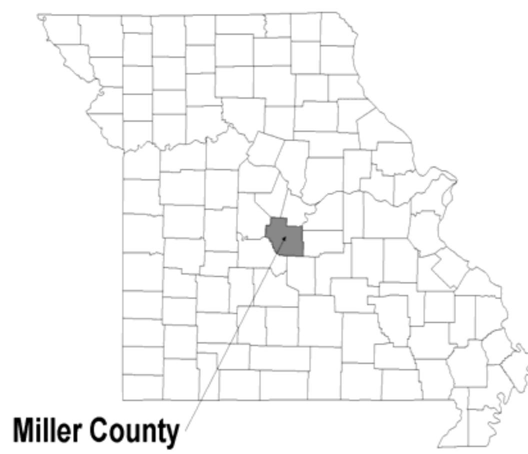
FLOOD INSURANCE STUDY

MILLER COUNTY, MISSOURI

AND INCORPORATED AREAS
VOLUME 1 OF 1



Community Name	Community Number
BAGNELL, TOWN OF	290496
BRUMLEY, TOWN OF	290984
ELDON, TOWN OF	290227
IBERIA, CITY OF	290719
LAKE OZARK, CITY OF	290698
LAKESIDE, TOWN OF	290983
MILLER COUNTY (UNINCORPORATED AREAS)	290226
OLEAN, TOWN OF	290985
ST. ELIZABETH, VILLAGE OF	290982
TUSCUMBIA, VILLAGE OF	290228

Federal Emergency Management Agency
FLOOD INSURANCE STUDY NUMBER
29131CV000B

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.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: May 18, 2009
Revised Countywide FIS Date: TBD – Revised to change Special Flood Hazard Areas and updated topographic information

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FLOOD INSURANCE STUDY
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1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) revises previous FISs/Flood Insurance Rate Maps (FIRMS) for the geographic area of Miller County, Missouri, including the villages, towns, and cities of Bagnell, Brumley, Eldon, Iberia, Kaiser, Lake Ozark, Lakeside, Olean, St. Elizabeth, Tuscumbia, and the unincorporated areas of Miller County (hereinafter referred to collectively as Miller County. This FIS 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 Miller 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 National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the City of Osage Beach is geographically located in Miller and Camden Counties. The flood-hazard information for the City of Osage Beach is for information purposes only. See separately published FIS report and Flood Insurance Rate Map (FIRM).

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 are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include incorporated communities within Miller County in a countywide FIS. Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS was compiled from their previously printed FIS reports and is show below.

For this countywide FIS, the hydrologic and hydraulic analyses were prepared by USACE for FEMA, under Contract No. HSFE60-15-D-0005.

Base map files were provided by the National Agriculture Imagery Program (NAIP) in the form of 7.5-Minute Series Digital Orthophoto Quarter Quadrangles (DOQQs). The DOQQs utilized are grayscale images with a 1-meter ground resolution. The DOQQs are referenced to the North American Datum of 1983 (NAD83) and cast on the Universal Transverse Mercator (UTM) projection, Zone 15 North in Meters.

1.3 Coordination

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

For this countywide FIS, an initial CCO meeting will be TBD.

For this Physical Map Revision FIS, the hydrologic and hydraulic analyses were prepared by STARR2. These analyses were completed on November 13, 2015. Under Contract Number HSFE60-15-D-0005, Task Order HSFE60-15-J-0002.

2.0 AREA STUDIED

2.1 Scope of Study

This countywide FIS covers the geographic area of Miller County, Missouri. All or portions of the following flooding sources were studied by detailed methods: Lake of the Ozarks, and the Osage River from the western county line near Lake Ozark, Grandglaize Creek, and the Osage River downstream of Bagnell Dam (mile marker 1) to the northeastern county line north of St. Elizabeth.

Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and/or on the FIRM (Exhibit 2). The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

All or portions of the following flooding sources with watersheds of one square mile or more were studied by approximate methods: Atwell Creek, Barren Fork, Bear Creek, Blue Spring Creek, Blythes Creek, Brumley Creek, Brushy Fork, Carroll Branch, Coon Creek, Cub Creek, Dog Creek, Dry Branch, Dry Creek, East Fork, Grand Glaize Creek, Jack Buster Creek, Little Bear Creek, Little Saline Creek, Little Tavern Creek, Mill Creek, Saline Creek, Tavern Creek, Wrights Creek, and the Osage River below Bagnell Dam. These watersheds added 600 square miles of new approximate study to Miller County. 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 Miller County.

2.2 CommunityDescription

Miller County is located in central Missouri, and is largely rural, except for rapid development along the shoreline of Lake of the Ozarks and its arms. Miller County has
a total land area within the county limits of approximately 710 square miles, where 592
square miles is land and 8 square miles is water. The county is bordered by Moniteau County to the north, Cole County and Osage County to the northeast, Maries County to the east, Pulaski County to the south, Camden County to the southwest, and Morgan County to the west. Miller County had a 2000 population of 23, 564,

The principal flooding source, the Osage River, is a right bank tributary of the Missouri River. The Osage River is the largest stream in the county and is controlled by two large hydropower dam projects that operate to meet peak power need of the state. These dams are Bagnell Dam located at the lower end in Miller County and Harry S. Truman Dam located upstream of Warsaw, Missouri in Benton County.

In the area surrounding the major streams, the topography consists mainly of steeply sloped hillsides that tend to produce flash flooding. Soils in Miller County are generally stony, and tend to consist of lean, silty, and fat clays and loams that are very erodible and have high runoff potential.

Most of the unincorporated areas are devoted to agriculture, with scattered residential development and numerous state parks. Accordingly, vegetation in the area ranges between forest, cropland, and pastureland. Tourism and commercial development are prevalent along the shore of the Lake of the Ozarks. Miller County is served by U.S. Route 54, Route 17, Route 42, Route 52, and Route 87.

The climate of Miller County is a humid continental climate. Weather changes in this area between summer and winter are generally subtle rather than extreme. However this climate can have very unpredictable fluctuations in temperature, precipitation, and humidity. Variable weather patterns and a large seasonal temperature variance can be as great as 55-70 degrees Fahrenheit. In the summer, the average high temperature is 90 degrees F with a low temperature of 68 degrees F. In the winter, the average high temperature is 40 degrees with a low temperature of 18 degrees F. The warmest month is July with the highest recorded temperature of 108 degrees F in 1986. The coldest month is January with the lowest recorded temperature of -20 degrees F in 1989. The maximum average precipitation occurs usually in May with over 5 inches of rain. Rainfall totals average 40.38 inches annually.

2.3 Principal Flood Problems

Flood problems in Miller County can be attributed to high releases from the

Harry S. Truman Reservoir dam or by high-intensity, short-duration rainfalls. Pool levels in the Lake of the Ozarks will only reach flood levels on rare occasions, especially when Harry S. Truman dam is making high releases. Harry S. Truman Reservoir acts as a buffer and is the major source of flood protection for the Lake of the Ozarks. Other flood protection reservoirs upstream of Harry S. Truman Reservoir include Stockton, Pomme De Terre, Hillsdale, Pomona, and Melvern. By contrast flooding on smaller streams is caused byhigh-intensity, short-duration rainfalls. Normal rainfall patterns are greatest during two distinct periods: 1) during spring from April through June, and 2) during the fall months of September through November. Rainfall during the spring months is caused primarily from southward moving cold fronts weakening and becoming stationary over the area. Warm tropical air moving north from the Gulf of Mexico will cause periods of intense rainfall both in duration and quantity along and near the stationary cold front. During the fall months, slow and southward moving cold air from Canada will interact with an existing warm and humid air mass causing another period of potentially heavy rain.

2.4 Flood Protection Measures

FEMA specifies that all levees must have a minimum of three foot of freeboard against the 1% annual chance flood to be considered for FEMA certification. No levees are indicated within Miller County.

Federal and State funded protection measures are being employed in Miller County with the construction of the Harry S. Truman Reservoir dam.

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 study. 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 exceed 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 100-year 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 study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for each flooding source studied in detail affecting the county.

3.1.1 Detailed Methods

A hydrologic analysis was conducted to establish peak 1%-annual-chance flood discharges for each flooding source studied in the community. Separate Hydrologic analyses were conducted for the Lake of the Ozarks and the major streams where detailed hydraulic analyses were performed.

The following steps were taken to complete the hydrology for the streams studied by detailed hydraulic methods:

a. The HEC ArcHydro program was utilized to delineate 57 sub-basins that flow into the Lake of the Ozarks. Area and slope were by GeoHMS for each sub-basin.
b. Areas and slopes from Step "a" were used to calculate the 10, 2, 1, and 0.2%- annual- chance flood flows at various locations in the basins using USGS regression equations.
c. Soil Conservation Service (SCS) Dimensionless Unit Hydrographs were then developed for the mainstem and each major tributary.

