

FLOODS ON MUD CREEK

Tennessee Valley Authority
P. O. Box 7426
Athensville, N. C. 28801

BAT FORK, DEVILS FORK

&

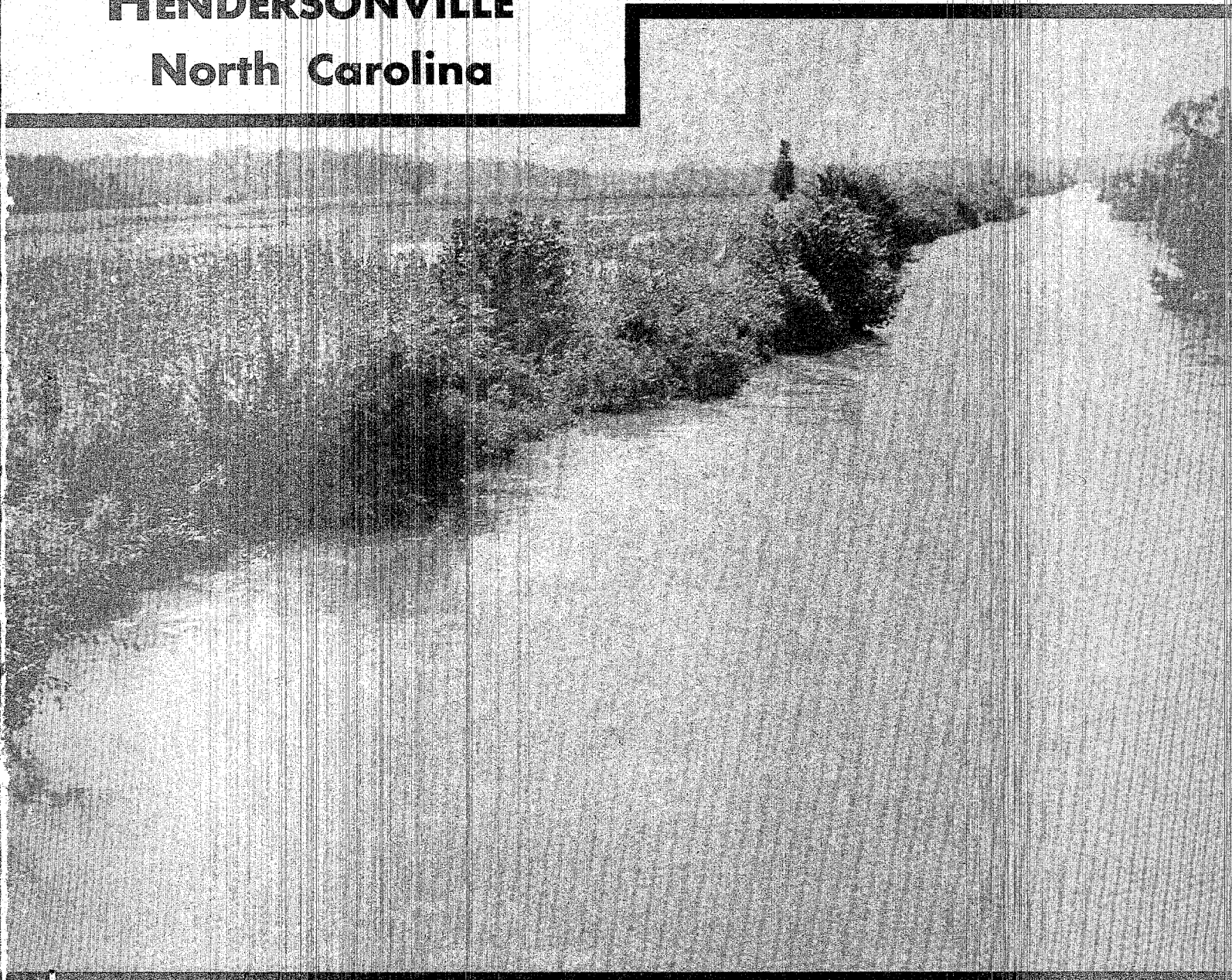
KING CREEK

Ray M. Dowell

Vicinity of

HENDERSONVILLE

North Carolina



TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

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DIVISION OF WATER CONTROL PLANNING

FLOODS ON MUD CREEK
BAT FORK, DEVILS FORK
&
KING CREEK
IN VICINITY OF
HENDERSONVILLE NORTH CAROLINA

REPORT NO. 0-5858

KNOXVILLE TENNESSEE

AUGUST 1958

CONTENTS

Preface	i
I. Past Floods on Mud Creek, Bat Fork, Devils Fork, and King Creek	
Summary of Flood History	2
Mud Creek Valley	3
Settlement	3
Mud Creek and Its Valley	5
Developments in the Flood Plain	8
Bridges	10
Encroachments on Natural Floodway	12
Plans for Watershed Protection and Flood Prevention in Mud Creek Watershed	13
Flood Situation	14
Flood Records	14
Flood Stages and Discharges	15
Discharges During Large Floods	18
Flood Occurrences	20
Backwater from French Broad River	20
Rate of Rise and Velocities in Large Past Floods on Mud Creek	21
Flooded Area on July 16, 1916	21
Flood Profiles	22
Valley Cross Sections	22
Flood Descriptions	23
June 1876	23
1901 and 1902	23
July 10, 1910	24
August 31, 1910	24
July 10, 1916	27
July 16, 1916	28
August 16, 1928	32
October 16, 1932	34
April 1936	35

CONTENTS--(Continued)

August 19, 1939	36
August 13, 1940	36
August 30, 1940	39
May 20, 1942	41
December 29, 1942	45
November 29, 1948	46
Floods of June, July, and August 1949	47
December 7, 1950	51
March 11, 1952	52
March 23, 1952	55
February 21, 1953	56
January 23, 1954	56
April 5, 1957	57
Acknowledgments	60

II. Past Floods on Streams in Hendersonville Region

Maximum Known Regional Floods	62
Mud Creek vs. Regional Flood Discharges	63
Flood Heights for Various Discharges	65
Acknowledgments	67

III. Maximum Probable Floods

Determination of Maximum Probable Flood	68
Observed Storms	69
Observed Floods	70
Maximum Probable Flood Discharges	72
Frequency	73
Possible Larger Floods	73
Flood Heights and Velocities	73
Flood Crest Profiles and Overflow Areas	73
Velocities and Rates of Rise	74
Acknowledgments	75

TABLES

<u>Table</u>		Page
1	Bridge Elevations and Clearances--Vicinity of Hendersonville, North Carolina	11
2	Flood Crest Elevations and Discharges above Bankfull Stage--Mud Creek at Naples, N. C., 1876-1957	16
3	Flood Crest Elevations in Order of Magnitude-- Mud Creek at Naples, N. C., Highest 25 Floods, 1876-1958	19
4	Maximum Known Discharges on Streams in General Region of Hendersonville, North Carolina	64
5	Flood Peaks from Regional Experience	65
6	Relative Flood Heights for Various Discharges	66
7	Selected Maximum Observed Storms--6-Hour Duration	69
8	Selected Maximum Observed Floods	71
9	Maximum Probable Flood Discharges	72

PLATES

<u>Plate</u>		Follows Page
1	Mud Creek Watershed	5
2	Floods above Bankfull Stage--Mud Creek at Naples, North Carolina	20
3	Stage Hydrograph--Flood of Mid-August 1940 on Mud Creek at Naples, North Carolina	21
4	Upper French Broad Area Showing July 1916 Estimated Storm Rainfall	28
5	Upper French Broad Area Showing Mid-August 1940 Storm Rainfall	36
6	Mud Creek Stages at Naples, N. C., and Rainfall at Hendersonville--June 10 to September 15, 1949	48
7	Maximum Known Flood Discharges--Region of Hendersonville, N. C.	63
8	July 1916 Flooded Area--Mud Creek, Bat Fork, Devils Fork, and King Creek--Vicinity of Hendersonville, N. C.	75

PLATES--(Continued)

<u>Plate</u>		<u>Follows Page</u>
9	July 1916 Flooded Area--Mud Creek Vicinity of Hendersonville, N. C.	75
10	High Water Profiles--Mud Creek Vicinity of Hendersonville, N. C.	75
11	High Water Profiles--Bat Fork, King Creek and Devils Fork, Vicinity of Hendersonville, N. C.	75
12	Valley Cross Sections--Mud Creek Vicinity of Hendersonville, N. C.	75
13	Valley Cross Sections--Bat Fork, Devils Fork, and King Creek, Vicinity of Hendersonville, N. C.	75

FIGURES

<u>Figure</u>		<u>Page</u>
1	Flood of Mid-August 1940	Frontispiece
2	Mud Creek-Bat Fork Junction, August 30, 1940	40
3	Mud Creek Bridge Washout, May 20, 1942	43
4	Typical Crop and Farm Damage by Summer Floods in 1949	49
5	March 1952 Flood near Hendersonville	54
6	Mud Creek near Naples, March 1952	54
7	April 1957 Flood at Hendersonville	59

PREFACE

Tennessee Valley Authority
Division of Water Control Planning

PREFACE

This is a report on the flood situation along Mud Creek and three tributary streams, Bat Fork, Devils Fork, and King Creek, in the vicinity of Hendersonville, North Carolina. It is one of a series of reports that TVA is preparing to aid communities in the Tennessee Valley (1) in the solution of local flood problems which are not eliminated by TVA's reservoir system and (2) in the best utilization of lands subject to overflow. These reports are based on work that 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, and other technical data bearing on the occurrence and magnitude of floods in localities throughout the region. These data provide the basis for preparation of flood histories of many streams so that this information may be made available to states, communities, and groups which are interested in local flood problems. This report has been prepared at the request of the Mayor and Board of Commissioners of the City of Hendersonville through the Board of Water Commissioners of the State of North Carolina.

Flood problems at Hendersonville and vicinity are the result of high water on Mud Creek and the tributary streams, Bat Fork, Devils Fork, and King Creek. This report discusses floods on these four streams.

For the most part, the flood plain lands along these streams are used for agricultural purposes including high-value truck^{ed} floral crops. However, there are some areas in Hendersonville and the immediate vicinity where commercial developments are within the limits of large floods.

The largest known flood on all four streams in and near Hendersonville occurred on July 16, 1916, some 42 years ago. This was one of the great floods of all times and was six feet higher than any other known flood at Hendersonville. This flood came as the result of terrific hurricane rains which dropped up to 20 inches of rain over parts of the Mud Creek watershed in 24 hours or less.

The highest recent flood was on April 5, 1957, when Mud Creek and tributaries were four or more feet overbank. This flood followed general intense rain over the watershed.

Following the 1916 hurricane rainfall flood, two other large floods caused by West Indian hurricanes occurred in the Mud Creek watershed, one on August 16, 1928, and the other on August 13, 1940. The 1928 flood was $6\frac{1}{2}$ feet lower than the 1916 flood and the 1940 flood was $8\frac{1}{2}$ feet under the 1916 flood. The Mud Creek watershed is so located that it is in the path of hurricane storms and it is from such storms that the area has experienced its largest floods of the past and will experience the largest floods in the future.

Floods above bankfull stage on Mud Creek, according to stream gage records kept over a period of 17 years at Naples, have occurred on the average of somewhat more than 2 per year. Summer floods can be very damaging but winter floods, unless unusually high, do not cause significant damages.

Mud Creek and the tributary streams rise fairly rapidly but not at a rate to be hazardous. The only residences in the flood plains are a few around the edges so there is little danger to life from a rising flood.

Velocities in the main channels reach 5 or more feet per second during floods such as that of 1940 when overbank depths were about 5 feet. During the great 1916 flood when water flowed through the Mud Creek valley 13 to 15 feet deep, velocities must have been higher than in 1940.

This report is in three parts, (1) a history of past floods on Mud Creek and the three tributary streams, (2) a description of past floods on streams of similar physical characteristics in the general geographical region of Hendersonville, and (3) a discussion of the Maximum Probable Floods that have been estimated as possible of occurrence on Mud Creek, Bat Fork, Devils Fork, and King Creek at some future time.

The first section of the report brings together a record of the largest known floods at Hendersonville. Profiles are presented showing the high water crest for the great flood of July 16, 1916. Maps show the area that was inundated in this flood.

The second section of this report treats of the largest floods known to have occurred on streams of similar physical characteristics located in the same general geographic region as that of Hendersonville and within not more than 75 miles from Hendersonville. Floods in this category, which have been experienced on streams having characteristics similar to and located in the same general region as Hendersonville, together with the Maximum Probable Floods described in Section III of this report, indicate the magnitude of the floods that may reasonably be expected to occur on Mud Creek and the tributaries in the future.

The third section of the report relates to the Maximum Probable Flood that has been developed for each of the four streams discussed in this report. Floods of this magnitude on most streams are considerably larger than any that have been experienced 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 local flood protection works. Such floods should also be considered in the utilization of the unprotected flood plain at Hendersonville where the occurrence of such a flood would result in large losses. The profile for this flood on each stream is shown in this report and the areas which would be inundated by such a flood are shown on the maps.

In problems concerned with the control of developments in the flood plain of the streams in the vicinity of Hendersonville, it is important to give appropriate consideration to the occurrence of floods of the magnitude of those that are recognized as possible of occurrence at Hendersonville. The facts should be weighed with regard to such floods in reaching decisions for the utilization of the lands in the flood plain in the reaches of the streams covered by this report.

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

The maps in the report show the extent of the flooded area and the profiles show elevations of high water through the reaches of the streams covered by this report. Elevations of the ground are shown by contours on the maps. Cross sections also show ground elevations along the line of each section. From these data the depth of probable flooding by either recurrence of the largest known historic floods or by occurrence of the much larger Maximum Probable Flood at any location may be ascertained. 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. Probably most large developments would have site maps made by private engineering firms. Such maps would show ground elevations in considerably greater detail than do the maps in this report and, in conjunction with the maps and profiles in this report, would provide the necessary basis for the development of any site.

Reference is made in Section I of this report to the plans that have been prepared by the Soil Conservation Service for flood relief in the Mud Creek watershed. These plans, which include floodwater retarding basins and channel improvements, are primarily designed to provide relief to the agricultural lands in the valleys of streams in the Mud Creek watershed from overflows resulting from runoff from storms such as those that have occurred every few years in the past. During floods of this kind, the proposed works would undoubtedly provide beneficial flood relief to the lands in the valleys of Mud Creek and its tributaries. However, the effect of these works on a great flood such as that of July 16, 1916, which followed a previous large flood on July 10, would not be sufficient to prevent large flood runoff and extensive overflow of the flood plains of streams in the watershed. With regard to lesser floods than that of July 16, 1916, such as those of 1876, 1910, 1928, 1932, and 1940, the construction of the proposed works would be expected to lower flood heights somewhat. The amount of lowering would in general be inversely proportional to the height of the floods. The magnitudes of floods which are treated in this report both in Section II and in Section III are considerably greater than those for which the proposed works are intended

to provide flood relief. Thus the height of the floods referred to in Sections II and III would not be appreciably affected by the proposed works. Therefore while the engineering studies have been made for present conditions, the findings presented in this report will be equally valid with respect to large floods after the proposed works have been built.

Acknowledgment is made of the assistance of many local people who furnished information regarding past floods. Special acknowledgment is made to the state and local offices of the Soil Conservation Service for making available a large amount of data that has been useful in compiling this report.

I.

PAST FLOODS

ON

MUD CREEK

BAT FORK DEVILS FORK

AND

KING CREEK



Tennessee Valley Authority
 Division of Water Control Planning
 Hydraulic Data Branch

I.

PAST FLOODS ON MUD CREEK, BAT FORK, DEVILS FORK,
AND KING CREEK

This section of the report covers investigations of floods which have occurred on Mud Creek and three tributary streams in the vicinity of Hendersonville, North Carolina. The portion of the river covered by the investigation includes the following reaches of the respective streams:

<u>Stream</u>	<u>From</u>	<u>To</u> Mile	<u>Total</u> Miles
Mud Creek	Mouth of Clear Creek, Mile 5.6	11.8	6.2
Bat Fork	Mouth, Mile 0.0	3.8	3.8
Devils Fork	Mouth, Mile 0.0	2.2	2.2
King Creek	Mouth, Mile 0.0	1.2	<u>1.2</u>
Total			13.4

The city limits of Hendersonville follow generally the left bank of Mud Creek from Mile 7.4 to Mile 9.7, a distance of 2.6 miles.

A record of streamflow on the Mud Creek was maintained for the period May to December 1907 and from September 1938 to September 1955 at a gaging station near Naples, 2.2 miles upstream from the mouth in the French Broad River and about 5 stream miles below Hendersonville. Engineers of TVA's Hydraulic Data Branch have investigated all significant floods during the past 25 years on Mud Creek and tributaries immediately following their occurrence. To obtain information on floods prior to that time,



Figure 1.--FLOOD OF MID-AUGUST 1940

Views are looking south on U. S. Highway 25 from bridge over Mud Creek just south of Hendersonville city limits. The flood of July 16, 1916, was about 2 feet higher than the 1940 flood at this location.

(Photo courtesy of Barber's Studio, Hendersonville)

research was made in newspaper files and historical records. Old residents were sought out and interviewed.

From all of these sources, it has been possible to develop the history of important known floods on streams in the Hendersonville vicinity covering the past 82 years.

SUMMARY OF FLOOD HISTORY

1. The highest flood known on Mud Creek and tributaries in the Hendersonville vicinity occurred on July 16, 1916, as the result of a tropical hurricane storm of great intensity and volume. The 1916 flood crest along the lower portion of Mud Creek was 6 feet above that of the second highest known flood which occurred in August 1910.

2. The third highest flood came in June 1876 during a period of large floods on streams throughout the upper French Broad region.

3. Other large floods occurred on these streams on July 10, 1916, August 16, 1928, October 16, 1932, August 13, 1940, and in May 1901.

4. The largest floods on streams in the Mud Creek watershed result generally from summer storms usually of the hurricane type as in mid-July 1916 and mid-August 1940.

5. Extensive overflows occur along these streams during each important flood, the width of overflow varying from a quarter to a half mile.

6. Backwater from large floods on the French Broad River affects the Mud Creek Valley for a distance of about 5 miles upstream from the mouth which is a half mile below the lower limit of the reach of Mud Creek covered by this report.

7. Principal damage from floods is to crops, many of which are high-value truck crops growing on the fertile bottom lands of the four streams. During major floods, U. S. Highways 25, 64, and 176 and the main line tracks of the Southern Railway are overflowed and some commercial establishments in Hendersonville are invaded by flood waters.

8. Floods on streams in the Mud Creek watershed may occur in any month of the year, either as a result of heavy winter rains, intense summer thunderstorms, or hurricane rainfall. The latter are especially dangerous because of the tremendous rainfall that accompanies such storms. Winter flooding is most prevalent in February and March. Summer flooding is most frequent in July and August.

9. Flooding of the Mud Creek Valley begins at a stage of 8 feet above the stream bed at the Naples stream gage. Some low lands are inundated at lower gage heights.

10. Ten highway, street, or road bridges and one railroad bridge cross Mud Creek in the reach investigated. All of the vehicular bridges have clearances from a few inches to about 11 feet lower than the level of the 1916 flood. Bat Fork, Devils Fork, and King Creek are crossed by 11 highway and road bridges which are $2\frac{1}{2}$ to 8 feet under the level of the 1916 flood.

MUD CREEK VALLEY

Settlement

What is now Henderson County was originally a hunting ground for the Cherokee Indians. There is no evidence that they had any permanent settlements or camp grounds here but much has been found to show that they did use the area frequently for hunting.

The travels of De Soto are not well chronicled but it is generally believed that he came into the Cherokee country from South Carolina in the course of his explorations. The remains of old mine workings and stories passed down by the Indians support the belief that the Spaniards made many expeditions into the mountains in search of gold, silver, and copper over the period from about 1540 to 1700.

James Needham and Arthur Gabriel from Virginia probably set up the first trade route into the Cherokee lands in 1673. It was traders from the South Carolina coastal settlements, however, who developed the trade with the Indians, trading tools for the furs that abounded in the

Cherokee lands. By 1747 the barter and traffic was flourishing with many small settlements along the routes, called the Trading Paths, leading from the coast to the mountains.

The land west of the Blue Ridge was recognized as Cherokee land until 1783, when by act of the General Assembly of North Carolina the lands east of Pigeon River were taken over by the white man. Settlers moved into the area rapidly after this and in 1792 Buncombe County was formed from land formerly considered part of Burke and Rutherford Counties, and included all that part of North Carolina lying west of the Blue Ridge, south of Toe River and between the boundaries of Tennessee, Georgia, and South Carolina. In 1838 an act of the General Assembly set up the County of Henderson which was formed from a part of Buncombe County. Two changes in the county boundaries have taken place since its origin. The first was in 1861 when a part was taken off to form Transylvania County, and the second in 1911 when a strip was taken from Henderson County to be added to Polk County.

Henderson County was named for Leonard Henderson, Chief Justice of the North Carolina Supreme Court. The town of Hendersonville was chartered in 1847. The country around Hendersonville was settled by English nobility who came to this region about 100 years ago searching for a summer resort where there was an abundance of fishing and hunting. These early settlers built fine homes and founded estates which have influenced the culture of this region.

The first corporation limit was defined as a circle of one-half mile radius from the Court House, but not to cross Mud Creek. The radius was later changed to one mile from the Court House with Mud Creek still marking the eastern limit of the town. The Corporation Limits have stayed the same from that time, although the city has grown far beyond its legal boundaries. The Board of City Commissioners are currently working to promote an extension of the city boundaries.

The early history of the county is more closely connected with South Carolina than with North Carolina. Most of the settlers came from the south and the trading was with South Carolina towns for many years. The first road to traverse the county was the Asheville-Greenville Plank Road, chartered in 1851, which crossed Mud Creek on a causeway with planks

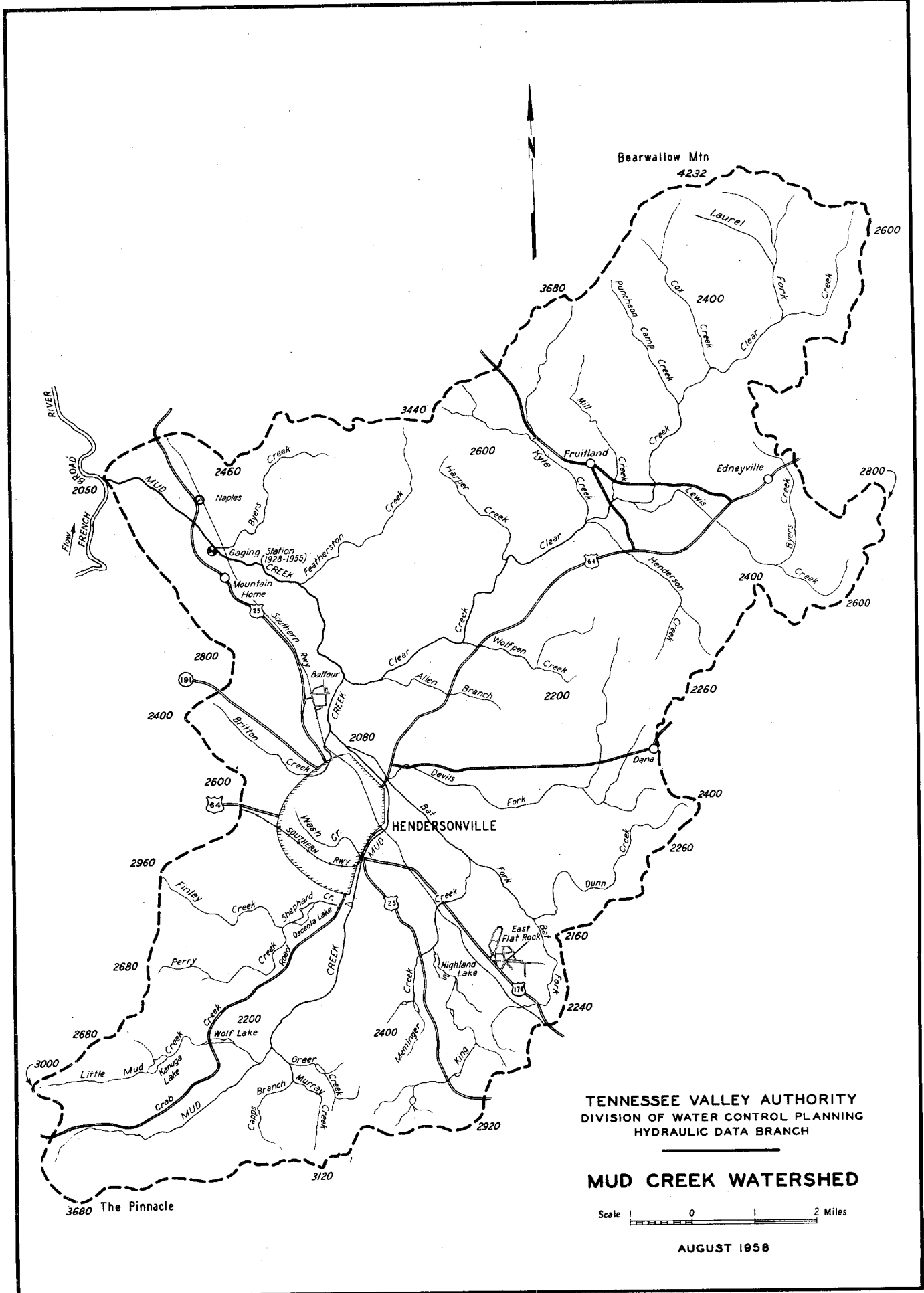
or poles providing the roadbed. The first railroad came in from the south, Spartanburg, South Carolina, having had rail service beginning in 1859. The railroad had been completed as far as Tryon in 1877 and the first train came into Hendersonville on July 4, 1879. The Asheville-Spartanburg branch of the Southern Railway was completed and rail service began between Hendersonville and Asheville in 1886, thus opening up transportation to the north and east.

The first North Carolina Census in 1850 listed 4,853 persons, free and slave, in Henderson County. The 1950 United States Census gives the population of Henderson County as 30,921 and the city of Hendersonville as 6,103. The Hendersonville Chamber of Commerce estimates the population figures as of January 1, 1958, as 34,700 for the county and 7,400 for the city.

