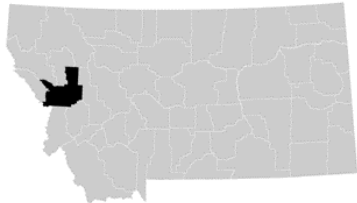


FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 2 OF 4



MISSOULA COUNTY, MONTANA

AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
MISSOULA COUNTY, UNINCORPORATED AREAS	300048
MISSOULA, CITY OF	300049

Preliminary Date:
8/28/2025

EFFECTIVE:

TBD

FLOOD INSURANCE STUDY NUMBER
30063CV002D

Version Number 2.6.4.6



FEMA

TABLE OF CONTENTS

Volume 1

	<u>Page</u>
SECTION 1.0 – INTRODUCTION	1
1.1 The National Flood Insurance Program	1
1.2 Purpose of this Flood Insurance Study Report	2
1.3 Jurisdictions Included in the Flood Insurance Study Project	2
1.4 Considerations for using this Flood Insurance Study Report	6
SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS	19
2.1 Floodplain Boundaries	19
2.2 Floodways	23
2.3 Base Flood Elevations	24
2.4 Non-Encroachment Zones	25
2.5 Coastal Flood Hazard Areas	25
2.5.1 Water Elevations and the Effects of Waves	25
2.5.2 Floodplain Boundaries and BFEs for Coastal Areas	25
2.5.3 Coastal High Hazard Areas	25
2.5.4 Limit of Moderate Wave Action	25
SECTION 3.0 – INSURANCE APPLICATIONS	26
3.1 National Flood Insurance Program Insurance Zones	26
SECTION 4.0 – AREA STUDIED	26
4.1 Basin Description	26
4.2 Principal Flood Problems	27
4.3 Dams and Other Flood Hazard Reduction Measures	28
4.4 Levee Systems	29
SECTION 5.0 – ENGINEERING METHODS	31
5.1 Hydrologic Analyses	31
5.2 Hydraulic Analyses	39
5.3 Coastal Analyses	45
5.3.1 Total Stillwater Elevations	45
5.3.2 Waves	46
5.3.3 Coastal Erosion	46
5.3.4 Wave Hazard Analyses	46
This section is not applicable to this Flood Risk Product.	46
SECTION 6.0 – MAPPING METHODS	47
6.1 Vertical and Horizontal Control	47
6.2 Base Map	48
6.3 Floodplain and Floodway Delineation	49
6.4 Coastal Flood Hazard Mapping	93
6.5 FIRM Revisions	93

6.5.1	Letters of Map Amendment	93
6.5.2	Letters of Map Revision Based on Fill	93
6.5.3	Letters of Map Revision	94

Figures

	<u>Page</u>
Figure 1: FIRM Index	8
Figure 2: FIRM Notes to Users	12
Figure 3: Map Legend for FIRM	15
Figure 4: Floodway Schematic	24
Figure 5: Wave Runup Transect Schematic	25
Figure 6: Coastal Transect Schematic	25
Figure 7: Frequency Discharge-Drainage Area Curves	37
Figure 8: 1% Annual Chance Total Stillwater Elevations for Coastal Areas	45
Figure 9: Transect Location Map	46

Tables

	<u>Page</u>
Table 1: Listing of NFIP Jurisdictions	2
Table 2: Flooding Sources Included in this FIS Report	20
Table 3: Flood Zone Designations by Community	26
Table 4: Basin Characteristics	26
Table 5: Principal Flood Problems	27
Table 6: Historic Flooding Elevations	28
Table 7: Dams and Other Flood Hazard Reduction Measures	29
Table 8: Levee Systems	30
Table 9: Summary of Discharges	33
Table 10: Summary of Non-Coastal Stillwater Elevations	37
Table 11: Stream Gage Information used to Determine Discharges	38
Table 12: Summary of Hydrologic and Hydraulic Analyses	40
Table 13: Roughness Coefficients	45
Table 14: Summary of Coastal Analyses	45
Table 15: Tide Gage Analysis Specifics	45
Table 16: Coastal Transect Parameters	46
Table 17: Summary of Alluvial Fan Analyses	46
Table 18: Results of Alluvial Fan Analyses	46
Table 19: Countywide Vertical Datum Conversion	47
Table 20: Stream-Based Vertical Datum Conversion	47
Table 21: Base Map Sources	48
Table 22: Summary of Topographic Elevation Data used in Mapping	49
Table 23: Floodway Data	51
Table 24: Flood Hazard and Non-Encroachment Data for Selected Streams	93
Table 25: Summary of Coastal Transect Mapping Considerations	93
Table 26: Incorporated Letters of Map Change	94

Volume 2

6.5.4	Physical Map Revisions	95
6.5.5	Contracted Restudies	95
6.5.6	Community Map History	95
SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION		96
7.1	Contracted Studies	96
7.2	Community Meetings	98
SECTION 8.0 – ADDITIONAL INFORMATION		100
SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES		101

Tables

Page

Table 27: Community Map History	96
Table 28: Summary of Contracted Studies Included in this FIS Report	97
Table 29: Community Meetings	99
Table 30: Map Repositories	100
Table 31: Additional Information	100
Table 32: Bibliography and References	102

Exhibits

Flood Profiles	<u>Panel</u>
Bitterroot River	001P
BlackFoot River	019P
Butler Creek	021P
Clark Fork River (near Mineral County)	022P
Clark Fork River	026P

Volume 3

Exhibits

<u>Flood Profiles</u>	<u>Panel</u>
Clark Fork River (Near Granite County)	080P
Clearwater River	082P
DS Glacier Split	090P
Glacier RD Split	096P
Grant Creek	098P
Guest R Split	107P
Honeysuckle Drainage Swale	108P
Kauffman Split	109P
LA Valle Creek	113P
Left Branch of Bitterroot River	115P
Lolo Creek	118P
Lower Grant Creek	126P
Lower Grant Creek Extension	129P
Middle Grant Creek	130P
Miller Creek	132P
Monroc Split	146P
Pattee Creek	147P
Rattlesnake Creek	149P
Rock Creek	154P

Volume 4

Exhibits

<u>Flood Profiles</u>	<u>Panel</u>
Swan River	160P

Published Separately

Flood Insurance Rate Map (FIRM)

6.5.4 Physical Map Revisions

A Physical Map Revisions (PMR) is an official republication of a community's NFIP map to effect changes to base flood elevations, floodplain boundary delineations, regulatory floodways and planimetric features. These changes typically occur as a result of structural works or improvements, annexations resulting in additional flood hazard areas or correction to base flood elevations or SFHAs.

The community's chief executive officer must submit scientific and technical data to FEMA to support the request for a PMR. The data will be analyzed and the map will be revised if warranted. The community is provided with copies of the revised information and is afforded a review period. When the base flood elevations are changed, a 90-day appeal period is provided. A 6-month adoption period for formal approval of the revised map(s) is also provided.

For more information about the PMR process, please visit www.fema.gov and visit the Floods & Maps "Change Your Flood Zone Designation" section.

6.5.5 Contracted Restudies

The NFIP provides for a periodic review and restudy of flood hazards within a given community. FEMA accomplishes this through a national watershed-based mapping needs assessment strategy, known as the Coordinated Needs Management Strategy (CNMS). The CNMS is used by FEMA to assign priorities and allocate funding for new flood hazard analyses used to update the FIS Report and FIRM. The goal of CNMS is to define the validity of the engineering study data within a mapped inventory. The CNMS is used to track the assessment process, document engineering gaps and their resolution, and aid in prioritization for using flood risk as a key factor for areas identified for flood map updates. Visit www.fema.gov to learn more about the CNMS or contact the FEMA Regional Office listed in Section 8 of this FIS Report.

6.5.6 Community Map History

The current FIRM presents flooding information for the entire geographic area of Missoula County. Previously, separate FIRMs, Flood Hazard Boundary Maps (FHBM) and/or Flood Boundary and Floodway Maps (FBFM) may have been prepared for the incorporated communities and the unincorporated areas in the county that had identified SFHAs. Current and historical data relating to the maps prepared for the project area are presented in Table 27, "Community Map History." A description of each of the column headings and the source of the date is also listed below.

- *Community Name* includes communities falling within the geographic area shown on the FIRM, including those that fall on the boundary line, nonparticipating communities, and communities with maps that have been rescinded. Communities with No Special Flood Hazards are indicated by a footnote. If all maps (FHBM, FBFM, and FIRM) were rescinded for a community, it is not listed in this table unless SFHAs have been identified in this community.
- *Initial Identification Date (First NFIP Map Published)* is the date of the first NFIP map that identified flood hazards in the community. If the FHBM has been converted to a FIRM, the initial FHBM date is shown. If the community has never been mapped, the upcoming effective date or "pending" (for Preliminary FIS

Reports) is shown. If the community is listed in Table 27 but not identified on the map, the community is treated as if it were unmapped.

- *Initial FHBM Effective Date* is the effective date of the first FHBM. This date may be the same date as the Initial NFIP Map Date.
- *FHBM Revision Date(s)* is the date(s) that the FHBM was revised, if applicable.
- *Initial FIRM Effective Date* is the date of the first effective FIRM for the community.
- *FIRM Revision Date(s)* is the date(s) the FIRM was revised, if applicable. This is the revised date that is shown on the FIRM panel, if applicable. As countywide studies are completed or revised, each community listed should have its FIRM dates updated accordingly to reflect the date of the countywide study. Once the FIRMs exist in countywide format, as PMRs of FIRM panels within the county are completed, the FIRM Revision Dates in the table for each community affected by the PMR are updated with the date of the PMR, even if the PMR did not revise all the panels within that community.

The initial effective date for the Missoula County FIRMs in countywide format was 08/16/1988.

Table 27: Community Map History

Community Name	Initial Identification Date	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Missoula, City of	03/08/1974	03/8/1974	08/15/1975	01/06/1983	TBD 07/06/2015 08/16/1988
Missoula County, Unincorporated Areas	08/30/1974	08/30/1974	05/24/1977	08/15/1983	TBD 10/05/2023 03/07/2019 07/06/2015 08/16/1988 06/05/1985

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION

7.1 Contracted Studies

Table 28 provides a summary of the contracted studies, by flooding source, that are included in this FIS Report.

Table 28: Summary of Contracted Studies Included in this FIS Report

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Bitterroot River	TBD	Morrison-Maierle	MAS 2019-02	2021	Missoula County, Unincorporated Areas
Blackfoot River	TBD	N/A	N/A	N/A	Missoula County, Unincorporated Areas
Clark Fork River (near Mineral County)	TBD	Allied Engineering Services, Inc.	WO-AESI-199	2023	Missoula County, Unincorporated Areas
Clark Fork River	TBD	Allied Engineering Services, Inc.	WO-AESI-199	2023	Missoula County, Unincorporated Areas; Missoula, City of
Clark Fork River (near Granite County)	TBD	Allied Engineering Services, Inc.	WO-AESI-199	2023	Missoula County, Unincorporated Areas
Clearwater River	TBD	Compass PTS JV	HSFE60-15-D-0003	October 2023	Missoula County, Unincorporated Areas
DS Glacier Split	TBD	N/A	N/A	N/A	Missoula County, Unincorporated Areas
Glacier Rd Split	TBD	N/A	N/A	N/A	Missoula County, Unincorporated Areas
Grant Creek	TBD	USACE	N/A	1973	Missoula County, Unincorporated Areas; Missoula, City of
Guest R Split	TBD	N/A	N/A	N/A	Missoula County, Unincorporated Areas
Honeysuckle Drainage Swale	TBD	N/A	N/A	N/A	Missoula, City of
Kauffman Split	TBD	N/A	N/A	N/A	Missoula County, Unincorporated Areas
La Valle Creek	TBD	PBS&J	N/A	2006	Missoula County, Unincorporated Areas

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Left Branch of Bitterroot River	TBD	Morrison-Maierle	MAS 2019-02	2021	Missoula County, Unincorporated Areas
Lolo Creek	TBD	USACE	N/A	June 1975	Missoula County, Unincorporated Areas
Lower Grant Creek	TBD	N/A	N/A	2011	Missoula County, Unincorporated Areas; Missoula, City of
Miller Creek	TBD	Professional Consultants, Inc.	N/A	1979	Missoula County, Unincorporated Areas
Monroc Split	TBD	Allied Engineering Services, Inc.	WO-AESI-199	2023	Missoula County, Unincorporated Areas; Missoula, City of
Pattee Creek	TBD	USACE	N/A	1977	Missoula County, Unincorporated Areas; Missoula, City of
Rattlesnake Creek	TBD	USACE	N/A	1976	Missoula County, Unincorporated Areas; Missoula, City of
Rock Creek	TBD	Morrison-Maierle	MAS 2019-02	2021	Missoula County, Unincorporated Areas
Swan River	TBD	DOWL	MAS No. 2015-01	November, 2016	Missoula County, Unincorporated Areas
Zone A Streams	TBD	Morrison-Maierle	EMW-84-R-1636	March 1986	Missoula County, Unincorporated Areas; Missoula, City of

7.2 Community Meetings

The dates of the community meetings held for this Flood Risk Project and previous Flood Risk Projects are shown in Table 29. These meetings may have previously been referred to by a variety of names (Community Coordination Officer (CCO), Scoping, Discovery, etc.), but all meetings represent opportunities for FEMA, community officials, study contractors, and other invited guests to discuss the planning for and results of the project.

Table 29: Community Meetings

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
Missoula, City of	TBD	08/24/2022	Flood Risk Review Meeting	The community, Missoula County, and Montana Dept of Natural Resources and Conservation
		TBD	Final CCO Meeting	TBD
Missoula County Unincorporated Areas	TBD	08/22/2022	Flood Risk Review Meeting	Missoula County, and Montana Dept of Natural Resources and Conservation
		TBD	Final CCO Meeting	TBD

SECTION 8.0 – ADDITIONAL INFORMATION

Information concerning the pertinent data used in the preparation of this FIS Report can be obtained by submitting an order with any required payment to the FEMA Engineering Library. For more information on this process, see www.fema.gov.

Table 30 is a list of the locations where FIRMs for Missoula County can be viewed. Please note that the maps at these locations are for reference only and are not for distribution. Also, please note that only the maps for the community listed in the table are available at that particular repository. A user may need to visit another repository to view maps from an adjacent community.

Table 30: Map Repositories

Community	Address	City	State	Zip Code
Missoula, City of	Office of Planning and Grants 435 Ryman Street	Missoula	MT	59802
Missoula County, Unincorporated Areas	Community and Planning Services Department 200 West Broadway	Missoula	MT	59802

The National Flood Hazard Layer (NFHL) dataset is a compilation of effective FIRM Databases and LOMCs. Together they create a GIS data layer for a State or Territory. The NFHL is updated as studies become effective and extracts are made available to the public monthly. NFHL data can be viewed or ordered from the website shown in Table 31.

Table 31 contains useful contact information regarding the FIS Report, the FIRM, and other relevant flood hazard and GIS data. In addition, information about the State NFIP Coordinator and GIS Coordinator is shown in this table. At the request of FEMA, each Governor has designated an agency of State or territorial government to coordinate that State's or territory's NFIP activities. These agencies often assist communities in developing and adopting necessary floodplain management measures. State GIS Coordinators are knowledgeable about the availability and location of State and local GIS data in their state.

Table 31: Additional Information

FEMA and the NFIP	
FEMA and FEMA Engineering Library website	www.fema.gov/flood-maps/products-tools/know-your-risk/engineers-surveyors-architects
NFIP website	www.fema.gov/flood-insurance
NFHL Dataset	msc.fema.gov
FEMA Region VIII	Denver Federal Center Building 710 Box 25267 Denver, CO 80225-0267 (303) 235-4800

Other Federal Agencies	
USGS website	www.usgs.gov
Hydraulic Engineering Center website	www.hec.usace.army.mil
State Agencies and Organizations	
State NFIP Coordinator	Traci Sears, CFM Dept. of Natural Resources and Conservation 1625 Eleventh Ave. Helena, MT 59601 Phone: (406) 444-6654 tsears@mt.gov
Bureau Chief of Water Operations	Stephen Story, PE, CFM Dept. of Natural Resources and Conservation 1625 Eleventh Ave. Helena, MT 59601 Phone: (406) 444-6816 sestory@mt.gov
Missoula County Floodplain Administrator	Matt Heime 200 W Broadway Missoula, MT 59802 Phone: (406) 258-3799 mheimel@missoulacounty.us

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES

Table 32 includes sources used in the preparation of and cited in this FIS Report as well as additional studies that have been conducted in the study area.

Table 32: Bibliography and References

Citation in this FIS	Publisher/ Issuer	<i>Publication Title</i> , "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
AE 2021	Federal Emergency Management Agency	Clark Fork River Enhanced Hydraulic Analysis and Floodplain Mapping Report, Granite County and Missoula County, MT	Allied Engineering	Washington DC	4/1/2021	
AE 2023	Federal Emergency Management Agency	Clark Fork River Enhanced Hydraulic Analysis and Floodplain Mapping Report Granite County and Missoula County, MT	Allied Engineering	Washington D.C.	1/31/2023	
CCH 2006	Clear Creek Hydrology, Inc.	Hydraulic Analyses of La Valle and Butler Creek, Missoula County, Montana			2006	
ESRI 2013	ESRI	ArcGIS 10.2	ESRI	Redlands, CA	2013	http://www.esri.com/software/arcgis/arcgis-for-desktop
FEMA 2009	Federal Emergency Management Agency	Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix C	Federal Emergency Management Agency		2009	http://www.fema.gov/media-library/assets/documents/34953
FEMA 2013	Federal Emergency Management Agency	cHECK-RAS, Version 2.0.1 Software.	Federal Emergency Management Agency		2013	http://www.fema.gov/check-ras-hec-ras-validation-tool
FEMA 2015A	Federal Emergency Management Agency	Flood Insurance Study, Missoula County, Montana and Incorporated Areas	Federal Emergency Management Agency		7/6/2015	msc.fema.gov

Table 32: Bibliography and References (Continued)

Citation in this FIS	Publisher/ Issuer	Publication Title, "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
FEMA 2015B	Federal Emergency Management Agency	LOMR Case No. 15-08-1043P	Federal Emergency Management Agency	Washington DC	7/29/2015	
FEMA 2015C	Federal Emergency Management Agency	Mapping Activity Statement (MAS) No. 2015-01 Missoula County, MT	Federal Emergency Management Agency		2015	https://www.fema.gov/cooperating-technical-partners-program
FEMA 2015D	Federal Emergency Management Agency	RASPLOT, Version 3.0 Software	Federal Emergency Management Agency		2015	https://www.fema.gov/rasplot-version-30
FEMA 2016	Federal Emergency Management Agency	Technical Reference: Flood Insurance Study (FIS) Report	Federal Emergency Management Agency		2016	http://www.fema.gov/media-library/assets/documents/34519
FEMA 2020	Federal Emergency Management Agency	Basemap Framework Submission for Missoula County, MT, USA	Federal Emergency Management Agency	Washington D.C.	3/2/2020	https://hazards.fema.gov
FEMA 2022A	Federal Emergency Management Agency	LOMR Case No. 21-08-0878P	Federal Emergency Management Agency	Washington D.C.	4/27/2022	
FEMA 2022B	Federal Emergency Management Agency	LOMR Case No. 21-08-0781P	Federal Emergency Management Agency	Washington D.C.	6/27//20200	
FEMA 2023A	Federal Emergency Management Agency	Missoula County, MT Effective NFHL Data	Federal Emergency Management Agency	Washington D.C.	10/5/2023	www.msc.fema.gov

Table 32: Bibliography and References (Continued)

Citation in this FIS	Publisher/ Issuer	Publication Title, "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
FEMA 2023B	Federal Emergency Management Agency	LOMR Case No. 22-08-0126P	Federal Emergency Management Agency	Washington D.C.	5/22/2023	
FEMA 2024A	Federal Emergency Management Agency	Missoula County, MT PMR Study - DFIRM Database	Federal Emergency Management Agency	Washington D.C.	4/16/2024	www.msc.fema.gov
FEMA 2024B	Federal Emergency Management Agency	Mineral County, MT Effective NFHL Data	Federal Emergency Management Agency	Washington D.C.	4/24/2024	www.msc.fema.gov
HDR 2011	Federal Emergency Management Agency	LOMR Case No. 11-08-0184P	Federal Emergency Management Agency	Washington D.C.	6/02/2011	
IACWD 1982	Interagency Advisory Committee on Water Data	Guidelines for Determining Flood Flow Frequency, Bulletin No. 17B of the Hydrology Subcommittee			1982	
MDH 1972	Montana Department of Highways	Application of Hydrologic and Hydraulic Research to Culvert Selection in Montana, Volumes I and II	E.R. Dodge		1972	
MDNRC 2015	Montana Department of Natural Resources and Conservation	Hydrology Design Report, Swan River Detailed Floodplain Study	MDNRC		2015	http://dnrc.mt.gov/divisions/water/operations/floodplain-management
Missoula County 2014	Department of Public Works Surveyor's Office Missoula, MT	Swan River Survey Report: Structures and Bathymetry	Missoula County	Missoula County, MT	2014	http://www.missoulacounty.us/government/public-works/public-works

Table 32: Bibliography and References (Continued)

Citation in this FIS	Publisher/ Issuer	Publication Title, "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
MM 2020	Federal Emergency Management Agency	Hydraulic Analysis and Floodplain Mapping Report: Rock Creek and Tributaries Floodplain Study, Missoula and Granite Counties, MT	Morrison-Maierle	Washington DC	2/12/2020	
MM 2021	Federal Emergency Management Agency	Hydraulic Analysis and Floodplain Mapping Report: Bitterroot River Floodplain Study, Missoula County, MT	Morrison-Maierle	Washington D.C.	5/28/2021	
MM 2021	Federal Emergency Management Agency	Hydraulic Analysis and Floodplain Mapping Report: Rock Creek and Tributaries Floodplain Study, Missoula and Granite Counties, MT	Morrison-Maierle	Washington D.C.	7/26/2021	
MM 2021	Federal Emergency Management Agency	Hydraulic Analysis and Floodplain Mapping Report: Bitterroot River Floodplain Study, Missoula County, MT	Morrison-Maierle	Washington DC	2/1/2021	
MSL 2017A	Montana State Library	PLSS Framework Montana	Montana State Library	Helena, Montana	3/15/2017	http://ftp.geoinfo.msl.mt.gov/Data/Spatial/MSDI/Cadastral/PLSS/
MSL 2017B	Montana State Library	Roads and Railroads from the Montana Transportation Framework	Montana State Library	Helena, Montana	7/7/2017	http://ftp.geoinfo.msl.mt.gov/Data/Spatial/MSDI/Transportation/
MSL 2019	Montana State Library	Montana Political Boundaries	Montana State Library	Helena, Montana	5/2/2019	http://ftp.geoinfo.msl.mt.gov/Data/Spatial/MSDI/AdministrativeBoundaries/

Table 32: Bibliography and References (Continued)

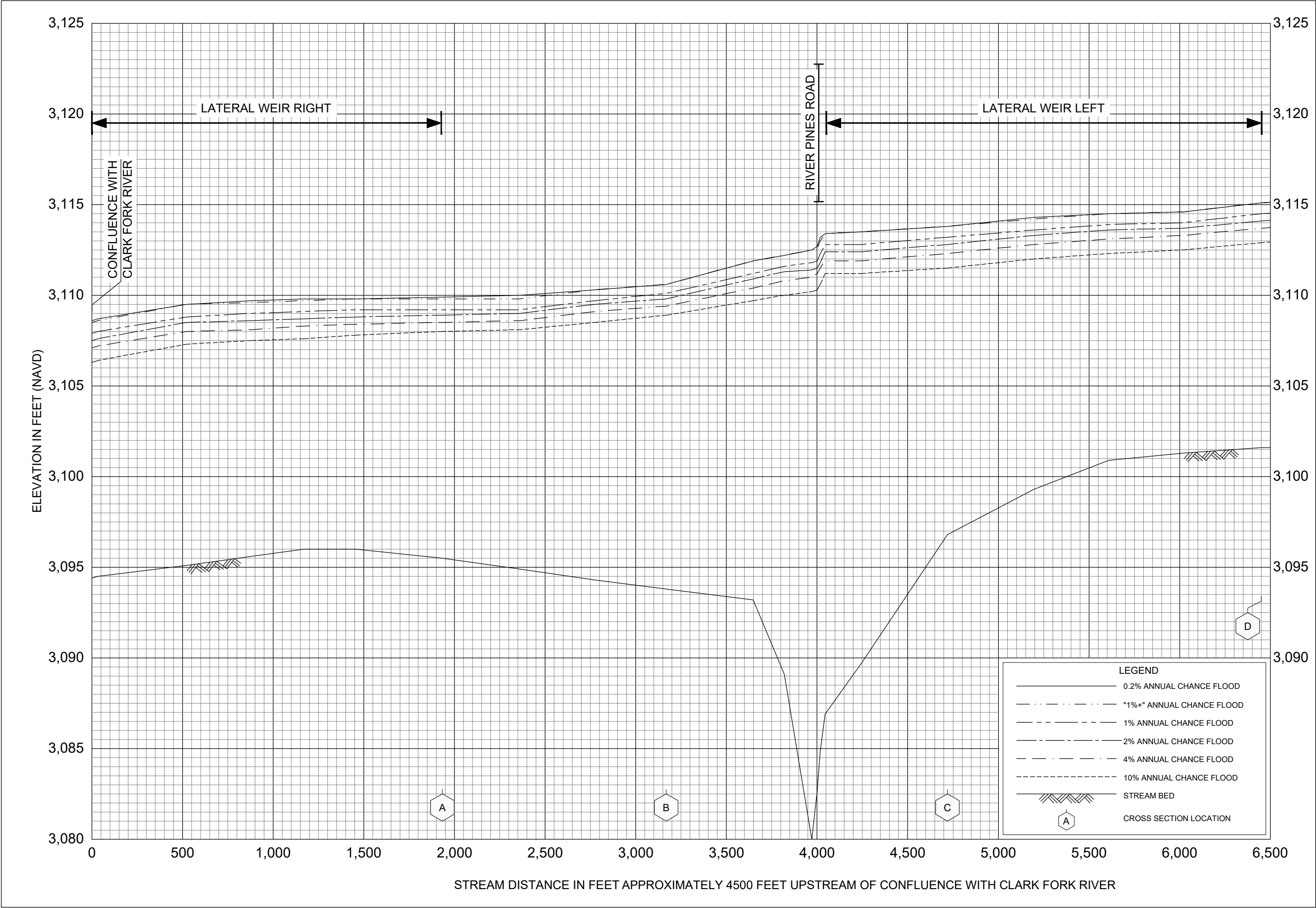
Citation in this FIS	Publisher/ Issuer	Publication Title, "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
NAIP 2017	Aerial Photography Field Office, US Department of Agriculture	USDA-FSA-AFPO Digital Ortho Mosaic	US Department of Agriculture	Salt Lake City, Utah	6/21/2017	http://ftp.geoinfo.msl.mt.gov/Data/Spatial/MSDI/Imagery/2017_NAIP/UTM_County_Mosaics/
Pro Consults 1979	Professional Consultants, Incorporated	Miller Creek Flood Plain Delineation		Missoula County, MT	1979	
PTSI 2020A	Pioneer Technical Services, Inc.	Missoula-Granite PMR, MAS No. 2019-02, Structure Survey Report	Pioneer Technical Services, Inc.		07/21/2020	
PTSI 2020B	Federal Emergency Management Agency	Missoula and Granite Counties, Montana Hydrologic Analysis Report	Federal Emergency Management Agency	Washington D.C.	7/09/2020	
Quantum Spatial 2015	Quantum Spatial Inc	Swan-Clearwater LiDAR Processing: Technical Data Report	Quantum Spatial Inc	Portland, OR	2015	https://quantumspatial.com/
SCS 1969	United States Department of Agriculture	Engineering Handbook, Hydrology, Section 4	Soil Conservation Service		1969	
Simons 1986A	Simons, LI & Associates, Inc.	Lower Swan River Flood Study, Lake County, Montana	Simons, LI & Associates, Inc.	Fort Collins, CO	1986	
Simons 1986B	Simons, LI & Associates, Inc.	Upper Swan River Flood Study, Lake County, Montana	Simons, LI & Associates, Inc.	Fort Collins, CO	1986	
Sorenson 1977	Sorenson and Co.	Flood Study Field Surveys for Missoula County, Montana		Missoula, MT	1977	

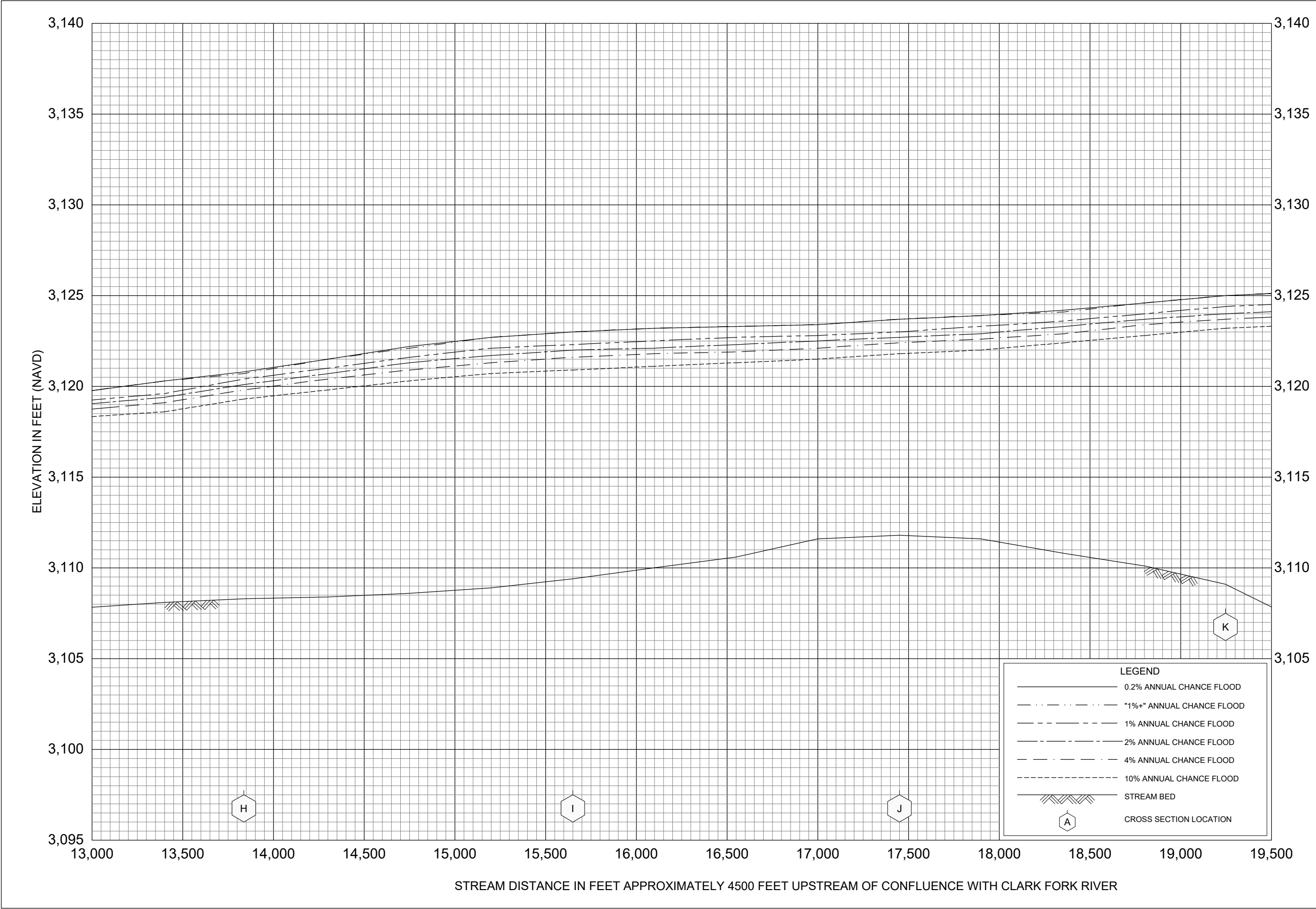
Table 32: Bibliography and References (Continued)

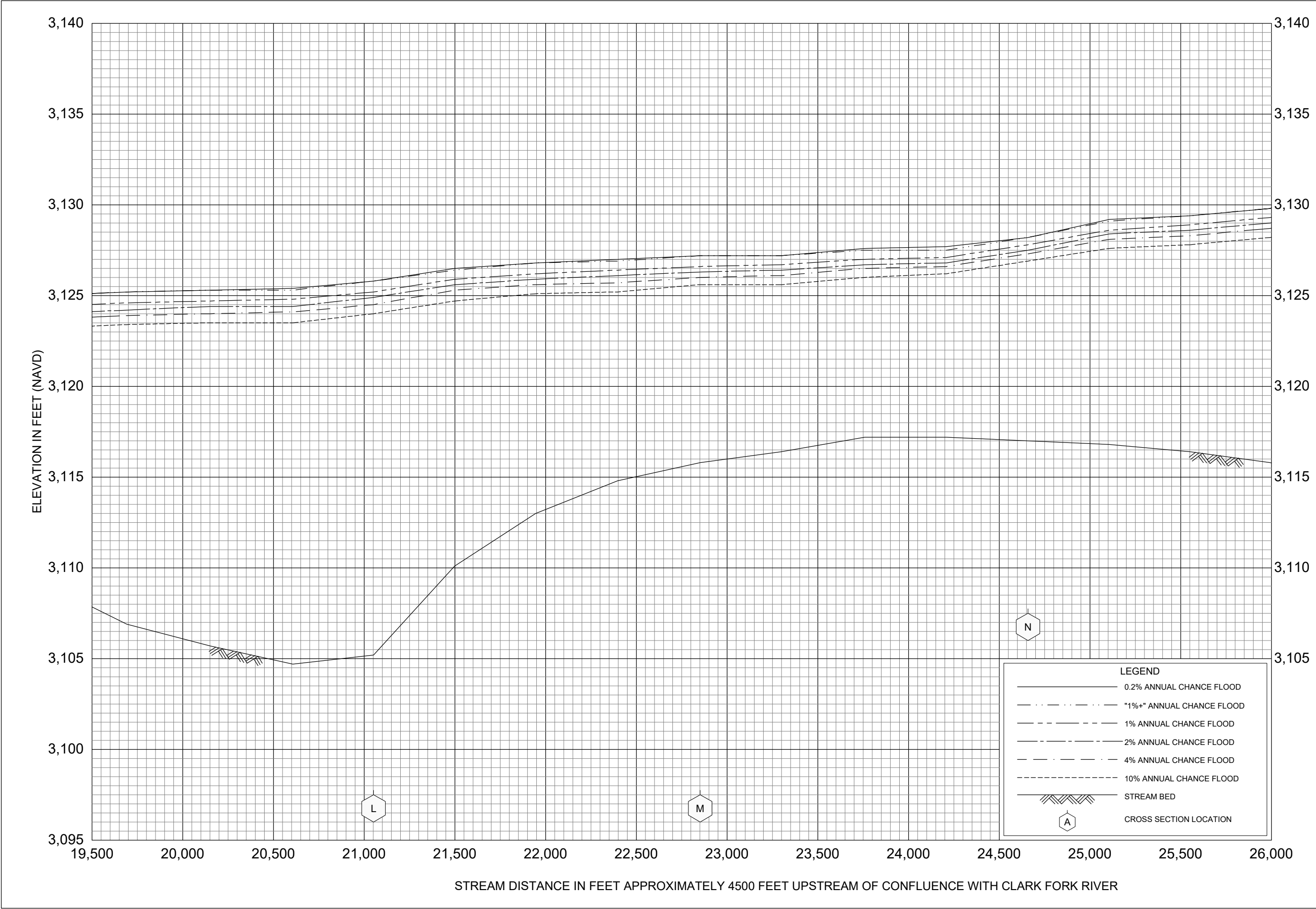
Citation in this FIS	Publisher/ Issuer	Publication Title, "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
TD&H 1977	Thomas, Dean and Hoskins Engineering Consultants	Storm Drainage Management Plan for South Hills Area, Missoula, Montana			June 1977	
TOPO 2019	Federal Emergency Management Agency	Clark Fork Bitterroot	Quantum Spatial, Inc	Washington DC	10/24/2019	
USACE 1975	United States Army Corps of Engineers	Special Study, Suggested Hydraulic Floodway, Bitterroot River and Lolo Creek, Vicinity of Lolo, Missoula County, Montana	USACE		1975	
USACE 1976	United States Army Corps of Engineers	Special Study, Suggested Hydraulic Floodway, Rattlesnake Creek, Vicinity of Missoula, Missoula County, Montana	USACE		1976	
USACE 2010A	United States Army Corps of Engineers	HEC-RAS Applications Guide, Version 4.1.0.	Hydrologic Engineering Center	Davis, CA	2010	http://www.hec.usace.army.mil/software/hecras/
USACE 2010B	United States Army Corps of Engineers	HEC-RAS Hydraulic Reference Manual, Version 4.1.0.	Hydrologic Engineering Center	Davis, CA	2010	http://www.hec.usace.army.mil/software/hecras/
USACE 2010C	United States Army Corps of Engineers	HEC-RAS User's Manual, Version 4.1.0.	Hydrologic Engineering Center	Davis, CA	2010	http://www.hec.usace.army.mil/software/hecras/
USACE 2012	United States Army Corps of Engineers	HEC-GeoRAS User's Manual, Version 10	Hydrologic Engineering Center	Davis, CA	2012	http://www.hec.usace.army.mil/software/hec-georas/

