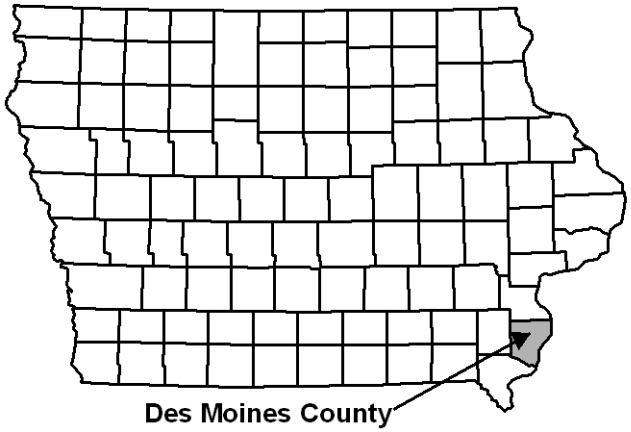
FLOOD INSURANCE STUDY

DES MOINES COUNTY, IOWA AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
BURLINGTON, CITY OF	190114
DANVILLE CITY, OF	190115
DES MOINES COUNTY UNINCORPORATED AREAS	190113
*MEDIAPOLIS, CITY OF	190615
*MIDDLETOWN, CITY OF	190778
WEST BURLINGTON, CITY OF	190682

* No Special Flood Hazard Areas Identified.



Preliminary

February 7, 2014

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
19057CV000B

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map Repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

Selected Flood Insurance Rate Map panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone(s)	New Zone
A1 through A30	AE
B	X (shaded)
C	X

Initial Countywide Effective Date: August 2, 2011
Revised FIS Report Date: TBD

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FLOOD INSURANCE STUDY

DES MOINES COUNTY, IOWA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and supersedes the FIS reports, Flood Insurance Rate Maps (FIRMs), Flood Boundary and Floodway Maps in the geographic area of Des Moines County, Iowa, including the Des Moines County Unincorporated Areas and the Cities of Burlington, Danville, Mediapolis, Middletown, and West Burlington and aids in the administration of the National
Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This
study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by Des Moines County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

The Cities of Mediapolis and Middletown are communities with no special flood hazard areas identified.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

The Digital Flood Insurance Rate Maps (DFIRMs) and FIS Report for this countywide study have been produced in digital format. Flood hazard information was converted to meet the Federal Emergency Management Agency (FEMA) DFIRM database specifications and Geographic Information System (GIS) format requirements. The flood hazard information was created and is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community.

1.2 Authority and Acknowledgments

The sources of authority for this countywide FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

Redelineation of previously effective flood hazard information for the 2011 FIS report and accompanying FIRMs, correction to the North American Vertical Datum of 1988 (NAVD 88), as well as conversion of the incorporated areas of Des Moines County into Countywide Format was performed by Stantec Consulting Services, Inc. for the Federal Emergency

Management Agency under Contract No. HSFE05-05-D-0026, Task Order No. HSFE07-08-J-0001. This work was completed in October, 2009.

Information pertaining to the authority and acknowledgements for the previously effective FIS report and new floodplain studies for communities within Des Moines County was compiled for this FIS report and is shown below.

Des Moines County Unincorporated Areas	The previously effective FIS report for Des Moines County is dated August 17, 1981. The hydrologic and hydraulic analyses for that study were performed by Shive-Hattery & Associates for FEMA under Contract No. H-4748. That study was completed in March 1980.
Burlington, City of	The previously effective FIS for the City of Burlington is dated August 17, 1981. The hydrologic and hydraulic analyses for that study were performed by Shive-Hattery & Associates for FEMA under Contract No. H-4748. That study was completed in October 1979.
New Detailed Studies:	The hydrologic and hydraulic analyses for the Mississippi River were performed by USACE as part of the Upper Mississippi River System Flow Frequency Study (UMRSFFS) (Reference 3). This study was a collaboration of effort between the Rock Island, St. Louis, Kansas City, Omaha, and St. Paul districts and was completed in 2003. The 1-percent-annual-chance flood water surface profile and floodway computations on the Mississippi River were performed within HEC-RAS for FEMA under Interagency Agreement No. EMW-2002-IA-0114 by the St. Paul, Rock Island, and St. Louis districts and were completed in 2004. The floodplain mapping for the Mississippi River was performed by Watershed Concepts for FEMA under Interagency Agreement No. HSFE07-07-C-0022.
New Approximate Studies:	New approximate hydrologic and hydraulic analyses for 112 stream reaches in Des Moines County were performed for this study by Fuller Mossbarger Scott and May Engineers (FMSM) (presently Stantec Consulting Services, Inc.) for FEMA under Contract No. EMK-2001-CO-2018, Task Order No. TO0034. This study was completed in April 2007 using the methodology reported in “Hydrologic Report: Development of Updated Flood Hazard Data for Des Moines County” by FMSM dated December, 2006 (Reference 4) and in “Hydraulic Report: Development of Updated Flood Hazard Data for Des Moines County” by FMSM dated March 30, 2007 (Reference 5). Study reaches included reaches with existing effective approximate flood hazards and additional reaches with

drainage areas of greater than 1 square mile. An addendum was also submitted in August of 2007 for 11 of the study reaches to show the area of inundation due to non-accredited levee systems. Additional new approximate hydrologic and hydraulic analyses were performed by Stantec for eleven streams behind the Mississippi River Levee. The engineering findings were summarized in a letter report dated March 6, 2009 and submitted to FEMA.

Revision: New flooding for the Mississippi River shown on the revised panels includes the interior drainage and remove the levee PAL note to Accreditation.

Light Detection and Ranging (LiDAR) data with 1.4 meter spacing was provided by the Iowa Department of Natural Resources (IDNR) (Reference 1). The coordinate system used for the production of this DFIRM is State Plane Iowa South 1402 Feet, North American Datum 1983, Lambert Conformal Conic Projection. Differences in the datum and projection system used in the production of DFIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on this DFIRM.

1.3 Coordination

The purpose of an initial Consultation Coordination Officer's (CCO's) meeting is to discuss the scope of the FIS. A final CCO meeting is held to review the results of the study. The dates of the initial and final CCO meetings held for the previous FIS reports covering the geographic area of Des Moines County Unincorporated Areas and the City of Burlington, Iowa are shown in Table 1. The initial and final CCO meetings were attended by representatives of FEMA, the study contractor, and local public interests.

TABLE 1. CCO MEETING DATES FOR PRE-COUNTYWIDE FIS

COMMUNITY NAME	INITIAL CCO DATE	FINAL CCO DATE
DES MOINES COUNTY (UNINCORPORATED AREAS)	April 4, 1978	March 4, 1981
BURLINGTON, CITY OF	September 14, 1979	August 25, 1980

Source: Reference 1 and 2

The initial CCO meeting for the 2011 countywide FIS revision was held on November 7, 2006 and was attended by representatives of FEMA, the study contractor, and representatives from Des Moines County. The results of the study were reviewed at the final CCO meeting held on November 17, 2009, and attended by representatives of FEMA and Des Moines County, and the study contractor. All problems raised at that meeting have been addressed.

A CCO meeting was not held for this current revision.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Des Moines County, Iowa. All previously effective FIRM panels for Des Moines County have been revised, updated and republished in a countywide format as a part of this FIS. Analyses described herein refer collectively to previous study efforts detailed in Reference 1 and 2. The FIRM panel index, published separately, illustrates the revised FIRM panel layout.

Approximate methods of analysis were used to study those areas having low development potential and/or minimal flood hazards. Approximate studies for the geographic area of Des Moines County, Iowa were performed by FMSM (presently Stantec Consulting Services, Inc.) in 2007. 123 streams with a drainage area larger than 1 square mile were studied using approximate methods. A total of 296 stream miles of approximate study were incorporated. In addition to the previous new Zone A study, eleven streams behind the Iowa River – Flint Creek Levee on the Mississippi River with a total 50 stream miles were studied in this contract through a Special Problem Report (SPR) process.

The areas studied by detailed methods were selected with priority given to known flood hazard areas, areas of projected development and proposed construction. The detailed reaches are summarized in Table 2.

TABLE 2. LIMITS OF DETAILED STUDY

STREAM REACH	STUDY LENGTH (MILES)	LIMIT OF DETAILED STUDY
Flint Creek	3.7	from its mouth at the Mississippi River to a point about 3,150 feet upstream of 165th Street
Hawkeye Creek	3.4	from approximately 1,500 feet upstream of Confluence with West Tributary Hawkeye Creek to Approximately 1,400 feet downstream of Northfield Road
Knotty Creek	2.0	from the mouth at Flint Creek to approximately 3,000 feet upstream of 160th Street
Little Flint Creek	4.3	from the mouth to a point about 7,000 upstream of Prairie Grove Road
Long Creek	1.8	from Highway 79 to about 500 feet downstream of E Kellar Drive
Mississippi River	29.9	from the downstream Des Moines/Lee County Boundaries to upstream Louisa/Des Moines County Boundaries
North Branch Spring Creek	2.8	from the mouth to a point 200 feet upstream of Haskell Road
Spring Creek	3.6	from a point about 200 feet upstream of the Burlington Northern Railroad to a point about 1500 feet upstream of Brush College Road
Tributary A	0.7	from the culvert near Gunnison Street to just downstream of Division Street

Source: Reference 1, 2 and 3

The 2011 countywide FIS also incorporated the determination of letters issued by FEMA resulting in map changes (Letters of Map Change, or

LOMCs). All LOMCs in Des Moines County for which information could be found are summarized in the Summary of Map Action (SOMA) included in the Technical Support Data Notebook (TSDN) associated with this FIS update. Copies of the SOMA may be obtained from the Community Map Repository. No Letters of Map Revision (LOMR) were incorporated into this FIS.

2.2 Community Description

Des Moines County, covering a land area of 408 square miles, lies in southeastern Iowa about 50 miles southwest of Davenport and about 135 miles southeast of Des Moines. Des Moines County is bordered by Mercer and Henderson County, Illinois to the east, Lee County, Iowa to the south; Henry County, Iowa to the west and Louisa County, Iowa to the north. The City of Burlington is the county seat and the largest city in Des Moines County (Reference 1). The 1970 population for the unincorporated areas of Des Moines County was 11,477. According to the U.S. Census Bureau, the estimated 2012 population of Des Moines County was 40,340.

Burlington and West Burlington were the only communities in the county with more than 2,500 people at the time of previous FIS (Reference 1). The Iowa Army Ammunition Plant, covering an area of more than 30 square miles west of Burlington, employs nearly 1,400 people (Reference 1). Most of the other industry in the county is in Burlington and immediate environs. The county's 874 farms (Reference 1) cover about 83 percent of the land area. Des Moines County Drainage Districts Nos. 7 and 8 and Louisa-Des Moines County Drainage District No. 4 adjoin the Mississippi River from the northern limits of the county to near Burlington.

Des Moines County is served by U.S. Highways 34 and 61, State Highways 99 and 406, and many county and local roads; the Burlington Northern and the Chicago Rock Island and Pacific Railroads; Mississippi River barge lines; and scheduled air service at Burlington.

The Mississippi River forms the eastern boundary and the Skunk River forms the southern boundary of the county. Flint Creek, draining 148 square miles of the central part of the county, is the principal interior stream. Minor streams, all draining less than 30 square miles, include Hawkeye, Yellow Spring, Spring, Brush, Long, Cedar, Little Flint, Knotty, North Branch Spring, and Cedar Fork Flint Creeks.

Besides the alluvial soils of the Mississippi River bottom land, the Clinton-Keswick-Lindley and the Otley-Mahaska-Taintor Soils Associations occur in Des Moines County. For the most part, these are silt loams derived from loess and, in places, glacial till having moderate to severe erosion hazard. Internal drainage characteristics range from moderate to good in the Clinton-Keswick-Lindley Association and poor to moderate in the Otley-Mahaska-Taintor Association. Alluvial aquifers where water levels are at or above stream surface occur in the Mississippi River bottom lands and along the principle streams. Ground water also occurs in the loess-over-glacial till that covers the upland areas of the county. The Mississippian bedrock aquifers, composed of shales and dolomites, immediately underlie the glacial till and are the most used source of ground water supplies in Des Moines County.Des Moines County has a humid continental climate with cold winters and hot, humid summers. The mean annual temperature is about 51 degrees

Fahrenheit (F.). Extremes of -27 degrees F. and 111 degrees F. have been recorded at Burlington. Normal annual precipitation (1941-70) is about 34 inches, of which about 22 inches falls in the normal crop season (Reference 1). Seasonable snowfall averages about 25 inches.

Residential development has occurred in scattered areas in Des Moines County with the principle development areas being immediately north of Burlington along State Highway 99 and south of Burlington along U.S. Highways 62 and 61. However, it does not appear that significant development in flood plain areas has occurred. Little commercial development has occurred in unincorporated areas in Des Moines County at the time of the previous FIS.

The City of Burlington is located in east-central Des Moines County. It is bordered on the east by the Mississippi River, on the north and south west by the unincorporated areas of Des Moines County and on the west by the City of West Burlington. The city is served by U.S. Highway 34 and U.S. Highway 61; State Highway 99; the Chicago, Rock Island and Pacific Railroad and the Burlington Northern railroad, Mississippi River barge lines, and a municipal airport with scheduled air service. It covers a land area of 13.1 square miles and had a population of 32,366 in 1970, down 0.2 percent from 1960 (Reference 2).

Burlington serves as a wholesale and retail trading center for a multi-county area of Iowa and Illinois. It is also a center of diversified manufacturing. The principal products produced, in order of number of workers employed, are fabricated metal products, electric machinery and equipment, non-electric machinery, furniture and wood products, food products and printing and publishing (Reference 2). There has been considerable industrial expansion in recent years despite the slight loss in population. Many of the workers reside outside the corporate limits of the city. Industrial growth is expected to continue at a moderate rate.

The climate of southeastern Iowa is humid continental. The average annual temperature is 51 degrees Fahrenheit (F.); extremes of -27 degrees F. and 111 degrees F. have been recorded. Average (1941-70) annual precipitation is 34.6 inches, 66 percent of which occurs in the six month period, April through September (Reference 2). Maximum monthly precipitation of 15.10 inches and maximum one-day precipitation of 6.28 inches have been recorded at Burlington (Reference 2). The average winter season snowfall is about 25 inches.

Flint Creek, a stream draining 148 square miles north and west of Burlington, is inside the city for only about 0.7 miles between State Highway 99 to the Mississippi River. Several ravines are deeply entrenched in the hills upon which Burlington is built. These serve as the principal drainage ways for stormwater runoff from the city. Several large trunk sewer lines, carrying sanitary sewage and stormwater, are laid in the downstream reaches of the ravines.

Most of the city is on high ground overlooking the dominant natural feature of the area, the Mississippi River. A narrow riverfront strip and a small flood plain, upstream from the main business district and adjoining Flint Creek, are subject to flooding from the Mississippi River and Flint Creek. South of Flint Creek, thissmall flood plain encompasses an industrial district surrounded by a levee but is vulnerable to significant flood damage if the levees fail or are overtopped. Development within the flood plains for the City of Burlington is moderate, consisting mainly of residential and light industrial.

2.3 Principal Flood Problems

Floods on the Mississippi River have an impact on more people than any other flooding source in the county. At the time of the previous FIS, the greatest damage potential was represented by the riverside industrial facilities in and around Burlington and the rich agricultural lands protected by levees in Drainage Districts Nos. 4, 7, and 8.The drainage districts are low-lying flood plain areas where the land and drainage-ditch gradients are very flat. Significant inundation can occur inside these drainage districts if heavy rains coincide with high water on the Mississippi River. An accurate delineation of the areas subject to this type of inundation is not possible with the available maps because of the extremely flat topography. For the most part, such inundation would be relatively shallow and would not directly affect most dwellings, which are generally located on the highest land on a farm.

Flooding on the Mississippi River at Burlington in April 1973 was the highest at the time of previous FIS since records began in 1878. It coincides with the elevation of the 50-year flood as determined by the USACE (Reference 7). The flood of April-May 1965 was only about 0.5 foot lower than the 1973 flood at Burlington, and was estimated to be a 36-year flood. The April 1973 flood was also the greatest flood of record on the Skunk River. The peak discharge recorded on April 23, 1973, at the gaging station on the Skunk River at Augusta, was about 20 percent greater than the discharge of the 1-percent-annual-chance flood (Reference 7). The recurrence interval for the April 1973 flood is approximately 300-years. Damage potential along the Skunk River is mostly agricultural. A large low-lying undeveloped area at the confluence of the Skunk and Mississippi Rivers is subject to periodic inundation. Severe floods on the interior streams would be caused by thunderstorm rainfall in late spring and summer. Records of flood flows and damages are not available for these streams.

Most of Burlington's flood problems stem from floods on the Mississippi River. The flood of April 1973 was the greatest flood on the Mississippi in 100 years of record at Keokuk, about 40 miles downstream. The stage of the 1973 flood in Burlington was about 1.0 foot lower than the stage for the 1-percent-annual-chance flood as determined by the USACE in 1979 and corresponds to the stage of the 1979 USACE 2-percent annual chance (50-year return period) flood (Reference 8). The second highest flood, in April-May 1965, was only 0.3 foot lower than the 1973 flood in Burlington. Other recent Mississippi River floods that have caused heavy damage occurred in 1951, 1952, and 1960. The largest of these was the 1960 flood. Early floods, with discharges between those of the 1960 and 1965 floods, occurred in 1881, 1888 and 1892. Flood damages, at 1974 prices, for the floods of 1951, 1952,1960,1965, and1973 in the Burlington metropolitan area are estimated as $63,400, $58,300, $125,600, $881,000, and $1,215,400 respectively (Reference 2).

Flint Creek floods have caused very little damage in the City of Burlington. High water on the Mississippi River causes sewers that empty stormwater into the river to back-up. This necessitates basement pumping along Front and Main

Streets and in the downstream business district as far west as Third Street. Problems due to ponding after heavy rainstorms, caused by inadequate drainage, have been reported in several locations in the southwestern part of the city.

2.4 Flood Protection Measures

A system of continuous levees extends along the Mississippi River from the northern limit of Des Moines County to the northern city limit of Burlington. Louisa-Des Moines County Drainage District No. 4, and Des Moines County Drainage Districts Nos. 7 and 8 lie between these levees and State Highway 99. District No. 4 extends to Hawkeye Creek about a mile south of Huron, District No. 7 from Hawkeye to Yellow Spring Creek, and District No. 8 from Yellow Spring Creek to Burlington. The levees along Districts 4 and 7 contained the floods of 1965 and 1973, both of which were lower than the 2-percent annual chance flood in this reach. Considerable ponding was experienced during the April 1973 flood in District No. 7 when heavy rains fell during the flood period coincident with malfunction of one of the large pumps at the pumping station (personal communication, Sherman Smith). District 8 levee was breached during the flood of 1965 causing extensive inundation. Since then, however, District 8 levee, as well as levees in Districts 4 and 7, have been reinforced and improved to provide protection against a 50-year flood with two to three feet of freeboard (Reference 1). The District 8 levee contained the 1973 flood, which was about 0.5 foot higher than the 1965 flood in the District 8 reach.

Levees in the Skunk-Mississippi confluence area provide protection for a belt along U.S. Highway 61 between Spring Creek and the Skunk River. According to the USACE (Reference 9), emergency levees were constructed in the spring of 1969 to protect the industrial district mentioned earlier. This area of about 223 acres is bounded by the Mississippi River, Flint Creek, and the high bluffs on the west. The emergency levee contained the flood of April 1973. The USACE had proposed a project to improve the existing emergency levees, construct new levees along the Mississippi River and Flint Creek, and construct an interior drainage ponding area and pump station for this industrial-commercial area. The proposed levees were to be designed to provide protection against a 0.5-percent annual chance flood, one that has a chance of 0.5 percent of occurring in any year. With the three and four feet of freeboard provided, the protection reaches the level of the standard project flood. The standard project flood was tentatively set at 550,000 cfs by the USACE (Reference 9). At the time of the previous FIS, it was anticipated that construction on the project would begin in May 1980 and be completed by September 1981. The city had plans for the redevelopment of the Mississippi riverfront, improvement of recreational facilities, and the preservation of natural areas using "greenbelt" concepts (Reference 9).

As part of the levee project, a levee was constructed in northern Burlington along the Mississippi River and Flint Creek and named "Burlington Northern Bottoms Levee". Flood hazards were revised to reflect the protection provided by this levee in a Letter of Map Revision (LOMR) dated 09/07/1989 with a Case No. 89-70-33.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in Des Moines County, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for these studies. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance flood in any 50-year period is approximately 40 percent (4 in 10); for any 90 year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of the original study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting Des Moines County. A summary of peak discharges for the 10-, 2-, 1-, and 0.2-percent annual chance (10-, 50-, 100-, and 500-year return period) floods of each flooding source studied in detail in Des Moines County is presented in Table 4. For each stream studied in detail, a hydrologic investigation was performed to generate flow quantities. A description of the derivation of flood discharges for each stream follows.

Major Upper Mississippi River Basin flooding during the 1990s resulted in significant losses, as well as raised questions regarding the frequency of the associated flood events. Reevaluation of the Upper Mississippi River System became necessary to address the questions resulting from the Great Flood of 1993, and was facilitated based on the availability of new topographic data, new computational techniques, and about 20 more years of recorded hydrologic data since the previous study of the Mississippi River had been performed in 1979. This is generally true for the Missouri River as well. The last major effort to comprehensively determine Missouri River flow frequencies was in 1962. The additional record of more than 35 years included the major events of 1993 downstream of Nebraska City and the 1997 large volume flood in the upper reaches of the Missouri River (Reference 6).

The Upper Mississippi River System Flow Frequency Study (UMRSFFS) was undertaken starting in 1998 with the purpose to update the discharge-frequency relationships and associated water-surface profiles for the Mississippi River from St. Paul, Minnesota to the confluence of the Ohio River; for the Illinois River from Lockport, Illinois to its mouth; and for the Missouri River from Gavins Point Dam to its mouth. Five US Army Corps of Engineers Districts participated in the study: Rock Island, St. Louis, St. Paul, Kansas City, and Omaha. The study was completed in 2003 (Reference 3).

The hydrologic analysis for the UMRSFFS utilized a combination of the following methods and approaches to determine discharge-frequency relationships: 100 years of record from 1898 to 1998; the log-Pearson Type III distribution for unregulated flows at gages; main stem flows between gages determined by interpolation of the mean and standard deviation for the annual flow distribution based on drainage area in conjunction with a regional skew; flood control reservoir impacts defined by developing regulated versus non-regulated relationships for discharges; extreme events determined by factoring up major historic events; HEC-HMS and/or HEC-1 models for the main tributaries; and the UNET unsteady flow program to address hydraulic impacts. In situations where historic records were not adequate or appropriate to develop discharge-frequency relationships or to verify the results, hydrologic modeling was used to create synthetic flows based on rainfall. Gage records for all streams were carefully evaluated.

