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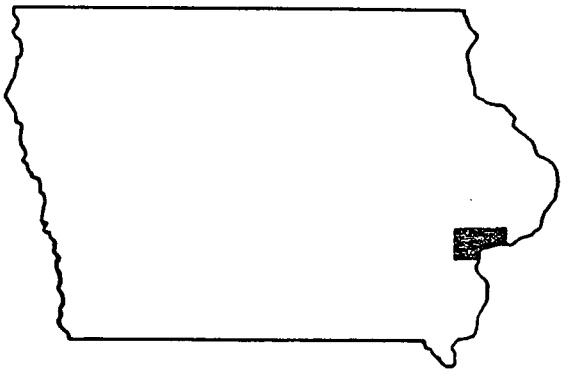
FLOOD INSURANCE STUDY

CITY OF MUSCATINE, IOWA
MUSCATINE COUNTY



JULY 1977

U.S. DEPARTMENT of HOUSING & URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

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FLOOD INSURANCE STUDY
CITY OF MUSCATINE, IOWA

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Muscatine, Muscatine County, Iowa, and to aid in the administration of the Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Muscatine to the regular program of flood insurance by the Federal Insurance Administration (FIA). Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

After an announcement of intent to perform a flood elevation study was published three times in the Muscatine Journal during August 1975, the initial public meeting was held on August 28, 1975, at the Muscatine City Hall. This meeting was attended by personnel representing DeWild Grant Reckert & Associates Company, the FIA, the Iowa Natural Resources Council, and public and private interests of the City of Muscatine. The purpose of the meeting was to select a community base map, identify streams which should be studied, initiate the data gathering and community input processes, and provide general information on the nature and impact of the Flood Insurance Program.

On August 11, 1975, a meeting was held between DeWild Grant Reckert & Associates Company and the Iowa Natural Resources Council to coordinate the hydrological and hydraulic methodology to be used as well as to assemble any information or data that may be available. During the course of the study, coordination was maintained with the City of Muscatine to ensure efficient and comprehensive data collection and analyses as well as proper flood boundary and floodway delineation. Additional contacts were made as necessary to coordinate the study with the Iowa Natural Resources Council. Through meetings and correspondence, the hydrologic analyses, flood profiles, and floodways for the Mississippi River and Mad Creek were coordinated with those previously developed by the U. S. Army Corps of Engineers (COE), Rock Island District.

On June 16, 1976, the intermediate public meeting was held at the Muscatine City Hall, with representatives of DeWild Grant Reckert & Associates Company, the FIA, the Iowa Natural Resources Council, and public and private interests of the City of Muscatine in attendance. During this meeting, the preliminary flood profiles and the flood plain and floodway boundaries were reviewed. On October 14, 1976, the preliminary draft report of the Muscatine Flood Insurance Study was reviewed at the final public meeting held at the Muscatine City Hall and attended by personnel of DeWild Grant Reckert & Associates Company, the FIA, the Iowa Natural Resources Council, and public and private interests of the City of Muscatine.

1.3 Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by DeWild Grant Reckert & Associates Company for the FIA under Contract No. H-3806. This work, which was completed in October 1976, covered all flooding sources in Muscatine with the exception of the Mississippi River. Flood discharges and elevations for the Mississippi River were provided by the U. S. Army Corps of Engineers, Rock Island District.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Muscatine. The area of study is shown on the Vicinity Map (Figure 1).

Floods caused by overflow of the Mississippi River, Mad Creek, and Geneva Creek were studied in detail. Approximate methods were used to determine the special flood hazard areas along Papoose Creek and the West Fork of Mad Creek. These areas of approximate study were justified during the initial public meeting described in Section 1.2. The flood hazard determinations were based on hydrologic and hydraulic conditions that existed at the time of the study or which would be in effect within eighteen months after the study was completed, approximately April 1978.

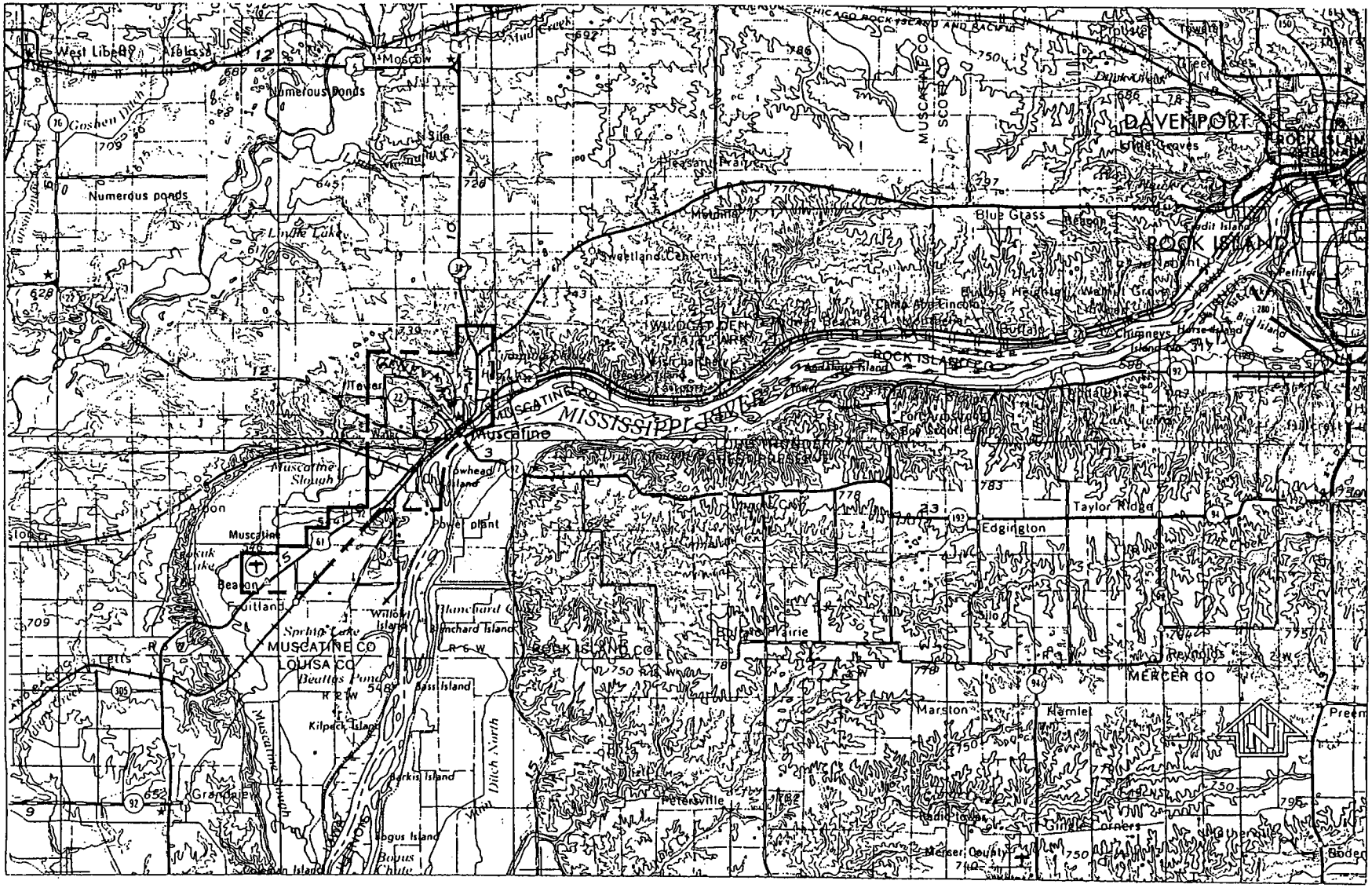


FIGURE 1

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

2.2 Community Description

The City of Muscatine is located in the southern half of Muscatine County, which is situated on the eastern boundary of the State of Iowa about 20 miles southwest of Davenport. The population of Muscatine (1970 census) of 22,405 persons represents an increase of 1,408 people over the 1960 census, of which 235 of this increase resulted from area annexed during this decade (Reference 1). The economy of this area is comprised chiefly of agriculture and agricultural-related industry and business.