Table 1: 1%-Annual-Chance Mainstem Unit Hydrograph Peaks

Upper Osage	85,000 cfs @ 28 hrs
Middle Osage	8,200 cfs @ 8 hrs
Lower Osage	13,000 cfs @ 11 hrs

d. USACE, Kansas City District Water Management Section determined that the 1%- annual- chance release for Harry S Truman Reservoir Dam under typical flood conditions would be 80,000 cfs. Therefore, a base flow of 80,000 cfs was used for all model runs on the Osage River below Harry S. Truman Reservoir Dam.

e. A Flood Frequency Analysis (FFA) was performed for the St. Thomas gauge just

downstream of Bagnell Dam as a way of double checking the flows at the dam. Gauge records were obtained for the years 1932 through 1997. Regulated flows were used for the pre-Harry S Truman Reservoir era before 1976, and actual flows were used for the post-Harry S Truman Reservoir time period, or 1977 and after. 10%-annual-chance flows at the dam were determined to be 81,300-cfs, 2%-annual-chance flow at 125,000 cfs, and 1%-annual-chance flows were confirmed at 150,000 cfs.

Table 2 presents the 10, 2, 1, and 0.2%-annual-chance discharges for each of the streams studied.

TABLE 2: SUMMARY OF DISCHARGES (CFS)

Osage River	0.2 %	1 %	2 %	10%
Mile 0.0- 6.2	190,000	150,000	125,000	81,300
Mile 6.2-18.8	190,000	149,000	125,000	81,000
Mile 8.8-31.2	190,000	137,000	114,000	81,000
Mile 31.2-40.0	112,000	88,000	80,000	80,000
Mile 40.0-50.0	108,000	81,000	80,000	80,000
Mile 50.0-60.0	85,000	80,000	80,000	80,000
Mile 60.0-70.0	84,000	80,000	80,000	80,000
Mile 70.0-80.0	83,000	80,000	80,000	80,000
Mile 80.0-92.0	81,000	80,000	80,000	80,000

Grandglaize Creek	0.2 %	1 %	2 %	10%
Mile 0-3	104,000	84,000	72,000	45,000
Mile 3-7	103,000	83,000	71,000	44,000
Mile 7-11	102,000	80,000	68,000	43,000
Mile 11-14	100,000	78,000	67,000	42,000
Mile 14-17	99,000	77,000	65,000	41,000

3.1.2 Approximate Methods

The 1%-annual-chance discharge was calculated as follows for all watersheds with drainage areas greater than 1 square mile for all streams studied by approximate hydraulic methods.

The hydrologic analysis for the approximate zones of the study used USGS regression equations for central Missouri to estimate the 1%-annual-chance discharges. The main equation used is shown below.

Q100 = 170 * A^0.794 * S^0.471

The drainage areas and slopes used to populate this equation were calculated using ArcHydro in GIS. Starting from the raw 10-meter DEMs, the tools within ArcHydro were used to delineate basins, define all streams with drainage areas 1 square mile or greater, calculate subbasin areas, locate the longest flow path for each basin or flow change location, and calculate the applicable slope between the 10 and 85% points on the longest flow path. The slopes and areas generated through this process were then imported into spreadsheets and used to populate the Q100 discharge equation for each flow change location.

3.2 Hydraulic Analyses

The hydraulic characteristics of floodplains in the county were studied to estimate the limits of flooding as a result of the 1%-annual-chance flood event.

3.2.1 Detailed Method

The HEC-RAS hydraulic model was utilized to perform the detailed hydraulic analysis. Cross-sectional data for all streams studied were obtained both from GIS mapping and a survey conducted by the USACE, Kansas City District. A hydrographic survey was utilized to obtain data for portions of the cross sections below Lake of the Ozarks elevation 656-ft. GIS mapping and GPS survey methods were utilized to obtain cross-sectional data above the 656-ft contour. Cross sections were located at close intervals upstream and downstream of bridges and culverts in order to compute the possible backwater effect of these structures. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments with a computed floodway, selected cross-section locations are shown on the Flood Boundaryand FloodwayMap (Exhibit 2).

Roughness factors, or Manning's "n" values, for studied streams were determined by field inspection, aerial photography, and calibration. Roughness coefficients used for all rivers are summarized in the following table.

TABLE 3: MANNING'S "N" VALUES

Stream Name	"n" Value Channel	"n" Value Floodplain
Osage River	0.026	0.045
Grand Glaize Creek	0.035	0.07 - 0.10

All elevations are referenced from National Geodetic Vertical Datum of 1988 (NAVD 88); elevation reference marks used in the study are shown on the maps.

A sensitivity analysis showed that Manning's "n" values have little effect on water surface profiles in the main bodyof the lake. This is due to the low velocityheads of 1 ft/sec or less. Hydraulic models were also checked for sensitivity to bridge expansion and contraction coefficients. In the main bodyof the lake, large variations of bridge coefficients resulted in infinitesimal changes in water surface. Therefore, expansion and contraction coefficients were held constant in the lake at 0.3 and 0.1, respectively. Expansion and contractiocoefficients around bridges upstream of the lake on the tributaries were set to 0.5 and 0.3, respectively, as suggested in the HEC-RAS Manual.

The Osage-arm HEC-RAS model was calibrated to the October 15, 1986 discharge event.

On that day, releases from Harry S. Truman Reservoir dam totaled 70,067-cfs, and the five major arms of Lake of the Ozarks contributed an additional 450 cfs. Stage measurements of 667.36-ft and 660.08-ft were recorded in the Harry S. Truman dam afterbay and at Bagnell dam, respectively, for a total drop of 7.28-ft in 93 miles across the lake. Manning's n values were globally increased in the HEC-RAS model until the model water surface matched the stage measurements within a quarter-foot.

There were no data available to calibrate the other tributaries.

In order to obtain starting water surface elevations, historic records of Bagnell dam releases were analyzed for the years 1932-1997. A plot of pool elevation vs. release was constructed and the following averages determined:

TABLE 4: BAGNELL DAM POOL ELEVATIONS

FREQUENCY	RELEASE	POOL ELEV
10 YEAR	81,300 cfs	662.17
50 YEAR	125,000 cfs	663.12
100 YEAR	150,000 cfs	663.88
500 YEAR	190,000 cfs	664.21

Pool elevations in Table 4 were used for starting water surface at Bagnell Dam, except for the 1% floodway computations on tributary streams where a starting elevation of 658.5-ft was used for each tributary. The tributary floodways were started at the lower elevation so that the floodways could be mapped to represent the 1% flow on the tributary when the lake was at a normal pool level. This results in a floodway that extends farther downstream. Flood profiles were plotted showing computed water- surface elevations to an accuracyof 0.5 foot for the 1% event (Exhibit 1).

The hydraulic analyses in this study were based on an assumption of unobstructed flow. Accordingly, flood elevations shown on the profiles are considered valid only if hydraulic structures remain unobstructed and channel and overbank conditions remain essentiallythe same as ascertained during this study.

3.2.2 Approximate Method

A Digital Terrain Model (DTM) was created from USGS 10 meter topographic data for all areas to be studied using approximate methods. Cross sections were created from DTM at one half to one mile intervals along streams to be studied and contour lines with a 10 foot contour interval were created to assist in placing the cross sections and evaluating the accuracy of the DTMs. A simplified HEC-RAS model was developed for each stream.

The water surface data was exported using HEC-GeoRAS software and approximate 1.0 percent flooded areas were created.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 100- and 500-year floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using digital topographic maps with a contour interval of 4 feet for areas mapped by detailed methods and 10-foot contours for areas mapped by approximate methods.

The 100- and 500-year boundaries are shown on the FIRM (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, and AO) and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year 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.

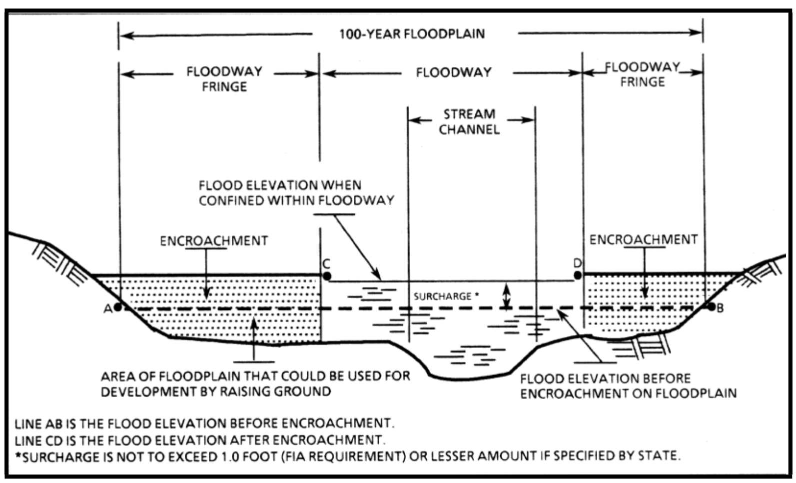
For the streams studied by approximate methods, only the 100-year floodplain boundaryis shown on the FIRM (Exhibit 2).