Mud Creek and Its Valley

The Mud Creek watershed is shown on Plate 1. The basin lies wholly within Henderson County and comprises 113 square miles, about one-third of the total area of the county. Mud Creek enters French Broad River at Mile 168.5, 20 river miles above Asheville, North Carolina. The basin is shaped like a broad fan with the Blue Ridge, the Tennessee Valley Divide, extending for some 20 miles in a northeast-southwest direction along the top of the fan. The principal tributary is Clear Creek, which drains the northeast half of the fan, 44.6 square miles of area, and joins Mud Creek 5.6 miles above the mouth. The southwestern half of the basin is drained by Mud Creek and the smaller tributaries, Bat Fork and Devils Fork. Elevations along the Blue Ridge Divide are generally less than 1000 feet above the valley floor. The Pinnacle, at the southwest corner of the basin, is 3680 feet in elevation and Bearwallow Mountain, at the northern end of the basin, is 4232 feet. Between these peaks the divide is under 3000 feet in elevation and drops as low as 2200 feet at Saluda Gap at the center of the divide.

Mud Creek heads against the Pinnacle, drops to an elevation of 2200 feet in about two miles, then flows through flat bottoms in a northeasterly direction to Hendersonville. It swings around the east side of the city and turns northwestward to its confluence with French Broad River 10 miles below Hendersonville. Bat Fork and Devils Fork head against the lower section of the Blue Ridge and flow generally north to



TENNESSEE VALLEY AUTHORITY
 DIVISION OF WATER CONTROL PLANNING
 HYDRAULIC DATA BRANCH

MUD CREEK WATERSHED

Scale 0 1 2 Miles

AUGUST 1958

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join Mud Creek in the wide bottoms at Hendersonville. King Creek drains the area which lies between Bat Fork and upper Mud Creek and joins Bat Fork $2\frac{1}{2}$ miles above its mouth.

The watershed lies within the Blue Ridge physiographic province, which consists of mountain ranges, rolling upland valleys and level stream bottoms. The most notable feature of the topography of Mud Creek, and also of most of the French Broad River basin above Asheville, is the broad rolling intermountain plateau or valley. To the east and south of the Blue Ridge Divide, the land drops off sharply to elevations of 900 to 1000 feet. The streams here are steep and the topography is rugged. Within the Mud Creek watershed the streams quickly enter the broad flat valley floors at elevations of about 2100 feet, where channel slopes become quite flat and drainage is often poor.

The soils in the valley bottoms are generally highly productive deep silt loams and sandy loams of the Congaree, Balfour, or Hayesville series. Productivity is in some places sharply affected by poor drainage, however. On the rolling lands back from the bottoms are found well drained second and third class soils, principally of the Hayesville and Balfour series. Similar soils are found at the higher elevations, but in shallow depths with numerous rock outcrops.

Some 30 percent of the watershed is in forest or woodland, almost entirely under private ownership. The basin is intensively cultivated with farm size averaging 62 acres. Principal crops are corn, hay, and truck crops, with the latter producing the greatest income. Gladioli are also raised in the flood plain and are a high-income crop. Land in apple orchards totals 2800 acres in the watershed.

The channel slope on Mud Creek ranges from 10 feet per mile above Hendersonville to 4 feet per mile near the mouth. The slope averages 6 feet per mile for the 6 miles covered in this investigation. Bat Fork slopes 5 feet per mile for the reach covered. Devils Fork and King Creek slope 8 feet per mile and 10 feet per mile, respectively.

Drainage areas of Mud Creek and the tributaries discussed in this report are as follows:

<u>Stream and Location</u>	<u>Mile</u>	<u>Drainage Area</u> sq. mi.
Mud Creek		
At mouth	0	113
At Naples stream gage	2.2	109
Above Clear Creek	5.6	52.7
Upper end of reach	11.8	12.4
Bat Fork		
At mouth	0.0	14.9
Upper end of reach	3.8	5.2
Devils Fork		
At mouth	0.0	9.3
Upper end of reach	2.2	6.2
King Creek		
At mouth	0.0	7.6
Upper end of reach	1.2	6.6

The banks of the streams are generally low, being about 4 to 8 feet above low water. In the three-mile reach from Balfour to Hendersonville, the banks of Mud Creek are only $3\frac{1}{2}$ feet above low water. The flat bottom lands in the creek valleys are extensively cultivated. However, drainage of the bottom lands is imperfect and limits cultivation to less than half of the available bottom lands.

Poor natural drainage has affected the usefulness of much of the bottom land in the Mud Creek basin. Attempts to improve the drainage go back at least as far as 1900 when landowners made a cooperative effort to enlarge and lower the channels through the bottom land near Hendersonville. Each owner bore the cost of the work on his land. An engineer laid out the work but no plans have been preserved for this work or any that followed. Dug channels are now maintained through most of the Mud Creek bottom at Hendersonville, on Bat Fork to above the airport, over much of Devils Fork, and on parts of King Creek. Intermittent channel work has been done at many other places and there has been much field ditching and tile work over the years.

The major part of the city of Hendersonville is at an elevation well above the maximum known flood of July 1916. The business district of Hendersonville is on the higher lands back from the left bank of Mud Creek and is generally above flood levels. However, some commercial establishments on the fringe of the business district are affected by flooding of a few feet overbank. Whenever there is a large flood, the highways to the south and east are overflowed cutting off communications with the city.

Three U. S. highways cross the basin and are the principal arteries of commercial and tourist traffic. U. S. Highway 25, connecting South Carolina and Florida with the middle west, crosses the Blue Ridge near McAlpine Mountain, runs north through Flat Rock, crosses Mud Creek at Hendersonville, continues north on the left side of the Mud Creek bottom and crosses Mud Creek again at Naples. U. S. 64 enters the basin from the west just outside of Hendersonville, intersects U. S. 25 at the center of town, continues east across the Mud Creek-Bat Fork bottom and leaves the basin at the head of Clear Creek. U. S. 176, which follows in general the old "Trading Paths" from the coast at Charleston, South Carolina, to the mountain area, enters the basin from Spartanburg at Saluda Gap, passes through East Flat Rock and joins U. S. 25 at the Mud Creek bridge at the Hendersonville south city limits.

The Asheville-Spartanburg Division of the Southern Railway crosses Mud Creek near Naples, runs parallel to U. S. Highway 25 on the left bank to Hendersonville, crosses Mud Creek in Hendersonville and leaves the basin through East Flat Rock and Saluda Gap. A branch line runs west from Hendersonville toward Brevard and Rosman.

Developments in the Flood Plain

Hendersonville has been more fortunate than most towns adjacent to a waterway, in that there has been sufficient room for growth of the business and residential sections without too great temptation, up to this time, to move into the natural flood plain. Most of the creek bottoms in the vicinity of the town are still being used for agriculture. Only in recent years has commercial development begun moving into the flood plain. There have been no residential developments in areas subject to flooding.

A group of stores and shops on the right bank flood plain near the junction of U. S. Highways 25 and 176 are subject to flooding. Included are a supermarket, a furniture store, a bowling alley, a hardware store, a self-service laundry, a branch bank, a veterinary office and several service stations, eating places, and produce stands. A large produce marketing building is just above White Street in this same area. An auto trailer park is within the flood plain at the north side of U. S. 176. On the left bank, a bulk oil plant, two service stations and an awning sales office are subject to flooding. Backwater along Wash Creek affects three produce sheds. On Kanuga Road, a large grocery and several shops are at the edge of the overflow area and likely to be affected in a major flood.

Below U. S. 25 a produce house, a bulk oil plant and a handbag plant are subject to flood damage. At the Old Spartanburg Highway a garage and car parts business is on the right bank. Similar small businesses are found along U. S. Highway 64 where it crosses the Mud Creek-Bat Fork bottom. A concrete block plant is on the left bank of Mud Creek, and a bulk oil plant is at the right edge of the flood plain on U. S. 64.

Backwater from Mud Creek floods of the magnitude of the 1916 flood will cross U. S. Highway 25 at two places in the Druid Hills section north of the present Corporation Limit. At Britton Creek a drive-in theatre and a new supermarket would be affected by floods. At the branch just north of Britton Creek, a large dairy and restaurant building and a greenhouse are in the overflow area, along with a grocery, two service stations, and a furniture salesroom.

There are several small sand digging plants along Mud Creek and the tributaries which intermittently pump sand from the creek beds after this has been brought down and deposited during high water periods.

Sewers from Hendersonville have their outlets in Mud Creek and would be affected by backwater during floods.

Residences subject to flooding are limited to houses at the edge of the bottom at scattered points, notably those near White Street, the Church Street-Kanuga Road intersection, Wilmouth and Cherry Streets near

the U. S. Highway 64 crossing of Mud Creek, and along U. S. Highway 25 near Meadowbrook Terrace in Druid Hills. All are in the low-cost category except those in Druid Hills, on the right bank at U. S. Highway 64, and on White Street. The newest residential section near the flood plain is the Hillview Subdivision along U. S. Highway 176, but this is well above flood danger.

Radio station WHKP is on the right bank flood plain of Devils Fork just above U. S. Highway 64.

Bridges

Twenty-one highway bridges and one railroad bridge cross Mud Creek or its tributaries in the reaches covered by this investigation. Table 1 lists pertinent elevations and clearances at the bridges. Only one bridge, the Southern Railway bridge which crosses Mud Creek at Hendersonville, has an underclearance elevation which is above the 1916 flood profile at this point. This bridge now has less overflow capacity, since a large part of the trestle section on the right bank has been replaced by an earth fill. A repetition of the 1916 flood would doubtless result in some heading up at this bridge.

The U. S. Highway 176 bridge over King Creek has a floor elevation about two feet higher than the 1916 flood reached at the point, but this bridge is on a long fill which has altered flow conditions at the site and a flood of the magnitude of the 1916 flood would probably overtop both the bridge and the fill as it is today. Two bridges on Mud Creek at Hendersonville, U. S. Highway 25 and White Street, have floor elevations which are a foot or two above the elevation reached in July 1916. Neither bridge would be usable in a repetition of the 1916 flood due to overflow on the right bank approaches. The development which has taken place on the right bank near these bridges would raise the flood height of the 1916 flood if this were to recur today, and both bridges would probably be overtopped. Both bridges have center piers which can collect drift. All the other bridges in the Hendersonville area are well under the 1916 flood profile, some by five feet or more. A repetition of the great flood would isolate Hendersonville, as it did in 1916. Some of the smaller bridges would be swept downstream and possibly piled against some of the higher bridges, increasing the danger at those points.

TABLE 1
BRIDGE ELEVATIONS AND CLEARANCES
VICINITY OF HENDERSONVILLE, NORTH CAROLINA

Mile Above Mouth	Identification	Stream Bed Eleva- tion feet	Floor Eleva- tion feet	Flood Crest July 1916 feet	Underclearance		
					Eleva- tion feet	Above July 1916 Flood feet	Below July 1916 Flood feet
<u>MUD CREEK</u>							
5.40	Balfour Road	2059.1	2070.9	2080.6*	2068.7		11.9
6.23	Ball Park Road	2063.1	2073.9	2083.0	2071.6		11.4
6.85	North Main Street	2065.4	2078.8	2083.7	2077.0		6.7
7.76	U. S. Highway 64	2070.9	2081.1	2084.7	2076.0		8.7
8.18	4th Ave. Extension	2072.8	2083.8	2085.6	2083.3		2.3
8.53	Southern Railway	2074.4	2094.2	2086.2	2086.7	0.5	
8.79	Old Spartanburg Road	2076.2	2085.5	2087.4	2083.7		3.7
9.07	U. S. Highway 25	2078.0	2090.6	2088.8	2087.6		1.2
9.21	White Street	2078.9	2091.5	2089.5	2089.2		0.3
9.86	Erkwood Drive	2080.5	2092.7	2094.2	2090.7		3.5
11.77	Crail Farm Road	2097.8	2110.1	2109.3	2108.0		1.3
<u>DEVILS FORK</u>							
0.06	U. S. Highway 64	2070.5	2080.4	2084.8	2076.8		8.0
0.41	Dana Road	2071.8	2081.2	2085.6	2079.1		6.5
0.51	Dana Road	2072.2	2082.7	2085.8	2080.8		5.0
2.18	Allen Road	2087.7	2097.1	2095.8*	2095.3		0.5
<u>BAT FORK</u>							
0.91	U. S. Highway 64	2070.4	2080.6	2084.7	2076.5		8.2
2.24	New Hope Road	2073.6	2085.3	2086.5	2083.1		3.4
2.71	Airport Road	2077.1	2086.3	2087.2	2083.6		3.6
3.78	Upward Road	2084.3	2093.4	2091.9	2091.6		0.3
<u>KING CREEK</u>							
0.38	Airport Road	2076.8	2088.1	2087.4	2085.8		1.6
1.01	Old Spartanburg Road	2083.8	2091.2	2092.3	2089.0		3.3
1.21	U. S. Highway 176	2085.5	2100.9	2094.6	2098.3	3.7	

* Elevation estimated.

U. S. Highway 64 crosses the wide bottom at Hendersonville on a low fill with three bridges, one over Mud Creek, one over Bat Fork, and one over Devils Fork. These are relatively low bridges, all with one or more pile bents in the channel. In the flood of August 13, 1940, when the road was located just upstream from the present alignment, heading up at the bridges amounted to about one foot. The 1916 flood was $3\frac{1}{2}$ to 4 feet higher than the bridges on U. S. Highway 64.

One bridge on King Creek at the Old Spartanburg Highway, Mile 1.02, is very low and is overtopped in any sizeable flood. Most of the remaining bridges have floors which are close to the elevation reached in the floods of August 13, 1940, and April 5, 1957.

All of the bridges across Mud Creek, Bat Fork, Devils Fork, and King Creek are below the height of the Maximum Probable Floods discussed in Section III of this report. During such a flood, many of these bridges would doubtless be washed away and destroyed.

Encroachments on Natural Floodway

The description of the developments in the flood plain makes it evident that the natural valleys of Mud Creek and the three tributary streams have been encroached upon by works of man which impair the natural flood-carrying capacity of the streams. The previous section describes the encroachments on the waterways of the streams by bridges.

A large number of buildings have been put up on the right bank of Mud Creek at U. S. Highways 25 and 176 which affect the natural floodway. Some filling has been done at this site also.

The Southern Railway crosses Mud Creek on a long fill at Hendersonville. A plate girder bridge spans the creek with a clearance elevation just above the 1916 flood at the point. A long timber trestle which originally crossed the right bank flood plain has been largely replaced by a fill. The present floodway opening consists of 180 feet of trestle plus two culverts, 60 inches and 84 inches in diameter, in the fill.

Hendersonville is now using the land fill method of garbage and refuse disposal. The dump area is on the right bank of Mud Creek just

below the Southern Railway bridge. The flood-carrying capacity of the valley is being reduced as this fill grows.

U. S. Highway 64 crosses Mud Creek and Bat Fork on a low fill. U. S. Highway 176 crosses King Creek on a long fill between Hendersonville and East Flat Rock. These fills may affect flood heights somewhat.

Plans for Watershed Protection and Flood Prevention in Mud Creek Watershed

Under the authority of laws passed by the Congress of the United States, the Henderson County Soil Conservation District, the Board of County Commissioners of Henderson County, and the City of Hendersonville with assistance by the Soil Conservation Service and the Forest Service, both of the U. S. Department of Agriculture, have prepared a Work Plan for watershed protection and flood prevention in the Mud Creek watershed. This includes the portion of the entire watershed which is covered by this report.

As stated in the Work Plan, "The primary purpose of this plan is the provision of watershed protection and flood prevention for the agricultural land of the watershed. In the accomplishment of this purpose, flood prevention will also be provided to the urban and industrial developments in the flood plain of Mud Creek, particularly in the vicinity of the city of Hendersonville."

On the watershed above Clear Creek discussed in this report, watershed protection is to be improved by the application of soil and water conservation measures, vegetation of roadbanks, and the revegetation of high runoff and sediment producing areas. Structural measures for flood relief to be constructed include 9 floodwater retarding structures and the enlargement or improvement by clearing and snagging of the channels of Mud Creek and Bat Fork to increase their water-carrying capacity. Three of the retarding basins are on Mud Creek and tributaries above Hendersonville, 3 on Bat Fork, 2 on Devils Fork, and 1 on King Creek. The combined drainage area above these 9 structures is 48 percent of the total watershed area of Mud Creek above the mouth of Clear Creek. Altogether, these basins have capacity to store 3.4 inches of runoff from the watersheds above the dams which create the basins. This is equivalent to 1.7 inches of runoff from the Mud Creek watershed above Clear Creek.

The proposed works are planned to provide flood relief to the agricultural lands in the valleys of the streams in the Mud Creek watershed. This objective is accomplished by regulation of runoff from storms that occur regularly year after year or every few years and which, under present conditions, overflow the bottom lands. However, when severe hurricane storms such as that of July 16, 1916, occur the proposed retarding basins and channel improvements would not be adequate to prevent very large flood runoff and extensive overflow. The July 16, 1916, flood was preceded by a large storm on July 10 which would have filled the retarding basins and these would not have emptied prior to the second great storm. Storms such as that of July 16, 1916, are of rare occurrence and of considerably less frequency than the magnitude of storms for which the proposed retarding basins and channel improvements are planned or for which it would be economically feasible to provide agricultural flood relief.

Following the 1916 flood in order of flood height are the floods of 1876, 1910, 1928, 1932, and 1940, which were from 6 to $8\frac{1}{2}$ feet lower than the 1916 flood. The proposed works would lower the height of floods in this range to some degree, the amount varying inversely with the height of flood.

The engineering studies which are the basis for this report by TVA have been made for conditions as they exist at the present time. However, after the construction of the proposed flood relief works, the findings presented in this report will be applicable with respect to the extent and depth of flooding during large floods.

FLOOD SITUATION

Flood Records

The U. S. Geological Survey maintained records of streamflow on Mud Creek near Naples from May to December 1907 and from September 1938 to September 1955 at a location 2.2 miles upstream from the mouth of Mud Creek in the French Broad River. The 1907 observations were made on a staff gage. From 1938 to 1955 a recording gage was in operation at the site. No streamflow records have been kept on Bat Fork, Devils Fork, or King Creek.

Investigations by engineers of the Hydraulic Data Branch were made immediately after their occurrence for the floods of August 13 and August 30, 1940, May 20, 1942, August 29, 1949, December 7, 1950, March 11 and 23, 1952, and April 5, 1957, to obtain flood heights and pertinent information for each of these floods. Local residents who possess knowledge of past floods were interviewed to obtain data regarding floods that occurred prior to the keeping of gage records on Mud Creek.

A thorough search was made by Hydraulic Data Branch engineers throughout the Mud Creek valley for high water marks of past floods. Flood profiles were developed for the floods of July 1916, August 1928, and the two August 1940 floods.

In addition, research was carried out in available files of newspapers and historical documents. The files of all Henderson County papers since 1910 were searched at the Hendersonville Library. The Asheville "Citizen" and "Times" files were reviewed back to 1889.

Although the flood valleys of Mud Creek and its tributaries have doubtless been subject to flooding throughout past years, the rural character of these valleys and the lack of other developments has resulted in little notice being given to these early floods. Only in more recent years when high-value crops are being raised on the fertile flood plain lands and some developments have been pushing out into the flood plain have floods attracted attention. Accordingly, there is no record either in the newspapers or in the minds of the residents of the watershed of past floods except those that have been most outstanding such as those of 1910 and 1916. This results in the record of past floods being fragmentary and including only the very large floods prior to the past 20 years.

Flood Stages and Discharges

Table 2 lists dates of occurrence, crest elevations, and peak discharges for floods which have exceeded bankfull stage of 8.0 feet at the Mud Creek stream gage at Naples. The list is complete for the period since continuous streamflow records were begun in 1938. Floods shown prior to 1938 are those found in the flood history research and doubtless

TABLE 2
FLOOD CREST ELEVATIONS AND DISCHARGES ABOVE BANKFULL STAGE

MUD CREEK AT NAPLES, N. C.

1876-1957

This table includes all known floods which have exceeded bankfull stage of 8.0 feet at the U. S. Geological Survey gaging station on Mud Creek at Naples, North Carolina. Period of gage record May 10 to December 31, 1907, and September 11, 1938, to September 30, 1955. Drainage area at gaging station is 109 square miles. Zero elevation of the gage is 2047.48 feet above mean sea level.

<u>Date of Crest</u>	<u>Gage Height</u>		<u>Peak Discharge</u>	
	<u>Stage</u> feet	<u>Elevation</u> feet	<u>Amount</u> cubic feet per second	<u>Per</u> <u>Sq. Mile</u> cubic feet per second
June 1876	15.0*	2062.5		
May 1901	13.0*	2060.5		
December 1901	12.0*	2059.5		
February 1902	12.0*	2059.5		
January 1906	10.0*	2057.5		
December 14, 1907	8.5	2056.0	1,410	13
July 1910	10.0	2057.5		
August 1910	15.5	2063.0		
July 10, 1916	15.0	2062.5		
July 16, 1916	21.5	2069.0	40,000	366
August 16, 1928	14.9	2062.4	17,000	156
October 16, 1932	13.5	2061.0		
April 6, 1936	9.0	2056.5		

Stream gaging records begun September 11, 1938.

March 1, 1939	8.47	2056.0	1,520	14
August 19, 1939	8.53	2056.0	1,520	14
August 13, 1940	13.07	2060.6	10,800	99
August 30, 1940	10.99	2058.5	4,800	44
December 28, 1940	8.18	2055.7	1,480	14
February 17, 1942	8.51	2056.0	1,610	15
March 9, 1942	9.85	2057.3	2,930	27
May 20, 1942	12.63	2060.1	8,880	81
December 29, 1942	10.07	2057.6	3,070	28
July 9, 1943	8.85	2056.3	1,840	17

TABLE 2--(Continued)

FLOOD CREST ELEVATIONS AND DISCHARGES ABOVE BANKFULL STAGEMUD CREEK AT NAPLES, N. C.1876-1957

<u>Date of Crest</u>		<u>Gage Height</u>		<u>Peak Discharge</u>	
		<u>Stage</u> feet	<u>Elevation</u> feet	<u>Amount</u> cubic feet per second	<u>Per</u> Sq. Mile cubic feet per second
March	30, 1944	8.44	2055.9	1,430	13
September	18, 1945	8.65	2056.1	1,440	13
January	7, 1946	9.45	2056.9	2,130	20
February	11, 1946	10.00	2057.5	2,800	26
January	21, 1947	9.23	2056.7	1,930	18
October	18, 1947	8.70	2056.2	1,570	14
February	13, 1948	9.08	2056.5	1,820	17
August	4, 1948	9.20	2056.7	1,910	18
November	29, 1948	10.38	2057.9	3,390	31
July	13, 1949	9.58	2057.1	2,270	21
July	19, 1949	9.58	2057.1	2,270	21
August	22, 1949	8.31	2055.8	1,390	13
August	29, 1949	11.52	2059.0	5,740	53
October	7, 1949	8.45	2055.9	1,450	13
October	31, 1949	8.75	2056.2	1,600	15
March	14, 1950	8.90	2056.4	1,690	16
September	9, 1950	9.75	2057.2	2,470	23
December	7, 1950	11.55	2059.0	5,940	54
December	22, 1951	9.40	2056.9	2,190	20
February	4, 1952	8.19	2055.7	1,350	12
March	4, 1952	8.83	2056.3	1,670	15
March	11, 1952	11.55	2059.0	5,940	54
March	23, 1952	9.71	2057.2	2,560	23
February	21, 1953	10.12	2057.6	3,150	29
January	23, 1954	11.07	2058.6	4,930	45
February	21, 1954	9.38	2056.9	2,170	20
December	30, 1954	8.00	2055.5	1,280	12
February	7, 1955	9.10	2056.6	1,890	17

Stream gaging records discontinued.

April	5, 1957	11.92	2059.4	6,770	62
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* Gage height estimated from best information available and is approximate only.

Sept 19, 1959
Oct 10, 1959

11.57 -
11.57

this list is incomplete, especially for the lesser floods of which there is no record or memory. Where crest stages are shown for these pre-record floods they have been estimated from high water marks or other historical information.

Table 3 lists the twenty-five highest known floods in the order of their magnitude. These include all the known floods that reached gage height 9.75 feet or above for which a definite gage height is known or could be estimated.

Discharges During Large Floods

Table 2 lists floods at the Naples gaging station on Mud Creek. This gives peak discharges where these have been determined by the U. S. Geological Survey during the 17-year period of gage records from 1938 to 1955. For other floods, estimates of peak discharge have been made where information is available for doing so.

The following is a tabulation of the peak discharges for the five largest floods for which discharges have been estimated.

<u>Date of Flood</u>	<u>Gage Height feet</u>	<u>Peak Discharge cubic feet per second</u>
July 16, 1916	21.5	40,000
August 16, 1928	14.9	17,000
August 13, 1940	13.07	10,800
May 20, 1942	12.63	8,880
April 5, 1957	11.92	6,770

TABLE 3
FLOOD CREST ELEVATIONS IN ORDER OF MAGNITUDE

MUD CREEK AT NAPLES, N. C.

HIGHEST 25 FLOODS

1876-1958

<u>Order No.</u>	<u>Date of Crest</u>		<u>Gage Height feet</u>	<u>Elevation feet</u>
1	July	16, 1916	21.5	2069.0
2	August	31, 1910	15.5	2063.0
3	June	1876	15.0*	2062.5
4	July	10, 1916	15.0	2062.5
5	August	16, 1928	14.9	2062.4
6	October	16, 1932	13.5	2061.0
7	August	13, 1940	13.07	2060.6
8	May	1901	13.0*	2060.5
9	May	20, 1942	12.63	2060.1
10	December	1901	12.0*	2059.5
11	February	1902	12.0*	2059.5
12	April	5, 1957	11.92	2059.4
13	December	7, 1950	11.55	2059.0
14	March	11, 1952	11.55	2059.0
15	August	29, 1949	11.52	2059.0
16	January	23, 1954	11.07	2058.6
17	August	30, 1940	10.99	2058.5
18	November	29, 1948	10.38	2057.9
19	February	21, 1953	10.12	2057.6
20	December	29, 1942	10.07	2057.6
21	January	22, 1906	10.0*	2057.5
22	July	1910	10.0	2057.5
23	February	11, 1946	10.0	2057.5
24	March	9, 1942	9.85	2057.3
25	September	9, 1950	9.75	2057.2

* Gage height estimated from best information available and is approximate only.

