flood plain information
MOORES CREEK
albemarle county and charlottesville, virginia

U.S. ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT

SEPTEMBER 1971

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INTRODUCTION

GENERAL

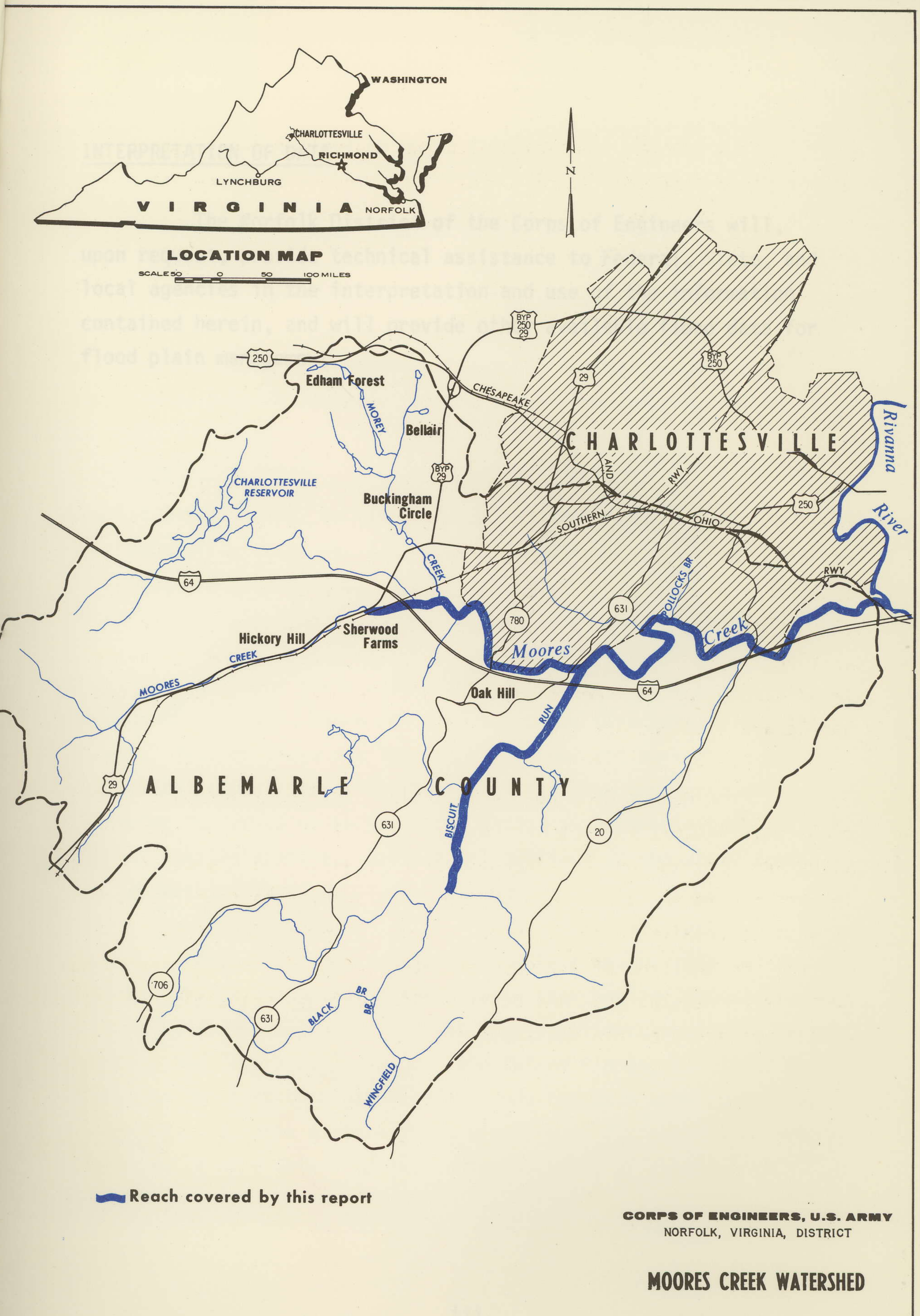
This report covers the flood situation along Moores Creek in the city of Charlottesville and in a portion of Albemarle County, Virginia. The report was prepared at the request of the governing bodies of Charlottesville and Albemarle County through application to the Commissioner of the Division of Water Resources, Department of Conservation and Economic Development of the Commonwealth of Virginia. Its purpose is to aid in defining local flood problems and in the best utilization of land subject to overflow. The report is based on information on rainfall, runoff, historical and current flood heights, and other technical data bearing upon the occurrence and size of floods along Moores Creek in the study area.

The report covers two significant phases of the flood problem. It first brings together a record of the largest known floods of the past on Moores Creek. Second, it treats of probable future floods: specifically, the Intermediate Regional Flood and the Standard Project Flood. The Intermediate Regional Flood is one having an average frequency of occurrence in the order of once in 100 years. It is determined from an analysis of known floods on Moores Creek, and on other streams which have similar physical characteristics and are in the same general geographical region. The Standard Project Flood is one of rare occurrence and, on most streams, is considerably larger than any flood of past occurrence. However, it should be considered in planning for use of a flood plain.

In problems concerned with the control of developments on the flood plains of Moores Creek, and in reaching decisions on the size of floods to consider for this purpose, appropriate consideration should be given to the possible future occurrence of floods of the size of those experienced in the past, the Intermediate Regional Flood, and the Standard Project Flood.

The report contains maps, profiles, cross sections, and photographs which indicate the extent of flooding that has been experienced and that which might occur in the future along Moores Creek. These should prove helpful in planning the best use of flood plains. From these data, the depth of probable flooding may be determined from recurrence of the largest known floods or by occurrence of the Intermediate Regional or Standard Project Floods at any location. With this information, floor levels and other critical features of structures may be planned high enough to avoid flood damage, or at lower elevations with recognition of the chance and hazard of flooding.

The report does not include plans for the solution of flood problems. Rather, it is intended to provide the basis for further study and planning on the part of Charlottesville and Albemarle County in arriving at solutions to minimize vulnerability to flood damages. This might involve local planning programs to guide developments by controlling the type of use made of the flood plain through zoning and subdivision regulations, the construction of flood protection works, or a combination of the two approaches.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CORPS OF ENGINEERS, U.S. ARMY
NORFOLK, VIRGINIA, DISTRICT
MOORES CREEK WATERSHED
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INTERPRETATION OF DATA

The Norfolk District of the Corps of Engineers will, upon request, provide technical assistance to Federal, State, and local agencies in the interpretation and use of the information contained herein, and will provide other available flood data for flood plain management.

SUMMARY OF FLOOD SITUATION

Moores Creek originates in the foothills of the Blue Ridge Mountains in the midwestern section of Albemarle County, Virginia. It flows easterly through the county and empties into the Rivanna River at Charlottesville. The river basin and location are shown on plate 1. The following U. S. Geological Survey quadrangle maps provide coverage for the study area and drainage basin.

Quadrangle Map	Contour Interval	Scale
Charlottesville East, Va. (7½ min)	20 feet	1:24,000
Charlottesville West, Va. (7½ min)	20 feet	1:24,000
Simeon, Va. (7½ min)	20 feet	1:24,000
Alberene, Va. (7½ min)	20 feet	1:24,000

The flood plain within the study area is not extensively developed. However, there are some scattered structures along the stream. Most of these are located along the left bank flood plain within the city limits of Charlottesville. Development is also beginning to spring up on the flood plains in Albemarle County nearest Charlottesville. Substantial portions of the study area are subject to flooding.

Residents along the river have been interviewed and newspaper files and historical documents searched for information concerning past floods. From these investigations, available gaging records, and from studies of possible future floods, the local flood situation for both past and future floods has been developed. The following paragraphs summarize the significant findings which are discussed in more detail in succeeding sections of this report.

THE GREATEST FLOOD on Moores Creek in the study area in recent history was probably that of October 1942.

* * *

OTHER LARGE FLOODS. A systematic record of flooding on Moores Creek has never been kept. Rainfall records, records of floods on other streams in the vicinity, and other available information indicate that large floods probably occurred on Moores Creek in May 1924, April 1937, September 1944, August 1955, and August 1969.

* * *

INTERMEDIATE REGIONAL FLOOD has an average return interval of once in 100 years. Such a flood for Moores Creek was determined by emperical methods and checked for reasonableness by comparison with frequency estimates determined for nearby streams of similar size and drainage characteristics for which a number of years of streamflow records are available.

* * *

STANDARD PROJECT FLOOD determination indicate that floods could occur on Moores Creek as much as 2 to 8 feet higher than the Intermediate Regional Flood crest.

* * *

FLOOD DAMAGES that would result from recurrences of major known floods would be substantial. Extensive damage would be caused by the Standard Project Flood because of its wider extent, greater depth, and higher velocities.

MAIN FLOOD SEASON. While minor to moderate flooding is more prevalent in the spring, the larger and more infrequent floods may occur at any time of the year. Most of the higher floods have resulted from heavy general rains or from intense rainfall produced by hurricanes or other storms of tropical origin which moved into the area from the Atlantic or Gulf Coasts. The storms of tropical origin almost always occur during the period from May through November.

* * *

VELOCITIES OF WATER during major floods would be dangerously high in the main channel. Velocities on the flood plain would be considerably lower and would vary widely depending on the location. During a Standard Project Flood, velocities would be extremely dangerous to life and property. In the channel they would range up to 15 feet per second and on the flood plain as high as 6 feet per second. Velocities greater than three feet per second combined with depths of three feet or greater are generally considered dangerous.

* * *

DURATION OF FLOODS depend to some extent on the duration of runoff producing rainfall over the drainage basin upstream from the study area. Stages can rise from normal low to extreme flood peaks in less than 14 hours following the beginning of intense rainfall. During the Intermediate Regional Flood, the stream will have a maximum rate of rise of 3.3 feet per hour, and remain above bankfull stage for about 10 hours. During the Standard Project Flood, the stream will rise 25 feet in about 20 hours and would remain above bankfull stage for over 15 hours.

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

* * *

FLOOD DAMAGE PREVENTION MEASURES. As far as known there are no existing, authorized or proposed flood control or related measures in the study area or upstream in the watershed which will provide significant protection to the study area. There are no flood plain regulations presently in effect in Albemarle County or Charlottesville.

* * *

FUTURE FLOOD HEIGHTS that would be reached if the Intermediate Regional or Standard Project Floods occurred are shown in table 1.

TABLE 1

RELATIVE FLOOD HEIGHTS

Flood	Distance Above Mouth of Stream feet	Estimated Peak Discharge c.f.s.	Water Surface Elevation feet, m.s.l.
ALBEMARLE LIVESTOCK MARKET - MOORES CREEK			
Intermediate Regional	4,900	20,800	330.1
Standard Project		28,500	337.0
VA. ROUTE 20 - MOORES CREEK			
Intermediate Regional	8,650	20,700	343.5
Standard Project		28,200	348.7
INTERSTATE 64 - BISCUIT RUN			
Intermediate Regional	910	9,700	387.8
Standard Project		12,800	390.1

GENERAL CONDITIONS AND PAST FLOODS

This section of the report includes a history of floods on Moores Creek and a discussion of general conditions as they apply to the flood situation.

Area Covered

The area investigated extends for approximately 7.5 miles along both the north and south sides of Moores Creek beginning at its confluence with Rivanna River. The study area also includes the flood plain along about 3 miles of Biscuit Run, a tributary of Moores Creek. The limits of the study area are shown on plate 1.

Extent of Flooding

At the present time, the flood plain along Moores Creek is not extensively developed. There are a few scattered structures near the downstream end of the stream in Charlottesville and some development is beginning to take place in Albemarle County, particu-larily in the area nearest Charlottesville. The remainder of the study area is used for agricultural purposes or remains essentially rural in character. The timely enactment of proper regulations to control further development will prevent these areas from adding to the flood problem.

As mentioned earlier, except for scattered development, the Moores Creek flood plain has heretofore been largely rural. Because of this, flooding, when it did occur, went practically unnoticed. But, no doubt large floods have occurred on the stream and will continue to happen at increasingly frequent intervals as the watershed becomes more urbanized and rooftops, parking areas, streets and other impervious surfaces are substituted for the existing natural absorbent areas.