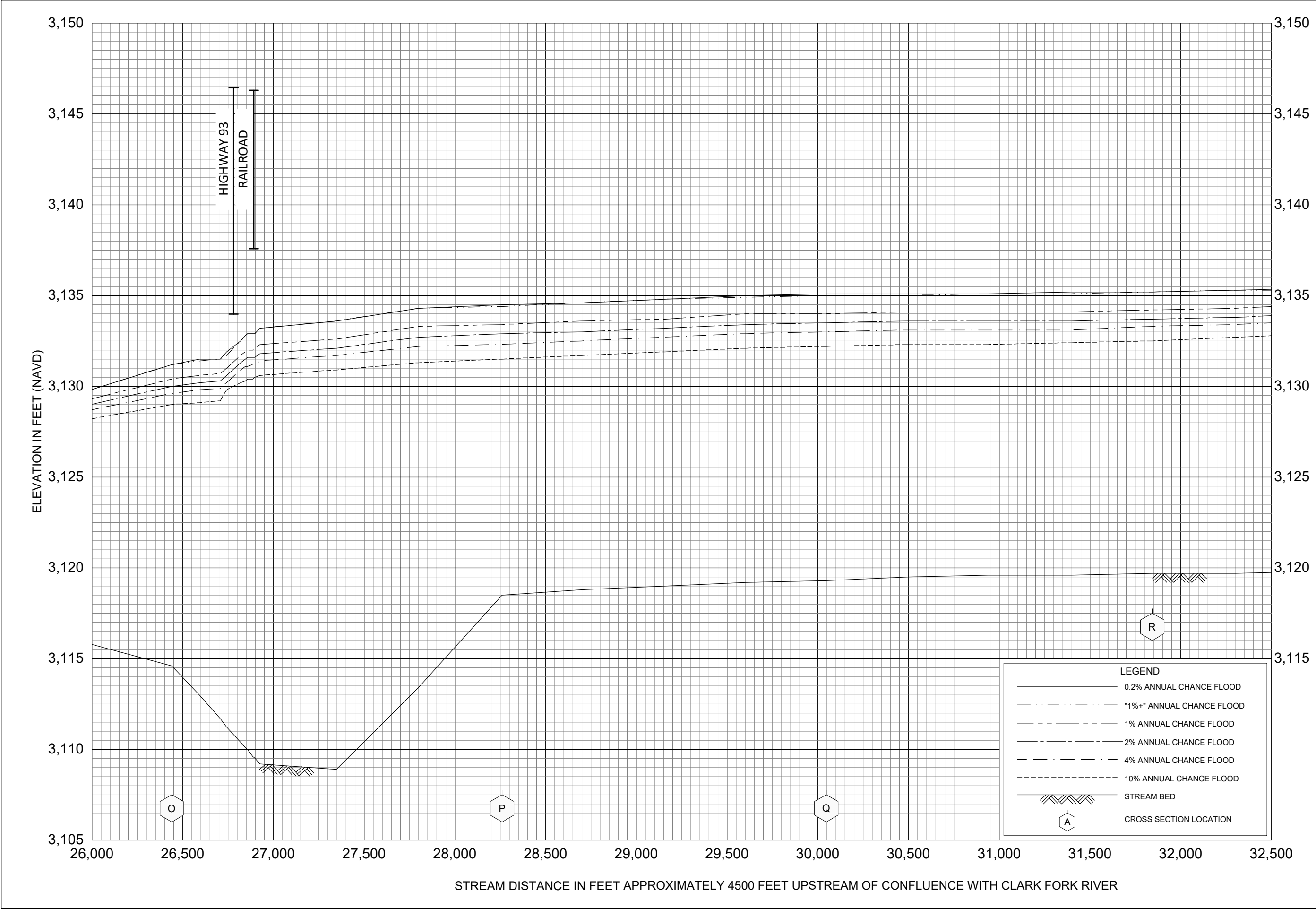
Table 32: Bibliography and References (Continued)

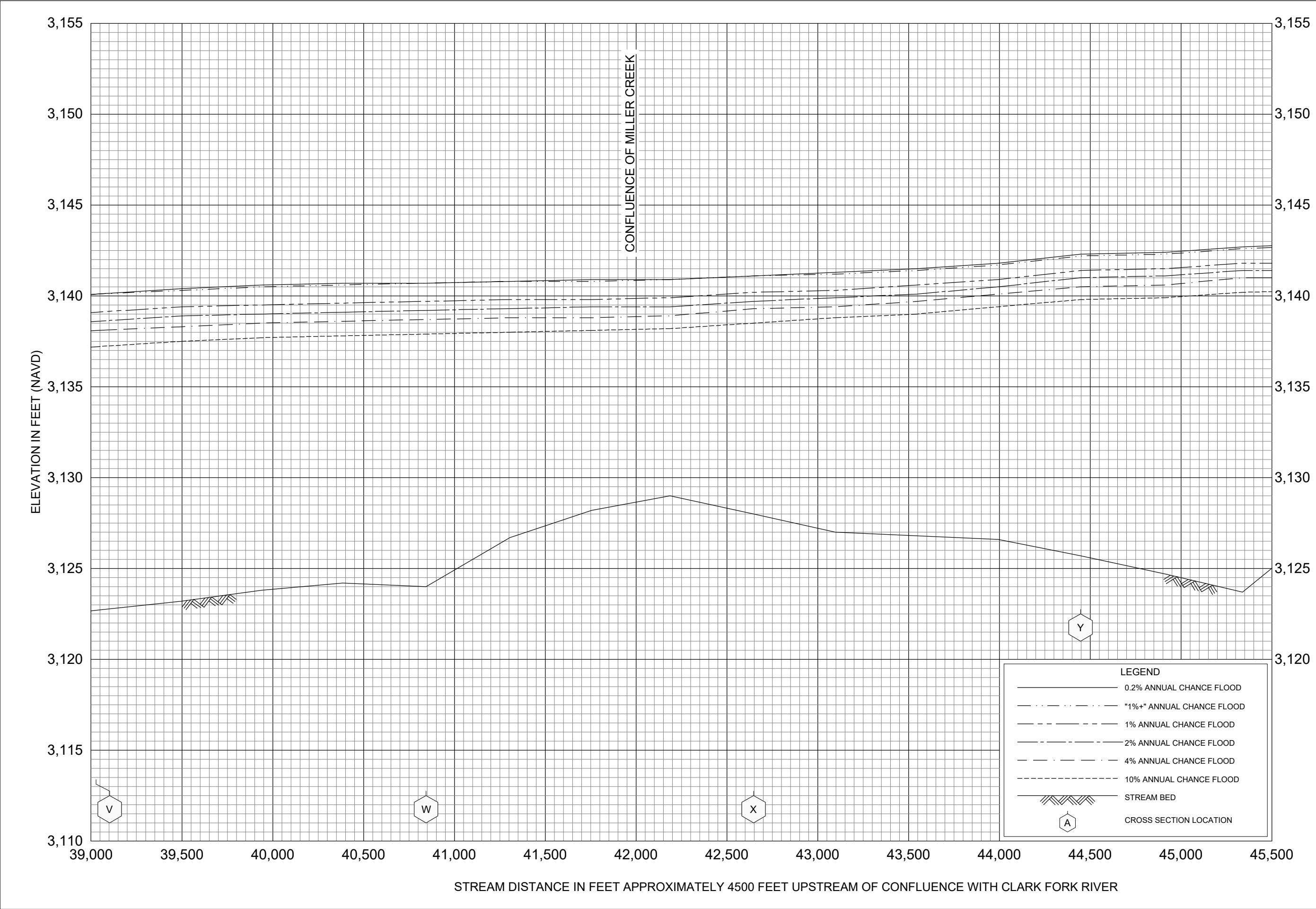
Citation in this FIS	Publisher/ Issuer	Publication Title, "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
USACE 2013	United States Army Corps of Engineers	HEC-GeoRAS 10.2, GIS Tools for Support of HEC-RAS	Hydrologic Engineering Center	Davis, CA	2013	http://www.hec.usace.army.mil/software/hec-georas/
USDA/NRCS 2019	USDA and NRCS	Watershed Boundary Dataset for Montana	USDA and NRCS	Fort Worth, Texas	10/17/2019	https://mslservices.mt.gov/Geographic_Information/Data/DataList/datalist_Details.aspx?did={e9120c8f-fc2b-4fe3-b5e4-fad4d5393ad9}
USDA-FSA 2013	United States Department of Agriculture: Farm Service Agency	National Agriculture Imagery Program (NAIP) Aerial Photographs	USDA-FSA	Salt Lake City, UT	2013	http://www.fsa.usda.gov/contact-us
USGS 1967	United States Geological Survey	Water-Supply Paper 1849, Roughness Characteristics of Natural Channels	Harry H. Barnes, Jr.	Washington, D.C	1967	http://pubs.usgs.gov/wsp/wsp_1849/
USGS 1976	United States Department of the Interior	Open-File Report 75-650, A Method for Estimating Magnitude and Frequency of Floods in Montana	Omang and Johnson		1976	
USGS 1981	United States Department of the Interior	Revised Techniques for Estimating Magnitude for Frequency of Floods in Montana	USGS	Helena, MT	September 1981	
USGS 2019	Montana State Library	Montana Hydrography Framework (National Hydrography Dataset)	US Geological Survey	Helena, Montana	10/29/2019	https://mslservices.mt.gov/Geographic_Information/Data/DataList/datalist_Details.aspx?did={db6c41bd-1f29-48ab-b4aa-2c1890f317e6}