The northern half of Muscatine has topography characteristic of the irregular and rolling hills commonly found along the bluff of the Mississippi River, whereas the southern half lies in the flat flood plain of the Mississippi River. The northern half of Muscatine drains either directly to the Mississippi River or its tributaries, such as Mad Creek and Papoose Creek. A portion of northern Muscatine drains to Geneva Creek, a tributary of Mad Creek. The southern half of Muscatine has poorly defined drainage patterns due to the flatness of the area; however, all of the area drains to the Mississippi River either directly or by way of tributaries such as Muscatine Slough.

Commercial, industrial, and older residential structures are commonly found located in the flood plains of the Mississippi River and its tributaries. Most of the recent residential development has been occurring on uplands in northern and western Muscatine, although some residential and industrial development has been occurring and likely will continue in southern Muscatine.

The climate of the Muscatine area is subhumid midcontinental, with the average annual precipitation being 33 inches. The mean temperature is 51° F., with the coldest and warmest months being January and July with average temperatures of 23° F. and 76° F., respectively.

Trees, shrubs, weeds, and grass abound in the undeveloped and uncultivated portions of the flood plains. In cultivated areas, crops of corn, soybeans, and oats are commonly found. Soils in the Muscatine area, which are typical of those found in east-central Iowa, are not known to have any unusual characteristics which would have a substantial effect on flooding conditions.

2.3 Principal Flood Problems

Unprotected low-lying areas in Muscatine are subject to periodic flooding caused by overflow of the Mississippi River and its

tributaries which flow through Muscatine. The most severe flooding, especially on the Mississippi River, occurs generally during the late spring as a result of rapid snow melt in conjunction with warm, heavy rains, with flooding being further aggravated at times by ice jams. The ten highest flood levels recorded for the Mississippi River at the Muscatine gage since 1878 occurred in 1965, 1973, 1969, 1952, 1951, 1922, 1967, 1944, 1938, and 1960, respectively. By relating the recorded peak elevations of 555.81 and 552.80 feet (NGVD 1929) to an elevation-frequency curve for this gage, the 1965 and 1973 floods are estimated to have recurrence intervals of 30 and 10 years, respectively.

No gaging records are available for Mad Creek and other tributaries to the Mississippi River which flow through Muscatine. Flooding along Mad Creek and the lower end of Geneva Creek has been a serious problem in areas which are unprotected. The upstream ends of Mad and Geneva Creeks have caused only minor flood damages in the past since the areas are in the early stages of development. Flooding along Mad and Geneva Creeks is significantly affected by such factors as hydraulic constrictions caused by bridges, culverts, debris and ice jams, and poorly maintained, clogged channels. Damages due to sewer back-up into basements during flood conditions have also occurred in the past in Muscatine, particularly due to the utilization of combined sewers.

2.4 Flood Protection Measures

Flood hazards in southern Muscatine are greatly reduced by an earthen levee, often referred to as the Muscatine Island Levee, which parallels the Mississippi River extending southward from about River Mile 455 into Louise County. The COE has recently proposed that this levee be raised by about four feet to provide for additional flood protection (Reference 2). Though this levee will hold the 100-year flood with one to one and a half feet of freeboard, the 500-year flood would top the levee by two and a half to three feet. Time of construction of this project is uncertain, and this proposed increase in levee height was not considered when evaluating the flood potential existing in southern Muscatine.

An area of Muscatine located immediately west of Mad Creek near its confluence with the Mississippi River is presently protected against flood events less severe than the 100-year flood by a levee consisting of a combination of earthen dikes and concrete floodwalls and commonly referred to as the Mad Creek Levee.

The COE has proposed a northwesterly extension of this levee to provide further protection from flooding from Mad and Geneva Creeks to a major industrial area (Reference 3). This construction has not yet begun and therefore the project was not considered in evaluating existing flood hazards in the proposed area of protection.

The City of Muscatine currently has mapped flood plain and floodway zones along Mad Creek and the Mississippi River within the old corporate boundaries and has adopted zoning ordinances regulating development in zones much in line with the present requirements of the FIA. In consideration of the area that has been annexed since the preparation of the previous zoning map, the City of Muscatine is planning to update their zoning map and ordinance with respect to this report and the requirements of the FIA to further their flood plain management program.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10, 50, 100, and 500 years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the drainage areas of the streams.

3.1 Hydrologic Analyses

In addition to the review of the results of hydrologic analyses presented in previous reports, additional hydrologic data were collected and computations made as necessary to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

The COE has previously made extensive hydrologic studies (Reference 4) of the Mississippi River for utilization in evaluating flood potential and analyzing and designing flood control projects. The peak discharge-frequency data presently being used evolved from statistical correlations of twelve gaging stations in the Upper Mississippi River Basin and from log-Pearson Type III (Reference 5) distributions of annual peak flow data. Several of these gaging stations have records of about 100 years. The 10-, 50-, 100-, and 500-year peak discharges for the Mississippi River at Muscatine are 250, 338, 380, and 480 thousand cubic feet per second (cfs),

respectively. In comparison, the maximum historical peak discharge at Muscatine occurred in April 1965 and is estimated to be about 310 thousand cfs from a stage-discharge curve for the Muscatine gage. The drainage area at this gage is about 99,400 square miles.

The peak discharge-frequency data for the tributaries of the Mississippi River which were studied in detail were derived from a regional analysis of peak discharges for bluff drainage along the Mississippi River as performed by the COE (Reference 6). The basis of the study was a log-Pearson Type III distribution of annual peak flow data for 34 gaging stations located along the bluff of the Mississippi River within the boundaries of the Rock Island District. Application of the results of the preliminary study has been limited to unregulated watersheds without either significant artificial or natural basin storage, located within 25 miles of the Mississippi River and within the Rock Island District boundary, and having drainage areas between 0.5 and 300 square miles. The primary results of this study were relationships between peak discharge and drainage area for various frequencies, which were used to estimate the 10-, 50-, 100-, and 500-year discharges for the tributaries of the Mississippi River which were studied in detail. These relationships, as well as the drainage area range for each tributary studied, are summarized in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
MISSISSIPPI RIVER					
At Muscatine Gage	99,400	250,000	338,000	380,000	480,000
MAD CREEK					
At mouth (Mississippi River)	17.50	3,140	6,100	7,700	12,100
Above Geneva Creek confluence	14.00	2,780	5,370	6,820	10,800
Northern corporate limits	9.50	2,240	4,390	5,600	8,950
GENEVA CREEK					
At mouth (Mad Creek)	2.90	1,140	2,330	3,020	4,960
Bidwell Road	2.25	1,000	2,050	2,670	4,410
Northern corporate limits	1.22	715	1,500	1,960	3,280

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams studied in detail in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these streams.

