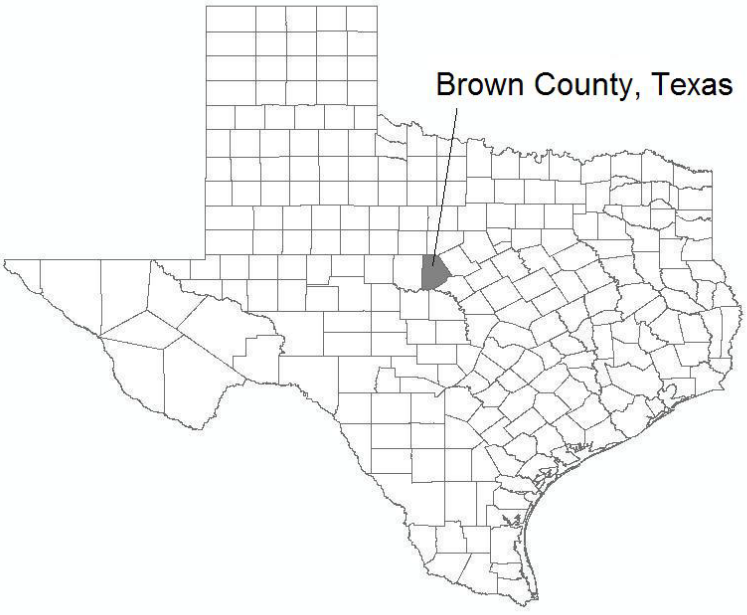
FLOOD INSURANCE STUDY

BROWN COUNTY, TEXAS

AND INCORPORATED AREAS



Community Name	Community Number
BANGS, CITY OF	480718
BLANKET, CITY OF	480719
BROWN COUNTY (UNINCORPORATED AREAS)	480717
BROWNWOOD, CITY OF	480087
EARLY, CITY OF	480088

PRELIMINARY

12/21/12

Effective Date:

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER

48049CV000A

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) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS 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 (FIRM) panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X
C	X

This preliminary revised Flood Insurance Study contains profiles presented at a reduced scale to minimize reproduction costs. All profiles will be included and printed at full scale in the final published report.

Initial Countywide FIS Effective Date:

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FLOOD INSURANCE STUDY
BROWN COUNTY, TEAXS AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Brown County, including the cities of Bangs, Blanket, Brownwood, and Early; and the unincorporated areas of Brown County (referred to collectively herein as Brown County), 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 and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

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.

1.2 Authority and Acknowledgments

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

This FIS was prepared to include all jurisdictions within Brown County into a countywide format FIS. Information on the authority and acknowledgments for each jurisdiction with a previously printed FIS report included in this countywide FIS is shown below.

Brownwood, City of:	The hydrologic and hydraulic analyses for the October 15, 1980, FIS report were performed by Bovay Engineers, Inc., for the Federal Insurance Administration (FIA), under Contract No. H-4603. This study was completed in July 1979.

There are no previous FIS Reports published for the Cities of Bangs, Blanket and Early, and the unincorporated areas of Brown County; therefore, the previous authority and acknowledgments for these communities are not included in this FIS.

For this countywide FIS, new detailed and approximate hydrologic and hydraulic analyses were prepared. Michael Baker Jr. Incorporated, in conjunction with Halff Associates and Morrison Hydrology, LLC, created floodplain boundaries based on more up-to-date topography submitted by the City of Brownwood, Texas, and the Lower Colorado River Authority (LCRA), for the Federal Emergency Management Agency (FEMA), under Contract No. EMT-2002-CO-00511, /Project Order No. HSTO034. This study was completed in December 2011.

Base map information shown on the Flood Insurance Rate Map (FIRM) was provided in digital format by Texas Natural Resources Information System, 2006; City of Brownwood,

2007, Brown County Appraisal District, 2012; and West Central Texas Council of Governments, 2007. The Data was created in State Plane North American Datum (NAD) coordinates, U.S. Survey Feet and was produced at scale 1:24,000.

The coordinate system used for the production of this FIRM is Texas State Plane Central Zone (FIPSZONE 4203). Corner coordinates shown on the FIRM are in latitude and longitude referenced to State Plane NAD 1983. Differences in the datum and spheroid used in the production of FIRMs 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 the FIRM.

1.3 Coordination

An initial Consultation Coordination Officer's (CCO) meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of an FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with the same representatives to review the results of the study.

Streams requiring detailed study were identified at a meeting attended by representatives of the study contractor, the FIA and representatives of the City of Brownwood in August 1977. Results of the hydrologic analyses were coordinated with the Texas Department of Water Resources (TDWR), the U.S. Department Agriculture Soil Conservation Services (SCS), which is now known as the U.S. National Resources Conservation Service (NRCS), and the U.S. Army Corps of Engineers (USACE).

The pre-countywide final CCO meeting was held for the City of Brownwood on May 23, 1980. The results of the study were reviewed at the final meeting attended by representatives of the study contractor, FIA, and community officials.

For this countywide FIS, an initial CCO meeting was held on May 14, 2007 and attended by representatives of FEMA; Halff Associates, Inc., the cities of Blanket, Brownwood, and Early, Texas Department of Transportation (TxDOT), LCRA, West Central Texas Council of Governments (WCTCOG), Brown County Water Improvement District #1 (BCWID #1), and Brown County.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS report covers the geographic area of Brown County, Texas, including the incorporated communities listed in Section 1.1.

All or portions of the flooding sources listed in Table 1, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

TABLE 1 - FLOODING SOURCES STUDIED BY DETAILED METHODS

Pecan Bayou	Tributary of South Willis Creek
South Willis Creek	West Adams Branch
South Willis Tributary East	Willis Creek

TABLE 1 - FLOODING SOURCES STUDIED BY DETAILED METHODS- continued

Tom Williams Creek

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through Brown County

For this countywide FIS, updated or new analyses were included for the flooding sources shown in Table 2, "Scope of Study."

TABLE 2 - SCOPE OF STUDY

Stream Name	Limits of Revised or New Detailed Study
Pecan Bayou	From approximately 0.31 mile downstream of Lake Forest Drive to approximately 2.10 miles upstream of Valley Falls Road
South Willis Creek	From the confluence with North Tyger River to approximately 260 feet upstream of US Highway 29
South Willis Tributary East	From approximately 627 feet downstream of Stephen F. Austin Drive to approximately 224 feet upstream of Mustang Drive.
Tom Williams Creek	From the confluence of Shoally Creek Tributary 2 to approximately 0.86 mile upstream of Old Furnace Road
Tributary of South Willis Creek	From the confluence with North Tyger River to approximately 260 feet upstream of US Highway 29
West Adams Branch	From approximately 0.10 mile downstream of Fountain Inn Road to approximately 260 feet upstream of Highway 14
Willis Creek	From the confluence of Shoally Creek Tributary 2 to approximately 0.86 mile upstream of Old Furnace Road

Numerous streams were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and Brown County.

2.2 Community Description

Brown County is located in north central Texas, covering an area of 957 square miles. It is bordered by Eastland County to the north, Comanche County to the northeast, Mills County to the southeast, San Saba County to the south, McCulloch County to the southwest, Coleman County to the west, and Callahan County to the northwest.

The county seat and largest city in Brown County is the City of Brownwood. There are five major highways in Brown County. U.S. Highway 67 is a major northeast-southwest artery. U.S. Highway 84 is a major east-west artery. U.S. Highway 183 is a major north-south artery. U.S. Highway 377 is a major northeast-southwest artery. State Highway 279 is a major north-south artery. Brown County is also served by the Burlington Northern Santa Fe Railroad.

According to the United States Census 2010 figures, the population of Brown County was 38,106. This represents a population increase of 1.1% since the 2000 census (Reference 1).

All of the streams studied in detail, except Pecan Bayou originate in the vicinity of the city of Brownwood, generally west of Pecan Bayou, which is the parent stream of all the flooding sources in the City of Brownwood.

Pecan Bayou originates at the western part of Callahan County. The headwater for Pecan Bayou is approximately 100 miles from the city with a drainage area of 1,641 square miles. It flows generally in a southeasterly direction into the Colorado River which is about 44 miles downstream of Brownwood.

West Adams Branch originates about five miles west of the city of Brownwood and flows generally eastward into Pecan Bayou east of Brownwood. The entire stream is about 13 miles long with a drainage area of 26 square miles.

Tom Williams Creek originates about two miles northwest of Brownwood and flows generally northeast and then southeast into West Adams Branch. The entire stream is about 4.5 miles long with a drainage area of 4.7 square miles.

Willis Creek originates above five miles southwest of the city of Brownwood and flows generally north and then east into Pecan Bayou east of Brownwood. The total length of the stream is about 10 miles and the drainage area of the watershed is about 27 square miles.

South Willis Creek originates about three miles south of Brownwood and flows generally northward into Willis Creek. The entire stream is about 5.5 miles long with a drainage area of 11.5 square miles.

The Tributary of South Willis Creek originates about one mile southeast of the city of Brownwood and flows generally in a northwesterly direction into South Willis Creek. The entire stream is about 2.5 miles long with a drainage area of 1.4 square miles.

The climate is mild in the vicinity of Brownwood. Average winter and summer temperatures are 46 degrees F and 84 degrees F, respectively. Average annual rainfall of the region is about 28 inches with an insignificant amount of snowfall. Precipitation is fairly evenly distributed throughout the year (Reference 2).

2.3 Principal Flood Problems

The City of Brownwood is subject to occasional general flooding from the principal streams flowing through the city. Short duration, high intensity storms contribute to these flooding conditions (Reference 3). Records of historical floods in the Pecan Bayou watershed are abundant. The most recent significant flood, since the completion of Brownwood Dam in 1932, occurred in May 1956 which registered a peak discharge of 26,500 cubic feet per second (cfs) at the gauge–Pecan Bayou at Brownwood. The most significant floods at West Adams Branch and Willis Creek occurred in July 1945. Although there are no gauging stations on either stream, the peak discharges were estimated by USACE to be 12,000 cfs and 17,800 cfs at West Adams Branch and Willis Creek, respectively. More recent floods have occurred in May 1989, May 1990, December 1991, July 2002 and June 2007.

2.4 Flood Protection Measures

Flood control structures in the Pecan Bayou watershed include Lake Brownwood Dam and several SCS dams. Lake Brownwood Dam is located on Pecan Bayou about 10 miles

upstream of the city. It controls a drainage area of 1,535 square miles. In the intervening drainage area between the dam and the gauging station at Brownwood, there are thirteen SCS dams controlling a total area of 32 square miles. There is one SCS dam each on Tom Williams Branch, West Adams Branch and Willis Creek. Two SCS dams are constructed at the headwaters of South Willis Creek. There are no other flood protection structures on the remaining streams studied in detail. Non-structural measures of flood protection are also being utilized to aid in the prevention of future flood damage. These are in the form of a floodplain ordinance adopted by the City of Brownwood which controls building within areas that have a high risk of flooding.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which 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 which equals or exceeds the 1-percent annual chance flood (1-percent chance of annual exceedance) in any 50-year period is approximately 40 percent (4 in 10), and, 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 county at the time of completion of this FIS. 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 the county.

Information on the methods used to determine peak discharge-frequency relationships for the streams studied by detailed methods is shown below.

Pre-countywide Analyses

Flood discharges for areas of approximate study were based on USGS regional studies. However, in these areas only the 1-percent annual chance frequency flood was considered.

Countywide Analyses

The hydrologic analysis completed for this study used the HEC-1 Method. The U.S. Army Corps of Engineers HEC-1 (Reference 4) computer program is one of the most widely- accepted method of computing run-off hydrographs for complex stream systems. The program can be used for the design of detention basins, drainage channels, or other drainage structures. The program also has the capability of analyzing reservoirs and performing optimization and other specialized functions. HEC-1 models a single rainfall event. As such, HEC-1 seeks to convert the precipitation, which is input by the user into a time history of the runoff: e.g. a hydrograph. The conversion is accomplished by

modeling to a greater or lesser degree each of the major processes of the surface portion of the hydrologic cycle. The hydrologic model is published separately.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 3, "Summary of Discharges."