The computation of unregulated flow frequency relationships on the Missouri River upstream of the Kansas River required special consideration due to the combination of the two historic peak flow periods consisting of the plains snowmelt of the early spring and the mountain snowmelt and plains rainfall of the late spring/early summer. An additional concern related to the Missouri River was flow depletion due to irrigation and reservoir evaporation. Historic depletions were added to the observed flow record to help obtain unregulated flows, while historic depletions were adjusted to present level depletions for computation of the regulated flow record.

The result of the hydrologic aspects of the study was a discharge and related frequency of occurrence for stations or given cross section located along each of the principle main stem rivers. More detailed information on each of the hydrologic methodologies used to determine discharges could be found in reference 3.

For Flint, Little Flint, Knotty, Spring, North Branch Spring, Hawkeye, and Long Creeks, the regional flood magnitude-frequency relationships developed by the USGS (Reference 10) were used wherever the drainage area exceeded two square miles. These relationships utilize size of drainage area and channel slope to determine flood discharges for specific recurrence intervals. For streams draining less than two square miles, discharges were determined by methods developed by the SCS in which rainfall and land use are factors (Reference 11). Flood discharges for the areas of approximate study were based on the USGS regional flood magnitude-frequency relationships (Reference 10).

Discharges for Tributary A, were computed by the TR-55 method developed by the SCS (Reference 12). The method involved computation of hydrographs and composite hydrographs using storm-frequency and land-use criteria. For Tributary A, no 2-percent-annual-chance flood frequency was determined because this frequency flood is not essential to the flood hazard factor determination or zone designations previously developed for floodplain mapping. This hydrologic analysis was approved by FEMA.

In the City of Burlington, discharges for a 1-percent-annual-chance flood were computed for many other locations on the drainage ways and large storm sewers in the city. For the open drainage ways, inundation widths were computed to be less than 200 feet permanently and these are not shown. Where storm sewer

capacity is inadequate to carry the 1-percent-annual-chance flood, the approximate path of the excess flow is shown, if the inundation width exceeded 200 feet.

For new approximate study reaches, hydrologic calculations were performed using regression equations presented in *Technique for Estimating Flood Frequency Discharges for Streams in Iowa*, by David A. Eash, United States Geologic Survey (USGS) Water Resources Investigation Report (WRIR) 00-4233. Except the eleven reaches studied in the Addendum, the one-variable regression equation was used for all the new approximate study reaches (Reference 4). One-variable regression equation takes into account of drainage area and a regional factor to determine the peak discharges. The watersheds of the approximate study streams were delineated using USGS 10 foot contours. For the eleven reaches studied in the SPR, three-variable regression equations were used (Reference 4). The three-variable regression equations take into account drainage area, main channel slope, and percent of wetland as well as a regional factor. The watersheds of these eleven reaches were delineated using USACE 4 foot contour mapping.

TABLE 3. SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ. MILES)	PEAK DISCHARGE (CFS) 10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT ANNUAL CHANCE	0.2-ANNUAL
HAWKEYE CREEK					
About 8,400 feet downstream of County Road	4.86	1,500	2,900	3,700	6,000
At County Road, about 7,850 feet downstream of Mediapolis	3.25	1,200	2,300	2,900	4,900
At City of Mediapolis Corporate Limits	1.56	650	900	1,200	1,700
FLINT CREEK					
At mouth	148	7,400	12,400	14,800	21,000
At U.S. Highway 61	125	6,700	11,500	13,500	19,700
At the County Road located about 4.6 miles downstream of County Road H50	93.4	6,100	10,400	12,300	18,000
At County Road H50	63.3	4,600	8,200	10,000	15,000
KNOTTY CREEK					
At mouth	13.9	2,500	4,600	5,700	9,000
About 10,400 feet upstream of mouth	9.8	2,400	4,400	5,400	8,400
LITTLE FLINT CREEK					
At mouth	12.6	2,250	4,200	5,200	8,300
At County Road about 9,000 feet upstream of County Road X40	8.34	1,900	3,600	4,500	7,200
LONG CREEK					
At County Road J20	7.01	1,700	3,200	4,000	6,300
At County Road located about 6,350 feet upstream of County Road J20	4.68	1,400	2,600	3,300	5,200

TABLE 3. SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ. MILES)	PEAK DISCHARGE (CFS) 10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT ANNUAL CHANCE	0.2-ANNUAL
MISSISSIPPI RIVER					
Downstream of Lock & Dam 19	119,000	262,000	331,000	366,000	428,000
MISSISSIPPI RIVER					
Downstream of Lock & Dam 18	113,600	252,000	319,000	347,000	412,000
MISSISSIPPI RIVER					
At Lock & Dam 17	99,600	227,000	291,000	315,00	370,000
NORTH BRANCH SPRING CREEK					
At mouth	6.31	2,000	3,500	4,500	7,000
About 4,850 feet upstream of mouth	4.16	1,400	2,700	3,400	5,500
Just downstream of Haskell Road	2.55	1,100	2,300	2,800	4,800
SPRING CREEK					
At mouth	22.5	3,000	5,400	6,700	10,300
At U.S. Highway 61	14.8	2,400	4,500	5,500	8,700
TRIBUTARY A					
At Gunnison Street	1.65	1,900	-	3,100	3,900
At Plane Street	1.08	1,530	-	2,680	3,400
At Division Street	0.49	640	-	1,080	1,370

Source: References 1 and 2

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristic 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. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

The main hydraulic tool used to determine flood elevations along the Mississippi River was the UNET unsteady flow computer modeling program (Reference 13). Included in the UNET model were the main stem of the Mississippi River, several of its main tributaries, navigation dams, and the levees and levee systems. Hydrographic surveys were assembled from navigation channel maintenance surveys, dam periodic inspection surveys, and environment management project surveys. These surveys date from 1997 or later. For areas where no digital hydrographic surveys were available, such as in some side channels and chutes, depths were estimated from the most current printed surveys available. Bluff-to-bluff digital terrain data collected in 1995 and 1998 were used to supplement the channel survey data. Model development consisted of constructing HEC-RAS

models from the original cross-sections, adding in ineffective flow areas or obstructions as necessary, and then converting the models to UNET (Reference 3).

The UNET (Reference 12) model was calibrated to reproduce recorded flood hydrographs for a selected period of record. The UNET model was calibrated to both stage and discharge at gaging locations primarily by adjusting roughness coefficients and estimated lateral inflows. Annual peak flows and peak stages from the period of record run of the calibrated UNET model were used to develop rating curves for each cross section location. Using these station rating curves and the station frequency flows developed during the hydrology phase, frequency elevation points were obtained for each cross section location. Connecting the corresponding points resulted in flood frequency profiles. These profiles were coordinated among the computational teams and appropriate adjustments were made to assure consistency (Reference 3).

Some special considerations and techniques were required to address especially complex flow reaches. The confluences of the Missouri and Illinois Rivers with the Mississippi relied primarily on development of graphical stage-probability relationships for backwater-impacted cross sections. These were created using a graphical Weibull approach. The graphical period-of-record stage-probability curves were combined to blend a consistent and reasonable profile for each probability flood. Confluences of many other smaller streams with the main stem also exhibited backwater effects resulting in discontinuities in the profiles. A computer routine was developed to smooth the profile in these reaches so as to form a consistent, reasonable transition through the zone of backwater (Reference 3).

The 1-percent-annual-chance water surface elevation profile was calculated using the HEC-RAS 3.1.3 computer program (Reference 14). Upon completion of the UMRSFFS, FEMA funded the Corps of Engineers to compute a floodway for the studied reach of the Missouri River. This floodway determination consisted of converting the hydraulic data from UNET to HEC-RAS, calibrating the HEC-RAS steady-state models to the UMRSFFS results for the 1-percent-annual-chance profile, and performing the floodway computations. The 1-percent-annual-chance elevations from this calibrated HEC-RAS model were used as the basis to delineate the associated 1-percent-annual-chance floodplain and correspond to the base flood elevation shown on the maps. The 10-, 2-, and 0.2-percent-annual-chance elevations shown on the flood profiles were plotted using the original UNET elevations (Reference 3).

The cross section stationing used in the Mississippi River model was based on existing US Army Corps of Engineers River Mile markers of 1960 (Reference 20). The reach length between cross sections is based on a model centerline developed for the HEC-RAS converted model of the Upper Mississippi River System Flow Frequency Study (UMRSFFS) (Reference 3). The distances between cross sections shown in the floodway data table and flood profile were created using the cross section stations based on the 1960 River Miles. While the calculated distance between cross sections using the 1960 River Miles are similar to the measured distance along the model centerline, some differences may occur. This difference in distance does not affect the calculated water surface elevation at each cross section shown on the floodway data table and flood profile, nor does it affect the placement of the BFEs on the map.

For more detailed information on each of the hydraulic methodologies used to calculate flood elevation profiles, the reader is encouraged to consult Reference 6.

Cross sections along Tributary A and Flint Creek were determined by the use of topographic maps at a scale of 1:1200, with contour intervals of two feet (Reference 15). For the rest of the detailed study streams, cross sections for the backwater analyses of the small streams studied in detail were obtained from aerial photographs flown in the spring of 1977, at a scale of 1:9600 (Reference 16). The below-water sections were obtained by field measurement. All bridges and culverts were field checked to obtain elevation data and structural geometry. Backwater analyses were not made for the Mississippi River in this study; profiles prepared by the USACE were used. 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 Flood Insurance Rate Map (published separately).

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. Table 5 shows the ranges of Manning's "n" for streams studied by detailed methods.

For all detailed study streams excluding Mississippi River, Tributary A and Tributary B water-surface elevations of floods of the selected recurrence intervals were computed through use of the USACE HEC-2 step-backwater computer program (Reference 17).

Starting water-surface elevations for Flint Creek were determined with the Mississippi River at the confluence of Flint Creek at normal pool elevations. Starting water surface for Hawkeye and Long Creeks were calculated using critical depth. For other detailed streams except Mississippi River, the water surface elevations from the main stream were used as the starting water surface elevations for the tributaries.

TABLE 4. CHANNEL AND OVERBANK ROUGHNESS (MANNING'S "N") FACTORS

STREAM NAME	ROUGHNESS COEFFICIENT	
	Channel	Overbank
FLINT CREEK	0.04-.0.07	0.04-.0.07
HAWKEYE CREEK	0.025-0.05	0.096-.015
KNOTTY CREEK	0.025-0.05	0.096-.015
LITTLE FLINT CREEK	0.025-0.05	0.096-.015
LONG CREEK	0.025-0.05	0.096-.015
MISSISSIPPI RIVER	0.02 – 0.028	0.03 – 0.12
NORTH BRANCH SPRING CREEK	0.025-0.05	0.096-.015
SPRING CREEK	0.025-0.05	0.096-.015
TRIBUTARY A	0.04-.0.07	0.04-.0.07

Source: Reference 1, 2 and 6

Flood profiles for Flint Creek were computed using HEC-2 (Reference 17). Ponding occurs on Tributary A at Division Street and at the inlet to the trunk storm sewer near Gunnison and Market Streets. Water-surface elevations at these locations were determined by routing inflow hydrographs through the storage areas using stage-storage curves and rating curves for the culverts under Division Street and for the sewer inlet. For the relatively short segment of Tributary A between Division Street and the ponding created at the storm sewer inlet near Gunnison Street, flood elevations were determined by slope-conveyance computations at several sections in the reach.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. In cases where the 2-percent-annual-chance and 1-percent-annual-chance flood elevations are close together, due to limitations of the profile scale, only the 1-percent-annual-chance profile has been shown.

The proposed levee and modified existing levee, south of Flint Creek were considered in this hydraulic analysis. The levee along Mississippi River were not been considered as providing protection at the time of the USACE UMRSFFS study. However, during the production of this FIS, this levee was designated to be Accredited. The floodplain mapping was revised to show the protection from the levee without revising the hydraulic analysis along Mississippi River. Other existing levees were not considered because they are not sufficient to provide protection from the 1-percent-annual chance flood.

New Approximate hydraulic analyses were performed using the USACE Hydraulic Engineering Center River Analysis System (HEC-RAS) computer program (Version 3.1.2). A HEC-RAS hydraulic model was created for each of the 123 study reaches originally scoped and the eleven reaches that were studied in the following SPR. Structural measurements and field survey were not performed. No structures were modeled in the new approximate study.

Cross sections of the approximate study were placed with an average spacing of approximately 2,000 feet. Cross section geometry was derived from 10-foot USGS topographic data developed from 1/3 arc-second Digital Elevation Models (DEMs) except the eleven reaches studied in the SPR. Cross-section geometry for the eleven reaches, with the exception of portions of Hawkeye Creek and Dolbee Creek, was created using 4-ft digital contours supplied by the U.S. Army Corps of Engineers dated 1995 and 1998. Cross-section data for portions of Hawkeye Creek and Dolbee Creek where newer contour data was not available were generated using 10-foot USGS topographic data.

Average roughness factors (Manning's n) for the new approximate study reaches were estimated based on aerial maps. Starting water surface elevation was specified as a known water surface if a downstream water surface elevation could be determined from an effective detailed study or a discharge-elevation curve. If a downstream water surface elevation was not available, starting water surface elevation was assumed to be normal depth.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the NAVD88, many FIS reports and FIRMs are now being prepared using NAVD88 as the referenced vertical datum. It is important to note that the adjacent counties may be referenced to NGVD29. This may result in differences of Base Flood Elevations (BFEs) across the county boundary.

Flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the community must be referenced to NAVD88. Effective information for this FIS was converted from NGVD 29 to NAVD88 based on data presented in Figure 1 and Table 5. An average conversion of -0.177 feet (NGVD29 – 0.177 = NAVD 88) was applied uniformly across the county to convert all effective BFEs and other profile elevations.

3.3.1 Methods for the Mississippi River

The studied reach of Mississippi River spans multiple counties in multiple states, and the river forms the actual border between adjacent counties. The UMRSFFS was originally performed using the NGVD29 vertical datum. Applying an average countywide datum shift to convert to NAVD88 would have resulted in a mismatch of elevations between counties. Therefore, in order to perform the most accurate vertical datum conversion possible, and to maintain consistency in approach across county lines, the datum conversion for the Mississippi River was performed on a cross-section by cross-section basis, rather than by applying an average county-wide or stream-wide value (Reference 3).

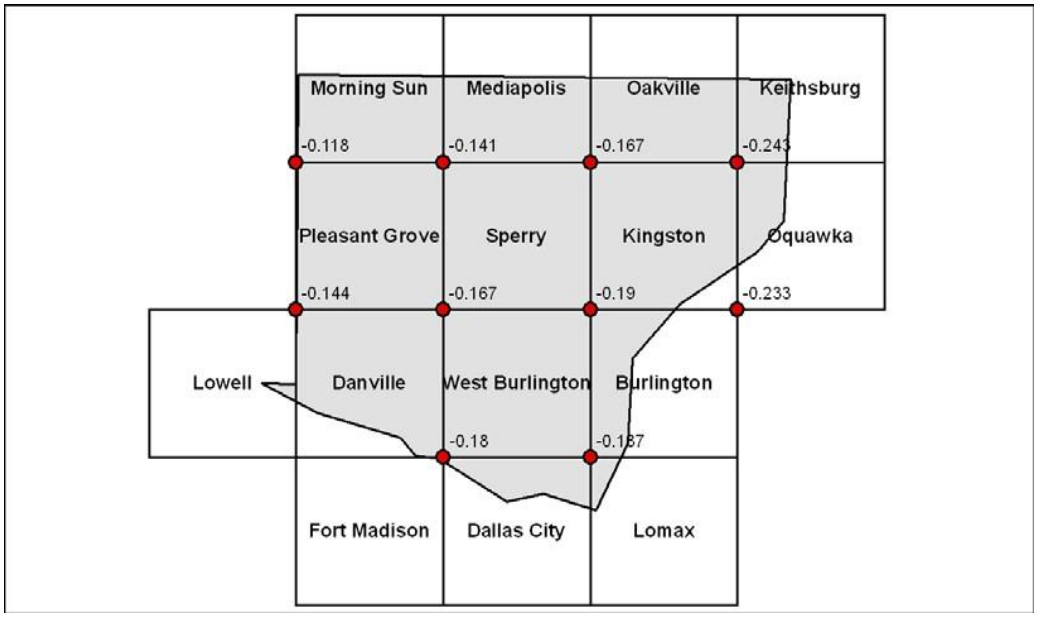


Figure 1. Vertical Datum Conversion

TABLE 5. VERTICAL DATUM ADJUSTMENT

QUADRANGLE NAME	CORNER	NAD 27 LONGITUDE (DEC. DEG)	NAD 27 LATITUDE (DEC. DEG)	CHANGE (FEET)
Morning Sun	SW	41.000	91.375	-0.118
Morning Sun	SE	41.000	91.250	-0.141
Mediapolis	SE	41.000	91.125	-0.167
Oakville	SE	41.000	91.000	-0.243
Kingston	SE	40.875	91.000	-0.233
Sperry	SE	40.875	91.125	-0.190
Pleasant Grove	SE	40.875	91.250	-0.167
Pleasant Grove	SW	40.875	91.375	-0.144
Danville	SE	40.750	91.250	-0.180
West Burlington	SE	40.750	91.125	-0.187
		Min		-0.243
		Max		-0.118
		Average		**-0.177**
		Maximum Offset		-0.066

For more information on NAVD88, see the FEMA publication entitled *Converting the National Flood Insurance Program to the North American Vertical Datum of 1988* (FEMA, June 1992), or contact the Spatial Reference Division of the National Geodetic Survey, National Oceanic and Atmospheric Administration, Silver Springs Metro Center 3, 1315 East-West Highway, Silver Springs, Maryland 20910-3282 (301) 713-3242 (Website: www.ngs.noaa.gov).

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook (TSDN) associated with the FIS report and FIRMs for this community. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance flood elevations and delineations of the 1- and 0.2-percent-annual-chance floodplain boundaries and 1-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles and Floodway Data Tables. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied

by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (published separately). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE); and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards (shaded Zone X). In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM.

4.1.1 Methods for the Mississippi River

For the current revision, between cross sections along the Mississippi River, the boundaries were interpolated using a digital terrain model (DTM) created from photogrammetric-derived mass points and break lines, with a post spacing of 15 feet and vertically accurate enough to support the creation of 4 foot contours (Reference 14). The levee along Mississippi River was provisionally accredited during the production of this FIS. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations by 10/07/2011 or 10/20/2011 as indicated on the DFIRM. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicate the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard information for this area to reflect accreditation of the levee system.

4.1.2 Methods for the other detailed studied areas

For Flint Creek and Tributary A, between cross sections the 1981 floodplains were interpolated using topographic maps at a scale of 1:1200 with a contour interval of 2-feet (Reference 15). For the current FIS revision, the Flint Creek and Tributary A detailed floodplains were digitally captured from the 1981 City of Burlington FIRM. For the rest of the detailed study areas, floodplains have been re-delineated using 10-foot USGS topography data (Reference 18).

4.1.3 Methods for Approximate Study Areas

Floodplains for the approximate study reaches excluding the areas behind the Mississippi River levees were delineated using 10-foot USGS topography data (Reference 18). For approximate study reaches in the areas behind the Mississippi River levees were delineated using a digital terrain model (DTM) created from photogrammetric-derived mass points and break lines, with a post spacing of 15 feet and vertically accurate enough to support the creation of 4 foot contours (Reference 19).

4.2 Floodways

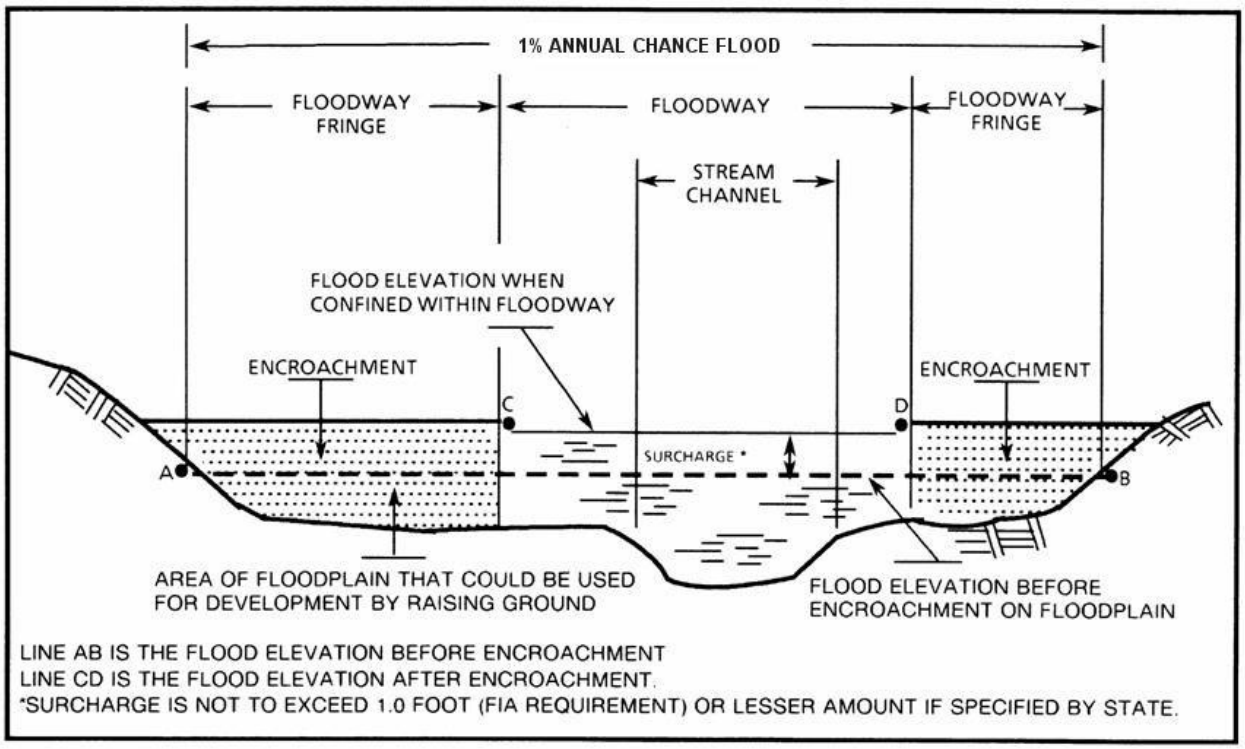
Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this FIS report and on the FIRM was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations have been tabulated for selected cross sections (Table 6). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

Along streams where floodways have not been computed, the community must ensure that the cumulative effect of development in the floodplain will not cause more than 1.0-foot increase in the base flood elevations at any point within the community.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

Figure 2. Floodway Schematic



In the redelineation efforts, the floodway was not recalculated. As a result, there were areas where the previous floodway did not fit within the boundaries of the 1-percent-annual-chance floodplain. Therefore, in these areas, the floodway was reduced. Table 7, Floodway Data Table lists the water surface elevations, with and without a floodway, the mean velocity in the floodway, and the location and area at each surveyed cross section as determined by hydraulic methods. The width of the floodway depicted by the FIRM panels and the amount of reduction to fit the floodway inside the 1-percent annual chance floodplain, if necessary, is also listed.