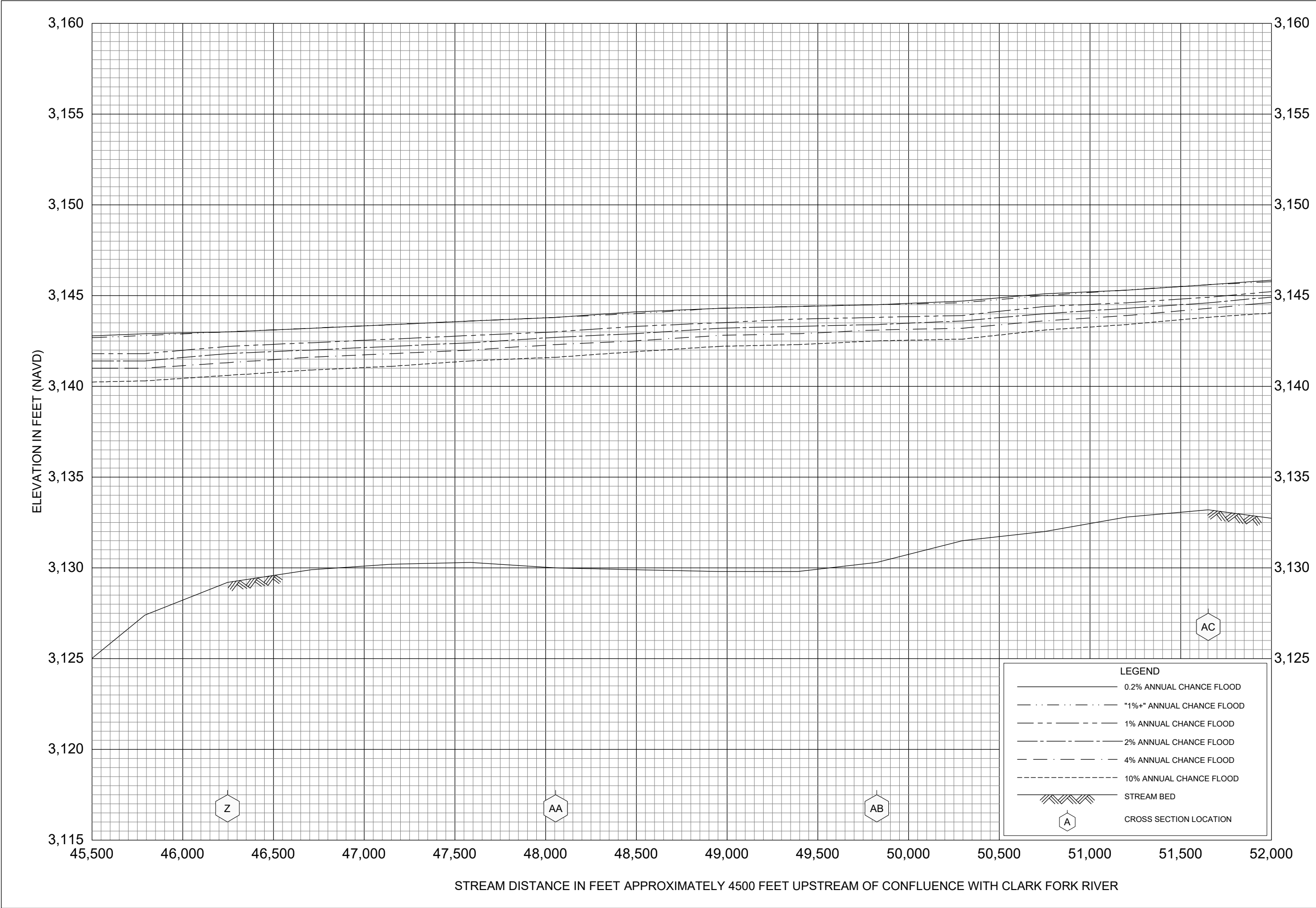


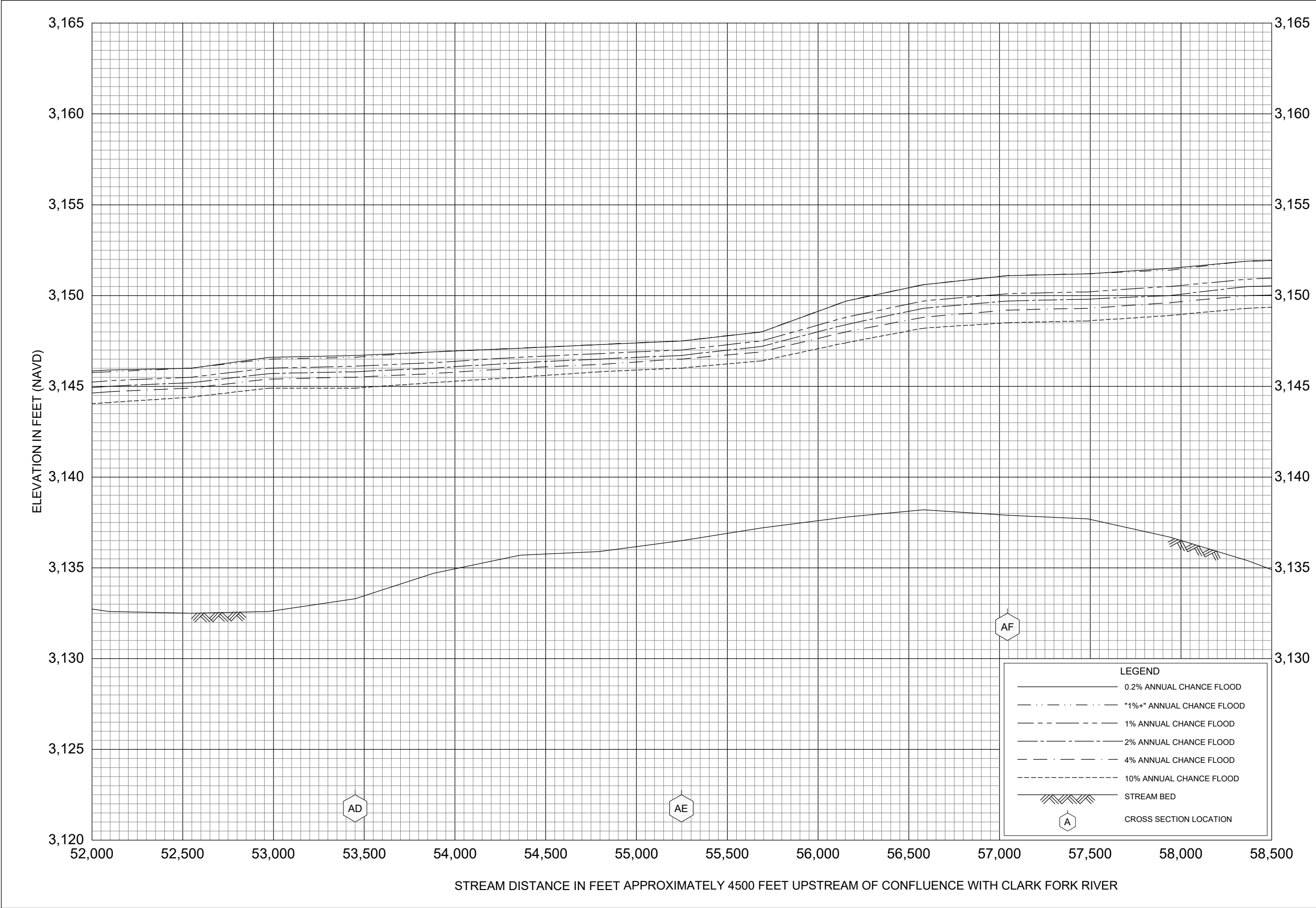


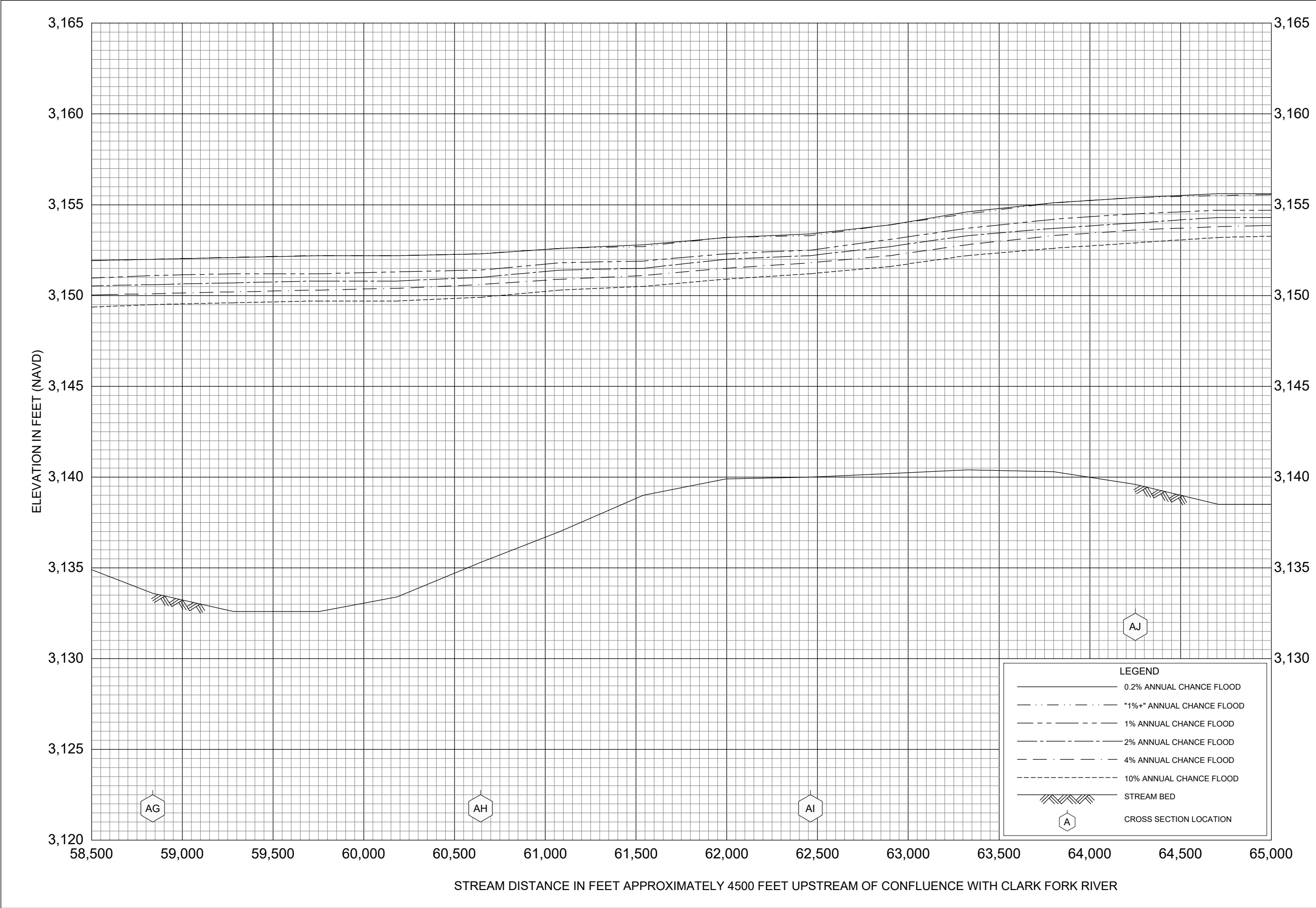


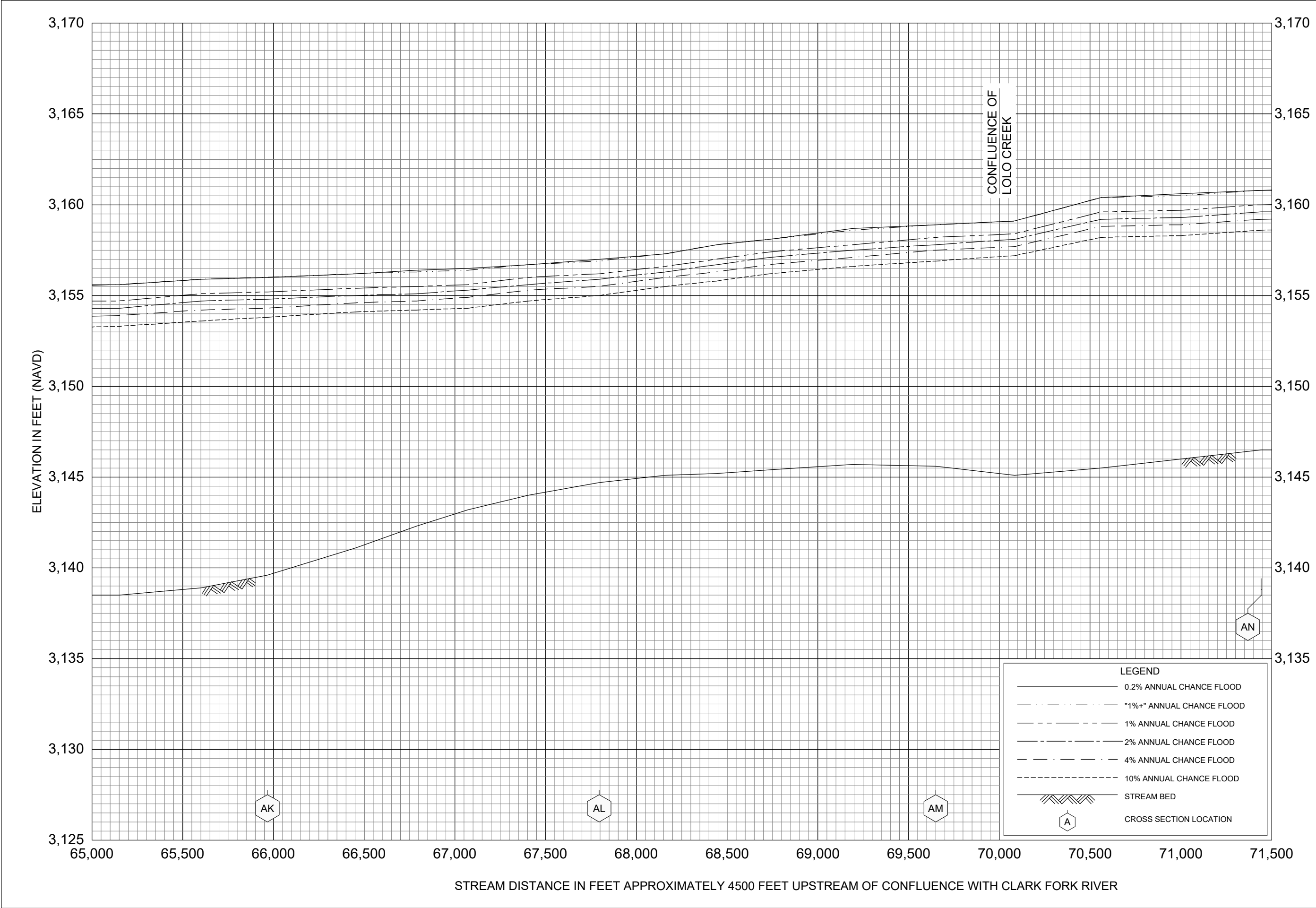


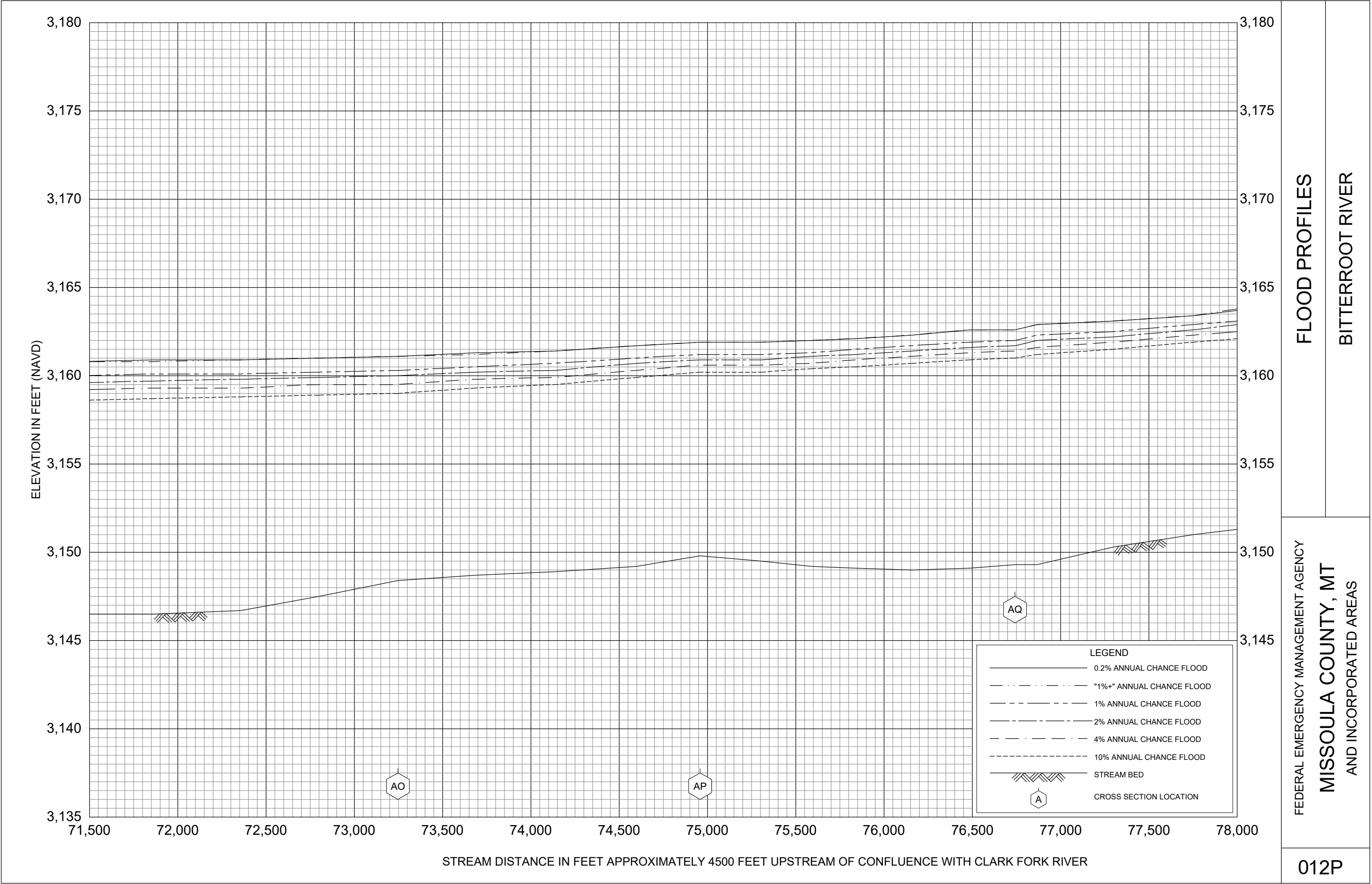


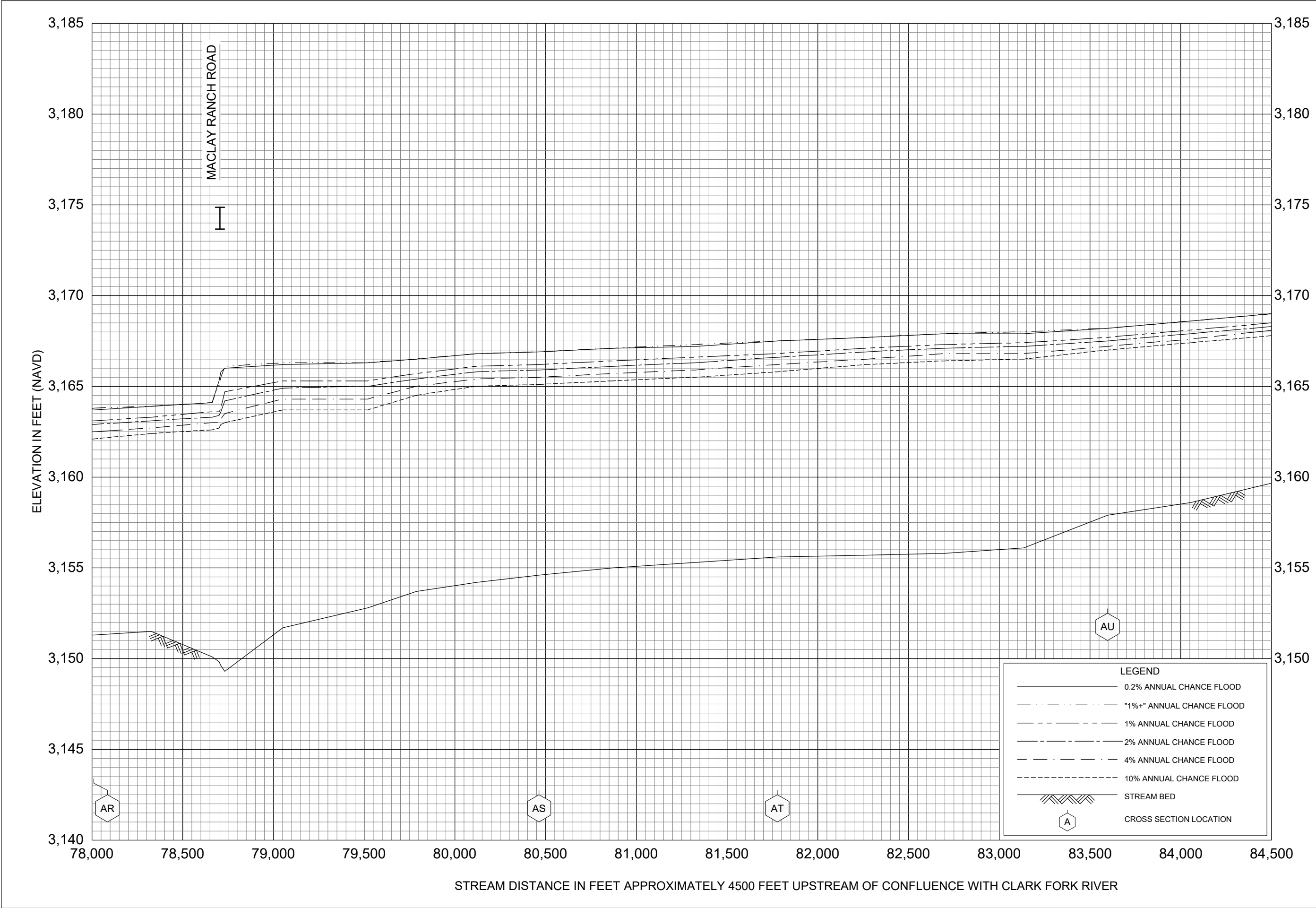


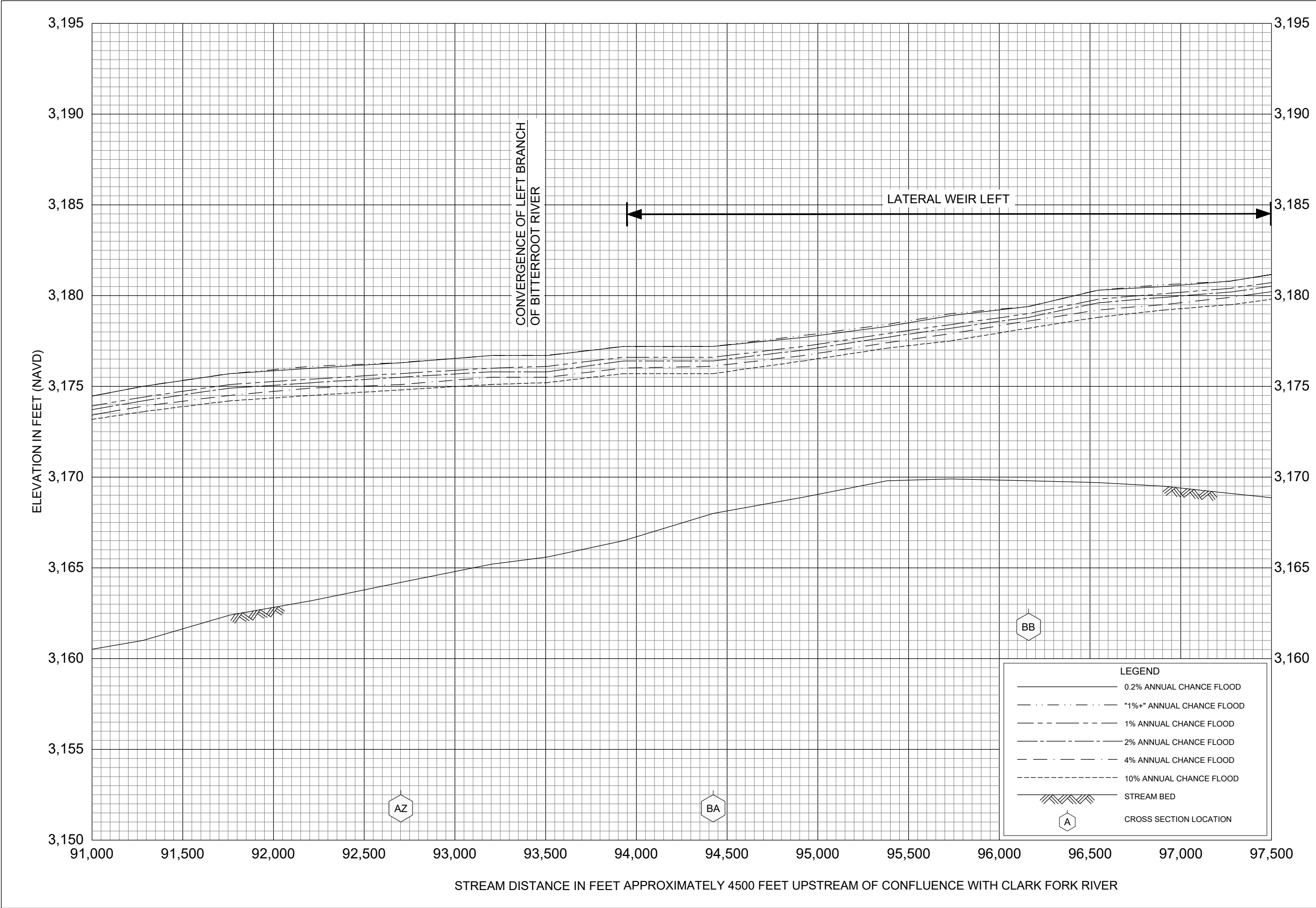


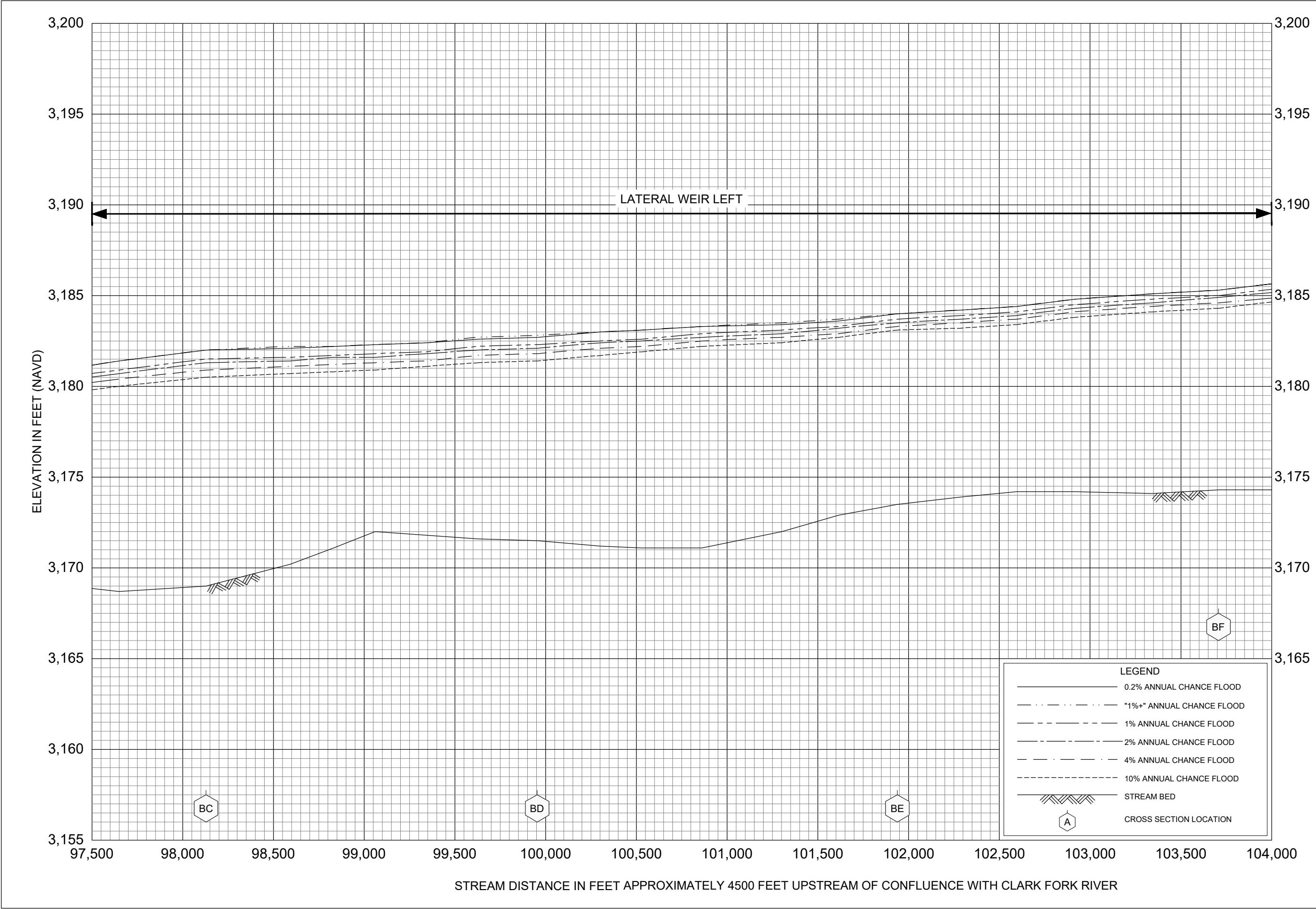


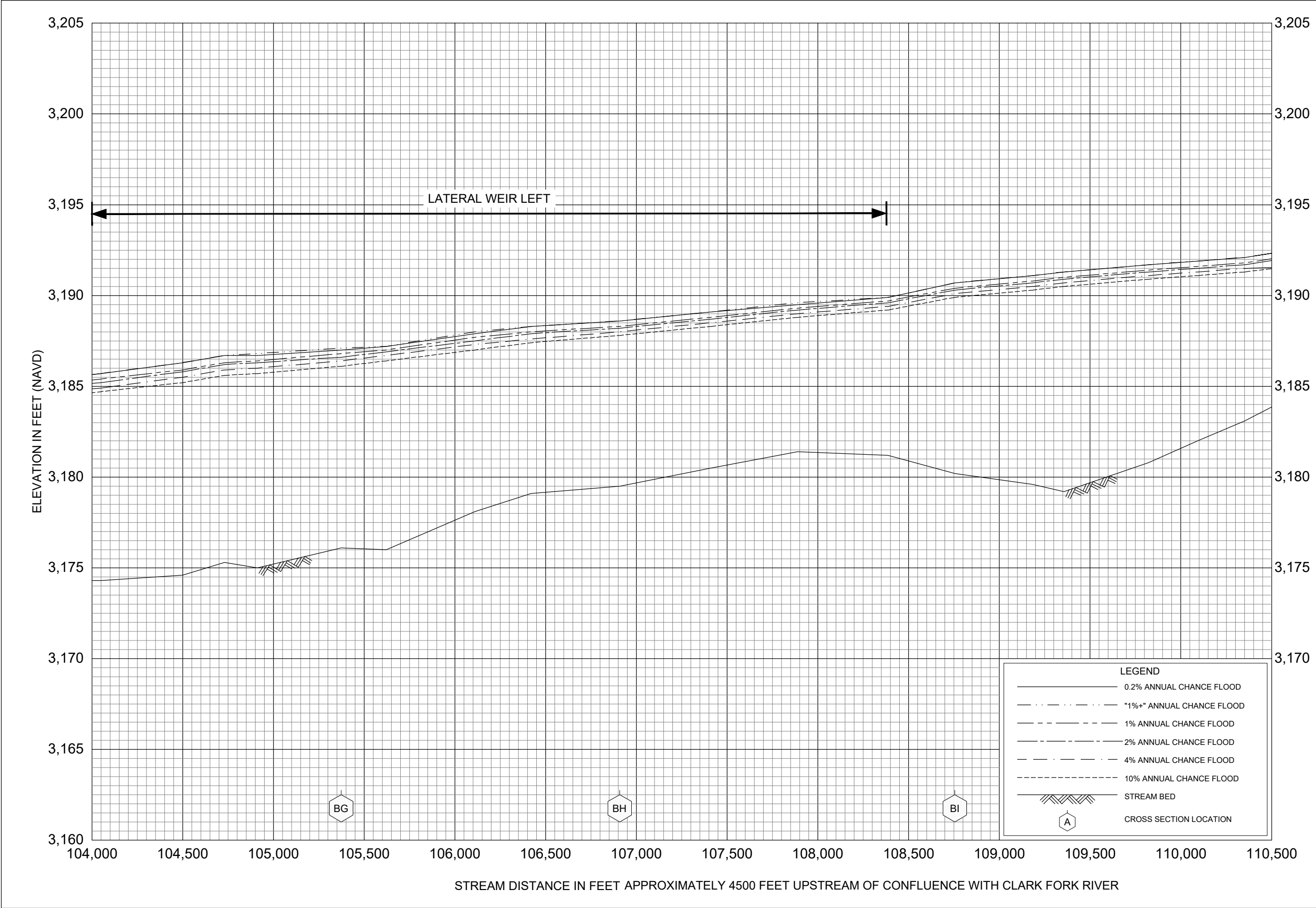


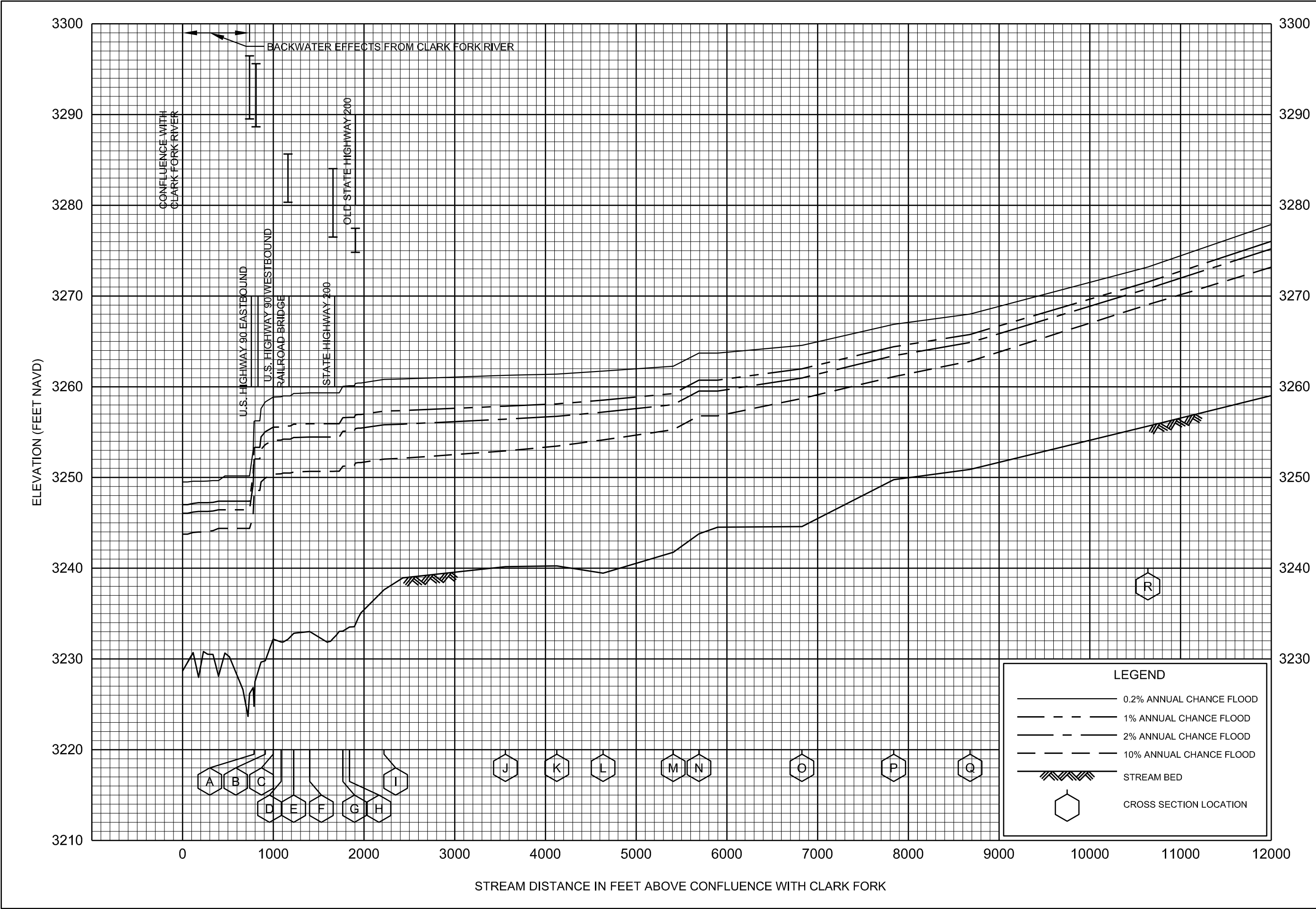


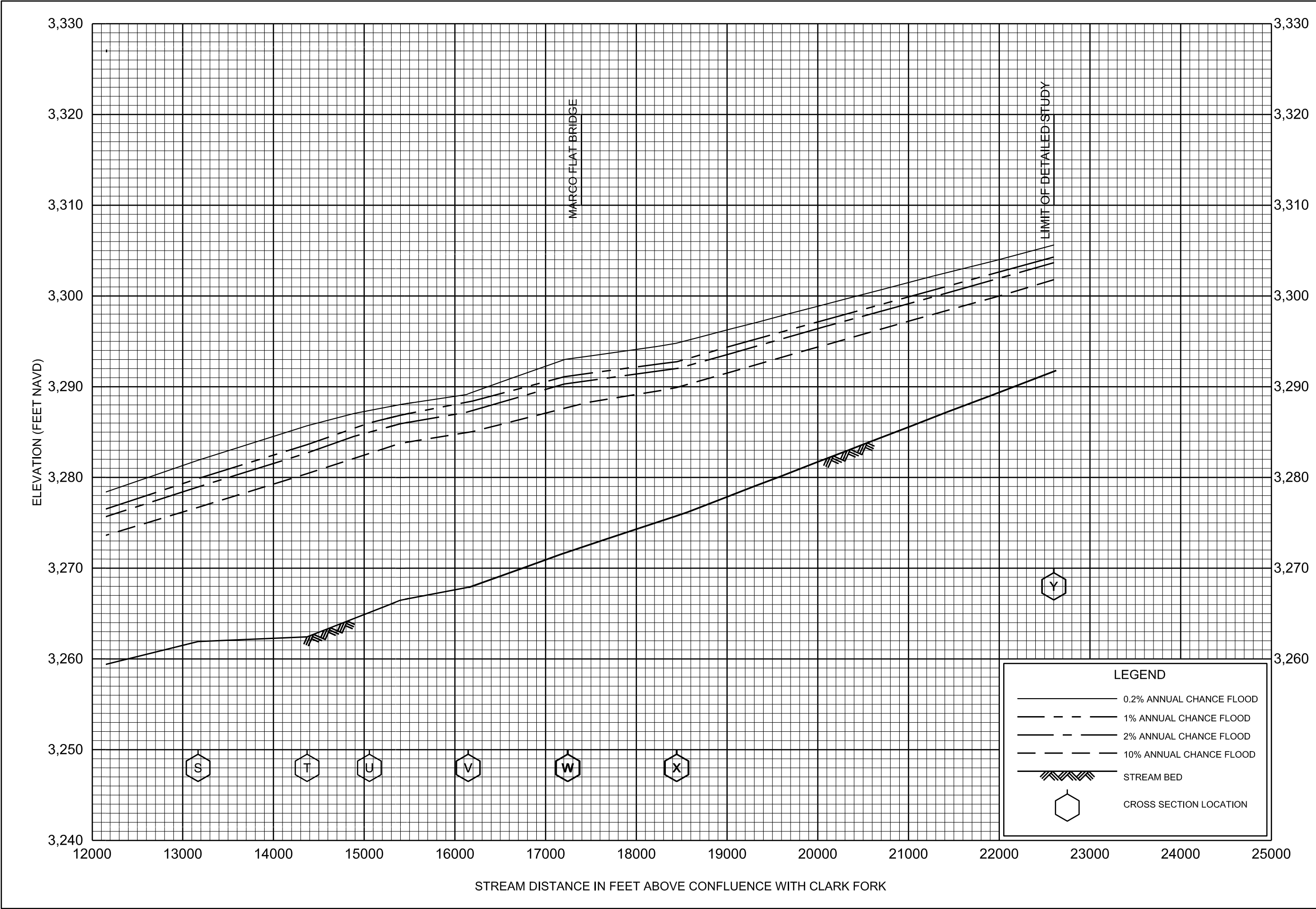


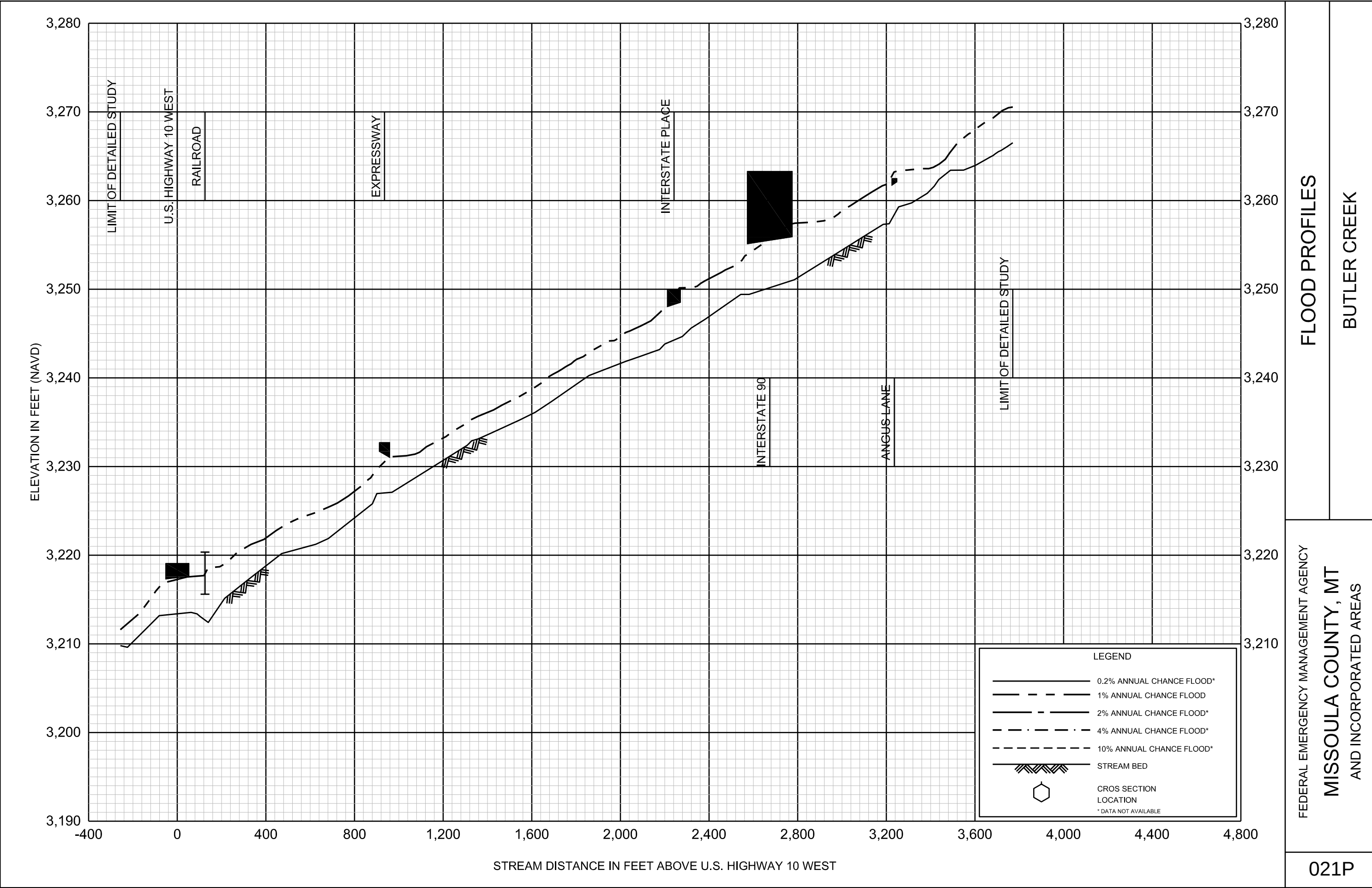










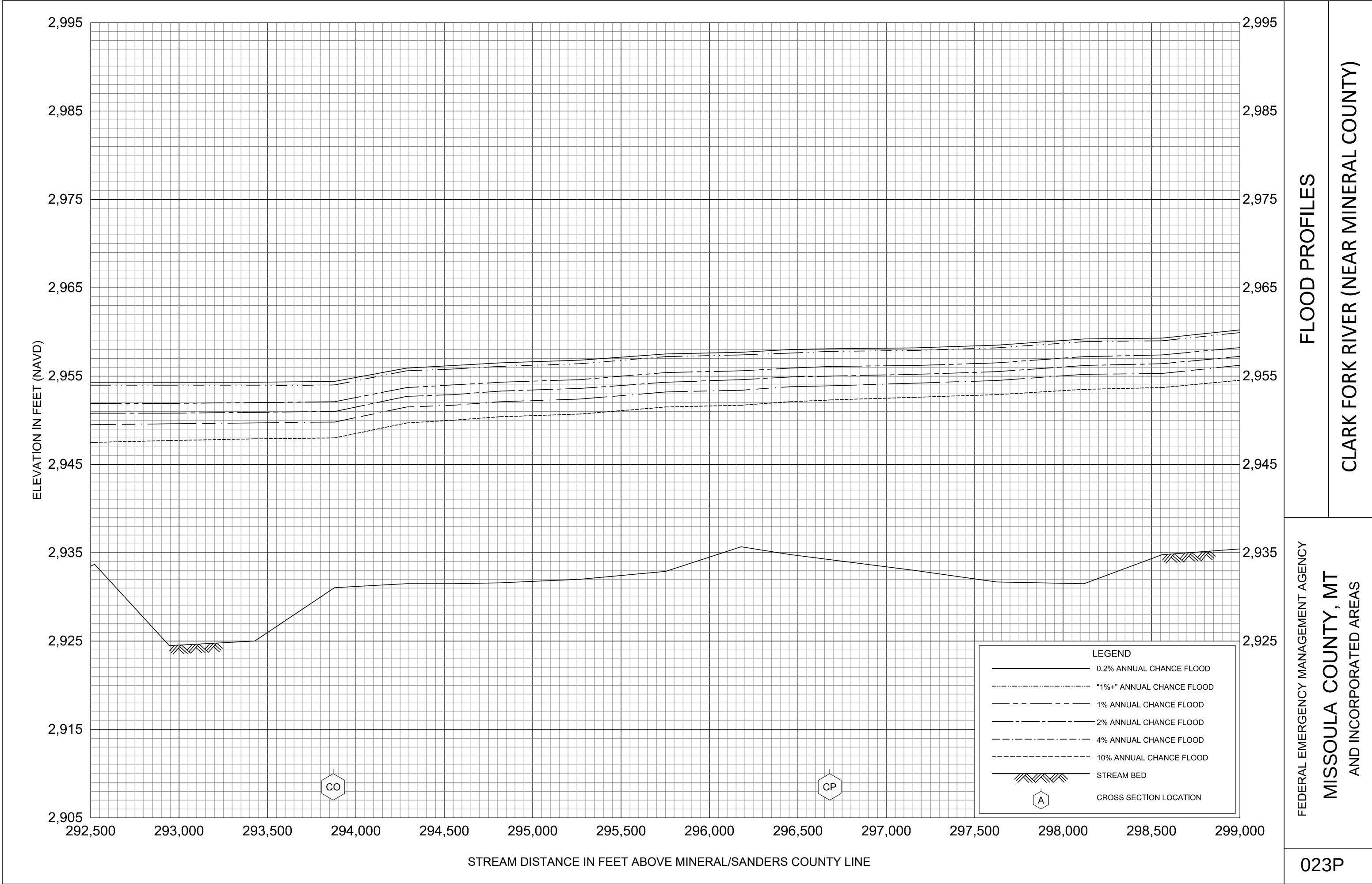


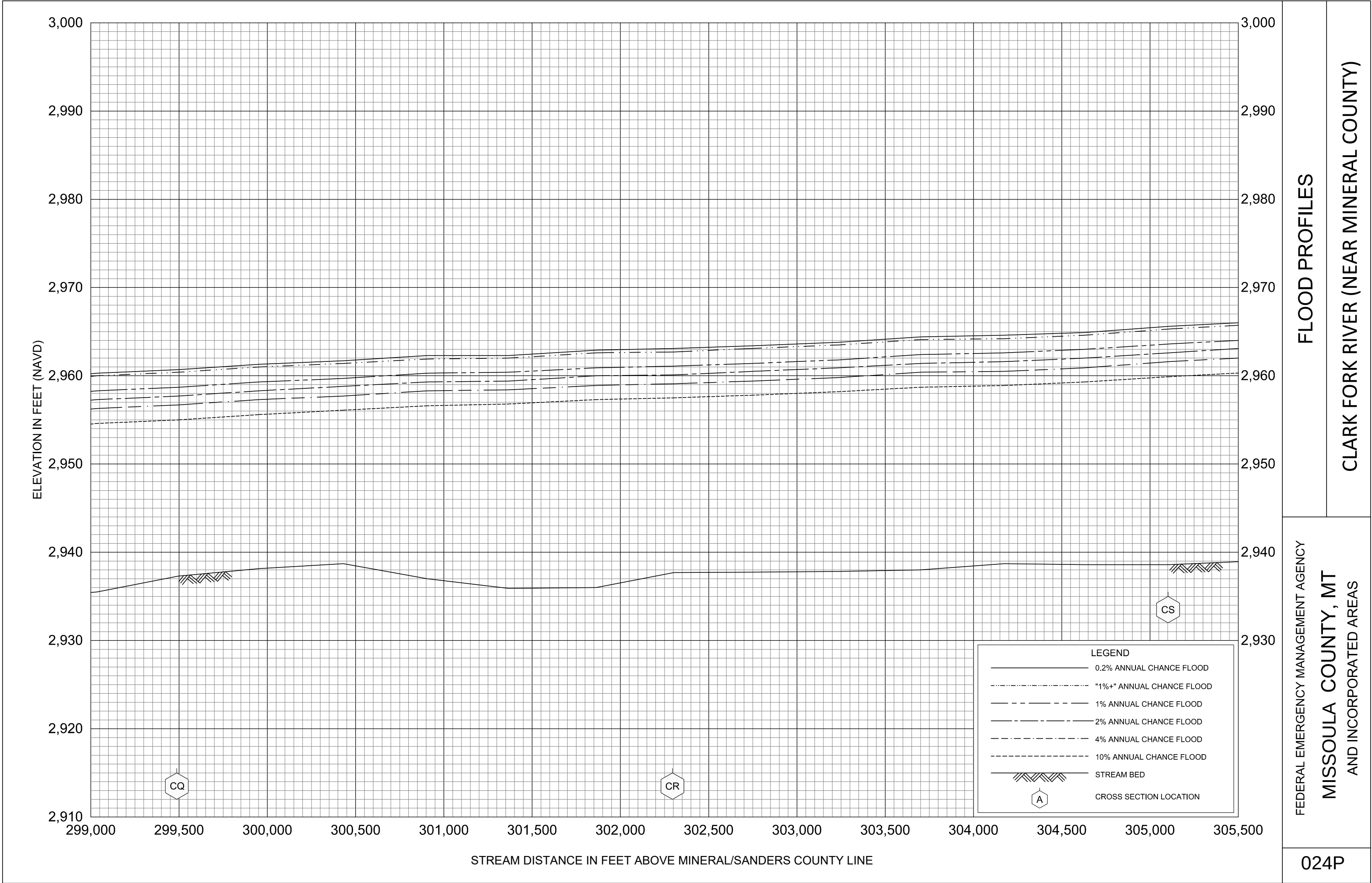
FLOOD PROFILES

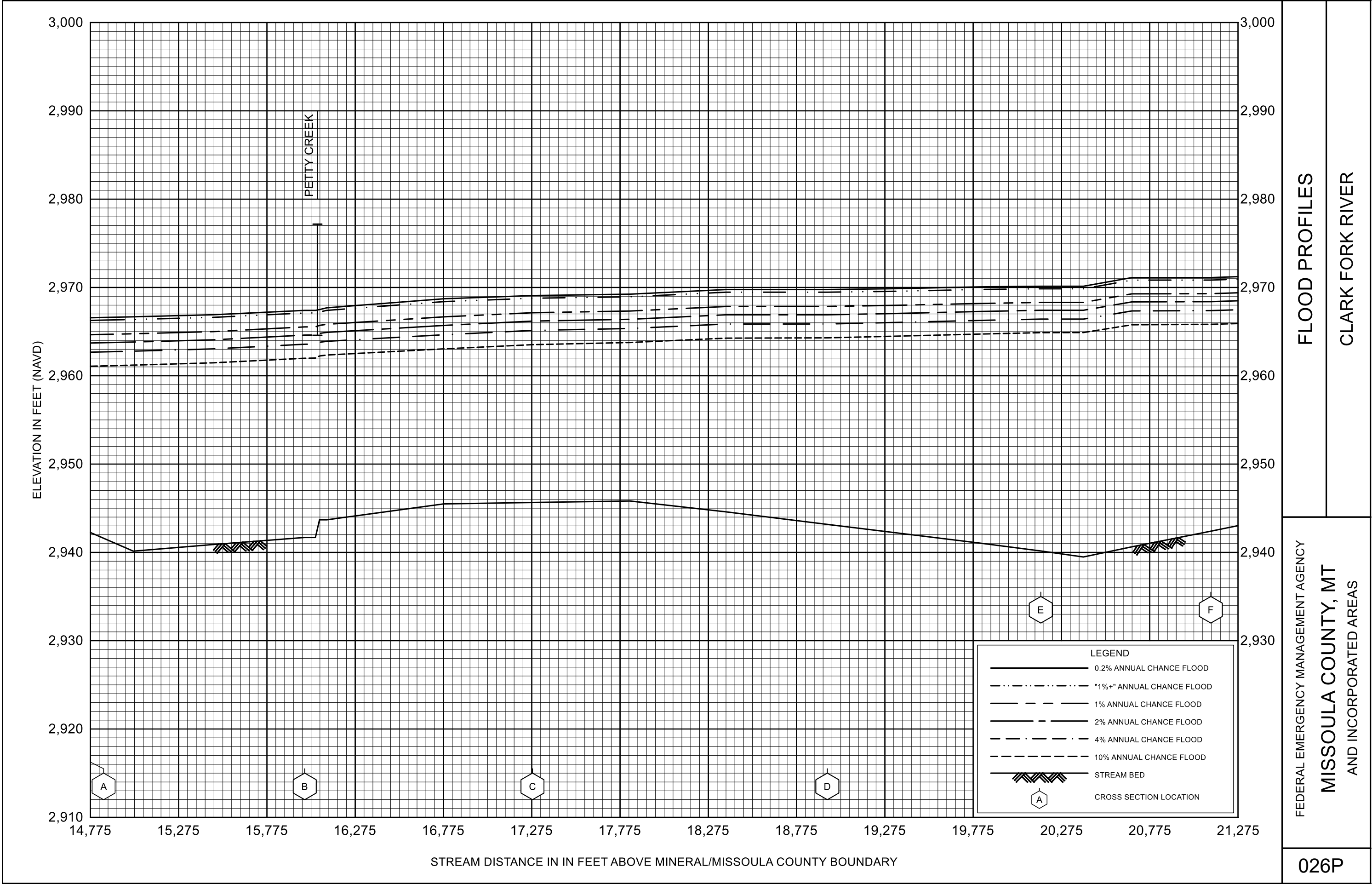
BUTLER CREEK

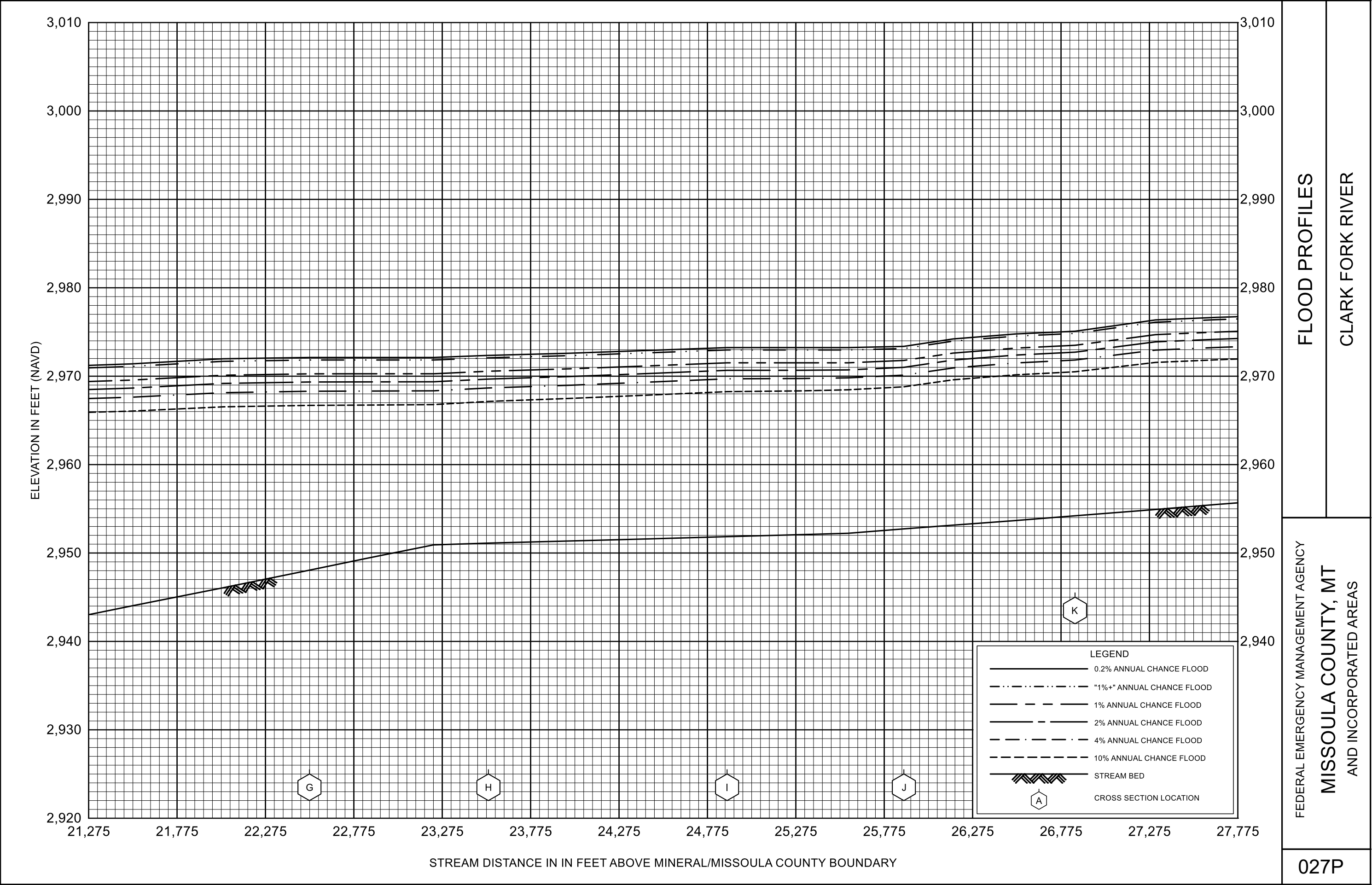
FEDERAL EMERGENCY MANAGEMENT AGENCY

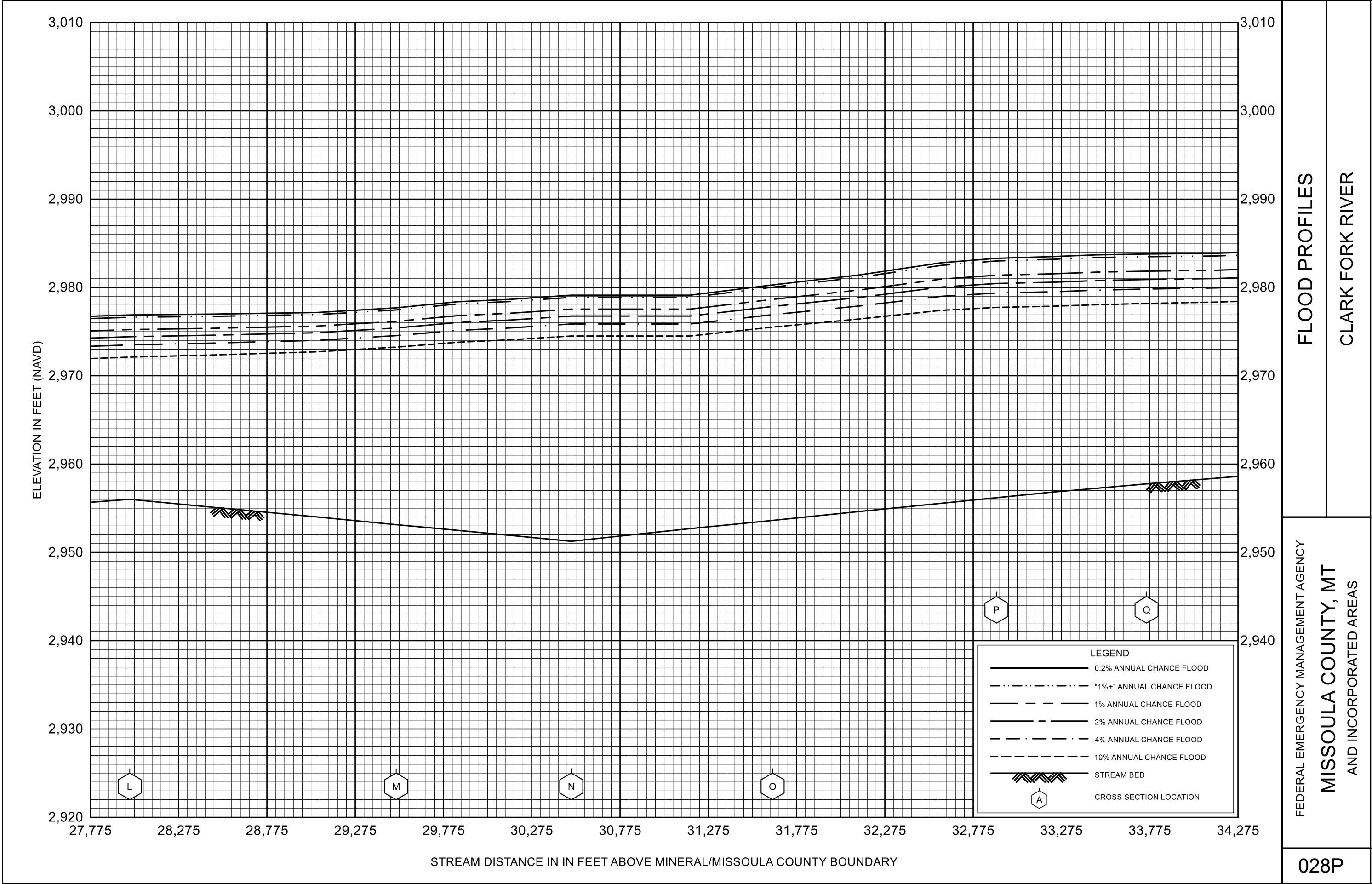
MISSOULA COUNTY, MT
AND INCORPORATED AREAS