TABLE 3 – SUMMARY OF DISCHARGES

Flooding Source And Location	Drainage Area (Sq. Mile)	Peak Discharges (cfs) 10-percent chance	2-percent chance	1-percent chance	0.2-percent chance
PECAN BAYOU					
Eastern City Limit	1,641	*	*	62,247	*
SOUTH WILLIS CREEK					
Above Confluence with Willis Creek	*	*	*	7,424	
Above Tributary of South Willis Creek	*	*	*	5,778	*
Below Tributary of South Willis Creek	*	*	*	8,791	*
SOUTH WILLIS TRIBUTARY EAST					
At confluence with Tributary of South Willis Creek	*	*	*	862	*
TOM WILIAMS CREEK					
At US Highway 67	*	*	*	14,010	*
Above Walnut Street	*	*	*	14,010	*
Above Hickory Street	*	*	*	14,010	*
TRIBUTARY OF SOUTH WILLIS CREEK					
Below Indian Creek Drive	*	*	*	3,192	*
WEST ADAMS BRANCH					
At Belle Plain Avenue	*	*	*	17,869	*
At Beaver Avenue	*	*	*	10,544	*
At Cordell Street	*	*	*	10,544	*
At Coleman Avenue	*	*	*	10,544	*
Above Burlington Northern and Santa Fe Railway	*	*	*	10,544	*
WILLIS CREEK					
Below Eastern City Limits	*	*	*	14,767	*
At Austin Avenue	*	*	*	14,767	*
Below South Willis Creek	*	*	*	14,767	*
Below Fourth Street	*	*	*	7,343	
Below Confluence of Split flow channel	*	*	*	5,796	*
Above Confluence of Split flow channel	*	*	*	1,750	*
Above Western City Limit	*	*	*	3,634	*

*Data Not Available

USACE had various studies in the entire Pecan Bayou watershed, which were compiled in a report published in October 1963 (Reference 5). Historical floods in the vicinity of the City of Brownwood were analyzed in the report and estimates of the 1-percent annual chance peak discharge were made for Pecan Bayou, Tom Williams Creek, West Adams Branch and Willis Creek, assuming 1963 conditions.

The streamflow gauging station, Pecan Bayou at Brownwood, had a continuous record since 1923.

Since the completion of Lake Brownwood Dam in 1932, the maximum flow recorded at the gauge was 26,500 cfs in 1956.

3.2 Hydraulic Analyses

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

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

The hydraulic analyses for this countywide FIS 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.

Pre-countywide Analyses

Within Brown County, only the City of Brownwood had a previously published FIS report. The streams studied by detailed and approximate methods have all been restudied for this countywide study.

Countywide Analyses

The hydraulic analysis for this study is based on the HEC-RAS computer model (Reference 6). The HEC-RAS program is intended for calculating water surface profiles for steady gradually varied flow in natural or man-made channels. Both sub-critical and supercritical flow profiles can be calculated. The effects of various obstructions such as bridges, culverts, weirs, and structures in the floodplain may be considered in the computations. The computational procedure is based on the solution of the one-dimensional energy equation with energy loss due to friction evaluated with Manning's equation.

Field surveys as-built plans and City 2' topographic maps were used to develop existing condition cross sections. These were used in the HEC-RAS computer method to develop a hydraulic model.

Roughness values were determined from coordination with the City of Brownwood, on-site investigation and aerial maps.

The main stream through the City of Brownwood is Pecan Bayou. All other streams eventually empty into Pecan Bayou. All flow values for Pecan Bayou were based on the hydrology provided in this report. Starting Conditions: The HEC-RAS model was started using a rating curve from FM Highway 2126. This rating curve was developed using HEC-RAS model procedures.

All flow values for Willis Creek were based on the hydrology provided in this report. Some of the cross section data was obtained from a study completed by Freese and Nichols, Inc. in January 2003 entitled Willis and South Willis Creek Master Drainage Plan (FNI master Plan). The HEC-RAS model was started using Normal Depth Methods assuming a slope of .01. Since the initial starting area is under backwater influence of Pecan Bayou, the starting condition is of no relevance.

All flow values for Tributary of South Willis Creek were based on the hydrology provided in this report. The HEC-RAS model was started using Normal Depth Methods assuming a slope of .0164. Since the initial starting area is under backwater influence of South Willis Creek, the starting condition is of no relevance.

All flow values for South Willis Creek were based on the hydrology provided in this report. Starting Conditions: The HECRAS model was started using Normal Depth Methods assuming a slope of .0036. Since the initial starting area is under backwater influence of Willis Creek, the starting condition is of no relevance.

Channel roughness factors (Manning's "n") used in hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness values for the main channel of all flooding sources range from 0.025 to 0.050. Floodplain roughness values range from 0.045 to 0.2. Table 4, "Manning's "n" Values," provides a listing of roughness coefficients used in the models.

TABLE 4 – MANNING'S "n" VALUES
Stream Reaches Studied by Detailed Methods

Stream Name	Channel "N" Value	Overbank "N" Value
Pecan Bayou	0.04 – 0.050	0.07 – 0.13
South Willis Creek	0.04 – 0.050	0.07 – 0.15
South Willis Tributary East	0.025 – 0.04	0.045
Tom Williams Creek	0.04 – 0.050	0.07 – 0.15
Tributary of South Willis Creek	0.04 – 0.050	0.07 – 0.1
West Adams Branch	0.04 – 0.050	0.1 – 0.2
Willis Creek	0.04 – 0.050	0.1 – 0.2

For FIRM panels dated July 16, 2004, or later, qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)

- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)

- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below the frost line)

- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain elevation, description, and /or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that 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 associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

3.3 Vertical Datum

All FIS s 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 FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are now prepared using NAVD as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the county must, therefore, be referenced to NAVD 88. It is important to note that adjacent counties may be referenced to NGVD 29. This may result in differences in BFEs across the county boundaries between the counties.

The datum conversion factor from NGVD29 to NAVD88 in Brown County is 0.35 feet.

For information regarding conversion between the NGVD and NAVD, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway

Silver Spring, Maryland 20910
(301) 713-3242

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS report provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplains; and a 1-percent-annual-chance floodway. 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 as well as additional information that may be available at the local community 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 the streams studied in detail, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

For this countywide FIS, flood boundaries were interpolated using topographic maps at a scale of 1" = 500' (1:6,000), with a contour interval of 2 feet (Reference 7).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. 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 (Exhibit 2).

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 base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 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 floodways presented in this study were 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 are tabulated for selected cross sections in Table 5, “Floodway Data.” The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 5 for certain downstream cross sections of West Adams Branch and Tom Williams Creek are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 5, "Floodway Data." To reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

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 by 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 1, "Floodway Schematic.”

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Pecan Bayou								
A	20,011	6,853	33,387	1.9	1,328.9	1,328.9	1,329.0	0.1
B	25,726	5,118	20,859	3.0	1,330.6	1,330.6	1,331.4	0.8
C	28,348	4,842	24,829	2.5	1,333.2	1,333.2	1,333.5	0.3
D	28,448	5,020	45,328	1.4	1,336.2	1,336.2	1,336.7	0.5
E	29,518	5,092	20,366	3.0	1,336.3	1,336.3	1,336.8	0.5
F	29,668	5,117	17,714	3.5	1,336.8	1,336.8	1,337.6	0.8
G	31,978	5,157	31,842	1.9	1,337.6	1,337.6	1,338.5	0.9
H	33,908	3,024	24,065	2.6	1,339.5	1,339.5	1,340.1	0.6
I	38,213	4,161	23,053	2.7	1,341.3	1,341.3	1,341.8	0.5
J	40,693	5,675	30,186	2.1	1,343.3	1,343.3	1,343.7	0.4
K	41,993	5,590	23,256	2.7	1,343.9	1,343.9	1,344.2	0.3

[1]Stream distance in feet above confluence with FM 2126

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

PECAN BAYOU

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
South Willis Creek								
A	2,533[1]	219	320	11.8	1,338.0	1,338.0	1,338.0	0.0
B	3,417[1]	355	979	3.9	1,345.6	1,345.6	1,345.9	0.3
C	4,130[1]	201	732	5.2	1,347.7	1,347.7	1,347.9	0.2
D	4,429[1]	370	785	4.8	1,348.3	1,348.3	1,348.6	0.3
E	5,170[1]	196	478	7.9	1,351.7	1,351.7	1,352.0	0.3
F	5,403[1]	134	692	5.6	1,353.5	1,353.5	1,353.6	0.1
South Willis Tributary East								
A	1,160[2]	278	576	5.5	1,360.3	1,360.3	1,360.3	0.0
B	2,056[2]	610	2,419	1.3	1,367.2	1,367.2	1,367.2	0.0
C	2,688[2]	607	1,378	2.3	1,383.8	1,383.8	1,383.8	0.0

[1]Stream distance in feet above confluence with Willis Creek
[2]Stream distance in feet above confluence with Tributary of South Willis Creek

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

SOUTH WILLIS CREEK / SOUTH WILLIS TRIBUTARY EAST

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tom Williams Creek								
A	345	525	3,317	4.2	1,340.0	1,339.5[2]	1,339.5	0.0
B	700	450	1,857	7.6	1,340.4	1,340.4	1,340.5	0.1
C	850	1,167	5,893	2.4	1,343.7	1,343.7	1,344.7	1.0
D	2,750	1,013	2,997	4.7	1,346.2	1,346.2	1,346.2	0.0
E	5,000	1,581	3,596	3.9	1,353.6	1,353.6	1,353.6	0.0
F	5,850	450	2,112	6.6	1,357.1	1,357.1	1,357.5	0.4
G	7,700	265	1,422	9.9	1,365.8	1,365.8	1,366.1	0.3
H	9,550	500	2,380	5.9	1,374.6	1,374.6	1,375.2	0.6

[1]Stream distance in feet above confluence with West Adams Branch
[2]Elevation computed without consideration of backwater effects from West Adams Branch

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

TOM WILLIAMS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tributary of South Willis Creek								
A	1,403[1]	40	63	0.8	1,362.4	1,362.4	1,362.4	0.0
B	1,960[1]	63	17	3.0	1,371.6	1,371.6	1,371.6	0.0
C	2,056[1]	61	35	1.4	1,371.9	1,371.9	1,371.9	0.0
D	2,994[1]	808	1,382	1.8	1,384.8	1,384.8	1,384.8	0.0
E	3,720[1]	127	295	7.9	1,393.3	1,393.3	1,393.3	0.0
F	4,782[1]	226	373	7.3	1,398.6	1,398.6	1,398.6	0.0
G	6,330[1]	299	660	4.2	1,407.4	1,407.4	1,407.4	0.0
H	7,059[1]	461	560	4.9	1,411.7	1,411.7	1,411.7	0.0
I	8,145[1]	205	400	6.8	1,419.1	1,419.1	1,419.1	0.0
West Adams Branch								
A	18,309[2]	1,210	5,538	3.2	1,333.1	1,333.1	1,334.1	1.0
B	18,739[2]	597	1,479	16.2	1,333.5	1,333.5	1,333.5	0.0
C	18,814[2]	619	4,035	4.4	1,338.1	1,338.1	1,338.2	0.1
D	19,970[2]	913	7,018	2.9	1,339.1	1,339.1	1,339.2	0.1
E	20,059[2]	528	9,778	2.1	1,339.4	1,339.4	1,339.7	0.3
F	20,888[2]	454	3,334	3.2	1,340.1	1,340.1	1,340.5	0.4
G	21,704[2]	159	1,353	7.8	1,340.5	1,340.5	1,340.6	0.1
H	22,321[2]	118	2,180	4.8	1,341.2	1,341.2	1,342.0	0.8
I	23,141[2]	189	1,946	5.4	1,342.5	1,342.5	1,342.8	0.3

[1]Stream distance in feet above confluence with South Willis Creek
[2]Stream distance in feet above confluence with Adams Branch

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

TRIBUTARY OF SOUTH WILLIS CREEK / WEST ADAMS BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Adams Branch (continued)								
J	23,336	107	924	11.4	1,342.5	1,342.5	1,342.6	0.1
K	23,422	500	1,238	8.5	1,344.4	1,344.4	1,344.9	0.5
L	26,131	1,911	3,153	3.3	1,351.3	1,351.3	1,351.4	0.1
M	26,230	2,191	2,654	4.0	1,352.9	1,352.9	1,353.8	0.9
N	27,168	525	1,126	9.4	1,354.9	1,354.9	1,355.4	0.5
O	30,009	100	1,300	8.1	1,365.8	1,365.8	1,365.8	0.0
P	30,909	395	3,189	3.3	1,372.2	1,372.2	1,372.2	0.0
Q	33,659	80	1,437	7.3	1,387.3	1,387.3	1,387.3	0.0
R	34,709	208	1,514	7.0	1,395.6	1,395.6	1,395.6	0.0
S	35,709	68	1,713	6.2	1,401.3	1,401.3	1,401.3	0.0
T	36,909	150	1,465	7.2	1,407.9	1,407.9	1,407.9	0.0
U	37,559	107	1,625	6.5	1,411.8	1,411.8	1,411.8	0.0
V	38,109	33	761	0.2	1,414.1	1,414.1	1,414.1	0.0
W	38,459	52	237	0.6	1,414.1	1,414.1	1,414.1	0.0

