Floods on Elk River and Whitehead, Shawneehaw, Hanging Rock, Horse Bottom, and Sugar Creeks in the Vicinity of Banner Elk, North Carolina

FLOOD REPORT
TVA/ONRED/AWR 85/27
SEPTEMBER 1985

Tennessee Valley Authority

TENNESSEE VALLEY AUTHORITY

Office of Natural Resources and Economic Development

FLOODS ON ELK RIVER AND WHITEHEAD, SHAWNEEHAW, HANGING ROCK, HORSE BOTTOM, AND SUGAR CREEKS IN THE VICINITY OF BANNER ELK, NORTH CAROLINA

Flood Report

TVA/ONRED/AWR-85/27

Knoxville, Tennessee

September 1985

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FLOODS ON ELK RIVER AND WHITEHEAD, SHAWNEEHAW, HANGING ROCK, HORSE BOTTOM, AND SUGAR CREEKS IN THE VICINITY OF BANNER ELK, NORTH CAROLINA

INTRODUCTION

This flood hazard information report describes the extent and severity of the flood potential along selected reaches of the Elk River and Whitehead, Shawneehaw, Hanging Rock, Horse Bottom, and Sugar Creeks in the vicinity of Banner Elk, North Carolina. This report was prepared by TVA's Floodplain Management Program in response to a request by the town for up-to-date information regarding the flood potential along the studied stream reaches in order to better administer its floodplain management program.

This report does not propose plans for the solution of identified flood problems along the studied stream reaches. Rather, the information and technical data contained herein are intended to provide a sound basis for informed decisions regarding the wise use of flood-prone lands within the town of Banner Elk and the surrounding portion of Avery County for those stream reaches covered by this report.

STUDY AND SCOPE

This report describes the flood situation along Elk River above Mill Pond in Banner Elk from stream mile 25.84 to stream mile 27.96. Downstream from Mill Pond, the Elk River flows through a gorge within most of the corporate limits. Downstream from the corporate limits, the

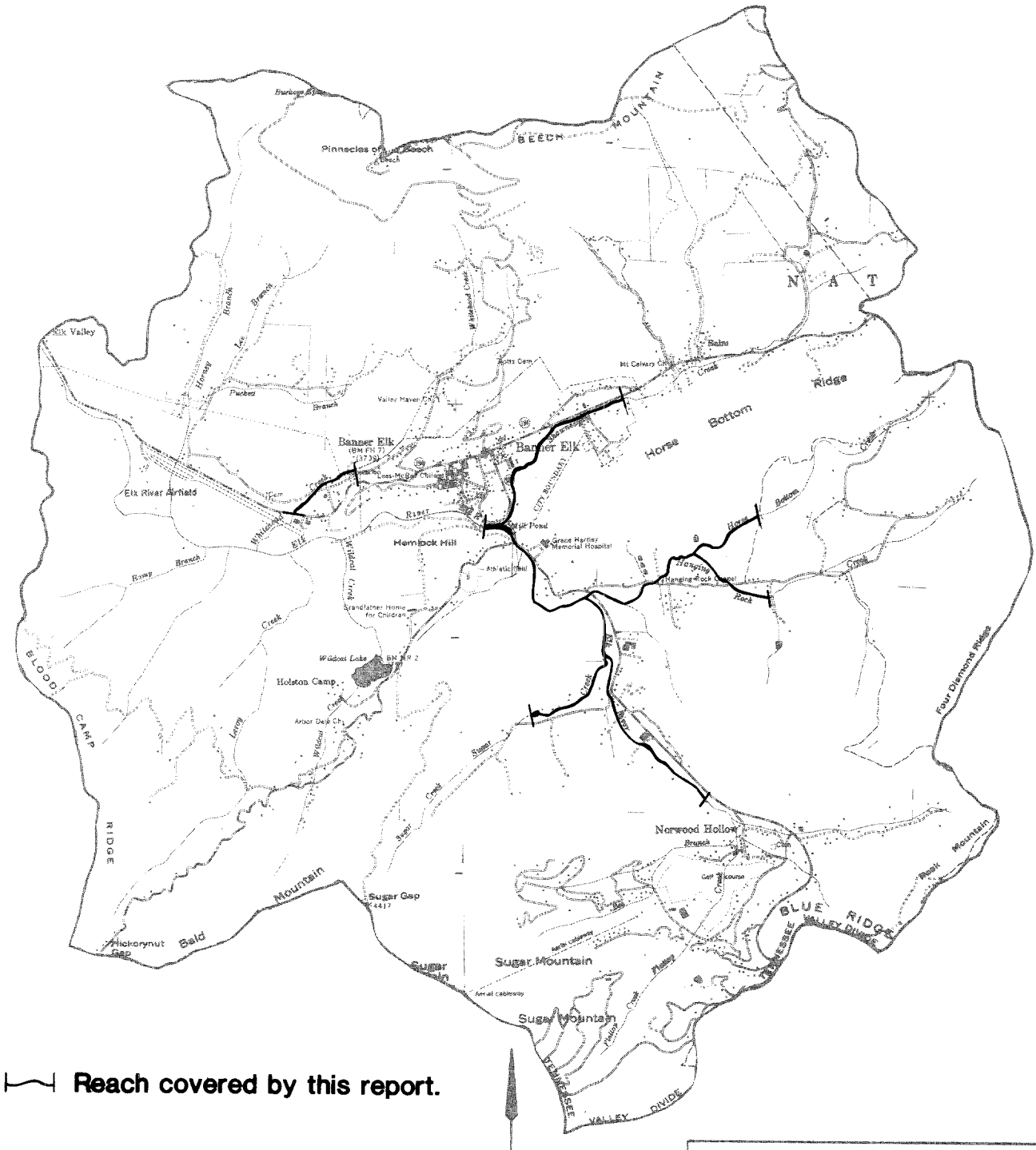
Elk River flows through the Elk River Club and golf course. Since potential development along this stream reach is limited, the reach was not studied.

Tributaries studied include Whitehead Creek from stream mile 0.29 at North Carolina Highway 194 to stream mile 0.75, Shawneehaw Creek from stream mile 0.12 to stream mile 0.97, Hanging Rock Creek from its mouth at Elk River to stream mile 1.17, Horse Bottom Creek from its mouth at Hanging Rock Creek to stream mile 0.39, and Sugar Creek from its mouth at Elk River to stream mile 0.48. Below mile 0.12, Shawneehaw Creek flows through a gorge. Because potential development along this stream reach is limited, the reach was studied by approximate methods. The vicinity map (plate 1) shows the stream reaches covered by this report.

The user of this report is cautioned that the information contained herein was developed to demonstrate the extent and severity of flood hazards along specific stream reaches. It does not imply that flooding will not occur on other stream reaches not studied in this report or that floods larger than those discussed will not occur. Flooding may occur along any stream or watercourse at any time. Floods larger than those discussed are possible and may occur infrequently. These flood risks should be considered by all users of this report.

WATERSHED DESCRIPTION

The Elk River is a tributary of the Watauga River at mile 46.83 and drains an area of 82.8 square miles. At the former United States Geological Survey (USGS) stream gage (about one mile west of Banner Elk)


BEECH MOUNTAIN
Pinnacles of Beech
N A T
Elk Valley
Horsepasture River
Lee Branch
Packers Branch
Whitehead Creek
Valley Haven Ch
Mt Calvary Ch
Balms
Ridge
Horse Bottom
Banner Elk
Banner Elk
Elk River Airfield
Elk River
Whitehead Creek
Wildcat Creek
Hemlock Hill
Mill Pond
Grace Hanley Memorial Hospital
Athletic Field
Grandfather Home for Children
Wildcat Lake
Holston Camp
Arbor Dale Ch
Laurel Creek
Sugar Creek
Four Diamond Ridge
BLOOD CAMP RIDGE
Norwood Hollow Branch
Golf Course
Sugar Gap 4417
Hickorynut Gap
Bald Mountain
Sugar Mountain
Sugar Mountain
Sugar Mountain
Rock Mountain
BLUE RIDGE
TENNESSEE VALLEY DIVIDE
Reach covered by this report.
N
ELK RIVER WATERSHED
SCALE 0 2000 4000 FEET
AUGUST 1985

the drainage area is 17.8 square miles, and above the confluence of Shawneehaw Creek the drainage area is 7.94 square miles. Above Banner Elk the watershed is roughly fan-shaped with a maximum length of about 3 miles and a maximum width of about 4 miles. The northern watershed boundary is Beech Mountain where elevations range up to 5440 feet. The southeast watershed boundary is the Tennessee Valley Divide with elevations ranging between 4500 and 5000 feet. The valley floor has an average elevation of about 3700 feet. (Elevations are feet above mean sea level, USC&GS 1936 Supplementary Adjustment.)

Pertinent information concerning the tributaries is shown below in Table 1.

Table 1

Pertinent Tributary Watershed Features

Stream	Mouth at Elk River Mile	Drainage Area (Sq. Miles)	Watershed Elevation Range (feet)	Approximate Slope of Reach Studied (Feet/Mile)
Whitehead Creek	24.62	1.44	3400/5440	195
Shawneehaw Creek	25.92	3.17	3610/5360	95
Hanging Rock Creek	26.64	3.08	3670/5200	75
Horse Bottom Creek	0.71*	0.84	3680/4640	85
Sugar Creek	27.02	1.14	3670/5200	90

*Mouth at Hanging Rock Creek

The town of Banner Elk and Avery County are experiencing development pressure due to rapid growth in tourism. Long known as a summer resort area, the tourist season has been extended year round with

the opening of ski resorts on Beech Mountain and Sugar Mountain. A third ski resort is planned for the Hanging Rock Creek watershed. To the west of Banner Elk, Elk River flows through the Elk River Club, a private golf and resort complex which borders the mile-long runway of Elk River Airport.

The central business district of Banner Elk is generally located on higher ground outside of the floodplain. However, along North Carolina Highway 184 southeast of Banner Elk, commercial strip development is taking place, much of which is in the Elk River and Sugar Creek floodplains. A portion of the athletic field at Lees-McRae Junior College is located in the Elk River floodplain, but the main campus is located well above the floodplain.

Along Shawneehaw Creek the area is primarily residential in the upper study reach and a mix of commercial and residential development along the lower reach. The stream flows along the edge of the central business district and through a small pond before crossing under North Carolina Highway 184 into Mill Pond. The town of Banner Elk is building a new town hall on the right bank at approximately stream mile 0.4.

Whitehead Creek enters the Elk River at mile 24.62. It flows under the airport runway and North Carolina Highway 194 through a 370-foot culvert and a 50-foot culvert, respectively. Development in the upper reach of the study area is primarily residential. The Mountain Electric Cooperative has a substation on the left bank at approximately stream mile 0.59.

Hanging Rock Creek and its principal tributary, Horse Bottom Creek, flow through primarily agricultural and undeveloped land. Present (1985) plans for development include several resort complexes including a ski slope, which will be limited to higher ground along the ridges.

REVIEW OF HISTORIC FLOODS

The developed portion of the town of Banner Elk is generally located on higher ground and past floods have occurred on lower undeveloped lands. However, this previously undeveloped land is now undergoing rapid development.

Documentation of the flood history in Banner Elk is sparse. Floods that have occurred in the past in the vicinity of Banner Elk have generally been widespread throughout western North Carolina, and damages in Banner Elk have received little coverage by the press.

The USGS maintained a stream gage near Banner Elk from 1935-1940 and a stream gage near Elk Park from 1935-1955.

A large flood occurred in the area in May 1901 which was known as the "May Tide." The heaviest rainfall from the storm was centered in the Cane Creek watershed near Bakersville in Mitchell County. An unofficial record at Cranberry (5-1/2 miles southwest of Banner Elk) reported a total of 8 inches in 12 hours. In July 1916 a storm which resulted from a hurricane caused widespread flooding over the area. The highest rainfall occurred along the Blue Ridge Mountains. At Altapass, 22.2 inches of rainfall were recorded in a 24-hour period.