4.2.1 Methods for the Mississippi River

Upon completion of the UMRSFFS, FEMA funded the Corps of Engineers to compute a floodway for the studied reach of the Mississippi River. This floodway determination consisted of converting the hydraulic data from UNET to HEC-RAS, calibrating the HEC-RAS steady-state models to the UMRSFFS results, and performing the floodway computations (Reference 3). Because the levee along Mississippi River has been designated as Accredited during the production of this FIS, the floodway of Mississippi River was set at the toe on the landside of the levee. The total floodway width and the width within Des Moines County has been adjusted to account for the shorten floodway.

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[2]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Flint Creek									
A	950	1114	9843	1.5		535.0	530.3[3]	531.3	1.0
B	1550	646	5511	2.7		535.0	530.6[3]	531.4	0.8
C	1700	400	1976	7.5		535.0	531.0[3]	531.6	0.6
D	2120	459	2189	6.8		535.0	533.5[3]	533.6	0.1
E	3320	1133	7774	1.9		535.9	535.9	536.3	0.4
F	4470	882	7404	2.0		536.4	536.4	537.1	0.7
G	4820	252	2750	5.4		536.5	536.5	537.2	0.7
H	5120	391	3472	4.3		536.7	536.7	537.7	1.0
I	6290	922	10037	1.5		537.6	537.6	538.6	1.0
J	6732	1794	13258	1.1		537.8	537.8	538.8	1.0
K	7532	1471	13491	1.1		537.8	537.8	538.8	1.0
L	9232	1504	13411	1.1		538.0	538.0	539.0	1.0
M	11032	1252	11680	1.3		538.2	538.2	539.2	1.0
N	11932	470	5616	2.6	134	538.3	538.3	539.3	1.0
O	12932	559	5251	2.8		538.9	538.9	539.8	0.9
P	15432	1022	6338	2.3		540.5	540.5	541.4	0.9
Q	18432	817	5528	2.7		542.6	542.6	543.4	0.8
R	20432	400	3286	4.1	33	544.6	544.6	545.4	0.8
S	22432	242	2251	6.0		548.0	548.0	548.7	0.7
T	22757	217	2152	6.3		548.8	548.8	549.3	0.5
U	23257	234	1930	7.0		549.4	549.4	550.0	0.6
V	24057	94	1450	9.3		550.6	550.6	551.6	1.0
W	25857	98	1487	9.1		555.3	555.3	556.3	1.0
X	28057	140	2338	5.8		559.5	559.5	560.4	0.9
Y	30057	892	7107	1.9		561.1	561.1	561.9	0.8

[1] FEET ABOVE MOUTH
[2] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS
[3] ELEVATIONS WITHOUT CONSIDERING BACKWATER EFFECT FROM MISSISSIPPI RIVER

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

FLINT CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[2]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Flint Creek (continued)									
Z	31557	1106	8163	1.7		561.7	561.7	562.4	0.7
AA	32357	218	2212	6.1		561.8	561.8	562.5	0.7
AB	33540	1131	11159	1.2		562.7	562.7	563.4	0.7
AC	34950	1207	2978	4.5		562.7	562.7	563.4	0.7
AD	37500	777	5357	2.5		566.1	566.1	566.7	0.6
AE	38775	835	4768	2.8		567.0	567.0	567.6	0.6
AF	41730	900	5093	2.7		569.1	569.1	569.9	0.8
AG	43470	107	1536	8.8		571.0	571.0	571.9	0.9
AH	46370	923	6265	2.2		574.8	574.8	575.6	0.8
AI	48695	1039	6046	2.2		575.9	575.9	576.6	0.7
AJ	51120	738	4186	3.1		577.5	577.5	578.2	0.7
AK	52820	720	4000	3.2		579.1	579.1	579.7	0.6
AL	55190	694	3955	3.3		580.8	580.8	581.2	0.4
AM	57290	425	2318	5.6		582.4	582.4	583.1	0.7
AN	58540	1009	5709	2.3		584.4	584.4	585.2	0.8
AO	60270	175	4769	2.7		586.7	586.7	587.2	0.5
AP	63510	115	1579	8.2		589.5	589.5	590.3	0.8
AQ	64005	761	5208	2.5		591.1	591.1	591.9	0.8
AR	64525	652	4197	3.1		591.5	591.5	592.4	0.9
AS	66465	1589	10955	1.2		592.2	592.2	593.1	0.9
AT	67415	885	6411	2.0		592.4	592.4	593.2	0.8
AU	69905	724	4719	2.8		593.4	593.4	594.3	0.9
AV	70255	407	2203	5.9		593.5	593.5	594.3	0.8
AW	73550	788	5204	2.4		597.0	597.0	597.9	0.9

[1] FEET ABOVE MOUTH
[2] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

FLINT CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[2]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Flint Creek (continued)									
AX	74170	574	3933	3.2		597.5	597.5	598.5	1.0
AY	76200	1185	4946	2.5		599.1	599.1	600.1	1.0
AZ	78700	930	2990	4.1		601.7	601.7	602.7	1.0
BA	80150	112	1511	8.2		604.9	604.9	605.7	0.8
BB	81150	130	1737	7.1		607.4	607.4	608.3	0.9
BC	82390	289	3345	3.7		609.6	609.6	610.6	1.0
BD	84340	518	5357	2.3		610.9	610.9	611.9	1.0
BE	86190	1254	11084	1.1		611.4	611.4	612.4	1.0
BF	87860	915	7369	1.7		611.6	611.6	612.6	1.0
BG	90700	202	1207	10.3		612.0	612.0	612.7	0.7
BH	92850	690	4362	2.8	-38	616.6	616.6	617.6	1.0
BI	94400	350	2518	4.9		618.3	618.3	619.2	0.9
BJ	95325	881	6565	1.8		619.2	619.2	620.2	1.0
BK	96825	760	5253	2.2		619.7	619.7	620.6	0.9
BL	97525	512	5214	1.9		620.1	620.1	620.9	0.8
BM	98615	178	1705	5.9		620.5	620.5	621.2	0.7
BN	98695	178	1783	5.6		620.6	620.6	621.4	0.8
BO	99345	569	3885	2.6		621.5	621.5	622.2	0.7
BP	100345	630	4094	2.4		622.0	622.0	622.7	0.7
BQ	101845	829	2853	3.5		622.4	622.4	623.1	0.7

[1] FEET ABOVE MOUTH
[2] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

FLINT CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[2]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Hawkeye Creek									
A	1750	44	345	10.7		672.3	672.3	673.3	1.0
B	2300	119	1090	3.4		675.0	675.0	675.9	0.9
C	3150	64	539	6.9		675.6	675.6	676.5	0.9
D	4150	130	703	5.3		678.3	678.3	679.3	1.0
E	5950	120	796	4.7		683.5	683.5	684.2	0.7
F	6950	95	750	3.9		685.2	685.2	686.2	1.0
G	7750	87	280	10.3		687.0	687.0	687.4	0.4
H	8750	76	404	7.2		693.4	693.4	694.1	0.7
I	9550	219	956	3.0		696.0	696.0	697.0	1.0
J	10140	37	212	13.7		698.9	698.9	698.9	0.0
K	10230	165	1124	2.6		703.9	703.9	703.9	0.0
L	10830	90	423	6.9		704.6	704.6	704.7	0.1
M	11230	107	530	5.5		706.7	706.7	707.3	0.6
N	12330	71	446	6.5		711.5	711.5	711.9	0.4
O	13680	55	195	10.2		727.8	727.8	727.9	0.1
P	14330	57	359	5.6		733.7	733.7	733.9	0.2
Q	15800	106	356	5.6		737.8	737.8	728.4	0.6
R	16700	107	674	3.0		740.9	740.9	741.9	1.0
S	17850	37	195	6.2		743.4	743.4	744.1	0.7

[1] FEET ABOVE CONFLUENCE OF WEST TRIBUTARY HAWKEYE CREEK
[2] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

HAWKEYE CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[2]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Knotty Creek									
A	1300	201	1277	4.5		561.8	561.6[3]	562.6	1.0
B	2200	179	1204	4.7		564.1	564.1	564.7	0.6
C	3200	179	1345	4.2		566.5	566.5	567.4	0.9
D	4750	159	955	6.0		568.8	568.8	569.4	0.6
E	5550	233	1508	3.8		571.8	571.8	572.8	1.0
F	6050	192	1406	4.1		572.9	572.9	573.8	0.9
G	7400	76	701	8.1		576.4	576.4	577.3	0.9
H	8250	96	1014	5.6		580.0	580.0	581.0	1.0
I	9200	220	1606	3.5		581.9	581.9	582.9	1.0
J	10400	137	1066	5.3		584.8	584.8	585.7	0.9

[1] FEET ABOVE CONFLUENCE WITH FLINT CREEK
[2] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS
[3] ELEVATIONS WITHOUT CONSIDERING BACKWATER EFFECT FROM FLINT CREEK

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

KNOTTY CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[2]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Little Flint Creek									
A	1800	97	643	8.1		577.5	576.7[3]	577.7	1.0
B	3230	157	1171	4.4		584.1	584.1	585.0	0.9
C	3930	427	2263	2.3		585.3	585.3	586.1	0.8
D	5130	177	1075	4.8		586.9	586.9	587.6	0.7
E	5960	102	694	7.5		589.3	589.3	590.0	0.7
F	7120	452	3050	1.7		594.2	594.2	594.2	0.0
G	8570	244	1183	4.4		596.2	596.2	596.5	0.3
H	9770	77	730	7.1		599.2	599.2	599.9	0.7
I	11770	146	898	5.8		604.6	604.6	605.3	0.7
J	13770	99	823	5.5		610.9	610.9	611.5	0.6
K	14970	60	824	5.5		613.5	613.5	614.2	0.7
L	16600	67	423	10.6		618.9	618.9	618.9	0.0
M	17800	65	621	7.2		625.2	625.2	626.1	0.9
N	19050	142	963	4.7		628.5	628.5	629.5	1.0
O	19950	106	479	9.4		632.0	632.0	632.0	0.0
P	21150	209	1258	3.5		639.3	639.3	639.9	0.6
Q	21950	304	1426	3.2		640.8	640.8	641.5	0.7

[1] FEET ABOVE MOUTH
[2] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS
[3] ELEVATIONS WITHOUT CONSIDERING BACKWATER EFFECT FROM FLINT CREEK

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

LITTLE FLINT CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[2]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Long Creek									
A	32	52	444	9.0		686.5	686.5	687.3	0.8
B	1312	210	1618	2.5		689.1	689.1	689.7	0.6
C	2112	169	1302	3.1		689.4	689.4	690.1	0.7
D	3212	145	945	4.2		690.2	690.2	691.2	1.0
E	3652	503	2670	1.5		690.6	690.6	691.6	1.0
F	4497	257	2782	1.2		697.7	697.7	698.7	1.0
G	5397	331	3166	1.0		697.7	697.7	698.7	1.0
H	6297	196	1667	2.0		697.8	697.8	698.8	1.0
I	6327	213	1883	1.8		698.5	698.5	699.5	1.0
J	6627	252	2187	1.5		698.5	698.5	699.5	1.0
K	6977	221	1908	1.7		698.6	698.6	699.6	1.0
L	7627	223	1793	1.8		698.8	698.8	699.7	0.9
M	8277	158	1027	3.2		699.3	699.3	700.1	0.8
N	8477	207	1323	2.5		699.8	699.8	700.6	0.8
O	8827	243	1216	2.7		700.0	700.0	700.7	0.7
P	8857	379	2457	1.3		702.3	702.3	703.0	0.7
Q	9157	254	1844	1.8		702.5	702.5	703.2	0.7
R	9407	236	1750	1.9		702.5	702.5	703.2	0.7

[1] FEET ABOVE 79TH HIGHWAY
[2] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

LONG CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)[2]	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[3]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MISSISSIPPI RIVER									
A	395.9	1117 / 9395	136363	2.7		531.1	531.1	531.1	0.0
B	396.6	1445 /10444	137962	2.5		531.6	531.6	531.7	0.1
C	397.0	1435 /10518	145124	2.4		531.9	531.9	532.1	0.2
D	397.5	1182 /10019	125947	2.8		532.1	532.1	532.2	0.1
E	398.0	1580 / 9860	146962	2.4		532.5	532.5	532.6	0.1
F	398.5	1164 /10362	162478	2.2		532.6	532.6	532.8	0.2
G	399.0	1199 /11342	170883	2.1		532.7	532.7	532.9	0.2
H	399.5	1107 /13002	173446	2.0		532.8	532.8	533.0	0.2
I	400.0	807 /11661	161278	2.2		533.0	533.0	533.2	0.2
J	400.5	1009 /10384	140966	2.5		533.2	533.2	533.4	0.2
K	401.0	1058 /10419	151876	2.3		533.5	533.5	533.7	0.2
L	401.5	889 / 8338	141038	2.5		533.8	533.8	534.0	0.2
M	402.0	363 / 6805	126319	2.8		533.9	533.9	534.1	0.2
N	402.5	448 / 5282	103549	3.4		533.9	533.9	534.1	0.2
O	403.0	403 / 4068	87621	4.0		534.0	534.0	534.2	0.2
P	403.5	530 / 2659	75084	4.6		534.2	534.2	534.3	0.1
Q	404.0	426 / 2485	77428	4.5		534.3	534.3	534.5	0.2
R	404.3	978 / 2519	70888	4.9		534.4	534.4	534.6	0.2
S	405.0	2520 / 5239	94200	3.7		534.7	534.7	534.9	0.2
T	405.5	4300 / 7168	123514	2.8		535.2	535.2	535.3	0.1
U	406.0	6857 / 8915	147417	2.4		535.4	535.4	535.5	0.1
V	406.4	7090 / 8732	134698	2.6		535.5	535.5	535.7	0.2

[1] MILES ABOVE CONFLUENCE WITH OHIO RIVER; DISTANCE BASED ON THE 1960 RIVER MILE STATIONING, WHICH MAY NOT MATCH THE MEASURED DISTANCE ALONG THE PROFILE BASELINE SHOWN ON THE MAPS
[2] WIDTH WITHIN DES MOINES COUNTY / TOTAL WIDTH
[3] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

MISSISSIPPI RIVER

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)[2]	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[3]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MISSISSIPPI RIVER (CONTINUED)									
W	407.0	6638 / 7723	125325	2.8		535.7	535.7	535.8	0.1
X	407.5	6635 / 8396	137662	2.5		535.9	535.9	536.0	0.1
Y	408.0	5726 / 7227	116564	3.0		536.0	536.0	536.2	0.2
Z	408.5	5029 / 5945	100006	3.5		536.1	536.1	536.3	0.2
AA	408.9	4348 / 5386	101750	3.4		536.4	536.4	536.6	0.2
AB	409.2	3863 / 4925	93019	3.8		536.5	536.5	536.7	0.2
AC	409.7	3260 / 4270	90757	3.9		536.7	536.7	536.8	0.1
AD	410.0	2650 / 4734	95781	3.7		536.8	536.8	537.0	0.2
AE	410.3	3620 / 4630	101398	3.4		537.0	537.0	537.1	0.1
AF	410.6	3986 / 4275	95365	3.6		537.4	537.4	538.0	0.6
AG	411.0	3816 / 4555	103463	3.3		537.6	537.6	538.1	0.5
AH	411.4	2807 / 4356	97701	3.5		537.7	537.7	538.3	0.6
AI	412.0	1793 / 8466	151194	2.3		537.9	537.9	538.4	0.5
AJ	412.4	2444 /11434	183980	1.9		538.0	538.0	538.6	0.6
AK	413.0	3908 /12098	189692	1.8		538.3	538.3	538.8	0.5
AL	413.5	5150 /11836	185188	1.9		538.4	538.4	538.9	0.5
AM	414.0	5026 /10657	162870	2.1		538.5	538.5	539.0	0.5
AN	414.4	5453 / 9813	147437	2.4		538.7	538.7	539.2	0.5
AO	415.0	4663 / 7706	116963	3.0		538.8	538.8	539.2	0.4
AP	415.7	2934 / 4612	92535	3.7		539.0	539.0	539.4	0.4
AQ	416.0	2428 / 3786	71628	4.8		539.1	539.1	539.5	0.4
AR	416.6	1991 / 3669	83790	4.1		539.4	539.4	539.8	0.4
AS	417.0	1624 / 3531	89553	3.9		539.5	539.5	539.9	0.4
AT	417.4	1633 / 3726	87075	4.0		539.6	539.6	540.0	0.4

[1] MILES ABOVE CONFLUENCE WITH OHIO RIVER; DISTANCE BASED ON THE 1960 RIVER MILE STATIONING, WHICH MAY NOT MATCH THE MEASURED DISTANCE ALONG THE PROFILE BASELINE SHOWN ON THE MAPS

[2] WIDTH WITHIN DES MOINES COUNTY / TOTAL WIDTH

[3] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

MISSISSIPPI RIVER

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)[2]	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[3]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MISSISSIPPI RIVER (CONTINUED)									
AU	418.0	1344 / 4738	78233	4.4		539.6	539.6	540.0	0.4
AV	418.6	1582 / 5770	86741	4.0		540.1	540.1	540.6	0.5
AW	419.0	2527 / 6821	108732	3.2		540.5	540.5	540.9	0.4
AX	419.4	2798 / 7485	108517	3.2		540.6	540.6	541.0	0.4
AY	420.0	4786 / 8654	109527	3.2		540.8	540.8	541.2	0.4
AZ	420.5	4699 / 8846	105965	3.3		541.1	541.1	541.5	0.4
BA	421.0	5552 / 9817	118605	2.9		541.5	541.5	541.8	0.3
BB	421.5	5867 / 9860	111399	3.1		541.7	541.7	542.0	0.3
BC	422.0	5949 / 10018	133839	2.6		542.0	542.0	542.3	0.3
BD	422.4	7229 / 10514	120922	2.9		542.1	542.1	542.4	0.3
BE	423.0	8047 / 11902	145316	2.4		542.4	542.4	542.7	0.3
BF	423.5	8598 / 12688	138506	2.5		542.5	542.5	542.8	0.3
BG	424.0	7839 / 10756	131484	2.6		542.8	542.8	543.1	0.3
BH	424.4	7106 / 9342	103948	3.3		542.9	542.9	543.1	0.2
BI	425.0	5579 / 8138	110614	3.1		543.3	543.3	543.5	0.2
BJ	425.5	2934 / 5819	84819	4.1		543.3	543.3	543.6	0.3

[1] MILES ABOVE CONFLUENCE WITH OHIO RIVER; DISTANCE BASED ON THE 1960 RIVER MILE STATIONING, WHICH MAY NOT MATCH THE MEASURED DISTANCE ALONG THE PROFILE BASELINE SHOWN ON THE MAPS

[2] WIDTH WITHIN DES MOINES COUNTY / TOTAL WIDTH

[3] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

MISSISSIPPI RIVER

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[2]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
North Branch Spring Creek									
A	2250	166	905	3.8		543.1	543.1	544.1	1.0
B	3250	219	1296	2.6		545.3	545.3	546.1	0.8
C	4050	107	436	7.8		548.5	548.5	549.4	0.9
D	4850	170	735	4.6		555.4	555.4	556.3	0.9
E	5950	94	343	9.9		565.2	565.2	565.2	0.0
F	7050	79	395	8.6		574.6	574.6	574.7	0.1
G	7750	126	553	6.1		580.5	580.5	580.8	0.3
H	8850	150	583	5.8		586.0	586.0	586.8	0.8
I	9950	128	448	7.6		595.8	595.8	595.8	0.0
J	10700	113	540	6.3		602.4	602.4	603.3	0.9
K	11500	83	297	9.4		611.1	611.1	611.1	0.0
L	11900	130	589	4.8		617.9	617.9	618.6	0.7
M	12700	100	515	5.4		623.2	623.2	623.9	0.7
N	13300	86	462	6.1		627.0	627.0	627.6	0.6
O	14100	110	576	4.9		633.9	633.9	634.3	0.4
P	14344	113	577	2.8		637.2	637.2	637.6	0.4

[1] FEET ABOVE CONFLUENCE WITH SPRING CREEK
[2] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

NORTH BRANCH SPRING CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)[2]	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Spring Creek									
A	200	304	1179	5.8		533.8	533.8	534.8	1.0
B	1050	355	1226	5.5		535.9	535.9	536.9	1.0
C	1850	756	3982	17.0		537.4	537.4	538.3	0.9
D	2900	294	1945	3.4		539.1	539.1	539.7	0.6
E	2944	437	4453	1.5		542.8	542.8	543.4	0.6
F	4344	597	4341	1.5		543.2	543.2	544.1	0.9
G	5344	615	3878	1.7		543.7	543.7	544.7	1.0
H	5944	430	2020	3.3		544.4	544.4	545.4	1.0
I	6544	103	978	5.6	45	546.5	546.5	547.3	0.8
J	7086	282	1460	3.8		548.1	548.1	548.7	0.6
K	8086	280	1431	3.8		550.3	550.3	551.2	0.9
L	8686	601	1599	3.4		552.2	552.2	552.8	0.6
M	9886	300	1682	3.3		556.0	556.0	556.3	0.3
N	11086	362	1764	3.1		558.8	558.8	559.5	0.7
O	12186	275	1382	4.0		562.8	562.8	563.3	0.5
P	13386	141	998	5.2		566.7	566.7	567.4	0.7
Q	14186	230	1372	3.8		568.6	568.6	569.6	1.0
R	14521	164	1459	3.6		572.0	572.0	573.0	1.0
S	15621	472	3670	1.4		573.4	573.4	574.3	0.9
T	16621	327	2079	2.5		573.7	573.7	574.7	1.0
U	17521	187	1486	3.5		574.9	574.9	575.7	0.8
V	17821	174	1214	4.3		575.2	575.2	576.1	0.9
W	18245	302	1594	3.3		575.7	575.7	576.6	0.9
X	19345	161	1162	4.5		578.1	578.1	579.1	1.0

[1] FEET ABOVE LIMIT OF RAILROAD
[2] SEE EXPLANATION IN SECTION 4.2 FLOODWAYS

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

FLOODWAY DATA

SPRING CREEK

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or base flood depths are shown within this zone.

