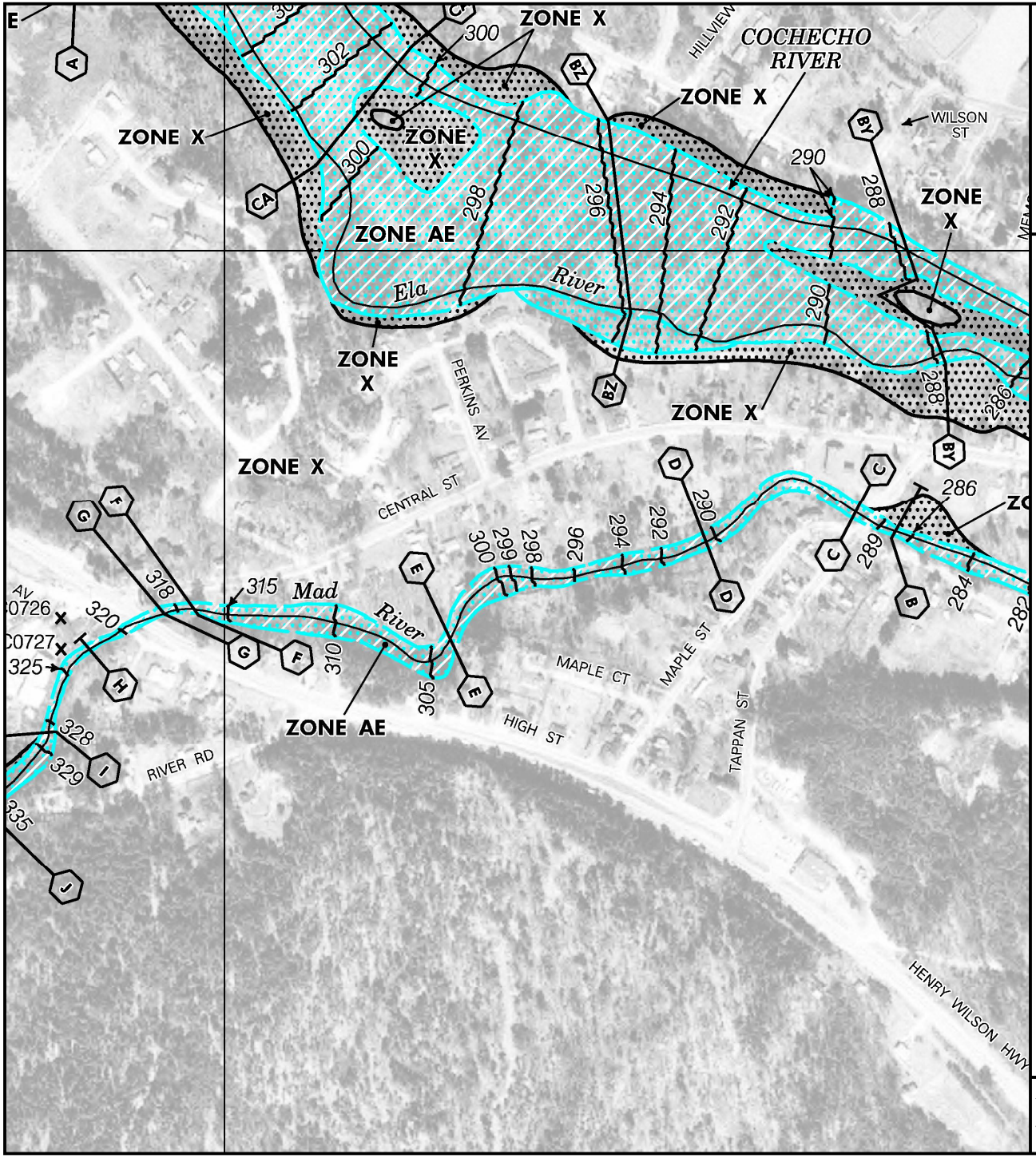
Appendix 5

FEMA Flood Insurance Rate Map (FIRM) and selected portions of the Strafford County Flood Insurance Study (FIS)



ZONE VE Coastal flood zone with velocity hazard (determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adja kept free of encroachment so that the 1% annual cha substantial increases in flood heights.