Water-surface profiles for the 10-, 50-, 100-, and 500-year floods on the Mississippi River were obtained from previous analyses performed by the COE (References 7 and 8), which were based on historical peak flood stage data and index station rating curves along the Mississippi River. Flood profiles for Mad Creek and Geneva Creek were developed using the HEC-2 computer backwater model (Reference 9), with the Mad Creek profiles being coordinated with those previously established by the COE (Reference 10).

In addition to the peak flood discharge data discussed in the preceding section, channel and valley cross sections, bridge and culvert geometry, and roughness coefficients comprise the basic input data needed for the HEC-2 computer backwater model. Channel and immediate overbank cross section data for Mad and Geneva Creeks were developed by field surveys, with most of the Mad Creek cross sections being obtained from the COE. These surveyed cross sections were extended as necessary through the stream valley using a topographic map having a two-foot contour interval and a scale of 1"=100' (Reference 11). All bridges and culverts were surveyed to obtain elevation data and structural geometry. Roughness coefficients (Manning's "n") for Mad and Geneva Creeks were estimated to be about 0.06 for the overbanks and to range from 0.035 to 0.040 for the channels, based on field reconnaissance and previous analyses performed by the COE. The starting water-surface elevations for Mad Creek consisted of the water-surface elevations for the Mississippi River at the point of confluence which corresponded to ten percent of the recurrence interval being studied on Mad Creek. For Geneva Creek, the water-surface elevations for Mad Creek at the point of confluence and for the same frequency flood were used as the starting water-surface elevations.

The approximate study methods used to delineate the flood hazard areas along the West Fork of Mad Creek and Papoose Creek consisted of estimating the flood depths using Manning's equation and approximated cross sections derived from topographic maps. These estimated flood depths then became the basis for mapping the flood hazard areas on topographic maps. Shallow flooding below Fulliam Avenue is due to an inadequate culvert above Fulliam Avenue on Papoose Creek. Depths were estimated using Manning's equation on approximated cross sections derived from topographic maps.

The water-surface profiles for floods on the Mississippi River, Mad Creek, and Geneva Creek are illustrated on the Flood Profiles (Exhibit 1). These profiles drawn to the nearest 0.5 foot represent the peak flood elevation on National Geodetic Vertical Datum of 1929 (NGVD 1929) '(formerly referred to as mean sea level datum with 1929 general adjustment) plotted against stream distance measured along the centerline of the stream channel. The elevations along the Mississippi River can be converted to mean sea level datum (1912 adjustment), which was used for the Mississippi River profiles previously published by the COE, by adding 0.47 feet to the NGVD 1929 elevations. Furthermore, the NGVD 1929 elevations can be converted to the City of Muscatine datum by subtracting 249.12 feet. Elevation reference marks used in the study are shown on the maps. The Mad and Geneva Creek profiles do not consider debris or ice jam effects, if such could occur at bridges, culverts, or natural constrictions. The profiles are also based on non-coincidence of equal frequency floods on the Mississippi River and Mad Creek, since the statistical probability of such coincidence is beyond the scope of this analysis.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps having scales of 1:600, 1:1,200, and 1:24,000, with contour intervals of one foot, two feet, and ten feet, respectively (References 11, 12, and 13). In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

For the areas studied by approximate methods, the 100-year flood boundary was delineated on the topographic maps using rough estimates of the 100-year flood elevations. The 100-year and 500-year flood plain boundaries are illustrated on the Flood Boundary and Floodway Map for Muscatine (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations, and therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

It should be noted that, in southern Muscatine, the 100-year flood boundary follows the alignment of the Muscatine Island Levee and that all of the leveed area is shown as a moderate flood hazard area (Zone B) because of the protection offered by the levee. As can be seen on the Mississippi River profile, the 100-year flood is 1.0-1.5 feet below the top of the levee, whereas the 500-year flood would overtop the existing levee by about 2.5-3.0 feet. Additionally, the levee height would most probably be raised during emergency flood-fighting measures.

The area protected by the existing Mad Creek levee is shown as a Special Flood Hazard Area (Zone A13) since the existing levee has no freeboard above the 100-year flood and does not have a structural tie-off on the south end. Therefore, this area is considered subject to flooding from the 100-year flood; however, it is protected from lesser magnitude floods (i.e. 10- and 25-year).

The sheet flow area along the Papoose Creek storm sewer (Zone B) represents that area that could conceivably be inundated to shallow depths (averaging 1 foot or less) during a 100-year flood event. The existing combined sewer has the capacity to convey up to about the 10-year flood discharge. With greater floods, a portion of the flood waters will flow overland to the Mississippi River. The area shown is an estimate of where the sheet flow would occur; however, structures outside this area could suffer damages resulting from sewer back-up in basements where the drains are not properly plugged or valved to prevent such back-up.

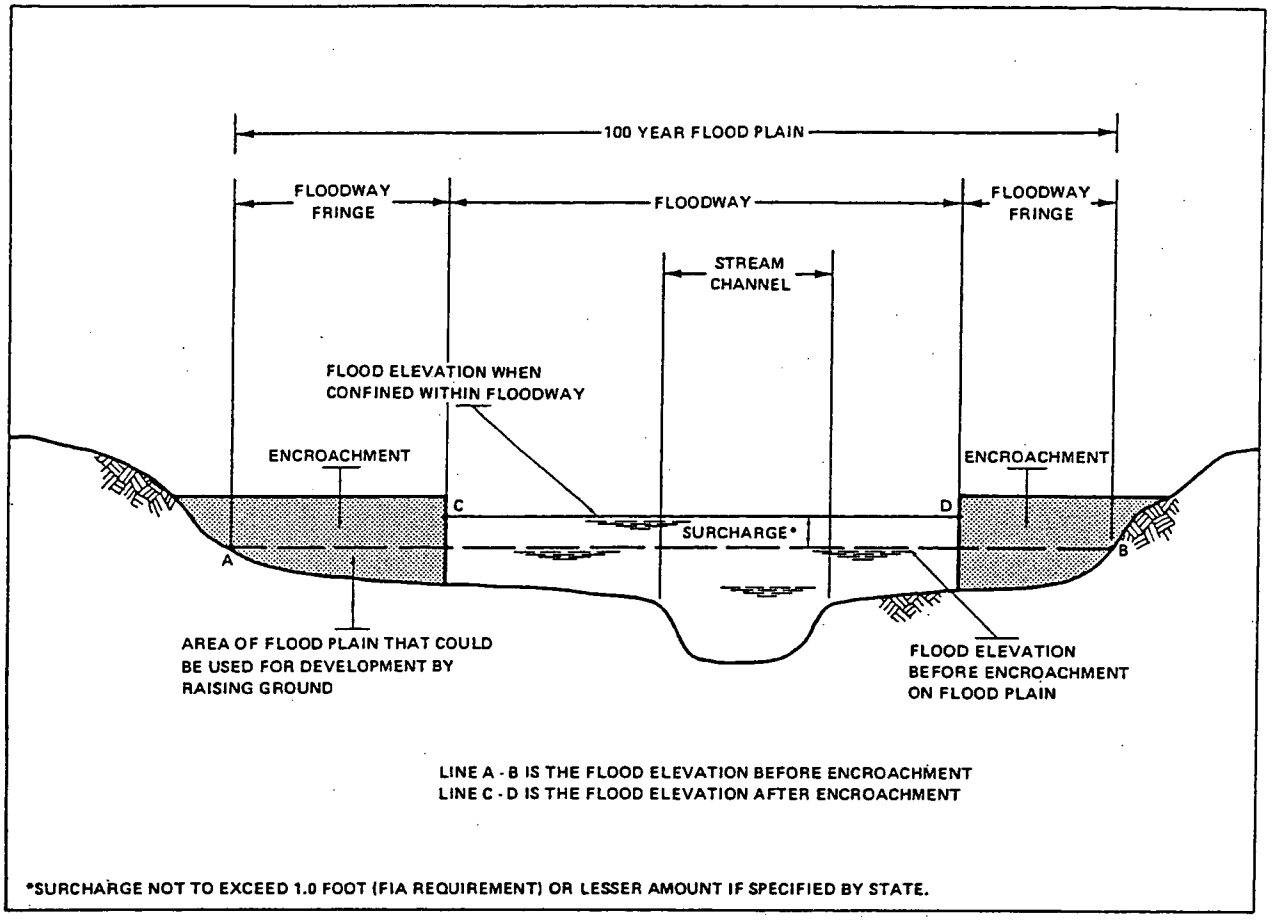
4.2 Floodways

Encroachment on flood plains, such as roadway and areal fill and construction of above-ground structures, reduces the flood-carrying capacity of the flood plain, increases the flood heights of the

