MAY 1964

KEY TO PLATES

PLATE 21



LEGEND: OVERFLOW LIMITS

JULY 1916 — MAXIMUM PROBABLE FLOOD

SCALE 0 400 800 FEET

Grid Based on N.C. State Plane Coordinate System, N.A. 1927
Elevations Refer to 1929 Mean Sea Level Datum

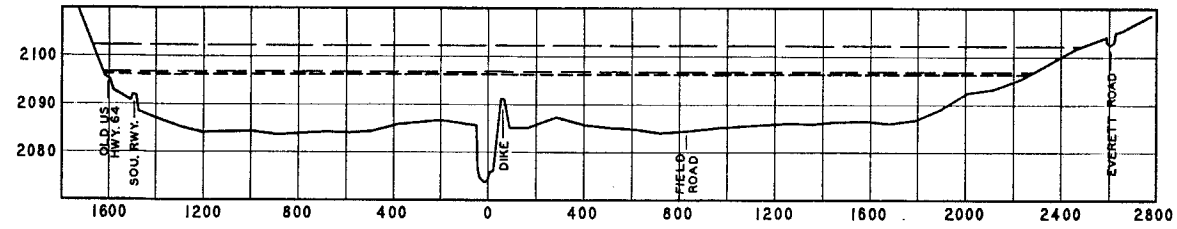
Compiled by Photogrammetric Methods
SEPTEMBER 1962
By
PIEDMONT AERIAL SURVEYS, Inc.
PHOTOGRAMMETRIC ENGINEERS
GREENSBORO, N.C.

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

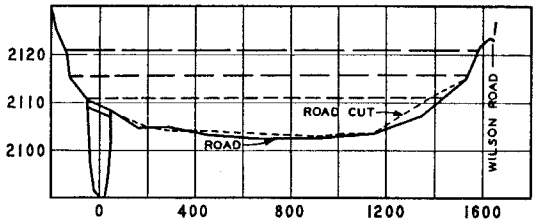
FLOODED AREAS
FRENCH BROAD RIVER
BREVARD, N. C.
MAY 1964

KEY TO PLATES

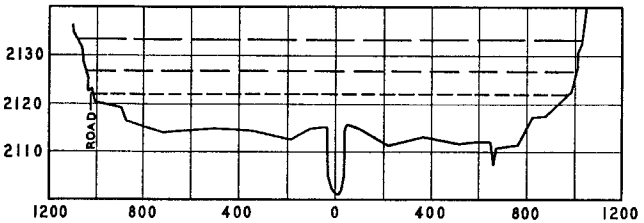
PLATE 22



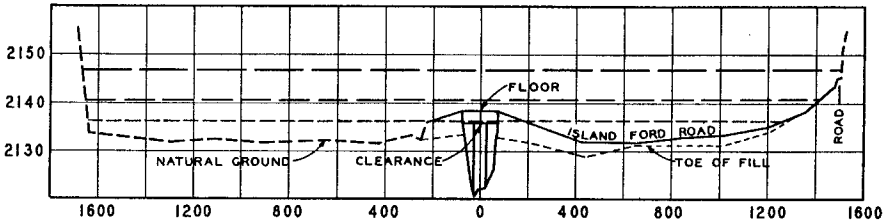
SECTION 3 - MILE 189.08



SECTION 10 - MILE 195.44



SECTION 15 - MILE 200.40

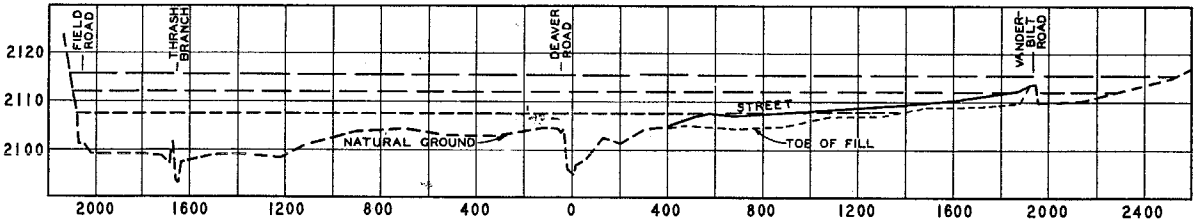


SECTION 21 - MILE 206.75

FRENCH BROAD RIVER
19 sections not shown

Sections taken looking downstream

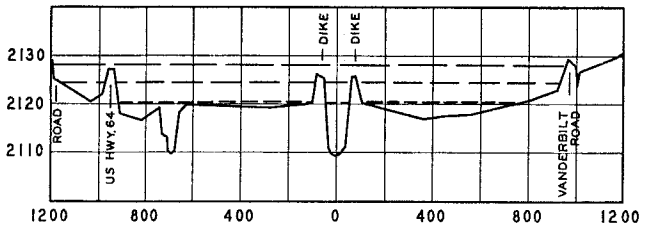
ELEVATION IN FEET (USC & GS 1936 SUPPL. ADJ.)