Flooding along the entire study area generally occurs as a result of prolonged intense rainfall over Moores Creek watershed. But, serious flooding of the downstream portion of the study area may occur as a result of backwater from the Rivanna River whenever that stream is experiencing high water. Of course, both Moores Creek and the Rivanna River may experience high water simultaneously which adds to the problem on either stream. However, because of the time difference required for floodwaters to concentrate on the two watersheds, there is only a remote possibility that flood crests originating from the fairly large Rivanna River basin and, by comparison, the much smaller Moores Creek watershed would ever coincide exactly at their confluence. Usually, the flood crest from Moores Creek, precedes that from the Rivanna River by several hours or longer.

While there is a substantial volume of information available which pertains to the flood situation on the Rivanna River and on several other streams located in the general vicinity of Moores Creek, flood data for Moores Creek itself is meager. Nevertheless, local residents have been interviewed, field investigations and office computations made, and searches made of newspaper files and historical documents. These sources and records of flooding on streams in the immediate vicinity, provide a reasonably sound basis for developing estimates of the frequency and size of future floods to be expected on Moores Creek.

Settlement

Data on settlement of Charlottesville City and Albemarle County have been extracted from "Economic Data Summary," Albemarle County, dated June 1966. This report is available from the Governor's Office, Office of Administration, Division of Planning, 1010 James Madison Building, Richmond, Virginia 23219.

Albemarle County was formed from Goochland County in 1744. Settlement here began about 1734. Charlottesville was established in 1762 and incorporated as a city in 1888.

Albemarle County and the city of Charlottesville are separate governmental units.

The County Board of Supervisors, consisting of representatives elected by the qualified voters, is the governing body of Albemarle County. One representative is chosen from each of six magisterial districts into which the county is divided. The administrative and business affairs of the county are carried out by a county executive who is appointed by, and serves at the pleasure of, the Board of Supervisors.

Charlottesville, a city of the first class, operates under the council-manager form of Government. The council consists of five members who are elected at large by the qualified voters of the city. The council elects one of its members to serve as mayor. Administrative and executive powers of the government are placed in the hands of the city manager who is appointed by, and serves at the pleasure of, the city council. The council retains all legislative functions and powers.

Both Charlottesville and Albemarle County have active planning commissions. The county has enacted subdivision regulations. Charlottesville has adopted a zoning ordinance, subdivision regulations and a comprehensive plan for future growth.

Albemarle County has a total area of 745 square miles of which rivers, lakes, and streams make up about 6 square miles. Over half of the county is forested. Lumbering, millwork, and other wood industries are important to the economy of the area. However, in recent years, more emphasis has been placed on livestock raising and dairying. In Charlottesville, manufacturing has grown in recent years. Products include machinery, electronic devices, fabrics, apparel, stock feeds, flour, scientific instruments and many others. The University of Virginia, with its many related enterprises, is the largest single business in Albemarle County.

Table 2 gives population statistics pertinent to the study area.

TABLE 2

POPULATION

Community	1940	1950	1960	1965	1970
Albemarle County	24,652	26,662	30,969	32,882	37,107
Charlottesville City	19,400	25,969	29,427	37,717	38,047

Flood Damage Prevention Measures

The Norfolk District Corps of Engineers is currently studying the flood situation in the entire James River Basin and ways by which flood problems may be solved. The Rivanna River Basin, of which Moores Creek Watershed is a part, is included in the study. Findings and recommendations with respect to flood problems, will be included in a comprehensive river basin report.

When completed, studies underway in the Rivanna River Basin could show that it may be feasible to provide flood protection at some locations in the form of dams, levees, channel improvements, or similar devices. In this connection, it should be kept in mind that such measures are normally undertaken only when it can be clearly illustrated that the benefits to be derived from the provision of these structures, exceed the cost of constructing and maintaining them. At the present time, studies are not far enough advanced to permit this type of an evaluation for projects being considered in the Rivanna River Basin.

In the large number of cases whereby an economical solution to the flood problem cannot be obtained through structural measures, the most effective means of dealing with the problem is through sound flood plain management practices. These usually involve the adoption of some form of land use control, such as a flood plain ordinance, which can be used to effectively guide and regulate development on the flood plain.

Charlottesville City and Albemarle County have not adopted any form of regulatory ordinance pertaining to the use on development of the flood plains. However, officials of both communities have expressed an interest in the formulation and adoption of such a measure. The data contained in this report provide the basis for sound land use planning and control in the area studied.

Flood Warning Forecasts

The National Weather Service maintains a flood warning plan for the study area. Whenever floods threaten, the Service issues warnings and forecasts for Rivanna River Basin and its tributaries through the normal news media.

The Stream and its Valley

Moores Creek Watershed covers an area of 34.5 square miles. It is located in the larger Rivanna River Basin near Charlottesville, Virginia as shown on plate 1. The watershed is fan shaped, has a length of about 8.5 miles and a maximum width of about 7.5 miles near its headwaters.

Moores Creek and its watershed area lie wholly within Albemarle County and the city of Charlottesville. The stream flows generally in an easterly direction for about 11 miles to its confluence with the main stem of the Rivanna River at Charlottesville. The principal tributary is Biscuit Run which merges with Moores Creek about 5 miles upstream from the confluence of Moores Creek with the Rivanna River.

Moores Creek Watershed lies wholly within the physiographic region known as the Piedmont Plateau. The Piedmont Plateau is located east of the Blue Ridge Mountains. The land slopes gradually eastward from the base of the mountains and is characterized by rolling terrain with elevations ranging from 1000 feet above mean sea level in the foothills to 300 feet near the eastern limits of the plateau. It is traversed by highlands which are cut by numerous small valleys.

Table 3 gives drainage area at selected points along Moores Creek

TABLE 3

DRAINAGE AREAS

MOORES CREEK BASIN

Location	Distance Above Mouth Moores Creek feet	Drainage Area sq. mi.
Mouth of Moores Creek		
Va. Route 20	0	34.5
Downstream from Confluence of Biscuit Run and Moores Creek	8,650	30.9
Mouth of Biscuit Run	24,200	26.2
Upper limits study area, Biscuit Run	24,270	12.3 (a)
Va. Route 631	15,200 (b)	6.3
Upper limits study area, Moores Creek - Old U. S. Route 29	24,850	13.8
	39,750	5.3

(a) Includes Biscuit Run drainage basin only.
(b) Feet above mouth of Biscuit Run

Developments on the Flood Plain

Plates 6, 7, 8, 9, 10, 11, 12, and 13 show areas that are subject to flooding. Development on the flood plain is concentrated in the downstream portion of the study area in and near Charlottesville.

Development includes residential, commercial and industrial buildings. Some structures on the flood plain have been damaged by floods in the past.

The flood plain upstream from Charlottesville is used primarily for agricultural purposes.

Highway and Railway Crossings in the Study Area

Eight highway bridges and two railway bridges cross Moores Creek in the study area. Three highway bridges cross Biscuit Run. Table 4 lists pertinent elevations for these structures and shows their relation to the crests of the Intermediate Regional and Standard Project Floods.

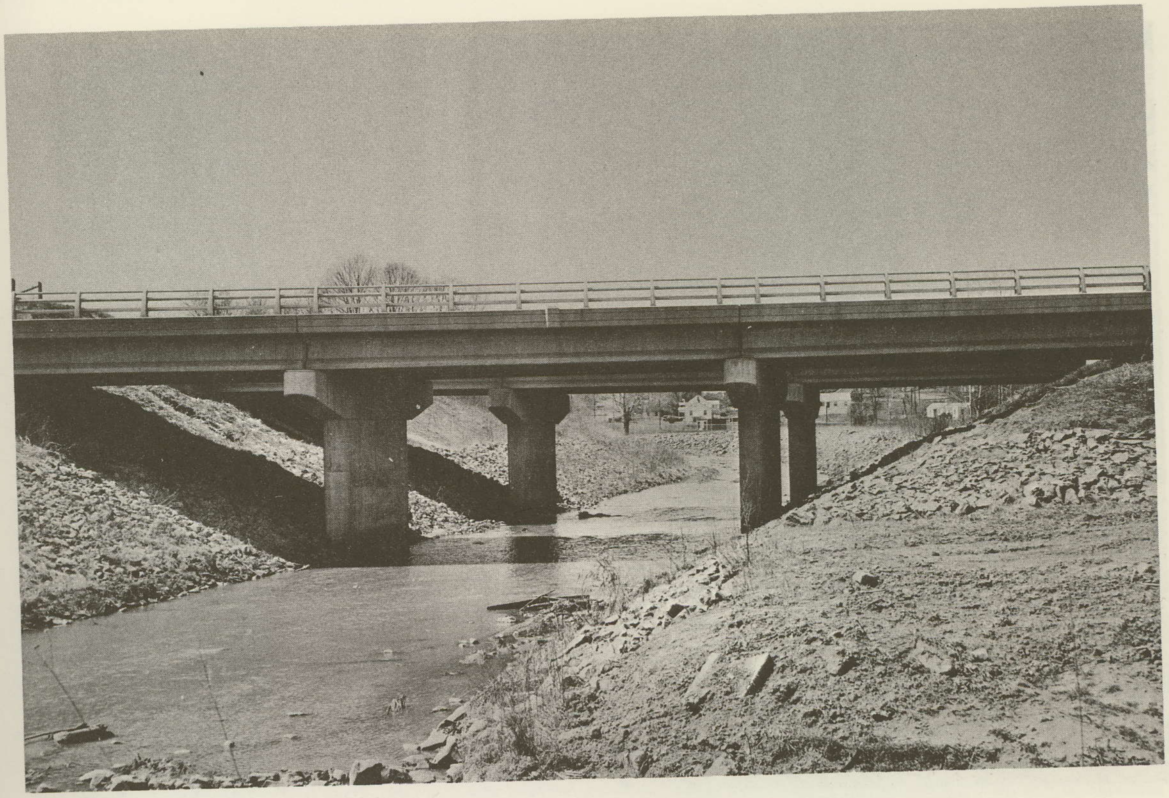
Table 4 shows that on Moores Creek, only the Interstate 64 highway and the Chesapeake and Ohio Railway bridges are entirely above the maximum level of flooding which would be experienced during the Intermediate Regional Flood. On Biscuit Run, only Interstate 64 is above this level. The roadbeds of Virginia Route 20, Virginia Route 780, Old U. S. Route 29, and the Southern Railway crossing are above the maximum level of flooding expected during the Intermediate Regional Flood, but, floodwaters during this event would rise above the low steel on each of these structures making their safe use questionable. Approach roadways to the Avon Street, Virginia Route 631, and Virginia Route 780 bridges are several feet lower than the bridge roadways themselves. Neither of these bridges would be passable during the Intermediate Regional Flood.

Figures 1, 2, 3, 4, and 5 are photographs of the bridges and culverts which carry highways and railways across the study area.

Obstructions to Flood Flows

Table 4 and the profiles on plates 14, 15, 16, and 17 show that considerable backwater effect is caused by several of the bridges which cross Moores Creek. At the Virginia Route 20 crossing, the bridge constriction produces an increase in water level immediately upstream of the structure amounting to about 5 feet during the Intermediate Regional Flood and over 7 feet during the Standard Project Flood. However, the bridge effect diminishes quite rapidly in an upstream direction and probably disappears altogether within a short distance. Virginia Route 780, the Southern Railway, and the Old U. S. Route 29 crossings on Moores Creek also produce significant backwater effects during large floods. Measurable backwater effects also occur at the Sunset Avenue and Avon Street crossings. Virginia Route 631 would cause a significant amount of backwater during small floods, but during large floods the backwater effect would be negligible.

A low dam, approximately 6 feet high, has been constructed between Virginia Route 780 and Sunset Avenue. While there is some amount of fall over the dam in the lower and more frequent floods, the structure becomes almost completely submerged in the larger floods and has practically no effect on upstream flood heights.