streams and increases flood hazards both at and upstream from the encroachment location. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazards. For the purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under the floodway concept, the area inundated by the 100-year flood is divided into a floodway and floodway fringe (see Figure 2). The floodway is the channel of a stream plus a portion of the adjacent flood plain area that must be kept free of encroachment in order that the 100-year flood be carried without substantial increase in the 100-year peak flood elevations. Minimum standards of the FIA limit such increases in flood heights to one foot, provided that hazardous velocities are not produced. The State of Iowa has adopted these standards for flood plain encroachment. The floodways presented herein, therefore, represent the minimum area which should be kept free of encroachment under future flood plain management efforts by the local community. However, the community has the option and may desire to maintain a larger floodway width than presented in this report. The floodway fringe, which is the area between the floodway and the boundary of the 100-year flood plain, represents the portion of the flood plain that could be completely obstructed without increasing the 100-year flood elevations more than one foot at any point. Therefore, filling and building construction could occur in the floodway fringe in the future, providing that any construction of buildings was performed in such a manner to protect them against the 100-year flood hazard and that such land reclamation was feasible to the owner.

For the Mississippi River, the floodway boundary on the Iowa side was based primarily on engineering judgement and previous reports, with input and review by the COE, the Iowa Natural Resources Council, and the City of Muscatine. The floodway boundary was located along existing levee alignments and excluded areas of existing development wherever possible. Although the rise in flood level which would result by excluding the flood fringe from conveying a portion of the 100-year flood discharge was not computed, it is estimated that such a rise would be very small (0.1 foot or less), since very little of the existing flood-carrying capacity will have been removed.

For the 10,000-foot reach of Mad Creek extending upstream from the mouth, a floodway was previously mapped and has been included in the City of Muscatine's zoning ordinance. At the



FLOODWAY SCHEMATIC Figure 2

City of Muscatine's request, this floodway was used in this Flood Insurance Study. The existing floodway was tested using the HEC-2 computer model and met the maximum 1.0-foot rise criteria.

For the remainder of Mad Creek and all of Geneva Creek, floodways were delineated at the stream cross sections by the equal reduction in conveyance method using the HEC-2 computer model, with the floodway boundary between cross sections being interpolated using topographic maps. The floodways were then adjusted to minimize undue variances in floodway width and then tested to ensure that they satisfied the maximum 1.0-foot rise criteria. The floodways presented for Mad Creek and Geneva Creek were then reviewed by the Iowa Natural Resources Council and the community of Muscatine during coordination meetings.

The floodway boundaries and the location of selected cross sections are illustrated on the Flood Boundary and Floodway Map (Exhibit 3). Pertinent data for the existing and presented floodways at selected cross sections on Mad and Geneva Creeks are tabulated in Table 2, "Floodway Data." The floodway along Mad Creek was evaluated with a coincident 10-year flood level on the Mississippi River; therefore, the 100-year flood elevations given for Mad Creek cross sections "A" through "G" in Table 2 are lower than the 100-year elevations shown on the flood profile for Mad Creek, which reflects backwater for the 100-year flood on the Mississippi River. The floodways were delineated and evaluated without consideration of possible debris or ice jamming, which could occur at bridges, culverts, and natural constrictions. In cases where the boundaries of the floodway and the 100-year flood are close together or are colinear, only the floodway boundary has been shown.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source affecting the City of Muscatine.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. For a given reach, this difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach length.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

Seven reaches meeting the above criteria were required for the flooding sources of Muscatine. These included one on the Mississippi River, two on Geneva Creek, and four on Mad Creek. The locations of the reaches are shown on the Flood Profiles (Exhibit 1).

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD 1929)	WITHOUT FLOODWAY (NGVD 1929)	DIFFERENCE (FT.)
Mad Creek							
A	0.35	160	1,712	4.50	554.4	553.4[2]	1.0
B	0.65	110	1,388	5.55	554.9	553.9[2]	1.0
C	1.25	260	1,649	4.67	555.7	554.8[2]	0.9
D	1.90	180	1,649	4.67	556.0	555.1[2]	0.9
E	2.57	350	3,363	2.29	557.4	556.8[2]	0.6
F	2.92	480	4,200	1.83	557.5	556.9[2]	0.6
G	4.02	490	1,960	3.93	559.0	558.7[2]	0.3
H	5.07	100	739	10.42	560.3	560.2	0.1
I	5.82	100	681	11.31	564.2	564.1	0.1
J	6.60	220	1,197	5.70	569.3	569.2	0.1
K	8.03	340	1,332	5.12	571.8	571.6	0.2
L	9.40	460	1,248	5.46	574.7	574.5	0.2
M	10.35	290	947	6.87	578.3	578.2	0.1
N	11.72	160	1,066	6.11	583.9	583.1	0.8
O	13.06	130	824	7.90	587.9	587.4	0.5
P	14.24	100	649	8.63	594.5	593.5	1.0
Q	15.80	180	945	5.93	602.6	601.6	1.0
R	17.30	200[3]	835	6.71	606.7	605.8	0.9

[1]THOUSANDS OF FEET ABOVE MOUTH

[2]WATER-SURFACE ELEVATIONS WITHOUT CONSIDERING MISSISSIPPI RIVER BACKWATER

[3]PORTION OF FLOODWAY IS LOCATED OUTSIDE CORPORATE LIMITS

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

FLOODWAY DATA

MAD CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD 1929)	WITHOUT FLOODWAY (NGVD 1929)	DIFFERENCE (FT.)
Geneva Creek							
A	0.25	70	436	6.93	565.1	564.4	0.7
B	1.40	75	575	5.25	568.2	567.3	0.9
C	2.25	65	459	6.58	569.8	568.8	1.0
D	5.72	70	434	6.96	587.1	586.1	1.0
E	7.80	70	368	7.26	600.4	599.7	0.7
F	9.92	60	434	6.15	611.5	610.5	1.0
G	13.51	40	236	8.31	628.5	627.8	0.7
H	14.95	40	180	10.89	642.1	642.0	0.1

[1]THOUSANDS OF FEET ABOVE MOUTH

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

FLOODWAY DATA

GENEVA CREEK

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of Muscatine was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Area inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown, or FHFs determined.
Zones A5, A6, A9, A13:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between Zones A5, A6, A9, A13, and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; and areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot. Zone B is not subdivided.

