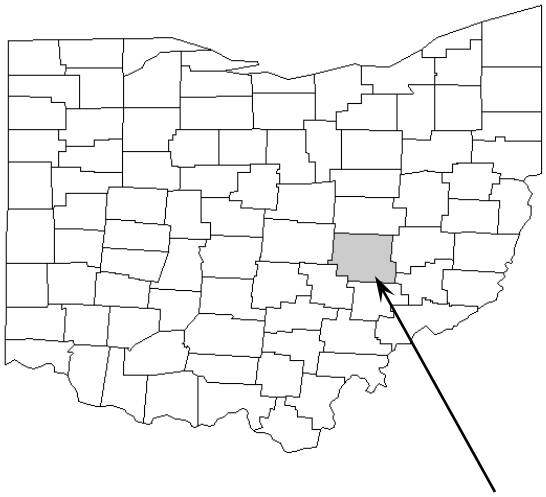
FLOOD INSURANCE STUDY

MUSKINGUM COUNTY, OHIO

AND INCORPORATED AREAS

Community Name	Community Number
* Adamsville, Village of	390937
Dresden, Village of	390705
Frazeysburg, Village of	390426
* Fultonham, Village of	390935
Muskingum County Unincorporated Areas	390425
New Concord, Village of	390847
* Norwich, Village of	390936
Philo, Village of	390851
Roseville, Village of (Muskingum and Perry Counties)	390646
South Zanesville, Village of	390860
Zanesville, City of	390427

* NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED



PRELIMINARY
9/18/2015

REVISED:
TBD

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
39119CV000B

NOTICE TO
FLOOD INSURANCE STUDY USERS

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

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

Initial Countywide FIS Effective Date: July 6, 2010

Revised FIS Report Date: To Be Determined

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PUBLISHED SEPARATELY
Flood Insurance Rate Map Index
Flood Insurance Rate Maps

FLOOD INSURANCE STUDY

MUSKINGUM COUNTY, OHIO AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) revises and supersedes the FIS reports, Flood Insurance Rate Maps (FIRMs) and/or Flood Boundary and Floodway Maps (FBFMs) in the geographic area of Muskingum County, including the Villages of Adamsville, Dresden, Frazeysburg, Fultonham, New Concord, Norwich, Philo, Roseville and South Zanesville, the City of Zanesville and the unincorporated areas of Muskingum County (hereinafter referred to collectively as Muskingum County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The Village of Gratiot is located in both Muskingum and Licking Counties and was included in the Licking County FIRMs and FIS which became effective May 2, 2007. 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 Muskingum County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), 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.

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

1.2 Authority and Acknowledgments

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

Information on the authority and acknowledgments for each of the previously printed FISs and FIRMs for communities within Muskingum County was compiled and is shown below.

Muskingum County:	The hydrologic and hydraulic analyses for the June 1988 study for the Unincorporated Areas of Muskingum County were performed by Burgess and Niple, Limited, for FEMA, under Contract No. EMW-85-C-1999. This work was completed in July 1987 (Reference 1).
Village of Dresden:	The hydrologic and hydraulic analyses for the May 1986 study for the Village of Dresden were obtained from "Flood Plain Management Study for the Village of Dresden" and "Flood Hazard Evaluation, State Route 208 over the Muskingum River" (References 2, 3, and 4).
Village of Roseville:	The hydrologic and hydraulic analyses for the January 1991 study for the Village of Roseville were performed by the U.S. Geological Survey (USGS), Water Resources Division (the Study Contractor) for FEMA, under Inter-Agency Agreement No. EMW-88-E-2738, Project Order No. 1. This study was completed in April 1989 (Reference 5).
City of Zanesville:	The hydrologic and hydraulic analyses for the September 1988 study for the City of Zanesville were prepared by Burgess and Niple, Limited, during the preparation of the FIS for the unincorporated areas of Muskingum County. The work for that study was completed in July 1987 (Reference 6).

Intial Countywide FIS -July 6, 2010

The hydrologic and hydraulic analyses for the July 6, 2010 FIS were performed by Stantec Consulting Services, INC (Stantec) for FEMA under Contract No. HSFE05-05-D-0026.

In addition to incorporating the existing three FISs for communities within Muskingum County, the July 2016 countywide FIS included new approximate studies, redelineation of all other effective profiles and incorporation of approved Letters of Map Change (LOMCs). The vertical datum was shifted to North American Vertical Datum of 1988 (NAVD88). The digital floodplain data was merged into a single, updated DFIRM. The DFIRM included 2002 digital orthophotography, two-foot contours countywide, political boundaries, road centerlines with street names, railroads with names, airports, rivers, lakes, streams, bridges and other hydraulic structures and elevation reference marks. This work, which was completed in May 2008, covered unprotected flooding sources affecting Muskingum County.

Revised Countywide FIS - TBD

For this revision, Strategic Alliance for Risk Reduction (STARR), which is a joint venture comprised of Atkins, Greenhorne & O'Mara, Stantec, and CDM, completed a Physical Map Revision (PMR) based on accreditation of the Roseville Local Protection Project (LPP) in the City of Roseville. The protected area includes portions of Muskingum and Perry Counties in Ohio. As part of the accreditation, DLZ Ohio, Inc. (DLZ) updated an existing interior drainage study on the landward side of the Roseville LPP. DLZ submitted their modeling as part of the accreditation package titled "Roseville LPP in Muskingum &

Perry Counties, Ohio – Levee Accreditation Submittal" and dated May 23, 2014. STARR updated the DFIRM mapping based on the results of DLZ's study which determined ponding elevations for four areas on the interior side of the Roseville LPP levee.

1.3 Coordination

The purpose of an initial Consultation Coordination Officer's (CCO's) meeting is to discuss the scope of the FIS. A final CCO meeting is held to review the results of the study. The dates of the initial and final CCO meetings held for the previous FIS for Muskingum County and the incorporated communities within its boundaries are shown in TABLE 1 (References 1, and 4-6).

TABLE 1 – Muskingum County CCO Meetings

Community Name	Initial CCO Date	Final CCO Date
Muskingum County		
Unincorporated Areas	March 5, 1985	March 10, 1987
Village of Dresden	(not published)	June 26, 1985
Village of Roseville	August 19, 1987	February 13, 1990
City of Zanesville	(not published)	May 27, 1987

Results of the technical aspects of this study were coordinated with, reviewed and approved by the Ohio Department of Natural Resources (ODNR), the State coordinating agency.

For the initial Countywide FIS, an initial CCO meeting was held on June 13, 2007. This meeting was attended by representatives of FEMA, ODNR, other local participants and the study contractor. The results of the study were reviewed at the final CCO meeting held on April 9, 2009, and attended by representatives of Muskingum County, ODNR and Stantec. All problems raised at the final CCO meeting have been addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This countywide FIS covers the geographic area of Muskingum County, Ohio, including the incorporated communities listed in Section 1.1.

The flooding sources studied previously by detailed methods are shown in TABLE 2.

TABLE 2 – Limits of Previous Detailed Studies

Flooding Source	Limits of Detailed Study
Licking River	From the confluence with the Muskingum River to Dillon Dam
Main Ditch	From the downstream corporate limits of the Village of Dresden to the outlet of the 36-inch diameter culvert under State Route 60
Moxahala Creek	The entire length within the corporate limits of the Village of Roseville
Muskingum River	Entire length within the county

No new or restudied detailed studies were completed as a part of the July 2010 FIS. However, two Appalachian Flood Risk Reduction Initiative (AFRRI) studies on Wakatomika Creek were incorporated.

Approximate analyses are usually used to study areas having a low development potential or minimal flood hazards. In the initial countywide FIS, streams previously studied by approximate methods were restudied and additional approximate analyses were performed to protect areas where flood hazards were not previously identified. Large lakes and areas of ponding that were previously studied by approximate methods were mapped using flood elevations provided by the United States Army Corps of Engineers (USACE), Huntington District or were digitally converted with consideration given to the revised topography.

Revised Countywide FIS - TBD

For this revision, STARR completed a PMR based on accreditation of the Roseville LPP in the City of Roseville. The protected area includes portions of Muskingum and Perry Counties in Ohio. As part of this work, the DFIRM mapping was updated to include ponding areas from an existing interior drainage study by DLZ for the landward area of the Roseville LPP.

This FIS also incorporates the determination of letters issued by the Federal Emergency Management Agency (FEMA) resulting in map revisions (Letters of Map Revision (LOMRs)) and map amendments (Letters of Map Amendment (LOMAs)). LOMAs incorporated for this study are summarized in the Summary of Map Actions (SOMA) included in the Technical Support Data Notebook (TSDN) associated with this FIS update. Copies of the SOMA may be obtained from the Community Map Repository. Copies of the TSDN may be obtained from FEMA.

2.2 Community Description

Muskingum County is located in east central Ohio about 50 miles east of Columbus. It encompasses a total area of approximately 673 square miles. It is bordered on the north by Coshocton County; on the east by Guernsey and Noble Counties; on the south by Morgan County; on the southwest by Perry County; and on the west by Licking County. The major transportation arteries of Muskingum County are Interstate 70, which travels east-west across the county; Ohio 146, which travels northwest-southeast across the county; Ohio 60, which travels north-south through the county; US 22, which travels east-west across the county; and US 40, which travels east-west across the county.

As of the 2000 census, the population of Muskingum County was reported by the U.S. Census Bureau to be 84,585. As of the 2010 census, the population was 86,074. The county seat is the City of Zanesville with a population of about 25,484 as of the 2010 census (Reference 7).

Muskingum County is located in the Allegheny Plateau, which is described as rough and well dissected. This description is true of the county everywhere except the broad valleys like along the Muskingum River. There are 12 soil classifications in the county with the main one being the Gilpin-Zanesville-Keene association. This association can be described as gently sloping to very steep, well drained to moderately well drained; and the upland soils are underlain by siltstone, shale, or sandstone bedrock (Reference 1).

Muskingum County is largely rural with nearly 429 square miles covered by forest and 217 square miles used for agricultural purposes. There are over 2,200 acres of lakes in Muskingum County. The largest is Dillion Reservoir which covers about 1,325 acres. The Dillion Dam was built in 1959 as part of the Muskingum Watershed Conservatory District (MWCD) and its main purpose is to control flooding on the Licking and Muskingum Rivers. There is also a small section of the Wills Creek Reservoir in the northeastern part of Muskingum County. This reservoir is also part of the Muskingum Watershed Conservancy District (MWCD) with the purpose of controlling flooding of the Muskingum River.

The Village of Dresden is located in the upper northwester portion of Muskingum County about 3 miles south of the Coshocton county line.

The Village of Roseville is in both Muskingum and Perry Counties, approximately 9 miles south of the City of Zanesville and is accessible by State Route 93.