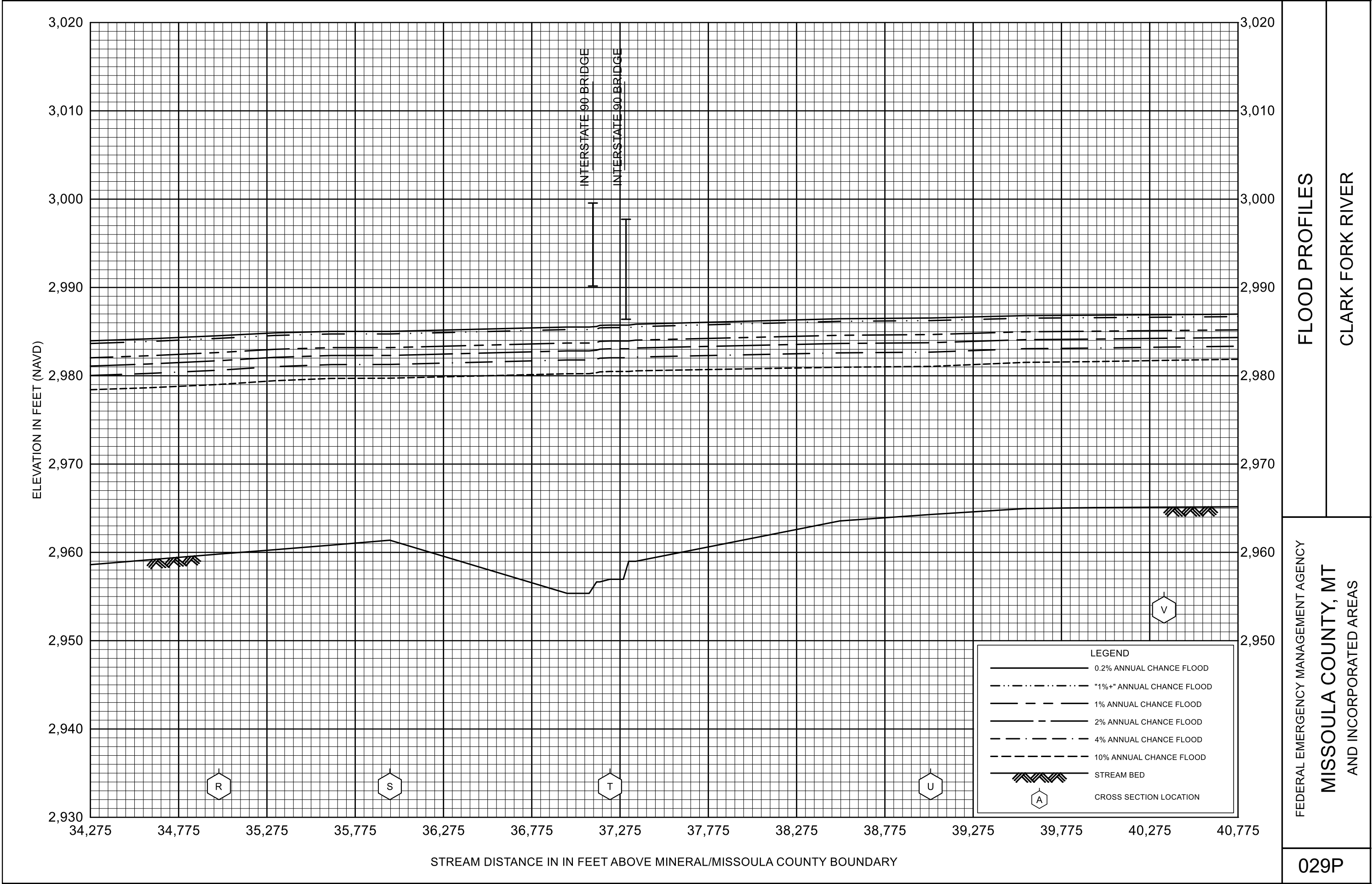


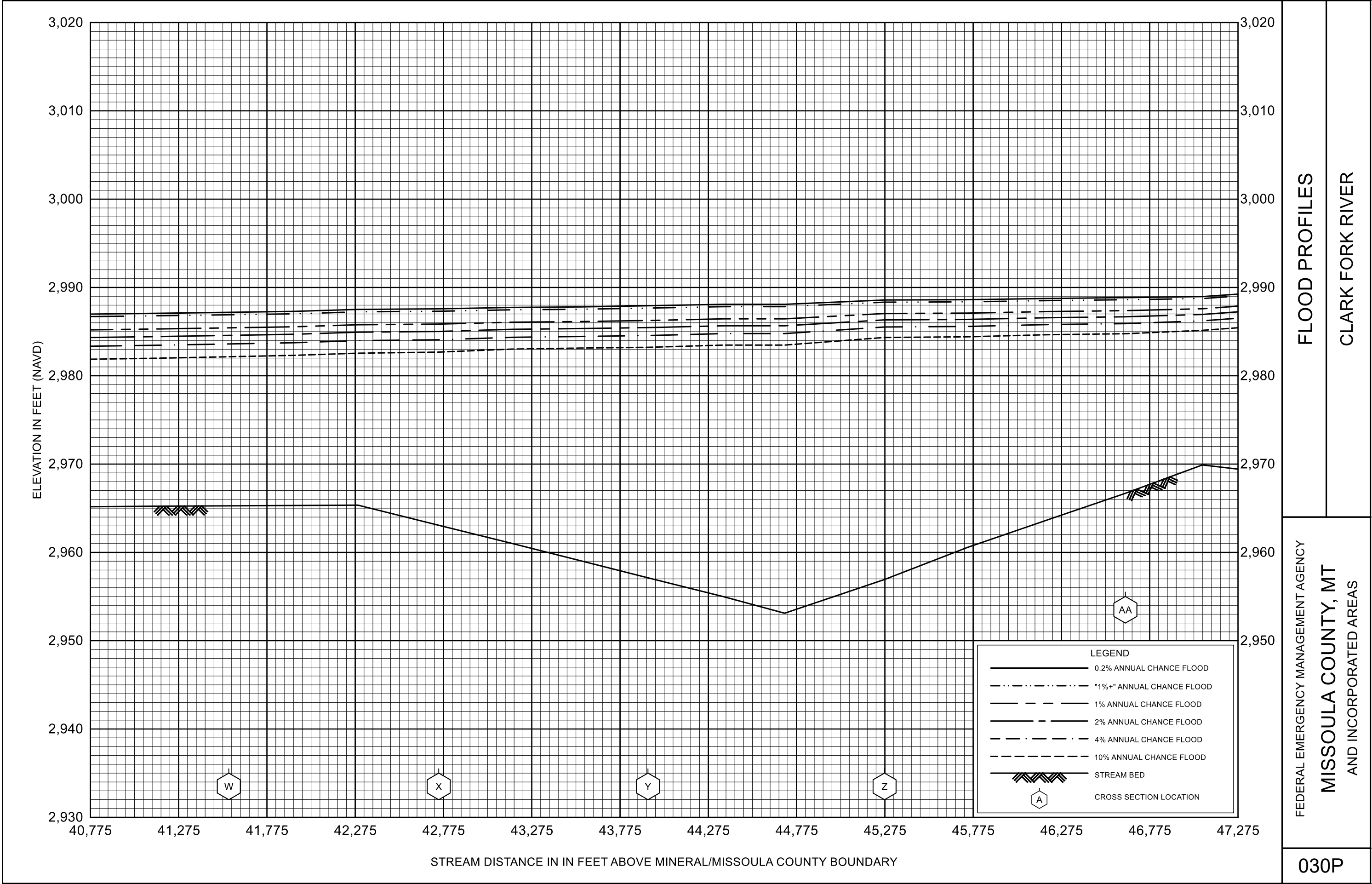


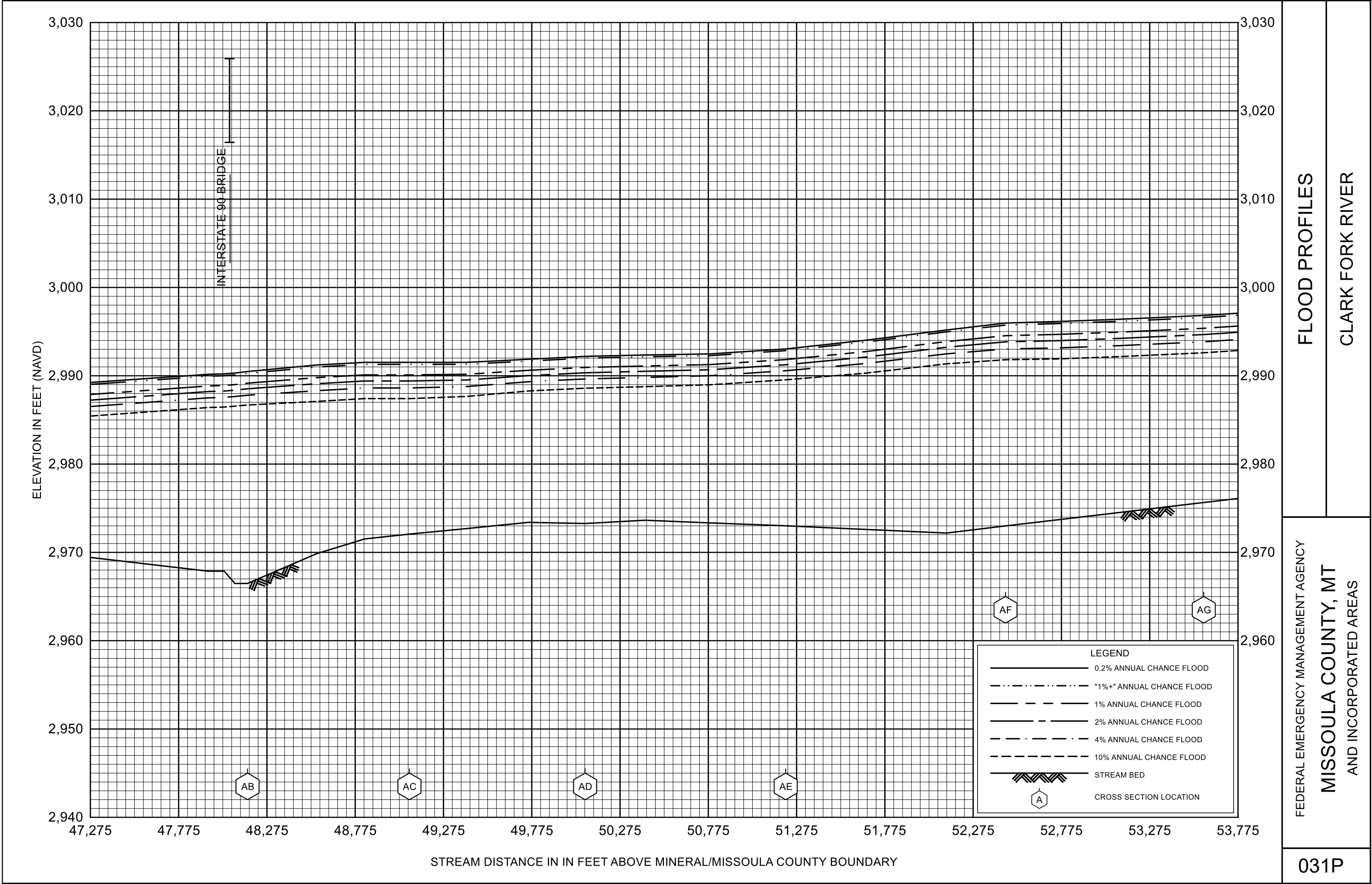










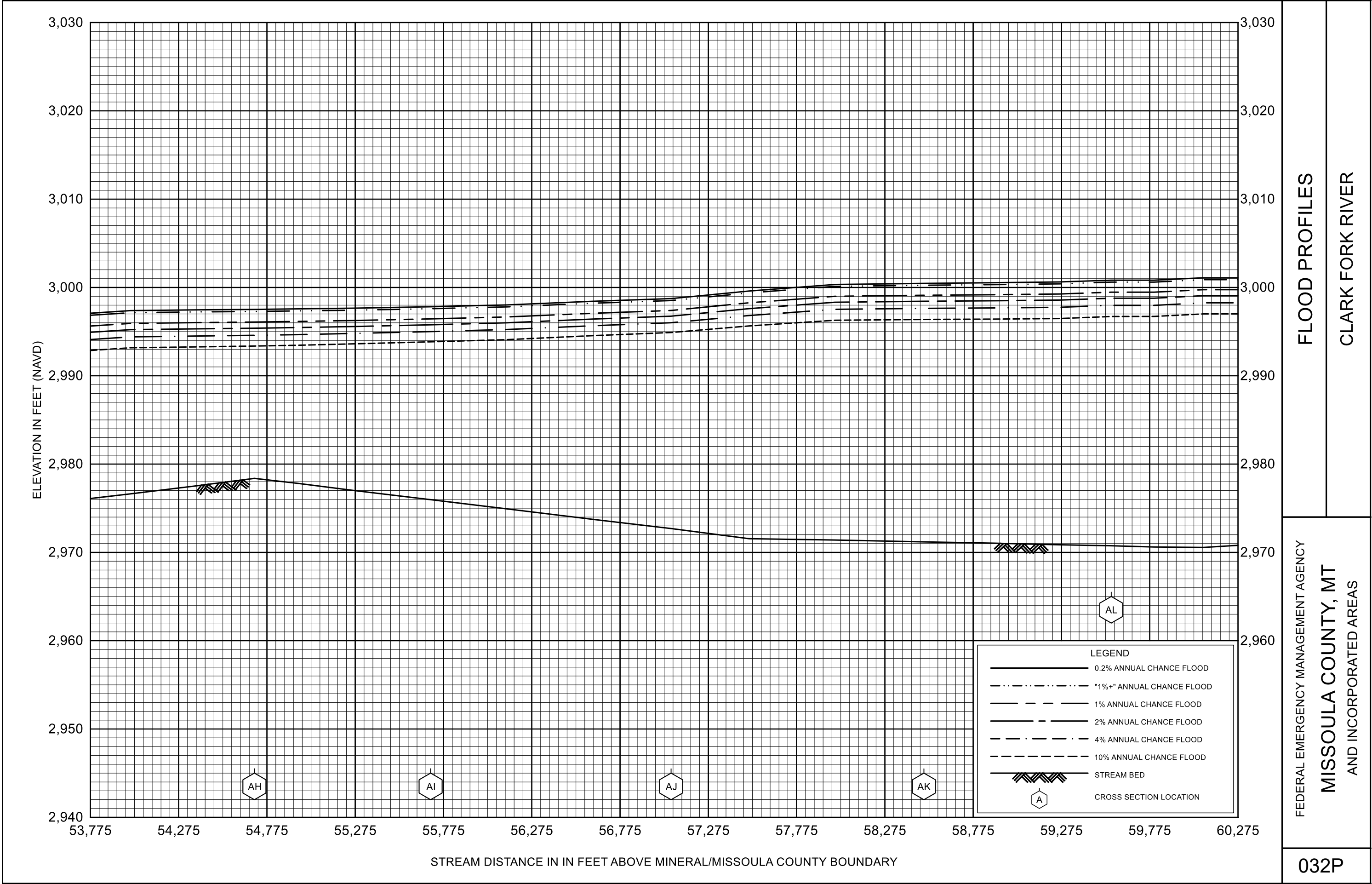


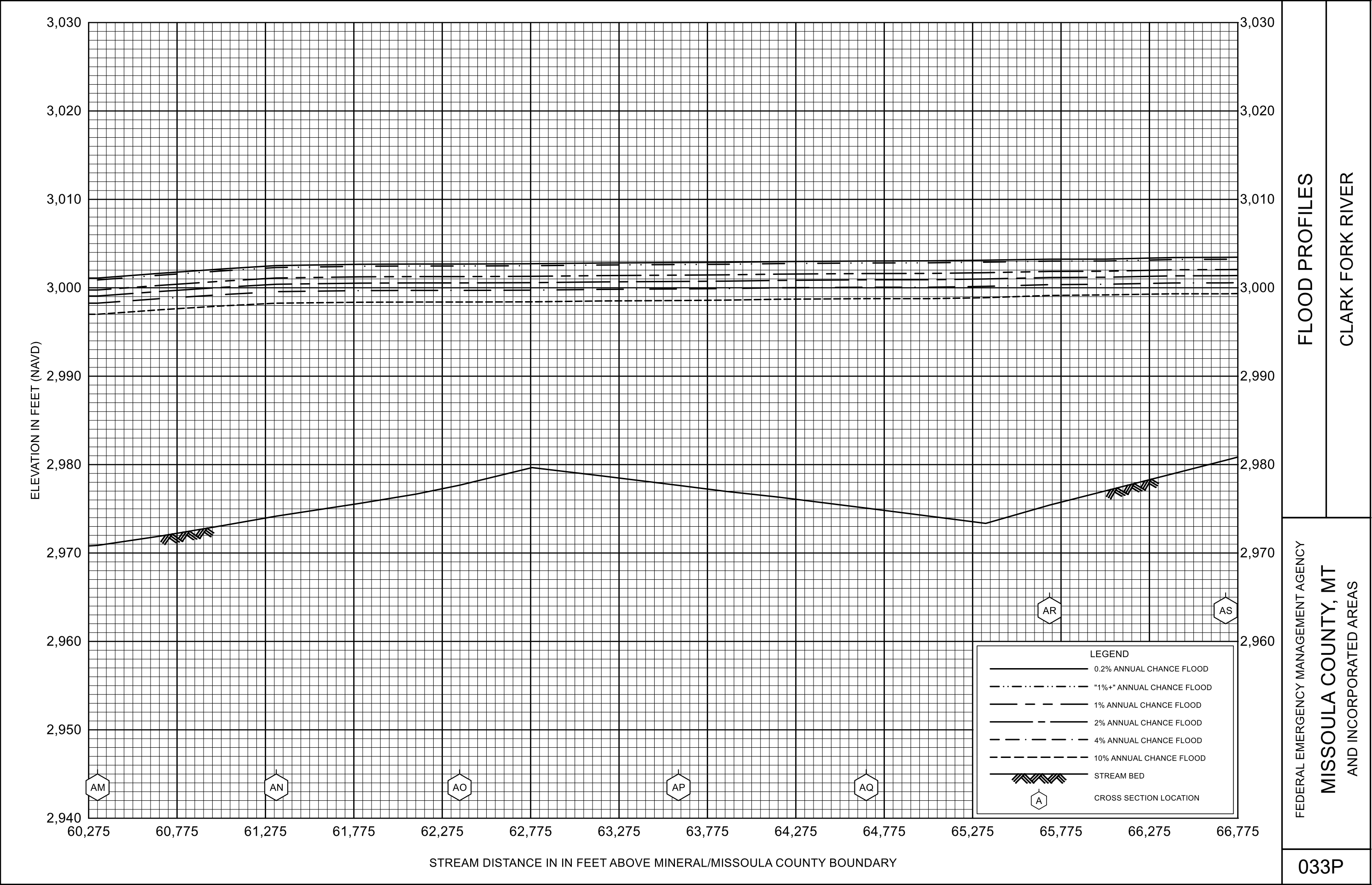
FLOOD PROFILES

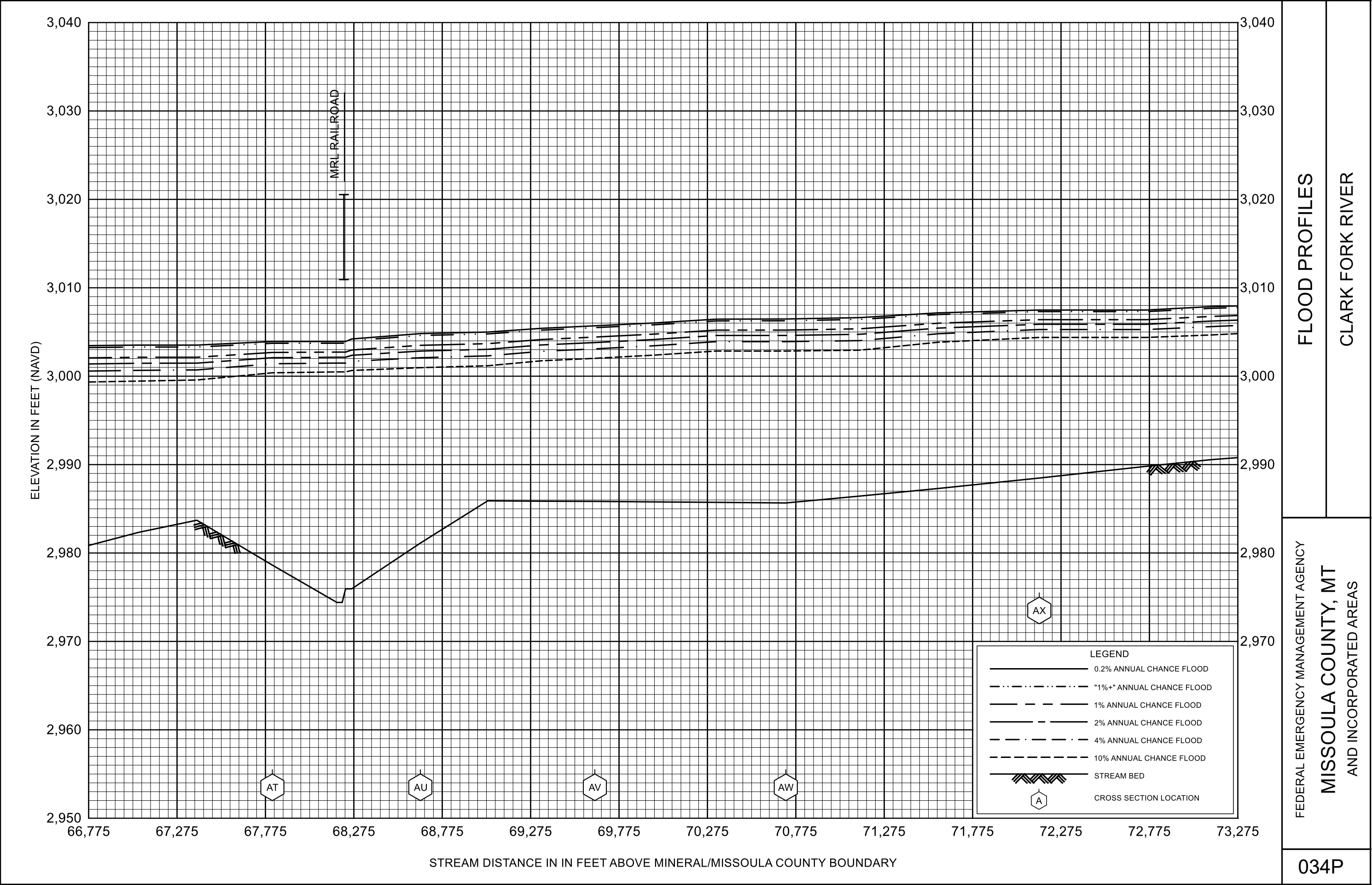
CLARK FORK RIVER

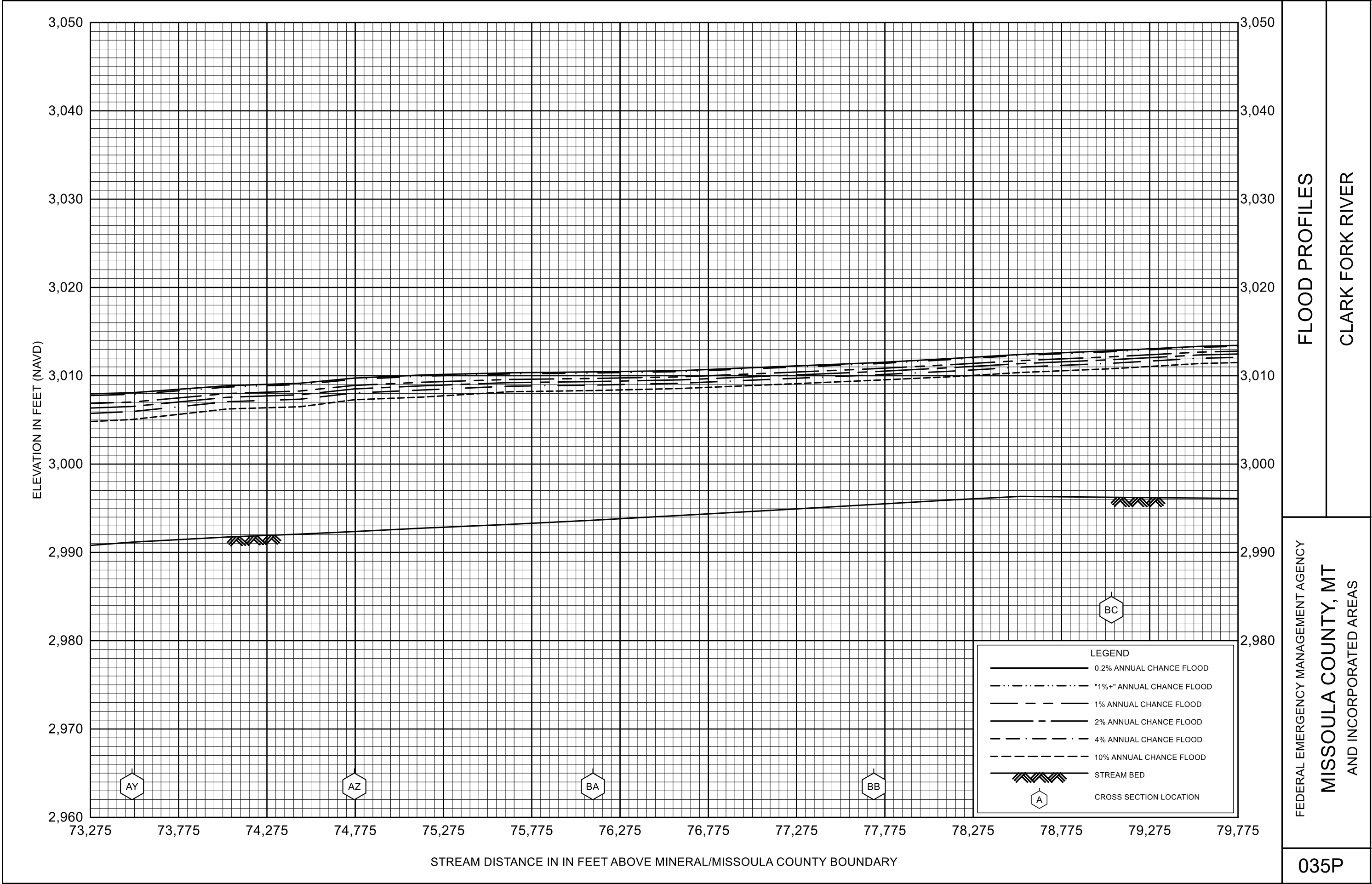
FEDERAL EMERGENCY MANAGEMENT AGENCY

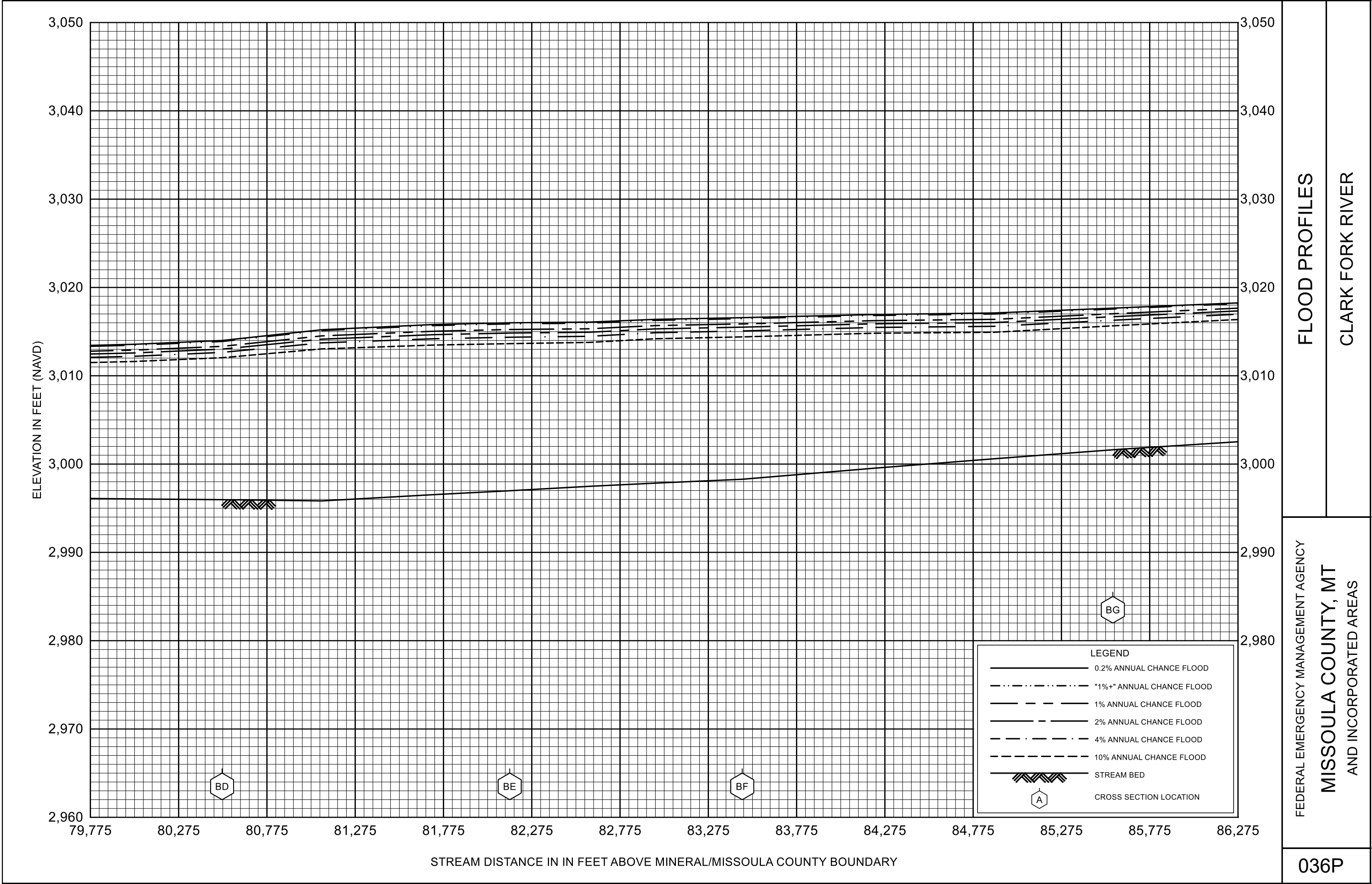
MISSOULA COUNTY, MT
AND INCORPORATED AREAS