Va. Route 20

Avon Street (Va. Route 742)

Figure 1. BRIDGES ACROSS MOORES CREEK

Private bridge near mouth of Biscuit Run, (O'Neill Enterprises)

"WILLOWBY" DRIVEWAY BRIDGE BUILT BY COL. U.S. GRANT FOR COL. L.J. OWEN IN 1932 (GRANDSON OF GEN GRAN

Interstate 64

Figure 2. BRIDGES ACROSS BISCUIT RUN

Va. Route 631 (Old Route)

FORMER HIGHWAY BRIDGE OVER MOORE'S CREEK FOR "OLD LYNCHBURG ROAD"

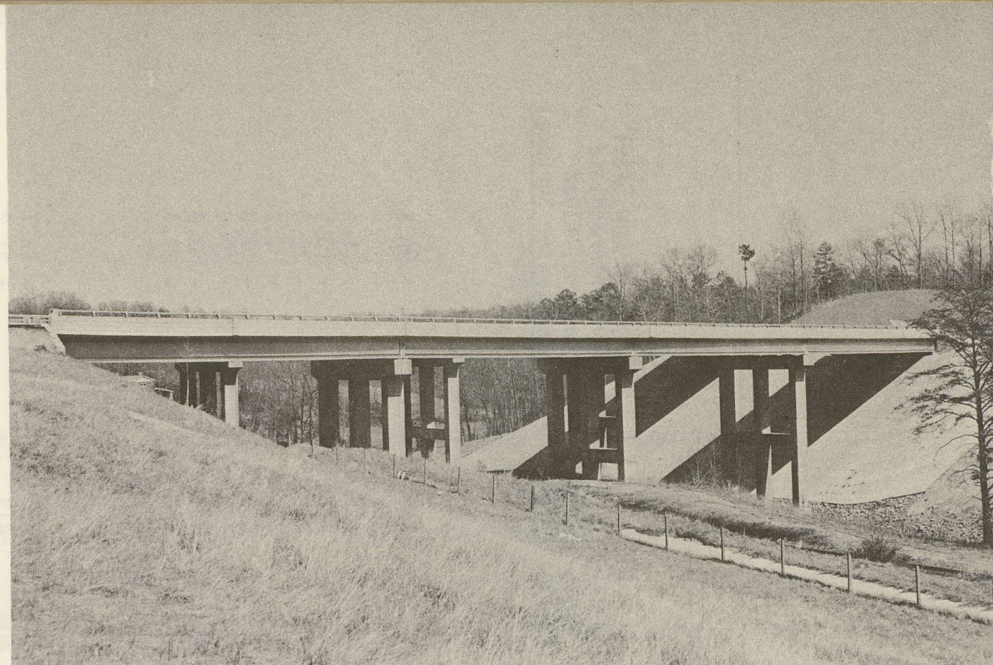
Va. Route 631 (New Route) NOW 5TH. ST.

Figure 3. BRIDGES ACROSS MOORES CREEK

Va. Route 780

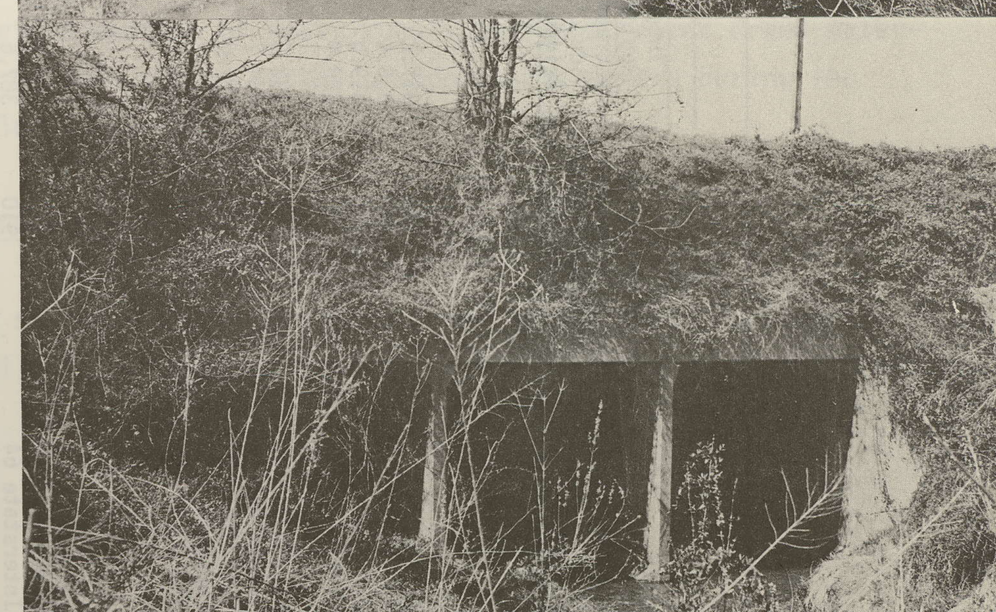
Sunset Avenue (Va. Route 781)

Figure 4. BRIDGES ACROSS MOORES CREEK



Interstate 64

Southern Railway



Va. Route 29
(Old Route)

Figure 5
BRIDGES ACROSS
MOORES CREEK

TABLE 4

BRIDGES ACROSS THE STREAM

Identification	Distance above Mouth of Stream	Elevations in Feet Referred to Mean Sea Level — Water Surface — Intermediate Regional Flood: Downstream Side of Bridge	Intermediate Regional Flood: Upstream Side of Bridge	Standard Project Flood: Downstream Side of Bridge	Standard Project Flood: Upstream Side of Bridge	Stream Bed	Low Steel	Bridge Floor	Height of Low Steel above Intermediate Regional Flood (Upstream Water Surface) feet
MOORES CREEK									
C&O Railway	750	327.2	327.2	335.2	335.2	291.8	348.0	359.7	+ 20.8
Va. Route 20	8,650	338.4	343.5	341.4	348.7	320.5	341.3	347.0	- 2.2
Avon Street	13,470	359.0	359.9	361.3	363.3	338.7	354.5	359.1	- 5.4
Abandoned Va. Route 631	24,750	386.9	387.1	389.4	389.6	364.6	376.6	378.0	- 10.5
Va. Route 631	24,830	387.1	387.7	389.6	390.0	366.2	377.7	385.6	- 10.0
Va. Route 780	29,180	393.3	395.8	395.1	397.2	378.8	390.6	398.5	- 5.2
Sunset Avenue	32,370	404.7	405.6	406.9	407.6	391.7	398.6	400.0	- 7.0
Interstate 64	37,550	429.6	430.4	430.5	431.2	415.0	478	482	+ 47.6
Southern Railway	39,100	435.7	441.7	437.4	442.2	424.8	437.8	443.6	- 3.9
Old U. S. Route 29	39,750	444.2	450.1	445.8	451.1	428.7	438.7	450.1	- 11.4
BISCUIT RUN									
O'Neill Enterprises	120	386.9	387.0	389.3	389.4	365.6	374.3	375.5	- 12.7
Interstate 64	910	387.6	387.8	389.9	390.1	367.0	409	413	+ 21.2
Private Bridge	14,450	412.3	412.6	413.3	413.7	400.1	407.1	408.1	- 5.5

FLOOD SITUATION

Flood Records

There are no records of stream stages or discharges for Moores Creek. Several highwater marks were located along the streams and their elevations determined following the moderate flooding of 19 August 1969. Information on other floods is meager. Newspaper accounts describing flooding near the mouth of Moores Creek more than likely refer to backwater effects from the Rivanna River rather than flooding caused by rainfall runoff from Moores Creek watershed itself. Interviews with local residents have established only that a number of large floods have occurred on Moores Creek within recent history. Those interviewed were uncertain as to the exact dates of these events. Streamflow records are available for nearby streams, including the Rivanna River, Schenks Branch, Mechum River, North Fork Moormans River, and the South Fork of Rivanna River. These records together with area precipitation records provide the best means of estimating the probable dates of significant flooding on Moores Creek. For example, the largest flood known to have happened on the Rivanna River at Charlottesville was that of 16 October 1942. Rainfall associated with this flood was heaviest in the immediate Charlottesville area. Therefore, despite the fact that none of the available accounts of this flood make specific mention of heavy runoff over the Moores Creek watershed, flooding on this stream was also undoubtably severe during the October 1942 flood.

Flood Stages and Discharges

Peak stages and discharges recorded by the U. S. Geological Survey are available for several streams in the vicinity of Moores Creek.

These records reflect the flood history of the general area and are reasonably indicative of the frequency of occurrence of floods to be expected on Moores Creek.

Available peak stages and discharges for gaging stations at Palmyra and Charlottesville on the Rivanna River are shown on tables 5 and 6, respectively. Tables 7, 8, 9, and 10 show flood crest stages and discharges for Mechum River near Ivy, North Fork Moormans River near Whitehall, South Fork Rivanna River near Earlysville, and Schenks Branch at Charlottesville, respectively.

Table 5 includes all recorded floods above bankfull stage of 17 feet at the Palmyra U. S. Geological Survey gaging station located at river mile 15.56. The drainage area at this point is 675 square miles.

TABLE 5

FLOOD CREST ELEVATIONS OF FLOODS

RIVANNA RIVER AT PALMYRA, VA.

Date of Crest	Gage Height feet	Elevation feet, m.s.l.	Discharge c.f.s. (a)
September 17, 1934	24.75	235.14	24,000
December 1, 1934	20.60	230.99	13,200
January 23, 1935	20.17	230.56	12,800
September 6, 1935	26.27	236.66	29,000
January 3, 1936	20.54	230.93	13,900
January 19, 1936	19.53	229.92	12,400
March 18, 1936	29.26	239.65	39,900
October 18, 1936	18.19	228.58	10,600
January 21, 1937	19.65	230.04	12,500
February 22, 1937	17.05	227.44	9,330
April 26, 1937	33.35	243.74	56,700
October 20, 1937	23.45	233.84	20,000
August 17, 1940	21.78	232.17	16,300
August 9, 1942	18.59	228.98	11,400
October 16, 1942	36.5	246.89	78,000
September 19, 1944	30.5	240.89	39,600
April 1, 1948	21.54	231.93	16,800
August 4, 1948	22.9	233.29	19,800
December 4, 1948	26.78	237.17	28,800
December 31, 1948	18.27	228.66	10,700
March 23, 1949	19.25	229.64	11,900
August 15, 1949	21.70	232.09	17,200
December 5, 1950	21.55	231.94	17,000
June 10, 1951	21.13	231.52	15,900
February 4, 1952	17.38	227.77	11,000

TABLE 5 (Cont'd

FLOOD CREST ELEVATIONS OF FLOODS

RIVANNA RIVER AT PALMYRA, VA.

Date of Crest	Gage Height feet	Elevation feet, m.s.l.	Discharge c.f.s. (a)
March 12, 1952	17.80	228.19	11,400
August 19, 1955	29.00	239.39	34,800
October 1, 1959	20.41	230.80	15,700
February 19, 1960	18.27	228.66	12,700
April 13, 1961	17.83	228.22	12,100
October 21, 1961	24.27	234.66	22,900
March 13, 1962	17.90	228.29	12,200
March 12, 1963	18.63	229.02	13,100
February 8, 1965	21.77	232.16	18,000
March 8, 1967	18.41	228.80	12,800
August 20, 1969	39.85	250.24	98,700

(a) Minor inconsistencies in data due to periodic changes in stage-discharge relationship.

Table 6 shows annual peak stages and discharges between February 1925 and May 1934 for the U. S. Geological Survey gaging station at Charlottesville. The drainage area at this gage (Rivanna River Mile 36.1) is 507 square miles.

TABLE 6

FLOOD CREST ELEVATIONS OF FLOODS

RIVANNA RIVER BELOW MOORES CREEK, NEAR CHARLOTTESVILLE, VA.