[1]Stream distance in feet above confluence with Adams Branch

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Willis Creek								
A	10,207	437	5,531	2.7	1,327.9	1,327.9	1,327.9	0.0
B	10,789	364	2,786	5.3	1,328.4	1,328.4	1,328.4	0.0
C	12,663	414	4,740	3.1	1,331.3	1,331.3	1,332.0	0.7
D	13,108	150	1,290	11.5	1,331.3	1,331.3	1,332.0	0.7
E	13,275	1,421	8,201	1.8	1,337.8	1,337.8	1,338.0	0.2
F	14,184	1,900	8,729	1.7	1,338.0	1,338.0	1,338.3	0.3
G	16,380	727	4,411	1.3	1,338.5	1,338.5	1,338.8	0.3
H	17,166	611	2,574	2.3	1,338.8	1,338.8	1,339.1	0.3
I	19,067	1,242	2,863	2.0	1,343.9	1,343.9	1,343.9	0.0
J	19,857	1,111	2,837	2.0	1,346.3	1,346.3	1,346.3	0.0
K	21,425	583	1,009	5.8	1,350.3	1,350.3	1,350.3	0.0
L	22,036	837	1,852	3.1	1,353.5	1,353.5	1,353.7	0.2
M	24,322	1,086	2,650	2.2	1,358.3	1,358.3	1,358.3	0.0
N	25,780	882	2,187	2.7	1,360.3	1,360.3	1,361.2	0.9
O	26,090	612	1,940	12.7	1,362.3	1,362.3	1,362.3	0.0
P	28,414	471	1,809	3.2	1,369.1	1,369.1	1,369.1	0.0
Q	29,387	328	1,956	3.0	1,372.3	1,372.3	1,372.3	0.0
R	30,342	106	3,856	6.0	1,377.7	1,377.7	1,377.7	0.0
S	31,360	177	1,090	5.3	1,381.3	1,381.3	1,381.3	0.0

[1]Stream distance in feet above confluence with Pecan Bayou

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX
AND INCORPORATED AREAS

FLOODWAY DATA

WILLIS CREEK

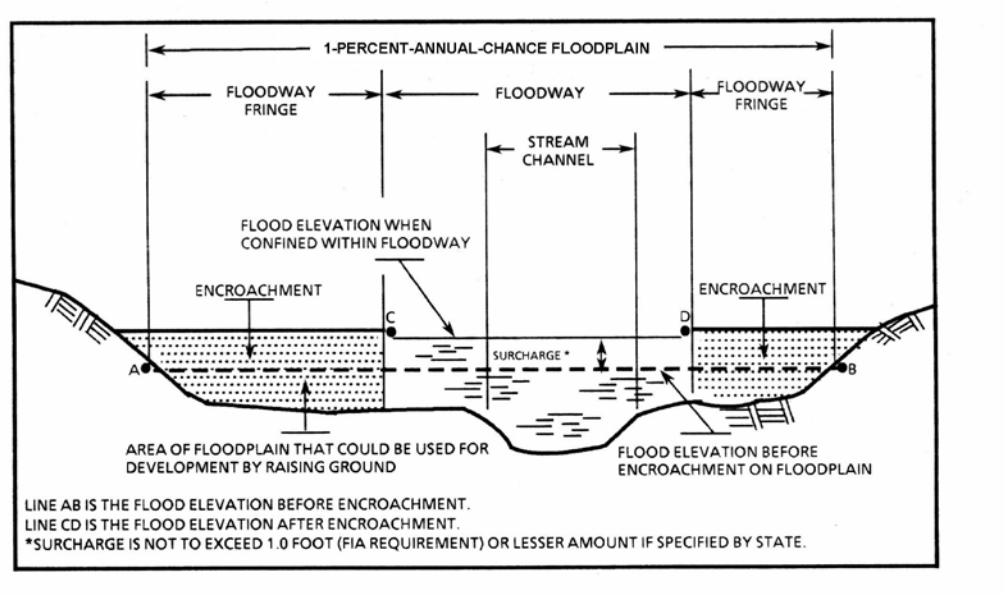

Figure 1: Floodway Schematic

5.0 INSURANCE APPLICATION

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

Zone AE

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

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile (sq. mi.), and areas protected from the base flood by levees. No BFEs or depths are shown within this zone.

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 rate 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 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 Brown County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each incorporated community with identified flood hazards. Historical map dates relating to pre-countywide maps prepared for each community are presented in Table 6, “Community Map History.”

COMMUNITY NAME	INTIAL NFIP DATE	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	INITIAL FIRM DATE	FIRM REVISIONS DATE
Bangs, City of	August 6, 1976	None	June 19, 1985	
Blanket, City of	April 2, 1992	None	April 2, 1992	
Brown County (Unincorporated Areas)	January 24, 1978	None	March 1, 1991	
Brownwood, City of	May 24, 1974	May 21, 1976 May 15, 1979	April 15, 1981	July 6, 1982
Early, City of	May 17, 1974	January 30, 1976	July 1, 1987	

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Brown County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS reports, and FIRMs for all of the incorporated jurisdictions within Brown County.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting Federal Insurance and Mitigation Division, FEMA Region VI, Federal Regional Center, Room 206, 800 North Loop 288, Denton, Texas 76201-3698.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U.S. Census Bureau, "State and County QuickFacts." Brown County, TX. <http://quickfacts.census.gov/qfd/states/48/48049.html>

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3. Federal Emergency Management Agency. (October, 1980). Flood Insurance Study City of Brownwood. Washington, D.C.

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5. U.S. Army Corps of Engineers, Review of Reports on Pecan Bayou Watershed, Colorado River Basin, Texas, Fort Worth, Texas, October 1963.

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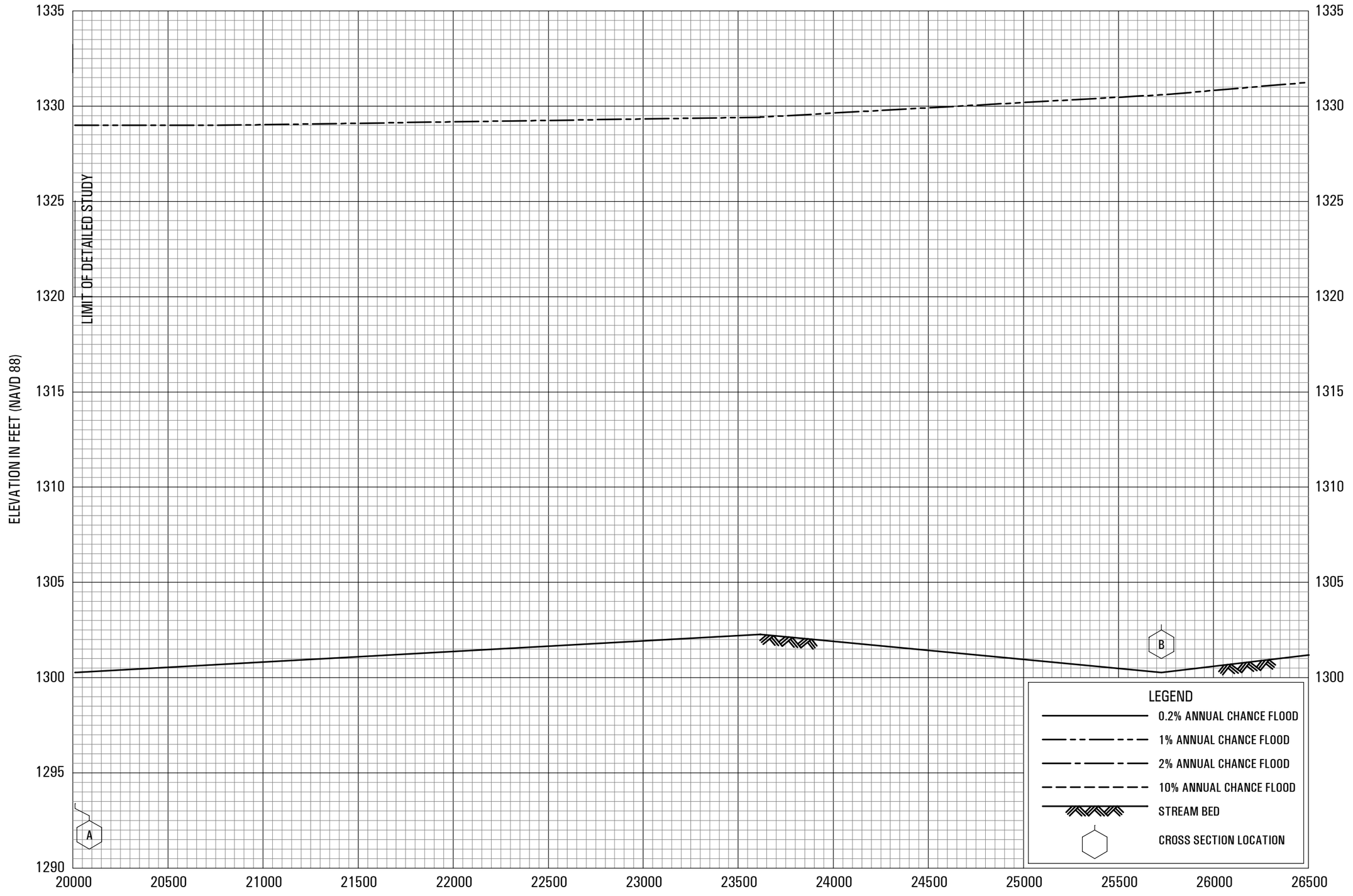


FLOOD PROFILES

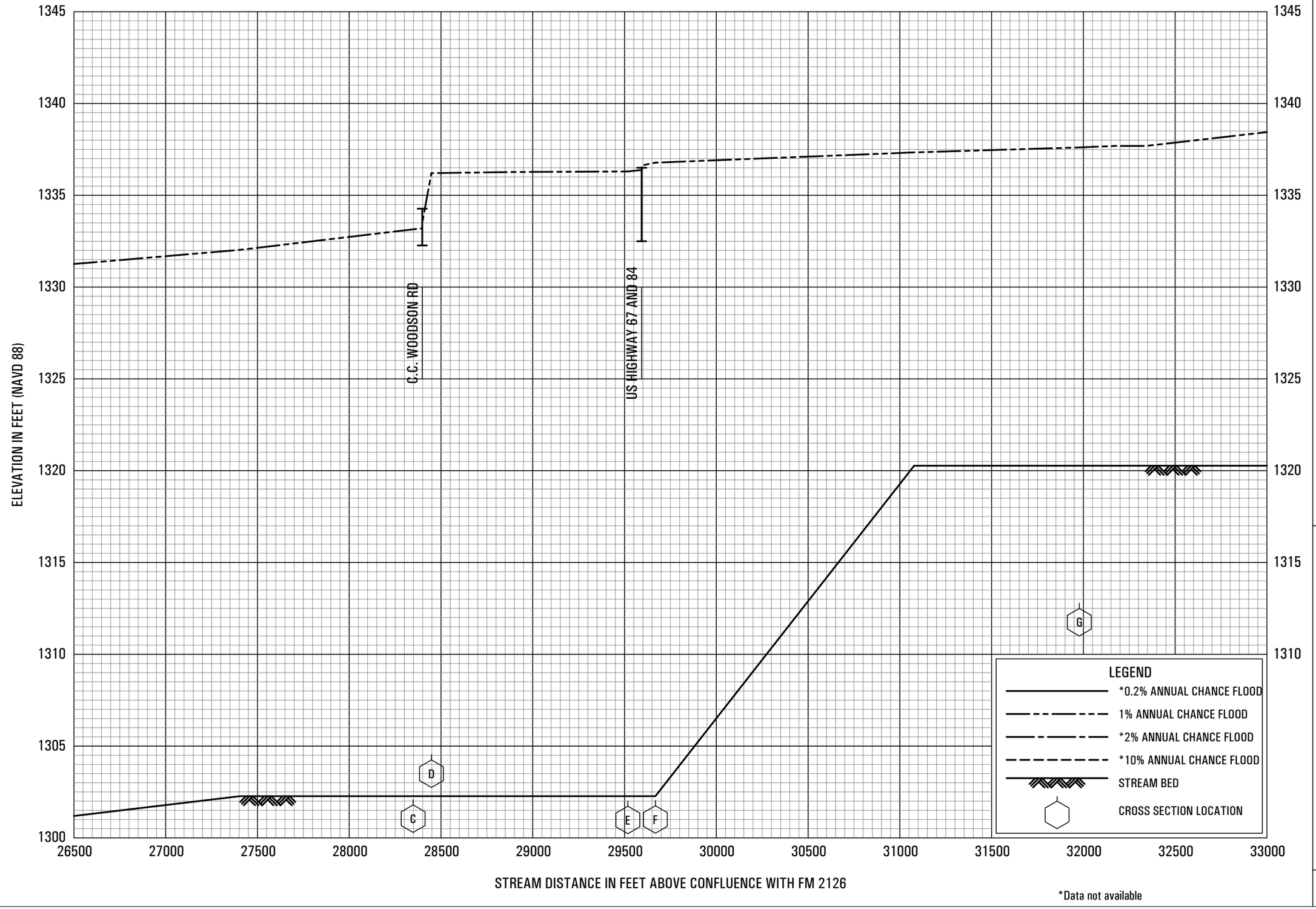
PECAN BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

01P



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FLOOD PROFILES

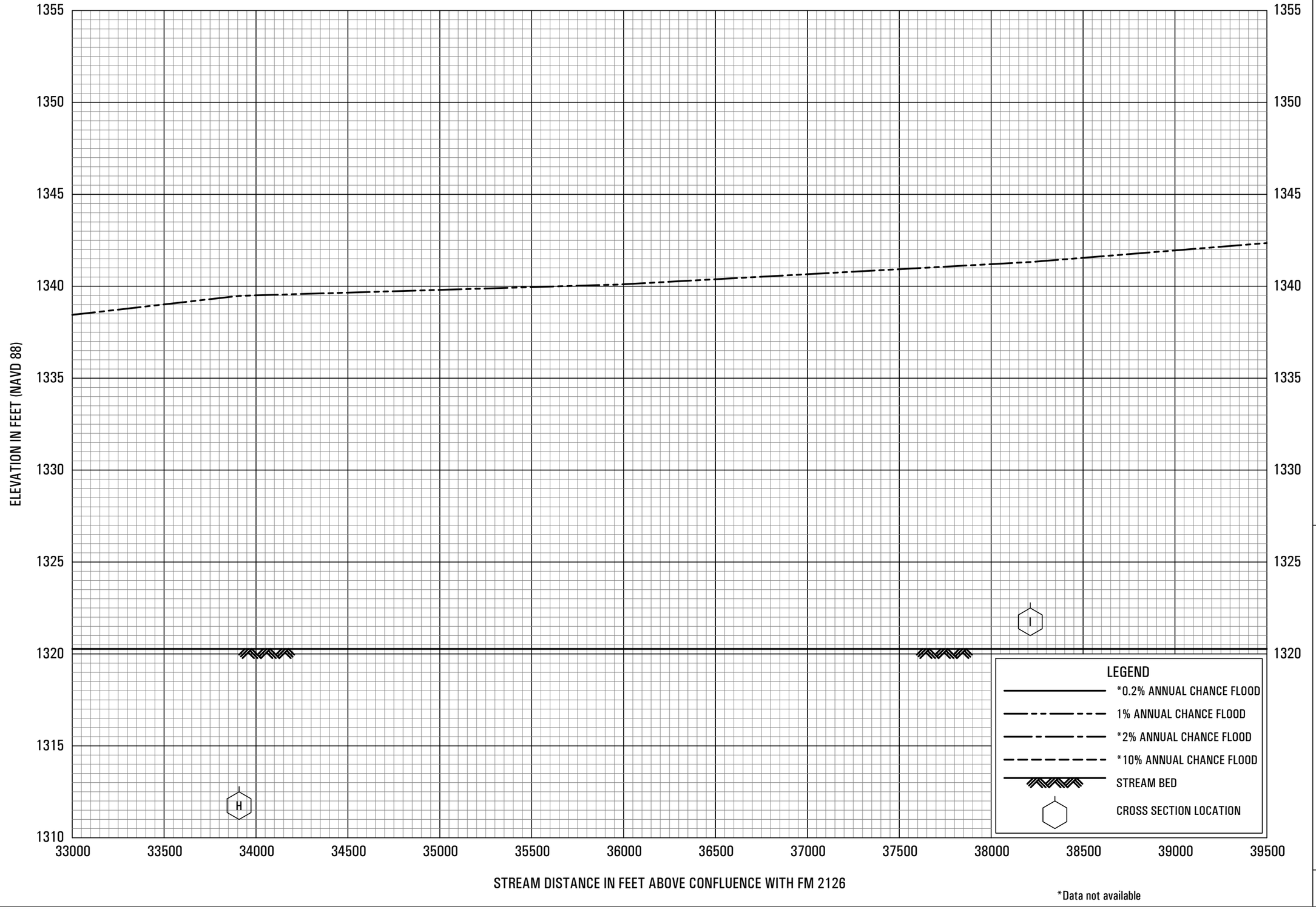
PECAN BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

02P



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FLOOD PROFILES

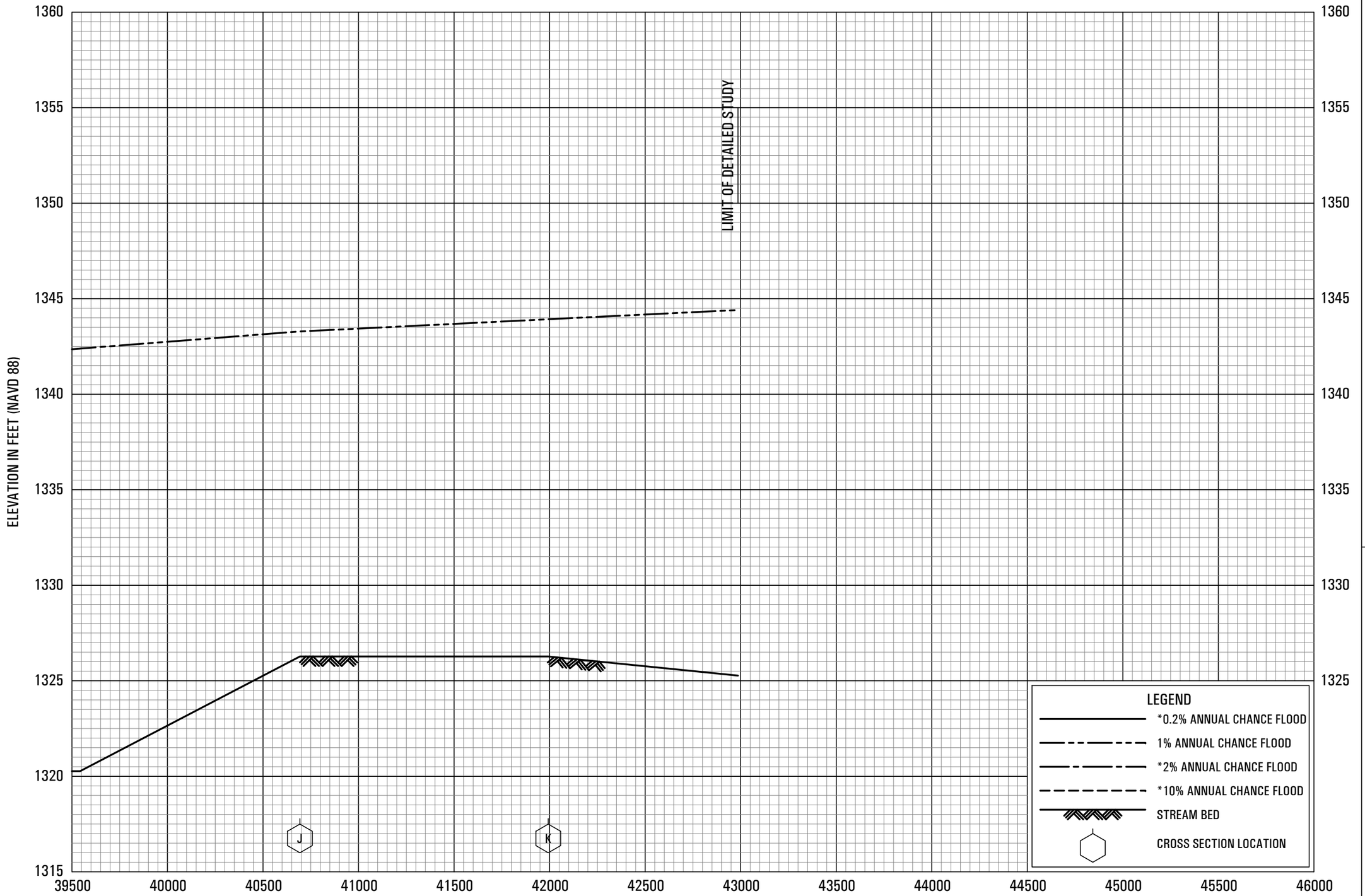
PECAN BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

03P



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FLOOD PROFILES

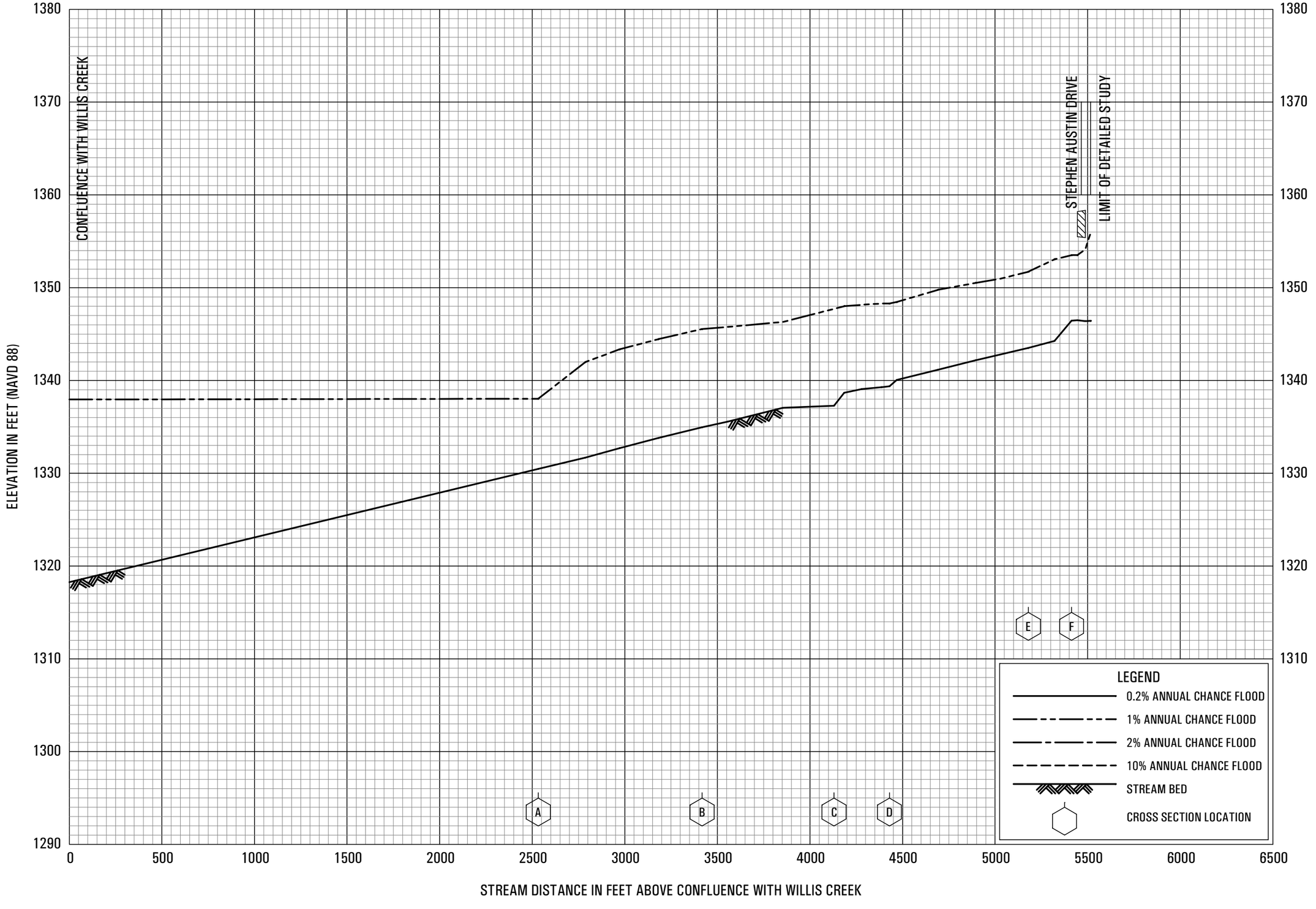
PECAN BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

04P



FLOOD PROFILES

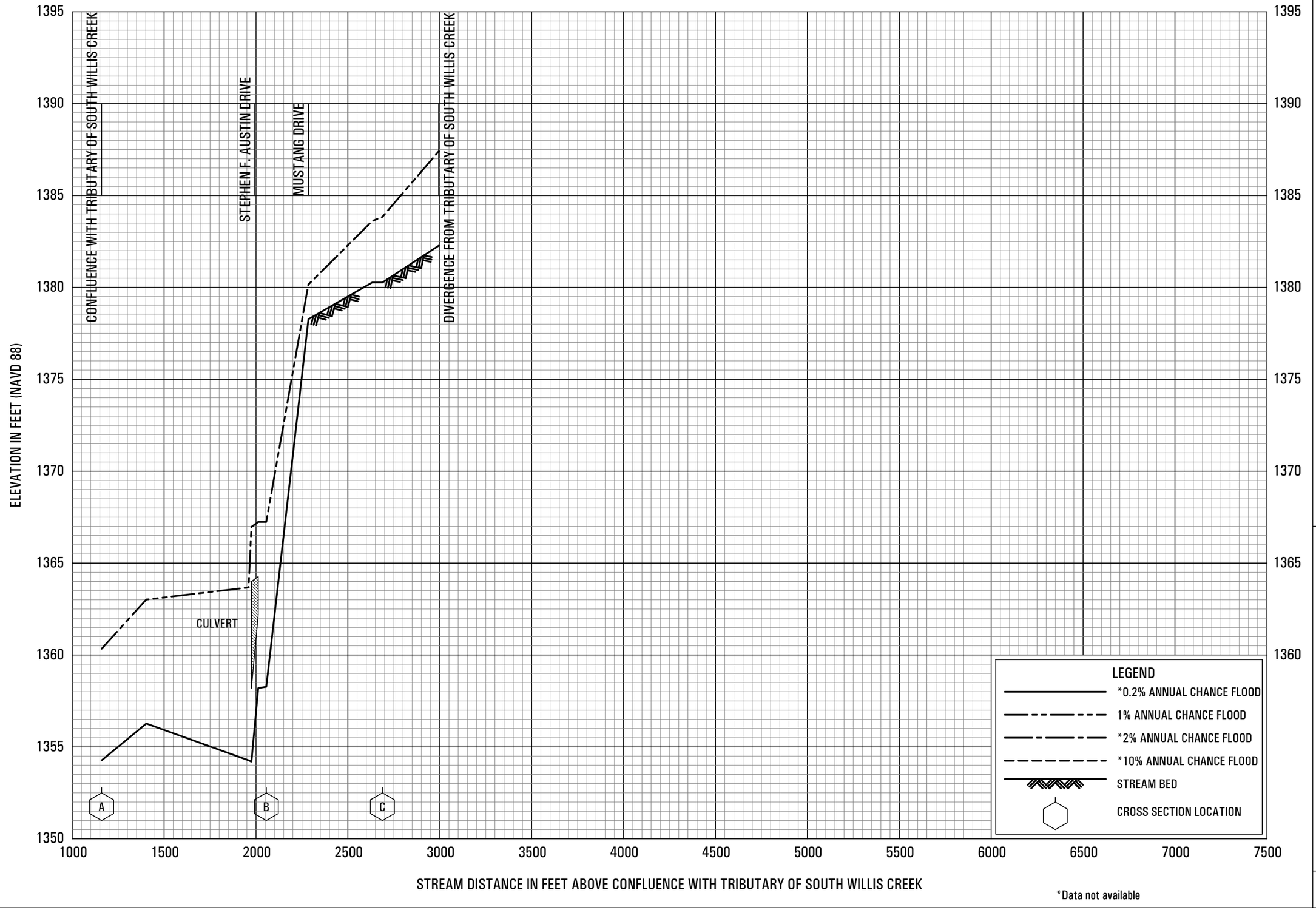
SOUTH WILLIS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

05P



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FLOOD PROFILES

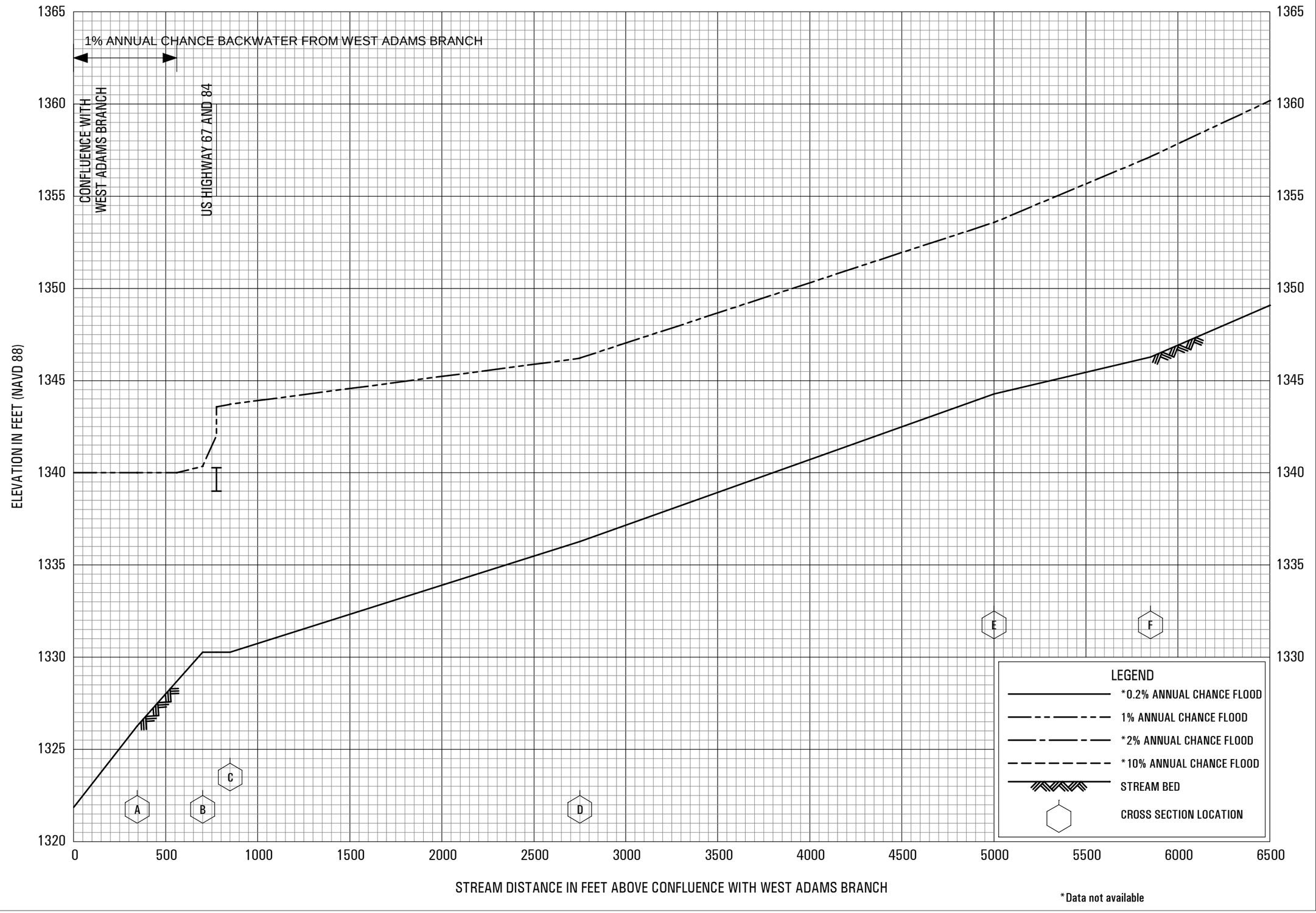
SOUTH WILLIS TRIBUTARY EAST

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

06P



FLOOD PROFILES

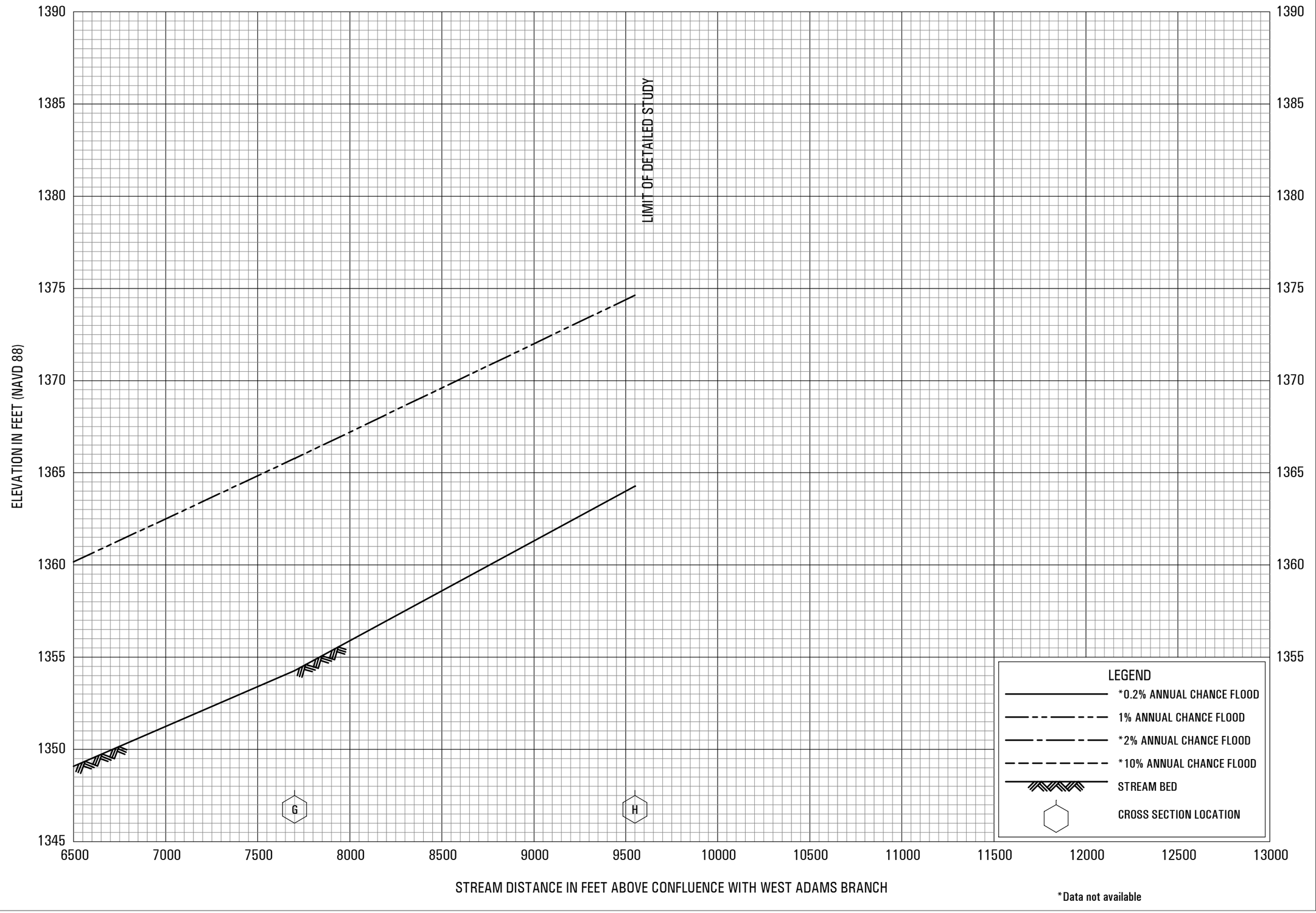
TOM WILLIAMS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