The City of Zanesville is located in the southwestern portion of Muskingum County and is completely surrounded by the unincorporated areas of the county. The Licking River, which flows southeast through the western portion of the county, flows into the Muskingum River at the City of Zanesville.

The average annual precipitation for the county is approximately 39 inches; however it can be as low as 36 inches in the southernmost portion of the county. January is typically the driest month and July is typically the wettest. The average annual temperature is 52 degrees Fahrenheit (Reference 8).

2.3 Principal Flood Problems

Past flooding on the streams within Muskingum County and the City of Zanesville indicates that flooding may occur during any season of the year; however, most major floods have occurred from January to April and are usually the result of rains and may worsen if accompanied by melting snow. Currently, flow of the Muskingum River in the county is regulated by USACE at 15 control reservoirs above the Licking River confluence plus Dillon Dam on the Licking River (Reference 1 and 6).

The principal sources of flooding within the Village of Dresden are the Muskingum River, Wakatomika Creek, Main Ditch, and Town Ditch. On August 13, 1980, Dresden experienced extremely heavy rainfall. This thunderstorm was part of a storm system

affecting a larger area including Cambridge and Zanesville. As a result of this storm and related flooding, assistance was requested from the Soil Conservation Service (SCS) (Reference 4).

Within the Village of Roseville, low-lying areas adjacent to Moxahala Creek are subject to flooding (Reference 5).

2.4 Flood Protection Measures

The MWCD, serving all of Muskingum County, was established in 1933. Flood control purposes of the MWCD were transferred to the USACE shortly thereafter.

Currently, the USACE is responsible for the operation of the flood control phase of these projects and the MWCD is responsible for the operation of the conservation and recreation phases of the original 14 projects. The following tabulation gives the name, location, date built, and flood storage capacity for each of the USACE reservoirs (Reference 9):

Project	Location	Date Built	Storage (Acre-feet)
Atwood	Indian Fork of Connotton Creek, Tuscarawas County	1936	26,100
Beach City	Sugar Creek, Tuscarawas County	1936	70,000
Bolivar	Sandy Creek, Stark and Tuscarawas Counties	1938	149,600
Charles Mill	Black Fork of Mohican River, Ashland County	1936	80,600
Clendening	Brushy Fork of Stillwater Creek, Harrison County	1936	27,500
Dover	Tuscarawas River, Tuscarawas County	1938	203,000
Leesville	McGuire Creek, Carroll County	1936	17,900
Mohawk	Walhounding River, Coshocton County	1936	285,000
Mohicanville	Lake Fork of Mohican River, Ashland County	1936	102,000
Piedmont	Stillwater Creek, Harrison County	1937	32,200
Pleasant Hill	Clear Fork of Mohican River, Ashland County	1937	74,200
Senecaville	Seneca Fork of Wills Creek, Guernsey County	1936	45,000
Tappan	Little Stillwater Creek, Harrison County	1936	26,500
Wills Creek	Wills Creek, Coshocton and Muskingum Counties	1936	190,000
Dillon	Licking River, Muskingum County	1959	260,900
North Branch Kokosing	North Branch Kokosing River, Knox County	1972	13,800

Non-structural measures in the form of land use regulations for flood protection are also being used to aid in the prevention of future flood damage along the Muskingum River (Reference 10).

Due to the past severe flooding of the Village of Roseville, Ohio, and the magnitude of damage to the community, the USACE Huntington District constructed a levee along Moxahala Creek to protect the community in 1960. The Village of Roseville owns the levee and is responsible for its operation and maintenance. The USACE is responsible for maintenance of the Moxahala Creek channel. There is an agreement between the community and the Huntington USACE for periodic inspections of the levee to be performed by the USACE (Reference 5).

This levee provides protection from the 1-percent-annual-chance flood event. The criteria used to evaluate protection against the 1-percent-annual-chance flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the 1-percent-annual-chance flood are not considered in the hydraulic analysis of the 1-percent-annual-chance floodplain (Reference 5).

No flood protection measures exist for Wakatomika Creek, Main Ditch, or Town Ditch (Reference 4).

3.0 ENGINEERING METHODS

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

The initial countywide FIS report included information from previously published FIS reports as well as new information. Unless indicated otherwise, the information provided in this section was obtained from the previously published FIS reports for Muskingum County.

Within Muskingum County and the City of Zanesville, both the Muskingum and Licking Rivers are regulated by the USACE for flood control purposes. The USACE provided flood frequency peak discharges at gaging stations within and beyond the study reaches (Reference 11). These gave very good definition of 1-percent-annual-chance flood peak discharge variations through the study reaches; intermediate changes were interpolated as needed from a log-log plot of the USACE peak discharges versus drainage area.

Peak discharges for the Muskingum River were taken from the discharge-frequency data found in Bulletin 45 (Reference 4) for USGS gage no. 0314450 located 70 feet downstream of the State Route 208 Bridge.

The frequency discharges for the Muskingum River reflect the effects of flow regulation by the upstream reservoirs built since 1938. The maximum recorded discharge subsequent to regulation was 45,200 cubic feet per second (cfs) (slightly less than the 1-percent-annual-chance event) on January 27, 1952 (Reference 4).

For the Village of Dresden, flood discharges for Main Ditch were established by valley flood routings through use of the SCS water model Project Formulation Hydrology, TR-20 (Reference 12). This program uses a modified Att-Kin method for stream and valley flood routing and a storage indication method for reservoir flood routing. The 36-inch pipe culvert under the Norfolk Southern Railway is partially sediment filled and is producing backwater effects upstream. Therefore, this area was flood routed with the reservoir procedure provided in TR-20 (Reference 12).

Within the Village of Roseville, a USGS Crest-stage gaging station (No. 03-148300) is located on Moxahala Creek. The 1-percent-annual-chance peak discharge for the reach studied is based on a statistical analysis of annual peak discharge data from this gage. These data were analyzed in accordance with Bulletin No. 17B (Reference 13). A USGS computer program (Reference 14) was used to perform the analysis, which was based on the systematic record of 25 years (1963-1987) and a weighted skew coefficient.

The discharge-frequency relationships for Wakatomika Creek within the Villages of Dresden and Frazeysburg were developed using USGS regression equations (Reference 15).

Hydrologic calculations for approximate studies were performed using the regression equations presented in the USGS Water-Resources Scientific Investigations Report (SIR) 2006-5312, "A Streamflow Statistics (StreamStats) Web Application for Ohio." Regional regression equations in this report for estimating the 1-percent-annual-chance flood-peak discharges at ungaged sites on rural, unregulated streams in Ohio were developed by means of ordinary and generalized least-squares regression techniques. Full-model, three-variable regional regression equations were developed based on selected basin characteristics and flood-frequency estimates determined for 305 streamflow-gaging stations in Ohio and neighboring states. The full-model regression equations employee three variables: drainage area, main-channel slope determined by the 10-85 method described in USGS Water-Resources SIR 2006-5312 and the percent storage in the basin (Reference 16).

Revised Countywide FIS - TBD – Interior Drainage Study

DLZ Ohio, Inc. updated the existing interior drainage study for the Roseville LPP in 2014 as part of the accreditation package for the Roseville LPP. The original study was included Design Memorandum No. 1, "Local Flood Protection, Roseville, Ohio" by the USACE, Huntington District, dated July 1958. The purpose of this revision was to incorporate changes in the hydrologic/hydraulic design procedures and update the study to due changes in the drainage system. Four ponding areas on the landward side of the levee were analyzed. The study focused on the performance of the system during high flow in Moxahala Creek when the pump station was active.

Bulletin 71 rainfall depths and the Huff 1st quartile rainfall distribution with a 2-hour duration were used in the hydrologic analysis. Four ponding areas were analyzed. The updated flows were computed in the USACE HEC-HMS computer program.

Results of this analysis were used to estimate the 10-, and 1-percent-annual-chance flows for the landward side of the levee.

A summary of the peak discharges for the streams studied by detailed methods is shown in TABLE 3.

TABLE 3 – Peak Discharge Values

Flooding Source and Location	Drainage Area (sq. miles)	10-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance	0.2-Percent Annual Chance
Licking River					
At confluence with Muskingum River	779.0	*	*	7,200	*
At USGS gage 03147500	742.0	*	*	7,200	*
Main Ditch					
About 300 feet upstream of Dresden Road	1.6	481	779	841	1,167
Moxahala Creek					
About 625 feet upstream of downstream Main Street	80.6	*	*	7,060	*
Muskingum River					
At USGS gage No. 0315000	7,422	*	*	77,700	*
At county boundary	7,386	*	*	77,700	*
Below confluence of Salt Creek	7,341	*	*	77,700	*
Above confluence of Salt Creek	7,196	*	*	74,000	*
Below confluence of Moxahala Creek	7,156	*	*	74,000	*
Above confluence of Moxahala Creek	6,853	*	*	68,000	*
At City of Zanesville Corporate Limits	6,850	*	*	68,000	*
Below confluence of Licking River	6,850	*	*	68,000	*
Above confluence of Licking River	6,071	*	*	64,500	*
At USGS gage No. 03145500	5,993	*	*	64,500	*
Below confluence of Wakatomika Creek	5,993	*	*	64,500	*
Above confluence of Wakatomika Creek	5,759	*	*	63,500	*
Below confluence of Wills Creek	5,740	*	*	63,500	*
At county Boundary	5,740	*	*	63,500	*
Above confluence of Wills Creek	4,886	*	*	60,600	*
At USGS gage No. 03140500	4,859	*	*	60,600	*

TABLE 3 – Peak Discharge Values (continued)

Flooding Source and Location	Drainage Area (sq. miles)	10-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance	0.2-Percent Annual Chance
Wakatomika Creek					
At the mouth	234.0	10,800	15,800	18,000	23,400
At the County Road 48 Bridge at Frazesburg	155.0	9,277	14,635	17,311	22,700
Roseville LPP Interior Ponding Areas					
Ponding Area 1	0.031	10	*	11	*
Ponding Area 2	0.035	15	*	18	*
Ponding Area 3	0.056	28	*	32	*
Pump Station Outlet	0.027	9	*	10	*

* Data not available

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

Cross section data used in the riverine hydraulic models are described in TABLE 4. The methods used to obtain cross section data for each hydraulic study are listed (References 1, 4-6, and 17-18).