A large flood in mid-August 1940 is remembered by local residents as the largest flood known to have occurred. This flood also

resulted from a tropical storm which moved inland. The storm is noted for the number of "breakouts," where water trapped under the soil breaks out on the side of the hill causing a mud slide. One slide in the Shawneehaw Creek watershed carried away a house, resulting in at least one fatality. A resident remembers the August 1940 flood on the Elk River as being from 6 to 12 inches deep on North Carolina Highway 184 near the present Holiday Inn. The highway has since been raised by about 12 to 18 inches.

The most recent floods that have occurred in the vicinity of Banner Elk include those of May 1973 and November 1977. A resident remembers the May 1973 flood as larger than the one of November 1977. During the flood of 1977, water from Shawneehaw Creek entered the ABC Store as well as a grocery store in the vicinity of stream mile 0.75. No information is available concerning the flood history of the remaining study streams.

COMPUTED FLOODS

To assist the town of Banner Elk in administering its floodplain management program, flood discharges and elevations have been computed for the 10-, 50-, 100-, and 500-year floods. Approximate floodplain boundaries have been determined for the 100- and 500-year floods.

HYDROLOGY

Computed flood discharges for the study streams are based on the analysis of stream gage records from similar watersheds in the region.

All stream gage analyses followed standard procedures outlined in "Guidelines for Determining Flood Flow Frequency" (reference 1). Discharge estimates based on records from both the Elk River near Banner Elk and Elk River near Elk Park stream gages supported use of the regional relationships.

Ten-Year Flood

The 10-year flood is defined as the flood which has 1 chance in 10 (10 percent) of being equaled or exceeded in any given year. In a normal 30-year home mortgage period, there is a 96-percent chance of its occurrence. The 10-year flood, based on current watershed and channel conditions, would crest about 1 foot above the top of banks along the Elk River. Information on the 10-year flood is provided because State of North Carolina regulations require that on-site waste disposal systems (septic tanks and drainfields) be located above the 10-year flood elevation.

Fifty-Year Flood

The 50-year flood is defined as the flood which has 1 chance in 50 (2 percent) of being equaled or exceeded in any given year. In a normal 30-year home mortgage period, there is a 45-percent chance of its occurrence. The 50-year flood, based on current watershed and channel conditions, would crest about 1 to 2 feet above the top of banks along the Elk River.

One Hundred-Year Flood

The 100-year flood is defined as the flood which has 1 chance in 100 (1 percent) of being equaled or exceeded in any given year. In a normal 30-year home mortgage period, there is a 26-percent chance of its occurrence. The 100-year flood, based on current watershed and channel conditions, would crest about 2 feet above the top of banks along the Elk River. The 100-year flood is the minimum standard required by the Federal Emergency Management Agency for floodplain management purposes for those communities participating in the National Flood Insurance Program.

Five Hundred-Year Flood

Although the 500-year flood may occur at any time, it is a relatively rare event with 1 chance in 500 (0.2 percent) of being equaled or exceeded in any given year. In a normal 30-year home mortgage period there is a about a 6-percent chance of its occurrence. The 500-year flood, based on current watershed and channel conditions, would crest about 2 to 3 feet above the top of banks along the Elk River. The 500-year flood level is provided as a guide for planning community and industrial development in those instances where a greater degree of protection from flooding must be provided. In planning for floodplain development, TVA strongly recommends that the effects of a 500-year or higher flood be explicitly considered and minimized to the fullest extent practicable.

HYDRAULICS

The hydraulic characteristics of the Elk River and Whitehead, Shawneehaw, Hanging Rock, Horse Bottom, and Sugar Creeks were analyzed using the U.S. Army Corps of Engineers HEC-2 backwater program (reference 2) to provide estimates of the 10-, 50-, 100-, and 500-year flood elevations at selected cross sections. These cross sections were field surveyed at bridges and other selected locations to define the floodplains of these streams. Locations of selected cross sections used in the hydraulic analyses are shown on the flooded area maps (plates 2-5).

The computed flood elevations for the 10-, 100-, and 500-year floods at the cross sections were plotted on a graph at the stream mile locations of the cross sections and joined by straight lines to create flood profiles (plates 6-12). The elevations shown are in feet above mean sea level, and the stream miles are measured from the mouth upstream along the stream channel. Tabulations of the 10-, 50-, 100-, and 500-year flood elevations and discharges for each cross section location along the studied stream reaches are given in Tables 2-7.

The computed flood elevations are based on the assumption that bridges and other hydraulic structures remain open and unobstructed. The accumulation of debris in bridges and culvert openings during times of flooding may increase the flood levels above those shown on the flood profiles.

The flooded area maps (plates 2-5) show the areas that would be inundated by the 100- and 500-year floods. Using the flood profiles and topographic maps (40-foot contour interval), the flood elevations were

Table 2

ELK RIVER PROFILE TABULATION

Cross Section		10-Year Flood		50-Year Flood		100-Year Flood		500-Year Flood	
		Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]
No.	Mile	(cfs)	(feet)	(cfs)	(feet)	(cfs)	(feet)	(cfs)	(feet)
1	25.84 US[a]	1,900	3641.2	3,340	3642.6	4,120	3643.1	6,420	3644.3
2	25.87	1,850	3641.3	3,255	3642.7	4,015	3643.3	6,255	3644.6
3	26.03 DS[a]	1,590	3642.9	2,795	3644.6	3,450	3645.3	5,365	3646.9
3	26.03 US	1,590	3643.6	2,795	3646.0	3,450	3646.8	5,365	3648.3
4	26.15	1,400	3644.3	2,450	3646.6	3,010	3647.4	4,660	3649.1
5	26.35	1,400	3646.8	2,450	3648.4	3,010	3649.0	4,660	3650.5
*	26.50	1,400	3650.1	2,450	3651.1	3,010	3651.6	4,660	3652.8
6	26.60	1,400	3652.3	2,450	3653.4	3,010	3653.8	4,660	3654.9
7	26.75	1,400	3659.6	2,450	3660.9	3,010	3661.4	4,660	3662.5
8	26.93	940	3671.0	1,630	3671.8	1,990	3672.2	3,050	3672.9
*	26.95	940	3674.9	1,630	3676.7	1,990	3677.1	3,050	3677.6
*	27.00	940	3678.4	1,630	3679.3	1,990	3679.5	3,050	3680.2
9	27.08 DS	660	3682.2	1,130	3683.4	1,380	3683.8	2,100	3684.5
9	27.08 US	660	3683.1	1,130	3684.4	1,380	3684.9	2,100	3685.8
*	27.21	660	3688.2	1,130	3689.4	1,380	3689.9	2,100	3691.1
10	27.22 DS	660	3689.2	1,130	3690.6	1,380	3691.2	2,100	3692.8
10	27.22 US	660	3690.6	1,130	3692.0	1,380	3692.6	2,100	3694.7
*	27.26	660	3694.7	1,130	3695.5	1,380	3695.7	2,100	3696.6
*	27.33	660	3699.2	1,130	3700.3	1,380	3700.9	2,100	3701.8
11	27.34 DS	660	3701.8	1,130	3702.4	1,380	3702.4	2,100	3703.1
11	27.34 US	660	3701.9	1,130	3703.6	1,380	3704.0	2,100	3704.7
12	27.43	660	3710.4	1,130	3711.2	1,380	3711.5	2,100	3712.5

*Section not shown on flooded area maps or flood profiles.

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a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 2

ELK RIVER PROFILE TABULATION

(Continued)

Cross Section No.	Mile	10-Year Flood Discharge[b] (cfs)	10-Year Flood Elevation[c] (feet)	50-Year Flood Discharge[b] (cfs)	50-Year Flood Elevation[c] (feet)	100-Year Flood Discharge[b] (cfs)	100-Year Flood Elevation[c] (feet)	500-Year Flood Discharge[b] (cfs)	500-Year Flood Elevation[c] (feet)
13	27.52 DS[a]	660	3718.2	1,130	3720.0	1,380	3720.6	2,100	3721.1
13	27.52 US[a]	660	3721.1	1,130	3721.9	1,380	3722.0	2,100	3723.3
*	27.54	660	3722.3	1,130	3723.4	1,380	3724.0	2,100	3724.8
*	27.60	660	3729.5	1,130	3731.0	1,380	3731.5	2,100	3732.8
*	27.74	660	3751.3	1,130	3752.3	1,380	3753.7	2,100	3754.6
14	27.75 DS	660	3752.6	1,130	3754.6	1,380	3755.0	2,100	3755.9
14	27.75 US	660	3756.7	1,130	3757.3	1,380	3757.5	2,100	3758.1
15	27.96	660	3777.3	1,130	3778.4	1,380	3778.9	2,100	3780.0

*Section not shown on flooded area maps or flood profiles.

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a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 3

WHITEHEAD CREEK PROFILE TABULATION

Cross Section		10-Year Flood		50-Year Flood		100-Year Flood		500-Year Flood	
		Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]
No.	Mile	(cfs)	(feet)	(cfs)	(feet)	(cfs)	(feet)	(cfs)	(feet)
2	0.29 DS[a]	440	3429.0	750	3435.8	920	3436.4	1,370	3437.7
2	0.29 US[a]	440	3430.8	750	3435.8	920	3436.5	1,370	3437.7
*	0.31	440	3432.8	750	3435.9	920	3436.5	1,370	3437.8
*	0.42	440	3450.4	750	3451.4	920	3451.9	1,370	3453.2
3	0.44 DS	440	3452.6	750	3453.8	920	3454.3	1,370	3455.2
3	0.44 US	440	3456.2	750	3456.7	920	3456.9	1,370	3457.4
*	0.47	440	3456.8	750	3457.4	920	3457.6	1,370	3458.2
*	0.52	440	3471.2	750	3472.4	920	3472.7	1,370	3473.1
*	0.55	440	3479.2	750	3480.4	920	3480.6	1,370	3481.1
4	0.65	440	3498.7	750	3499.3	920	3499.8	1,370	3500.4
5	0.75	440	3522.8	750	3523.5	920	3524.0	1,370	3524.4

*Section not shown on flooded area maps or flood profiles.