Flood Occurrences

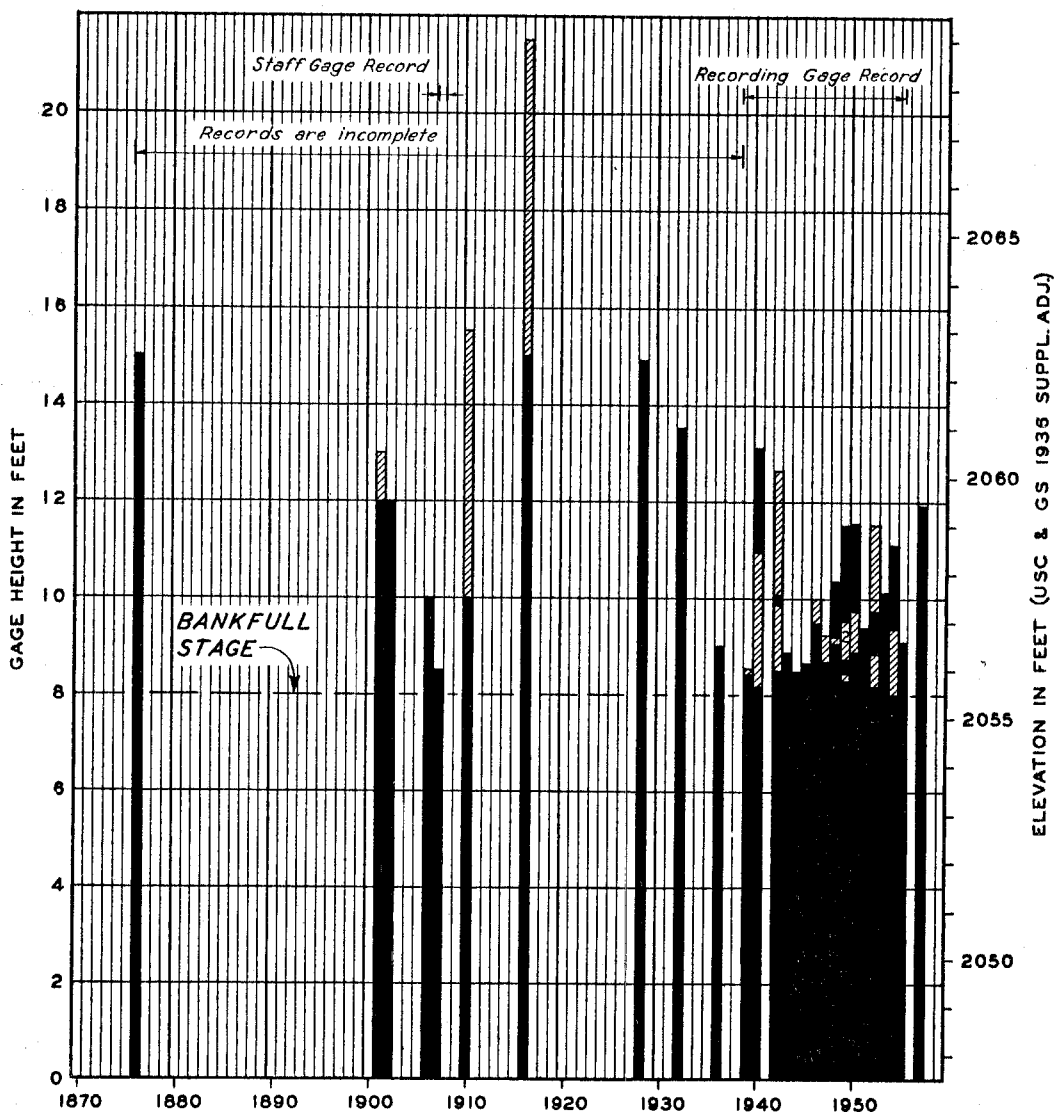
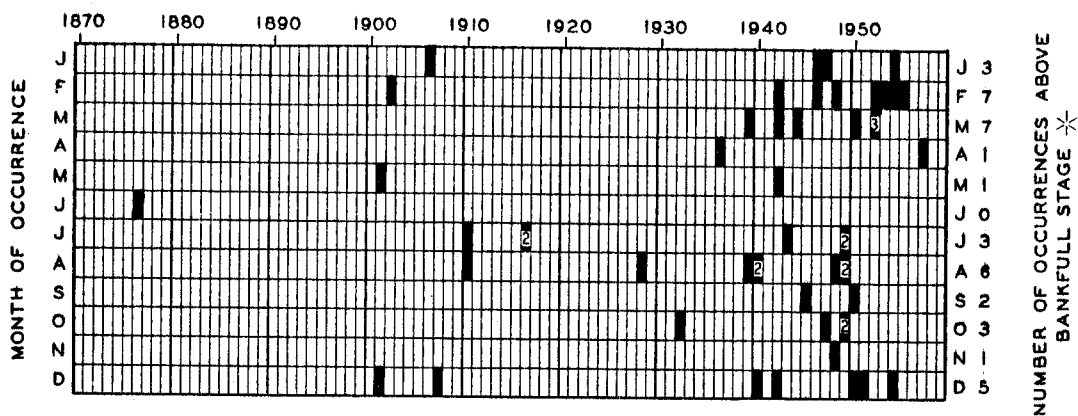
Plate 2 shows the crest stage and month of occurrence of known floods on Mud Creek at Naples. During the 17-year period of streamflow records from September 1938 to September 1955, 40 floods occurred. The monthly distribution of these is as follows:

January	4	July	3
February	7	August	6
March	7	September	2
April	0	October	3
May	1	November	1
June	1	December	5

This shows that floods on Mud Creek in the past have been most likely to occur in the winter and summer seasons and that the spring and fall seasons have been relatively free of floods. However, Plate 2 shows that some high floods have occurred in the spring prior to the initiation of stream gage records in 1938 but that no large floods have ever occurred in the fall. Table 3 shows that the largest floods have occurred during the summer. These floods have been the ones that result from hurricane storms of great volume and intensity. Plate 2 shows that floods of some magnitude can occur on Mud Creek during any month in the year.

Backwater from French Broad River

When the French Broad River is in high flood, backwater from that stream extends up the Mud Creek valley to just below the mouth of Clear Creek. This is beyond the downstream limit of the reach of creek covered by this report. Hence there is no backwater effect on the reach of Mud Creek treated in this report.



* Number of occurrences during 17 years of gage record, 1938-1955.

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

FLOODS ABOVE BANKFULL STAGE

MUD CREEK

AT NAPLES, NORTH CAROLINA

AUGUST 1958

Rate of Rise and Velocities in Large Past Floods on Mud Creek

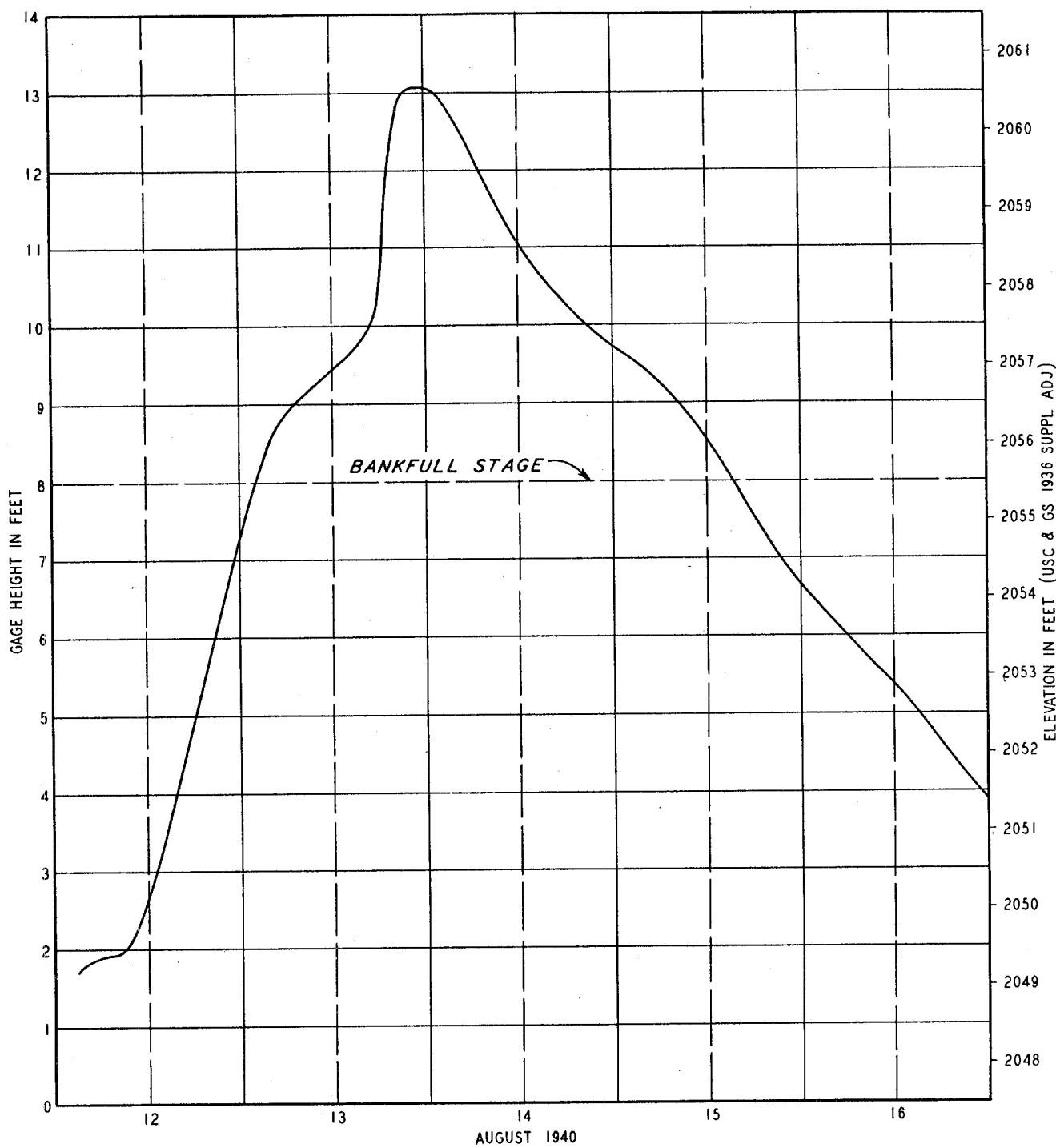
The rate of rise of Mud Creek during large floods is illustrated by the hydrograph, Plate 3, for the flood of August 13, 1940. This is the highest flood on Mud Creek since streamflow records began in September 1938. This was a summer flood which resulted from hurricane rainfall. At the Naples stream gage the river rose from bankfull to 10 feet above in 19 hours beginning at 2:00 a.m. on the morning of August 13. The upper 6 feet of rise came in $4\frac{1}{2}$ hours. The creek receded in 42 hours to within banks again.

Plate 6 is a stage hydrograph of Mud Creek during the summer of 1949 which shows a series of peaks for relatively small floods which, however, were quite damaging.

During floods of the magnitude of that of August 1940, average velocities in the channel of Mud Creek at Naples are about 5 feet per second and maximum velocities somewhat greater. In the flood plain bordering the creek, velocities are estimated to have been of the order of 1 to 2 feet per second. During larger floods, velocities in the channel and in the overflow would be greater. There are indications in the press accounts of the great July 1916 flood indicating that the rate of rise was considerably more rapid and velocities greater than in the 1940 flood.

Flooded Area on July 16, 1916

Plates 8 and 9 show the area that was overflowed in the great flood of July 16, 1916. The culture on Plate 8 is that for 1947. Considerable changes and additional developments have been made since that time as is shown by the aerial photograph, Plate 9, made April 13, 1958. The limits of overflow as shown on the map and aerial photograph have been estimated using flood profile elevations, valley cross sections, and topography as shown on the map. The boundaries of the overflow area as defined by this latter means are sufficiently accurate for the intended purpose, but the actual limits of overflow on the ground may vary somewhat from that which is shown on the map. This is because the contour



Hydrograph was developed from
U.S. Geological Survey Records

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

STAGE HYDROGRAPH
FLOOD OF MID-AUGUST 1940 ON MUD CREEK
AT
NAPLES, NORTH CAROLINA
AUGUST 1958

interval of Plate 8, which is 20 feet, does not in all cases permit precise plotting of the flooded area boundaries. To define these limits with a higher degree of accuracy would require costly surveys which present purposes do not warrant.

Flood Profiles

Plates 10 and 11 show the high water profiles for the floods of July 16, 1916, April 5, 1957, and August 13, 1940. High water marks for the floods of 1916 and 1940 on Mud Creek were obtained by Hydraulic Data Branch engineers, for the latter flood immediately after it occurred. The 1957 flood profile on Mud Creek has been developed from high water marks furnished by the Soil Conservation Service supplemented by marks obtained by Hydraulic Data Branch engineers. The flood profiles for Bat Fork, Devils Fork, and King Creek are based on high water marks furnished by the Soil Conservation Service augmented by high water marks obtained by Hydraulic Data Branch engineers in order to develop detailed profiles.

Shown also on Plates 10 and 11 are profiles of the stream bed and top of banks. Elevations of the floor and underclearance at bridges are indicated on the profiles. The Maximum Probable Flood profiles on Plates 10 and 11 are discussed in Section III of this report.

Valley Cross Sections

Plate 12 shows 5 typical cross sections of the Mud Creek valley. Plate 13 shows 5 typical valley cross sections for Bat Fork, Devils Fork, and King Creek. These were selected from a larger number of cross sections which were furnished by the Soil Conservation Service to TVA for use in the engineering studies made for this report. Location of all the cross sections is shown on the map, Plate 10. The cross sections not reproduced are available to anyone who may have need for them from TVA's Hydraulic Data Branch or from the Raleigh, North Carolina, office of the Soil Conservation Service.

Each cross section shows the elevations and limits of overflow for the July 16, 1916, and August 13, 1940, floods and also for the Maximum Probable Flood which is discussed in Section III of this report.

FLOOD DESCRIPTIONS

The following descriptions cover the more important floods that have occurred in the vicinity of Hendersonville on Mud Creek and the four tributaries for which information is available. The flood descriptions are based on investigations made by TVA Hydraulic Data Branch engineers, on information furnished by local residents, on newspaper accounts of past floods, and on historical documents. In the absence of actual records of stream heights and discharges, local residents, diaries, and newspaper accounts are the best available source of information covering past floods. Each newspaper account has been reviewed to present only material that appears to give a correct portrayal of the flood being reported.

June 1876

This is the first large flood of which definite evidence exists at Asheville as to the exact height of the flood. Old residents proclaimed the flood as higher than ever before. Known as the "June freshet," the French Broad and its tributaries above Asheville were swollen with flood waters which combined to give the flood height at Asheville. Little is known of this flood on Mud Creek but based on the known big flood at Asheville, Mud Creek too must have had a large flood at that time.

1901 and 1902

Mr. Joe Byers, old resident of the Naples community, recalled that several times prior to 1916 floods occurred in which water flowed over the tracks of the Southern Railway at Naples. He remembered one of these as having been in June of 1902 or 1903. Most likely the flood he referred to occurred in May 1901. The floods of May 1901, December 1901, and February 1902 were all prominent floods on the French Broad at Asheville but no mention of a flood on Mud Creek is found in any of the newspaper accounts.

July 10, 1910

The "Daily Herald," Hendersonville, North Carolina, for July 11, 1910, states:

Wash Creek, a turbulent, swollen torrent of angry waters, the result of the terrific rains Sunday, compelled scores of people from the entire southwest part of town yesterday to either return home, to make a wide detour, or to get out and walk across the high foot bridge there and then continue afoot to town.

Police Officer Garren stationed a man on either side of the stream for had a team attempted to cross the treacherous water, swift flowing with death on its crest, they would inevitably have been swept, horses and passengers, to destruction.

Wash Creek is a tributary that flows through Hendersonville and empties into Mud Creek just above U. S. Highways Nos. 25 and 176.

Asheville newspapers mention severe damage throughout the mountain area from a 34-hour rainfall with washouts on the Asheville-Spartanburg Division of the Southern Railway near Tryon and Landrum, on the south side of the Blue Ridge. With the storm thus indicated to be quite general, it is probable that Mud Creek lands were overflowed to some extent although damage was not sufficient to warrant newspaper comment.

August 31, 1910

This is the second highest known flood on Mud Creek. The Hendersonville "Daily Herald" for August 31, 1910, contains the following:

TERRIFIC RAINS CAUSE ENORMOUS PROPERTY LOSS IN SOUTH
 HENDERSONVILLE ALMOST ISOLATED FROM OUTSIDE WORLD
 HAND OF JUPITER PLUVIUS RESTS HEAVILY UPON THIS COUNTY,
 FROM ALL PARTS OF WHICH COME TALES OF WOE AND DISASTER
 HEAVIEST DOWNPOUR OF RAIN IN MANY YEARS INFLECTS ENORMOUS
 DAMAGE. BRIDGES SWEEPED AWAY. ROADS IMPASSABLE.
 CROPS PARTLY DESTROYED.

No Trains to Asheville and Southbound. They Creep
 Along at Snail Pace. Tracks in Dangerous Condition.

Every river, branch, stream, and tiny rill in the mountains of Western North Carolina today make a new work of swollen, turbulent, property devastating, life devouring, raging torrents, leaving within their wake a loss and damage

to property amounting to hundreds and thousands of dollars, the result of incessant downpour of rain since early Monday night. The older citizens of Hendersonville say during their long lives they have never seen such a fall of water for the length of time. There was a constant downpour on today, yesterday, and last night, and the streets were overflowing with water.

The electric power of the city was put out of commission about 10 o'clock last night and the city was left in darkness for the remainder of the night.

No destruction to property was reported until this morning when loss and damage was reported on every side. There is little traffic beyond the city limits today because of the number of bridges that have been washed away. The long string of bridges over Mud Creek were covered by water that nearly reached the railing, two of the bridges being washed away during the night and others badly deranged. The bridges at Columbia Park, save one, floated away with the raging stream. The bridges around Lake Osceola were washed away during the night and the destruction of the massive dam was greatly threatened this morning, which resulted in the opening of all of the pipes leading therefrom that a burst might be averted. A great mass of earth composing the outer part of the dam was washed out during the night. The Flat Rock Road was covered with several inches of water early this morning.

It is reported that the crops in the surrounding country are greatly damaged, some of them having been washed away, while others are submerged by several feet of water.

Bridges all over the country have been torn from their foundations several of which are entirely destroyed. Railroad traffic was almost impossible today. The engine of the morning train from the south came in early, leaving the passenger coaches behind, but bringing them in later after looking over the line. There was a washout and a landslide near Melrose, also a small washout at Flat Rock. . . .

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A loss of stock is reported from some sections.

Every part of the county is cut off, and apart from other sections today.

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The reference to water being over the bridges over Mud Creek at Hendersonville indicates this flood was of the magnitude of the 1928 flood and that it probably exceeded it. The bridges at that time may have been

slightly lower than now but they were probably within a foot or so of their present elevations. The 1928 flood did not overflow the bridges, according to the best information available.

"The Daily Herald" for September 1, 1910, reported further:

DIRE RUIN AND DEVASTATION IN WAKE OF AWFUL FLOODS
ONE HUNDRED THOUSAND DOLLARS DAMAGE TO HENDERSONVILLE CROPS
BRIDGES DOWN, FRENCH BROAD OVER ITS BANKS, AND ESTIMATED
DAMAGE TO CORN CROP ALONE PLACED AT \$50,000

The farmers of Henderson County are poorer by one hundred thousand dollars as a result of the recent floods.

This is the estimate of men competent to judge.

The loss may not reach that staggering total, in the opinion of many. Some believe the total loss of the county, including the bridges swept away, the damage to the roads, will at least total that figure.

The county and town authorities are making every effort to repair the damage to the bridges and wards and large forces of men are at work in different sections of the county, endeavoring to make travel possible.

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A large part of the county is under water, and should it not recede within the next 12 hours, it is believed that almost the entire corn crop will have been ruined.

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The Hendersonville Power Company's plant on Big Hungry is totally destroyed, and the loss alone there is not less than \$10,000.

The site of the building is as clean as a pin while the machinery which once furnished the lights for Hendersonville is scattered along the banks of the rushing and roaring torrent.

All the dams of the different lakes have withstood the pressure and there is absolutely no danger to be apprehended from that source.

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The Southern Railway and the Brevard railroad schedules were completely disorganized and for many hours it was utterly

impossible to get a train out of Hendersonville in any direction.

Asheville had almost a similar experience. The flood put the electric company there out of business and the town was one dark place, even the street car service being suspended.

Between Hendersonville and Brevard three trestles were washed away, and near Cannons the tracks for a distance of 300 feet were carried off by the raging waters.

At Busbee, Arden, Naples, Hillgirt there were landslides or washouts and the track is still in a dangerous condition.

Unless the rains continue, it is believed conditions will be normal within the next 3 days.

The Hendersonville Light and Power Company is making every effort to give the people of the town service, even despite the complete destruction of its plant on Big Hungry.

. . . . The powerhouse at Big Hungry will be rebuilt. The dam is intact.

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The Asheville "Gazette" of September 1, 1910, states:

The most serious break in the Asheville-Spartanburg line (of the Southern Railway) was in the Mud Creek bottoms at a point near Fletchers, where some 100 feet of track were flooded and the Mud Creek bridge damaged.

July 10, 1916

July 1916 saw two large floods on Mud Creek, the first coming on July 10 and rising to about 7 feet over banks of Mud Creek and inundating all the stream valleys. This was the fourth largest flood known on Mud Creek. Damage to crops in the bottom lands was extensive.

The Asheville "Citizen" of July 10, 1916, describes the July 10 flood as follows:

HENDERSON COUNTY SUFFERS, WHERE CONDITIONS NOW
APPROXIMATE THOSE OF FLOODS OF 1910

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From Hendersonville comes word that conditions there are about as bad as during the flood of 1910 and everybody in

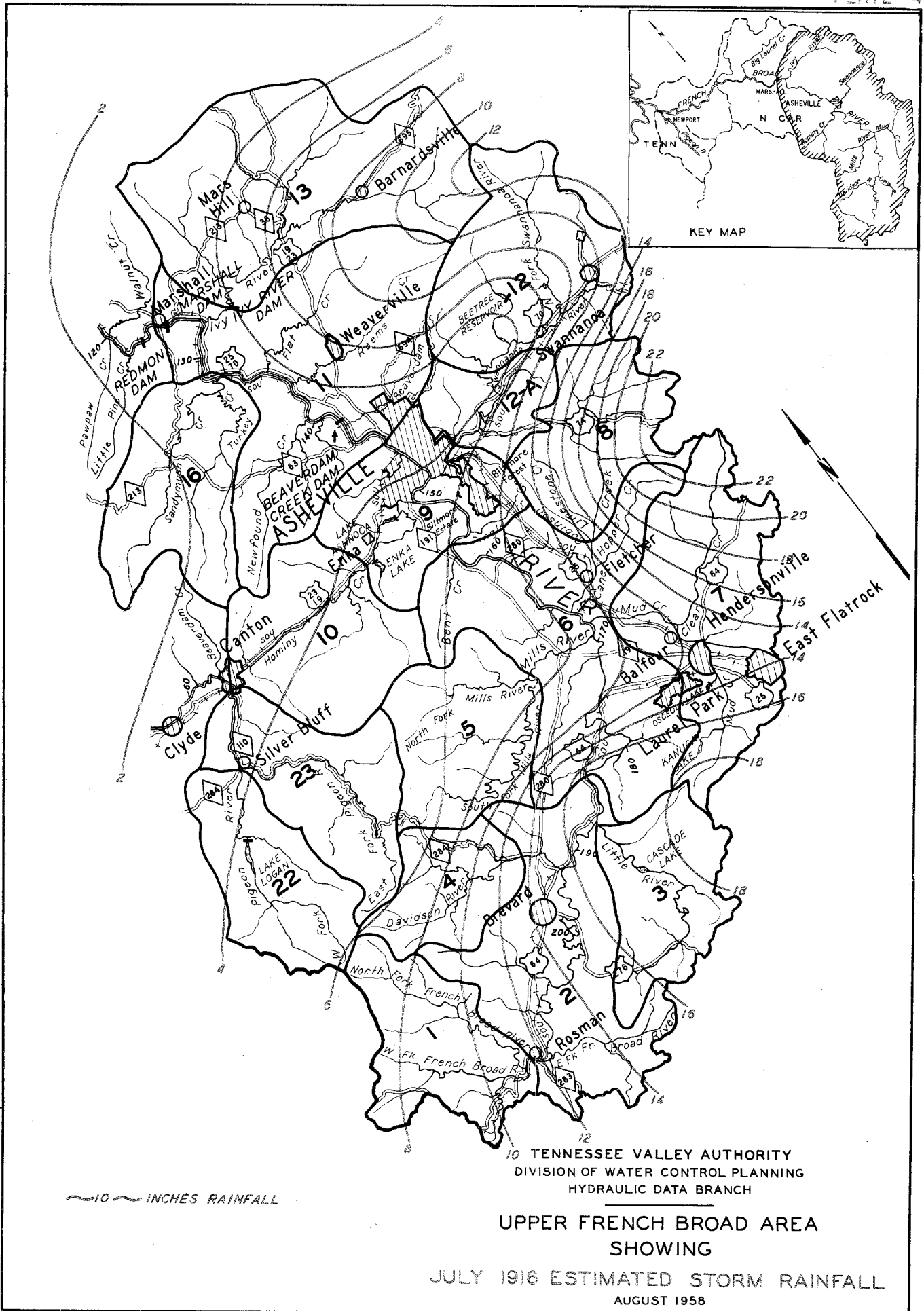
Henderson County has a vivid recollection of what happened there in 1910 when serious damage was caused. At the confluence of Mud Creek and Devils Fork, which is crossed by a series of three long wooden bridges, those structures were swept entirely away, and loss of life was narrowly averted.

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July 16, 1916

This flood which followed the July 10 flood by only 6 days exceeds all others known in the basin by a wide margin. This was one of the great floods of all time and was very devastating throughout the entire upper French Broad and western North Carolina region. Compared to the 1928 flood on Mud Creek, next highest most recent flood, the 1916 flood was $2\frac{1}{2}$ feet higher near Hendersonville and about $6\frac{1}{2}$ feet along the lower part of Mud Creek. All bottom lands were inundated. Railroads and highways were flooded and traffic badly disrupted.

The storm of July 1916 originated as a tropical hurricane. It passed inland over Charleston, South Carolina, on July 14 with the winds of near hurricane intensity. The storm center advanced northwestward across South Carolina and finally was dissipated over the upper French Broad valley on July 16. The storm was accompanied by extremely high rains over South Carolina, western North Carolina, and extreme eastern Tennessee. Although a center of high rainfall in excess of 16 inches was recorded in east-central South Carolina, the general rainfall pattern became heavier in the westerly direction across North Carolina. The heaviest recorded rainfall was found near the divide between the Atlantic and Tennessee River drains. In this region, 22 inches of rain was recorded in 24 hours at Altapass and a considerable area received over 10 inches. Plate 4 is a map showing the storm rainfall for the July 1916 storm. Rainfall amounts of above 20 inches occurred along the eastern rim of the area. Over the Mud Creek watershed above the mouth of Clear Creek, the estimated rainfall during this storm varied from 14 to 18 inches. Up to 22 inches of rain is estimated to have fallen on the headwaters of Clear Creek, Mud Creek's principal tributary. The major portion of the flood-producing rainfall occurred during a 12-hour period on the night of July 15-16. The average rainfall over the Mud Creek basin during the 1916 storm was 15.9 inches. Engineering studies by Hydraulic Data Branch engineers indicate that 79 percent of this intense rainfall ran off into the streams.