4.2 Floodways

Encroachment on floodplains by man-made 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 a portion of the floodplain set aside to limit the effects of encroachment on flood heights. The floodway is a tool to assist local communities in managing floodplain development. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. A floodway is the channel of a stream, plus any adjacent floodplain areas that must be kept free of encroachment so that the 100- year 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 either be adopted directly or used as a basis for additional floodway studies.

The floodway presented in this FIS 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 are tabulated for selected cross sections (Table 5, "Floodway Data"). The computed floodway is shown on the FIRM (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. The area between the floodway and the 100-year floodplain boundaries is termedthe floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1 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 1: FLOODWAY SCHEMATIC



A starting elevation of 658.5 was assumed for all 100-year floodway runs. No floodways were computed for the main body of the Lake of the Ozarks, or portions of the lake below the 100-year elevation of 663.88-ft at Bagnell Dam.

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY[2]	WITHOUT[3] FLOODWAY	WITH[3] FLOODWAY	INCREASE
AE	11.67	767 / 1,248[4]	13,817	3.6	665.5	663.2	663.2	0.0
AF	11.83	134 / 1,613[4]	15,480	3.2	665.7	663.5	663.5	0.0
AG	12.05	1,627	17,885	2.8	665.9	663.8	663.8	0.0
AH	12.27	1,024	13,339	3.7	665.9	663.9	664.0	0.1
AI	12.43	1,249	14,967	3.3	666.1	664.2	664.2	0.0
AJ	12.54	744	8,333	6.0	666.1	664.2	664.2	0.0
AK	12.72	851	10,030	4.9	666.5	664.9	665.0	0.1
AL	12.91	1,289	13,043	3.8	666.9	665.4	665.6	0.2
AM	13.15	898	10,171	4.9	667.1	665.9	666.1	0.2
AN	13.44	1,271	13,481	3.7	667.6	666.6	666.9	0.3
AO	13.60	982	9,886	5.0	667.8	666.9	667.2	0.3
AP	13.85	766	8,923	5.6	668.7	668.0	668.6	0.8
AQ	14.05	1,056	12,412	4.0	669.9	669.5	670.3	0.9
AR	14.19	1,112	12,321	4.0	670.4	670.0	670.9	1.0
AS	14.37	1,065	13,120	3.8	671.0	670.7	671.7	1.0
AT	14.45	1,089	12,501	4.0	671.2	670.9	671.9	1.0
AU	14.57	1,139	13,199	3.8	671.7	671.5	672.5	1.0
AV	14.68	1,153	14,766	3.4	672.1	671.9	672.9	1.0
AW	14.86	366	6,433	7.7	672.5	672.4	673.4	1.0
AX	14.99	948	13,854	3.6	674.3	674.2	675.1	0.9
AY	15.14	1,062	14,142	3.5	674.7	674.6	675.6	1.0

[1]Distance in miles above the confluence with Osage River
[2]Elevations computed based on the downstream starting elevation at the 1% chance flood elevation for the Osage River Arm of the Lake of the Ozarks
[3]Elevations computed based on normal depth
[4]Width within county/Width

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MILLER COUNTY, MISSOURI

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: GRAND GLAIZE RIVER

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
AZ	15.28	861	10,685	4.6	675.1	675.0	676.0	1.0
BA	15.50	813	10,809	4.6	676.0	675.9	676.9	1.0
BB	15.64	817	10,238	4.7	676.7	676.6	677.5	0.9
BC	15.80	442	7,970	6.0	677.4	677.3	678.3	1.0
BD	15.97	615	10,287	4.7	678.3	678.2	679.3	1.0

[1]Distance in miles above the confluence with Osage River
[2]Elevations computed based on the downstream starting elevation at the 1% chance flood elevation for the Osage River Arm of the Lake of the Ozarks
[3]Elevations computed based on normal depth
[4]Width within county/Width

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

MILLER COUNTY, MISSOURI

AND INCORPORATED AREAS

FLOODWAY DATA

FLOODING SOURCE: GRAND GLAIZE RIVER

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 100-year floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole- foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

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 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations 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 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area Miller County, Missouri. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps, where applicable. Historical data relating to the maps prepared for each community up to and including this countywide FIS are presented in Table 6, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Bagnell, Town of	May 18, 2009	None	May 18, 2009	None
Brumley, Town of	May 18, 2009	None	May 18, 2009	None
Eldon, Town of	March 29, 1974	February 6, 1976	May 18, 2009	June 18, 1987
Iberia, City of	May 18, 2009	None	May 18, 2009	None
Lake Ozark, City of	June 16, 1977	None	May 18, 2009	None
Lakeside, Town of	May 18, 2009	None	May 18, 2009	None
Miller County (Unincorporated Areas)	September 30, 1987	None	May 18, 2009	None
Olean, Town of	May 18, 2009	None	May 18, 2009	None
St. Elizabeth, Villag e of	May 18, 2009	None	May 18, 2009	None
Tuscumbia, Village of	October 25, 1974	November 21, 1975	May 18, 2009	None

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

MILLER COUNTY, MO
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Because it is based on more up-to-date analyses, this countywide FIS supersedes any previously printed FISs within Miller County.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA Region VII, Mitigation Division, 9221 Ward Parkway, Suite 300, Kansas City, MO 64114-3372

9.0 BIBLIOGRAPHY AND REFERENCES

1. U.S. Department of Commerce, Bureau of the Census, 2000 Census of Population, Number of Inhabitants, Missouri, Washington, D.C., 2000
2. Midwestern Regional Climate Center, http://mcc.sws.uiuc.edu
3. U.S. Department of Agriculture, Soil Conservation Service, Soil Surveys, for Camden, Morgan, and Benton Counties.
4. U.S. Army Corps of Engineers Hydrologic Engineering Center, HEC-GEORAS 3.1 River Analysis System, October 2002.
5. U.S. Geological Survey, Technique for Estimating the Magnitude and Frequency of Missouri Floods, 1974.
6. U.S. Army Corps of Engineers Hydrologic Engineering Center, HEC-RAS 3.1 River Analysis System, *May 2003.*
7. United States Geological Survey, Techniques for Estimating the 2- to 500-Year Flood Discharges on Unregulated Streams in Rural Missouri by the USGS Water-Resources Investigations Report #95-4231 Region II (Ozark Plateaus) 1995.
8. United States Geological Survey, 7.5-Minute Series Digital Orthophoto Quarter Quadrangles (DOQQs), Reference North American Datum of 1983 (NAD83) and cast on the Universal Transverse Mercator (UTM) projection, Zone 15 North in Meters.
9. Federal Emergency Management Agency, Flood Insurance Study, Warsaw, City of, Washington D.C., July 16, 1990.

10.0 REVISIONS DESCRIPTION

This section has been added to provide information regarding significant revisions made since the original FIS report and FIRM were printed. Future revisions may be made that do not result in the republishing of the FIS report. All users are advised to contact the Community Map Repository at the address below to obtain the most up-to-date flood hazard data. Map Repository Table 7.