Date of Crest	Gage Height feet	Elevation feet,m.s.l.	Discharge c.f.s.
November 16, 1926	11.96	304.86	8,790
October 4, 1927	11.83	304.73	8,570
April 28, 1928	10.80	303.70	7,490
April 16, 1929	14.15	307.05	11,200
March 8, 1930	9.30	302.20	5,990
July 25, 1931	11.00	303.90	7,690
October 17, 1932	15.00	307.90	12,100
April 17, 1933	16.50	309.40	13,800
September 17, 1934	19	311.90	18,000

Table 7 includes all recorded floods above bankfull stage of 9 feet at the U. S. Geological Survey gaging station on the Mechum River near Ivy, Virginia. The drainage area at the gage is 97 square miles and the altitude is 440 feet mean sea level.

TABLE 7

FLOOD CREST ELEVATIONS OF FLOODS
MECHUM RIVER NEAR IVY, VA.

Date of Crest	Gage Height feet	Discharge c.f.s.
October 15, 1942	30.3	20,000
December 30, 1942	10.8	3,030
September 18, 1944	21.9	10,600
September 18, 1945	9.32	2,360
April 1, 1948	9.58	2,740
August 4, 1948	10.9	3,490
December 4, 1948	14.7	5,340
September 13, 1950	16.8	6,330
December 4, 1950	16.28	5,980
September 30, 1959	18.05	7,200

Table 8 includes the annual peak discharges at the U. S. Geological Survey gaging station on the North Fork Moormans River near Whitehall, Virginia. The drainage area is 11.4 square miles and the altitude of the gage is 999 feet mean sea level.

TABLE 8

ANNUAL PEAK DISCHARGES

NORTH FORK MOORMANS RIVER NEAR WHITEHALL, VA.

Date of Crest	Gage Height feet	Discharge c.f.s.
October 15, 1942	11.7	7,620
February 4, 1952	4.40	437
March 24, 1953	4.61	492
March 1, 1954	4.93	603
August 18, 1955	7.94	2,400
October 31, 1956	4.59	490
February 26, 1957	4.70	520
December 29, 1958	4.65	592
September 30, 1959	5.97	1,180
May 8, 1960	5.72	1,050
October 21, 1961	4.41	505
November 10, 1962	4.17	424
March 12, 1963	3.91	334
- 1964	3.62	241
February 7, 1965	3.94	344
September 21, 1966	4.84	662
August 24, 1967	5.02	720
May 27, 1968	5.16	780
July 7, 1969	4.12	407

Table 9 includes all recorded floods above bankfull stage of 10 feet at the U. S. Geological Survey gaging station on the South Fork Rivanna River near Earlysville, Va. The drainage area at the gage is 216 square miles and the altitude is 369 feet mean sea level.

TABLE 9

FLOOD CREST ELEVATIONS OF FLOODS

SOUTH FORK RIVANNA RIVER NEAR EARLYSVILLE, VA.

Date of Crest	Gage Height feet	Discharge c.f.s.
October 1942	(a) 33	-
February 4, 1952	12.18	6,190
March 11, 1952	13.55	7,480
March 25, 1953	11.71	5,750
March 1, 1954	15.55	9,560
August 8, 1955	26.1	30,200
June 2, 1959	12.22	6,190
September 30, 1959	24.35	25,500
February 18, 1960	11.97	6,010
April 13, 1961	11.84	5,340
October 21, 1961	14.00	7,200
November 10, 1962	11.47	5,570
February 7, 1965	14.05	7,200
February 13, 1966	11.10	4,780
February 28, 1966	10.78	4,560
September 22, 1966	10.68	4,490

(a) From information by local residents

Table 10 includes all recorded floods above bankfull stage of 7 feet at the U. S. Geological Survey gaging station on Schenks Branch. The drainage area at the gage is 1.34 square miles and the altitude is 380 feet mean sea level.

TABLE 10

FLOOD CREST ELEVATIONS OF FLOODS

SCHENKS BRANCH AT CHARLOTTESVILLE, VA.

Date of Crest	Gage Height feet	Discharge c.f.s.
July 20, 1956	8.60	650
September 30, 1959	7.99	580
May 1, 1962	9.41	900
July 11, 1968	7.74	504
August 20, 1969	7.15	(a)

(a) Discharge not determined.

Flood Occurrences

Plate 2 shows the dates and heights of floods since 1933 which have exceeded bankfull stage on the Rivanna River at Palmyra.

Duration and Rate of Rise

A stage-discharge relationship was developed for Moores Creek to include a range of stages and discharges up to the size of the Standard Project Flood. Using this relationship, stage hydrographs were computed for the Intermediate Regional Flood and Standard Project Flood which reflect rates of rises and duration of flooding which may be expected in the study area.

Plate 3 shows the stage hydrograph for the Intermediate Regional Flood at a typical location in the study area. In this flood, Moores Creek would rise from elevation 362 to elevation 384 in 14 hours at an average rate of about 1.6 feet per hour. The stream would remain above bankfull stage for about 10 hours.

Plate 4 shows the stage hydrograph for the Standard Project Flood. In this flood Moores Creek would rise from elevation 362 to its maximum stage at elevation 387 in about 20 hours. The stream would remain above bankfull stage for about 15 hours.

Velocities

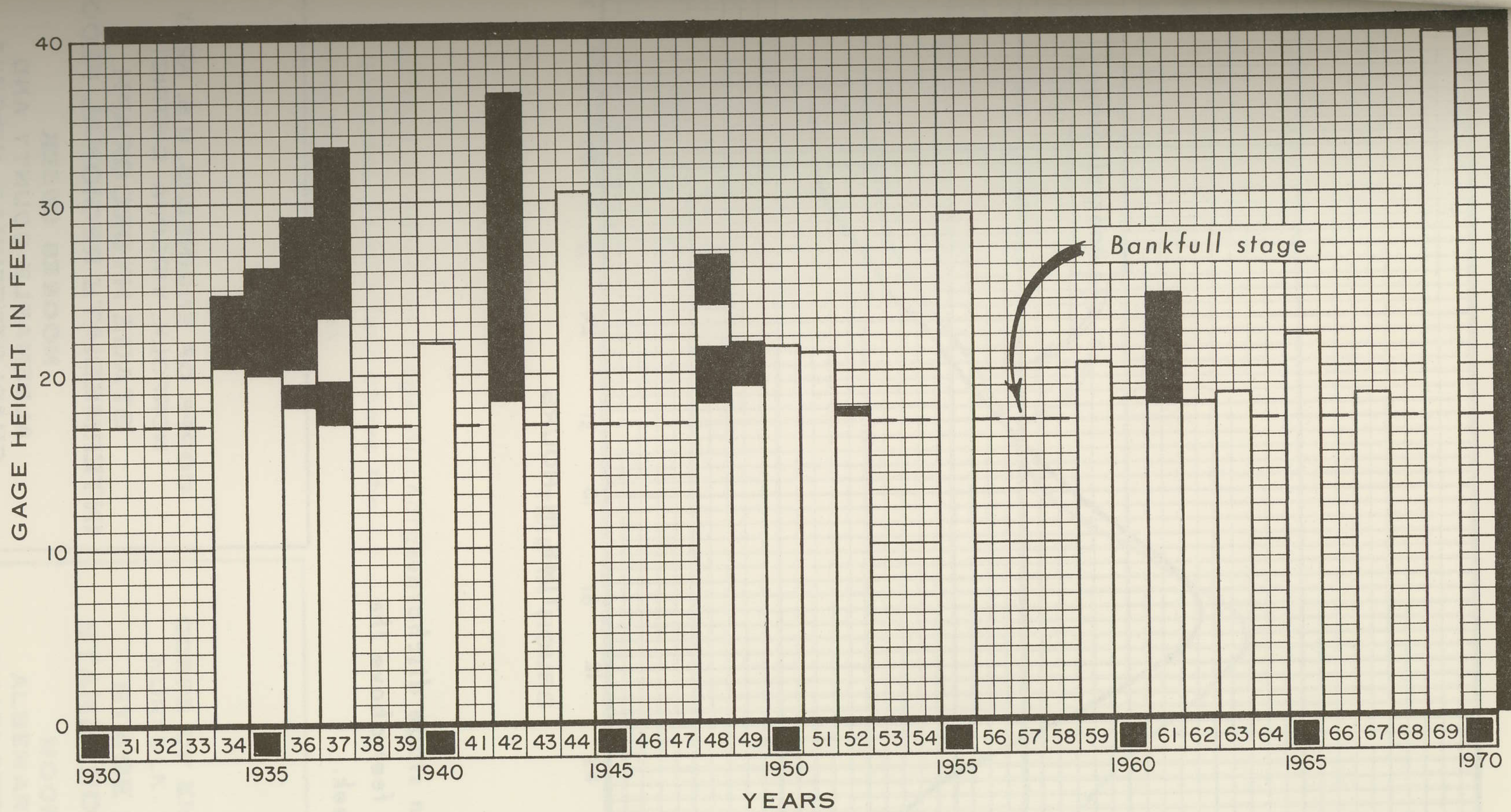
Velocities in Moores Creek may become hazardous in time of flooding, table 11 which follows gives an indication of velocities to be expected.

TABLE 11

VELOCITIES DURING FLOODTIME (a)

Flood	Velocity of Water in feet per second	
	Channel	Overbank
Intermediate Regional	8.1	3.7
Standard Project	8.3	3.9

(a) Average velocities in study reach.



U.S. Geological Survey gaging station at Palmyra, Virginia. Datum of gage is 210.39 feet above mean sea level.

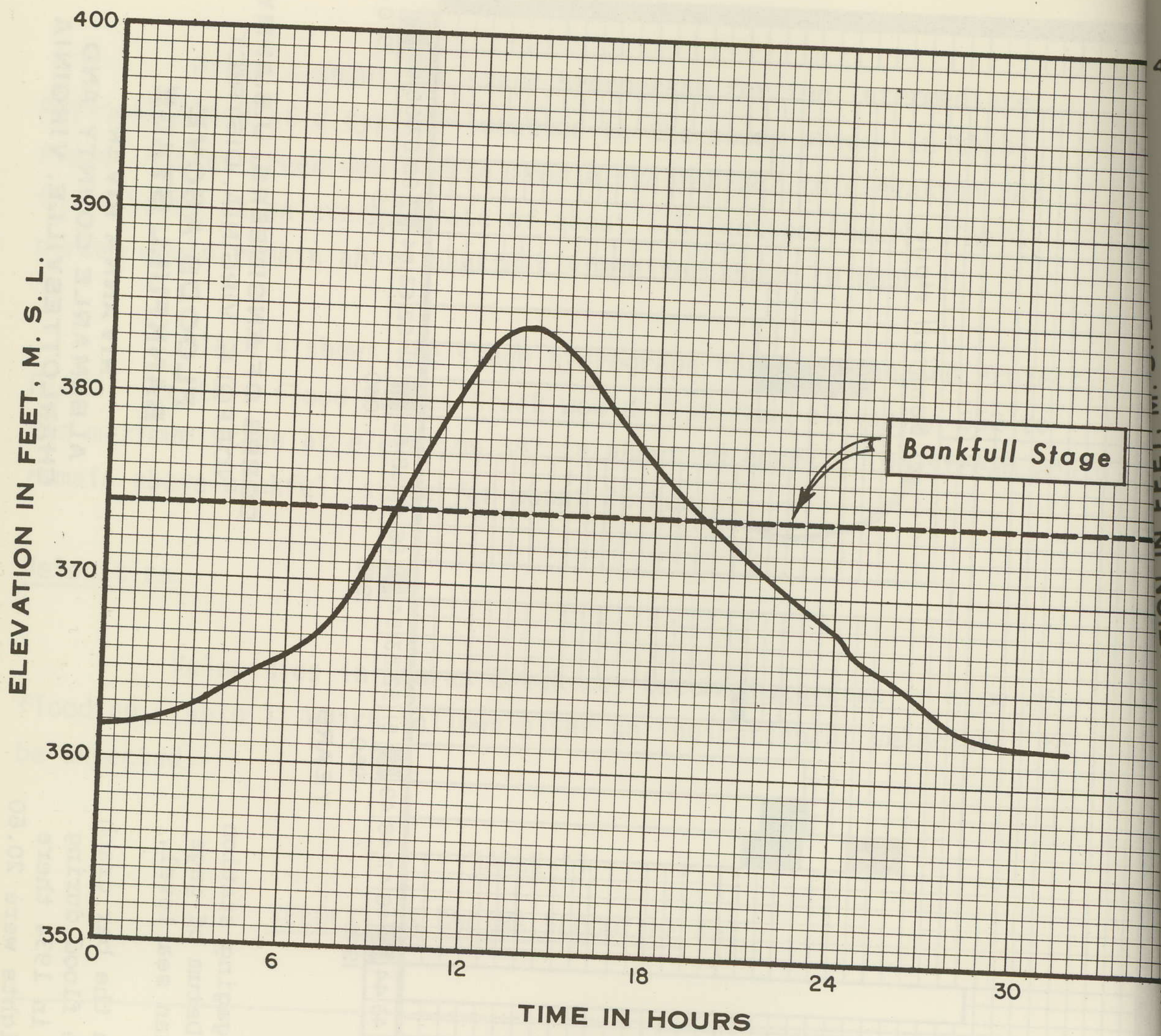
Variation in shading on the bar graph indicates more than one flood during the year. For example in 1934 there were 2 floods; gage heights were 20.60 and 24.75 feet.