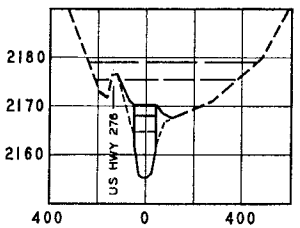
SECTION 3 - MILE 0.75

LEGEND:

——— Maximum Probable Flood
— — — Regional Flood
— · — · — July 1916



SECTION 6 - MILE 1.90



SECTION 12 - MILE 4.18

DAVIDSON RIVER
10 sections not shown

HORIZONTAL DISTANCE IN FEET

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

CROSS SECTIONS
FRENCH BROAD RIVER
AND
DAVIDSON RIVER
VICINITY OF BREVARD, N. C.

MAY 1964

PLATE 24

ELEVATION IN FEET (USC & GS 1936 SUPPL. ADJ.)

2040 2060 2080 2100 2120 2140 2160

210 208 206 204 202 200 198 196 194 192 190 188

MILES ABOVE MOUTH

Section 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2

SCS 316
SCS 111 C
SCS 317
SCS 112 C
SCS 318
SCS 113 C
SCS 319
SCS 114 C
SCS 320
SCS 115 C
SCS 321
SCS 116 C
SCS 117 C
SCS 322
SCS 118 C
SCS 323
SCS 119 C
SCS 324
SCS 120 C
SCS 121 C
SCS 325
SCS 122 C
SCS 326
SCS 123 C
SCS 327
SCS 124 C
SCS 328
SCS 125 C
SCS 126 C
SCS 329
Everett Road (Patton Bridge)
SCS 330
SCS 127 C
SCS 331
SCS 128 C
SCS 332
SCS 129 C
SCS 333

Catheys Creek
Cantrell Creek
Aiken Mill Creek
Island Ford Road
Adams Branch
Carson Creek
Dunn Creek
Haunty Branch
County Road
Hogsed Creek
Nicholson Creek
Sewage Pumping Station
U. S. Hwy. 276 (Wilson Bridge)
County Road (Tom Wilson Bridge)
King Creek
Williamson Creek
Allison Creek
Clough Road
Davidson River
Thrash Branch

Stream Bed
Water Surface November 1963
Top of Bank
February 1940
Base of Pumps
July 1916
Regional Flood
Maximum Probable Flood

Olin Mathieson Water Supply Intake
Glade Creek
Lyday Creek
Little River
Little River Road (Penrose Bridge)