Zone C: Area not subject to flooding by the 500-year flood. Zone C is not subdivided.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Muscatine is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

5.5 Estimate of Structures

Estimates of the number of structures of various types that are located within Special Flood Hazard Areas (SFHA) in the City of Muscatine are shown below:

Structural Type	Detailed SFHA	Approximate SFHA
1. One- to four-family units	64	3
2. Multi-family units	0	0
3. Small businesses	77	0
4. All others	8	0

6.0 OTHER STUDIES

A Flood Plain Information report for the Mississippi River was completed in 1969 for Scott and Muscatine Counties in Iowa and Rock Island County in Illinois by the COE (Reference 7). The hydrological data and flood profiles upon which this report was based were reviewed and found to be compatible for use in this Flood Insurance Study. Two recent project reports, one for flood control along Mad Creek in Muscatine (Reference

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3]
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Mississippi River							
Reach 1	0001A-0002A	-6.5	-2.0	+4.3	065	A13	Varies
Mad Creek							
Reach 1	0001A	-4.7	-1.7	+3.6	045	A9	Varies
Reach 2	0001A	-2.8	-0.9	+1.8	030	A6	Varies
Reach 3	0001A	-4.3	-1.2	+4.4	045	A9	Varies
Reach 4	0001A	-2.4	-0.8	+2.8	025	A5	Varies
Geneva Creek							
Reach 1	0001A	-4.3	-1.3	+2.9	045	A9	Varies
Reach 2	0001A	-2.6	-0.9	+2.3	025	A5	Varies

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT– SEE MAP

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

FLOOD INSURANCE ZONE DATA

MISSISSIPPI RIVER, MAD CREEK AND GENEVA CREEK

3) and one for additional flood protection for the Muscatine Island Levee District (Reference 2) were also reviewed for consideration in the preparation of the Flood Insurance Study.

In 1972, the COE completed a flood hazard investigation of Mad Creek upstream of Clay Street (Reference 9). The pertinent input data and results of this study were reviewed and found to be technically sound. However, the flood profiles published herein are slightly lower, due to the fact that the flood discharges for Mad Creek were based on a study of Mississippi River bluff drainage recently completed by the COE and are lower than those used in the previous study. The new profiles for Mad Creek were discussed with the COE and agreed upon.

In view of the fact that all known conflicts between the results of this study and those of previous studies have been resolved, the data presented in this report either supersede or are compatible with previous determinations. Therefore, this study is authoritative for the purposes of the Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study will be on file through December 1981, at the office of DeWild Grant Reckert & Associates Company, Consulting Engineers-Architects, 315 First Avenue, Rock Rapids, Iowa 51246.

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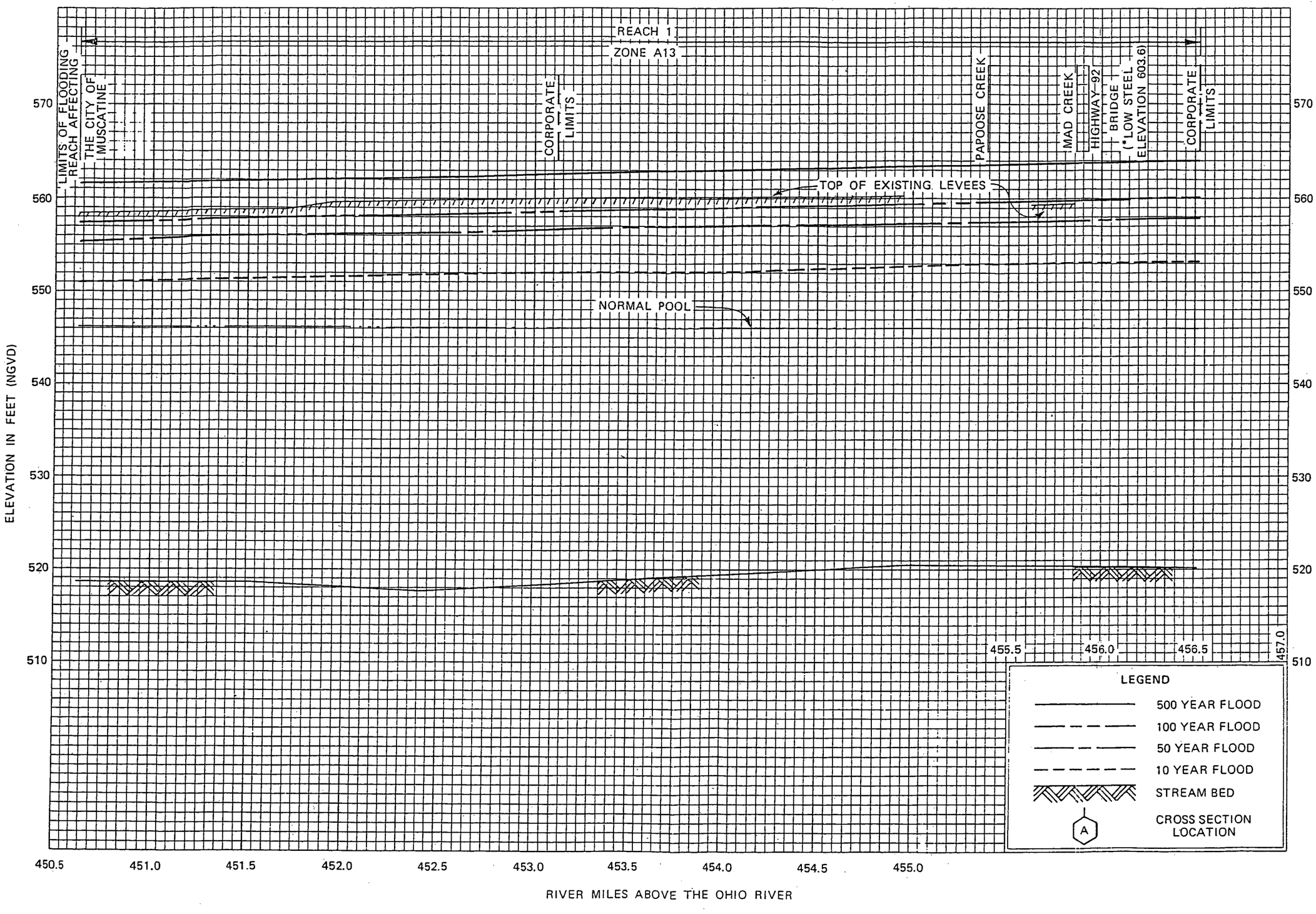