CORPS OF ENGINEERS, U.S.ARMY
NORFOLK, VIRGINIA, DISTRICT

FLOODS ABOVE BANKFULL STAGE

RIVANNA RIVER
ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA

PLATE 2



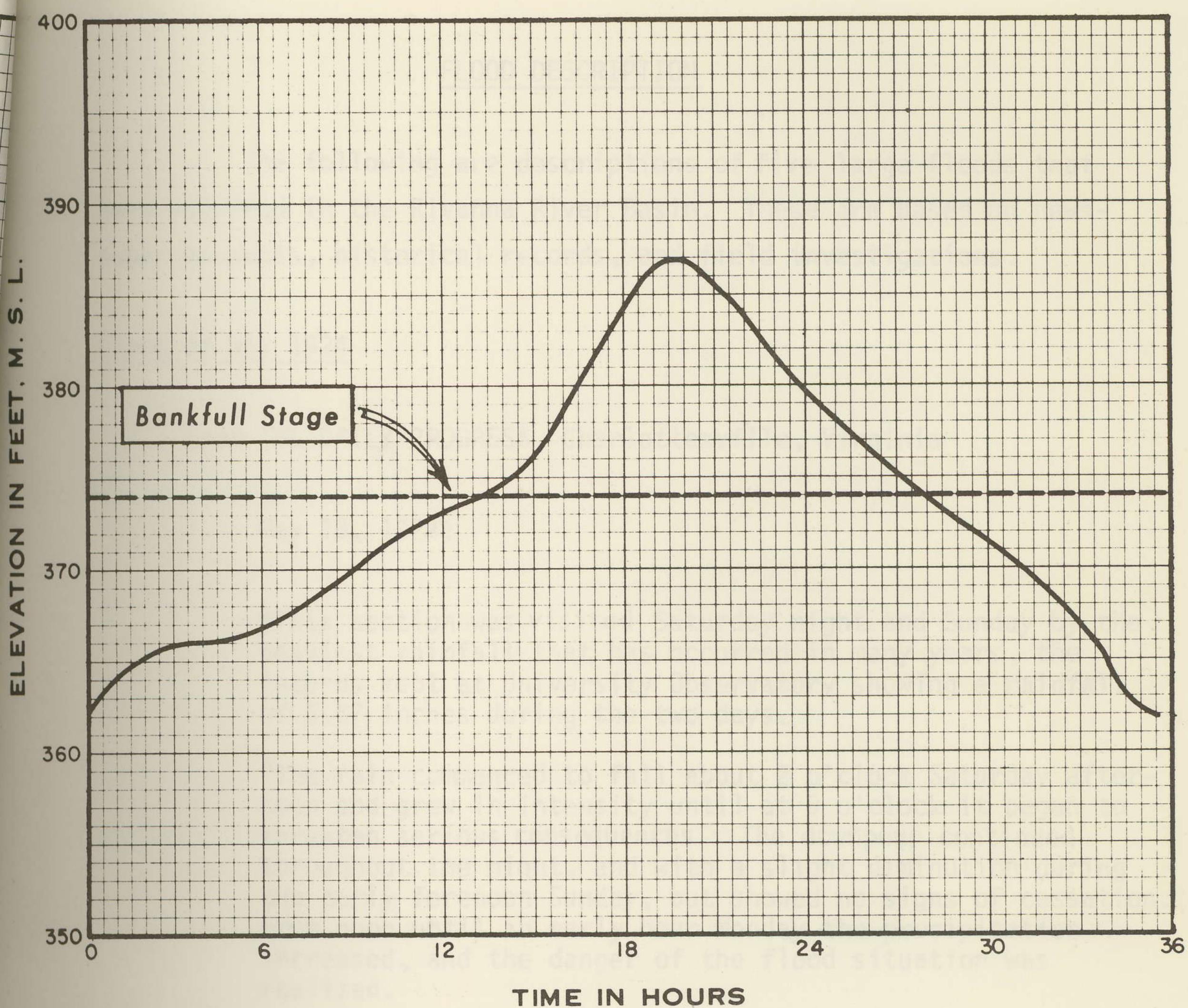
Hydrograph based on stage discharge relationship 23, 200 feet above the mouth of Moores Creek.

CORPS OF ENGINEERS, U.S. ARMY
NORFOLK, VIRGINIA, DISTRICT

STAGE HYDROGRAPH
INTERMEDIATE REGIONAL FLOOI

MOORES CREEK
ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA

PLATE

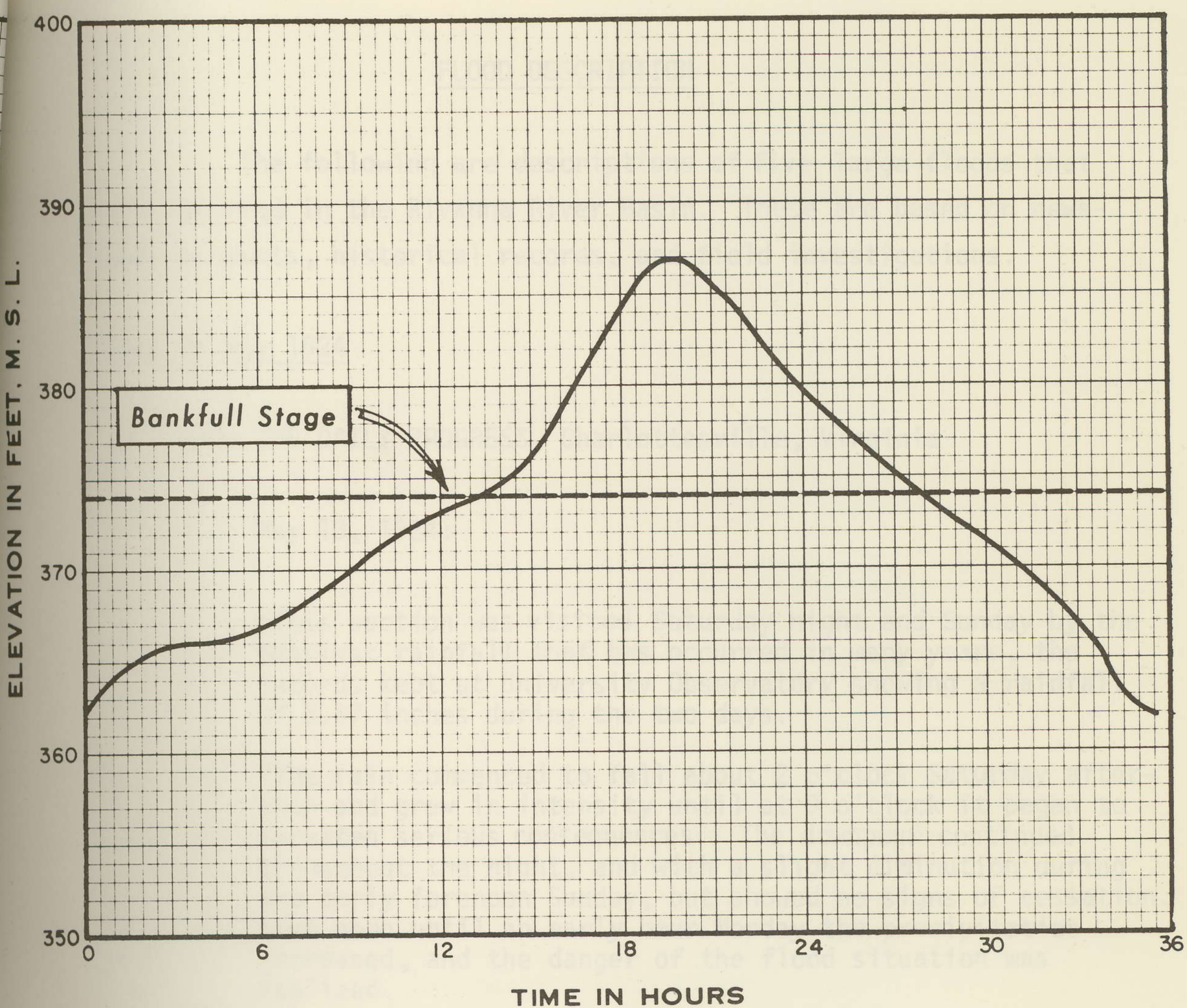


Hydrograph based on stage discharge relationship 23,200 feet above the mouth of Moores Creek.

CORPS OF ENGINEERS, U.S. ARMY
NORFOLK, VIRGINIA, DISTRICT

STAGE HYDROGRAPH
STANDARD PROJECT FLOOD

MOORES CREEK
ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA

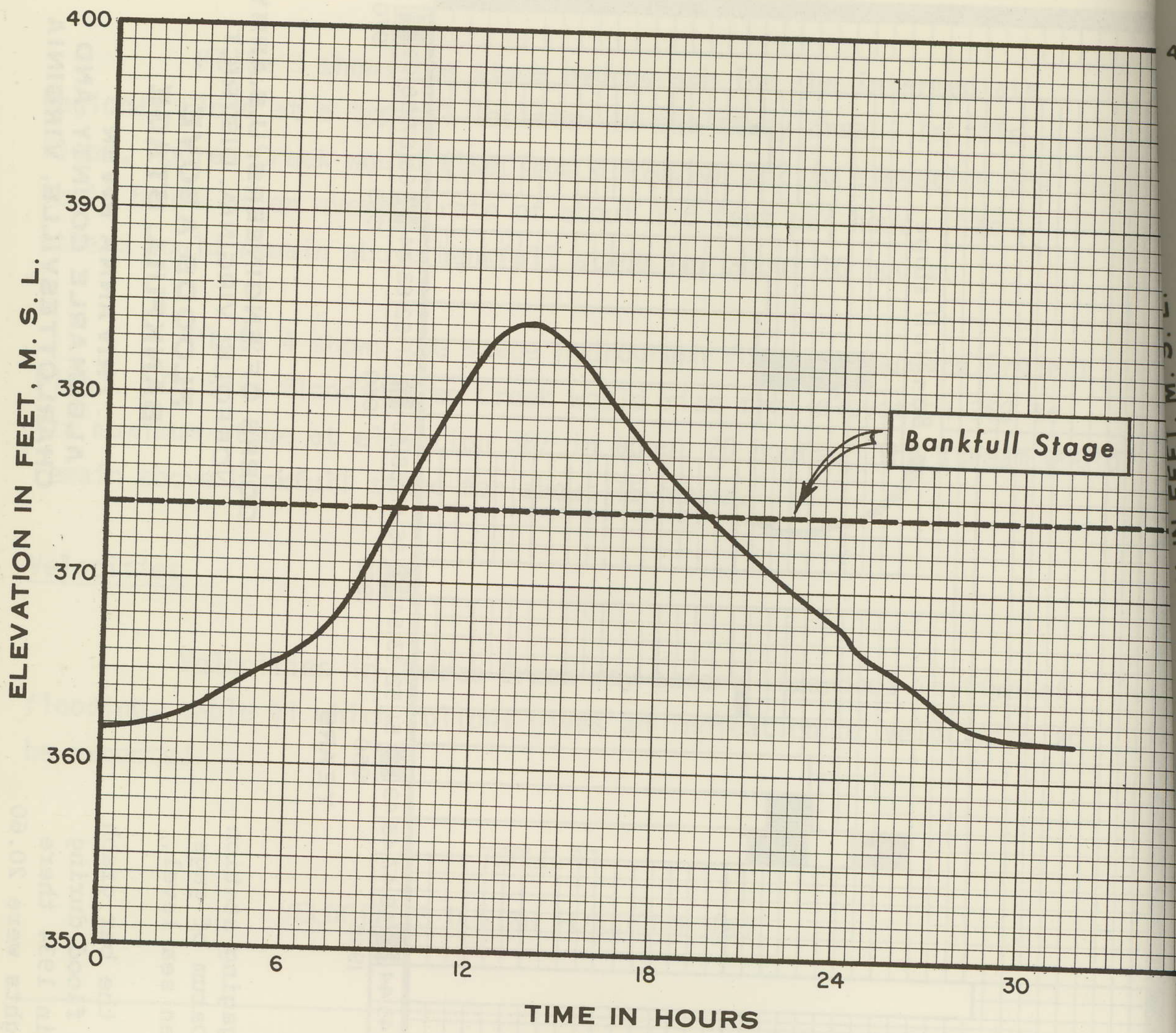


Hydrograph based on stage discharge relationship 23,200 feet above the mouth of Moores Creek.