Brevard

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

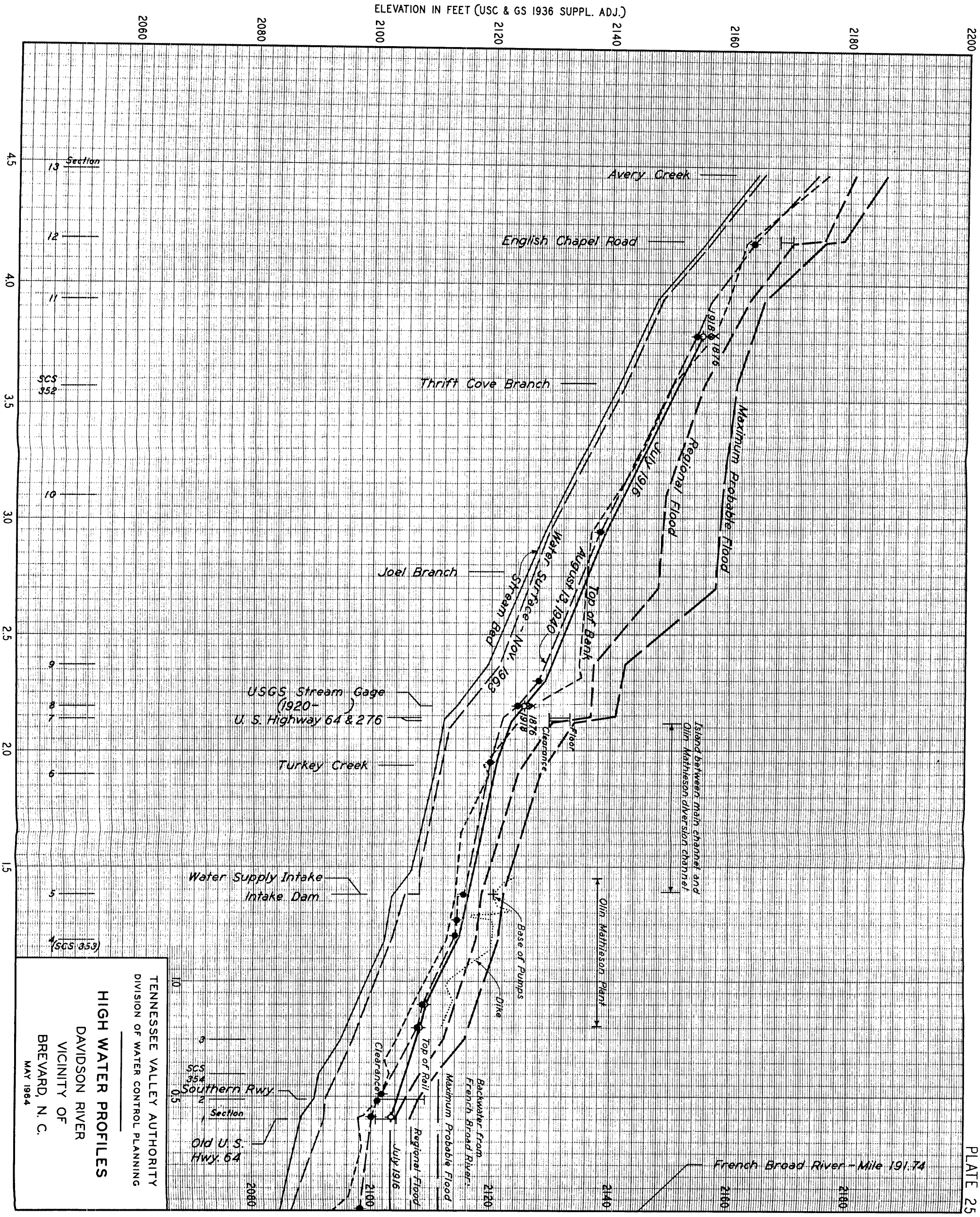
HIGH WATER PROFILES

FRENCH BROAD RIVER
VICINITY OF
BREVARD, N.C.

MAY 1964

PLATE 23

HD-1311



TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

HIGH WATER PROFILES

DAVIDSON RIVER
VICINITY OF
BREVARD, N. C.

MAY 1964

PLATE 25

ELEVATION IN FEET (USC & GS 1936 SUPPL. ADJ.)

2100 2120 2140 2160 2180 2200 2220

KING CREEK

Section 10 — Ford — Regional Flood — Maximum Probable Flood — Brevard

9

8 — Tinsley Road — Floor Clearance — Top of Rail — Brevard College

7 / 6 — Railroad Avenue — Southern Railway

5 — Tinsley Creek — U.S. Highway 64 & 276

4 — Private Road — Footbridge

3 — Private Road

Sewage Treatment Plant

Sewage Pumping Station

2 — Neely Road

Stream Bed — Water Surface — Nov. 1963 — Top of Bank — July 1916 — Maximum Probable Flood — Backwater from French Broad River — Base of Pumps — Regional Flood

1 Section

French Broad River — Mile 194.17

2.0 1.5 1.0 0.5 0

2100 2120 2140 2160 2180 2200 2220

NICHOLSON CREEK

Section 12 — Casniers Valley Road — Southern Railway — Graham Creek

11

10

9 — Nicholson Creek Road

8

7 — U. S. Highway 64

6 — Lawrence Ave.

5 — Tucker Creek

4

3 — Country Club Rd.