Table 7: Map Repositories

Community	Address	City	State	Zip Code
BAGNELL, TOWN OF	407 OLD BAGNELL ROAD	BAGNELL	MO	65026
BRUMLEY, TOWN OF	COUNTY COURTHOUSE 2001 HIGHWAY 52	TUSCUMBIA	MO	65082
ELDON, TOWN OF	201 EAST 1ST STREET	ELDON	MO	65026
IBERIA, CITY OF	CITY HALL 803 HIGHWAY 42	IBERIA	MO	65486
LAKE OZARK, CITY OF	CITY HALL 2624 BAGNELL DAM BOULEVARD	LAKE OZARK	MO	65049
LAKESIDE, TOWN OF	617 RIVER ROAD	LAKE OZARK	MO	65049
MILLER COUNTY	COUNTY COURTHOUSE 2001 HIGHWAY 52	TUSCUMBIA	MO	65082
OLEAN, TOWN OF	322 SHAW ROAD	ELDON	MO	65026
ST. ELIZABETH, VILLAGE OF	COUNTY COURTHOUSE 2001 HIGHWAY 52	TUSCUMBIA	MO	65082
TUSCUMBIA, VILLAGE OF	COUNTY COURTHOUSE 2001 HIGHWAY 52	TUSCUMBIA	MO	65082

10.1 First Revision (Revised TBD)

a. Acknowledgements
   The hydrologic and hydraulic analyses for this revision were completed by STARR under contract with FEMA Contact HSFE60-15-D-0005.

b. Coordination
   i) A Flood Risk Review meeting was held on March XX, 2016 to review the draft result of this study.
   ii) A final CCO meeting was held on May XX, 2016 to review the revisions to the Flood Insurance Study for Miller County, MO.

c. Scope
   The revision included revised detail analysis for the Grand Glaize Creek from the confluence with the Lake of the Ozarks to the county boundary.

d. Hydrologic Analysis

   Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for each flooding source studied. Hydrologic analyses are typically performed at the watershed level. Depending on factors such as watershed size and shape, land use and urbanization, and natural or man-made storage, various models or methodologies may be applied. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

   A summary of the discharges is provided in Table 8. The peak discharges reported in this table are derived from regression equations.

Table 8: Summary of Discharges (Study Revision)

			Peak Discharge (cfs)			
Flooding Source	**Location**	**Drainage Area (Sq Mile)**	**10% Annual Chance**	**2% Annual Chance**	**1% Annual Chance**	**0.2% Annual Chance**
Grand Glaize Creek	Mile 0.0 - 3.0	444	27,000	43,100	50,000	66,600
Grand Glaize Creek	Mile 3.0 - 7.0	431	26,500	42,700	49,600	66,200
Grand Glaize Creek	Mile 7.0 - 11.0	419	26,500	42,700	49,600	66,200
Grand Glaize Creek	Mile 11.0 - 14.0	407	26,500	42,700	49,600	66,200
Grand Glaize Creek	Mile 14.0 - 17.0	379	25,700	41,300	48,000	64,100

e. Hydraulic Analysis

Hydraulic analyses were carried out to provide estimates of the elevations of flood of the selected recurrence intervals. The 1-percent annual chance floodway computations on tributary streams used a starting pool elevation of 658.5-ft so that the floodway could be mapped to represent the 1-percent annual chance discharge on the tributary when the lake was at a normal pool level. This results in a floodway that extends further downstream.

Roughness factors, or Manning's "n" values, were determined by field inspection, aerial photography, and calibration. Roughness coefficients from streams restudied by detailed methods are summarized in Table 10.

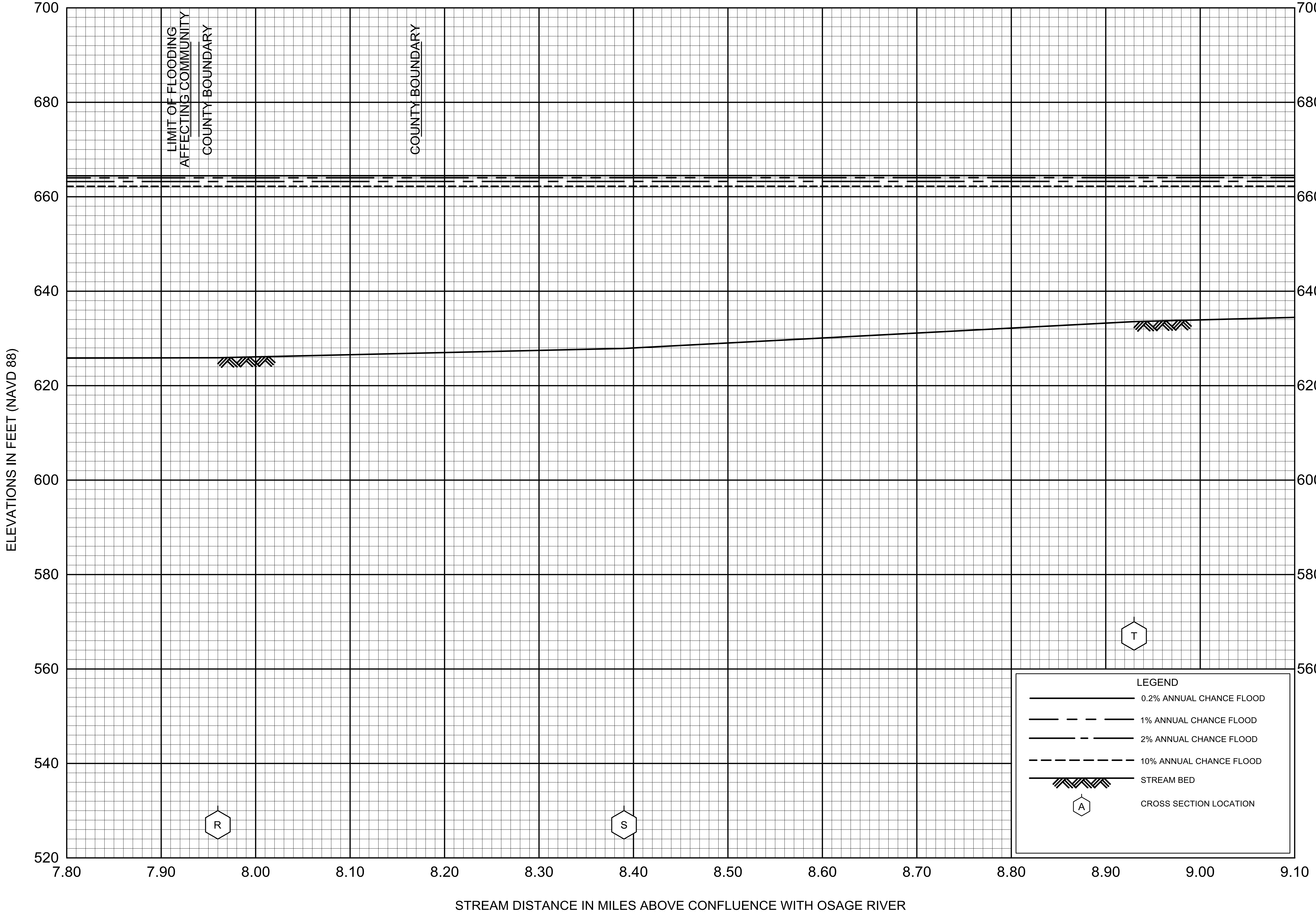
The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail. A summary of stillwater elevations developed for Bagnell Dam is provided in Table 9. Channel roughness coefficients are provided in Table 10.

Table 9: Summary of Stillwater Elevations (Study Revision)

	Elevation (Feet NAVD)			
Flooding Source	**10-Percent-Annual-Chance**	**2-Percent-Annual-Chance**	**1-Percent-Annual-Chance**	**0.2-Percent-Annual-Chance**
Bagnell Dam	662.17	663.12	663.88	664.21

Table 10: Summary of Roughness Coefficients (Study Revision)

	Roughness Coefficients	
Flooding Source	**Channel**	**Overbanks**
Grand Glaize Creek	0.035	0.07 – 0.10



FLOOD PROFILES

GRAND GLAIZE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MILLER COUNTY, MO

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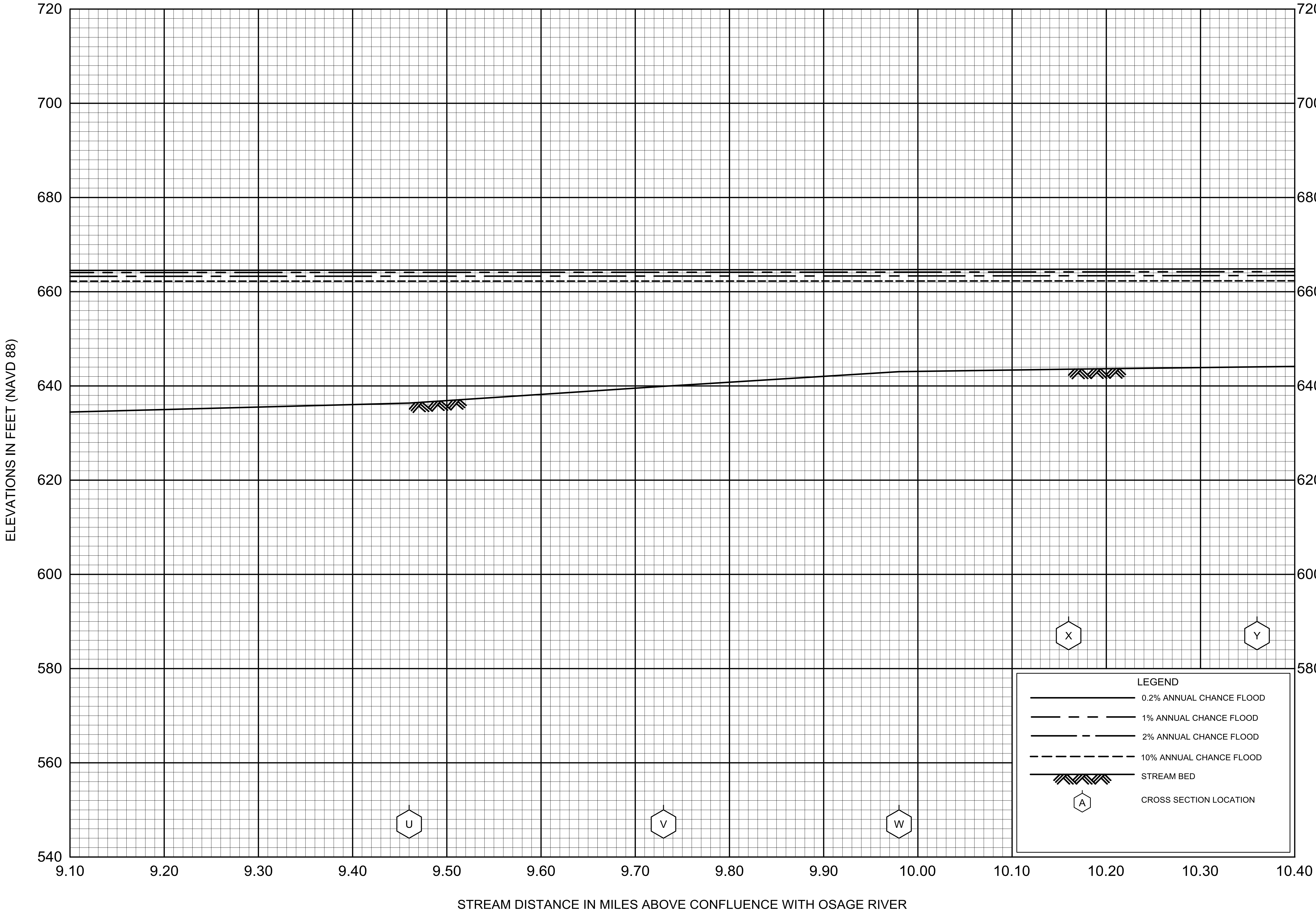

FLOOD PROFILES

GRAND GLAIZE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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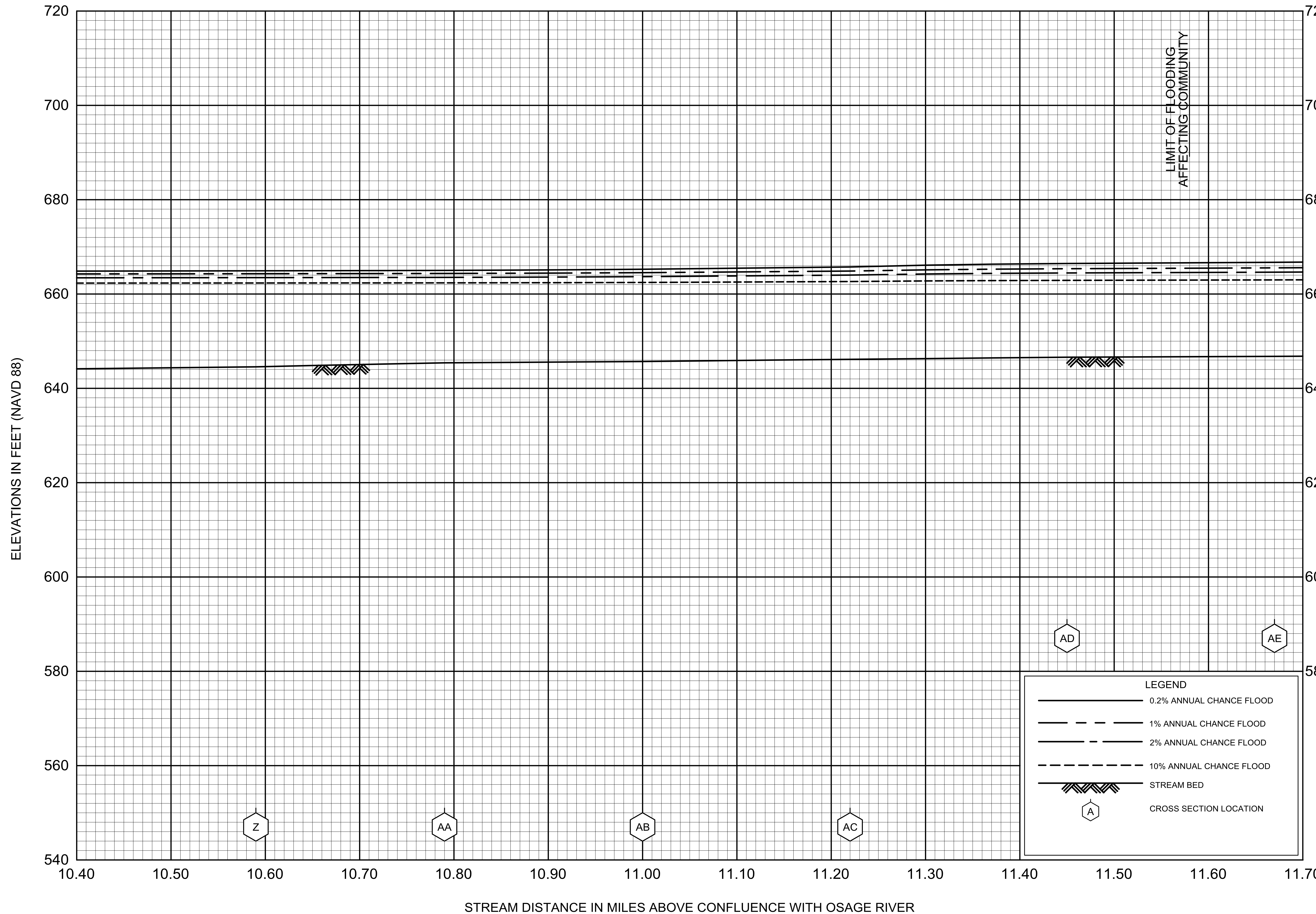

FLOOD PROFILES

GRAND GLAIZE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MILLER COUNTY, MO

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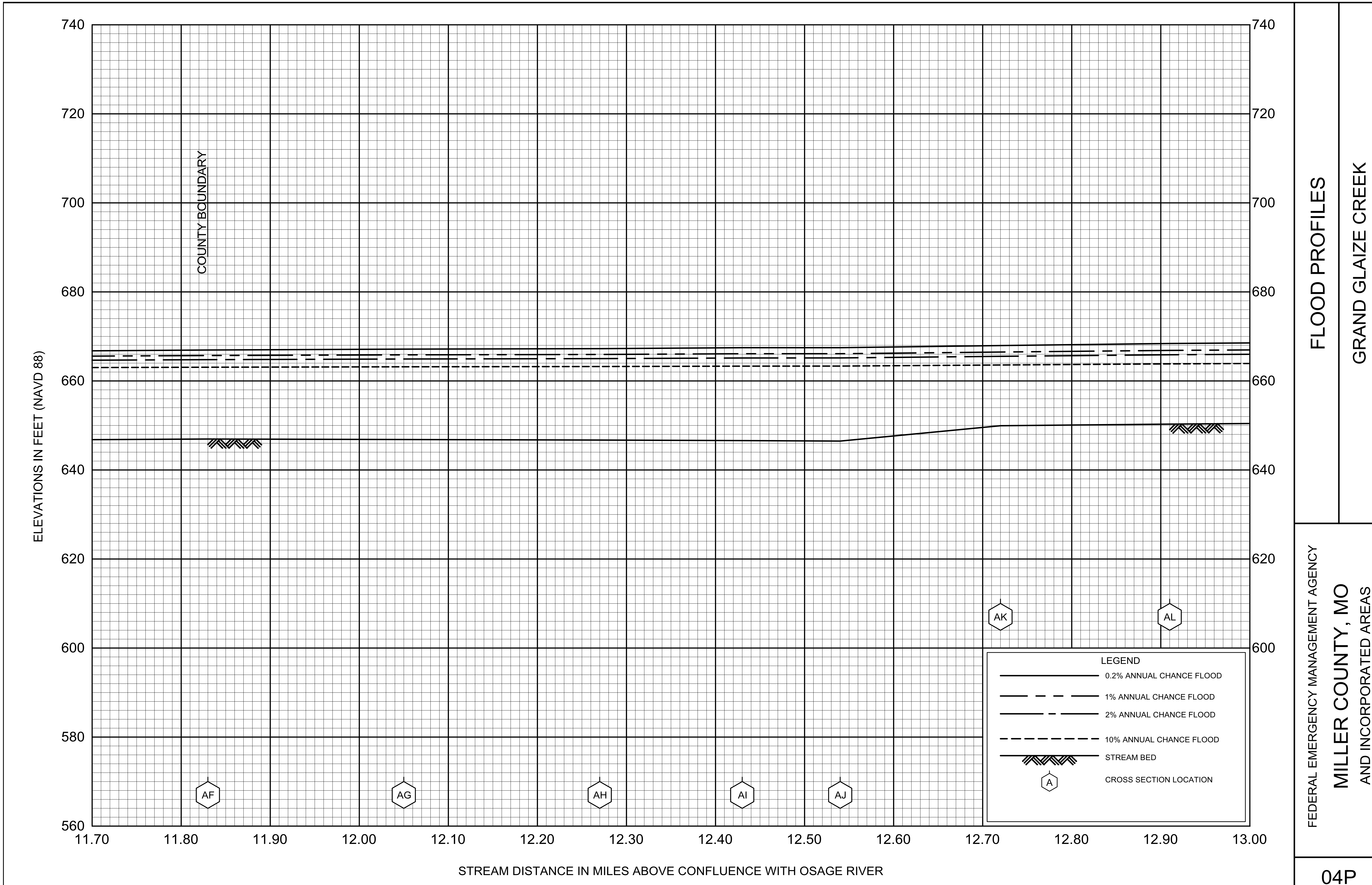