CORPS OF ENGINEERS, U.S. ARMY
NORFOLK, VIRGINIA, DISTRICT

STAGE HYDROGRAPH
STANDARD PROJECT FLOOD

MOORES CREEK
ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA

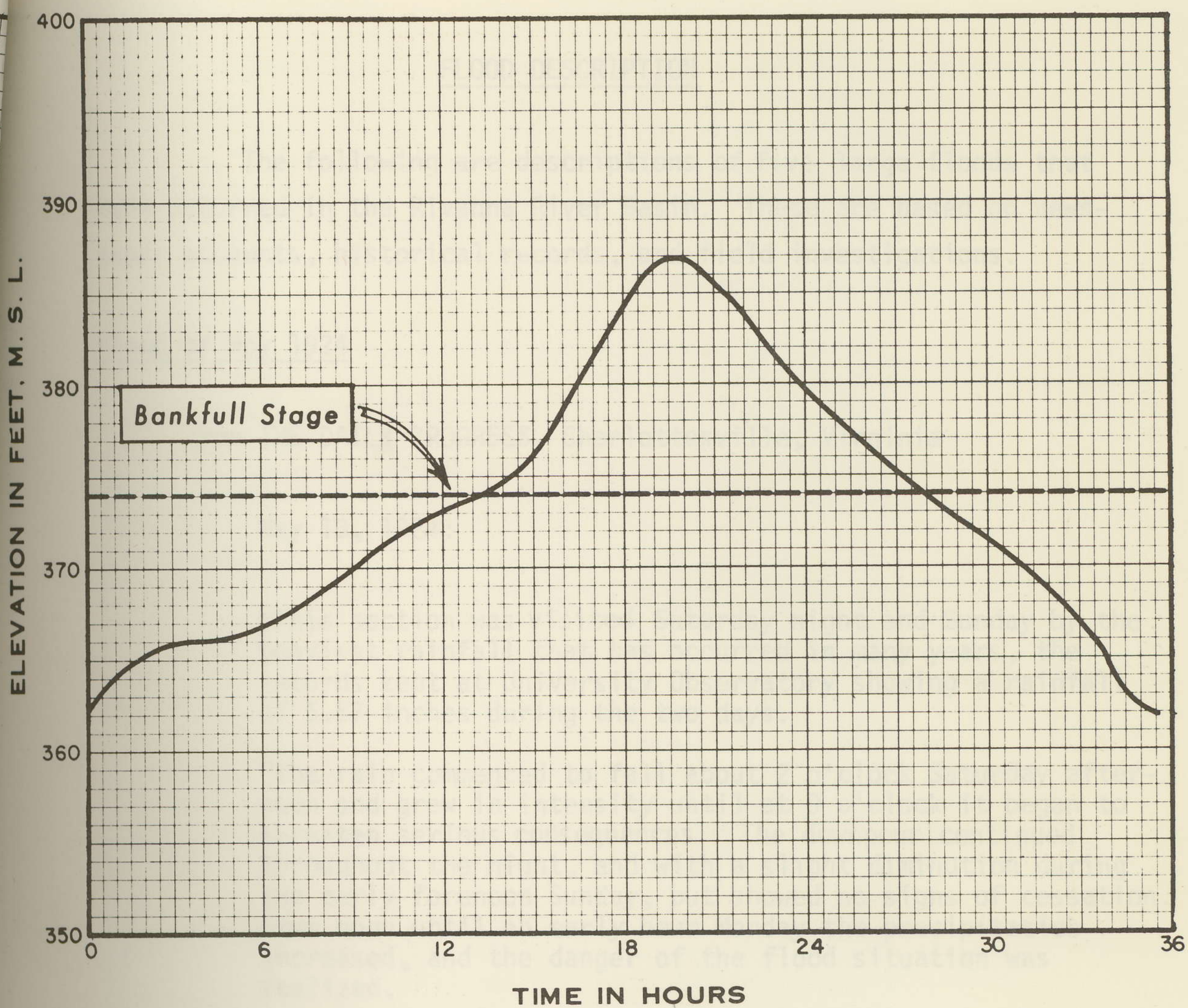


Hydrograph based on stage discharge relationship 23, 200 feet above the mouth of Moores Creek.

CORPS OF ENGINEERS, U.S. ARMY
NORFOLK, VIRGINIA, DISTRICT

STAGE HYDROGRAPH
INTERMEDIATE REGIONAL FLOOD

MOORES CREEK
ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA



Hydrograph based on stage discharge relationship 23,200 feet above the mouth of Moores Creek.

CORPS OF ENGINEERS, U.S. ARMY
NORFOLK, VIRGINIA, DISTRICT

STAGE HYDROGRAPH
STANDARD PROJECT FLOOD

MOORES CREEK
ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA

FLOOD DESCRIPTION

The following are descriptions of five large floods that have occurred in the Rivanna River Basin. These are based on newspaper accounts, historical records, and field investigations.

Flood of May 1924

From THE DAILY PROGRESS, Charlottesville, Virginia

May 13, 1924:

"This section was visited Saturday night and Sunday by the heaviest rainfall that has occurred in many years, the records kept at University Observatory showing a rainfall of 5.57 inches during the two days.

"The rain commenced to fall about 2 o'clock Saturday afternoon and grew in intensity until at 9 o'clock it began to threaten serious consequences. The downpour continued throughout the night, and with a slight diminution during the early forenoon Sunday, but showed no signs of cessation. From noon until an early hour Monday the precipitation increased, and the danger of the flood situation was realized.

"By noon the streams from the mountains had reached flood height, and the water was overflowing the low lands of the territory through which they pass and in the face of the continuing downpour of rain residents along the course of these streams became apprehensive of the worst flood in many years.

"The rain continued without cessation, and as night approached some fear was felt as to the safety of certain bridges, but no one especially the county officials entertained any uneasiness about the new steel bridges which had been erected within recent years at such flood levels "as were considered absolutely safe. However, their calculation proved not well founded in the face of a downpour of rain which raised the normal water level at least 30 feet, as was recorded by measurement on the steel bridge at Hydraulic which withstood the strain of the high tide, although the approach to it from the west was washed away. At this bridge the water was five feet higher than the level of the flood in 1870.

" . . . Havoc was played by the flood waters at the Woolen Mills where the swollen river overflowed and backed the waters of Moore's Creek to a height of 25-feet above the normal reading the highest level since 1877, and three feet higher than the last serious flood, which occurred on May 3rd, 1901.

"Public utilities in the city soon felt the effects of high water as the Rivanna River reached a height which flooded the power plant of the Virginia-Western Power Co., and before 8'o'clock the arc lights on the streets went out. . . .

"In addition to the damage sustained by the Virginia-Western Power Co. at the power plant two of their new steel towers, erected for supporting heavy cables on their line westward, caught the strain of the flood tide in the Rivanna River, and one of the towers was badly twisted."

May 14, 1924

"Following the Account Yesterday That Many Bridges Had Been Swept Away and Large Damage Done at the Woolen Mills, Later Information Tells of Heavy Losses Sustained by Farmers - Scottsville Suffered When James River Rose to Greater Height - Travel and Delivery of Mail Badly Interrupted in the county."

May 15, 1924

"After suspension of service at 9 o'clock Sunday night on account of lack of current occasioned by the flooded condition of the power plant, street cars began to run today and resumed the regular schedule.

"Following an interruption for a period of one hour, from 5 to 6 yesterday afternoon, electric current for power and light was supplied, but the interruption occurred before The Progress was able to complete the press run for the day and many readers were deprived of the paper last night."

Flood of April 1937

From THE DAILY PROGRESS, Charlottesville, Virginia

April 26, 1937

"The swollen water of the Rivanna River were receding rapidly here today after a heavy week-end rainfall which set an all-time record, temporarily paralyzed transportation for several hours late yesterday afternoon and last night.

"For forty-eight hours, ending at 9 o'clock today, a steady downpour raised streams in this area far above the flood stage, setting a record precipitation of 7:60 inches, according to the University of Virginia Observatory. 'Cloudy weather' will continue through tonight.

"An unofficial reading at the Charlottesville Woolen Mills at noon showed the Rivanna had reached a flood stage of thirty-two feet, two feet less than the record mark of 1924. The entire basement floor of the old building of the plant was entirely submerged and approximately two-thirds of the floor of the new division was under water."

April 27, 1937

"The unrully water of the Rivanna River had subsided today and danger of serious flood damage to Charlottesville had passed.

April 28, 1937

"Red Cross begins relief activities as flood recedes."

Flood of October 1942

The largest and most damaging flood known to have occurred on the Rivanna River and probably in the study area was that of October 1942. Intense rainfall associated with the remnants of a tropical hurricane fell over the Rivanna River watershed for about three days. Amounts totalling almost 10 inches were measured in the Rivanna watershed while a short distance to the northeast, in the Rappahannock River Basin, up to 18.9 inches at Big Meadows were recorded. This storm also produced record flooding on the Rappahannock River.

Rainfall depths measured during the October 1942 storm indicate that the largest amounts and most intense rainfall occurred over the upper portion of the Rivanna River watershed. The adjacent Rappahannock Basin experienced even heavier and more intense rainfall.

Following are excerpts from the Charlottesville newspaper which relate to the October 1942 flood.

From THE DAILY PROGRESS, Charlottesville, Virginia

October 16, 1942

"Fire Department Saves Residents in Flooded Areas."

"Charlottesville was almost isolated today when slides blocked traffic by rail, and water cut off all service. The City Fire squad was kept busy last night rescuing citizens stranded by the rising water.

"A number of bridges in the county have been reported washed out or partially damaged, and many of the secondary road bridges have been affected.

"There was a severe threat last night when the water rose to 61 inches in the engine room, 52 inches higher than the nine inches of 1924 when the city was thrown into darkness.

"Only the third and fourth floor workers were at their regular jobs at the woolen mills today, after a flood affecting the first and second stories with water five feet deeper 'than any known before.' Workers have been diverted to cleaning up the damage."

Flood of August 1955

From THE DAILY PROGRESS, Charlottesville, Virginia

August 18, 1955

"About five inches of rain fell here between daylight yesterday and 9 a. m. today and the resulting flooded streams have blocked roads and made ponds out of lowlands throughout this area.

"At noon today there was 33 inches of water in the basement of the Charlottesville Woolen Mills, but plant operation had not been stopped. Another two and a half or three feet would put water in the 'finishing room,' lowest part of the plant.

"Moores' Creek water was largely responsible for the flooding of the Woolen Mills basement, as the creek flows into the river within a stone's throw of the plant.