FLOOD PROFILES

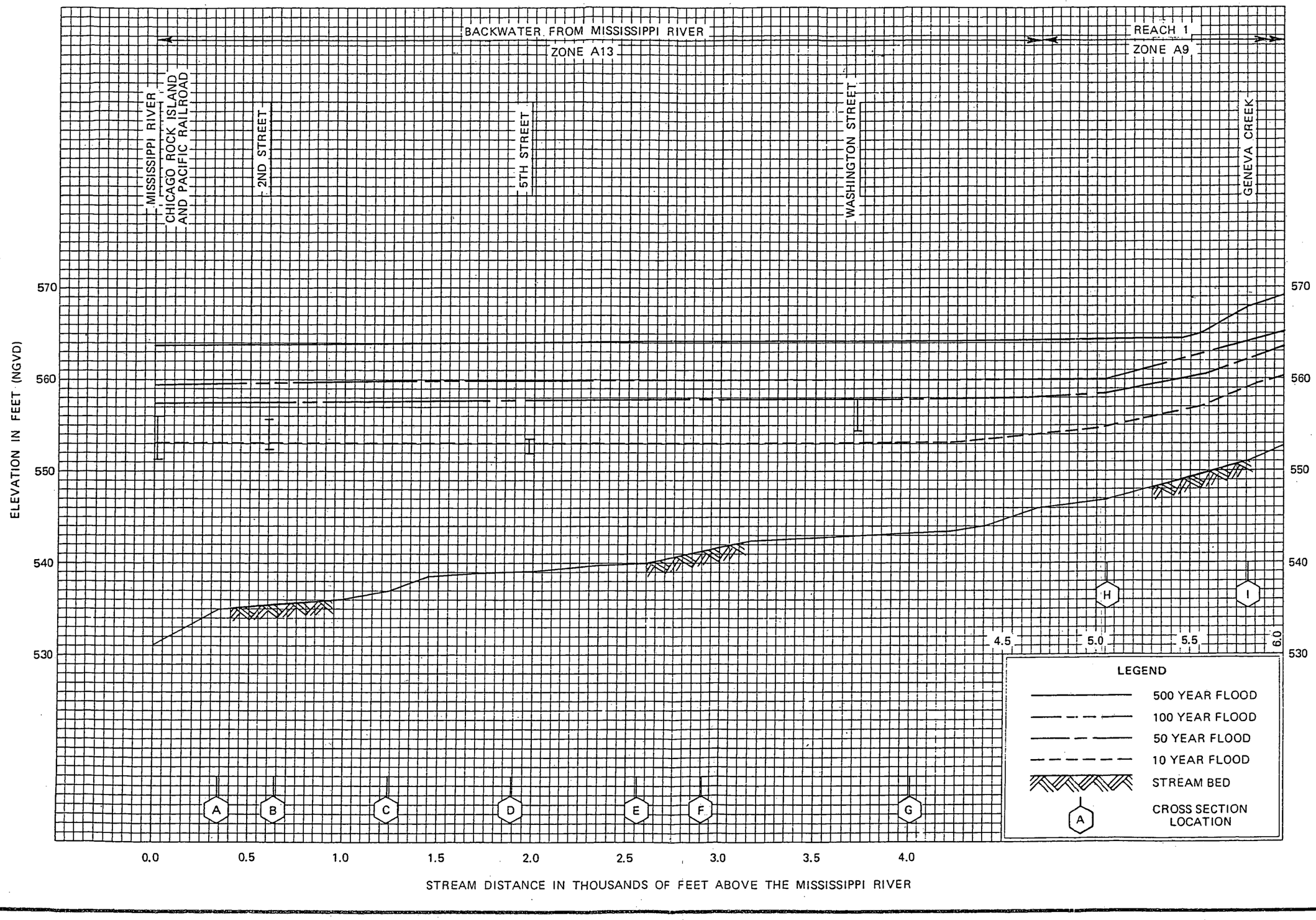
MISSISSIPPI RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

01P

EXHIBIT 1



FLOOD PROFILES

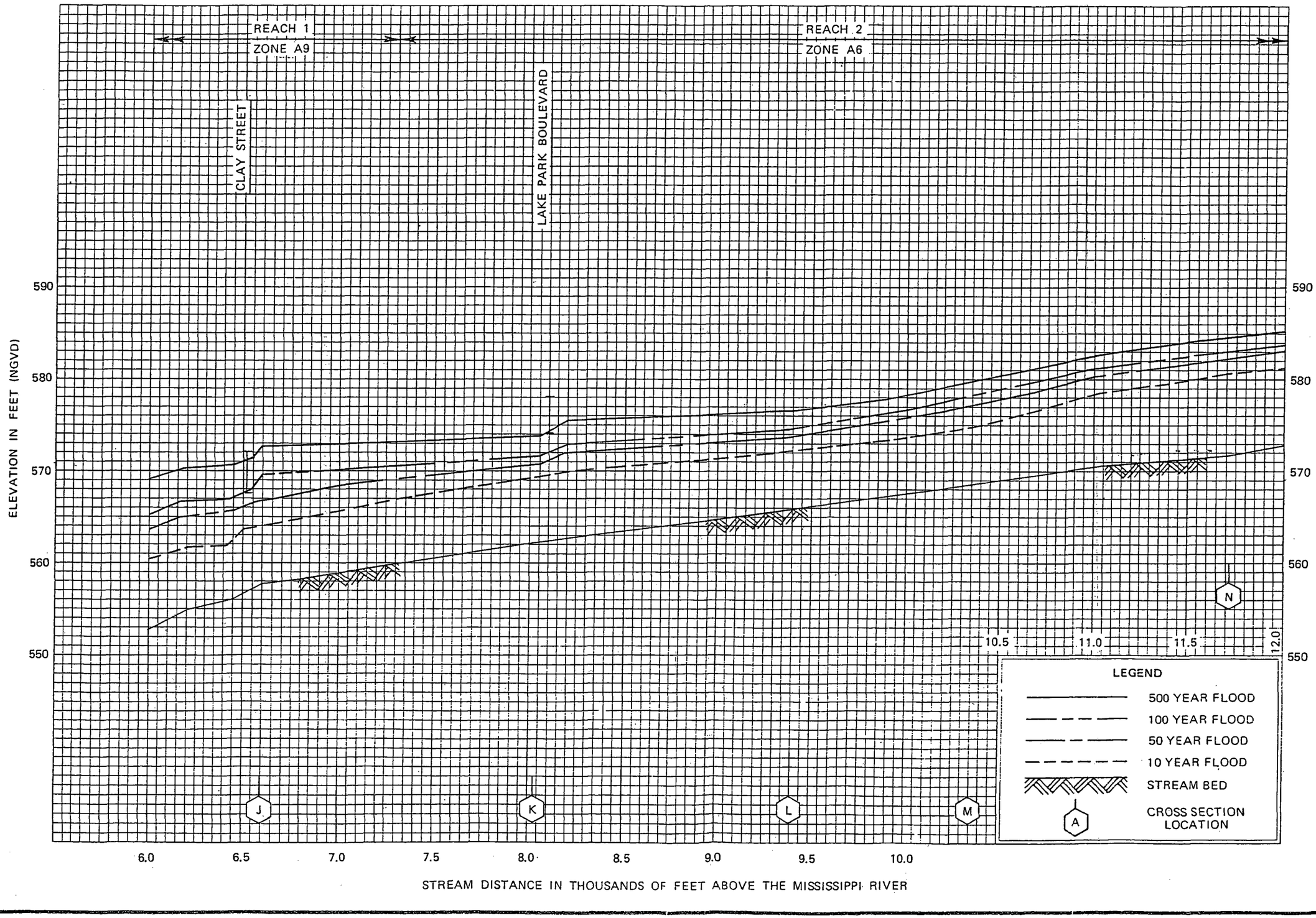
MAD CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