740
720
700
680
660
640
620
600
580
560
COUNTY BOUNDARY
ELEVATIONS IN FEET (NAVD 88)
AF
AG
AH
AI
AJ
AK
AL
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
A
CROSS SECTION LOCATION
11.70
11.80
11.90
12.00
12.10
12.20
12.30
12.40
12.50
12.60
12.70
12.80
12.90
13.00
STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH OSAGE RIVER
FLOOD PROFILES
GRAND GLAIZE CREEK
FEDERAL EMERGENCY MANAGEMENT AGENCY
MILLER COUNTY, MO
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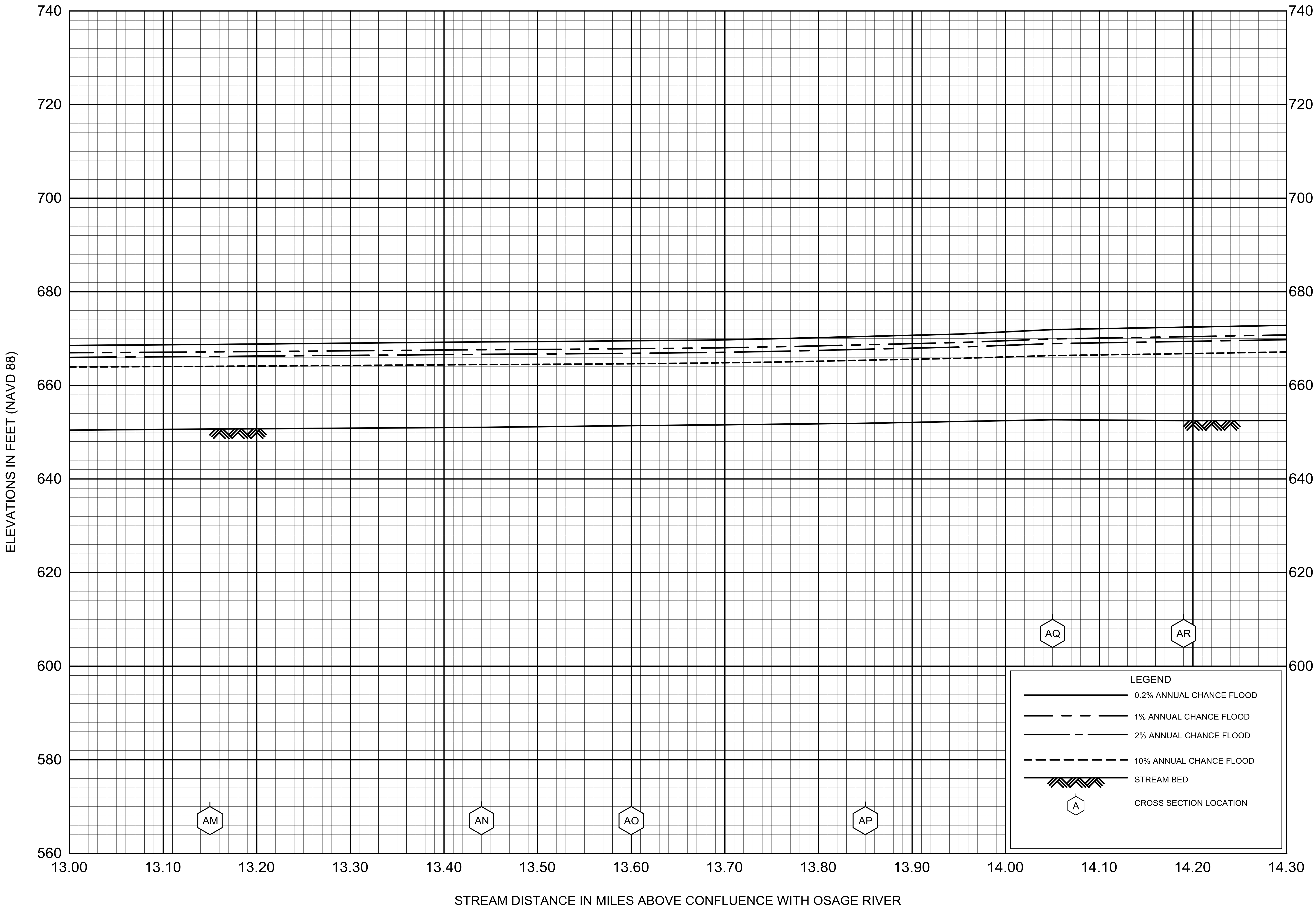

FLOOD PROFILES

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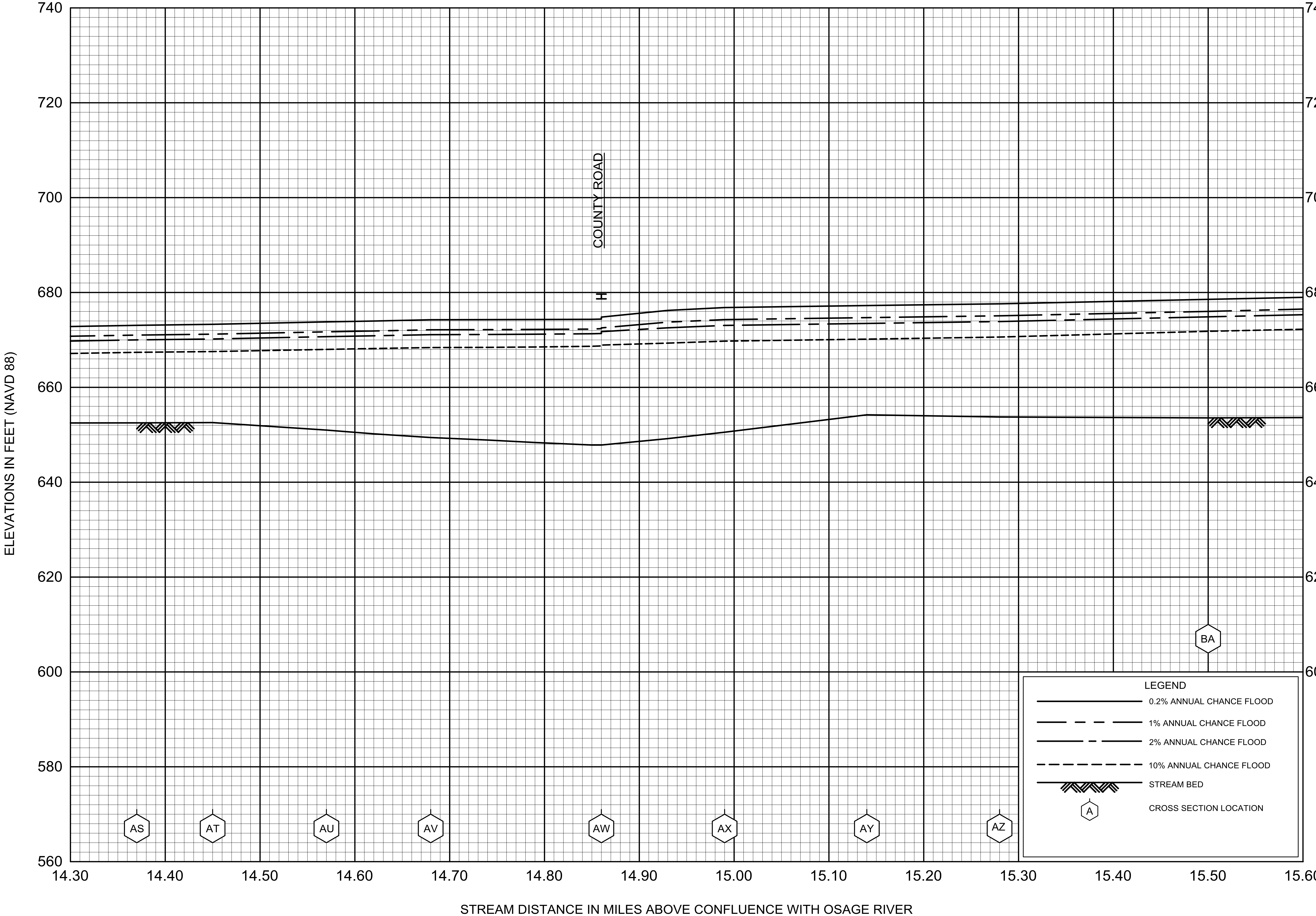