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a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 4

SHAWNEEHAW CREEK PROFILE TABULATION

Cross Section No.	Mile	10-Year Flood Discharge[b] (cfs)	10-Year Flood Elevation[c] (feet)	50-Year Flood Discharge[b] (cfs)	50-Year Flood Elevation[c] (feet)	100-Year Flood Discharge[b] (cfs)	100-Year Flood Elevation[c] (feet)	500-Year Flood Discharge[b] (cfs)	500-Year Flood Elevation[c] (feet)
1	0.12 US[a]	770	3667.0	1,320	3668.0	1,620	3668.3	2,450	3668.9
2	0.16	770	3667.1	1,320	3668.1	1,620	3668.4	2,450	3669.2
3	0.31	750	3677.9	1,300	3678.2	1,580	3678.4	2,400	3678.8
4	0.40	740	3683.5	1,280	3684.1	1,570	3684.3	2,370	3684.9
5	0.52	730	3693.0	1,260	3693.3	1,540	3693.5	2,340	3693.9
6	0.59	720	3699.1	1,250	3699.8	1,530	3700.1	2,320	3700.9
6A	0.68	720	3705.7	1,250	3706.5	1,530	3706.9	2,320	3707.8
7	0.72 DS[a]	680	3714.1	1,160	3715.3	1,410	3715.4	2,150	3716.0
7	0.72 US	680	3716.1	1,160	3716.7	1,410	3716.9	2,150	3717.5
8	0.78 DS	670	3720.5	1,150	3721.5	1,400	3721.9	2,130	3723.0
8	0.78 US	670	3724.2	1,150	3724.8	1,400	3725.0	2,130	3725.5
8B	0.83 DS	670	3725.5	1,150	3727.0	1,400	3727.6	2,130	3729.0
8B	0.83 US	670	3730.4	1,150	3730.9	1,400	3731.1	2,130	3731.6
8A	0.87 DS	670	3730.5	1,150	3731.0	1,400	3731.1	2,130	3732.2
8A	0.87 US	670	3731.1	1,150	3732.5	1,400	3733.1	2,130	3734.8
9	0.97 DS	650	3745.6	1,120	3746.4	1,370	3746.7	2,080	3747.3
9	0.97 US	650	3747.9	1,120	3748.4	1,370	3748.6	2,080	3749.1

a. Downstream and upstream at bridges and dams.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 5

HANGING ROCK CREEK PROFILE TABULATION

Cross Section		10-Year Flood		50-Year Flood		100-Year Flood		500-Year Flood	
		Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]
No.	Mile	(cfs)	(feet)	(cfs)	(feet)	(cfs)	(feet)	(cfs)	(feet)
*	0.00[a]	-	3654.2	-	3655.4	-	3655.8	-	3656.9
1	0.04 DS[b]	755	3654.2	1,300	3655.6	1,590	3657.3	2,420	3657.9
1	0.04 US[b]	755	3658.9	1,300	3660.9	1,590	3661.4	2,420	3662.5
*	0.06	750	3658.9	1,295	3660.9	1,580	3661.4	2,410	3662.5
*	0.20	730	3660.2	1,260	3661.3	1,540	3661.7	2,350	3662.7
2	0.30	715	3663.4	1,235	3663.7	1,510	3663.9	2,300	3664.5
3	0.44 DS	695	3668.3	1,195	3668.8	1,470	3668.9	2,335	3669.3
3	0.44 US	695	3671.2	1,195	3672.1	1,470	3672.3	2,335	3672.8
*	0.45	695	3671.2	1,195	3672.1	1,470	3672.4	2,335	3672.9
*	0.60	695	3675.6	1,195	3676.5	1,470	3676.8	2,335	3677.6
*	0.66	665	3681.9	1,140	3682.4	1,400	3682.6	2,125	3683.1
4	0.67 DS	665	3682.7	1,140	3683.1	1,400	3683.3	2,125	3683.7
4	0.67 US	665	3683.5	1,140	3684.0	1,400	3684.2	2,125	3684.6
*	0.71	665	3684.8	1,140	3685.2	1,400	3685.4	2,125	3685.9
5	0.82	490	3694.0	840	3694.4	1,030	3694.6	1,540	3695.0
*	0.95	490	3710.2	840	3711.1	1,030	3711.2	1,540	3711.7
6	0.96 DS	490	3711.4	840	3712.0	1,030	3712.3	1,540	3713.0
6	0.96 US	490	3712.8	840	3713.5	1,030	3713.7	1,540	3714.1
*	0.98	490	3712.9	840	3713.6	1,030	3713.9	1,540	3714.3
*	1.05	490	3718.9	840	3719.8	1,030	3720.0	1,540	3720.5
*	1.10	490	3723.9	840	3724.5	1,030	3724.8	1,540	3725.2
7	1.17	490	3729.8	840	3730.8	1,030	3731.1	1,540	3731.7

*Section not shown on flooded area maps or flood profiles.

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a. Elk River mile 26.64 elevations at the mouth of Hanging Rock Creek.
b. Downstream and upstream at bridges and dams.
c. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
d. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 6

HORSE BOTTOM CREEK PROFILE TABULATION

Cross Section		10-Year Flood		50-Year Flood		100-Year Flood		500-Year Flood	
		Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]	Discharge [b]	Elevation [c]
No.	Mile	(cfs)	(feet)	(cfs)	(feet)	(cfs)	(feet)	(cfs)	(feet)
*	0.00[a]	-	3684.8	-	3685.2	-	3685.4	-	3685.9
1	0.12	300	3691.9	510	3692.2	620	3692.4	910	3692.6
*	0.25	300	3699.1	510	3699.4	620	3699.6	910	3700.0
2	0.39	300	3715.8	510	3716.0	620	3716.2	910	3716.3

*Section not shown on flooded area maps or flood profiles.

a. Hanging Rock Creek mile 0.71 elevations at the mouth of Horse Bottom Creek.
b. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
c. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 7

SUGAR CREEK PROFILE TABULATION

Cross Section		10-Year Flood		50-Year Flood		100-Year Flood		500-Year Flood	
		Discharge[b]	Elevation[c]	Discharge[b]	Elevation[c]	Discharge[b]	Elevation[c]	Discharge[b]	Elevation[c]
No.	Mile	(cfs)	(feet)	(cfs)	(feet)	(cfs)	(feet)	(cfs)	(feet)
*	0.00[a]	-	3679.4	-	3680.3	-	3680.6	-	3681.3
1A	0.05 DS[b]	380	3679.4[a]	630	3680.5	770	3681.1	1,150	3682.2
1A	0.05 US[b]	380	3679.7	630	3680.9	770	3681.6	1,150	3682.7
1	0.10	380	3684.0	630	3684.4	770	3684.7	1,150	3685.2
*	0.18	380	3690.5	630	3691.0	770	3691.2	1,150	3691.9
*	0.26	380	3696.8	630	3697.3	770	3697.5	1,150	3698.0
2	0.27 DS	380	3698.6	630	3698.8	770	3699.1	1,150	3699.4
2	0.27 US	380	3699.0	630	3699.4	770	3699.6	1,150	3700.0
*	0.38	380	3705.1	630	3706.2	770	3706.4	1,150	3706.7
*	0.43	380	3712.3	630	3713.4	770	3713.5	1,150	3713.9
3	0.48	380	3723.1	630	3724.1	770	3724.3	1,150	3724.7

*Section not shown on flooded area maps or flood profiles.

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a. Elk River mile 27.02 elevations at the mouth of Sugar Creek.
b. Downstream and upstream at bridges and dams.
c. Cubic feet per second (cfs) is a measurement of the volume of water flowing past a given point per second.
d. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

transferred from the flood profiles to the corresponding elevation locations on the maps to establish the expected limits of flooding on the ground.

FLOODWAYS

Encroachments in the floodplain such as fill or structures reduce its flood-carrying capacity and increase the risk of flood damage in other areas. In reviewing floodplain development proposals, the economic gain of the proposed development must be compared to the possibility of increased flood damage to both the new development and to existing neighboring developments. However, prohibiting any further floodplain development may be excessively restrictive.

Frequently, the community must decide how much additional floodplain development to allow, what the effect of such development on flood levels will be, and where the development should take place. If the community is participating in the National Flood Insurance Program, it must not allow additional development which will cumulatively increase the existing level of the 100-year flood by more than 1 foot at any point along the stream.

To accommodate some reasonable level of floodplain development, the floodplain can be divided into two separate parts--the floodway and the flood fringe (figure 1). This division recognizes the natural functions of the floodplain. The floodway is the stream channel and that portion of the adjacent floodplain which must remain open and unobstructured to permit safe passage of floodwaters. The floodwaters

flow deepest and swiftest in the floodway, and structures and other uses located in this area are subject to the greatest danger during times of flooding. The remainder of the floodplain is called the flood fringe. Here the water is more shallow and may have little or no movement. Floodwaters in the flood fringe area are being temporarily stored until they can pass downstream. Most communities, therefore, permit development in this portion of the floodplain provided the development is elevated or otherwise protected to the regulatory (usually 100-year) flood level.

While a community may have some flexibility in setting the limits, a floodway must be determined which is capable of accommodating all of the floodwaters which are expected to occupy the entire floodplain area during the occurrence of the regulatory flood. When making this determination, it is assumed that development will be permitted in the remainder of the floodplain (flood fringe area) and the total development of the flood fringe area will ultimately occur, thereby prohibiting the flow of floodwaters through the developed area.

The floodway areas needed to safely pass floodwaters through the community without causing increases in flood heights by more than the National Flood Insurance Program requirement of 1 foot maximum (or to a lesser amount if desired by the community) are determined by engineering calculations and are field checked for reasonableness and accuracy. Once the floodway boundaries are determined and officially designated by local ordinance, total filling or development of the flood-fringe areas will not increase flood levels by more than the previously determined amount

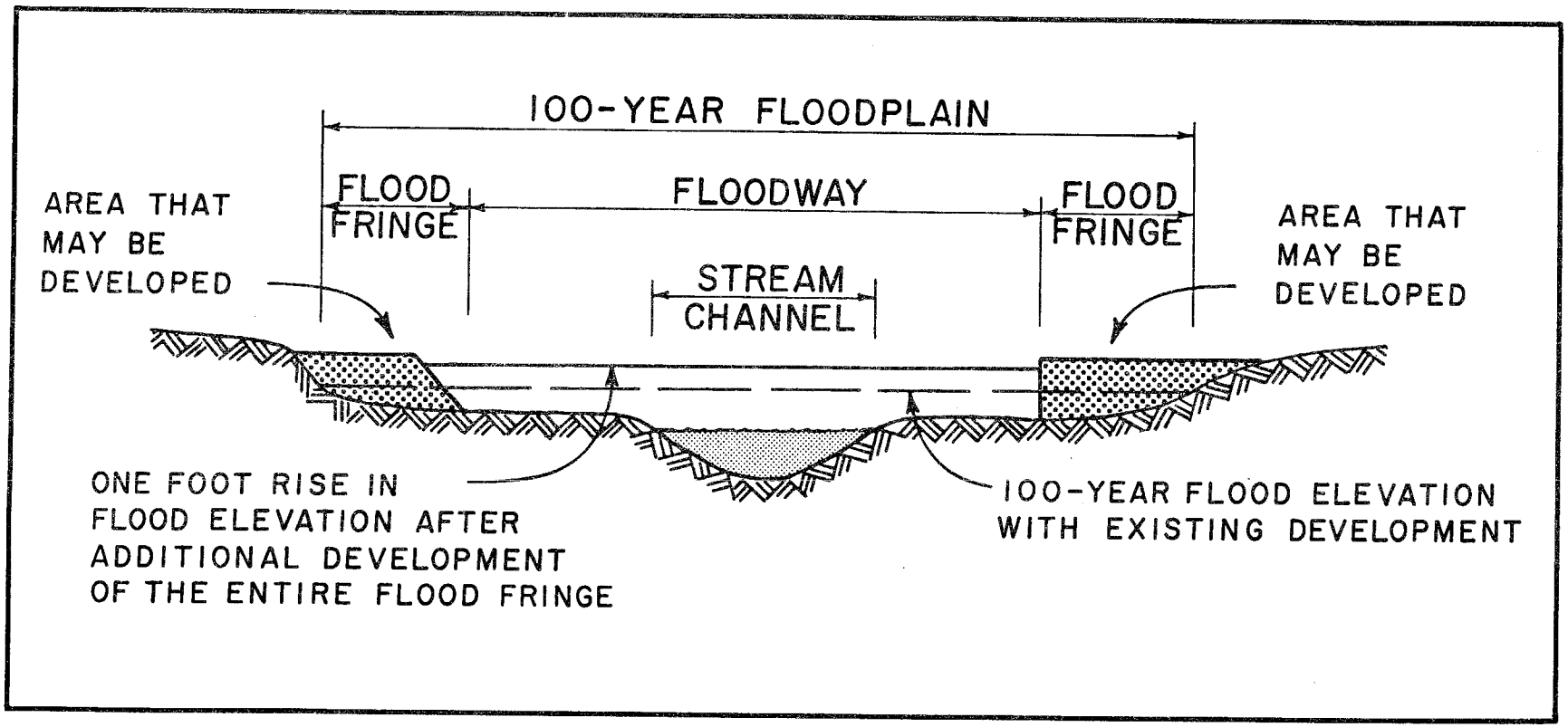

FIGURE 1. 100-YEAR FLOODPLAIN SCHEMATIC

(usually 1 foot). Tabulations of 100-year floodway data are given in Tables 1A-6A. Proposed floodway boundaries are shown on the flooded area maps (plates 2-5).