02P

EXHIBIT 1



FLOOD PROFILES

MAD CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

03P

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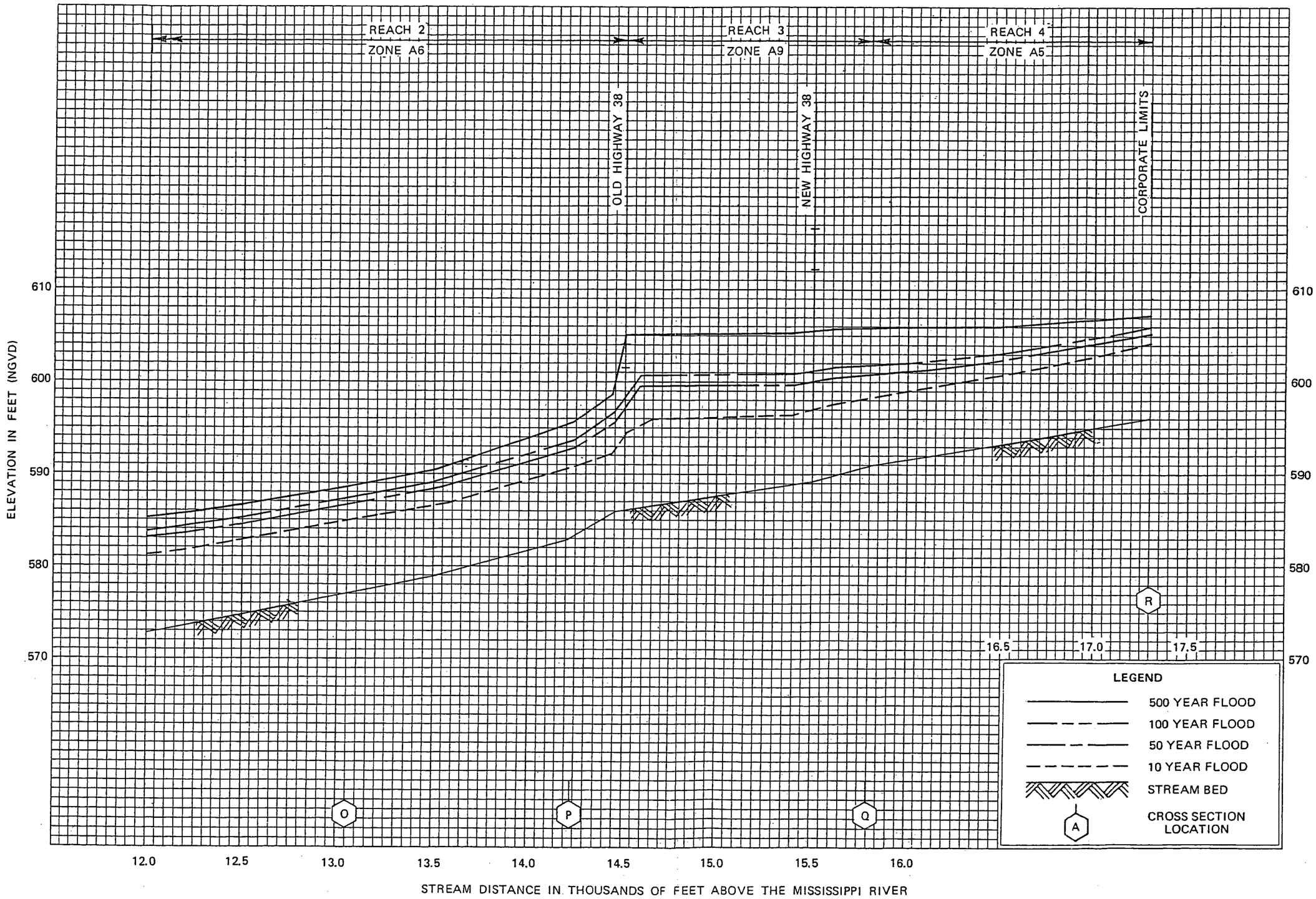

FLOOD PROFILES

MAD CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

04P

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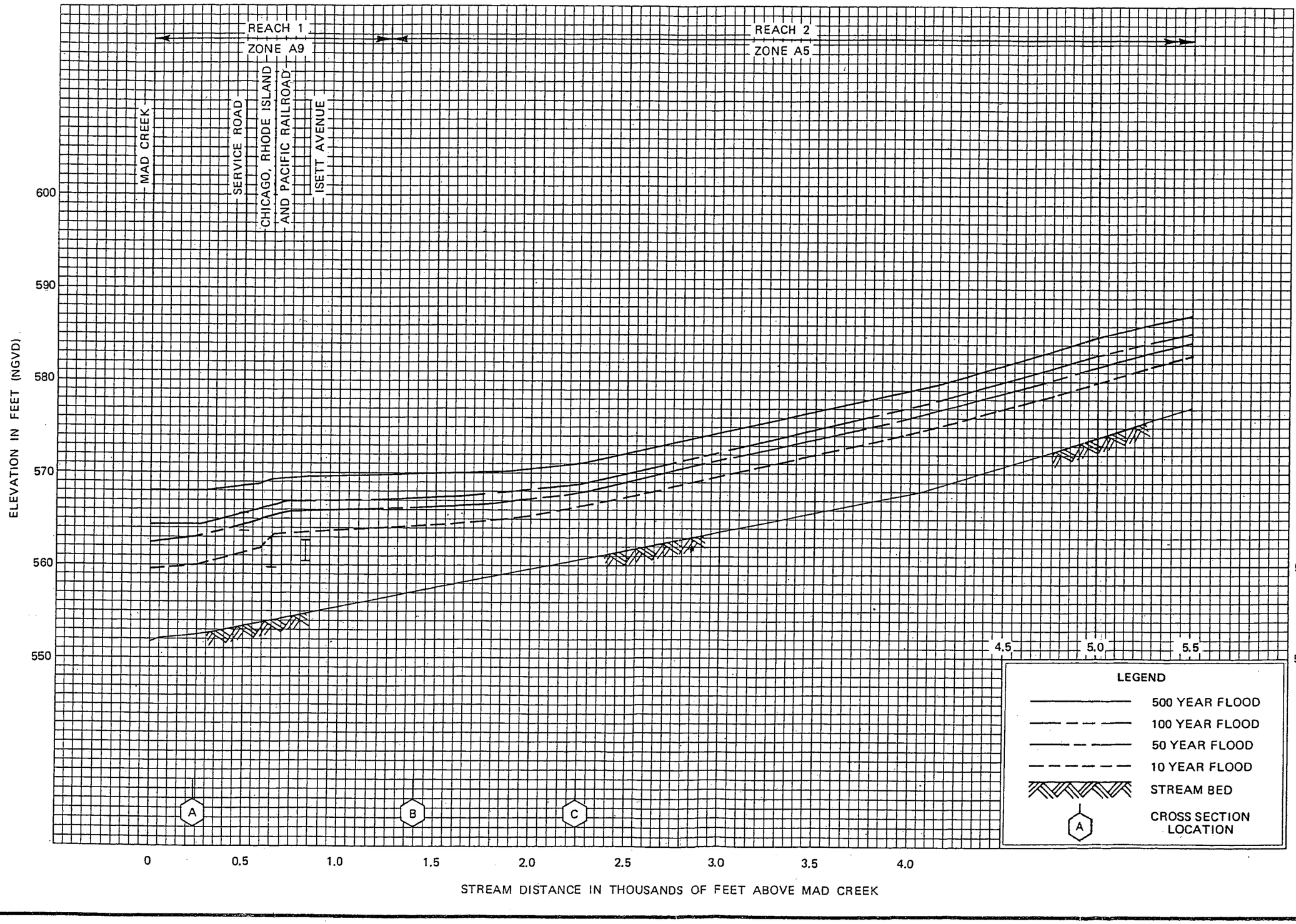