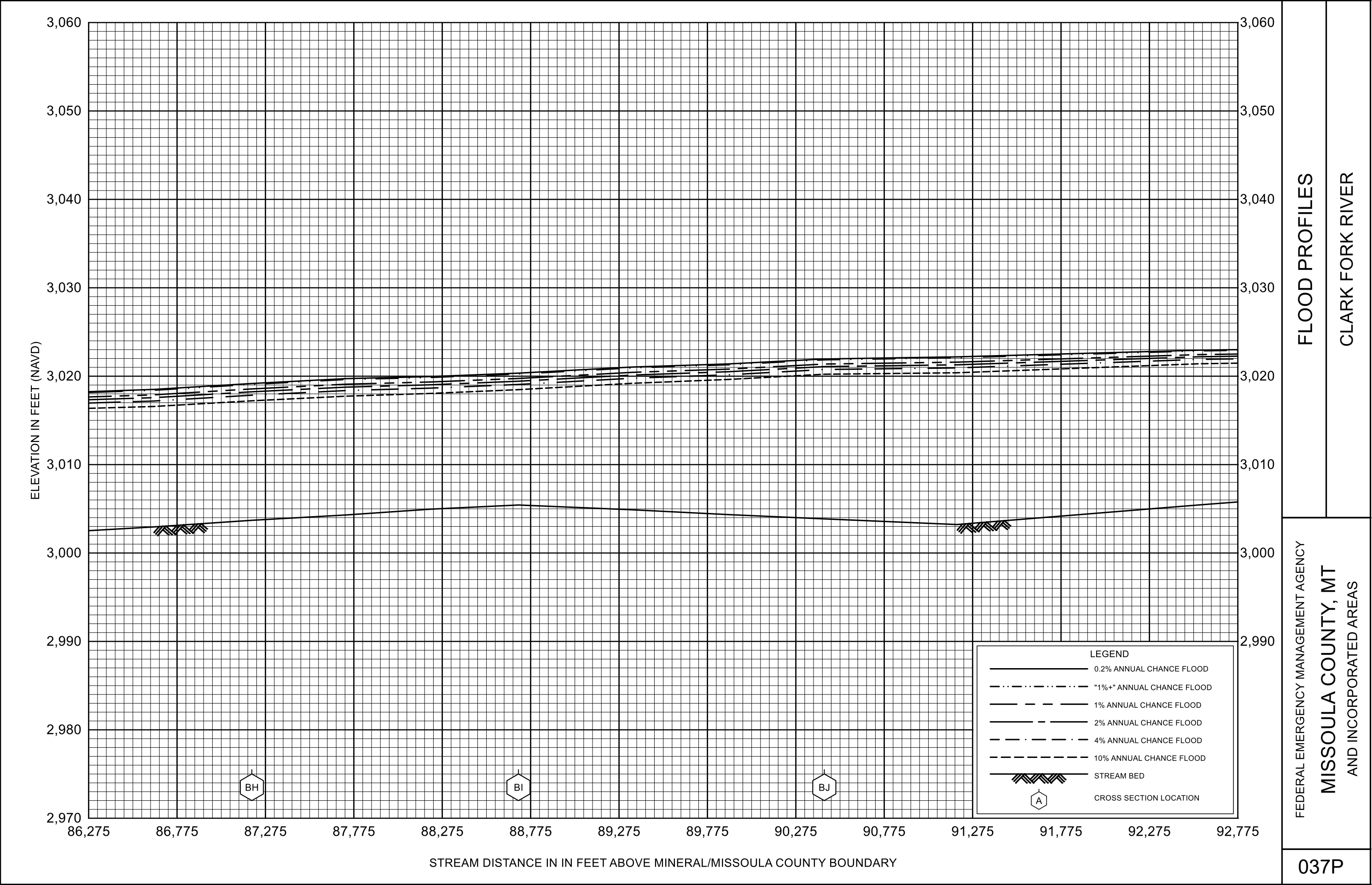












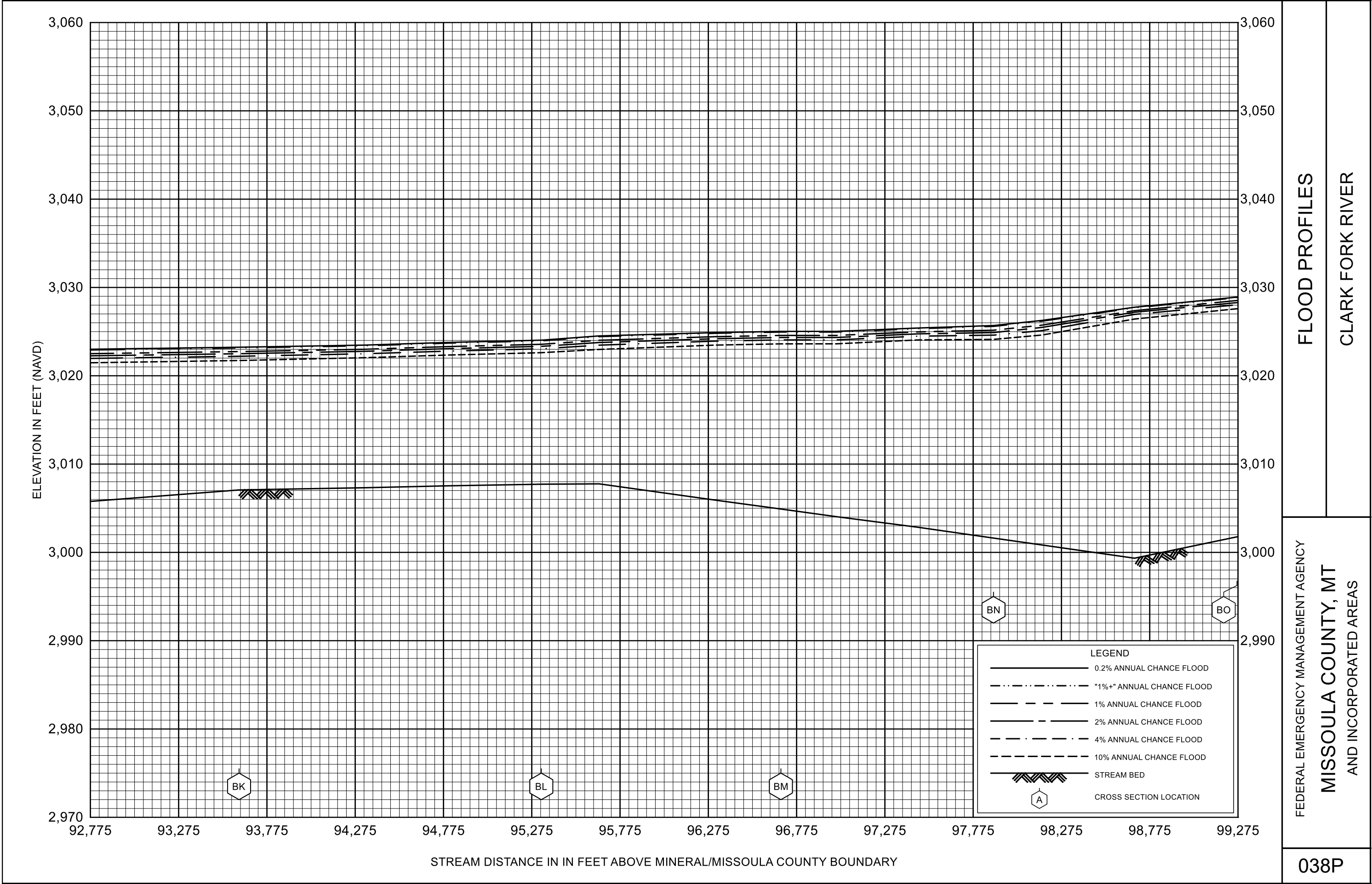
FLOOD PROFILES

CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS

037P

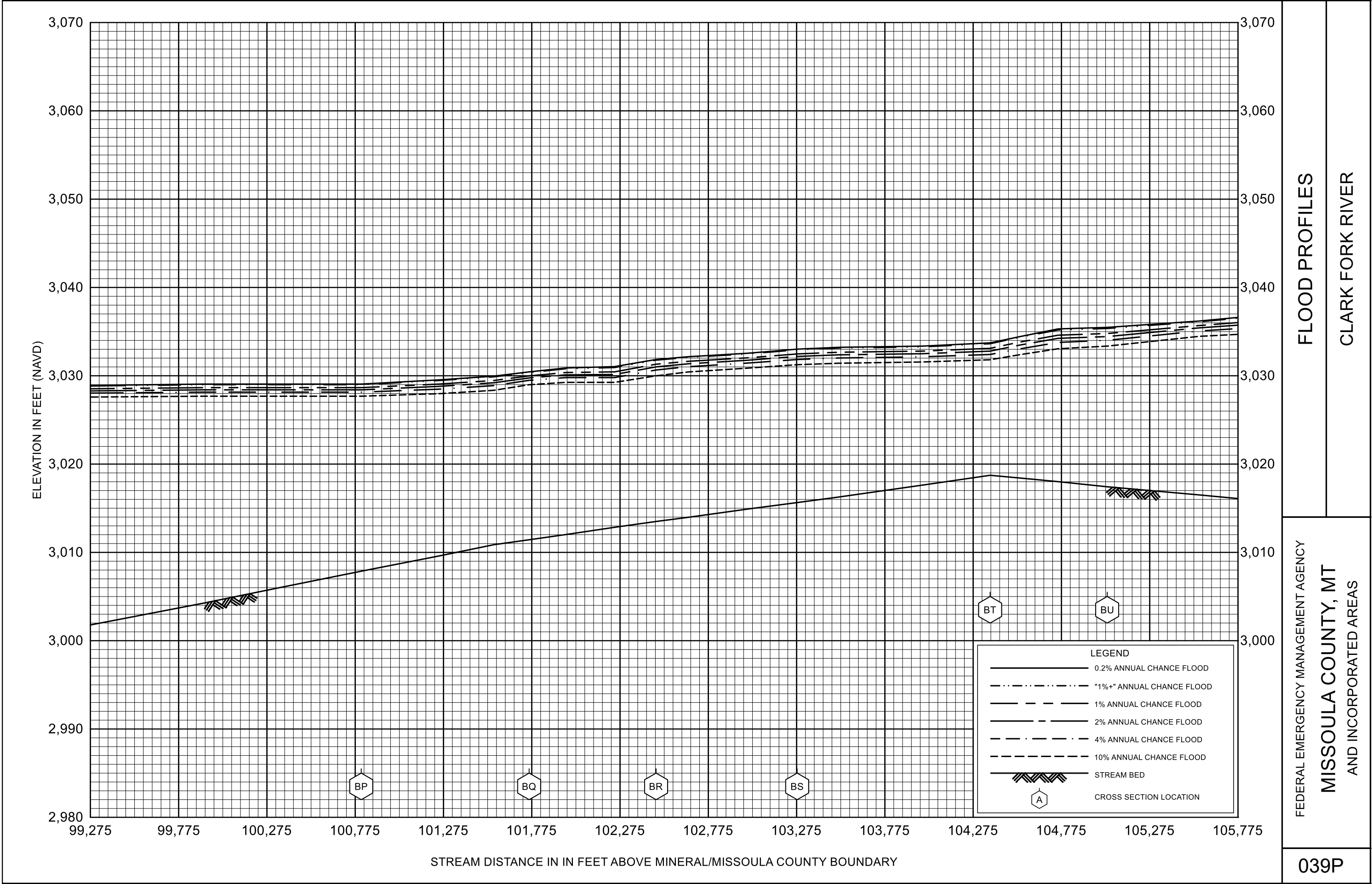


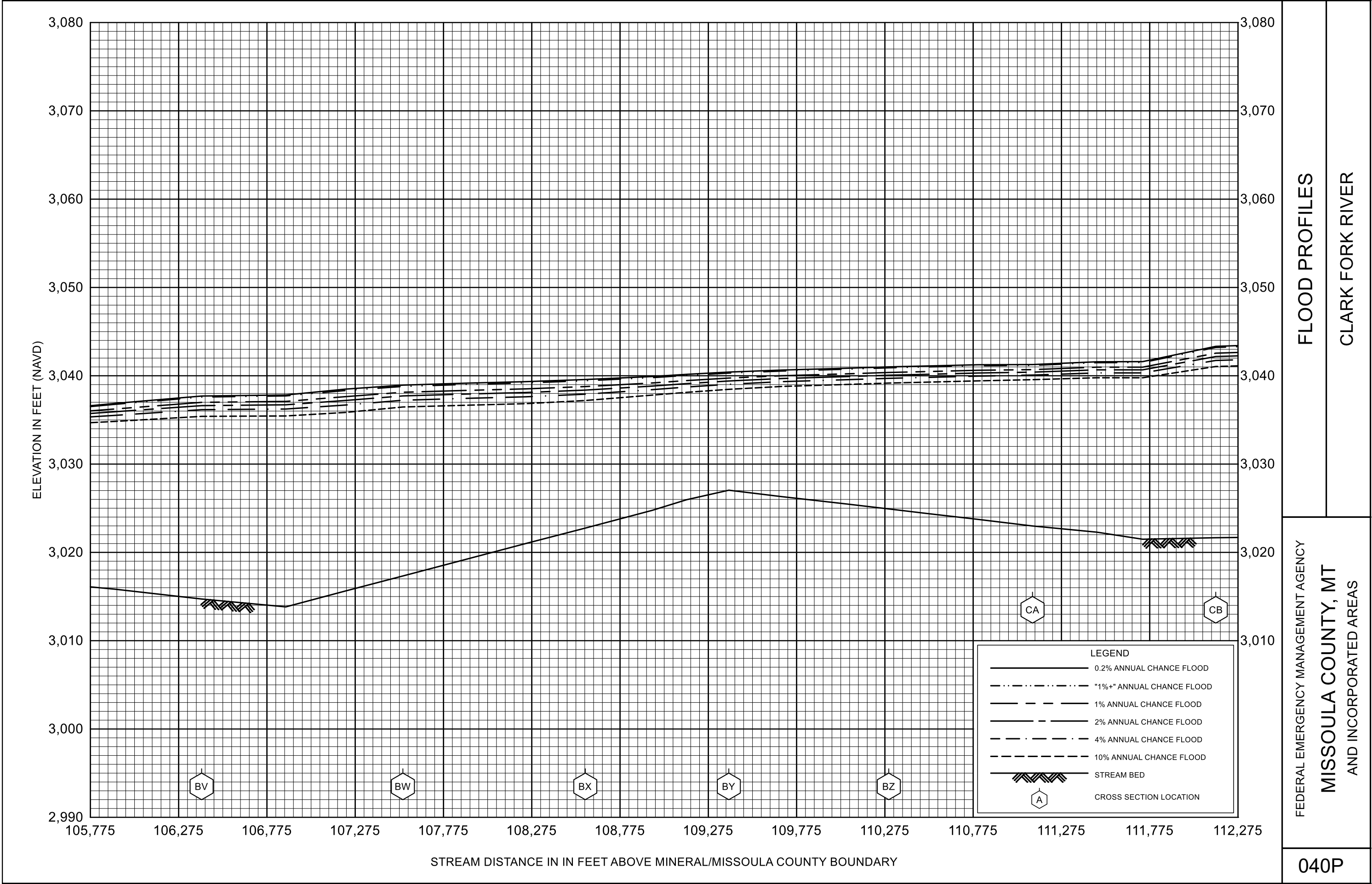
FLOOD PROFILES

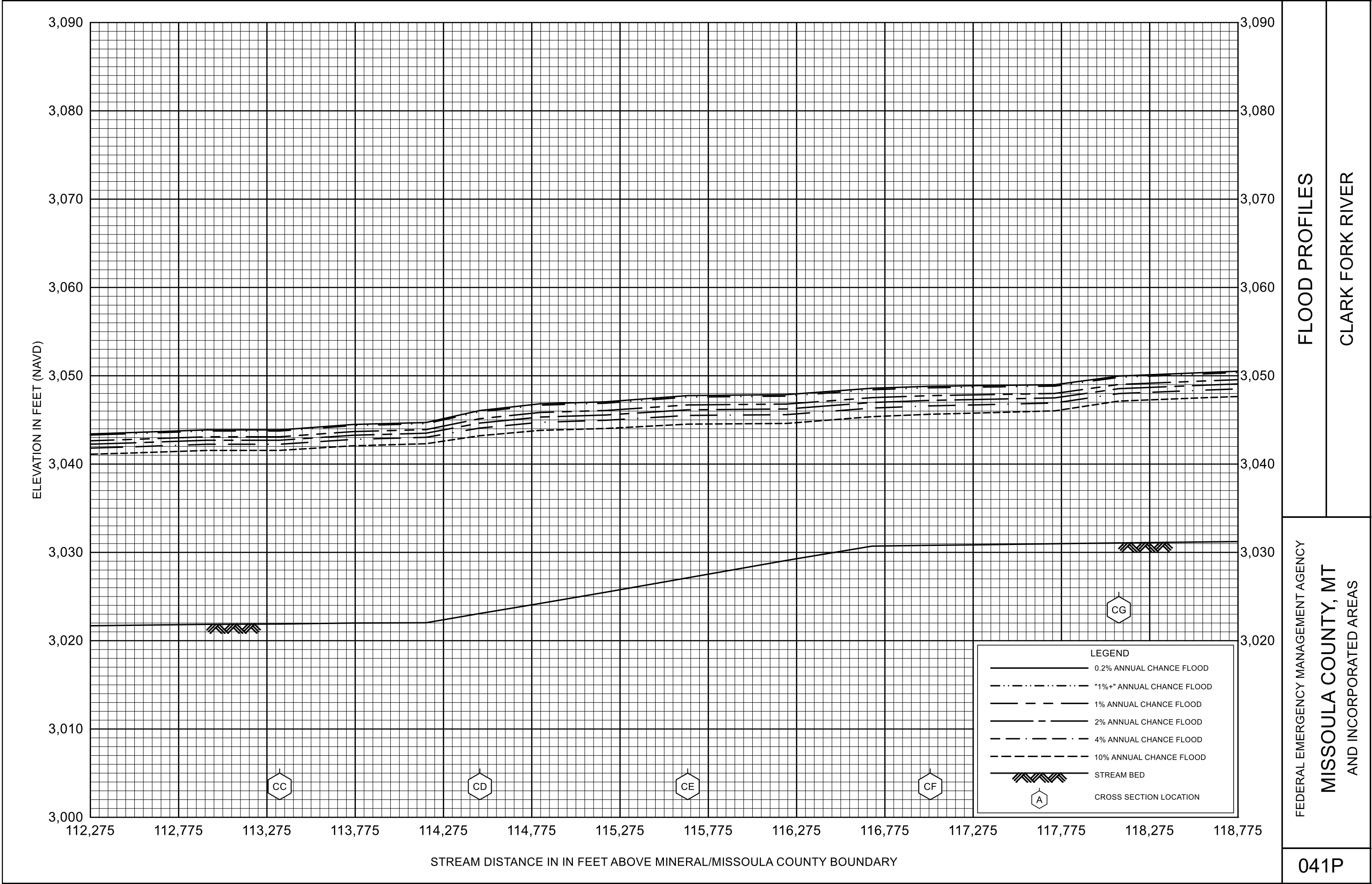
CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS





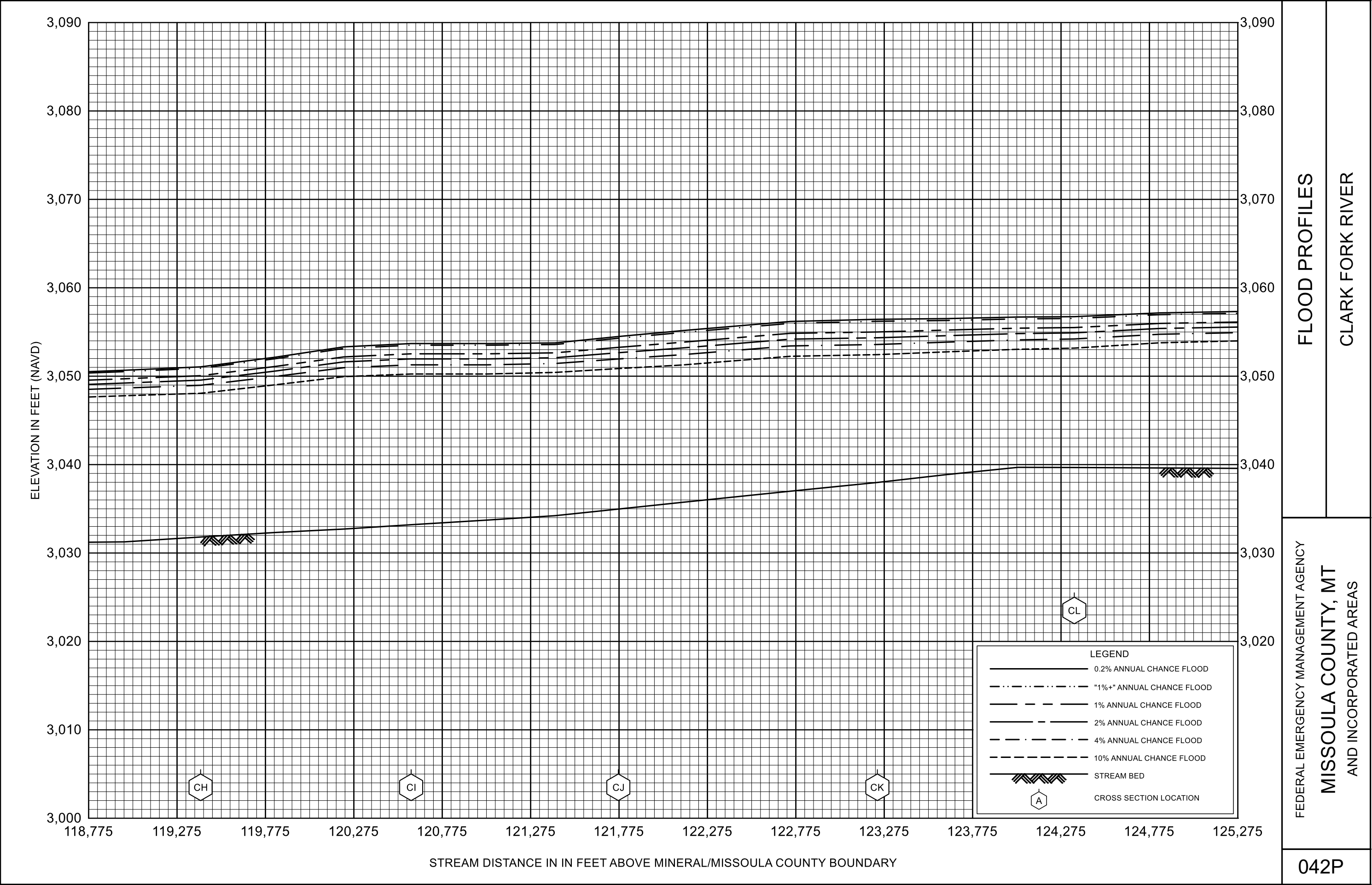


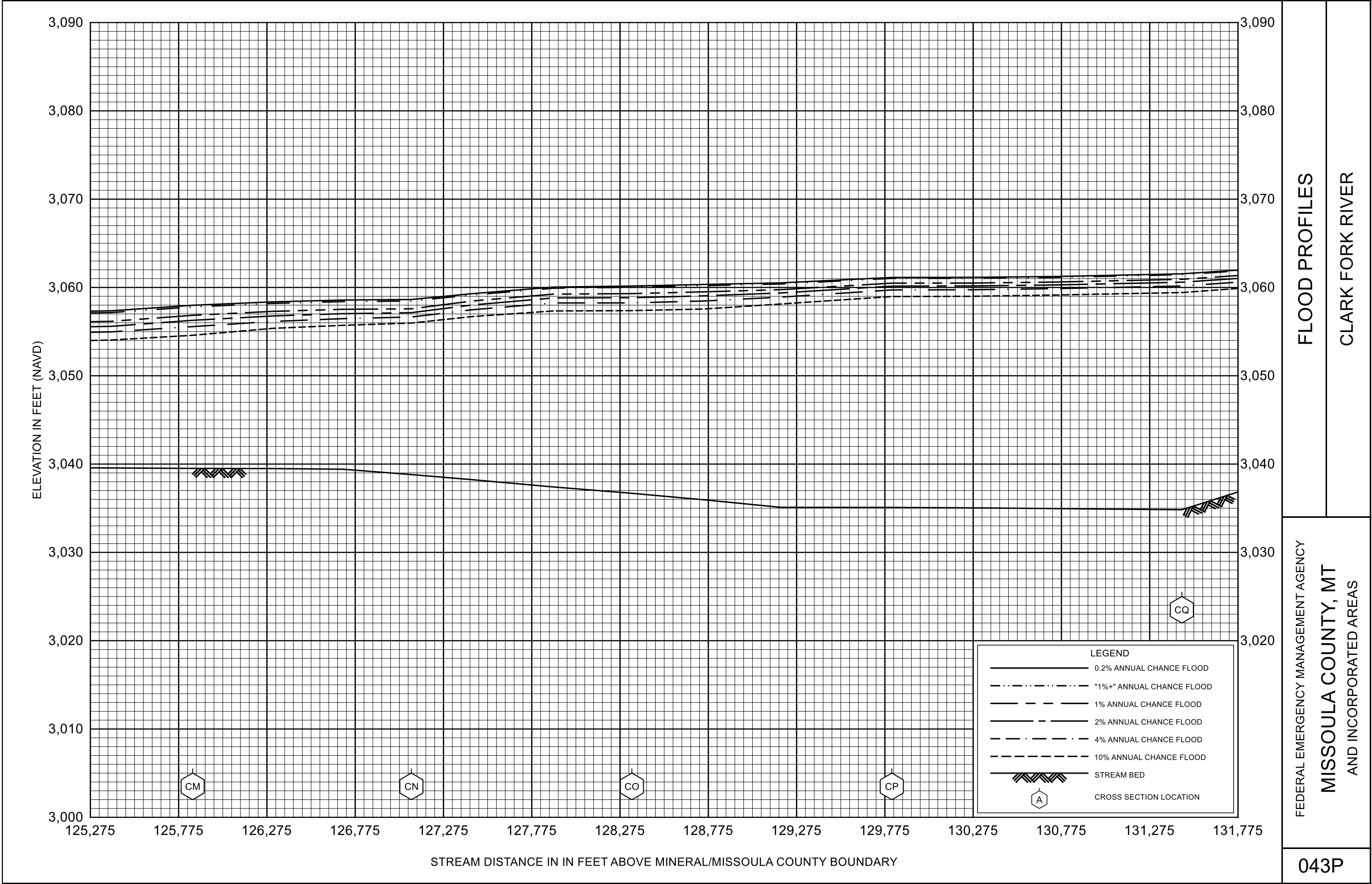
FLOOD PROFILES

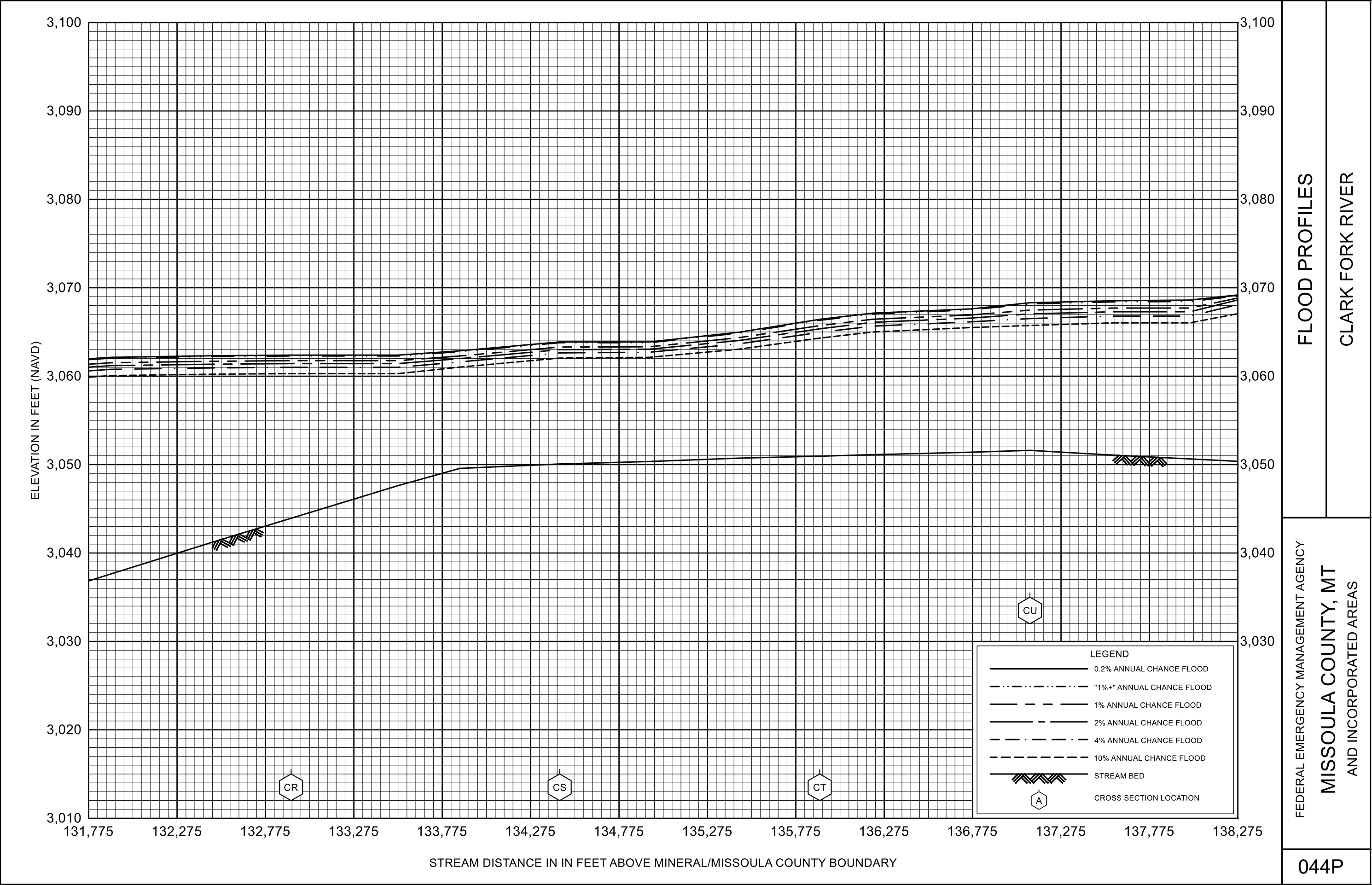
CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS





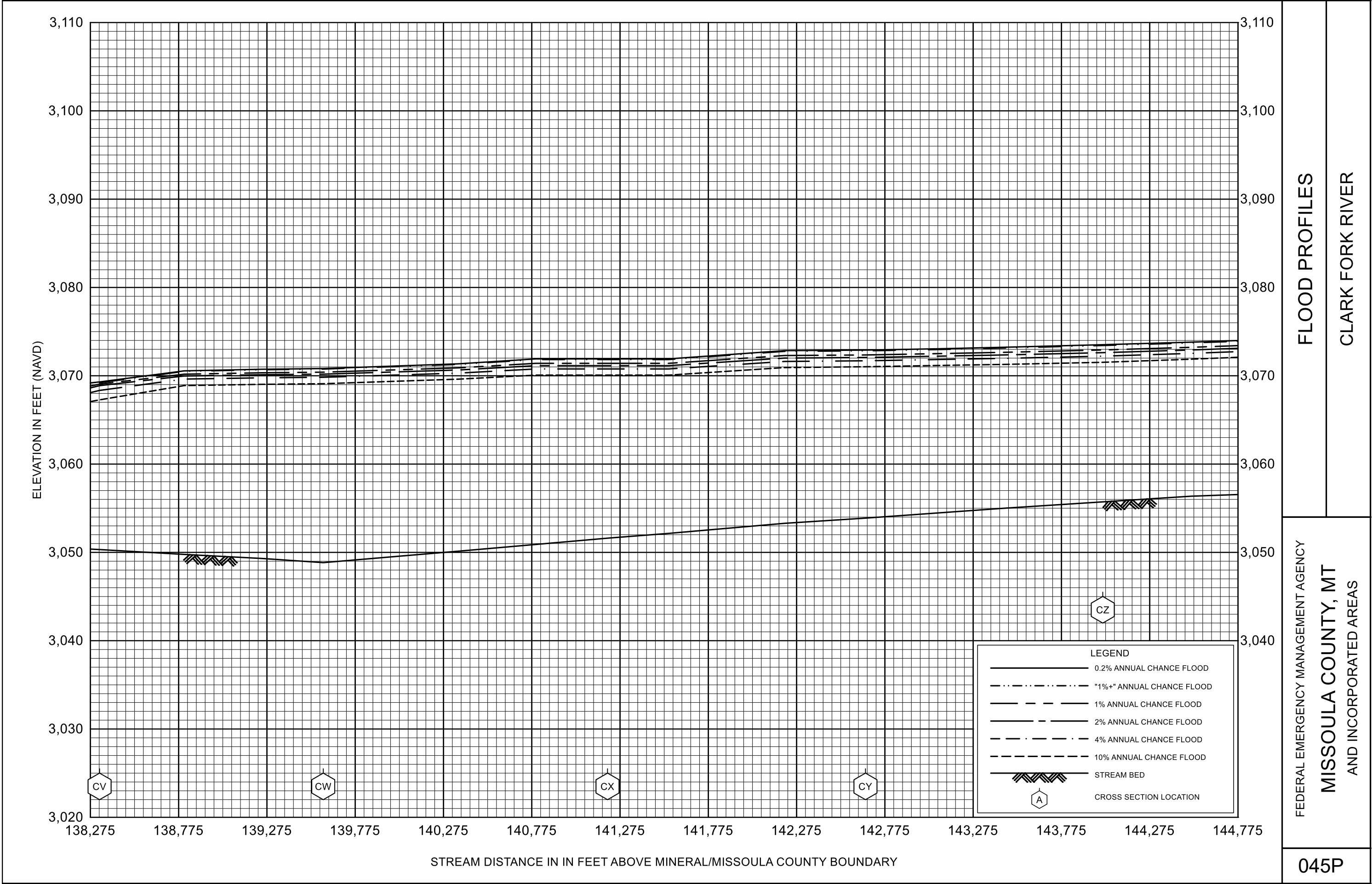


FLOOD PROFILES

CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS

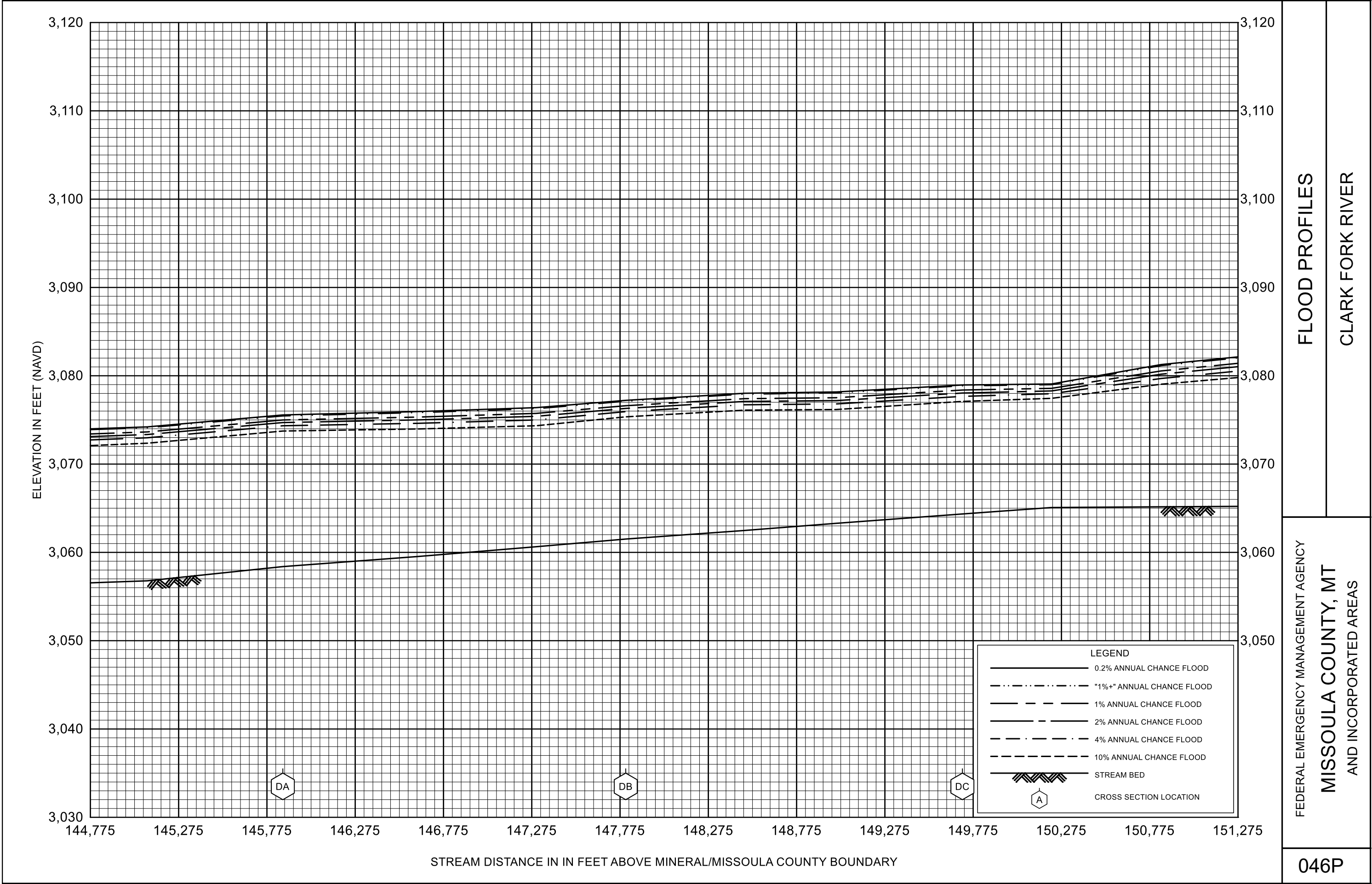


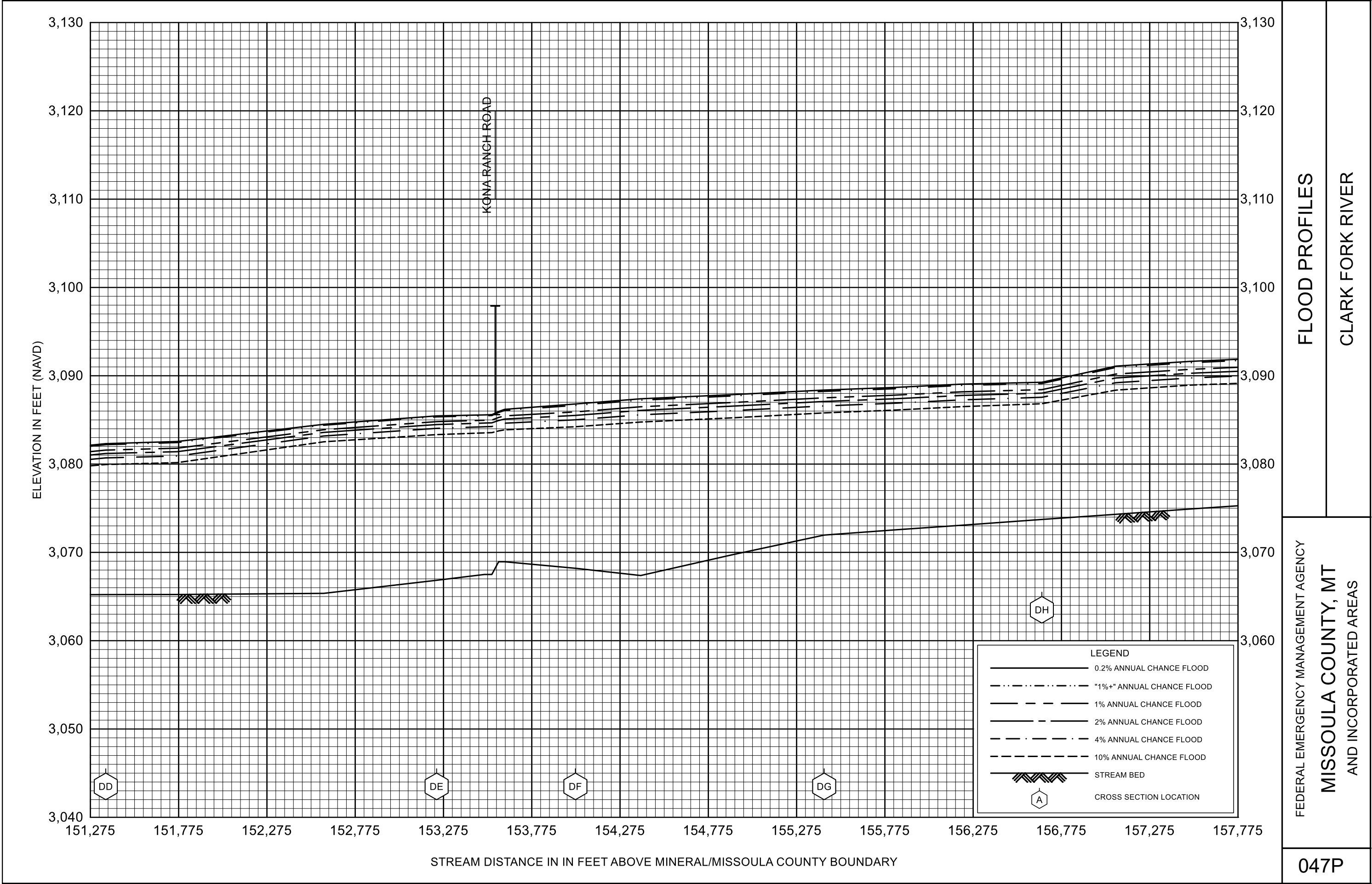
FLOOD PROFILES

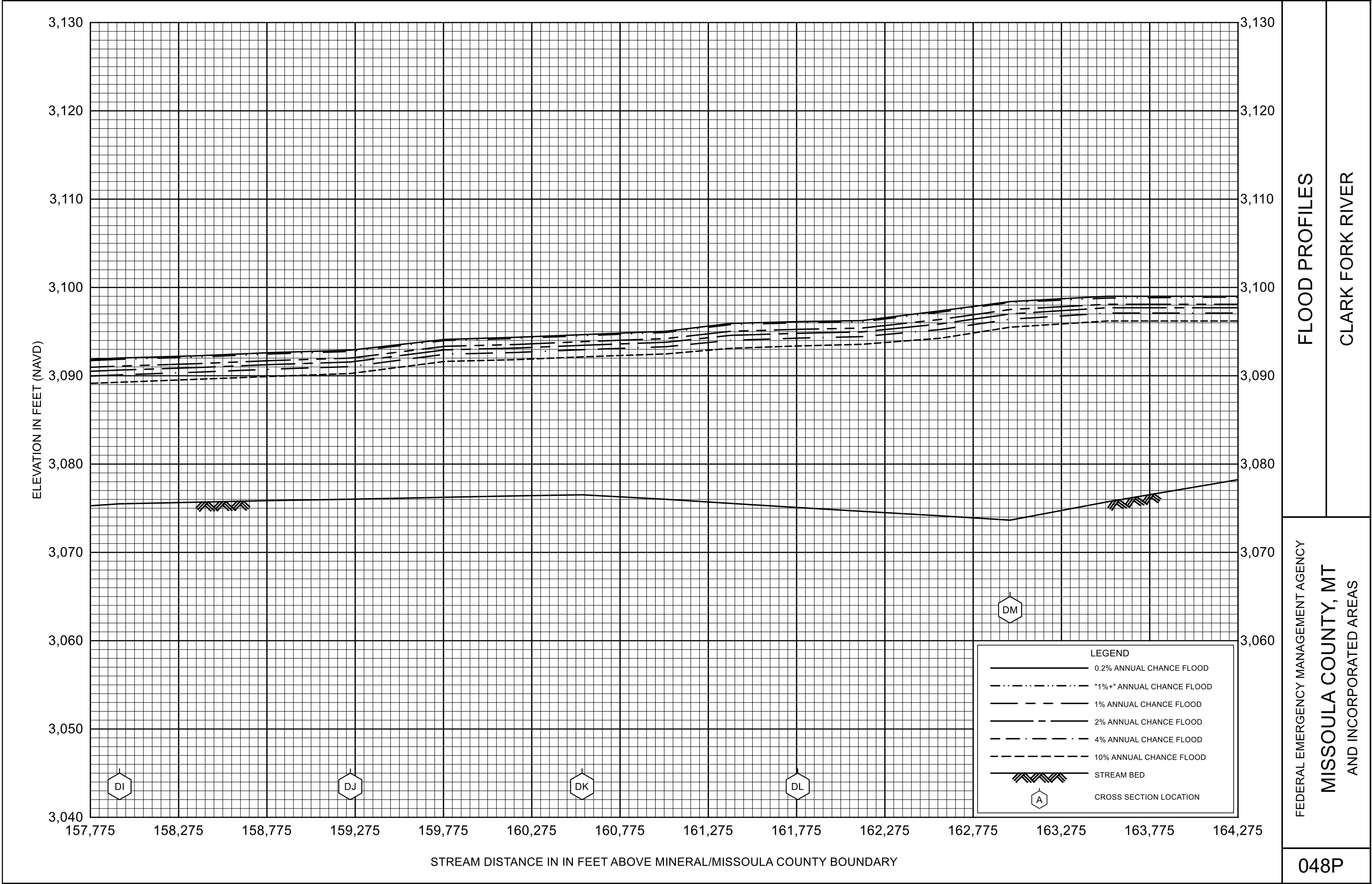
CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS





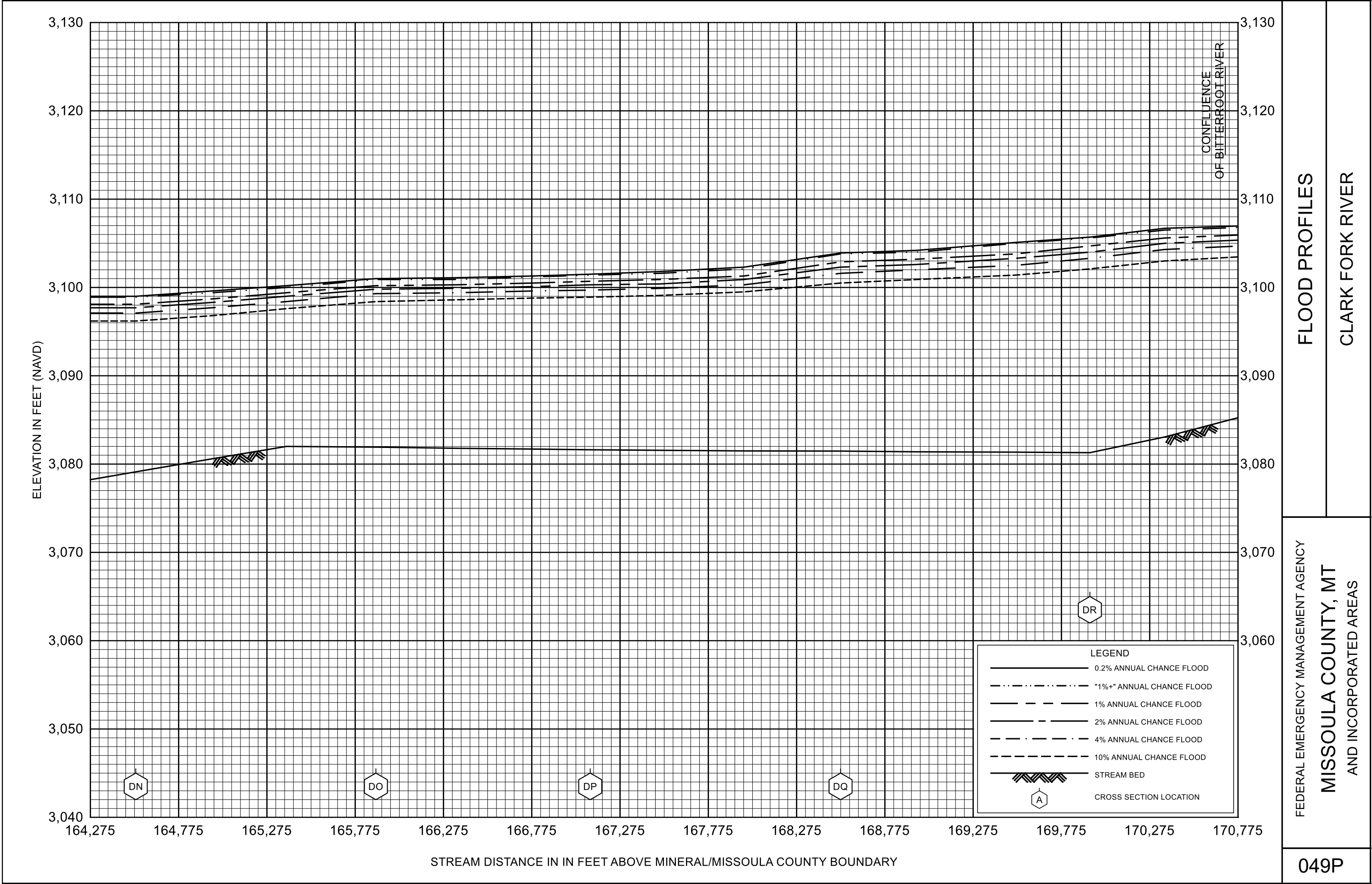


FLOOD PROFILES

CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

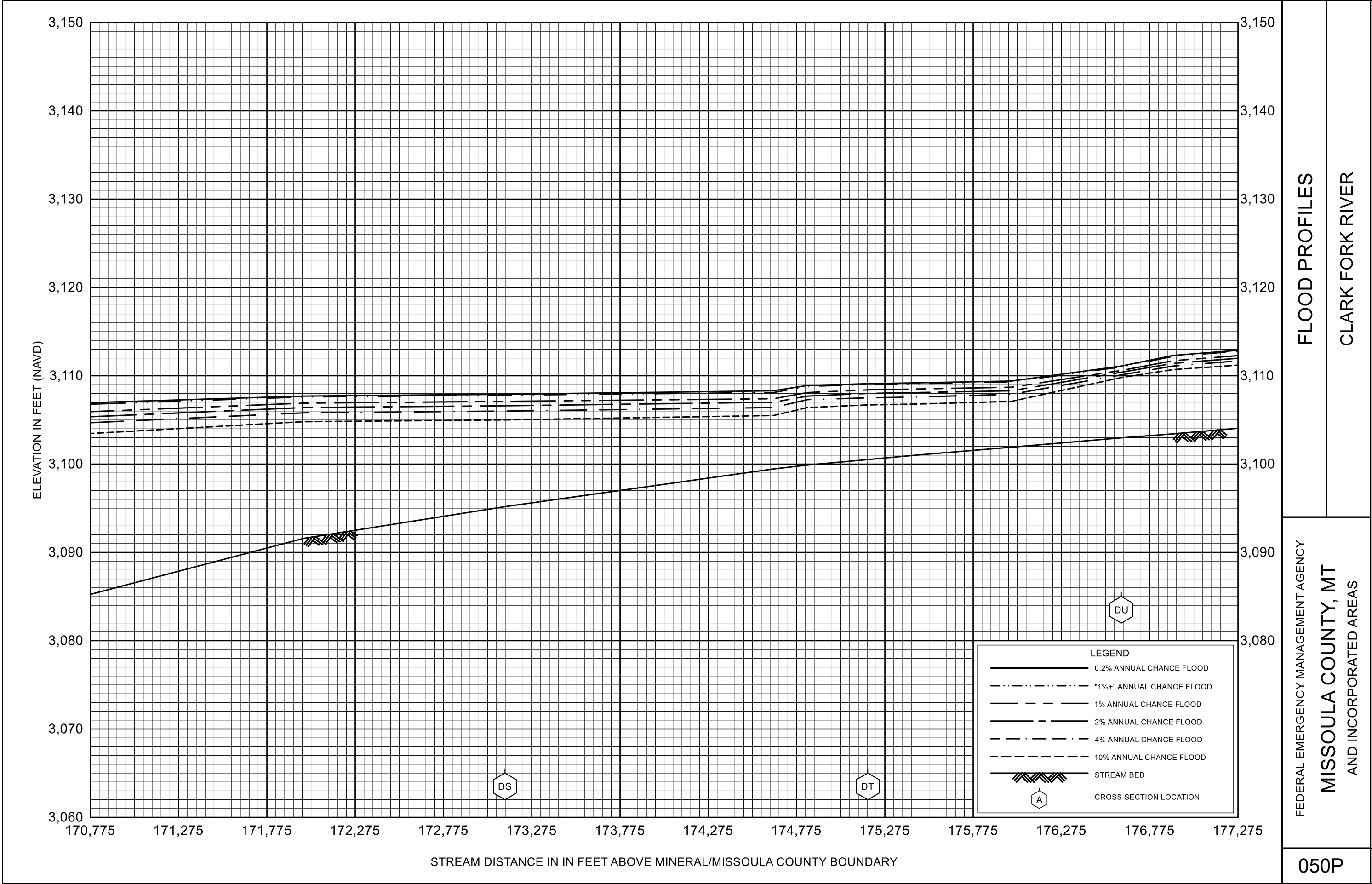
MISSOULA COUNTY, MT
AND INCORPORATED AREAS

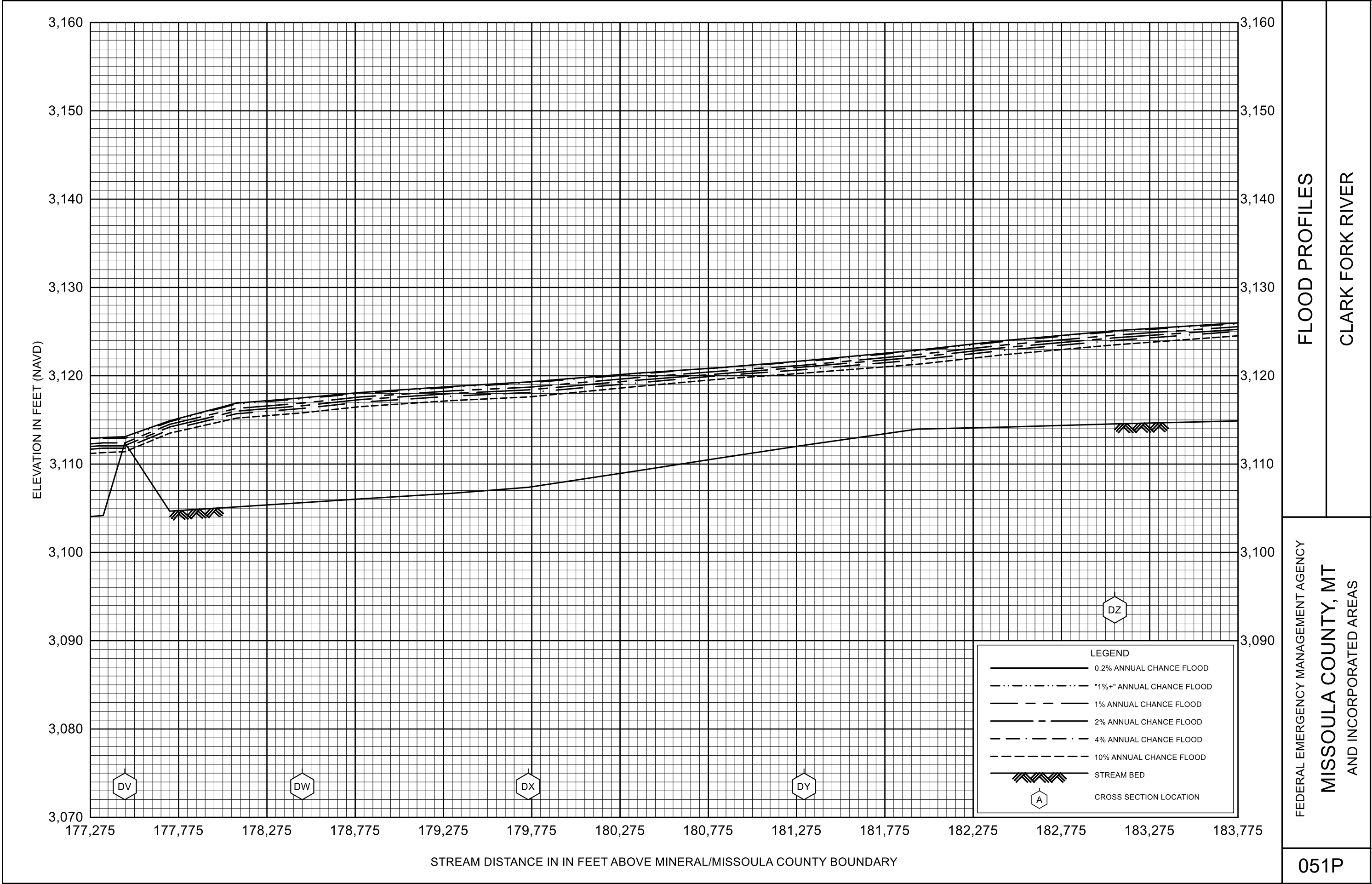


FLOOD PROFILES

CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
MISSOULA COUNTY, MT
AND INCORPORATED AREAS



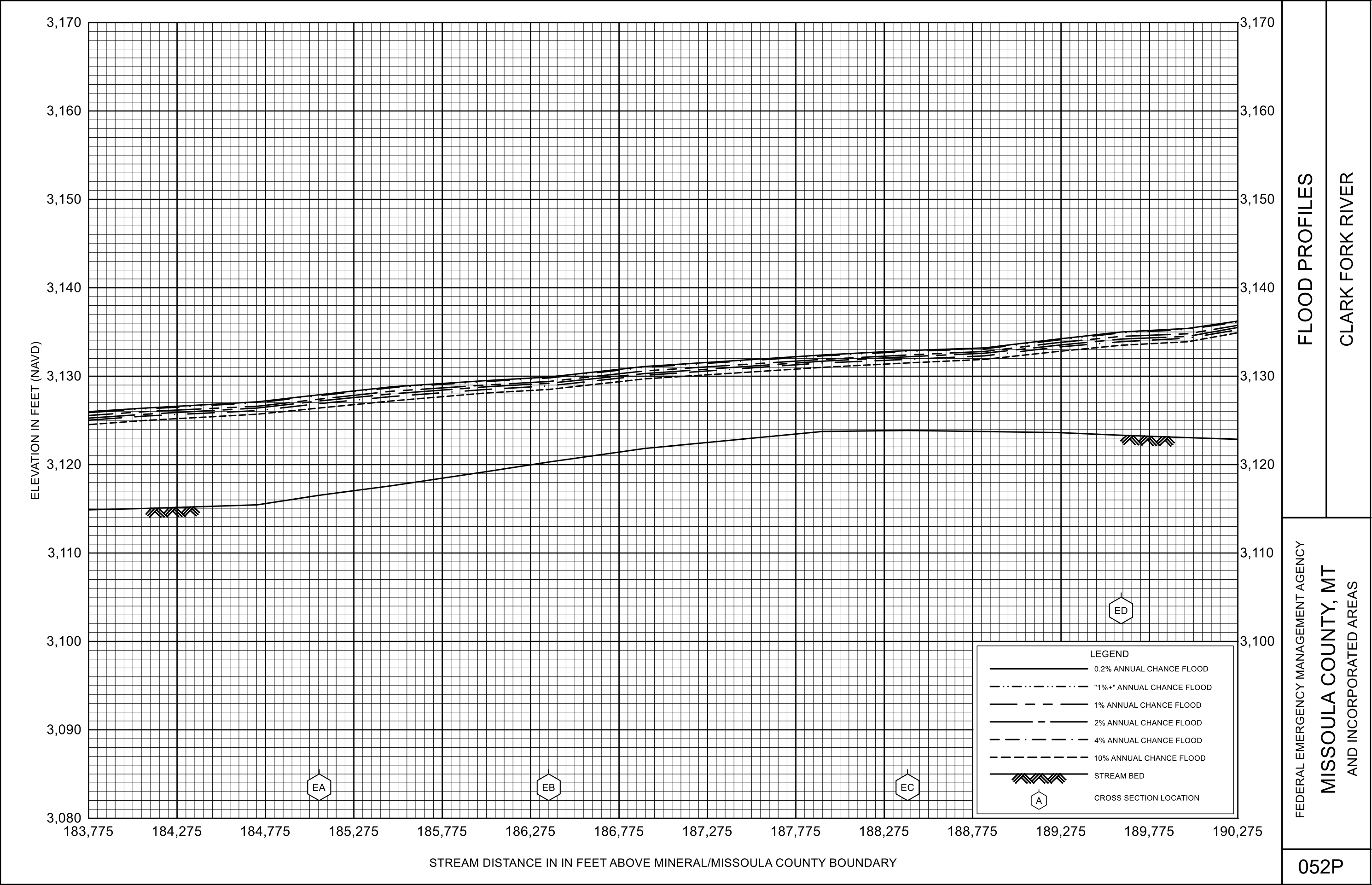


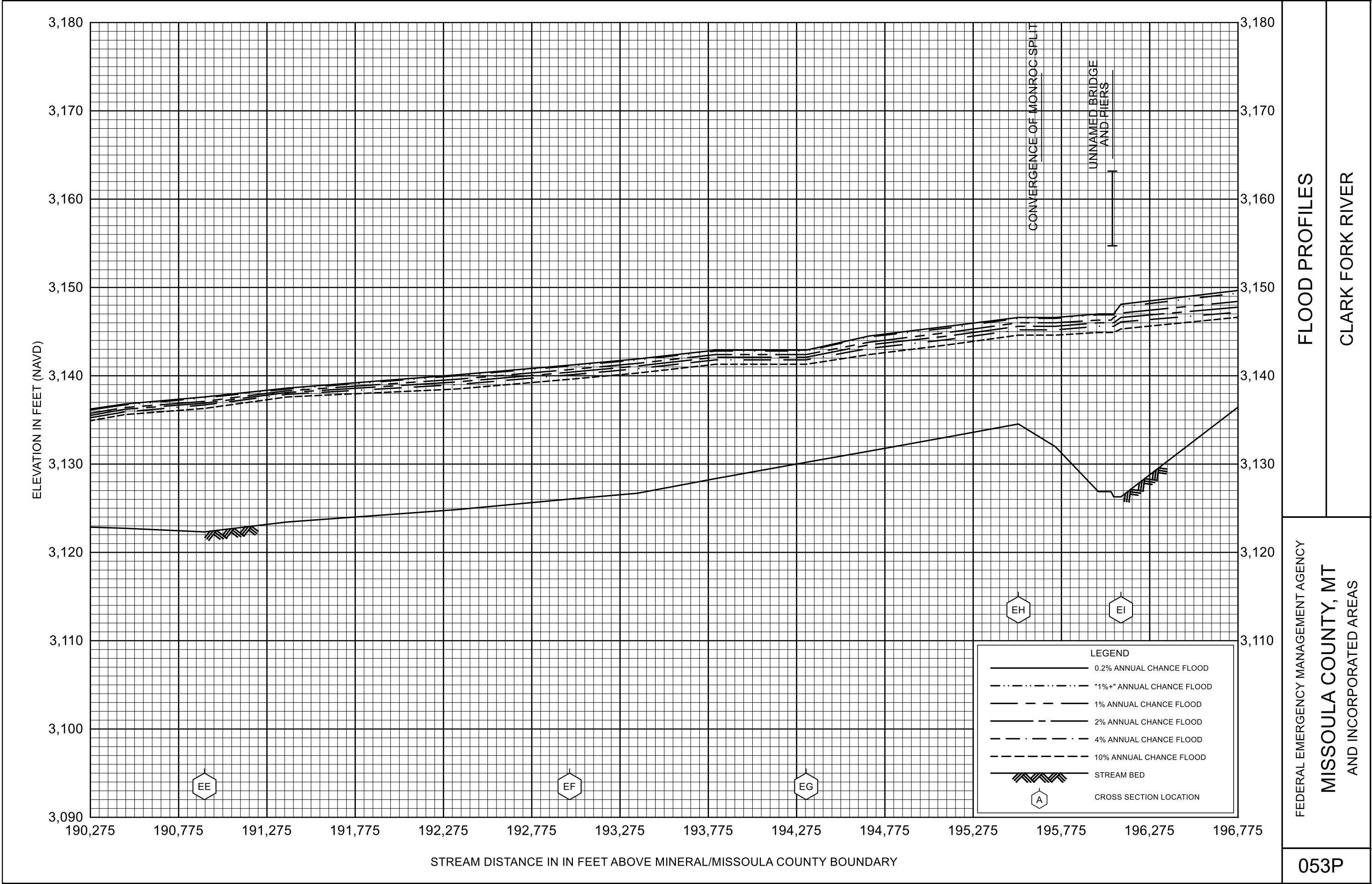
FLOOD PROFILES

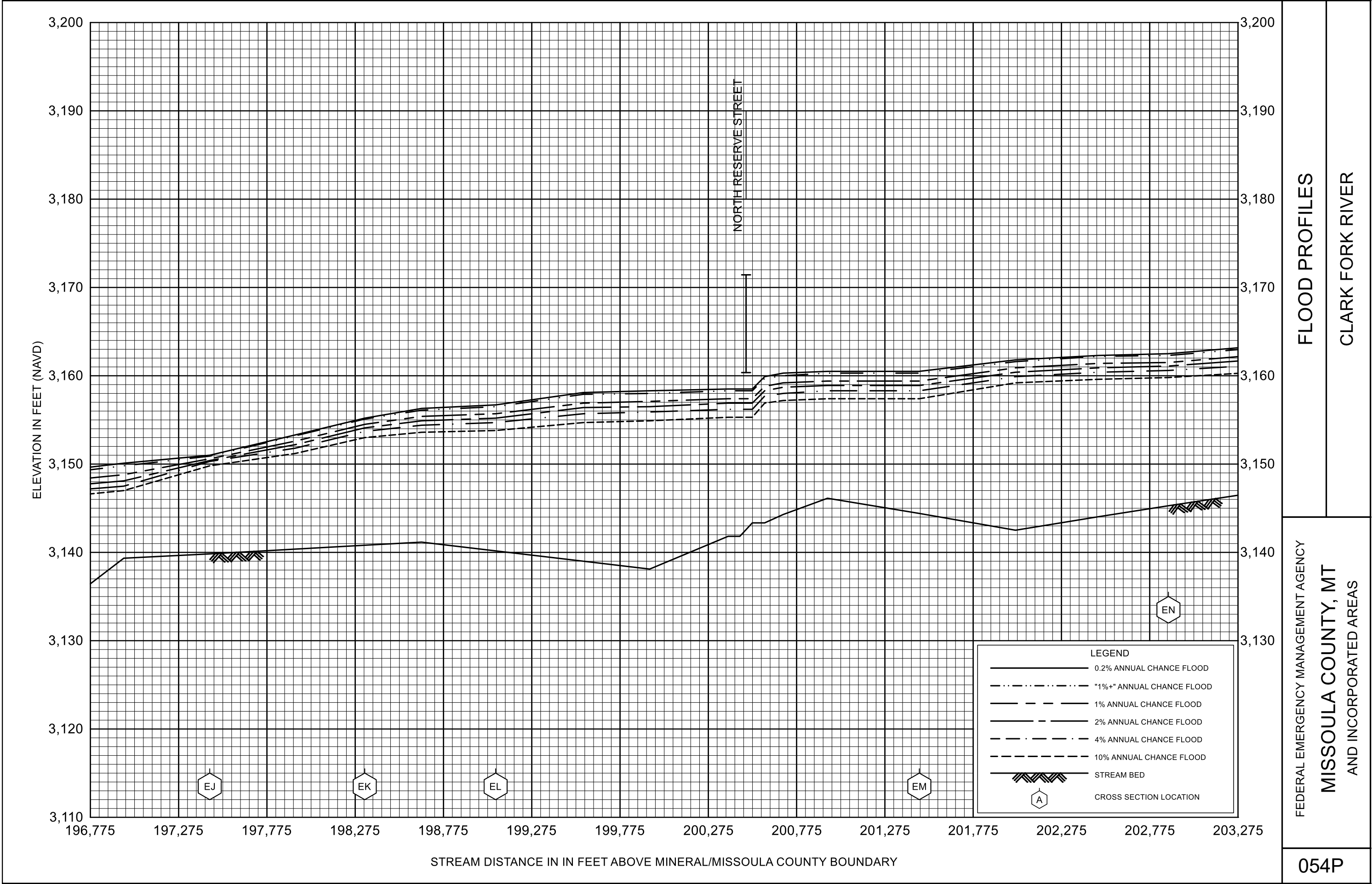
CLARK FORK RIVER

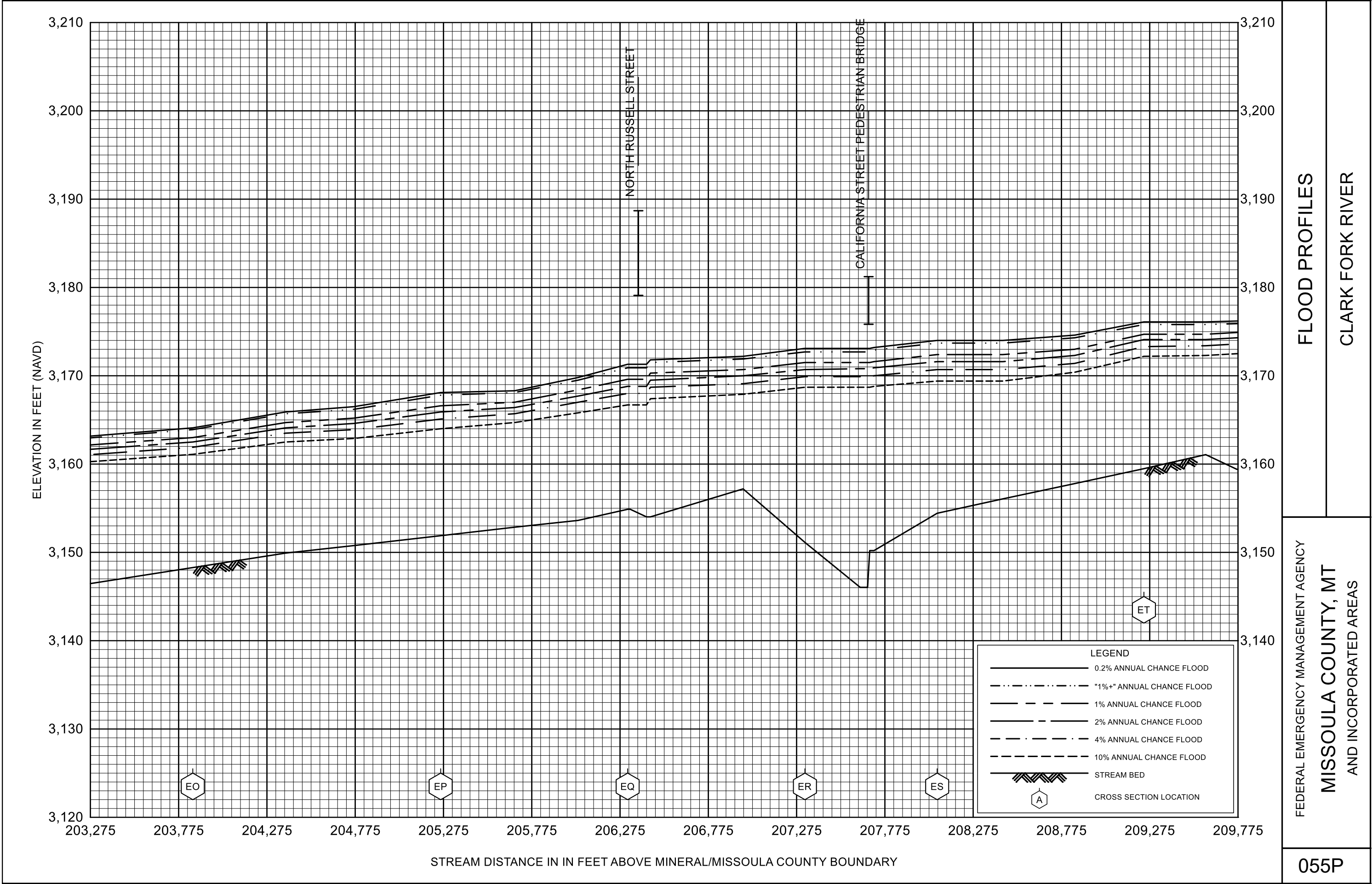
FEDERAL EMERGENCY MANAGEMENT AGENCY

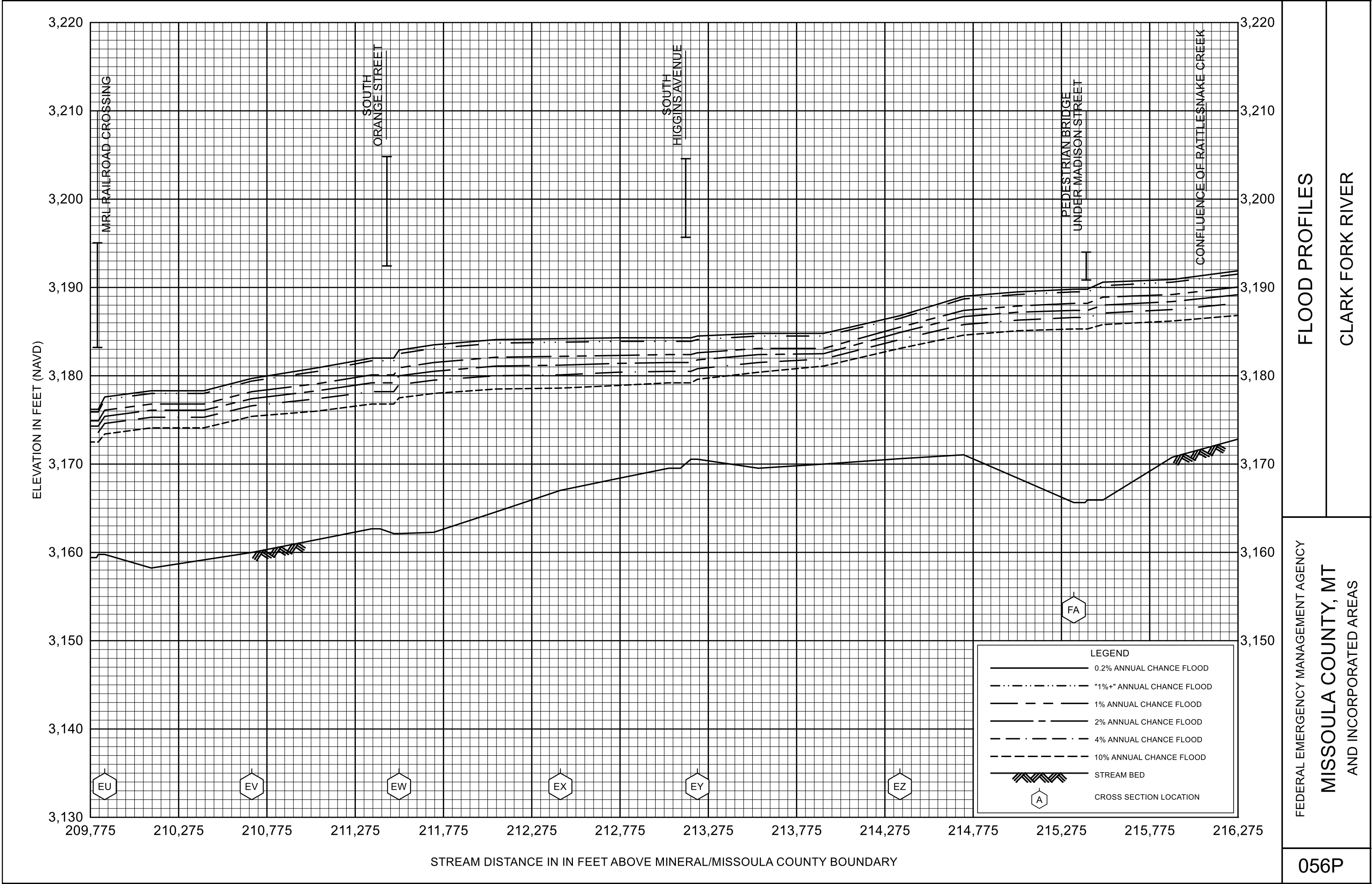
MISSOULA COUNTY, MT
AND INCORPORATED AREAS

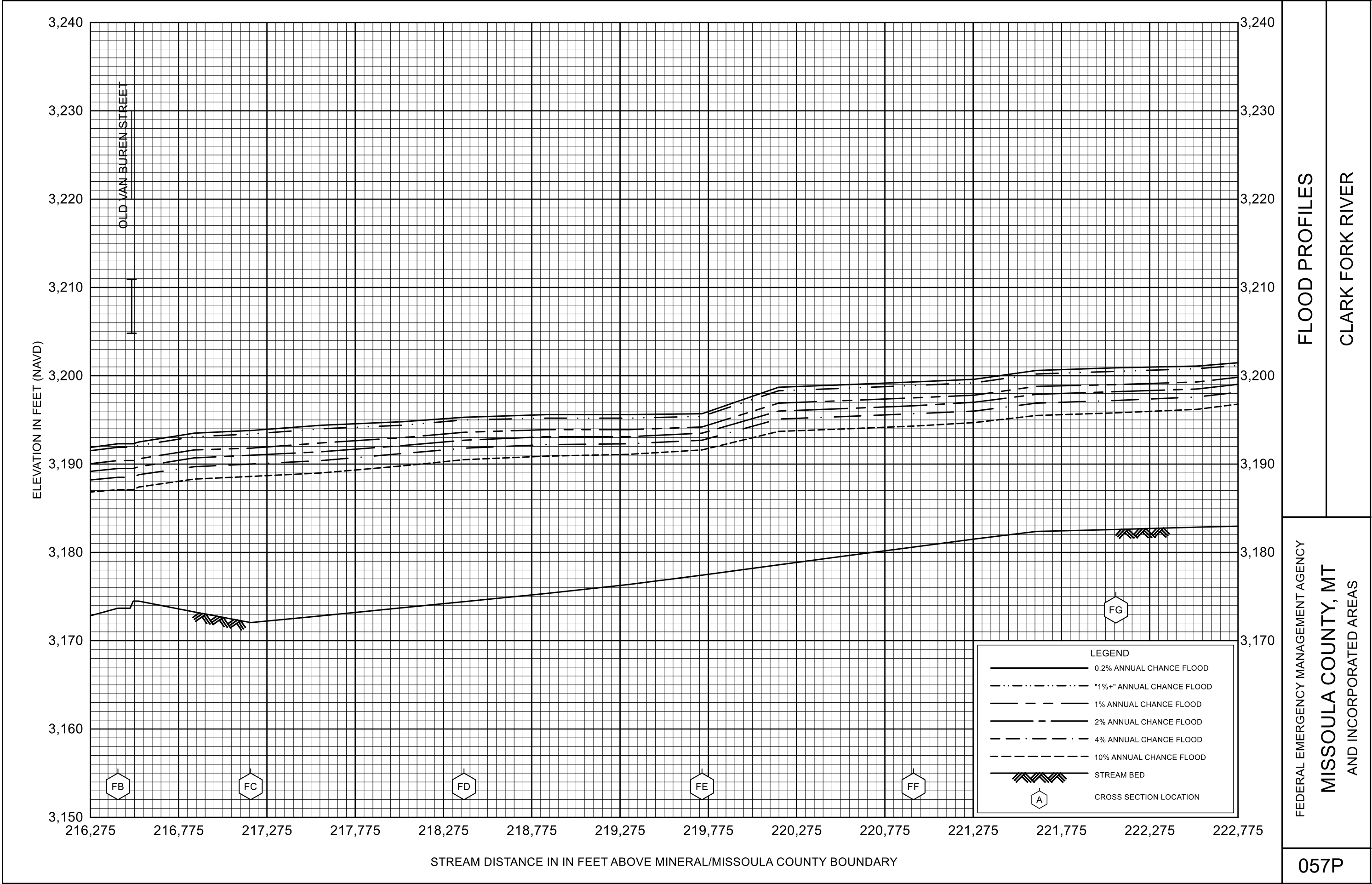


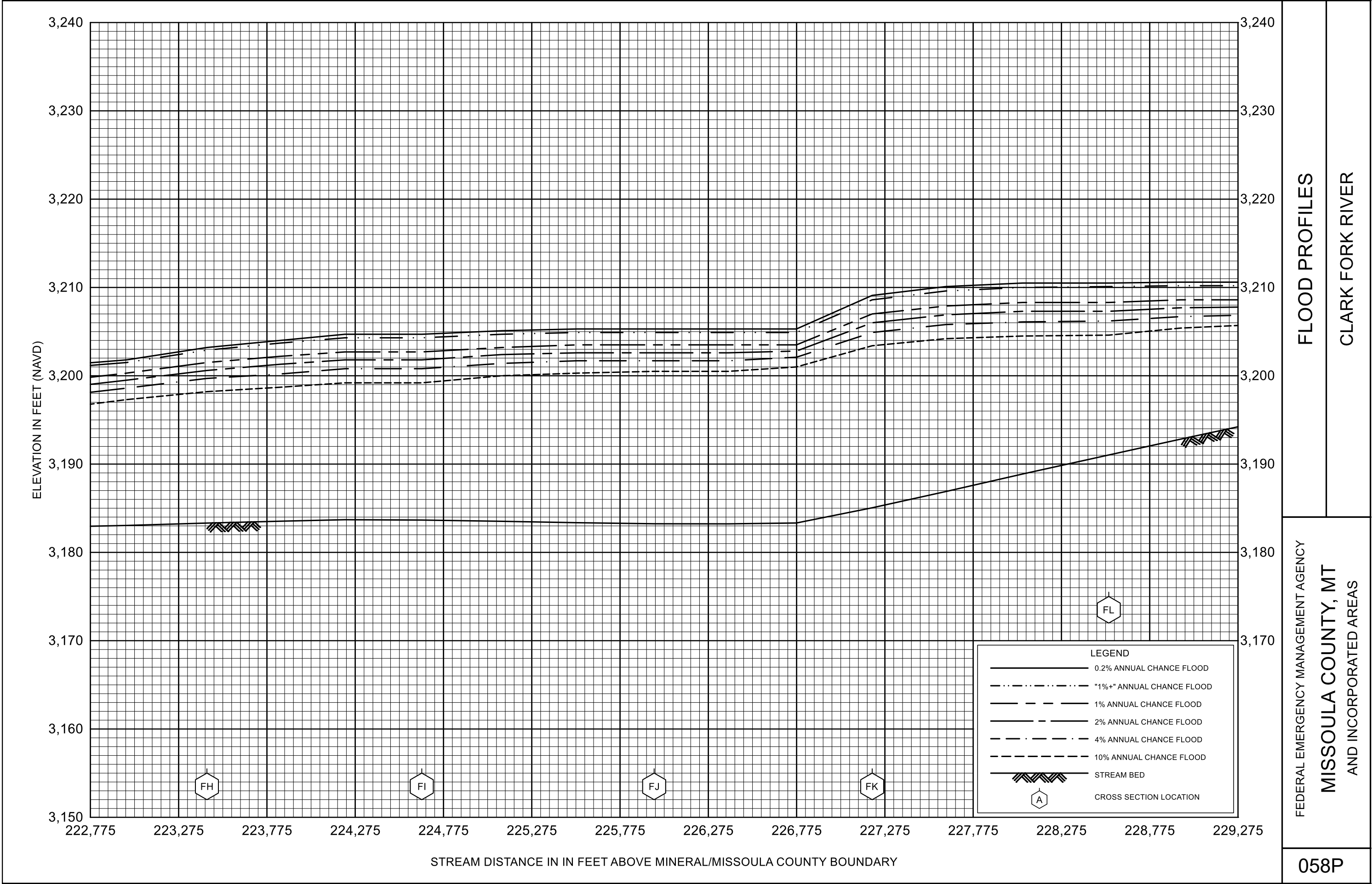












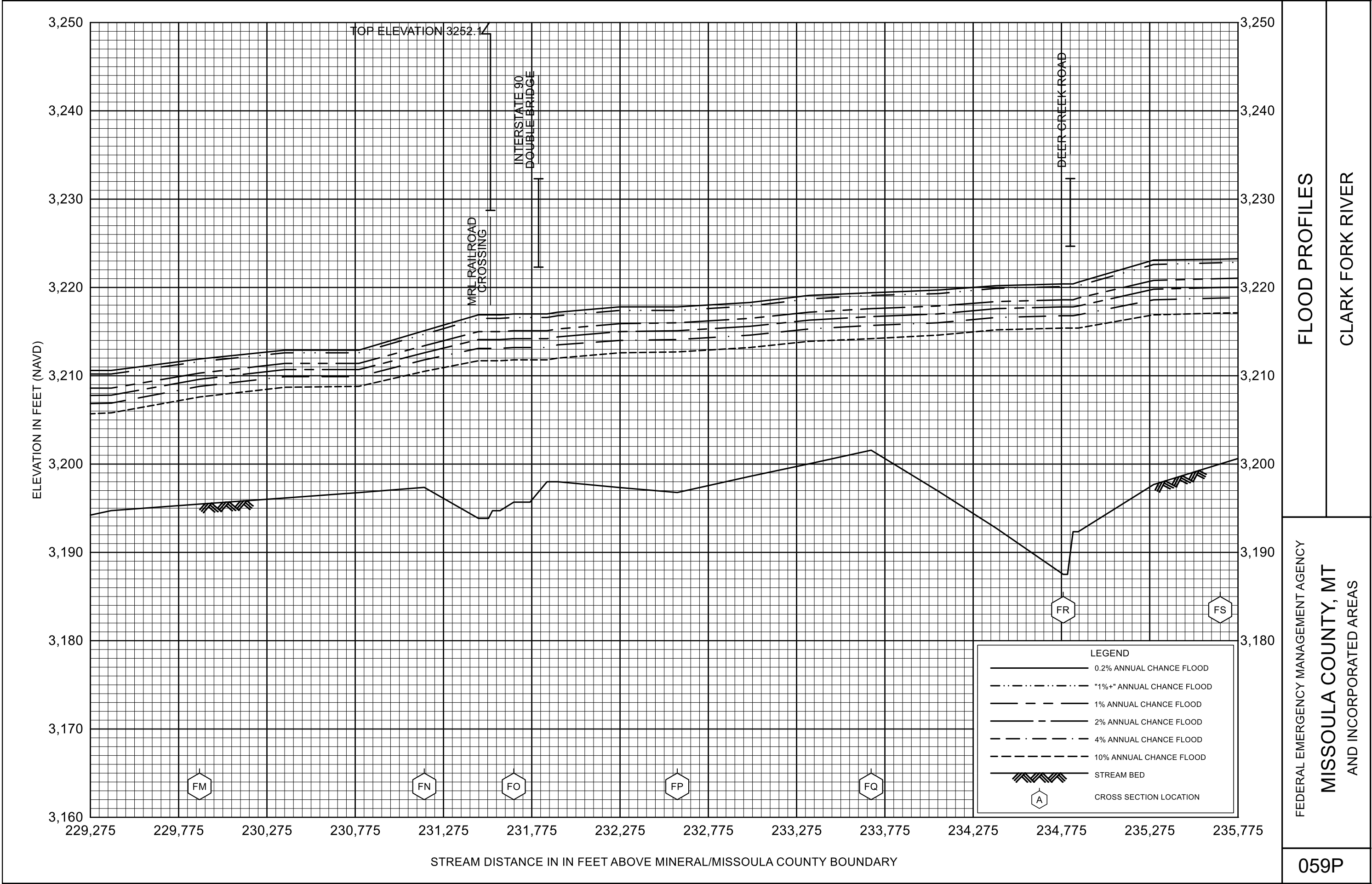
FLOOD PROFILES

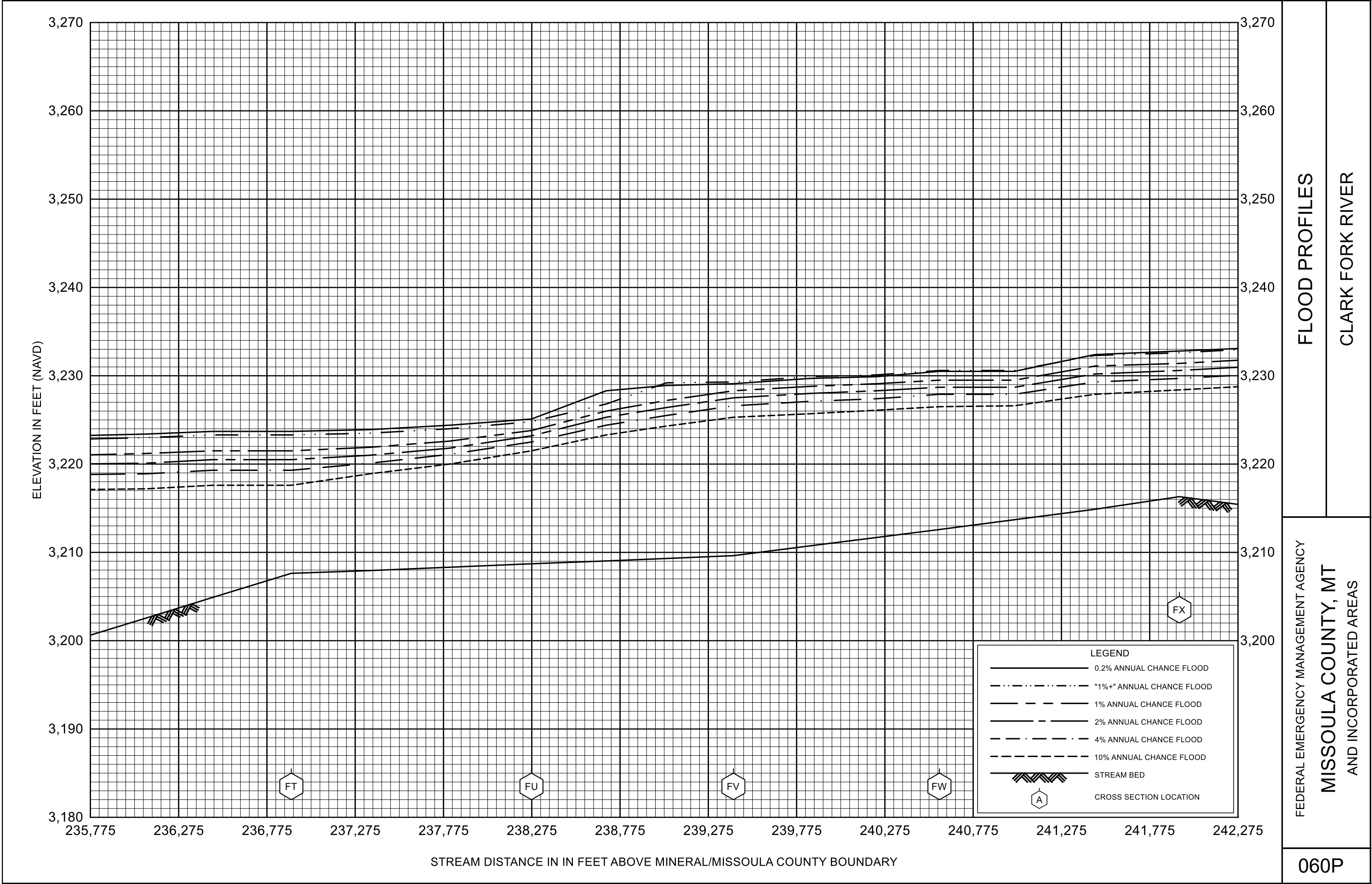
CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS

058P



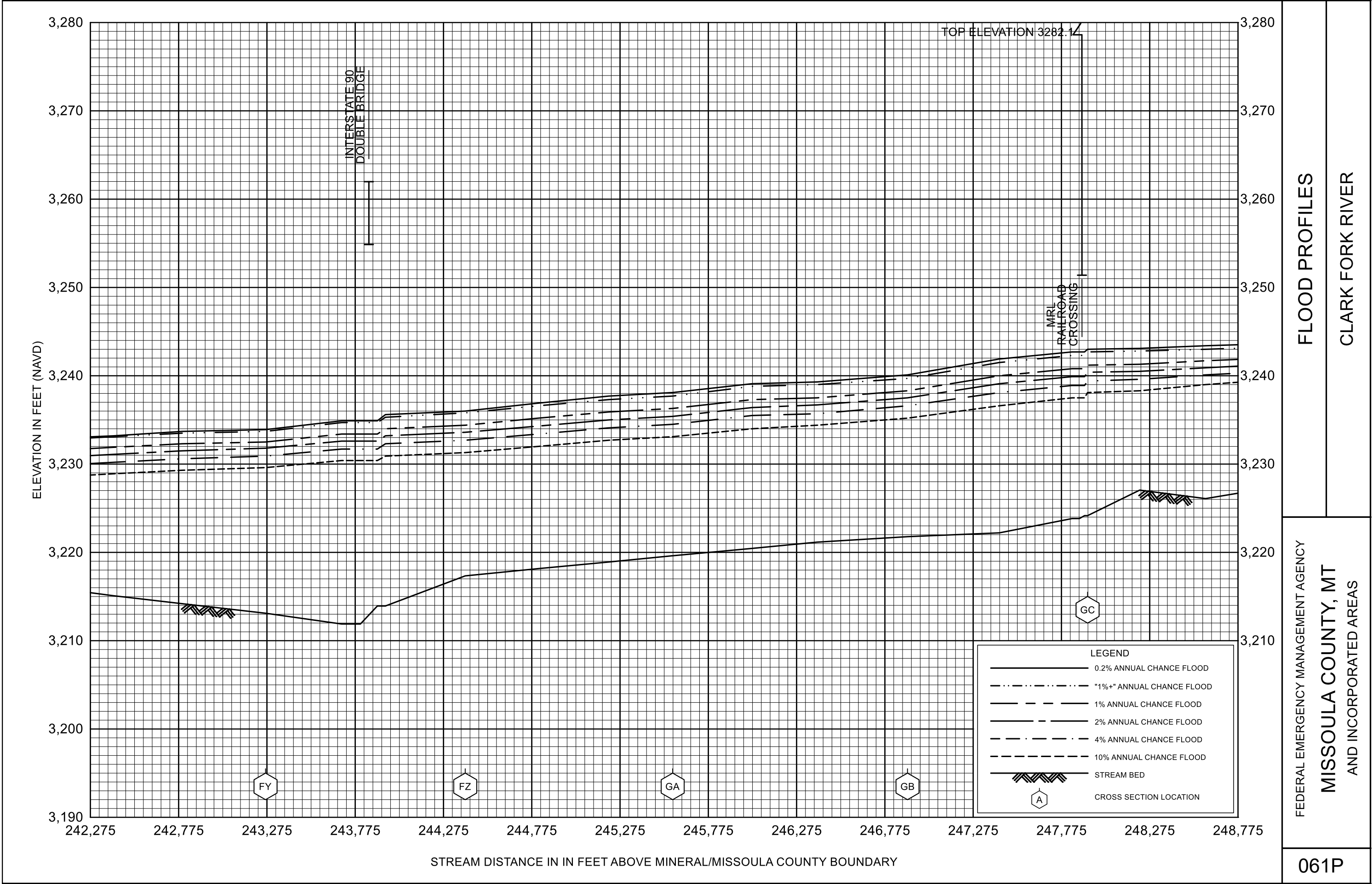


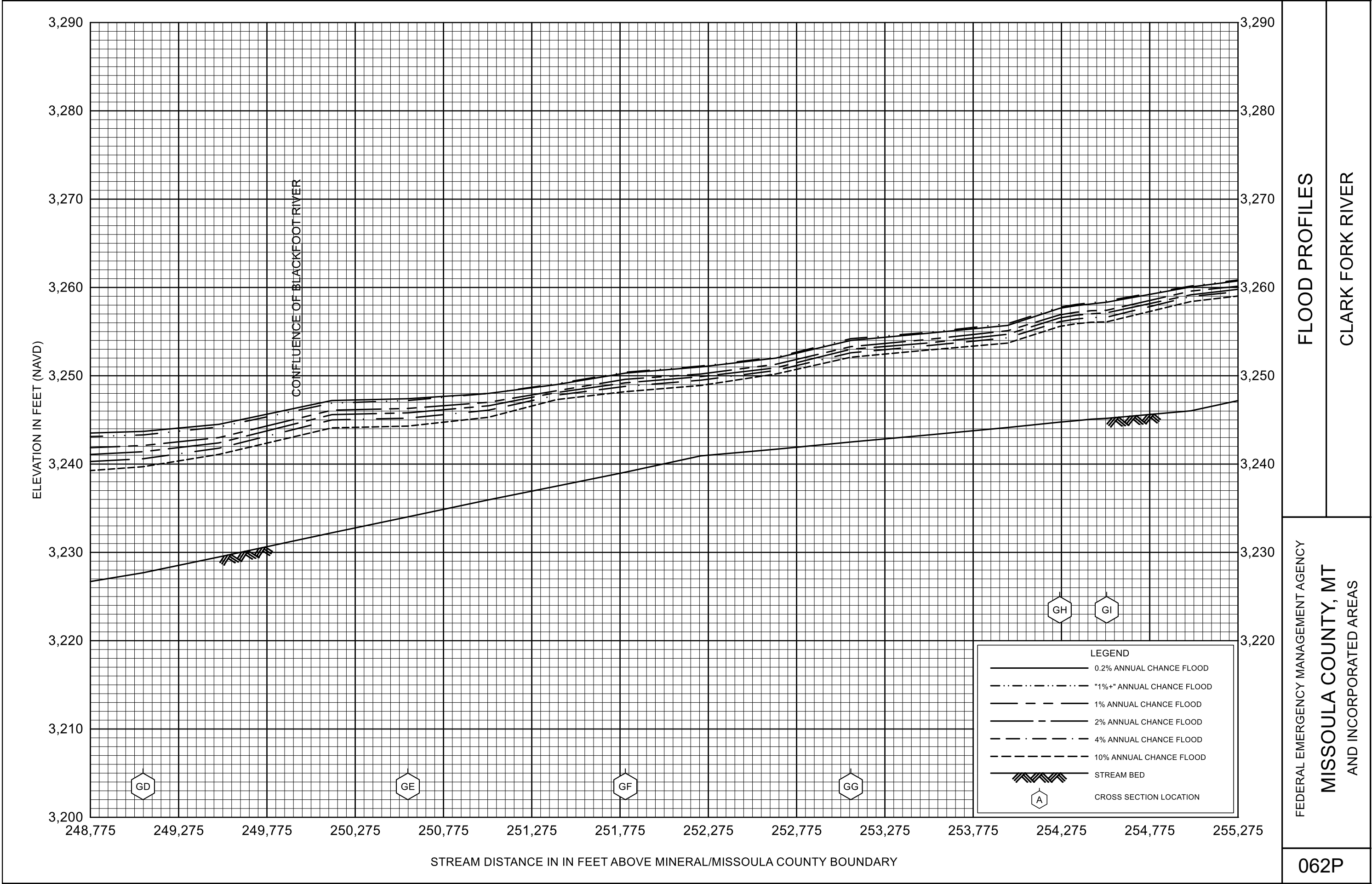
FLOOD PROFILES

CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS



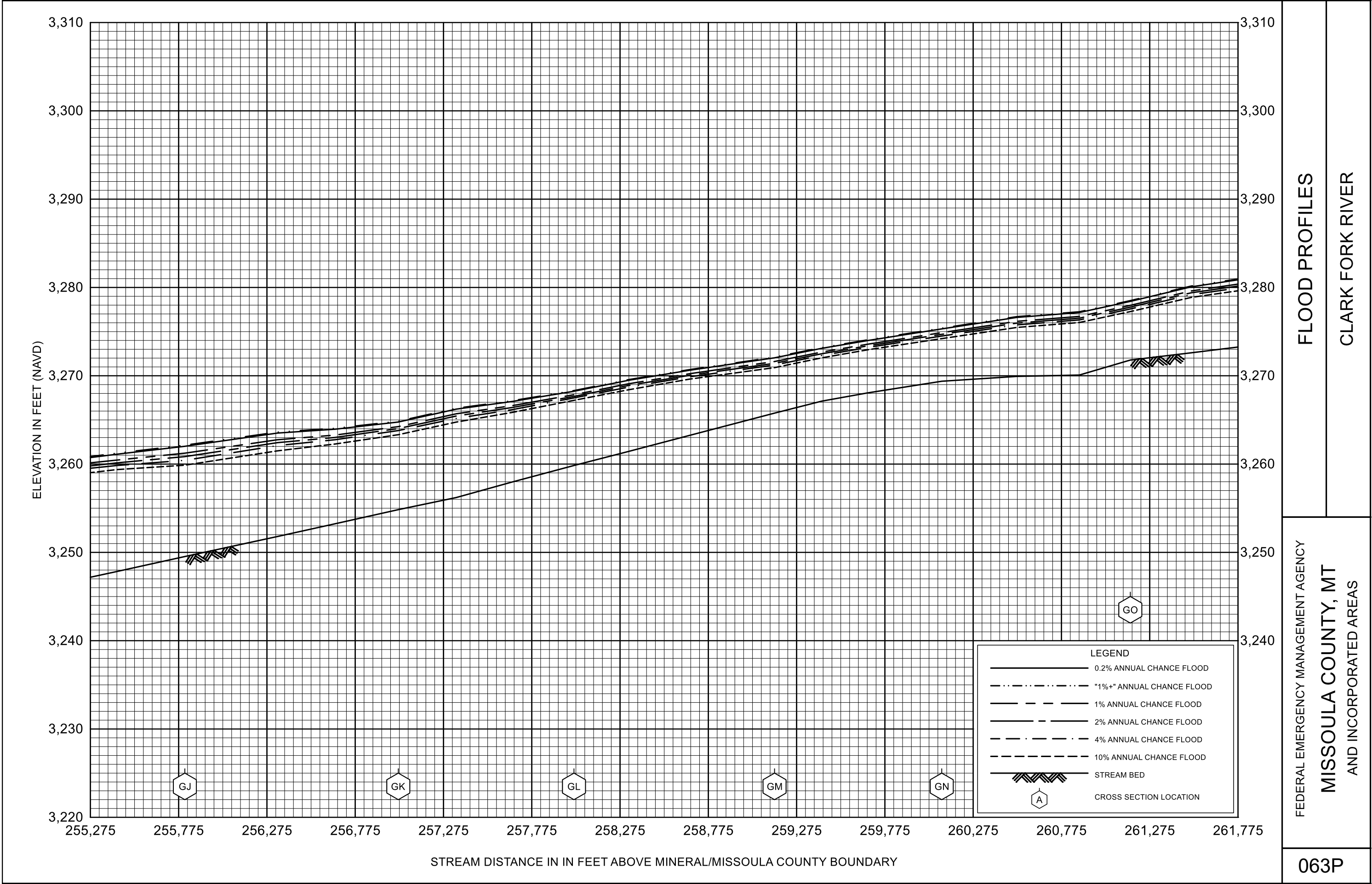


FLOOD PROFILES

CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS

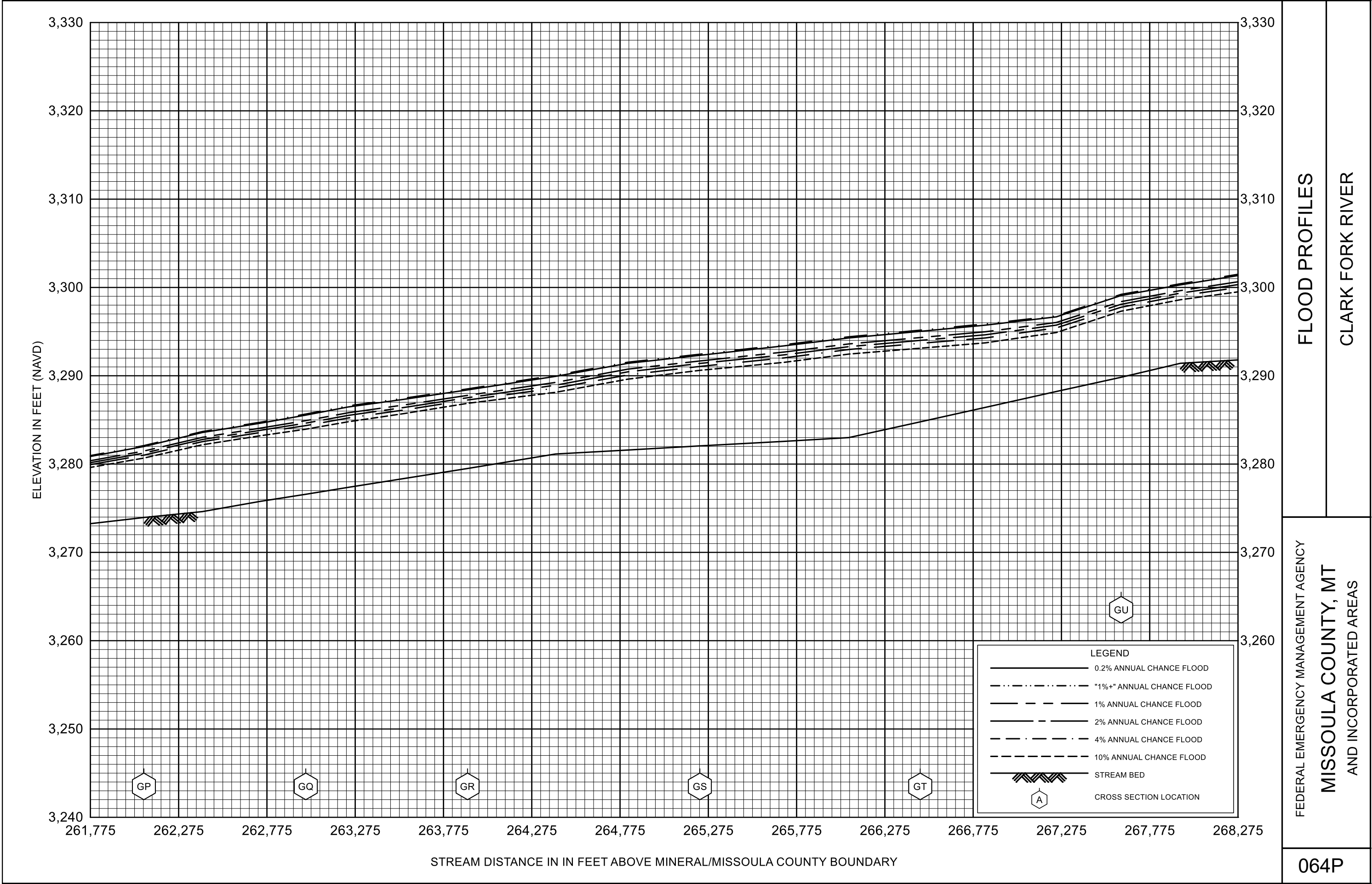


FLOOD PROFILES

CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS

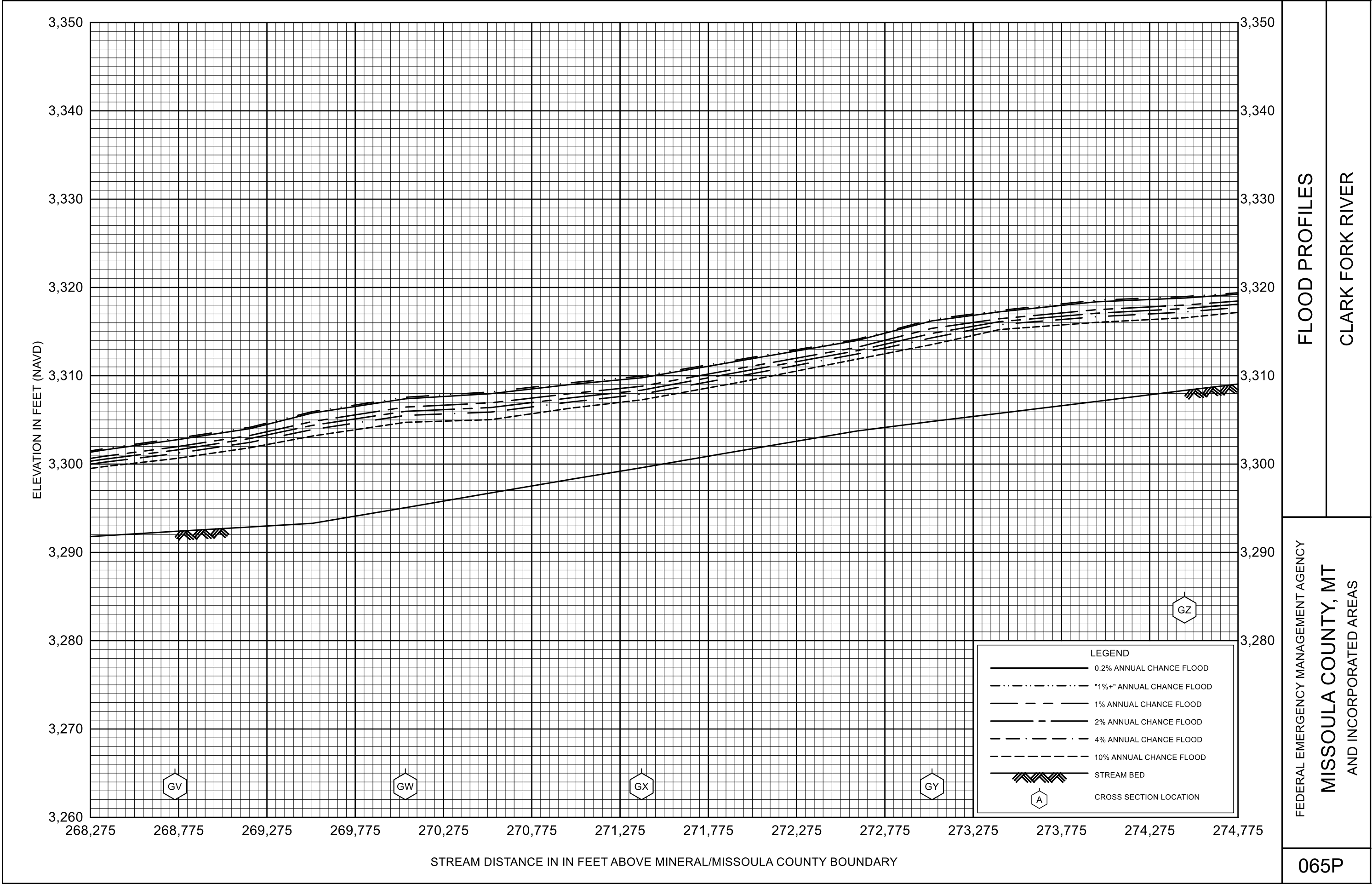


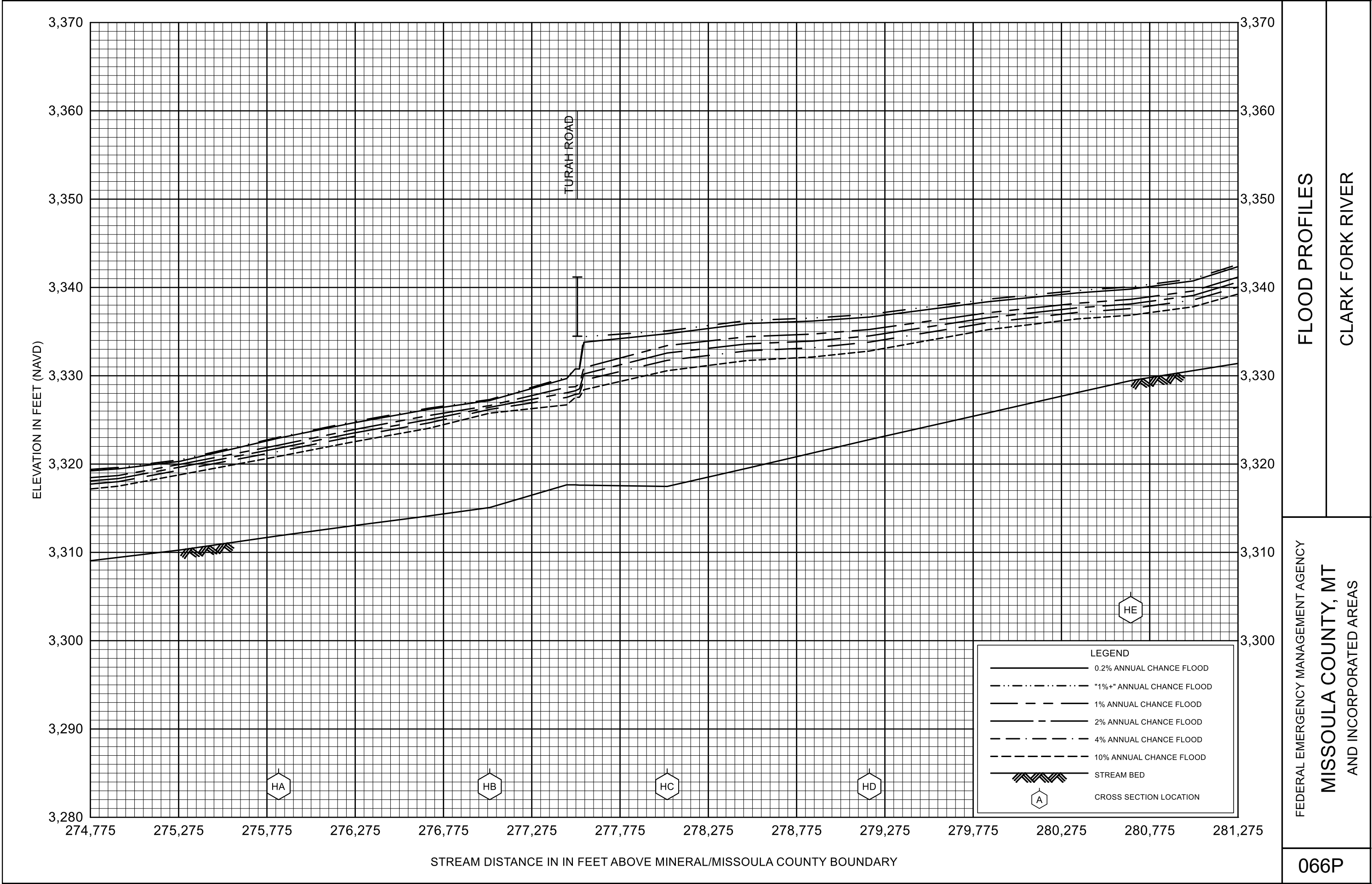
FLOOD PROFILES

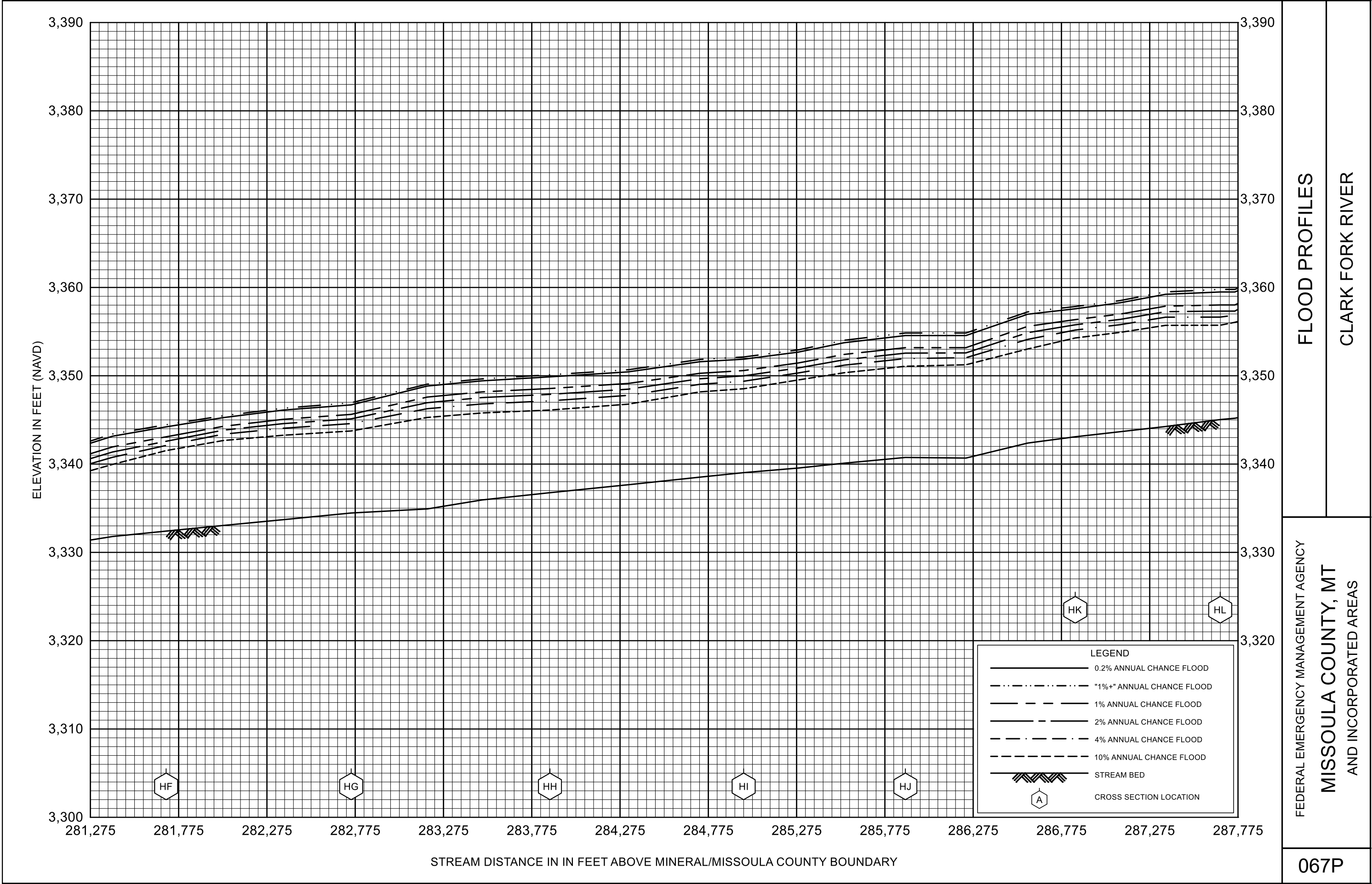
CLARK FORK RIVER

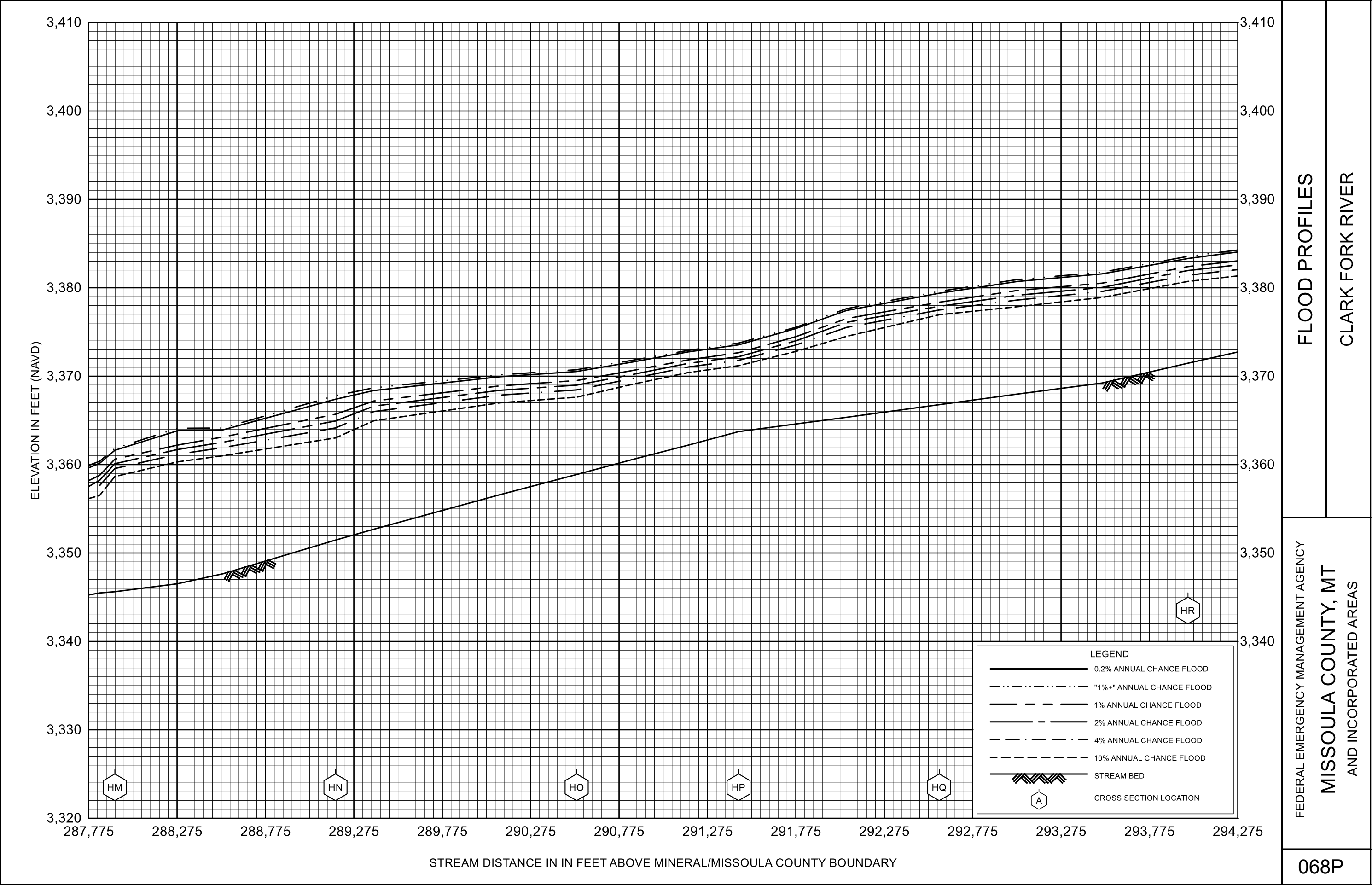
FEDERAL EMERGENCY MANAGEMENT AGENCY

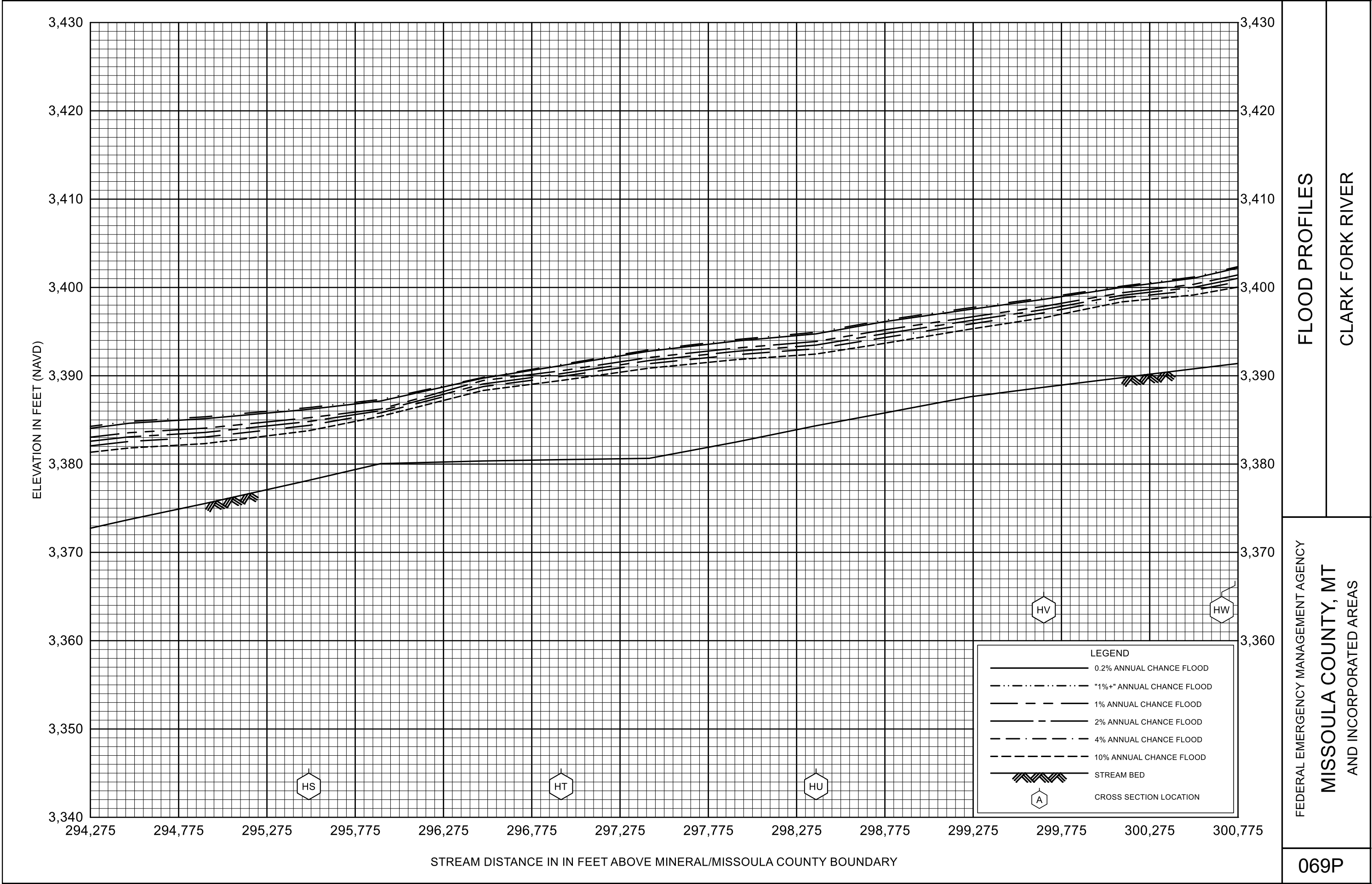
MISSOULA COUNTY, MT
AND INCORPORATED AREAS

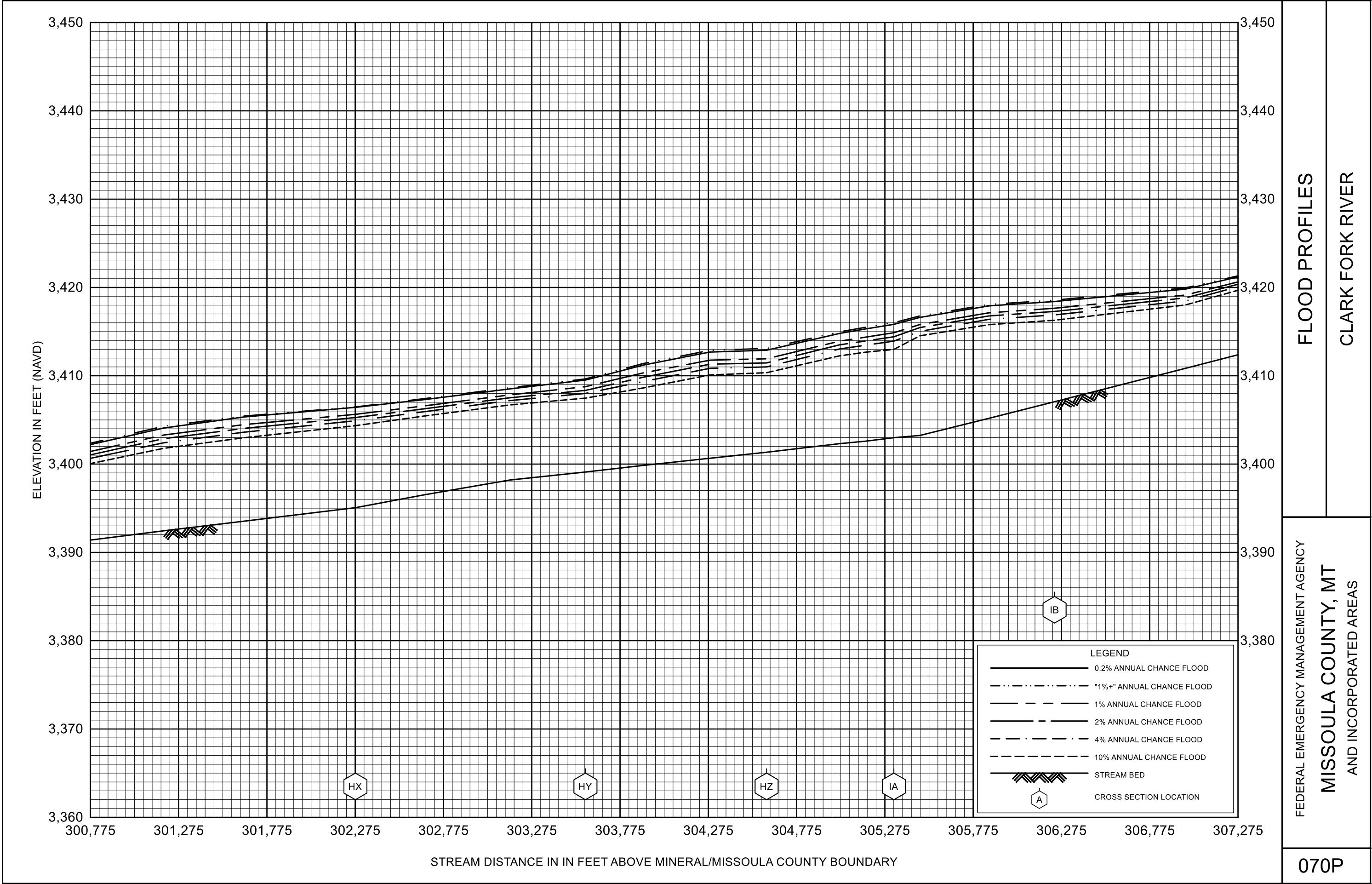












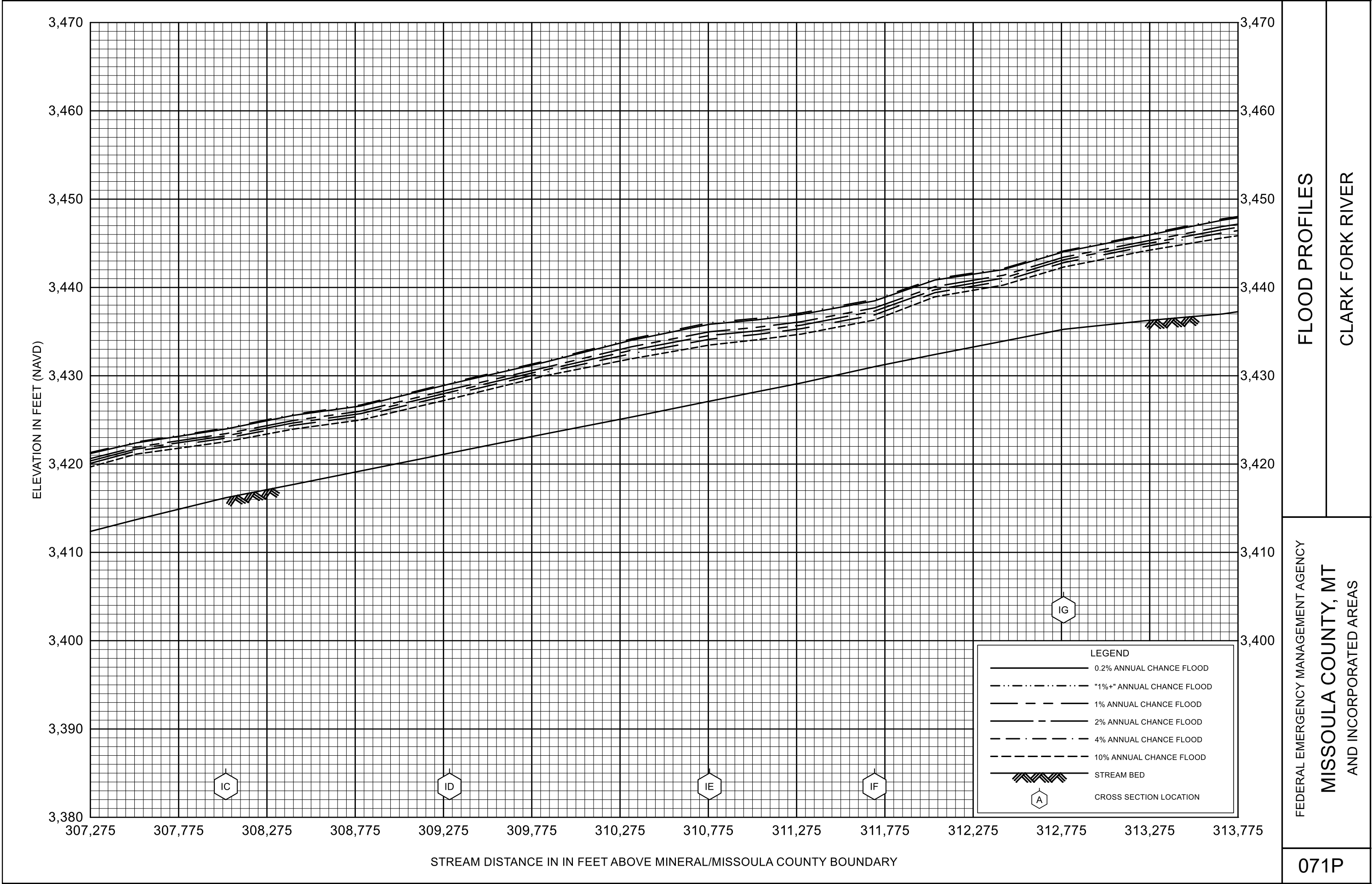
FLOOD PROFILES

CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS

070P

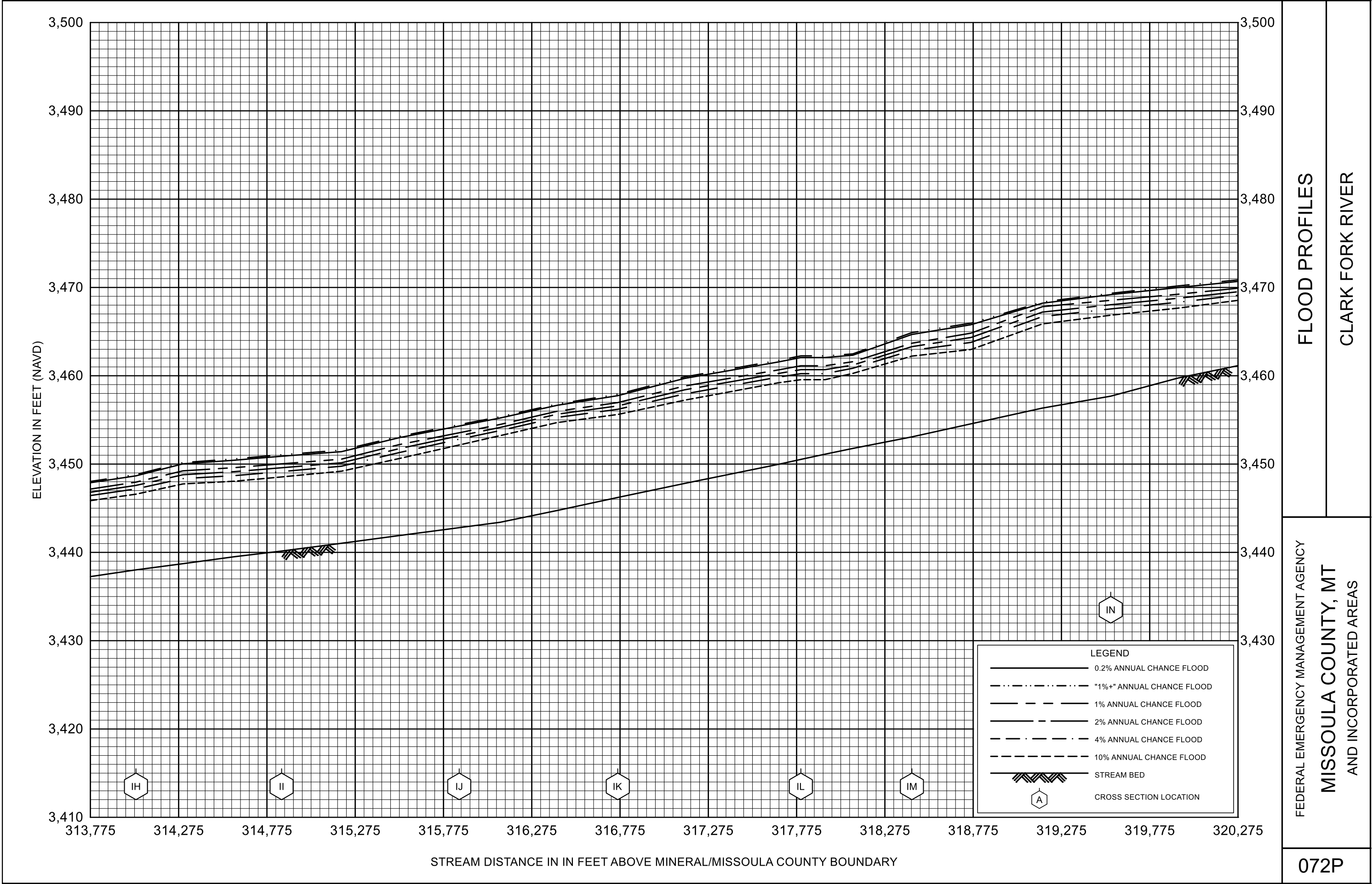


FLOOD PROFILES

CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS



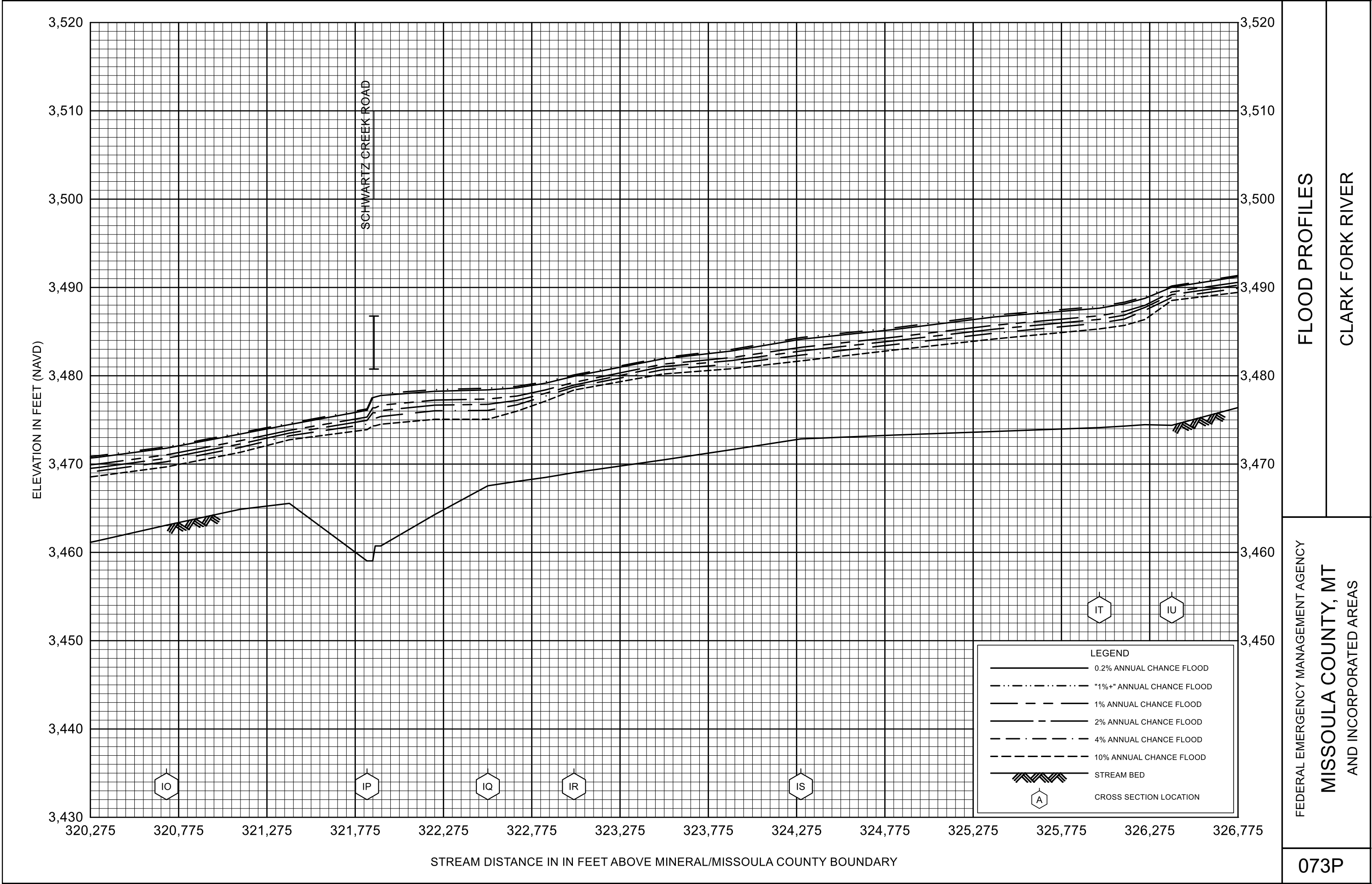
FLOOD PROFILES

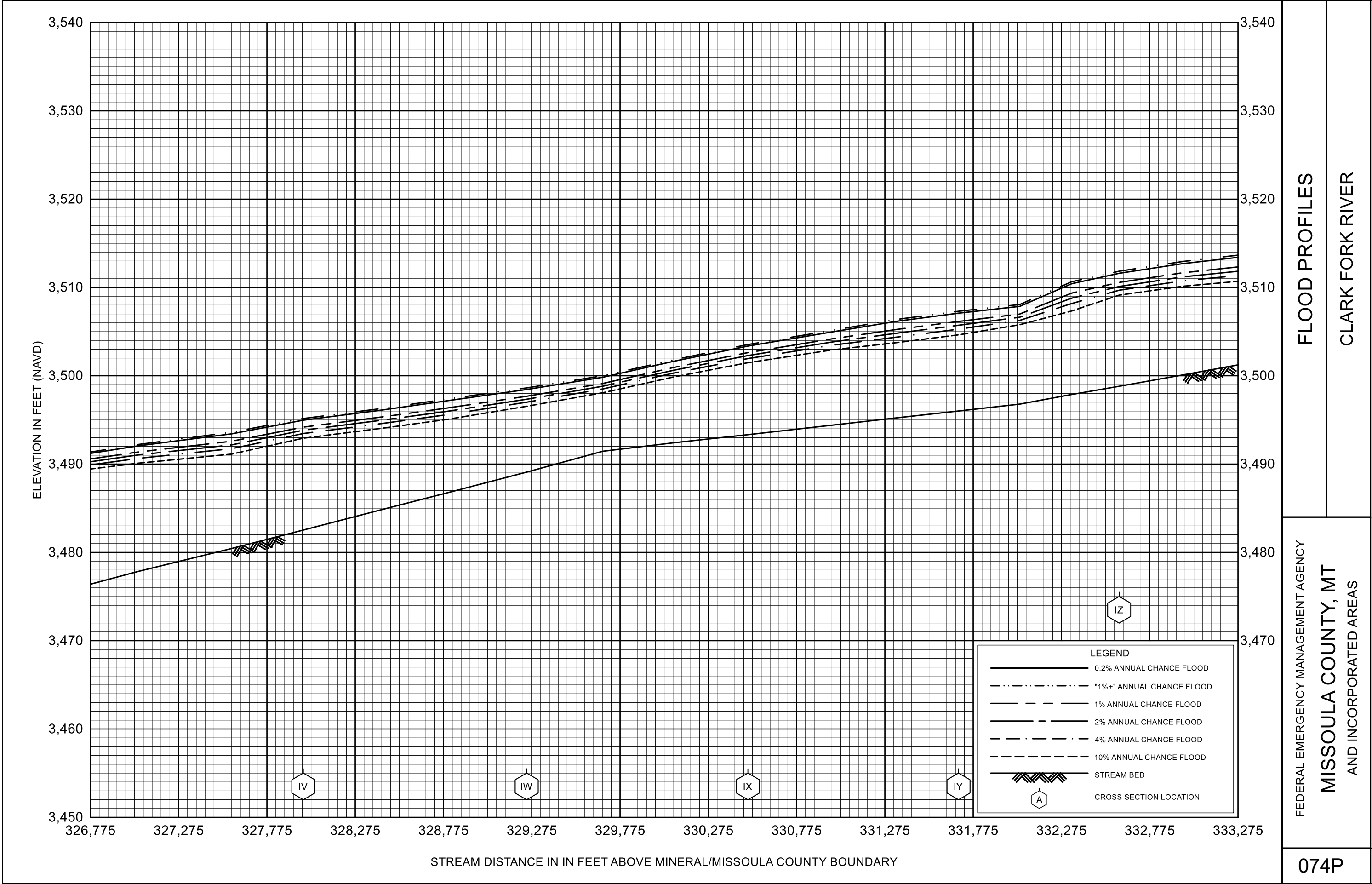
CLARK FORK RIVER

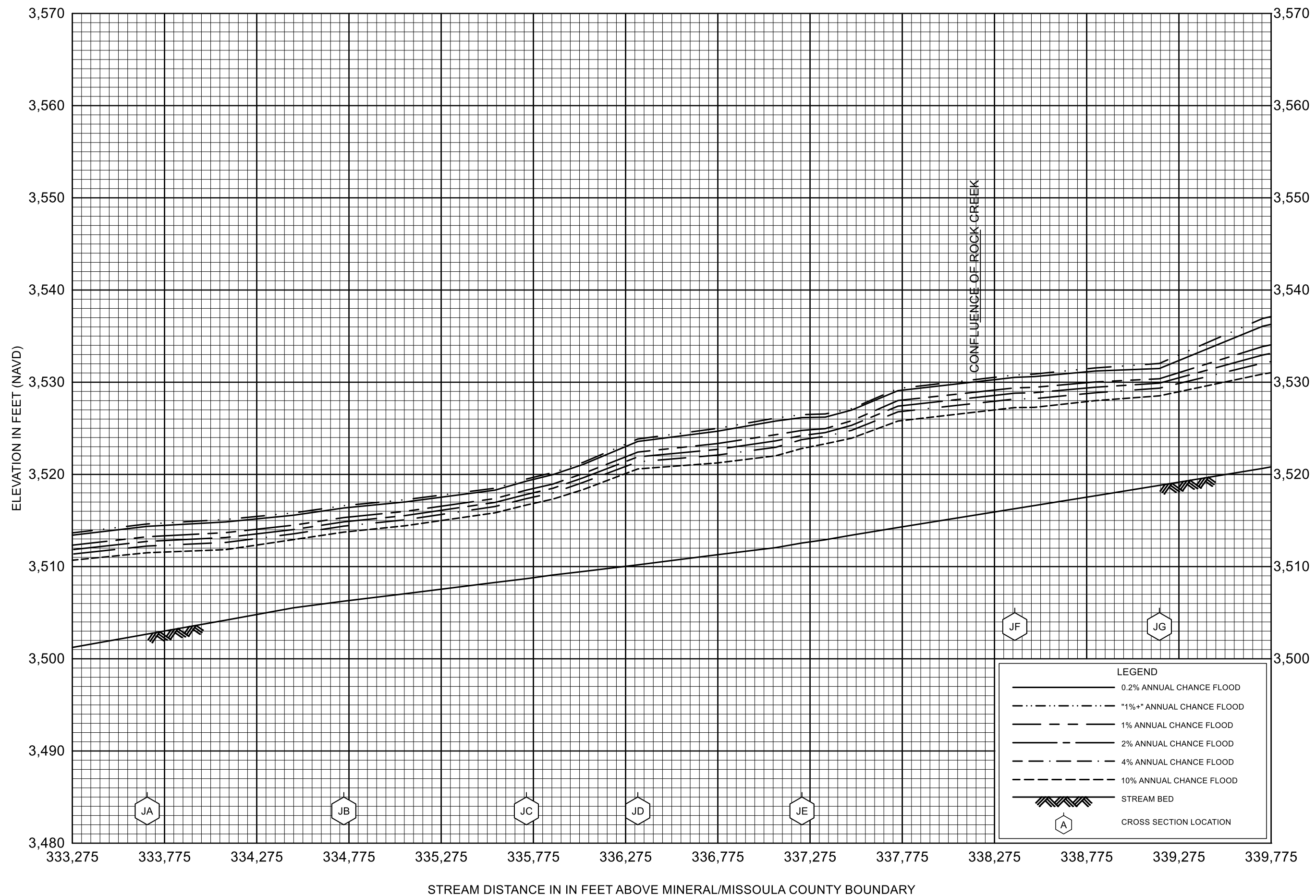
FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS

072P







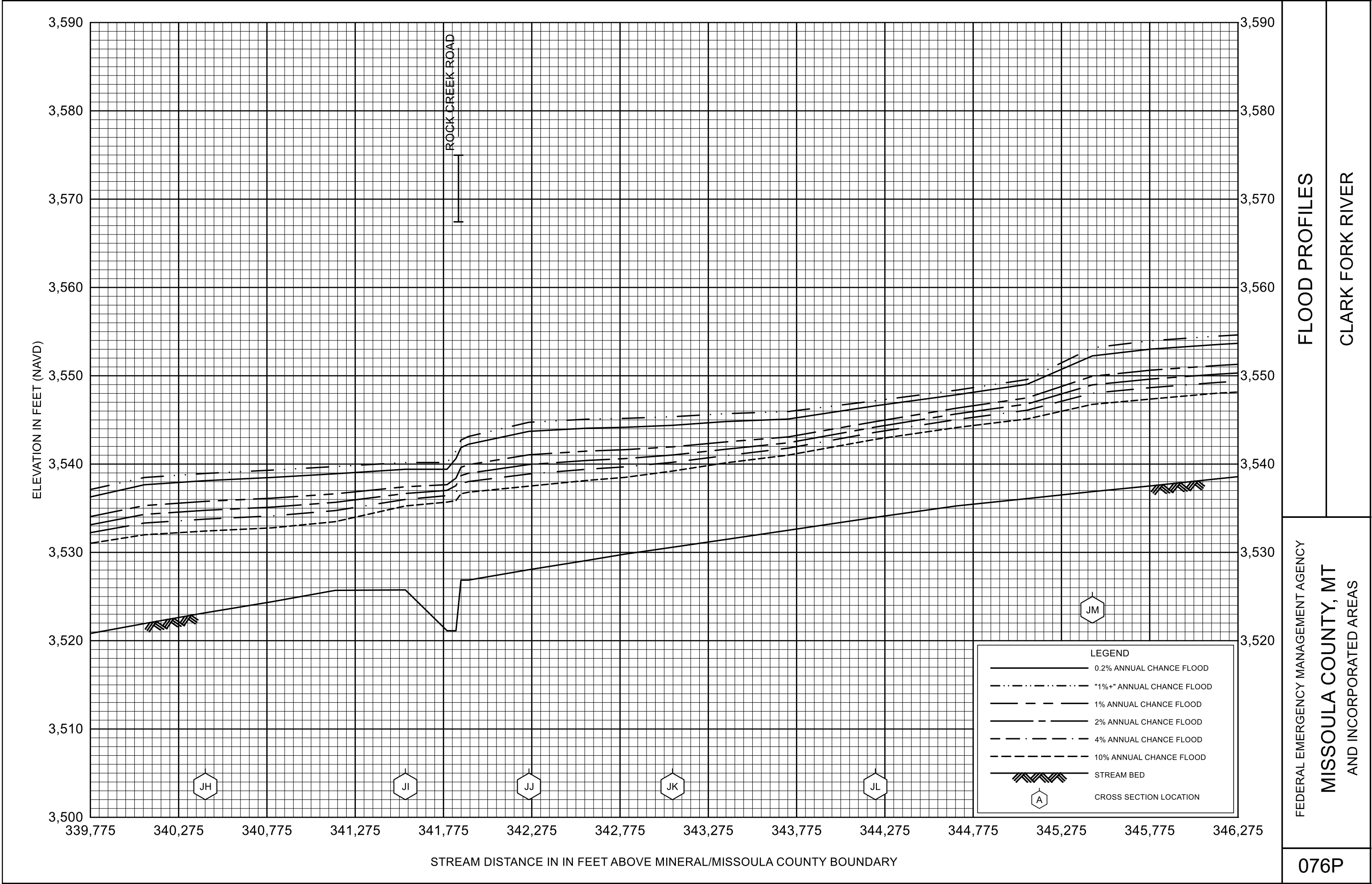
FLOOD PROFILES

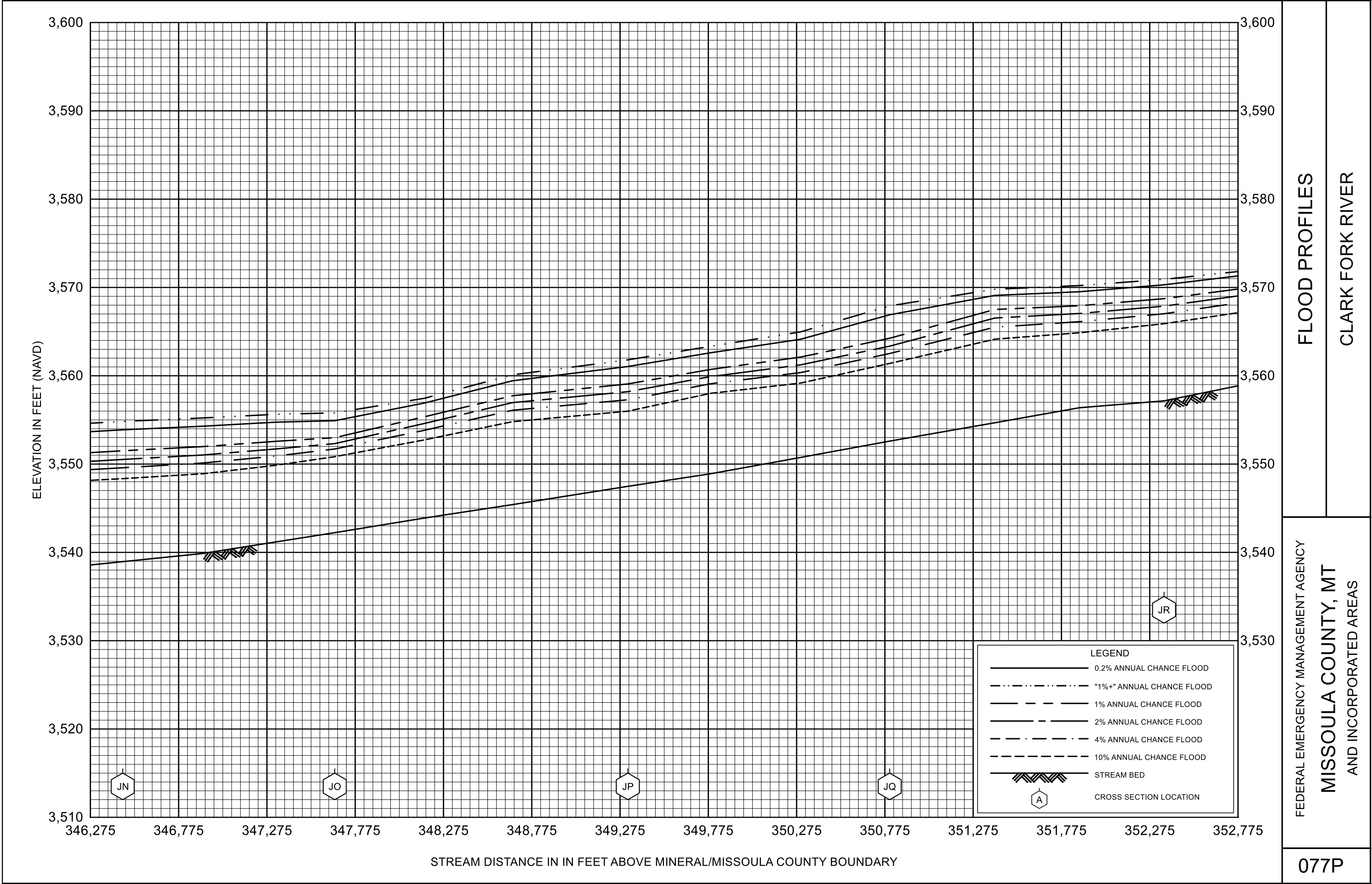
CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS

075P





FLOOD PROFILES

CLARK FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MISSOULA COUNTY, MT
AND INCORPORATED AREAS

077P