TABLE 4 – Cross Section Data

Flooding Source	Location	Year	Description
Licking River	Muskingum County (Unincorporated Areas)		Developed by the USACE, Huntington District
	City of Zanesville		Developed by the USACE, Huntington District
Main Ditch	Village of Dresden	1982	Cross sections and structure elevations were determined by field surveys.
Moxahala Creek	Village of Roseville		Cross section data and bridge elevations were determined from field surveys.
Muskingum River	Muskingum County (Unincorporated Areas)		Developed by the USACE, Huntington District
	City of Zanesville		Developed by the USACE, Huntington District
Flooding Source	**Location**	**Year**	**Description**
Muskingum River	Village of Dresden	1980	Cross sections in the vicinity of the State Route 208 bridge and downstream to the corporate limits were supplied by the USGS. Cross sections north of the bridge were taken from topographic maps at a scale of 1:2400 and USGS 7.5 minute quadrangle maps.
Wakatomika Creek	Village of Dresden	2005	Cross sections and bridge geometry were field surveyed in 2005. A triangular irregular network (TIN) was constructed from the field survey points. This TIN was then used to "cut" the cross sections.
	Village of Frazeysburg	2004	Cross sections upstream and including County Road 48 Bridge were obtained from field surveys. Cross sections downstream of the bridge were obtained from two-foot contours.

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

Roughness coefficients (Manning's "n") were used to compute the hydraulic conveyance of each cross section and to compute friction losses between adjacent sections. The values for Main Ditch and the section of the Muskingum River that flows near Dresden were

based on field observations of the streams and flood plain areas (Reference 19). Values for Wakatomika Creek near Dresden and Frazeysburg were based on field investigations and aerial photographs (References 17 and 18). TABLE 5 shows the channel and overbank "n" values typical for the flooding sources studied by detailed methods (References 1, 4-6, and 17-18).

TABLE 5 – Manning's "n" Values

Flooding Source	Channel "n" Values	Overbank "n" Values
Licking River	0.020 - 0.050	0.020 - 0.060
Main Ditch	0.030 - 0.064	0.035 - 0.120
Moxahala Creek	0.028 - 0.055	0.028 - 0.100
Muskingum River	0.025 - 0.064	0.035 - 0.120
Wakatomika Creek	0.040 - 0.050	0.040 - 0.150

The methods for determining starting water surface elevations used in each hydraulic model are described in TABLE 6 (References 1, 4-6, and 17-18).

TABLE 6 – Starting Water Surface Elevations

Flooding Source	Location	Method for Determining Starting WSE
Licking River		N/A
Main Ditch		N/A
Moxahala Creek		Determined by slope-conveyance
Muskingum River		N/A
Wakatomika Creek	Village of Dresden	Determined by using normal depth calculations.
Wakatomika Creek	Village of Frazeysburg	Determined by using normal depth calculations at a cross section located about one mile downstream of the study area.

For the unincorporated areas of Muskingum County and the City of Zanesville, the historical floods method was used to establish 1-percent-annual-chance flood elevations on both the Muskingum and Licking Rivers. For the Muskingum River, data provided by the USACE included a high-water profile exhibit for the March 1913, August 1935, and January 1937 flood plus 1-percent-annual-chance flood elevations at gaging stations within and beyond the study reach (References 11 and 20). Supplementary data were provided by the ODNR on upper and lower pool high-water gage board readings at their lock and dam installations within the study reach (Reference 21). The USGS data included current gaging station rating tables and annual peak discharges.

Historical flood elevations and discharges at gaging stations were checked against the current rating tables and the elevations adjusted as appropriate. The USACE 1-percent-annual-chance flood elevation at gaging stations were plotted on the high-water profiles exhibit and interconnected as a continuous profile in relationship to the historic profiles. Rating curves were developed at the ODNR lock and dam installations from their gage board readings and corresponding USGS annual peak discharges. These ratings curves corroborated the 1-percent-annual-chance flood profile.

For the Licking River, the USACE Dillon Dam Failure Study provided an elevation for a discharge of 6,500 cfs, very close to the 1-percent-annual-chance flood discharge of 7,200 cfs (Reference 22). This base profile reflected Muskingum River backwater conditions at the confluence. It was therefore used for the 1-percent-annual-chance flood profile only form Dillon Dam downstream to the limit of Muskingum River 1-percent-annual-chance flood elevation backwater. The USGS Hydrologic Investigations of floods at Zanesville contains a profile of the January 1959 flood that did not have backwater effects (Reference 23). The profile was used as the basis to develop the 1-percent-annual-chance flood elevations without backwater for computing floodway limits in the confluence area.

Within the Village of Dresden, the SCS water-surface profile program WSP-2 (Reference 24) was used to compute the water-surface elevations of floods of the selected recurrence intervals on Main Ditch. Two separate computer runs were made for the reservoir area upstream of the Norfolk Southern Railway. For the first run, it was assumed that the culvert under State Route 60 was unobstructed. The flow was confined to Main Ditch until it reached the railroad culvert. The underdesigned culvert caused ponding. For the second run, it was assumed that the State Route 60 culvert was obstructed with sediment, causing the flow to overtop the road fill and flow south through the village. The second run resulted in higher water-surface elevations. The first run was used to compute the 10- and 2-percent-annual-chance-flood elevations. The second run was used to compute the water-surface elevations for the 1- and 0.2-percent-annual-chance floods, simulating overtopping of State Route 60 for larger storms.

Within the Village of Roseville, water-surface elevations for Moxahala Creek for the 1-percent-annual-chance flood were computed using WSPRO, a step-backwater computer program (Reference 25).

The studies of Wakatomika Creek near the Villages of Dresden and Frazeysburg were conducted using the Hydrologic Engineering Center, River Analysis System (HEC-RAS) Version 3.1.2 computer program (References 17 and 18).

Detail-studied streams that were not restudied as part of initial Countywide FIS or subsequent revisions may include a "profile base line" on the maps. This "profile base line" provides a link to the flood profiles included in this FIS. The detail-studied stream centerline may have been digitized or redelineated as part of this revision. The "profile base lines" for these streams were based on the best available data at the time of their study and are depicted as they were on the previous FIRMs. In some cases where improved topographic data was used to redelineate floodplain boundaries, the "profile base line" may deviate significantly from the channel centerline or may be outside the SFHA.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles (Exhibit 1) are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study. Flood profiles were drawn showing the computed water surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. In cases where two or more profiles are close together, due to limitations of the profile scale, only the higher profile has been shown.

Water-surface elevations for the 1-percent-annual-chance flood for the streams studied by approximate analyses were computed using the USACE HEC-RAS computer program. Roughness factors for these streams were determined based on visual observation of aerial photography and standard, accepted values published in Open-Channel Hydraulics by V.T. Chow (Reference 26). Separate overbank and channel roughness values were selected for each stream reach. Starting water-surface elevations were determined using the normal depth routine in the HEC-RAS program, with the downstream gradient for each stream estimated though the use of USGS topographic maps.

Revised Countywide FIS - TBD – Interior Drainage Study

Detailed hydraulic analyses were performed using the EPA SWMM Version 5. This model contains manholes, pipelines, pumps, and storage areas. The downstream boundary condition was set assuming that Moxahala Creek would drop to approximately the 10-percent annual chance elevation at the time of the peak elevation the 1-percent annual chance storm for the interior drainage area.

The 1-percent annual chance elevations computed for the four ponding areas are summarized in Table 7.

TABLE 7 – Summary of Stillwater Elevations

Flooding Source and Location	Drainage Area (sq. miles)	10-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance	0.2-Percent Annual Chance
Roseville LPP Interior Ponding Areas					
Ponding Area 1	0.031	732.3	*	732.5	*
Ponding Area 2	0.035	730.3	*	730.5	*
Ponding Area 3	0.056	728.2	*	728.5	*
Pump Station Outlet	0.027	727.3	*	727.6	*

* Data not available

All elevations are referenced from NAVD88; elevation reference marks used in the study are shown on the maps.

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of

1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988, many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

Effective information for the initial countywide FIS report and subsequent revisions was converted from NGVD29 to NAVD88 based on data presented in TABLE 8. The average conversion of -0.701 foot was applied to convert all effective Base Flood Elevations (BFEs). Structure and ground elevations in the community must, therefore, be referenced to NAVD88. It is important to note that adjacent communities in other counties not presented in this countywide FIS may be referenced to NGVD29. This may result in differences in BFEs across the corporate limits between communities.

TABLE 8 – Datum Conversion Calculations

Point ID	Quadrangle Name	Quadrangle Corner	Latitude	Longitude	Difference
1	Norwich	SE	39.875	-81.750	-0.653 ft
2	Zanesville East	SE	39.875	-81.875	-0.715 ft
3	Zanesville West	SE	39.875	-82.000	-0.722 ft
4	Gratiot	SE	39.875	-82.125	-0.709 ft
5	Otsego	SE	40.000	-81.750	-0.728 ft
6	Adamsville	SE	40.000	-81.875	-0.738 ft
7	Dresden	SE	40.000	-82.000	-0.715 ft
8	Toboso	SE	40.000	-82.125	-0.699 ft
9	Wills Creek	SE	40.125	-81.750	-0.715 ft
10	Conesville	SE	40.125	-81.875	-0.705 ft
11	Trinway	SE	40.125	-82.000	-0.732 ft
12	Perryton	SE	40.125	-82.125	-0.709 ft
13	Ruraldale	SE	39.750	-81.750	-0.630 ft
14	Philo	SE	39.750	-81.875	-0.666 ft
15	Crooksville	SE	39.750	-82.000	-0.686 ft

	Average Conversion	-0.701
NAVD = NGVD - 0.701	Range	-0.738 to -0.630
	Max Offset	0.071

For more information on NAVD88, see the FEMA publication entitled *Converting the National Flood Insurance Program to the North American Vertical Datum of 1988* or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Silver Spring, Maryland 20910 (http://www.ngs.noaa.gov).

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

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides l-percent-annual-chance (100-year) flood elevations and delineations of the 1- and 0.2-percent-annual-chance (500-year) floodplain boundaries and l-

percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of this countywide FIS report, including Flood Profiles, Floodway Data Table and Summary of Stillwater Elevations Table. Users should reference the data presented in this countywide FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance (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 each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps with a contour interval of two feet.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM. On this map, the l-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 l-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 l-percent-annual-chance floodplain boundary is shown on the FIRM. For lakes designated as Zone A, the floodplains were delineated using the 1-percent-annual-chance pool elevation, which was obtained from the USACE, Huntington District, if available. Otherwise, they were digitized to the nearest contour and checks were made to see that the elevations fall between the normal pool and the top of dam elevations.

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 l-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 l-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

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

The area between the floodway and l-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 l-percent-annual-chance flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in FIGURE 1.