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0114D

FIRM

FLOOD INSURANCE RATE MAP

STRAFFORD COUNTY, NEW HAMPSHIRE (ALL JURISDICTIONS)

PANEL 114 OF 405

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
FARMINGTON, TOWN OF	330147	0114	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

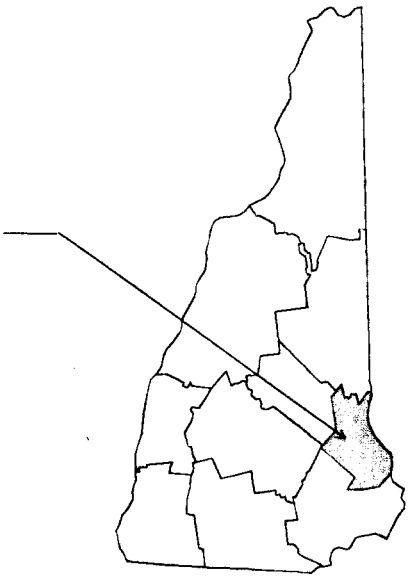
MAP NUMBER 33017C0114D

EFFECTIVE DATE MAY 17, 2005

Federal Emergency Management Agency

FLOOD INSURANCE STUDY

STRAFFORD COUNTY, NEW HAMPSHIRE
(ALL JURISDICTIONS)



COMMUNITY NAME	COMMUNITY NUMBER
BARRINGTON, TOWN OF	330178
DOVER, CITY OF	330145
DURHAM, TOWN OF	330146
FARMINGTON, TOWN OF	330147
LEE, TOWN OF	330148
MADBURY, TOWN OF	330219
MIDDLETON, TOWN OF	330222
MILTON, TOWN OF	330149
NEW DURHAM, TOWN OF	330227
ROCHESTER, CITY OF	330150
ROLLINSFORD, TOWN OF	330190
SOMERSWORTH, CITY OF	330151
STRAFFORD, TOWN OF	330196

MAY 17, 2005

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
33017CV000A

Cochecho River was in excess of a 1-percent chance event. The flood of March 1936 caused damage to structures in the floodplains of the Cochecho River and the Salmon Falls River. The March 1936 flood on the Salmon Falls River had approximately a 50-year recurrence interval. The March 1977 flood on the Bellamy River was approximately a 7-percent chance event.

On the Lamprey River, several large floods have occurred since the USGS gage No. 01073500 was installed at Packers Falls. The two most severe floods were in March 1936 and April 1987. The respective discharges associated with these events were 5,490 cubic feet per second (cfs) and 7,500 cfs. The estimated return period for floods of these magnitudes are 25 years and in excess of 100 years, respectively. In the Town of Durham, these floodwaters caused damage to roads, bridges, and dams, especially in the area of State Route 108, and in the area of Longmarsh Road. (USGS, 1934-1985).

Low-lying areas adjacent to the Ela River, Great Bay and tidal portions of the Oyster River are subject to periodic flooding. However, little significant damage occurs in these areas due to the general absence of buildings and other structures.

Ice and debris jams occurring at culverts, bridges, and other debris-catching structures, especially along the Cochecho River, have helped to compound flooding in the county.

2.4 Flood Protection Measures

In the Town of Farmington, channel modifications and dike construction were completed in 1955 and 1958 and included modifications of the Cochecho River, the Mad River, and Dames Brook. In 1955, the improvement consisted of straightening and enlarging 600 feet of the Mad River channel and 3,100 feet of the channel of the Cochecho River from the Central Street bridge to the South Main Street bridge. Construction of 3,000 feet of dike along the left bank of the Cochecho River between the two bridges was also completed (U.S. Army Corps of Engineers [USACE], 1955). In 1958, an additional 200 feet of dike was constructed on the left bank just downstream of the South Main Street bridge. FEMA specifies that all levees must have a minimum of 3 foot freeboard against 100-year flooding to be considered a safe flood protection structure. This dike does meet the FEMA 3-foot freeboard requirements.

Bow Lake in the Cochecho River watershed and Swains Lake and Bellamy Reservoir in the Bellamy River watershed give a degree of flood protection incidental to their design use. The New Hampshire Water Resources Board operates Bow Lake and Swains Lake for recreational use of the reservoirs. Each fall the pools are drawn down in anticipation of the spring runoff. This procedure not only prevents damage to shoreline property, but also allows for temporary storage of floodwater, thus lowering the frequency of downstream flooding. Bellamy Reservoir, a water supply site for the City of Portsmouth, New Hampshire, has a significant effect on the Bellamy River flood potential within the City of Dover. The flood storage available due to the 362-acre normal pool,

In the Town of Durham, peak discharge computations for the Oyster River and the Lamprey River were based on log-Pearson Type III analyses of gage records at USGS gaging stations No. 01073000 and No. 01073500, respectively (USGS, 1981). Peak discharge computations for the Oyster River at Mill Pond Dam and the Lamprey River at gage No. 01073500 were based on discharge values that were determined in the 1990 Town of Durham FIS.

In the Town of Durham, peak discharge computations for College and Pettee Brooks were based on regional regression equations developed by the USGS from peak-discharge records for floods along selected rivers in urbanized areas (USGS, 1994). The 100-year recurrence interval was then transposed to the drainage areas at different locations along the rivers in Durham using the following drainage area-discharge ratio formula:

$$Q = Q_g (A/A_g)^{0.75}$$

Where Q is the discharge at the different specific site locations, Q_g is the drainage at the USGS stream gage, and A and A_g are the drainage areas at the specific site and at the USGS stream gage, respectively.

In the Town of Milton and the Cities of Somersworth and Rochester, flood discharge frequencies for the Salmon Falls River were computed using log-Pearson Type III Statistical Analysis of peak discharges at USGS gage No. 01072100 located on the Salmon Falls River just downstream of the Milton Three Ponds Dam and at USGS gage No. 01072500, in operation from 1930 to 1969, located on the Salmon Falls River near South Lebanon, Maine (U.S. Water Resources Council, 1977). The discharges for the Salmon Falls River in the Town of Milton were compared to the FIS for the City of Rochester and discrepancies were resolved (FEMA, September 16, 1982).

Flood discharges for the Branch River and Miller Brook in the Town of Milton, the Cochecho River in the City of Rochester and the Town of Farmington, and the Mad River, the Ela River, Dames Brook, and Kicking Horse Brook in the Town of Farmington were determined using USGS regional equations which were based on multiple analysis of gaged data in New Hampshire (USGS, 1978).

In the Town of Farmington, flood discharges for the streams studied by approximate methods were also determined using these USGS regional equations (USGS, 1978).

A summary of the drainage area-peak discharge relationships for all of the streams studied by detailed methods is shown in Table 4, "Summary of Discharges."

TABLE 4 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
KICKING HORSE BROOK					
At confluence with Dames Brook	0.6	40	80	105	175
At Bunker Street	0.45	30	60	80	120
LAMPREY RIVER					
At Strafford-Rockingham county boundary	188.0	3,877	5,450	6,000	7,500
At Wiswall Road Dam	182.1	4,120	6,270	7,300	10,000
At diversion to Oyster River	*	243	820	1,300	2,500
MAD RIVER					
At confluence with Cochecho River	9.7	710	1,320	1,630	2,550
Upstream of Brook C	8.3	620	1,160	1,440	2,280
Approximately 0.93 mile upstream of Brook C	7.6	560	1,050	1,300	2,045
Upstream of Brook B	4.6	330	620	760	1,200
MILLER BROOK					
At confluence with Salmon Falls River	3.1	210	370	440	660
OYSTER RIVER					
At Mill Pond Dam	19.5	765	1,060	1,500[1]	2,700[1]
Above confluence of Hamel Brook	16.7	690	990	1,120	1,430
At USGS gage (01073000)	12.1	545	777	879	1,125
PETTEE BROOK					
Above confluence with Beards Brook	0.99	90	140	160	220
Above Edgewood Road	0.80	60	90	105	145
Above UNH Parking Lot "A"	0.66	50	80	90	125
SALMON FALLS RIVER					
At Buffumsville Road	234.7	4,600	7,460	9,000	13,800
At Walnut Grove Road	148.6	3,360	5,450	6,570	10,080
At Spaulding Avenue	130.5	3,050	4,940	5,960	9,150
At Milton-Rochester corporate limits	117.3	3,030	4,700	5,500	7,960