FLOOD PROFILES

GENEVA CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

05P

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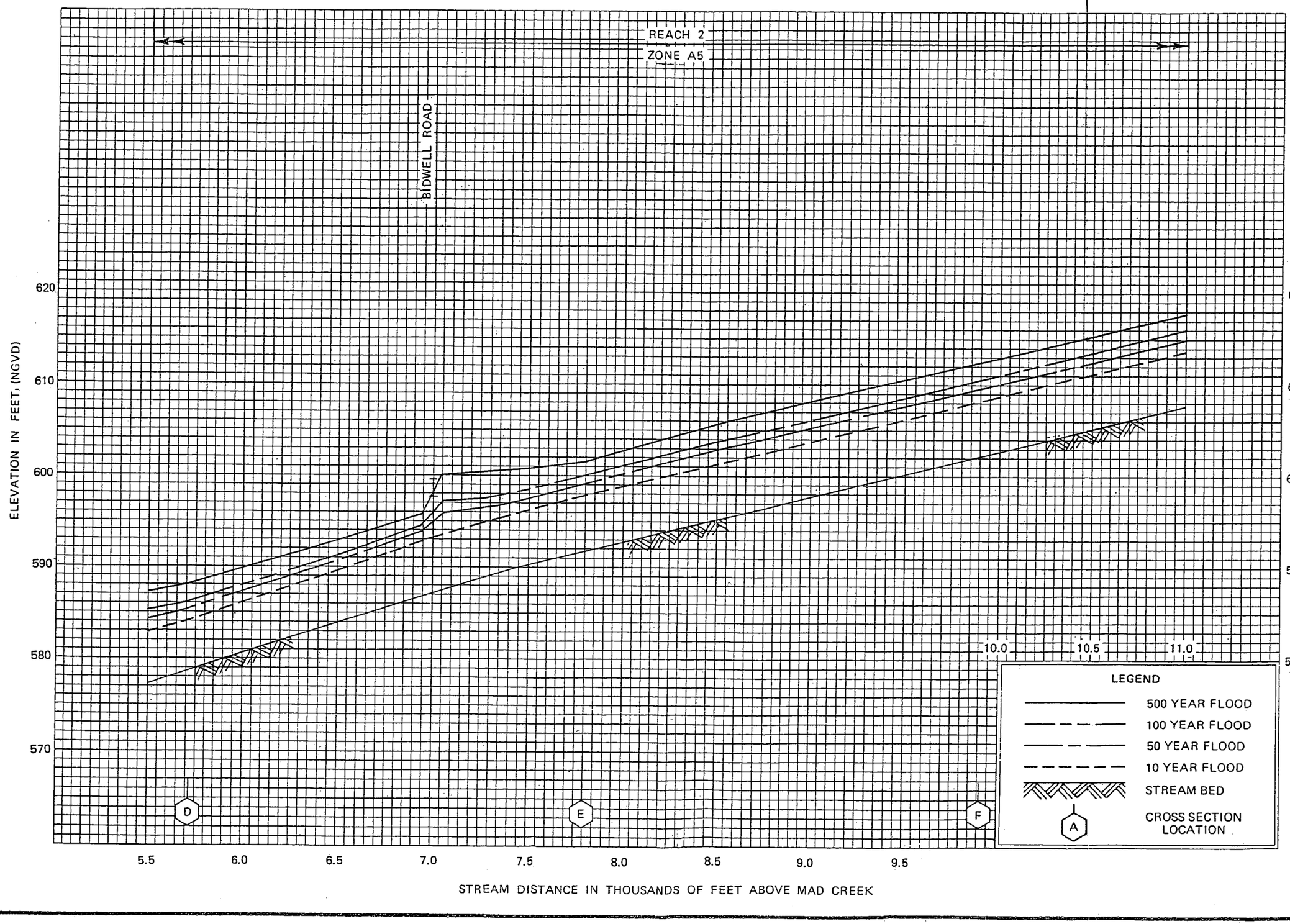

FLOOD PROFILES

GENEVA CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

06P

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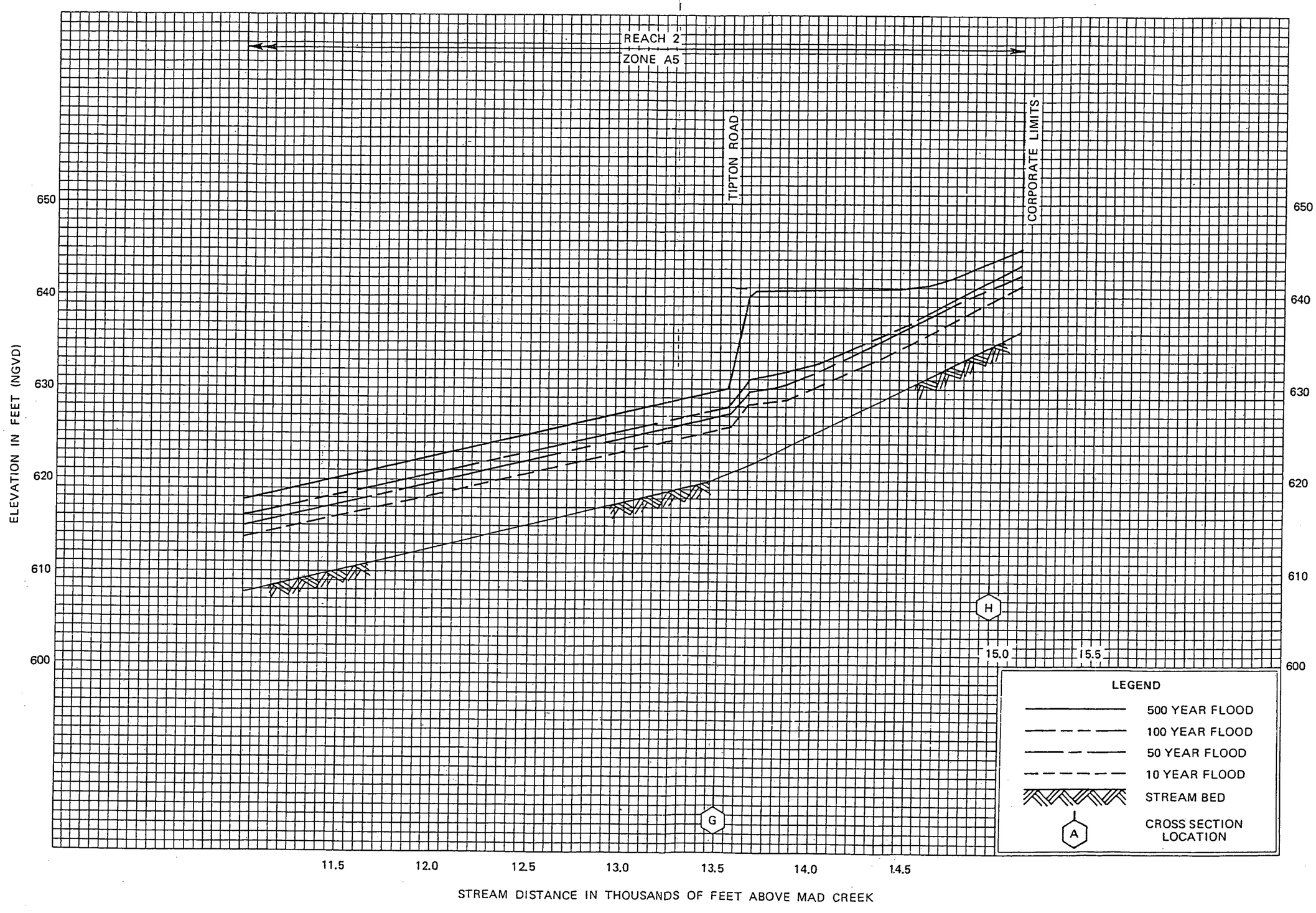

FLOOD PROFILES

GENEVA CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF MUSCATINE, IA
(MUSCATINE CO.)

07P

EXHIBIT 1