Zone AE

Zone AE is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone V

Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

Zone VE

Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

Zone X (Shaded)

Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depth of less than 1 foot or with drainage areas less than a square mile; and areas protected by levees from 1% annual chance flood.

Zone X

Zone X is the flood insurance risk zone that corresponds to areas determined to be outside of the 0.2% annual chance floodplain.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance risk zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the entire geographic area of Des Moines County. Historical data relating to the maps prepared for each community are presented in Table 7.

7.0 OTHER STUDIES

This FIS report either supersedes or is compatible with all previous studies on streams studied in this report and should be considered authoritative for purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Flood Insurance and Mitigation Division, Federal Emergency Management Agency Region VII, 9221 Ward Parkway, Suite 300, Kansas City, Missouri 64114-3372.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
City of Burlington	May 17, 1974	February 27, 1976 October 18, 1977	July 2, 1981	April 17, 1985
City of Danville	August 2, 2011	None	August 2, 2011	None
Des Moines County (Unincorporated Areas)	May 17, 1977	None	February 17, 1982	None
City of Mediapolis[1]	N/A	None	None	None
City of Middletown[1]	N/A	None	None	None
City of West Burlington	N/A	None	August 2, 1011	None

[1] No Special Flood Hazard Areas Identified

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

9.0 BIBLIOGRAPHY AND REFERENCES

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2. Federal Emergency Management Agency, Flood Insurance Study, City of Burlington, Iowa, April 17, 1985.

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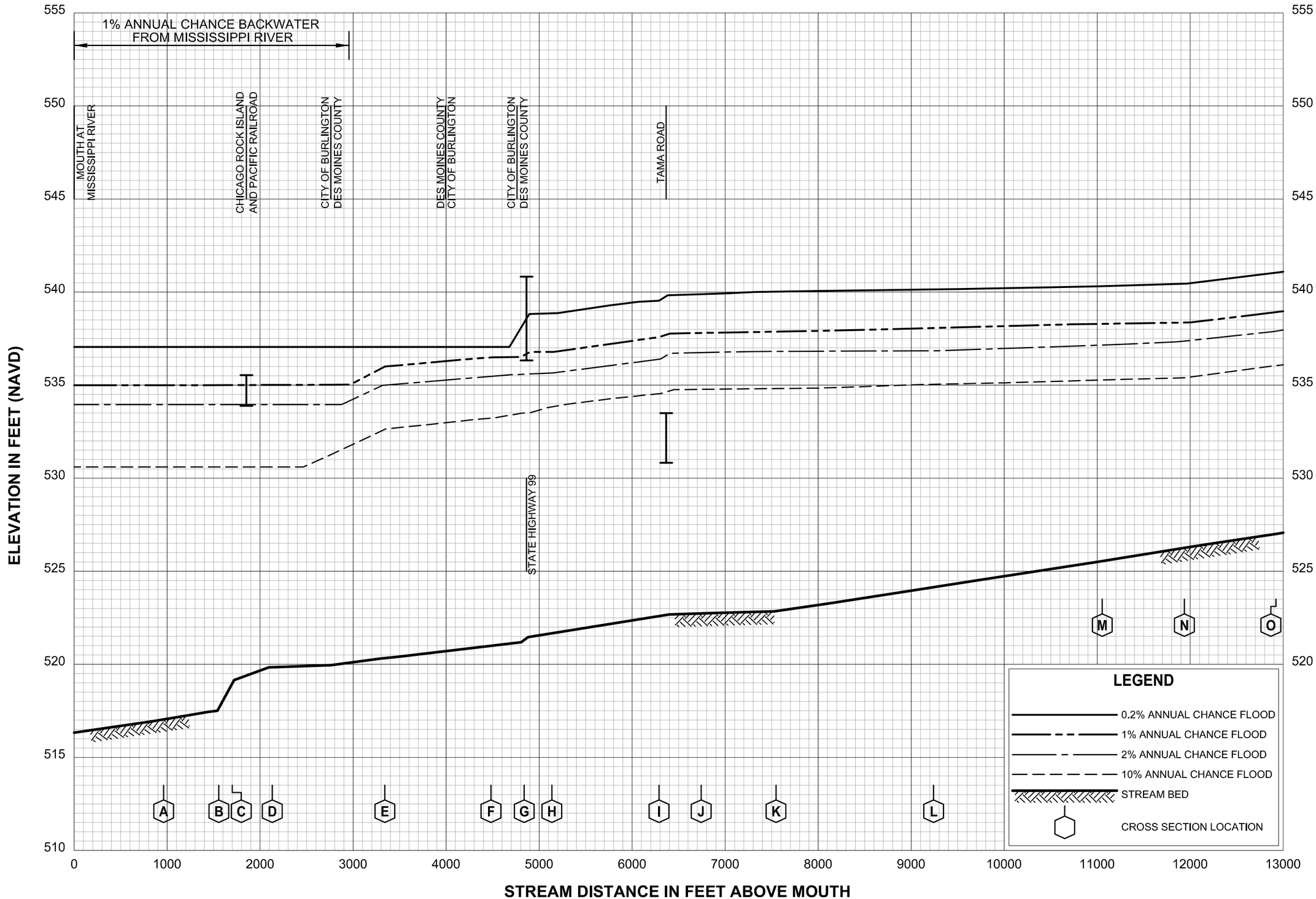


FLOOD PROFILES

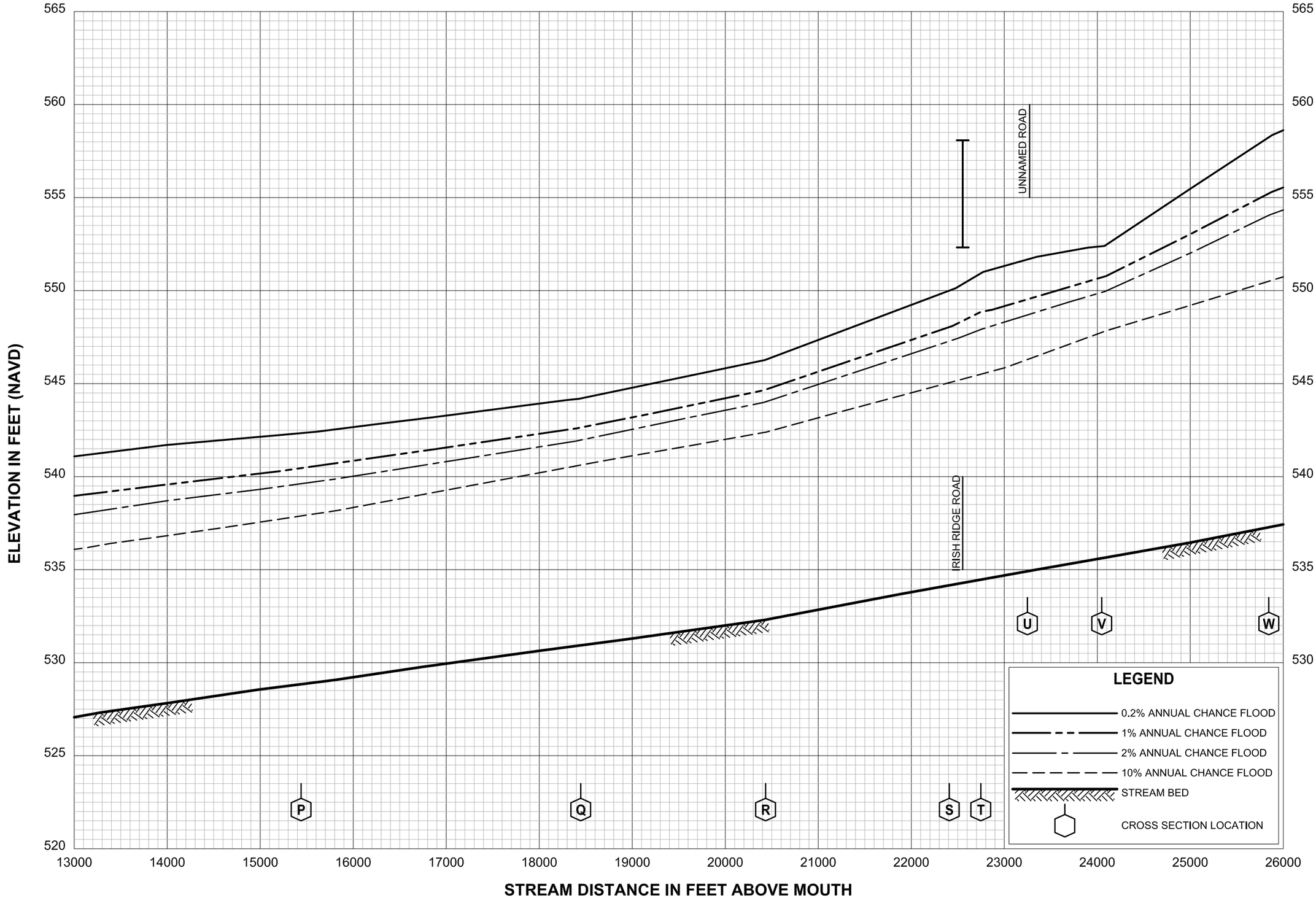
FLINT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

01P



FLOOD PROFILES

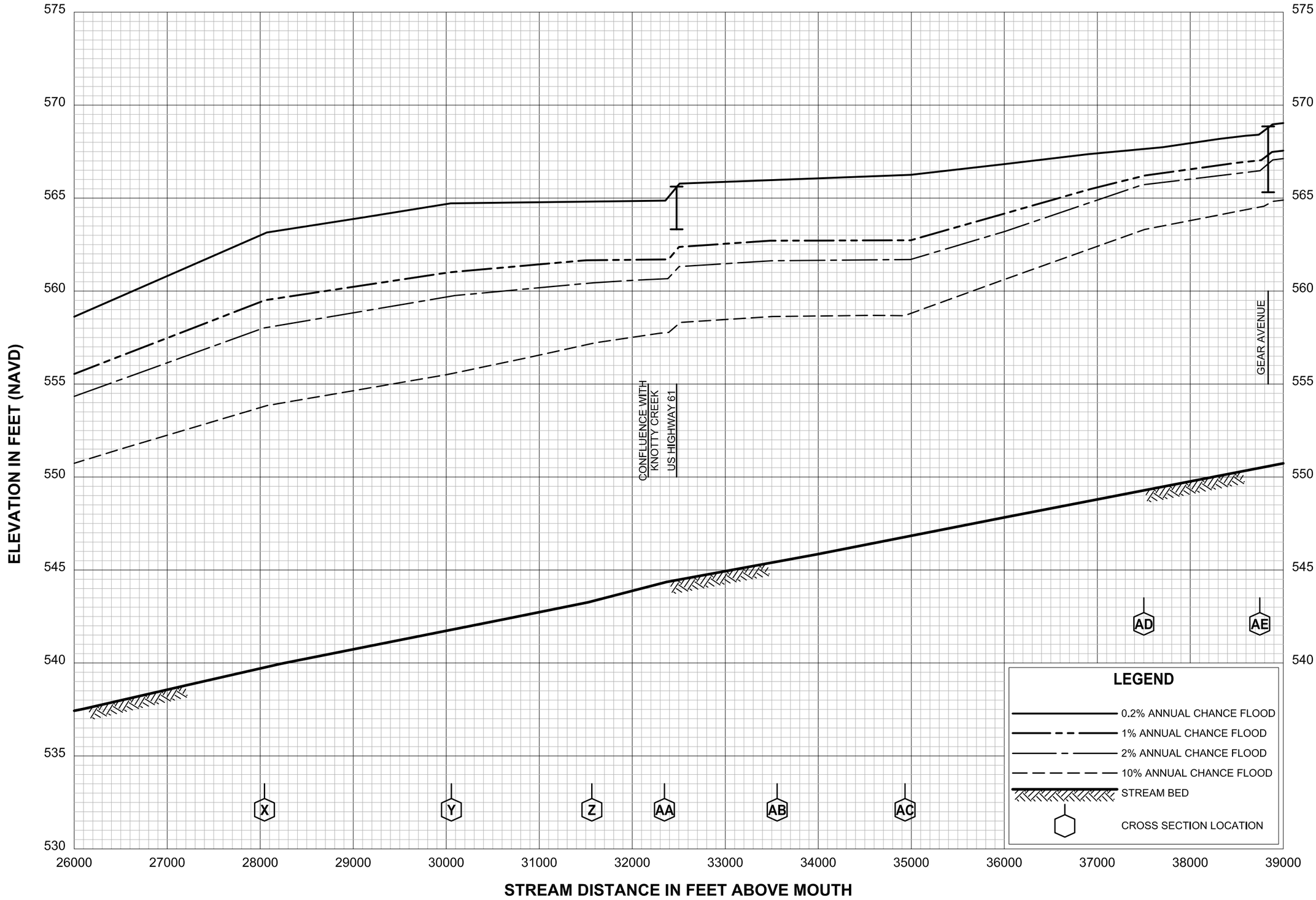
FLINT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

02P



FLOOD PROFILES

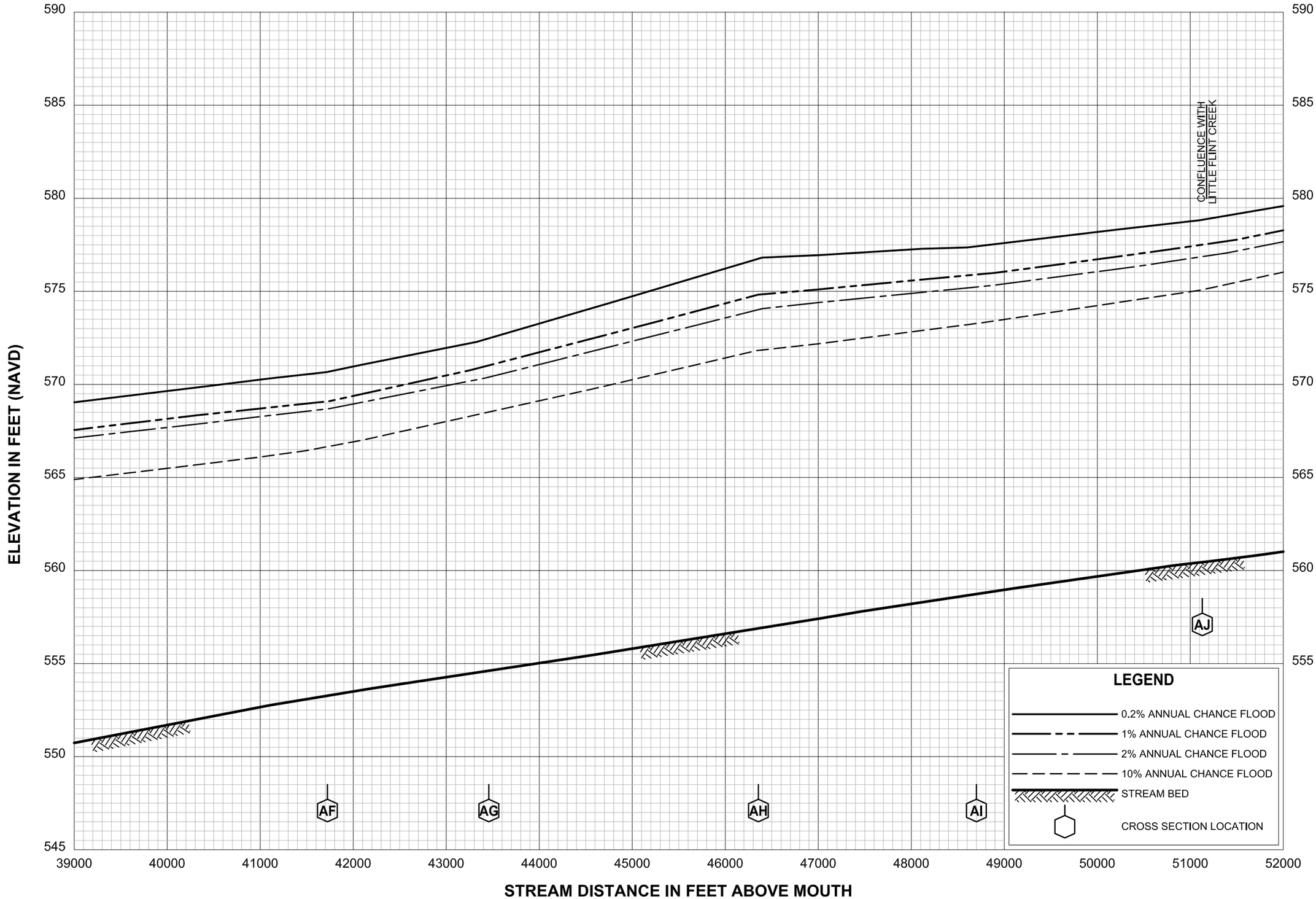
FLINT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

03P



FLOOD PROFILES

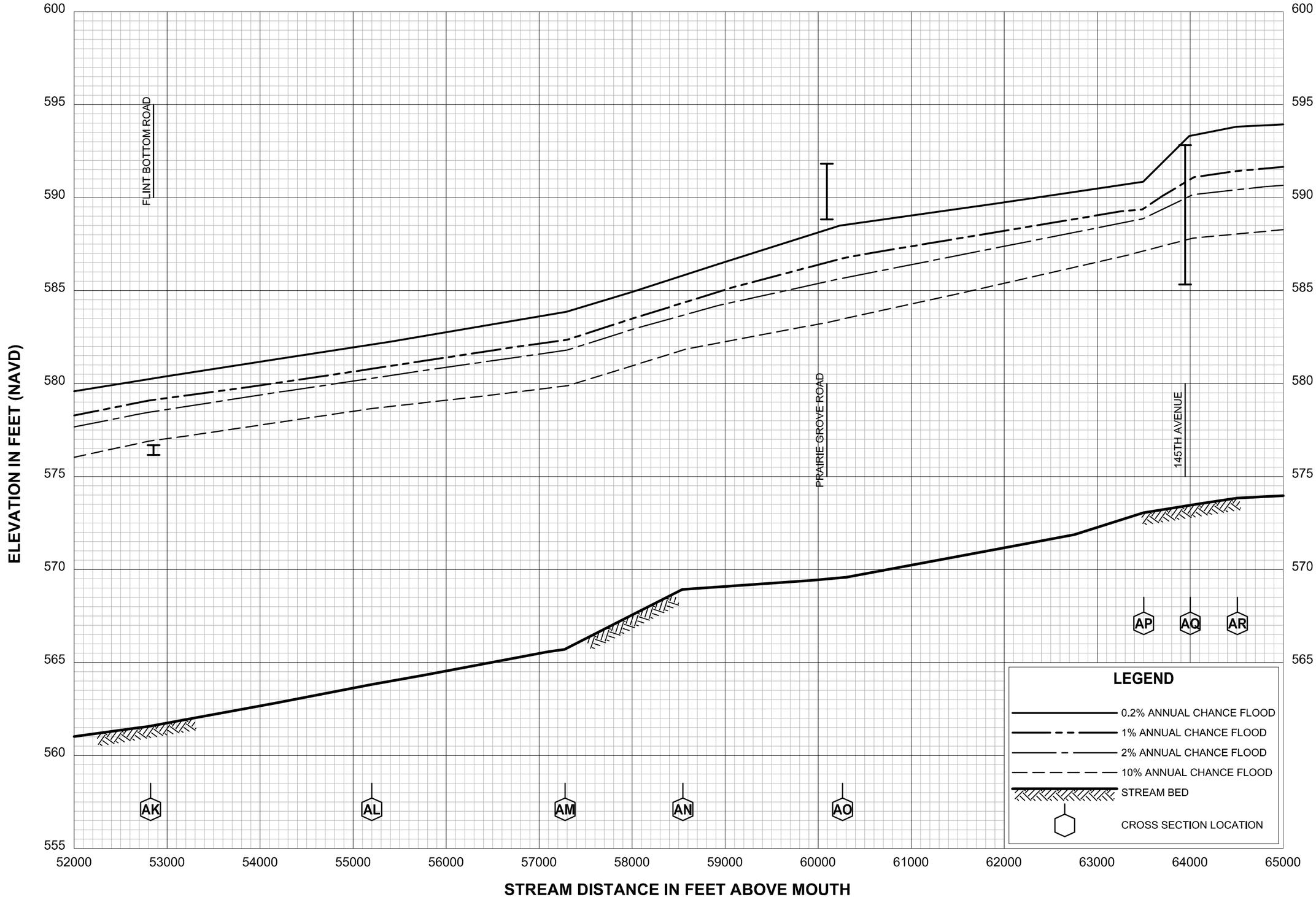
FLINT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