[1]Discharge due to diversion
*Data not available

TABLE 5 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD[1]) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
BOW LAKE				
At Bow Lake Dam (routed)	*	*	516.9	*
CLUB POND				
For its entire shoreline within the Town of New Durham	*	*	533.9	*
LITTLE BAY AND OYSTER RIVER				
Downstream of Mill Pond Dam within the Town of Durham	6.3	6.8	7.0	7.6

[1]National Geodetic Vertical Datum of 1929
*Data not computed

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Exhibit 2).

For all riverine flooding sources studied in detail, flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

For each jurisdiction within Strafford County that has a previously printed FIS report, the hydraulic analyses described in those reports have been compiled and are summarized below.

Cross sections for the backwater analyses of the Salmon Falls River and the Cochecho River in the City of Rochester were obtained from aerial photographs flown in May 1980 at a scale of 1.0 inch equals 800 feet (Moore Survey and Mapping, May 1980, Scale 1:9,600). Cross sections for the backwater analyses of all streams studied in detail in the Towns of Farmington and Milton were obtained from aerial photographs flown in May 1984 at a scale of 1:4,800 with a contour

interval of 4 feet, and supplemented by field surveys and bridge plans (Quinn Associates, Inc., 1985).

Cross-section data for the Lamprey River in the Town of Durham was obtained through FEMA from the 1990 Town of Durham FIS step backwater model and from field measurements. Cross-section data for the Oyster River, Pettee Brook, and College Brook were obtained from field surveys. All bridges, dams, and culverts were field checked to obtain or verify elevation data and structural geometry.

Along certain portions of the Oyster River in the Town of Durham, a profile base line is shown on the maps to represent channel distances as indicated on the Flood Profiles and Floodway Data tables.

For Bow Lake in the Town of Strafford, water-surface elevations of floods of the selected recurrence intervals were computed through an analysis of the Bow Lake dam using weir and orifice equations. For Bow Lake, the 100-year water surface elevation was used along with USGS topographic maps to determine the extent of the flooding (U.S. Department of the Interior, 1958, et cetera).

For the Ela River in the Town of New Durham, and the Cochecho and Bellamy Rivers in the Town of Dover, water-surface elevations of floods of the selected recurrence intervals were computed using the SCS WSP-2 step-backwater computer program (USDA, 1976). Starting water-surface elevations for the Ela River were determined by computing critical depth at a cross section a short distance downstream of the Old Quaker Road bridge abutment. The results of the water-surface computations for Ela River are tabulated for selected cross sections in Table 6, "100-Year Flood Data."

For the Cochecho River in the City of Rochester and Town of Farmington, the Salmon Falls River, Branch River, and Miller Brook in the Town of Milton, the Mad River, the Ela River, Dames Brook, and Kicking Horse Brook in the Town of Farmington, and the Oyster River, the Lamprey River, College Brook, and Pettee Brook in the Town of Durham, water surface elevations of floods of the selected recurrence intervals were computed using USACE HEC-2 step-backwater computer program (USACE, 1991).

Starting water-surface elevations for the Cochecho River were taken from known elevations in the City of Rochester FIS (FEMA, September 1982). Starting water-surface elevations for the Salmon Falls River in the City of Rochester and the Town of Milton, were taken from known elevations in the City of Somersworth FIS and City of Rochester FIS, respectively (FEMA, August 1982; FEMA, September 1982). Starting water-surface elevations for the Salmon Falls River in the City of Somersworth, the Cochecho River in the City of Rochester, the Branch River and Miller Brook in the Town of Milton, and the Mad River, the Ela River, Dames Brook, and Kicking Horse Brook in the Town of Farmington, were calculated using the slope/area method. The starting water-surface elevation for

the Oyster River was calculated using normal depth at the mouth of the Oyster River. The starting water-surface elevations for the Lamprey River was determined by computing critical depths at the MacCallen Dam in the Town of Newmarket, Rockingham County, and Mill Pond Dam, respectively. The gates were assumed to be closed. The starting water-surface elevations for College and Pettee Brooks were calculated using normal depth at the mouth. The water-surface elevations determined for the 100-year flood, floodway, and 500-year were then used, along with USGS topographic maps and a base map generated by the University of New Hampshire (UNH), to determine the extent of flooding (USGS, 1958, et cetera; UNH, 1996).