07P



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FLOOD PROFILES

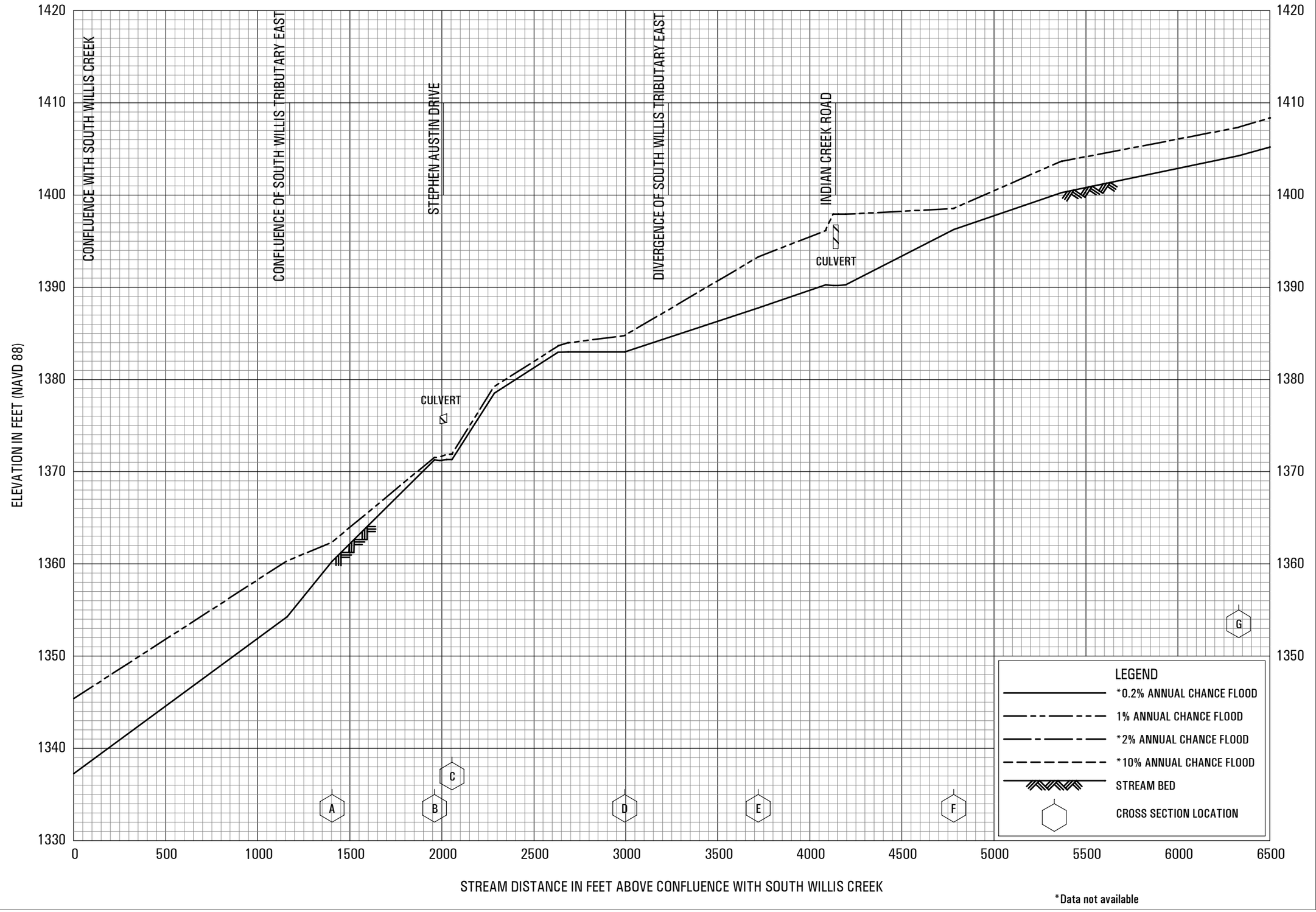
TOM WILLIAMS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

08P



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FLOOD PROFILES

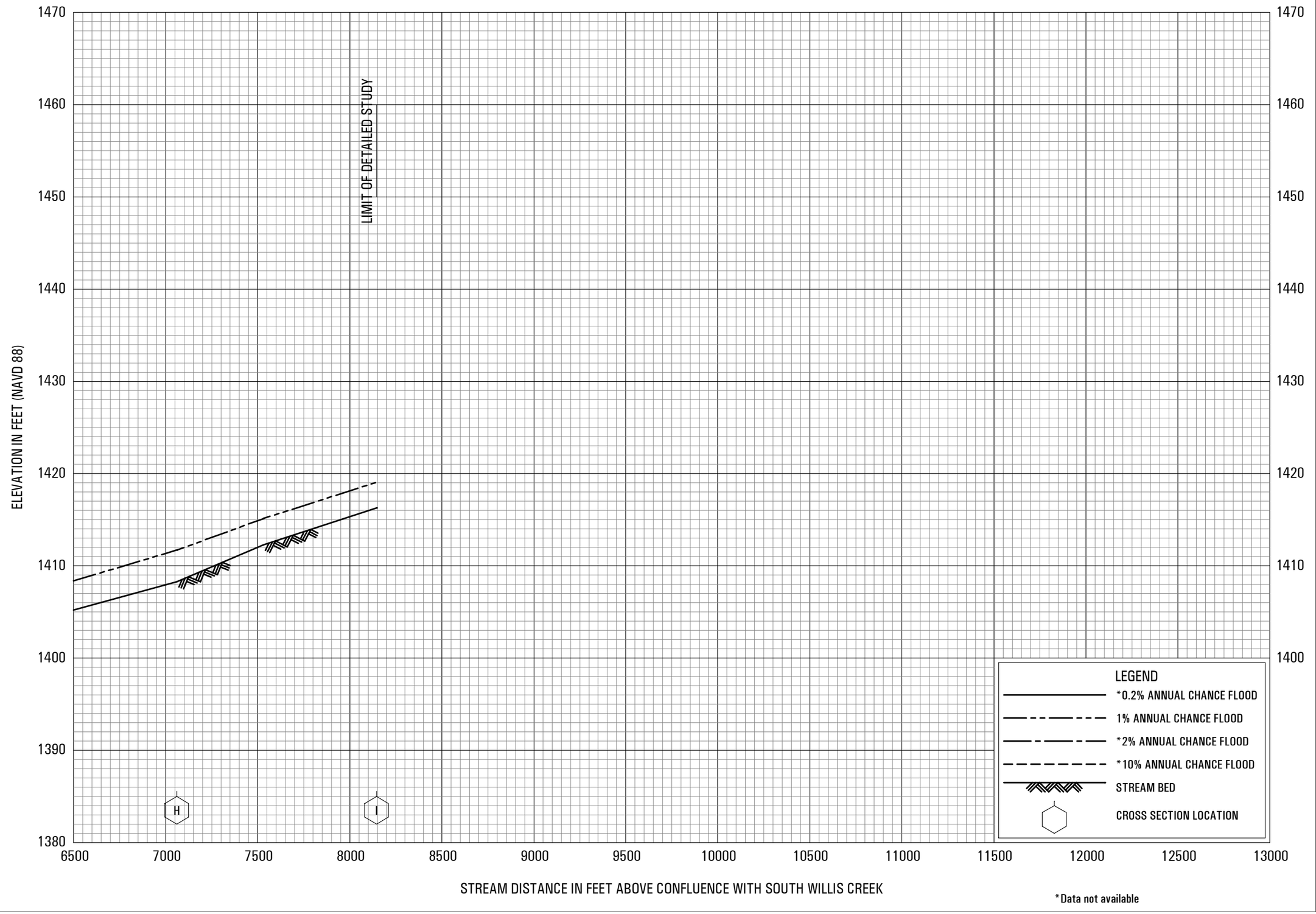
TRIBUTARY OF SOUTH WILLIS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

09P



FLOOD PROFILES

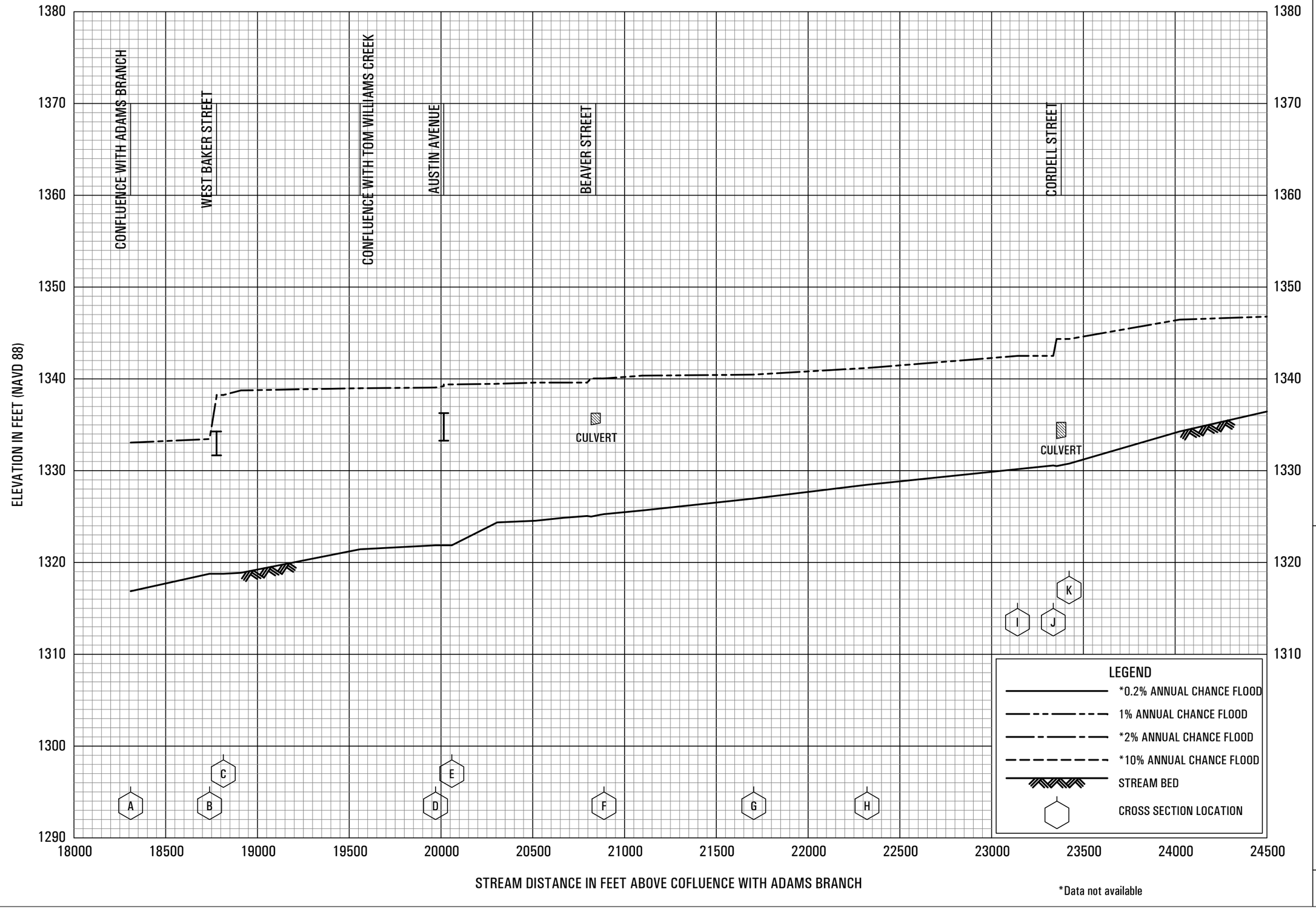
TRIBUTARY OF SOUTH WILLIS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

10P



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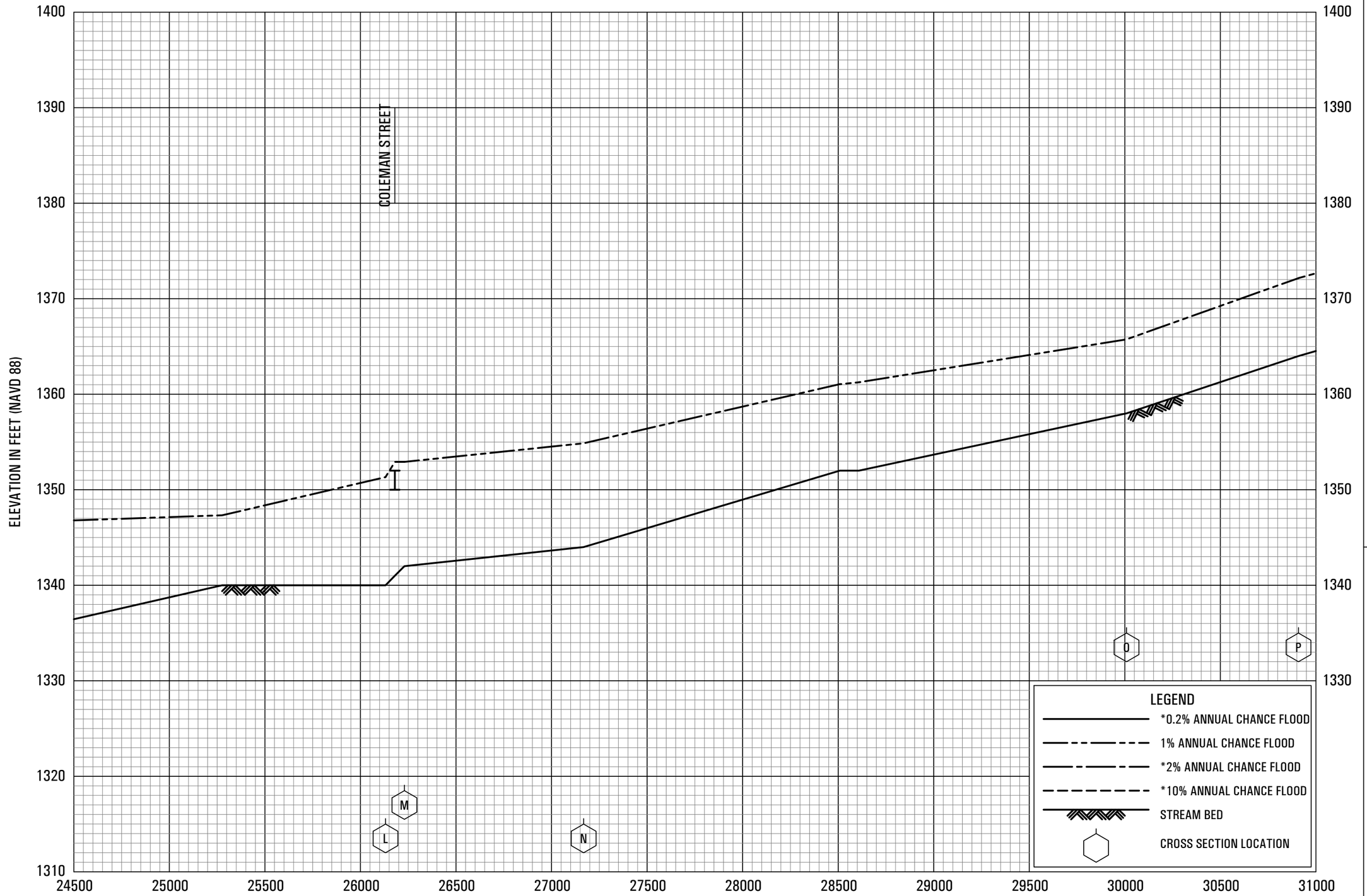
FLOOD PROFILES