Descriptive of this flood along Mud Creek in the Hendersonville vicinity is the following article from the "French Broad Hustler and Western Carolina Democrat," July 17, 1916.

DISASTROUS FLOODS VISIT WESTERN NORTH CAROLINA
FLOODS IN HENDERSON WORST IN COUNTY'S HISTORY
MUCH DAMAGE DONE

The heavy rainfall of Saturday, Saturday night, and Sunday caused great damage in this section and the property loss will run into hundreds of thousands of dollars. Rain began falling Saturday morning and continued without interruption until Sunday noon and, as a result, Hendersonville was cut off from communication with the outside world with the exception of a badly crippled telephone and telegraph service, and although both the Western Union and Postal Telegraph Companies accepted a great volume of messages, these were only taken subject to an indefinite delay.

MUD CREEK ON A RAMPAGE

Much damage was caused by the exceptionally high water on Mud Creek, a small stream which almost encircles the city. The heavy rains caused this stream to overflow its banks and inundate the lowlands lying along its bed and adding to this the dams impounding the waters of Kanuga and Osceola bursted, adding this immense amount of water to the creek and as a consequence it was swollen to a height almost without precedent. Police officials were busy Saturday night when the waters had risen to the danger point, going from house to house along the creek warning the occupants to get out, and scores of persons were rendered homeless for the time being. At one place the people were still asleep when Chief Powers went into the house and at that time the water was about two feet deep on the floor in the bedroom.

BIG LAKES GONE

Osceola Lake was the first to go, the dam breaking at two o'clock Sunday morning. Nothing is left of the lake now but a small stream flowing through the center of where the big body of water used to be. The Kanuga Dam went down about 10:15 Sunday morning and persons hearing of this occurrence hastened to the creek to see the water rise, and when the water got to Hendersonville the creek rose with amazing rapidity and soon Mud Creek was a veritable Mississippi, carrying bridges, lumber, and everything that stood in its way on the crest of the water. The bridge on the Kanuga Road at the foot of South Washington Street withstood the force of the water but many other bridges, among them being the one on the road to Chimney Rock, were washed away. Numerous houses along the stream were flooded and the big steam shovel standing just above the Chimney Rock

Road on the outskirts of the city was almost covered with water and probably damaged to a considerable extent.

TRAIN SERVICE CRIPPLED

The Southern Railway lost heavily and it is said that it will take 30 days to repair the damage done on the Toxaway Division. Bridges were destroyed and fills washed out, leaving the track and ties suspended in the air. Train No. 4 for Columbia was the last train to arrive in Hendersonville Saturday night and the entire train is being held here until the track beyond Hendersonville can be repaired so trains could get through. No trains from the south have arrived in Hendersonville since Saturday morning, a big slide at Melrose on Salude Mountain covering the track for a considerable distance and the heavy downpour of rain made the task of clearing the track a most disagreeable one and, in fact, made all attempts at work Saturday night almost impossible.

Adding to the disagreeabilities of the flood was the overflow into the city's water reservoir in Laurel Park, the muddy water in the overflow rendering the city's water supply entirely unfit for use. . . .

POWERHOUSE OUT

The plant of the Hendersonville Light and Power Company situated on Big Hungry River on the line between Henderson and Polk Counties was put out of commission early Sunday morning. Those in charge of the plant kept it going as long as they could and the lights were on until the water had come up to the powerhouse and it kept rising until the generators were three or four feet under water. However the steam auxiliary plant located on the railroad below the depot was started up Sunday evening and the town was not put to the inconvenience of not having electric lights.

At one time it was feared that the big railroad bridge across Mud Creek just below the station would be washed away but it held its own against the flood, thanks to the piling that had been driven in above the bridge. This caught all the trash and saved the structure.

WIRES KEPT BUSY

Many visitors and tourists are in the city and these, almost without exception, are concerned about conditions in their homes and the telegraph and telephone companies were taxed to the limit with messages. The city was completely cut off from the rest of the country with any other means of communication. No trains and no automobiles could get here from Asheville or Spartanburg or any other place for that matter...

BIG DAMAGE TO ROADS

The damage to the roads and bridges of the county cannot be estimated, many fine highways are ruined and will have to be rebuilt. J. M. King and M. R. Ervin of Greenville, S. C. and Fred Jones who were passengers on northbound train No. 10 which was held up by the slide at Melrose walked all the way to Hendersonville Sunday and reported that the roads were torn all to pieces between here and that place. Railroad trestles were washed away and numerous washouts appeared along the line. On Saluda Mountain the earth had slid down on the track in 10 or 15 different places.

NEARLY TEN INCHES RAINFALL

The rainfall for the 12 hours including Saturday night was nearly 10 inches. Although it is said we have had more rainfall for the same period of time in the past, the ground had been thoroughly soaked from the recent rains and practically all of the water that fell found its way into the streams.

TWO CLING TO TREES

Hicks Garren and Vernon Rogers had a narrow escape Saturday night. They had gone out after some pigs at the end of Depot Street and the rising water forced them to make to the trees where they clung from one o'clock at night until 6 in the morning when they were rescued by parties using a boat.

CROPS DAMAGED

The damage to growing crops is enormous and it is believed that not more than 25 percent of the normal crop will be raised in Henderson County. Nearly all the bottom and the uplands were washed to a considerable extent. . . .

LAKES WERE PRIDE OF COUNTY

Kanuga and Osceola Lakes were the pride of Henderson County and were the largest of the county's numerous artificial lakes. The rains caused the earthen dams holding back the water of the lakes to overflow and this gradually ate away from below until the dams gave way entirely. Dynamite was called for at Kanuga to be used in an effort to save the large dam but before this could be gotten out there the whole thing gave way and the water's were turned into Mud Creek. The crest of the flood passed Hendersonville about noon Sunday.

JUICE FROM HYDRO PLANT TONIGHT

The steam plant of the Hendersonville Light and Power Company located on the railroad just below the depot was put in

operation last night and that is rendering the necessary service for lights and power. In order to put this plant in operation yesterday it was necessary to build a bridge and put in a gasoline engine to pump the water for the boiler. No. 1 hydro plant on Big Hungry was 8 feet under water at 2:30 Sunday morning. The No. 2 plant on the other side of the river from plant No. 1 is still intact and will be in operation tonight. The Light and Power Company requests the people of the city to be as lenient as possible

WATER SUPPLY SHORT

Mineral water was in great demand here Sunday as the water supply of the city ran entirely out before night. . . . Many boarding houses and hotels caught a quantity of rain water during the day and this served to tide them over until the city got good water into their mains.

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Mayor Brooks announced that it was the intention of the city authorities to begin work at once on a new concrete bridge on the Flat Rock Road over Mud Creek. . . .

It is thought by many that when the floods clear up and a conservative estimate of the damages done to the crops of Henderson County that at least 50 percent of the estimated damages will dwindle.

Mud Creek receded very fast Sunday night and this morning it was almost normal. Many of the smaller streams became their original size as early as Sunday at noon.

The long bridge on the Clear Creek Road near Hendersonville withstood the raging Mud Creek, while every bridge on the Bat Cave Road was washed away, excepting the new concrete one near Lawrance's Store, about 8 miles out of the city.

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August 16, 1928

Twelve years after the great flood of July 1916 came another large flood on August 16, 1928. High water marks establish it as exceeding the flood of August 13, 1940, by one-half foot near Hendersonville and by two feet near Naples. Railway tracks at Naples were overflowed, highway traffic was stopped at Naples and Hendersonville due to washing out of bridges and flooding of roads. Serious damage to crops resulted.

The Hendersonville "Times-News" for August 16, 1928, describes the flood as follows:

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With 38 hours of rainfall ending in the city and county shortly before 6 o'clock this morning, Hendersonville was practically isolated this morning insofar as railway and high communication was concerned. In many directions telephone wires were down and it was said that from a third to a half of the service was out in the county. Bridges in many directions were reported out though these were for the most part unconfirmed and communication with road and bridge officials of the county was impossible.

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Although flood gates had been open since early Wednesday afternoon, the earthen dam at Kanuga Lake, 5 miles southwest of Hendersonville went out about one o'clock Thursday morning. With the breaking of the dam about 30 acres of water was turned loose on lowlands to the east, but the area was so large that no damage of consequence was done.

About 100 feet of the dam at the south end where the water was deepest went out. This section represented about one-half the dirt in the dam but not one-half the length of the dam. The water went out with a roar and today the lake bed is practically dry.

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The Kanuga Dam went out in the flood of 1916 but was soon rebuilt. The loss in the present flood was estimated today--but not authoritatively--at \$5000.

A sheet of water varying to a half mile in width and stretching from the southwest of Hendersonville at a point beyond the polo field and around the southeast border of the city and in through the Mud Creek section and down to and beyond Balfour in the lowest country, formed during the night and was extending this morning over a distance of some four miles.

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So far as the city itself is concerned it has never had any inundation in its history. However, in the edges of the city toward the Mud Creek bottom it was said that two or possibly three small houses were flooded to the point that they could not be occupied.

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Numerous small bridges in the immediate vicinity of Hendersonville either were covered by water, washed out, or damaged. A foot of water covered the first bridge outside of town on the Flat Creek Road over Mud Creek; one or more new bridges over the same creek between town and the Blue Ridge School for Boys went out while others over the same creek on other roads met similar fates. The lowest parts of outlying sections remained under water; it was believed this would begin to recede this afternoon. Greatest damage in the lowlands was to corn and other crops.

"The Times-News" for August 17, 1928, said:

Hendersonville today was rapidly recovering the effects of the flood experienced over this region Wednesday and Thursday and highway, telephone lines, and mail were about back to normal today with the exception that all Southern Railway trains . . . would be making their schedules as usual by tonight.

Estimates placed damage done by floods in the high-land region at close to \$500,000 including crops, public utilities, industries, communications, and homes.

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October 16, 1932

This flood ranks as sixth among known floods on Mud Creek and is one of the few floods that have occurred in the fall of the year.

The Hendersonville "Times-News" of October 17, 1932, contains the following account of this flood.

HIGHWAYS ARE SUBMERGED, CROPS DAMAGED BY FLOOD AS
HEAVY RAIN FALLS IN COUNTY

RAINFALL IS ONLY 5 INCHES HERE

CORN SUFFERS; PUBLIC SERVICES NOT DISRUPTED; BOTTOMS FLOODED

With almost 5 inches of rainfall here since 6 p.m., Saturday, and the consequent rising of creeks and streams in this section, thousands of dollars of damage has been done to crops in this county, a survey today revealed.

Official figures show that 4.75 inches of rain has fallen here since Saturday evening, almost as much as the normal rainfall for the month of October, which is slightly above 5 inches.

Mud Creek and other smaller streams in the county were out of their confining banks yesterday and today and thousands of acres of bottom land, mostly planted in corn, are under water. The corn standing in the field in this bottom land is mostly ruined by the high water and much valuable feed and corn has been damaged or entirely ruined by the water.

Mud Creek for the most part is from 10 to 12 feet above its normal level and the French Broad River is also out of its banks and bottom lands along these streams are under water.

Heavy rains on Sunday caused Mud Creek to rise above the level of the Greenville highway just outside the city limits and last night about 200 yards of this highway lay under about 2 feet of water.

Although rain fell during the night, the creek carried most of the water off but the Greenville highway for about 200 yards was still under water this morning.

The Spartanburg highway along the flats just beyond the Hendersonville and Brevard line of the Southern Railway was also under from one to two feet of water last night and was still submerged this morning.

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The depth of water over the Spartanburg Highway (U. S. Highway No. 25) indicates that this flood exceeded the August 13, 1940, flood, at least on the upper portion of Mud Creek.

April 1936

The Hendersonville "Times-News" of April 6, 1936, describes this moderate flood as follows:

THOUSANDS OF ACRES FLOODED HERE

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Creeks and rivers in the county are out of their banks and thousands of acres of bottom land were under water.

Mud Creek and its tributaries covered thousands of acres around Hendersonville. . . .

Highways out of the city with the exception of the Haywood Road were clear. King Street near the point where it joins Main Street was under about a foot of water.

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August 19, 1939

A moderate flood occurred on this date on all tributaries of the French Broad above Mills River. An investigation by Hydraulic Data Branch engineers revealed a small amount of overflow on Mud Creek, with negligible damage.

August 13, 1940

On August 13, 1940, 12 years after the hurricane flood of 1928, a West Indian hurricane swept inland and resulted in an intense storm over the eastern section of the Tennessee River basin with resulting high floods on streams in that area. On Mud Creek this storm resulted in the seventh highest known flood on that stream. The valleys of Mud Creek and its tributaries were overflowed for several days to depths of 5 or more feet. This resulted in loss of crops on the bottom lands, including large areas of high-value truck crops. The storm of mid-August 1940 was of tropical origin, having developed in the Atlantic Ocean east of the Bahamas sometime prior to August 13, 1940. It was of hurricane intensity when it moved inland over Georgia and South Carolina. Plate 5 shows the rainfall over the upper French Broad area during this storm. Over the Mud Creek basin it is estimated that an average of 8.8 inches of rain fell of which about 36 percent ran off into the streams. Rainfall over the Mud Creek watershed above Hendersonville was from 8 to 11 inches. Rainfall occurred principally during a 48-hour period from August 11-13.

Figure 1, frontispiece of this report, is a flood scene on the outskirts of Hendersonville in the Mud Creek valley on August 13, 1940.

"The Times-News," August 13, 1940, carried this account:

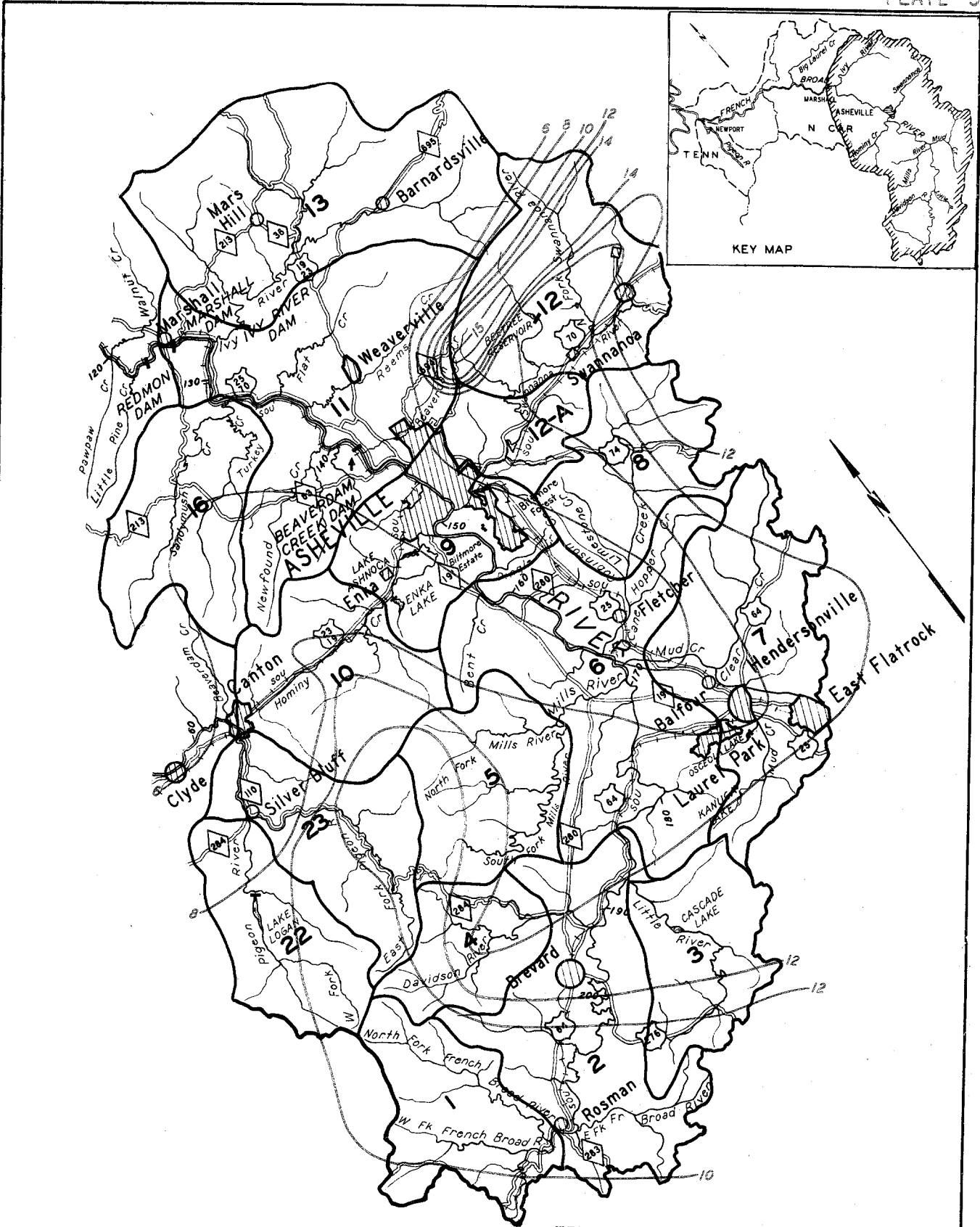
JORDAN DAM GONE; LOWLANDS FLOODED

DAMAGE TO COUNTY CORN CROP HEAVY

Six Inches of Rain Falls in 42 Hours Ending Noon Today

HIGHLAND LAKE DAM MAY ALSO GO

A report from the state highway prison camp early this afternoon indicated that two main highways were under water in Henderson county and a third threatened with washouts.



10 INCHES RAINFALL

TENNESSEE VALLEY AUTHORITY
 DIVISION OF WATER CONTROL PLANNING
 HYDRAULIC DATA BRANCH

**UPPER FRENCH BROAD AREA
 SHOWING
 MID-AUGUST 1940 STORM RAINFALL**

AUGUST 1958

Water was reported covering the Haywood or West Asheville road in the Mills River section.

Highway No. 64 leading to Chimney Rock was reported under water near Edneyville.

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A small dam was washed out, crops destroyed or damaged, lowlands flooded and some highways inundated today as streams of the county, swollen by six inches of rain in 42 hours up to noon, were out of their banks in all sections.

A concrete and stone dam at the Henderson County mill, better known as the old Jordon mill, gave way early today after flood waters had undermined it at one side.

Crops immediately below this dam, which is located on a side road between Flat Rock and East Flat Rock, were swept away and the road bridge just below the dam damaged. The road was closed by the sheriff's department and the state highway department notified.

Water from this lake, covering several acres, swept on into Highland lake where water was already pouring over the dam at the Old Mill Playhouse and fears were expressed that this dam also might give way.

THOUSAND OF ACRES OF CROP LAND FLOODED

Thousands of acres of pasture and cropland were flooded along Mud Creek and damage to standing corn was believed heavy. Mud Creek was out of its banks over its entire course.

The Greenville highway just south of the city was under water of a depth of about one foot for about 200 yards. The old Spartanburg road was under water for some distance in the lowlands just south of the city.

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The same newspaper for August 14, 1940, contained a story of the flood throughout western North Carolina and east Tennessee with reference to the Hendersonville vicinity as follows:

Flood waters, fed by the incessant rains of 36 hours, coursed down the mountains in the southeast, forcing rivers over their banks in four states, blocking roads and imperiling supplies of drinking water.

At least four were drowned.

Continued rains were forecast for today for the affected states--the Carolinas, Georgia and Tennessee--and it was feared that flood conditions would become more acute.

Asheville, N. C., was virtually isolated and for many hours only one road was open westward to Knoxville, Tenn.

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ASHEVILLE, Aug. 14 (UP) Rains in the western sections of North and South Carolina--by-product of a hurricane which struck the coast Sunday--abated last night after 42 hours of steady downpour sent mountain streams and rivers gushing over their banks.

Asheville was virtually isolated.

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It was impossible to estimate crop damage until the waters subsided. It was believed to be large. Damage was said to be especially heavy in the valleys of Mud creek, French Broad river, Mills river and the Swannanoa, all of which left their banks.

Rainfall here during the past 48 hours was between seven and eight inches--greatest since the floods of 1916-1918. Rainfall at Hendersonville during the past 24 hours was 5.53 inches. Dams in Highland lake, Kanuga and Osceola and Laurel Park lakes were holding fast, although waters were above flood stage.

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Highways from Hendersonville in four directions were under water with prospects they would be closed before morning. County roads were impassable and one Hendersonville street near Mud creek was flooded. Small steel bridges on county roads were said to have been washed out.

A small mill dam near Hendersonville went out early yesterday and several other dams were threatened. . . .

With regard to the local situation, the August 14 issue of "The Times-News" said:

FLOOD WATERS FALLING HERE

Situation Improved After Many Marooned Temporarily

Light showers fell here today but Henderson county's flood situation was much improved.

Highways leading to Spartanburg and Greenville on the south, to Asheville on the north, and to Chimney Rock on the east were open for traffic today and flood waters in the vicinity of Hendersonville were falling rapidly.

The Highway to Brevard was still closed, as was the road to West Asheville.

Hundreds of travelers were marooned here and the chamber of commerce office was open until 11 p.m. to assist visitors. Many others sought road information and the chamber office reported 175 visitors and 138 phone calls up to 10 a.m. today.

Crop damage in this county was believed to be heavy but no estimate can be made until water runs off the lowland areas.

August 30, 1940

About two weeks after the mid-August 1940 storm and flood, another flood occurred on August 30 which was about 2 feet lower than the mid-August flood. This storm, unlike the mid-August storm, was not of tropical hurricane origin. It did not originate as a well-defined storm center but produced heavy rains in many areas in the southern Appalachian Mountains of eastern Tennessee and western North Carolina. Rainfall over the Mud Creek watershed averaged 6.8 inches of which about one-third ran off into the streams. Above Hendersonville the rainfall was slightly higher than the average for the basin. Damages during this storm were relatively light since most crops had been destroyed by the mid-August storm. Figure 2 is a photograph of this flood near the junction of Mud Creek and Bat Fork.

The following story about this flood in Henderson County is from the August 30, 1940, issue of "The Times-News."

NEAR 7-INCH RAINFALL HERE

Thousands of Acres of Bottom Lands Are Again Flooded

Streams of Henderson county were out of their banks today for the second time this month after almost seven inches of rain fell in a 36-hour period.

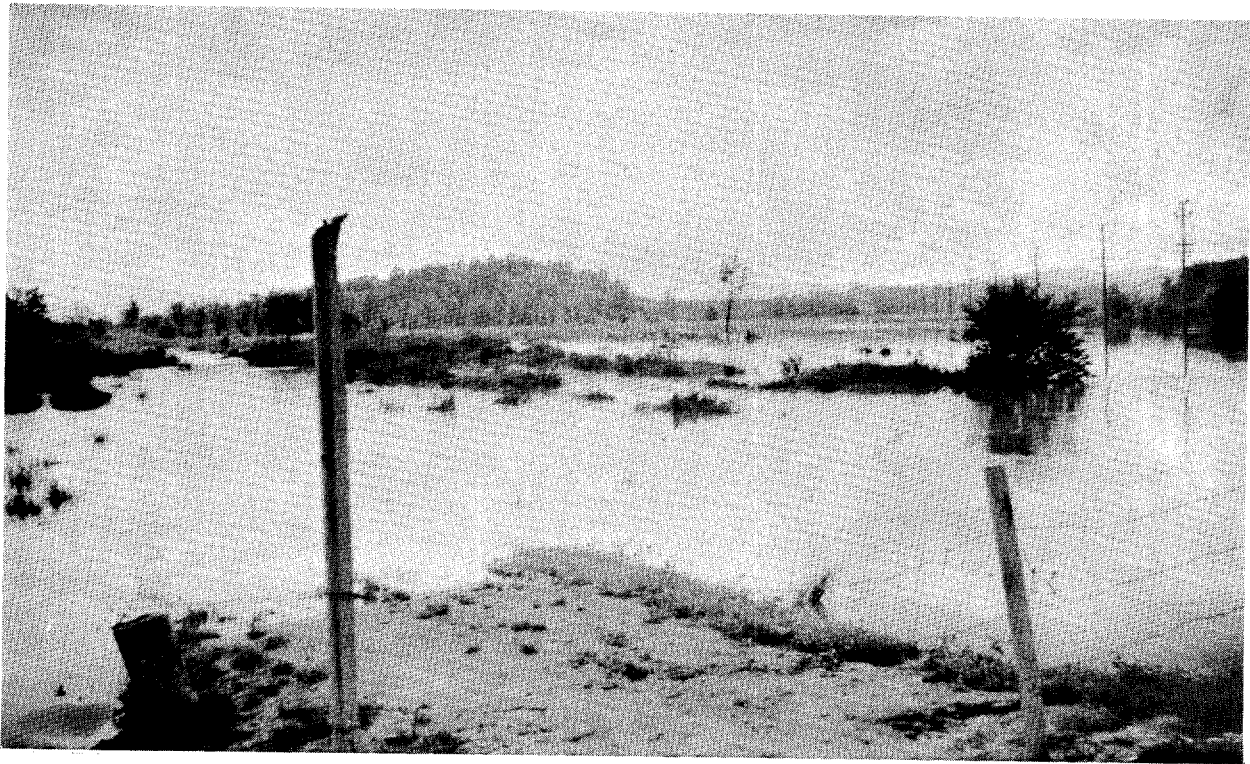


Figure 2.--MUD CREEK-BAT FORK JUNCTION, AUGUST 30, 1940

Upstream along Mud Creek valley during flood of August 30, 1940. Mud Creek flows to left of transmission line. Bat Fork is on left of picture. The flood of July 1916 was 8 feet higher here than that of August 30, 1940.

The heavy rain, which continued practically all night, stopped just before dawn, skies were clearing today and the water was rapidly running off.

Thousands of acres of bottom lands were flooded and water covered many main highways and secondary roads. Water from Mud creek covered the Greenville highway and Chimney Rock highway; Mills river was out of its banks and covered the Haywood road near Davenport's store; Cane creek covered the Asheville highway at Fletcher.

Traffic was forced to detour around Mills river but other highways were passable.