FLOOD PROFILES

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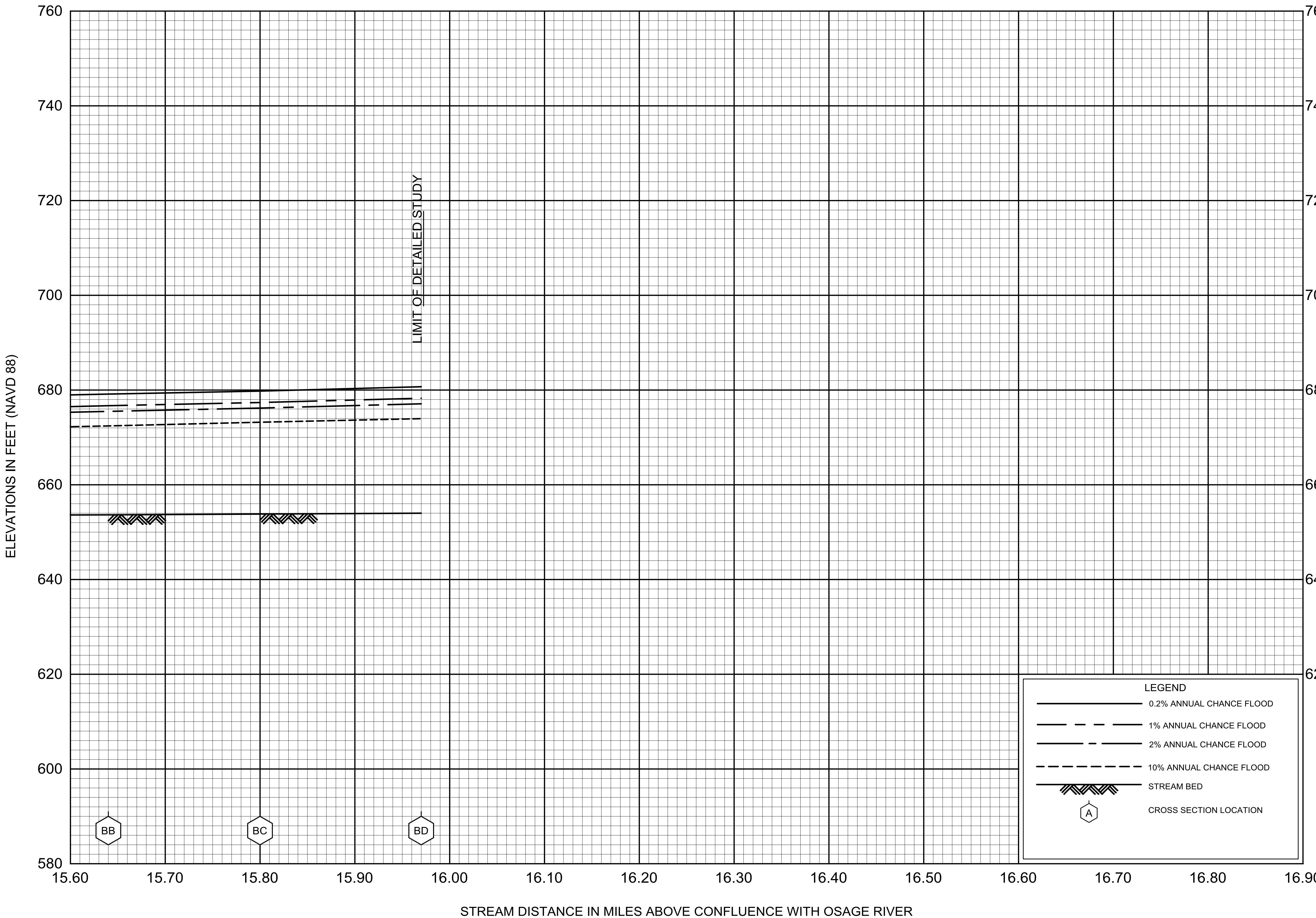

FLOOD PROFILES

GRAND GLAIZE CREEK

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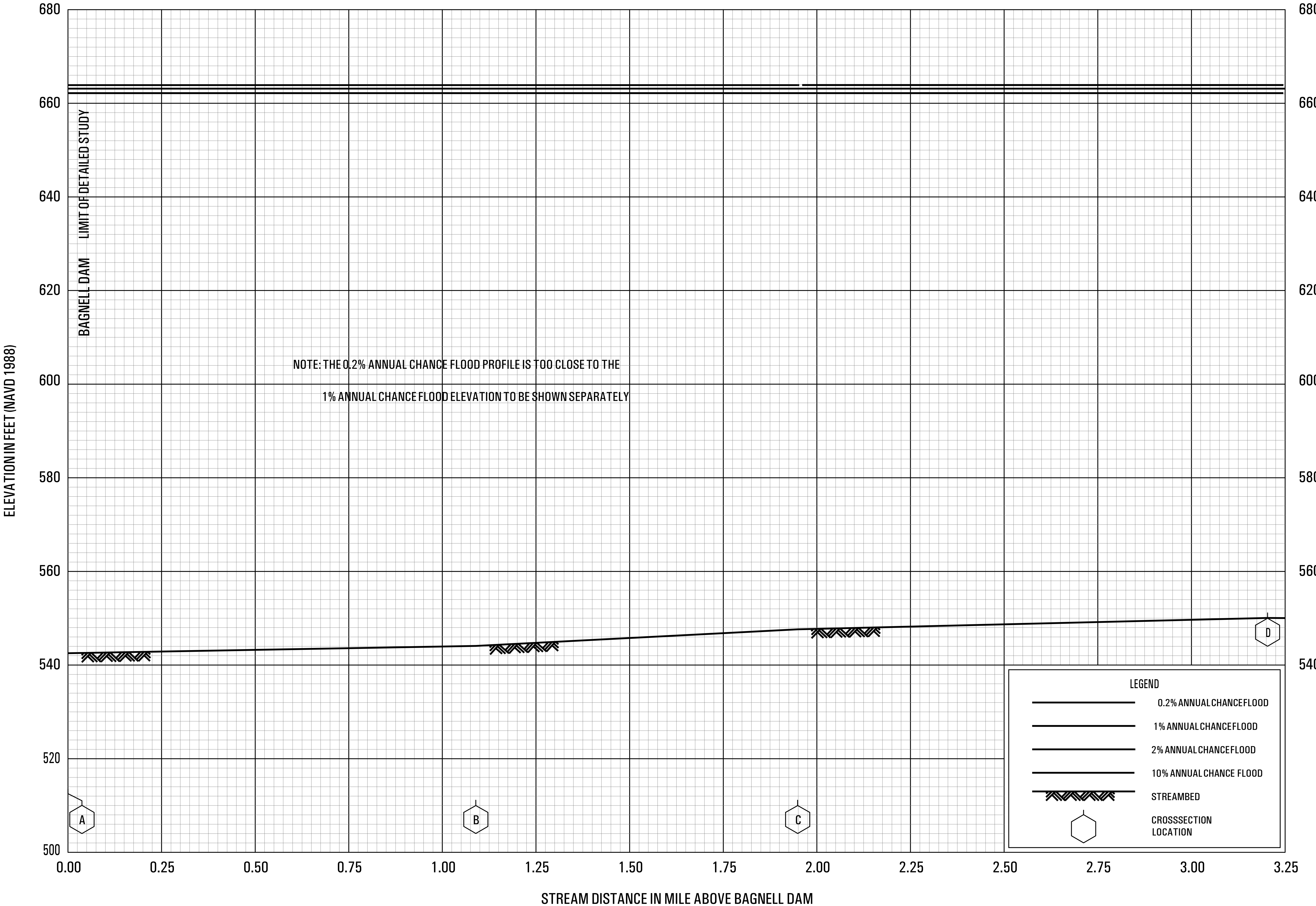