WEST ADAMS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS



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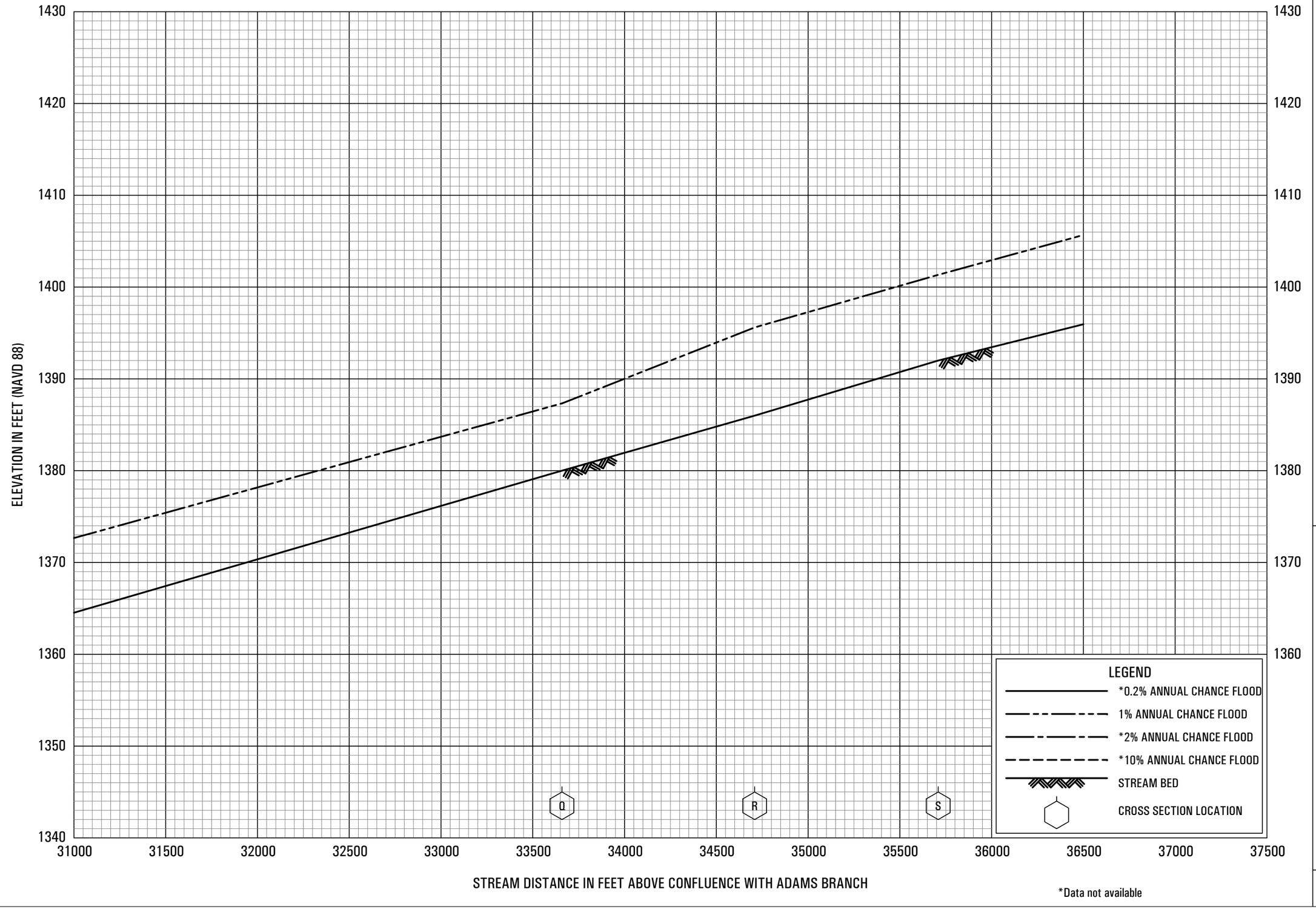
FLOOD PROFILES

WEST ADAMS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS



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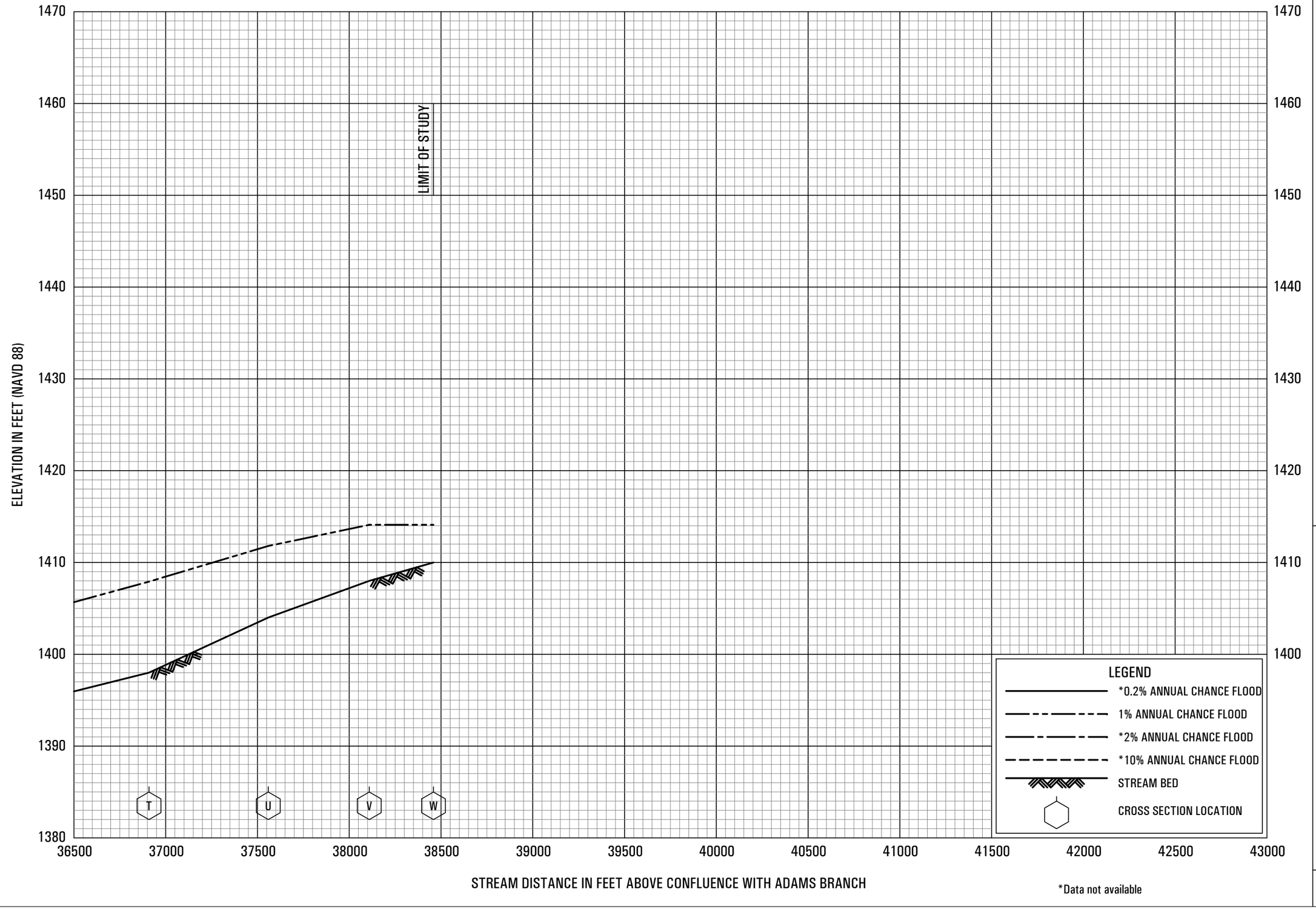
FLOOD PROFILES

WEST ADAMS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS



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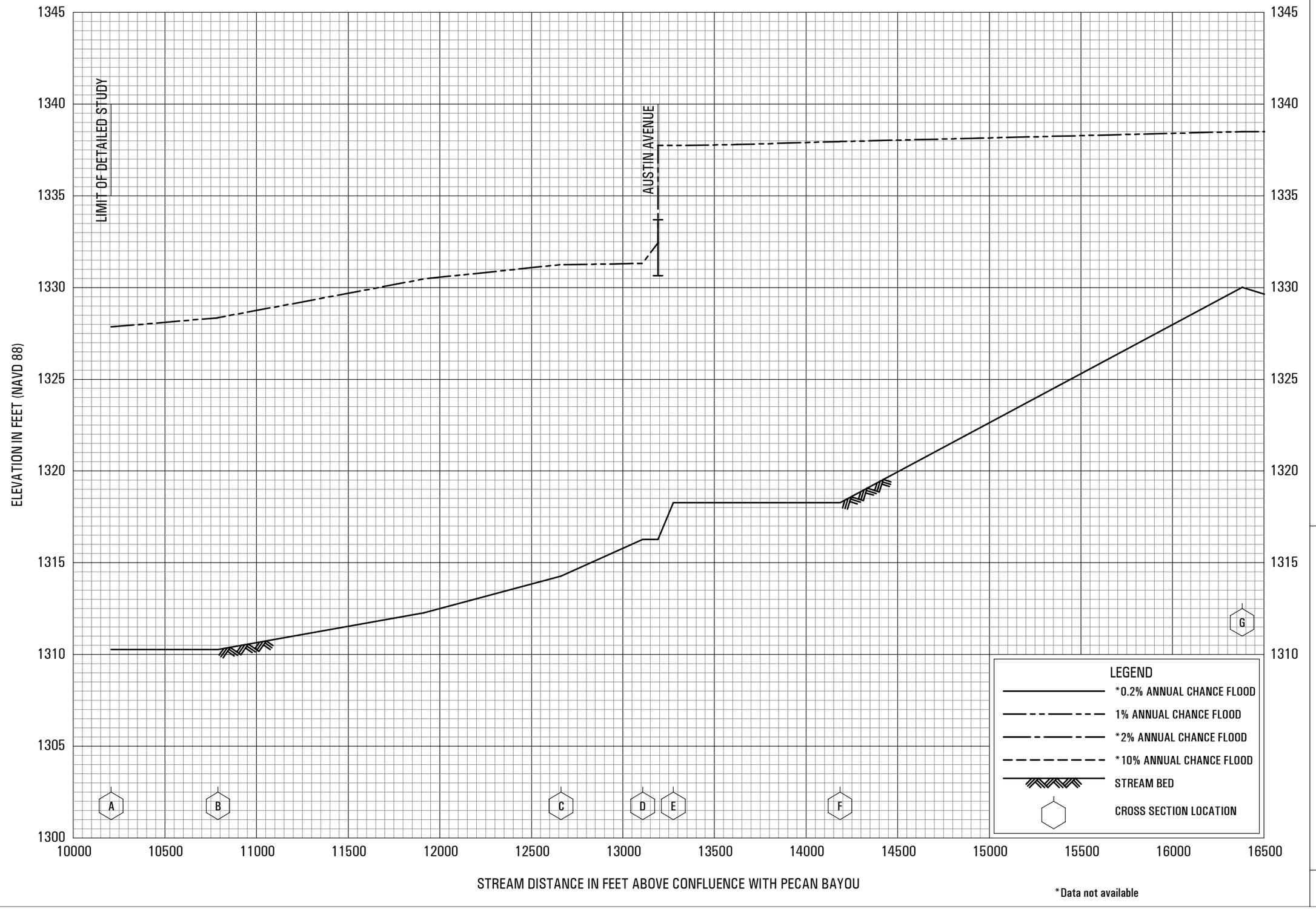
FLOOD PROFILES