STUDY USE

The information and technical data contained in this report may be used as the engineering basis for adopting and administering regulations governing the use and development of flood-prone lands within the town of Banner Elk. Such regulations may be in the form of a separate floodplain management ordinance or may be incorporated into the community's zoning and subdivision regulations and building codes. The adoption of land-use regulations governing the development and use of flood-prone lands is a major requirement for community participation in the National Flood Insurance Program. The town of Banner Elk has participated in the emergency phase of the flood insurance program since November 13, 1974.

In addition to use by town building officials and local planning commission members, the flood profiles and flooded area maps contained in this report can be used by developers, engineers, industries, businesses, individuals, and others to gain knowledge of the extent and severity of flood hazards at specific locations within the town of Banner Elk.

The information contained in this report may also be used as a basis for further study and planning on the part of the town of Banner Elk in developing and evaluating alternative long-term solutions to local flooding problems.

Table 1A

ELK RIVER 100-YEAR FLOODWAY DATA

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway	Water Surface Elevation[b] Without Floodway	Water Surface Elevation[b] Difference
1	25.84	100	374	11.0	3643.1	3643.1	0.0
2	25.87	125	1,057	3.8	3643.6	3643.3	0.3
3	26.03 DS[a]	85	605	5.7	3645.6	3645.3	0.3
3	26.03 US[a]	85	789	4.4	3647.8	3646.8	1.0
4	26.15	235	1,543	2.0	3648.4	3647.4	1.0
5	26.35	125	665	4.5	3650.0	3649.0	1.0
6	26.60	160	683	4.4	3654.5	3653.8	0.7
7	26.75	45	295	10.2	3662.3	3661.4	0.9
8	26.93	125	423	4.7	3673.2	3672.2	1.0
9	27.08 DS	35	177	7.8	3684.6	3683.8	0.8
9	27.08 US	35	221	6.2	3685.8	3684.9	0.9
10	27.22 DS	50	239	5.8	3691.9	3691.2	0.7
10	27.22 US	50	208	6.6	3693.5	3692.6	0.9
11	27.34 DS	35	134	10.3	3702.4	3702.4	0.0
11	27.34 US	35	162	8.5	3704.0	3704.0	0.0
12	27.43	35	142	9.8	3712.2	3711.5	0.7
13	27.52 DS	60	158	8.7	3720.6	3720.6	0.0
13	27.52 US	60	208	6.6	3722.8	3722.0	0.8
14	27.75 DS	40	201	6.9	3755.1	3755.0	0.1
14	27.75 US	40	326	4.2	3758.3	3757.5	0.8
15	27.96	30	122	11.3	3778.9	3778.9	0.0

a. Downstream and upstream at bridges and dams.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 2A

WHITEHEAD CREEK 100-YEAR FLOODWAY DATA

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway	Water Surface Elevation[b] Without Floodway	Water Surface Elevation[b] Difference
2	0.29 DS[a]	25	284	3.2	3436.4	3436.4	0.0
2	0.29 US[a]	25	185	5.0	3436.7	3436.5	0.2
3	0.44 DS	55	196	4.7	3454.3	3454.3	0.0
3	0.44 US	55	293	3.1	3457.9	3456.9	1.0
4	0.65	35	113	8.1	3499.9	3499.8	0.1
5	0.75	35	113	8.1	3524.1	3524.0	0.1

a. Downstream and upstream at bridges and dams.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 3A

SHAWNEEHAW CREEK 100-YEAR FLOODWAY DATA

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway	Water Surface Elevation[b] Without Floodway	Water Surface Elevation[b] Difference
1	0.12 US[a]	125	553	2.9	3668.4	3668.3	0.1
2	0.16	70	313	5.2	3668.4	3668.4	0.0
3	0.31	70	202	7.8	3679.2	3678.4	0.8
4	0.40	90	312	5.0	3685.3	3684.3	1.0
5	0.52	75	188	8.2	3694.0	3693.5	0.5
6	0.59	75	300	5.1	3701.1	3700.1	1.0
6A	0.68	60	301	5.1	3707.5	3706.9	0.6
7	0.72 DS[a]	100	216	6.5	3715.6	3715.4	0.2
7	0.72 US	100	425	3.3	3717.7	3716.9	0.8
8	0.78 DS	75	158	8.9	3722.0	3721.9	0.1
8	0.78 US	75	416	3.4	3725.7	3725.0	0.7
8B	0.83 DS	83	144	9.7	3727.6	3727.6	0.0
8B	0.83 US	83	351	4.0	3732.0	3731.1	0.9
8A	0.87 DS	83	213	6.6	3732.1	3731.1	1.0
8A	0.87 US	83	299	4.7	3733.7	3733.1	0.6
9	0.97 DS	70	192	7.1	3746.7	3746.7	0.0
9	0.97 US	70	396	3.5	3749.6	3748.6	1.0

a. Downstream and upstream at bridges and dams.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 4A

HANGING ROCK CREEK 100-YEAR FLOODWAY DATA

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway	Water Surface Elevation[b] Without Floodway	Water Surface Elevation[b] Difference
1	0.04 DS[a]	280	325	4.9	3657.5	3657.3	0.2
1	0.04 US[a]	280	1,641	1.0	3662.4	3661.4	1.0
2	0.30	145	311	4.9	3664.6	3663.9	0.7
3	0.44 DS	125	271	5.4	3669.5	3668.9	0.6
3	0.44 US	125	510	2.9	3672.9	3672.3	0.6
4	0.67 DS	280	587	2.4	3684.3	3683.3	1.0
4	0.67 US	280	844	1.7	3685.2	3684.2	1.0
5	0.82	70	157	6.6	3695.5	3694.6	0.9
6	0.96 DS	75	223	4.6	3712.6	3712.3	0.3
6	0.96 US	75	381	2.7	3714.7	3713.7	1.0
7	1.17	40	122	8.4	3731.2	3731.1	0.1

a. Downstream and upstream at bridges and dams.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 5A

HORSE BOTTOM CREEK 100-YEAR FLOODWAY DATA

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[a] With Floodway	Water Surface Elevation[a] Without Floodway	Water Surface Elevation[a] Difference
1	0.12	45	137	4.5	3693.4	3692.4	1.0
2	0.39	30	79	7.9	3717.2	3716.2	1.0

a. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

Table 6A

SUGAR CREEK 100-YEAR FLOODWAY DATA

Cross Section No.	Mile	Floodway Width (Feet)	Floodway Section Area (Sq. Ft.)	Floodway Mean Velocity (Ft/Sec)	Water Surface Elevation[b] With Floodway	Water Surface Elevation[b] Without Floodway	Water Surface Elevation[b] Difference
1A	0.05 DS[a]	50	167	4.6	3682.1	3681.1	1.0
1A	0.05 US[a]	50	181	4.2	3682.4	3681.6	0.8
1	0.10	35	104	7.4	3685.3	3684.7	0.6
2	0.27 DS	65	138	5.6	3699.8	3699.1	0.7
2	0.27 US	65	186	4.1	3700.5	3699.6	0.9
3	0.48	150	86	8.9	3724.6	3724.3	0.3

a. Downstream and upstream at bridges and dams.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

USER'S GUIDE

TVA has published a document entitled "Guide for the Use of Technical Information and Data for Floodplain Management in the Tennessee River Basin" (reference 3) to assist those who use this report and other flood hazard data in interpreting and applying such information and technical data to specific lands or development proposals.

The "User's Guide," together with this flood hazard information report, can be a valuable tool in assisting the town of Banner Elk in administering and enforcing its floodplain management program. Copies of the "User's Guide" are available upon request from the following TVA offices:

Floodplain Management Staff
Division of Services and
Field Operations
Tennessee Valley Authority
179 Charlotte Street
Asheville, North Carolina 28801
Telephone (704) 254-8346

or

Floodplain Management Program
Flood Protection Branch
Tennessee Valley Authority
200 Liberty Building
Knoxville, Tennessee 37902
Telephone (615) 632-4792

ACKNOWLEDGEMENTS

The data and plates included in his report were prepared by the Flood Protection Branch, Division of Air and Water Resources with assistance from Data Services Branch, Mapping Services Branch, and Field Operations Eastern Area, Division of Services and Field Operations.

DEFINITION OF TERMS

Computed Flood - An estimated future flood based on a hydraulic analysis of the potential storm runoff from an area and flow of water through the floodplain.

Cross Section of a Floodplain - A vertical section of the floodplain surface, normally taken at right angles to the direction of floodflow.

Effective Stream Mileage - The point along the centerline of the stream channel which has the same flood elevation as a specified location in the floodplain.

Flood - A temporary rise in water levels or an accumulation of water runoff, resulting in inundation of areas not ordinarily covered by water.

10-Percent-Chance (10-Year) Flood - A flood having 10 chances in 100 (1 chance in 10) of being equaled or exceeded in any 1-year period.

2-Percent-Chance (50-Year) Flood - A flood having 2 chances in 100 (1 chance in 50) of being equaled or exceeded in any 1-year period.

1-Percent-Chance (100-Year) Flood - A flood having 1 chance in 100 of being equaled or exceeded in any 1-year period.

0.2-Percent-Chance (500-Year) Flood - A flood having 0.2 chance in 100 (1 chance in 500) of being equaled or exceeded in any 1-year period.

Flood Boundary - The estimated outermost limit the waters of a flood of a certain magnitude will reach.

Flood Elevation or Water Surface Elevation - The height (expressed in relation to mean sea level) reached by floods or channel flows of various magnitudes.

Flood Fringe - The area of a floodplain which is outside of the floodway.

Floodflow Line - A line drawn on a map indicating the general direction of the floodwaters in a floodplain.

Flooded Area Map - A map which shows the horizontal flood limits for one or more floods.

Floodplain - Any land area susceptible to inundation by water from any source including, at a minimum, that area subject to a 1-percent or greater chance of flooding in any given year.

Floodplain Management - A term applied to the full range of public policy and action for ensuring wise use of the floodplains. It includes, but is not limited to, collection and dissemination of flood control information acquisition of floodplain lands, enactment and administration of floodplain regulations including building codes, and construction of flood-modifying structures.

Floodplain Regulations - A general term applied to the full range of codes, ordinances, and other regulations relating to the use of land and construction within designated floodplain limits.

Flood Profile - A graph of flood elevations along a stream.

Flood Stage - The vertical distance to the surface of the floodwater as measured from or compared to some arbitrarily fixed and generally accepted point such as a United States Geological Survey stream gage. Local residents may more commonly use the term "flood depth," which is the vertical distance from the water surface to some point such as the floor, ground, or road.

Floodway - The channel of the stream and those portions of the adjoining floodplain which carry and discharge floodwaters of a particular flood event.

Historic Flood - A flood known to have occurred in a specific area.

Maximum Known Flood - The largest flood known to have occurred on a stream or in an area.

Mean Sea Level - The average height of the sea for all stages of the tide over a 19-year period.

Peak Discharge - The greatest rate of flow normally expressed in cubic feet per second (cfs), occurring during a period of high water.

Reach - Segments of a stream which mark boundaries such as the limits of a study, corporate limits, State or county lines, or other definable features.

Stream Gage - An instrument which makes regular observations of either the water surface elevation (measured from some arbitrary point) or streamflow at a particular site on a stream, canal, lake, or reservoir.

Stream Mileage - Distance measured along the centerline of the stream from some designated point, usually where the stream enters into a larger body of water.

U.S. Coast and Geodetic Survey Levels - The vertical control surveys conducted to establish permanent elevation references.

BENCH MARKS[a]

Elk River

Elevation[b]	Number	Description
3639.6	TBM- 1	Downstream corner of right bank end of dam at section number 2, mile 25.84.
3645.0	TBM- 2	Chiseled square on downstream lfet bank wingwall of bridge and painted TBM 7 at section number 3, mile 26.03.
3643.7	TBM- 3	Chiseled square on downstream end of headwall of culvert perpendicular to creek on right bank, near mile 26.15.
3677.0	TBM- 4	Chiseled square on upstream land corner of light pole base at downstream end of Holiday Inn parking lot, near mile 26.9.
3685.2	TBM- 5	Chiseled square on downstream right bank wingwall of new bridgeat section number 9, mile 27.08.
3693.3	TBM- 6	Chiseled square on downstream right bank of wingwall at section number 10, mile 27.22.

Hanging Rock Creek

3660.5	TBM- 7	Chiseled square on downstream end of left bank headwall of bridge at section number 1, mile 0.04.
3670.7	TBM- 8	Bolt head in timber over centerline of downstream culvert at cross section number 3, mile 0.44.

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a. Temporary bench marks are fourth order accuracy.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

BENCH MARKS[a]

(Continued)

Hanging Rock Creek (continued)

Elevation[b]	Number	Description
3684.4	TBM- 9	A 60d nail in powerpole 6 feet from right downstream bridge corner, at section number 4, near mile 0.67.
3713.5	TBM-10	Top of bolt head on upstream right end of curb one foot from right end of bridge, at section number 6, near mile 0.96.

Horse Bottom Creek

3731.0	TBM-11	A 60d nail in streamside of pole on edge of road, first pole back from transformer, near mile 0.4.

Sugar Creek

3699.5	TBM-12	A 60d nail in powerpole with transformer near section number 2, mile 0.27.

Whitehead Creek

3418.6	TBM-13	Chiseled square on downstream end of right bank headwall near mile 0.18.
3432.3	TBM-14	Downstream corner of left bank headwall of highway bridge at section number 2, mile 0.29.
3560.5	TBM-15	Fireplug on left bank at the Highlands, near mile 0.83.

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a. Temporary bench marks are fourth order accuracy.
b. Feet above mean sea level (USC&GS 1936 Supplementary Adjustment).

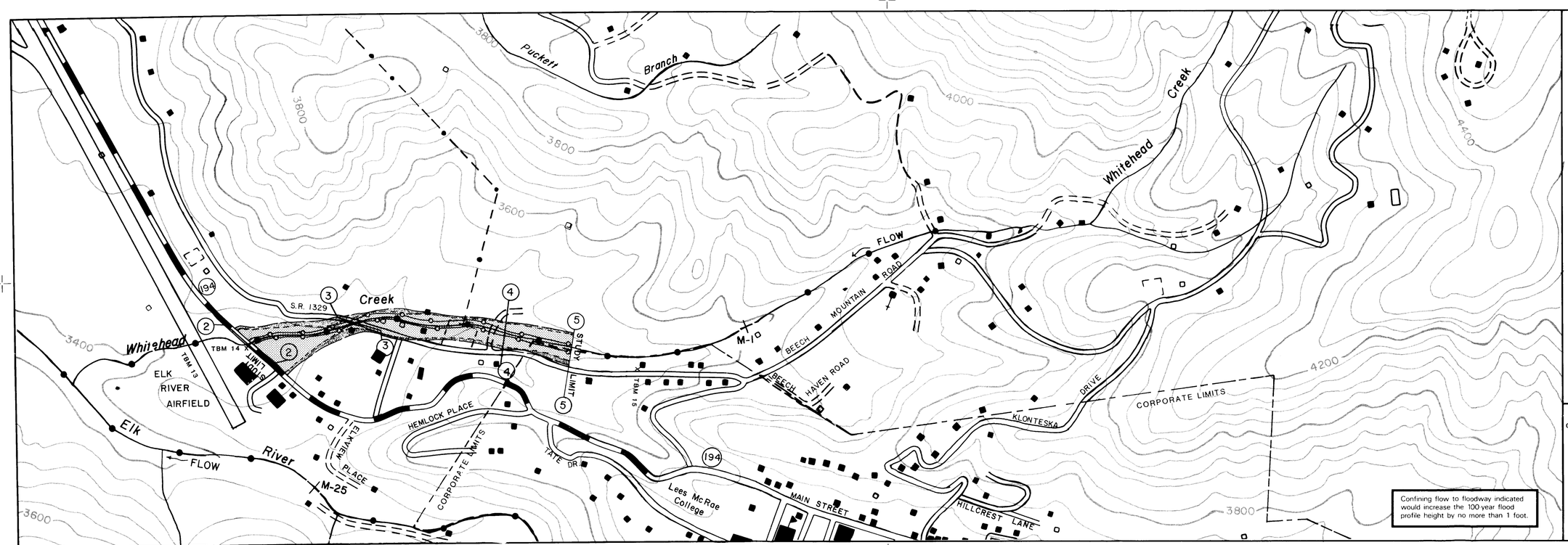
REFERENCES

1. U.S. Water Resources Council, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B of the Hydrology Committee, Washington, D.C., September 1981.

2. U.S. Army Corps of Engineers, HEC-2 Water Surface Profiles Generalized Computer Program, Hydrologic Engineering Center, Davis, California, April 1980.

3. Tennessee Valley Authority, Floodplain Management Services Branch, Office of Community Development, Guide for the Use of Technical Information and Data for Floodplain Management in the Tennessee River Basin, October 1980.

PLATE 2



LEGEND:

OVERFLOW LIMITS:

100-YEAR FLOOD

500-YEAR FLOOD

+ M-1 MILES ABOVE MOUTH

1/10 MILE MARK

5 — 5 CROSS SECTION

100-YEAR FLOODWAY

The extent of flood overflow is based on data and measurements from aerial photography. Because of the methods used, the flooded areas as shown may not represent exact conditions on the ground.

Base map is a reproduced portion of USGS-TVA topographic quadrangle maps 215-NW and 215-NE dated 1978 with minor revisions.

40-FOOT CONTOUR INTERVAL

N

Confining flow to floodway indicated would increase the 100-year flood profile height by no more than 1 foot.

TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

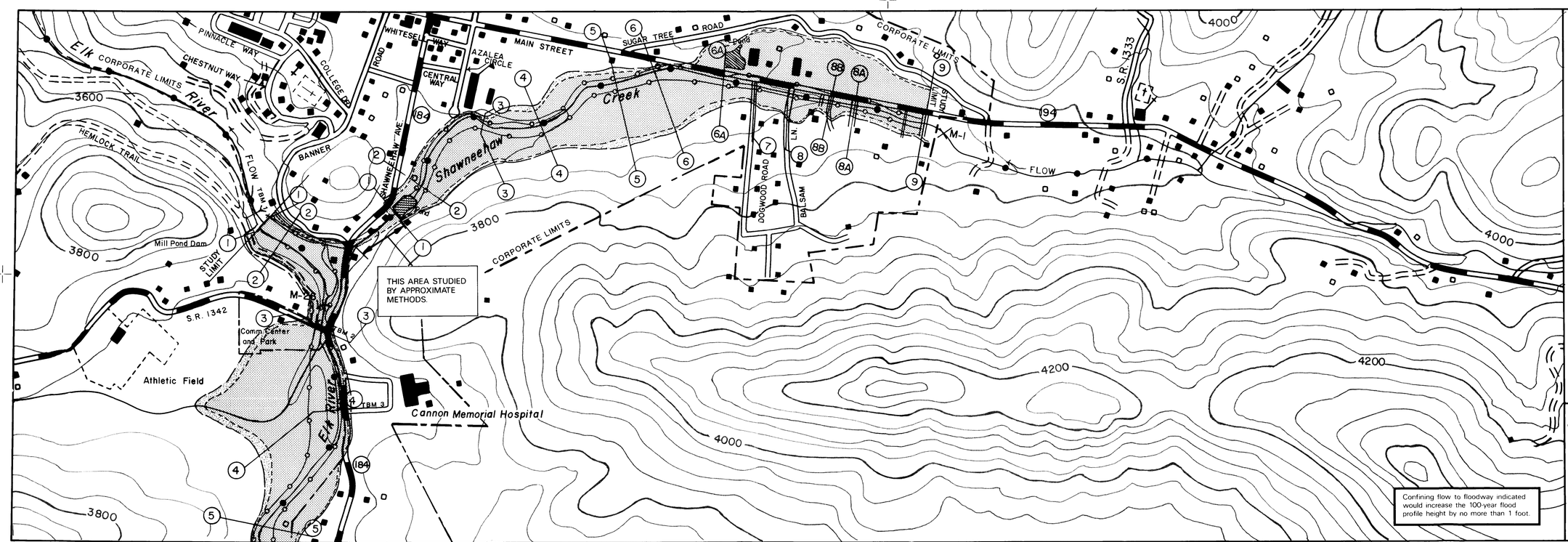
FLOODED AREAS WITH PROPOSED FLOODWAY

WHITEHEAD CREEK
MILE 0.29 TO MILE 0.75

BANNER ELK, NORTH CAROLINA

SCALE 0 400 800 FEET

August 1985



LEGEND:

OVERFLOW LIMITS: 100-YEAR FLOOD / 500-YEAR FLOOD

+ M-26 MILES ABOVE MOUTH

1/10 MILE MARK

3—3 CROSS SECTION

100-YEAR FLOODWAY

The extent of flood overflow is based on data and measurements from aerial photography. Because of the methods used, the flooded areas as shown may not represent exact conditions on the ground.

Base map is a reproduced portion of USGS-TVA topographic quadrangle maps 215-NW and 215-NE dated 1978 with minor revisions.

40-FOOT CONTOUR INTERVAL

N

TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

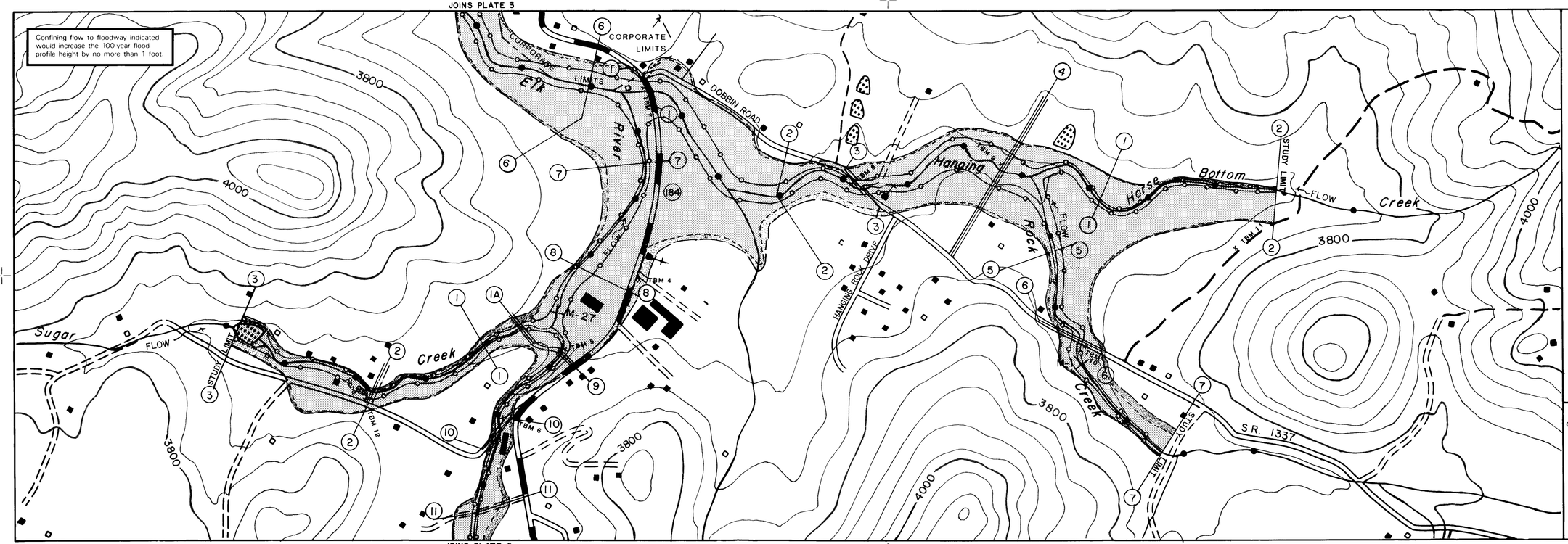
FLOODED AREAS WITH PROPOSED FLOODWAY

ELK RIVER	MILE 25.84 TO MILE 26.37
SHAWNEEHAW CREEK	MILE 0.00 TO MILE 0.97

BANNER ELK, NORTH CAROLINA

SCALE 0 400 800 FEET

August 1985



LEGEND:

OVERFLOW LIMITS:

100-YEAR FLOOD | 500-YEAR FLOOD

+ M-27 MILES ABOVE MOUTH

1/10 MILE MARK

2 2 CROSS SECTION

100-YEAR FLOODWAY

The extent of flood overflow is based on data and measurements from aerial photography. Because of the methods used, the flooded areas as shown may not represent exact conditions on the ground.

Base map is a reproduced portion of USGS-TVA topographic quadrangle map 215-NE dated 1978 with minor revisions.

40-FOOT CONTOUR INTERVAL

N

TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

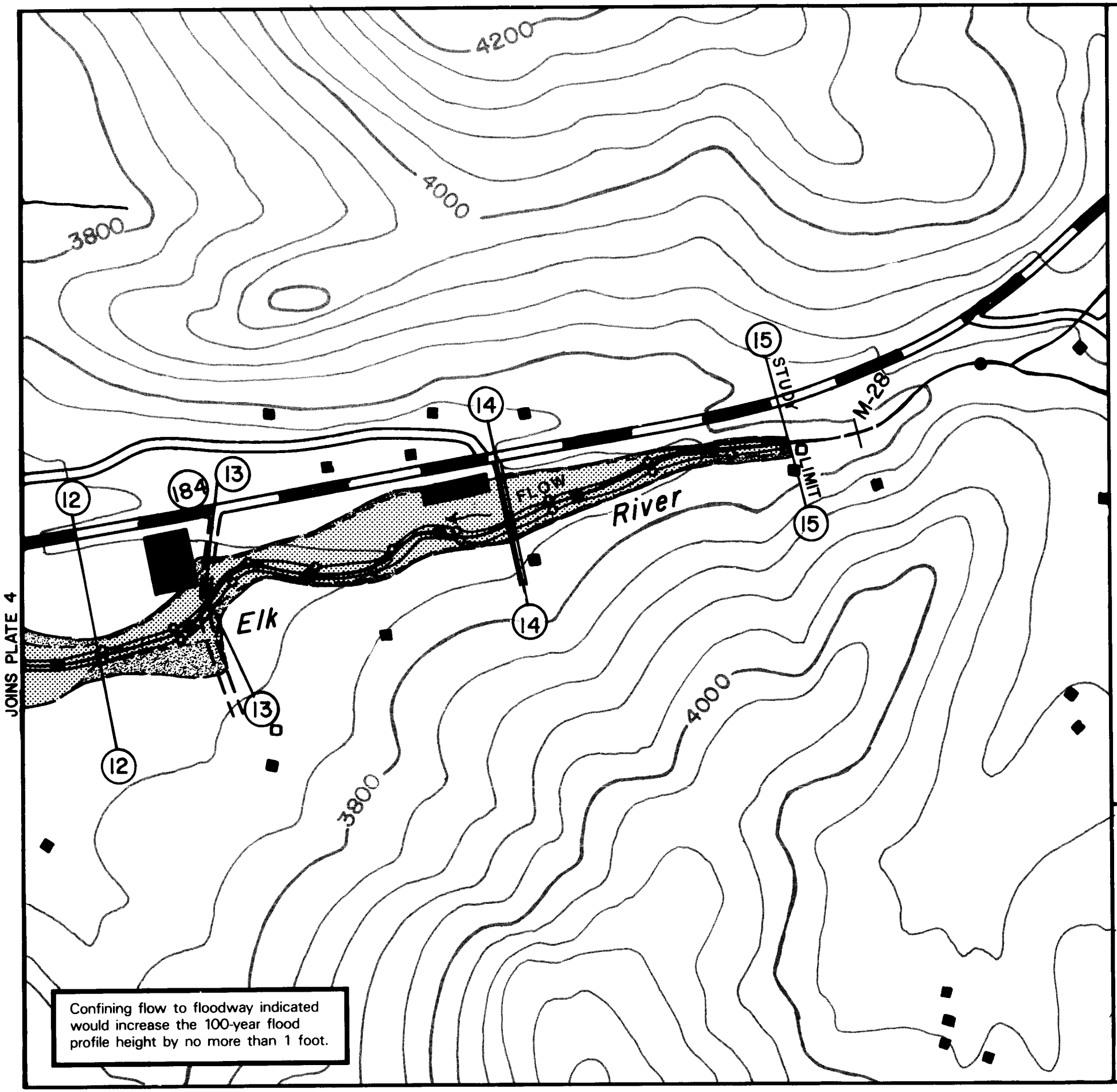
FLOODED AREAS WITH PROPOSED FLOODWAY

ELK RIVER	MILE 26.37 TO MILE 27.38
HANGING ROCK CREEK	MILE 0.00 TO MILE 1.17
HORSE BOTTOM CREEK	MILE 0.00 TO MILE 0.39
SUGAR CREEK	MILE 0.00 TO MILE 0.48

BANNER ELK, NORTH CAROLINA

SCALE 0 400 800 FEET

August 1985



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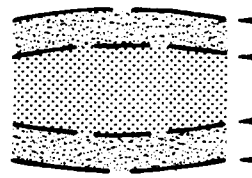
OVERFLOW LIMITS:



100-YEAR FLOOD

500-YEAR FLOOD

+ M-28 MILES ABOVE MOUTH

● 1/10 MILE MARK

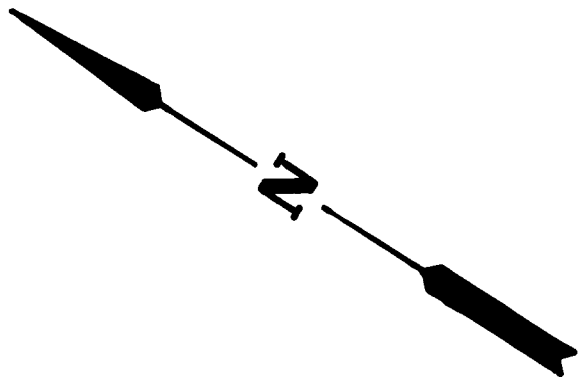
12—12 CROSS SECTION

100-YEAR FLOODWAY

The extent of flood overflow is based on data and measurements from aerial photography. Because of the methods used, the flooded areas as shown may not represent exact conditions on the ground

Base map is a reproduced portion of USGS-TVA topographic quadrangle map 215-NE dated 1978 with minor revisions.

40-FOOT CONTOUR INTERVAL



TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

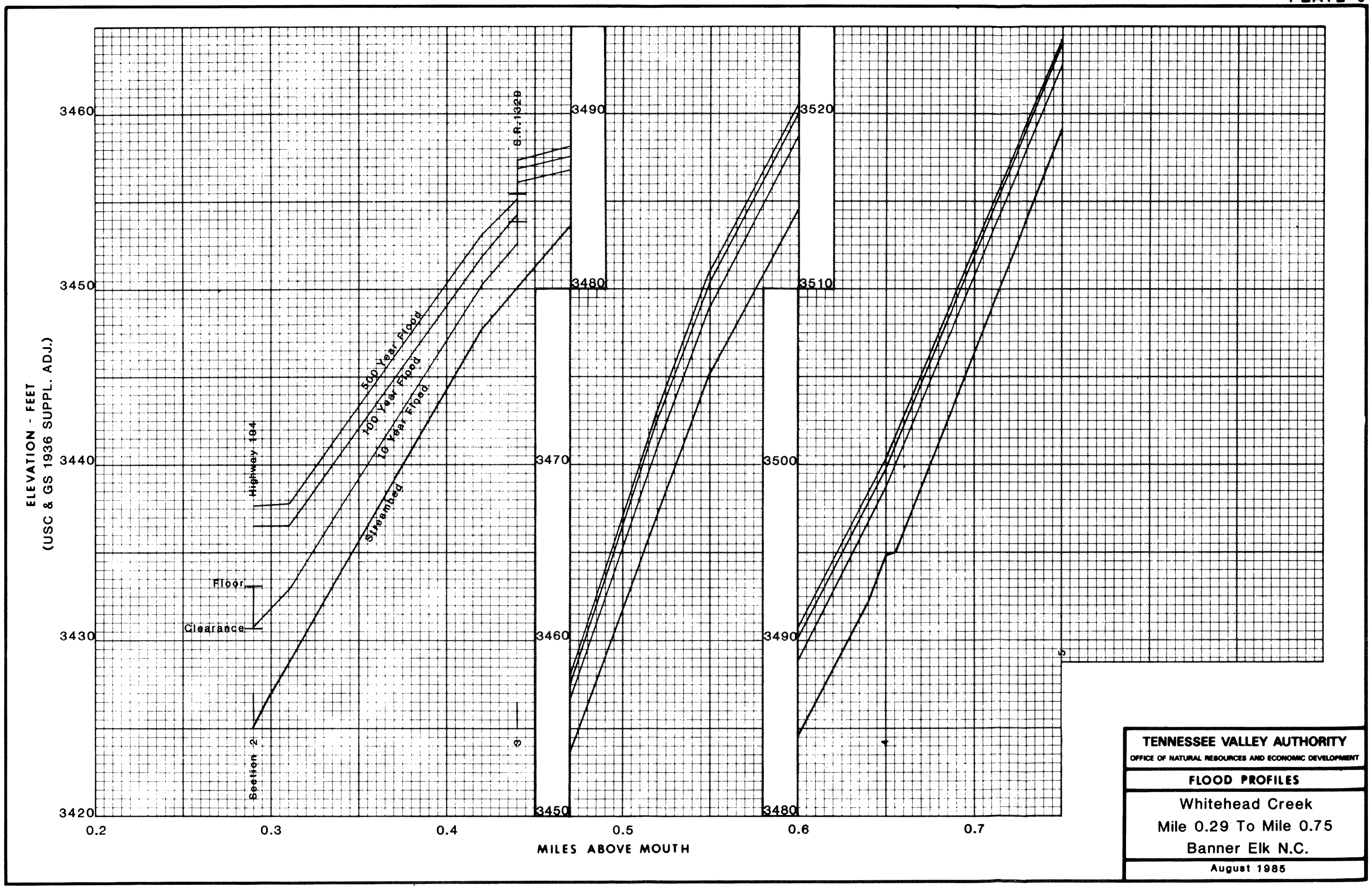
FLOODED AREAS WITH PROPOSED FLOODWAY

ELK RIVER
MILE 27.37 TO MILE 27.95

BANNER ELK, NORTH CAROLINA

SCALE 0 400 800 FEET

August 1985

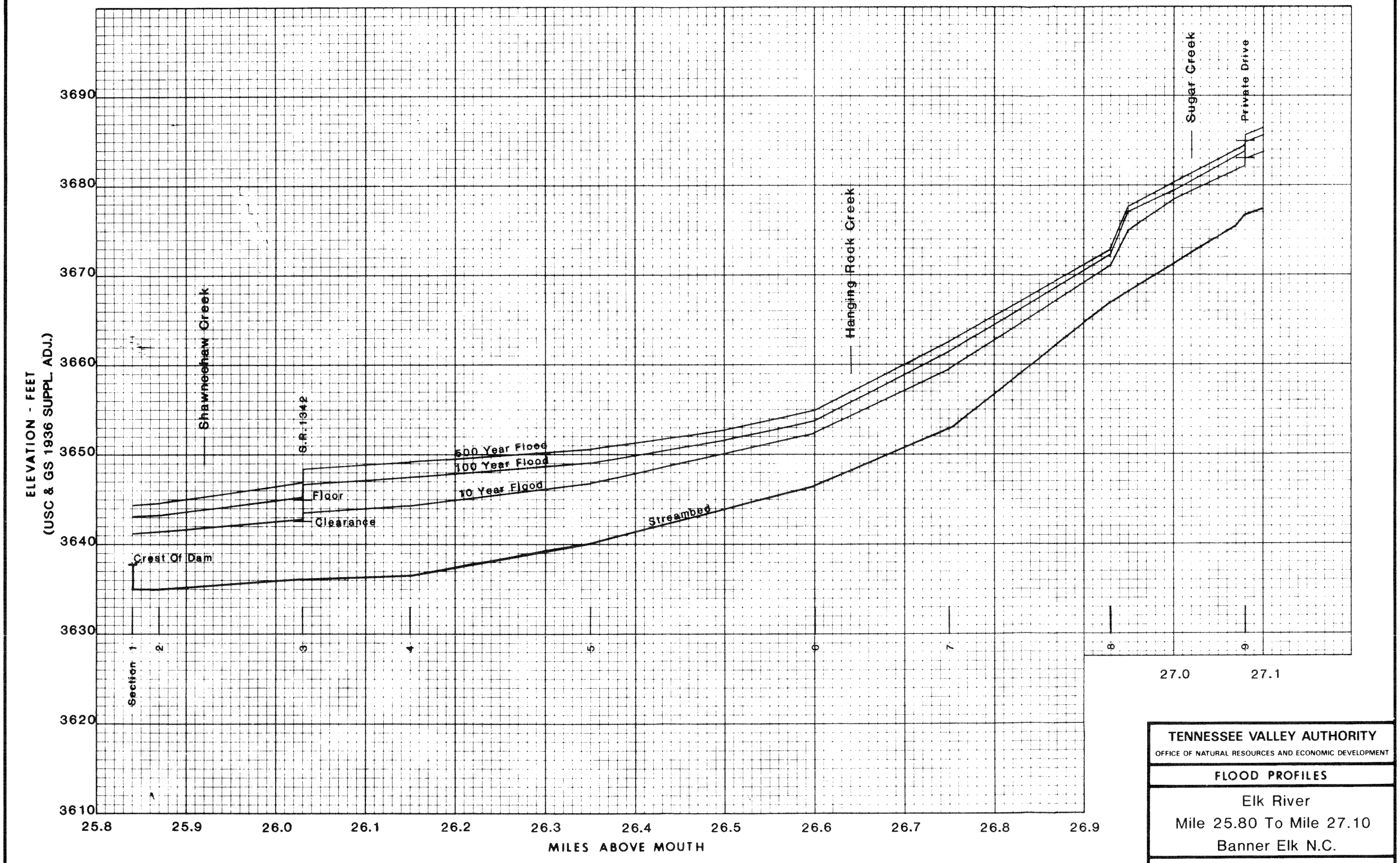


TENNESSEE VALLEY AUTHORITY
OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

Whitehead Creek
Mile 0.29 To Mile 0.75
Banner Elk N.C.

August 1985



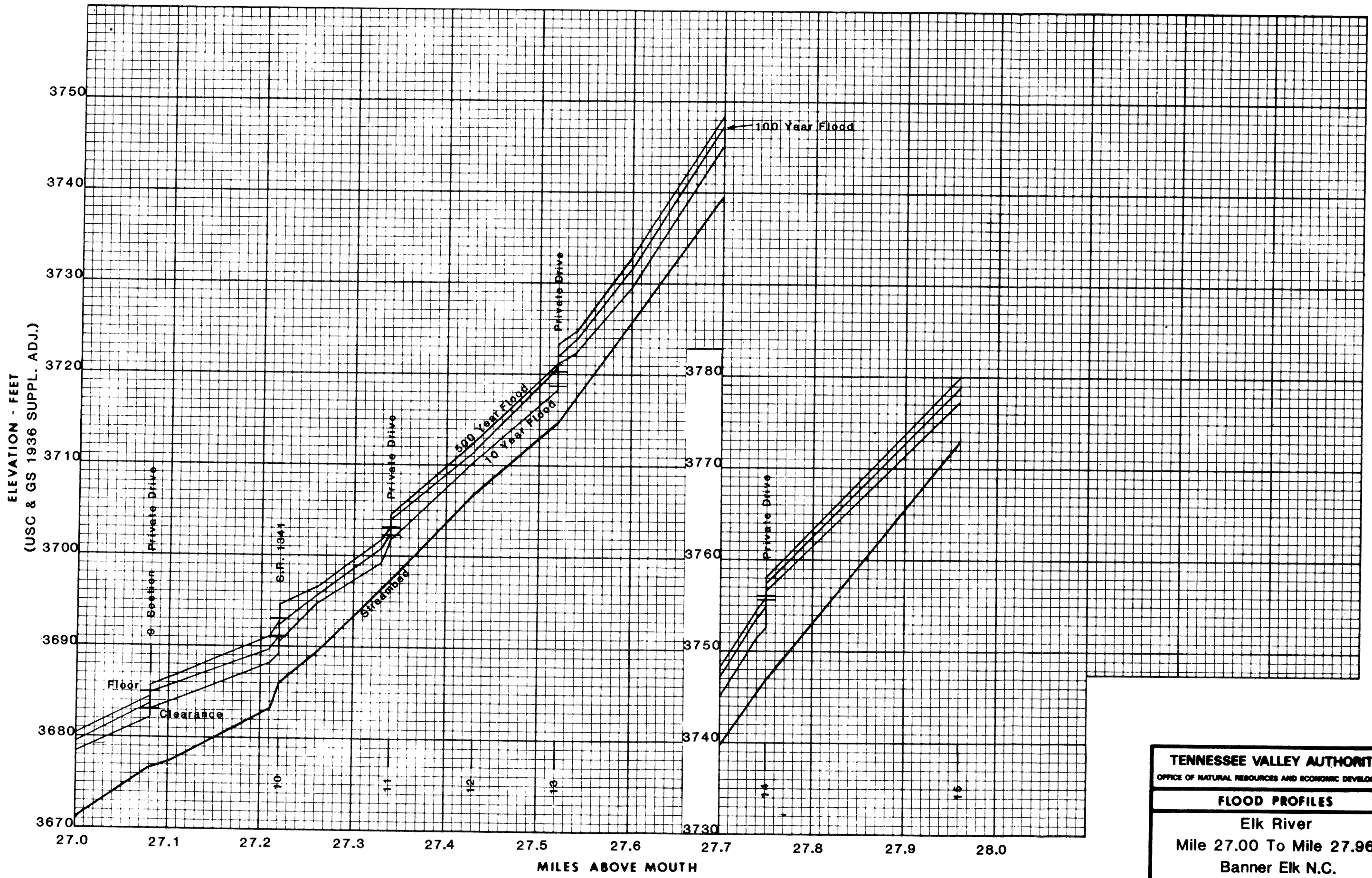
TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

Elk River
Mile 25.80 To Mile 27.10
Banner Elk N.C.

August 1985

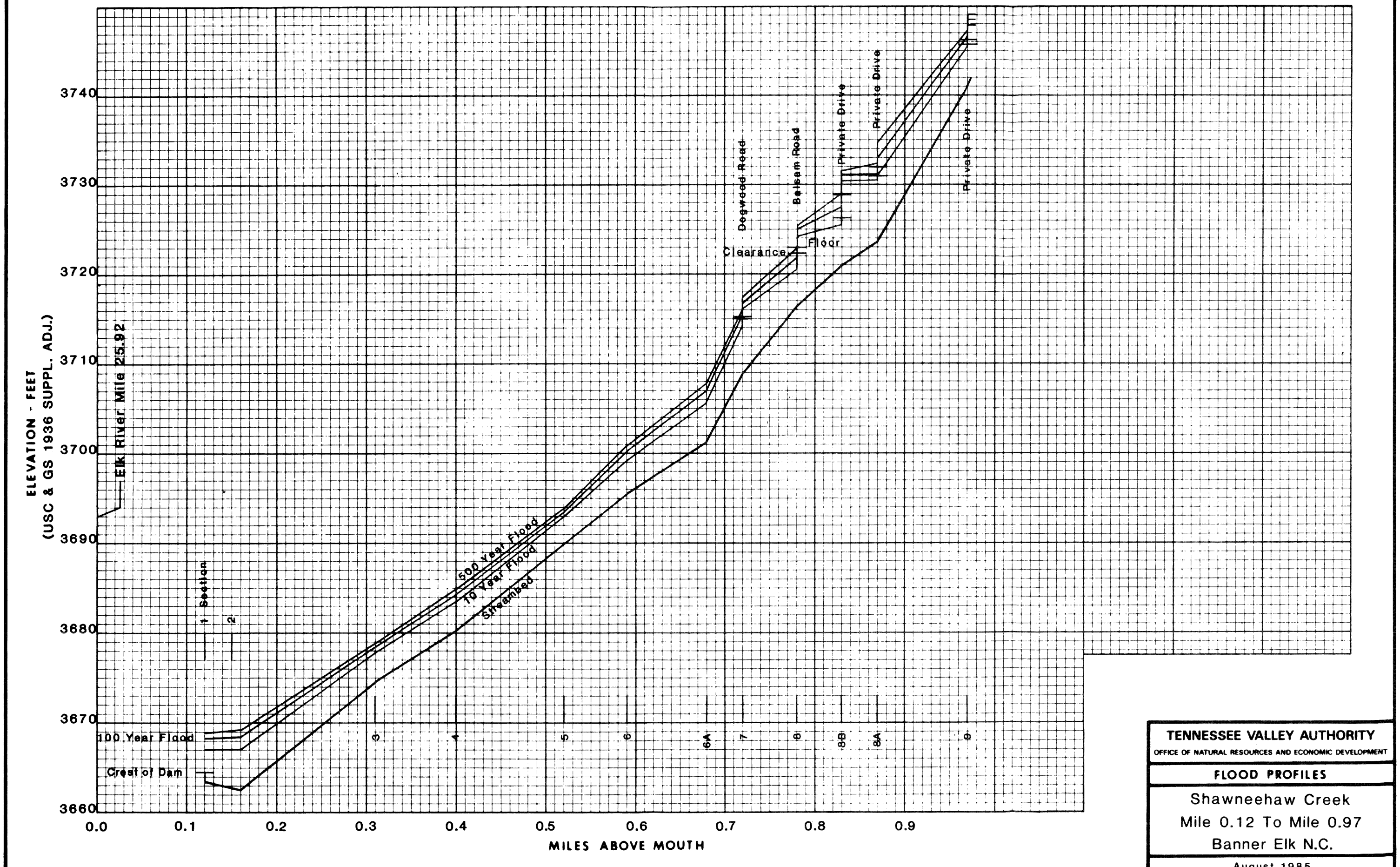


TENNESSEE VALLEY AUTHORITY
OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

Elk River
Mile 27.00 To Mile 27.96
Banner Elk N.C.

August 1985

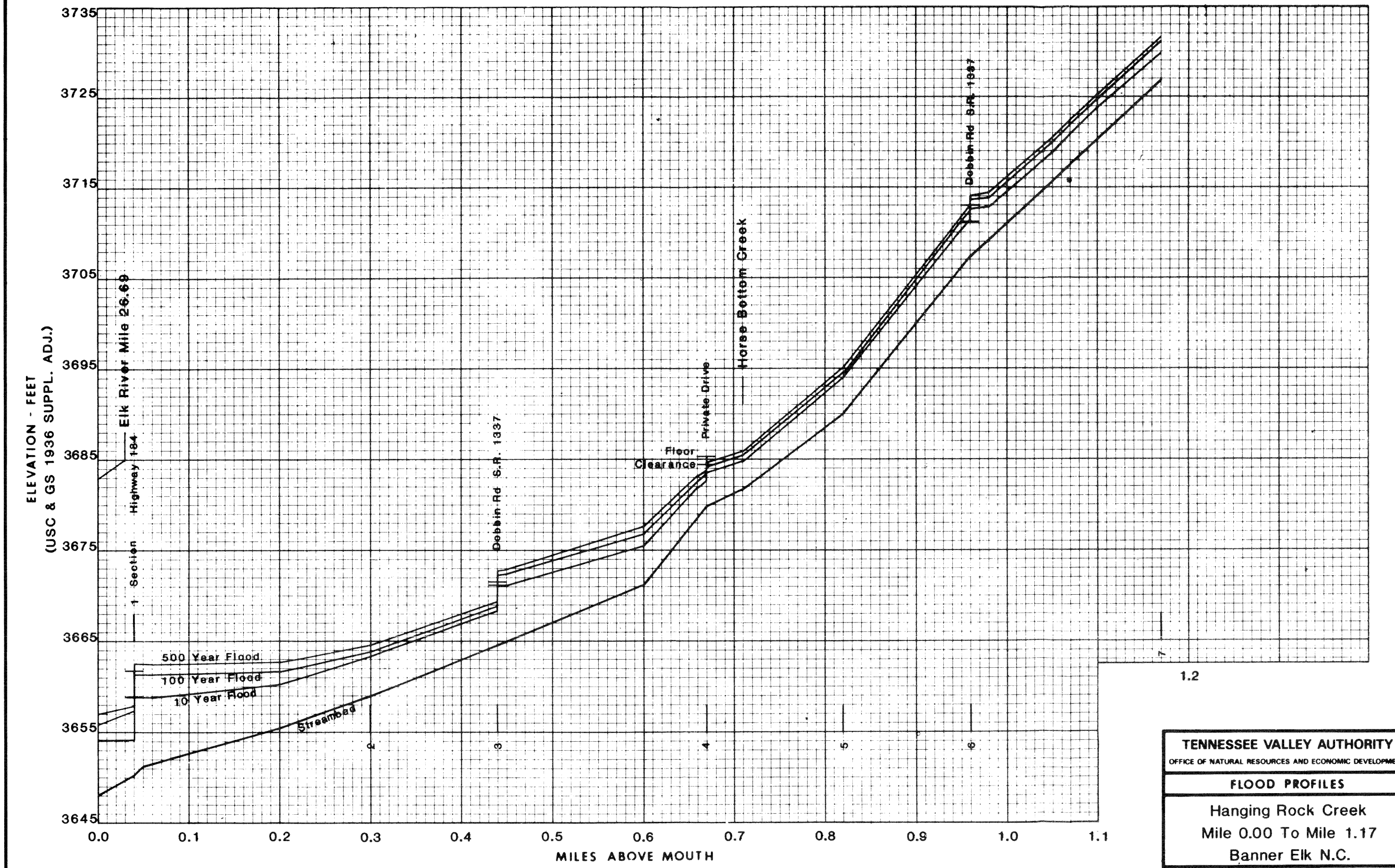


TENNESSEE VALLEY AUTHORITY
OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

Shawneehaw Creek
Mile 0.12 To Mile 0.97
Banner Elk N.C.

August 1985



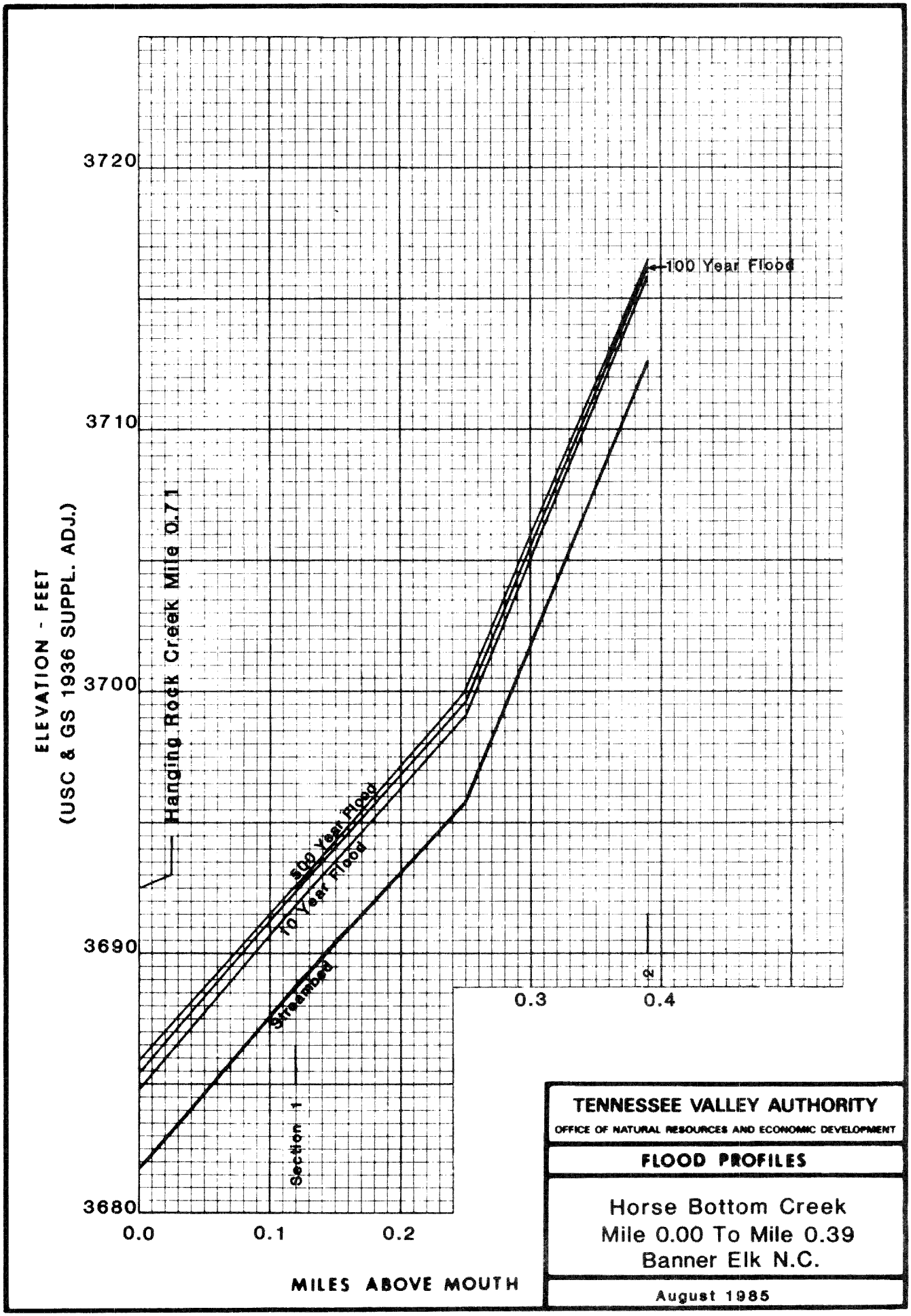
TENNESSEE VALLEY AUTHORITY
OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

Hanging Rock Creek
Mile 0.00 To Mile 1.17
Banner Elk N.C.

August 1985

PLATE 11



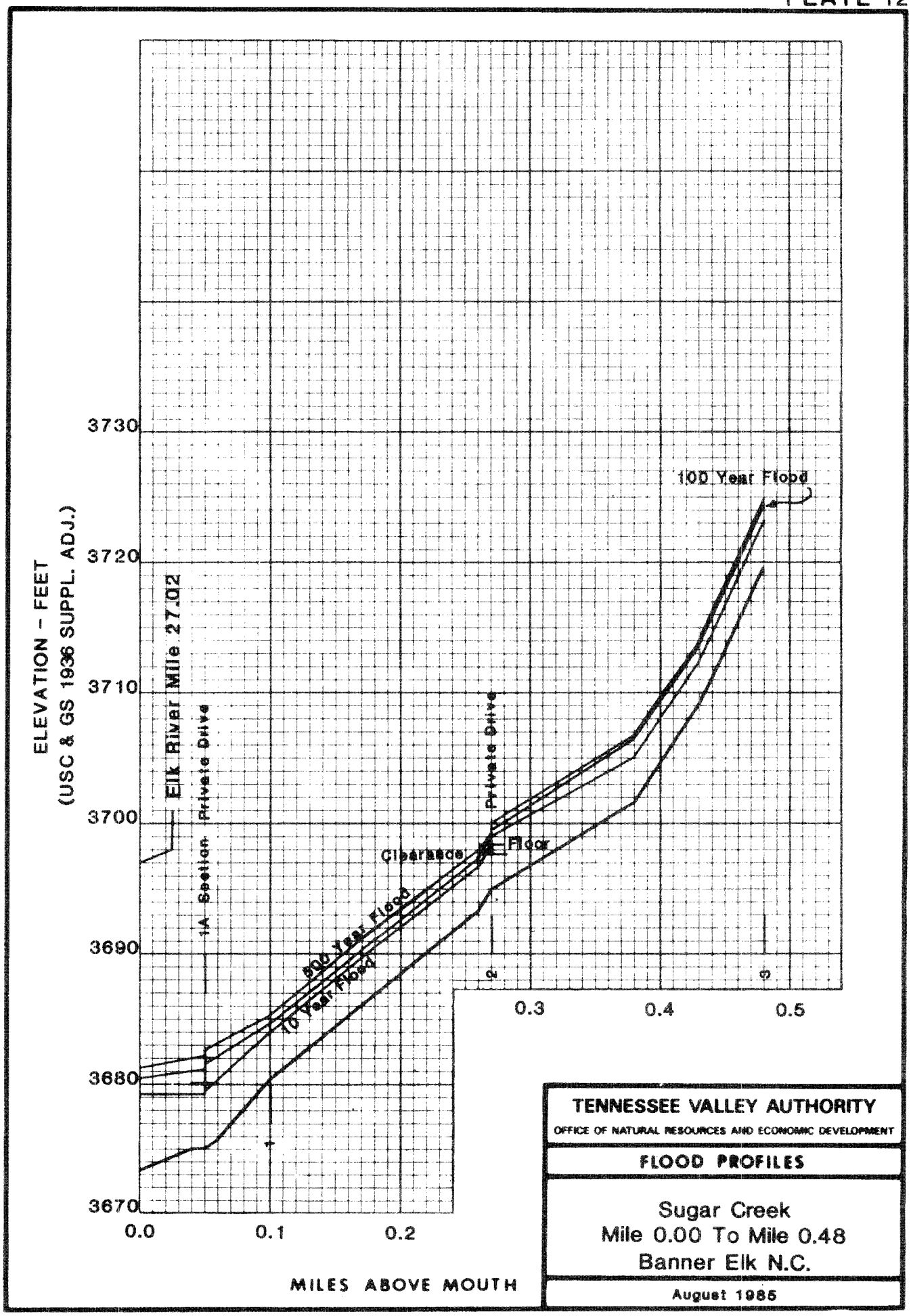
TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

Horse Bottom Creek
Mile 0.00 To Mile 0.39
Banner Elk N.C.

August 1985



TENNESSEE VALLEY AUTHORITY

OFFICE OF NATURAL RESOURCES AND ECONOMIC DEVELOPMENT

FLOOD PROFILES

Sugar Creek
Mile 0.00 To Mile 0.48
Banner Elk N.C.

August 1985