04P



FLOOD PROFILES

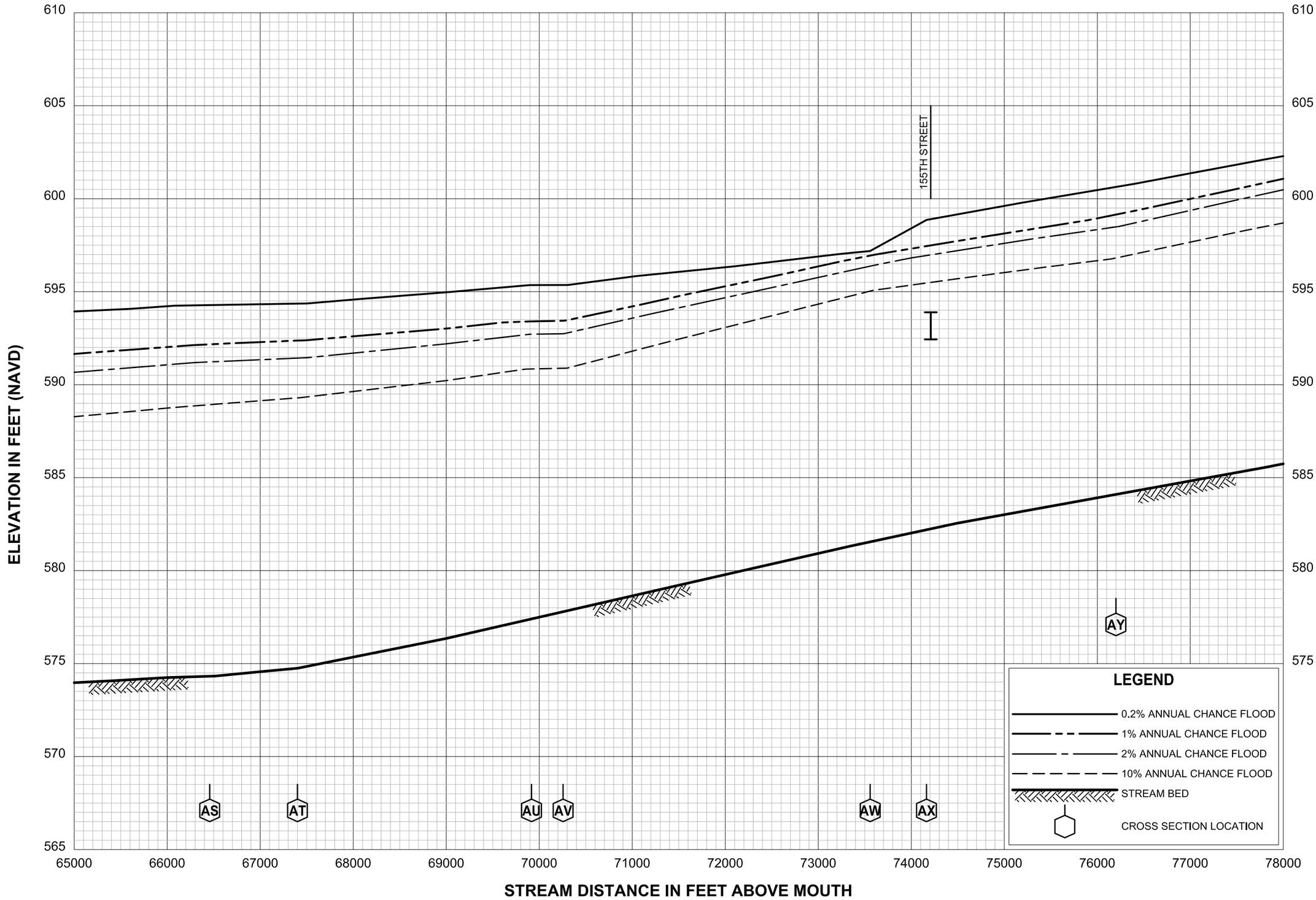
FLINT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

05P



FLOOD PROFILES

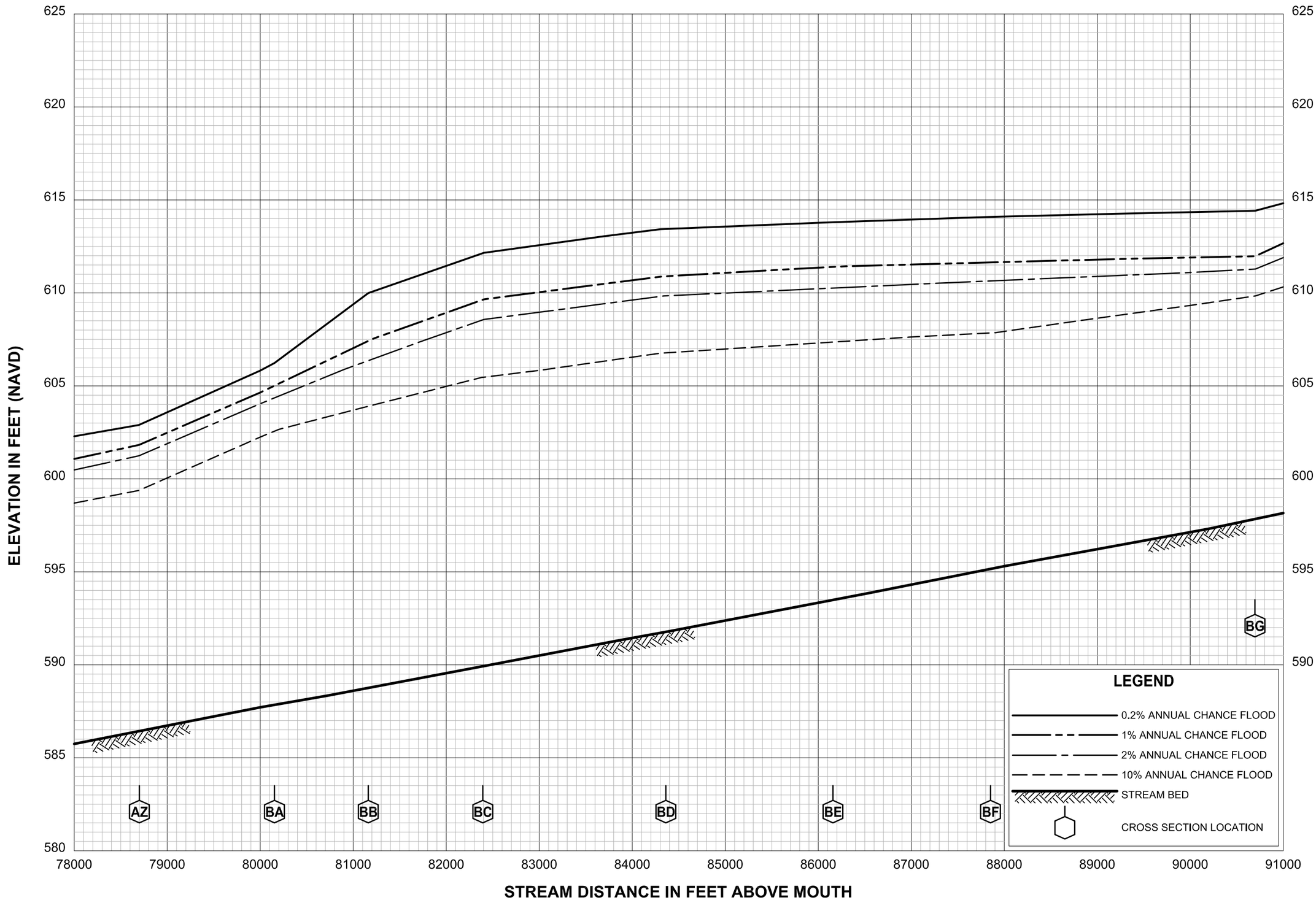
FLINT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

06P



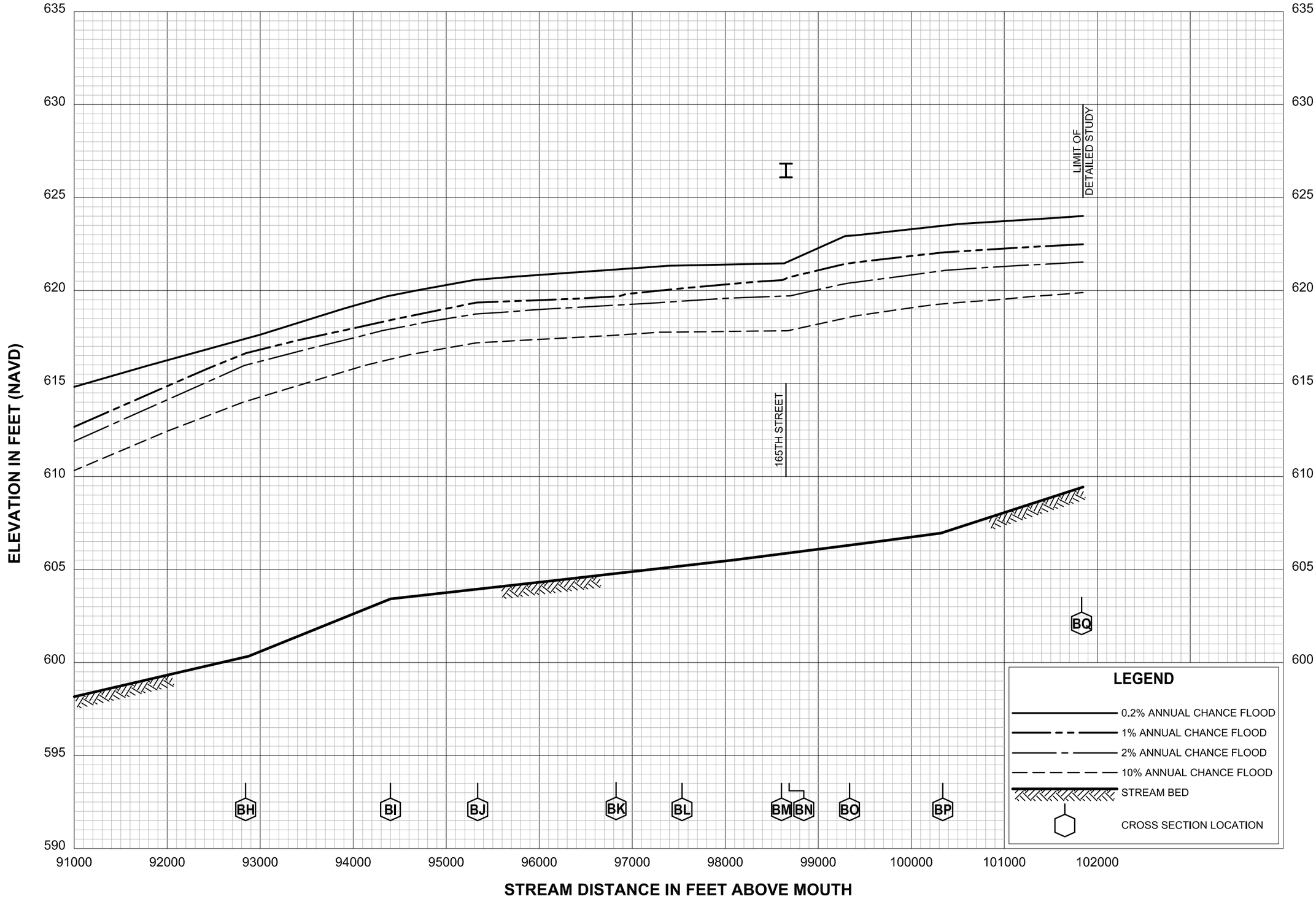
FLOOD PROFILES

FLINT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



FLOOD PROFILES

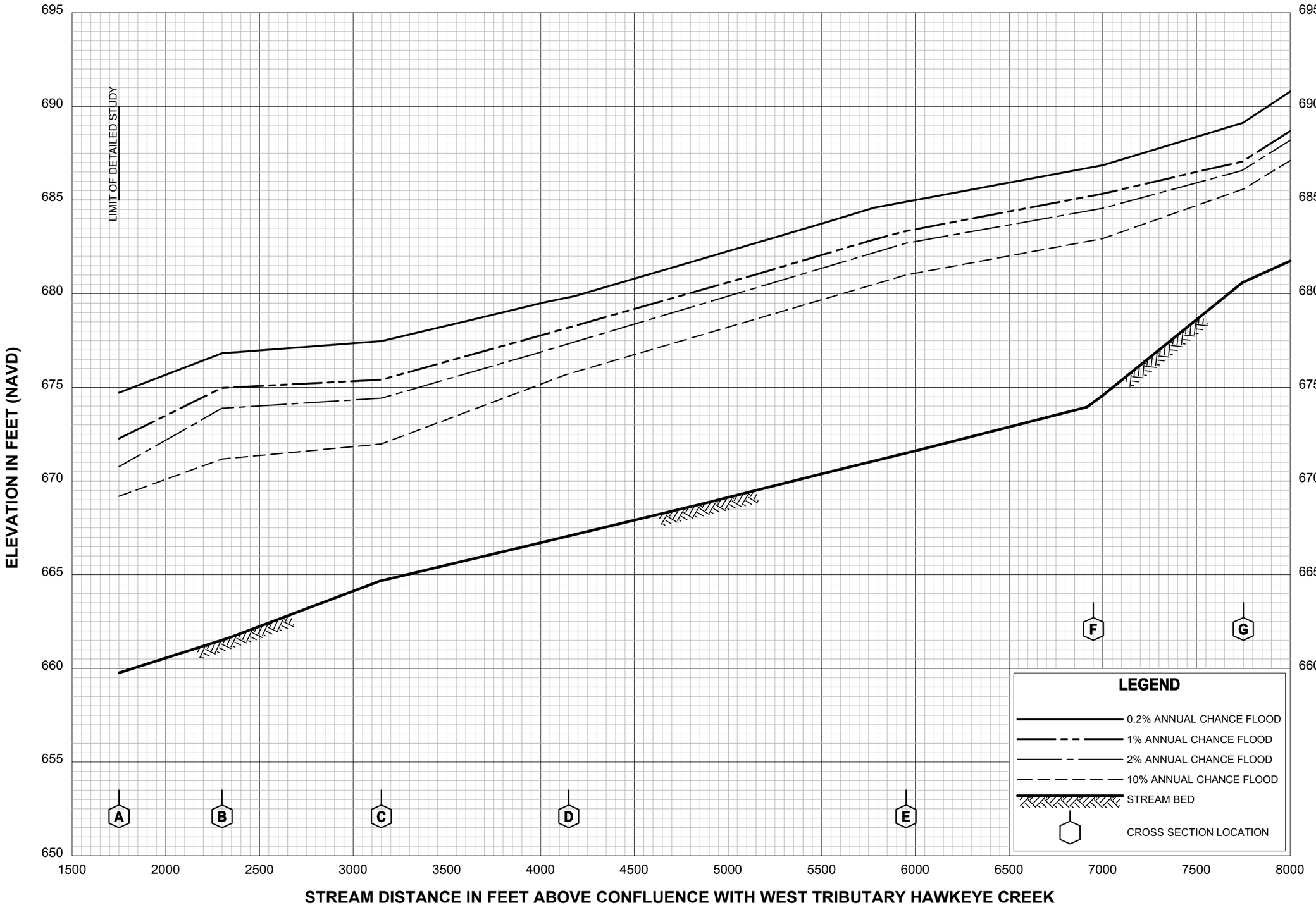
FLINT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

08P



FLOOD PROFILES

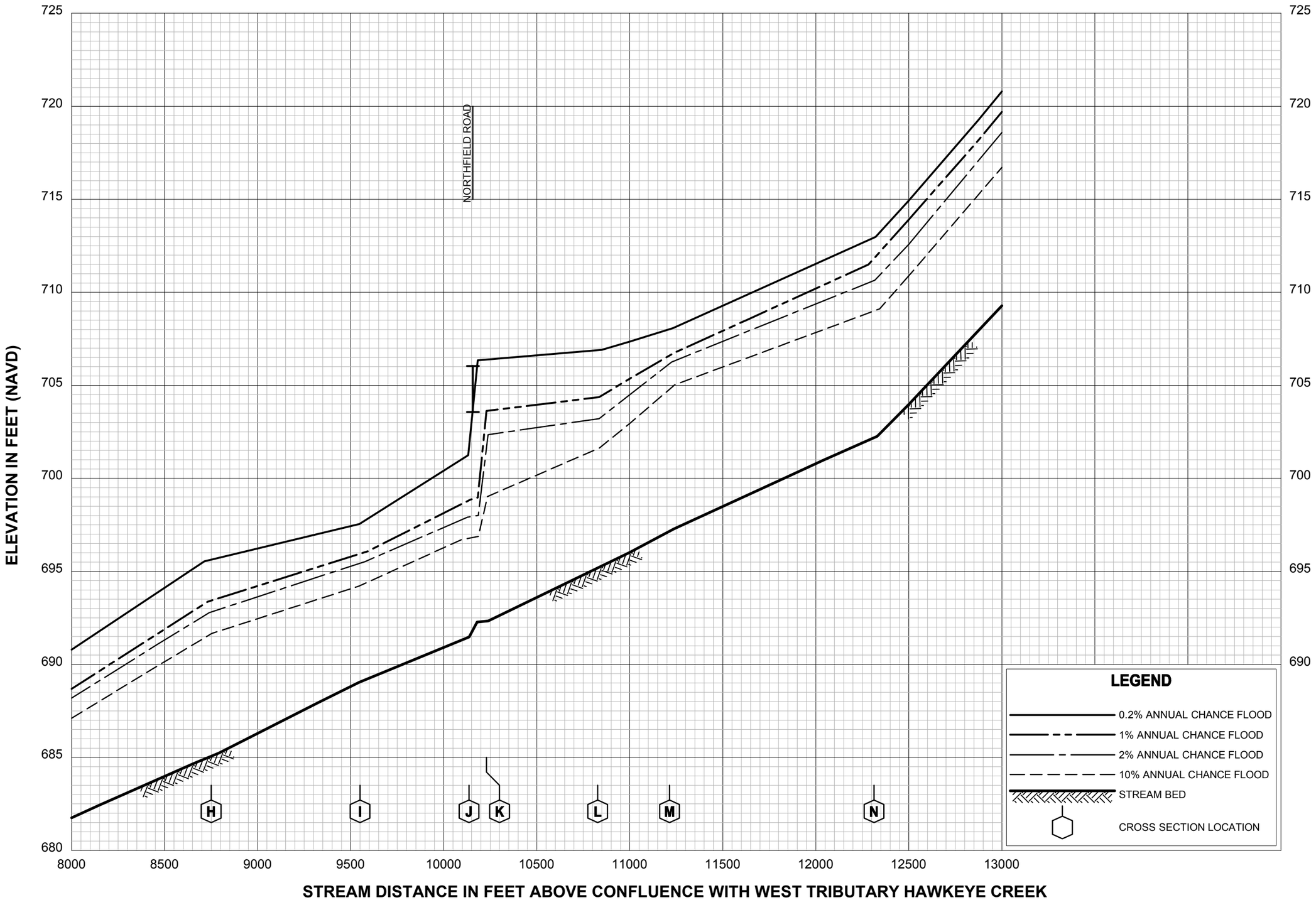
HAWKEYE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS

09P



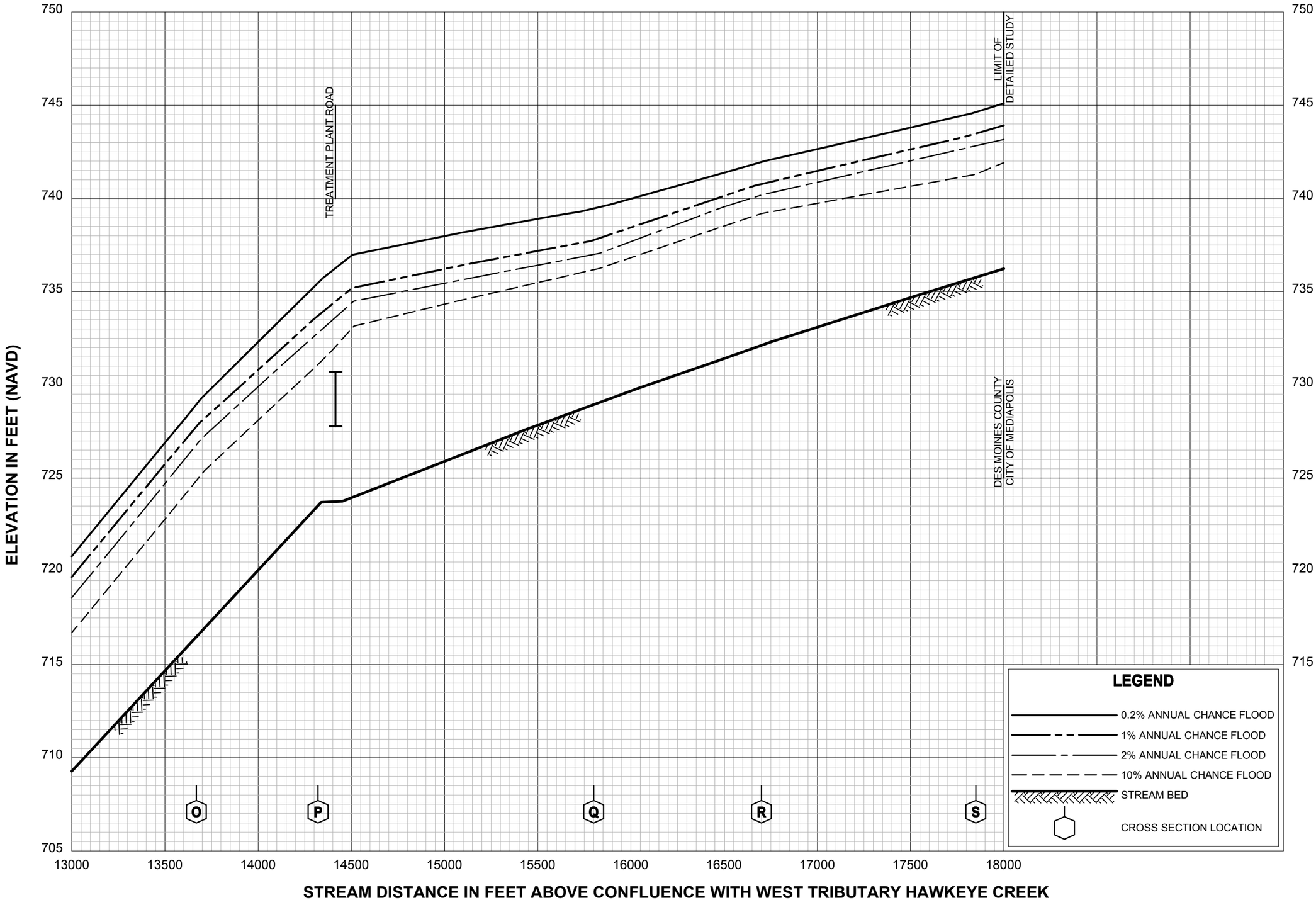
FLOOD PROFILES

HAWKEYE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



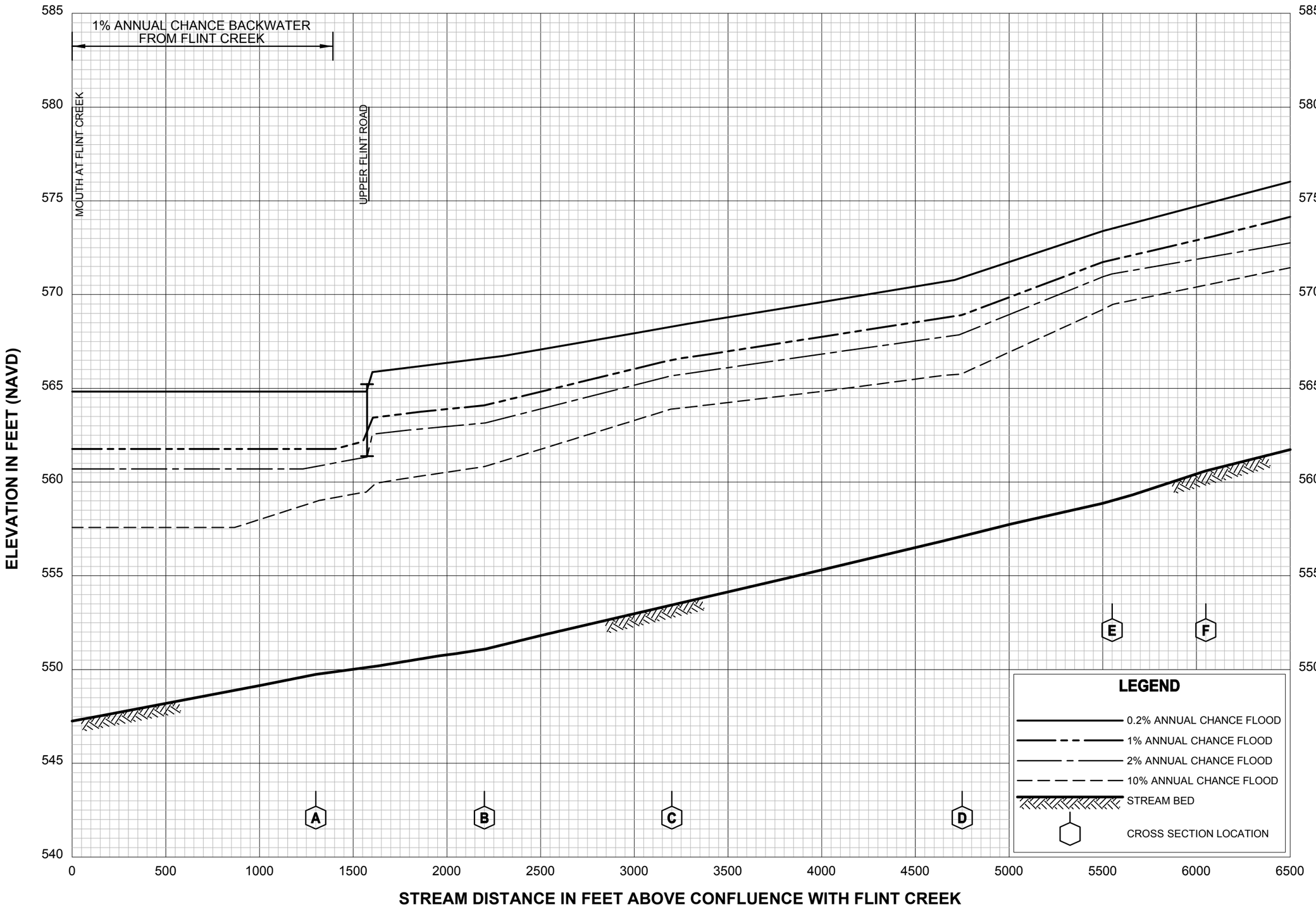
FLOOD PROFILES

HAWKEYE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



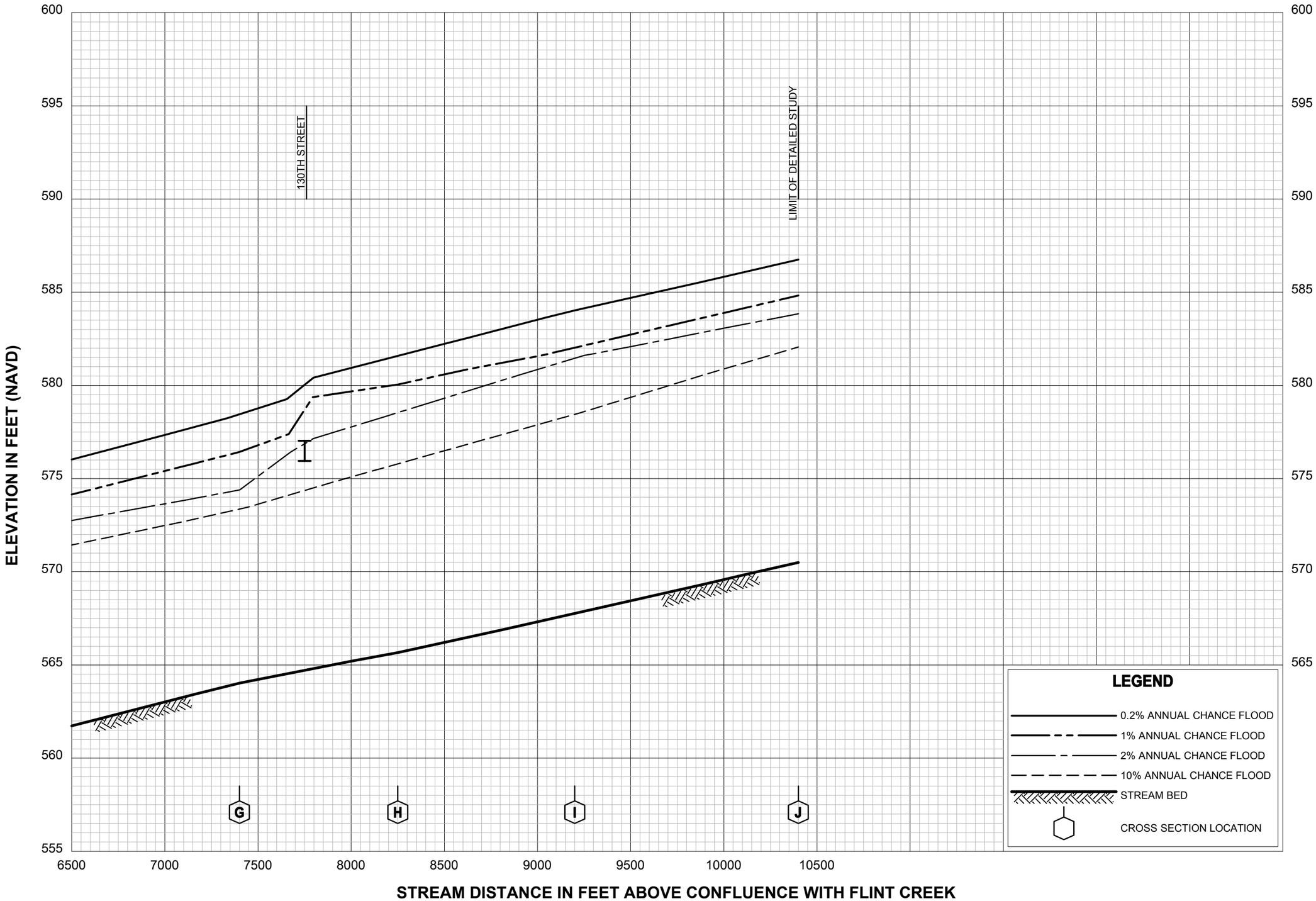
FLOOD PROFILES

KNOTTY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



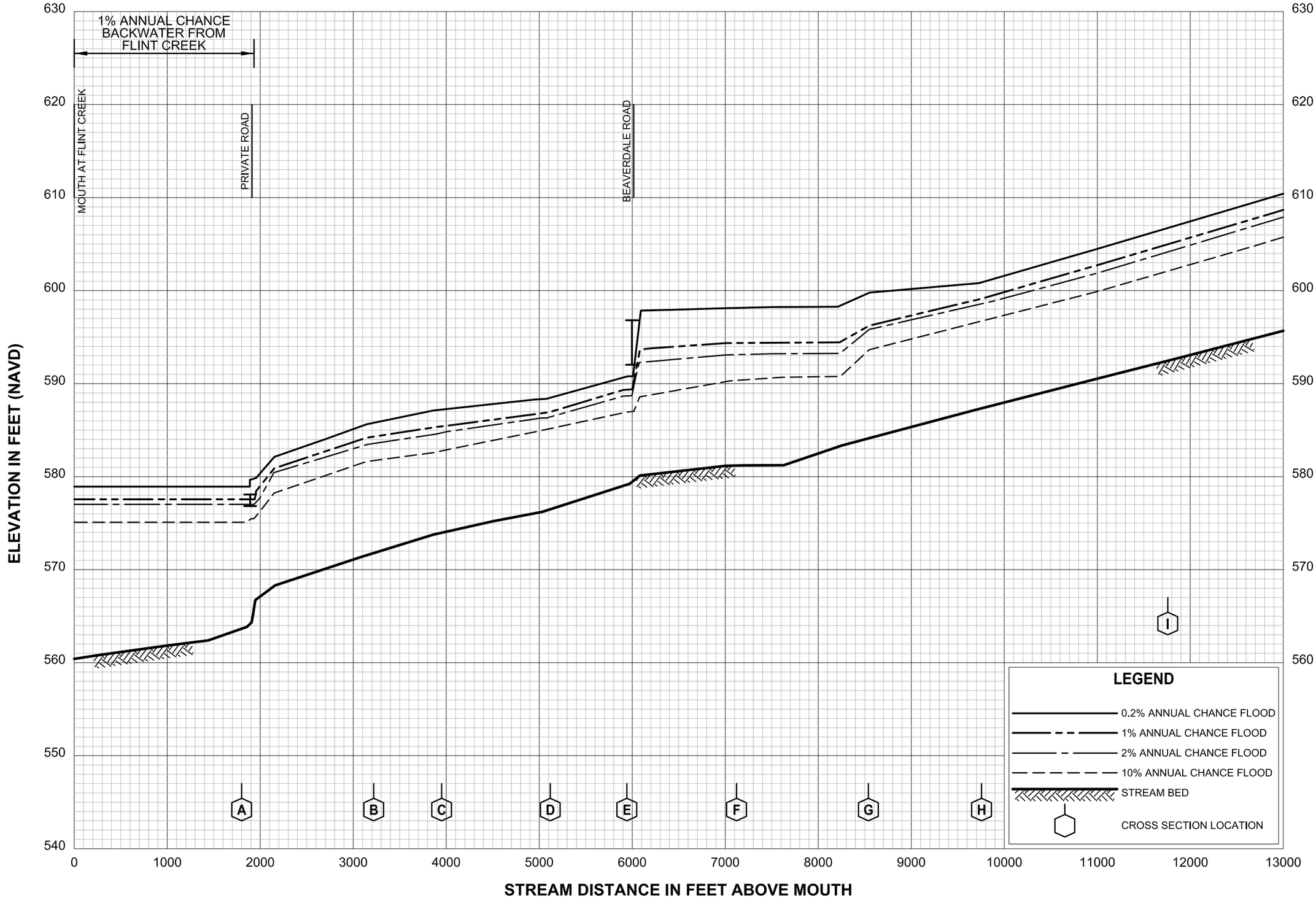
FLOOD PROFILES

KNOTTY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



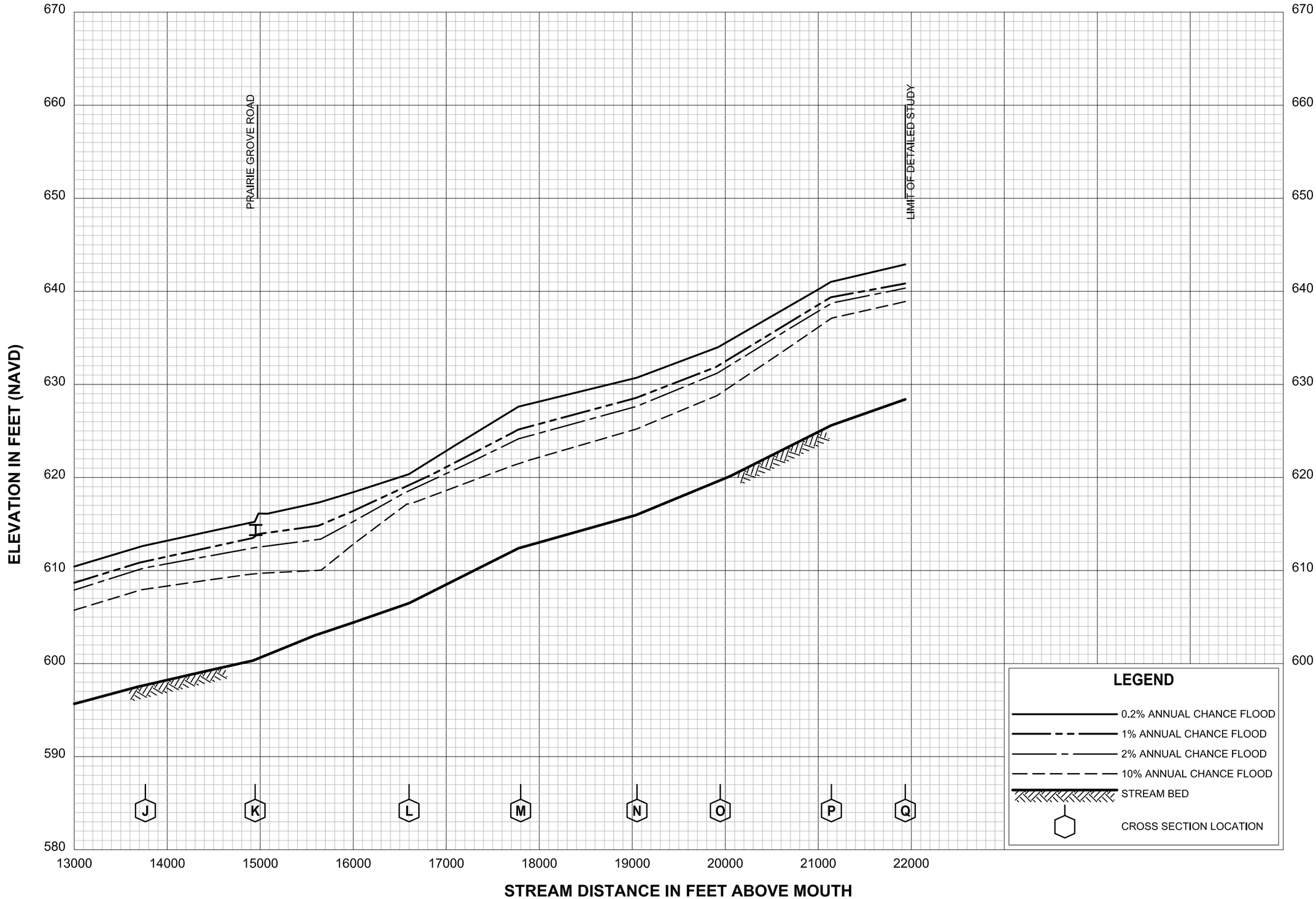
FLOOD PROFILES

LITTLE FLINT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



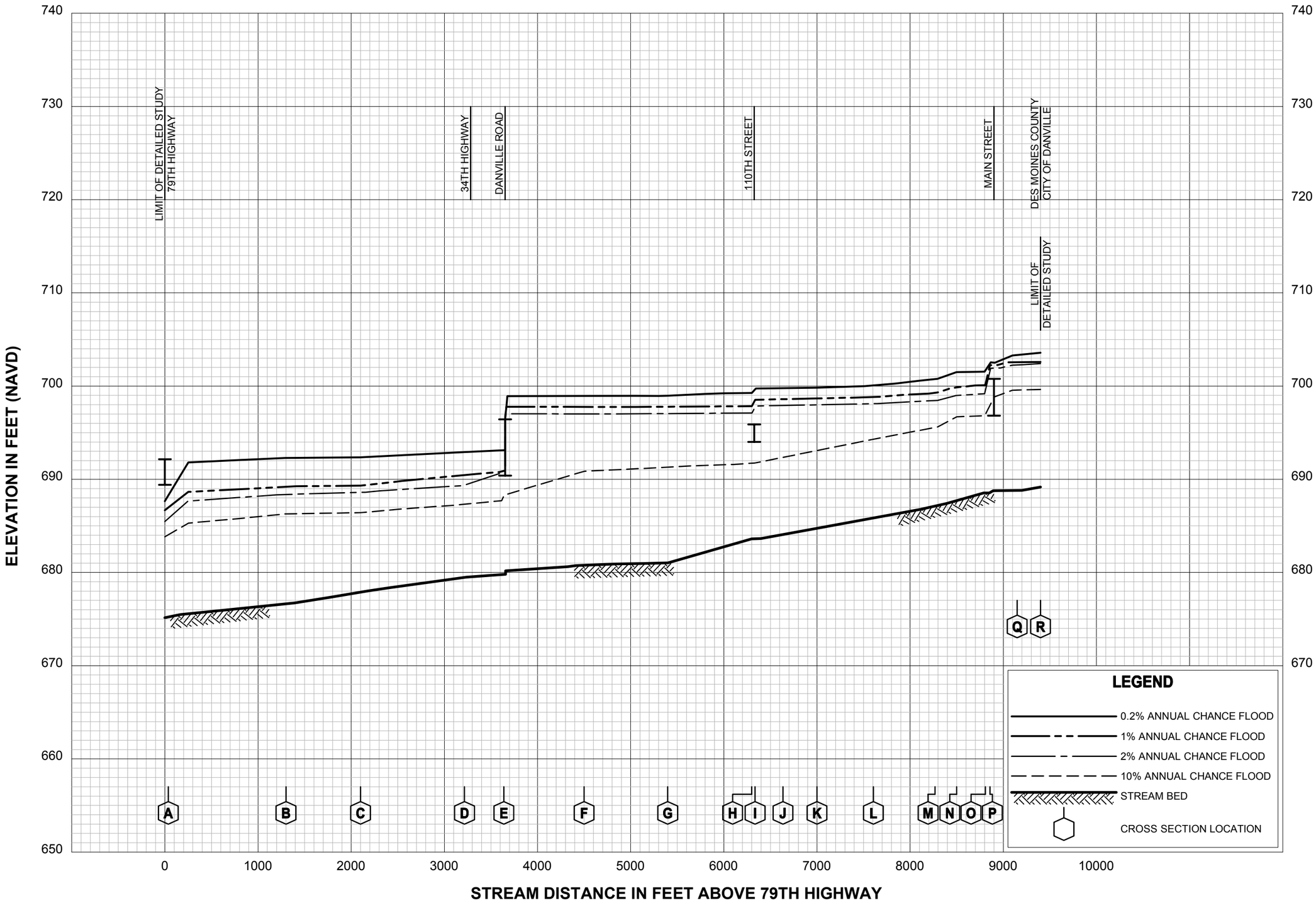
FLOOD PROFILES

LITTLE FLINT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



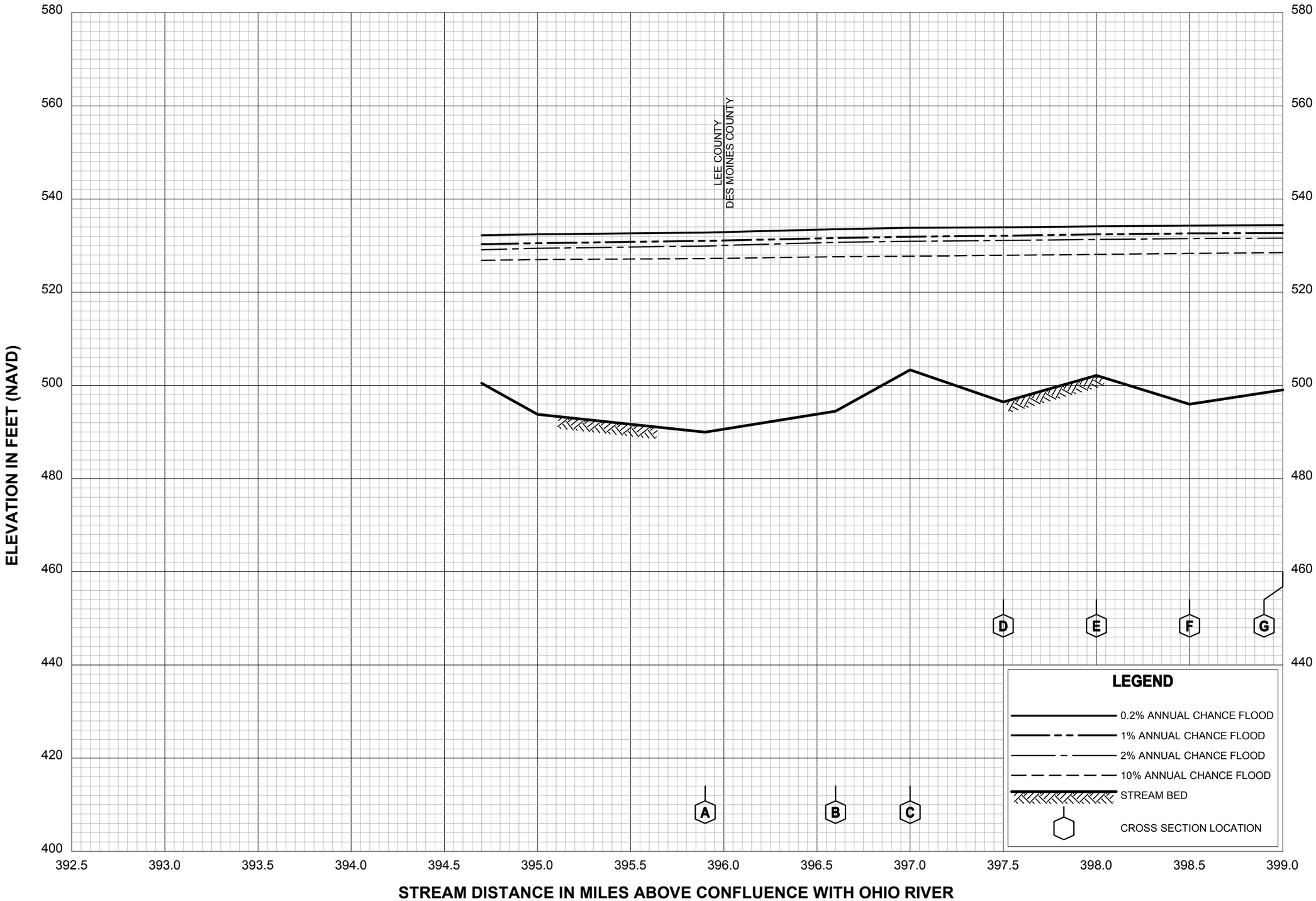
FLOOD PROFILES

LONG CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



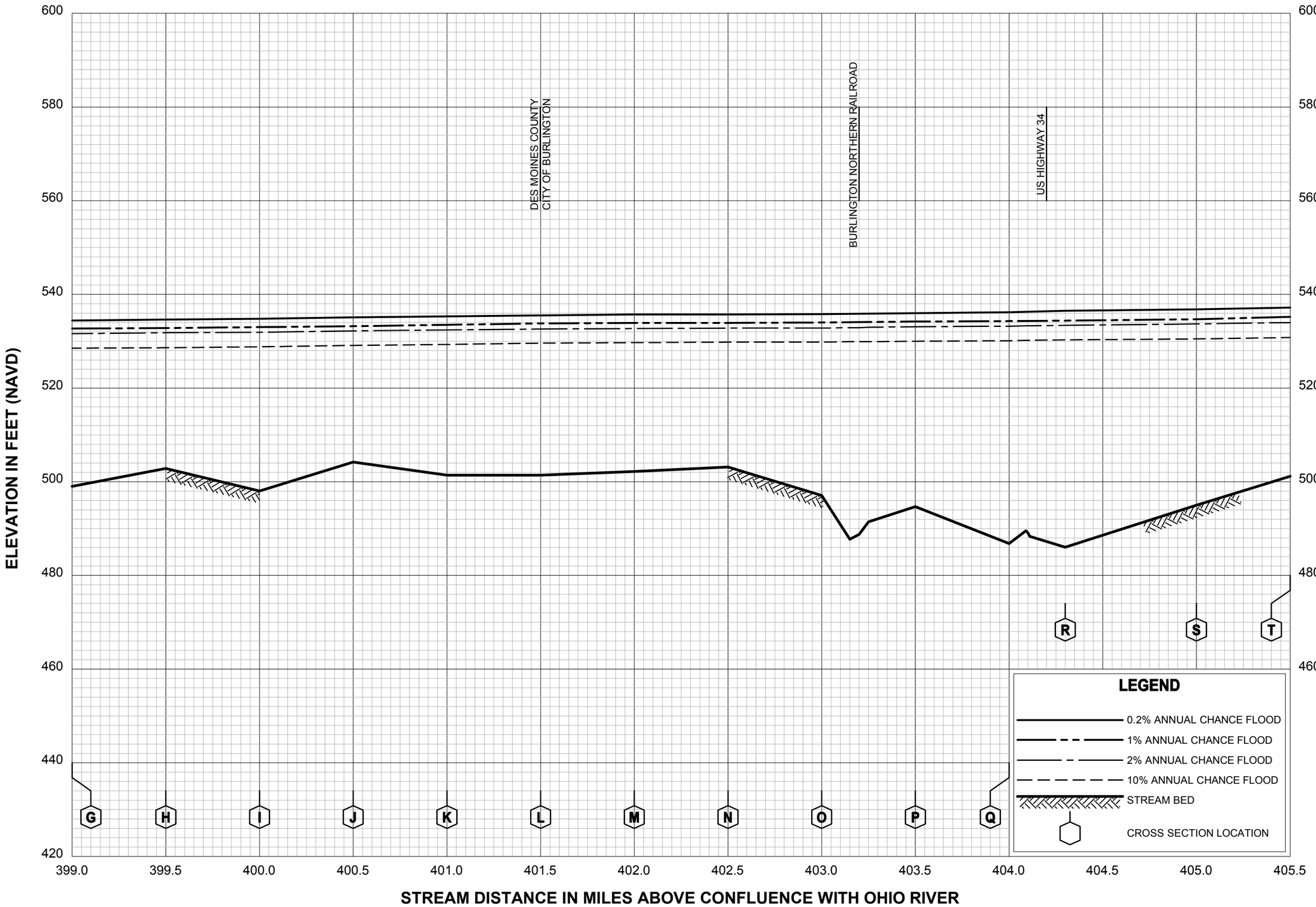
FLOOD PROFILES

MISSISSIPPI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



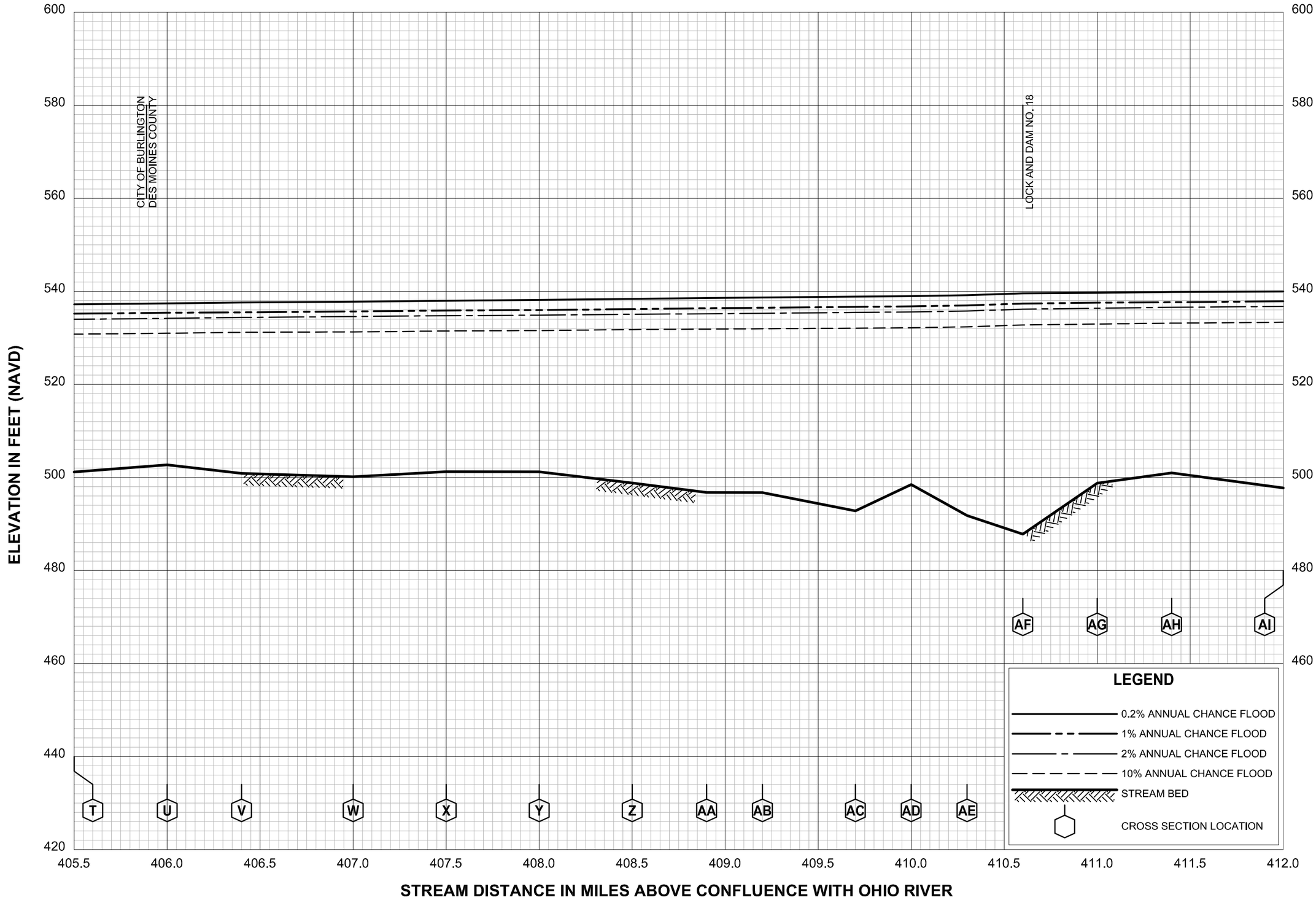
FLOOD PROFILES

MISSISSIPPI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



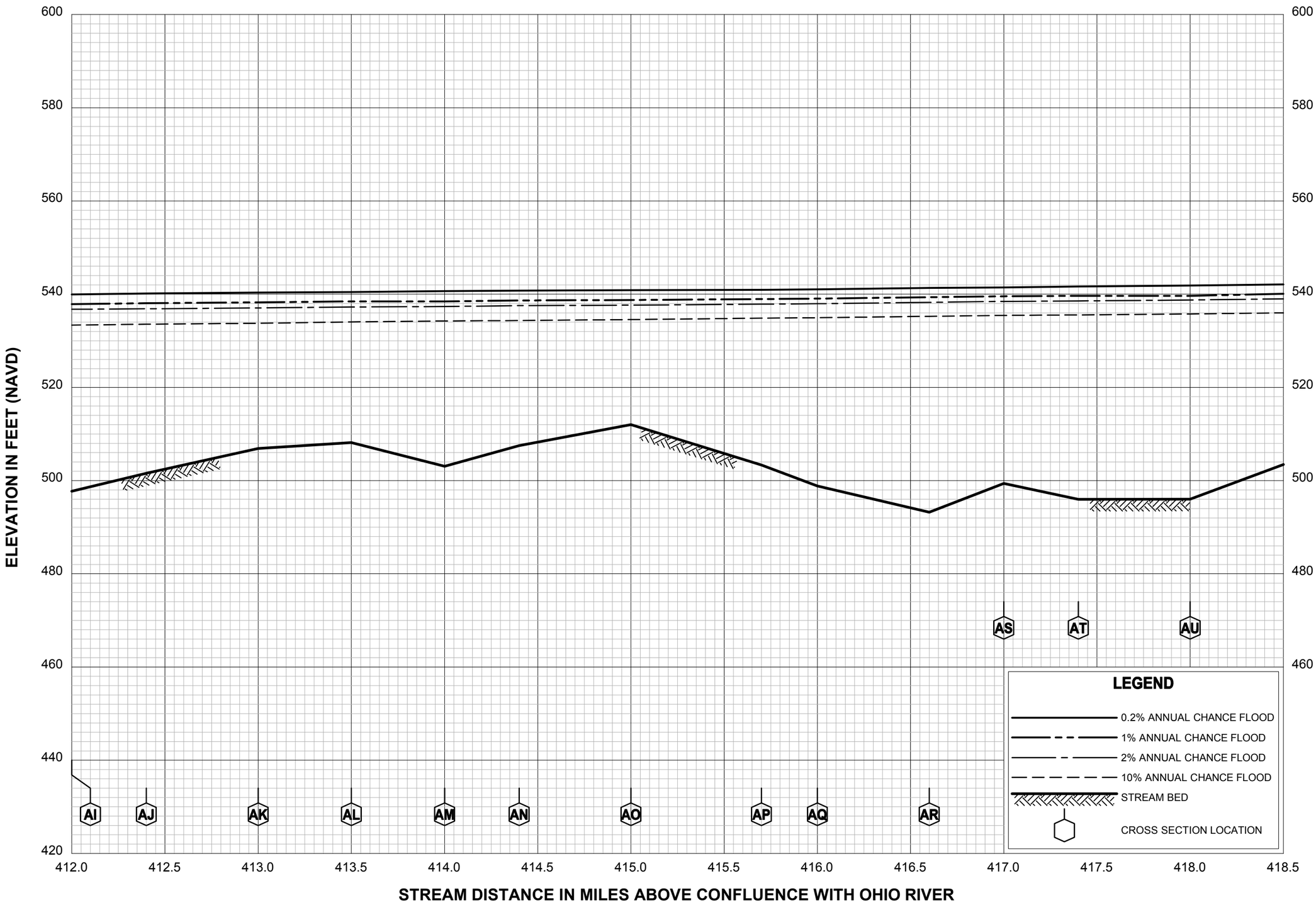
FLOOD PROFILES

MISSISSIPPI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



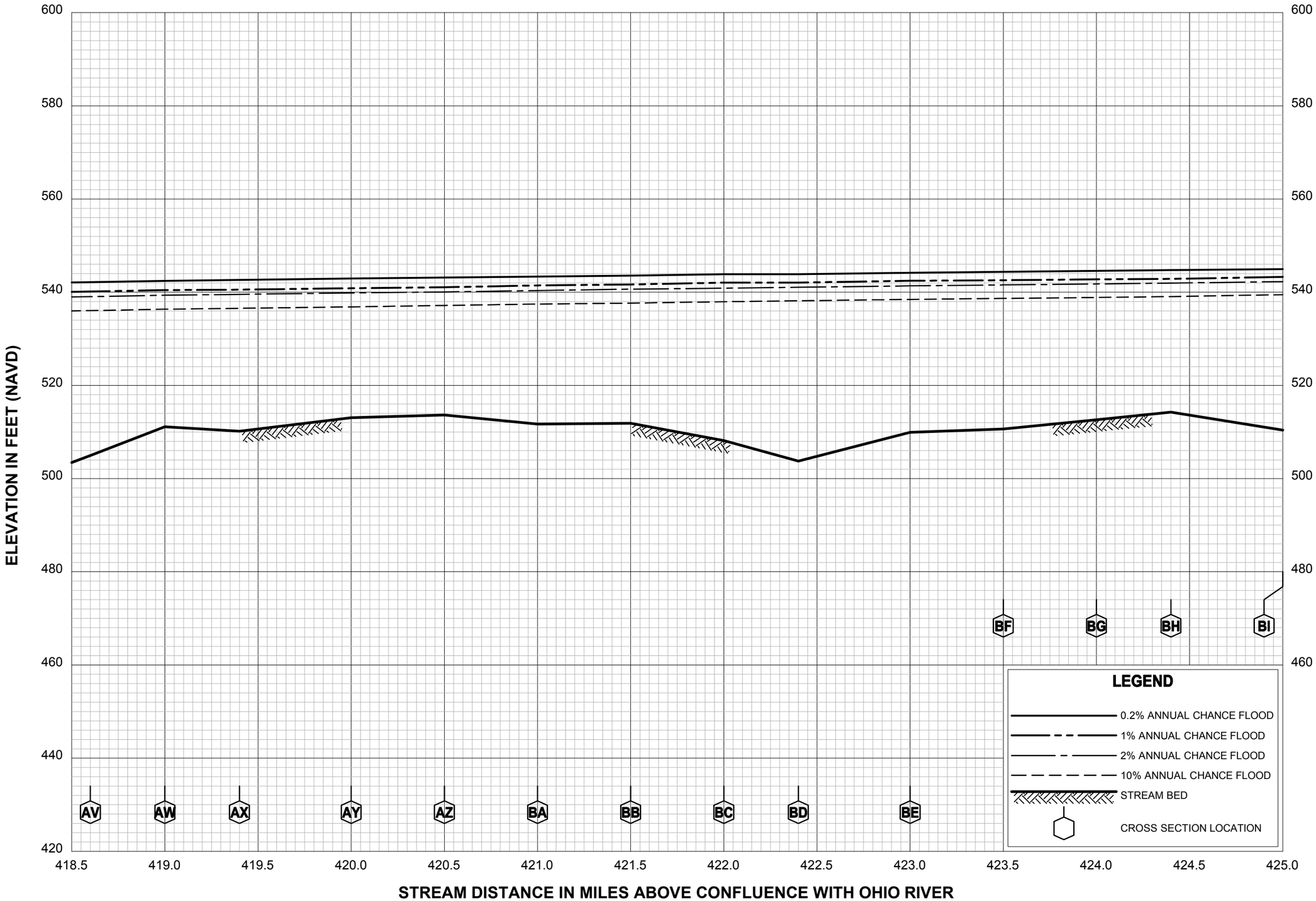
FLOOD PROFILES

MISSISSIPPI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



FLOOD PROFILES

MISSISSIPPI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

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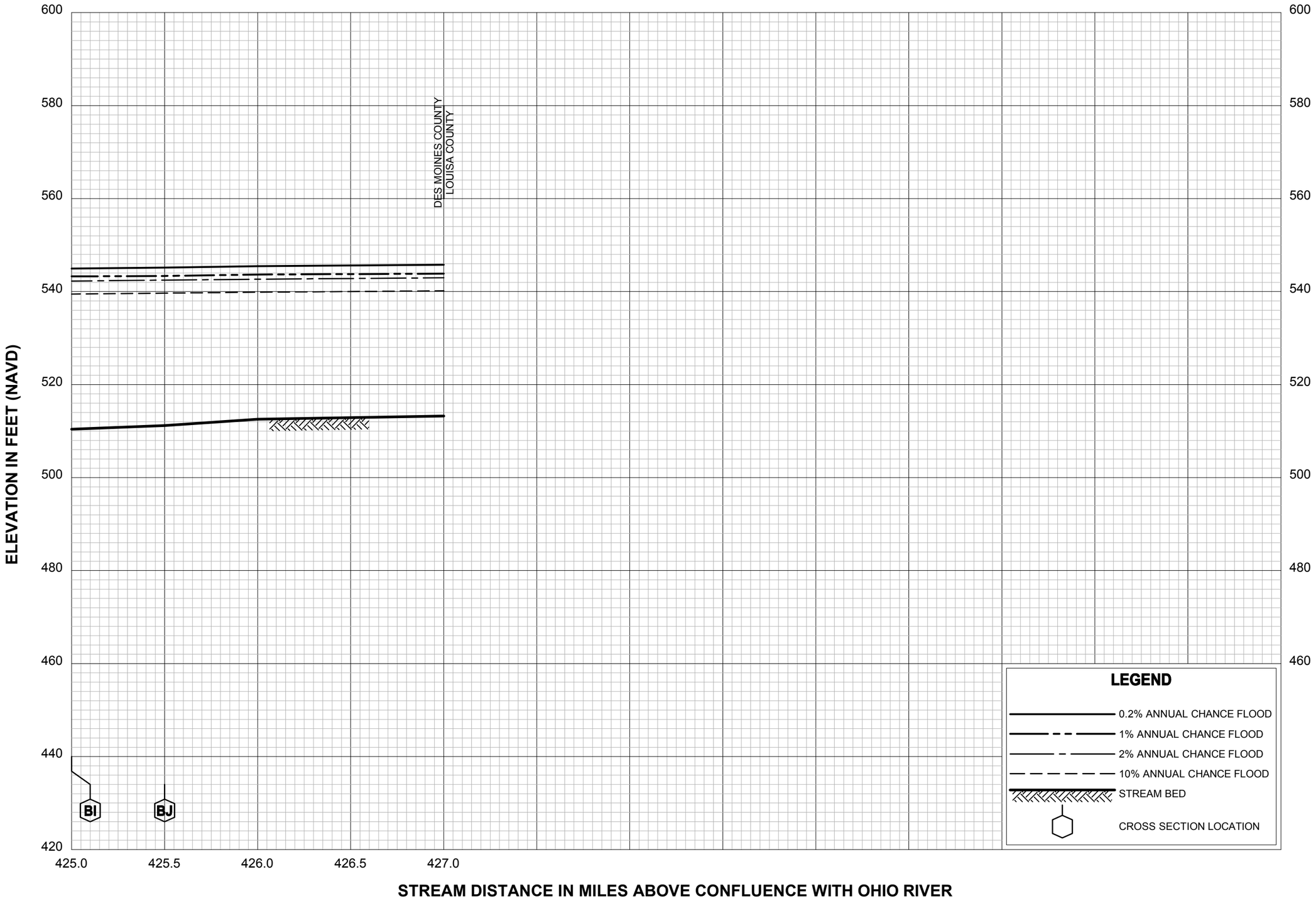


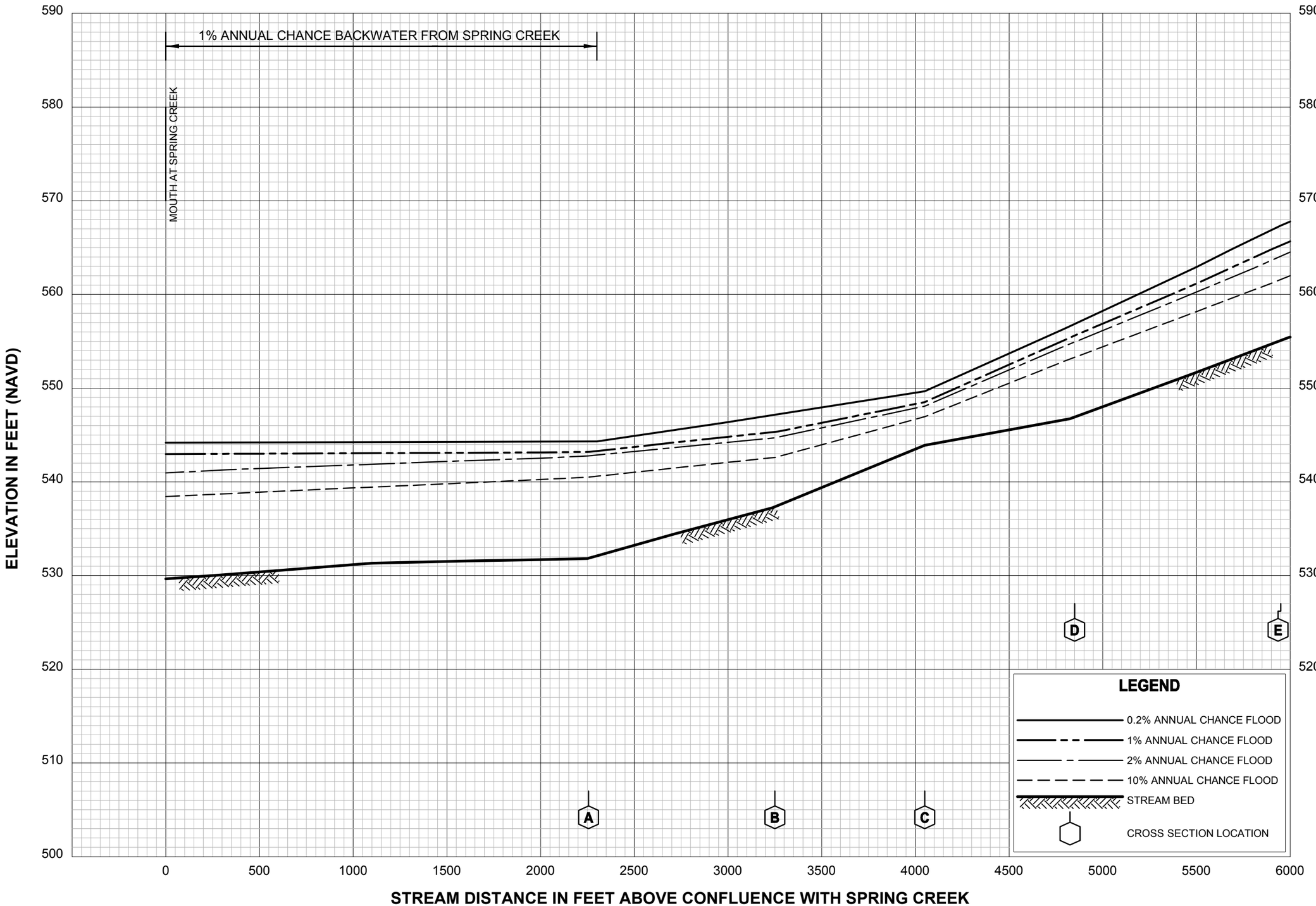
FLOOD PROFILES

MISSISSIPPI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



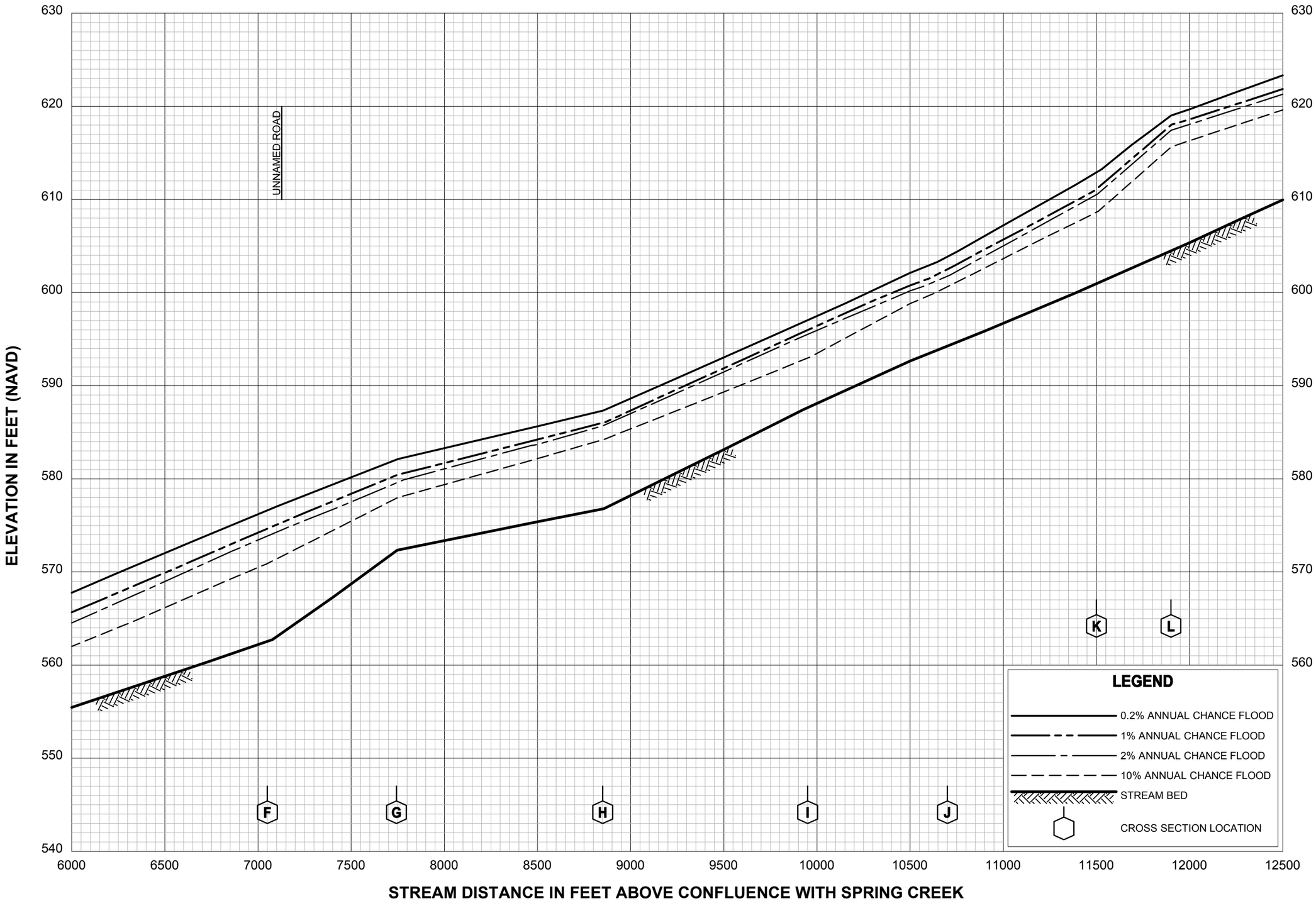
FLOOD PROFILES

NORTH BRANCH SPRING CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



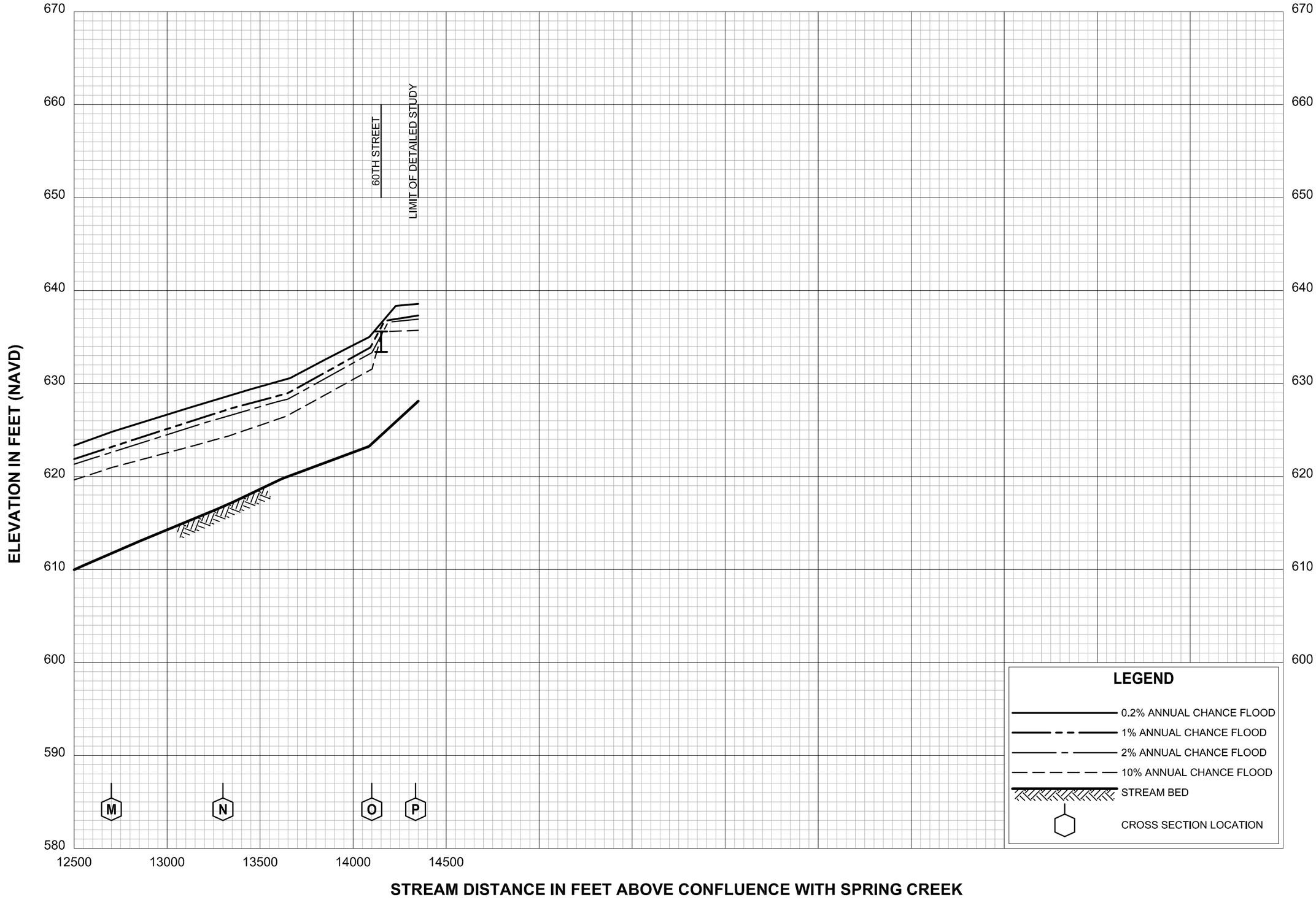
FLOOD PROFILES

NORTH BRANCH SPRING CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



FLOOD PROFILES

NORTH BRANCH SPRING CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

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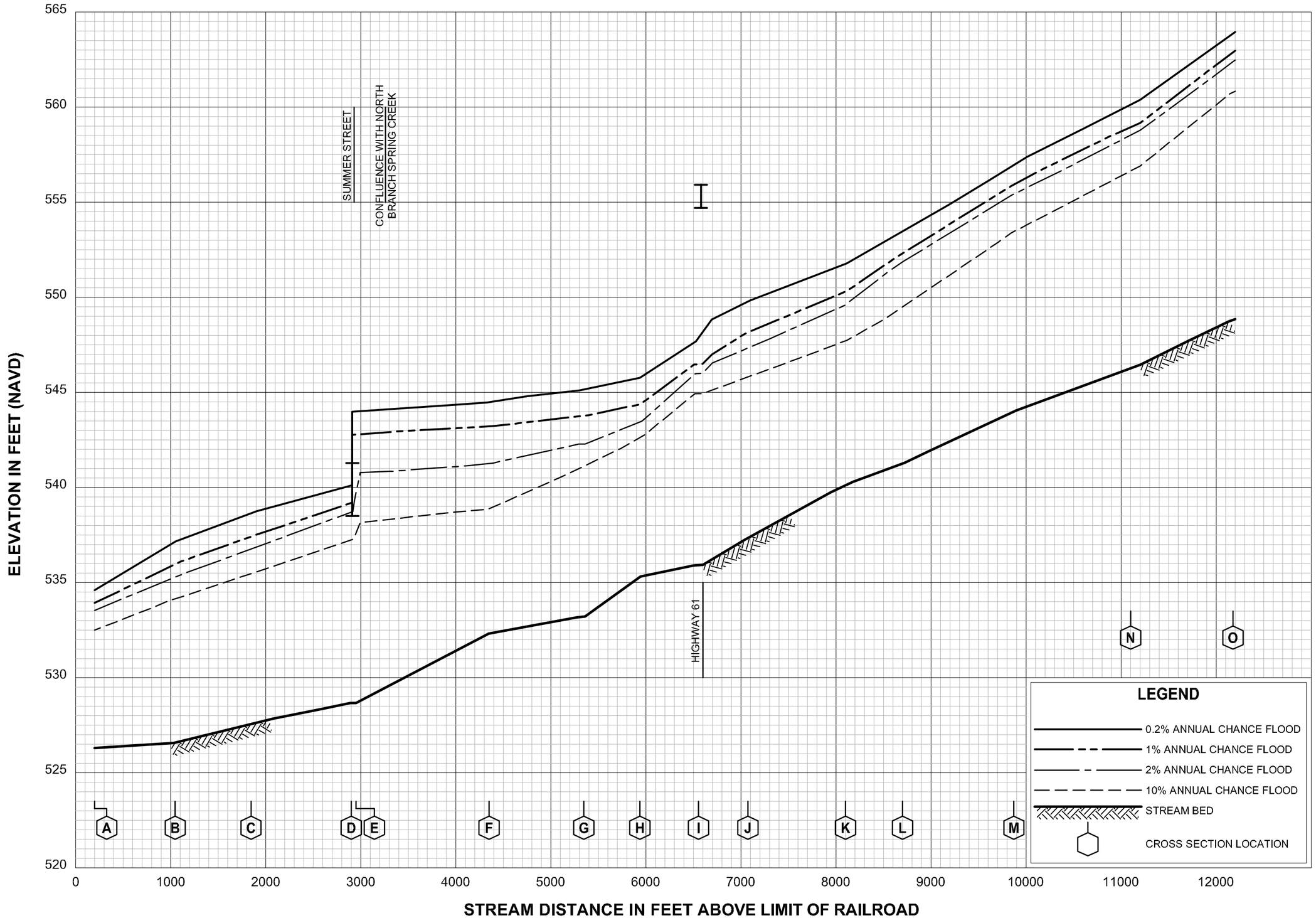


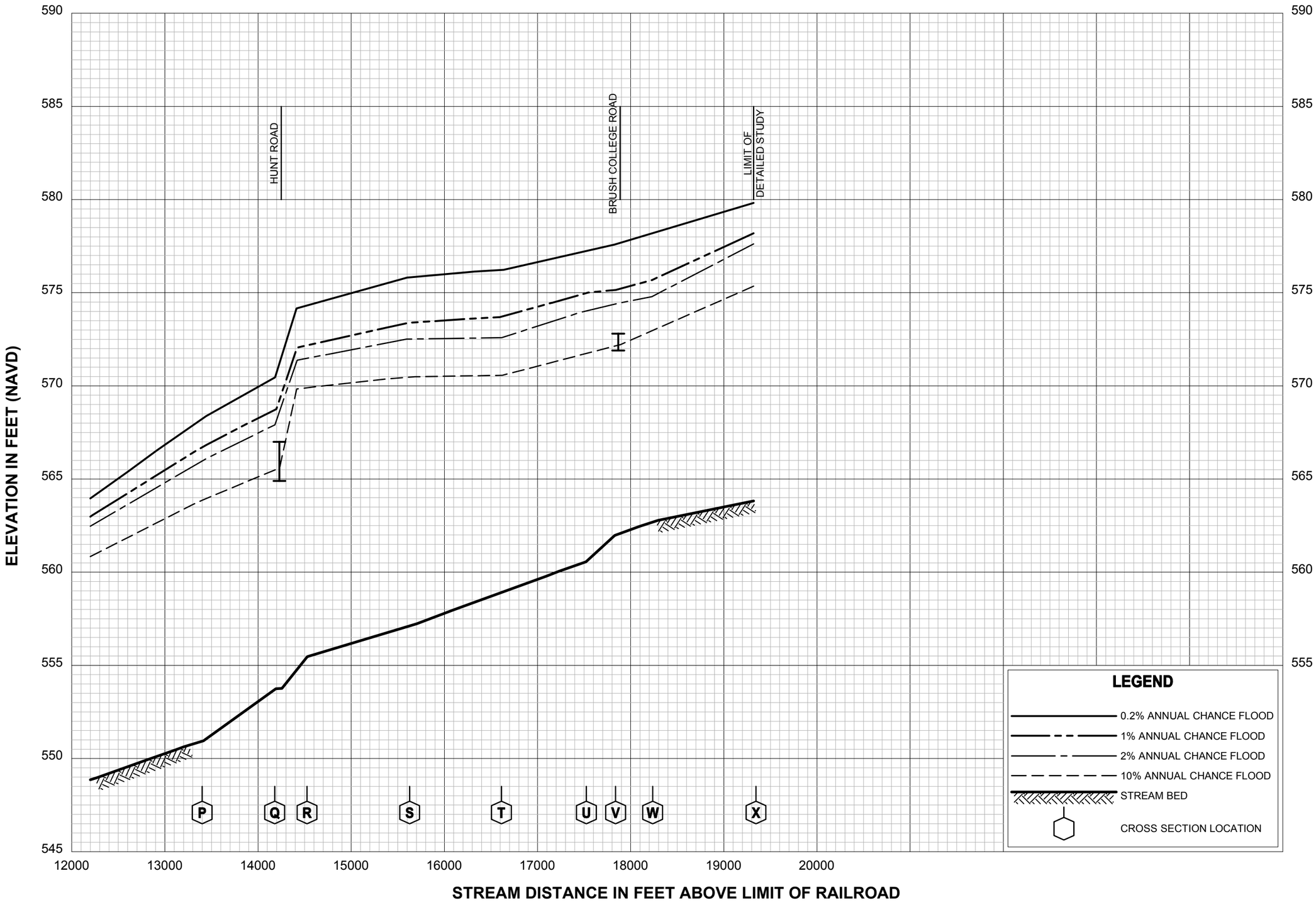
FLOOD PROFILES

SPRING CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



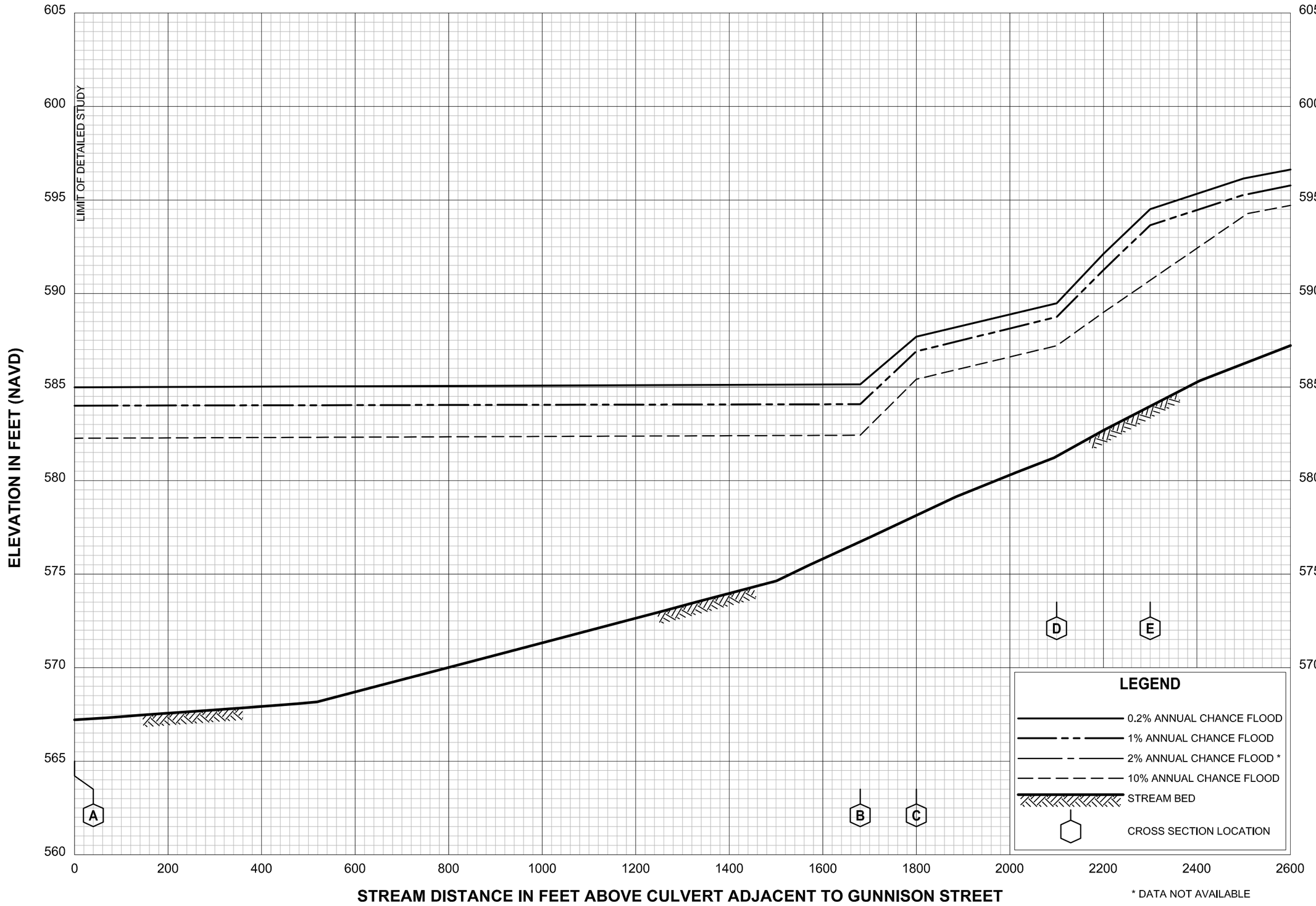
FLOOD PROFILES

SPRING CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



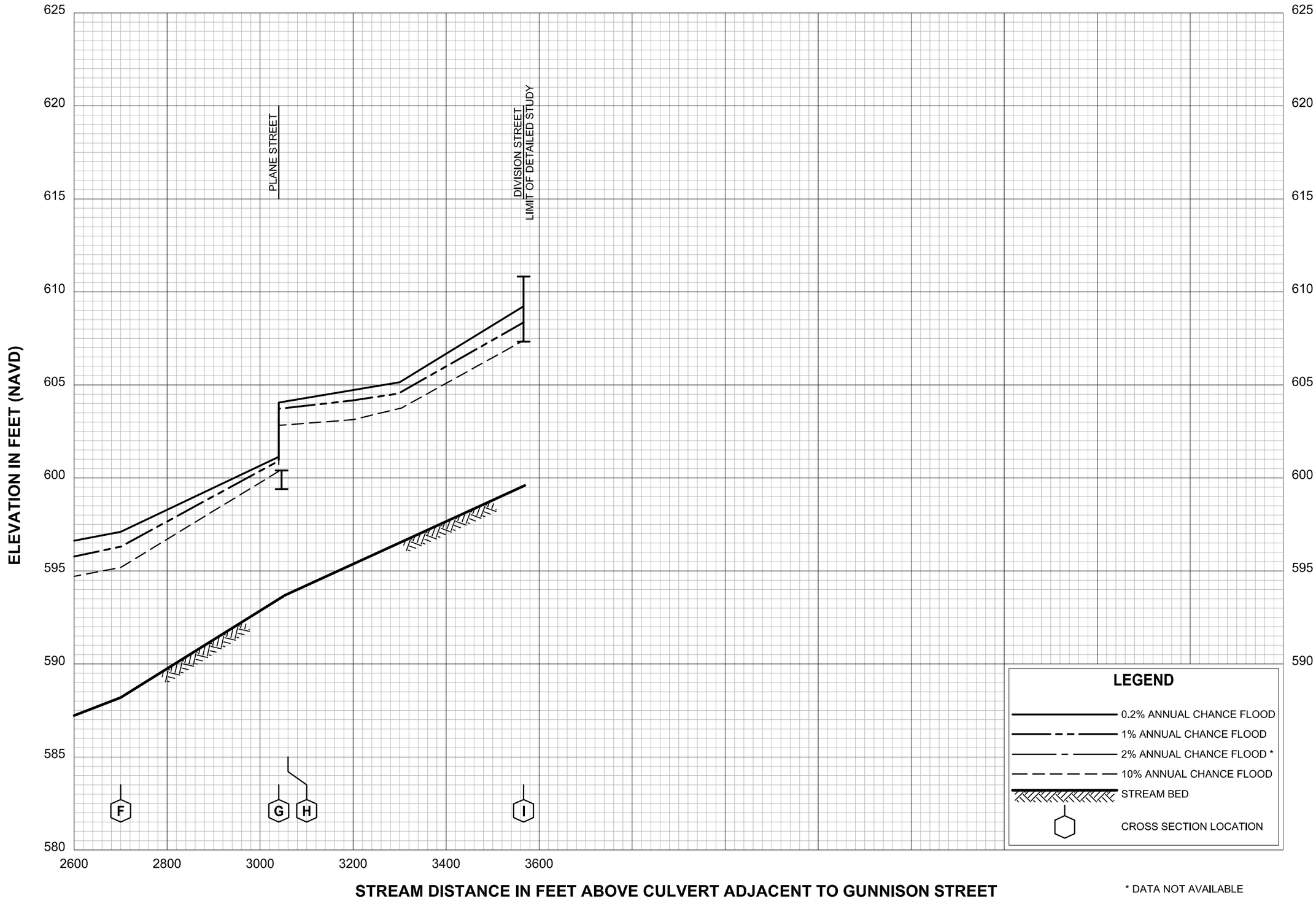
FLOOD PROFILES

TRIBUTARY A

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS



* DATA NOT AVAILABLE

FLOOD PROFILES

TRIBUTARY A

FEDERAL EMERGENCY MANAGEMENT AGENCY

DES MOINES COUNTY, IA

AND INCORPORATED AREAS