WEST ADAMS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS



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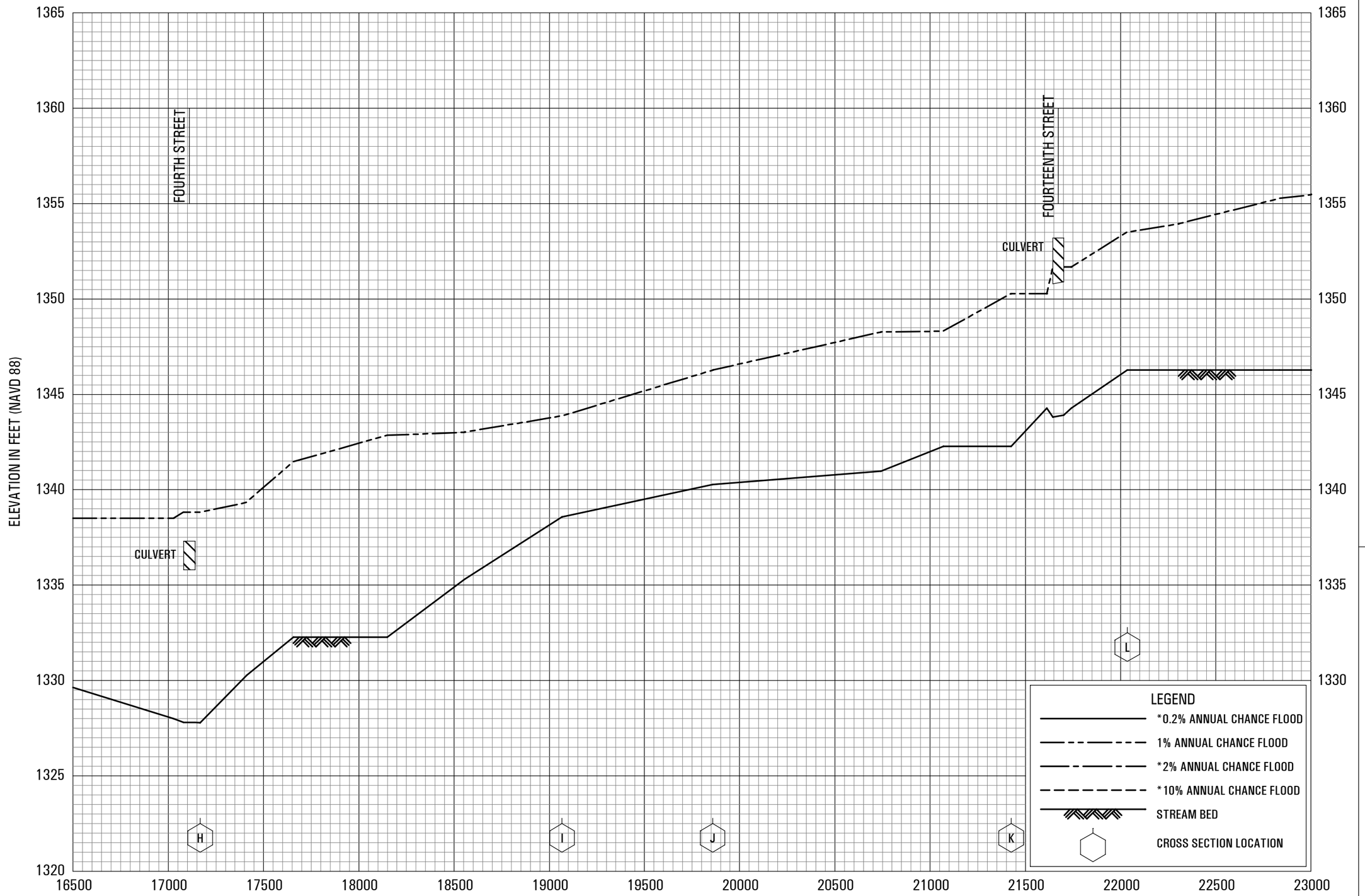
FLOOD PROFILES

WILLIS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS



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FLOOD PROFILES

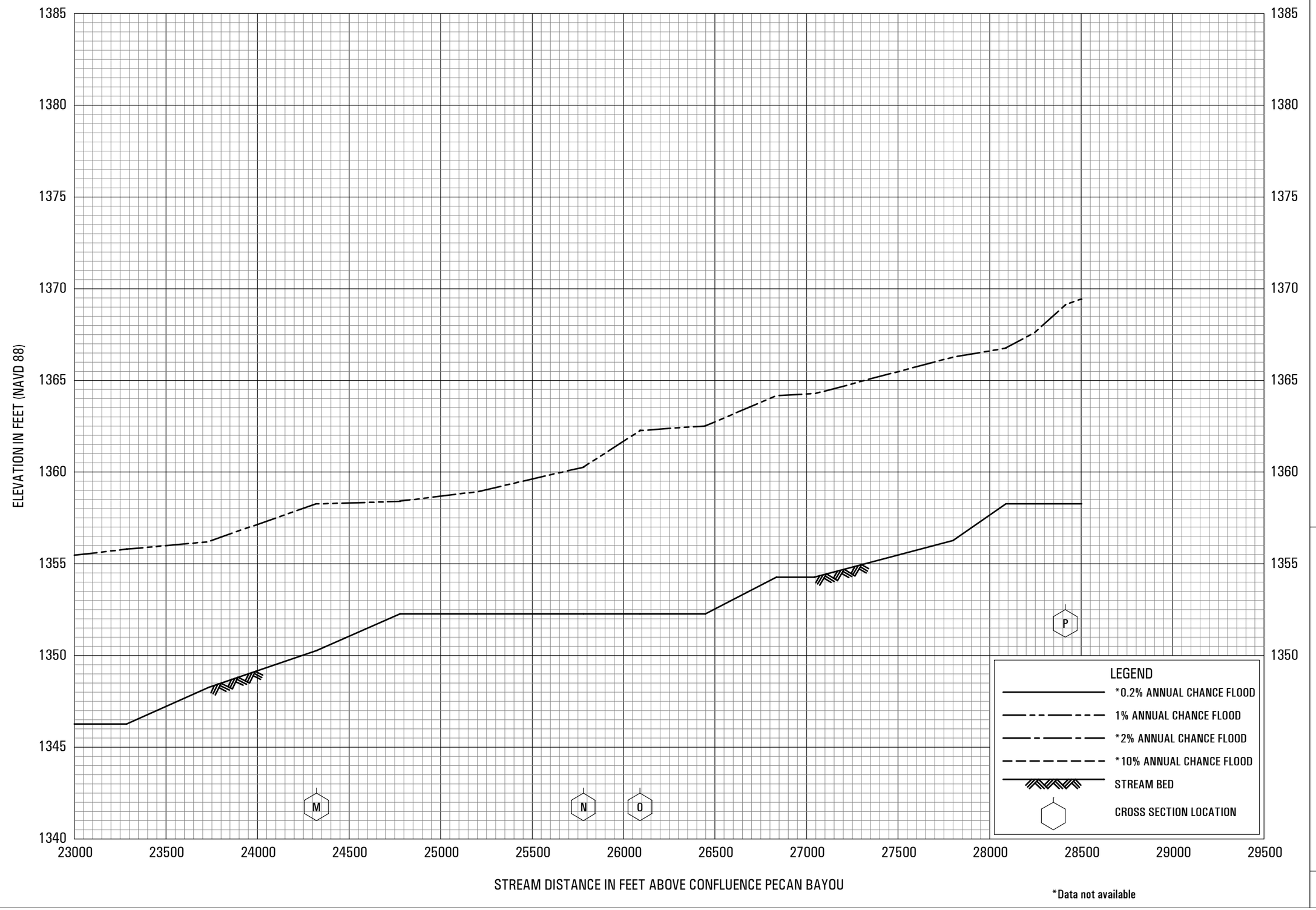
WILLIS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

16P



*Data not available

FLOOD PROFILES

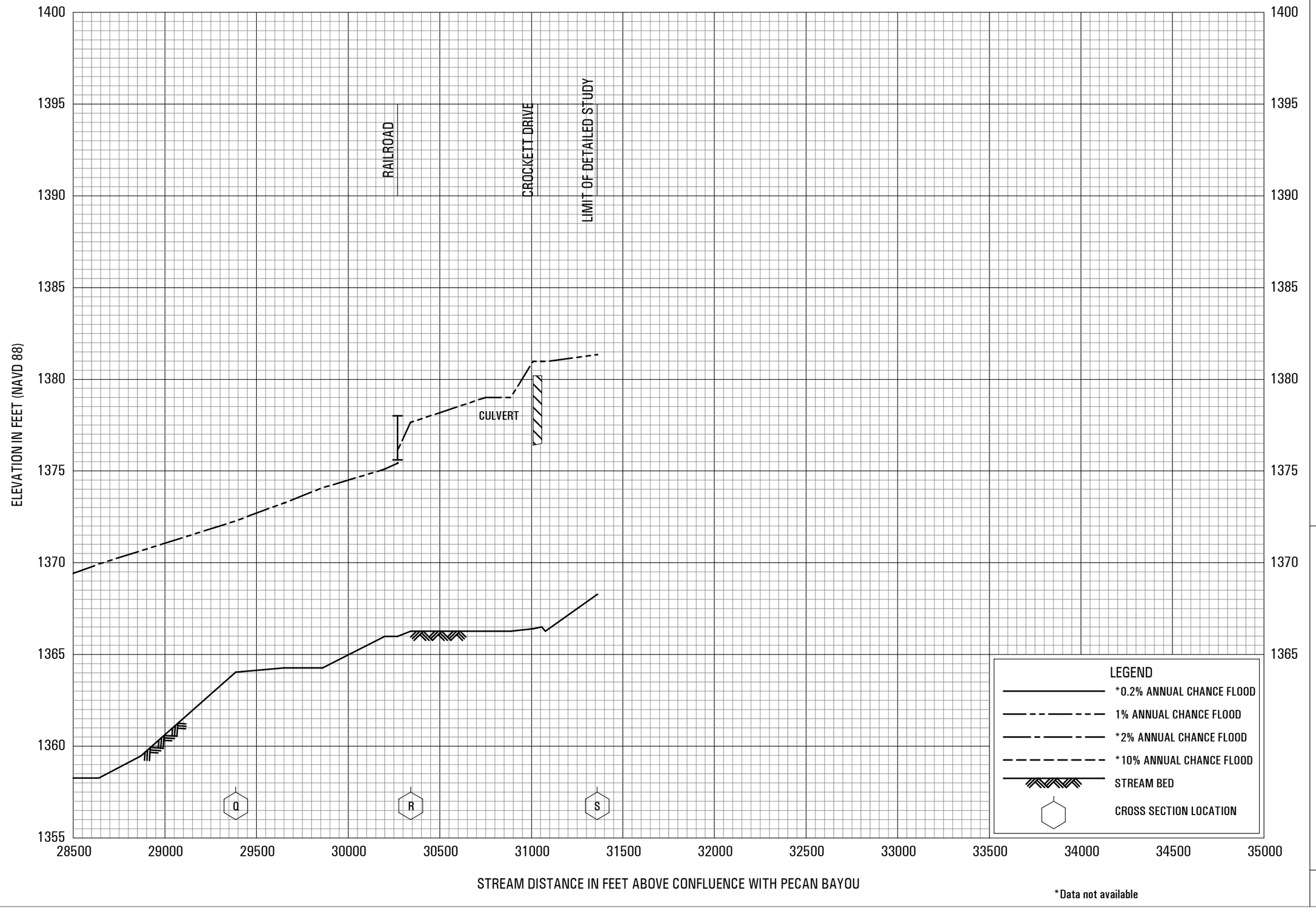
WILLIS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BROWN COUNTY, TX

AND INCORPORATED AREAS

17P



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