Rainfall for the 24-hour period ending at 6 p.m. yesterday was 4.77 inches. An additional 2.05 inches fell last night, making a total of 6.82 inches for the 36-hour period. Total rainfall for the month is 16 inches compared to the normal of 7.15 inches.

High water inside the city limits, caused by inability of drains to carry off the heavy rainfall, did considerable damage in some places.

There was no estimate on crop or highway damage today.

May 20, 1942

As a result of an intense storm over the Blue Ridge Mountains in the headwaters of the French Broad River and its tributaries on May 20 and 21, 1942, large floods were experienced throughout this region. One of the highest centers of rainfall from this storm was at Hendersonville, where more than 8 inches of rain fell in a period of 20 hours. The major part of the storm was between 8 p.m. on the nineteenth and 10 a.m. on the morning of the twentieth with the rain stopping around 5 p.m. on that day. Hydraulic Data Branch engineers made a field investigation immediately following this storm and flood.

As a result of the intense rainfall in the Hendersonville vicinity, Mud Creek and its tributaries rose rapidly during the early morning hours of May 20. Mud Creek left its banks in the early morning hours of May 20 and crested at the Naples gage at 12.63 feet at 6:30 p.m. on May 20.

Many farmers reported that they had never seen the creeks rise so rapidly. By daylight all of the smaller creeks were raging torrents.

A number of farmers barely had time to drive their stock from pastures in the bottoms.

The stream was back in its banks by the morning of May 22 except where it was affected by backwater from the French Broad. Overflow of the relatively low banks of the creek was extensive and crops and land were badly damaged. Corn, pasture, and truck crops were all damaged. Considerable damage was done to small bridges throughout Henderson County. Two bridges on Mud Creek were washed out and a number of other bridges in the watershed had to be repaired. Figure 3 shows a bridge wash-out in this flood. U. S. Highway 64 was closed for two days during the flood by high water.

The following are excerpts from the Hendersonville "Times-News," May 20, 1942:

Highway traffic south of Hendersonville was halted before noon today as western North Carolina suffered one of the worst downpours in many years. Rain which began falling shortly after 8 o'clock last night had mounted to more than eight inches as The Times-News went to press.

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From 8 p.m. yesterday until 7:45 o'clock this morning Hendersonville's rainfall was 5.20 inches. From then until 1 p.m. today an additional 2.70 inches was recorded. It was believed that another inch had fallen when this paper went to press.

The "Asheville Citizen," May 21, 1942, carried this article about the flood:

RAIN CAUSES HEAVY DAMAGE IN HENDERSON

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Highways Closed

All southbound highways, the Hendersonville-West Asheville highway and the Hendersonville-Brevard road were closed to traffic before noon Wednesday. High waters, which overran creek banks and flooded the roads, was receding slightly Wednesday night.

It was believed that unless additional rains set in, all roads would be open early Thursday morning. There were no reports of serious bridge damage. The Osceola lake dam and the Kanuga lake dam, both southwest of Hendersonville, which were reported in danger early in the afternoon, were believed safe Wednesday night.

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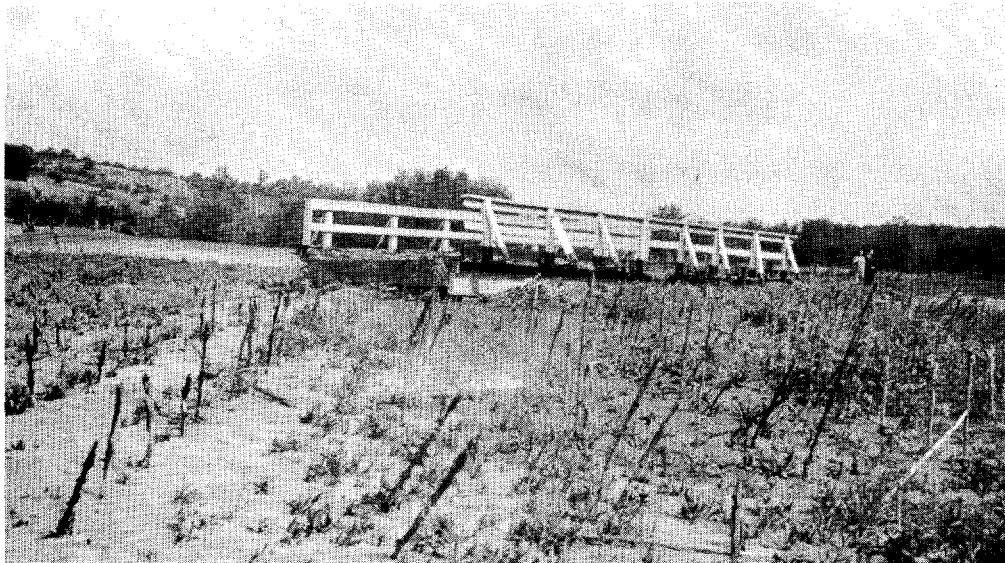
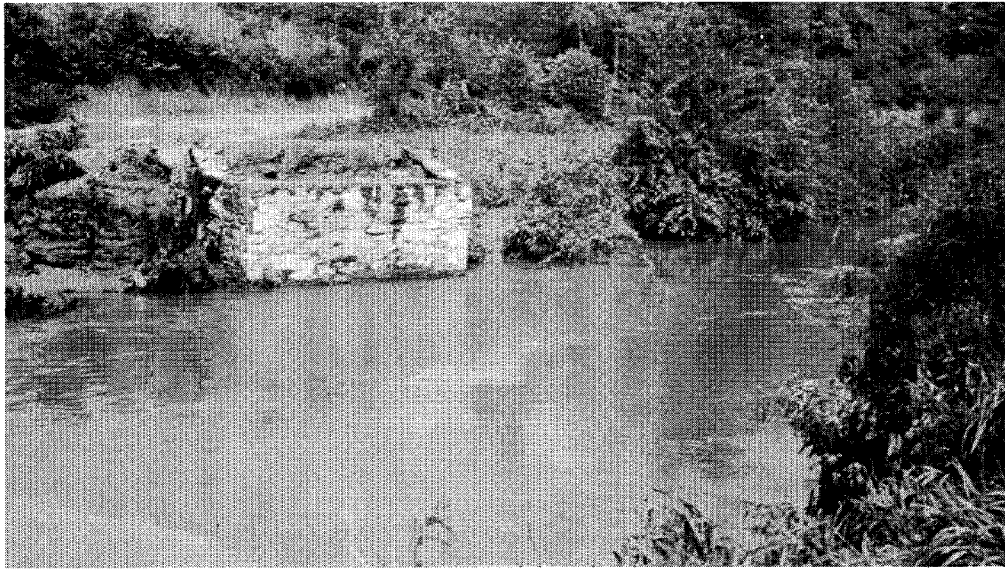


Figure 3.--MUD CREEK BRIDGE WASHOUT, MAY 20, 1942

The upper view shows the site of the former bridge across Mud Creek near Balfour. The bridge was washed out by the May 1942 flood which was about 5 feet overbank . The bridge was floated downstream and set down in a corn field a quarter of a mile from the bridge site. Many present bridges across Mud Creek and its tributaries are of this type and may be expected to be floated off their abutments and carried away during high floods.

Downtown streets were nearly deserted early Wednesday and school attendance was reported at approximately 30 percent in the morning. All city schools closed at noon. They will reopen on schedule Thursday morning unless additional heavy rains fall during the night, it was stated.

On May 21, 1942, the Hendersonville "Times-News" said:

SAY LOWLAND CROPS WIPED OUT IN COUNTY
Not Too Late for Crops To Be Replanted,
Is Pointed Out

BREVARD HIGHWAY REMAINS CLOSED

County Agent G. D. White today estimated that yesterday's record rainfall caused at least \$250,000 damage to Henderson County crops and farm land.

"It is impossible to tell yet just how much damage has been suffered by the farmers," Mr. White said, "but a preliminary survey indicates that a quarter of a million dollars is a conservative estimate."

The agent explained that the greatest damage was caused by erosion of farm land. Nearly all crops on low land, however, were destroyed.

"Fortunately, it is still early enough to replant, and the crop losses consisted mainly of loss of seed and fertilizer," Mr. White said.

Although showers are forecast for today and tonight, it is believed that all immediate danger of further damage is over. Rivers and creeks still are out of their banks in many instances and water has not completely drained from some low land, but it is draining rapidly.

A total of 8.25 inches of water fell from shortly after 8 p.m. Tuesday until about 4 p.m. Wednesday, one of the heaviest downpours on record for this section. From Tuesday night until 1 p.m. Wednesday the rainfall was recorded as 7.90 inches. Only .35 of an inch fell during the afternoon.

The Hendersonville-Brevard highway was still closed today, however, and it was believed that part of the road had been washed out. Water is still over a section of the highway just this side of Etowah and it is impossible to determine the damage until it recedes.

All south-bound highways were opened late last night as soon as the water drained from them. Other highways are open today. A number of secondary roads still are closed.

The damage suffered by secondary roads has not been determined, but it is believed that many of them have washed to such an extent that they will not be usable until filled in.

City schools, which closed yesterday at noon, were reopened today on schedule.

December 29, 1942

The flood resulted from rainfall amounting to as much as 8 inches during the storm in the headwaters of Mud Creek. At Rush Mountain the total was 8.35 inches. At Hendersonville it was 5.59 inches. Hydraulic Data Branch engineers made a special investigation and report covering flood conditions throughout the upper French Broad region including the Mud Creek watershed. Mud Creek left its banks late on the afternoon of December 28 and rose until midnight of December 30. Bottom lands near Hendersonville were overflowed and secondary roads were flooded and closed to traffic.

The Hendersonville "Times-News," Tuesday, December 29, 1942, reported:

HIGH WATERS COVER ROADS

Rainfall Since Sunday Night Recorded At Four Inches

Heavy rainfall throughout the WNC area hampered highway traffic today and made roads dangerous for travel as the precipitation continued all morning.

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Late today the state highway department announced the Haywood road between Hendersonville and West Asheville had been closed. . . . Mud Creek was overflowing the bottoms along its course, but was not above the highway level at 2 o'clock.

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The Hendersonville "Times-News," Wednesday, December 30, 1942, said:

HIGHWAYS OUT OF CITY STILL FLOODED

High water due to the excessive rainfall this section has received during the past several days continued to mar traffic as two main highways out of Hendersonville remained closed today. The rain stopped during last night and clear weather was forecast for today

Highway 191 between Hendersonville and West Asheville has been closed since yesterday, due to high water over the road. Last night Highway 64 between the city and Brevard, and Chimney Rock was closed to traffic due to high water.

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The State Highway Department said this morning that water was standing as high as 30 inches in numerous places over county roads. The same source also reported that the highways would not be open today as flood waters failed to recede this afternoon.

The Hendersonville "Times-News," Thursday, December 31, 1942, reported:

ALL COUNTY HIGHWAYS ARE RE-OPENED

Flood Damage Throughout W.N.C. Extensive
Says State Highway Dept.

All highways in Henderson county, with the exception of the Hendersonville, West Asheville road have now been re-opened, it was announced this afternoon by the State Highway Dept. . . . The highways from here to Brevard, and Chimney Rock were reopened yesterday. Flood waters which covered roads as deep as 30 inches are receding rapidly, it was said.

Damage throughout WNC was extensive, however, according to the highway department. . . .

Only slight damage was caused in Henderson county, it was said. The main highways suffered only slight damage, but county school bus roads were washed severely and many will have to be re-rocked.

November 29, 1948

Storm activity during this month caused three minor and one significant rise on streams in the Mud Creek watershed. None approached the major floods on these streams but their occurrences during the month of November were unusual. The fourth storm during the month caused the

highest rise in Mud Creek and the Naples gage rose to 10.38 on November 29. The greatest damage from flooding was suffered by corn crops and winter cover crops. More than 4 inches of rain fell in the Hendersonville vicinity during this storm in a period of about 60 hours. In the bottom lands along Mud Creek the lands that had been used for truck crops during the summer were in small grain for winter cover crops. Damage to these and to the corn on other lands in the bottoms was not extensive.

The "Asheville Citizen," November 29, 1948, reported:

THIS AREA HARD HIT BY DELUGE

Henderson: Many secondary roads under water. . . . Old Spartanburg highway under water from Hendersonville to fairgrounds. Considerable bottom land also flooded. Rainfall as recorded at Hendersonville at 6 p.m., 3.24 inches.

On November 30, 1948, the "Asheville Citizen" said:

SWOLLEN STREAMS RECEDING

Streams in various parts of Western North Carolina, swollen almost to flood stage by a sudden storm that swept over the area during the week end, appeared to be subsiding yesterday and last night, leaving in their wake the usual accumulation of debris.

Damage for the most part was confined to crops that had been left in fields, but this amounted to a very little, a survey showed.

. . . . Mud Creek near Naples was out of its banks but dropping rapidly at its headwaters above Hendersonville.

Rainfall in Hendersonville over the week end brought the total precipitation for the month to 12.54 inches--the greatest in a 30-day period there since June, 1943, when 22.08 inches of rain fell.

Streams of the county were reported receding to their banks yesterday and only Highway 191 (the West Asheville road) was under water for a short distance yesterday afternoon. The inundated portion of the road was on both sides of the bridge over the French Broad River, about six miles from Hendersonville.

Floods of 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

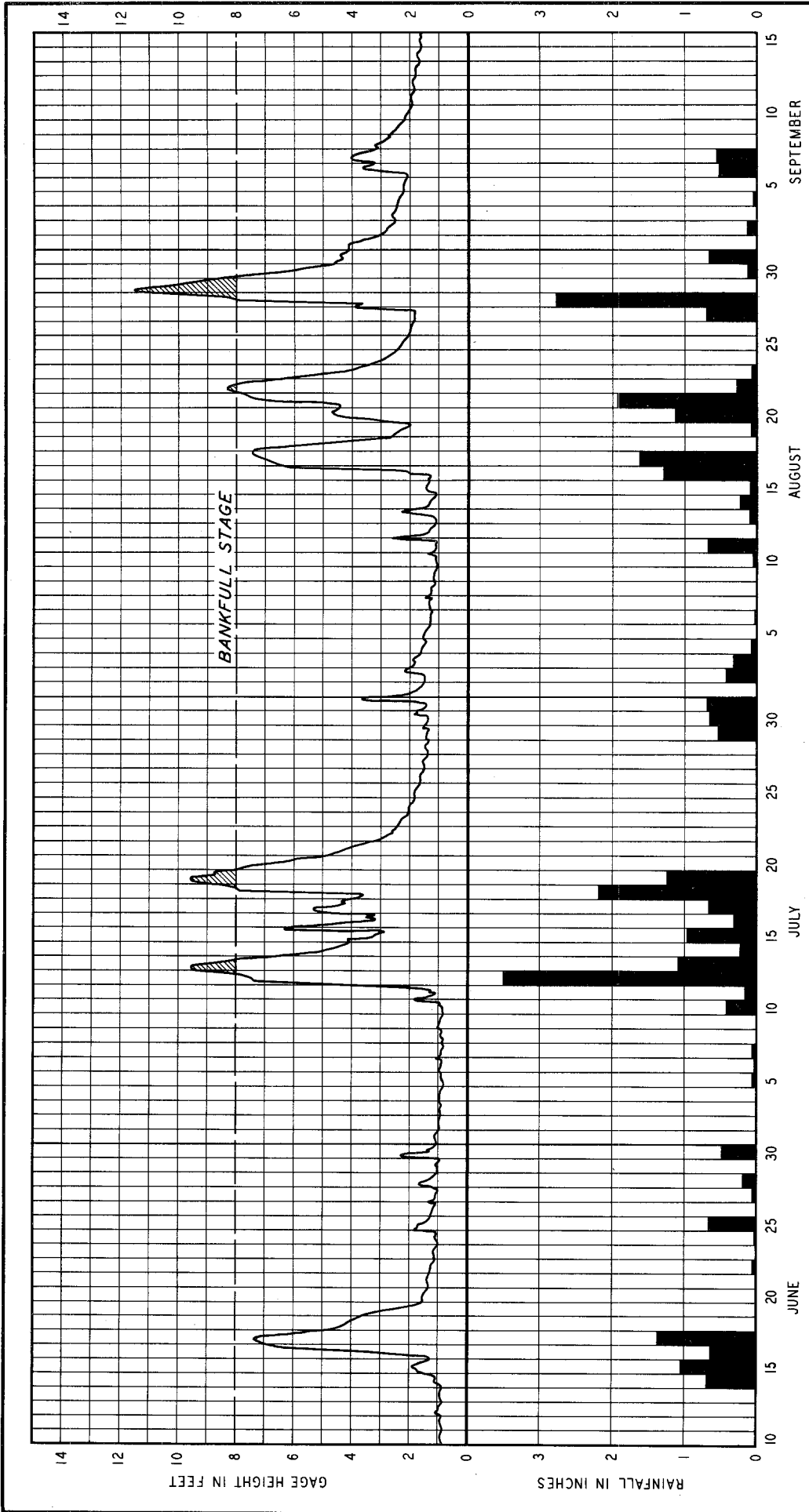
basin. The truck crop industry suffered particularly devastating losses. Plate 6 is a stage graph of the Naples gage on Mud Creek for the summer of 1949. This shows the rises in June, July, and August, together with rainfall at Hendersonville. Special field investigations of all these high water periods were made by Hydraulic Data Branch engineers. Figure 4 shows typical crop damage resulting from the high waters during the summer of 1949.

On Mud Creek, the June flood was not particularly serious as the creek only rose to a gage height of 7.34 at Naples on June 16 which is slightly under flood stage and did not result in extensive overflow.

The period July 11-19 was one of daily showers which were heavy on the eleventh and twelfth and again on the seventeenth and eighteenth. During this period rainfall at Hendersonville totaled about 10 inches, and rainfall over the Mud Creek basin above Naples was from 9 to 10 inches. The periods of heaviest rainfall caused overbank flooding on July 12 and again on July 19 when Mud Creek rose to a gage height of 9.54 resulting in serious overflows of the high-value truck and other crops planted in the bottoms.

Following these two rises, growers in many areas planted what they hoped would be a late crop. However, on August 29, as a result of heavy rains during a storm on August 27-28 which accompanied the passage of a decadent tropical hurricane just east of the upper French Broad River basin, Mud Creek again rose, this time to a height of 11.52 feet, and for the third time floods inundated the fields along Mud Creek and its tributaries. Rainfall along the borders of the Mud Creek watershed totaled over 9 inches. In addition to truck crops, corn, small grain, and pastures suffered damages. Highways were overflowed and scoured and a number of bridges were washed out.

Flood heights during June, July, and August 1949 were moderate as compared, for example, to those of August 1940 and the much greater floods of August 1928 and July 1916. However, damages were much greater than in 1940, largely due to the growing use of the bottom lands for high-value truck crops which was not so prevalent in 1940.



1949

TENNESSEE VALLEY AUTHORITY
 DIVISION OF WATER CONTROL PLANNING
 HYDRAULIC DATA BRANCH

**MUD CREEK STAGES AT NAPLES, N.C.
 AND
 RAINFALL AT HENDERSONVILLE**
 JUNE 10 TO SEPTEMBER 15, 1949
 AUGUST 1958

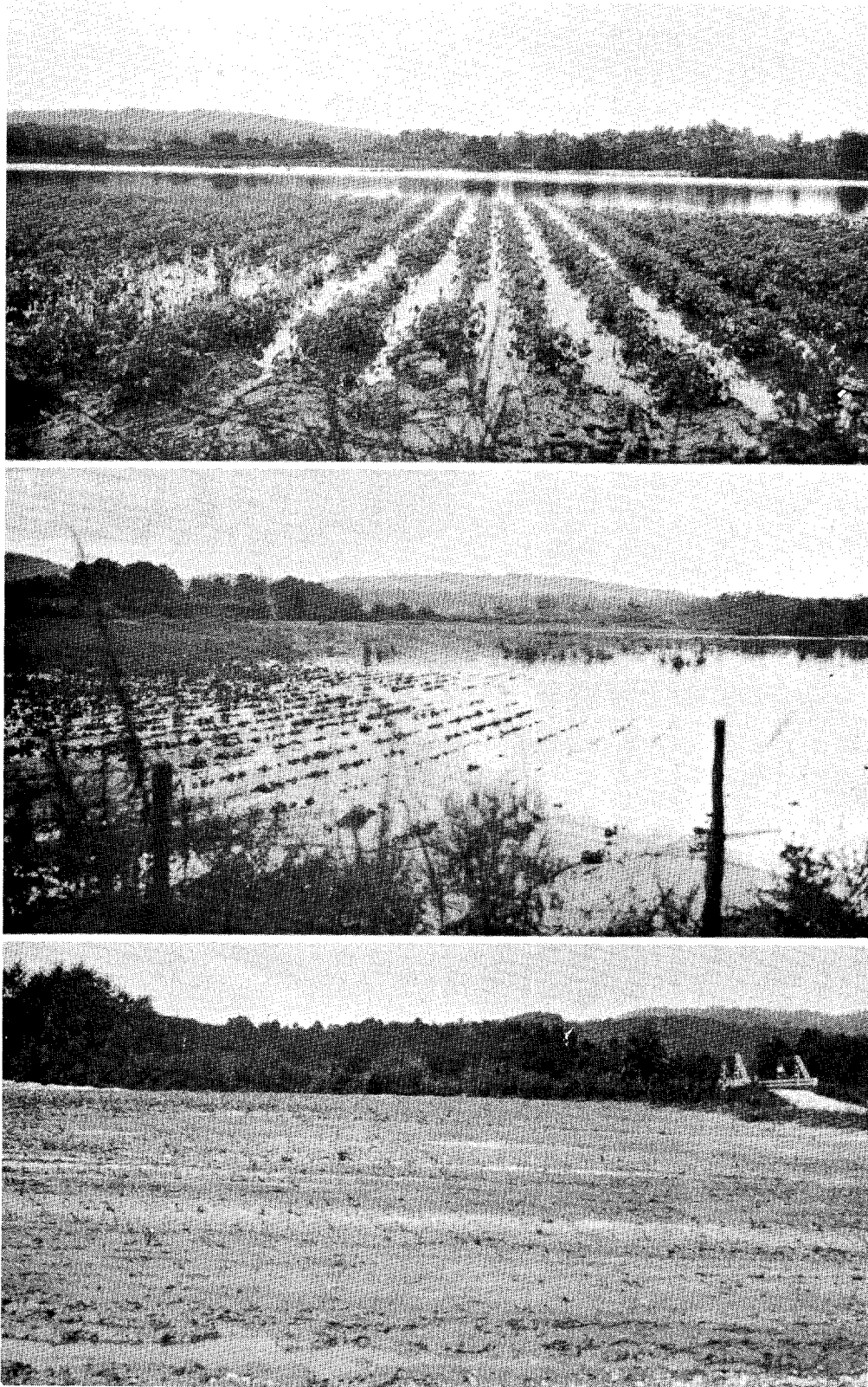


Figure 4.--TYPICAL CROP AND FARM DAMAGE
BY SUMMER FLOODS IN 1949

The upper view shows overflow in a bean field in the Mud Creek flood plain July 19, 1949. The middle view shows the same field overflowed on August 29, 1949. The bottom view shows the ruined bean crop and land scoured after the August overflow had receded. This is typical of what happened throughout the valleys of Mud Creek and its tributaries in the summer of 1949.

In the June rise, about 250 acres were flooded along Mud Creek but little of this was in cultivation. Damages during this rise were not large. In July the overflow along Mud Creek alone was 1070 acres, of which about one-third was in bush beans, pole beans, cabbage, and other valuable truck crops. Mud Creek was out of its banks below Hendersonville for 24 hours on July 12 and 13 and for 21 hours on July 19 and 20. The July floods caused more flooding of highways and delay of transportation than did the June flood. In the August flood about 1800 acres were overflowed in the Mud Creek watershed, a considerable portion of this being in truck crops. Secondary roads throughout the Mud Creek watershed were blocked during the crest of the floods.

Damages resulting from floods during June, July, and August in the Mud Creek watershed were estimated by Hydraulic Data Branch engineers to be about \$217,000. Of this, about three-fourths are losses suffered by truck crops. Unfortunately, although the Mud Creek basin is ideally suited for growing of high-value truck crops otherwise, such crops are particularly vulnerable to overflow damage because the planting and growing seasons coincide with the period of most serious flooding on the creek and its tributaries.

The water during none of these floods was high enough to result in any particular damage to industrial, commercial, or residential property at Hendersonville but was confined largely to the agricultural damages suffered in the bottom lands of Mud Creek and its tributaries.

The "Asheville Citizen," Wednesday, July 20, 1949, carried the following article about the July floods, most of which is applicable to the Mud Creek situation.

THE FLOODS AND THE FARMER

One by one the mountain counties are counting up their losses from two heavy floods within a month. Henderson, for instance, has a bill of approximately one million dollars, though this includes damage from hail storms, late frosts and insects. In a dispatch to The Citizen our Hendersonville correspondent tots up the flood bill in this manner:

BEANS AND TRUCK CROPS. Thousands of acres covered by flood waters. Two plantings lost. Estimated cost between \$300,000 and \$400,000.

APPLE CROP. Principal damage from frost, but apples suffered from rust due to wet weather and standing water. Crop normally valued at one million dollars will make only 50 percent of full yield.

CORN CROP. A conservative estimate is that 1,000 acres have been destroyed in two floods. Damage about \$100,000.

DAIRYING AND LIVESTOCK. Some pasture lands permanently damaged, pastures denied to herds at height of pasturing season. Terraces and ditches on other farm lands destroyed by floods. Damage unestimated but is in addition to the one million dollars over-all damage.

It is easy enough to draw from Henderson's experience a conclusion which fits all the flood-damaged counties of Western North Carolina. The farmer has suffered most. He is the first to feel the onrush of flood waters and the last to be rid of their destruction. Henderson, for example, is one of the richest bean growing areas in the world. This money crop has been dealt the hardest blow of all. It means less income in 1949 for Henderson county.

Western North Carolina has precious little farming land that is fertile enough to support large scale agriculture. Where that land lies, it is rich beyond dreams. But nearly every year, and sometimes (as in 1949) twice a year, the priceless topsoil is skinned off the land by floods and is carried down the rivers.

What other area of North Carolina, or for that matter of the whole Southeast, has a greater stake in flood control?

December 7, 1950

As a result of general heavy rains on the late afternoon of December 6 and the morning of December 7 overbank flows occurred on Mud Creek, resulting in a stage of 11.55 at the Naples stream gage. Rainfall at Hendersonville during the storm was 4.63 inches. A special investigation of the flood was made by Hydraulic Data Branch engineers immediately following the flood.

Water rose over the main highways between Hendersonville and Brevard but did not get high enough to stop traffic. Numerous secondary roads were impassable. Flood damages were moderate, mainly due to the fact that crops had been gathered and a considerable amount of bottom lands were protected by winter cover crops. Minor flooding occurred from

Mud Creek to two concerns in Hendersonville. At the W. A. Keith Company water was 2 feet deep over the lower floor and several tons of feed stored in the basement were lost. At the Sinclair Oil Company water rose to two feet over the storage yard and into a small pump house.

"The Times-News," Hendersonville, N. C., December 7, 1950, reported the following:

LARGE AREA INUNDATED BY RAIN HERE

4.42-Inch Deluge Hits Area; Cold
Weather Coming

Low areas of Hendersonville and Henderson county were under water, some schools were not in operation and highway traffic was hampered after 4.43 inches of rain fell from about 7 p.m. Wednesday to 8 a.m. today.

The rain continued until about 9:30 a.m. adding only a small fraction of an inch of rainfall.

The forecast for today was for colder weather with the possibility of snow later in the day.

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Mud Creek rapidly left its banks, covered U. S. Highway 25 and 176 at the junction just south of Hendersonville and flooded low areas in the Hendersonville area.

Water rose several feet in the basement of the W. A. Keith Co., location on South King Street, and did considerable damage to stored feed. A boat was being used to remove feed from the basement.

The high water from Mud Creek also covered the Sinclair Oil Co., area on South King Street. A boat was used to enter the company office early this morning. . . .

North of Hendersonville, small creeks flooded a considerable area and several streets in the Druid Hills area but this water was receding.

March 11, 1952

Heavy rainfall from early afternoon on March 10 until about 1 a.m. on March 11 in the Blue Ridge along the southern rim of the upper French Broad River basin resulted in flood conditions throughout the region.

Rainfall at Hendersonville during this storm was 3.56 inches. Rainfall at Rush Mountain in the headwaters of Mud Creek was 5.75 inches. Hydraulic Data Branch engineers made a special field investigation of this flood.

Mud Creek rose to a height of 11.55 feet at Naples. The main highways in Henderson County were impassable at a number of points and secondary roads were inundated for periods up to 3 days. Agricultural flood damages were only moderate since the flood occurred early in the season before many crops had been planted. Figures 5 and 6 are scenes during this flood.

An increasing proportion of the bottoms are being protected by winter cover crops, and flooding of pastures and cover crops at this time of year for a short period is not very damaging.

The Skyline Handbag Company at Hendersonville suffered a loss as a result of Mud Creek overflow. This consisted of necessary reprocessing of handbag material that was flooded, general cleanup, and a loss of two work days. This company, manufacturer of woven-cloth handbags, occupies the building formerly occupied by W. A. Keith Company which suffered damage in the December 1950 flood. Sinclair Oil Company adjacent to the Skyline Handbag Company suffered loss due to an electric motor being wetted by flood waters and washing of gravel surfaces in the yard.

"The Times-News" of Hendersonville, N. C., March 11, 1952, reported this flood as follows:

HEAVY RAINFALL HERE PUSHES STREAMS OUT OF BANKS
BUT DAMAGE IS REPORTED LIGHT

A rainfall of 4.10 inches in approximately 12 hours sent Henderson streams out of their banks today, flooding hundreds of acres of land and covering roads and highways in some places, but no serious damage had been reported.

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Early today Mud Creek was out of its banks, covering U. S. 25 and U. S. 176 a depth of several inches just south of Hendersonville. Last night several inches of water covered U. S. 64 just east of the city.

High water reached the station and transmitter of WHKP but did no damage to equipment.

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Figure 5.--MARCH 1952 FLOOD NEAR HENDERSONVILLE

The view shows the J. L. Thomas produce packing plant in the Mud Creek flood plain at the crest of the flood of March 11, 1952. The flood of July 1916 was about 5 feet higher at this location than that of March 1952.

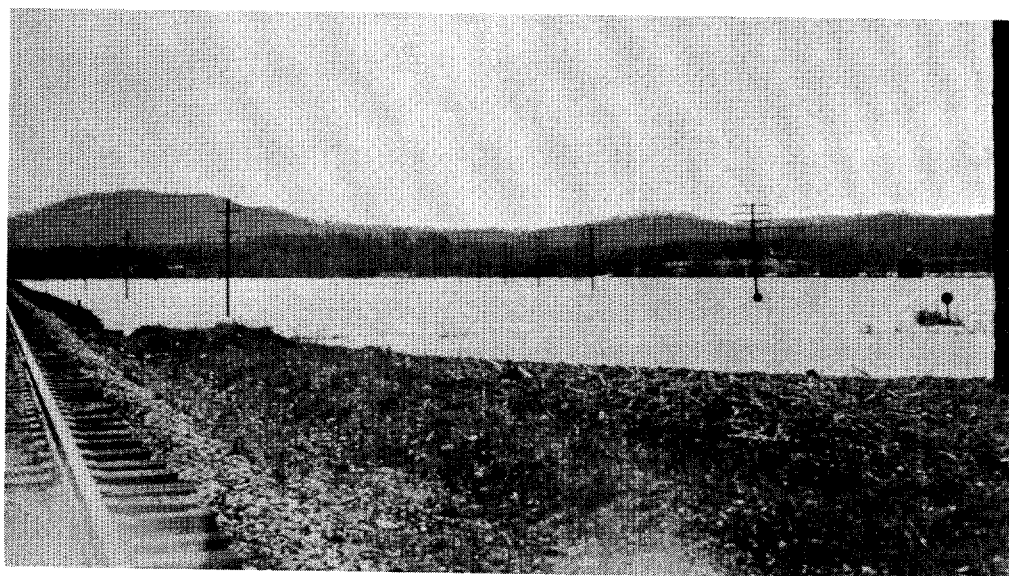


Figure 6.--MUD CREEK NEAR NAPLES, MARCH 1952

This is the lower section of the Mud Creek valley near the crest of the March 11, 1952, flood. The 1916 flood was 10 feet higher at this place.

Rain began falling shortly after noon yesterday and continued until after midnight with the greatest fall after 6 p.m.

The 4.10 inches was considered a very heavy fall for that period but was not a record for a 24-hour period. The previous greatest 24-hour fall was 4.90 inches on December 7, 1950.

The "Asheville Times," March 12, 1952, said:

The rivers and streams were gradually receding today after going on a minor rampage due to rains which ranged as high as six inches Sunday night and Monday.

Mud Creek at Naples in Henderson County was one of the several creeks that left its banks and flooded farmland over a wide area.

There was every indication of a good-sized lake last night at Naples--one of the lowest points in Western North Carolina. The waters from the creek did not touch U. S. 25 at Hendersonville.

March 23, 1952

For the second time in March 1952, Mud Creek rose above flood stage, cresting on the twenty-third at a stage of 9.71 at the Naples stream gage. Rainfall at Hendersonville on March 22 and 23 totaled 2.83 inches and at Rush Mountain in the headwaters of Mud Creek 4.25 inches. Secondary roads were impassable for periods up to $2\frac{1}{2}$ days. U. S. highways were covered by flood waters at several points but traffic was not stopped. Flood damage was slight largely due to the fact that crops had not yet been planted and a large percentage of the bottoms were protected by winter cover crops minimizing sanding and scouring.

"The Times-News," Hendersonville, N. C., March 24, 1952, said of this flood:

HIGH WATERS BLOCK ROADS IN THIS AREA

3-Inch Rainfall Swamps Parts of
3 Arteries; Rain, Cold Forecast

Flood conditions closed several Henderson county highways again today after almost three inches of rainfall

over the weekend and the forecast was for additional rain and colder weather today.

U. S. Highway 64 between Hendersonville and Brevard was under water near the Henderson-Transylvania line and the Crab Creek road was inundated near the junction with U. S. 64.

N. C. 191, the Haywood road, was under water in the vicinity of the French Broad bridge.

Thousands of acres of lowlands were inundated by the heavy rains of the last two days.

Rain, which began Saturday afternoon, continued into Sunday and the fall was measured at 1.96 inches on Sunday afternoon. An additional fall of .76 inch was recorded up to 8 a.m. today and snow, sleet and rain continued during the morning today.

Total rainfall for March, to 8 a.m. today, was 11.37 inches.

February 21, 1953

This was a winter flood which caused Mud Creek to rise to a stage of 10.12 on the gage at Naples. The flood resulted from rainfall amounting to 3.53 inches at Hendersonville and 5.80 at Rush Mountain. Heavy snow fell a few days prior to this storm. Because of the season, damages were slight.

The Hendersonville "Times-News," February 21, 1953, reported:

AREA RAIN IS 3.53 INCHES

Small Streams in Sector Out of Banks
as Result of Downpour

A rainfall of 3.53 inches in approximately 36 hours brought flood conditions to some sections of Henderson County. Most small streams were out of their banks.

January 23, 1954

Mud Creek rose to a stage of 11.07 on this date. With more than 2 inches of rain in 12 hours on the 22nd, streams throughout Henderson County overflowed their banks and covered highways with water. The storm rainfall for January 21 to 23 was 5.51 inches at Hendersonville and 6.78 inches at Rush Mountain in the Mud Creek headwaters. Damages due to overflow were slight and winter cover crops reduced damages to land from scour and sanding.

The Hendersonville "Times-News," Friday, January 22, 1954, reported this high water as follows:

DOWNPOUR ENGULFS LARGE AREA HERE

With more than two inches of rainfall in the last 12 hours streams in Henderson County were overflowing their banks today and indications were that a number of highways would be under water by nightfall.

Rain which began last night measured 1.50 inches at 8 a.m. today, an additional 0.50 inch was recorded at 10 a.m. and an additional 0.38 inch at noon.

This rainfall was in addition to 2.25 inches reported yesterday. Small streams of the county were out of their banks.

On the following day, Saturday, January 23, 1954, the Hendersonville "Times-News" said:

HIGHWAYS IN THE AREA OPEN FOR TRAFFIC

With the exception of N. C. Highway 191 (Haywood Rd.) highways in Henderson County were open for traffic today after flood waters covered a number of other roadways yesterday.

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April 5, 1957

Heavy rains over the upper French Broad River basin from April 2 to 5 resulted in floods on streams throughout the region including Mud Creek. A special field investigation of this storm and flood was made by Hydraulic Data Branch engineers immediately following the flood. Rainfall at Hendersonville was 2.51 inches on the 2nd, 0.12 on the 4th, and 5.13 on the 5th, giving a storm-period total of 7.76 inches. At Rush Mountain in the headwaters of Mud Creek, rainfall was slightly more than at Hendersonville with a storm total of 8.40 inches, 5.50 inches of which was recorded on the 5th.

Following this heavy rainfall, Mud Creek rose to a gage height at Naples of 11.92 feet, the highest water since May 1942 when the flood height was about 8 inches higher. The 1957 flood was more than a foot lower than the mid-August 1940 flood and nearly 10 feet lower than the great flood of mid-July 1916.

The high water overflowed the valleys of Mud Creek, Bat Fork, Devils Fork, and King Creek and came into some commercial establishments in Hendersonville. The flood came soon after the start of the planting season so that there was appreciable crop damage. Fortunately the flood was not of long duration which tended to reduce damages. In some cases where soil preparation was under way, winter cover crops had been plowed under, exposing the land to the flood waters. Scouring and washing of such newly cultivated land was significant in some areas.

In Hendersonville, Skycraft, Inc., manufacturers of rugs and pocketbooks, suffered loss to stock and equipment when Mud Creek flood waters entered the basement work and storage area. Water four feet deep inundated the yard of the Sinclair Distributing Company resulting in loss of empty drums which were floated away and other minor losses. Figure 7 shows the high water at the Sinclair plant.

U. S. Highway 25 was overflowed 15 inches just south of Hendersonville. Other highways throughout the watershed were overflowed with only small damages.

A group of 173 used cars on a lot in the Mud Creek flood plain along U. S. Highway 176 across Mud Creek from Hendersonville were inundated by the flood waters with appreciable damage to the cars.

The area around Hendersonville's radio station WHKP in the flood plain along U. S. Highway 64 was overflowed with some inconvenience but no damages.

The Hendersonville "Times-News," April 5, 1957, reported this storm and flood in the following account:

5 INCHES OF RAIN REPORTED
HERE IN LESS THAN 24 HOURS

More than five inches of rainfall in less than 24 hours brought flood conditions to Henderson county and Western North Carolina today, but the forecast was for clearing skies late today.

Rainfall for the 24-hour period ending at 6 p.m. yesterday was 1.30 inches. An additional fall of 3.25 inches was recorded from 6 p.m. yesterday to 8 a.m. today, making a total of 5.05 inches.

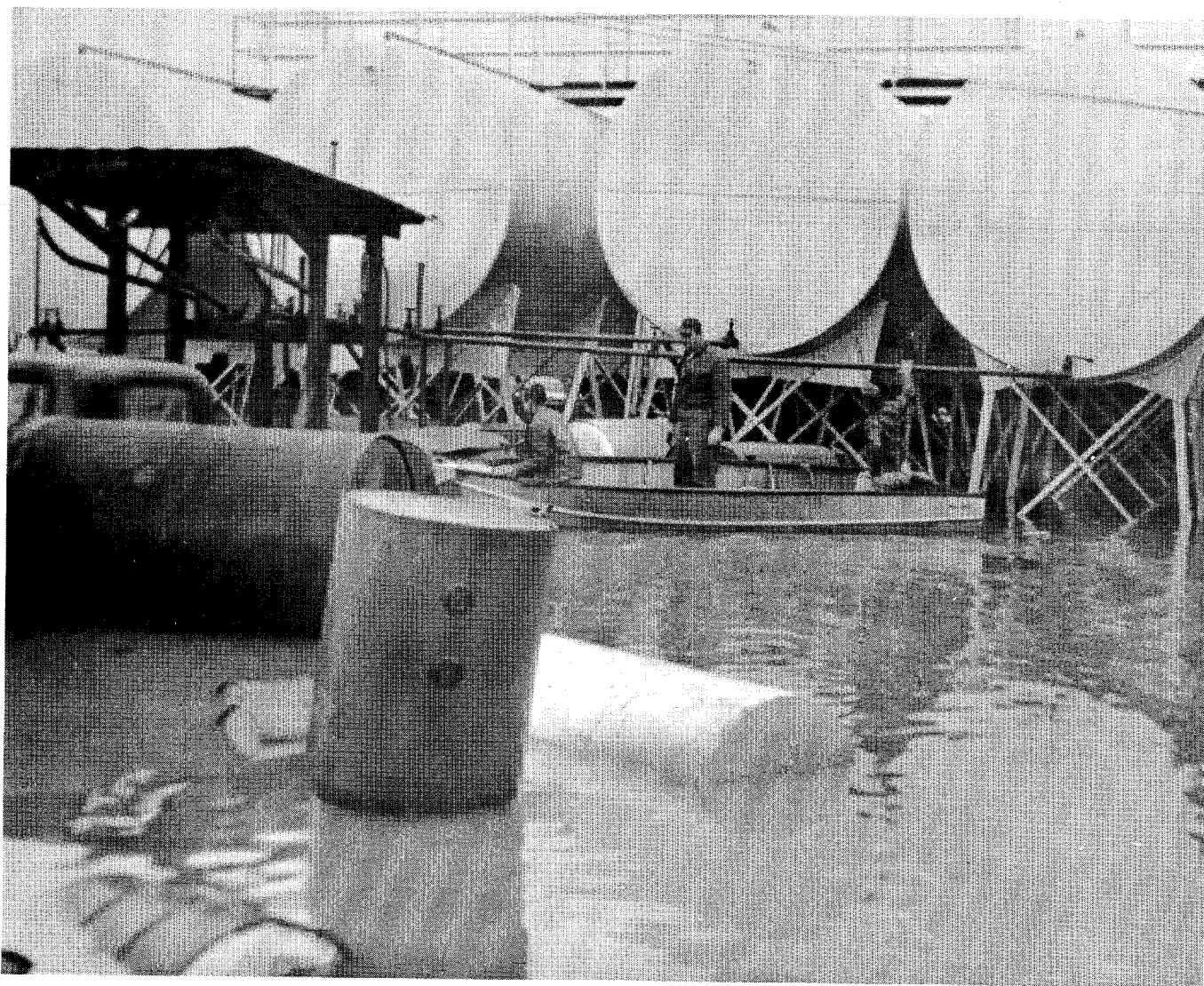


Figure 7.--APRIL 1957 FLOOD AT HENDERSONVILLE

Flood waters from Mud Creek invaded the plant of the Sinclair Oil Company on South King Street, Hendersonville, on April 5, 1957. Water was four feet deep in the yard and empty drums were floated away by the flood.

(Photo courtesy Hendersonville "Times-News")

Added to 2.20 inches recorded on Sunday and Monday, the total for this week was 7.25 inches. The normal rainfall for April is 4.28 inches.

Most of the smaller streams in the county were out of their banks and a number of local roads were under water.

U. S. Highway 25 just south of the city limit was covered by water to a depth of approximately a foot and a half this morning but traffic was passing.

Mud Creek flooded King Street on the southern edge of the city and King was closed between Caswell and the junction with South Main.

In this area the basement of the Skyland Crafts Co. was flooded to a depth of about two feet, the Sinclair Oil Co. office was isolated and the yard flooded and water surrounded the packing house of the J. C. Powell Co.

Streets in Druid Hills along U. S. Highway 25 were flooded by a small creek.

A boat was used to ferry office personnel to the Sinclair office and water almost covered a pick-up truck in the yard.

Other than U. S. Highway 25 south, main roads and highways in the county were free of water.

All Henderson county schools were closed because of water and the condition of side roads.

ACKNOWLEDGMENTS

This section of the report has been prepared by personnel of the Hydraulic Data Branch, Division of Water Control Planning, under the general direction of Reed A. Elliot, Chief Water Control Planning Engineer, and the immediate supervision of Albert S. Fry, Chief, Hydraulic Data Branch. Field investigations were made under the direction of James W. Beverage, Head of the Field Investigations Section. High water investigations in the field were carried out by District Engineer Myron O. Jensen, assisted by Area Engineer Joseph S. Enloe.

Thomas C. Bounds, Head of the Office Engineering Unit, prepared charts and maps for the report under the direction of Paul C. Spath, Head of the Hydraulic Investigations Section.

This report was prepared by the Branch Chief, assisted by Mr. Jensen and other members of the Branch.

It is desired to especially acknowledge the cooperation and assistance of both the state and local offices of the Soil Conservation Service in furnishing data on Mud Creek and its tributaries collected by the SCS in the course of its recent planning for flood relief in the Mud Creek watershed. Stream profiles, flood plain cross sections, and high water information furnished by SCS were most useful in TVA's engineering studies. Particular acknowledgment for this helpful cooperation is made to R. M. Dailey, Deputy State Conservationist, and Lonnie F. Thompson, Party Leader, Watershed Work Plan Party, Raleigh, North Carolina, and to John L. Brown, Work Unit Conservationist, Hendersonville, North Carolina.

II.

PAST FLOODS

ON

STREAMS

IN

HENDERSONVILLE REGION

Tennessee Valley Authority
Division of Water Control Planning
Hydraulic Data Branch

II.

PAST FLOODS ON STREAMS IN HENDERSONVILLE REGION

As a result of exceptionally heavy rains, large floods have been experienced in the past on some streams in the general geographic and physiographic region of Hendersonville, North Carolina, the watersheds of which are similar with respect to topography and watershed cover to those of Mud Creek and its tributaries. Some of these floods on neighboring streams are relatively larger and some relatively smaller than those known to have occurred on Mud Creek and its tributaries. In either case, a review of these floods that have occurred in the Hendersonville region on streams whose watersheds are similar to the Mud Creek watershed is helpful in determining the magnitude of floods that may occur on Mud Creek and its tributaries in the future.

Maximum Known Regional Floods

For the purposes of this report, the region of Hendersonville is considered to be the area within 50 miles of the city. Because of the less rugged topography of the Mud Creek watershed as compared with most watersheds in western North Carolina in the Hendersonville region, the number of suitable watersheds for comparison with Mud Creek is limited to only a few. The channel gradients of Mud Creek and its tributaries in the reaches included in this report are flat as compared to most streams in the Hendersonville region. The streams in the Mud Creek watershed flow through wide valleys which overflow during each important rise in the streams. Such stream characteristics tend to reduce peak flood discharges and similar characteristics are found in only a few watersheds in the region of Hendersonville. Orographic considerations preclude comparison with streams which lie to the north and west of Hendersonville in the upper French Broad watershed since most streams in that area have their headwaters in steep mountain country.

Table 4 lists the maximum known floods that have occurred on streams in the watersheds whose characteristics are generally similar to those of the streams treated in this report. The largest known flood discharges on Mud Creek and its tributaries are included in this table.

The most noteworthy storms that have occurred in the Hendersonville region have been as a result of West Indian hurricanes sweeping inland and deluging the country with large volumes of rain in relatively short times. Those which caused the floods of July 16, 1916, August 16, 1928, and August 13, 1940, are outstanding. Of these the 1916 storm and flood was considerably greater than the other two and produced the greatest known floods on many streams in the upper French Broad region. During this storm, a maximum point rainfall of 23.73 inches was observed at Altapass, North Carolina, approximately 50 miles northeast of Hendersonville. From 14 to 18 inches of rain fell on the Mud Creek watershed above the mouth of Clear Creek. This storm and flood was tremendously devastating and resulted in heavy flood losses and damages throughout the storm area. A description of this great storm and flood is contained in Section I.

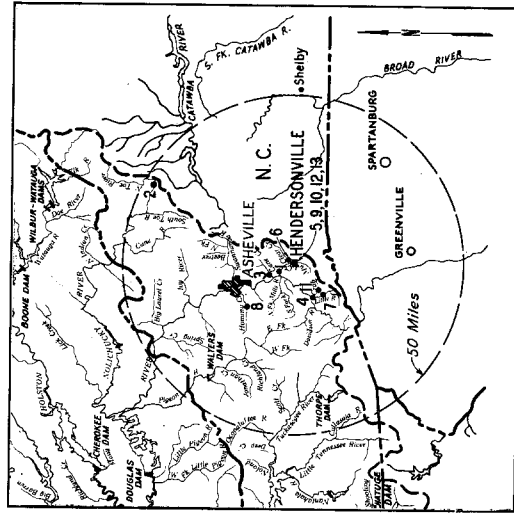
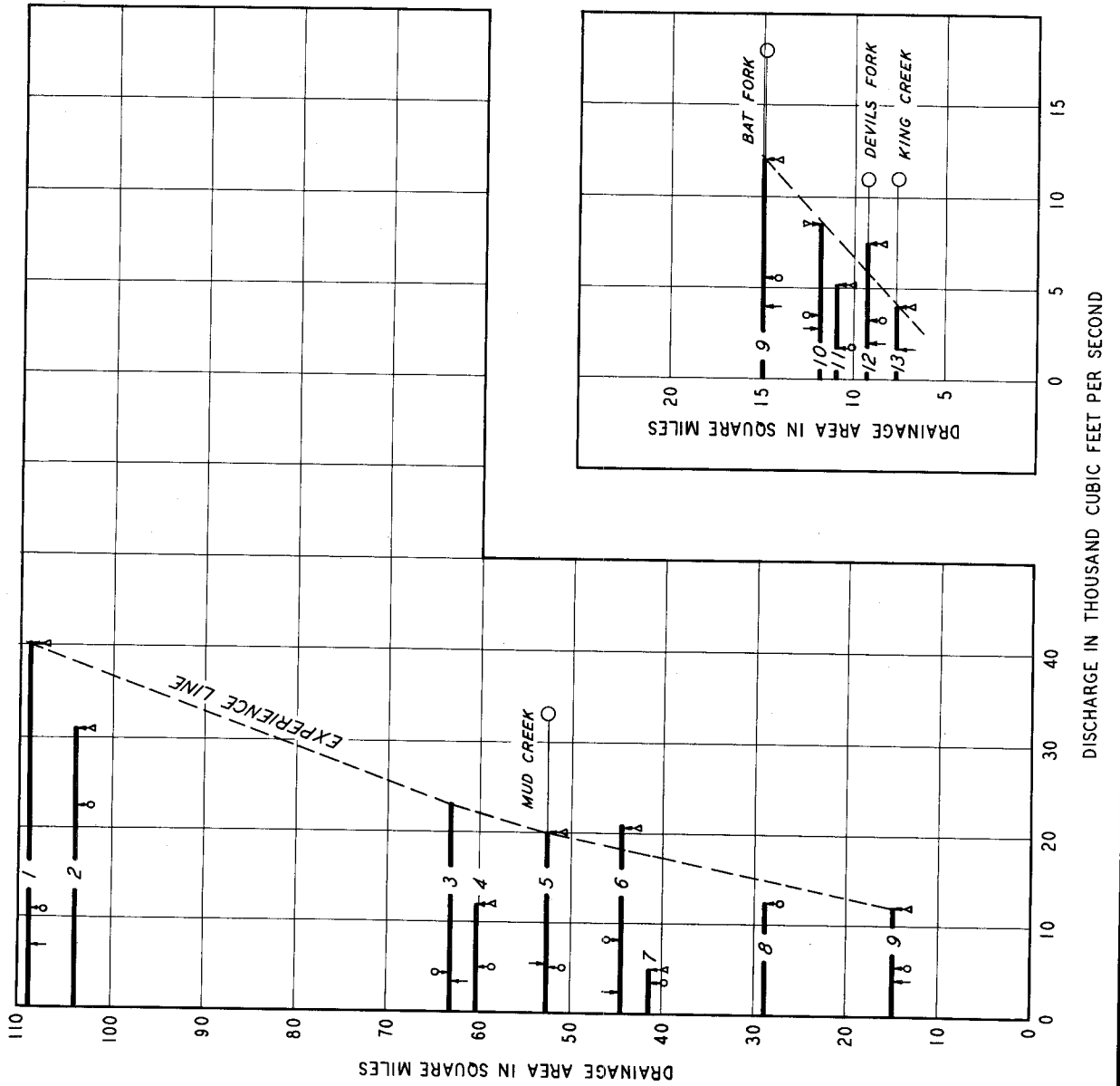
Floods of a magnitude similar to those listed in Table 4 may be expected to occur in the future on Mud Creek and the tributaries included in this report.

Mud Creek vs. Regional Flood Discharges

The flood discharges in Table 4 have been plotted on Plate 7. This shows graphically for drainage areas of various sizes the maximum flood discharges that have been experienced on streams in the Mud Creek watershed and on streams in the Hendersonville region of comparable watershed characteristics. Plate 7 includes Mud Creek, Bat Fork, Devils Fork, and King Creek. The key map on Plate 7 shows the locations of the streams for which the discharges are plotted.

Plate 7 shows peak discharges experienced on the several streams considered as comparable to Mud Creek and its tributaries. It is known that maximum discharges in excess of those shown on Plate 7 have been

ASG-1311



KEY MAP

Scale 0 20 40 60 Miles

Numbers on chart refer to those on Key Map and in Table 4.

○—Estimated Maximum Probable Flood determined by Flood Control Branch.

▲—Year of Flood Discharges
1957 1940 1916

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

**MAXIMUM KNOWN
FLOOD DISCHARGES
REGION OF HENDERSONVILLE, N.C.**

AUGUST 1958

TABLE 4

MAXIMUM KNOWN DISCHARGES ON STREAMS

IN GENERAL REGION OF HENDERSONVILLE, NORTH CAROLINA

All floods occurred within 50 miles of Hendersonville.

Reference No.	Stream	Location	Drainage Area sq.mi.	Peak Discharges		
				July 16, 1916 cu.ft. per sec.	August 13, 1940 cu.ft. per sec.	April 5, 1957 cu.ft. per sec.
1	Mud Creek	at Naples, N. C.	109	40,000	10,800	6,800
2	North Toe River	at Altepess, N. C.	104	30,800	22,200	-
3	Cane Creek	near Fletcher, N. C.	63.1	23,000	4,200*	3,300
4	Little River	near Calhoun, N. C.	60.1	12,000	5,000	-
5	Mud Creek	above Clear Creek	52.7	20,000	5,000	5,500
6	Clear Creek	at mouth, near Hendersonville	44.6	20,600	8,100	2,400
7	Little River	near Penrose	41.4	5,000#	3,400	-
8	Hominy Creek	above Candler, N. C.	28.9	-	12,400	-
9	Bat Fork	at mouth, near Hendersonville	14.9	12,000	5,500	4,000
10	Mud Creek	above Hendersonville	11.8	8,500	3,500	2,800
11	Crab Creek	near Penrose	10.9	5,200	1,600	-
12	Devils Fork	at mouth, near Hendersonville	9.3	7,500	3,200	2,000
13	King Creek	at mouth, near Hendersonville	7.6	4,000	-	1,600

August 1928 peak discharge 4,500 cfs.

* August 30, 1940.

experienced on other streams within 50 miles of Hendersonville but, as previously pointed out, the watersheds of these streams are more rugged than that of Mud Creek, the streams and flood valleys are dissimilar, and these streams cannot be considered to be comparable to the streams in the Mud Creek watershed.

Considering only the floods known to have occurred in the Hendersonville region on Mud Creek or on the streams comparable to those in the Mud Creek watershed, it would be reasonable to expect peak discharges during future floods on the streams covered by this report to be in the order of the following:

TABLE 5

FLOOD PEAKS FROM REGIONAL EXPERIENCE

<u>Stream</u>	<u>Mile</u>	<u>Drainage Area</u> sq. mi.	<u>Estimated Peak Discharge</u> cu. ft. per sec.
Mud Creek	5.6	52.7	20,000
Mud Creek	11.8	12.4	8,000
Bat Fork	0.0 (mouth)	14.9	12,000
Devils Fork	0.0 (mouth)	9.3	6,000
King Creek	0.0 (mouth)	7.6	4,000

Plate 7 shows with an open circle symbol the magnitude of the Maximum Probable Flood for Mud Creek, Bat Fork, Devils Fork, and King Creek. The Maximum Probable Flood for each of these is discussed in Section III of this report.

Flood Heights for Various Discharges

In order to show the height of floods with greater discharge than that of 1957, Table 6 has been prepared.

TABLE 6

RELATIVE FLOOD HEIGHTS FOR VARIOUS DISCHARGES

<u>Description</u>	<u>Discharge Cubic Feet Per Second</u>	<u>Feet Above 1957 Flood</u>
<u>Mud Creek above Clear Creek (Mile 6.4)</u>		
August 13, 1940	5,000	-0.7
April 5, 1957	5,500	0.
--	10,000	3.5
--	15,000	6.2
July 16, 1916	20,000	8.4
--	25,000	9.9
Maximum Probable Flood	33,000	11.9
<u>Mud Creek above Hendersonville (Mile 11.3)</u>		
April 5, 1957	2,800	0
August 13, 1940	3,500	0.5
July 16, 1916	8,500	3.0
--	15,000	5.7
Maximum Probable Flood	20,500	7.7
<u>Bat Fork near Mouth (Mile 2.0)</u>		
April 5, 1957	4,000	0
August 13, 1940	5,500	1.0
--	8,000	2.4
July 16, 1916	12,000	4.4
Maximum Probable Flood	18,000	7.4
<u>Devils Fork near Mouth (Mile 0.6)</u>		
April 5, 1957	2,000	0
August 13, 1940	3,200	1.2
--	5,000	3.1
July 16, 1916	7,500	5.4
Maximum Probable Flood	11,000	8.1
<u>King Creek near Mouth (Mile 0.6)</u>		
April 5, 1957	1,600	0
July 16, 1916	4,000	1.7
Maximum Probable Flood	11,000	3.7

The elevations of the discharges given in Table 6 are shown by ticks on the profiles, Plates 10 and 11, at the locations indicated on the table.

Acknowledgments

This section of the report has been prepared by personnel of the Hydraulic Data Branch, Division of Water Control Planning, under the general direction of Reed A. Elliot, Chief Water Control Planning Engineer, and the immediate supervision of Albert S. Fry, Chief, Hydraulic Data Branch. The flood studies were made under the direction of Willard M. Snyder, Head of the Hydrology Section, by Roger P. Betson. The report has been prepared by the Branch Chief.

III.

MAXIMUM PROBABLE FLOODS

Tennessee Valley Authority
Division of Water Control Planning
Flood Control Branch

III.

MAXIMUM PROBABLE FLOODS

The preceding sections have told about the floods that have already occurred on Mud Creek and its tributaries, Devils Fork, Bat Fork, and King Creek, in the vicinity of Hendersonville, and of large floods known to have occurred on other streams close to Hendersonville. This section describes the basis for the Maximum Probable Floods that may reasonably be expected, and discusses the extent of the flood plain that would be affected by these floods. Floods of these magnitudes are of the kind considered in planning the design and operation of protective works, the failure of which might be disastrous.

Extreme floods on small watersheds such as that of Mud Creek and its tributaries (areas ranging from 52.7 square miles for Mud Creek above the mouth of Clear Creek to 7.58 square miles for King Creek) may result either from intense showers during winter storms covering a prolonged period of rainfall when infiltration and other losses are small, or from intense summer storms of the cloudburst or hurricane type.

DETERMINATION OF MAXIMUM PROBABLE FLOOD

Section I stated that the maximum known flood on Mud Creek occurred in July 1916. Its peak discharge is estimated to have been about 24,000 cubic feet per second above the mouth of Clear Creek. It is reasonable to expect that floods greater than that of 1916 will occur in the future, and that these will result from rain falling over all or most of the drainage area.

In determining the Maximum Probable Flood, consideration was given to great storms and floods that have already occurred in the immediate vicinity of Hendersonville, and to those which have occurred

elsewhere but could have occurred in the Hendersonville area. The transposition of storms which have occurred elsewhere helps to overcome the lack of hydrologic data in the relatively short period for which dependable records are available.

Observed Storms

Observed storms are meteorologically transposable within a broad region extending generally from the Atlantic Ocean to the Appalachian Mountains. The source of moisture for storms in this region is the warm, moist air which flows north from the Gulf of Mexico or the Caribbean Sea, generally the farther north the less moisture available. When transferring storms within the broad region to the Hendersonville vicinity, appropriate adjustments were made for differences in this moisture potential.

Table 7 lists known rainfall depths for several large storms transposable to the Mud Creek watershed. Numerous other high-intensity short-duration storms on small areas probably have occurred but were not reported due to the lack of rainfall observations.

TABLE 7
SELECTED MAXIMUM OBSERVED STORMS
6-HOUR DURATION

<u>Date</u>	<u>Location</u>	<u>Rainfall Depth</u> <u>(Inches)</u>	
		<u>10 Sq. Mi.</u>	<u>50 Sq. Mi.</u>
June 1889	Wellsboro, Pa.	7.4	7.3
October 1903	Patterson, N. J.	5.4	5.2
July 1916	Altapass, N. C.	8.0	7.5
November 1927	Kinsman Notch, N. H.	7.8	6.7
August 1939	Manahawkin, N. J.	9.7	9.3
September 1940	Ewan, N. J.	20.1	18.6
October 1941	Trenton, Fla.	12.9	11.6

In addition to the above storms, the June 30, 1956, storm on Cove Creek basin, Haywood County, North Carolina, is of particular interest. It is estimated that from 10 to 12 inches of rain fell at the center of this one-hour storm.

On the basis of these data, rainstorms ranging from 17.5 inches to 20.2 inches in 6 hours, depending on the size and other characteristics of the watersheds, were adopted for computing the Maximum Probable Floods on Mud Creek and its tributaries. The unit hydrograph technique, with appropriate watershed factors, was used in this computation.

Storms greater than that which would produce the Maximum Probable Flood can occur. Under extreme maximizing conditions it is estimated that the maximum possible storm would be about 60 percent more than the storm adopted for the Maximum Probable Flood on the different streams of the Mud Creek watershed.

Observed Floods

When considering peak discharges on other streams, engineering judgment determined whether their application to Mud Creek and its tributaries would be appropriate. In addition to the floods listed in Table 4 of Section II, the following Table 8 lists peak discharges for observed floods on several streams of drainage areas enveloping the sizes of Mud Creek and its tributaries. Although some of the floods listed are greater than are probable on Mud Creek, they are included to show the great flood-producing potential of some other streams in the region. For comparison the discharge of the 1916 flood, the maximum known on Mud Creek at Naples, is listed.

TABLE 8
SELECTED MAXIMUM OBSERVED FLOODS

<u>Stream</u>	<u>Location</u>	<u>Drainage Area</u> sq.mi.	<u>Year</u>	<u>Peak Discharge</u>	
				<u>Amount</u> cfs	<u>Per</u> <u>Sq. Mi.</u> cfs
Crab Orchard Cr.	Valle Crucis, N. C.	2.09	1940	6,000	2,870
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
Pigeon River	Spruce, N. C.	8.4	1940	16,400	1,950
W. F. Pigeon River	Spruce, N. C.	12.2	1940	16,500	1,350
Wolf Creek	Tuckasegee River, N. C.	14.1	1940	14,480	1,030
Steels Creek	Tablerock, N. C.	16.0	1940	24,000	1,500
Elk Creek	Banner Elk, N. C.	17.8	1940	22,000	1,200
Cane Creek	Pensacola, N. C.	18.1	1940	15,000	830
Elk River	Banner Elk, N. C.	20.1	1940	16,500	822
Upper Creek	Tablerock, N. C.	20.2	1940	25,000	1,240
Hunting Creek	Morganton, N. C.	21.7	1940	14,000	650
Cane Creek	Bakersville, N. C.	22	1901	29,500	1,340
N.F. Swannanoa R.	Black Mountain, N. C.	23.8	1949	16,500	693
W.F. Lewis Fork	Champion, N. C.	25.8	1940	27,000	1,050
Stony Fork	Hendrix, N. C.	27.1	1940	37,000	1,370
S. Toe River	Busick, N. C.	32.8	1940	18,000	550
Watauga River	Valle Crucis, N. C.	33.1	1940	38,000	1,150
Caney Fork	Above E. Laport, N. C.	37.5	1940	21,700	578
N. F. Catawba R.	Woodlawn, N. C.	41.8	1940	55,000	1,320
Elk River	Elk Park, N. C.	42	1940	27,500	655
Elk Creek	Elkville, N. C.	50	1940	70,000	1,400
Watauga River	Above Sugar Grove, N. C.	55.1	1940	41,000	745
S. Toe River	Newdale, N. C.	60.8	1927	33,000	544
Linville River	Branch, N. C.	65	1940	39,500	608
Wilson Creek	Adako, N. C.	66	1940	99,000	1,500
Johns River	Collettsville, N. C.	69.1	1940	31,000	450
E.F. Tuckasegee R.	Tuckasegee, N. C.	80.3	1940	30,000	370
Warrior Fork	Morganton, N. C.	80.5	1940	38,000	470
Watauga River	Near Sugar Grove, N. C.	90.8	1940	50,800	560
Mud Creek	Naples, N. C.	109	1916	40,000	367

Maximum Probable Flood Discharges

From consideration of the flood discharges in Tables 4 and 8 and of the transposition of outstanding storms which have occurred elsewhere but can occur over the Mud Creek watershed, the peak discharges of the Maximum Probable Floods for Mud Creek and its tributaries were determined to be as follows:

TABLE 9
MAXIMUM PROBABLE FLOOD DISCHARGES

<u>Stream</u>	<u>Location</u>	<u>Drainage Area</u> sq.mi.	<u>Peak Discharge</u> cfs
Mud Creek	Above mouth of Clear Creek	52.7	33,000
	At upper limit of study	12.4	20,000
Bat Fork	At mouth	14.9	18,000
Devils Fork	At mouth	9.3	11,000
King Creek	At mouth	7.6	11,000

The discharge for Mud Creek above the mouth of Clear Creek is about 1.7 times the presently known maximum, that of July 16, 1916.

The above Maximum Probable Floods for Mud Creek and its tributaries are smaller than the Maximum Probable Floods for some streams in the region and many of the observed floods listed in Table 8. This is because of the physical characteristics which affect the flood-producing potential of Mud Creek. Although draining from the Tennessee Valley Divide, the primary water courses of Mud Creek and its tributaries are comparatively flat with wide flood plains throughout most of their length. Moreover, the divide at this location is much lower than peaks of the mountains to the north and west. Elevations of the Hendersonville area are above the 2,000-foot level, and considered to be in the mountains, but the range in elevations within the watershed is not great compared to areas of similar size in the Little Tennessee and Hiwassee drainage systems and even elsewhere in the French Broad system. In addition, a number of artificial lakes may tend to reduce crest flood flows. These factors combine to reduce the relative magnitude of the Maximum Probable Flood.

It has not been practicable to investigate the stability of the dams forming the many artificial lakes. For this reason, no major failures are assumed which would influence the magnitude of the Maximum Probable Flood.

Frequency

The frequency of a flood of the magnitude of that of the maximum probable is not susceptible of definite determination. Such a flood would occur on the average only at rather long intervals of time, but it could occur in any year.

Possible Larger Floods

Floods larger than any of those discussed are hydrologically possible. However, the combination of factors that would be necessary to produce such floods would occur at rare intervals, if at all. The consideration of floods of this magnitude is of greater importance in some flood problems than in others and should not be overlooked in the study of any flood problem. Such floods, because of their extreme rarity and uncertainty of occurrence on a given watershed, need be considered only where dependence is placed on protective works, the failure of which would cause loss of life or destruction of valuable property.

FLOOD HEIGHTS AND VELOCITIES

Flood Crest Profiles and Overflow Areas

The crest profile computed for the Maximum Probable Flood on Mud Creek is shown on Plate 10, and for Devils Fork, Bat Fork, and King Creek on Plate 11. The profiles were computed using stream characteristics for selected reaches as determined from valley cross sections and observed flood profiles, and are based on channel conditions existing in 1958. On Mud Creek the Maximum Probable Flood would be generally from 3 to 8 feet higher than the elevations experienced in the flood of July 1916. On Devils Fork, Bat Fork, and King Creek the Maximum Probable Flood would be as much as 3 to 5 feet higher than the July 1916 flood elevations.

Upstream from the Southern Railway Bridge at Mile 8.52 on Mud Creek, Maximum Probable Flood elevations are increased by the bridge and fill. This crossing of the Mud Creek valley has been changed since the 1916 flood and most of the trestle work existing at that time has been replaced by embankment. This accounts for the heading up under present conditions which did not exist in 1916. In such large floods as the Maximum Probable Flood the velocity and pressure of the water might destroy part or all of the bridge, but these possibilities cannot be appraised accurately. In computing the profile of the Maximum Probable Flood the survival of the bridge and its approach fills was assumed.

The limits of flood overflow areas in the Maximum Probable Flood along Mud Creek and its tributaries in the vicinity of Hendersonville are not shown on Plates 8 and 9 because the areas would not be appreciably greater than those shown for the 1916 flood. The elevations shown on the profiles, Plates 10 and 11, on the cross sections, Plates 12 and 13, and the overflow areas shown on Plates 8 and 9 have been determined as accurately as is consistent with the basic data, but actual elevations may vary from those shown on the profiles, cross sections, and maps. The contour interval of the map, Plate 8, permits only an approximate plotting of the boundaries of the flooded areas. To determine flood elevations and limits with a higher degree of accuracy would require costly surveys and studies that are not warranted.

Velocities and Rates of Rise

The channel velocity in the Maximum Probable Flood on Mud Creek would range from about 1 to nearly 7 feet per second, the maximum occurring downstream from the mouth of Bat Fork. Overflow velocities would range from about 1 to about 5 feet per second, with the maximum near the upper limits of the study.

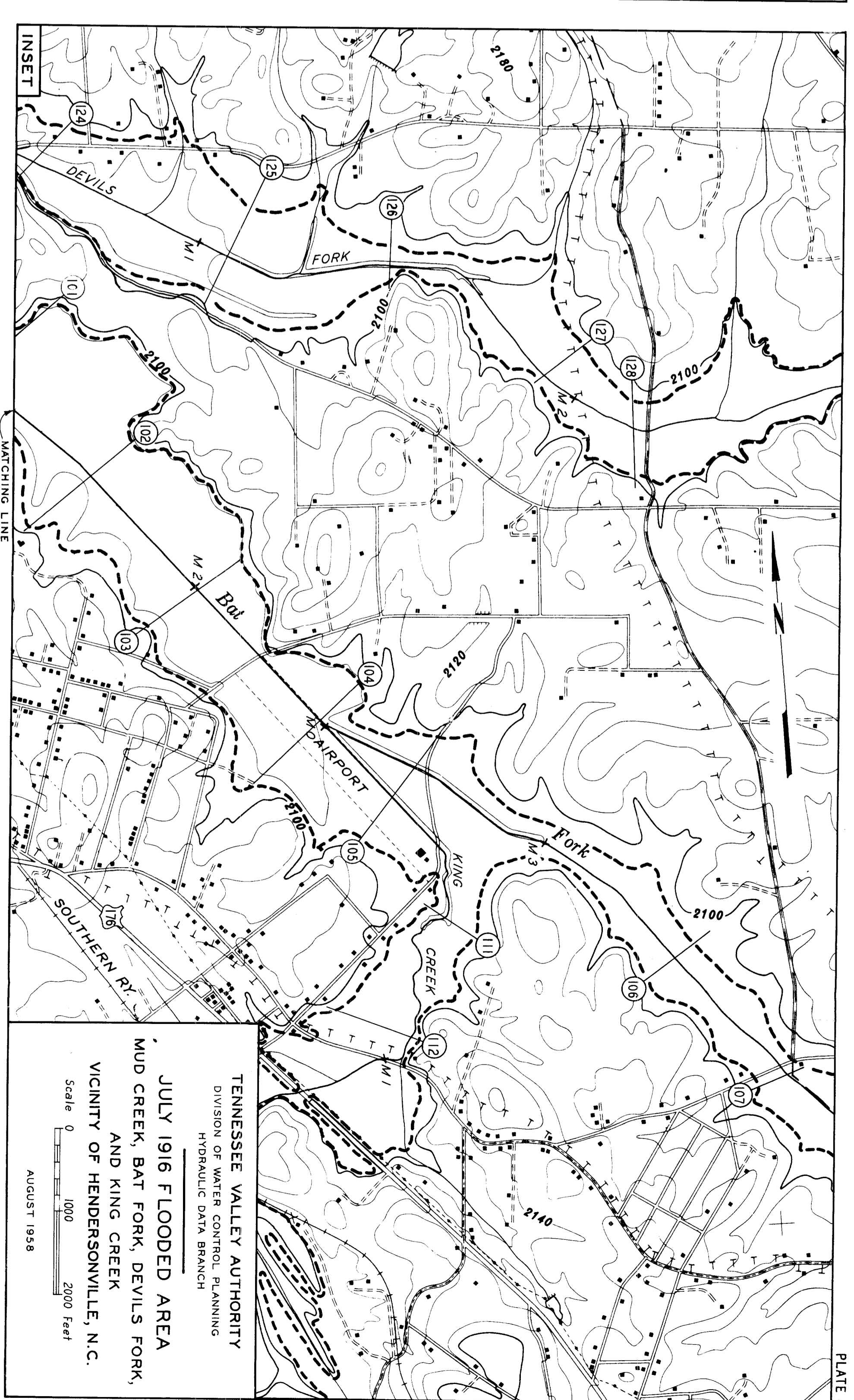
Velocities in the channel of Bat Fork would range from about 2 to about 6 feet per second and in the overflow area from 1 to 5 feet per second. On Devils Fork the range in velocities would be from 1 to 7 feet per second in the channel and less than 1 to nearly 6 feet per second in the overflow area. The corresponding range in channel and overbank velocities on King Creek would be from 1 to about 4 feet per second.

Deep, moving water in the overflow areas will affect crops, buildings, and people. Even where velocities are not extremely high, flooding and its resulting destruction can be costly.

The Maximum Probable Flood on Mud Creek near U. S. Highway 64 Bridge would rise to its crest 16 feet above low water in about 11 hours. Its maximum rate of rise would be about 9 feet in 4 hours. These rates on Bat Fork near the city of Hendersonville are 17 feet to the crest in 8 hours--maximum rate, 12 feet in 4 hours. Similar rapid rates of rise would exist on Devils Fork and King Creek.

ACKNOWLEDGMENTS

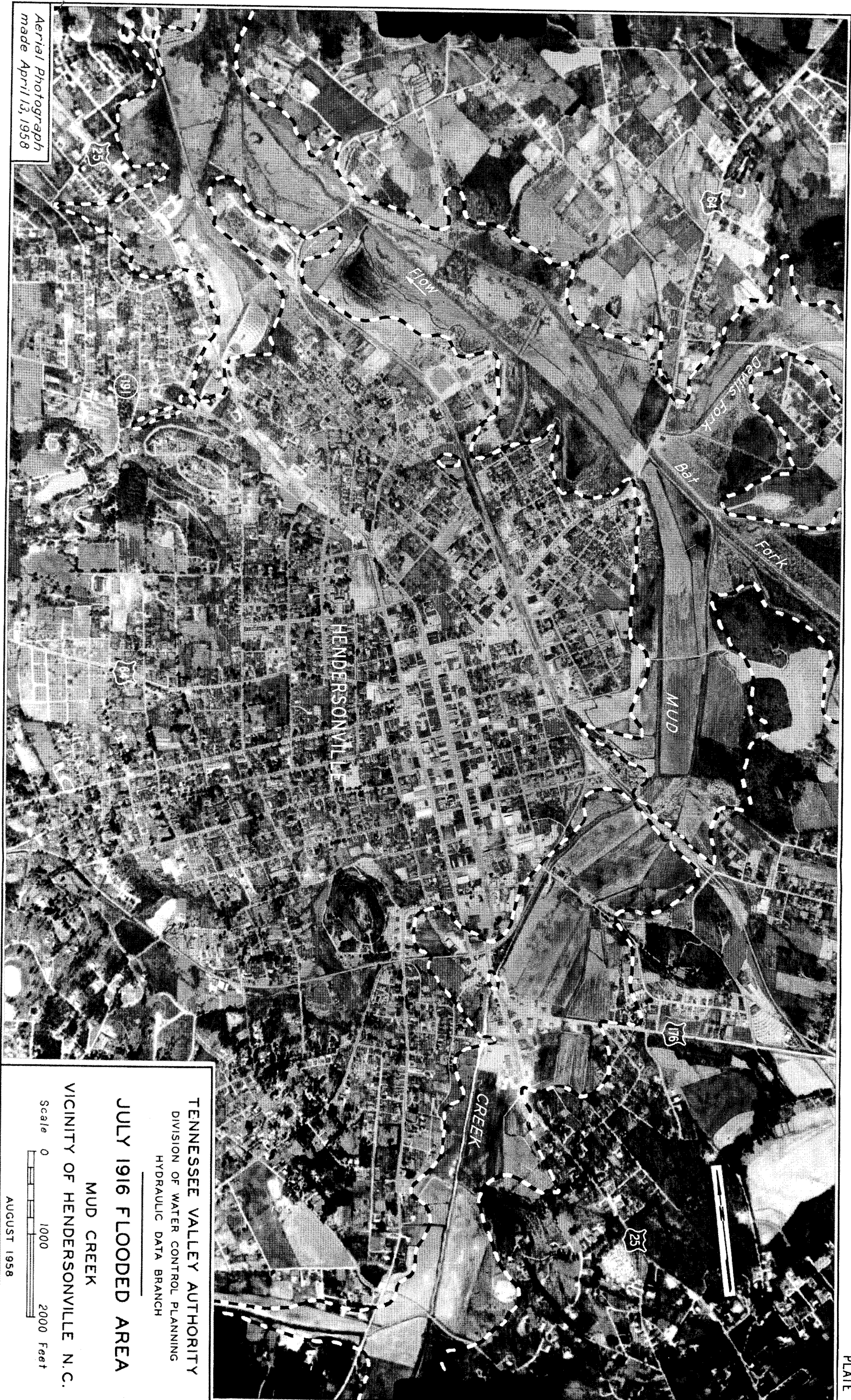
This section was prepared by the Flood Control Branch of the Division of Water Control Planning under the general direction of Reed A. Elliot, Chief Water Control Planning Engineer, and the immediate direction of Edward J. Rutter, Chief, Flood Control Branch. Basic hydraulic data were furnished by the Hydraulic Data Branch, and the Soil Conservation Service of the Department of Agriculture. Flood studies were under the supervision of B. J. Buehler, Head, Operation Studies Section. The flood discharges were determined by Donald W. Newton and the profiles were computed by Logan A. Gillett and Bevan W. Brown, Jr.