Approximately one mile north of the Town of Durham (Strafford County)-Town of Newmarket (Rockingham County) corporate limits, flood flows in the Lamprey River divide, with a portion being diverted over State Route 108 into Longmarsh Brook in the Oyster River watershed. The quality of flow diverted was subtracted from the flow within the Lamprey River in order to model backwater conditions present during flood events. Trial and error computer runs were made until the downstream flow of the Lamprey River plus the diverted flow equaled the upstream inflow to the diversion location.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 7, "Manning's "n" Values."

TABLE 7 - MANNING'S "n" VALUES

Stream	Channel "n"	Overbank "n"
Bellamy River	0.035-0.065	0.050-0.120
Branch River	0.030-0.040	0.040-0.120
Cochecho River	0.024-0.055	0.050-0.200
College Brook	0.030-0.050	0.020-0.060
Dames Brook	0.030-0.036	0.065-0.120
Ela River	0.035-0.070	0.070-0.120
Kicking Horse Brook	0.013-0.065	0.020-0.120
Lamprey River	0.028-0.075	0.060-0.150
Lamprey River diversion	0.025-0.070	0.060-0.120
Mad River	0.030-0.055	0.060-0.120
Miller Brook	0.032-0.050	0.050-0.090
Oyster River	0.030-0.060	0.045-0.085
Pettee Brook	0.020-0.070	0.020-0.060
Salmon Falls River	0.029-0.070	0.035-0.150

The flood levels caused by the storm tides on the coast at Portsmouth were translated upstream to the Great Bay at the Town of Durham. These levels were

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Mad River								
A	630	49	228	7.1	279.2	279.2	279.2	0.0
B	1,420	25	126	12.9	286.5	286.5	286.5	0.0
C	1,575	50	443	3.7	289.1	289.1	289.6	0.5
D	2,125	56	166	9.8	290.0	290.0	290.0	0.0
E	3,115	67	235	6.9	303.4	303.4	303.4	0.0
F	4,015	40	148	11.0	317.1	317.1	317.1	0.0
G	4,145	35	162	10.1	318.4	318.4	318.9	0.5
H	4,410	26	188	8.7	322.7	322.7	323.0	0.3
I	4,700	46	211	7.7	328.4	328.4	328.4	0.0
J	5,045	48	157	10.4	336.9	336.9	336.9	0.0
K	6,190	29	145	9.9	358.8	358.8	359.2	0.4
L	7,060	43	204	7.1	369.7	369.7	370.4	0.7
M	7,870	38	134	10.7	387.4	387.4	387.4	0.0
N	8,730	39	178	8.1	410.5	410.5	411.1	0.6
O	9,440	37	133	10.8	433.8	433.8	433.8	0.0
P	9,558	31	125	11.5	436.1	436.1	436.1	0.0
Q	10,400	49	166	8.6	455.8	455.8	456.2	0.4
R	11,110	53	159	8.2	472.4	472.4	472.4	0.0
S	12,105	60	174	7.5	493.0	493.0	493.3	0.3
T	13,255	57	153	8.5	518.3	518.3	518.3	0.0
U	13,780	24	107	12.1	544.7	544.7	544.7	0.0
V	14,310	47	196	6.6	553.8	553.8	554.1	0.3
W	15,050	30	150	8.7	559.7	559.7	560.1	0.4
X	16,045	48	183	4.1	565.6	565.6	565.8	0.2
Y	16,580	75	109	6.9	569.2	569.2	569.2	0.0