"The swollen waters of Moores' Creek pass close beneath Moores' Creek Bridge on the southeastern edge of the city. Water near here flooded over onto Route 53, cutting off the approach to Monticello for several hours this morning.

"High water from Moores' Creek and the Rivanna River back up across a driveway and parking area at the Charlottesville Woolen Mills, where basements were flooded to a depth of 22 inches by 10:40 a.m. today. Water was still rising at the rate of about a foot at that time."

Flood of August 1969

Torrential rains associated with the remnants of "Hurricane Camille" which passed across the state on the night of August 19-20, 1969 were responsible for the worst natural disaster known in Virginia. Over 150 lives, mostly in the mountainous portion of the state, were lost as a result of flash flooding and mud slides.

In one respect, those on the flood plain at Charlottesville and the remainder of the area studied in this report were fortunate during the "Camille" flood. The main storm center passed some distance to the south of the study area. Consequently, in the Charlottesville area, occupants of the flood plain were not nearly as seriously affected as were those on other streams in the storm's path. Flood stages on Moores Creek, Meadow Creek, and the Rivanna River at Charlottesville were much lower in August 1969 than those experienced in some of the earlier recorded floods. However, downstream on the Rivanna River at Palmyra, the 1969 flood established an all-time record.

In connection with any study of the flood situation on Moores Creek and other streams in and around Charlottesville, it is extremely important to consider the all-time record rainfall of August 1969 in Virginia and its disastrous results. The reason for this is not because flooding in the Charlottesville area during this storm was particularly severe, although flooding here was substantial, but primarily because of the inferences which may be drawn from the occurrence of such an event. For example, had the main storm center passed a few miles to the north of its actual path, some of the heaviest concentrations of rain could have fallen over the Moores Creek watershed and other small drainage basins in the vicinity of Charlottesville. Rainfall amounts totalling as much as 21 inches were recorded about 15 miles south of Charlottesville at Union Mills during the August 1969 storm. With a storm center of this magnitude positioned favorable for maximum catchment within the draingage basin of Moores Creek, it is not difficult to imagine the devastation which could have taken place. Flooding much more severe than that indicated for the Standard Project Flood, as discussed in detail in succeeding paragraphs, would have almost assuredly occurred in the study area.

FUTURE FLOODS

This section of the report discusses the Standard Project Flood and the Intermediate Regional Flood on Moores Creek and some of the hazards of great floods. Floods of the size of the Standard Project Flood represent reasonable upper limits of expected flooding. Those of the size of the Intermediate Regional Flood represent floods that may reasonably be expected to occur more frequently, although they will not be as high or severe as the infrequent Standard Project Flood.

Extremely large floods have been experienced in the past on streams in the general geographical and physiographical region. Heavy storms similar to those causing these floods could occur over the watershed of Moores Creek. In this event, floods would result comparable in size with those experienced on neighboring streams. It is therefore desirable, in connection with any determination of future floods which may occur on Moores Creek, to consider storms and floods that have occurred in the region on watersheds whose topography, watershed cover, and physical characteristics are similar.

DETERMINATION OF INTERMEDIATE REGIONAL FLOOD

The Intermediate Regional Flood is defined as one having an average frequency of occurrence of once in 100 years at a designated location, although the flood may occur in any year. Ideally, probability estimates are based on statistical analysis of streamflow records available for the watershed under study. However, on numerous streams, as on Moores Creek, lack of adequate record requires that frequency estimates be determined by indirect methods. A commonly used method involves the application of rainfall runoff amounts to a synthetic graph (unit-hydrograph). Results are generally checked for reasonableness by appropriate comparison with more reliable values determined for watersheds in the "general region" of the area under study. The above described technique was used to determine the Intermediate Regional Flood for Moores Creek.

Results of the studies indicate that the Intermediate Regional Flood on Moores Creek would have a peak discharge of 21,000 cubic feet per second at the mouth of the stream, and 5,800 cubic feet per second at the upstream limits of the study area. Table 12 shows flood stages and discharges at various points along the stream which would result from the occurrence of the Intermediate Regional Flood. Figures 6, 7, 8, and 9 show heights that the Intermediate Regional Flood would reach at selected locations along Moores Creek.

TABLE 12

FLOOD STAGES AND DISCHARGES - INTERMEDIATE REGIONAL FLOOD

Location	Distance Above Mouth Moores Creek feet	Stage feet, m.s.l.	Discharge c.f.s.
Virginia Route 20 Bridge	8,650	343.5	20,700
Mouth Biscuit Run	24,270	386.8	9,900 (a)
Virginia Route 631 Bridge	24,850	387.7	10,700
Old U. S. Route 29	39,750	450.1	5,800

(a) Includes Biscuit Run drainage basin only.

DETERMINATION OF STANDARD PROJECT FLOODS

Only in rare instances has a specific stream experienced the largest flood that is likely to occur. Severe as the maximum known flood may have been on any given stream, it is a commonly accepted fact that, in practically all cases, sooner or later a larger flood can and probably will occur. The Corps of Engineers, in cooperation with the Weather Bureau, has made comprehensive studies based on the vast records of experienced storms and floods, and has evolved generalized procedures for estimating the flood potential of streams. These procedures have been used in determining the Standard Project Flood for the study area. It is defined as the largest flood that can be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical region involved. Table 13 which follows, is a tabulation of the maximum heights of water and discharges which would occur during the Standard Project Flood. Figures 6, 7, 8 and 9 show heights which the Standard Project Flood would reach at selected locations in the study area.

TABLE 13

FLOOD STAGES AND DISCHARGES - STANDARD PROJECT FLOOD

Location	Distance Above Mouth feet	Stage feet, m.s.l.	Discharge c.f.s.
Virginia Route 20 Bridge	8,650	348.7	28,250
Mouth Biscuit Run	24,270	389.3	13,100 (a)
Virginia Route 631 Bridge	24,850	390.0	14,200
Old U. S. Route 29	39,750	451.1	7,650

(a) Includes Biscuit Run drainage basin only.

Frequency

It is not practical to assign a frequency to the Standard Project Flood. The occurrence of such a flood would be a rare event; however, it could occur in any year.

Possible Larger Floods

Floods larger than the Standard Project Flood are possible; however, the combination of factors that would be necessary to produce such floods would rarely occur. Consideration of floods of this magnitude is important in cases where the consequences of flooding would be disastrous, or, otherwise, not acceptable under any circumstances.

Sewage Disposal Plant

Albemarle Livestock Market

Figure 6. FLOOD HEIGHTS

Commercial Property on Monticello Road

Avon Street Bridge (Va. Route 742)

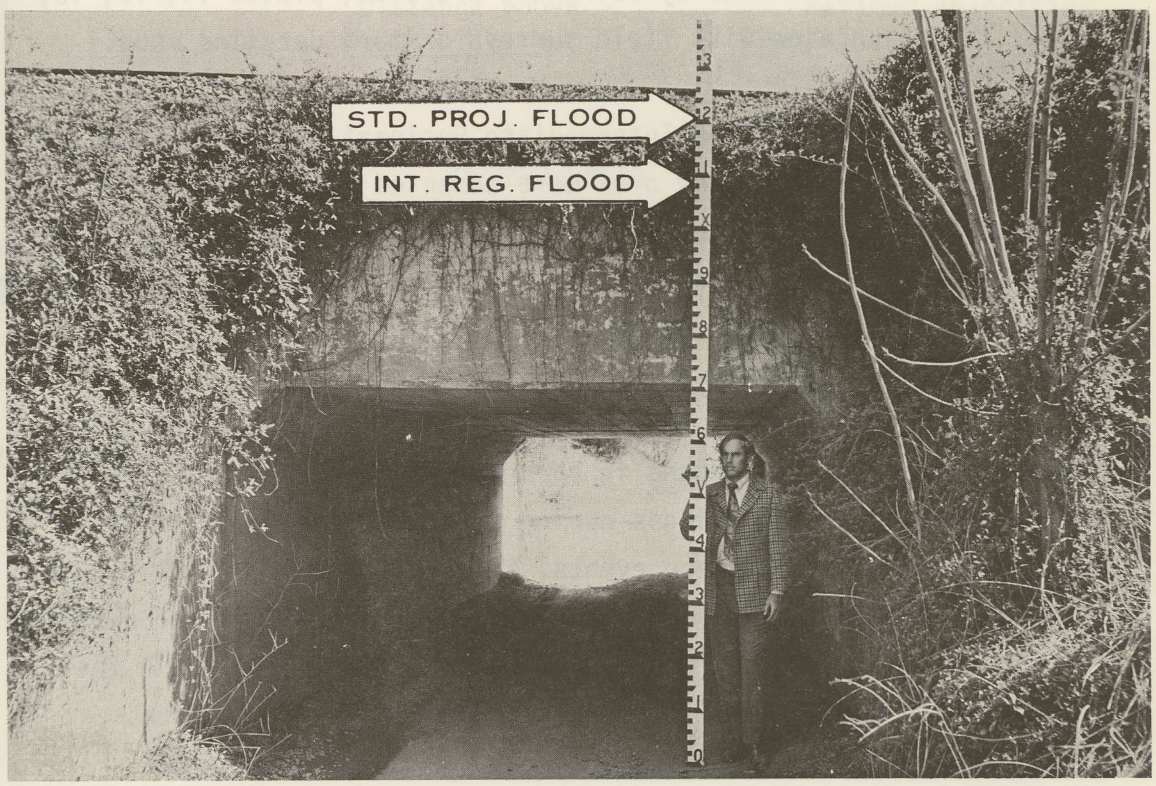
Figure 7. FLOOD HEIGHTS

Bridge over Biscuit Run just upstream from its
confluence with Moores Creek. (O'Neill Enterprises)

Va. Route 631 Bridge

Figure 8. FLOOD HEIGHTS

Va. Route 859 at Southern Railway



Sunset Avenue Bridge (Va. Route 781)

Figure 9. FLOOD HEIGHTS

HAZARDS OF GREAT FLOODS

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

Areas Flooded and Heights of Flooding

The area along Moores Creek that would be flooded by the Standard Project Flood and the Intermediate Regional Flood is shown on plates 6, 7, 8, 9, 10, 11, 12, and 13. The actual limits of these overflow areas on the ground may vary somewhat from those shown on the maps because the large contour interval and scale of the maps do not permit precise plotting of the flooded areas. More exact determination can be made by using the profiles, plates 14, 15, 16, and 17 in conjunction with field surveys or more detailed maps.

Profiles for the Intermediate Regional Flood and Standard Project Flood for the study area were computed using stream characteristics determined from topographic maps, valley cross sections, and field inspections. Typical valley cross sections used in the study are shown for selected locations on plates 18 and 19.

The profiles of the Standard Project Flood and the Intermediate Regional Flood depend in part upon the degree of destruction or clogging of various bridges during the flood. Because it is impossible to forecast these events, it was assumed that all bridge structures would stand, and that no clogging would occur. The Standard Project Flood profile for Moores Creek would vary from 2 to 8 feet higher than the Intermediate Regional Flood in the study area.

Velocities, Rates of Rise, and Duration

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

Table 14 lists the maximum velocities that would occur in the main channel and overbank area of Moores Creek and Biscuit Run during the Intermediate Regional and Standard Project Floods.

TABLE 14

INTERMEDIATE REGIONAL AND STANDARD PROJECT FLOODS, MAXIMUM VELOCITIES

Flood	Distance Above Mouth of Stream feet	Maximum Velocities Channel ft. per sec.	Maximum Velocities Overbank ft. per sec.
MOORES CREEK			
Intermediate Regional	17,550	14	5
Standard Project	17,550	15	6
BISCUIT RUN			
Intermediate Regional	15,200	10	4
Standard Project	15,200	11	5

The rate of rise and duration of flooding depend largely on the time required for floodwaters to concentrate in the area and on the duration of flood-producing rainfall.

Table 15 indicates for the Intermediate Regional and Standard Project Floods the time required for the floods to rise to maximum height and the duration above bankfull stage.