SEE INSET

MATCHING LINE

PLATE 8

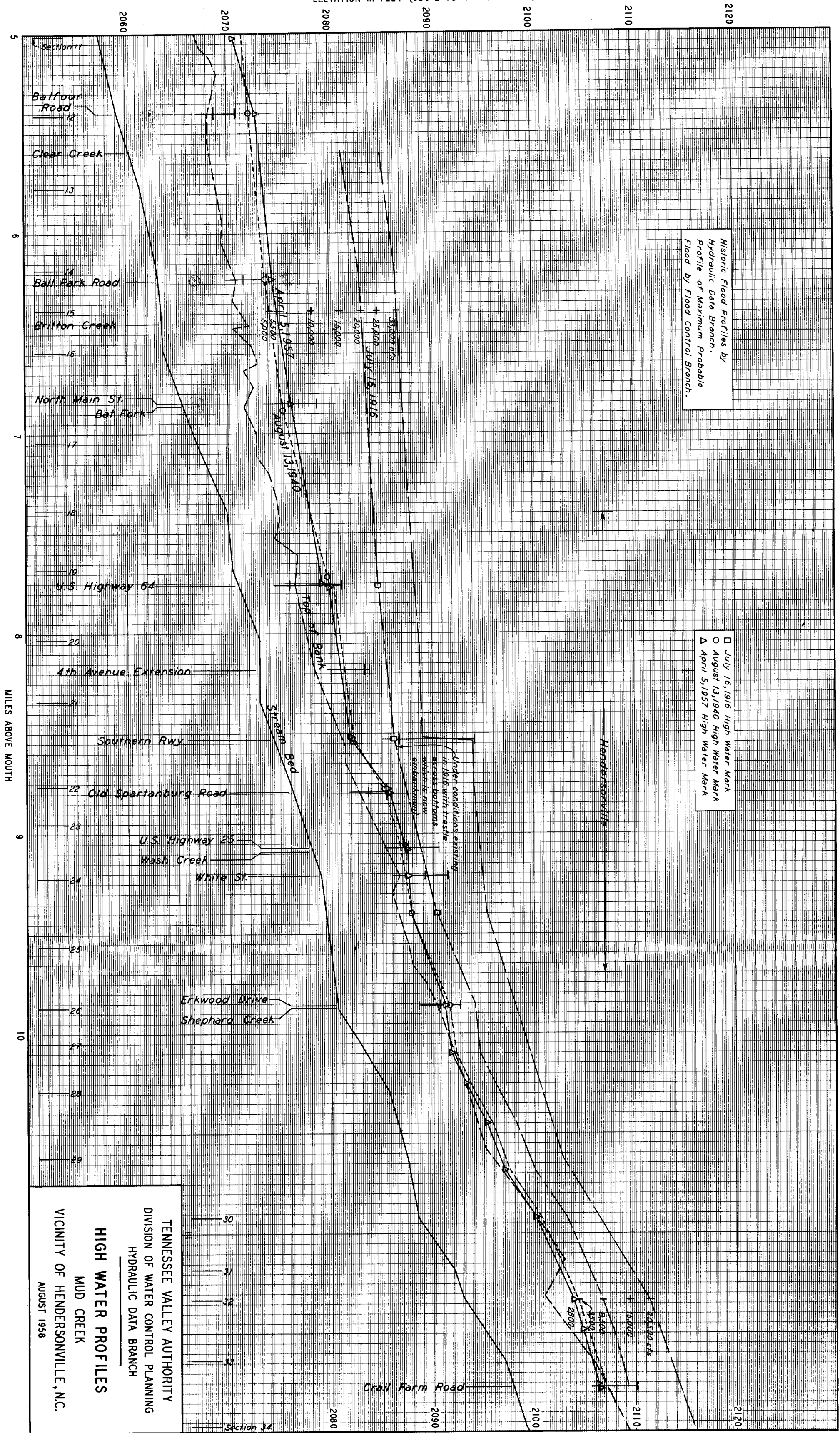


Aerial Photograph
made April 13, 1958

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

JULY 1916 FLOODED AREA
MUD CREEK
VICINITY OF HENDERSONVILLE N.C.

Scale 0 1000 2000 Feet
AUGUST 1958

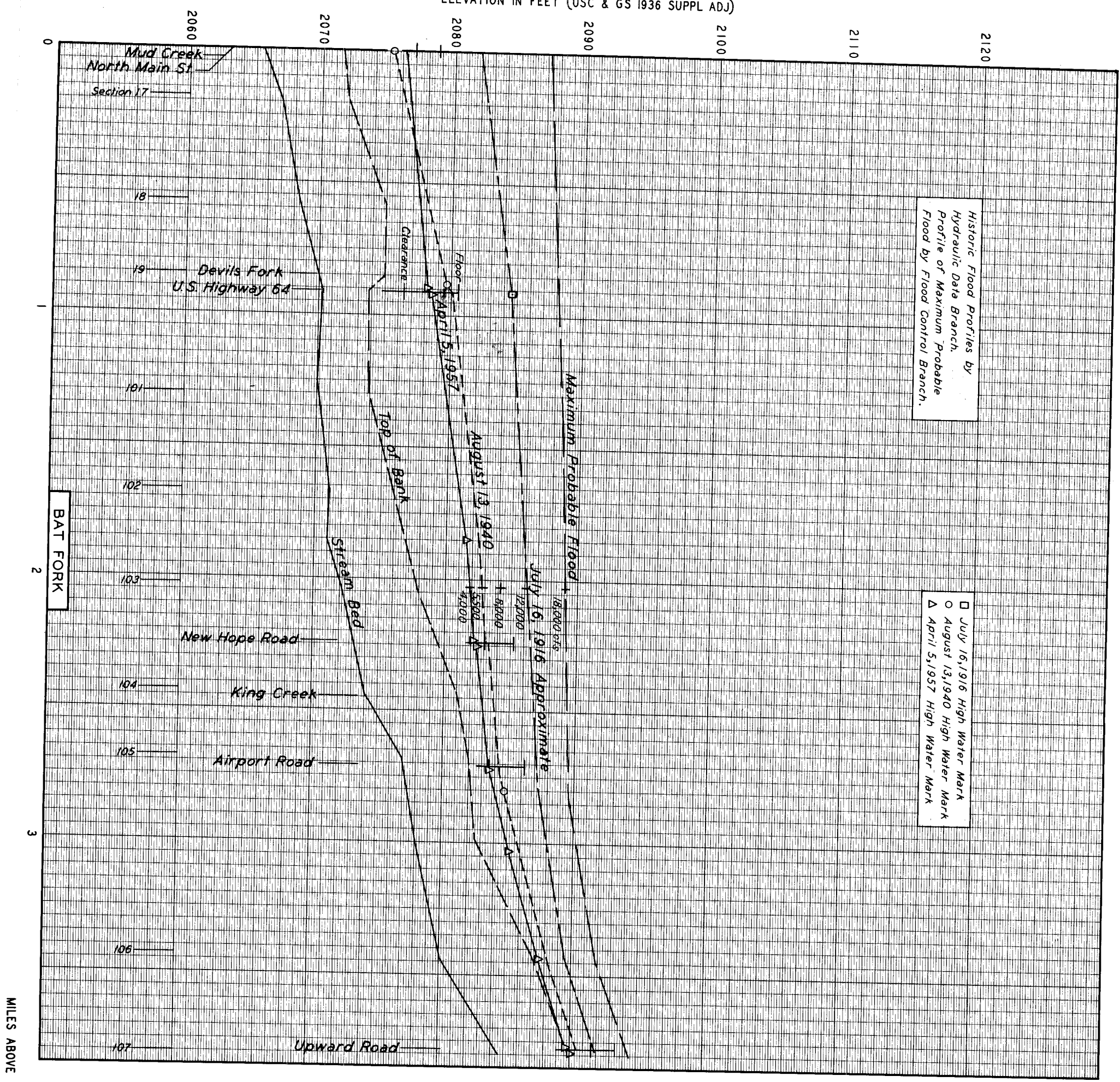


Historic Flood Profiles by Hydraulic Data Branch, Flood by Flood Control Branch.

□ July 16, 1916 High Water Mark
 ○ August 13, 1940 High Water Mark
 △ April 5, 1957 High Water Mark

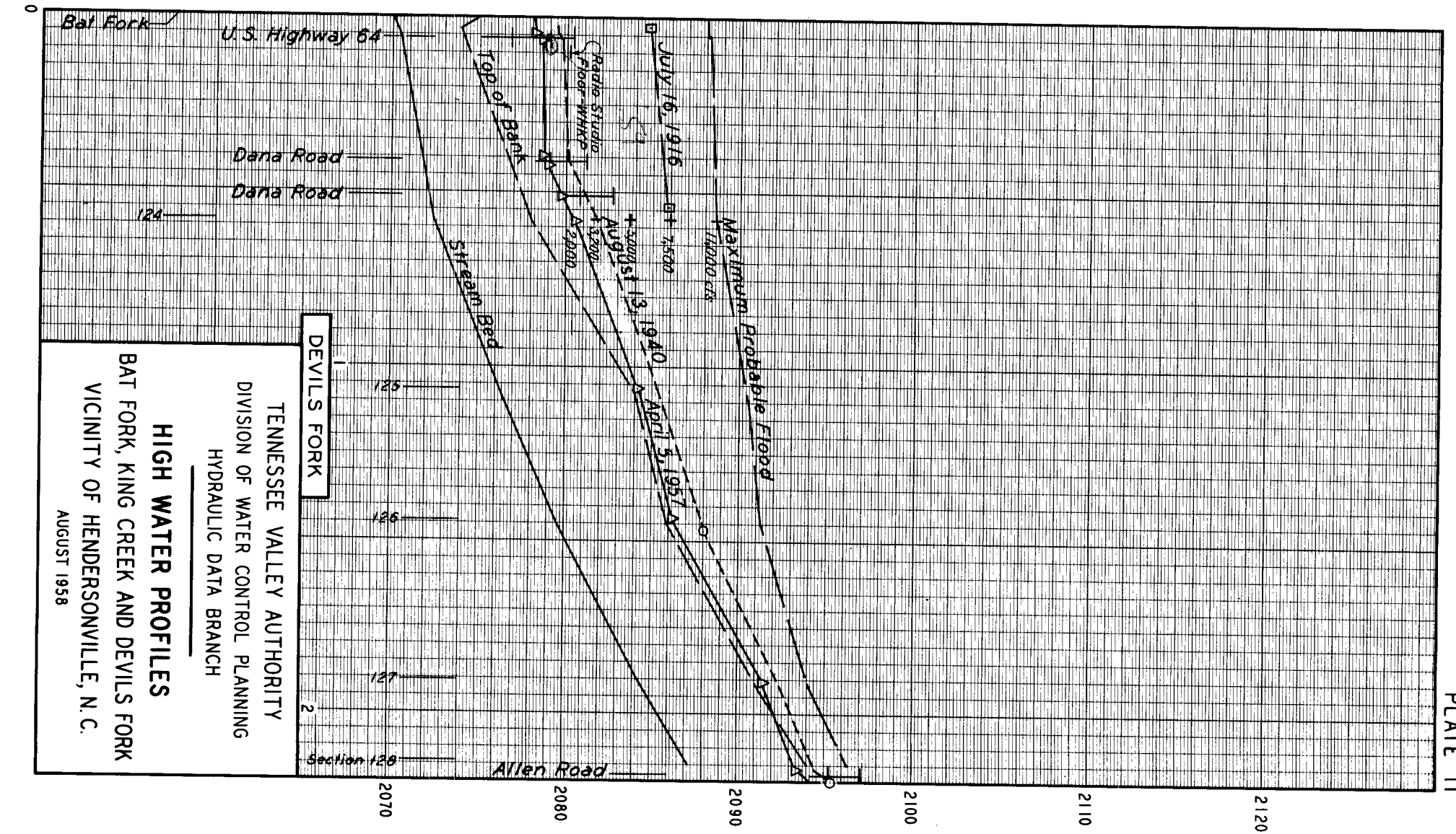
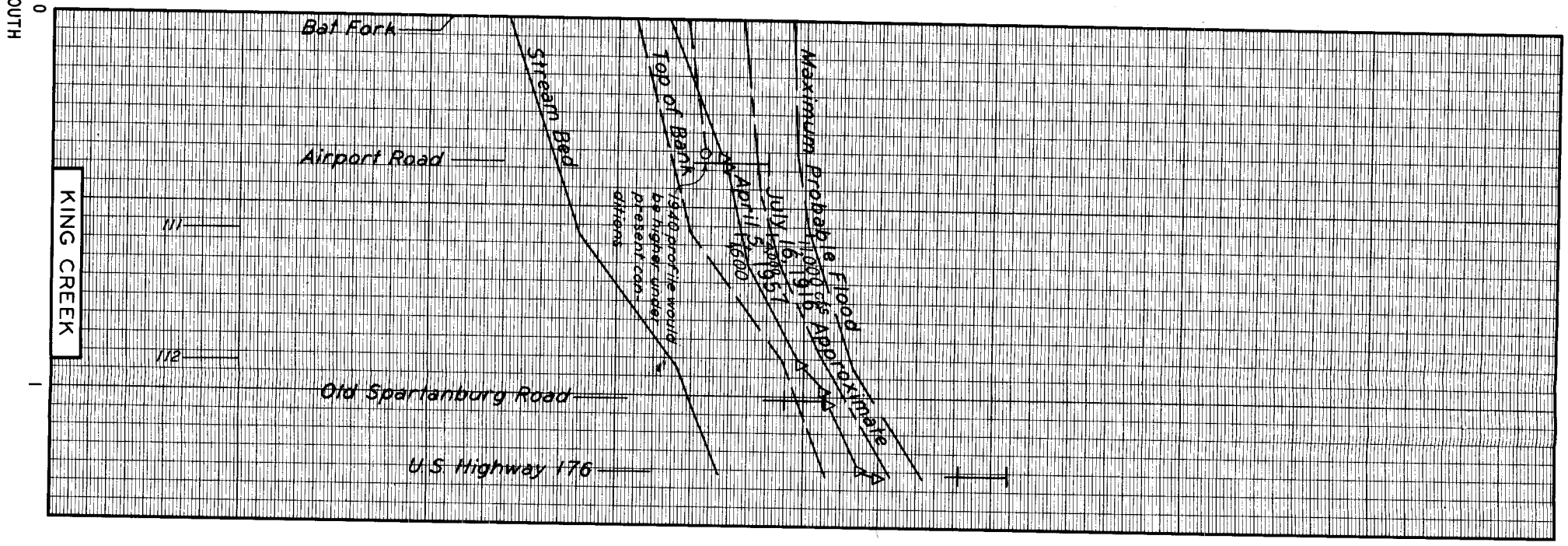
TENNESSEE VALLEY AUTHORITY
 DIVISION OF WATER CONTROL PLANNING
 HYDRAULIC DATA BRANCH
HIGH WATER PROFILES
 MUD CREEK
 VICINITY OF HENDERSONVILLE, N.C.
 AUGUST 1958

ELEVATION IN FEET (USC & GS 1936 SUPPL ADJ)



Historic Flood Profiles by Hydraulic Data Branch Profile of Maximum Probable Flood by Flood Control Branch.

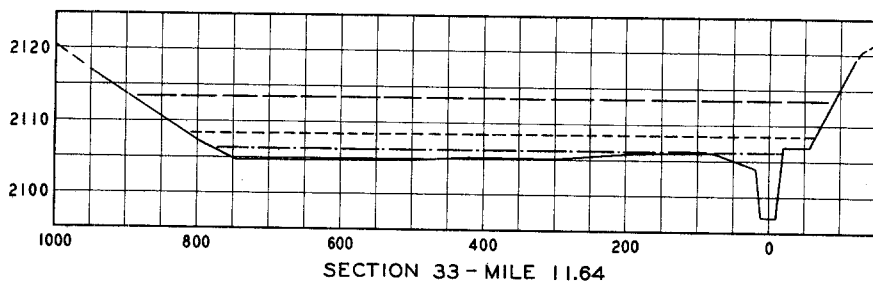
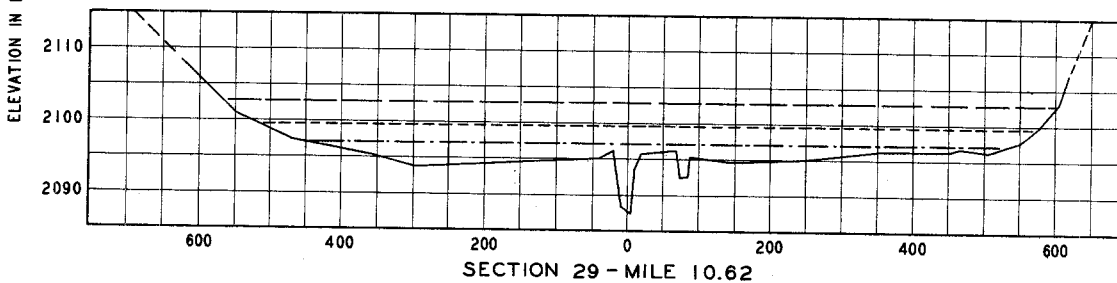
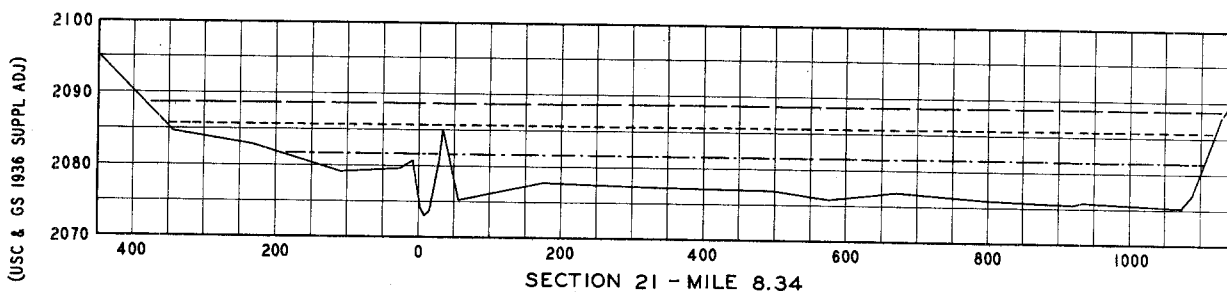
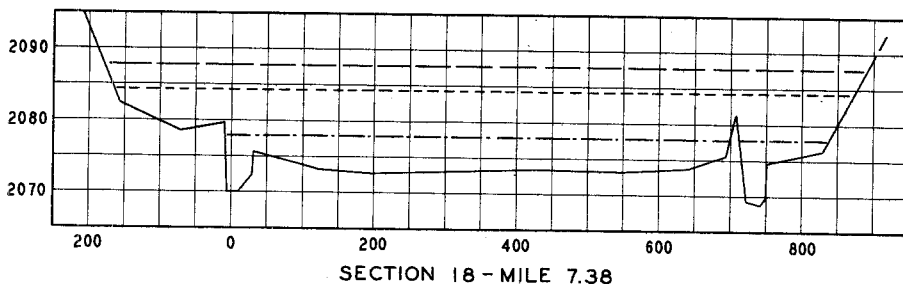
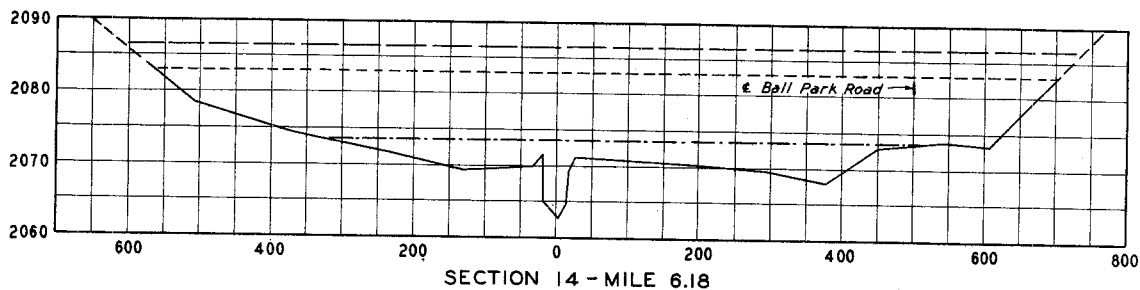
- July 16, 1916 High Water Mark
- August 13, 1940 High Water Mark
- △ April 5, 1957 High Water Mark



DEVILS FORK

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

HIGH WATER PROFILES
BAT FORK, KING CREEK AND DEVILS FORK
VICINITY OF HENDERSONVILLE, N. C.
AUGUST 1958



LEGEND:
 ——— Maximum Probable Flood
 - - - July 16, 1916 High Water
 - · - August 13, 1940 High Water

Sections taken looking downstream.

Cross section data furnished by
 Soil Conservation Service.

July 16, 1916 and August 13, 1940 flood
 elevations by Hydraulic Data Branch.

Elevations of Maximum Probable Flood
 determined by Flood Control Branch.

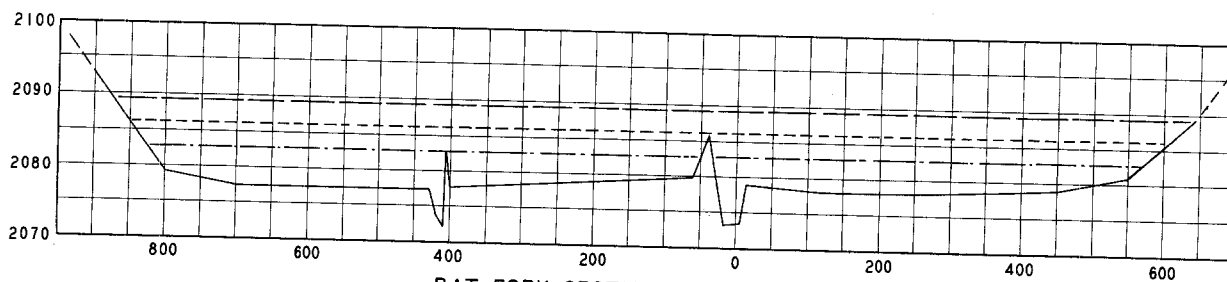
Additional cross sections not shown.

TENNESSEE VALLEY AUTHORITY
 DIVISION OF WATER CONTROL PLANNING
 HYDRAULIC DATA BRANCH

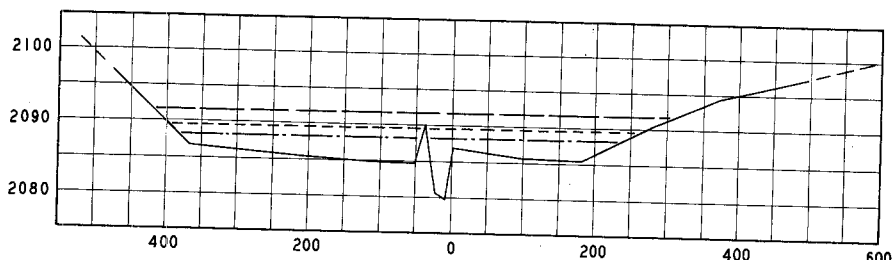
VALLEY CROSS SECTIONS
 MUD CREEK
 VICINITY OF HENDERSONVILLE, N.C.

AUGUST 1958

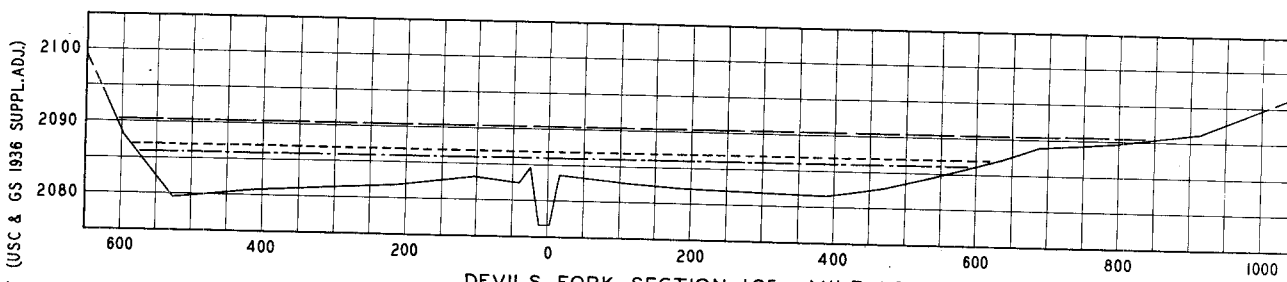
HORIZONTAL DISTANCE IN FEET



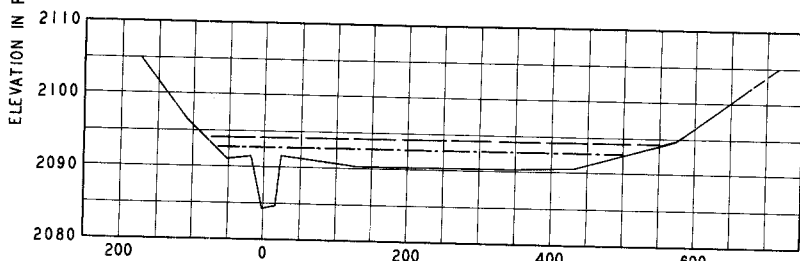
BAT FORK SECTION 103 - MILE 2.02



BAT FORK SECTION 106 - MILE 3.43



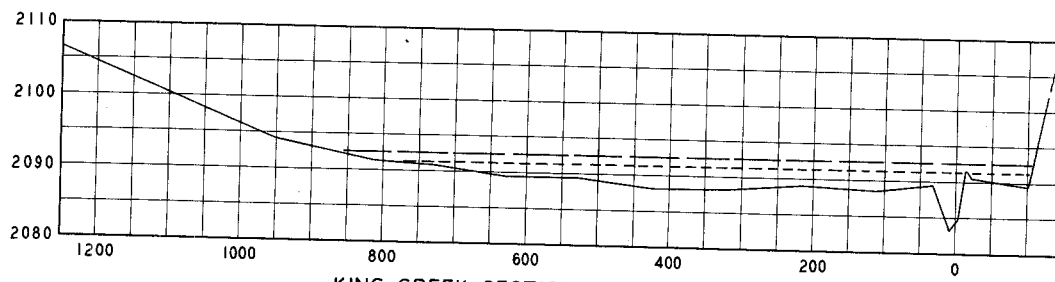
DEVILS FORK SECTION 125 - MILE 1.08



DEVILS FORK SECTION 127 - MILE 1.91

LEGEND:

- Maximum Probable Flood
- - - July 16, 1916 High Water
- · - August 13, 1940 High Water



KING CREEK SECTION 112 - MILE 0.92

Sections taken looking downstream.

Cross section data furnished by Soil Conservation Service.

July 16, 1916 and August 13, 1940 flood elevations by Hydraulic Data Branch.

Elevations of Maximum Probable Flood determined by Flood Control Branch.

Additional cross sections not shown.

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
HYDRAULIC DATA BRANCH

VALLEY CROSS SECTIONS
BAT FORK, DEVILS FORK, AND KING CREEK
VICINITY OF HENDERSONVILLE, N.C.

HORIZONTAL DISTANCE IN FEET

AUGUST 1958