[1]Feet above confluence with Cochecho River

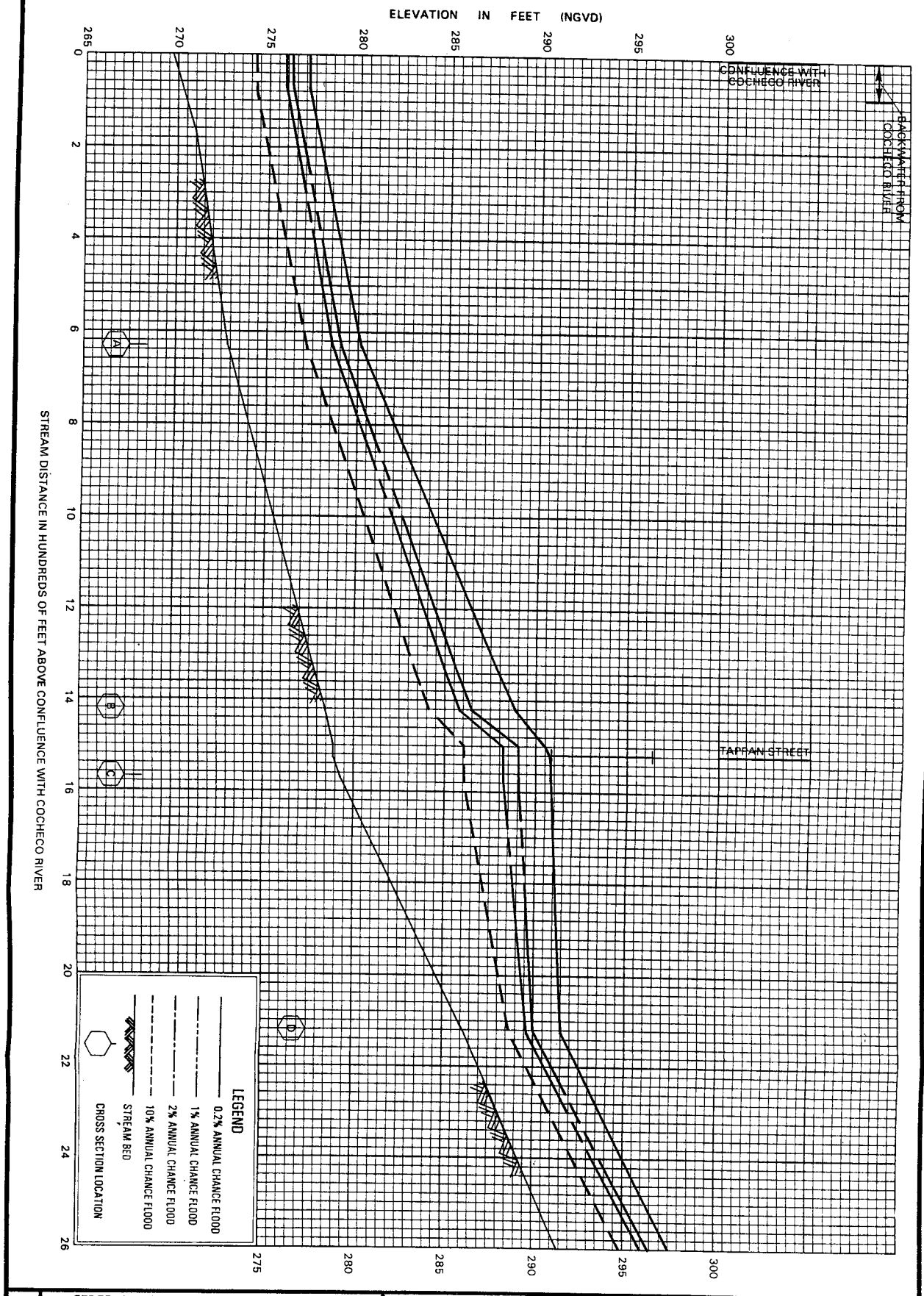
TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