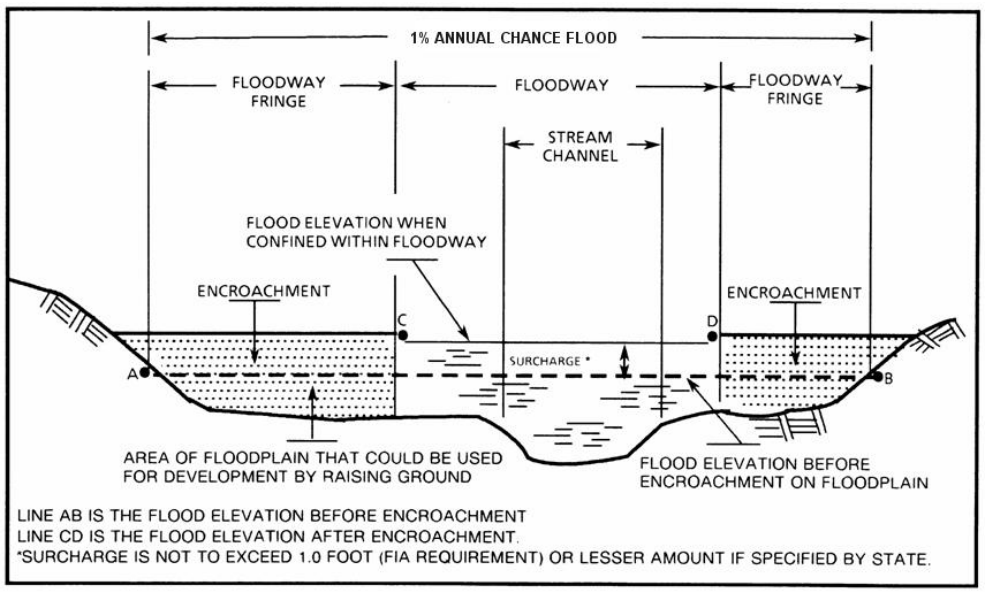

FIGURE 1 – Floodway Schematic

The floodways presented in this study were initially computed on the basis of equal conveyance reduction from each side of the flood plain. In those areas where problems arose with the equal conveyance reduction encroachment option of the HEC-2 or HEC-RAS backwater programs, modifications were applied based on experience.

In the redelineation efforts, the floodways were not recalculated. As a result, there were areas where the previous floodway did not fit within the boundaries of the redelineated 1-percent-annual-chance floodplain. In these areas, the floodway was reduced. Water surface elevations, both with and without a floodway, the mean velocity in the floodway and the location and area at each surveyed cross section as determined by hydraulic methods can be seen in TABLE 9, Floodway Data Table. The width of the floodway depicted by the FIRM panels and the amount of reduction to fit the floodway inside the 1-percent-annual-chance floodplain, if necessary, is also listed.

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
LICKING RIVER									
A	6547	160	1608	4.5		692.8[2]	684.6	685.6	1.0
B	10560	120	846	8.5		692.8[2]	687.3	688.3	1.0
C	16262	130	1510	4.8		694.3	694.3	695.3	1.0
D	20962	170	1165	6.2		700.3	700.3	701.3	1.0
E	26189	90	684	10.5		705.6	705.6	706.6	1.0
F	30730	49	788	9.1		710.7	710.7	711.7	1.0

[1]Feet above confluence with Muskingum River
[2]Elevation controlled by backwater from Muskingum River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH
AND INCORPORATED AREAS

FLOODWAY DATA

LICKING RIVER

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MOXAHALA CREEK									
A	605	163[2]	1373	5.1		733.6	733.6	734.1	0.5
B	1130	210[2]	2084	3.4		734.1	734.1	734.6	0.5
C	2770	383[2]	3463	2.0		734.7	734.7	735.3	0.6
D	3750	375	2827	2.5		734.8	734.8	735.5	0.7
E	4300	257	1811	3.9		734.9	734.9	735.7	0.8
F	4725	156	1438	4.9		734.9	734.9	735.8	0.9
G	5135	146	1327	5.3		735.3	735.3	736.2	0.9
H	5675	140	1372	5.1		735.8	735.8	736.5	0.7
I	5975	175	1332	5.3		735.9	735.9	736.7	0.8
J	6670	172	1549	4.6		736.9	736.9	737.4	0.5
K	10895	414[2]	2855	2.5		738.4	738.4	739.4	1.0
L	11375	128[2]	1247	5.7		739.9	739.9	740.7	0.8

[1]Feet above limit of detailed study (4,650 feet downstream of First Street)
[2]This width extends beyond corporate limits

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH
AND INCORPORATED AREAS

FLOODWAY DATA

MOXAHALA CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MUSKINGUM RIVER									
A	60.6	354	12276	6.3	61	676.3	676.3	677.3	1.0
B	62.2	1065	21121	3.7		678.1	678.1	679.1	1.0
C	64.7	420	13152	5.9		680.7	680.7	681.7	1.0
D	66.7	500	15919	4.9	70	682.5	682.5	683.5	1.0
E	68.6	810	22901	3.2		684.5	684.5	685.5	1.0
F	70.7	540	14760	5.0		686.3	686.3	687.3	1.0
G	72.7	487	14369	5.1	73	688.3	688.3	689.3	1.0
H	74.6	485	13862	5.3		690.3	690.3	691.3	1.0
I	75.1	481	13377	5.1		690.3	690.3	691.3	1.0
J	80.1	561	14595	4.4		699.3	699.3	700.3	1.0
K	82.9	445	10786	6.0		703.3	703.3	704.3	1.0
L	86.0	370	9130	7.1		708.3	708.3	709.3	1.0
M	89.1	1155	16338	3.9		713.8	713.8	714.8	1.0
N	91.8	450	10618	6.1		717.4	717.4	718.4	1.0
O	93.1	653	14071	4.6		718.5	718.5	719.5	1.0
P	94.5	3778	32601	1.9		720.9	720.9	721.9	1.0
Q	97.9	2883	22032	2.9		725.8	725.8	726.8	1.0
R	100.5	1800	25895	2.5		729.4	729.4	730.4	1.0

[1]Miles above confluence with Ohio River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH
AND INCORPORATED AREAS

FLOODWAY DATA

MUSKINGUM RIVER

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
WAKATOMIKA CREEK									
A	4510	132	2522	7.1		719.8[2]	719.4	719.8	0.4
B	4797	384	5195	3.5		720.4	720.4	720.8	0.4
C	5553	836	8841	2.0		720.7	720.7	721.1	0.4
D	6093	966	10163	1.8		720.9	720.9	721.3	0.4
E	6796	582	5886	3.1		721.0	721.0	721.4	0.4
F	7016	370	3532	5.1		721.0	721.0	721.4	0.4
G	7326	154	2684	6.7		721.1	721.1	721.5	0.4
H	7393	154	2675	6.7		722.4	722.4	722.8	0.4
I	7572	300	3614	5.0		722.9	722.9	723.3	0.4
J	7680	321	3177	5.7		722.9	722.9	723.2	0.3
K	7895	222	3400	5.3		723.2	723.2	723.6	0.4
L	8096	159	2508	7.2		723.2	723.2	723.6	0.4
M	8172	159	2550	7.1		723.5	723.5	723.9	0.4
N	8308	180	2713	6.6		724.0	724.0	724.0	0.0
O	8870	492	6693	2.7		724.7	724.7	725.2	0.5
P	9731	453	5795	3.1		724.9	724.9	725.5	0.6
Q	56690	1865	13378	1.3		744.9	744.9	745.8	0.9
R	57518	1123	8720	2.0		745.2	745.2	746.1	0.9
S	58273	612	4529	3.8		745.6	745.6	746.5	0.9
T	58710	891	6743	2.6		746.3	746.3	747.1	0.8
U	59092	1152	8468	2.0		746.6	746.6	747.4	0.8
V	59732	262	3572	5.0		747.0	747.0	747.8	0.8
W	59805	284	3648	4.8		747.8	747.8	748.8	1.0
X	60021	309	3854	4.5		748.1	748.1	749.0	0.9
Y	60693	568	6322	2.7		748.7	748.7	749.6	0.9

[1]Feet above confluence with Muskingum River
[2]Elevation controlled by backwater from Muskingum River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH
AND INCORPORATED AREAS

FLOODWAY DATA

WAKATOMIKA CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
WAKATOMIKA CREEK									
Z	60996	751	7471	2.3		748.9	748.9	749.7	0.8
AA	61548	855	8633	2.0		749.0	749.0	749.9	0.9
AB	62583	984	9440	1.8		749.2	749.2	750.1	0.9
AC	63082	757	7575	2.3		749.3	749.3	750.2	0.9
AD	63701	934	7643	2.3		749.5	749.5	750.4	0.9
AE	64242	946	7877	2.2		749.6	749.6	750.6	1.0
AF	64961	752	7428	2.3		749.9	749.9	750.8	0.9
AG	65480	413	4768	3.6		750.0	750.0	750.9	0.9
AH	65969	735	7958	2.2		750.5	750.5	751.4	0.9

[1]Feet above confluence with Muskingum River
[2]Elevation controlled by backwater from Muskingum River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH
AND INCORPORATED AREAS

FLOODWAY DATA

WAKATOMIKA CREEK

5.0 INSURANCE APPLICATIONS

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

Zone A

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

Zone AE

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

Zone X

Zone X is the flood insurance risk 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 that 1 square mile, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or base flood 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 risk zones described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

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

The current FIRM presents flooding information for the entire geographic area of Muskingum County. Previously, separate FIRMs were prepared for each identified floodprone incorporated community and the unincorporated areas of the county. Historical data relating to the maps prepared for each community are presented in TABLE 10.

7.0 OTHER STUDIES

This countywide FIS incorporates all previously published FISs and FIRMs for the incorporated and unincorporated areas within Muskingum County.

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

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Flood Insurance and Mitigation Division, Federal Emergency Management Agency, 536 South Clark Street, Sixth Floor, Chicago, Illinois 60605.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
* Adamsville, Village of	n/a	none	July 6, 2010	none
Dresden, Village of	February 14, 1975	none	May 15, 1986	none
Frazeysburg, Village of	July 6, 2010	none	July 6, 2010	none
* Fultonham, Village of	n/a	none	July 6, 2010	none
Muskingum County (Unincorporated Areas)	March 28, 1975	December 23, 1977 June 1, 1979	June 3, 1988	TBD**
New Concord, Village of	September 8, 1978	none	July 6, 2010	none
* Norwich, Village of	n/a	none	July 6, 2010	none
Philo, Village of	March 30, 1979	none	July 6, 2010	none
Roseville, Village of	February 15, 1974	June 18, 1976	January 17, 1991	TBD**
South Zanesville, Village of	October 20, 1978	none	July 6, 2010	none
Zanesville, City of	May 3, 1974	September 12, 1975 August 3, 1979 June 27, 1980 August 21, 1981	September 16, 1988	September 5, 1990

* NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED

** TO BE DETERMINED

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

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FIGURE 2 – Notes to FIRM Users

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Flood Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to Table 10 in this FIS Report.

To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

PRELIMINARY FIS REPORT: FEMA maintains information about map features, such as street locations and names, in or near designated flood hazard areas. Requests to revise information in or near designated flood hazard areas may be provided to FEMA during the community review period, at the final Consultation Coordination Officer's meeting or during the statutory 90-day appeal period. Approved requests for changes will be shown on the final printed FIRM.