TABLE 15

INTERMEDIATE REGIONAL AND STANDARD PROJECT FLOODS, RATES OF RISE, AND DURATION MOORES CREEK (a)

Flood	Height of Rise feet	Time of Rise hour	Maximum Rate of Rise feet per hr	Duration Above Bankfull hours
Intermediate Regional	22	14	3.3	10
Standard Project	25	20	2.7	15

(a) As determined 23,200 feet above the mouth of Moores Creek.

The rapid rates of rise and high stream velocities, shown in tables 14 and 15 in combination with deep, fairly long-duration flooding, would create a hazardous situation in developed areas. Velocities greater than three feet per second combined with depths of three feet or greater are generally considered hazardous.

GLOSSARY OF TERMS

BANKFULL STAGE. The stage or elevation above which extensive overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

* * *

ELEVATION. As used herein refers to height in feet above mean sea level datum (USGS Supplemental Adjustment 1936).

* * *

FLOOD. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in stream flow or stage but not the ponding of surface water that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased stream flow and other problems.

* * *

FLOOD CREST. The maximum stage or elevation reached by the waters of a flood at a given location.

FLOOD PEAK. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest.

* * *

FLOOD PLAIN. The relatively flat area or low lands adjoining the channel of a river, stream or watercourse or ocean, lake, or other body of standing water which has been or may be covered by flood water.

* * *

FLOOD PROFILE. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

* * *

FLOOD STAGE. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

* * *

HEAD LOSS. The effect of obstructions, such as narrow bridge openings or buildings that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

INTERMEDIATE REGIONAL FLOOD. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the "general region of the watershed."

* * *

LEFT BANK. The bank on the left side of a river, stream, or watercourse, looking downstream.

* * *

LOW STEEL (OR UNDERCLEARANCE). See "underclearance."

* * *

NORMAL WATER SURFACE. The elevation of the water surface on a stream at times other than during drought or flooding. In this report, it is the elevation obtained by field surveys.

* * *

RIGHT BANK. The bank on the right side of a river, stream, or watercourse, looking downstream.

* * *

STANDARD PROJECT FLOOD. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Such floods as used by the Corps of Engineers are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

* * *

<u>TIME OF CONCENTRATION</u>. The flow time from the most remote point in the drainage area to the point in question.

* * *

<u>UNDERCLEARANCE</u>. The lowest point of a bridge or other structure over or across a river, a stream, or watercourse that limits the opening through which water flows. This is referred to as "low steel" in some regions.

A U T H O R I T Y

PUBLIC LAW. This report has been prepared in accordance with the authority granted by Section 206 of the Flood Control Act of 1960 (PL 86-645), as amended.

A C K N O W L E D G E M E N T

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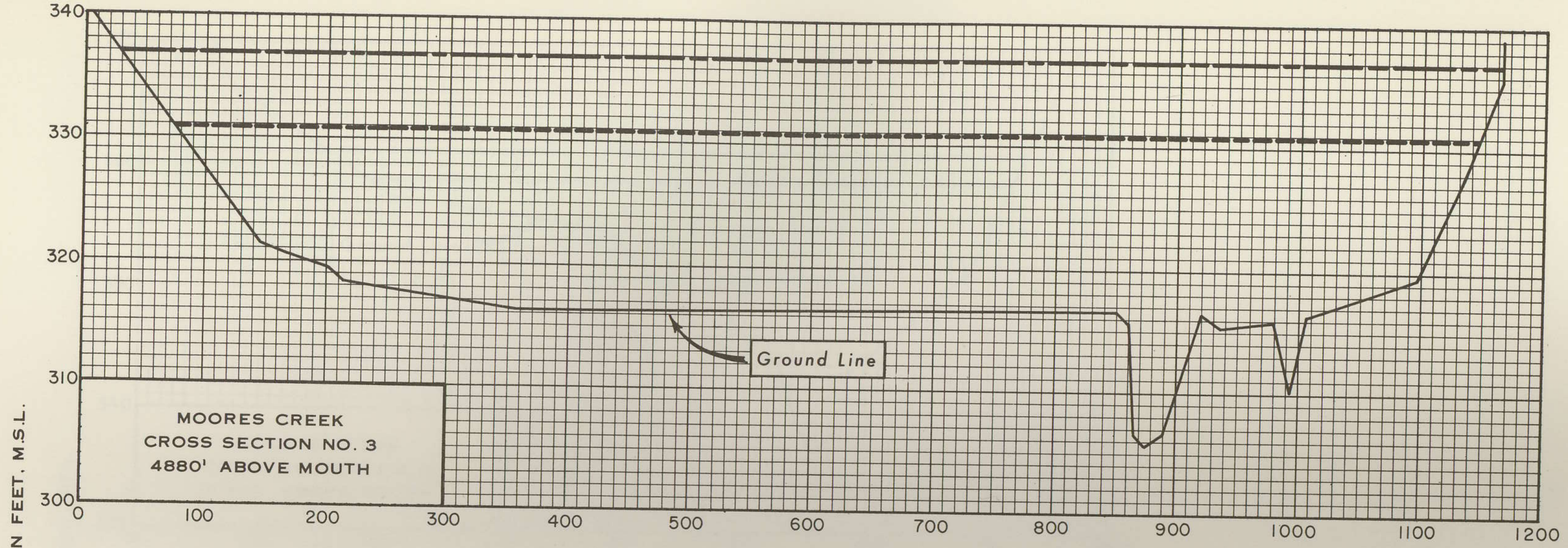
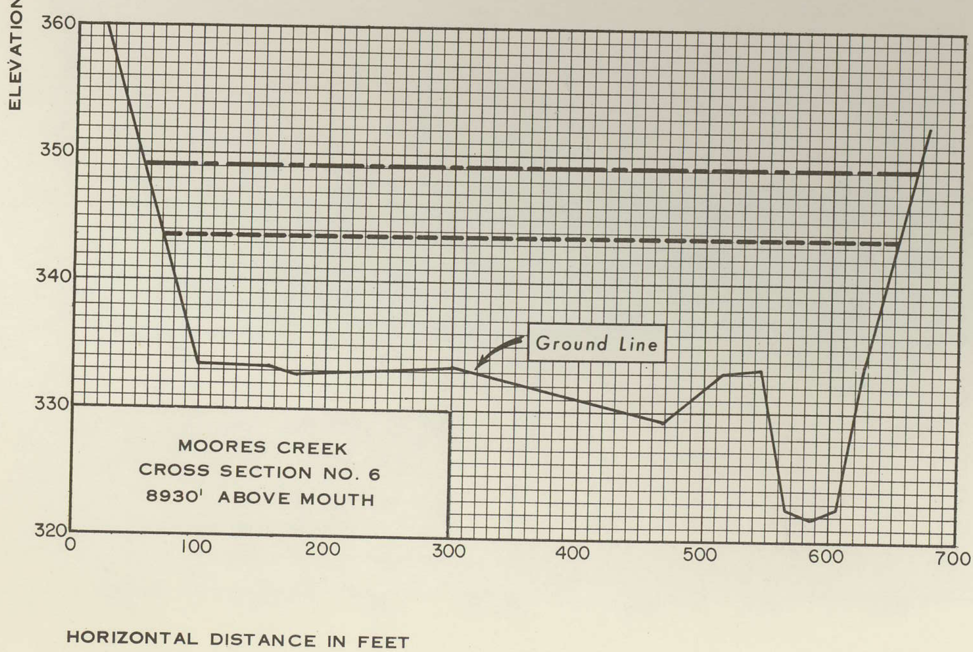
MRS. MARY T. CHERRY

OTHER AGENCIES. Assistance and cooperation of the United States Weather Bureau, United States Geological Survey, Virginia Department of Highways, The Daily Progress, the City of Charlottesville, Albemarle County and private citizens in supplying useful data are appreciated.





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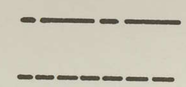


STANDARD PROJECT FLOOD

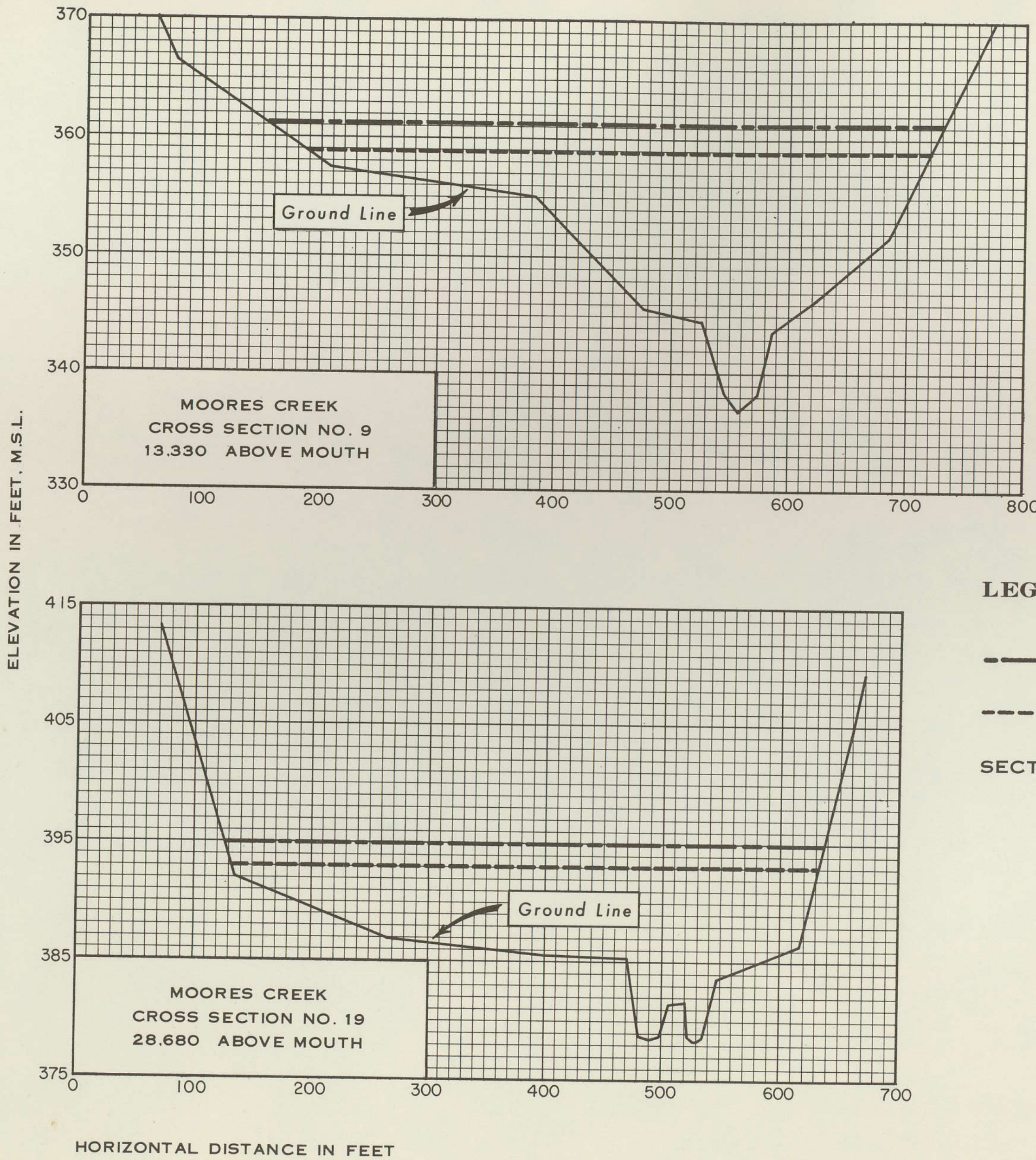
INTERMEDIATE REGIONAL FLOOD

SECTIONS TAKEN LOOKING DOWNSTREAM

CORPS OF ENGINEERS, U.S.ARMY
NORFOLK, VIRGINIA, DISTRICT

CROSS SECTIONS

MOORES CREEK, VIRGINIA



LEGEND

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- - - - - - - INTERMEDIATE REGIONAL FLOOD

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NORFOLK DISTRICT