STRAFFORD COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

MAD RIVER

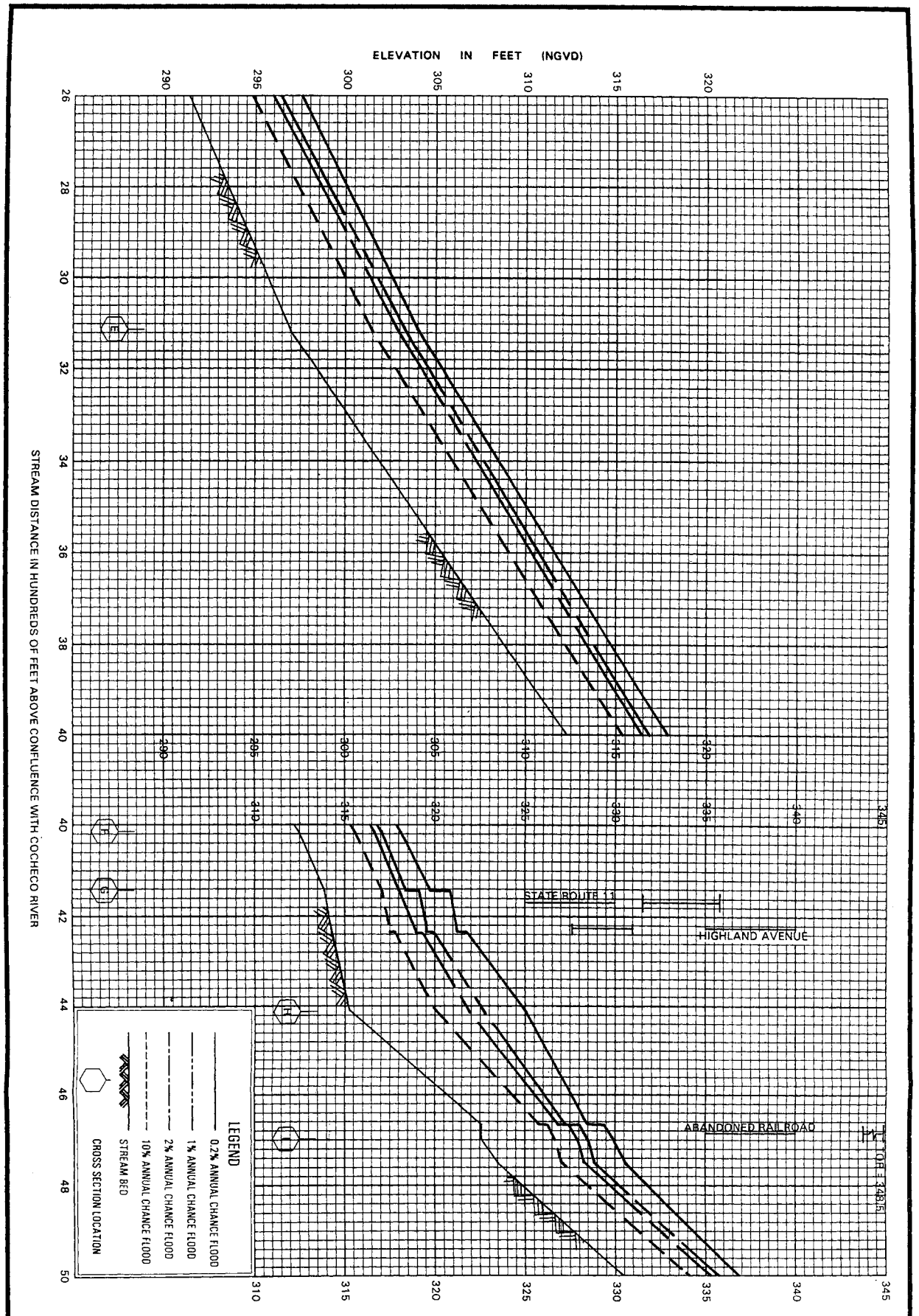


FEDERAL EMERGENCY MANAGEMENT AGENCY

STRAFFORD COUNTY, NH
(ALL JURISDICTIONS)

FLOOD PROFILES

MAD RIVER



FEDERAL EMERGENCY MANAGEMENT AGENCY

STRAFFORD COUNTY, NH
(ALL JURISDICTIONS)

FLOOD PROFILES

MAD RIVER