2

1 Section — Jordan Rd.

Stream Bed — Water Surface — Nov. 1963 — Top of Bank — July 1916 — Maximum Probable Flood — Regional Flood — Backwater from French Broad River — Maximum Probable Flood — Brevard

French Broad River — Mile 198.10

2.0 1.5 1.0 0.5 0

2100 2120 2140 2160 2180 2200 2220

TUCKER CREEK

Section 8

7

6

Brushy Creek — Hunt's Branch

Maximum Probable Flood — Regional Flood — Top of Bank — Brevard

Mills Avenue — Southern Railway — Cashiers Valley Road

5 / 4

3 — Dam (Abandoned)

2

1 Section

Stream Bed — Water Surface — Nov. 1963 — Floor Clearance — Top of Rail — Silversteen Drive — Private Road — U.S. Highway 64

Nicholson Creek — Mile 1.33

2140 2160 2180

1.5 1.0 0.5 0

MILES ABOVE MOUTH

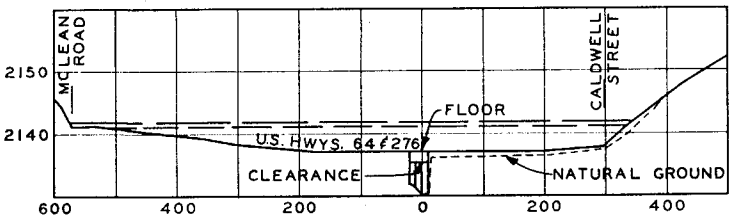
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

HIGH WATER PROFILES

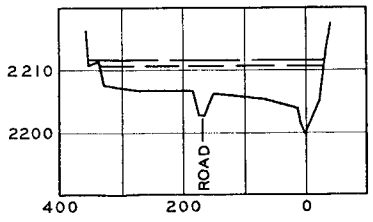
KING, NICHOLSON & TUCKER CREEKS
VICINITY OF BREVARD, N. C.

MAY 1964

PLATE 26



SECTION 5 - MILE 1.33



SECTION 9 - MILE 2.07

LEGEND:

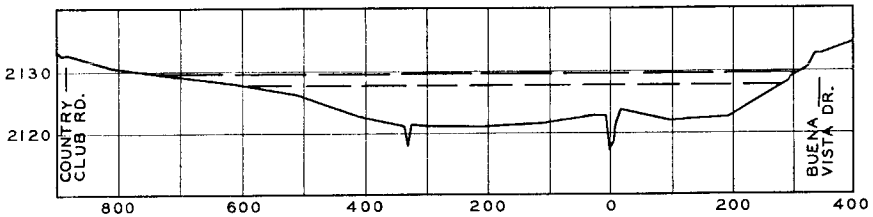
——— ——— MAXIMUM PROBABLE FLOOD

— — — — REGIONAL FLOOD

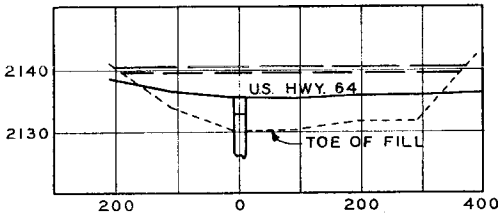
No information known on large floods on King, Nicholson, and Tucker Creeks

KING CREEK

7 SECTIONS NOT SHOWN



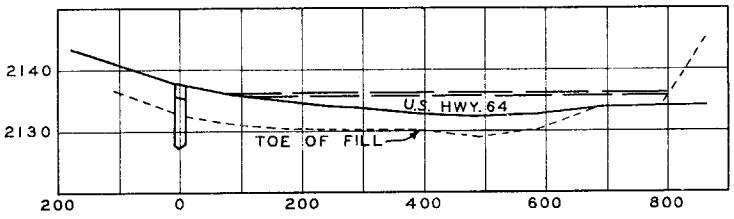
SECTION 4 - MILE 1.15



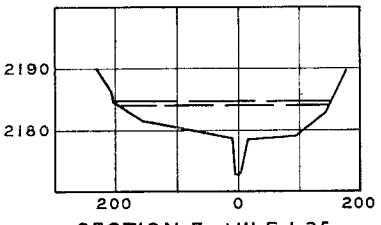
SECTION 7 - MILE 1.60

NICHOLSON CREEK

10 SECTIONS NOT SHOWN



SECTION 1 - MILE 0.33



SECTION 7 - MILE 1.35

TUCKER CREEK

6 SECTIONS NOT SHOWN

SECTIONS TAKEN LOOKING DOWNSTREAM

ELEVATION IN FEET (USC & GS 1936 SUPPL. ADJ.)

HORIZONTAL DISTANCE IN FEET

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

CROSS SECTIONS

KING, NICHOLSON, AND TUCKER CREEKS

VICINITY OF BREVARD, N. C.

MAY 1964

PLATE 27