FLOOD PROFILES

OSAGE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

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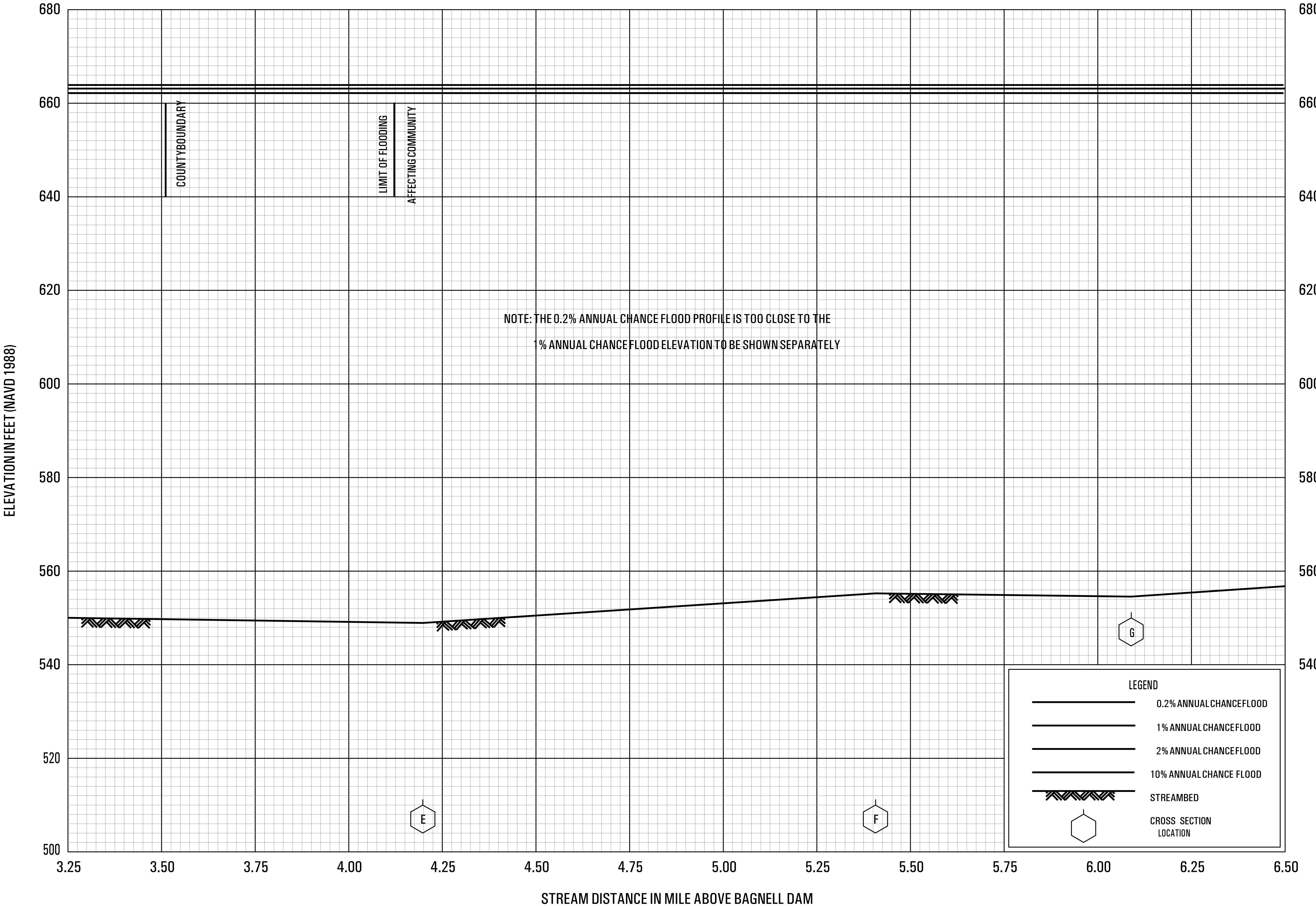

FLOOD PROFILES

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MILLER COUNTY, MO

AND INCORPORATED AREAS

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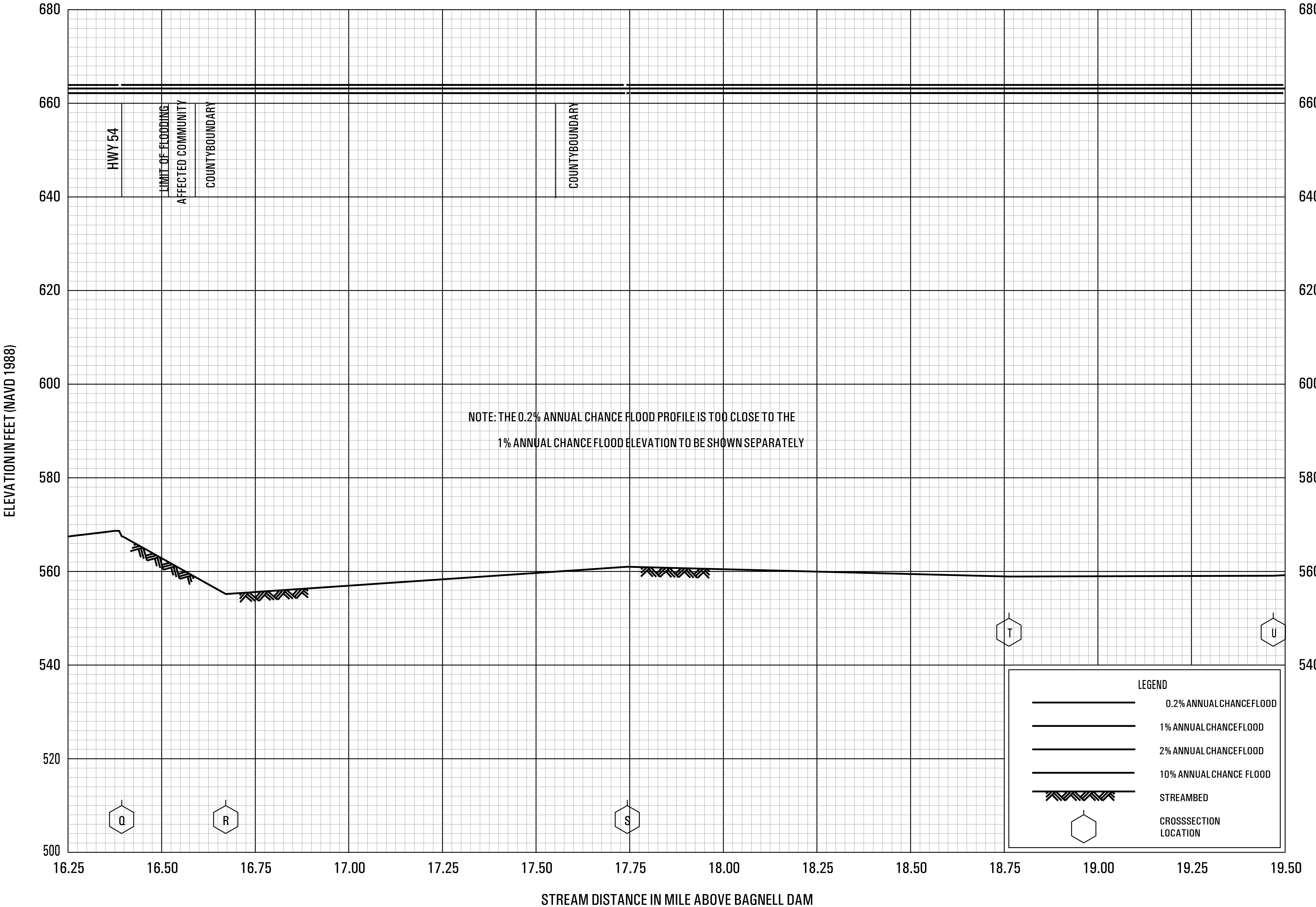

FLOOD PROFILES

OSAGE RIVER

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MILLER COUNTY, MO
AND INCORPORATED AREAS