The map is for use in administering the NFIP. It may not identify all areas subject to flooding, particularly from local drainage sources of small size. Consult the community map repository to find updated or additional flood hazard information.

BASE FLOOD ELEVATIONS: For more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables within this FIS Report. Use the flood elevation data within the FIS Report in conjunction with the FIRM for construction and/or floodplain management.

FLOODWAY INFORMATION: Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the FIS Report for this jurisdiction.

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

PROJECTION INFORMATION: The projection used in the preparation of the map was State Plane Ohio South FIPS 6402. The horizontal datum was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://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 20910-3282
(301) 713-3242

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community.

BASE MAP INFORMATION: Base map information shown on the FIRM was provided by Muskingum County GIS Department.

The map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map.

Corporate limits shown on the map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after the map was published, map users should contact appropriate community officials to verify current corporate limit locations.

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Muskingum County, Ohio, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 10 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Muskingum County, Ohio, effective TBD.

ACCREDITED LEVEE: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/national-flood-insurance-program.

FLOOD RISK REPORT: A Flood Risk Report (FRR) may be available for many of the flooding sources and communities referenced in this FIS Report. The FRR is provided to increase public awareness of flood risk by helping communities identify the areas within their jurisdictions that have the greatest risks. Although non-regulatory, the information provided within the FRR can assist communities in assessing and evaluating mitigation opportunities to reduce these risks. It can also be used by communities developing or updating flood risk mitigation plans. These plans allow communities to identify and evaluate opportunities to reduce potential loss of life and property. However, the FRR is not intended to be the final authoritative source of all flood risk data for a project area; rather, it should be used with other data sources to paint a comprehensive picture of flood risk.

FIGURE 3 – Map Legend for FIRM

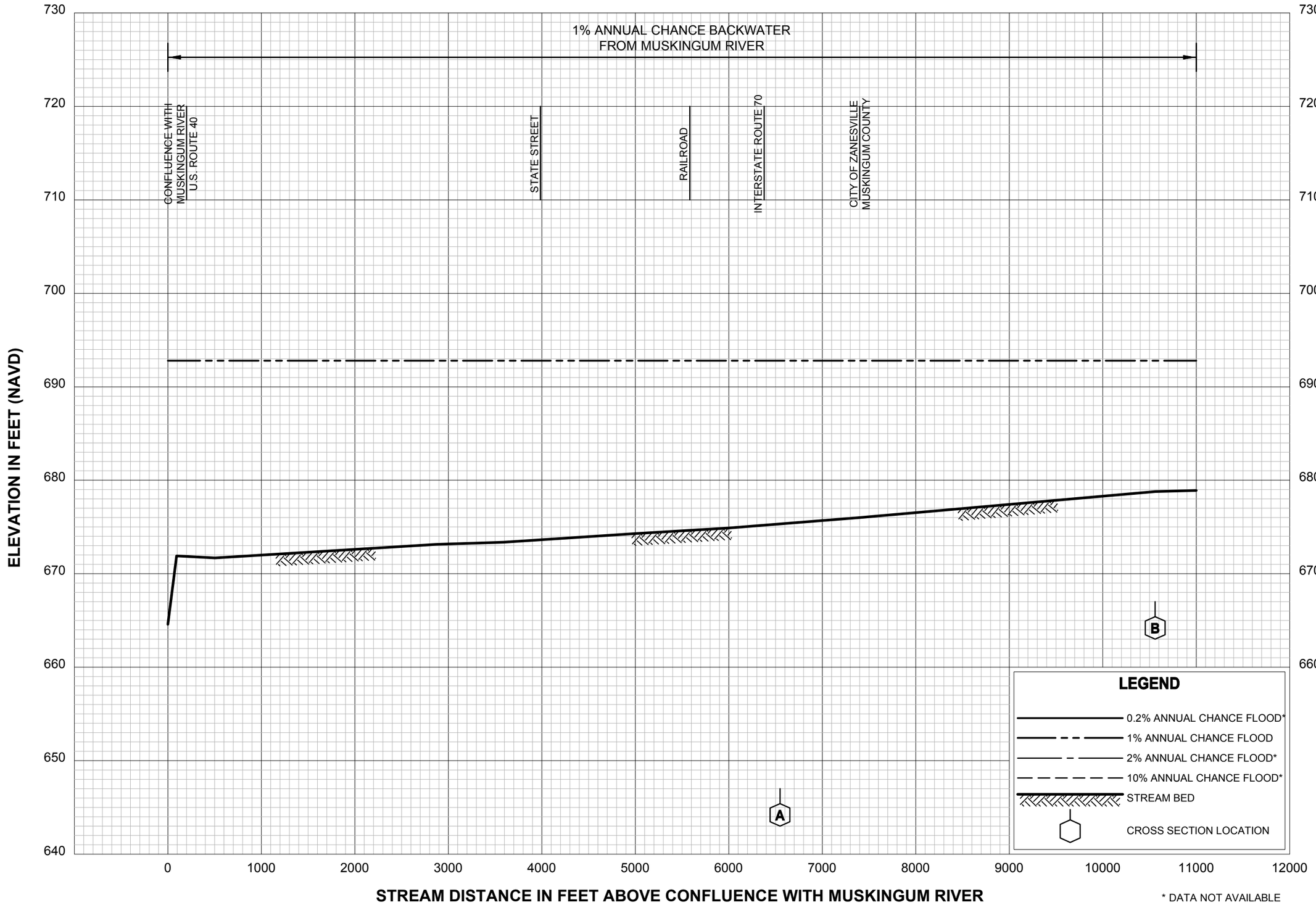
SPECIAL FLOOD HAZARD AREAS: *The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. See note for specific types. If the floodway is too narrow to be shown, a note is shown.*

	Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)
Zone A	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. No base (1% annual chance) flood elevations (BFEs) or depths are shown within this zone.
Zone AE	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone.
Zone AH	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the hydraulic analyses are shown at selected intervals within this zone.
Zone AO	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the hydraulic analyses are shown within this zone.
Zone AR	The flood insurance rate zone that corresponds to areas that were formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
Zone A99	The flood insurance rate zone that corresponds to areas of the 1% annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.
Zone V	The flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.
Zone VE	Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.
	Regulatory Floodway determined in Zone AE.
	Non-encroachment zone (see Section 2.4 of this FIS Report for more information)

FLOOD INSURANCE IS NOT AVAILABLE FOR STRUCTURES NEWLY BUILT OR SUBSTANTIALLY IMPROVED ON OR AFTER APRIL 8, 1987, IN THE DESIGNATED COLORADO RIVER FLOODWAY	The Colorado River Floodway was established by Congress in the Colorado River Floodway Protection Act of 1986, Public Law 99-450 (100 Statute 1129). The Act imposes certain restrictions within the Floodway.
OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced the flood risk from the 1% annual chance flood. See Notes to Users for important information.
	Area with Flood Risk due to Levee: Areas where a non-accredited levee, dike, or other flood control structure is shown as providing protection to less than the 1% annual chance flood.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
NO SCREEN	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
(ortho) (vector)	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
Aqueduct *Channel* *Culvert* *Storm Sewer*	Channel, Culvert, Aqueduct or Storm Sewer

Dam *Jetty* *Weir*	Dam, Jetty, Weir
	Levee, Dike or Floodwall
Bridge	Bridge
COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas. See Notes to Users for important information.*	
CBRS AREA **09/30/2009**	Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.
O **THERWISE PROTECTED AREA** **09/30/2009**	Otherwise Protected Area
REFERENCE MARKERS	
22.0	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
B 20.2	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
5280 21.1	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
17.5	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
8	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
513	Base Flood Elevation Line
ZONE AE **(EL 16)**	Static Base Flood Elevation value (shown under zone label)

ZONE AO (DEPTH 2)	Zone designation with Depth
ZONE AO (DEPTH 2) (VEL 15 FPS)	Zone designation with Depth and Velocity
BASE MAP FEATURES	
Missouri Creek	River, Stream or Other Hydrographic Feature
234	Interstate Highway
234	U.S. Highway
234	State Highway
234	County Highway
MAPLE LANE	Street, Road, Avenue Name or Private Drive if shown on Flood Profile
RAILROAD	Railroad
	Horizontal Reference Grid Line
—	Horizontal Reference Grid Ticks
+	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
$^{42}76^{000m}$E	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16’ 52.5”	Corner Coordinates (Latitude, Longitude)



FLOOD PROFILES

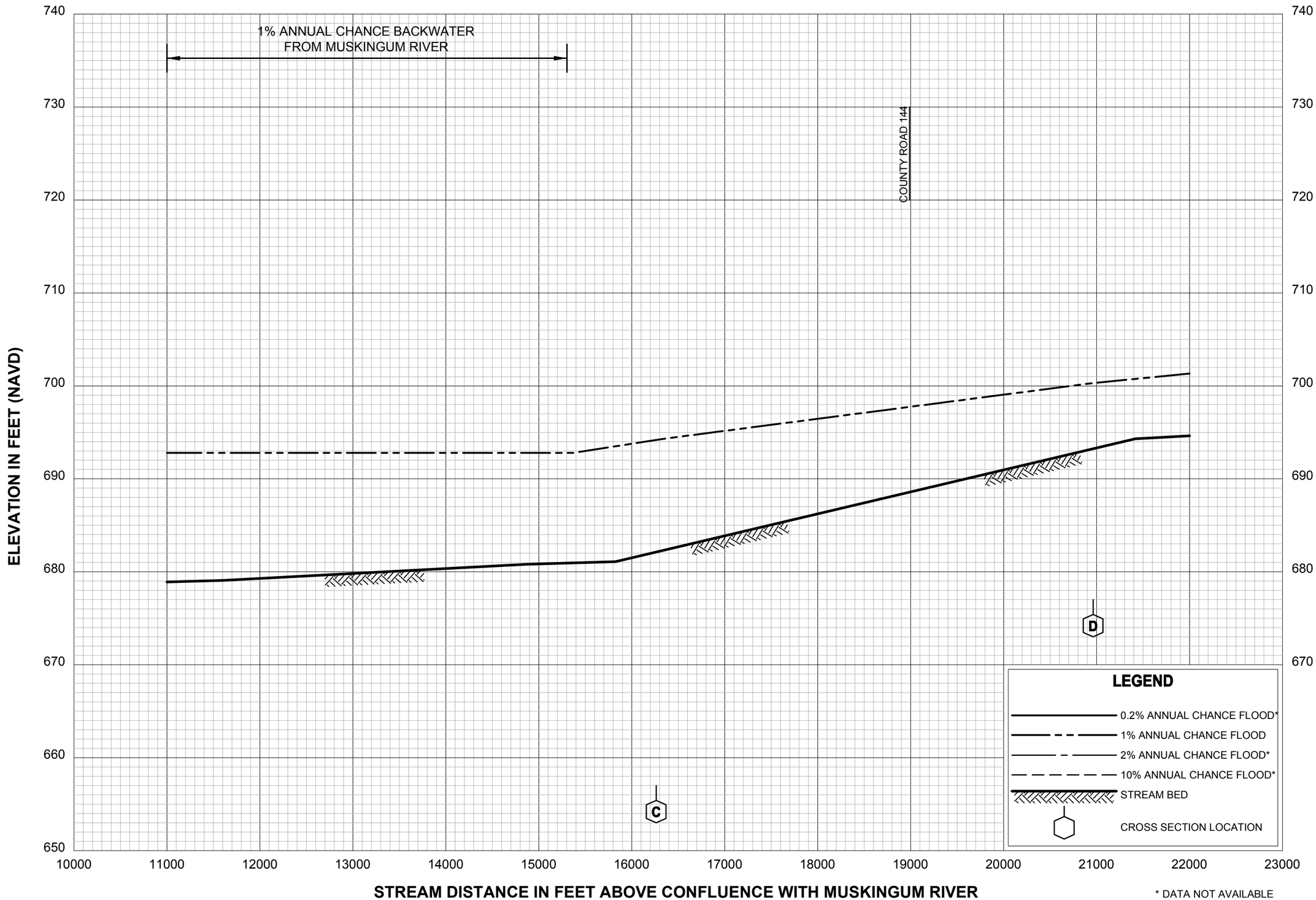
LICKING RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS

01P



FLOOD PROFILES

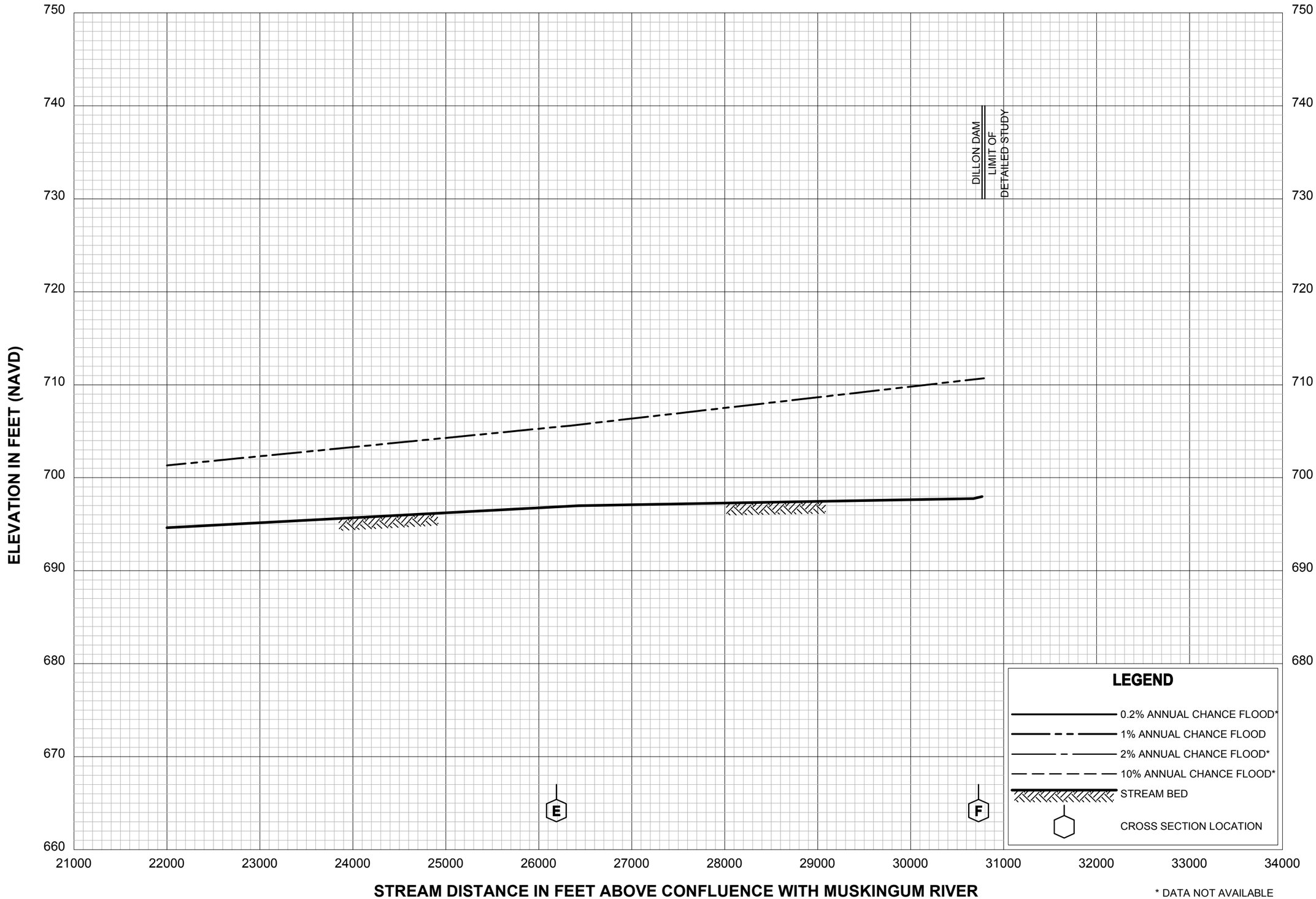
LICKING RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS

02P



* DATA NOT AVAILABLE

FLOOD PROFILES

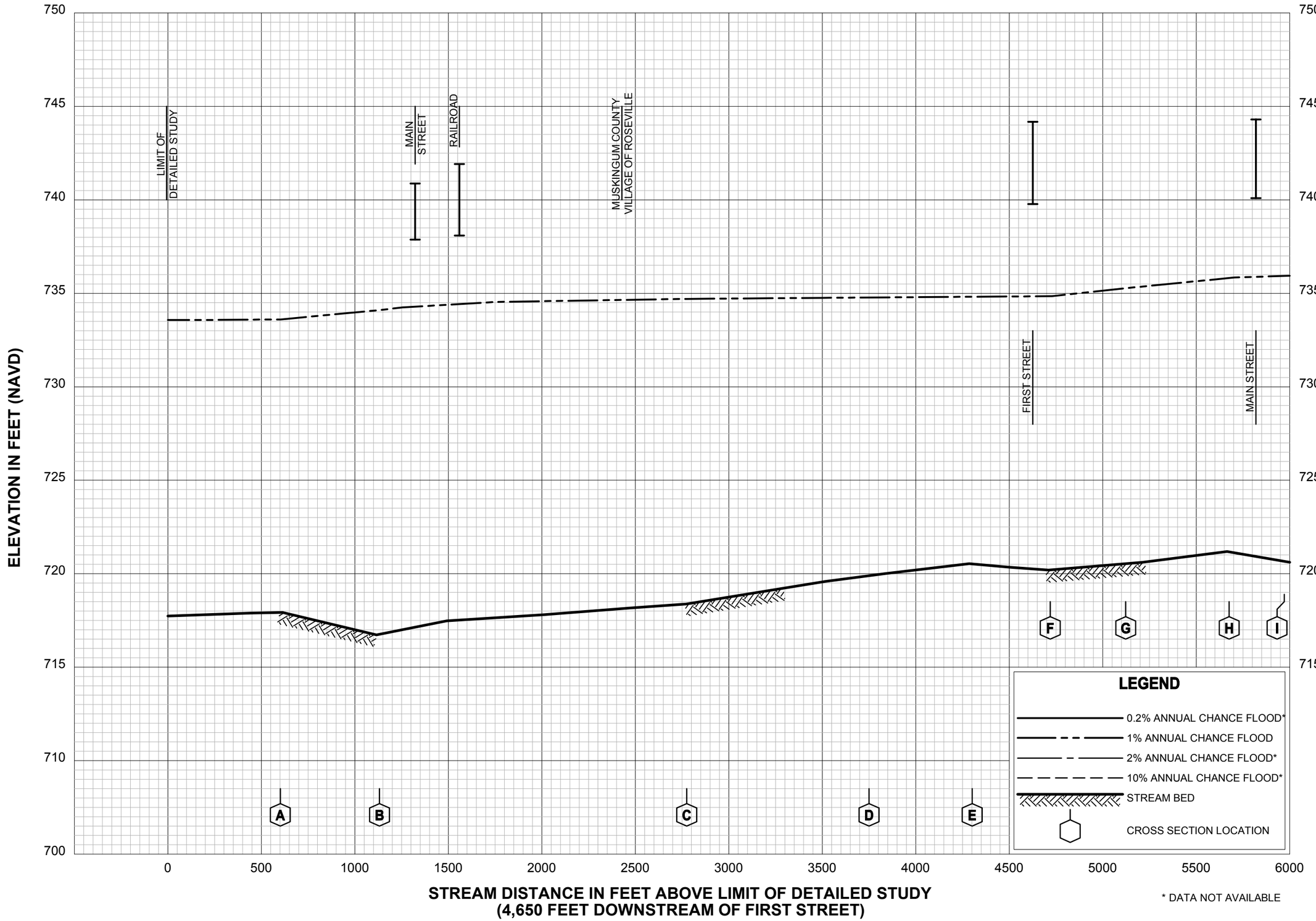
LICKING RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS

03P



FLOOD PROFILES

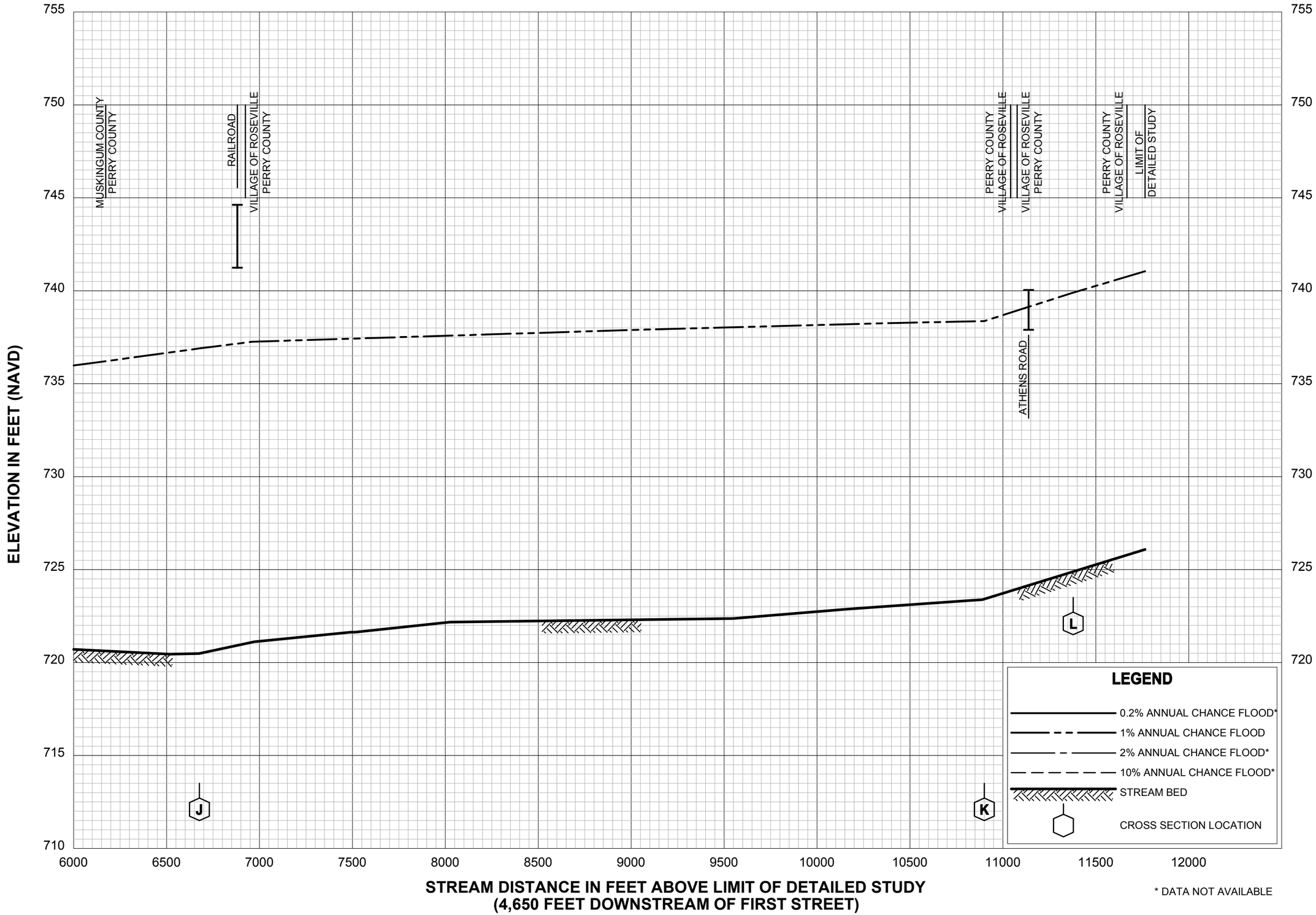
MOXAHALA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS

04P



FLOOD PROFILES

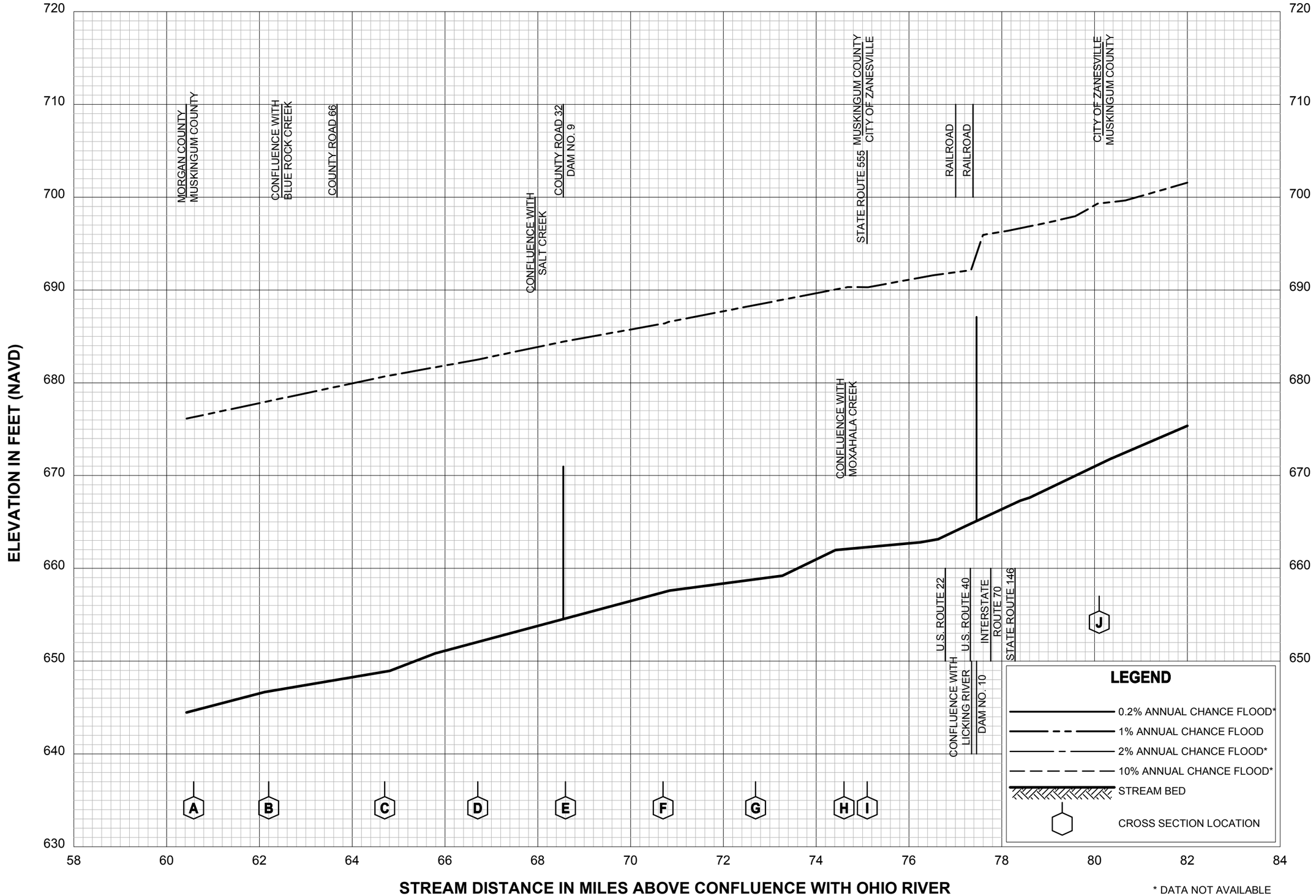
MOXAHALA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS

05P



FLOOD PROFILES

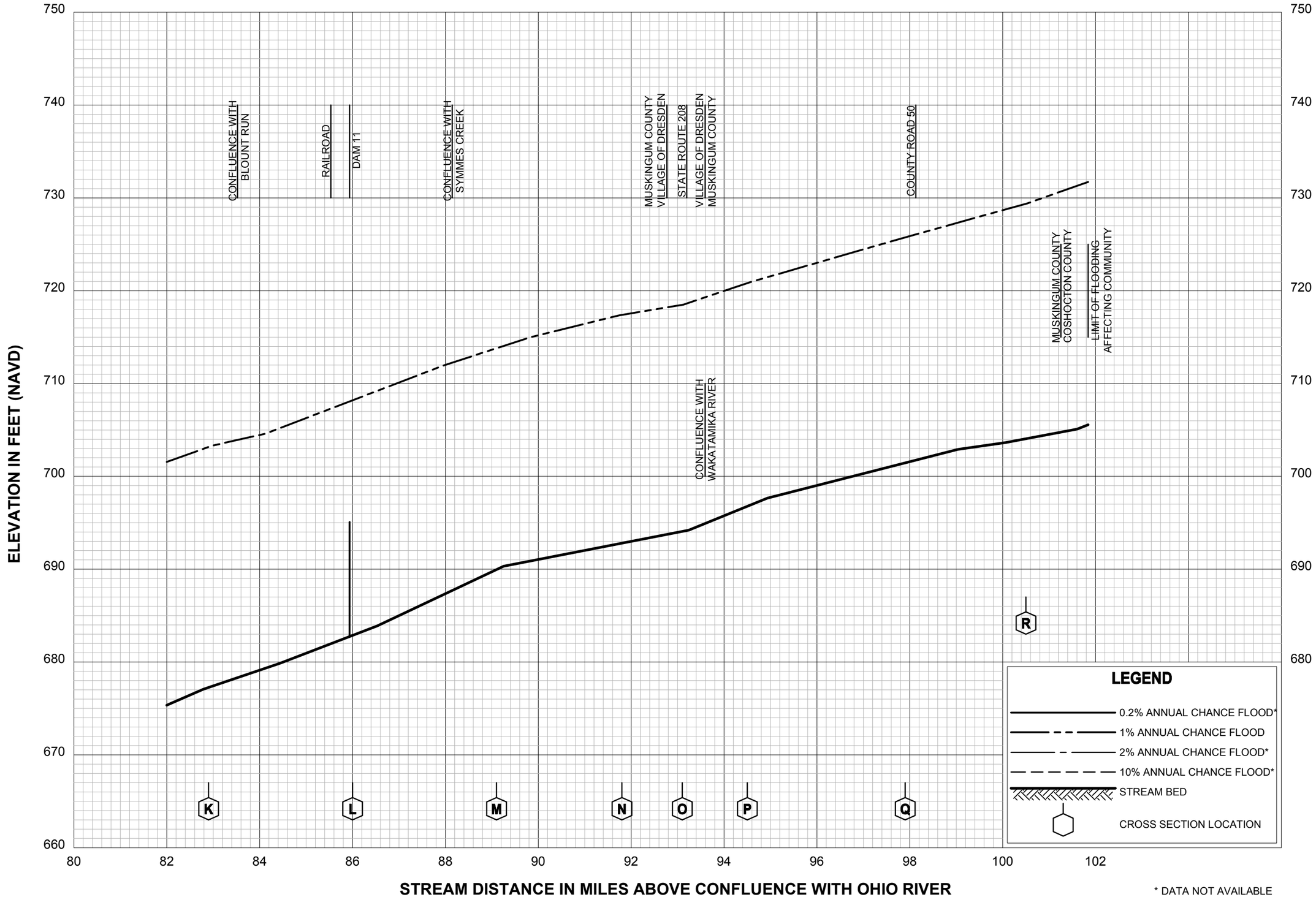
MUSKINGUM RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS

06P



* DATA NOT AVAILABLE

FLOOD PROFILES

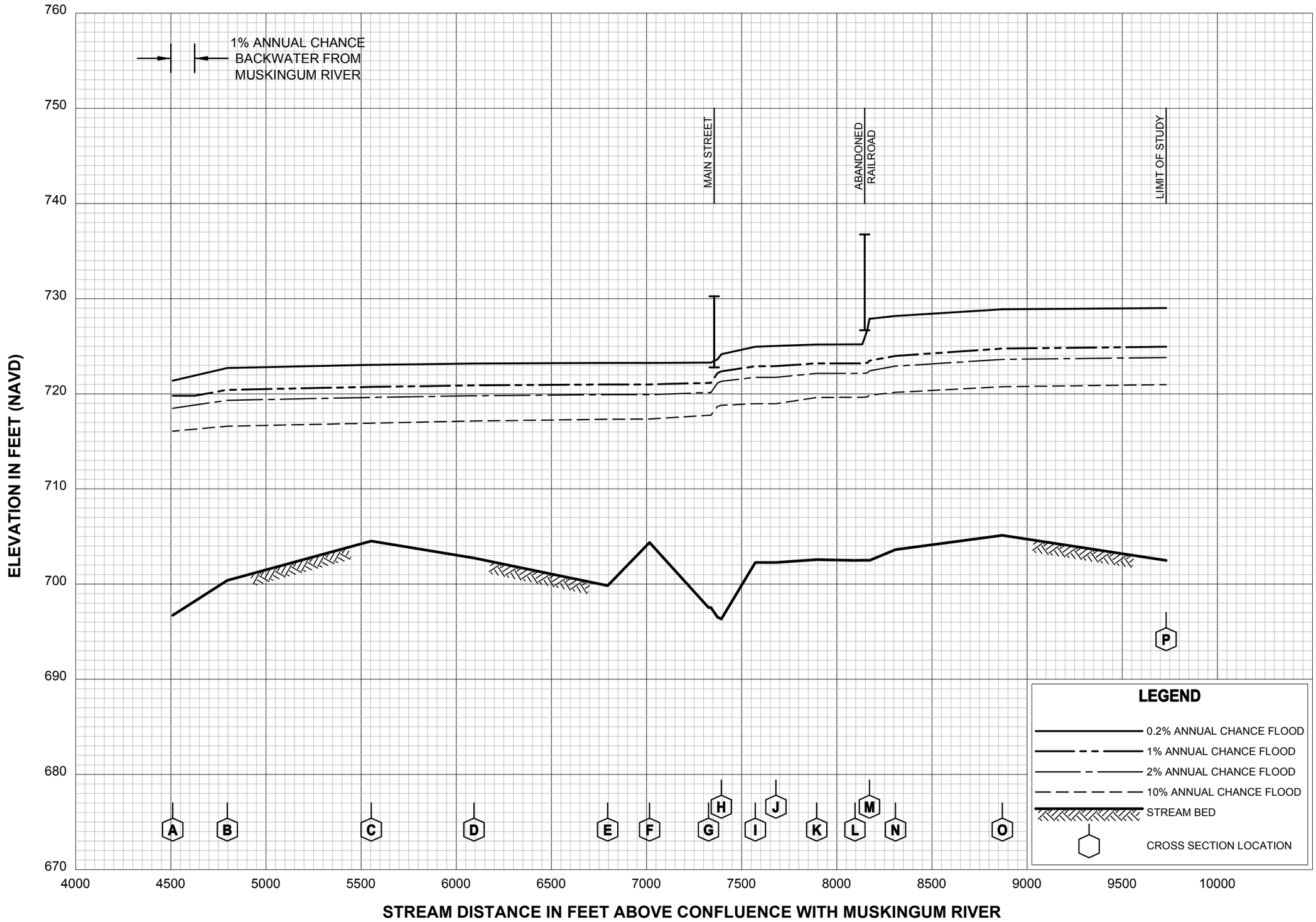
MUSKINGUM RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS

07P



FLOOD PROFILES

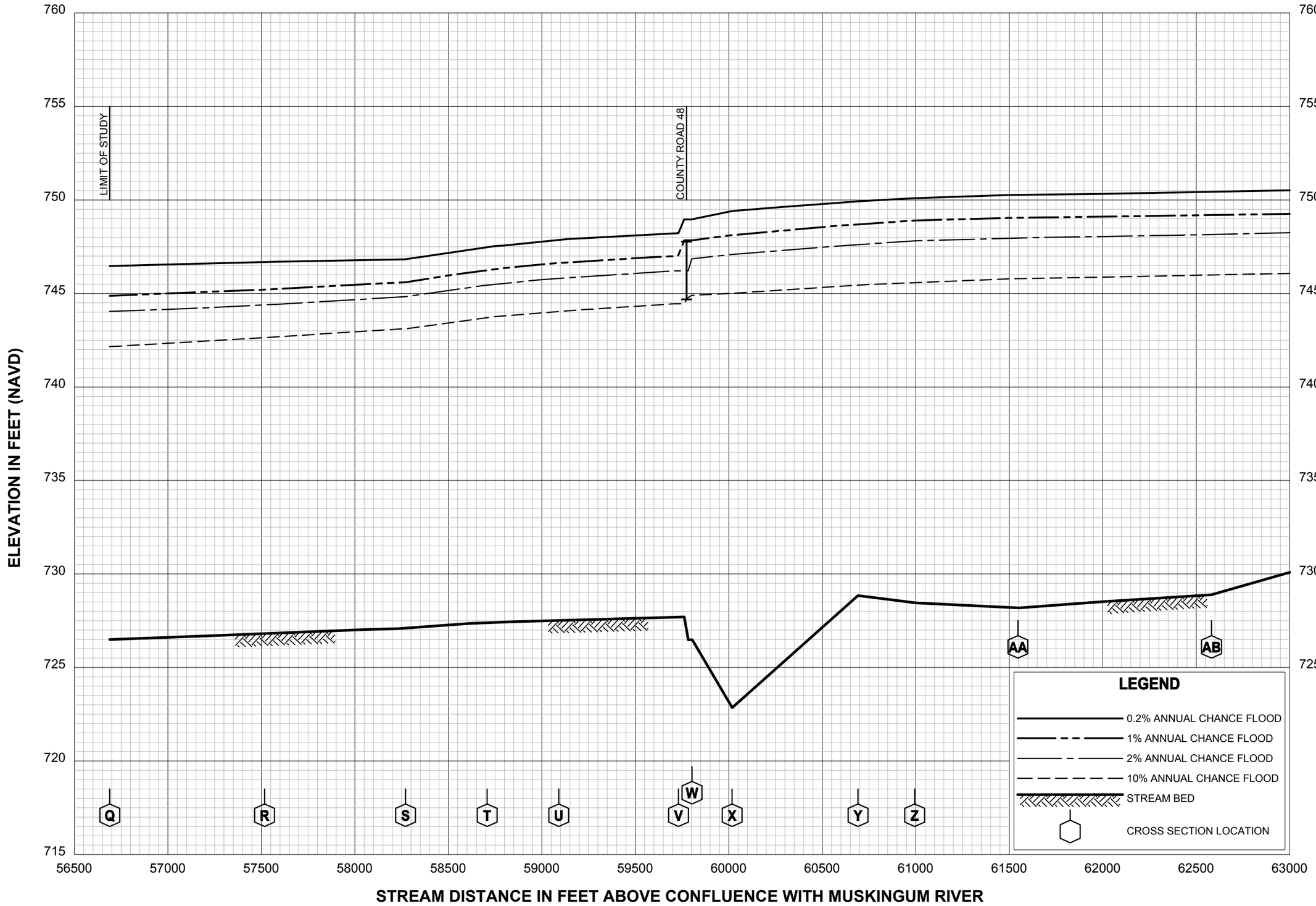
WAKATOMIKA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS

08P



FLOOD PROFILES

WAKATOMIKA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS

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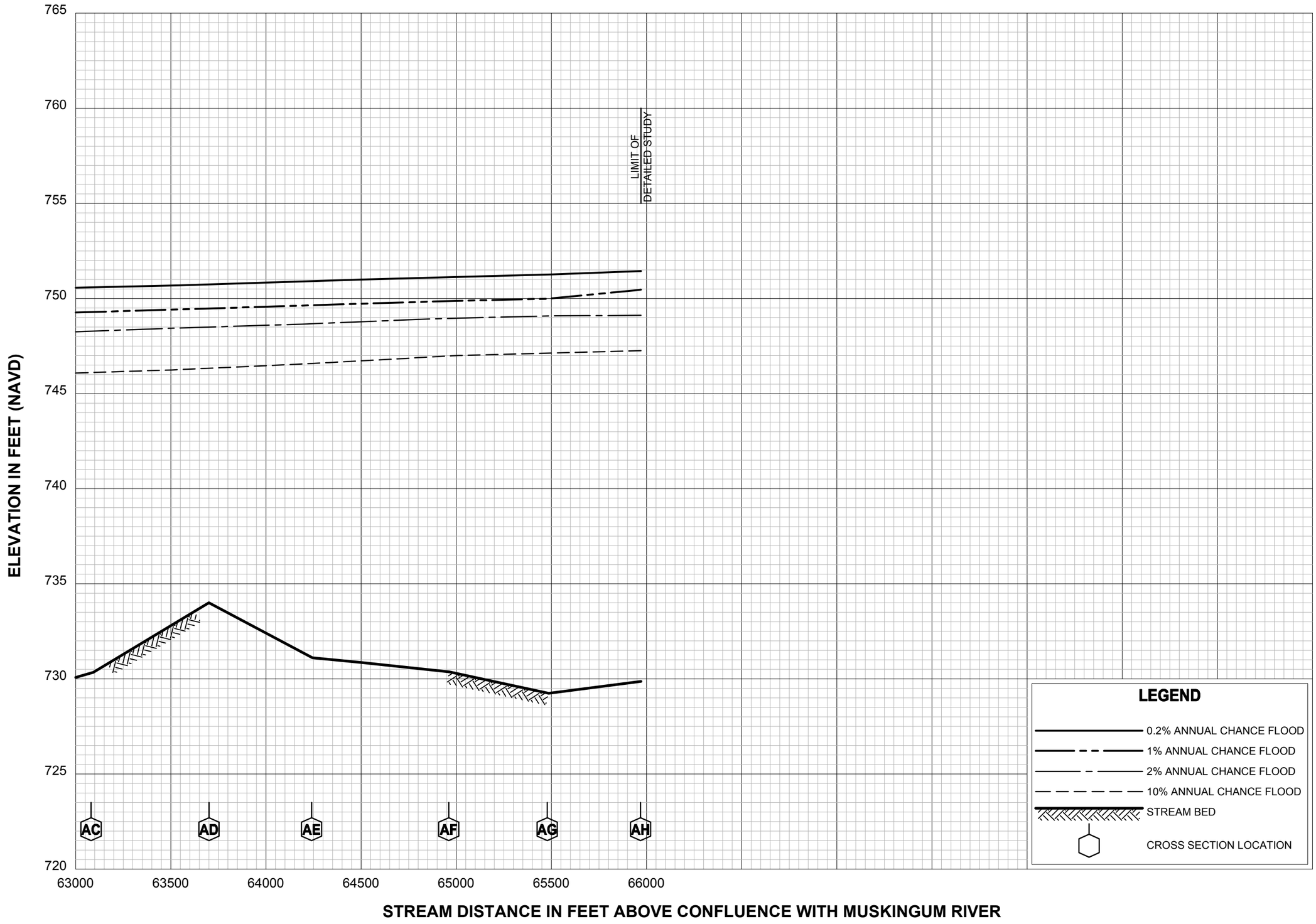

FLOOD PROFILES

WAKATOMIKA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS