U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
WESTERN FEDERAL LANDS HIGHWAY DIVISION
610 East Fifth Street
Vancouver Washington, 98661

RIVER S BRIDGE TS&L HYDRAULICS REPORT

To: Mike Traffalis, WFLHD Project Manager
From: Megan Frye, WFLHD Hydraulics Engineer
Date: June 17, 2014
Project: Design for River S Bridge Replacement, WA RRP RIDG 100(2)

Background

The Western Federal Lands Highway Division (WFLHD), in cooperation with the U.S Fish and Wildlife Service - Ridgefield Wildlife Refuge, is proposing construction of a new bridge crossing over Lake River to the Ridgefield Wildlife Refuge River S Unit. The project begins at the intersection of South Hillhurst Road and South Refuge Road and continues approximately 0.5 miles to the intersection at the River S Unit Entry Station.

The intent of the project is to provide safe and efficient access to the River S Unit by replacing the existing bridge. The existing access is a narrow steep, gravel road with an at-grade railroad crossing followed by a one-lane bridge. The access road and one-lane bridge is too narrow for the types and volume of traffic accessing the River S Unit. Information collected by the Ridgefield National Wildlife Refuge indicates vehicle traffic and visitation is increasing and they expect that trend to continue. The at-grade railroad crossing directly adjacent to the narrow, winding entrance road and one-lane bridge creates an inefficient, unsafe traffic situation.

The proposed structure is a two-lane, grade separated bridge. Widening the bridge to two lanes will provide more efficient access to the River S Unit and raising the bridge above the railroad crossing will eliminate disturbance in traffic created by the at-grade railroad crossing.

The purpose of this memorandum is to document the recommendations for the proposed bridge crossing at Lake River. The results of site morphological, hydrologic, hydraulic, and scour analyses and recommendations for bridge orientation, low chord elevation, foundation depths, and scour protection are presented.

Conclusions and Recommendations

Bridge Low Chord

Lake River is classified as navigable water by the US Coast Guard. The clearance restriction for the proposed structure matches the existing bridge low chord elevation of 40.5 feet (NGVD 1947) which equates to 39.10 (NAVD 88).

Design guidance for WFLHD recommends a minimum of 3.5 to 5 feet of clearance above the 50-year water surface elevation where the potential for woody debris exists. Based on previous bridge inspections, a moderate amount of floating and submerged debris in the channel should be

expected. The 50-year water surface elevation, 26 feet (NAVD 88), was identified in the current Flood Insurance Study for Clark County developed by the Federal Emergency Management Agency (Flood Insurance Study Number 53011CV001A, September 5, 2012) which can be found in **Appendix E**. The low chord elevation of 40.5 feet (NAVD 88) needed for the grade separated bridge option over the existing railroad crossing exceeds the minimum clearance requirements driven by the water surface elevation.

The hydraulic capacity of the proposed bridge assumes a multi-span, 512-foot bridge with a 250-foot waterway width.

Scour

Riprap is recommended at the west abutment to mitigate the potential erosion both during high flow and from foot traffic down to the channel. Set the riprap crest at 31 feet (1.5 feet above the 100-year water surface elevation). Place the riprap toe at two feet below the existing ground elevation at the west abutment. Grade the finished surface of the riprap slopes at 1.75(h):1(v). Use Class 3 riprap, placed in a minimum 2.5-foot thick layer. Place the riprap on a geotextile fabric. See **Appendix C** for riprap details. See **Appendix D** for riprap size calculations.

Stream Impacts

The proposed structure should have no impact on the stream function. Comparing the number of obstructions in the channel with the existing structure (19 bents) and the proposed structure (2 drilled shafts), the proposed structure should have less restriction on the stream flow conveyance, sediment transport, or woody debris transport.

Floodplain and Flood-rise Impacts

There is private property along the east bank of Lake River at the proposed bridge location. The proposed structure should not have an appreciable impact on the flooding risk upstream or downstream given the reduced number of obstructions in the channel upon construction of the proposed structure and removal of the existing structure.

Construction

The proposed bridge construction may require some form of temporary work structure. The temporary work structure should not limit navigability along Lake River. The minimum low chord should be 39.10 feet. The contractor will be required to submit drawings for all temporary structures including design calculations and supporting data.

Pile driving activities are anticipated to be restricted to July through October. All other construction activities can take place at any time. Debris tarps will be required to prevent construction debris from entering the channel. The existing timber structure will be removed as a part of the proposed project. The timber pile bents will either be removed completely or cut flush with the channel bottom.

The location and geometry of the proposed bridge is shown on the Preliminary Layout Sheet in **Appendix C**.

Site Conditions

Lake River is an overflow channel of the Columbia River. The channel gradient both upstream and downstream of the proposed bridge is around 0.001 feet/feet. The streambed material is predominately sandy silt. Around the proposed crossing, the channel is confined on the east with a relatively steep, 1(h):1(v), well-vegetated bank and confined on the west by a man-made dike. At the crossing, the dike sits approximately 450 feet from the west bank with a wide, grassy floodplain between the dike and the bank. Downstream of the crossing, the dike sits approximately 100 feet from the west bank with a grassy floodplain between the two. See **Appendix A** for aerial photos of the site.

The existing water quality and proposed actions for monitoring water quality during construction can be found the *Water Quality Report* (Megan Frye, WFLHD 2014) found in **Appendix E**.

The OHWM line was documented and surveyed by the Federal Highway Administration on June 2012 as 11.70 feet (NAVD 88). The ordinary high water mark (OHWM) as defined by the shoreline management act (SMA) is a biological vegetation mark. According to RCW 90.58.030, the definition of ordinary high water mark is the " ordinary high water mark on all lakes, streams, and tidal water is that mark that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation as that condition exists on June 1, 1971, as it may naturally change thereafter, or as it may change thereafter in accordance with permits issued by a local government or the department: Provided, that in any area where the ordinary high water mark cannot be found, the ordinary high water mark adjoining salt water shall be the line of mean higher high tide and the ordinary high water mark adjoining fresh water shall be the line of mean high water".

For determination of State Lands Boundary, the US Fish and Wildlife Service, through a contract with Minister-Glaeser Surveying, Inc. in 2000, performed a survey to update a Washington Department of Natural Resources permit. To determine the mean high water (MHW, river side property boundary) at Columbia River mile 90 (equivalent river mile to the River S access bridge), Minister-Glaeser documented and recorded with Clark County Washington (Book 25, page 50) the State Lands Boundary. Note three of this recorded document states, "" Ordinary High Water Line: The ordinary high water line, (OHWL) for the Columbia River Mile 89-92 was computed from the United States Army Corps of Engineers, (USACE) publication " Flood Profiles, CL-03-116, April 1973 Revision." The OHWL at the Columbia River Mile 90 is 13.6 Columbia River Datum (CRD)."" The FHWA River S Access Bridge project is being developed in NAVD 1988 therefore, Aquatics Land Lease documents will be prepared showing the State Lands Boundary at elevation 13.6 feet (CRD), 14.58 feet (NGVD 1947), and 17.86 feet (NAVD 88).

The existing bridge is a one-lane, timber structure 332 feet in length. The original bridge was constructed with 19 spans. A 56-foot, main span was added in 1980 to provide an increased horizontal opening. This was carried out under a Vancouver Lake dredge contractor through a permit action with the US Fish and Wildlife Service. The low chord elevation is 39.10 feet (NAVD 88). The Bridge Inspection and Appraisal Report developed by the Ridgefield National Wildlife Refuge, both in August 2008 and August 2010, list no sign of scour at the existing bridge. Both reports identify a 4-foot high vertical bank and active sloughing along the west shoreline requiring minor repairs to the bank protection.

Hydrology

Lake River originates approximately 7 miles upstream of the proposed bridge at Vancouver Lake. It is fed by major tributaries Flume Creek, Whipple Creek, Salmon Creek, and Burnt Bridge Creek. Lake River is a tributary to the Columbia River. The confluence is approximately two miles downstream of the proposed bridge. Lake River, like the Columbia River, is tidally influenced. At the confluence with Lake River and the Columbia River, the mean tide range is approximately 2 feet based on NOAA Water Level predictions.

According to the Geotechnical Condition Assessment developed by FHWA, the geology in the area consists of cataclysmic-flood deposits, conglomerate, and alluvium. The cataclysmic-flood deposits are described as unconsolidated clay, silt, and fine to medium sand. The conglomerate is described as semi-consolidated pebble and cobble gravel containing minor lenses of cemented sand. The alluvium is described as unconsolidated sediments underlying modern floodplains of the Columbia River and Lake River.

Peak discharges for Lake River were estimated using the Columbia River Flood Profiles, Flood Insurance Study *(Clark County, Washington and Incorporated Areas - Flood Insurance Study Number 53011CV001A)*. The drainage area is shown in Figures 1 and 2 of **Appendix A**. Peak discharge estimates are presented in **Appendix B**.

Water Surface Elevations and Flow Velocities

Water surface elevations were estimated using the FEMA, Flood Insurance Study for Clark County, Washington and the average velocities were estimated by applying the estimated peak flow water surface elevations and channel characteristics in the FHWA, Hydraulic Toolbox Channel Analysis (Hydraulics Toolbox Version 4.1). Results are summarized in **Appendix D**.

Floodplain and Flood-rise Limitations

Executive Order 11988, Floodplain Management, established federal policies for protecting floodplains and floodways. The intention of the associated regulations is to avoid, to the extent practical, adverse impacts to floodplains; minimize the impact of floods to human safety, health, and welfare; and avoid supporting land use development that is incompatible with the natural and beneficial floodplain values. When avoidance is not possible, the policies require appropriate consideration of methods to minimize adverse impacts.

The bridge is located within an area of special flood hazard designated by a Federal Emergency Management Agency (FEMA) flood insurance rate map (FIRM) or detailed mapping study (FIS). A volume equivalent to the volume of fill placed within the 100-year floodplain will be added within the floodplain so the total volume within the 100-year floodplain remains the same. Based on the site conditions, the proposed bridge is not expected to result in a rise in the 100-year water surface elevation. FHWA policy allow up to one-foot rise in the 100-year water surface elevations.

Scour

A HEC-18 based scour analysis was performed. Geotechnical boring logs indicate sandy silt layer extending down approximately 8 feet. Silty gravel with sand and sandy silty with traces of gravel is found below the sandy silt layer extending down 25 feet. Draft bore logs from the geotechnical investigation can be found in **Appendix E**.

The primary mode of scour expected at the proposed bridge is pier scour for the 100-year and 500-year flood events at 3.61 feet and 3.74 feet respectively. Although no scour at the abutments was determined in the calculations, the flow conditions at the 100-year and 500-year flood are difficult to represent accurately in the calculations without a more comprehensive two-dimensional flow analysis as the flow will be divided in both the channel and on the west floodplain. Given the relatively flat gradient and slow velocities, the expected conditions at the west abutment can be approximated without an in depth modeling effort. Scour analysis and results are summarized in **Appendix D**.

attachments: Appendix A – F

APPENDIX A

Figure 1: USGS, Drainage Basin

Figure 2: Google Earth, Drainage Basin

Figure 3: Aerial Photo

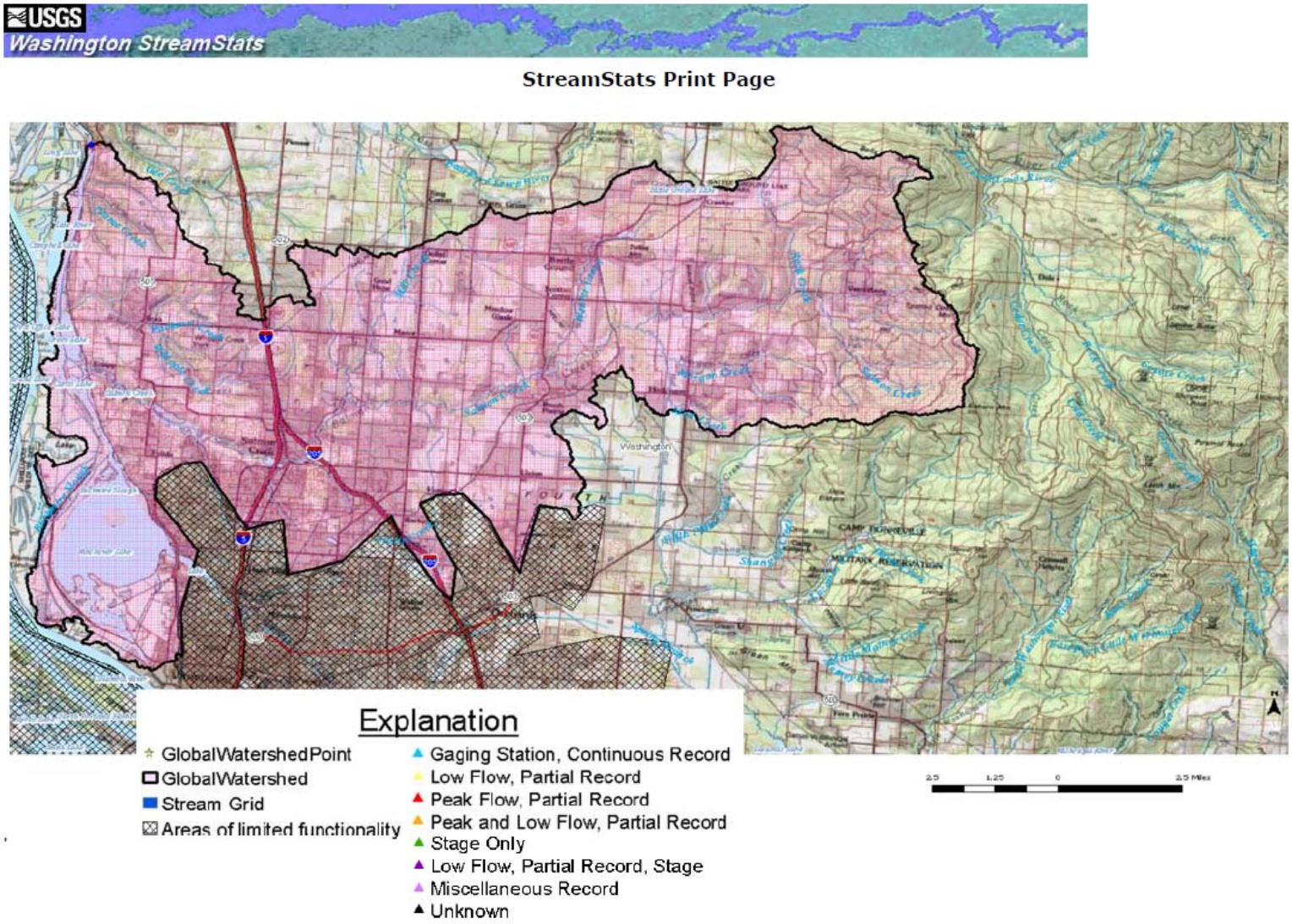


Figure 1

Lake River Stream Stats
Drainage Area

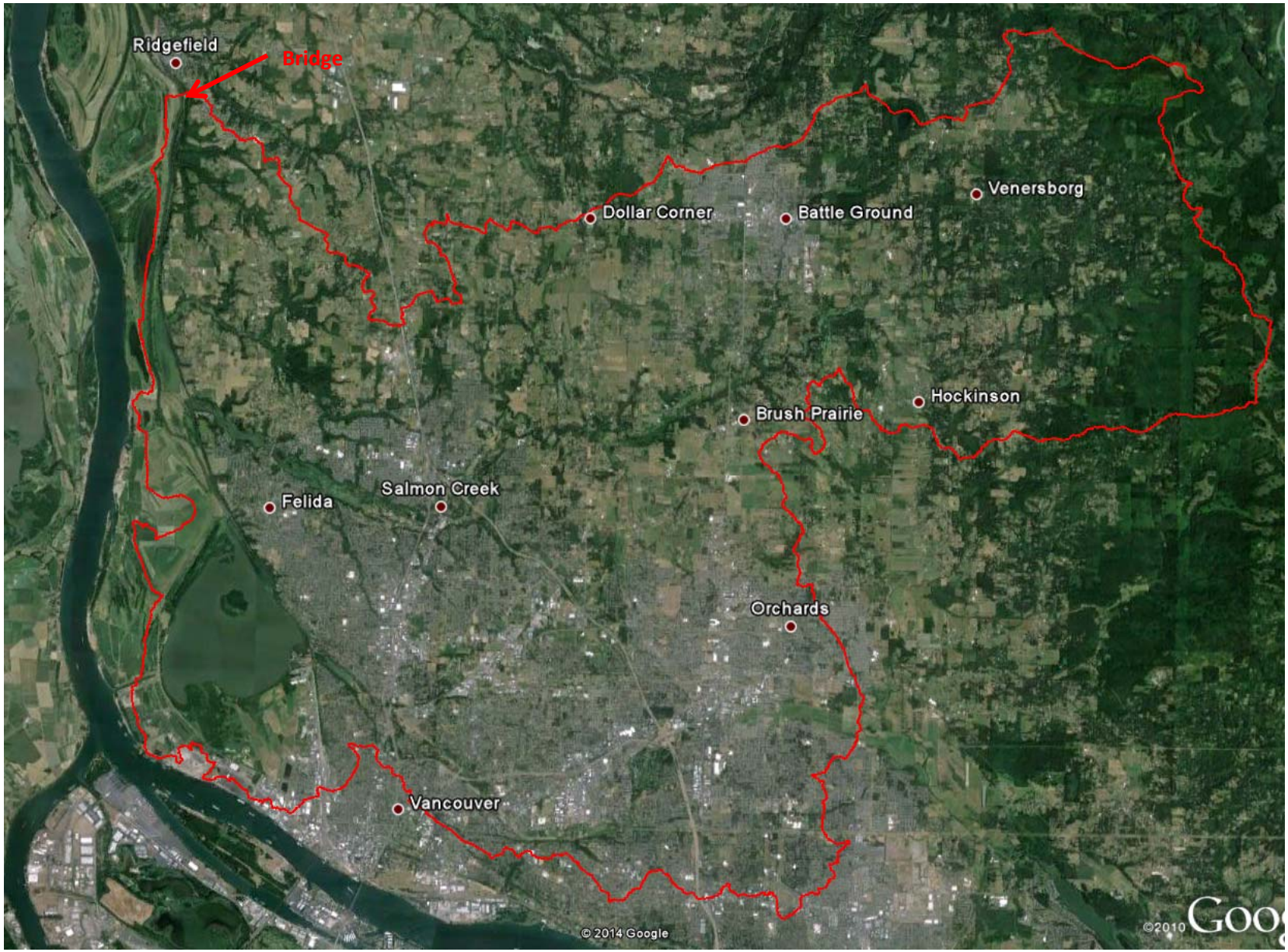


Figure 2

Lake River Drainage Area
Aerial Photo

Figure 3

Aerial Photo

APPENDIX B

Table 1: Peak Discharge Estimates

Table 2: Water Surface Elevation, Clearance, Flow Velocity

Table 1.

Peak Discharge Estimates

Peak Discharge Estimation Method	**Drainage Area (sq. miles)**	**Recurrence Interval**			
		10-year	**50-year**	**100-year**	**500-year**
FEMA FIS – Flood Profiles	118	8322 cfs	12,584 cfs	13,868 cfs	17,287 cfs
Flood Profiles		22 ft	26 ft	27 ft	29.5 ft

Notes:
1. Columbia River Flood Profiles, *Flood Insurance Study, Clark County, Washington and Incorporated Areas* (Flood Insurance Study Number 53011CV001A).
2. Flood profile elevation datum: NAVD 88

Table 2.

Proposed Lake River Bridge

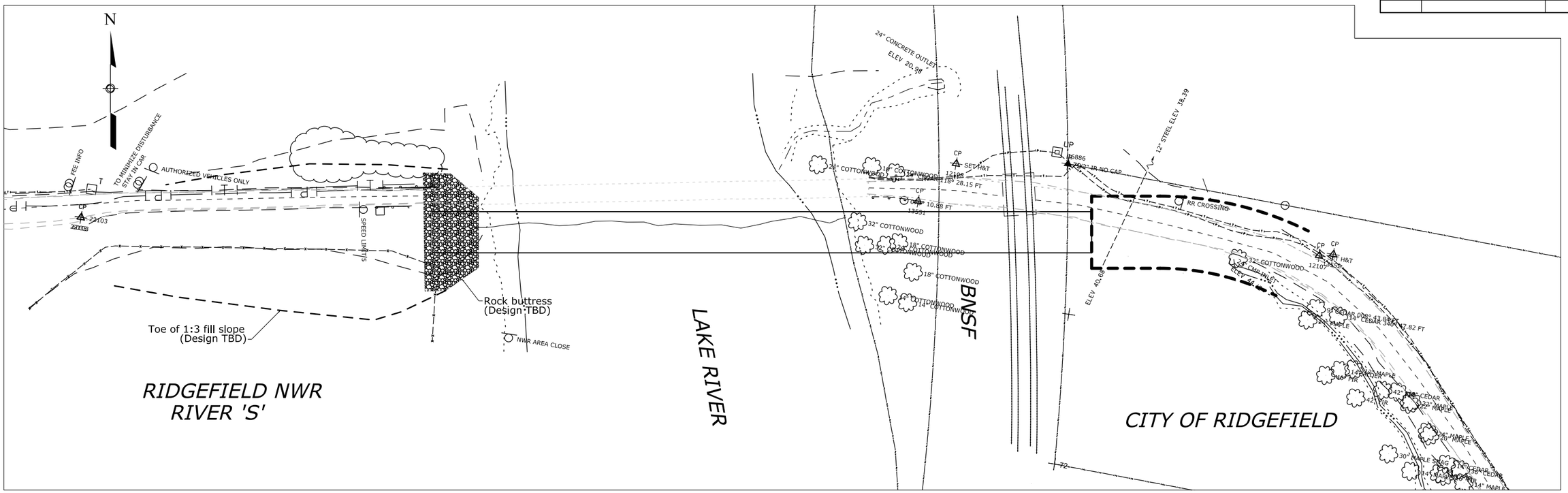
	Recurrence Interval			
	10-year	**50-year**	**100-year**	**500-year**
Existing Water Surface Elevation (feet)	22	26	27	29.5
Clearance (feet)	14.4	10.4	9.4	6.9
Flow Velocity (ft/sec)	1.40	1.51	1.55	1.63

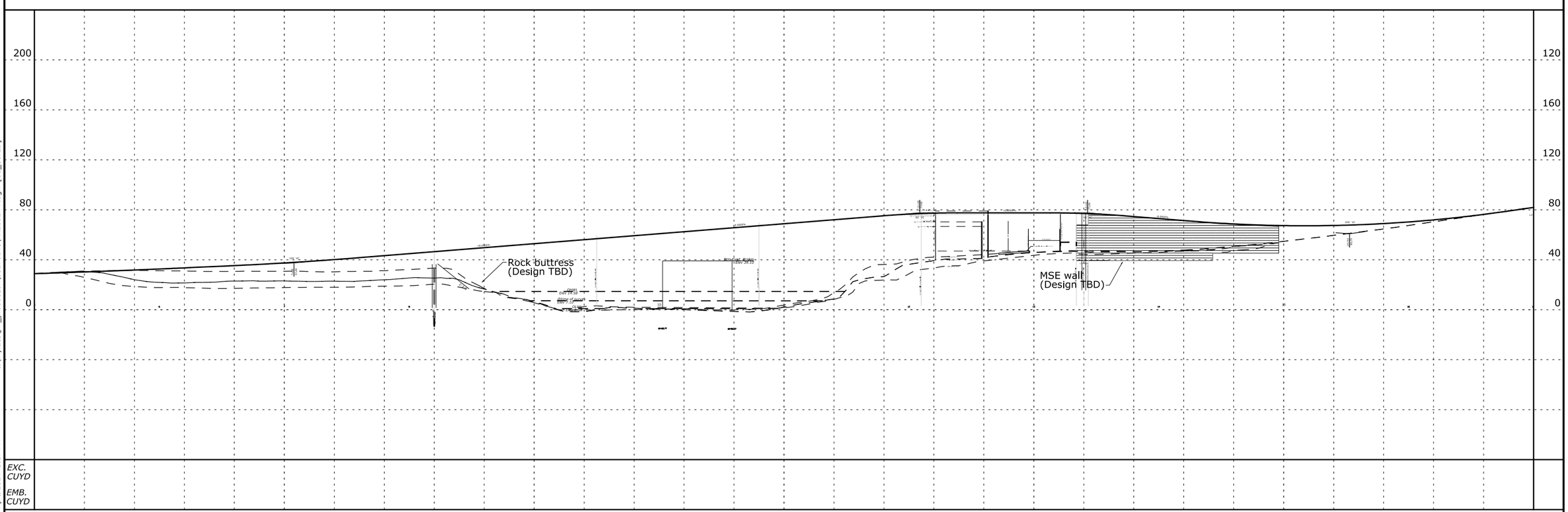
Notes:
1. Elevation datum – NAVD88
2. Clearance is distance between low chord and water surface (Bridge low chord – 36.4 feet)

APPENDIX C

Proposed Bridge/Riprap Layout

STATE	PROJECT	SHEET NUMBER





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APPENDIX D

Scour Analysis

Riprap Analysis

Velocity Calculations (FHWA, Hydraulic Toolbox Results)

Water Surface Elevations (Flood Profiles, 16P, Flood Insurance Study 53011CV001A)

Scour Analysis

SCOUR ESTIMATE

Project:	**Design for River S Bridge Replacement, WA RRP RIDG 100(2)**	File:	**scour18-4-1.xls**
Desc:	**Lake River**	Date:	**4/15/2014**
Units:	**ENG**	By:	**M. Frye**

	Check abutment scour along wingwall first. If undermined, wingwall and pipe pile will perform as pier and pier scour will control maximum scour depth.	**Location Description**			
		100-YEAR	**500-YEAR**	**100-YEAR**	**500-YEAR**
CONSTANTS		**Left Overbank**		**Main Channel**	
UNITS	SI or ENG	**ENG**	**ENG**	**ENG**	**ENG**
g	ACCELERATION OF GRAVITY, 9.81 m/s2, 32.2 ft/s2	**32.20**	**32.20**	**32.20**	**32.20**
Du	D UNIT CONVERSION, 0.001 SI, 0.00328 English	**0.00328**	**0.00328**	**0.00328**	**0.00328**
LIVE-BED OR CLEAR-WATER DETERMINATION					
y	AVERAGE FLOW DEPTH, m, ft	**27.0**	**29.5**	**27.0**	**29.5**
D50	DIAMETER 50% FINER BED PARTICLES, mm	**10**	**10**	**10**	**10**
V	AVERAGE VELOCITY, m/s, ft/s	**1.5**	**1.6**	**1.5**	**1.6**
Ku	UNIT COEFFICIENT, 6.19 SI, 11.17 English	**11.170**	**11.170**	**11.170**	**11.170**
Vc (5.1)	CRITICAL VELOCITY, m/s, ft/s	**6.20**	**6.29**	**6.20**	**6.29**
LB / CW	LIVE BED or CLEAR WATER	**CW**	**CW**	**CW**	**CW**
LIVE-BED CONTRACTION SCOUR					
y1	AVERAGE U/S DEPTH, MAIN CHANNEL, m, ft	**8.0**	**12.5**	**27.0**	**29.5**
y0	AVERAGE CONTRACTED DEPTH BEFORE SCOUR, m, ft	**8.0**	**12.5**	**27.0**	**29.5**
Q1	FLOW IN UPSTREAM CHANNEL, m3/s, ft3/S	**3878.0**	**6372.0**	**9990.0**	**10915.0**
Q2	FLOW IN CONTRACTED CHANNEL, m3/s, ft3/S	**500.0**	**500.0**	**9990.0**	**10915.0**
W1	WIDTH OF THE UPSTREAM CHANNEL, m, ft	**379.0**	**379.0**	**300.0**	**300.0**
W2	WIDTH OF THE CONTRACTED SECTION, m, ft	**55.0**	**55.0**	**300.0**	**300.0**
S1	ENERGY SLOPE OF MAIN CHANNEL, m/m, ft/ft	**0.0001**	**0.0001**	**0.0001**	**0.0001**
w (Fig 6.8)	D50 FALL VELOCITY, m/s	**0.500**	**0.500**	**0.500**	**0.500**
	UNIT COEFFICIENT, 1.0 SI, 3.28 English	**3.28**	**3.28**	**3.28**	**3.28**
	D50 FALL VELOCITY, m/s, ft/s	**1.640**	**1.640**	**1.640**	**1.640**
k1 (p5.11)	TRANSPORT COEFFICIENT	**0.59**	**0.59**	**0.59**	**0.59**
	BED MATERIAL TRANSPORT MODE	**BL**	**BL**	**BL**	**BL**
V*	SHEAR VELOCITY, m/s, ft/s	**0.16**	**0.20**	**0.29**	**0.31**
y2 (5.2)	AVERAGE DEPTH, CONTRACTED SECTION, m, ft	**4.32**	**4.41**	**27.00**	**29.50**
yS (5.3)	AVERAGE SCOUR DEPTH, m, ft	**0.00**	**0.00**	**0.00**	**0.00**
As	AVERAGE SCOUR AREA, m2, ft2	**0.00**	**0.00**	**0.00**	**0.00**

CLEAR-WATER CONTRACTION SCOUR					
y0	AVERAGE CONTRACTED DEPTH BEFORE SCOUR, m, ft	8.0	12.5	27.0	29.5
D50	MEDIAN DIAMETER BED MATERIAL, mm	10	10	10	10
Q	DISCHARGE THROUGH THE BRIDGE, m3/s, ft3/s	500.0	500.0	9990.0	10915.0
W	BOTTOM WIDTH OF THE CONTRACTED SECTION, m, ft	240.0	240.0	370.0	370.0
Ku	UNIT COEFFICIENT, 0.025 SI, 0.0077 English	0.0077	0.0077	0.0077	0.0077
Dm	DIA. SMALLEST NONTRANSPORT PARTICLE, m, ft	0.0410	0.0410	0.0410	0.0410
y2 (5.4)	AVERAGE DEPTH, CONTRACTED SECTION, m, ft	0.58	0.58	5.22	5.63
yS (5.5)	AVERAGE SCOUR DEPTH, m, ft	0.00	0.00	0.00	0.00
As	AVERAGE SCOUR AREA, m2, ft2	0.00	0.00	0.00	0.00
PRESSURE FLOW CONTRACTION SCOUR					
Hb	DISTANCE LOW CHORD TO STREAM BED, m, ft				
y1	FLOW DEPTH UPSTREAM FACE OF BRIDGE, m, ft				
D50	D50 OF BED MATERIAL IN OPENING, mm				
Va	AVERAGE VELOCITY THROUGH OPENING, m/s, ft/s				
Ku	UNIT COEFFICIENT, 6.19 SI, 11.17 English	11.170	11.170	11.170	11.170
Vc (5.1)	CRITICAL VELOCITY, m/s, ft/s	0.00	0.00	0.00	0.00
ys	VERTICAL SCOUR DEPTH, m, ft	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
PIER SCOUR					
y1	FLOW DEPTH U/S OF THE PIER, m, ft			27.0	29.5
V1	APPROACH VELOCITY, m/s, ft/s			1.5	1.6
a	PIER WIDTH, m, ft			3	3
L	PIER LENGTH, m, ft			3	3
FA	FLOW ANGLE, degrees			0	0
K1 (Tbl 6.1)	CORRECTION FOR PIER SHAPE (0.9 to 1.1, >5deg, 1)			0.9	0.9
K3 (Tbl 6.3)	CORRECTION FOR BED FORM (1.1 to 1.3)			1.1	1.1
K4, BED ARMORING, D50 ≥ 2 mm and D95 > 20 mm					
D50	DIAMETER 50% FINER BED PARTICLES, mm			10	10
D95	DIAMETER 95% FINER BED PARTICLES, mm			3.0	3.0
Ku	UNIT COEFFICIENT, 6.19 SI, 11.17 English	11.17	11.17	11.17	11.17
Vc50 (6.8)	CRITICAL VELOCITY D50, m/s, ft/s	0.00	0.00	6.19	6.29
Vc95	CRITICAL VELOCITY D95, m/s, ft/s	0.00	0.00	4.15	4.21
Vic50 (6.7)	INCIPIENT VELOCITY NEAR PIER D50, m/s, ft/s	0.00	0.00	3.14	3.19
Vic95	INCIPIENT VELOCITY NEAR PIER D95, m/s, ft/s	0.00	0.00	1.98	2.01
Vr (6.6)	VELOCITY RATIO	0.00	0.00	0.00	0.00
K4 (6.5)	CORRECTION FOR ARMORED BED (>0.4)	0.00	0.00	1.00	1.00
K2 (6.4)	CORRECTION FOR FLOW ANGLE (1 to 5)	0.00	0.00	1.00	1.00
yS (6.3)	SCOUR DEPTH, m, ft	0.00	0.00	3.61	3.74
L/a	PIER LENGTH/WIDTH RATIO (MAX. L/a = 12))	0.00	0.00	1.00	1.00
Fr	FROUDE RATIO	0.00	0.00	0.05	0.05

ABUTMENT SCOUR					
L'	LENGTH OF OBSTRUCTION, m, ft			0.0	0
Ae	AREA OF OBSTRUCTED FLOW, m2, ft2			0.0	0
Qe	OBSTRUCTED FLOW, m3/s, ft3/s			0.0	0.00
K1 (Tbl 7.1)	CORRECTION FOR ABUTMENT SHAPE (0.55, 0.82, 1.0)			1.00	1
Theta	EMBANKMENT ANGLE, deg (ds theta<90, us theta>90)			90	90
K2 (7.1)	CORRECTION FOR FLOW ANGLE	0.00	0.00	1.00	1.00
ya (7.1)	AVERAGE FLOODPLAIN DEPTH, m, ft	0.00	0.00	0.00	0.00
Ve (7.1)	OBSTRUCTED VELOCITY, m/s, f/s	0.00	0.00	0.00	0.00
Fr (7.1)	FROUDE RATIO	0.00	0.00	0.00	0.00
yS (7.1)	SCOUR DEPTH, m, ft	0.00	0.00	0.00	0.00
TOTAL SCOUR					
Base Elevation		14.5	14.5	0.0	0.0
Contraction Scour					
	Live Bed	0.0	0.0	0.0	0.0
	Clear Water	0.0	0.0	0.0	0.0
	Pressure Flow (assumes clear water)	0.0	0.0	0.0	0.0
Contraction + Pier (without Pressure Flow Scour)					
	Pier	0.0	0.0	3.6	3.7
	Total Live Bed	0.0	0.0	3.6	3.7
	Live Bed Scour Elevation	14.5	14.5	-3.6	-3.7
	Total Clear Water	0.0	0.0	3.6	3.7
	Clear Water Scour Elevation	14.5	14.5	-3.6	-3.7
Contraction + Pier (with Pressure Flow Scour)					
	Pier	0.0	0.0	0.0	0.0
	Total Live Bed	0.0	0.0	0.0	0.0
	Live Bed Scour Elevation	14.5	14.5	0.0	0.0
	Total Clear Water	0.0	0.0	0.0	0.0
	Clear Water Scour Elevation	14.5	14.5	0.0	0.0
Contraction + Abutment					
	Abutment	0.0	0.0	0.0	0.0
	Total Live Bed	0.0	0.0	0.0	0.0
	Live Bed Scour Elevation	14.5	14.5	0.0	0.0
	Total Clear Water	0.0	0.0	0.0	0.0
	Clear Water Scour Elevation	14.5	14.5	0.0	0.0

Note:

HEC 18, 4th ED. 5/2001 (EQUATIONS SHOWN IN PARENTHESIS)

Qe (Obstructed Flow) = (design flow / top width of upstream channel) * length of obstruction

Riprap Analysis

RIPRAP DESIGN - FHWA

Project: **Design for River S Bridge Replacement, WA RRP RIDG 100(2)**

Desc: **Abutment Riprap** Date: **04/30/14**

FOR ENGLISH OUTPUT, SET g = 32.2 FT/SEC^2 **g = 32.2**

FOR METRIC OUTPUT, SET g = 9.81 M/SEC^2

Location	Riprap Class	Qdes	Y_o	V	VCF	■	D65 D_m	SS	SL	S_s	VB	Output SFS	SFB	Riprap Channel Safety Factors S_m	V_r	🗀	🖐	V_s
Abutment	2	50	26.0	1.5	1.50	42	0.99	1.25	0.001	2.65	2.26	1.12	89.03	1.13	1.33	0.0101	0.0146	0.95
	2	50	26.0	1.5	1.50	42	0.99	1.50	0.001	2.65	2.26	1.34	89.03	1.35	1.33	0.0101	0.0164	0.95
	2	50	26.0	1.5	1.50	42	0.99	1.75	0.001	2.65	2.26	1.56	89.03	1.58	1.33	0.0101	0.0184	0.95
	2	50	26.0	1.5	1.50	42	0.99	2.00	0.001	2.65	2.26	1.78	89.03	1.80	1.33	0.0101	0.0204	0.95
	3	50	26.0	1.5	1.50	42	1.33	1.25	0.001	2.65	2.26	1.12	105.45	1.13	1.40	0.0084	0.0121	1.00
	3	50	26.0	1.5	1.50	42	1.33	1.50	0.001	2.65	2.26	1.34	105.45	1.35	1.40	0.0084	0.0136	1.00
DESIGN	3	50	26.0	1.5	1.50	42	1.33	1.75	0.001	2.65	2.26	1.56	105.45	1.58	1.40	0.0084	0.0152	1.00
	3	50	26.0	1.5	1.50	42	1.33	2.00	0.001	2.65	2.26	1.79	105.45	1.80	1.40	0.0084	0.0169	1.00
	4	50	26.0	1.5	1.50	42	1.67	1.25	0.001	2.65	2.26	1.12	119.45	1.13	1.46	0.0073	0.0105	1.05
	4	50	26.0	1.5	1.50	42	1.67	1.50	0.001	2.65	2.26	1.34	119.45	1.35	1.46	0.0073	0.0118	1.05
	4	50	26.0	1.5	1.50	42	1.67	1.75	0.001	2.65	2.26	1.57	119.45	1.58	1.46	0.0073	0.0132	1.05
	4	50	26.0	1.5	1.50	42	1.67	2.00	0.001	2.65	2.26	1.79	119.45	1.80	1.46	0.0073	0.0146	1.05

River Engineering for Highway Encroachments, Highways in the River Environment, HDS NO. 6, DECEMBER 2001, River Stabilization and Bank Protection, Riprap Design and Placement, Chapter 6, FHWA

SAFETY FACTOR FOR RIPRAP PLACED ALONG A STREAM CHANNEL, (EQUATIONS 6.3, 6.9, 6.10, 6.11, 6.12, 6.16 AND 6.22)

Y_o = NORMAL FLOW DEPTH FOR DESIGN DISCHARGE WITHIN THE CHANNEL IN FEET OR METERS,
CHECK SAFETY FACTORS FOR Y_o = THE TOTAL DEPTH AND Yo = 0.4 OF THE TOTAL DEPTH

V = LOCAL AVERAGE VELOCITY (FT/SEC) OR (M/SEC), USE AVERAGE CHANNEL VELOCITY FOR BENDS

VCF = VELOCITY CORRECTION FACTOR FOR BENDS (1.0 FOR STRAIGHT CHANNELS
TO 2.0 FOR SEVERE CURVATURE ; RECOMMEND 1.5 FOR MOST NATURAL BENDS)

VB = LOCAL AVERAGE VELOCITY IN A BEND OR IN A STRAIGHT CHANNEL (FT/SEC) OR (M/SEC)

■ = ANGLE OF REPOSE FOR RIPRAP IN DEGREES

D_m = REPRESENTATIVE RIPRAP SIZE IN FEET OR METER
(NORMALLY THE SIZE THAT 65% OF THE RIPRAP IS FINER BY WEIGHT, D_{65}, or APPROXIMATELY $1.25D_{50}$)

SS = HORIZONTIAL UNITS PER UNIT VERTICAL(I.E. 2 HOR. : 1 VER. , SS = 2)

SL = LONGITUDINAL CHANNEL SLOPE IN FEET/FEET OR METER/METER

S_s = SPECIFIC GRAVITY OF THE RIPRAP

SFS = SAFETY FACTOR FOR SIDE SLOPES; RECOMMEND SFS = 1.5

SFB = SAFETY FACTOR FOR CHANNEL BED; RECOMMEND SFB = 1.5

S_m = RATIO OF TANGENTS OF FRICTION ANGLE TO SIDE SLOPE ANGLE

V_r = REFERENCE VELOCITY, FEET PER SECOND OR METER PER SECOND

□ = STABILITY NUMBER FOR RIPRAP ON A PLANE BED

□ = S_m * □ * SECANT(SIDE SLOPE ANGLE)

V_s = VELOCITY AGAINST THE STONE, FEET PER SECOND OR METER PER SECOND

Hydraulic Toolbox Results

Hydraulic Analysis Report

Project Data

Project Title: Design for River S Bridge Replacement

Designer: M. Frye

Project Date: Sunday, May 11, 2014

Project Units: U.S. Customary Units

Notes: Lake River

Channel Analysis: Q10

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station ft	Elevation ft	Manning's n
0.00	28.87	0.0800
40.00	25.85	0.0800
80.00	18.49	0.0800
120.00	17.68	0.0800
160.00	17.12	0.0800
200.00	17.77	0.0800
240.00	17.96	0.0800
280.00	18.89	0.0800
320.00	20.41	0.0800
360.00	14.51	0.0800
400.00	5.65	0.0600
440.00	-1.50	0.0600
480.00	1.23	0.0600
520.00	0.03	0.0600
560.00	0.00	0.0600
600.00	2.08	0.0600
640.00	8.61	0.0600
680.00	23.76	0.0800
720.00	33.32	0.0800
760.00	39.08	0.0800
800.00	43.53	-----

Longitudinal Slope: 0.0001 ft/ft

Depth: 22.0000 ft

Result Parameters

Flow: 8321.5243 cfs

Area of Flow: 5862.9047 ft^2

Wetted Perimeter: 607.4604 ft

Average Velocity: 1.4194 ft/s

Top Width: 602.3119 ft

Froude Number: 0.0802

Critical Depth: 5.9395 ft

Critical Velocity: 10.8863 ft/s

Critical Slope: 0.0342 ft/ft

Critical Top Width: 207.6901 ft

Calculated Max Shear Stress: 0.1373 lb/ft^2

Calculated Avg Shear Stress: 0.0602 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0475

Channel Analysis: Q50

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station ft	Elevation ft	Manning's n
0.00	28.87	0.0800
40.00	25.85	0.0800
80.00	18.49	0.0800
120.00	17.68	0.0800
160.00	17.12	0.0800
200.00	17.77	0.0800
240.00	17.96	0.0800
280.00	18.89	0.0800
320.00	20.41	0.0800
360.00	14.51	0.0800
400.00	5.65	0.0600
440.00	-1.50	0.0600
480.00	1.23	0.0600
520.00	0.03	0.0600
560.00	0.00	0.0600
600.00	2.08	0.0600
640.00	8.61	0.0600
680.00	23.76	0.0800
720.00	33.32	0.0800
760.00	39.08	0.0800
800.00	43.53	-----

Longitudinal Slope: 0.0001 ft/ft

Depth: 26.0000 ft

Result Parameters

Flow: 12584.0378 cfs

Area of Flow: 8337.1723 ft^2

Wetted Perimeter: 641.9496 ft

Average Velocity: 1.5094 ft/s

Top Width: 635.7522 ft

Froude Number: 0.0735

Critical Depth: 7.1749 ft

Critical Velocity: 12.2185 ft/s

Critical Slope: 0.0317 ft/ft

Critical Top Width: 222.1361 ft

Calculated Max Shear Stress: 0.1622 lb/ft^2

Calculated Avg Shear Stress: 0.0810 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0544

Channel Analysis: Q100

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station ft	Elevation ft	Manning's n
0.00	28.87	0.0800
40.00	25.85	0.0800
80.00	18.49	0.0800
120.00	17.68	0.0800
160.00	17.12	0.0800
200.00	17.77	0.0800
240.00	17.96	0.0800
280.00	18.89	0.0800
320.00	20.41	0.0800
360.00	14.51	0.0800
400.00	5.65	0.0600
440.00	-1.50	0.0600
480.00	1.23	0.0600
520.00	0.03	0.0600
560.00	0.00	0.0600
600.00	2.08	0.0600
640.00	8.61	0.0600
680.00	23.76	0.0800
720.00	33.32	0.0800
760.00	39.08	0.0800
800.00	43.53	-----

Longitudinal Slope: 0.0001 ft/ft

Depth: 27.0000 ft

Result Parameters

Flow: 13867.2634 cfs

Area of Flow: 8977.7349 ft^2

Wetted Perimeter: 651.7793 ft

Average Velocity: 1.5446 ft/s

Top Width: 645.3728 ft

Froude Number: 0.0730

Critical Depth: 7.5085 ft

Critical Velocity: 12.5540 ft/s

Critical Slope: 0.0309 ft/ft

Critical Top Width: 225.6846 ft

Calculated Max Shear Stress: 0.1685 lb/ft^2

Calculated Avg Shear Stress: 0.0860 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0553

Channel Analysis: Q500

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Station ft	Elevation ft	Manning's n
0.00	28.87	0.0800
40.00	25.85	0.0800
80.00	18.49	0.0800
120.00	17.68	0.0800
160.00	17.12	0.0800
200.00	17.77	0.0800
240.00	17.96	0.0800
280.00	18.89	0.0800
320.00	20.41	0.0800
360.00	14.51	0.0800
400.00	5.65	0.0600
440.00	-1.50	0.0600
480.00	1.23	0.0600
520.00	0.03	0.0600
560.00	0.00	0.0600
600.00	2.08	0.0600
640.00	8.61	0.0600
680.00	23.76	0.0800
720.00	33.32	0.0800
760.00	39.08	0.0800
800.00	43.53	-----

Longitudinal Slope: 0.0001 ft/ft

Depth: 29.5000 ft

Result Parameters

Flow: 17286.1178 cfs

Area of Flow: 10639.3336 ft^2

Wetted Perimeter: 693.0775 ft

Average Velocity: 1.6247 ft/s

Top Width: 686.2637 ft

Froude Number: 0.0727

Critical Depth: 8.3399 ft

Critical Velocity: 13.3389 ft/s

Critical Slope: 0.0292 ft/ft

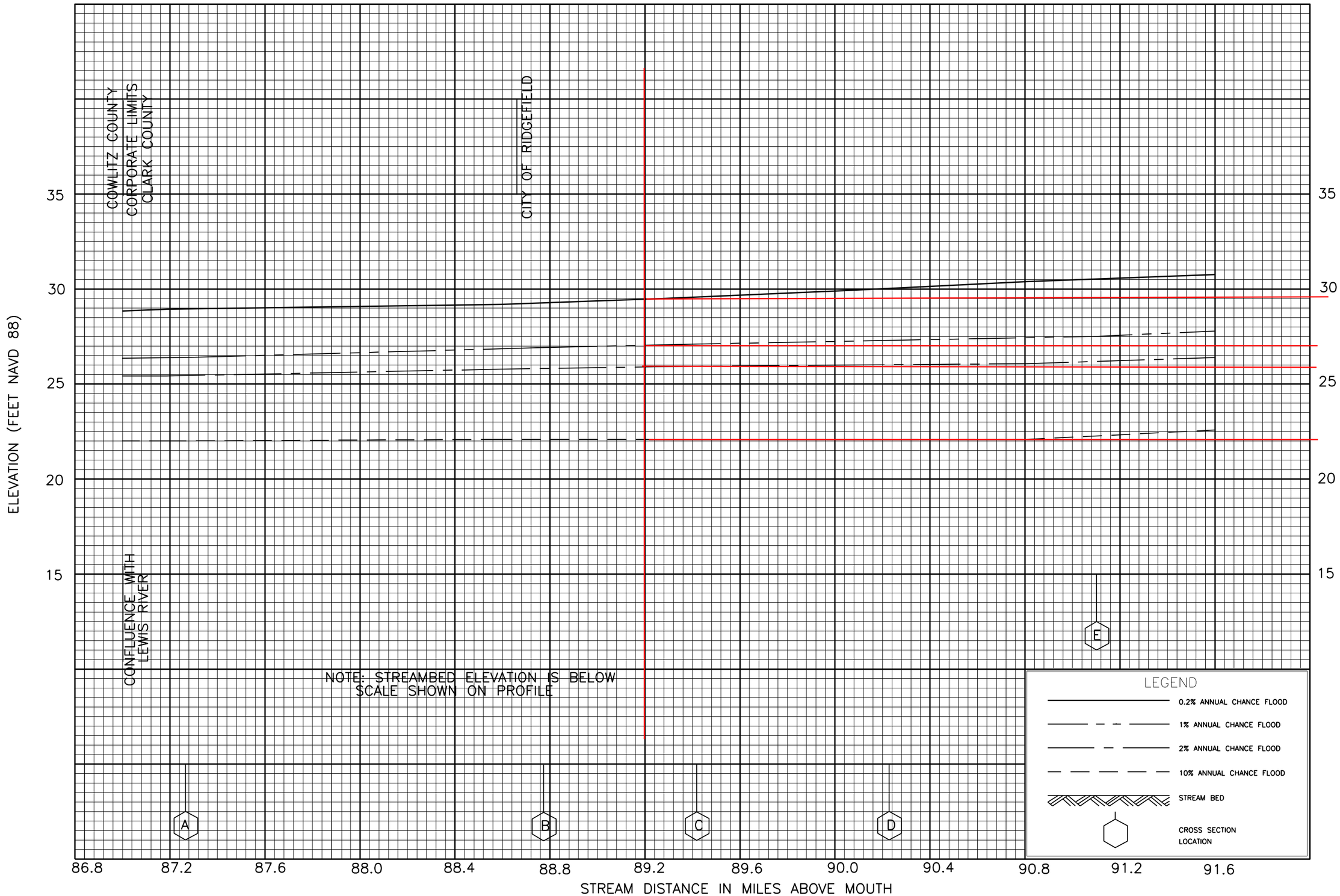
Critical Top Width: 234.5282 ft

Calculated Max Shear Stress: 0.1841 lb/ft^2

Calculated Avg Shear Stress: 0.0958 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0565



FLOOD PROFILES

COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

APPENDIX E

Flood Insurance Study for Clark County (FIS No. 53011CV001A, 9/5/2012)

Water Quality Report (Megan Frye, WFLHD 2014)

FLOOD INSURANCE STUDY

VOLUME 2 OF 2

CLARK COUNTY, WASHINGTON
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
BATTLE GROUND, CITY OF	530025
CAMAS, CITY OF	530026
CLARK COUNTY	
(UNINCORPORATED AREAS)	530024
LA CENTER, CITY OF	530248
RIDGEFIELD, CITY OF	530298
VANCOUVER, CITY OF	530027
WASHOUGAL, CITY OF	530028
YACOLT, TOWN OF	530269

EFFECTIVE DATE: SEPTEMBER 5, 2012

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
53011CV002A

NOTICE TO
FLOOD INSURANCE STUDY USERS

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

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

Old Zone(s)	New Zone
Al through A30	AE
Vl through V30	VE
B	X
C	X

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.

FIS Effective Date: September 5, 2012

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EXHIBITS

Exhibit 1 - Flood Profiles

Burnt Bridge Creek	Panels 01P-12P
China Ditch	Panels 13P-15P
Columbia River	Panels 16P-24P
Curtin Creek	Panels 25P-28P
East Fork Lewis River	Panels 29P-40P

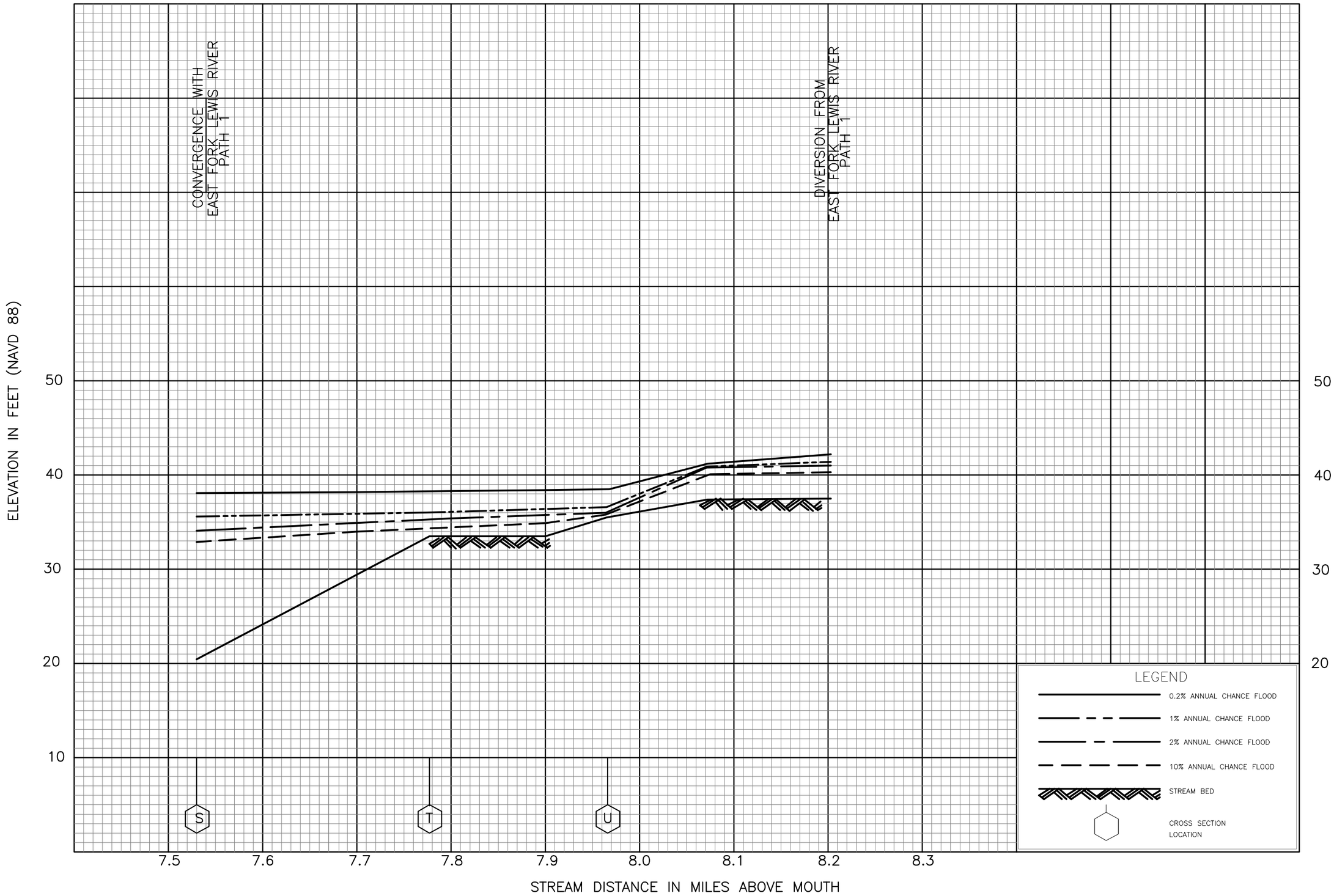
VOLUME 2

EXHIBITS

East Fork Lewis River Lower Split	Panel 41P
East Fork Lewis River Path 2	Panel 42P
East Fork Lewis River Path 3	Panel 43P
Fifth Plain Creek	Panels 44P-47P
Gee Creek	Panels 48P-55P
Lacamas Creek	Panels 56P-65P
Lewis River	Panels 66P-80P
Mill Creek	Panels 81P-86P
Packard Creek	Panels 87P-92P
Padden Creek	Panel 93P
Salmon Creek	Panels 94P-111P
Spring Branch Creek	Panel 112P
Unnamed Tributary to Gee Creek	Panel 113P
Washougal River	Panels 114P-118P
Weaver Creek	Panels 119P-123P
Whipple Creek	Panels 124P-130P

PUBLISHED SEPARATELY:

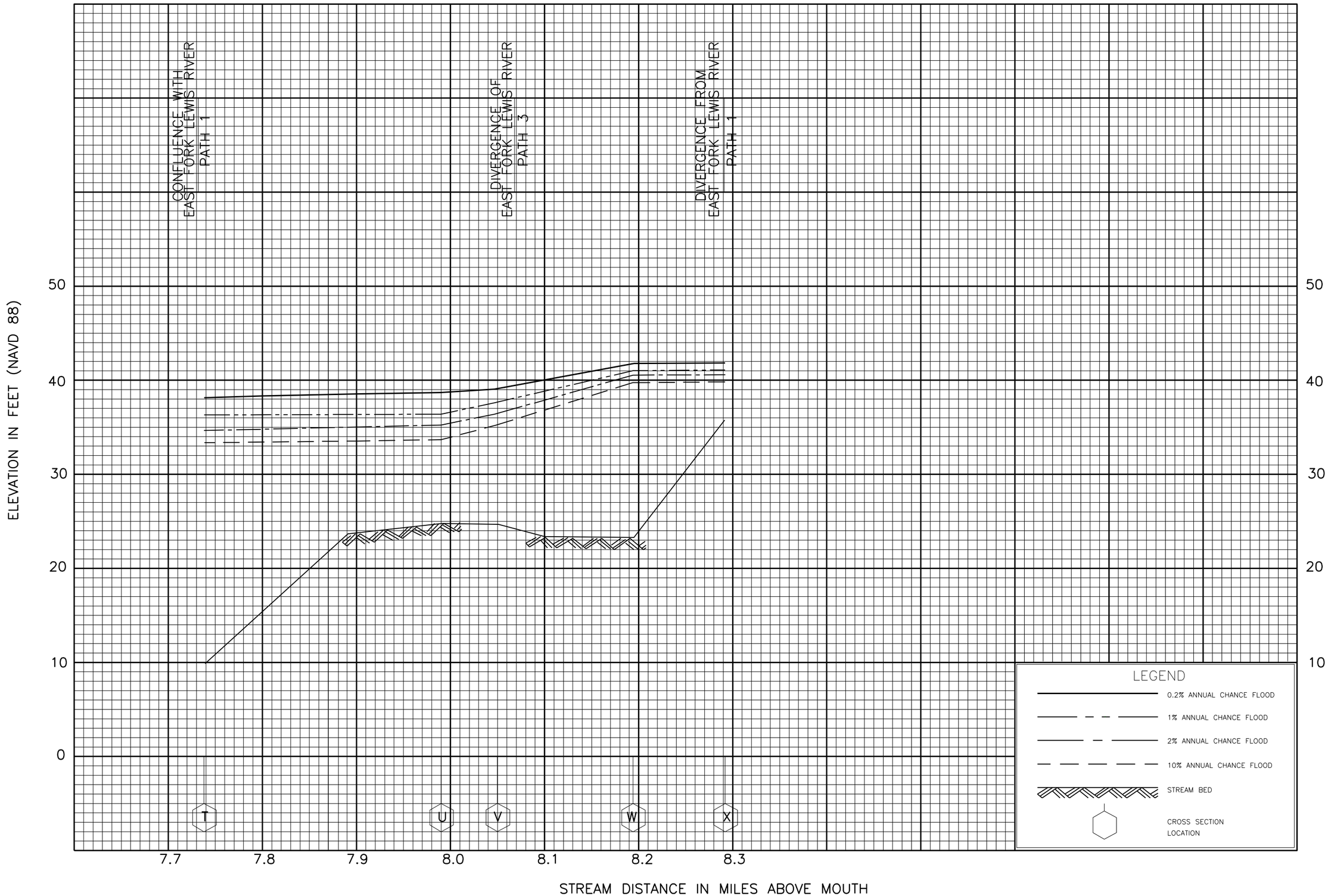
Exhibit 2 - Flood Insurance Rate Map Index
Flood Insurance Rate Map



FLOOD PROFILES

EAST FORK LEWIS RIVER LOWER SPLIT

FEDERAL EMERGENCY MANAGEMENT AGENCY
CLARK COUNTY, WA
AND INCORPORATED AREAS

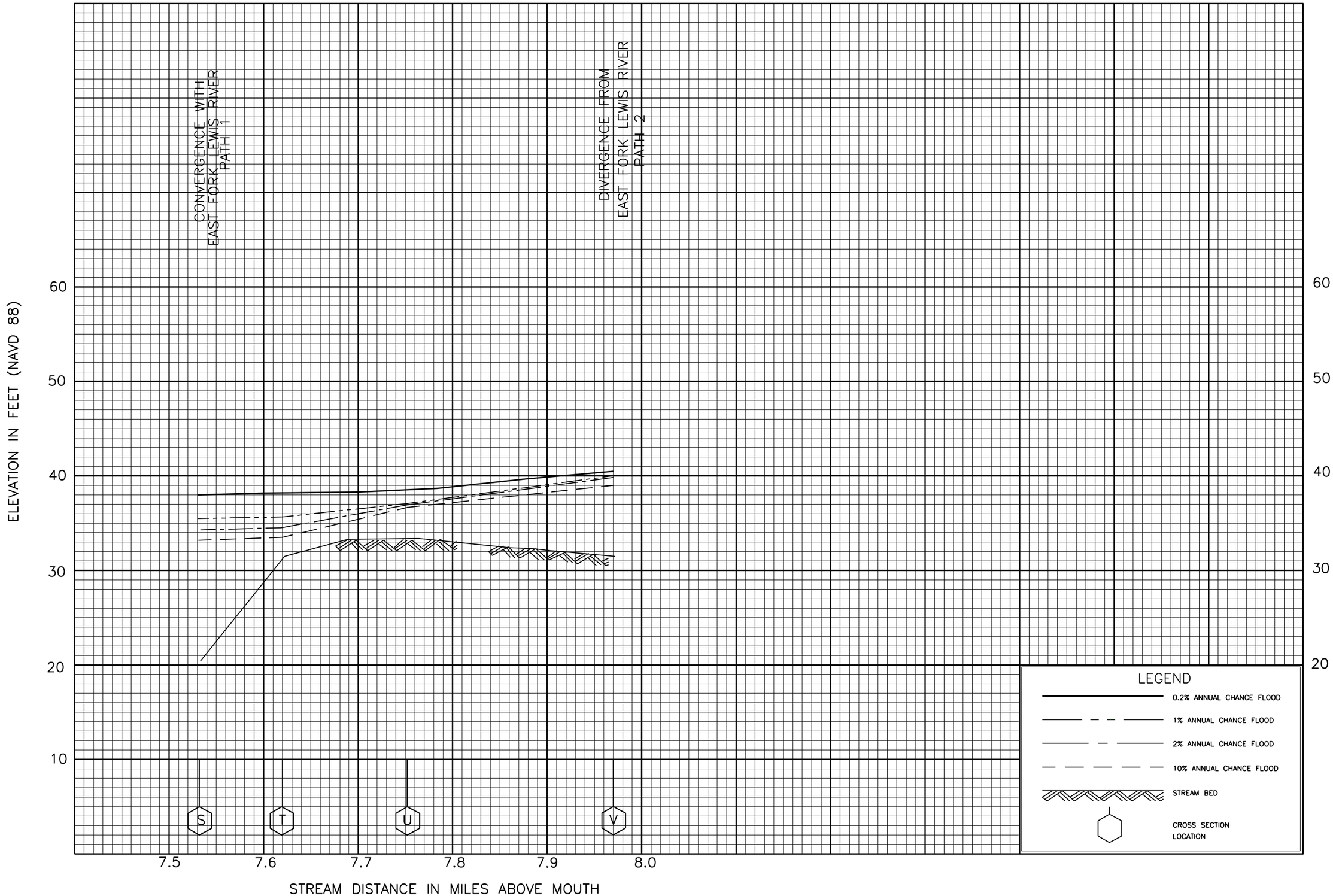


FLOOD PROFILES

EAST FORK LEWIS RIVER PATH 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

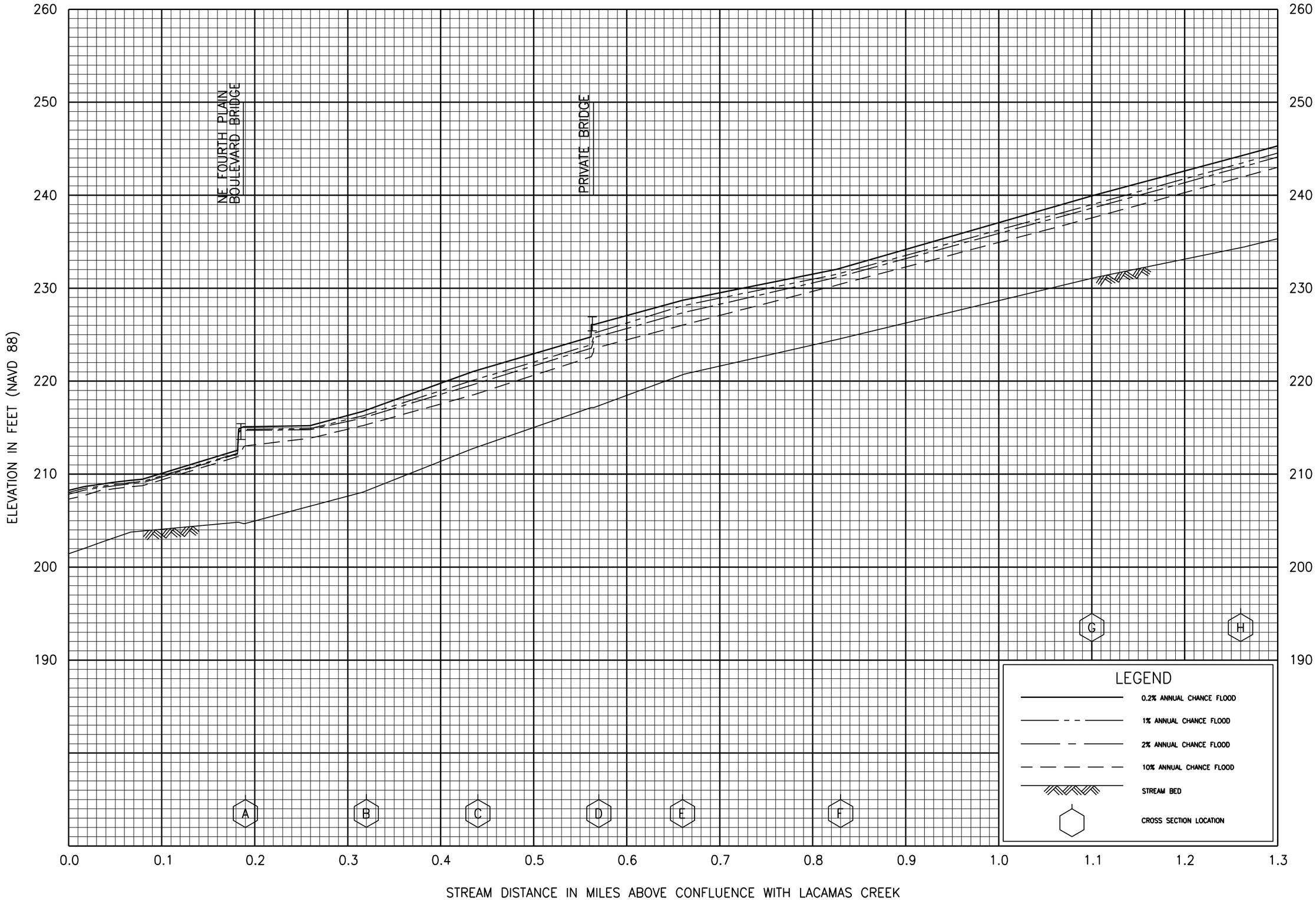


FLOOD PROFILES

EAST FORK LEWIS RIVER PATH 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

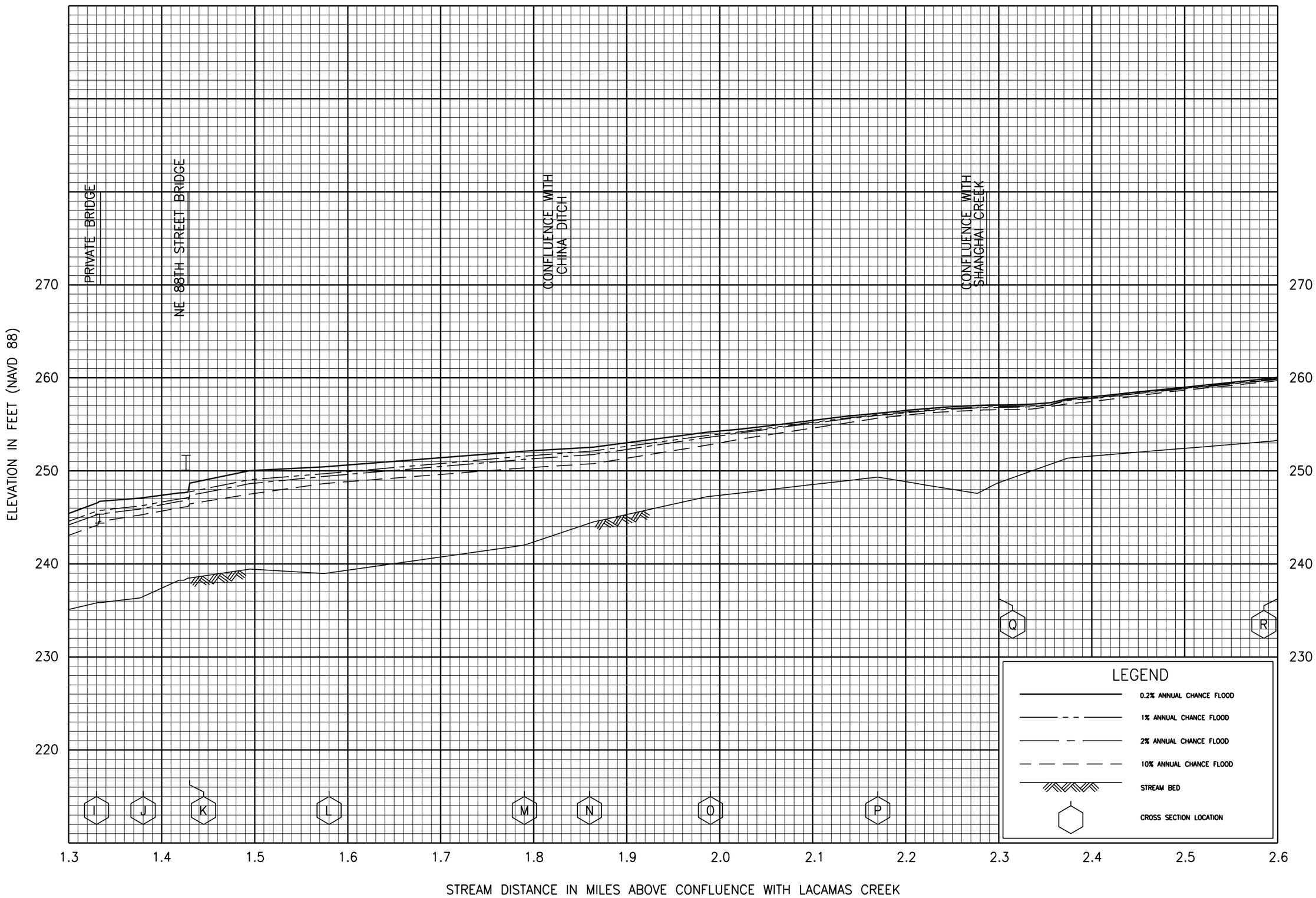


FLOOD PROFILES

FIFTH PLAIN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

FIFTH PLAIN CREEK

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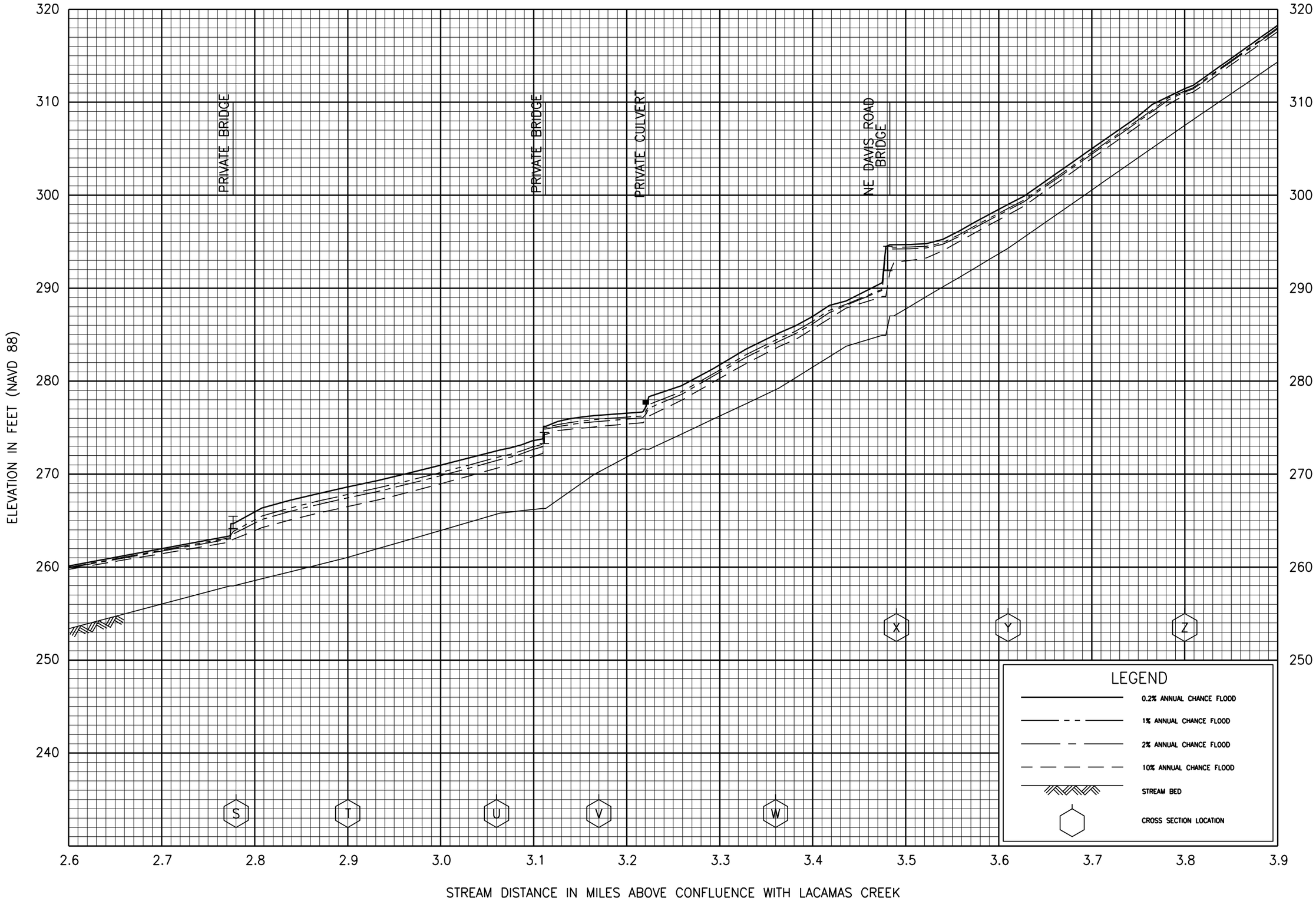

FLOOD PROFILES

FIFTH PLAIN CREEK

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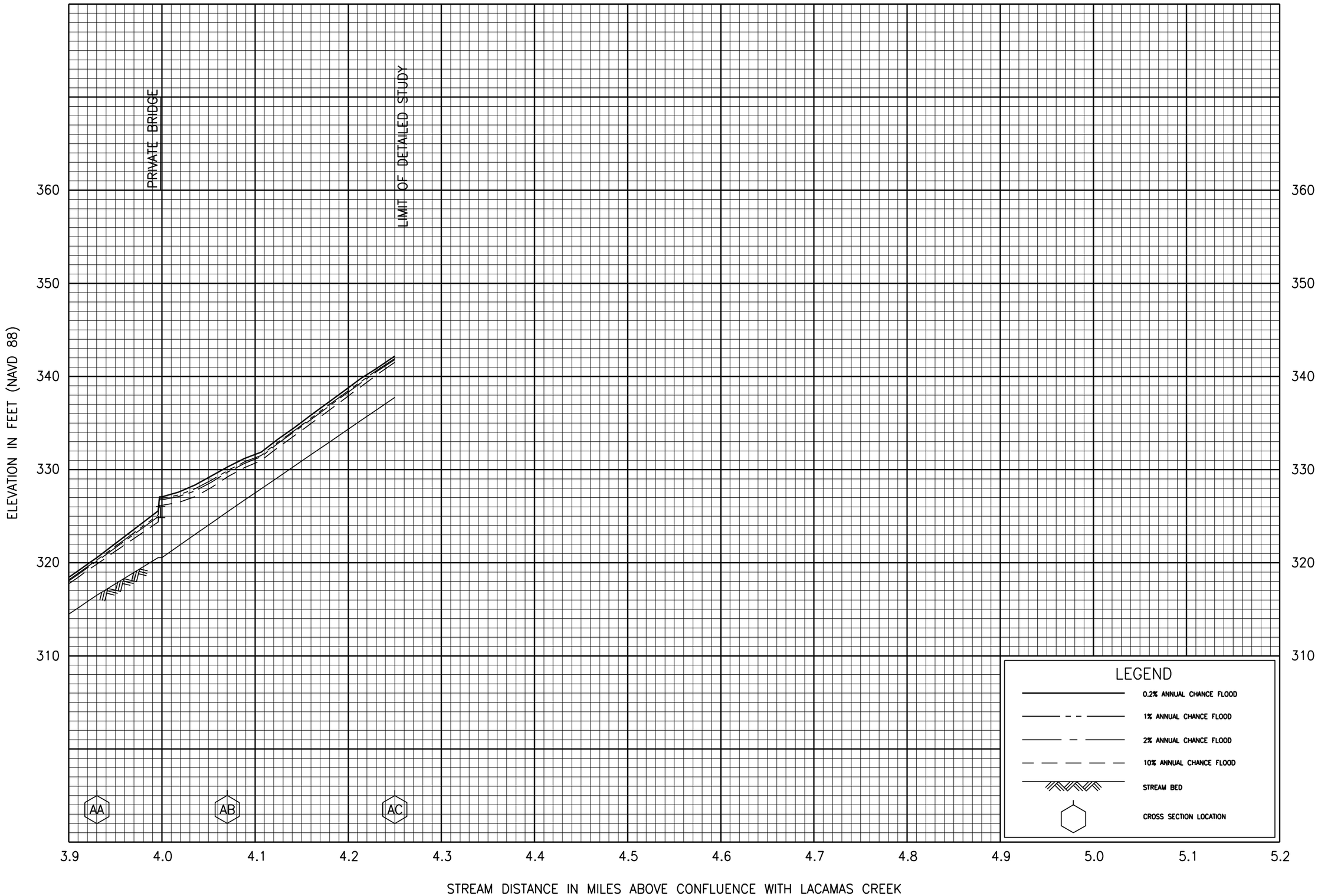

FLOOD PROFILES

FIFTH PLAIN CREEK

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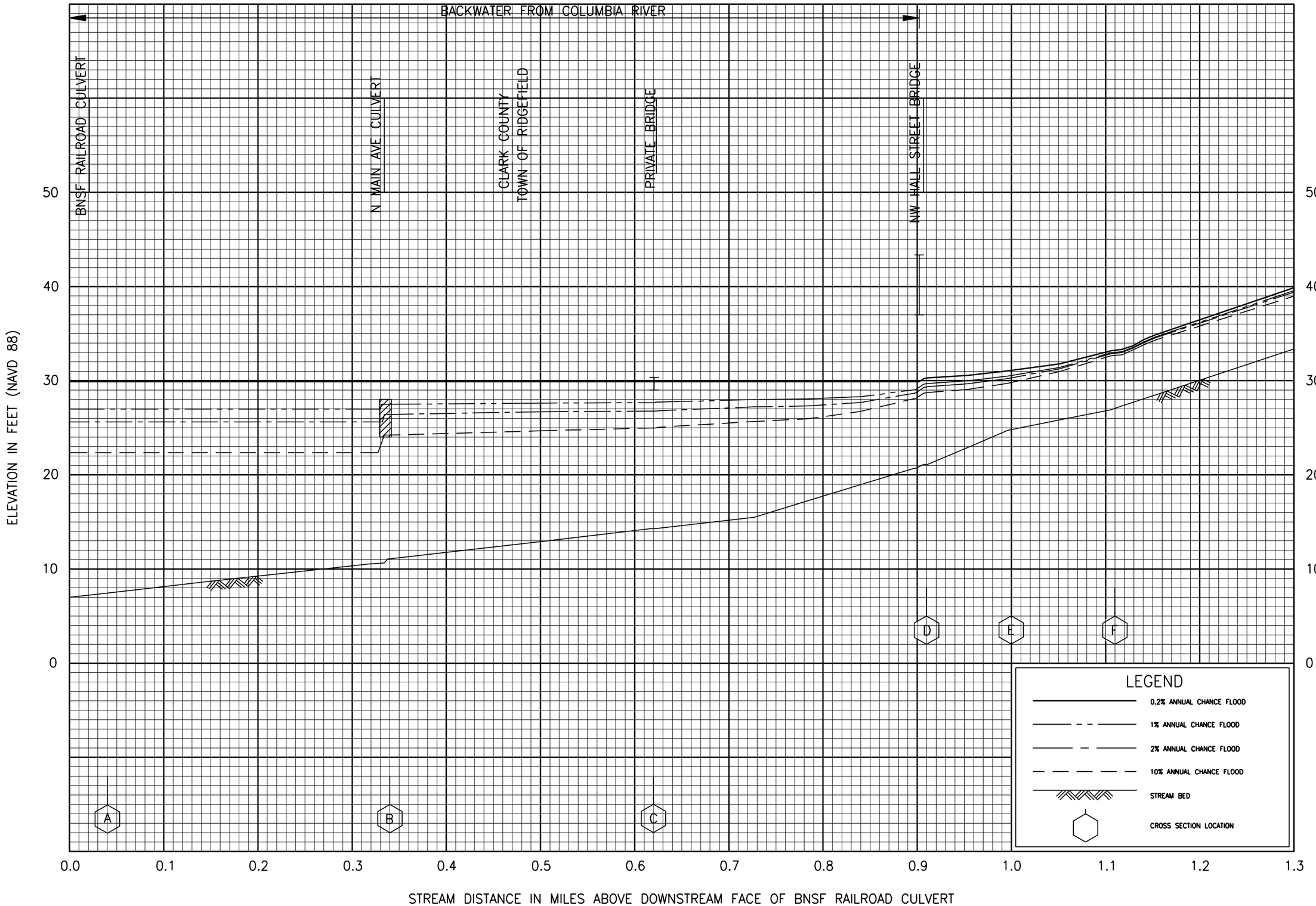

FLOOD PROFILES

GEE CREEK

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CLARK COUNTY, WA

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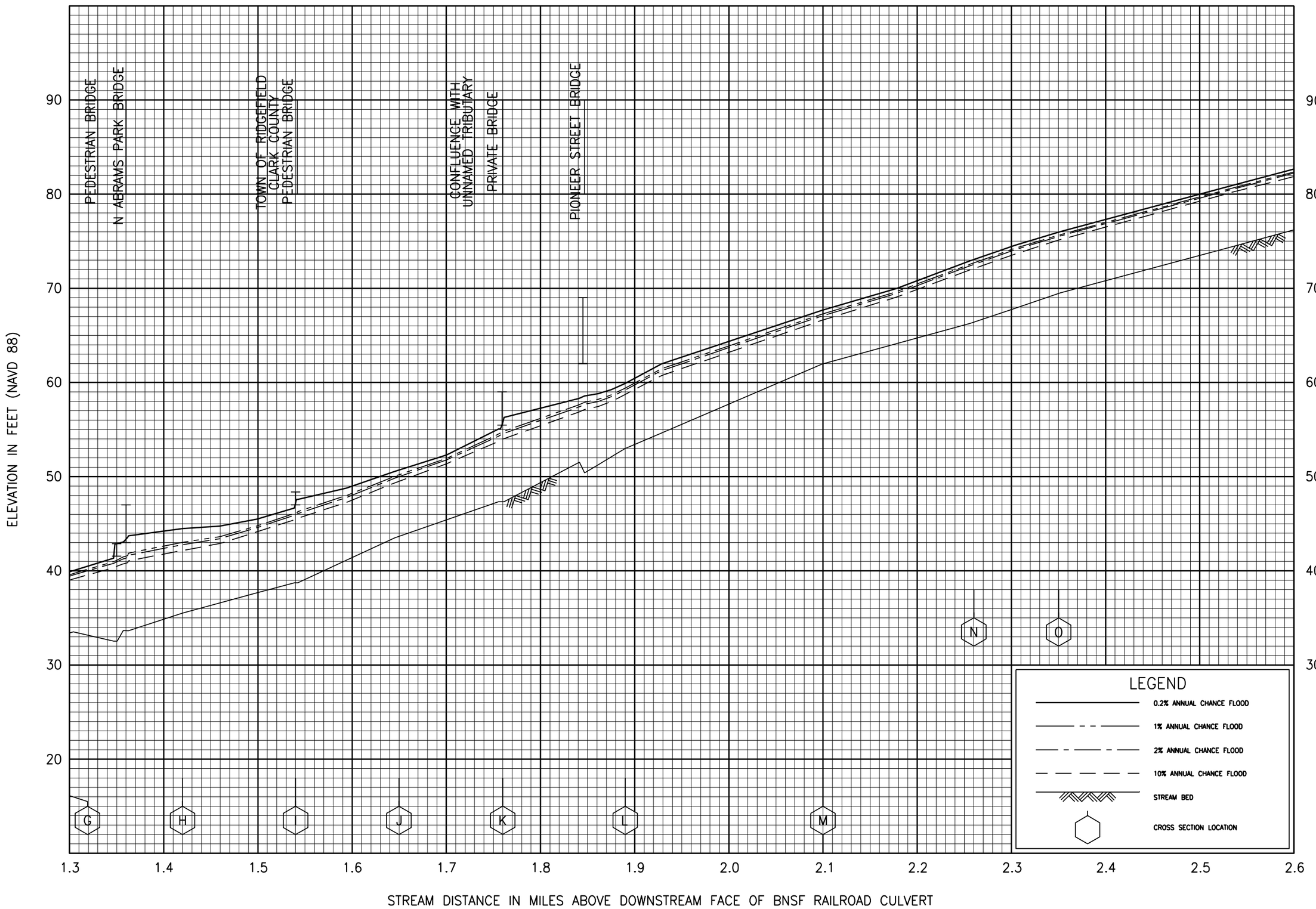

FLOOD PROFILES

GEE CREEK

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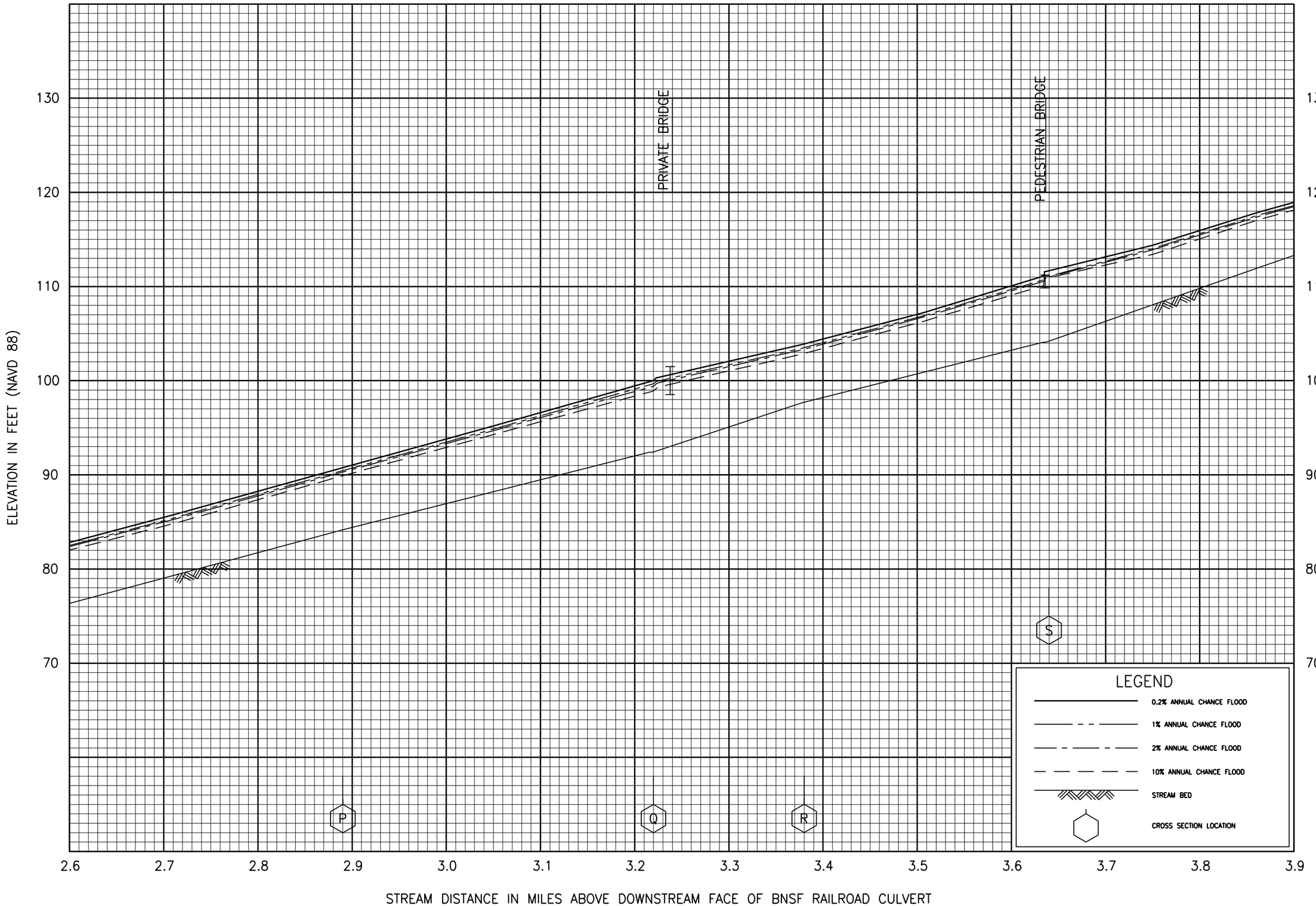

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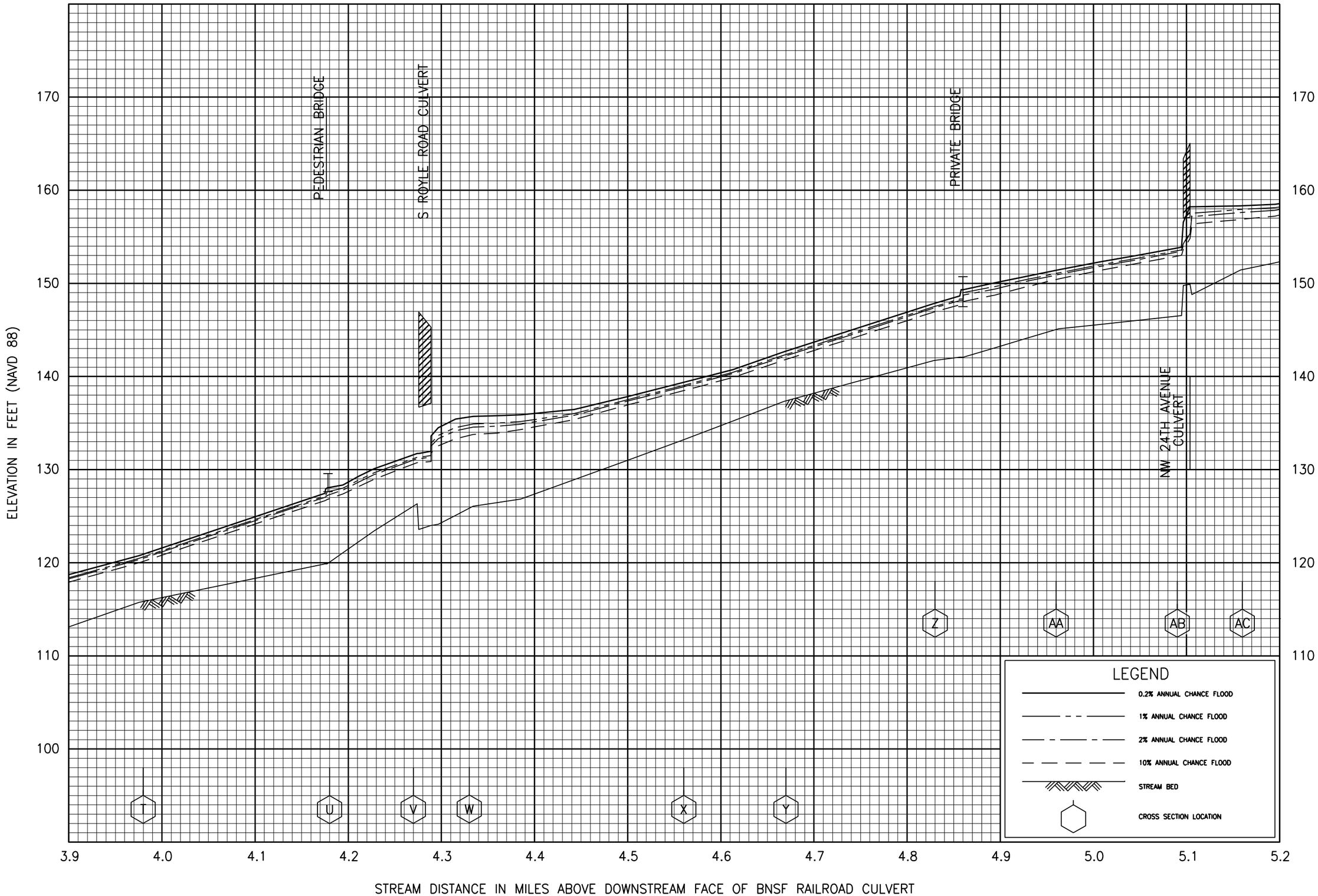

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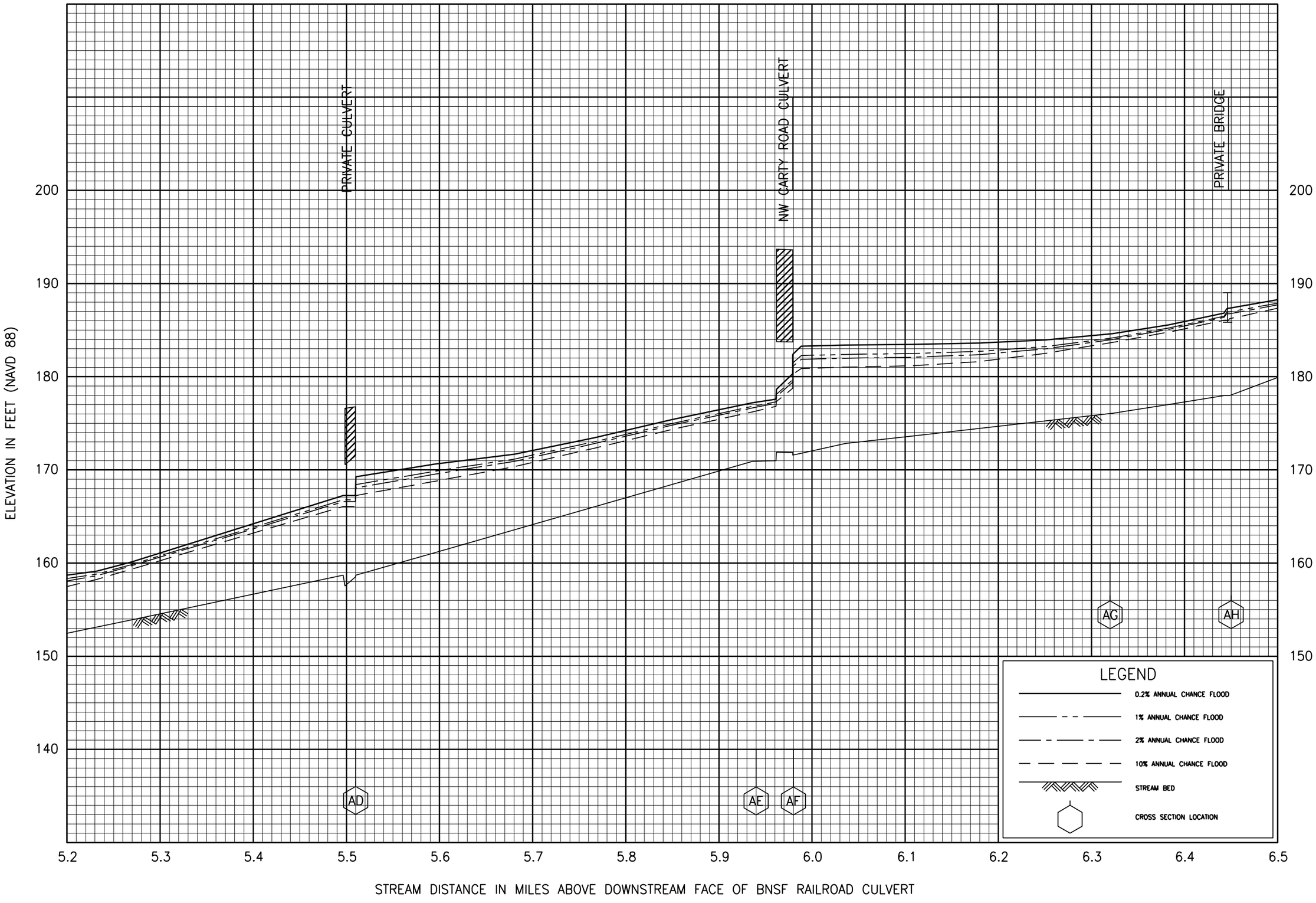

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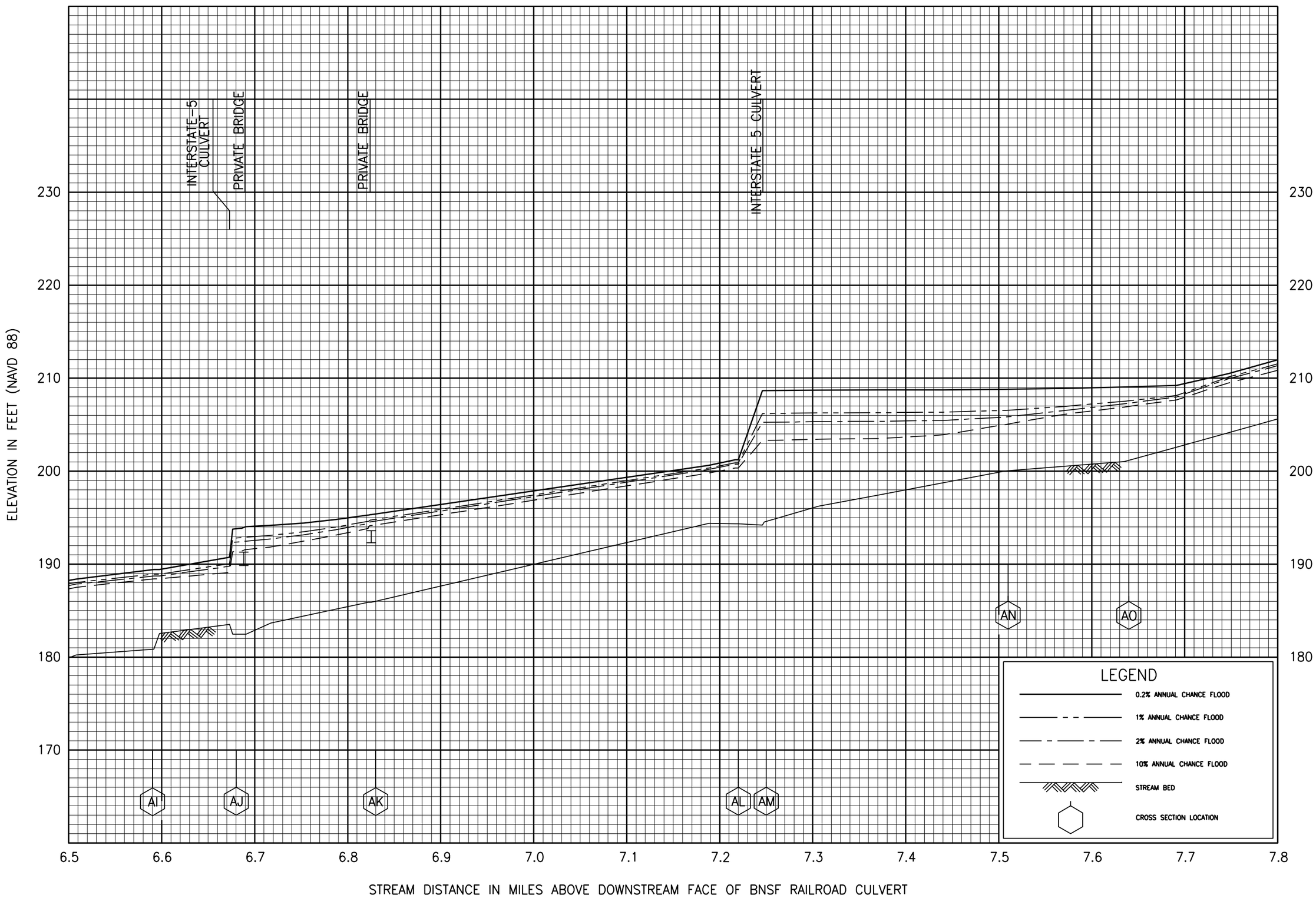

FLOOD PROFILES

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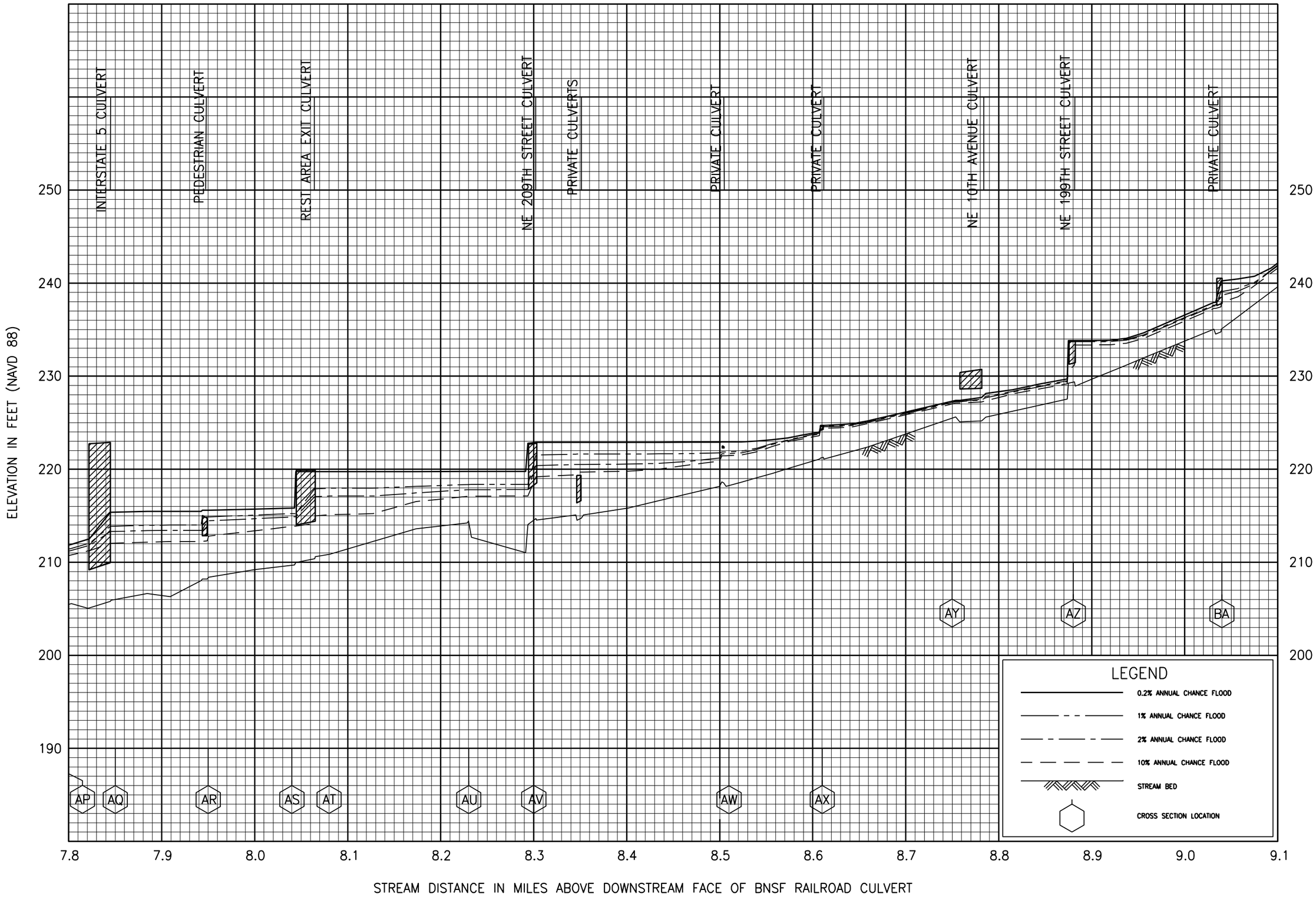

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GEE CREEK

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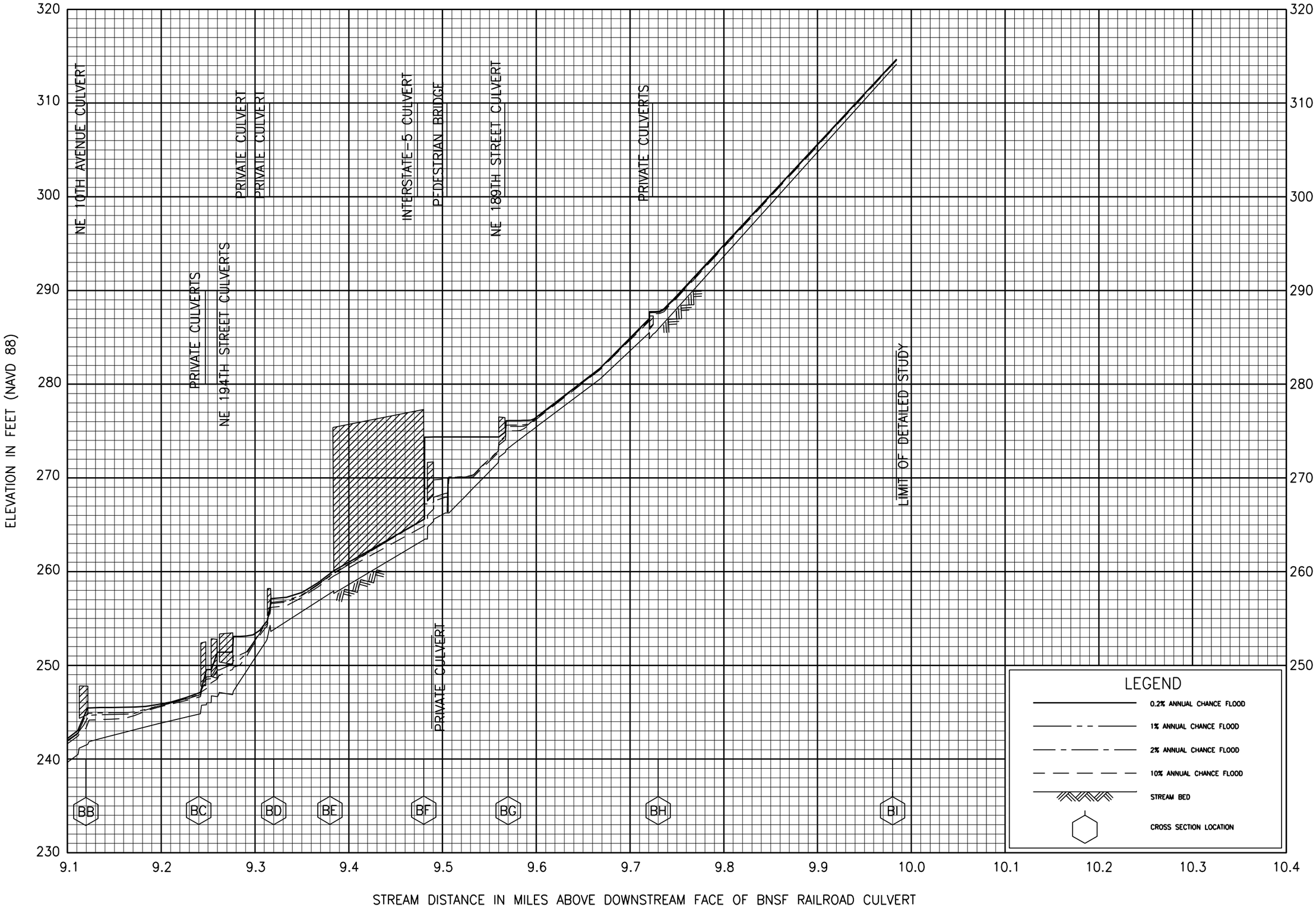

FLOOD PROFILES

GEE CREEK

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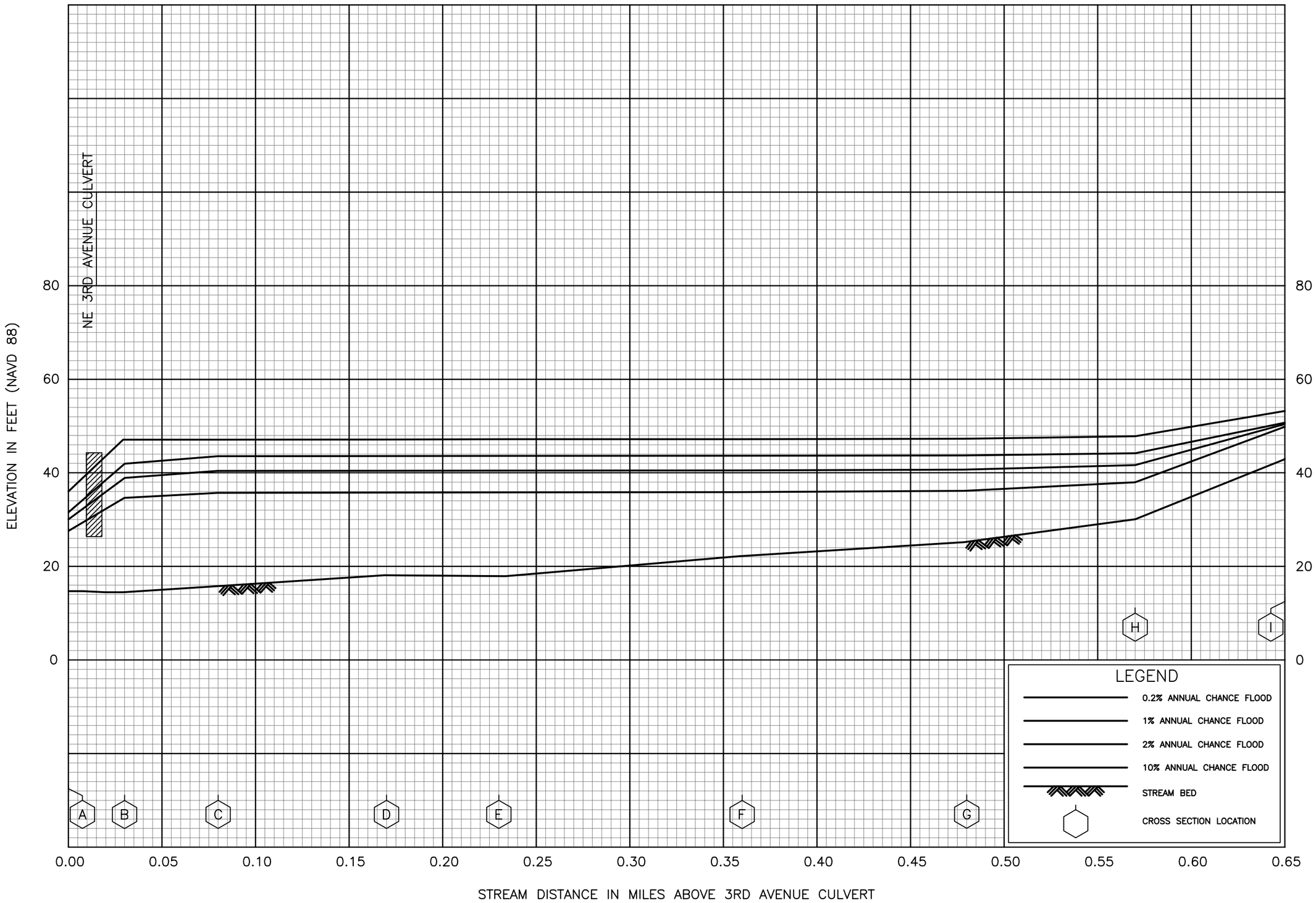
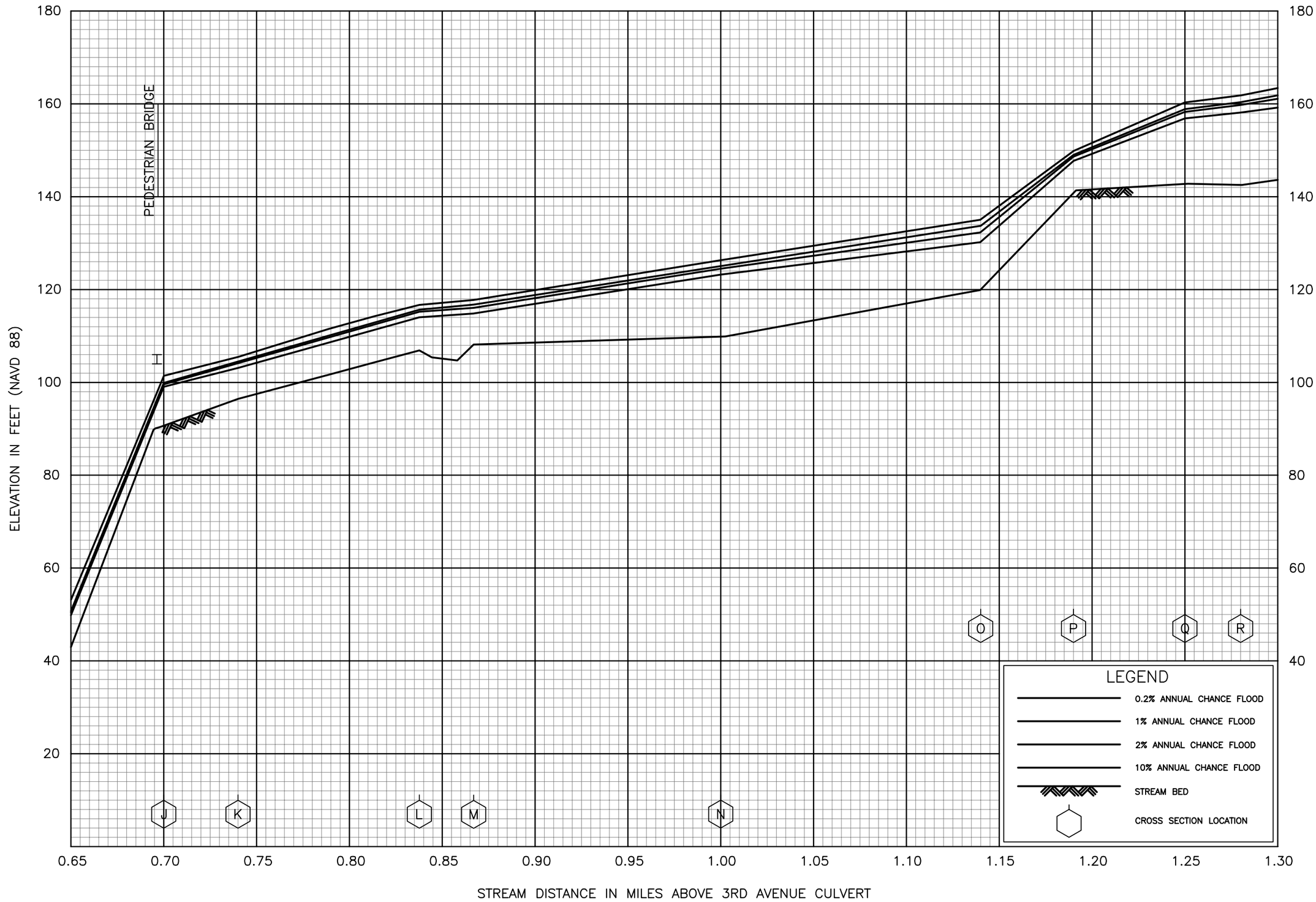


FLOOD PROFILES

LACAMAS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



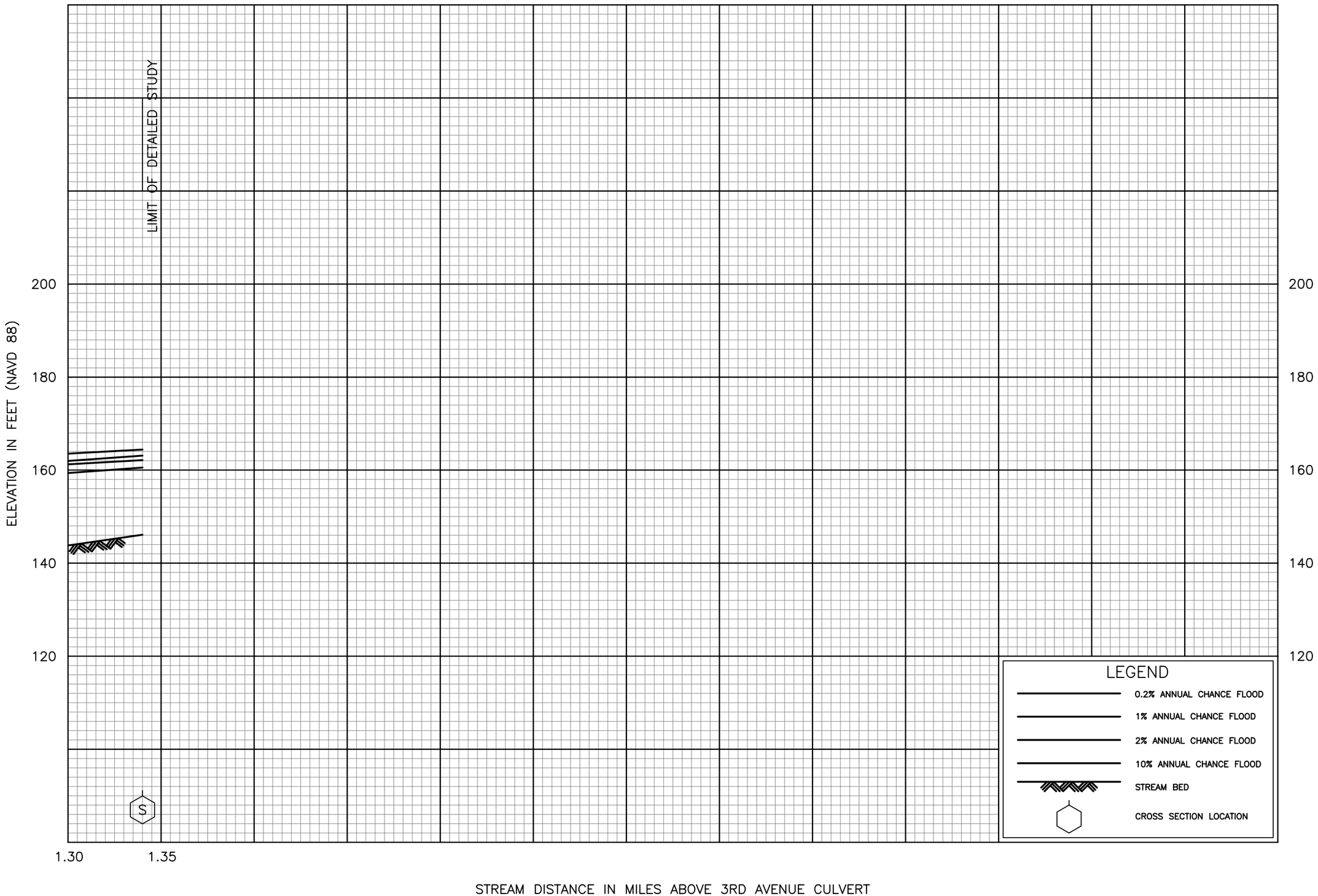
FLOOD PROFILES

LACAMAS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA

AND INCORPORATED AREAS



FLOOD PROFILES

LACAMAS CREEK

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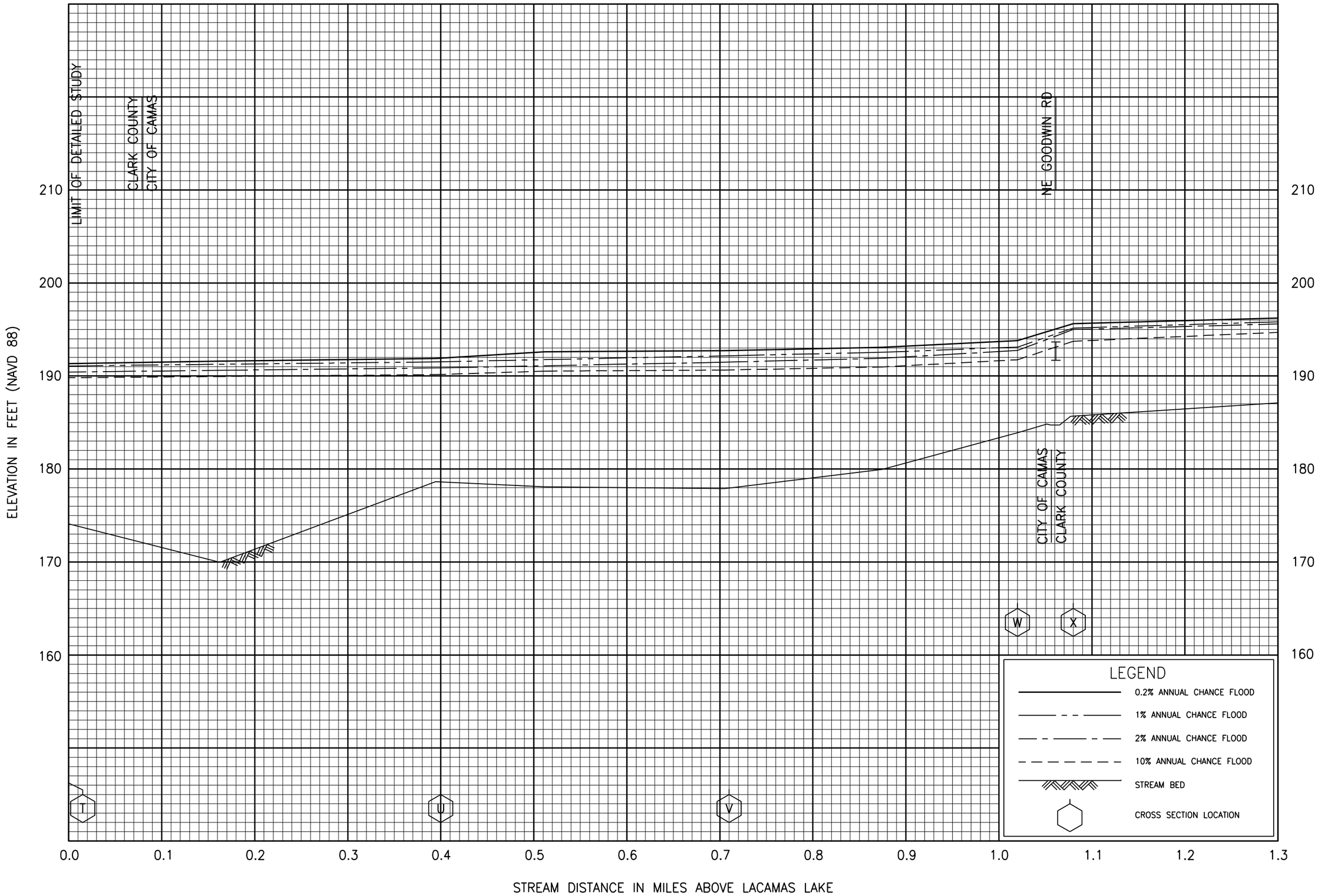

FLOOD PROFILES

LACAMAS CREEK

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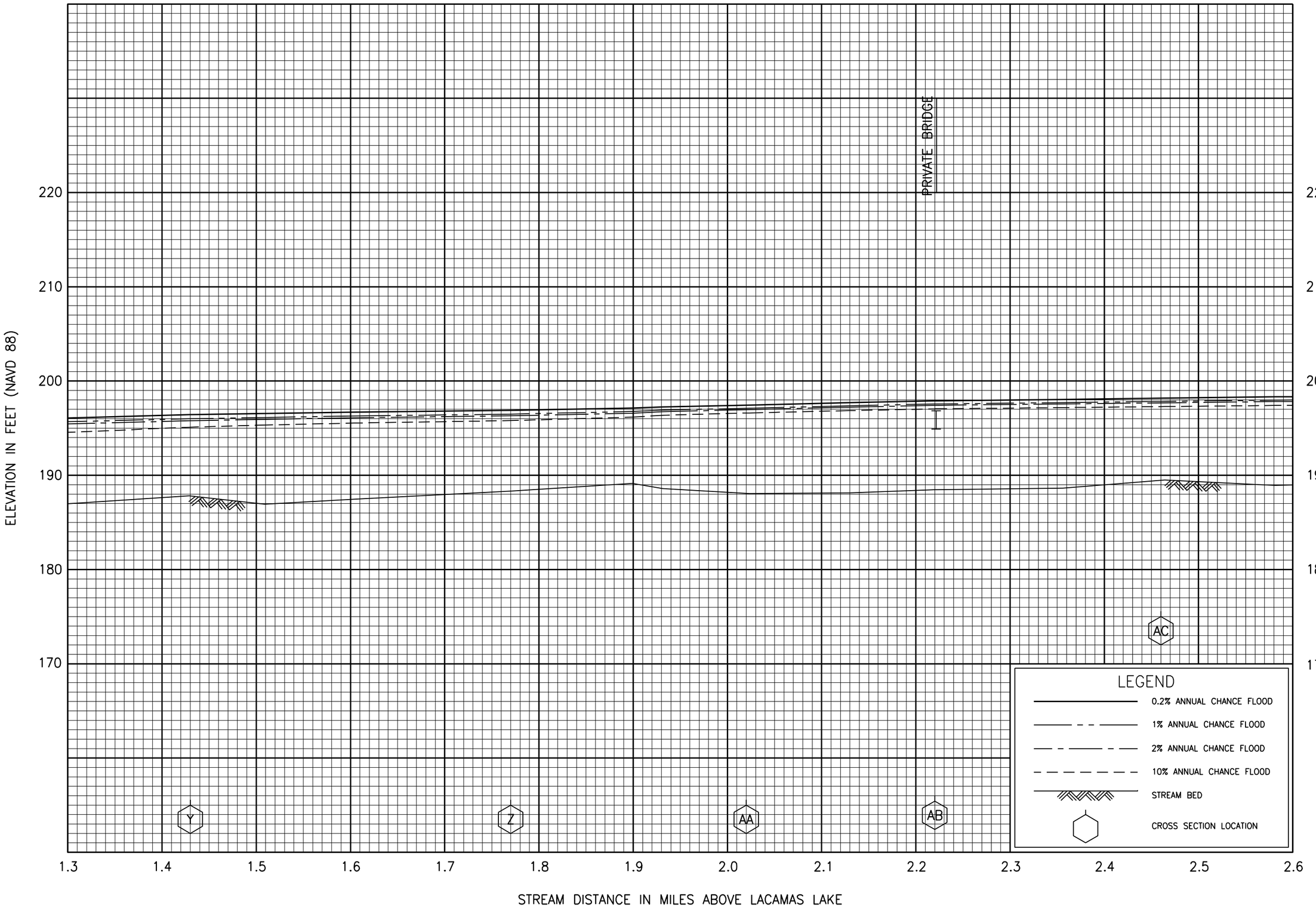
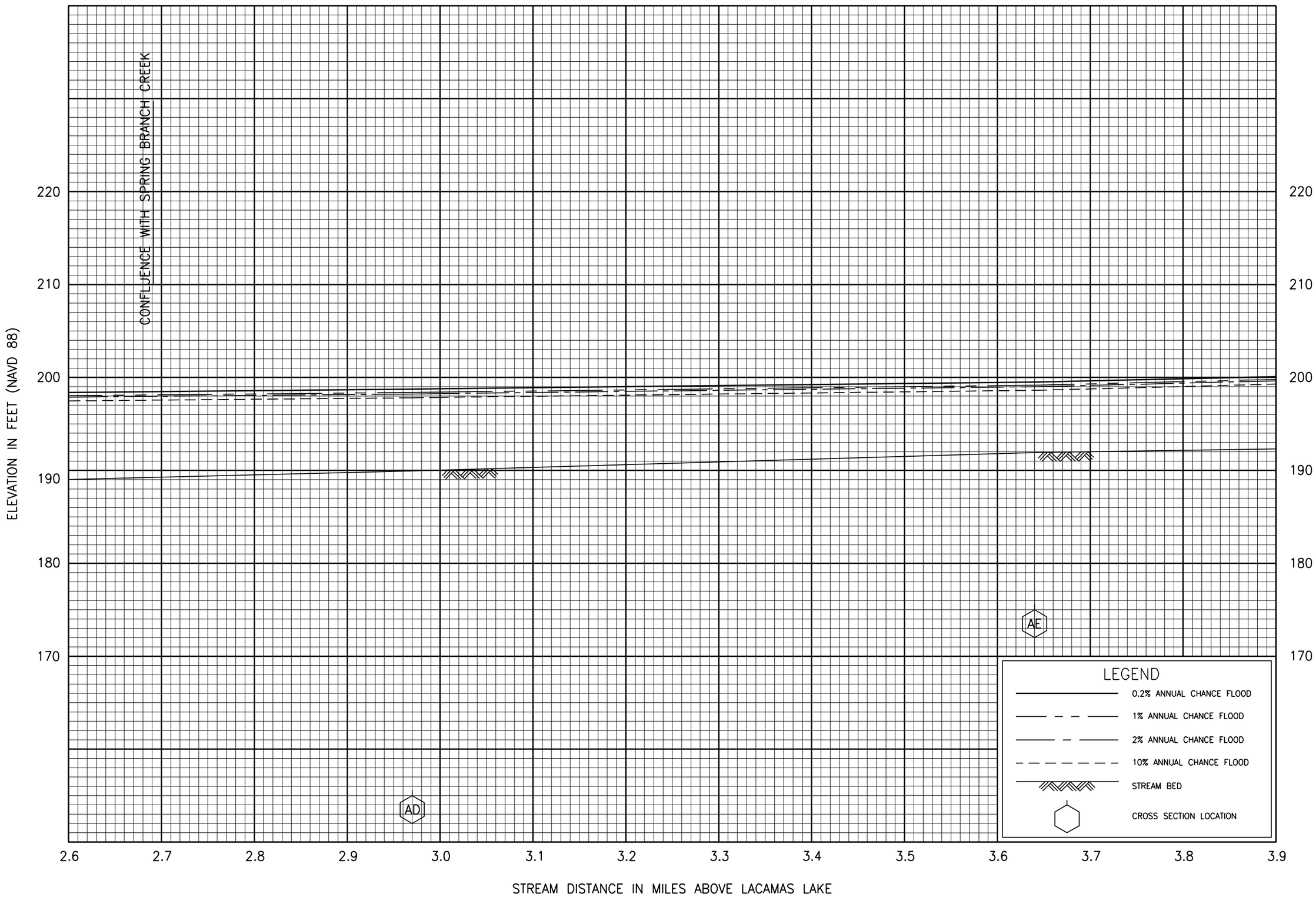


FLOOD PROFILES

LACAMAS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

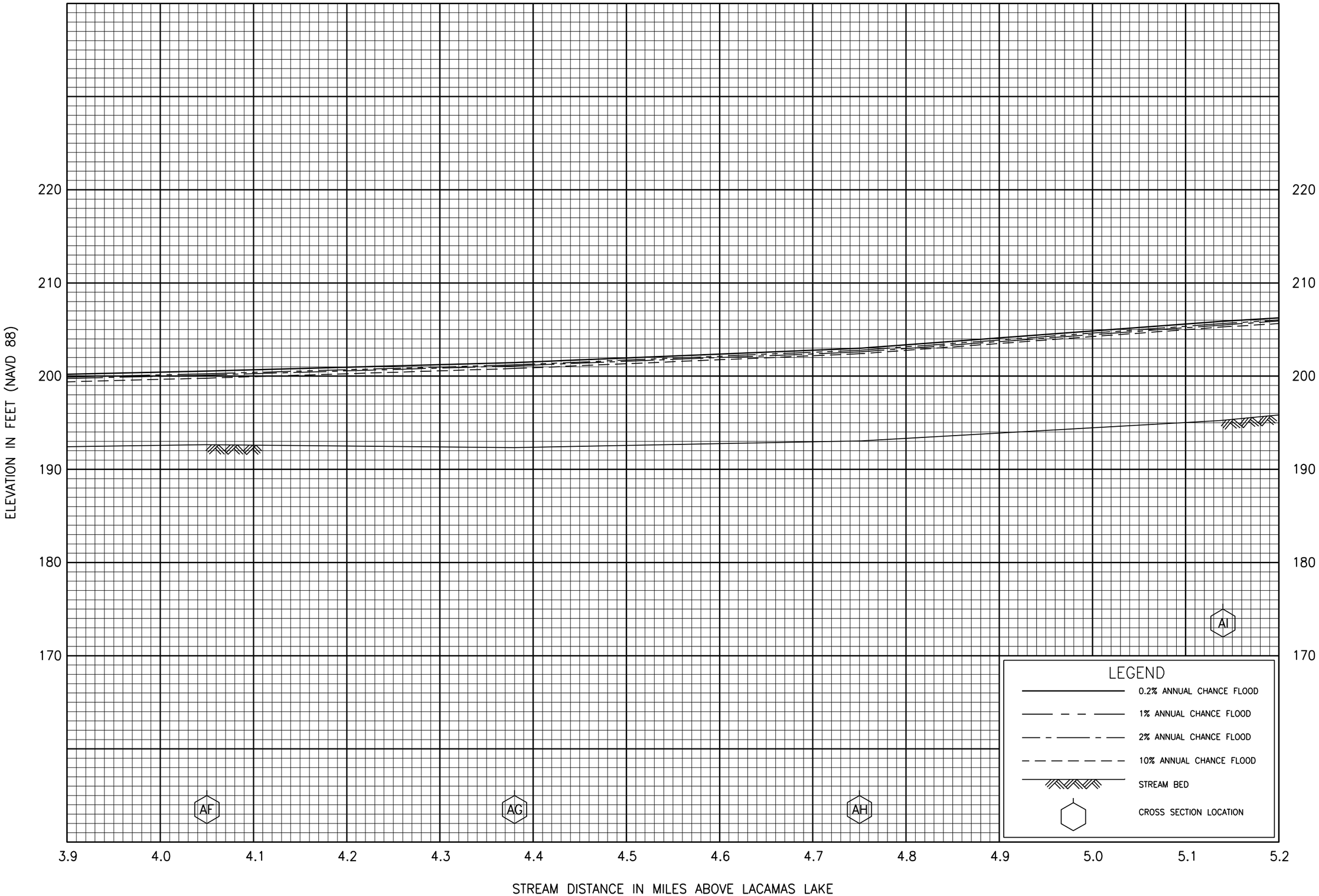


FLOOD PROFILES

LACAMAS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



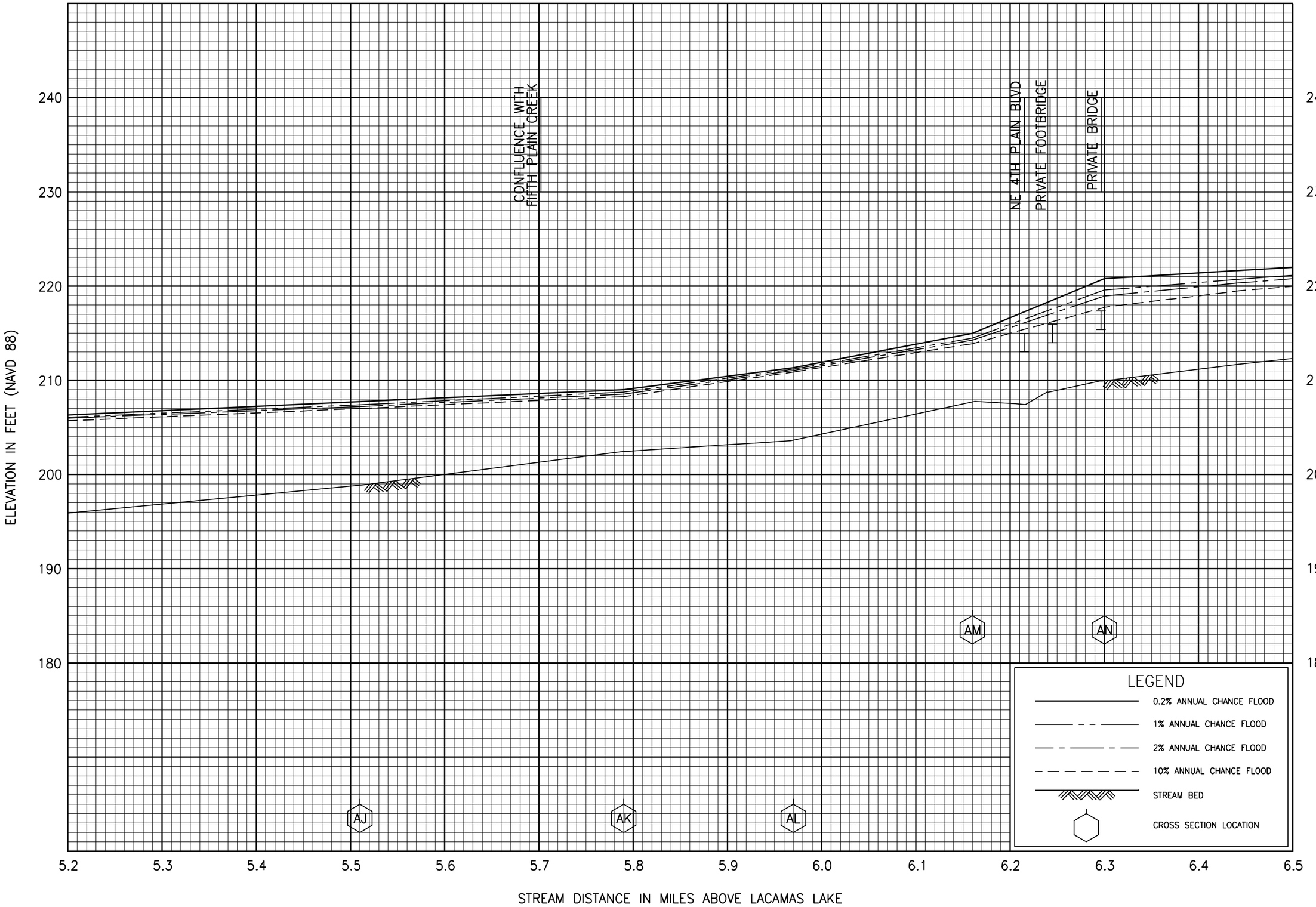
FLOOD PROFILES

LACAMAS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA

AND INCORPORATED AREAS



FLOOD PROFILES

LACAMAS CREEK

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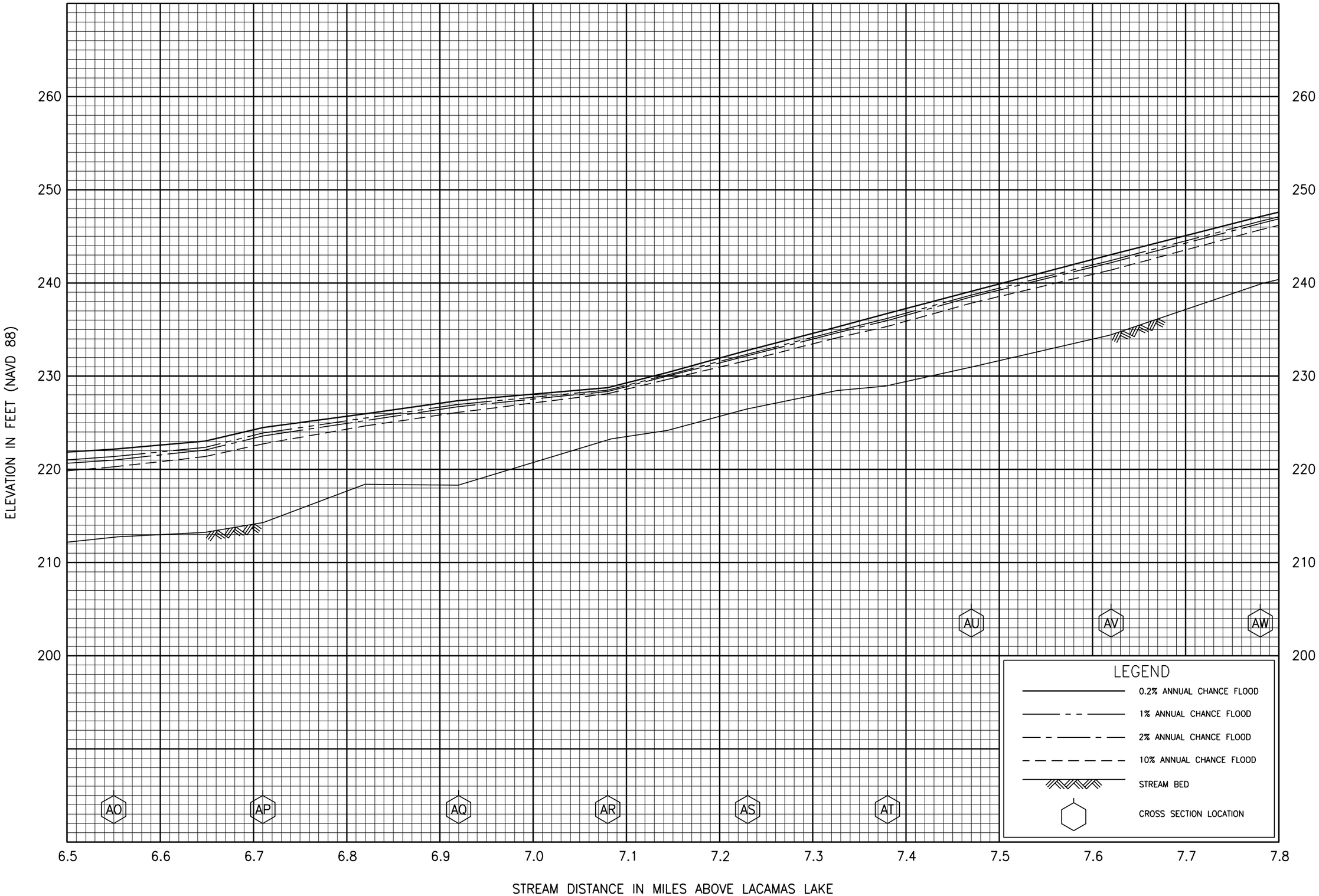
CLARK COUNTY, WA
AND INCORPORATED AREAS



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CLARK COUNTY, WA

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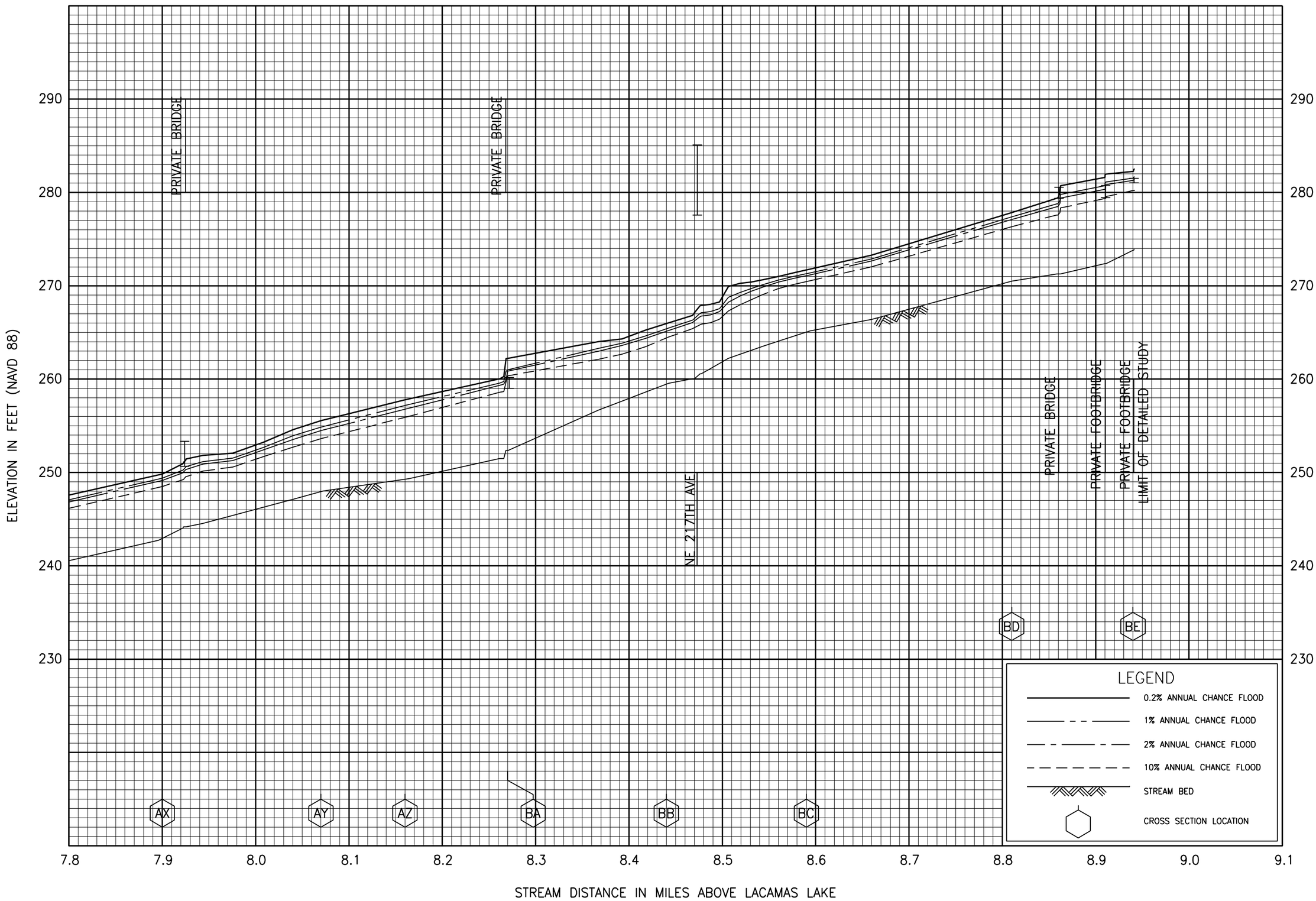
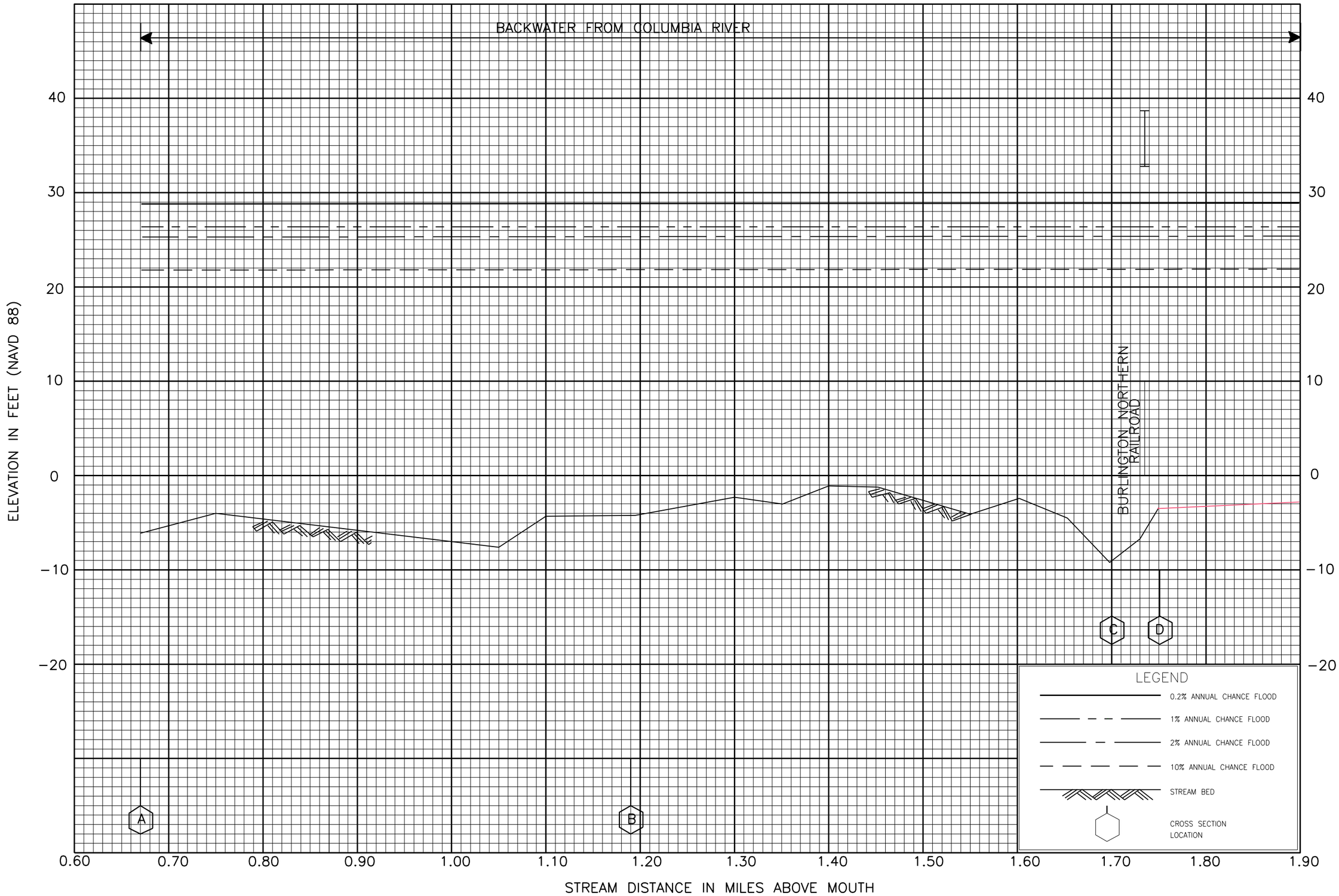


FLOOD PROFILES

LACAMAS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

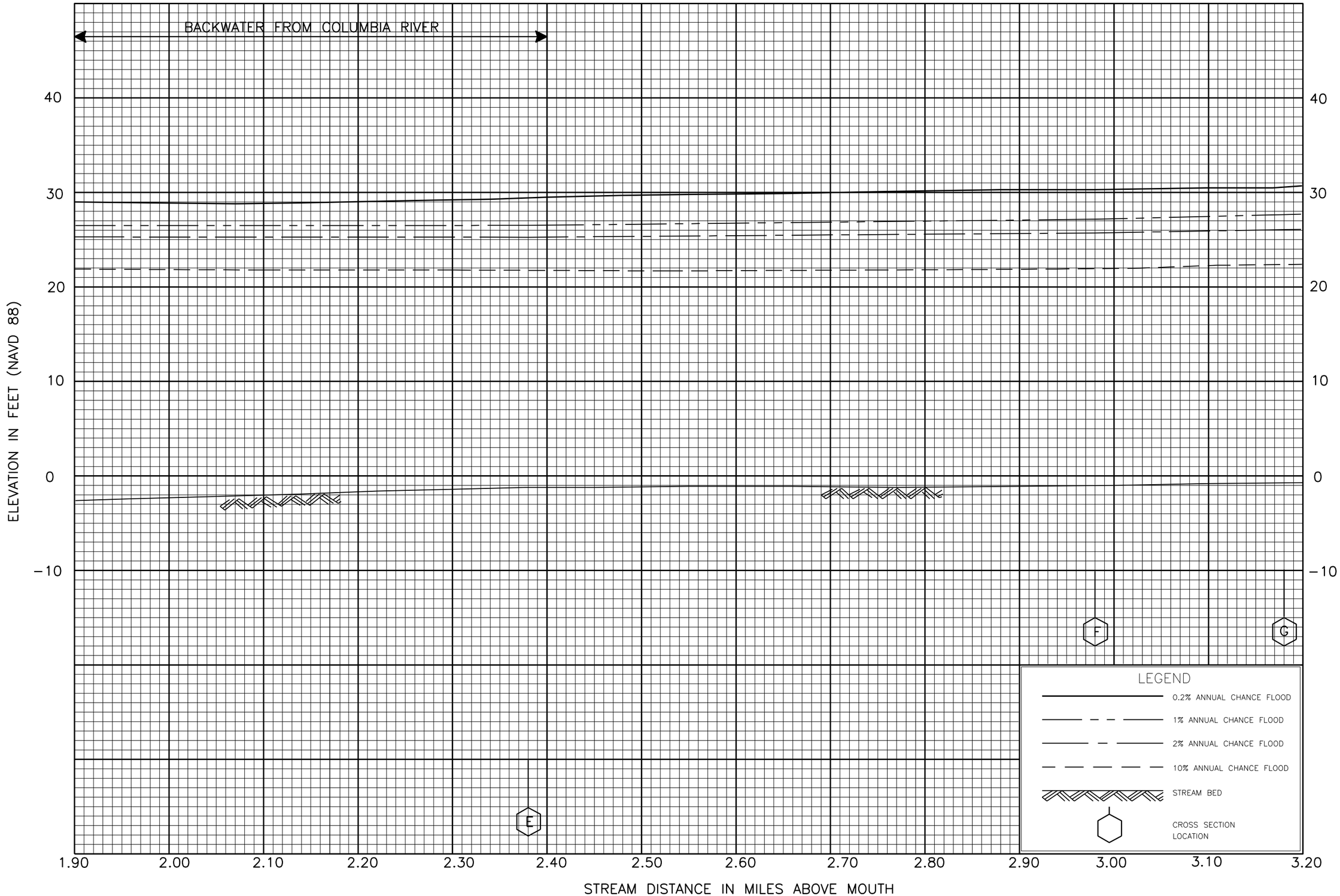


FLOOD PROFILES

LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



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CLARK COUNTY, WA
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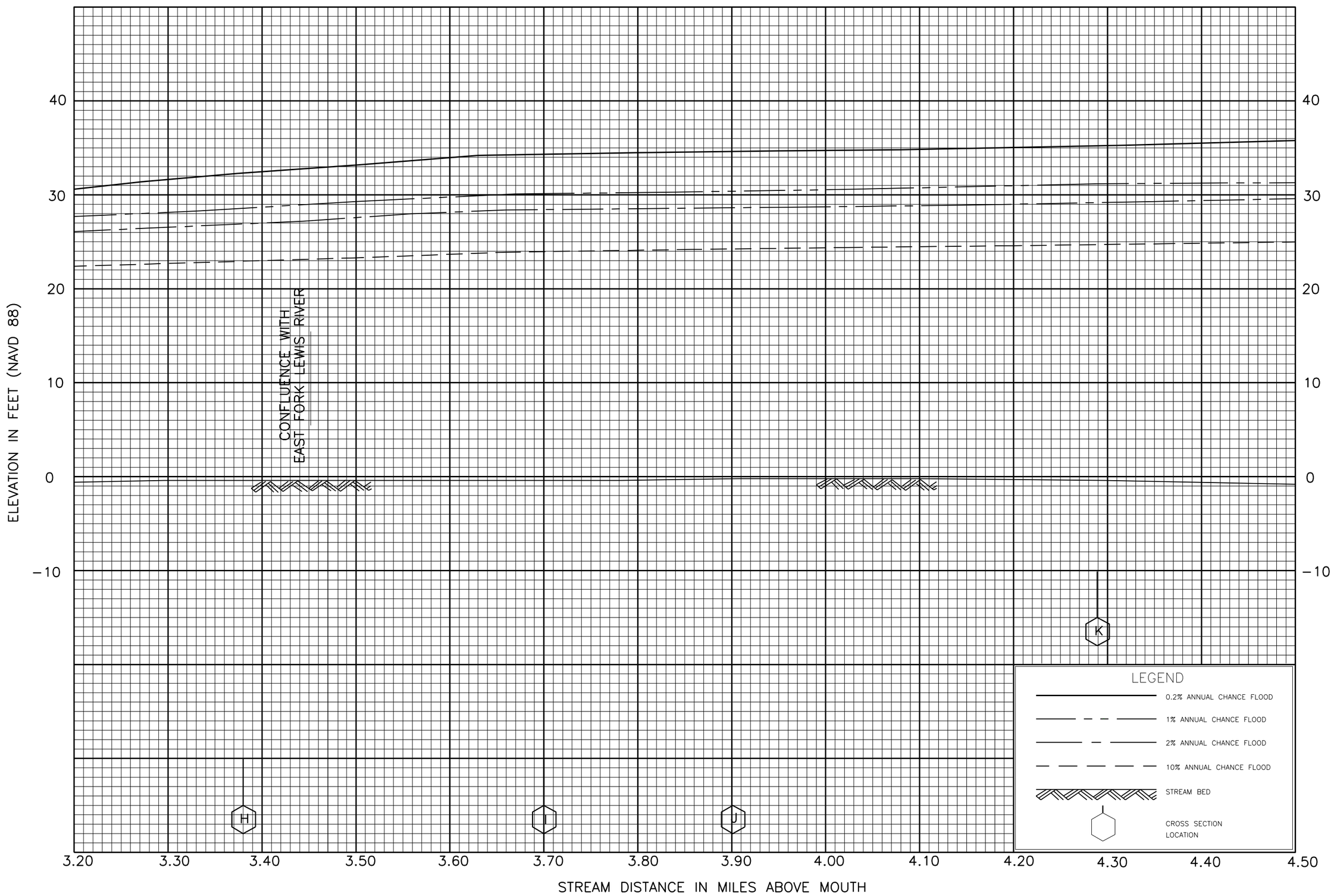

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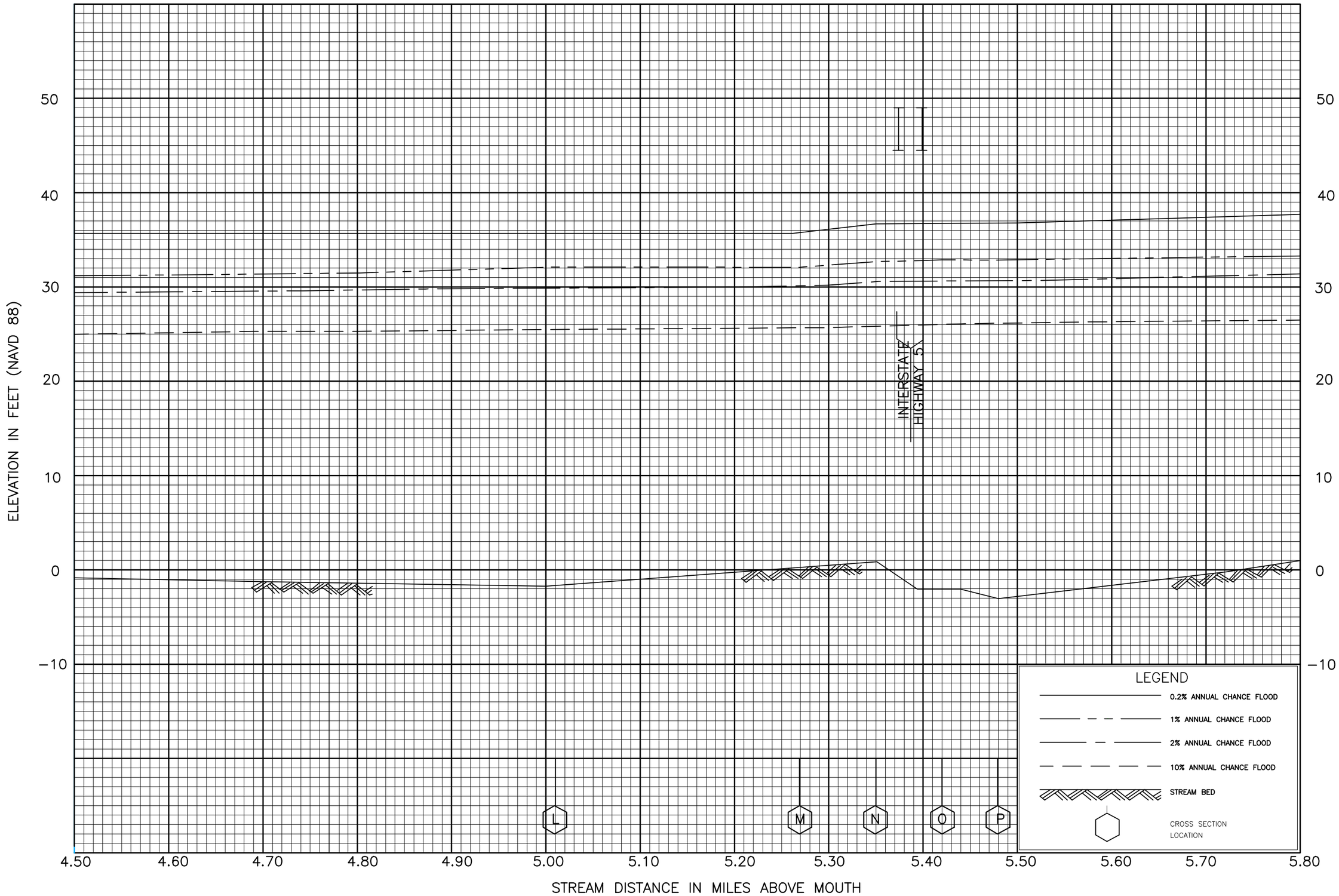

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CLARK COUNTY, WA
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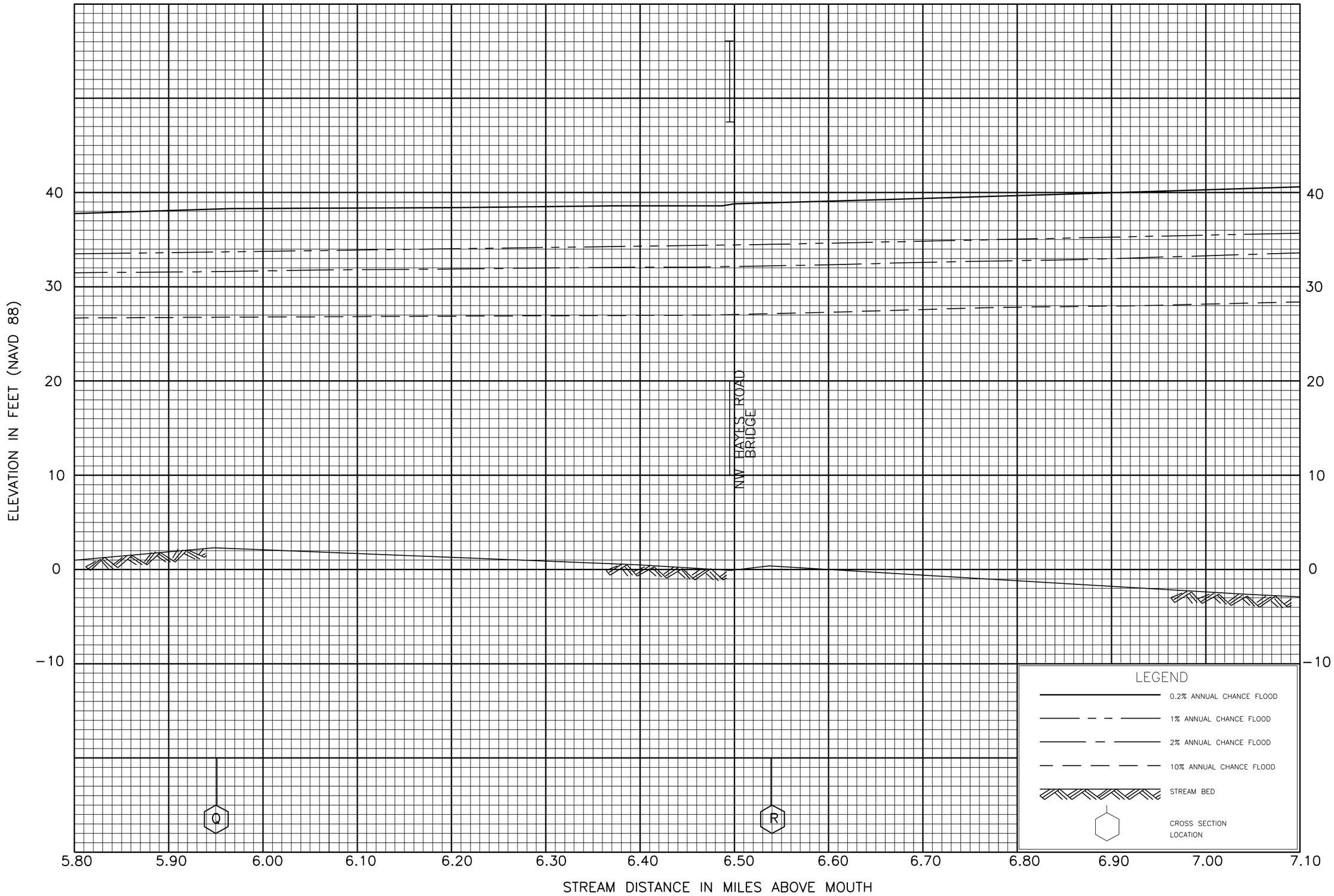

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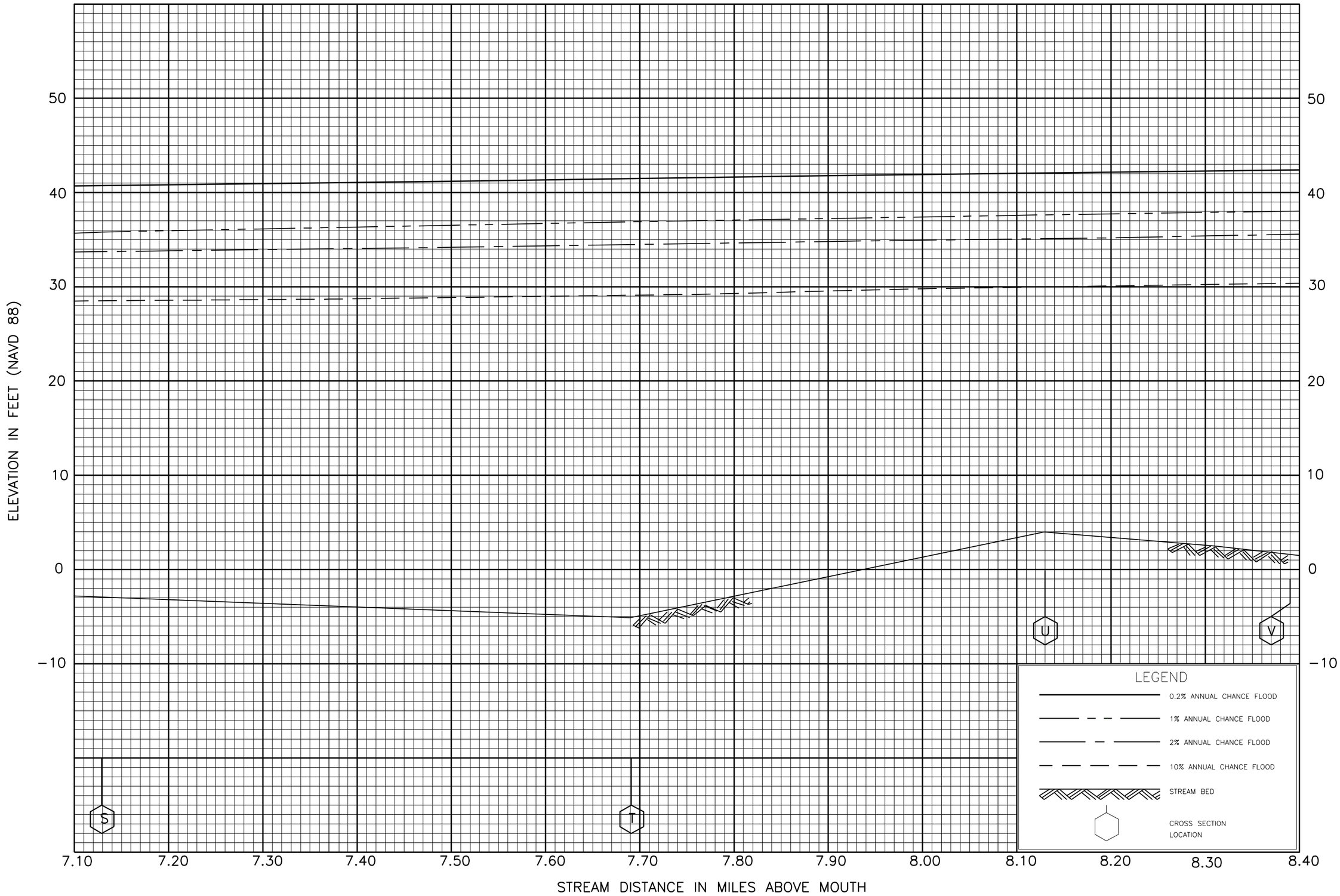

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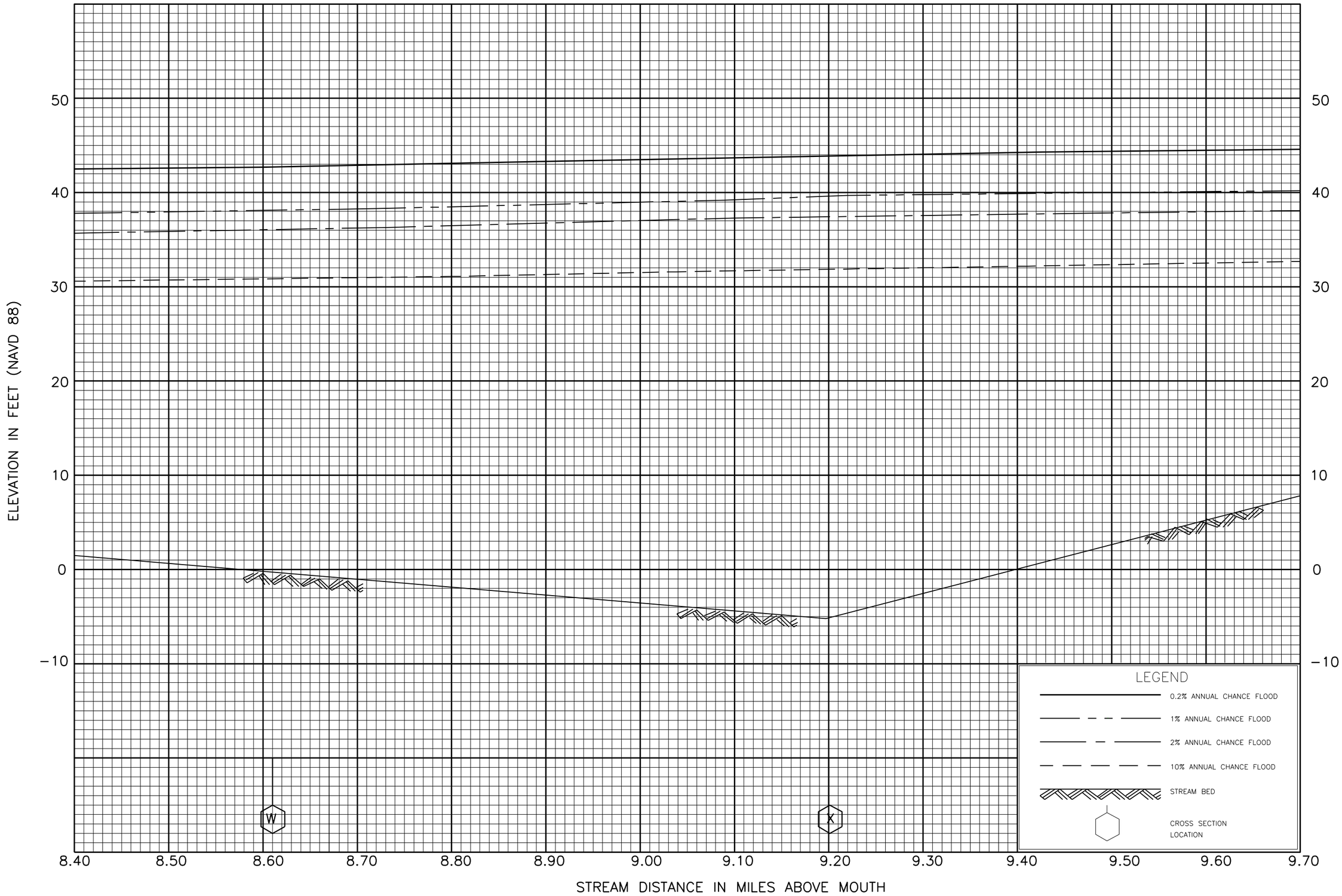

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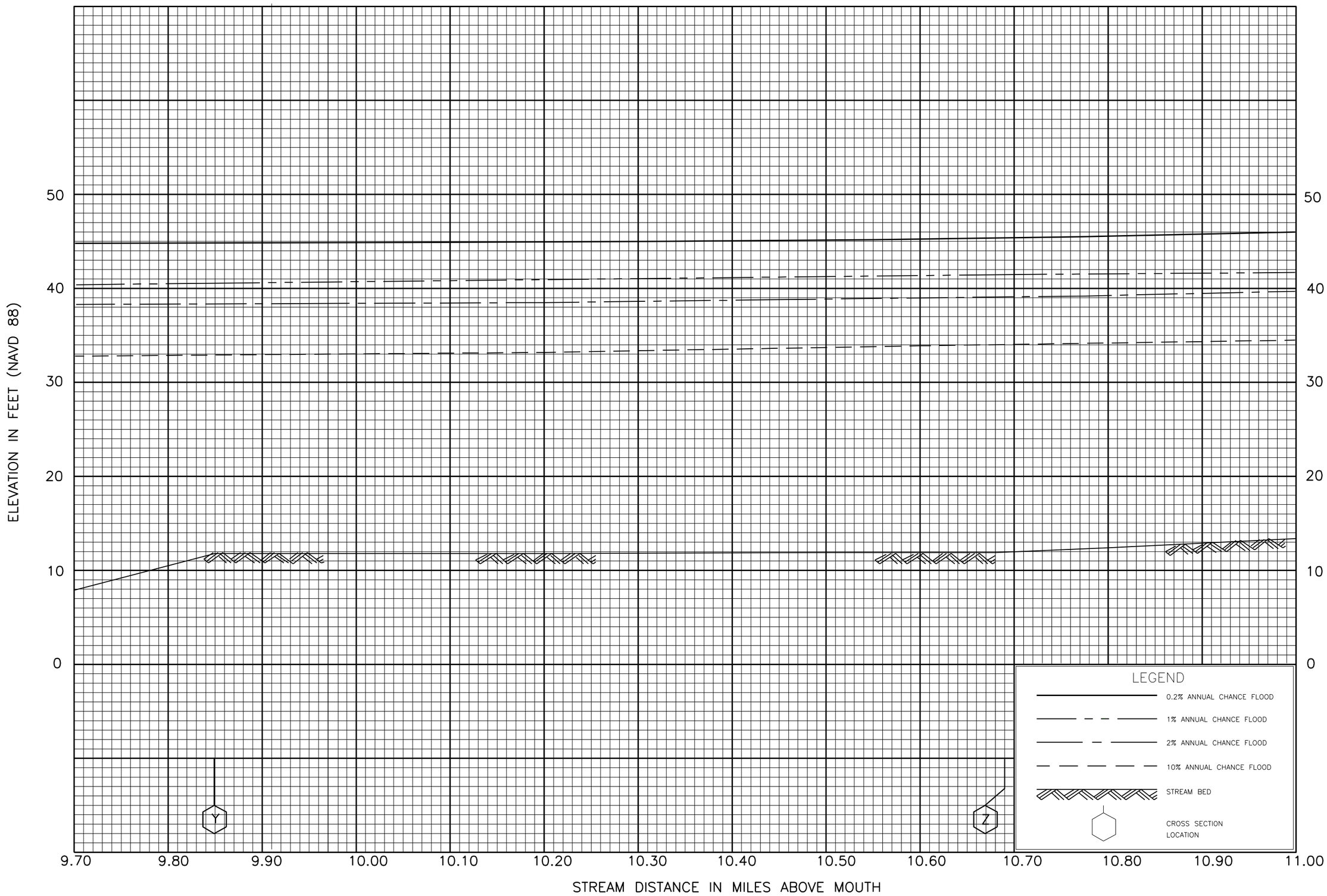

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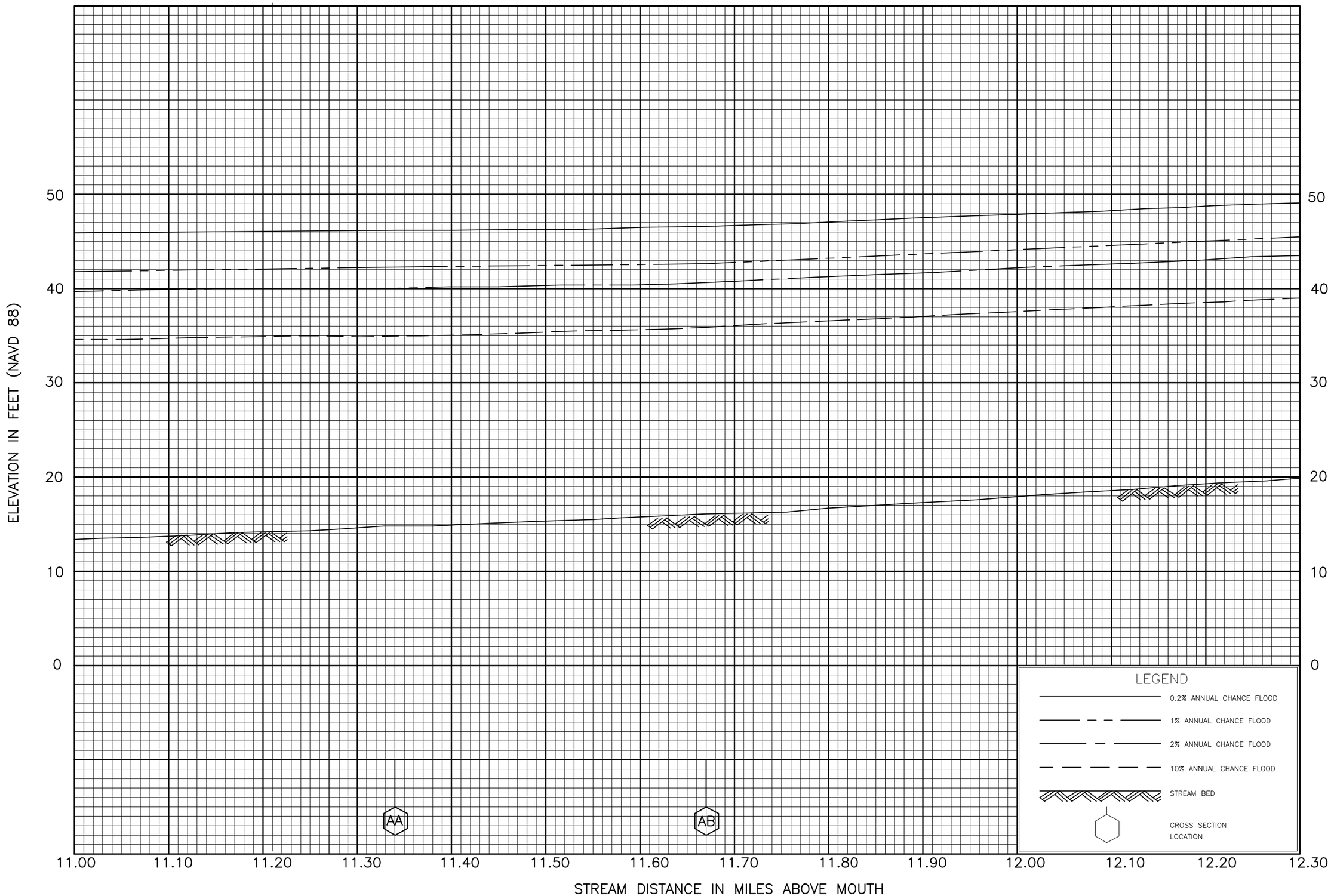

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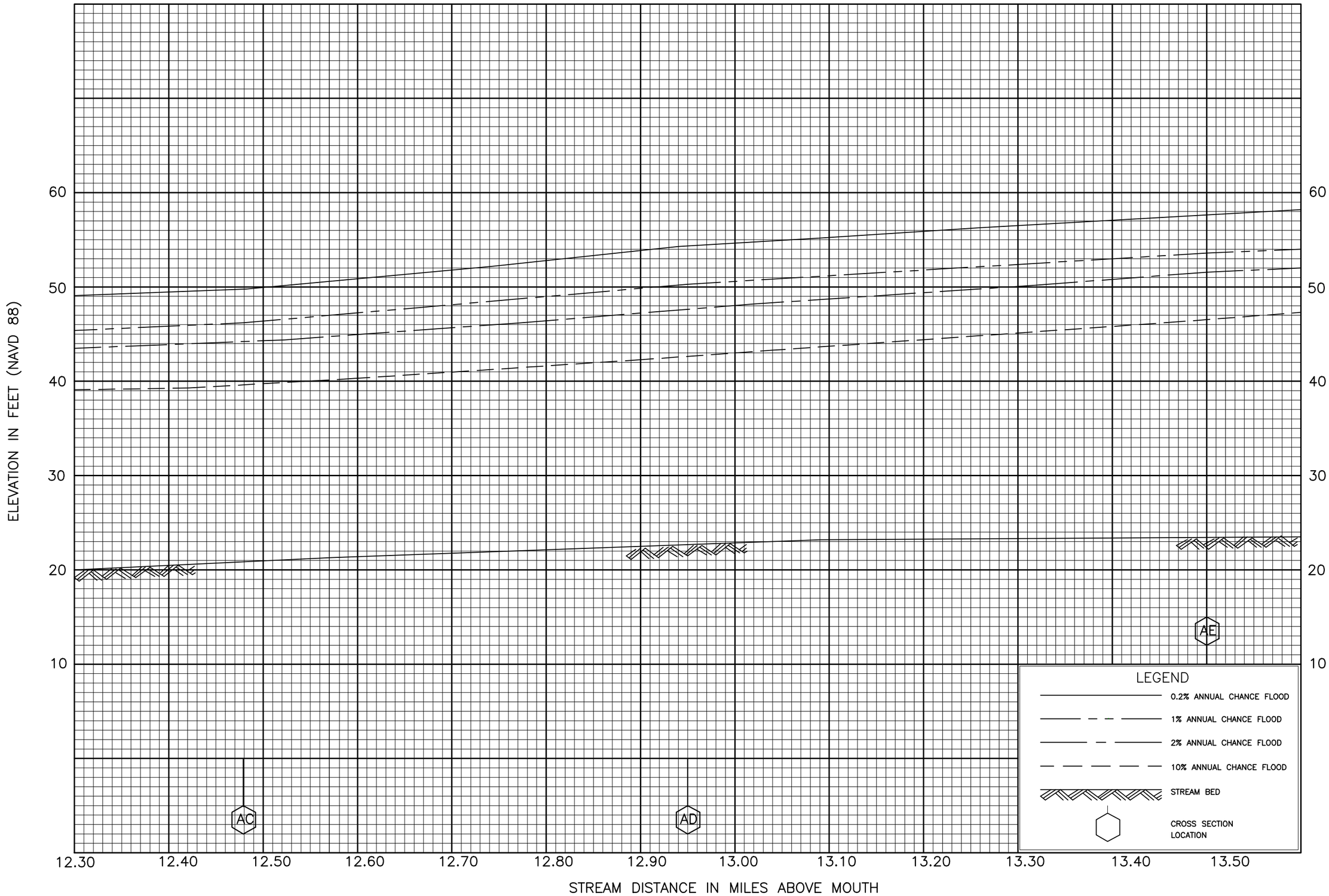

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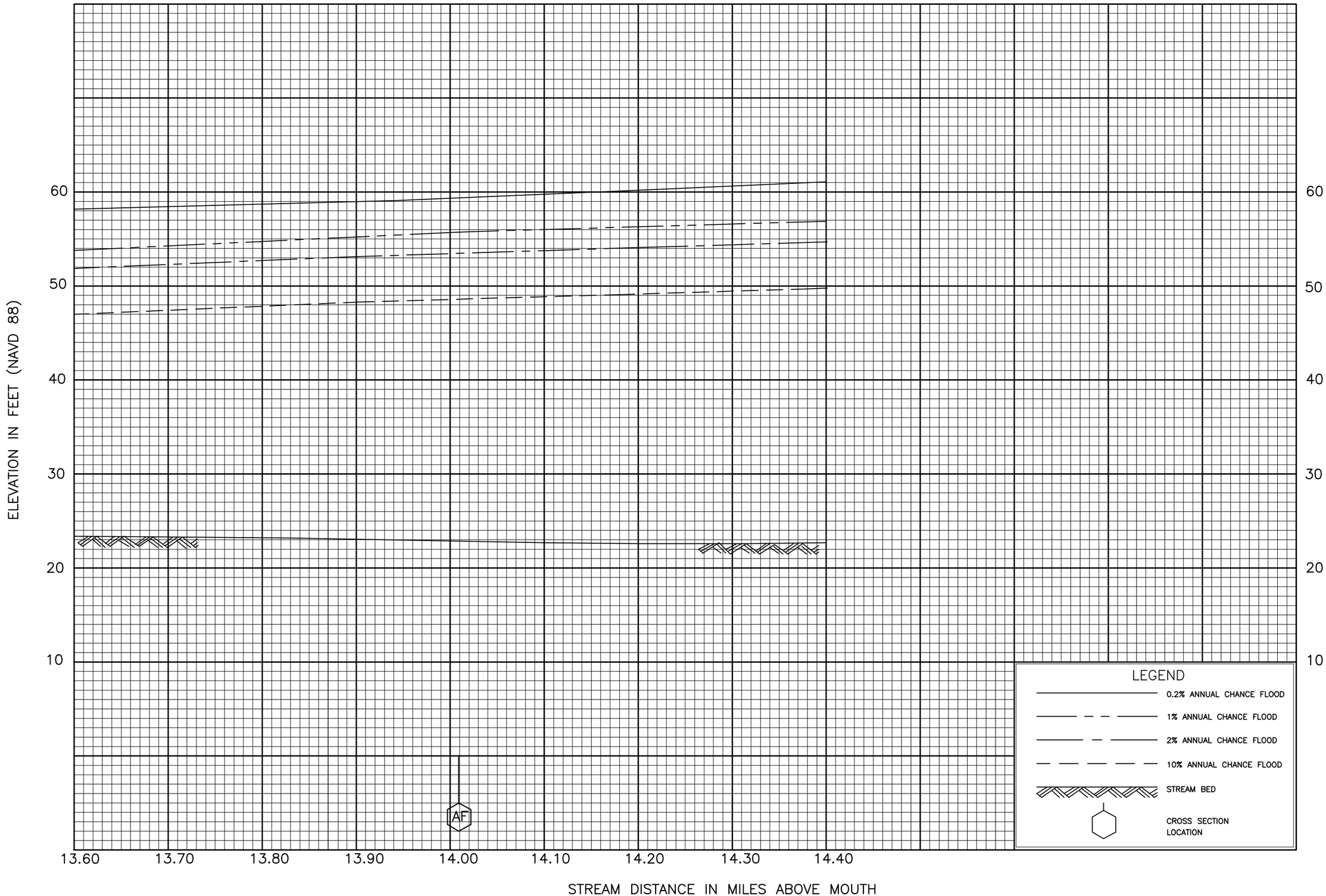

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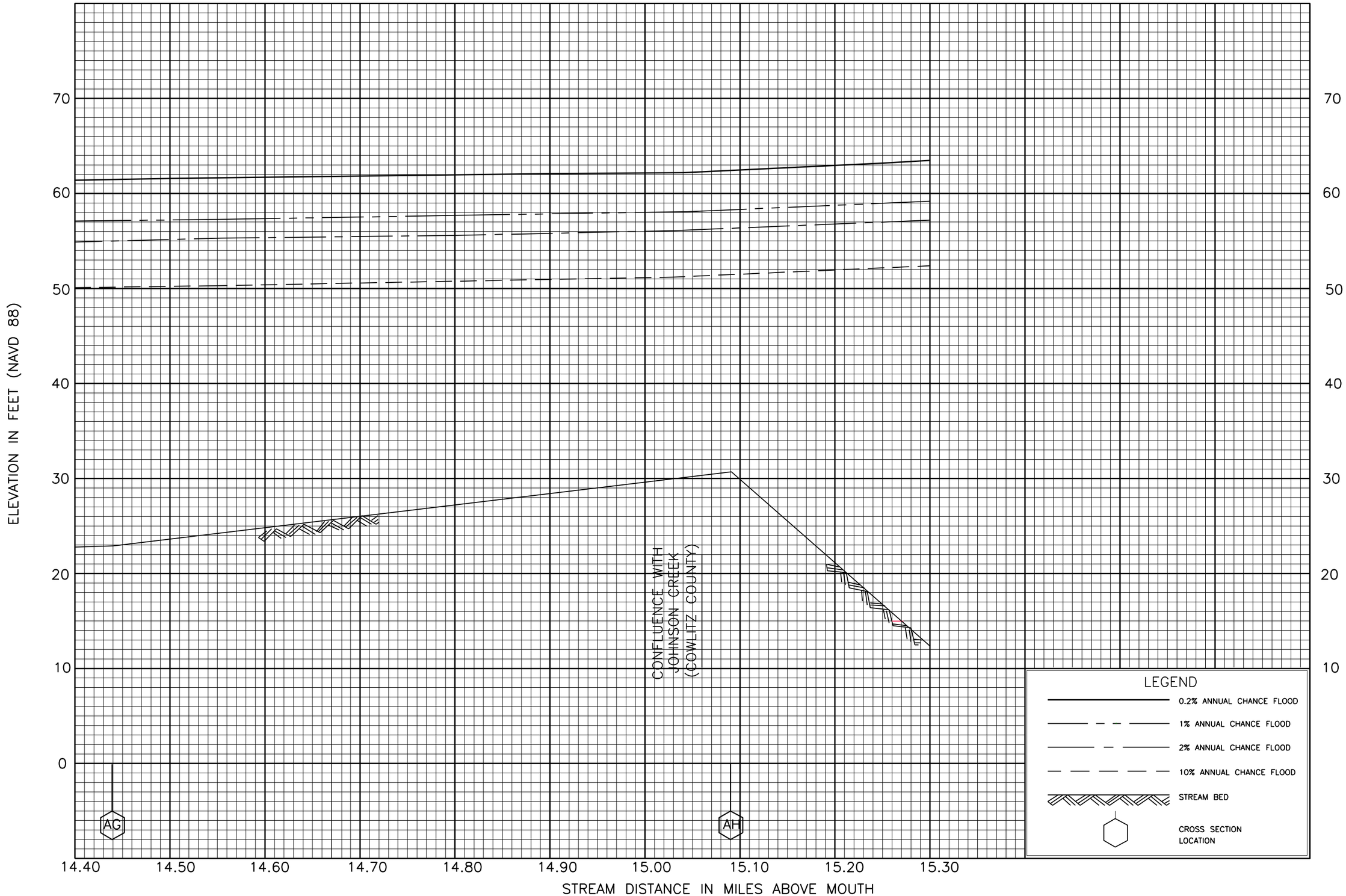

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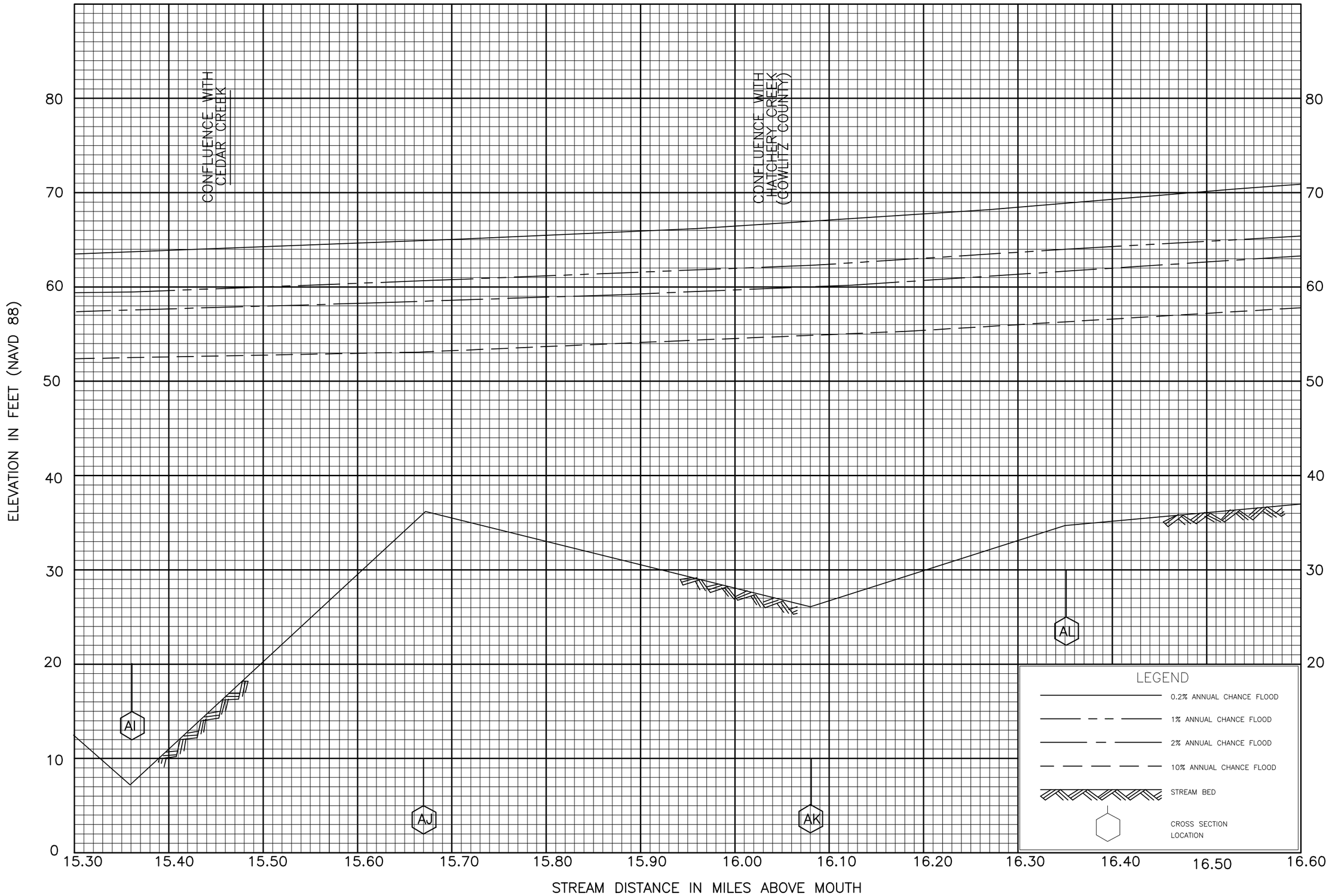

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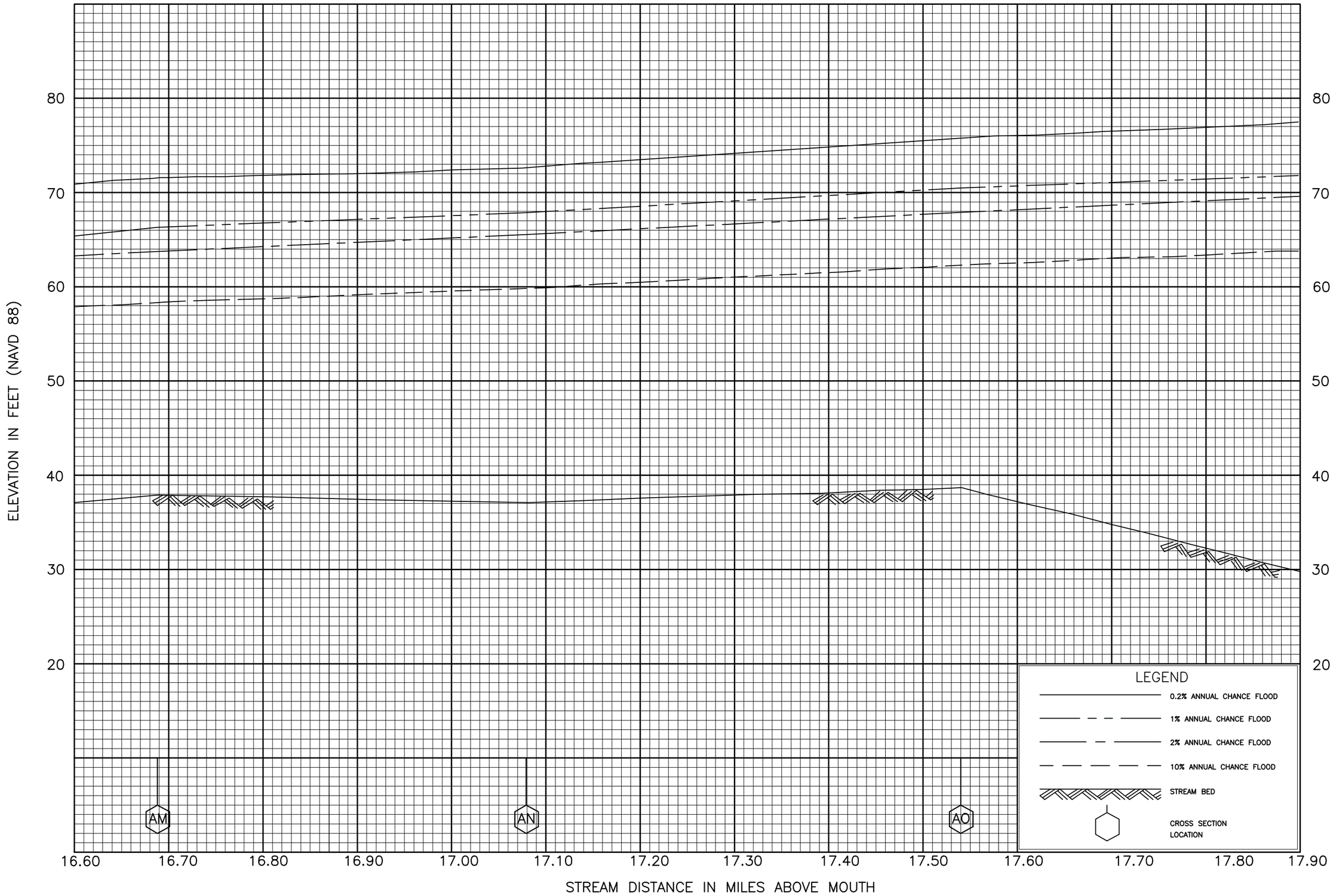

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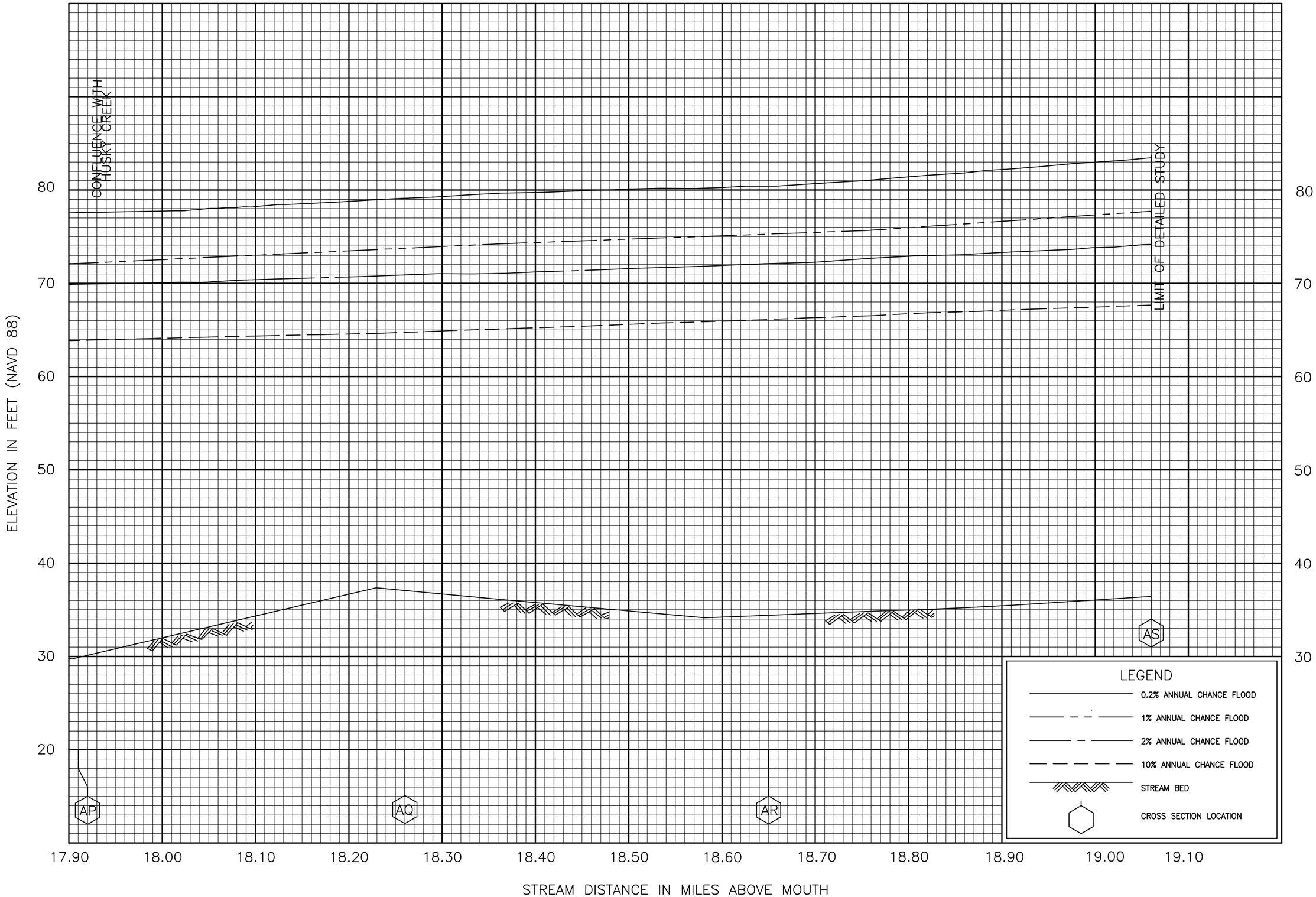

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CLARK COUNTY, WA
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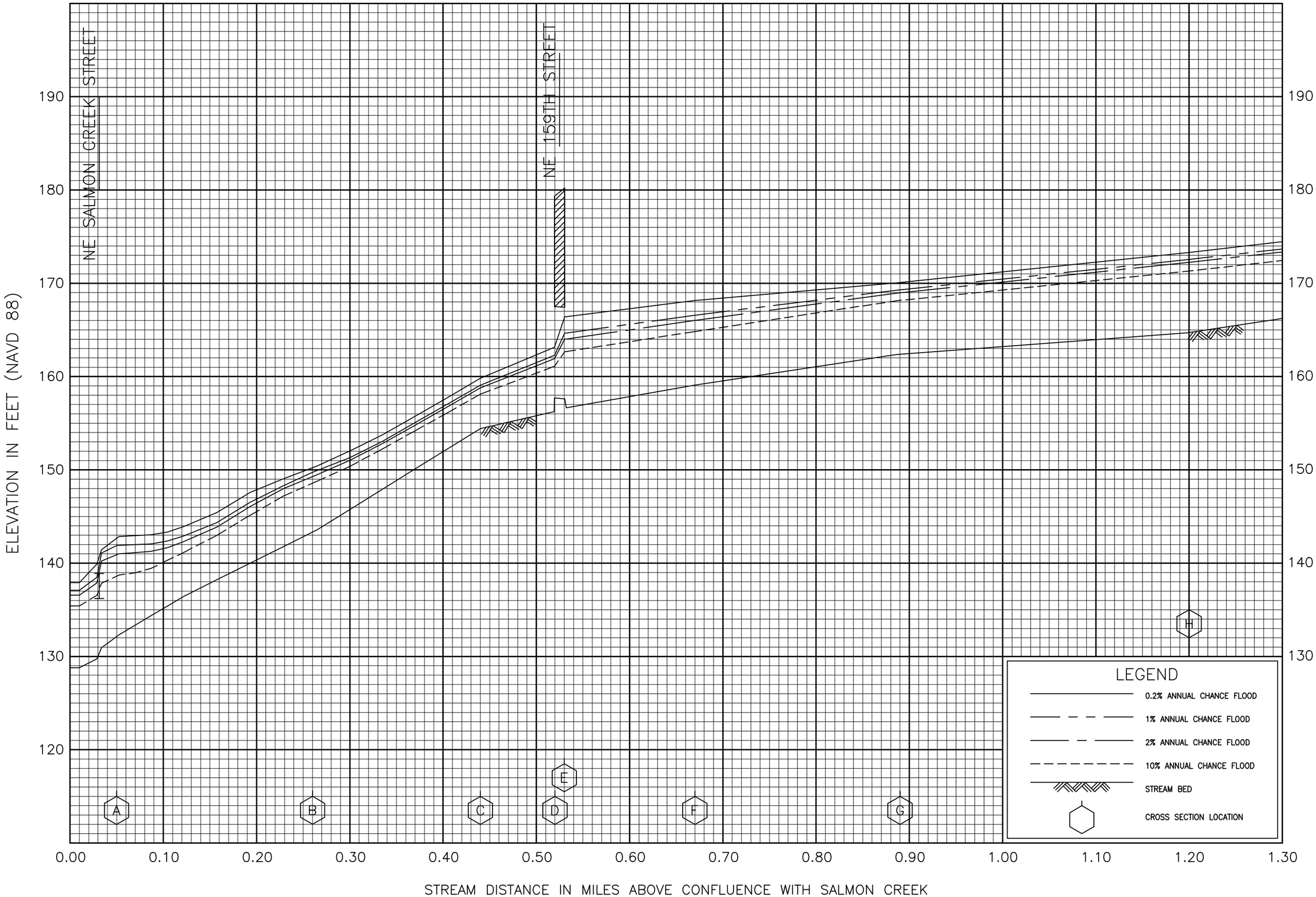
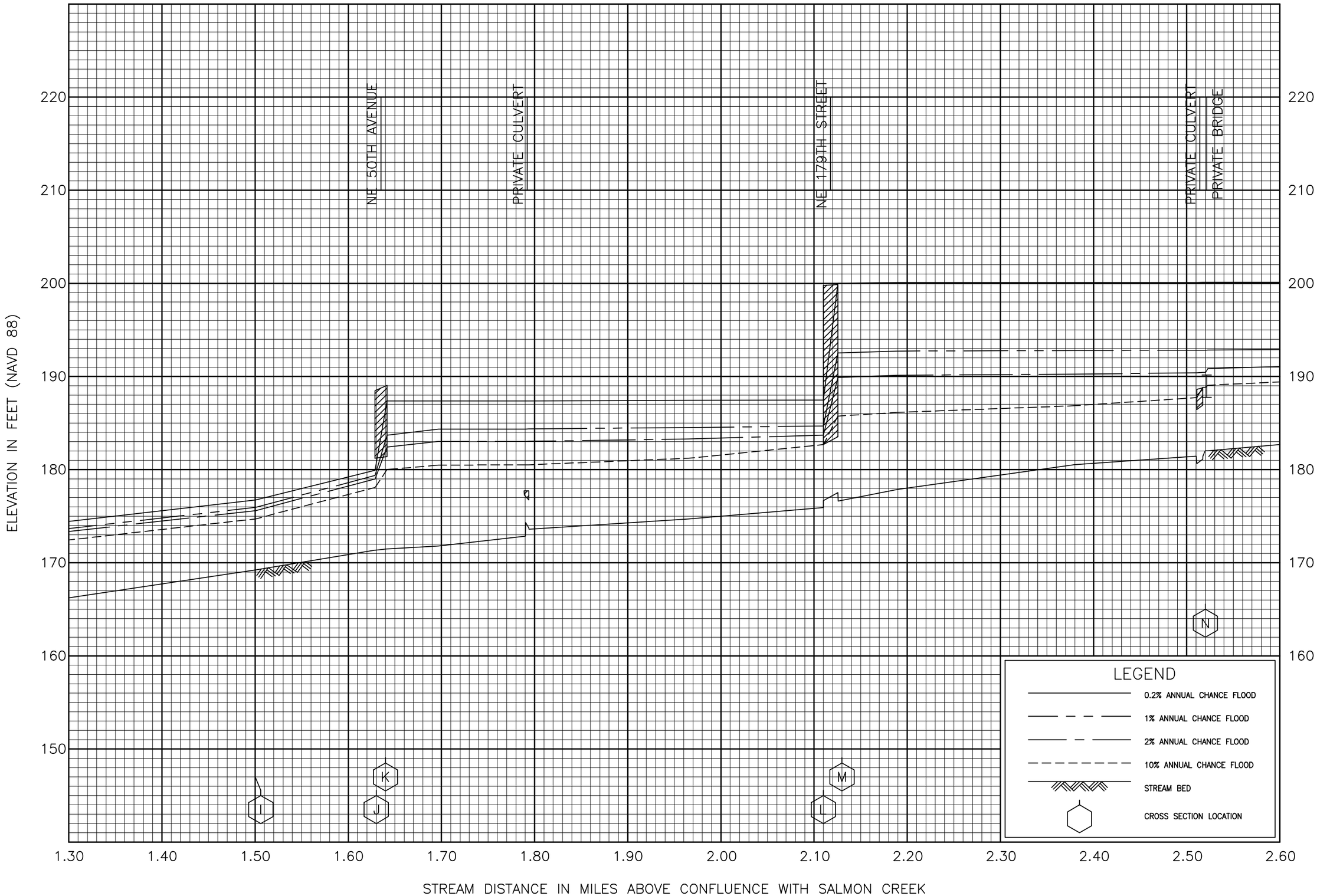


FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

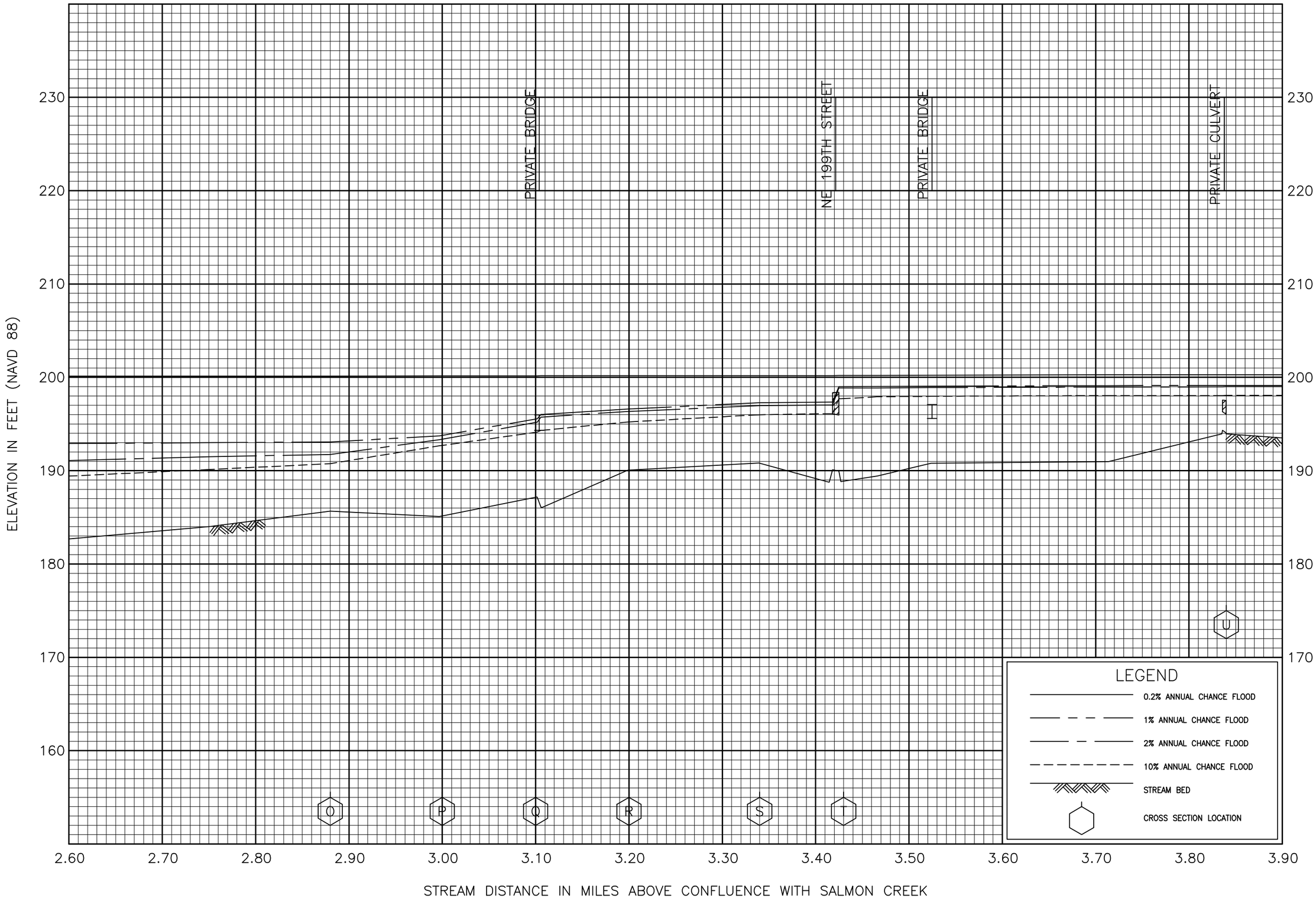


FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

MILL CREEK

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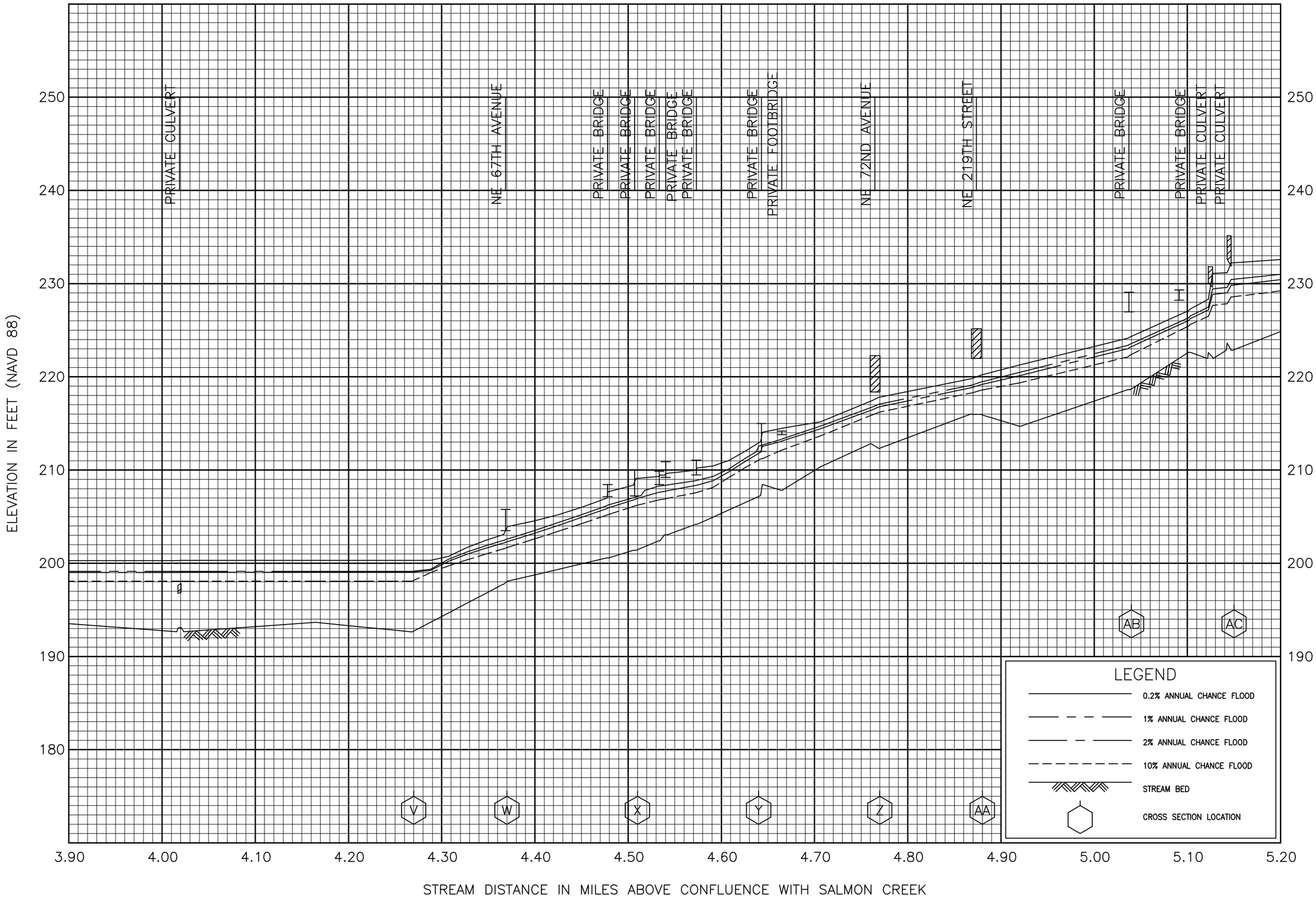
CLARK COUNTY, WA
AND INCORPORATED AREAS



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MILL CREEK

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CLARK COUNTY, WA
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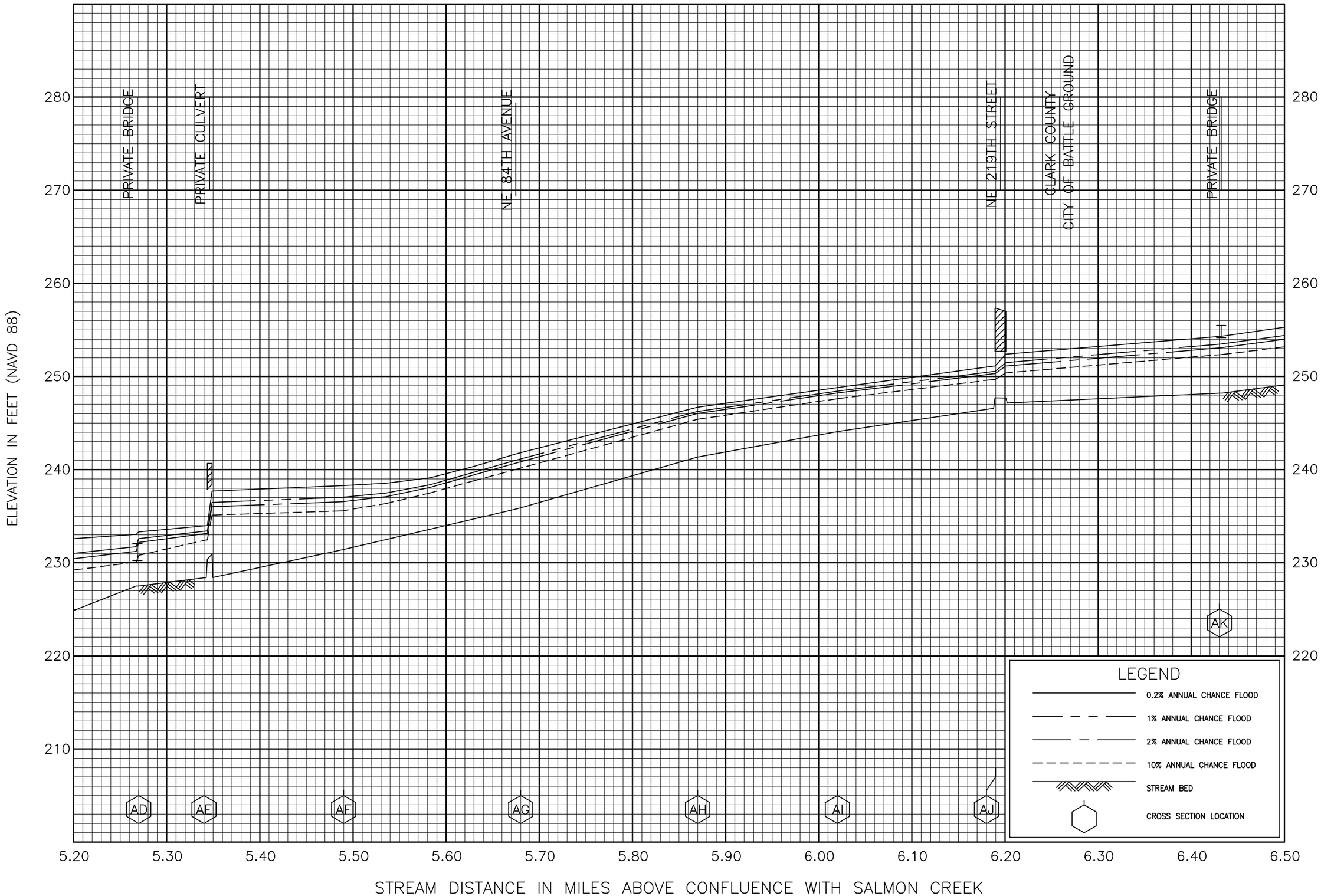

FLOOD PROFILES

MILL CREEK

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CLARK COUNTY, WA
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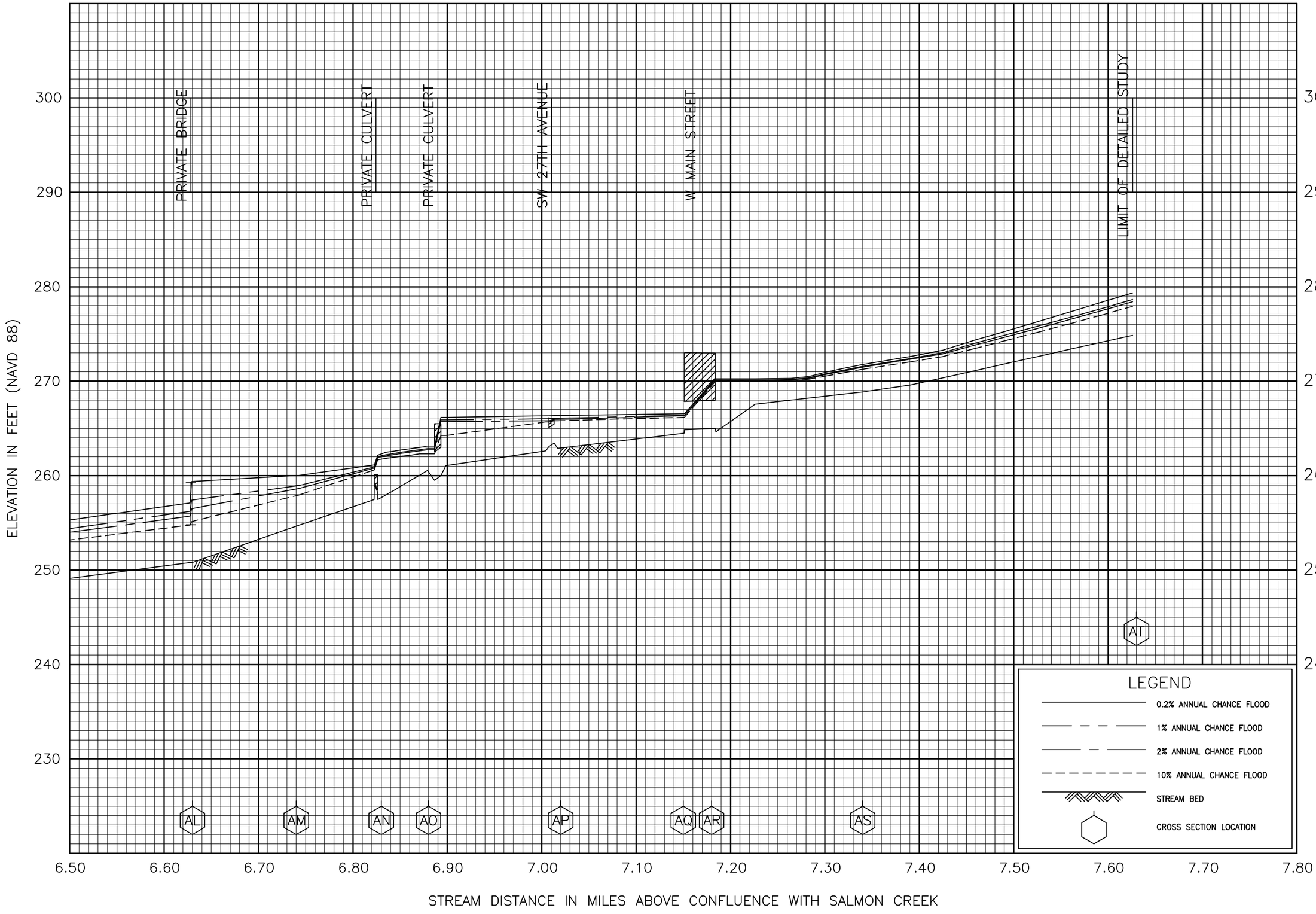

FLOOD PROFILES

MILL CREEK

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CLARK COUNTY, WA
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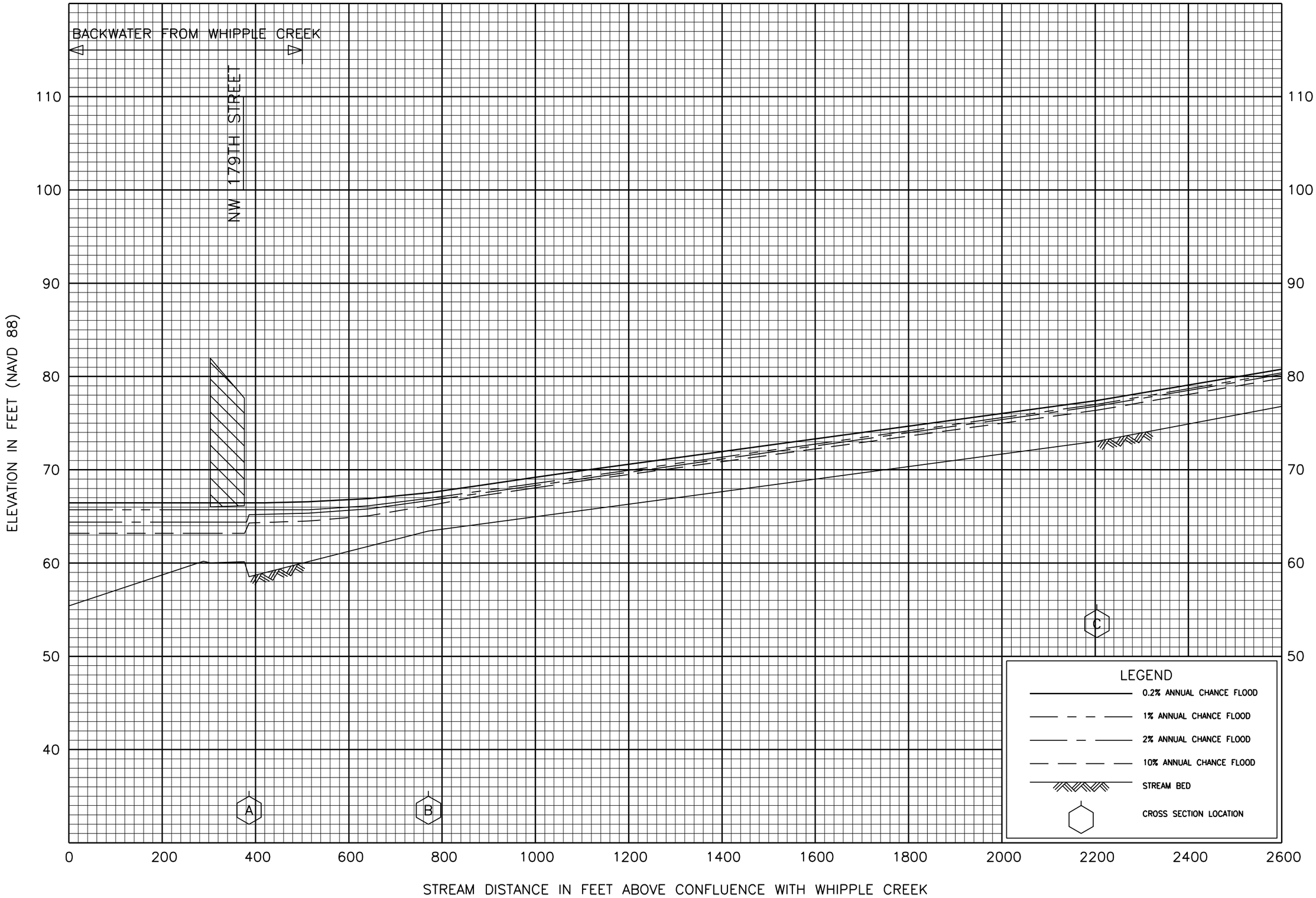
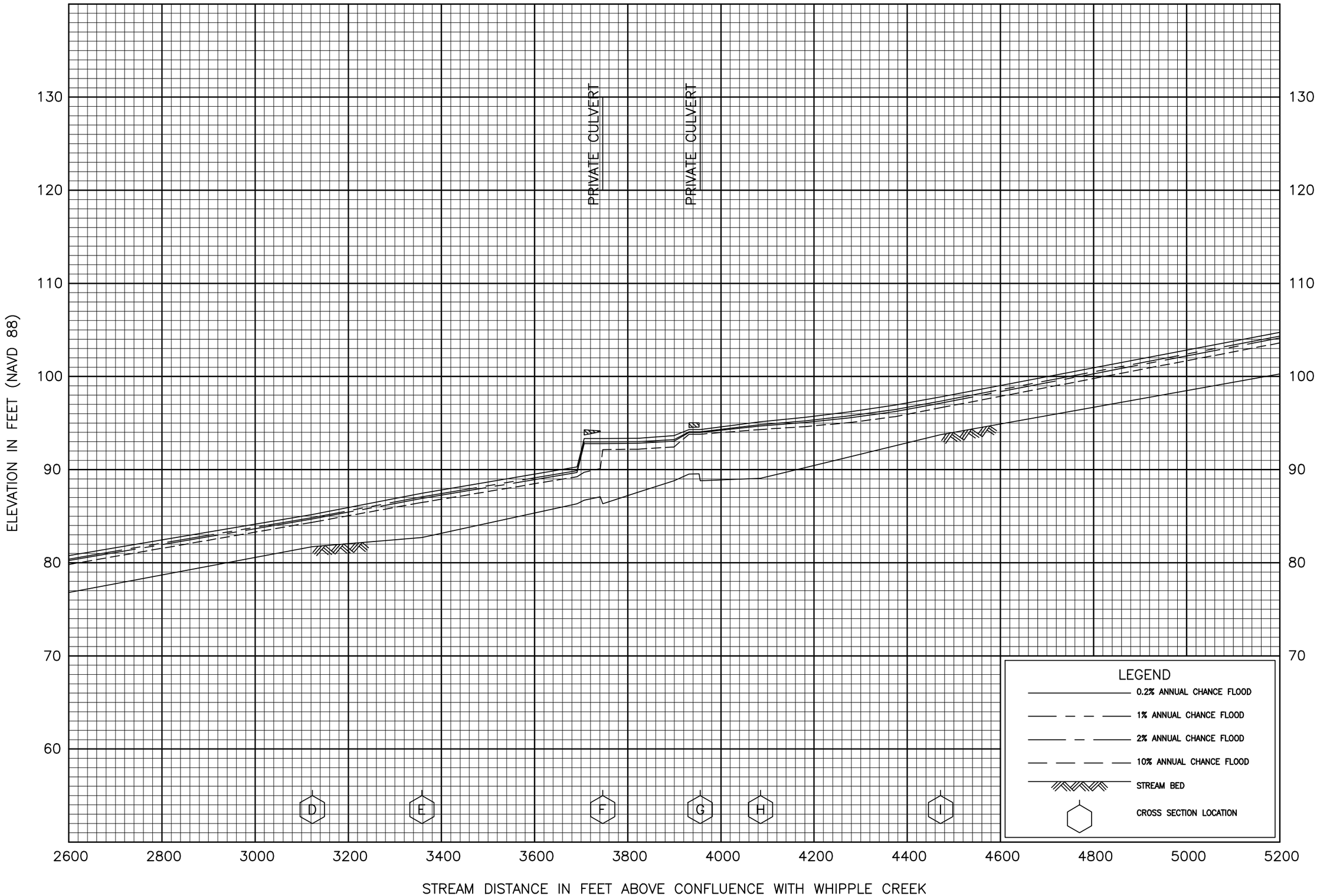


FLOOD PROFILES

PACKARD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

PACKARD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

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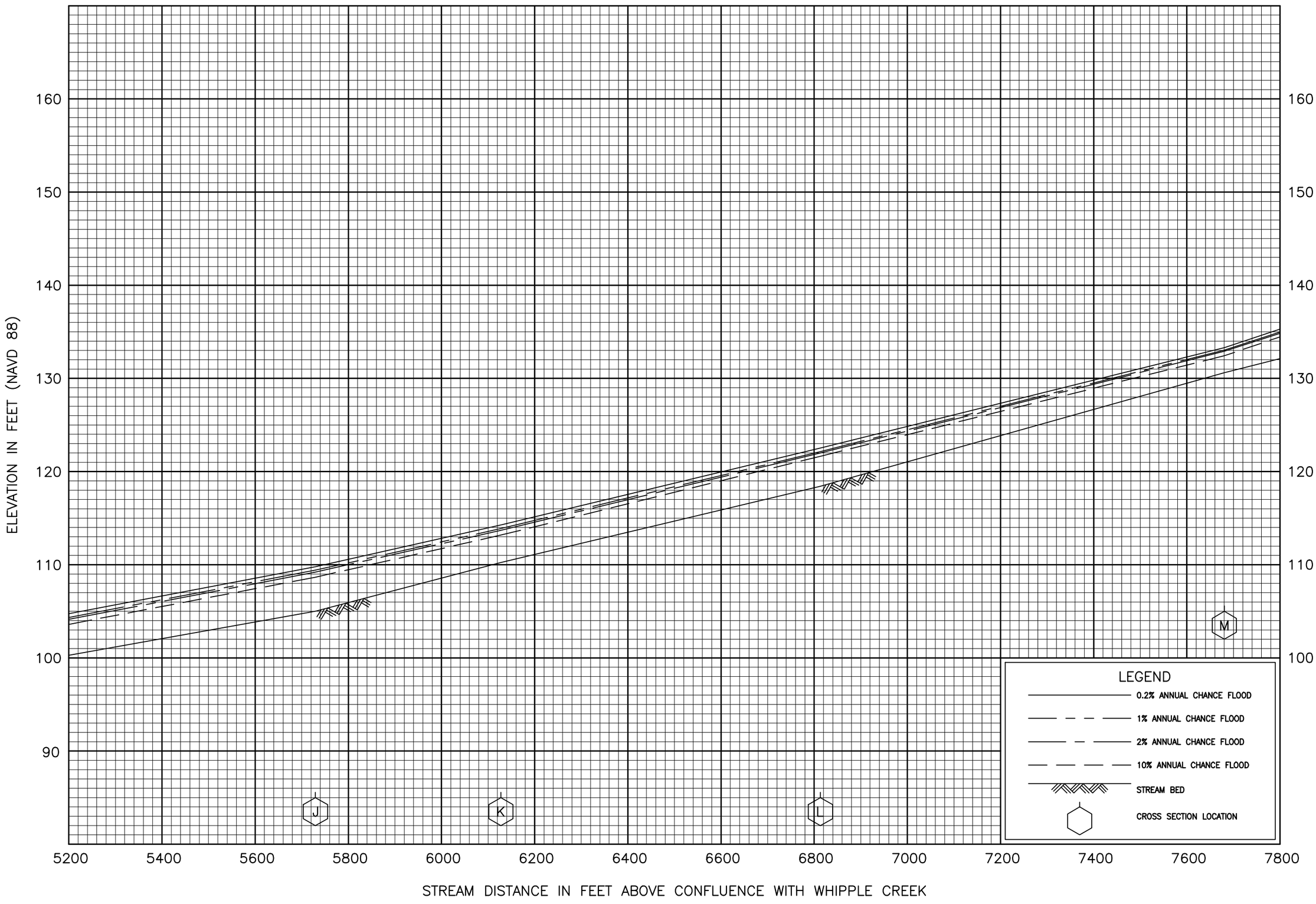
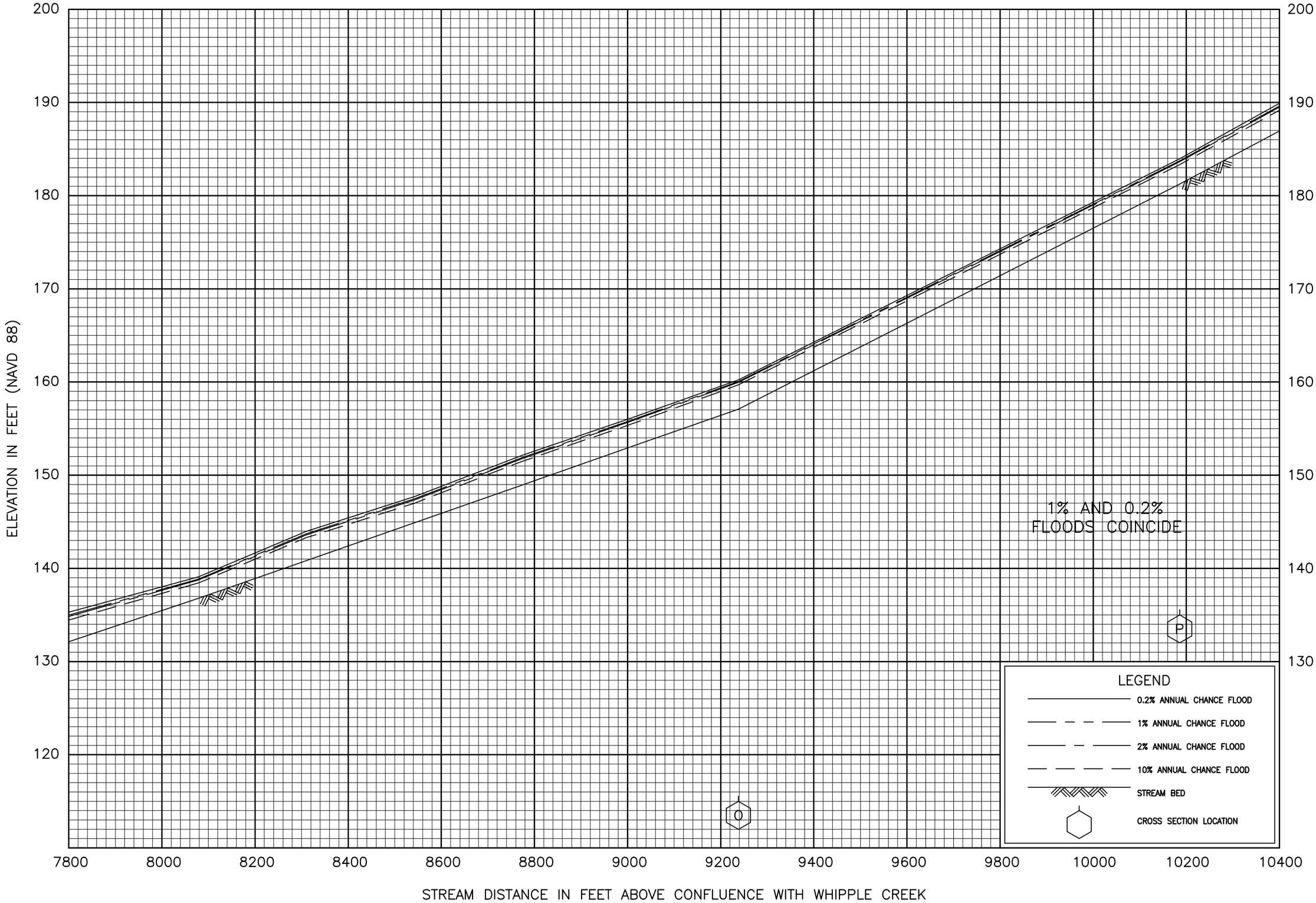


FLOOD PROFILES

PACKARD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



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PACKARD CREEK

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CLARK COUNTY, WA
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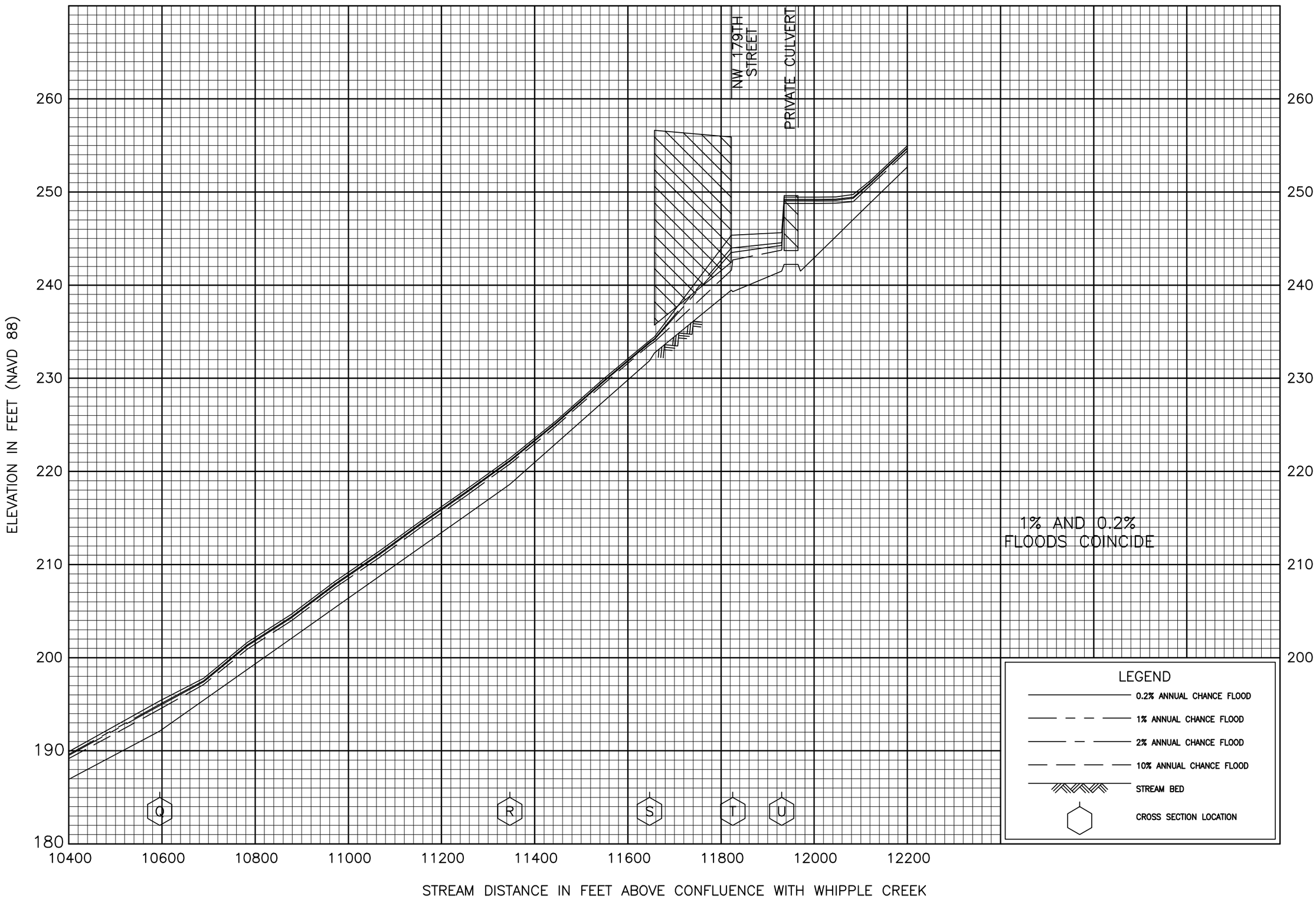

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PACKARD CREEK

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CLARK COUNTY, WA
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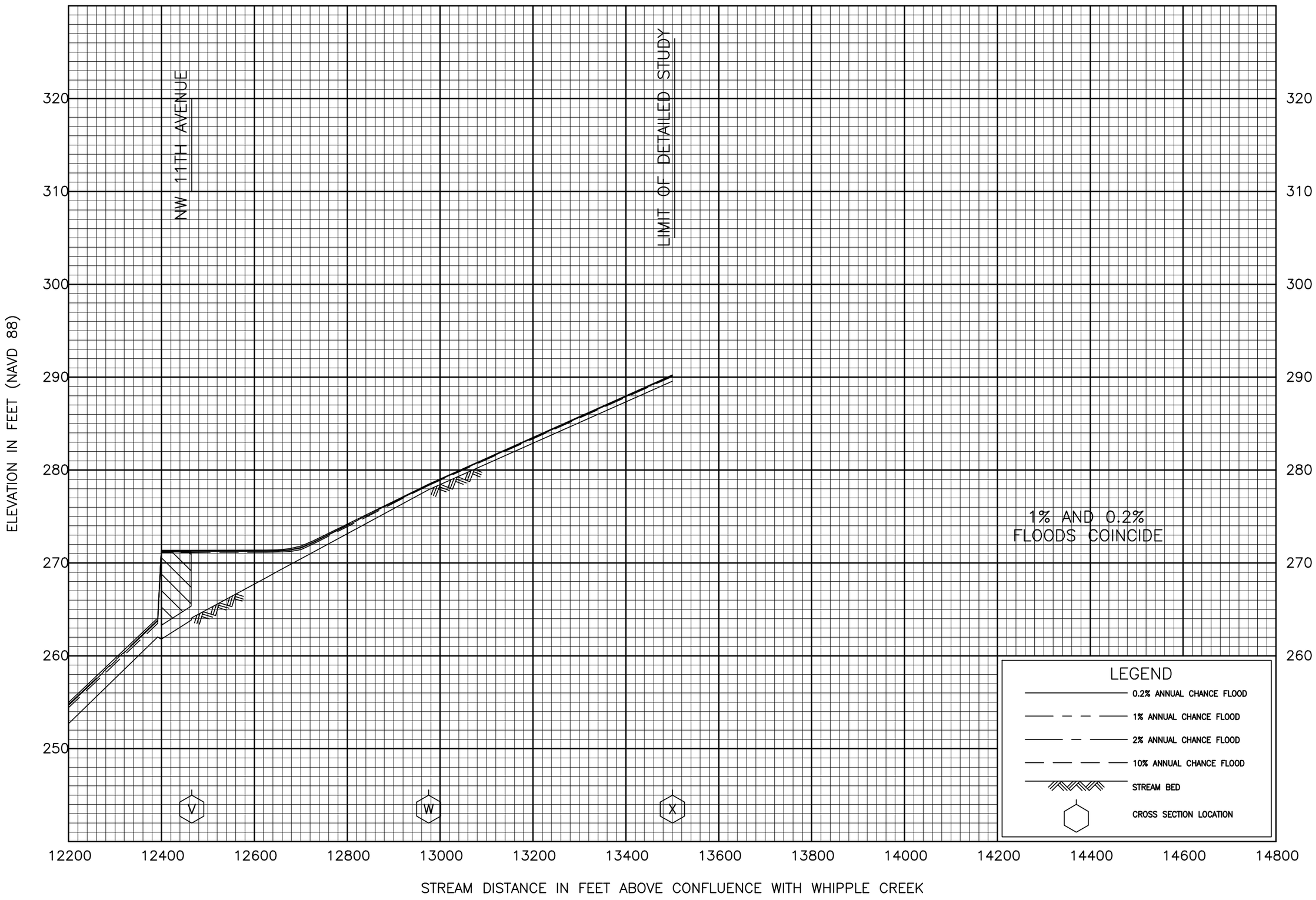

FLOOD PROFILES

PACKARD CREEK

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CLARK COUNTY, WA
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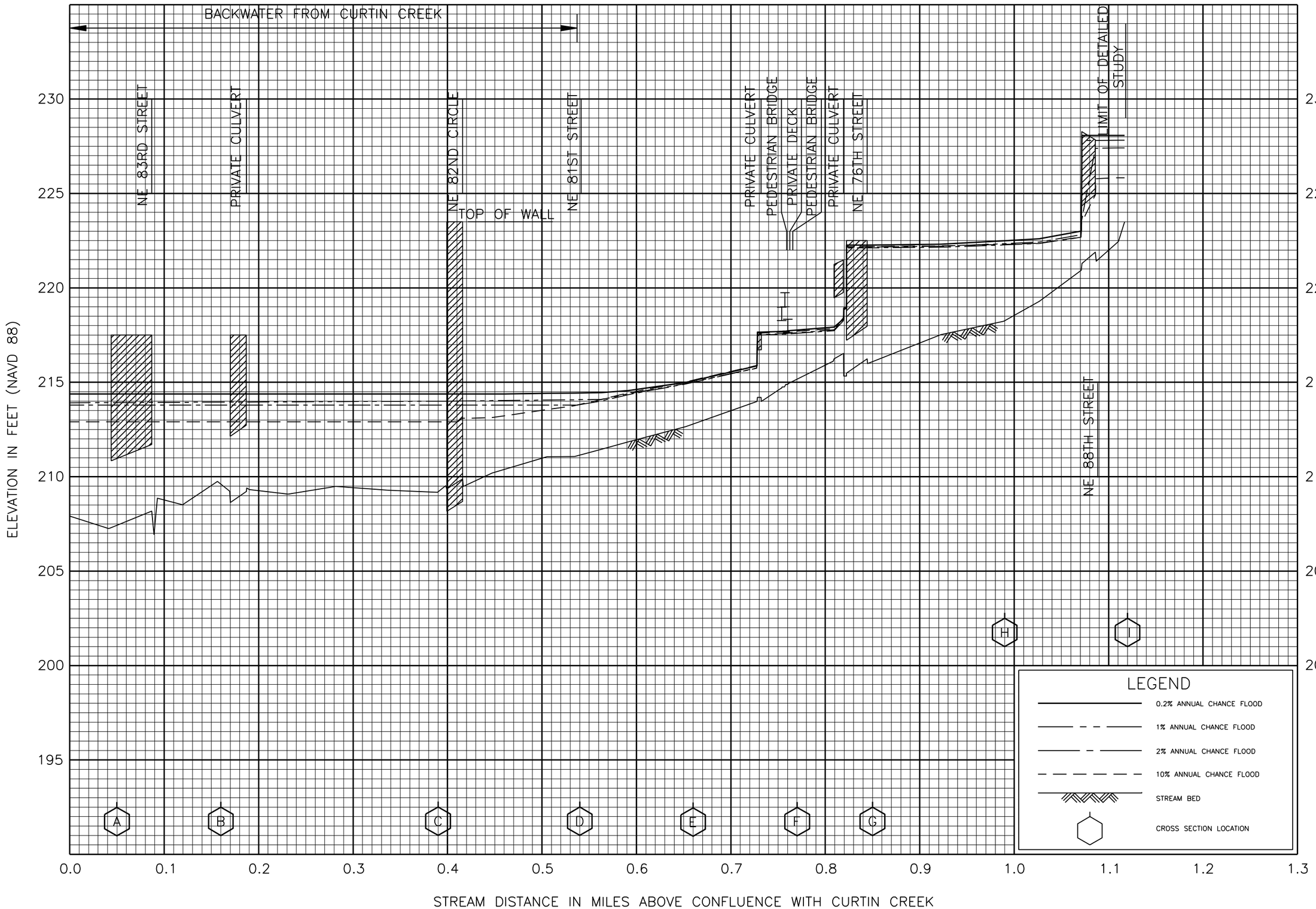

FLOOD PROFILES

PADDEN CREEK

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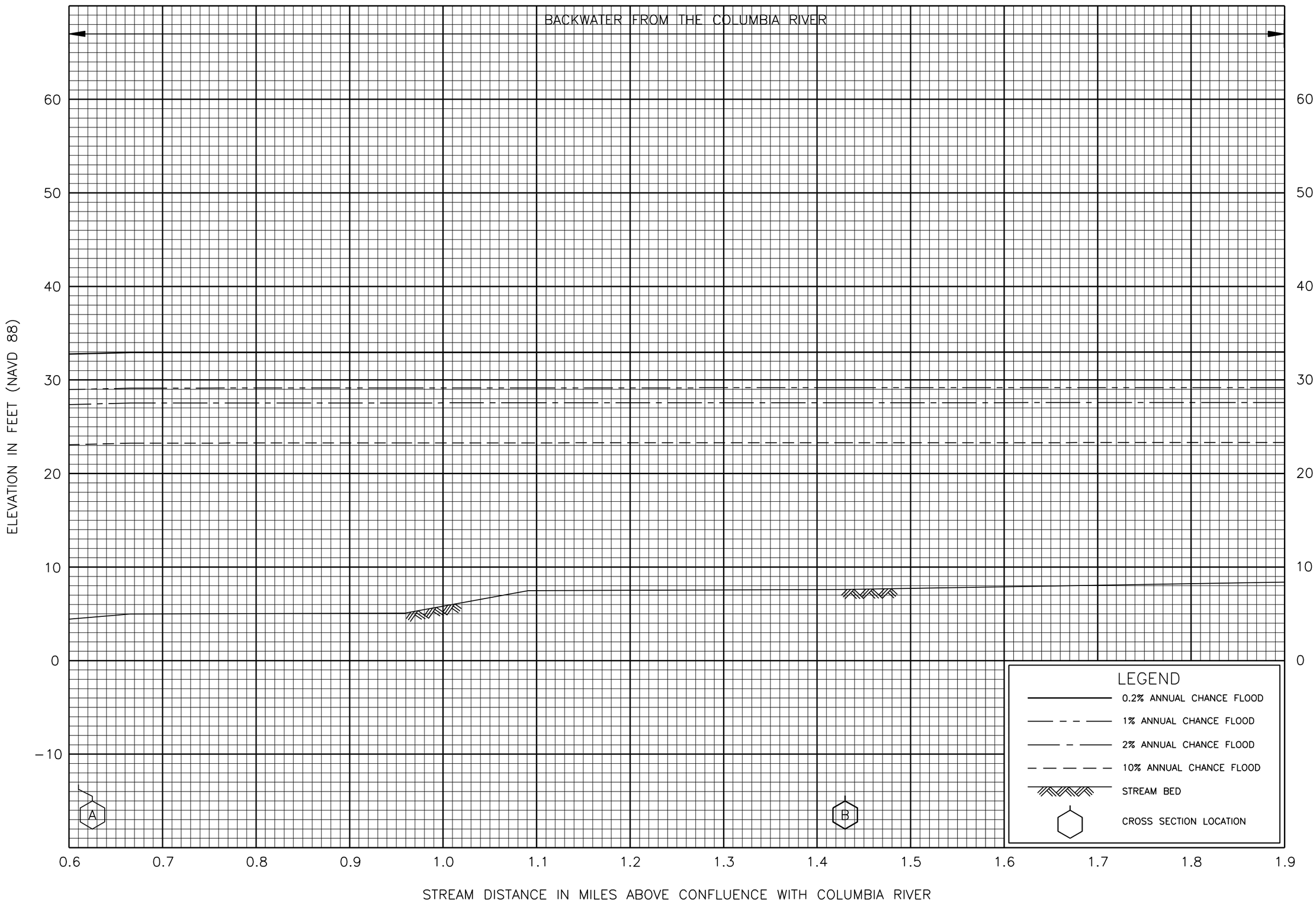

FLOOD PROFILES

SALMON CREEK

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CLARK COUNTY, WA
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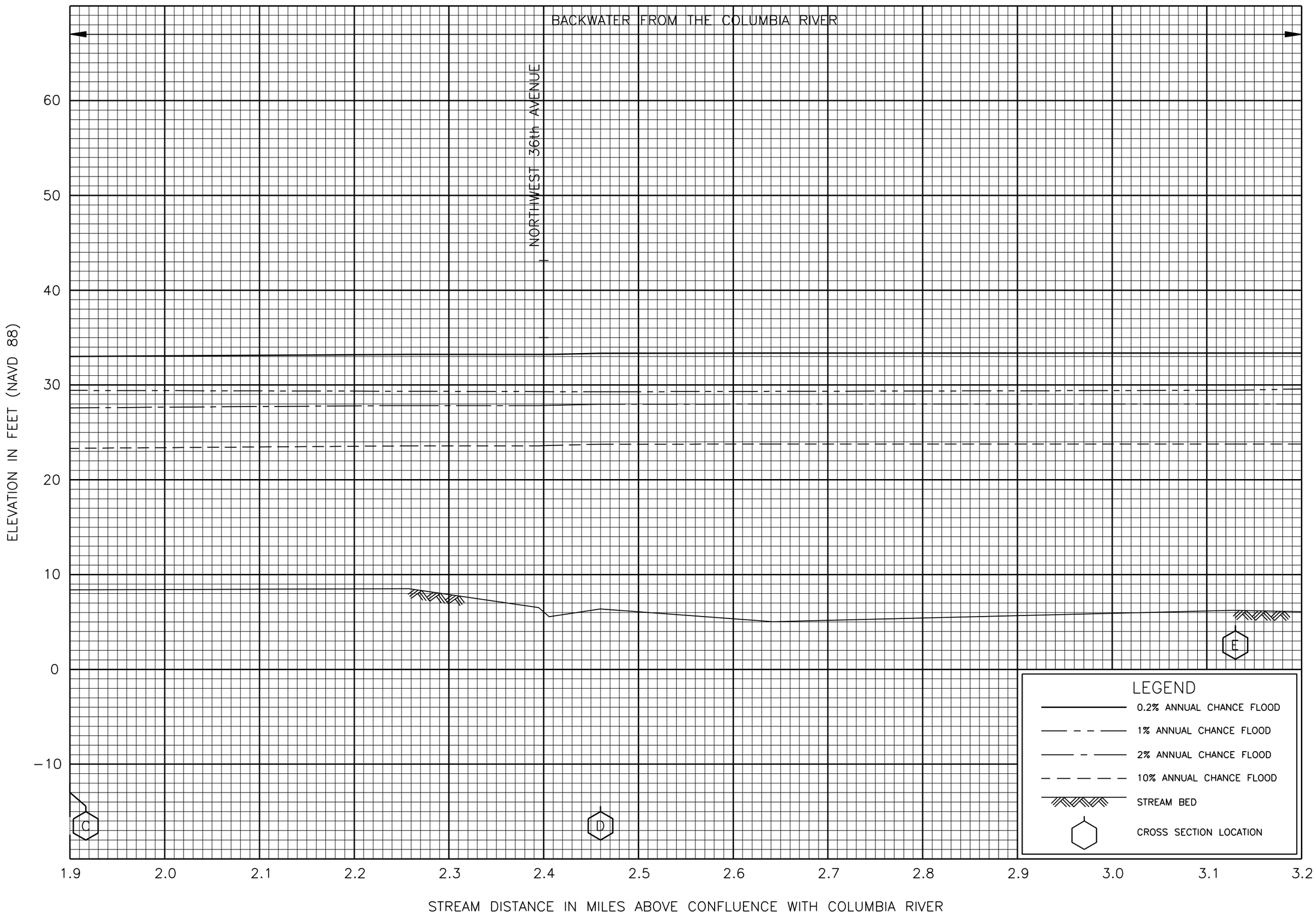

FLOOD PROFILES

SALMON CREEK

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CLARK COUNTY, WA
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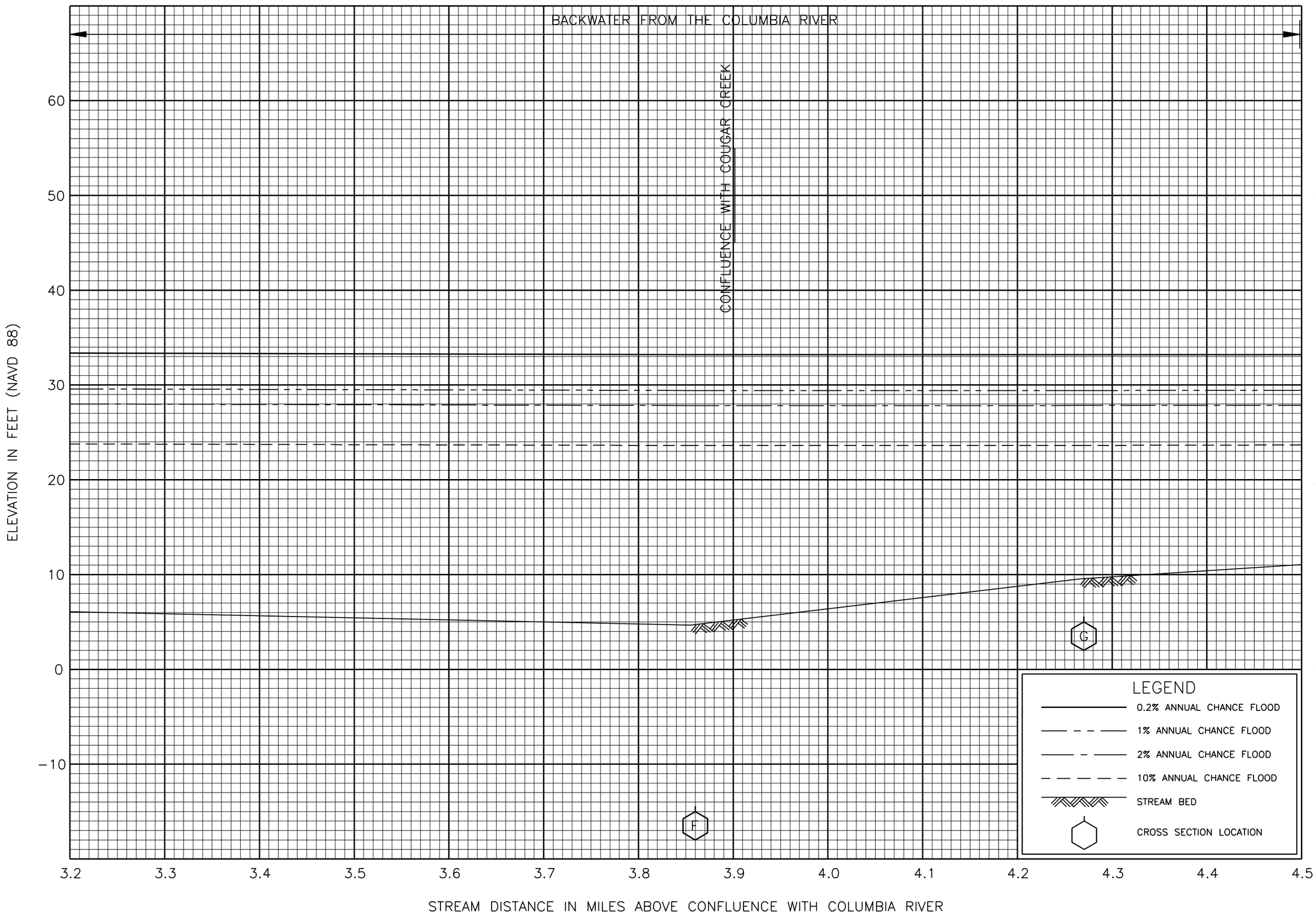

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SALMON CREEK

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CLARK COUNTY, WA

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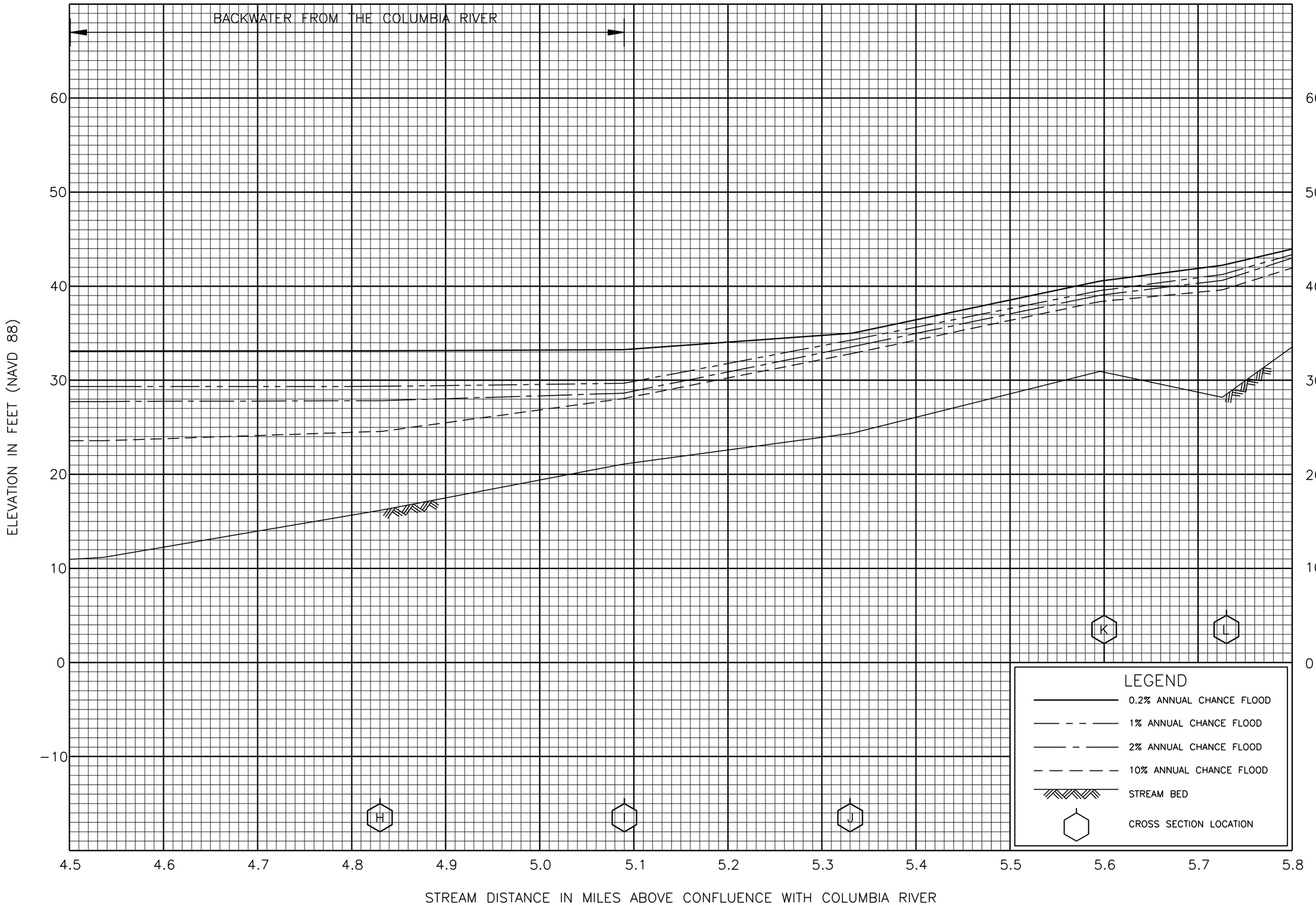

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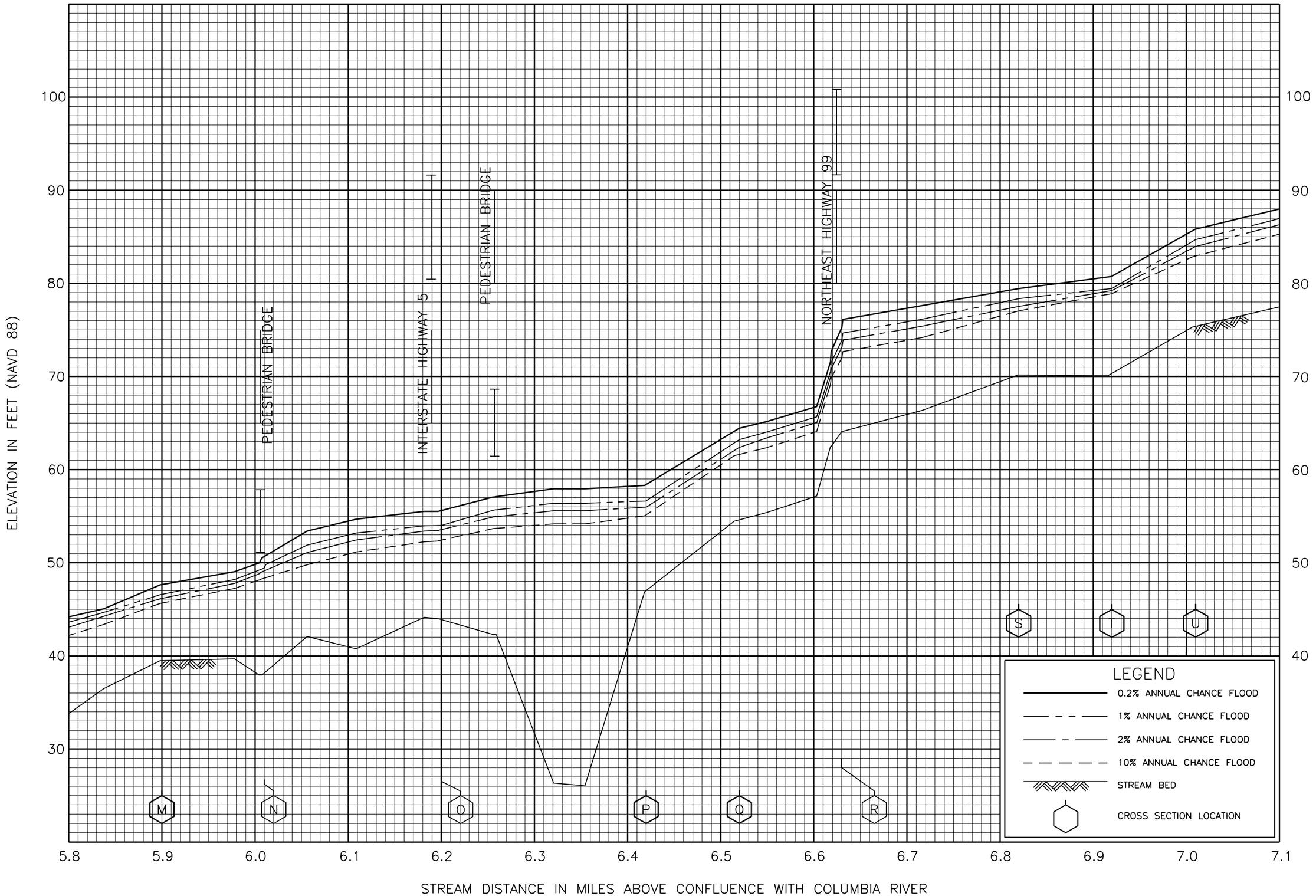

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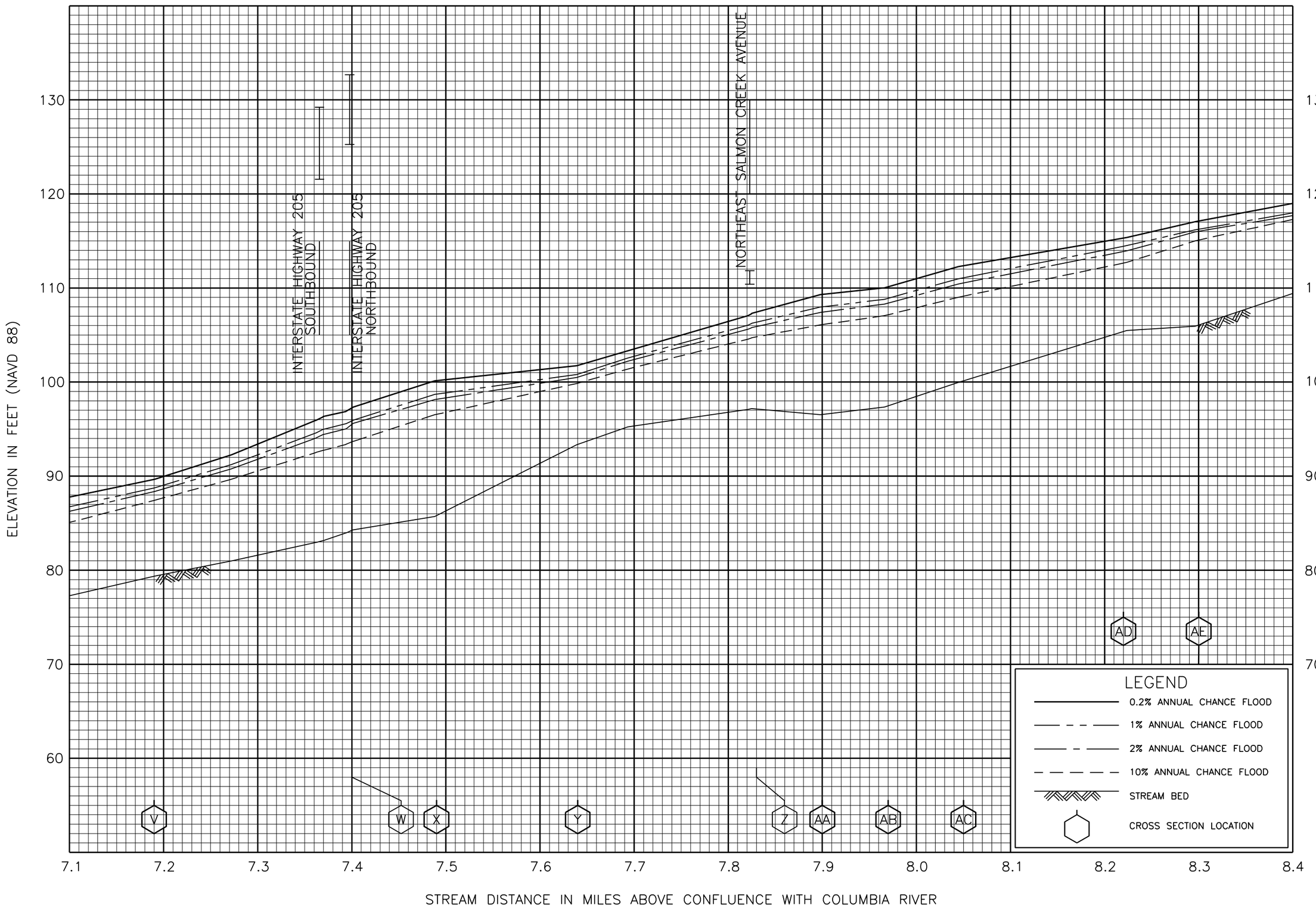

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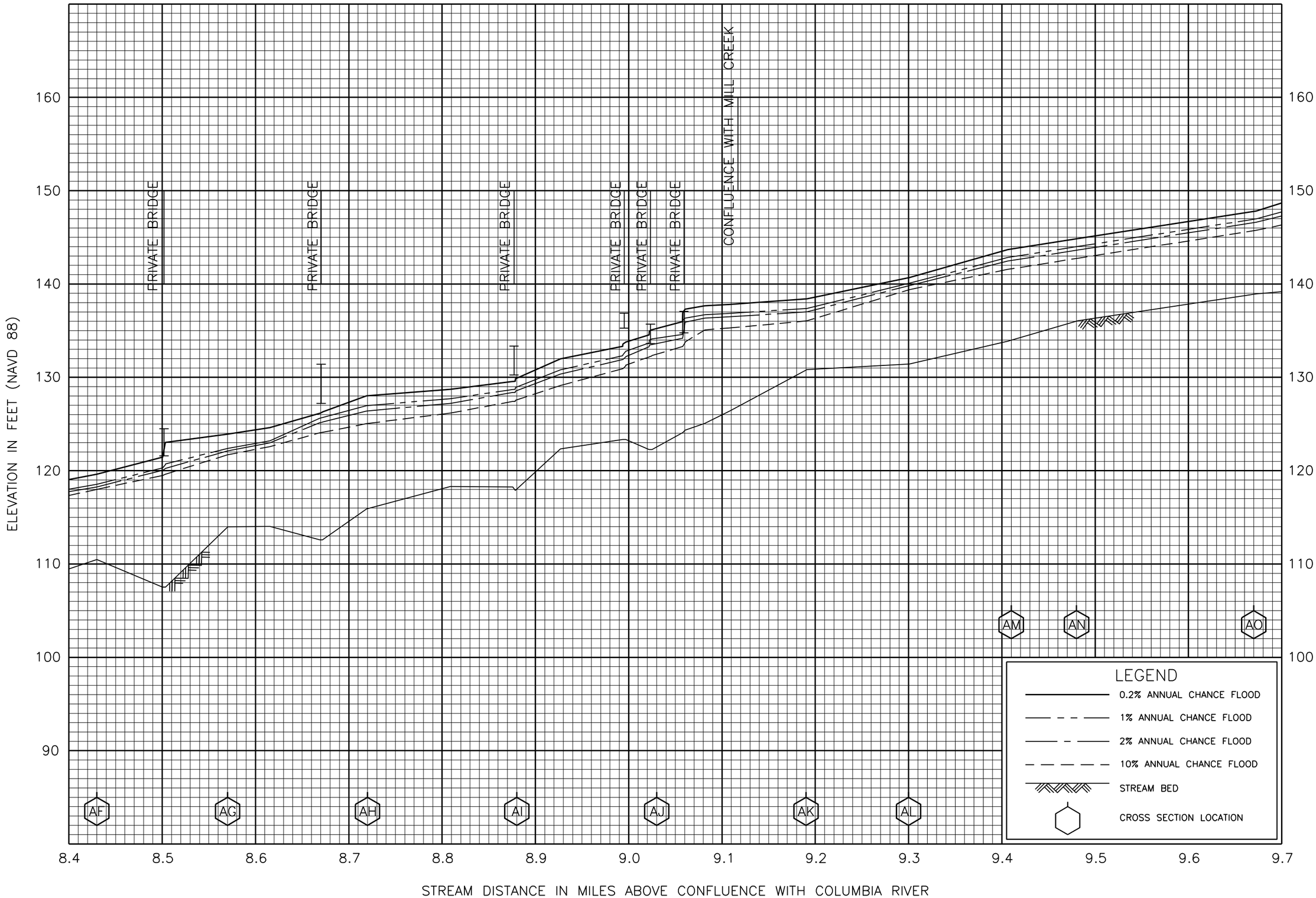

FLOOD PROFILES

SALMON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

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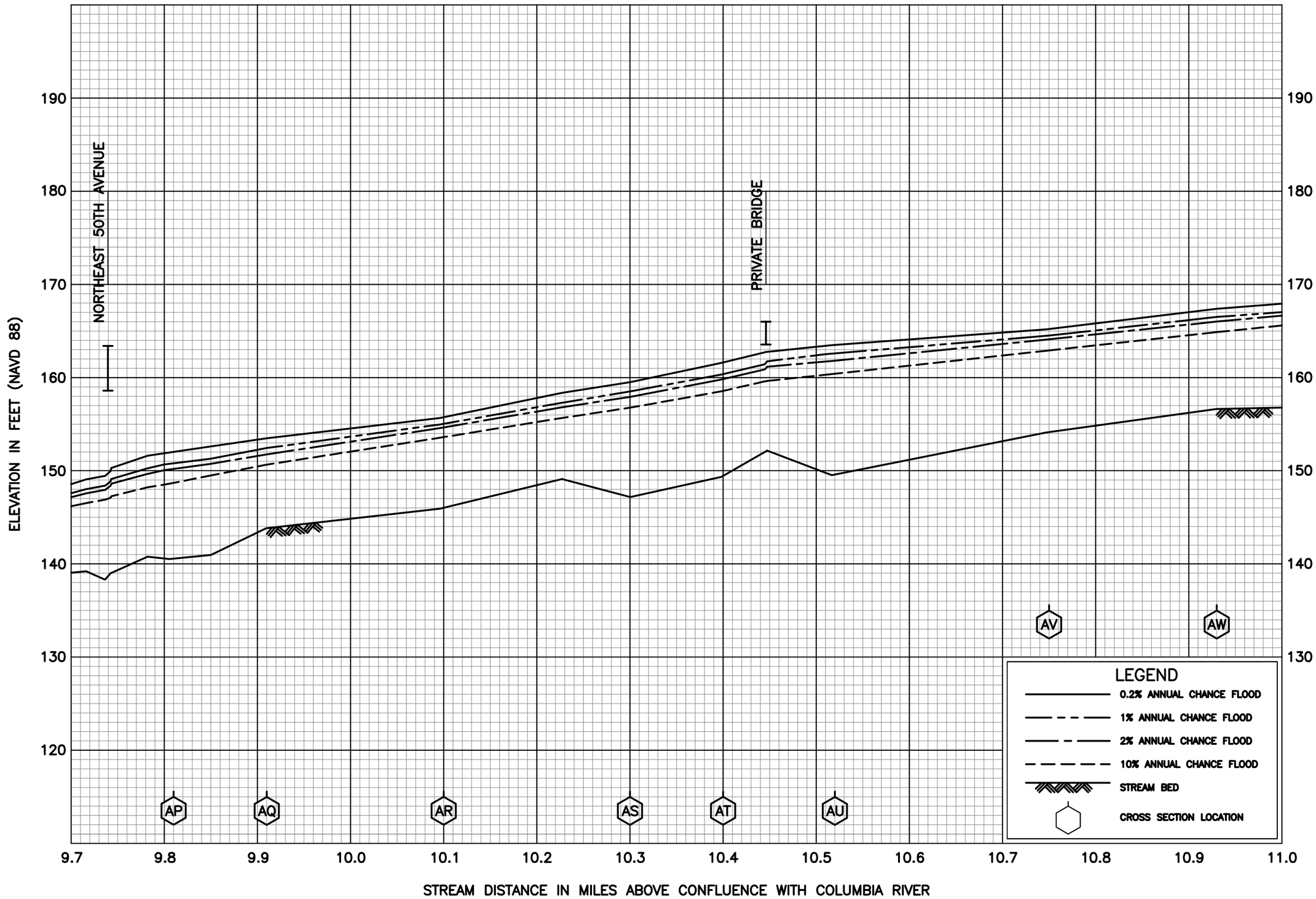

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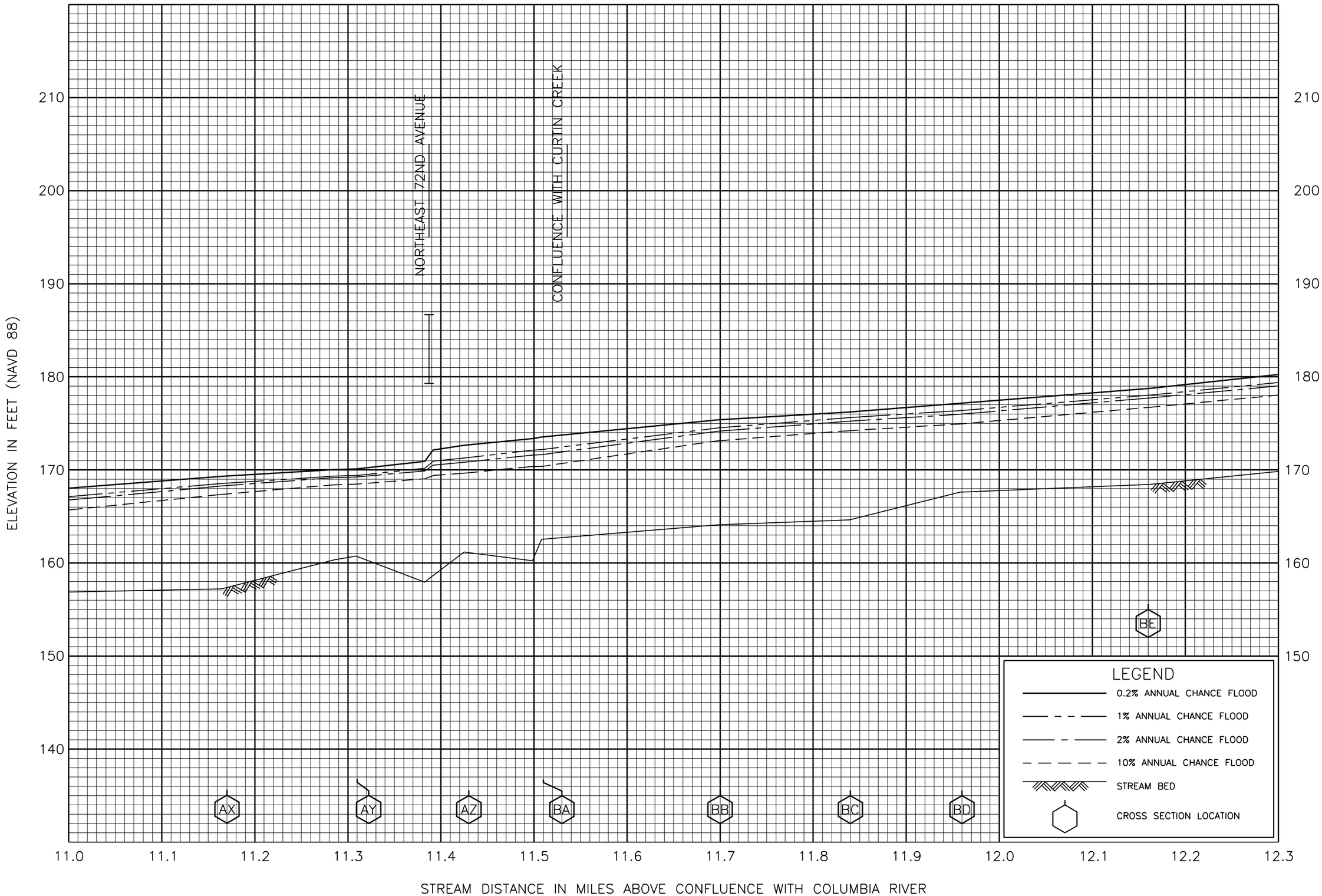

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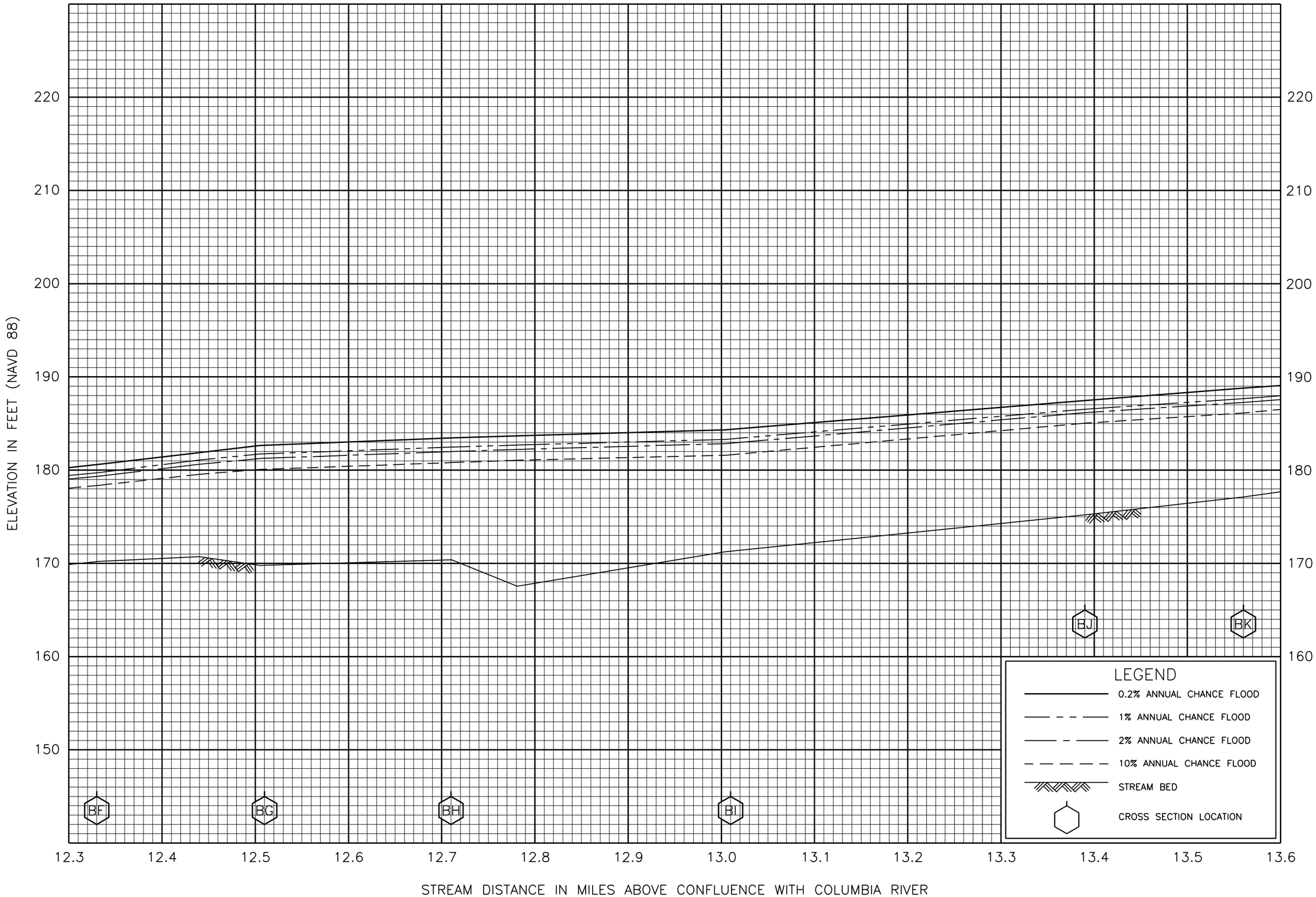

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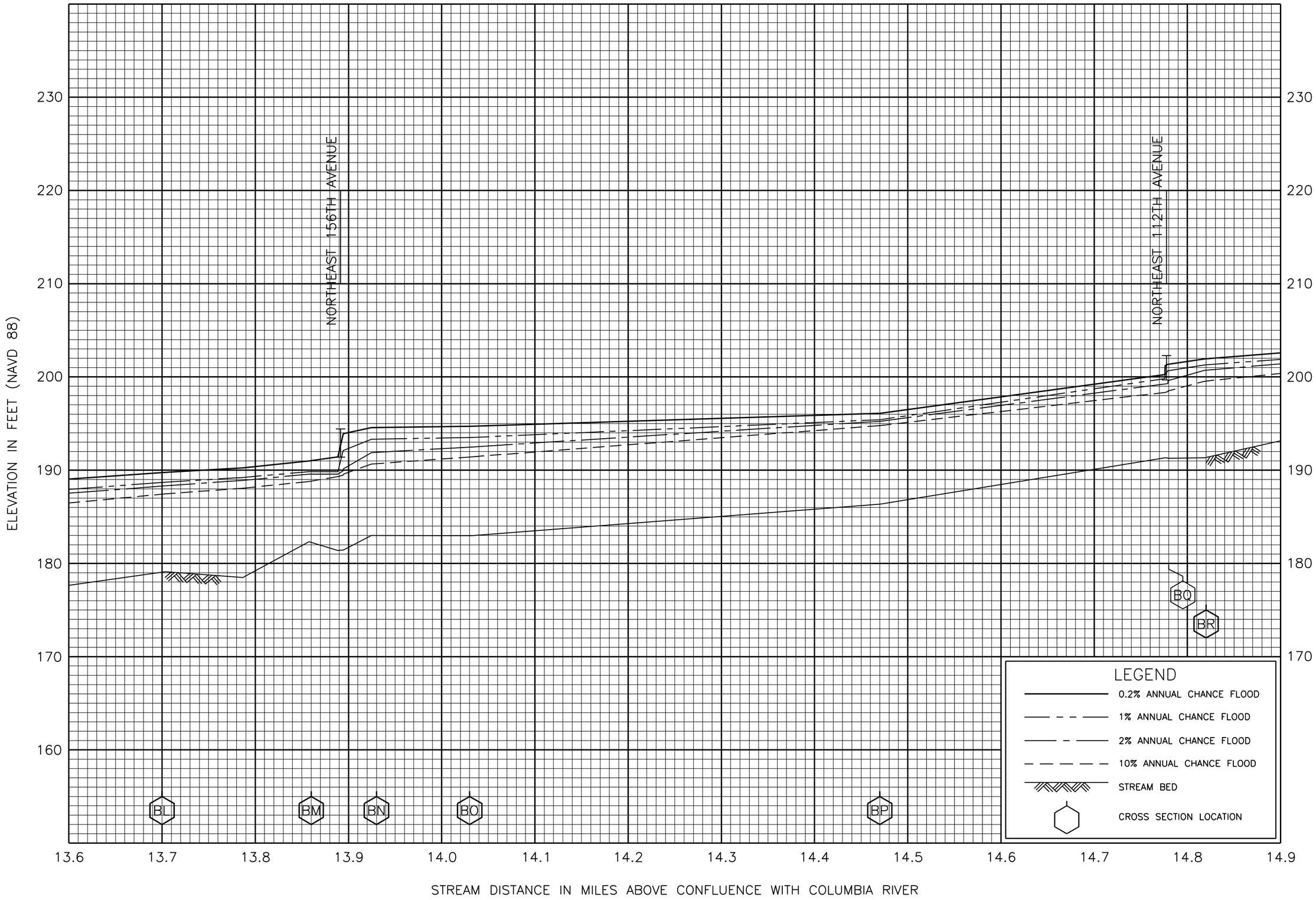

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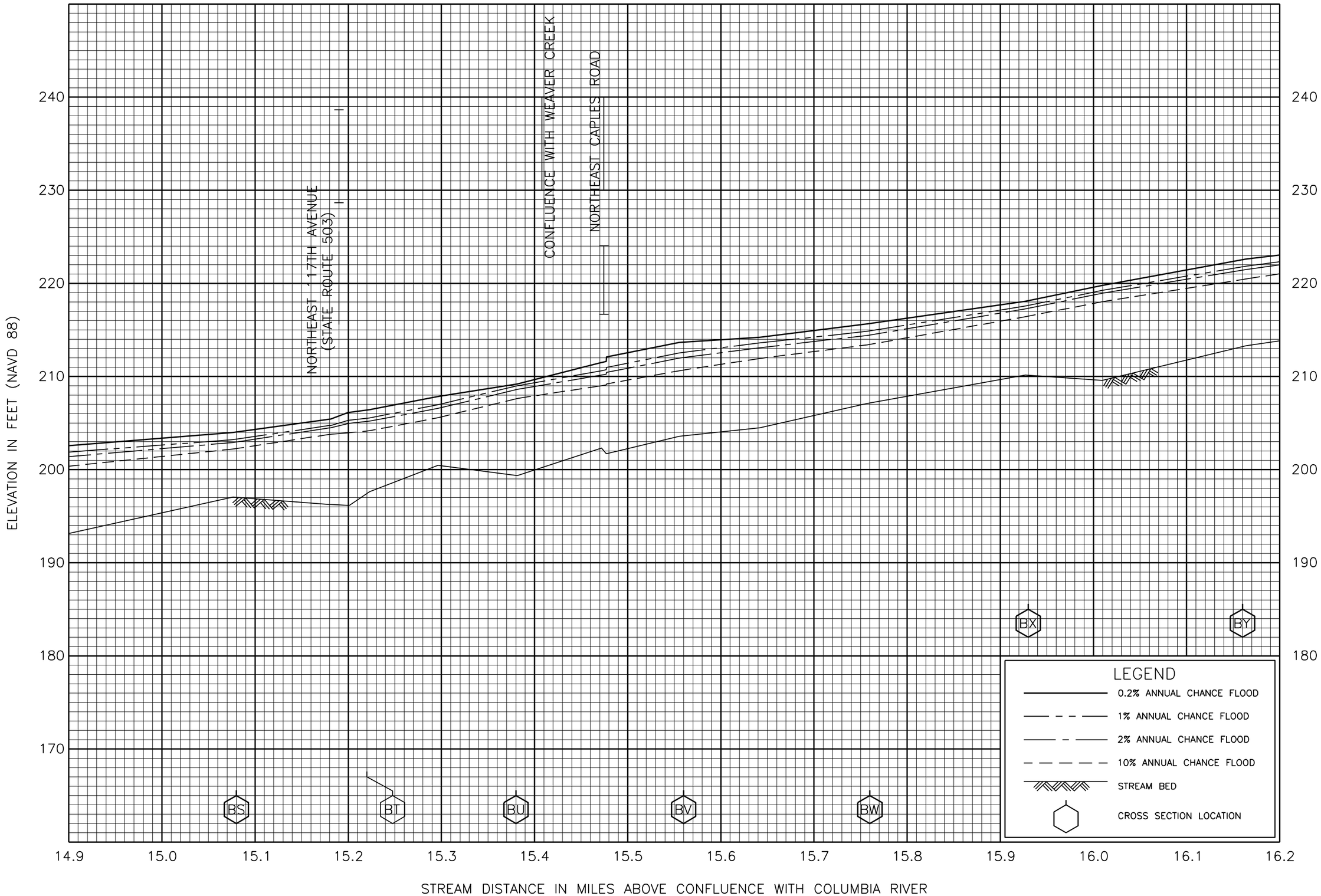

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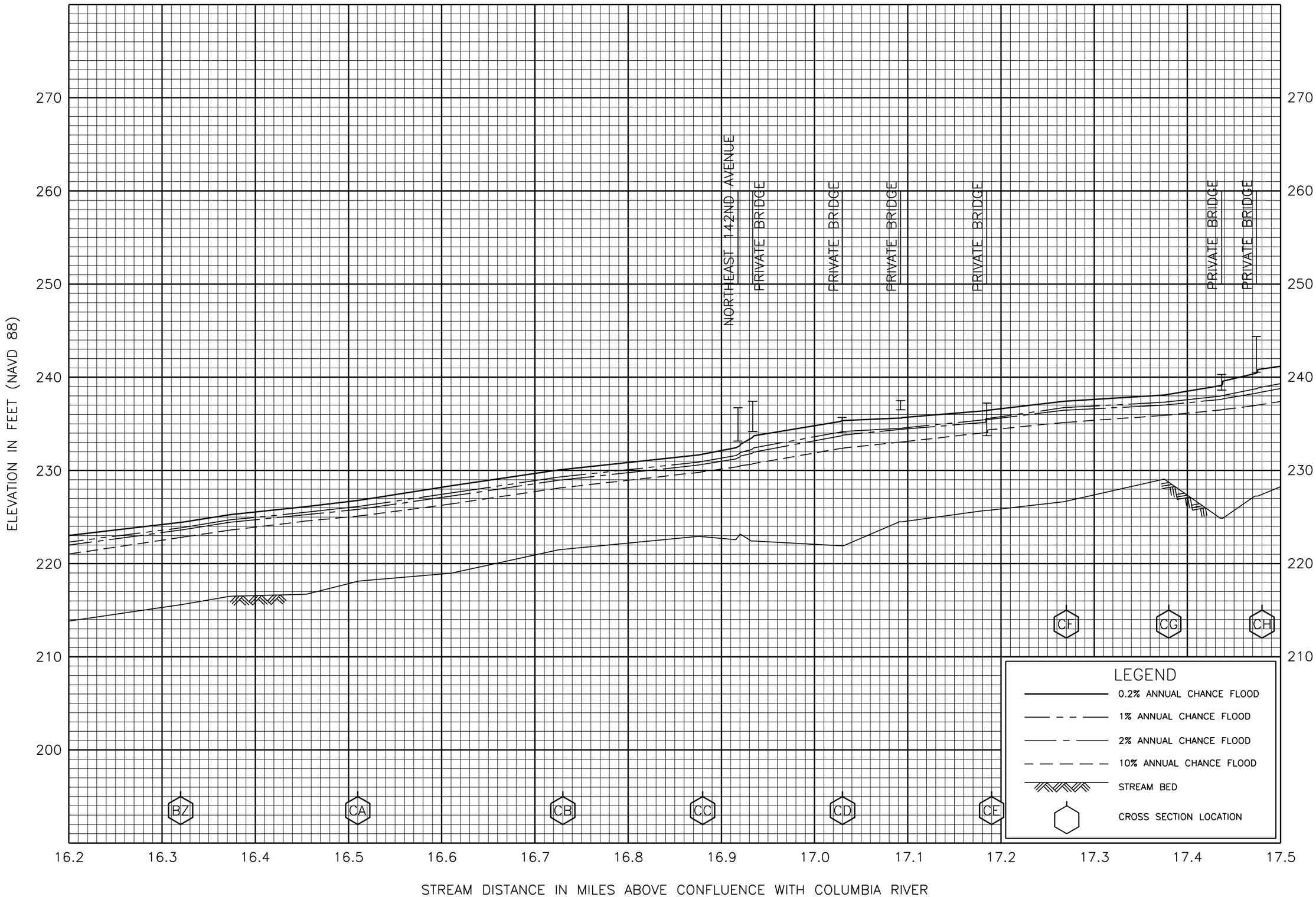

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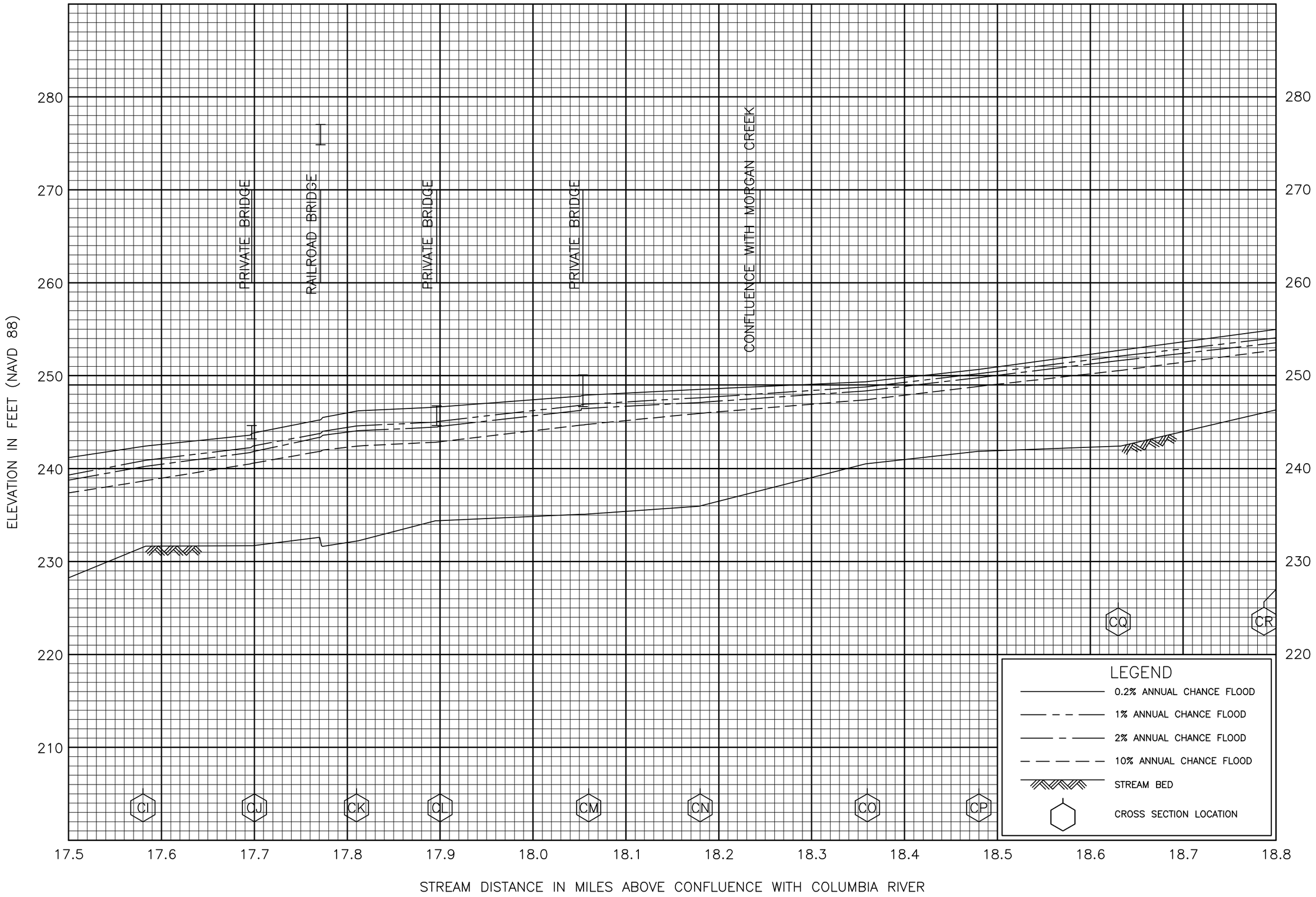
CLARK COUNTY, WA
AND INCORPORATED AREAS

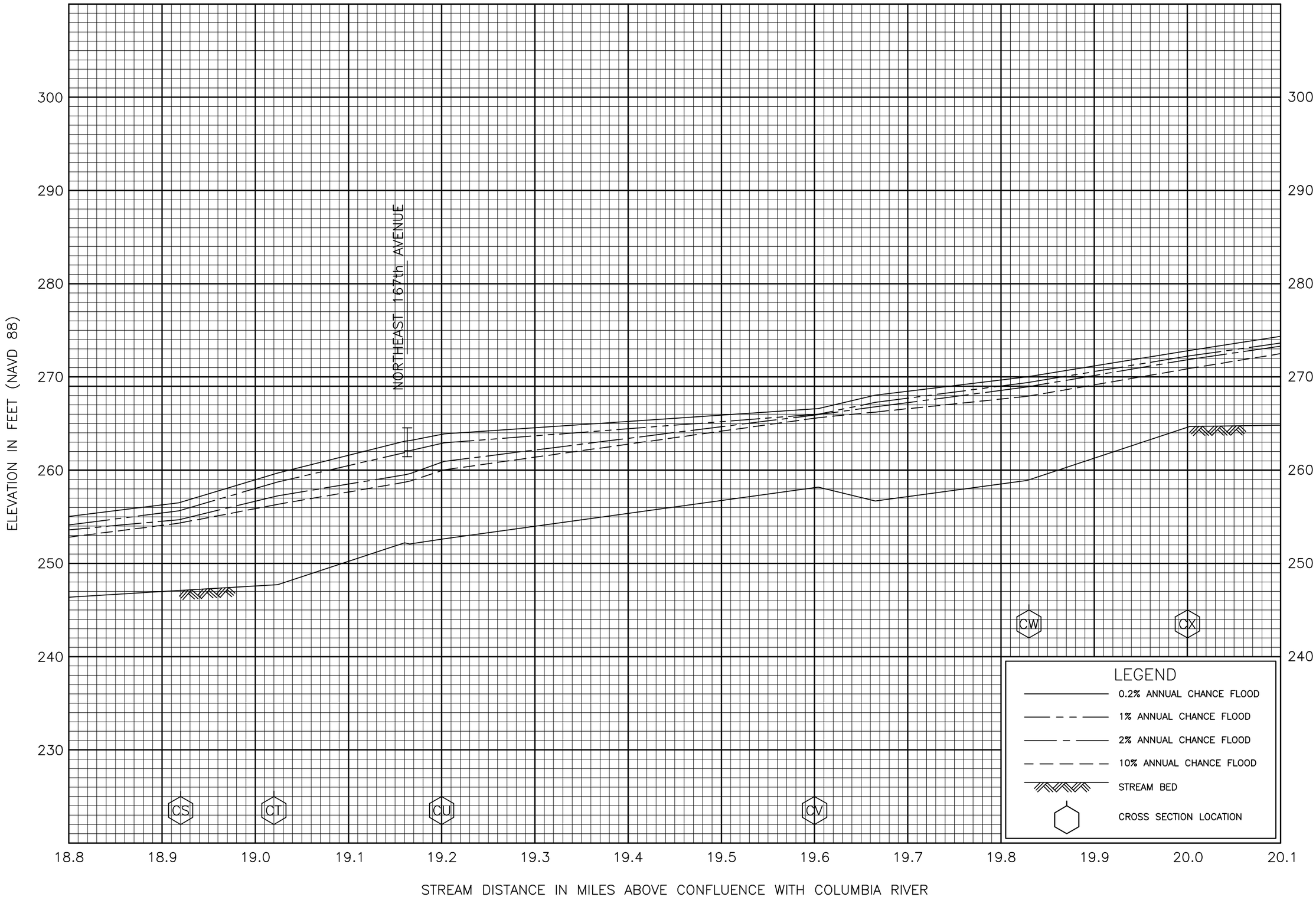


FLOOD PROFILES

SALMON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

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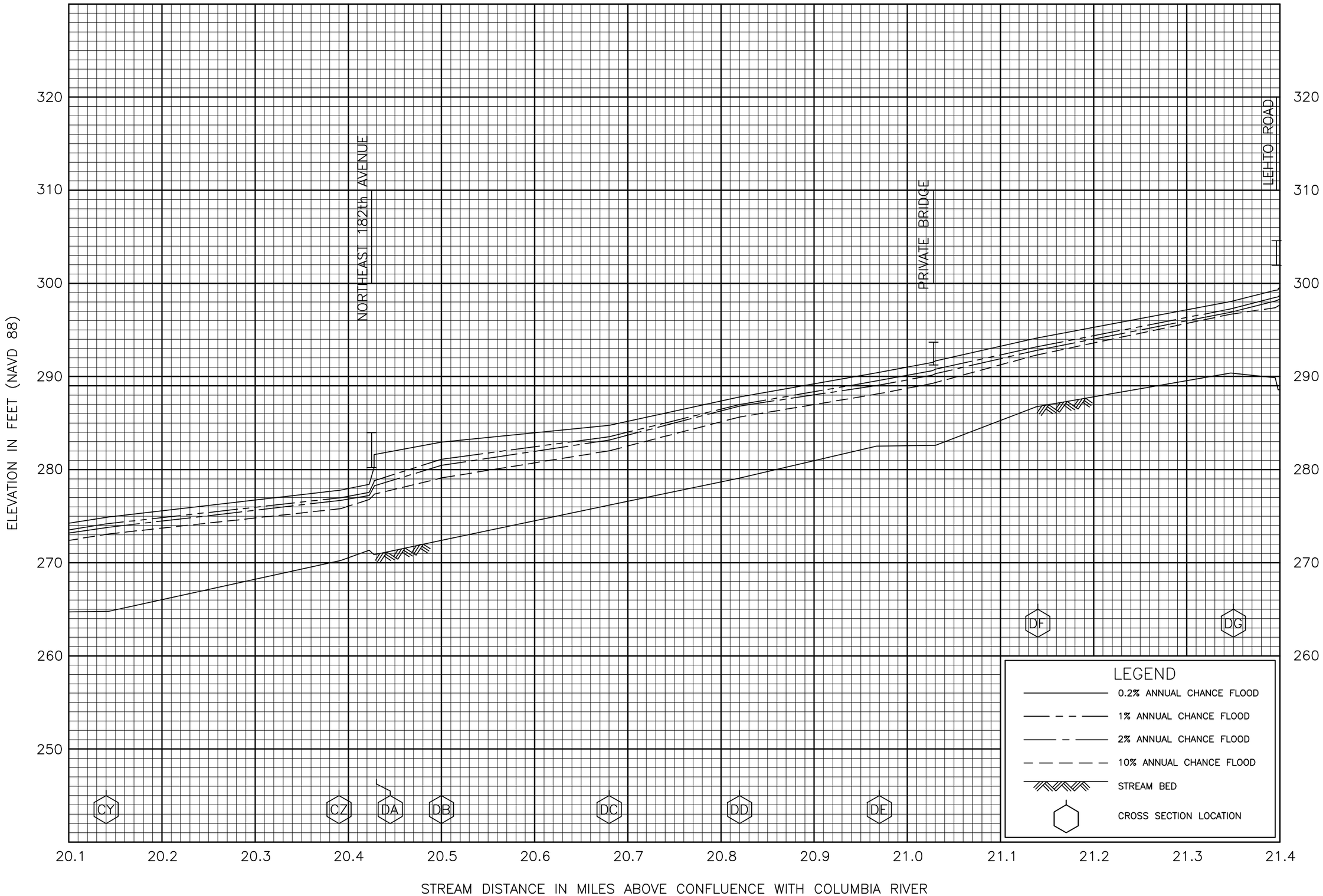

FLOOD PROFILES

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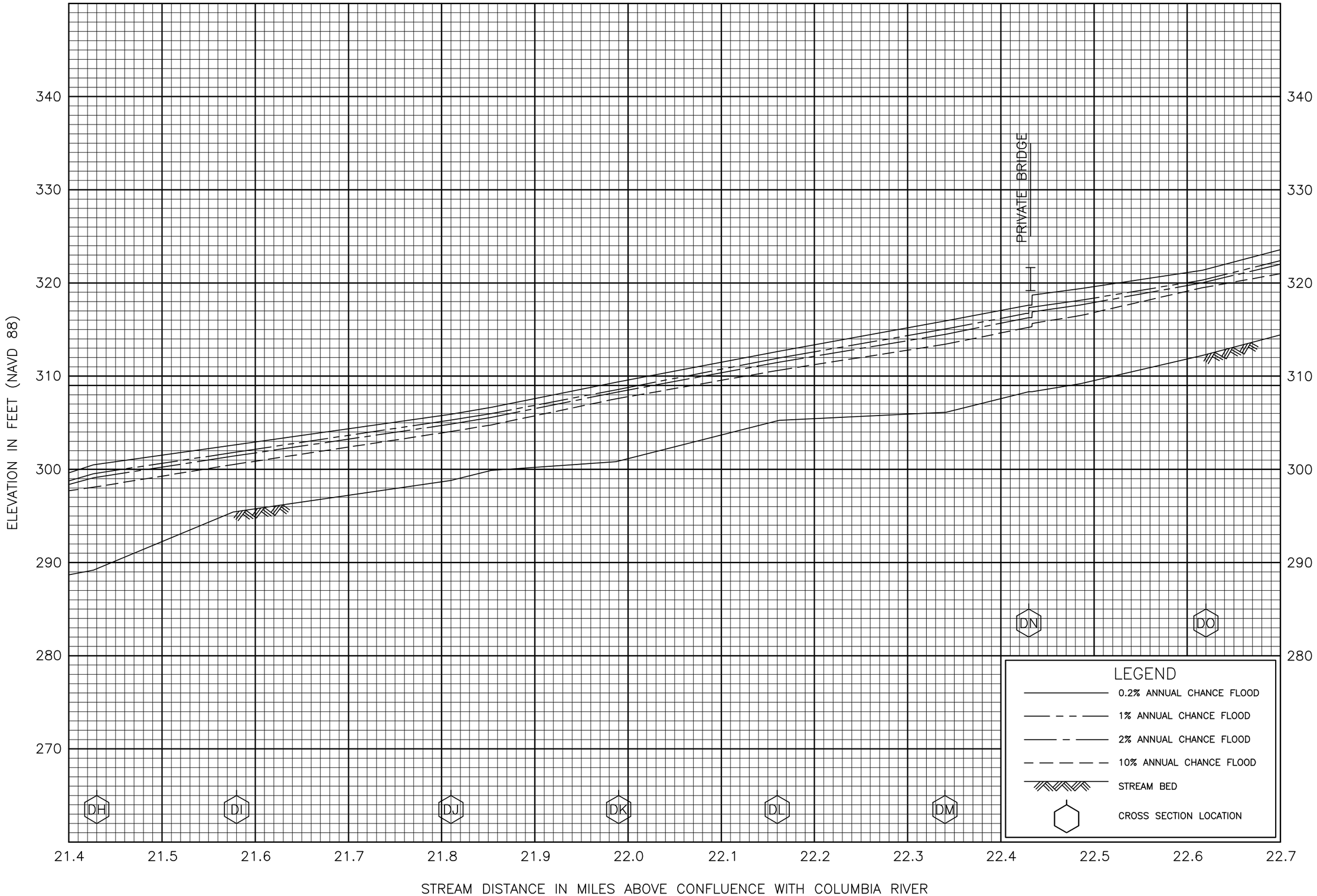

FLOOD PROFILES

SALMON CREEK

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CLARK COUNTY, WA
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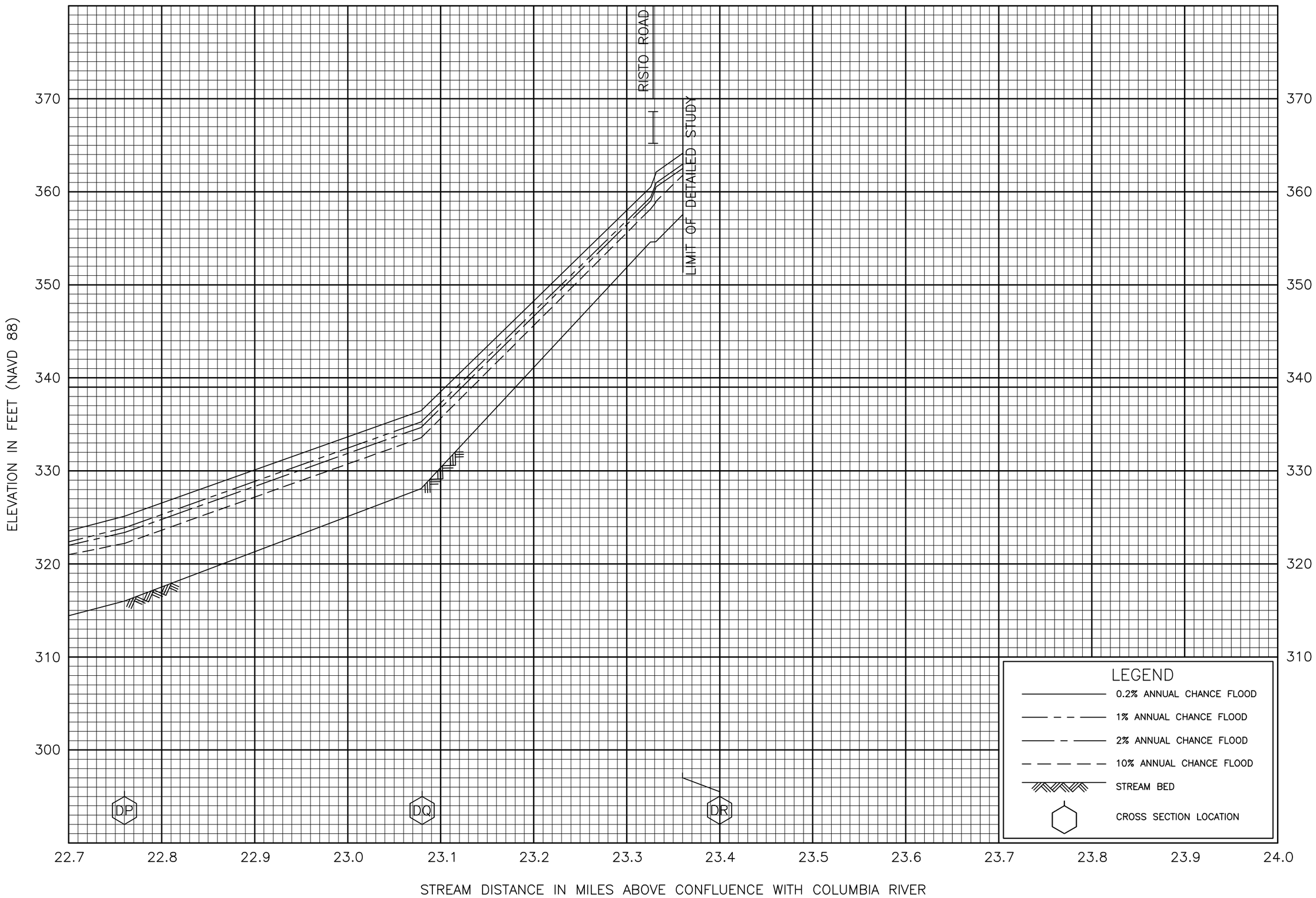
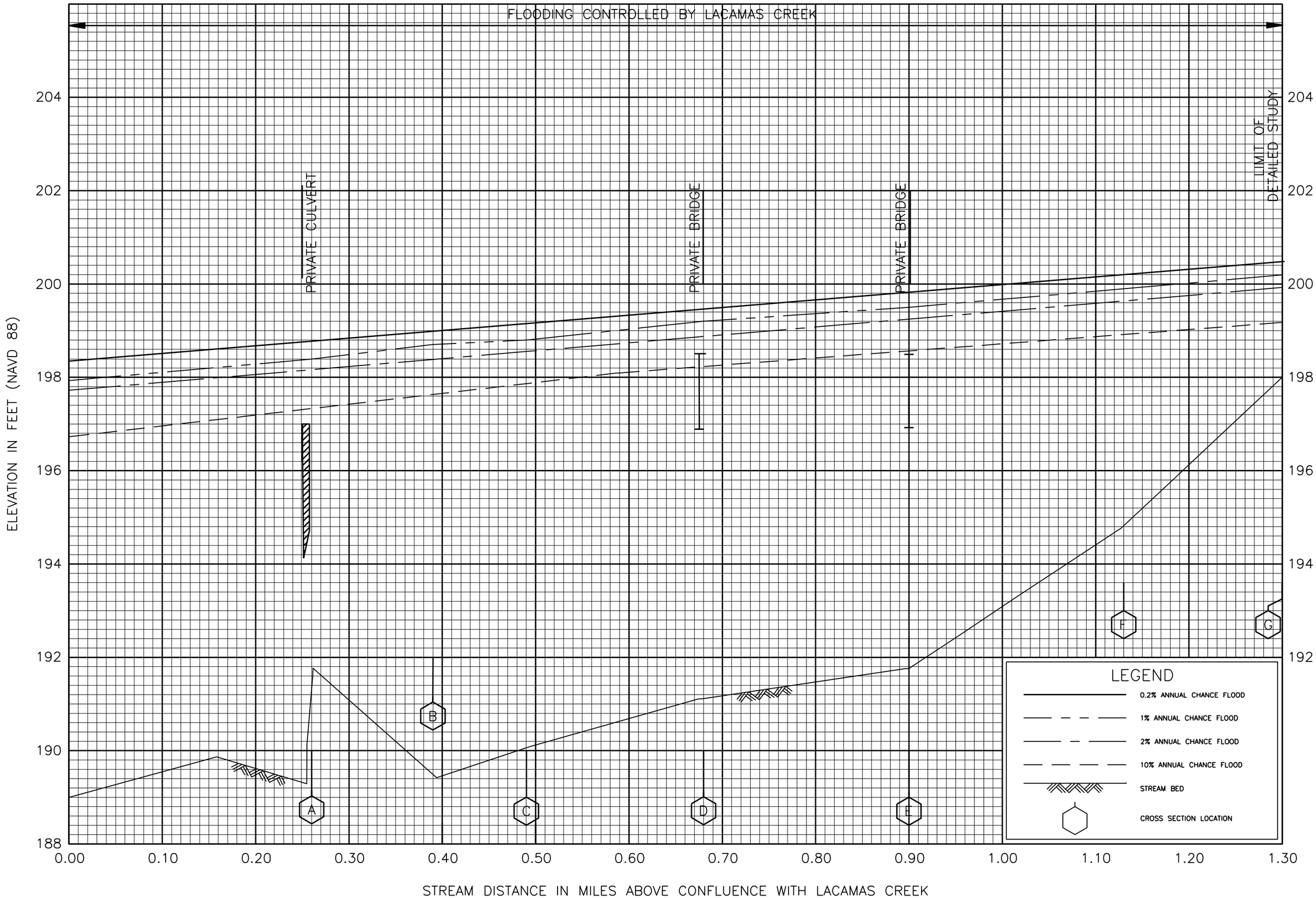


FLOOD PROFILES

SALMON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

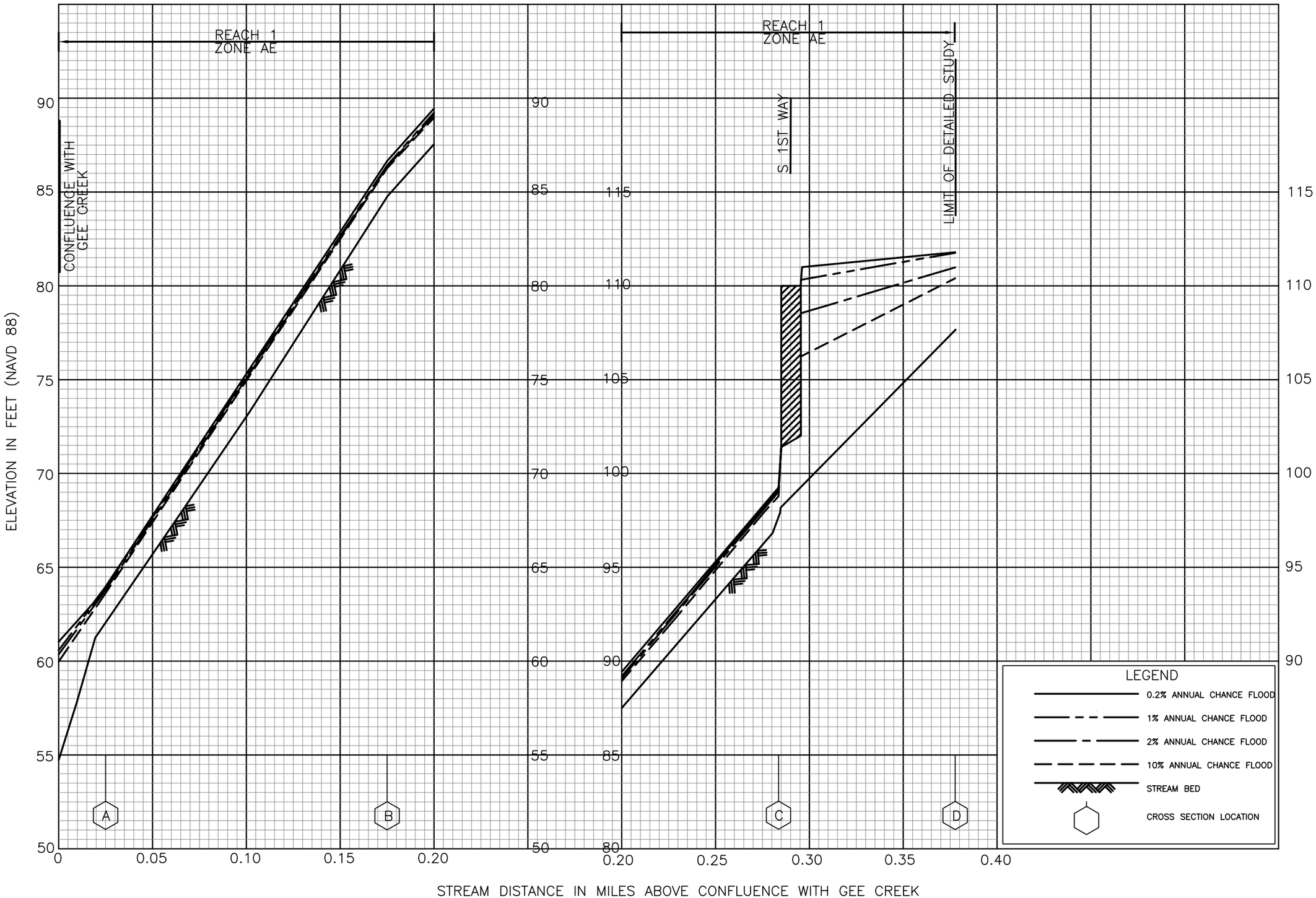


FLOOD PROFILES

SPRING BRANCH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

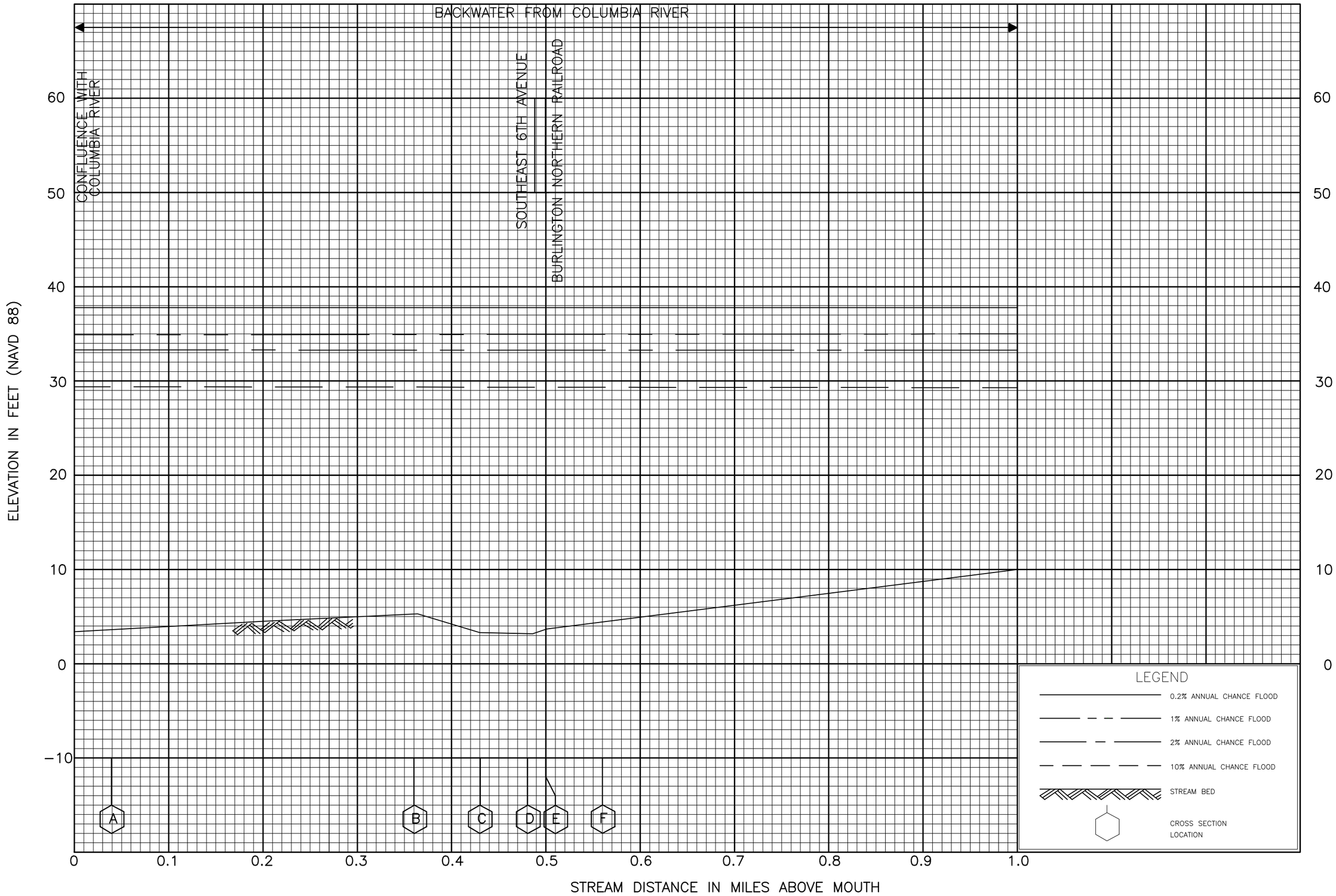


FLOOD PROFILES

UNNAMED TRIBUTARY TO GEE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

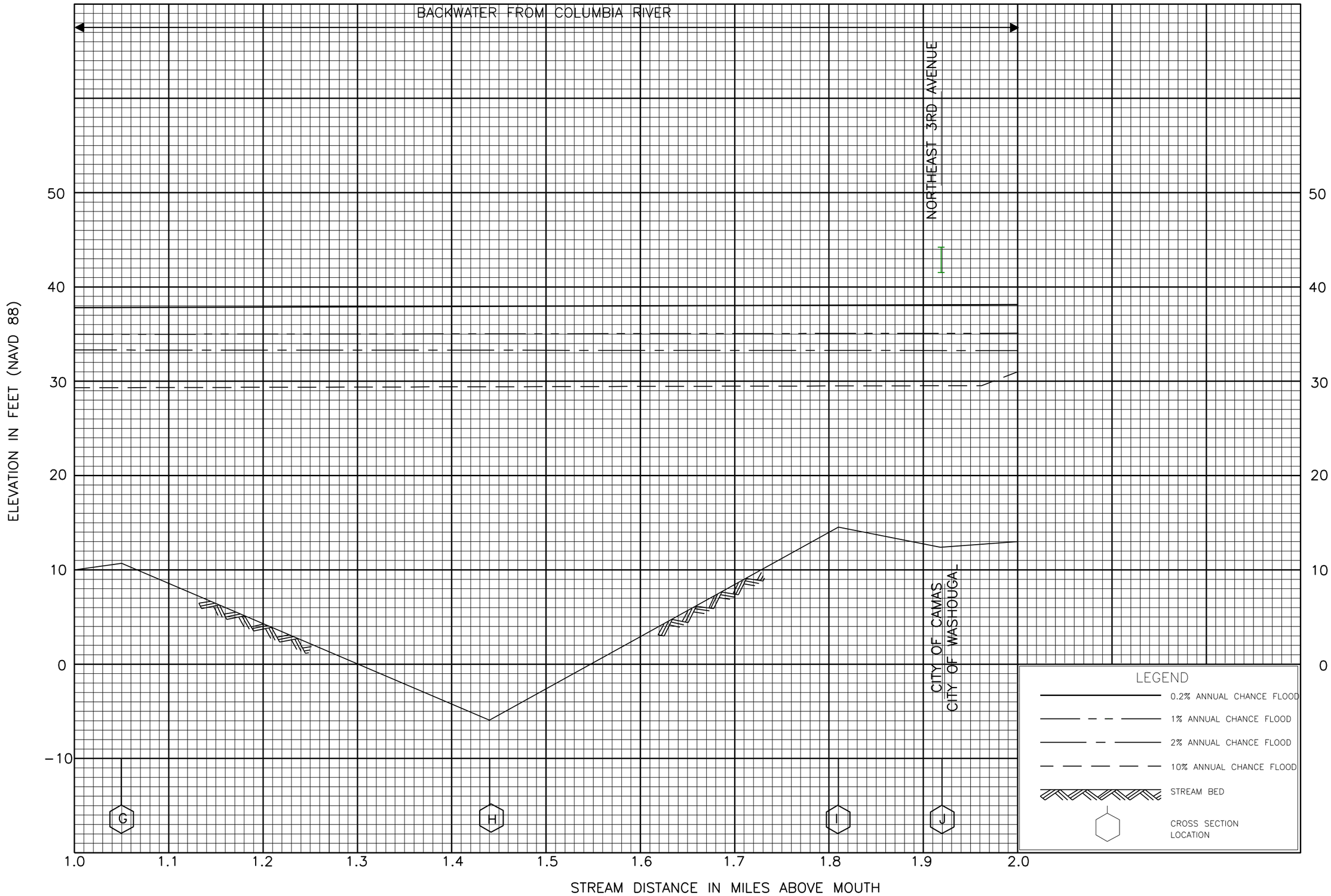


FLOOD PROFILES

WASHOUGAL RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

WASHOUGAL RIVER

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CLARK COUNTY, WA
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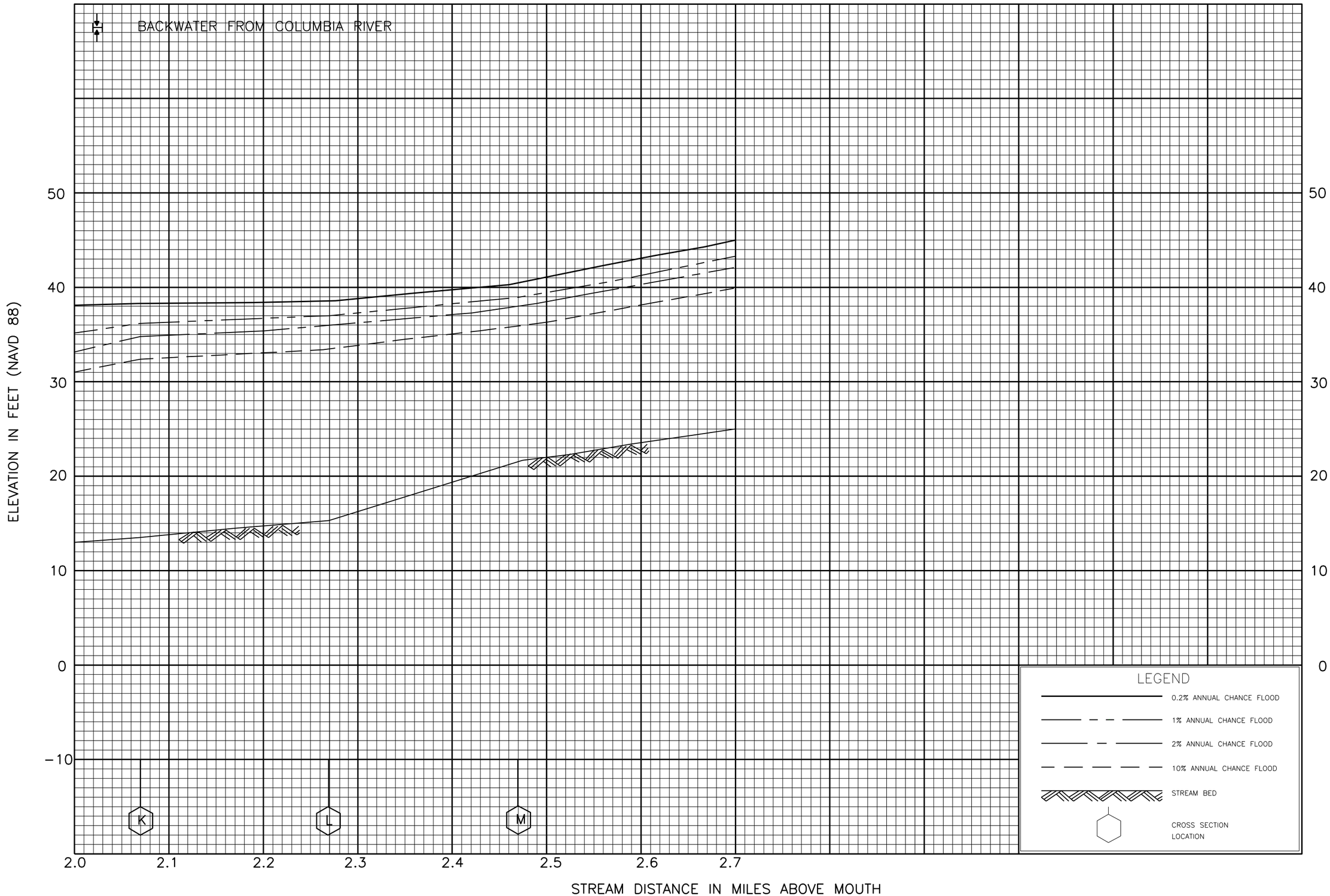

FLOOD PROFILES

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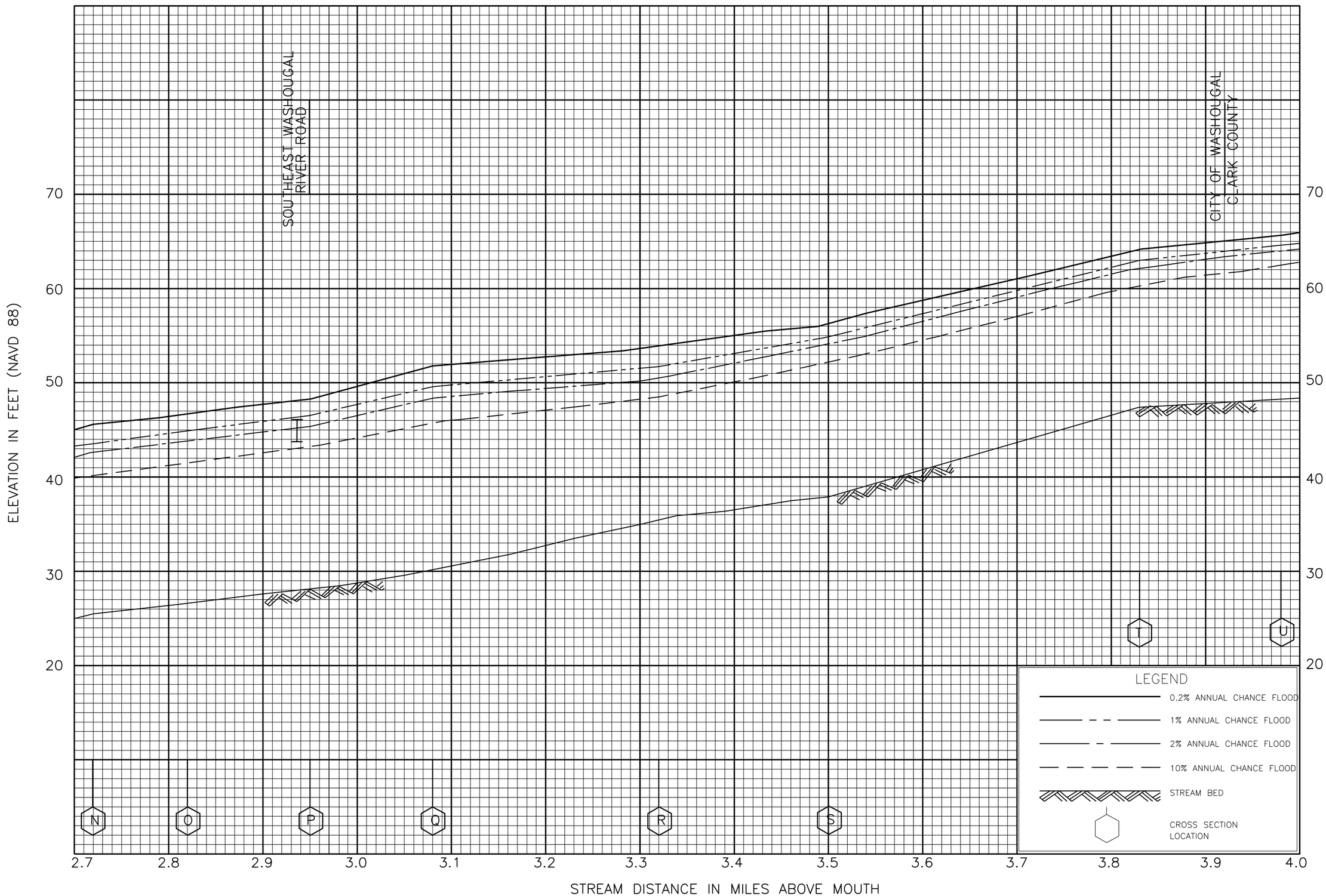

FLOOD PROFILES

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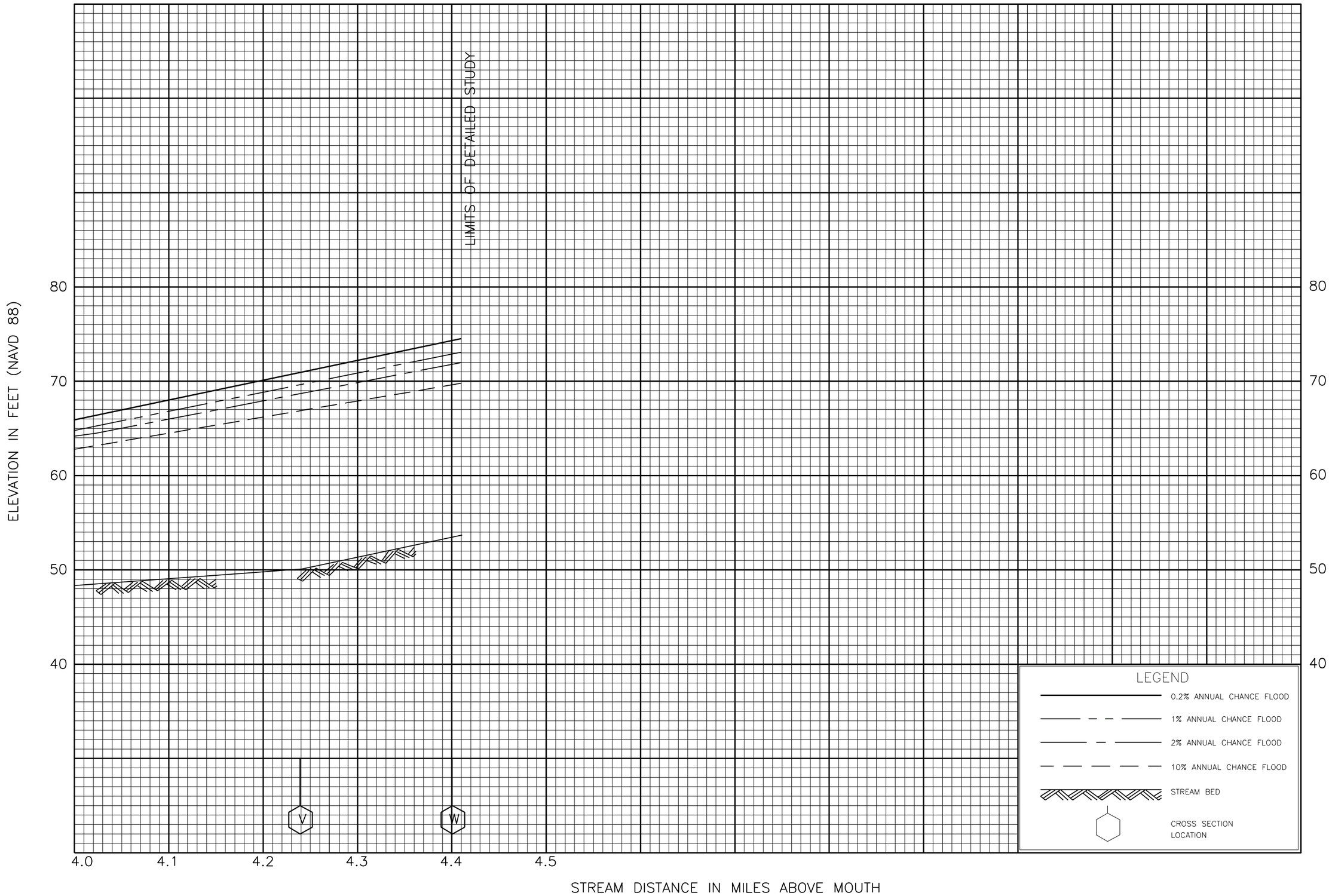

FLOOD PROFILES

WASHOUGAL RIVER

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CLARK COUNTY, WA
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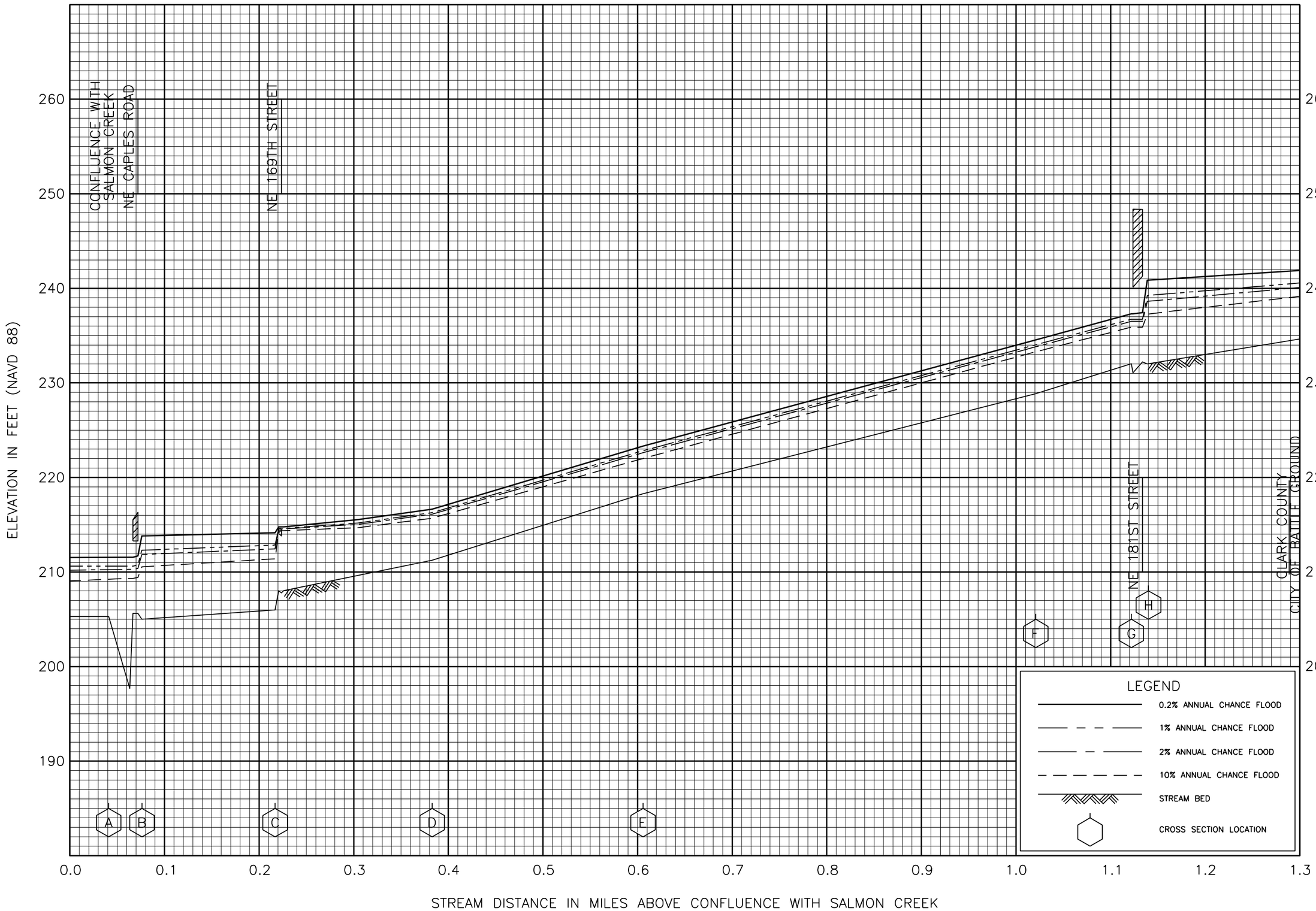
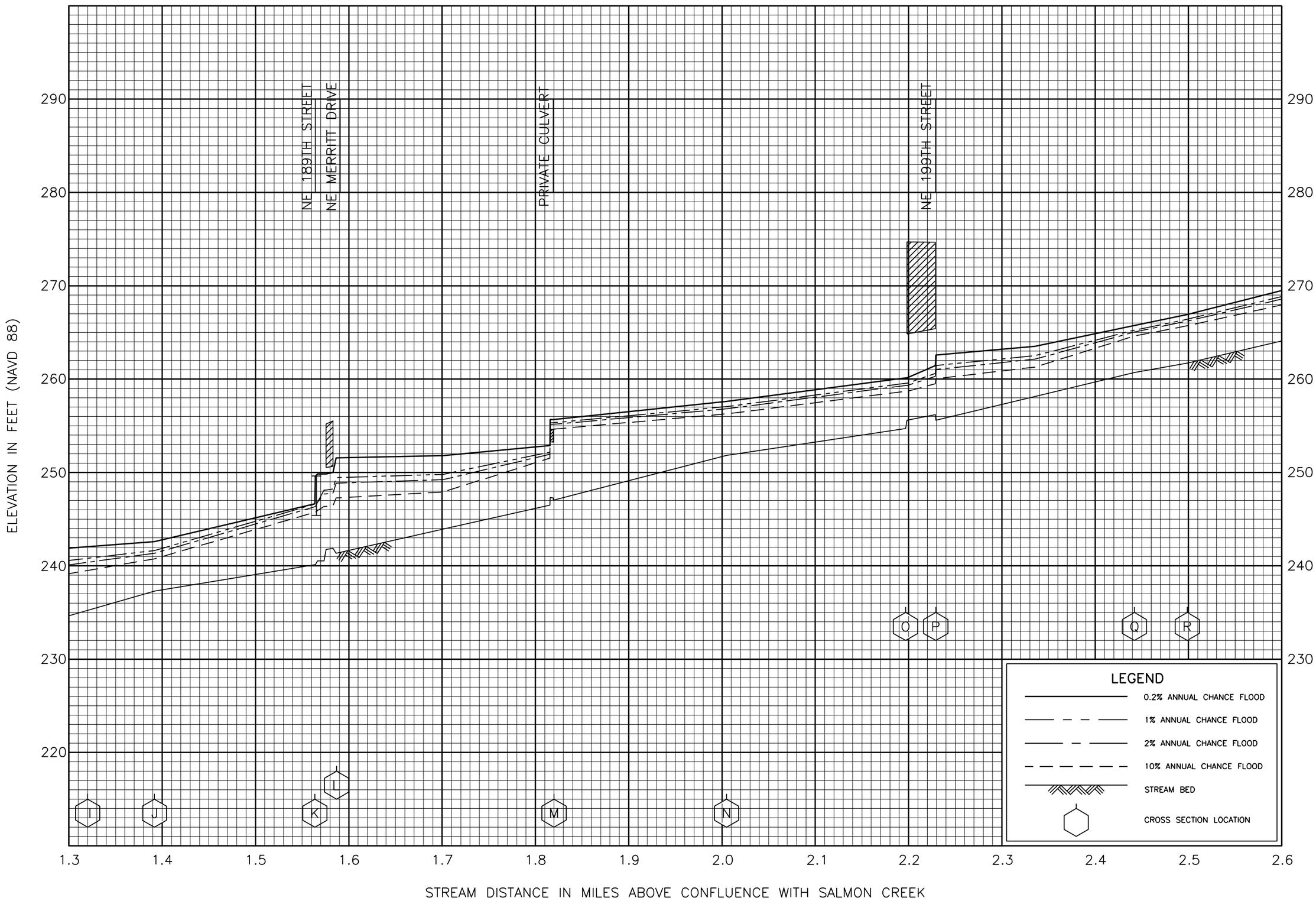


FLOOD PROFILES

WEAVER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

WEAVER CREEK

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CLARK COUNTY, WA
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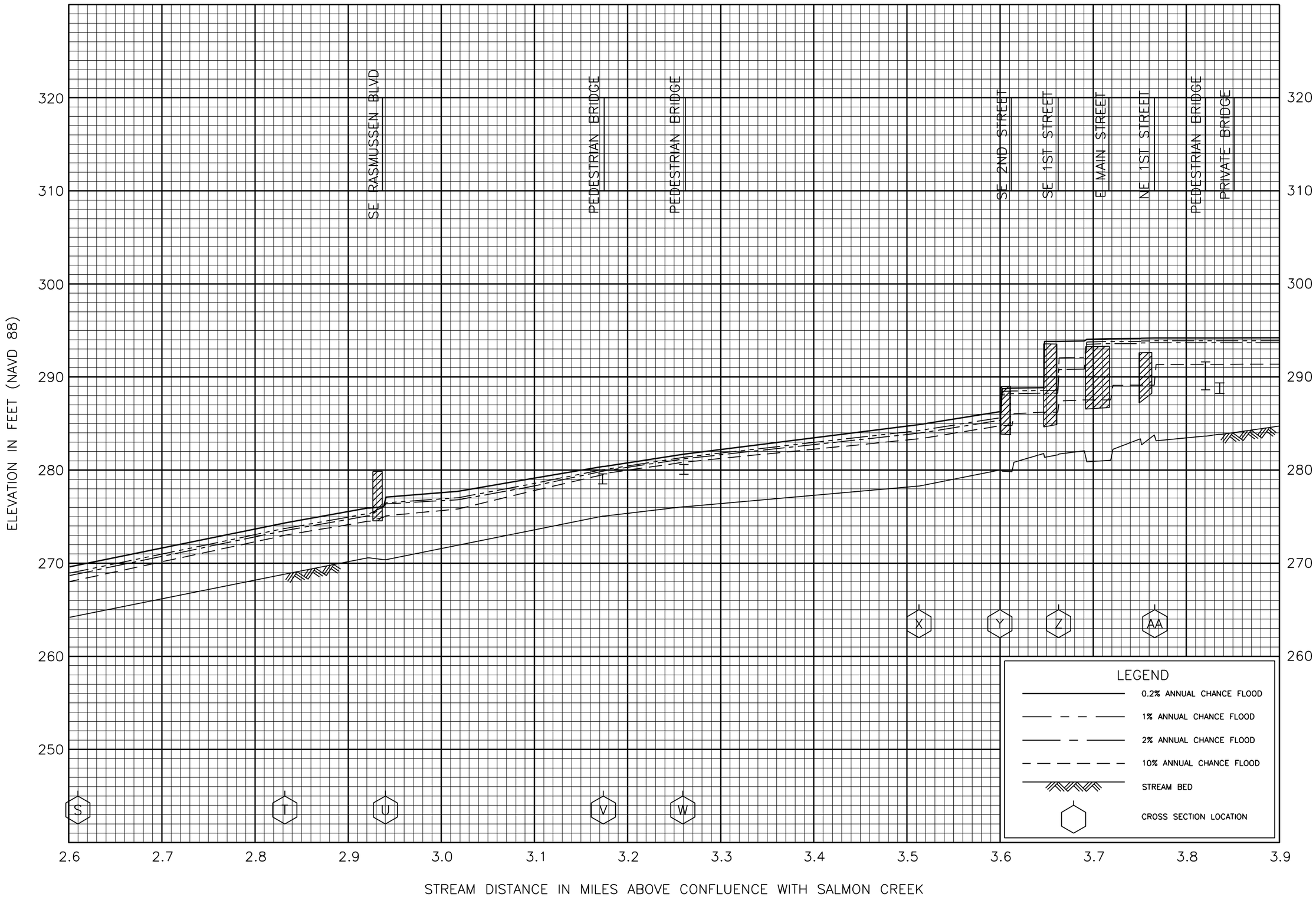

FLOOD PROFILES

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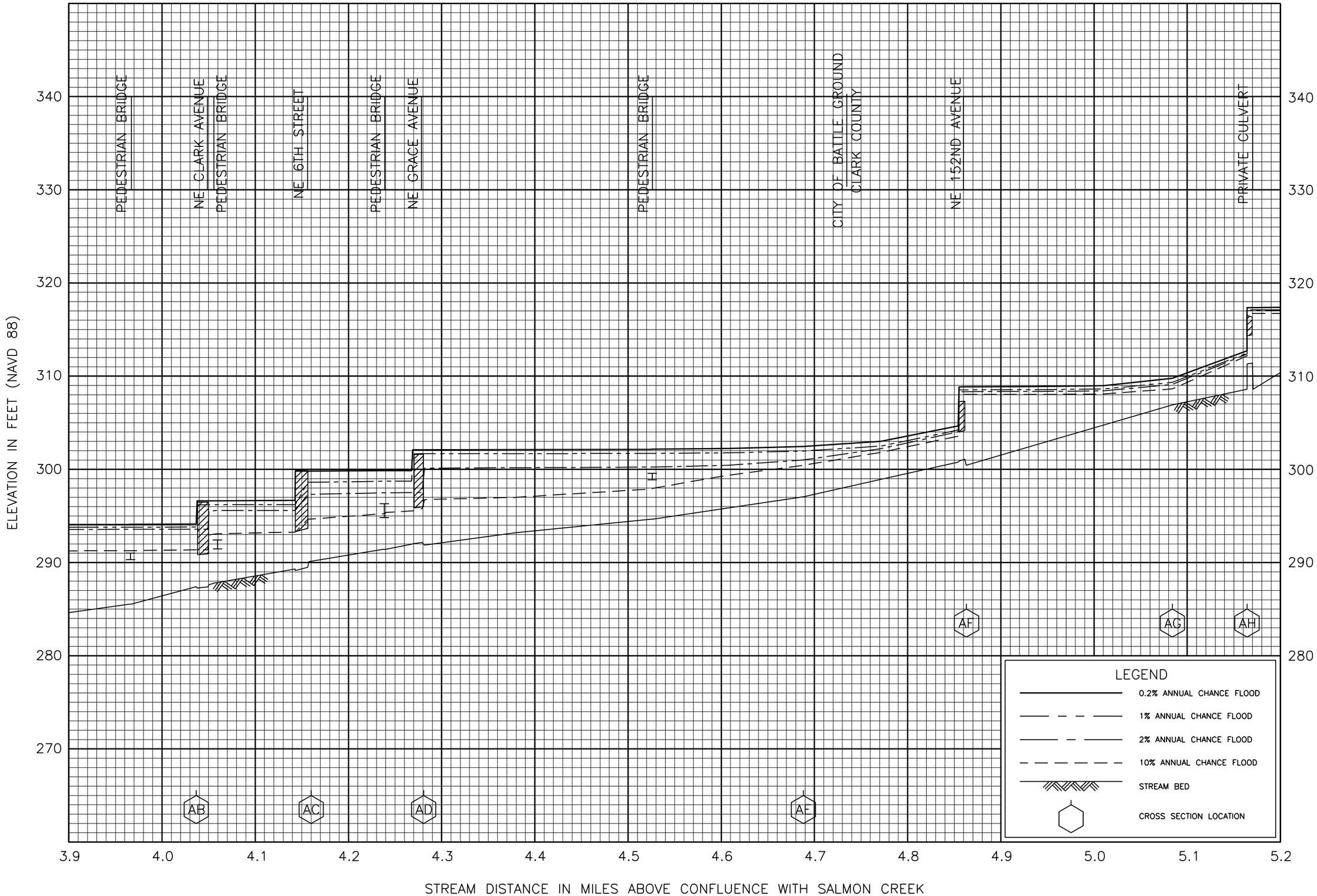

FLOOD PROFILES

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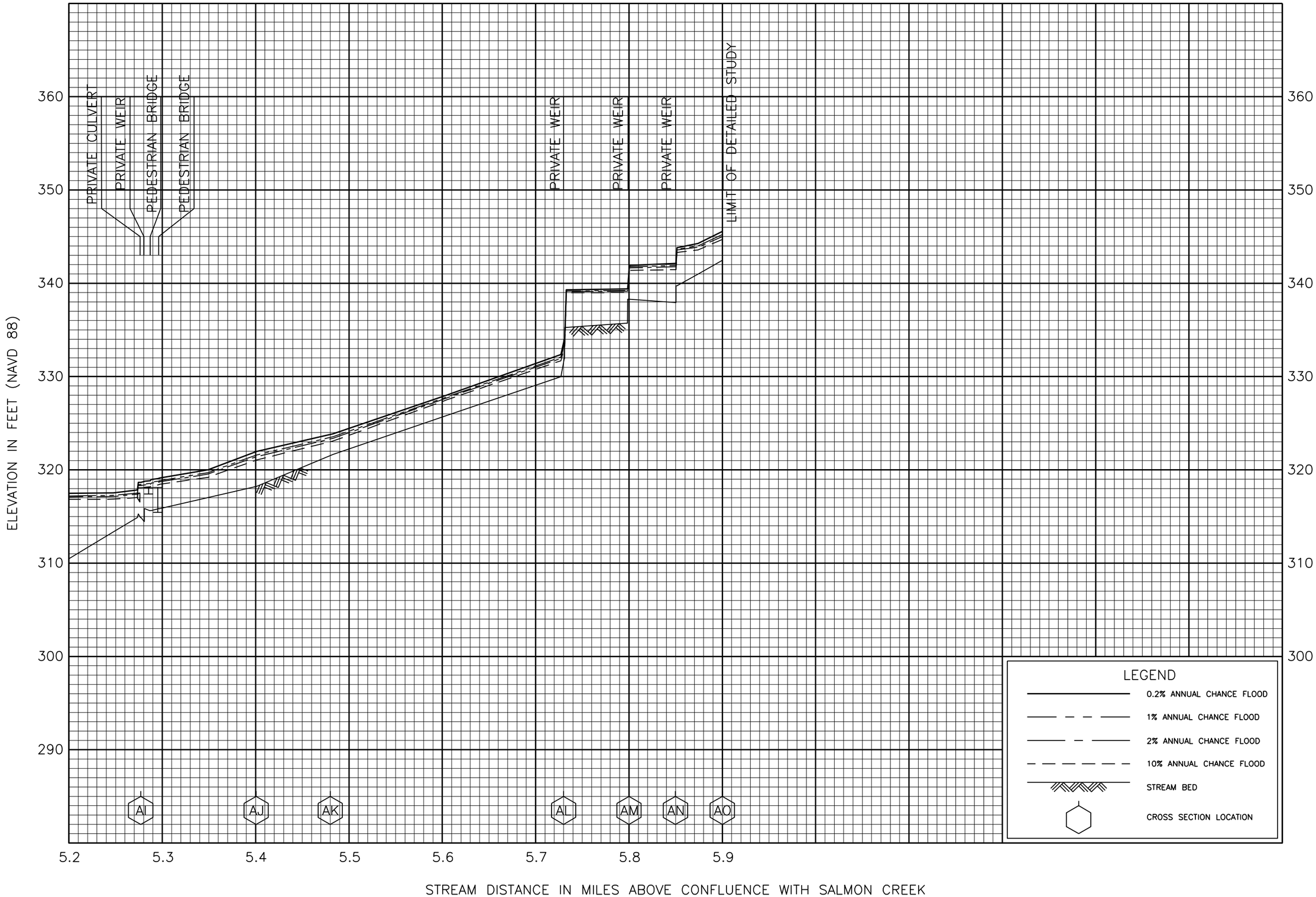

FLOOD PROFILES

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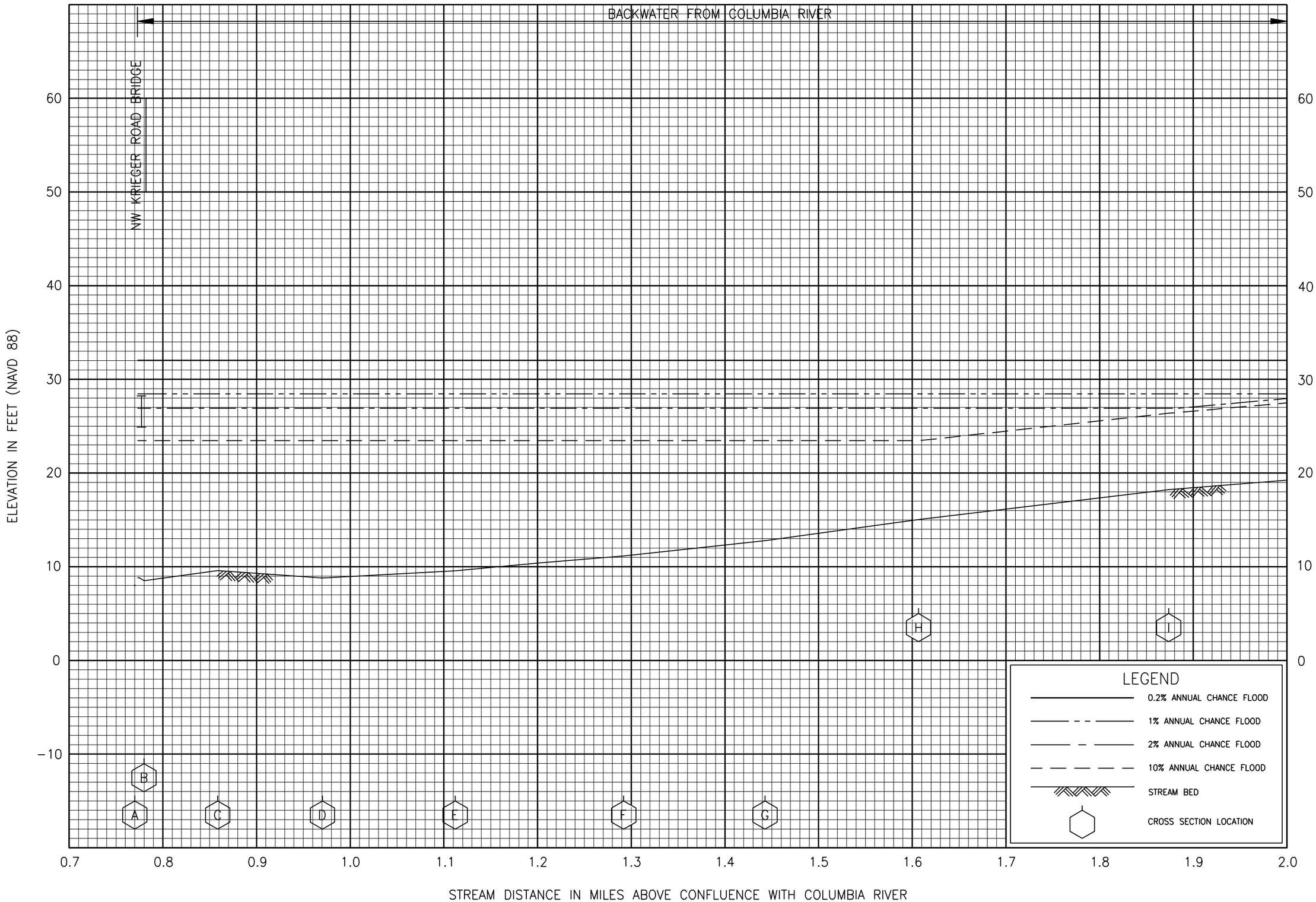


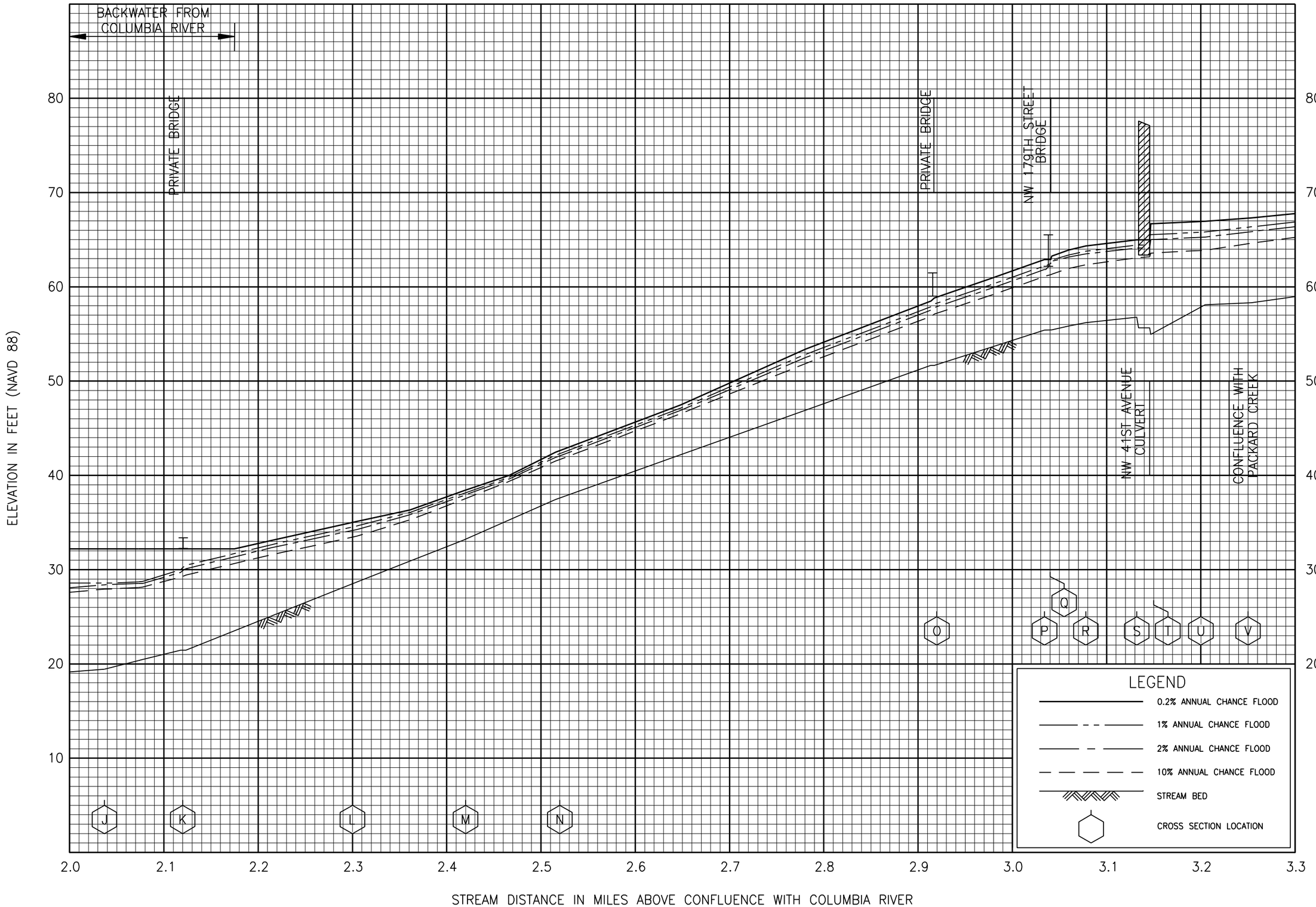
FLOOD PROFILES

WHIPPLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA

AND INCORPORATED AREAS



FLOOD PROFILES

WHIPPLE CREEK

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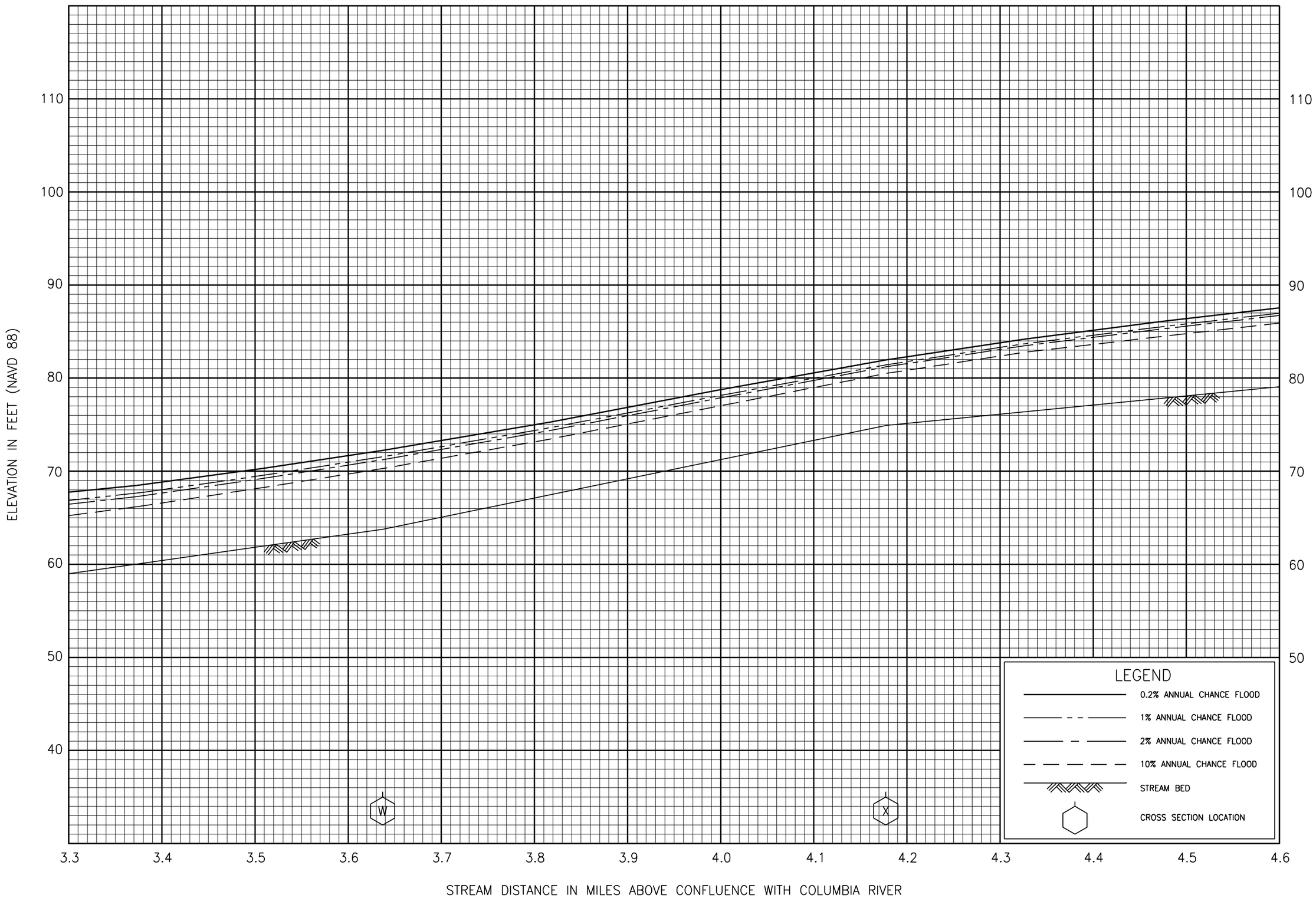
CLARK COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

WHIPPLE CREEK

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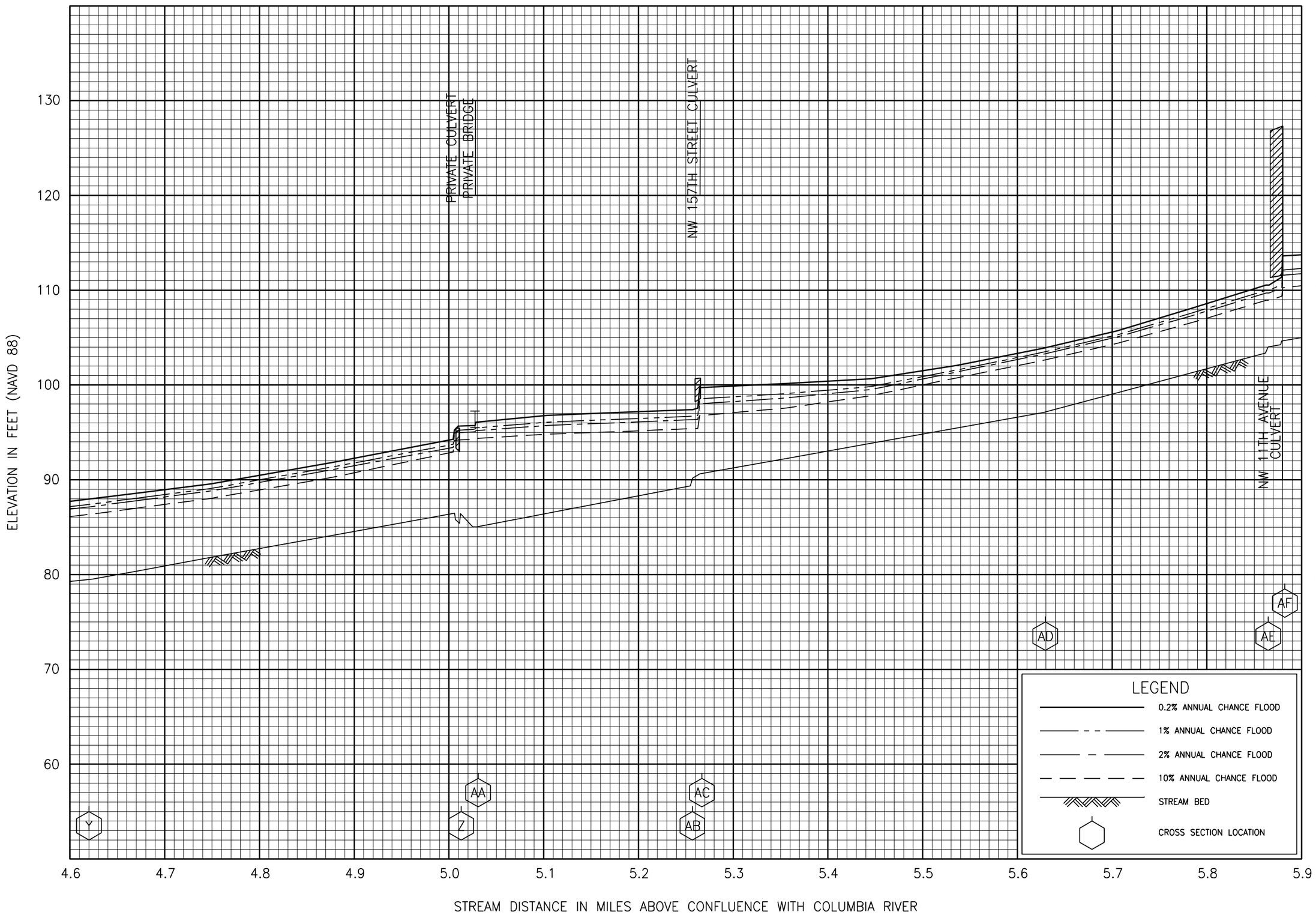

FLOOD PROFILES

WHIPPLE CREEK

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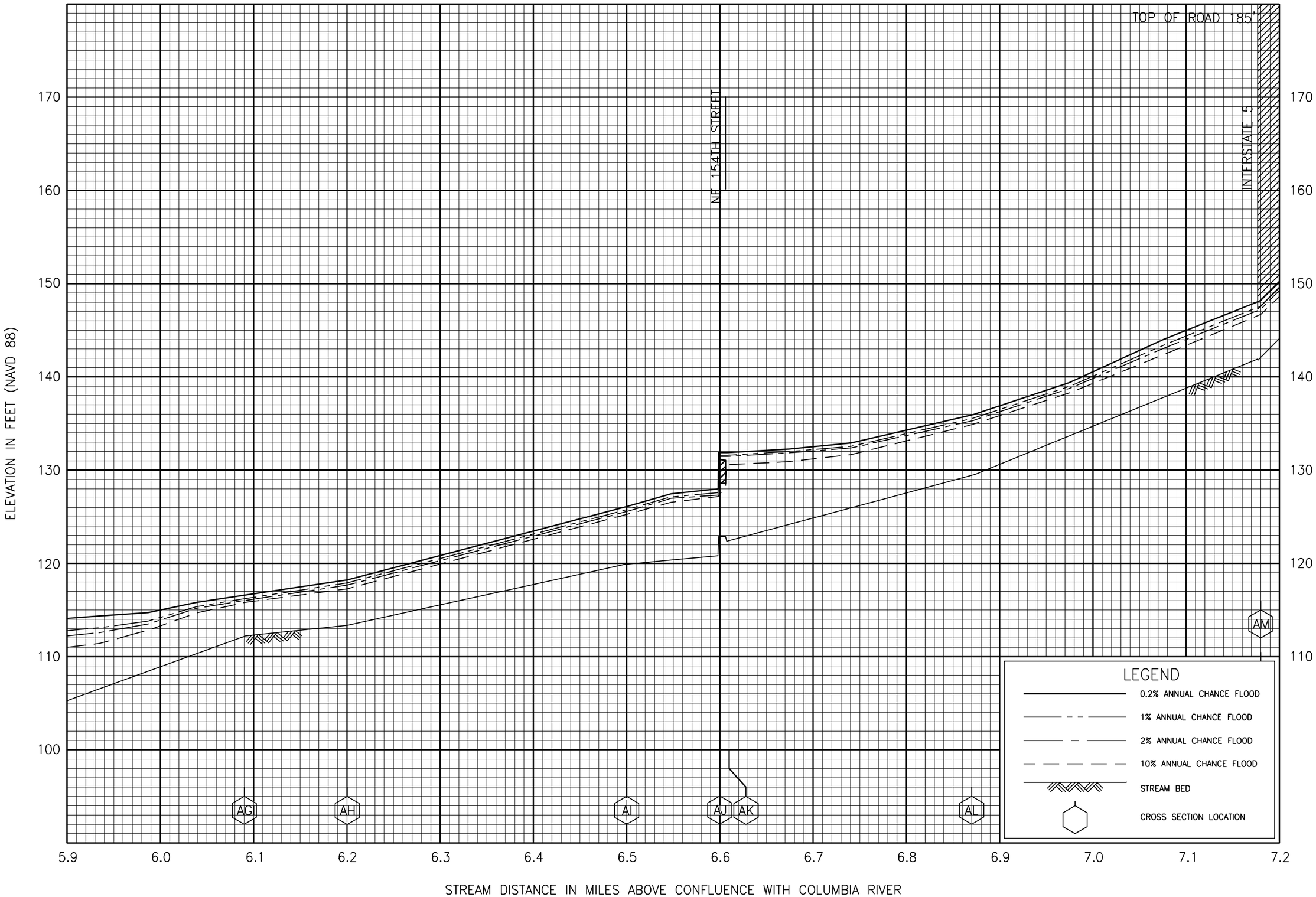

FLOOD PROFILES

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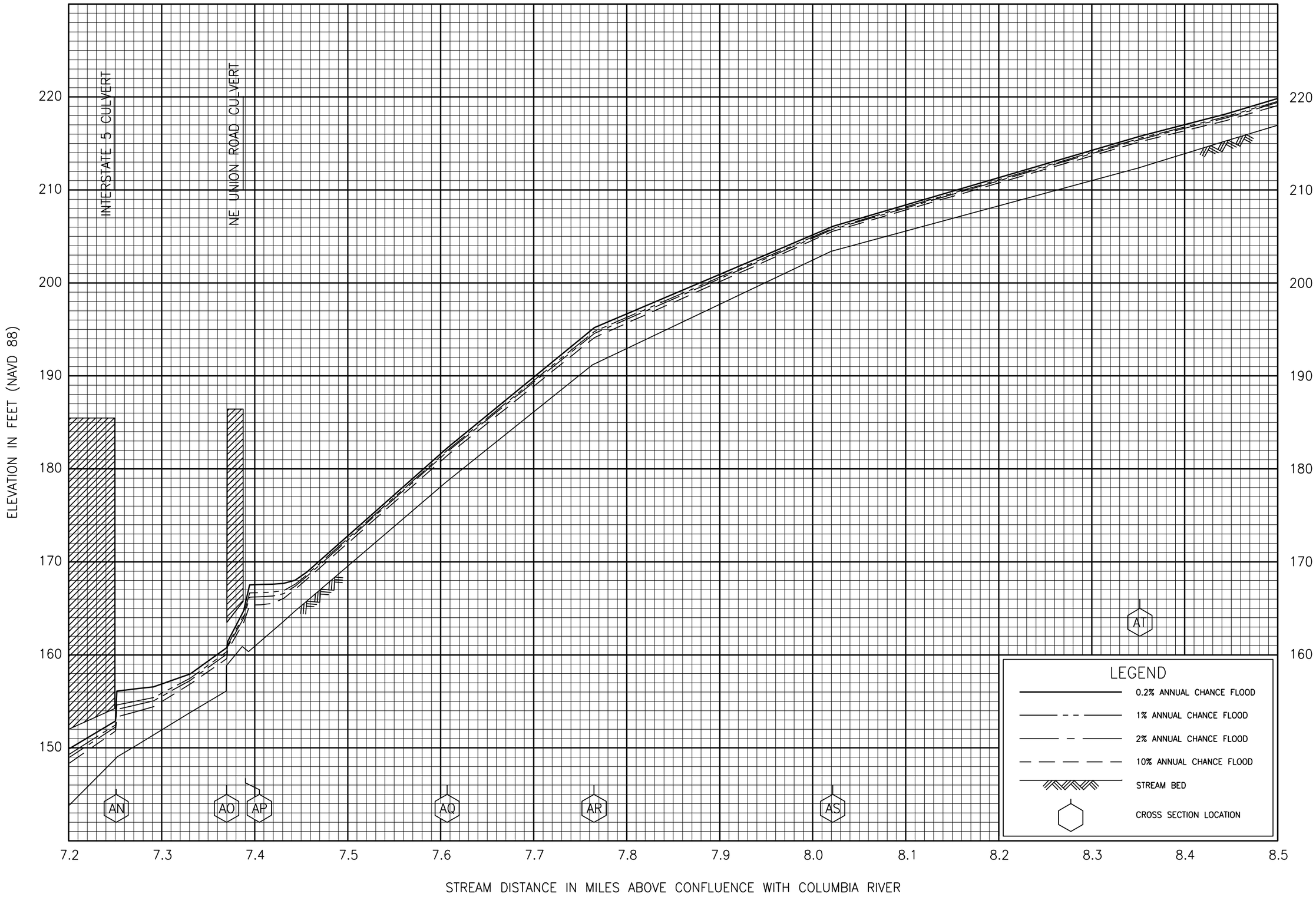

FLOOD PROFILES

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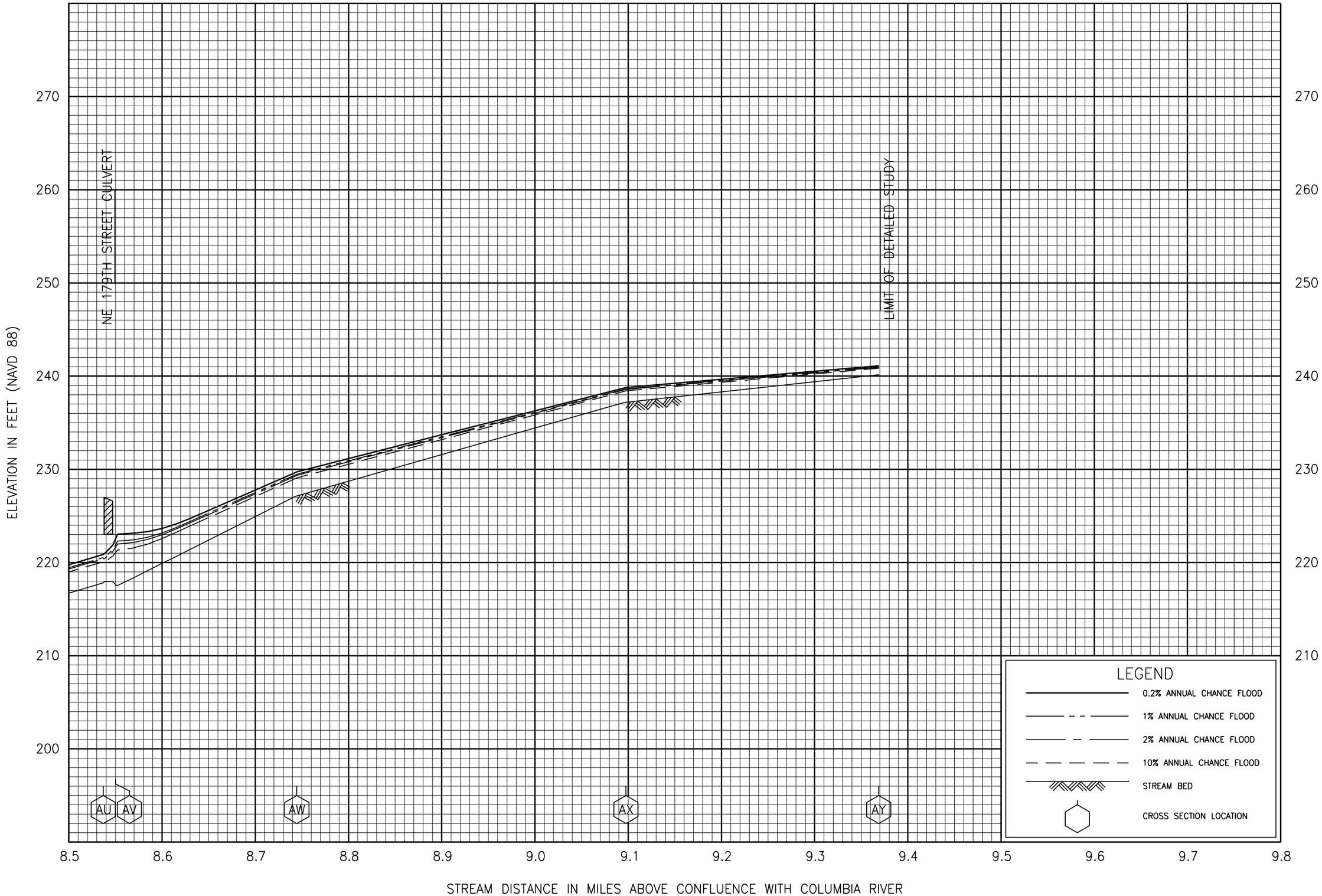

FLOOD PROFILES

WHIPPLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

FLOOD INSURANCE STUDY

VOLUME 1 OF 2

CLARK COUNTY, WASHINGTON
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
BATTLE GROUND, CITY OF	530025
CAMAS, CITY OF	530026
CLARK COUNTY	
(UNINCORPORATED AREAS)	530024
LA CENTER, CITY OF	530248
RIDGEFIELD, CITY OF	530298
VANCOUVER, CITY OF	530027
WASHOUGAL, CITY OF	530028
YACOLT, TOWN OF	530269

EFFECTIVE DATE: SEPTEMBER 5, 2012

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
53011CV001A

NOTICE TO
FLOOD INSURANCE STUDY USERS

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

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

Old Zone(s)	New Zone
Al through A30	AE
Vl through V30	VE
B	X
C	X

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.

FIS Effective Date: September 5, 2012

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Exhibit 1 - Flood Profiles

Burnt Bridge Creek	Panels 01P-12P
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Columbia River	Panels 16P-24P
Curtin Creek	Panels 25P-28P
East Fork Lewis River	Panels 29P-40P

VOLUME 2

EXHIBITS

East Fork Lewis River Lower Split	Panel 41P
East Fork Lewis River Path 2	Panel 42P
East Fork Lewis River Path 3	Panel 43P
Fifth Plain Creek	Panels 44P-47P
Gee Creek	Panels 48P-55P
Lacamas Creek	Panels 56P-65P
Lewis River	Panels 66P-80P
Mill Creek	Panels 81P-86P
Packard Creek	Panels 87P-92P
Padden Creek	Panel 93P
Salmon Creek	Panels 94P-111P
Spring Branch Creek	Panel 112P
Unnamed Tributary to Gee Creek	Panel 113P
Washougal River	Panels 114P-118P
Weaver Creek	Panels 119P-123P
Whipple Creek	Panels 124P-130P

PUBLISHED SEPARATELY:

Exhibit 2 - Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
CLARK COUNTY, WASHINGTON AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Clark County, including the Cities of Battle Ground, Camas, La Center, Ridgefield, Vancouver, and Washougal; and the Town of Yacolt; and the unincorporated areas of Clark County (referred to collectively herein as Clark County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the City of Woodland is geographically located in Cowlitz and Clark Counties. The City of Woodland is not included in this FIS report.

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

1.2 Authority and Acknowledgments

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

The original hydrologic and hydraulic analyses for Burnt Bridge Creek, the Columbia River, the East Fork Lewis River, Gee Creek, Lacamas Creek, the Lewis River, Mill Creek, Salmon Creek, an Unnamed Tributary to Gee Creek, the Washougal River, and Weaver Creek were performed by the U.S. Army Corps of Engineers (USACE), Portland District, for the Federal Emergency Management Agency (FEMA), under Interagency Agreement No. IAA-H-l0-77, Project Order No. 15; Interagency Agreement No. IAA-H-7-76, Project Order No. 1; Interagency Agreement No. IAA-H-16-75, Project Order No. 10, 16, and 19; Interagency Agreement No. IAA-H-20-74, Project Order No. 17. This work was completed in November 1979.

The hydrologic and hydraulic analyses for this study were performed by WEST Consultants Inc., for FEMA, under Contract No. EMS-2001-CO-0068. This study was completed in August 2005. Gee Creek, Lacamas Creek, Mill Creek, Salmon Creek, and Weaver Creek were restudied entirely. A Portion of Burnt Bridge Creek was restudied. China Ditch, Curtin Creek, Fifth Plain Creek, Packard Creek, Padden Creek, Spring Branch Creek, and Whipple Creek were studied by detailed methods. Little Matney Creek, Matney Creek, Morgan Creek, Mud Creek, and Shanghai Creek were studied by approximate methods.

1.3 Coordination

The initial Consultation Coordination Officer (CCO) meetings were held with representatives from FEMA, the communities, and the study contractors, to explain the nature and purpose of an FIS, and to identify the streams to be studied or restudied. All affected communities were requested to provide any data pertinent to the study. The final CCO meetings were held with representatives from FEMA, the communities, and the study contractor to review the results of the study.

The initial and final meeting dates for previous FIS reports for Clark County and its communities are listed on Table 1, "Initial and Final CCO Meeting Dates".

Table 1 – Initial and Final CCO Meeting Dates

Community	Initial CCO Date	Final CCO Date
Battle Ground, City of	November 16, 1976	March 4, 1980
Camas, City of	*	March 5, 1980
Clark County (Unincorporated Areas)	*	September 1, 1981
La Center, City of	*	September 26, 1986
Ridgefield, City of	November 16, 1976	June 10, 1980
Vancouver, City of	May 22, 1975	June 10, 1980
Washougal, City of	March 30, 1979	November 18, 1979
Yacolt, Town of	*	*

* Data not available

For this countywide study, the final CCO meeting held on September 15, 2010, and attended by representatives of FEMA, Michael Baker Jr. Inc., the WA Department of Ecology, the Port of Camas-Washougal, and the local communities of the Cities of Camas, Ridgefield, Vancouver, and Washougal; and Clark County. All problems raised at that meeting have been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

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

For this countywide FIS, the FIS report and FIRM were converted to countywide format, and the flooding information for the entire county, including both incorporated and unincorporated areas, is shown. Also, the vertical datum was converted from the National Geodetic Vertical Datum of 1929 (NGVD29) to the North American Vertical Datum of 1988 (NAVD88). In addition, the Transverse Mercator, State Plane coordinates, previously referenced to the North American Datum of 1927 (NAD27), are now referenced to the North American Datum of 1983 (NAD83).

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development.

The November 1979 study performed by USACE provided a detailed study along Burnt Bridge Creek from City of Vancouver corporate limits to approximately 0.22 mile upstream of Northeast 152nd Avenue. The Columbia River was studied by detailed method from Clark-Cowlitz County boundary to Clark-Skamania County boundary. The East Fork Lewis River was studied by detailed method from its confluence with the Lewis River to upstream of Boy Scout Camp. The Lewis River was studied by detailed method from its confluence with the Columbia River to approximately 500 feet downstream of Merwin Dam. Unnamed Tributary to Gee Creek was studied by detailed method from its confluence with Gee Creek to approximately 500 feet upstream of Northwest 54th Avenue. The Washougal River was studied by detailed method from its confluence with the Columbia River to approximately 0.86 miles upstream of City of Washougal corporate limits. In addition, approximate methods were used to continue the East Fork Lewis River and Lewis River studies to Big Tree Creek and the Clark-Skamania County boundary, respectively. Cedar Creek, Chelatchie Creek, and Unnamed Tributary to Chelatchie Creek were studied by approximate method.

The August 2005 study performed by West Consultants Inc provided new detailed information for Burnt Bridge Creek from the downstream face of the Interstate 205 culvert to approximately 1 mile upstream of Northeast 137th Avenue. Gee Creek, Lacamas Creek, Mill Creek, Salmon Creek, and Weaver Creek were restudied entirely. China Ditch, Curtin Creek, Fifth Plain Creek, Packard Creek, Padden Creek, Spring Branch Creek, and Whipple Creek were studied entirely by detail method. The study also provided approximate study for Little Matney Creek, Matney Creek, Morgan Creek, Mud Creek, and Shanghai Creek.

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

This countywide FIS incorporates the determinations of Letter of Map Revisions (LOMRs) issued by FEMA, for the projects listed by community in Table 2, "Letters of Map Change (LOMCs)".

Table 2 – Letters of Map Change (LOMCs)

Community	Case Number	Stream(s) / Project Identifier	Date Issued
Clark County (Unincorporated Areas)	94-10-039P	The 1-percent-annual-chance flood for Unnamed Tributary to Curtin Creek is contained in a channel and culvert west of Northeast Meadows Drive	June 21, 1994
Clark County (Unincorporated Areas)	04-10-0710P	Cold Creek from approximately 750 feet downstream to approximately 600 feet upstream of Northeast 58th Avenue	June 6, 2005

2.2 Community Description

Clark County is in southwestern Washington. Adjacent counties are Cowlitz on the north; Skamania on the east; and Multnomah and Columbia Counties, Oregon, on the south and west, respectively. Vancouver, the County seat, is in the southwestern corner of Clark County, and is linked to Portland, Oregon, by the Interstate Highway 5 Bridge over the Columbia River.

Clark County occupies an area of 627 square miles between the Pacific Coast Range on the west and the Cascade Range on the east. The western and southern areas are primarily agricultural lands. The eastern and northern areas of the county are steep, forested foothills and mountains of the Cascade Range. The soils of the northern and eastern areas are well drained, while those of the western and southern areas are poorly to moderately drained (Reference l). Most of the development in the county is along the Columbia River. However, there are small areas of development throughout the County. The population of the unincorporated areas of Clark County rose from 238,053 in 1990 to 345,238 in 2000 (Reference 2).

Vancouver, a fast-growing suburb of Portland, Oregon, is the largest incorporated City in Clark County, with a population of approximately 143,560 in 2000. The total population of the incorporated areas of Clark County was 178,959 in 2000 (Reference 2).

Economic activity centers on industrial products, which include, in order of amount produced, lumber, pulp, paper, aluminum, carborundum, and chemicals. Agriculture is also an important industry, the major products being dairy products, livestock, poultry, vegetables, berries, and orchard fruit. In 1970, 25 percent of the Clark County work force was employed in Oregon (Reference 3).

The Columbia River, which forms the southern and western boundaries of the county, is the major inland waterway in the northwestern United States. It drains an area of approximately 241,000 square miles of southwestern Canada and northwestern United States upstream of Vancouver, Washington.

From its source on the northwestern slopes of Mount Adams, the Lewis River flows southwesterly along the northern boundary of Clark County. It drains 1,046 square miles of rugged, heavily timbered land before joining the Columbia River near Ridgefield. The East Fork Lewis River, with headwaters in the Gifford Pinchot National Forest of Skamania County, drains 212 square miles of mountainous timber land and flows westerly before entering the Lewis River near the City of La Center.

As it flows westerly and southerly into the Columbia River at Camas, the Washougal River drains 168 square miles of steep, forested land. Salmon Creek, a tributary of the Lake River, drains 92 square miles of moderately sloping agricultural land in western Clark County.

Many of the small streams of Clark County flow southerly or westerly from sources in steep timberland, pass through lower reaches of gently sloping agricultural land or residential areas, and finally enter the Columbia River.

Clark County has a temperate marine climate typical of western Washington. Summers are dry with mild temperatures, and winters are rainy with occasional snow. At Vancouver, average annual temperatures range from a mean daily minimum of 33 degrees Fahrenheit

(°F) in January to a mean daily maximum of 80°F in July (Reference 4). Average annual precipitation varies from 39 inches at Vancouver to 75 inches at Yacolt in north central Clark County. More than 65 percent of the annual precipitation occurs from November through March (Reference 5).

2.3 Principal Flood Problems

Although many large Columbia River floods have occurred in Clark County, existing flood control storage will reduce the severity of future floods. The June 1948 and June 1956 floods were typical spring-summer floods caused by snowmelt runoff. Although less significant than the aforementioned floods, the December 1964 flood is noteworthy because it was an unusually large winter flood resulting primarily from rainfall. Peak discharges at the U.S. Geological Survey (USGS) gage at The Dalles, Oregon, for the June 1948 and June 1956 floods were 1,010,000 and 823,000 cubic feet per second (cfs), respectively. Discharges are given for The Dalles (approximately 55 miles upstream of Vancouver) rather than at Clark County because The Dalles is the first gage upstream of the mouth of the Columbia River with a reliable stage- discharge relationship. The discharge of the December 1964 flood is not comparable to the floods of 1948 and 1956 because large inflows occurred downstream of The Dalles. The estimated return periods for the 1948 and 1956 floods were 48 years and 18 years, respectively. The Columbia River floods of 1948 and 1956 caused light damage to residential areas of Clark County. Most of the damage in the unincorporated areas occurred in low lying farm and industrial areas. Emergency flood fighting measures along the Columbia River and temporary evacuation reduced damage.

The largest flood of record on the Lewis River occurred in December 1933. At the USGS gage at Ariel (station no. 14220500), the discharge was 129,000 cfs.

The historical patterns of flooding along Salmon Creek, the East Fork Lewis River, the Washougal River, Burnt Bridge Creek, and Mill Creek are similar. Overbank flooding has been minor on the upper reaches; however, near the confluence with a larger stream, backwater effects produce more frequent overbank flooding.

A combination of intense rainfall and snowmelt caused major East Fork Lewis River floods in January 1972 and December 1977. At the gage near Heisson (River Mile (RM) 20.2), the discharge for both floods was 19,200 cfs with an approximate return interval of the 1-percent-annual-chance flood. These two floods caused minor damage in Clark County.

The largest flood during the 35 years of gaging record on Salmon Creek occurred in December 1977, with a discharge of 2,600 cfs at the gage below Rock Creek at RM 22.1. January 1954 and December 1964 were also major floods on Salmon Creek, with discharges of 1,500 and 1,460 cfs, respectively. Those floods caused only minor damage.

The only major floods on Burnt Bridge Creek have been caused by Columbia River backwater. Although it is not large for the size of the area drained, the highest flow observed on Burnt Bridge Creek was 176 cfs in December 1955. Minor flood damage was observed in adjacent unincorporated areas.

The largest flood along the Washougal River, since a USGS stream gage was established in 1944, 6 miles upstream of the City of Washougal, occurred in December 1977. The flood was an extremely rare event, greater than a 0.2-percent-annual-chance flood at the gage site, and had an estimated peak discharge of 40,400 cfs at the gage. Because there was little overbank flooding and limited development outside of the Cities of Camas and

Washougal along the river, only minor damage occurred. Other large floods along the Washougal River occurred in January 1972 and December 1964, with return periods of 18 years and 9 years and peak discharges of 27,700 cfs and 25,100 cfs, respectively.

Records of past floods on the remaining flooding sources in Clark County are not well documented, but past floods have caused only minor damage.

2.4 Flood Protection Measures

The Columbia River Basin includes more than 50 storage projects with a total flood control storage volume of approximately 40 million acre-feet (Reference 6). Significant reductions in flood elevations have been achieved through the use of that flood storage. Table 3 (Reference 7) compares Columbia River flood levels at Vancouver, Washington, with and without regulation, to demonstrate the effect of existing flood control storage.

Table 3 – Comparison of Major Columbia River Floods

	June 1894	June 1948	June 1956	December 1964
Flood Crest Stages[1]				
Vancouver Gage				
Unregulated	34.4	31.0	30.0	32.5
Regulated[2]	22.3	21.5	17.0	26.7
Days Duration Above Flood Stage[3]				
Bankfull	74	51	70	9
Major Flood	38	26	12	2

[1] National Weather Service Gage heights in feet (Zero of Vancouver Gage is +5.32 feet NAVD88)
[2] Based on present level of irrigation and reservoir development
[3] Flood or bankfull stage for Columbia River is 16 feet at the Vancouver Gage.
A flood of 26 feet or higher results in extensive damage and is considered a major flood.
The duration shown is based on the unregulated flood hydrograph.

The drainage districts along the Columbia River in Clark County have levees of varying flood protection capacities. Thus, safe water levels have been established by the USACE (Reference 8). The safe water level is the highest flood elevation, considering surveillance and minor remedial work, for which reasonable assurance can be given that a levee system will not fail. The determination of the levee safe water level was based on need for freeboard, structural deficiencies observed in the field, knowledge of levee and foundation materials, and flood fighting records. Although the perimeter levee of a particular drainage district may be capable of withstanding large floods, major rainstorms could cause extensive interior ponding in low areas if runoff exceeds the capacity of the dewatering-drainage pumps.

In the vicinity of Vancouver, some protection from Columbia River flooding is provided by levees along the Lower River Road and at Fruit Valley. However, certain known deficiencies in their design and maintenance limit the degree of protection to below the

1-percent-annual-chance flood level for the Lower River Road area and below the 0.2-percent-annual-chance flood level for the Fruit Valley area.

Southwest of Ridgefield at Lake River Delta and Bachelor Island are two projects that include levees, pumping stations, tide boxes, and interior drainage canals. However, certain known deficiencies in their design and maintenance limit the degree of protection to well below 1-percent-annual-chance flood levels.

The criteria used to evaluate whether a levee provides 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.

The Washougal Area Drainage District, constructed by the USACE in 1965 and 1966, extends 5.5 miles along the Columbia River from Lawton Creek west to Camas and includes levee embankment, revetment, tide box, and freshwater inlets, and a pumping plant with interior drainage canals.

There are three major storage projects along the Lewis River that have an effect on flood peaks. All three projects, Swift Reservoir, Yale Reservoir, and Lake Merwin, are operated by PP&L. Under the present Federal Energy Regulatory Commission license, PP&L is not required to reserve storage space for flood protection.

On August 18, 1983, FEMA and PP&L agreed to make approximately 70,000 acre-feet available for flood control storage on the Lewis River System at Merwin Dam, thus reducing the 1-percent-annual-chance discharge at Woodland from 128,000 cfs to 102,000 cfs.

Clark County follows FEMA guidelines for controlling development within the floodplain. The county has established an ordinance intended to reduce future flood losses through control of buildings and other land uses within floodplains. The Flood Plain Combining Zone Ordinance establishes two new zoning classifications called the Floodway District and the Floodway Fringe District (Reference 9). Clark County requires building permits for all proposed construction and reviews those permits to assure that sites are reasonably free from flooding.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude 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-annual-chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance (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 the peak discharge frequency relationships affecting the community for each flooding source studied in detail, except the Columbia River.

The stage discharge relationship on the Columbia River is influenced by ocean tides and Willamette River backwater; thus, flood frequencies are more reliably determined for river stages than for discharges. Stage-frequency curves for seven locations on the Columbia River between RM 50 and RM 123 were developed using existing data (References 10 and 11) for fall-winter, and spring-summer flood seasons. Those locations include USGS gage No. 14144700 on the Columbia River at Vancouver, Washington (Reference 12), and USGS gage No. 1421172 on Willamette River at the Morrison Street Bridge (Reference 13). Both gages were established in 1876 (References 14 and 15).

The fall and winter curves and spring and summer curves at each location were combined by statistical methods to obtain combined stage-frequency curves. Those stage-frequency curves are the basis for the Columbia River flood profiles presented in this study.

The discharges used in floodway computations for the Columbia River were correlated, based on data at USGS gage No. 14105700 (established in 1857) at The Dalles, Washington (Reference 16), to yield water-surface profiles similar to those prepared using the combined stage-frequency curves.

The Lewis River stream gage records were statistically analyzed using the standard Log-Pearson Type III distribution, as outlined by the U.S. Water Resources Council (Reference 17). Natural and regulated discharge-frequency curves were developed for the USGS gages at Ariel and Amboy, using data from 1912 to 1978. Peak annual flows used in deriving the natural discharge-frequency curve were calculated by combining observed flows at the gage and by correlating with flow information for adjacent gaging stations in the Lewis River basin and working downstream to Merwin Dam. The regulated discharge-frequency relationship was developed by comparison of natural versus regulated discharges for six flood events in the basin. The regulated discharges for these floods were based on the PP&L plan of flood control operation, considering 70,000 acre-feet of flood control storage at Merwin Dam.

The following streams and respective periods of USGS gaging records were analyzed in the same manner as the Lewis River, the Washougal River, from 1944 to 1978; and the East Fork Lewis River, from 1929 to 1974.

Lake River and Vancouver Lake are submerged by the Columbia River during large floods; therefore, the hydrologic analysis of the Columbia River includes the Lake River and Vancouver Lake.

Stream gage records were not available for the Gee Creek basin (Gee Creek and Unnamed Tributary to Gee Creek). Rain gage recordings were used to estimate precipitation frequencies for selected recurrence intervals used in this study. The USACE HEC-l flood hydrograph computer program (Reference 18) was then used to develop peak discharges.

Burnt Bridge Creek discharge-frequency data were based on records from the USGS crest stage gage at RM 2.9 and on an analysis of rainfall and runoff characteristics of Burnt Bridge Creek basin and the general region.

A discharge-frequency curve was developed for Cedar Creek basin using 21 years of recorded data at the USGS gage on Cedar Creek near Ariel and discharges obtained using the regional method presented in Procedure for Determination of Maximum Annual Flood Peak and Volume Frequencies for Portland District (Reference 29). That report utilizes multiple regression analysis to determine discharges of an ungaged basin for selected recurrence intervals using the drainage area and normal annual precipitation. Cedar Creek basin includes Cedar Creek, Chelatchie Creek, and Unnamed Tributary to Chelatchie Creek.

Flood flow frequencies for Salmon Creek, Curtin Creek, Mill Creek, Weaver Creek and Morgan Creek were based on a statistical analysis of the results of a long-term simulation using the Hydrological Simulation Program Fortran (HSPF) computer program. The HSPF program is a continuous rainfall-runoff watershed model. Continuous simulation of multiple years to several decades allows the watershed to be evaluated under a variety of flow conditions ranging from low summer base flows to periods of winter flooding. In particular, continuous modeling allows simulation of floods in response to a wide variety of individual storm characteristics and sequence of storm events. The development of the HSPF model for the Salmon Creek watershed is documented in Hydrologic Analysis of Salmon Creek Watershed using the HSPF Model (Reference 20). The model results at various locations within the watershed were analyzed in accordance with criteria outlined in *Bulletin 17B* (Interagency Advisory Committee on Water Data, 1982). Discharge-frequency data were computed using the HEC-FFA computer program (HEC 1992) developed by the Hydrologic Engineering Center of the USACE, using a systematic record of 61 years.

A discharge-frequency curve was developed for Spring Branch Creek, Mud Creek, Whipple Creek, and China Ditch using the regional method presented in Magnitude and Frequency Flood in Washington (Reference 21). That report utilizes multiple regression analyses to determine discharges of an ungaged basin for selected recurrence intervals using drainage area and normal annual precipitation data.

The discharge-frequency data for the Little Washougal River, Fifth Plain Creek, and Lacamas Creek and Lake were also determined using the regional method described in Reference 19.

Peak discharge-drainage area relationships for the streams studied by detailed methods in Clark County are shown in Table 4, “Summary of Discharges”.

Table 4 – Summary of Discharges

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ. MILES)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
Burnt Bridge Creek					
At mouth	22.5	115	220	255	330
At USGS Gage	19.8	120	230	270	340
At N.E. 112th Avenue	5.0	55	110	135	180
China Ditch					
At mouth	8.9	495	665	740	915
Curtin Creek					
At mouth	11.0	335	460	520	670
At NE 109th Street	4.5	225	360	405	530
At NE 83rd Street	1.0	60	85	95	130
East Fork Lewis River					
At mouth	212.0	19,200	24,400	26,900	32,000
Upstream of confluence with Lockwood Creek	185.0	17,000	21,700	23,800	28,300
Approximately 17,000 feet downstream of Daybreak Road	165.0	20,650	28,630	32,200	40,900
At Daybreak Road	152.0	18,600	26,050	29,300	37,210
At Lewisville Park	150.0	15,300	19,400	21,400	25,400
Fifth Plain Creek					
At mouth	20.2	1,280	1,750	1,960	2,460
Upstream of China Ditch	9.0	650	895	1,000	1,260
Upstream of Shanghai Creek	4.6	360	495	555	700
At 119th Street	2.6	225	315	350	445
Gee Creek					
At Burlington Northern Railroad	13	850	1,010	1,080	1,260
At County Road	9	580	695	745	870
Lacamas Creek					
At Goodwin Road	52.8	4,170	5,740	6,430	8,080
At Fourth Plain Road	22.7	1,990	2,740	3,060	3,850

Table 4 – Summary of Discharges (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ. MILES)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
Lewis River					
At mouth	1046	75,000[1]	114,000[1]	132,700[1]	181,000[1]
At Woodland	820	54,400[1]	86,300[1]	102,000[1]	142,000[1]
At USGS Gage near Ariel	731	49,000[1]	79,000[1]	94,000[1]	132,000[1]
Mill Creek					
At mouth	11.5	670	985	1,140	1,570
Downstream of Unnamed Tributary (RM 0.85)	11.0	595	865	1,000	1,370
Upstream of Unnamed Tributary (RM 0.85)	9.1	510	780	915	1,300
At confluence with Unnamed Tributary (RM 3.12)	6.7	285	585	685	975
At NE 199th Street	4.8	290	415	480	655
Packard Creek					
At mouth	2.4	135	180	200	250
Upstream of Unnamed Tributary (RM 1.0)	0.6	43	58	64	79
Padden Creek					
At confluence with Curtin Creek	1.0	39	45	48	53
Downstream of NE 76th Street	0.8	21[2]	21[2]	22[2]	22[2]
At Interstate 205	0.7	43	57	64	79
Salmon Creek					
At mouth	88.0	3,230	4,460	5,020	6,490
At County Gage SMN020, Klineline Park	80.0	2,970	4,100	4,620	5,970
Below Mill Creek	72.0	2,710	3,730	4,210	5,430
Downstream of Confluence with Curtin Creek	60.0	2,330	3,250	3,700	4,860

[1] Regulated by Merwin Dam
[2] Maximum flow passing NE 76th Street Culvert. Additional flow is diverted out of the basin by NE 76th Street

Table 4 – Summary of Discharges (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ. MILES)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
Salmon Creek (Continued)					
At County Gage SMN045, NE 156th Street	45.0	1,960	2,740	3,110	4,090
Downstream of Confluence with Morgan Creek	31.0	1,290	1,920	2,240	3,140
At County Gage S-01, Battle Ground, WA	18.0	1,130	1,770	2,110	3,120
Spring Branch Creek					
At mouth	1.8	105	140	155	190
Unnamed Tributary to Gee Creek					
At mouth	1.7	85	100	105	125
Washougal River					
At mouth	168	29,800	39,000	43,000	51,900
At USGS Gage (RM 9.2)	108	21,500	28,400	31,300	38,000
Weaver Creek					
At mouth	7.1	350	495	565	755
At NE 199th Street	5.9	310	440	500	665
Upstream of Unnamed Tributary (RM 3.45)	4.4	225	330	385	535
At NE 167th Ave	1.5	85	125	150	205
Whipple Creek					
At mouth	11.1	510	685	755	925
Upstream of Unnamed Tributary (RM 1.19)	9.5	450	600	665	815
Upstream of Packard Creek (RM 2.47)	6.4	320	430	475	580
Upstream of NE 157th Ave (RM 4.53)	4.5	240	320	355	435

Table 4 – Summary of Discharges (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ. MILES)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
Whipple Creek (Continued)					
Upstream of Interstate 5 Freeway (RM 6.45)	1.9	115	150	170	210
Upstream of NE 179th Street (RM 7.74)	0.9	55	75	85	110
At mouth	168	29,800	39,000	43,000	51,900
At USGS Gage (RM 9.2)	108	21,500	28,400	31,300	38,000
Weaver Creek					
At mouth	7.1	350	495	565	755
At NE 199th Street	5.9	310	440	500	665
Upstream of Unnamed Tributary (RM 3.45)	4.4	225	330	385	535
At NE 167th Ave	1.5	85	125	150	205
Whipple Creek					
At mouth	11.1	510	685	755	925
Upstream of Unnamed Tributary (RM 1.19)	9.5	450	600	665	815
Upstream of Packard Creek (RM 2.47)	6.4	320	430	475	580
Upstream of NE 157th Ave (RM 4.53)	4.5	240	320	355	435
Upstream of Interstate 5 Freeway (RM 6.45)	1.9	115	150	170	210
Upstream of NE 179th Street (RM 7.74)	0.9	55	75	85	110

3.2 Hydraulic Analyses

Hydraulic analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding source studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shoreline. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management

purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

For the Lewis River, the East Fork Lewis River, Burnt Bridge Creek, the Washougal River, and an Unnamed Tributary to Gee Creek, water surface elevations (WSELs) of floods of the selected recurrence intervals were computed through use of the USACE HEC-2 step backwater computer program (Reference 22).

For the Columbia River, the HEC-2 program was only used for the floodway determination. Flood profiles were derived directly from the combined stage-frequency curves described in Section 3.1. The starting WSELs for the HEC-2 analyses were calculated using the slope-area method for Unnamed Tributary to Gee Creek, Burnt Bridge Creek, and the Washougal River. The Lewis River starting WSELs were selected to correspond with estimated Columbia River elevations at the time the Lewis River peaks. The East Fork Lewis River starting WSELs were based on the Lewis River elevations at their confluence.

Cross sections for the Columbia River were based on several sources of data: a USACE condition survey in June 1977 was used for the underwater portion; a USACE topographical survey of Columbia River (References 23 and 24) and USGS topographic maps (Reference 25) were used for the above-water portions.

Cross sections for original Burnt Bridge Creek study were obtained from City of Vancouver topographic maps, dated 1974 (Reference 26). The underwater sections were obtained by field measurements.

Cross sections for the backwater analysis of the Lewis River, the East Fork Lewis River, an Unnamed Tributary to Gee Creek, and Washougal River were taken from field surveys and topographic maps (Reference 27).

For Salmon Creek, Curtin Creek, Mill Creek, Weaver Creek, China Ditch, Spring Branch Creek, Whipple Creek, Gee Creek, Packard Creek, Padden Creek, Fifth Plain Creek, Lacamas Creek, and the additional study upstream of the previous study area of Burnt Bridge Creek, WSELs of floods of the selected recurrence intervals were computed through use of the HEC-RAS step-backwater computer program, Version 3.1.2 (Reference 28)

Starting WSELs for Salmon Creek, Curtin Creek, Mill Creek, Weaver Creek, China Ditch, Spring Branch Creek, Whipple Creek, Gee Creek, Packard Creek, and Fifth Plain Creek, were based on normal depth. Starting WSELs for Lacamas Creek above Lacamas Lake were based on Lacamas Lake WSELs. Starting WSELs for Burnt Bridge Creek were based on WSEL reported in the previous FIS for Clark County.

Cross sections for the backwater analyses were obtained from topographic maps compiled from aerial photographs (Reference 29), and Light Detection and Ranging (LIDAR) data (Reference 30). Below water sections were obtained by field surveys. All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the stream and floodplain areas.

Roughness factors for each stream studied in detail are listed in Table 5. Shallow flooding areas were determined using engineering judgment, aerial photographs (Reference 29), and topographic maps (Reference 25).

Table 5 – Manning's "n" Values

STREAM	CHANNEL "n"	OVERBANK "n"
Burnt Bridge Creek		
From City of Vancouver corporate limits to approximately 0.22 mile upstream of Northeast 152nd Avenue	0.024 to 0.07	0.045 to 0.12
From downstream face of I-205 culvert to approximately 1 mile upstream of Northeast 137th Avenue	0.04 to 0.050	0.050 to 0.120
China Ditch	0.035 to 0.040	0.030 to 0.060
Curtin Creek	0.038 to 0.065	0.040 to 0.100
East Fork Lewis River	0.032 to 0.070	0.020 to 0.107
Fifth Plain Creek	0.040 to 0.060	0.037 to 0.120
Gee Creek	0.045 to 0.080	0.050 to 0.120
Lacamas Creek	0.045 to 0.055	0.050 to 0.150
Lewis River	0.032 to 0.047	0.058 to 0.100
Mill Creek	0.040 to 0.080	0.035 to 0.100
Packard Creek	0.050 to 0.080	0.050 to 0.120
Padden Creek	0.040 to 0.060	0.040 to 0.070
Salmon Creek	0.040 to 0.070	0.055 to 0.150
Spring Branch Creek	0.045 to 0.060	0.050 to 0.100
Unnamed Tributary to Gee Creek	0.050	0.080 to 0.120
Washougal River	0.030 to 0.070	0.050 to 0.157
Weaver Creek	0.040 to 0.090	0.040 to 0.100
Whipple Creek	0.050 to 0.120	0.050 to 0.150

The Columbia River controls the flooding on Vancouver Lake. The Columbia River 1-percent-annual-chance flood elevation is 26.7 feet at Blue Rock Landing. The effect of increasing the elevation of the 1-percent-annual-chance flood on Vancouver Lake at this point is minimal due to a 0.5 foot head loss from Columbia River to Vancouver Lake.

Elevations for approximate 1-percent-annual-chance flood area of Little Matney Creek, Matney Creek, Morgan Creek, Mud Creek, and Shanghai Creek were developed using HEC-RAS program and information from aerial photographs and LiDAR data. (Reference 54)

Elevations for the other approximate 1-percent-annual-chance flood areas were developed using information from local residents, county officials, using LiDAR data supplied by Clark County GIS department (Reference 54), and USGS topographic maps (Reference 25). Field surveys were conducted in critical areas.

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

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

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the NGVD29. With the completion of the NAVD88, many FIS reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVD29 and NAVD88, visit the National Geodetic Survey (NGS) website at www.ngs.noaa.gov, or contact the NGS at the following address:

NGS Information Services, NOAA, N/NGS12
National Geodetic Survey SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282
Fax: (301) 713-4172, or
Telephone: (301) 713-3242

The conversion factor from NGVD29 to NAVD88 for all streams in this report except the Columbia River is +3.5 feet. The conversion for the detailed study areas of the Columbia River within Clark County is NGVD29 + 3.3 feet = NAVD88.

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the 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 1-percent-annual-chance (100-year) flood elevations and delineations of the 1- and 0.2-percent-annual-chance (500-year) floodplain boundaries and 1-

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

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps with a contour interval of 2 feet (Reference 31).

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

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

Approximate 1-percent-annual-chance floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map for City of Camas, City of Vancouver, City of Washougal, Towns of Battle Ground, Town of La Center, Town of Ridgefield, Town of Yacolt; and Clark County (References 32-50).

Base map information shown on this FIRM was provided in digital format by the USGS and dated July 15, 1990, or later. Non-revised floodplains were reviewed for accuracy in relation to this new base and re-fit where appropriate. In accordance with FEMA Memo 36, profile baselines have been put into all areas of detailed study. Profile baselines are shown in the location of the original work without regard to the redelineation or floodplain adjustment to the new base map. This is to maintain the relationship to the hydraulic models, floodway data tables, and profiles.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the

1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

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

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

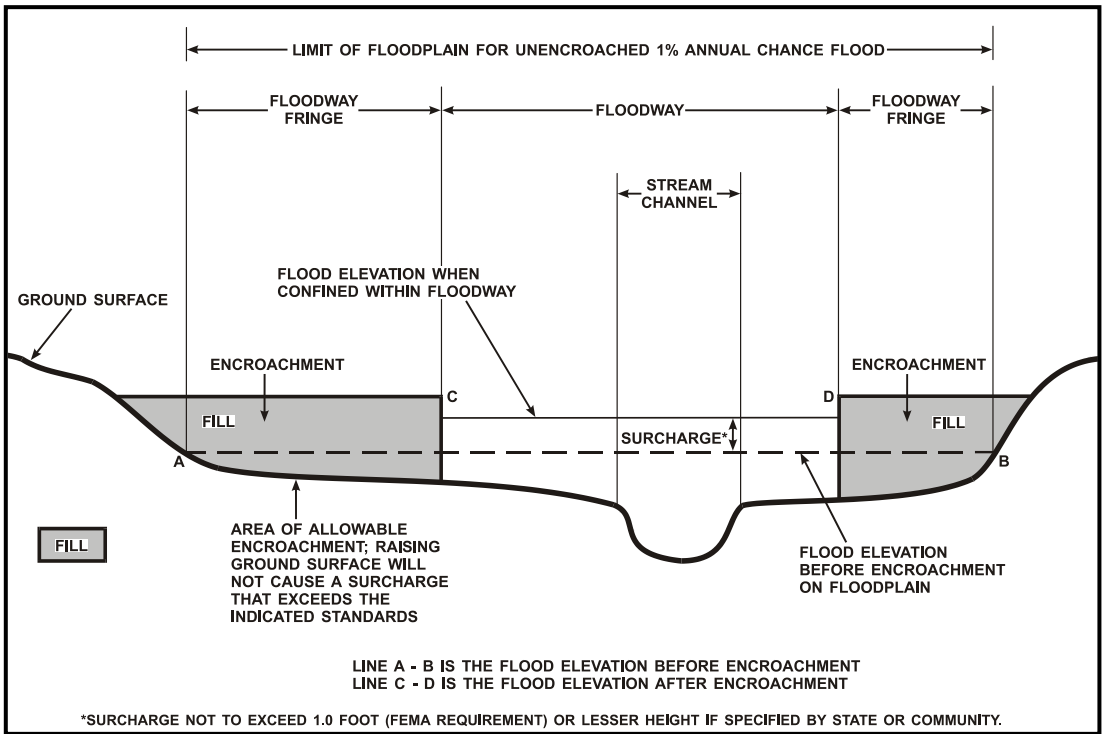

Figure 1 – Floodway Schematic

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
BURNT BRIDGE CREEK								
A	0.02	8	47	5.4	29.5	17.3[2]	18.3[2]	1.0
B	0.07	6	51	5.0	29.5	18.3[2]	19.2[2]	0.9
C	0.12	200	1,912	0.1	29.5	253.5	19.8[2]	0.8
D	0.78	150	323	0.8	29.5	19.0[2]	19.8[2]	0.8
E	1.54	35	162	1.6	39.4	39.4	39.4	0.0
F	1.67	43	211	1.2	44.8	44.8	44.8	0.0
G	1.73	26	200	1.3	48.0	48.0	48.0	0.0
H	1.78	20	138	1.8	48.2	48.2	48.2	0.0
I	1.97	25	177	1.4	50.8	50.8	50.9	0.1
J	2.43	44	215	1.2	59.0	59.0	59.3	0.3
K	2.58	59	192	1.3	60.8	60.8	60.8	0.0
L	2.68	28	70	3.7	61.7	61.7	61.7	0.0
M	2.88	38	78	3.3	65.5	65.5	65.5	0.0
N	2.92	19	163	1.7	75.1	75.1	75.1	0.0
O	3.47	22	71	3.8	78.9	78.9	78.9	0.0
P	4.06	21	48	5.6	92.6	92.6	92.9	0.3
Q	4.43	43	176	1.5	100.6	100.6	100.6	0.0
R	4.83	19	35	7.7	107.7	107.7	107.7	0.0
S	5.55	35	69	3.9	136.7	136.7	136.7	0.0
T	5.81	37	260	1.0	159.2	159.2	159.2	0.0
U	6.11	20	87	3.1	167.8	167.8	167.8	0.0
V	6.18	33	175	1.5	168.0	168.0	168.1	0.1
W	6.31	43	225	1.2	168.2	168.2	168.4	0.2
X	6.60	23	129	2.1	168.7	168.7	168.9	0.2
Y	6.85	50	203	1.3	168.8	168.8	169.2	0.4
Z	7.12	50	227	1.2	168.8	168.8	169.6	0.8

(1)Stream distance in miles above mouth

(2)Elevations computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

BURNT BRIDGE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
BURNT BRIDGE CREEK								
AA	7.37	40	193	1.6	169.2	169.2	170.0	0.8
AB	7.82	177	711	0.4	169.6	169.6	170.6	1.0
AC	8.35	18	28	7.1	172.7	172.7	172.7	0.0
AD	8.47	86	202	1.0	175.6	175.6	175.9	0.3
AE	8.90	40	130	1.0	180.6	180.6	180.7	0.1
AF	9.29	40	94	1.3	185.4	185.4	185.4	0.0
AG	9.36	27	35	2.7	185.9	185.9	186.2	0.3
AH	9.42	31	74	1.3	188.0	188.0	188.0	0.0
AI	9.71	19	109	1.2	192.0	192.0	193.0	1.0
AJ	9.86	54	106	1.4	192.3	192.3	193.2	0.9
AK	10.10	37	103	1.4	194.1	194.1	194.4	0.3
AL	10.40	22	69	1.8	195.1	195.1	195.2	0.1
AM	10.43	19	106	1.2	196.8	196.8	196.9	0.1
AN	10.87	22	32	2.6	197.1	197.1	197.2	0.1
AO	10.89	14	40	2.1	198.0	198.0	198.1	0.1
AP	11.01	16	90	0.9	198.2	198.2	198.4	0.2
AQ	11.46	31	111	0.9	198.2	198.2	198.4	0.2
AR	11.75	68	62	0.9	198.2	198.2	198.5	0.3
AS	12.30	100	80	1.1	198.9	198.9	199.2	0.3
AT	12.54	83	95	0.8	199.3	199.3	199.7	0.4
AU	12.78	55	64	1.0	199.6	199.6	199.9	0.4

(1) Stream distance in miles above mouth

(2) Elevations computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

BURNT BRIDGE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
CHINA DITCH								
A	0.01	74	390	1.9	251.8	251.8	252.8	1.0
B	0.13	51	275	2.7	252.1	252.1	253.0	0.9
C	0.39	45	221	3.3	253.3	253.3	253.8	0.5
D	0.63	49	228	3.1	254.7	254.7	254.9	0.2
E	0.75	41	184	3.5	255.3	255.3	255.5	0.2
F	0.94	36	148	2.3	256.3	256.3	256.4	0.1
G	1.14	35	92	3.4	257.1	257.1	257.1	0.0
H	1.41	31	99	2.8	258.6	258.6	258.6	0.0
I	1.75	22	71	3.2	260.9	260.9	260.9	0.0
J	1.96	18	27	3.4	264.0	264.0	264.0	0.0
K	2.20	14	36	1.9	269.6	269.6	269.6	0.0
L	2.42	13	18	2.6	271.3	271.3	271.3	0.0
M	2.65	19	17	1.5	274.7	274.7	274.7	0.0
N	2.73	20	17	1.2	275.2	275.2	275.2	0.0
O	2.82	17	23	0.6	275.3	275.3	275.3	0.0

(1) Stream distance in miles above confluence with Fifth Plain Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

CHINA DITCH

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
COLUMBIA RIVER								
A	87.29	4,700 / 2,392[2]	158,438	4.7	26.4	26.4	27.4	1.0
B	88.75	3,800 / 2,254[2]	148,987	5.0	26.9	26.9	27.9	1.0
C	89.43	3,500 / 2,480[2]	159,074	4.7	27.1	27.1	28.1	1.0
D	90.23	3,930 / 3,032[2]	167,183	4.4	27.3	27.3	28.3	1.0
E	91.01	4,800 / 2,661[2]	169,233	4.4	27.5	27.5	28.5	1.0
F	91.77	4,570 / 2,580[2]	177,151	4.2	27.8	27.8	28.8	1.0
G	92.34	3,089 /1,633[2]	155,478	4.8	27.8	27.8	28.8	1.0
H	93.00	2,880 / 1,598[2]	159,220	4.7	28.0	28.0	29.0	1.0
I	94.00	3,050 / 876[2]	141,666	5.3	28.1	28.1	29.1	1.0
J	95.00	2,650 / 869[2]	141,851	5.3	28.5	28.5	29.5	1.0
K	96.00	3,300 / 1,966[2]	157,503	4.8	28.8	28.8	29.8	1.0
L	96.49	3,550 / 2,270[2]	165,476	4.6	28.8	28.9	29.8	0.9
M	98.43	3,950 / 2,815[2]	159,986	4.8	29.3	29.5	30.3	0.8
N	99.28	2,959 / 1,860[2]	140,334	5.4	29.6	29.8	30.5	0.7
O	100.43	3,521 / 2,081[2]	168,626	4.5	29.8	30.3	31.0	0.7
P	101.20	3,363 / 2,225[2]	195,911	3.9	30.0	30.6	31.2	0.6
Q	102.18	3,233 / 526[2]	222,371	2.5	30.2	30.9	31.5	0.6
R	104.43	3,360 / 2,520 / /871[3]	184,160	3.1	30.8	31.1	31.8	0.7
S	105.63	3,423 / 2,320 / 1,060[3]	164,080	3.4	31.2	31.3	32.3	1.0
T	106.42	3,285 / 2,680 / 1,139[3]	147,140	3.8	31.4	31.4	32.4	1.0
U	107.39	4,594 / 3,840 / 1,128[3]	189,800	3.0	31.7	31.7	32.7	1.0
V	109.49	4,960 /1,321[2]	204,990	2.8	32.1	31.9	32.9	1.0
W	110.17	4,000 / 1,129[2]	161,600	3.5	32.2	32.0	32.9	0.9
X	111.15	4,619 / 1,289[2]	185,625	3.0	32.5	32.2	33.1	0.9
Y	112.93	7,245 / 738[2]	191,008	3.0	32.8	32.5	33.4	0.9
Z	115.02	4,292 / 602[2]	161,790	3.5	33.4	33.0	33.9	0.9

(1)Stream distance in miles above mouth

(2)Width/width within county limits

(3)Width excluding island/right channel width looking downstream/width of right channel within corporate limits

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

COLUMBIA RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
COLUMBIA RIVER								
AA	116.10	4,773 / 1,206[2]	178,406	3.2	33.7	33.2	34.1	0.9
AB	118.06	6,731 / 3,745[2]	210,779	2.7	34.2	33.6	34.4	0.8
AC	119.88	2,280 / 1,367[2]	127,035	4.4	34.6	33.9	35.0	0.9
AD	121.37	4,250 / 1,101[2]	157,277	3.6	34.9	34.3	35.1	0.8
AE	122.86	5,500 / 1,856[2]	189,310	2.9	35.1	34.7	35.5	0.8
AF	123.43	5,700 / 2,039[2]	197,499	2.8	35.3	34.8	35.7	0.9
AG	123.98	5,800 / 2,475[2]	206,916	2.7	35.4	34.8	35.7	0.9
AH	125.53	6,950 / 4,728[2]	198,505	2.8	35.6	35.1	36.0	0.9
AI	126.58	5,900 / 5,498[2]	173,646	3.2	35.8	35.2	36.1	0.9

(1) Stream distance in miles above mouth
(2) Elevations computed without consideration of backwater from Columbia River
(3) Elevations based on HEC-2 hydraulic model
(4) Width/width within county limits
(5) Width excluding island/right channel width looking downstream/width of right channel within corporate limits

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY
CLARK COUNTY, WASHINGTON
AND INCORPORATED AREAS

FLOODWAY DATA

COLUMBIA RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
CURTIN CREEK								
A	515	57	375	1.6	174.3	174.2	175.1	0.9
B	1,419	114	516	1.7	174.5	174.5	175.4	0.9
C	1,867	79	272	3.2	174.7	174.7	175.5	1.0
D	2,380	41	173	4.5	175.6	175.6	176.5	0.8
E	3,031	26	147	4.6	178.7	178.6	179.0	0.3
F	3,790	58	296	2.0	180.0	180.0	181.0	1.0
G	4,980	58	208	2.5	181.3	181.3	182.1	0.8
H	6,639	45	151	4.6	186.7	186.7	187.6	0.9
I	8,010	44	230	1.7	191.3	191.3	191.7	0.4
J	8,960	40	184	2.1	191.6	191.6	192.0	0.4
K	10,306	40	250	1.7	196.2	196.2	196.8	0.6
L	12,979	79	428	1.1	196.3	196.3	197.2	0.9
M	15,741	138	750	0.5	196.5	196.5	197.4	0.9
N	17,494	29	60	3.9	197.0	197.0	197.7	0.6
O	18,499	51	64	3.5	211.5	211.5	211.5	0.0
P	18,954	24	116	2.1	213.9	213.9	214.5	0.6
Q	19,655	21	37	2.1	221.1	221.1	221.1	0.0
R	20,249	13	32	2.5	233.6	233.6	233.6	0.0
S	21,124	23	53	1.5	236.2	236.2	236.2	0.0
T	21,781	23	32	2.5	247.4	247.4	247.4	0.0
U	22,408	23	78	1.0	252.9	252.9	253.3	0.4
V	22,880	16	26	2.7	253.9	253.9	254.1	0.2
W	23,571	25	51	1.4	254.9	254.9	255.3	0.4
X	23,996	71	363	0.2	258.3	258.3	259.4	1.1
Y	24,691	131	433	0.3	258.3	258.3	259.4	1.1
Z	24,891	130	591	0.2	259.8	259.8	260.8	1.0
AA	25,481	122	518	0.1	259.8	259.8	260.8	1.0

(1)Stream distance in feet above confluence with Salmon Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

CURTIN CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
EAST FORK LEWIS RIVER								
A	0.78	539	10,656	2.5	32.6	32.6	33.0	0.4
B	0.92	370	7,995	3.4	32.6	32.6	33.0	0.4
C	1.72	355	7,898	3.4	33.0	253.5	33.5	0.5
D	2.39	1,020	21,460	1.3	33.2	33.2	33.7	0.5
E	2.83	1,535	31,767	0.8	33.3	33.3	33.8	0.5
F	3.13	433	11,443	2.4	33.3	33.3	33.8	0.5
G	3.24	760	11,527	2.3	33.3	33.3	33.8	0.5
H	3.50	1,230	21,782	1.2	33.5	33.5	34.1	0.6
I	3.75	1,300	25,095	1.1	33.5	33.5	34.1	0.6
J	4.03	1,400	24,901	1.1	33.5	33.5	34.1	0.6
K	4.64	1,400	24,960	0.1	33.6	33.6	34.3	0.7
L	5.23	2,120	33,838	0.7	33.6	33.6	34.4	0.8
M	5.61	2,000	25,892	0.9	33.6	33.6	34.4	0.8
N	6.02	3,450	49,595	0.6	33.7	33.7	34.5	0.8
O	6.24	2,650	29,227	0.6	33.7	33.7	34.5	0.8
P	6.46	2,650	20,849	1.1	33.7	33.7	34.5	0.8
Q	6.78	3,500	25,699	1.3	35.0	35.0	35.7	0.7
R	7.28	3,702	27,036	1.2	35.3	35.3	36.0	0.7
S	7.53	3,162	18,332	1.6	35.5[2] / 35.6[3]	35.5	36.2	0.7
T	7.74[4]	872	10,277	3.3	35.8[2] / 35.9[3]	35.9	36.6	0.7
U	7.89[4]	825	3,086	4.4	36.7[2] / 36.8[3]	36.7	37.3	0.6
V[5]								
W	8.00[4]	606	3,550	3.8	38.1[2] / 38.3[3]	38.1	38.6	0.5
X	8.24[4]	1,318	4,073	3.3	41.3[2] / 41.6[3]	41.3	41.7	0.4
Y	8.41	2,000	8,206	3.6	45.4[2] / 45.7[3]	45.4	45.7	0.3
Z	8.66	1,541	6,739	4.4	52.1[2] / 52.2[3]	52.1	52.3	0.2

(1) Stream distance in miles above mouth

(2) Elevations calculated without consideration of ridge along right overbank

(3) Elevations computed with consideration of ridge along right overbank

(4) Measured along profile baseline of East Fork Lewis River Path 1

(5) Cross section does not cross East Fork Lewis River Path 1

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

EAST FORK LEWIS RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
EAST FORK LEWIS RIVER								
AA	8.95	1,226	5,120	5.7	58.5[2] / 58.6[3]	58.5	58.7	0.2
AB	9.22	789	4,496	6.5	64.0[2] / 64.0[3]	64.0	64.1	0.1
AC	9.39	732	3,401	8.6	67.7[2] / 67.8[3]	67.8	67.8	0.0
AD	9.83	387	3,027	9.7	77.2[2] / 77.2[3]	77.2	77.6	0.4
AE	9.96	175	2,378	12.3	79.2[2] / 79.2[3]	79.2	80.0	0.8
AF	9.98	228	2,431	9.0	80.9	80.9	81.4	0.5
AG	10.08	495	4,124	5.3	82.7	82.7	83.0	0.3
AH	10.20	680	3,084	7.1	85.0	85.0	85.2	0.2
AI	10.48	1,020	4,123	5.3	90.1	90.1	90.6	0.5
AJ	10.67	714	3,082	7.1	94.5	94.5	94.8	0.3
AK	10.86	550	3,202	6.8	99.1	99.1	99.6	0.5
AL	11.03	600	3,533	6.2	102.0	102.0	102.7	0.7
AM	11.33	2,030	6,035	3.6	107.1	107.1	107.1	0.0
AN	11.61	1,028	4,590	4.8	112.6	112.6	112.7	0.1
AO	11.81	860	3,530	6.2	118.7	118.7	118.7	0.0
AP	12.06	252	2,276	9.6	125.6	125.6	125.9	0.3
AQ	12.31	456	3,191	6.9	133.2	133.2	133.3	0.1
AR	12.56	162	1,927	11.4	139.0	139.0	139.1	0.1
AS	12.68	212	3,163	6.9	142.2	142.2	142.3	0.1
AT	12.83	510	2,008	10.7	144.1	144.1	144.1	0.0
AU	13.25	389	3,061	7.0	157.1	157.1	157.7	0.6
AV	13.51	662	3,480	6.1	163.3	163.3	163.5	0.2
AW	13.85	204	1,962	10.9	172.3	172.3	172.9	0.6
AX	14.15	513	3,604	5.9	180.0	180.0	180.2	0.2

(1) Stream distance in miles above mouth

(2) Elevations calculated without consideration of ridge along right overbank

(3) Elevations computed with consideration of ridge along right overbank

(4) Measured along profile baseline of East Fork Lewis River Path 1

(5) Cross section does not cross East Fork Lewis River Path 1

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

EAST FORK LEWIS RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	**DISTANCE[1]**	**WIDTH (FT.)**	**SECTION AREA (SQ. FT.)**	**MEAN VELOCITY (F. P. S.)**	**REGULATORY (NAVD88)**	**WITHOUT FLOODWAY (NAVD88)**	**WITH FLOODWAY (NAVD88)**	**INCREASE**
EAST FORK LEWIS RIVER PATH 2 A-S[2]								
T	7.74	872	7,262	3.3	36.3[3] / 36.3[4]	36.3	36.6	0.7
U	7.99	418	1,941	5.9	36.3[3] /36.3[4]	37.1	37.6	0.5
V	8.05	273	1,791	12.5	37.8[3] / 37.9[4]	37.8	38.1	0.3
W	8.19	862	12,158	3.7	41.0[3] / 41.3[4]	41.0	41.3	0.3
X	8.29	371	2,440	6.5	41.1[3] / 41.4[4]	41.1	41.4	0.3

(1) Stream distance in miles above mouth

(2) Path 2 diverges from East Fork Lewis River at Cross Section T

(3) Elevations computed without consideration of ridge along right overbank

(4) Elevations computed with consideration of ridge along right overbank

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

EAST FORK LEWIS RIVER PATH 2

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
EAST FORK LEWIS RIVER PATH 3								
A-R[2]								
S	7.53	3,162	18,334	1.6	35.5[3] / 35.6[4]	35.5	36.2	0.7
T	7.62	1,067	4,548	1.1	35.7[3] / 35.7[4]	35.7	36.4	0.7
U	7.75	868	2,234	2.3	37.1[3] / 37.2[4]	37.1	37.4	0.3
V	7.97	272	1,667	3.1	40.0[3] / 40.2[4]	40.0	40.2	0.2

(1)Stream distance in miles above mouth

(2)Path 2 diverges from East Fork Lewis River at Cross Section T

(3)Elevations computed without consideration of ridge along right overbank

(4)Elevations computed with consideration of ridge along right overbank

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

EAST FOR LEWIS RIVER PATH 3

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
FIFTH PLAIN CREEK								
A	0.19	195	673	4.8	214.7	214.7	214.9	0.2
B	0.32	29	205	10.9	216.2	216.2	216.8	0.6
C	0.44	34	257	7.6	220.0	220.0	221.0	1.0
D	0.57	45	321	6.8	226.8	226.8	226.9	0.1
E	0.66	44	293	6.7	228.1	228.1	228.2	0.1
F	0.83	39	240	8.2	231.2	231.2	231.7	0.5
G	1.10	49	271	8.9	239.1	239.1	239.2	0.1
H	1.26	42	233	10.1	243.4	243.4	243.4	0.0
I	1.33	68	357	6.2	245.8	245.8	246.0	0.2
J	1.38	70	354	6.5	246.3	246.3	247.2	0.9
K	1.43	39	301	7.1	247.9	247.9	248.3	0.4
L	1.58	48	391	5.8	249.8	249.8	250.5	0.7
M	1.79	50	353	3.5	251.7	251.7	252.5	0.8
N	1.86	50	263	4.9	252.2	252.2	252.8	0.6
O	1.99	65	236	5.7	253.9	253.9	254.5	0.6
P	2.17	160	335	4.8	256.1	256.1	256.7	0.6
Q	2.30	230	427	2.1	257.0	257.0	257.9	0.9
R	2.60	257	308	3.4	260.0	260.0	260.9	0.9
S	2.78	14	78	7.2	263.9	263.9	264.5	0.6
T	2.90	27	135	4.8	267.9	267.9	268.6	0.7
U	3.06	16	97	5.7	271.9	271.9	272.7	0.8
V	3.17	75	354	2.8	275.9	275.9	276.7	0.8
W	3.36	21	90	8.0	284.6	284.6	285.3	0.7
X	3.49	20	123	5.5	294.5	294.5	294.9	0.4
Y	3.61	23	93	6.0	298.6	298.6	299.2	0.6
Z	3.80	64	139	6.8	311.2	311.2	312.1	0.9

(1)Stream distance in miles above confluence with Lacamas Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

FIFTH PLAIN CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
FITH PLAIN CREEK								
AA	3.93	39	110	7.0	320.2	320.2	321.1	0.9
AB	4.07	20	87	6.7	329.9	329.9	330.5	0.6
AC	4.25	21	73	6.3	341.8	341.8	342.7	0.9

(1)Stream distance in miles above confluence with Lacamas Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

FIFTH PLAIN CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
GEE CREEK								
A	0.04	48	323	3.8	27.0	20.3[2]	21.0[2]	0.7
B	0.34	56	586	2.4	27.5	27.5	28.2	0.7
C	0.62	108	634	2.9	27.7	27.7	28.7	1.0
D	0.91	92	526	2.8	29.7	29.7	30.3	0.6
E	1.00	117	363	4.6	30.5	30.5	30.9	0.4
F	1.11	69	228	6.1	33.0	33.0	33.7	0.7
G	1.30	52	220	5.4	39.7	39.7	39.8	0.1
H	1.42	63	308	4.5	43.0	43.0	43.2	0.2
I	1.54	50	217	6.0	46.3	46.3	46.3	0.0
J	1.65	101	285	5.6	50.0	50.0	50.2	0.2
K	1.76	35	181	6.4	54.8	54.8	54.8	0.0
L	1.89	31	142	7.0	59.4	59.4	59.5	0.1
M	2.10	64	215	5.8	67.3	67.3	67.4	0.1
N	2.26	39	173	6.0	72.6	72.6	72.7	0.1
O	2.35	44	190	5.1	75.7	75.7	75.9	0.2
P	2.89	37	195	4.9	90.3	90.3	90.8	0.5
Q	3.21	43	226	4.8	99.7	99.7	100.3	0.6
R	3.38	45	223	4.3	103.3	103.3	103.5	0.2
S	3.64	55	211	5.8	111.1	111.1	111.4	0.3
T	3.98	50	194	5.0	120.5	120.5	121.2	0.7
U	4.18	89	240	5.3	127.6	127.6	128.5	0.9
V	4.27	29	102	7.3	131.4	131.4	131.6	0.2
W	4.33	26	180	4.2	135.0	135.0	135.1	0.1
X	4.56	34	179	4.2	139.0	139.0	139.5	0.5
Y	4.67	34	155	4.8	142.3	142.3	142.7	0.4
Z	4.83	35	155	5.1	147.5	147.5	147.7	0.2

(1)Stream distance in miles above downstream face of BNSF railroad culvert

(2)Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

GEE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
GEE CREEK								
AA	4.96	30	178	4.2	151.2	151.2	151.8	0.6
AB	5.09	41	227	3.3	153.6	153.6	154.3	0.7
AC	5.16	34	207	3.6	158.0	158.0	158.1	0.1
AD	5.51	24	150	5.0	168.3	168.3	168.4	0.1
AE	5.94	40	207	3.6	176.7	176.7	177.2	0.5
AF	5.98	24	119	6.2	181.4	181.4	181.4	0.0
AG	6.32	60	249	4.1	184.1	184.1	185.1	1.0
AH	6.45	58	279	3.9	186.9	186.9	187.7	0.8
AI	6.59	37	265	2.9	188.9	188.9	189.8	0.9
AJ	6.68	43	308	2.9	192.7	192.7	192.8	0.1
AK	6.83	44	249	4.2	194.7	194.7	195.4	0.7
AL	7.22	23	120	3.6	200.8	200.8	201.6	0.8
AM	7.25	26	260	1.5	206.1	206.1	206.9	0.8
AN	7.51	38	174	2.7	206.5	206.5	207.4	0.9
AO	7.64	32	134	3.1	207.4	207.4	208.4	1.0
AP	7.80	18	87	4.5	211.5	211.5	211.6	0.1
AQ	7.85	13	83	1.5	213.9	213.9	214.0	0.1
AR	7.95	12	68	1.8	214.9	214.9	215.4	0.5
AS	8.04	12	60	2.1	215.3	215.3	216.0	0.7
AT	8.08	15	97	1.7	218.0	218.0	218.7	0.7
AU	8.23	23	132	1.3	218.4	218.4	219.2	0.8
AV	8.30	17	71	1.8	221.6	221.6	222.4	0.8
AW	8.51	26	85	1.3	221.9	221.9	222.9	1.0
AX	8.61	16	53	1.9	224.7	224.7	225.6	0.9
AY	8.75	11	22	2.0	227.4	227.4	227.8	0.4
AZ	8.88	16	62	0.9	233.8	233.8	234.0	0.2

(1)Stream distance in miles above downstream face of BNSF railroad culvert

(2)Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

GEE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
GEE CREEK								
BA	9.04	9	19	2.3	239.1	239.1	239.1	0.0
BB	9.12	17	43	1.2	244.9	244.9	244.9	0.0
BC	9.24	9	19	2.3	246.9	246.9	247.4	0.5
BD	9.32	8	20	1.1	256.7	256.7	256.7	0.0
BE	9.38	11	6	3.7	259.9	259.9	259.9	0.0
BF	9.48	15	33	0.7	268.8	268.8	268.9	0.1
BG	9.57	11	25	1.2	275.6	275.6	275.6	0.0
BH	9.73	4	11	2.2	287.7	287.7	288.4	0.7
BI	9.98	22	10	2.3	314.7	314.7	314.7	0.0

(1)Stream distance in miles above downstream face of BNSF railroad culvert

(2)Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

GEE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
LACAMAS CREEK								
A	0.00[1]	39	386	13.3	35.0 [4]	31.6	32.6	0.9
B	0.03[1]	45	638	8.0	42.0	42.0	43.0	1.0
C	0.08[1]	150	3,926	2.4	43.5	43.5	44.3	0.7
D	0.17[1]	180	4,263	2.1	43.5	43.5	44.4	0.9
E	0.23[1]	240	5,075	1.8	43.5	43.5	44.4	0.9
F	0.36[1]	145	2,863	2.8	43.5	43.5	44.4	0.9
G	0.48[1]	80	1,417	4.4	43.6	43.6	44.5	0.9
H	0.57[1]	65	844	7.7	44.1	44.1	45.0	0.9
I	0.65[1]	64	522	11.5	50.4	50.4	51.4	0.9
J	0.70[1]	113	608	10.1	99.9	99.9	99.9	0.0
K	0.74[1]	76	525	11.0	104.5	104.5	104.5	0.0
L	0.84[1]	61	486	10.4	115.5	115.5	115.9	0.5
M	0.87[1]	63	547	9.2	116.8	116.8	117.4	0.6
N	1.00[1]	40	513	13.0	125.1	125.1	125.7	0.7
O	1.14[1]	54	677	9.3	132.8	132.8	133.5	0.7
P	1.19[1]	55	351	14.4	149.0	149.0	149.4	0.4
Q	1.25[1]	56	718	11.2	158.8	158.8	159.8	1.0
R	1.28[1]	51	696	11.7	160.4	160.4	161.2	0.8
S	1.34[1]	45	671	11.1	163.5	163.5	164.2	0.7
T	0.00[2]	121	1,135	4.0	191.1	187.0[3]	188.0[3]	1.0
U	0.40[2]	98	819	6.7	191.5	188.9[3]	189.7[3]	0.8
V	0.71[2]	195	1,409	4.7	192.1	190.4[3]	191.2[3]	0.8
W	1.02[2]	362	1,757	6.2	193.1	192.5[3]	193.3[3]	0.8
X	1.08[2]	913	3,062	3.1	195.2	195.2	195.8	0.6
Y	1.43[2]	1,040	4,405	2.5	196.0	196.0	197.0	1.0
Z	1.77[2]	1,349	4,981	2.1	196.5	196.5	197.5	1.0

(1) Stream distance in miles above 3rd Avenue Culvert

(2) Stream distance in miles above Lacamas Lake

(3) Elevation computed without consideration of backwater from Lacamas Lake

(4) Elevation computed with consideration of backwater from Washougal River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

LACAMAS CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
LACAMAS CREEK								
AA	2.02	1,022	3,397	2.1	197.1	197.1	198.1	0.9
AB	2.22	1,080	4,226	1.5	197.6	197.6	198.4	0.8
AC	2.46	1,146	4,682	1.2	197.9	197.9	198.6	0.7
AD	2.97	1,653	5,701	1.2	198.3	198.3	199.1	0.7
AE	3.64	1,389	3,374	2.2	199.1	199.1	199.8	0.7
AF	4.05	1,357	3,143	2.4	200.1	200.1	200.9	0.8
AG	4.38	1,235	2,768	3.0	201.1	201.1	201.9	0.8
AH	4.75	1,239	2,208	4.1	202.7	202.7	203.6	0.9
AI	5.14	1,058	2,307	3.7	205.6	205.6	206.4	0.8
AJ	5.51	1,034	2,434	3.3	207.4	207.4	208.1	0.7
AK	5.79	796	1,798	2.0	208.6	208.6	209.0	0.4
AL	5.97	433	876	4.4	211.1	211.1	211.6	0.5
AM	6.16	239	455	7.1	214.5	214.5	215.1	0.6
AN	6.30	130	613	5.5	219.6	219.6	220.0	0.4
AO	6.55	82	542	4.9	221.3	221.3	222.2	0.9
AP	6.71	114	490	6.1	223.9	223.9	224.6	0.7
AQ	6.92	320	1,003	3.8	226.9	226.9	227.4	0.5
AR	7.08	343	546	6.7	228.5	228.5	229.1	0.6
AS	7.23	288	571	7.5	232.3	232.3	233.1	0.8
AT	7.38	90	353	7.6	236.1	236.1	236.6	0.5
AU	7.47	104	394	7.5	238.7	238.7	239.6	0.9
AV	7.62	100	450	7.0	242.4	242.4	243.4	1.0
AW	7.78	93	462	5.2	246.6	246.6	247.1	0.5
AX	7.90	92	405	7.0	249.3	249.3	249.7	0.4
AY	8.07	51	334	7.0	254.9	254.9	255.4	0.5
AZ	8.16	85	422	7.2	257.2	257.2	257.8	0.6

(1)Stream distance in miles above Lacamas Lake

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

LACAMAS CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
LACAMAS CREEK								
BA	8.27	157	561	6.8	261.0	261.0	261.5	0.6
BB	8.44	55	313	8.1	265.4	265.4	266.2	0.8
BC	8.59	79	450	5.2	271.3	271.3	272.2	0.9
BD	8.81	67	406	5.8	277.3	277.3	278.1	0.8
BE	8.94	51	397	5.9	281.6	281.6	282.4	0.8

(1)Stream distance in miles above Lacamas Lake

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

LACAMAS CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
LEWIS RIVER								
A	0.67	969 / 550[2]	17,362	7.6	26.5	20.6	21.6	1.0
B	1.19	818 / 400[2]	15,387	8.6	26.5	22.0	23.0	1.0
C	1.70	788 / 400[2]	17,223	7.7	26.5	23.5	24.5	0.7
D	1.75	799 / 350[2]	16,995	7.8	26.5	24.2	25.2	1.0
E	2.38	884 / 420[2]	17,318	7.7	26.5	26.0	26.6	0.6
F	2.98	636 / 240[2]	14,395	9.2	27.2	27.2	28.0	0.8
G	3.18	536 / 236[2]	12,769	10.4	27.7	27.7	28.4	0.7
H	3.38	1,090 / 240[2]	16,615	8.0	28.6	28.6	29.3	0.7
I	3.70	1,130 / 500[2]	19,165	5.3	30.4	30.4	30.9	0.5
J	3.90	655 / 320[2]	15,104	6.8	30.6	30.6	31.1	0.5
K	4.29	1,151 / 850[2]	19,207	5.3	31.2	31.2	31.7	0.5
L	5.01	715 / 315[2]	17,108	6.0	32.1	32.1	32.7	0.6
M	5.27	547 / 247[2]	12,906	7.9	32.1	32.1	32.7	0.6
N	5.35	660 / 310[2]	15,763	6.5	32.7	32.7	33.3	0.6
O	5.42	581 / 320[2]	14,943	6.8	32.8	32.8	33.4	0.6
P	5.48	511 / 250[2]	14,815	6.9	32.8	32.8	33.4	0.6
Q	5.95	762	17,384	5.9	33.7	33.7	34.2	0.5
R	6.54	490 / 210[2]	13,418	7.6	34.5	34.5	35.5	1.0
S	7.13	512 / 232[2]	14,974	6.8	35.9	35.9	36.7	0.8
T	7.69	1,466 / 166[2]	22,075	4.6	36.9	36.9	37.8	0.9
U	8.13	716 / 385[2]	17,283	5.9	37.6	37.6	38.5	0.9
V	8.39	851 / 490[2]	17,418	5.9	38.0	38.0	38.8	0.8
W	8.61	512 / 212[2]	12,213	8.4	38.2	38.2	39.0	0.8
X	9.20	1,709 / 1,530[2]	27,613	3.7	39.8	39.8	40.6	0.8
Y	9.85	1,420 / 1,300[2]	28,526	3.6	40.6	40.6	41.5	0.9
Z	10.69	3,021 / 2,836[2]	33,201	3.1	41.5	41.5	42.4	0.9

(1) Stream distance in miles above mouth

(2) Width/width within county limits

(3) Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

LEWIS RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
LEWIS RIVER								
AA	11.34	2,600 / 2,430[2]	30,012	3.4	42.3	42.3	43.2	0.9
AB	11.67	724 / 620[2]	15,050	6.8	42.8	42.8	43.6	0.8
AC	12.48	420 / 190[2]	8,954	11.4	46.2	46.2	46.7	0.5
AD	12.95	386 / 226[2]	9,518	10.7	50.2	50.2	50.5	0.3
AE	13.50	990 / 820[2]	16,017	6.4	53.7	53.7	54.5	0.8
AF	14.01	658 / 388[2]	14,327	7.1	55.8	55.8	56.8	1.0
AG	14.44	691 / 361[2]	19,542	5.2	57.3	57.3	58.3	1.0
AH	15.09	540 / 150[2]	11,444	8.9	58.5	58.5	59.5	1.0
AI	15.36	373 / 253[2]	11,212	9.1	59.5	59.5	60.5	1.0
AJ	15.67	499 / 100[2]	10,651	8.8	60.7	60.7	61.7	1.0
AK	16.08	256 / 130[2]	7,868	11.9	62.2	62.2	63.1	0.9
AL	16.35	313 / 270[2]	7,659	12.3	64.0	64.0	64.8	0.8
AM	16.69	438 / 378[2]	10,160	9.3	66.3	66.3	67.3	1.0
AN	17.08	330 / 170[2]	8,979	10.5	67.9	67.9	68.9	1.0
AO	17.54	362 / 202[2]	8,967	10.5	70.5	70.5	71.4	0.9
AP	17.91	257 / 140[2]	8,179	11.5	72.1	72.1	73.1	1.0
AQ	18.26	339 / 169[2]	9,552	9.8	73.9	73.9	74.9	1.0
AR	18.65	272 / 112[2]	8,394	11.2	75.4	75.4	76.4	1.0
AS	19.06	356 / 136[2]	11,511	8.2	78.1	78.1	79.0	0.9

(1) Stream distance in miles above mouth
(2) Width/width within county limits
(3) Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY
CLARK COUNTY, WASHINGTON
AND INCORPORATED AREAS

FLOODWAY DATA

LEWIS RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
MILL CREEK								
A	0.05	97	517	2.3	141.9	141.9	142.3	0.4
B	0.26	60	203	5.6	149.7	149.7	149.7	0.0
C	0.44	51	158	6.3	159.1	159.1	159.1	0.7
D	0.52	24	124	9.1	162.3	162.3	162.3	0.1
E	0.53	26	170	5.9	164.7	164.7	164.7	0.0
F	0.67	29	175	5.7	166.6	166.6	166.8	0.2
G	0.89	104	346	4.4	169.3	169.3	169.9	0.0
H	1.20	30	187	4.4	172.5	172.5	172.9	0.4
I	1.50	46	204	4.5	175.9	175.9	176.6	0.6
J	1.63	59	70	11.9	179.4	179.4	179.4	0.0
K	1.64	121	145	5.7	183.7	183.7	183.7	0.0
L	2.11	30	137	6.4	184.7	184.7	184.8	0.1
M	2.13	34	276	4.0	192.5	192.5	192.5	0.0
N	2.52	60	485	2.0	192.8	192.8	193.2	0.4
O	2.88	86	408	2.2	193.1	193.1	194.0	0.9
P	3.00	45	187	4.1	193.7	193.7	194.5	0.8
Q	3.10	90	217	3.7	195.6	195.6	195.7	0.2
R	3.20	26	116	4.1	196.6	196.6	196.9	0.3
S	3.34	83	359	1.7	197.3	197.3	197.7	0.4
T	3.43	146	562	1.0	199.0	199.0	199.3	0.3
U	3.84	153	525	0.8	199.1	199.1	199.6	0.4
V	4.27	168	183	2.6	199.1	199.1	199.8	0.7
W	4.37	28	85	4.3	202.6	202.6	202.7	0.0
X	4.51	24	75	4.9	207.2	207.2	207.2	0.0
Y	4.64	29	85	4.3	212.6	212.6	212.6	0.0
Z	4.77	31	106	2.8	217.1	217.1	217.1	0.0

(1) Stream distance in miles above confluence with Salmon Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

MILL CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
MILL CREEK								
AA	4.88	21	73	4.1	219.5	219.5	219.5	0.0
AB	5.04	18	62	4.8	223.5	223.5	223.5	0.0
AC	5.15	40	103	2.9	230.5	230.5	230.5	0.0
AD	5.27	29	99	3.0	232.6	232.6	232.7	0.1
AE	5.34	25	67	4.4	233.4	233.4	233.6	0.2
AF	5.49	16	79	3.8	237.0	237.0	237.1	0.1
AG	5.68	19	67	3.5	241.1	241.1	241.2	0.1
AH	5.87	13	51	4.5	246.2	246.2	246.6	0.4
AI	6.02	23	82	2.8	248.4	248.4	248.8	0.4
AJ	6.19	26	69	4.3	250.5	250.5	250.6	0.1
AK	6.43	20	72	2.2	253.5	253.5	253.4	0.0
AL	6.63	21	59	2.7	257.4	257.4	257.4	0.0
AM	6.74	33	71	2.2	259.0	259.0	259.0	0.0
AN	6.83	28	60	2.7	262.0	262.0	262.1	0.1
AO	6.88	55	84	1.9	262.9	262.9	262.9	0.1
AP	7.02	360	657	0.3	266.1	266.1	267.0	0.9
AQ	7.15	237	41	3.9	266.4	266.4	267.4	1.0
AR	7.18	249	146	0.7	270.2	270.2	270.5	0.4
AS	7.34	31	52	2.0	271.6	271.6	271.8	0.2
AT	7.63	20	41	2.6	278.7	278.7	278.7	0.0

(1)Stream distance in miles above confluence with Salmon Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

MILL CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
PACKARD CREEK								
A	386	13	75	2.7	65.7	65.5[2]	65.5[2]	0.0
B	771	15	55	3.7	66.9	66.9	67.4	0.5
C	2,204	11	48	4.2	77.0	77.0	77.9	0.9
D	3,123	15	48	4.2	84.8	84.8	85.5	0.7
E	3,358	10	46	4.4	87.1	87.1	87.7	0.6
F	3,746	12	80	2.5	93.0	93.0	93.3	0.4
G	3,955	36	79	3.9	94.1	94.1	95.1	1.0
H	4,085	9	56	3.6	94.8	94.8	95.7	0.9
I	4,472	11	47	4.3	97.3	97.3	98.2	0.9
J	5,729	11	55	3.6	109.4	109.4	110.2	0.8
K	6,128	11	45	4.4	113.9	113.9	114.7	0.8
L	6,813	6	21	3.0	122.1	122.1	122.8	0.6
M	7,680	5	16	4.1	133.0	133.0	133.9	0.9
N	7,846	8	24	2.6	135.7	135.7	136.3	0.6
O	9,238	7	19	3.5	160.0	160.0	160.6	0.6
P	10,186	5	14	4.6	183.7	183.7	184.5	0.8
Q	10,595	6	18	3.6	195.0	195.0	195.6	0.6
R	11,347	6	14	4.5	221.2	221.2	221.5	0.3
S	11,646	10	14	4.9	233.9	233.9	234.0	0.1
T	11,825	9	31	2.4	244.0	244.0	244.0	0.0
U	11,930	7	13	4.8	244.5	244.5	244.6	0.0
V	12,465	23	129	0.7	271.3	271.3	272.0	0.7
W	12,975	45	19	3.3	278.4	278.4	278.4	0.0
X	13,500	44	26	2.5	290.2	290.2	290.3	0.1

(1)Stream distance in feet above confluence with Whipple Creek

(2)Elevation computed without consideration of backwater from Whipple Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

PACKARD CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
PADDEN CREEK								
A	0.05	8	31	1.6	213.9	211.2[2]	211.6[2]	0.4
B	0.16	19	49	1.0	213.9	212.5[2]	213.1[2]	0.6
C	0.39	40	159	0.3	213.9	212.9[2]	213.4[2]	0.5
D	0.54	9	26	1.6	214.0	214.0	214.8	0.8
E	0.66	7	21	1.9	215.0	215.0	216.0	1.0
F	0.77	14	31	1.1	217.6	217.6	218.0	0.4
G	0.90	15	79	0.9	222.2	222.2	222.9	0.7
H	0.99	18	61	1.2	222.4	222.4	223.2	0.8
I	1.12	12	24	2.6	227.8	227.8	228.0	0.2

(1) Stream distance in miles above confluence with Curtin Creek

(2) Elevation computed without consideration of backwater from Curtin Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

PADDEN CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
SALMON CREEK								
A	0.61	121	1,626	3.1	29.0	27.1[2]	28.1[2]	1.0
B	1.43	941	16,632	0.6	29.2	27.3[2]	28.3[2]	1.0
C	1.90	790	13,181	0.8	29.2	27.3[2]	28.3[2]	0.9
D	2.46	363	6,023	1.6	29.3	27.6[2]	28.5[2]	0.9
E	3.13	1,208	20,356	0.4	29.4	27.6[2]	28.6[2]	1.0
F	3.86	1,076	15,628	0.6	29.4	27.6[2]	28.6[2]	1.0
G	4.27	1,009	11,756	0.8	29.4	27.6[2]	28.6[2]	1.0
H	4.83	986	5,350	2.4	29.4	27.7[2]	28.7[2]	1.0
I	5.09	594	2,150	5.1	29.7	28.6[2]	29.2[2]	0.6
J	5.33	487	1,540	5.6	34.3	34.3	34.3	0.0
K	5.60	448	955	6.5	39.6	39.6	39.6	0.0
L	5.73	294	1,722	4.7	41.4	41.4	41.4	0.0
M	5.90	364	1,231	5.5	46.4	46.4	46.4	0.0
N	6.01	57	454	10.2	49.4	49.4	49.4	0.0
O	6.20	86	568	7.9	54.0	54.0	54.0	0.0
P	6.42	49	312	14.4	56.7	56.7	56.7	0.0
Q	6.52	131	664	7.3	63.2	63.2	63.2	0.0
R	6.63	81	668	6.7	74.5	74.5	74.5	0.0
S	6.82	205	1,166	6.4	78.4	78.4	78.5	0.1
T	6.92	84	398	12.0	79.5	79.5	79.9	0.5
U	7.01	141	662	7.0	84.7	84.7	84.7	0.0
V	7.19	121	607	8.7	88.8	88.8	88.8	0.0
W	7.40	75	496	9.0	96.0	96.0	96.0	0.0
X	7.49	272	1,201	5.6	98.7	98.7	98.8	0.1
Y	7.64	136	855	7.0	100.8	100.8	101.4	0.5
Z	7.83	73	666	6.3	106.3	106.3	107.0	0.7

(1) Stream distance in miles above confluence with Columbia River

(2) Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

SALMON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
SALMON CREEK								
AA	7.90	161	977	4.7	108.0	108.0	108.4	0.4
AB	7.97	146	707	8.3	108.8	108.8	109.1	0.2
AC	8.05	214	983	6.3	111.0	111.0	111.1	0.1
AD	8.22	196	718	8.0	114.4	114.4	114.6	0.2
AE	8.30	474	1,630	5.7	116.2	116.2	116.7	0.5
AF	8.43	310	1,040	6.0	118.5	118.5	119.0	0.5
AG	8.57	240	891	7.0	122.4	122.4	123.1	0.7
AH	8.72	114	784	6.2	127.0	127.0	127.0	0.0
AI	8.88	84	592	7.1	128.9	128.9	129.5	0.6
AJ	9.03	282	1,185	5.8	134.0	134.0	134.5	0.5
AK	9.19	377	997	7.4	137.4	137.4	137.4	0.0
AL	9.30	395	1,445	5.8	140.1	140.1	140.6	0.6
AM	9.41	148	762	5.7	142.8	142.8	142.9	0.1
AN	9.48	131	730	5.1	144.0	144.0	144.3	0.3
AO	9.67	101	665	5.6	147.0	147.0	147.6	0.7
AP	9.81	124	748	5.0	150.7	150.7	150.8	0.2
AQ	9.91	189	1,010	5.3	152.4	152.4	152.5	0.1
AR	10.10	84	621	6.0	155.1	155.1	155.4	0.3
AS	10.30	111	656	6.5	158.5	158.5	158.7	0.1
AT	10.40	145	721	6.9	160.4	160.4	160.5	0.0
AU	10.52	150	909	5.3	162.5	162.5	162.4	0.0
AV	10.75	142	802	5.5	164.5	164.5	165.0	0.6
AW	10.93	201	897	5.7	166.5	166.5	167.1	0.6
AX	11.17	377	1,579	4.5	168.5	168.5	169.4	0.9
AY	11.31	305	1,218	4.5	169.4	169.4	170.0	0.7
AZ	11.43	94	636	6.2	171.3	171.3	171.6	0.3

(1)Stream distance in miles above confluence with Columbia River

(2)Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

SALMON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
SALMON CREEK								
BA	11.51	175	804	6.2	172.2	172.2	172.5	0.3
BB	11.70	166	814	4.6	174.5	174.5	174.7	0.2
BC	11.84	271	817	4.4	175.6	175.6	175.8	0.2
BD	11.96	91	572	6.3	176.4	176.4	176.6	0.2
BE	12.16	202	904	5.7	178.0	178.0	178.5	0.5
BF	12.33	284	827	6.0	179.7	179.7	180.1	0.4
BG	12.51	256	1,119	4.1	181.7	181.7	181.8	0.1
BH	12.71	200	1,067	4.9	182.4	182.4	182.5	0.1
BI	13.01	372	1,054	6.5	183.3	183.3	183.5	0.2
BJ	13.39	179	793	4.7	186.5	186.5	186.5	0.0
BK	13.56	281	1,109	5.8	187.6	187.6	187.7	0.1
BL	13.70	421	1,232	5.3	188.7	188.7	188.9	0.2
BM	13.86	179	604	6.9	189.8	189.8	190.2	0.3
BN	13.93	264	1,531	2.5	193.3	193.3	193.8	0.5
BO	14.03	460	1,883	2.9	193.5	193.5	194.0	0.5
BP	14.47	498	1,351	4.4	195.4	195.4	195.7	0.3
BQ	14.78	42	320	8.4	199.8	199.8	199.8	0.0
BR	14.82	256	1,343	4.0	201.3	201.3	201.8	0.5
BS	15.08	298	923	5.2	203.2	203.2	203.7	0.5
BT	15.22	97	542	5.0	205.6	205.6	205.7	0.1
BU	15.38	124	479	5.6	209.0	209.0	209.1	0.1
BV	15.56	196	958	6.0	212.6	212.6	212.6	0.1
BW	15.76	128	560	5.2	214.9	214.9	215.1	0.2
BX	15.93	62	392	7.3	217.6	217.6	218.2	0.6
BY	16.16	93	546	5.5	221.9	221.9	222.8	0.9
BZ	16.32	191	823	4.5	223.9	223.9	224.9	1.0

(1)Stream distance in miles above confluence with Columbia River

(2)Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

SALMON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
SALMON CREEK								
CA	16.51	108	594	4.7	226.1	226.1	227.1	1.0
CB	16.73	105	681	4.4	229.3	229.3	230.3	1.0
CC	16.88	63	455	5.4	230.9	230.9	231.8	0.9
CD	17.03	87	544	5.0	234.2	234.2	234.9	0.7
CE	17.19	284	763	4.6	235.6	235.6	236.7	1.0
CF	17.27	88	669	3.6	236.8	236.8	237.4	0.6
CG	17.38	66	513	4.8	237.3	237.3	238.1	0.7
CH	17.48	48	394	6.2	238.9	238.9	239.6	0.7
CI	17.58	52	419	5.9	240.9	240.9	241.4	0.5
CJ	17.70	52	407	6.0	242.5	242.5	243.4	1.0
CK	17.81	69	658	4.1	244.6	244.6	245.2	0.6
CL	17.90	91	480	5.3	245.1	245.1	246.1	1.0
CM	18.06	188	915	3.8	246.9	246.9	247.8	0.8
CN	18.18	104	749	4.5	247.6	247.6	248.5	0.8
CO	18.36	79	512	4.6	248.8	248.8	249.8	1.0
CP	18.48	80	527	5.4	250.2	250.2	251.1	0.9
CQ	18.63	160	634	4.4	252.1	252.1	252.9	0.8
CR	18.80	207	845	4.5	254.1	254.1	254.7	0.6
CS	18.92	140	516	6.1	255.6	255.6	256.4	0.7
CT	19.02	80	500	5.2	258.7	258.7	259.1	0.4
CU	19.20	330	1,407	2.7	262.9	262.9	263.8	0.9
CV	19.60	159	473	5.9	266.0	266.0	266.7	0.7
CW	19.83	93	582	4.6	269.4	269.4	270.3	0.9
CX	20.00	125	642	4.8	272.2	272.2	273.1	0.8
CY	20.14	142	643	4.2	274.2	274.2	275.2	1.0
CZ	20.39	140	747	2.8	277.1	277.1	277.7	0.6

(1)Stream distance in miles above confluence with Columbia River

(2)Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

SALMON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
SALMON CREEK								
DA	20.43	59	315	6.7	278.9	278.9	278.9	0.1
DB	20.50	137	694	4.2	281.1	281.1	281.3	0.2
DC	20.68	137	448	6.0	283.5	283.5	284.3	0.8
DD	20.82	106	522	4.8	287.1	287.1	287.8	0.7
DE	20.97	107	644	4.7	289.6	289.6	290.6	1.0
DF	21.14	151	722	5.0	293.2	293.2	293.8	0.6
DG	21.35	120	584	3.6	297.3	297.3	298.2	0.9
DH	21.43	100	475	5.4	299.5	299.5	300.3	0.8
DI	21.58	221	939	4.0	301.8	301.8	302.8	1.0
DJ	21.81	177	699	4.0	305.3	305.3	305.8	0.6
DK	21.99	106	473	5.1	308.5	308.5	309.5	1.0
DL	22.16	73	445	5.4	311.9	311.9	312.9	0.9
DM	22.34	68	484	4.4	315.1	315.1	316.0	1.0
DN	22.43	121	574	5.2	317.4	317.4	318.4	1.0
DO	22.62	76	374	6.2	320.3	320.3	321.3	1.0
DP	22.76	90	548	5.6	323.9	323.9	324.8	0.9
DQ	23.08	62	379	5.6	335.3	335.3	335.7	0.5
DR	23.36	58	251	8.4	362.7	362.7	362.8	0.0

(1)Stream distance in miles above confluence with Columbia River

(2)Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

SALMON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
SPRING BRANCH CREEK								
A	0.26	38	42	1.7	198.4	196.1[2]	196.9[2]	0.8
B	0.39	37	100	0.6	198.7	196.2[2]	197.2[2]	1.0
C	0.49	30	84	0.7	198.8	196.2[2]	197.2[2]	0.9
D	0.68	32	90	0.3	199.2	196.4[2]	197.3[2]	0.9
E	0.90	19	57	0.4	199.5	196.5[2]	197.4[2]	0.9
F	1.13	23	28	0.8	199.9	197.3[2]	197.6[2]	0.3
G	1.30	31	19	1.2	200.2	200.0[2]	200.0[2]	0.0

(1)Stream distance in miles above confluence with Lacamas Creek

(2)Elevation computed without consideration of influence from Lacamas Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

SPRING BRANCH CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
UNNAMED TRIBUTARY TO GEE CREEK								
A	0.02	12	17	6.6	63.8	63.8	63.8	0.0
B	0.18	14	23	4.7	86.4	86.4	86.6	0.2
C	0.28	7	16	6.9	99.2	99.2	99.6	0.4
D	0.38	9	40	2.8	111.7	111.7	112.5	0.8

(1)Stream distance in miles above confluence with Gee Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

UNNAMED TRIBUTARY TO GEE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
WASHOUGAL RIVER								
A	0.04	588	5,561	7.7	35.0	17.3[2]	18.3[2]	1.0
B	0.36	1,002	8,353	5.1	35.0	19.6[2]	20.1[2]	0.5
C	0.43	498	5,070	8.5	35.0	19.7[2]	20.2[2]	0.6
D	0.48	334	4,021	10.7	35.0	20.0[2]	20.6[2]	0.6
E	0.50	406	4,231	10.2	35.0	20.6[2]	21.1[2]	0.5
F	0.56	657	6,238	6.9	35.0	22.8[2]	22.9[2]	0.1
G	1.05	632	4,837	7.9	35.0	25.7[2]	26.0[2]	0.3
H	1.44	330	5,253	7.3	35.0	28.6[2]	28.9[2]	0.3
I	1.81	255	2,762	13.9	35.0	29.4[2]	29.8[2]	0.4
J	1.92	194	2,634	14.6	35.0	31.6[2]	31.9[2]	0.3
K	2.07	376	4,733	8.1	36.1	36.1	36.1	0.0
L	2.27	213	3,106	12.4	36.7	36.7	36.8	0.1
M	2.47	180	2,668	14.4	38.9	38.9	39.1	0.2
N	2.72	280	3,821	10.0	43.6	43.6	44.3	0.7
O	2.82	309	4,010	9.6	44.9	44.9	45.4	0.5
P	2.95	198	3,011	12.8	46.5	46.5	46.8	0.3
Q	3.08	320	4,286	9.0	49.6	49.6	49.6	0.0
R	3.32	233	3,017	12.7	51.7	51.7	51.9	0.2
S	3.50	184	2,400	16.0	54.8	54.8	54.8	0.0
T	3.83	640	5,335	7.2	63.0	63.0	63.7	0.7
U	3.98	390	4,179	9.2	64.7	64.7	65.3	0.6
V	4.24	208	2,813	13.7	69.4	69.4	69.7	0.3
W	4.40	206	3,117	12.3	72.9	72.9	73.0	0.1

(1) Stream distance in miles above mouth

(2) Water-surface elevations computed without consideration of backwater effects from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

WASHOUGAL RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
WEAVER CREEK								
A	0.04	80	280	3.6	210.6	210.0[2]	211.0[2]	1.0
B	0.08	40	226	3.2	212.4	212.3	212.5	0.3
C	0.22	64	201	3.4	212.9	212.8	213.2	0.4
D	0.38	60	162	5.2	216.2	216.2	216.9	0.7
E	0.61	40	119	5.9	222.8	222.8	222.8	0.0
F	1.02	33	115	5.7	234.0	234.0	235.0	1.0
G	1.12	18	96	5.5	236.7	236.7	237.5	0.8
H	1.14	28	155	4.2	239.2	239.2	239.3	0.0
I	1.32	22	120	4.6	240.7	240.7	241.1	0.4
J	1.39	18	77	7.2	241.6	241.6	242.5	0.9
K	1.56	19	111	4.7	246.6	246.6	247.6	0.9
L	1.59	23	174	3.7	249.5	249.5	250.0	0.6
M	1.82	31	170	3.5	255.3	255.3	256.3	0.9
N	2.01	26	121	4.5	257.1	257.1	257.9	0.9
O	2.20	26	130	3.9	259.6	259.6	260.4	0.9
P	2.23	26	150	3.4	261.5	261.5	261.8	0.3
Q	2.44	28	107	4.7	265.2	265.2	266.0	0.8
R	2.50	22	111	4.2	266.4	266.4	267.4	1.0
S	2.61	27	112	4.5	269.1	269.1	269.8	0.8
T	2.83	26	109	4.6	273.7	273.7	274.7	1.0
U	2.94	25	121	3.5	276.4	276.4	276.8	0.3
V	3.17	34	112	3.8	280.0	280.0	281.0	1.0
W	3.26	43	154	3.0	281.3	281.3	282.0	0.7
X	3.51	40	126	3.5	284.2	284.2	284.5	0.4
Y	3.60	21	81	5.1	285.6	285.6	285.8	0.2
Z	3.66	30	255	1.8	292.0	292.0	293.0	1.0

(1) Stream distance in miles above confluence with Salmon Creek

(2) Elevation computed without consideration of backwater from Salmon Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

WEAVER CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
WEAVER CREEK								
AA	3.77	48	387	1.0	293.8	293.8	294.7	0.9
AB	4.04	27	175	2.0	293.9	293.9	294.8	0.9
AC	4.16	14	122	2.4	298.7	298.7	299.3	0.7
AD	4.28	17	169	1.7	301.7	301.7	302.3	0.6
AE	4.69	23	99	3.2	302.0	302.0	302.9	0.9
AF	4.86	36	274	0.9	308.6	308.6	308.8	0.2
AG	5.08	28	52	3.7	309.4	309.4	309.8	0.4
AH	5.16	32	59	3.3	312.5	312.5	312.6	0.1
AI	5.28	21	76	2.6	318.4	318.4	319.2	0.9
AJ	5.40	26	71	3.8	321.6	321.6	321.9	0.4
AK	5.48	28	59	2.6	323.5	323.5	324.0	0.5
AL	5.73	21	24	6.2	333.6	333.6	333.6	0.0
AM	5.80	85	141	1.4	339.2	339.2	339.3	0.1
AN	5.85	26	74	2.0	341.9	341.9	341.9	0.0
AO	5.90	28	51	2.9	345.0	345.0	345.1	0.1

(1)Stream distance in miles above confluence with Salmon Creek

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

WEAVER CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
WHIPPLE CREEK								
A	0.77	36	309	2.7	28.5	19.1[2]	19.5[2]	0.4
B	0.78	42	334	2.5	28.5	19.5[2]	19.8[2]	0.3
C	0.86	80	422	2.5	28.5	19.7[2]	20.0[2]	0.3
D	0.97	140	566	2.3	28.5	19.7[2]	20.3[2]	0.6
E	1.11	222	760	1.6	28.5	19.7[2]	20.6[2]	0.9
F	1.29	180	330	4.0	28.5	20.3[2]	21.2[2]	0.9
G	1.44	198	390	3.4	28.5	22.2[2]	23.1[2]	0.9
H	1.61	197	423	3.4	28.5	24.1[2]	24.5[2]	0.4
I	1.87	220	257	4.9	28.5	27.0[2]	27.0[2]	0.0
J	2.04	159	347	3.3	28.5	28.5	29.1	0.7
K	2.12	12	92	7.3	29.9	29.9	30.9	1.0
L	2.30	24	128	5.2	34.5	34.5	35.0	0.5
M	2.42	26	124	5.4	37.9	37.9	38.7	0.7
N	2.52	31	129	5.1	42.0	42.0	42.7	0.7
O	2.92	23	145	4.6	58.1	58.1	58.8	0.7
P	3.03	21	143	4.7	62.1	62.1	63.0	0.9
Q	3.04	26	153	4.8	62.7	62.7	63.3	0.6
R	3.08	25	191	3.5	63.7	63.7	64.4	0.7
S	3.13	26	202	3.3	64.3	64.3	65.1	0.8
T	3.15	30	299	2.2	65.4	65.4	66.2	0.8
U	3.20	26	208	3.2	65.7	65.7	66.6	0.9
V	3.25	22	175	2.7	66.2	66.2	67.1	0.9
W	3.64	20	144	3.3	71.4	71.4	72.4	1.0
X	4.18	19	114	4.2	81.3	81.3	81.8	0.4
Y	4.62	18	133	3.6	87.1	87.1	87.8	0.6
Z	5.01	29	220	2.7	95.0	95.0	95.9	0.9

(1) Stream distance in miles above confluence with Columbia River

(2) Elevation computed without consideration of backwater from Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

WHIPPLE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F. P. S.)	REGULATORY (NAVD88)	WITHOUT FLOODWAY (NAVD88)	WITH FLOODWAY (NAVD88)	INCREASE
WHIPPLE CREEK								
AA	5.03	24	204	2.9	95.2	95.2	96.2	1.0
AB	5.26	22	165	2.2	96.4	96.4	97.3	0.9
AC	5.27	25	173	2.5	98.3	98.3	98.8	0.5
AD	5.63	14	93	3.8	103.2	103.2	104.1	0.9
AE	5.87	12	73	4.9	109.7	109.7	110.6	0.9
AF	5.88	20	133	2.7	112.3	112.3	112.7	0.5
AG	6.09	66	173	3.0	116.2	116.2	116.6	0.4
AH	6.20	67	164	3.4	117.9	117.9	118.9	1.0
AI	6.50	28	111	3.9	125.8	125.8	126.6	0.8
AJ	6.60	14	98	3.6	127.6	127.6	128.5	0.9
AK	6.61	20	165	2.3	131.6	131.6	132.1	0.5
AL	6.87	23	99	4.8	135.6	135.6	136.6	1.0
AM	7.18	10	50	3.5	147.7	147.7	148.3	0.6
AN	7.25	23	98	2.1	154.5	154.5	154.5	0.0
AO	7.37	17	36	4.8	160.3	160.3	160.4	0.2
AP	7.39	29	153	1.2	166.6	166.6	166.6	0.0
AQ	7.61	10	40	4.2	181.9	181.9	182.7	0.7
AR	7.77	11	48	3.5	194.7	194.7	195.5	0.8
AS	8.02	23	61	3.0	205.8	205.8	206.7	0.9
AT	8.35	22	72	2.7	215.5	215.5	216.5	1.0
AU	8.54	17	29	3.0	220.5	220.5	221.1	0.6
AV	8.55	16	60	1.4	222.3	222.3	222.4	0.1
AW	8.75	13	36	2.3	229.5	229.5	230.2	0.7
AX	9.10	35	77	1.2	238.6	238.6	239.6	0.9
AY	9.37	83	99	0.9	241.0	241.0	241.4	0.4

(1)Stream distance in miles above confluence with Columbia River

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WASHINGTON

AND INCORPORATED AREAS

FLOODWAY DATA

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

Zone AE

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

Zone AH

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

Zone X

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

Zone D

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

6.0 FLOOD INSURANCE RATE MAP

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

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

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

The countywide FIRM presents flooding information for the entire geographic area of Clark County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. This countywide FIRM also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps, where applicable. Historical data relating to the maps prepared for each community are presented in Table 7, "Community Map History".

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE(S)
Battle Ground, City of	May 24, 1974	December 26, 1975	April 15, 1981	None
Camas, City of	June 14, 1974	June 11, 1976	February 18, 1981	None
Clark County (Unincorporated Areas)	September 6, 1974	June 7, 1977	August 2, 1982	July 19, 2000 August 19, 1986 May 2, 1991
La Center, City of	November 12, 1976	None	September 29, 1986	None
Ridgefield, City of	January 24, 1975	December 24, 1976	May 19, 1981	None
Vancouver, City of	August 2, 1974	November 14, 1975	August 17, 1981	None
Washougal, City of	March 15, 1974	August 6, 1976	March 2, 1981	May 17, 1982
Yacolt, Town of	July 2, 1976	None	None	None

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

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 the 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 Federal Insurance and Mitigation Division, FEMA Region X, Federal Regional Center, 130 228th Street, SW, Bothell, Washington 98021-9796.

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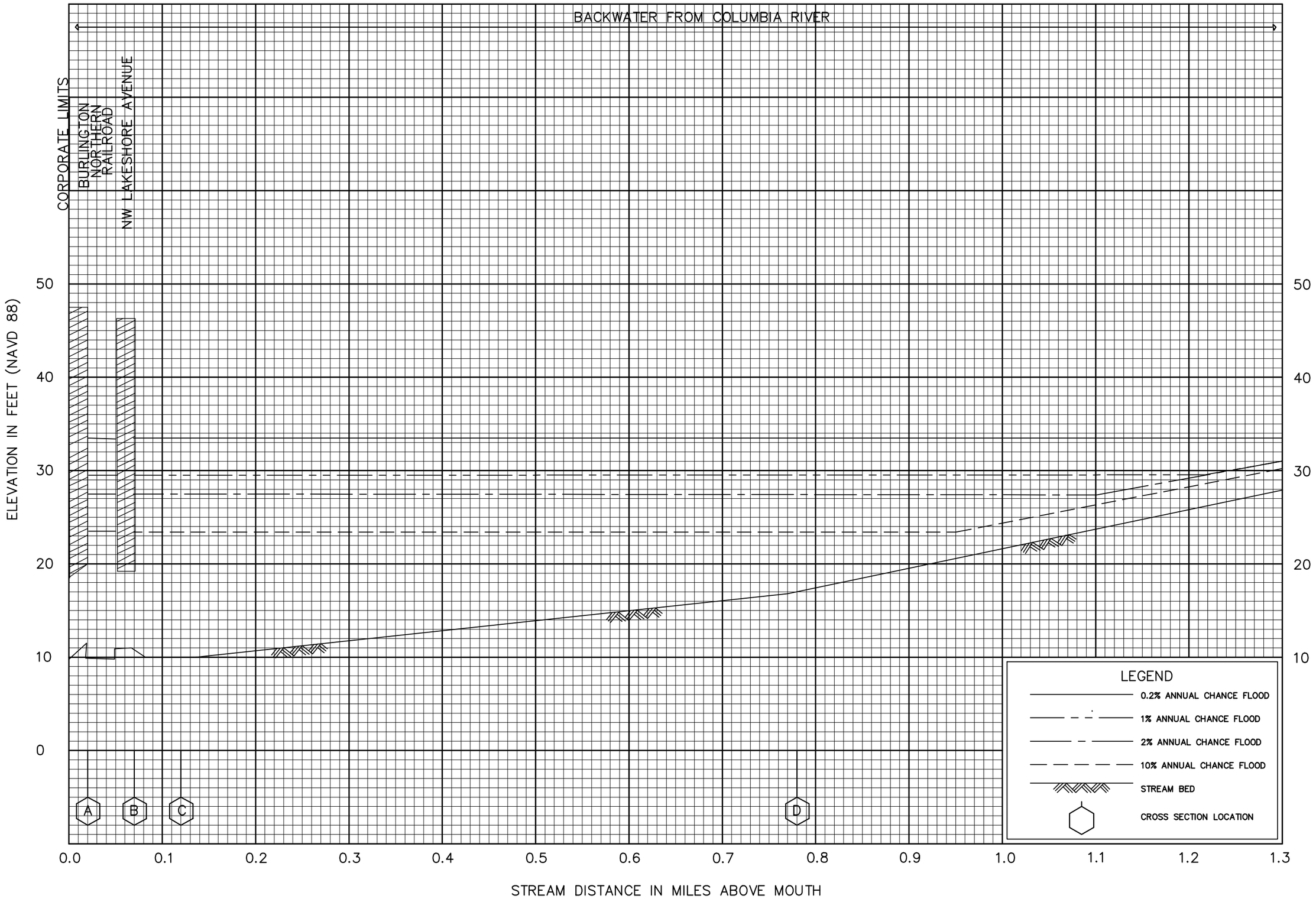
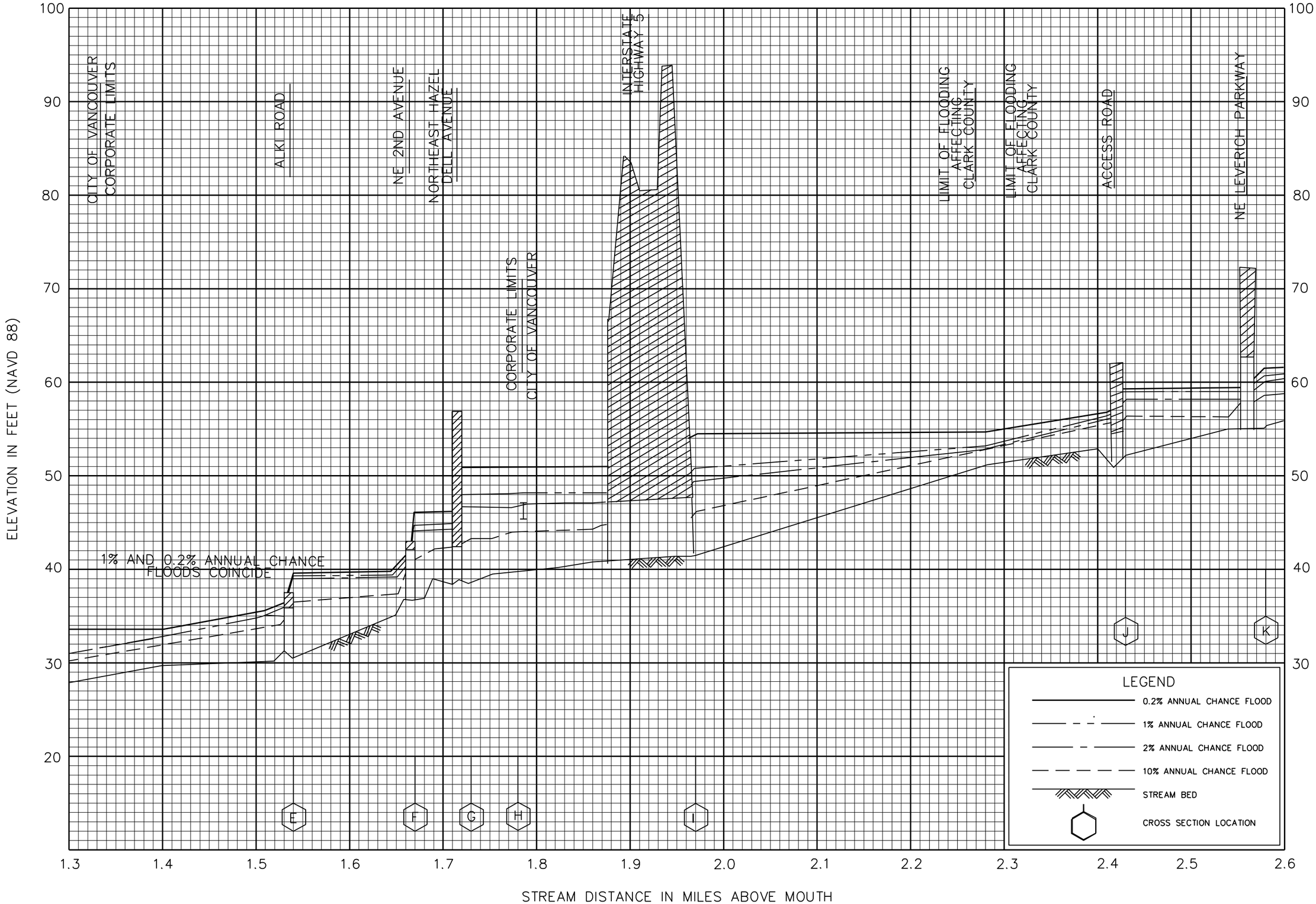


FLOOD PROFILES

BURNT BRIDGE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

BURNT BRIDGE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

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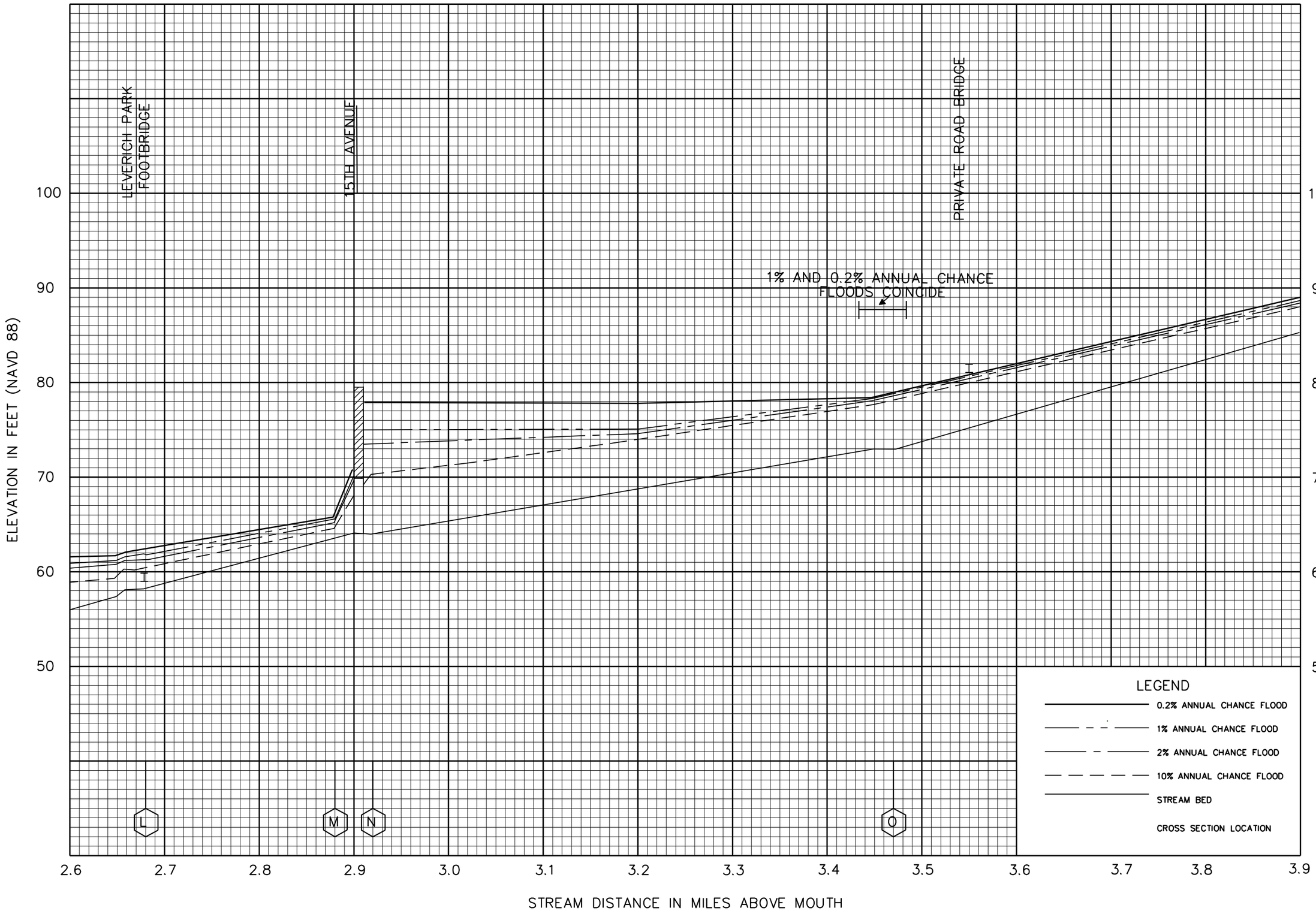

FLOOD PROFILES

BURNT BRIDGE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
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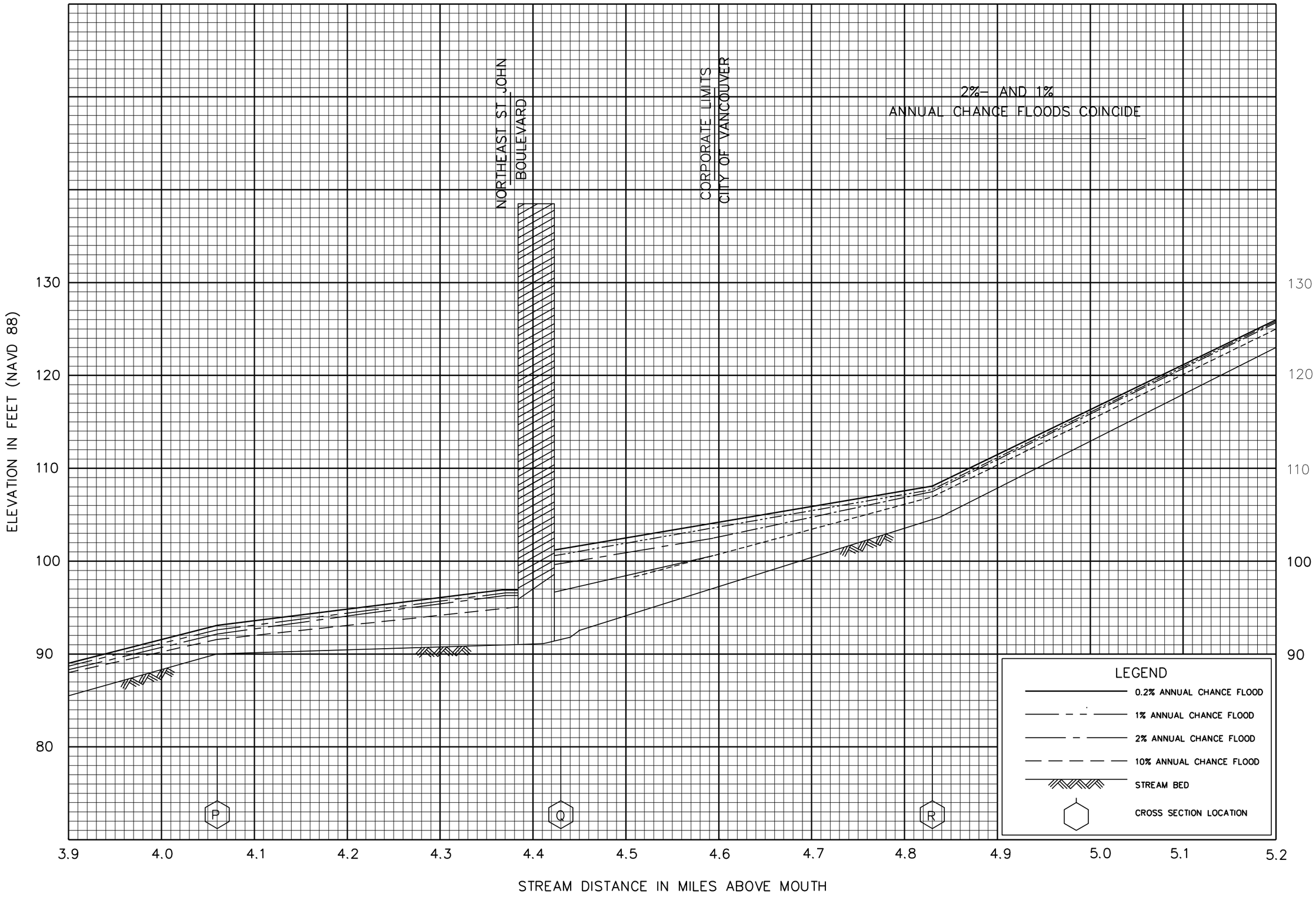

FLOOD PROFILES

BURNT BRIDGE CREEK

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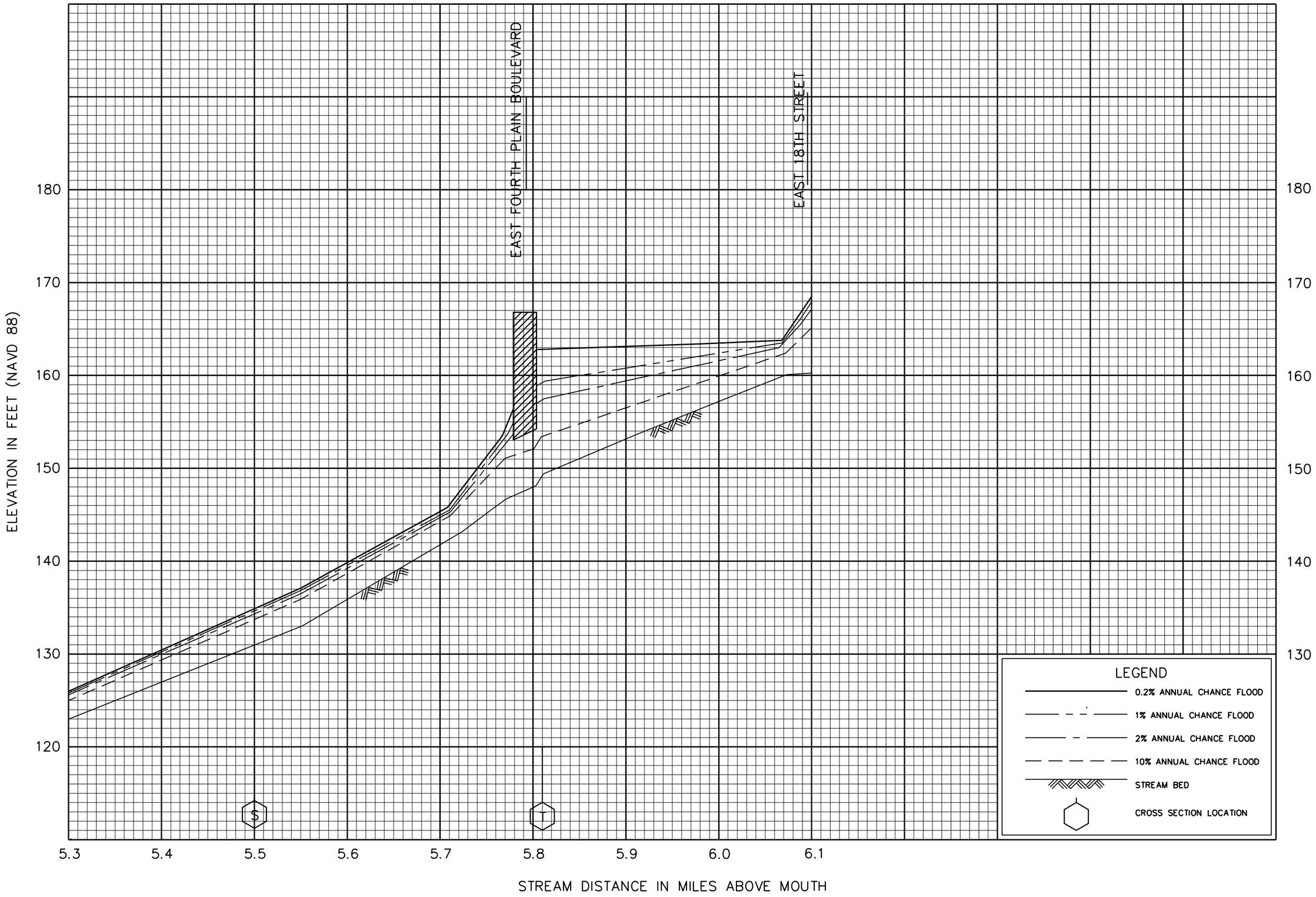

FLOOD PROFILES

BURNT BRIDGE CREEK

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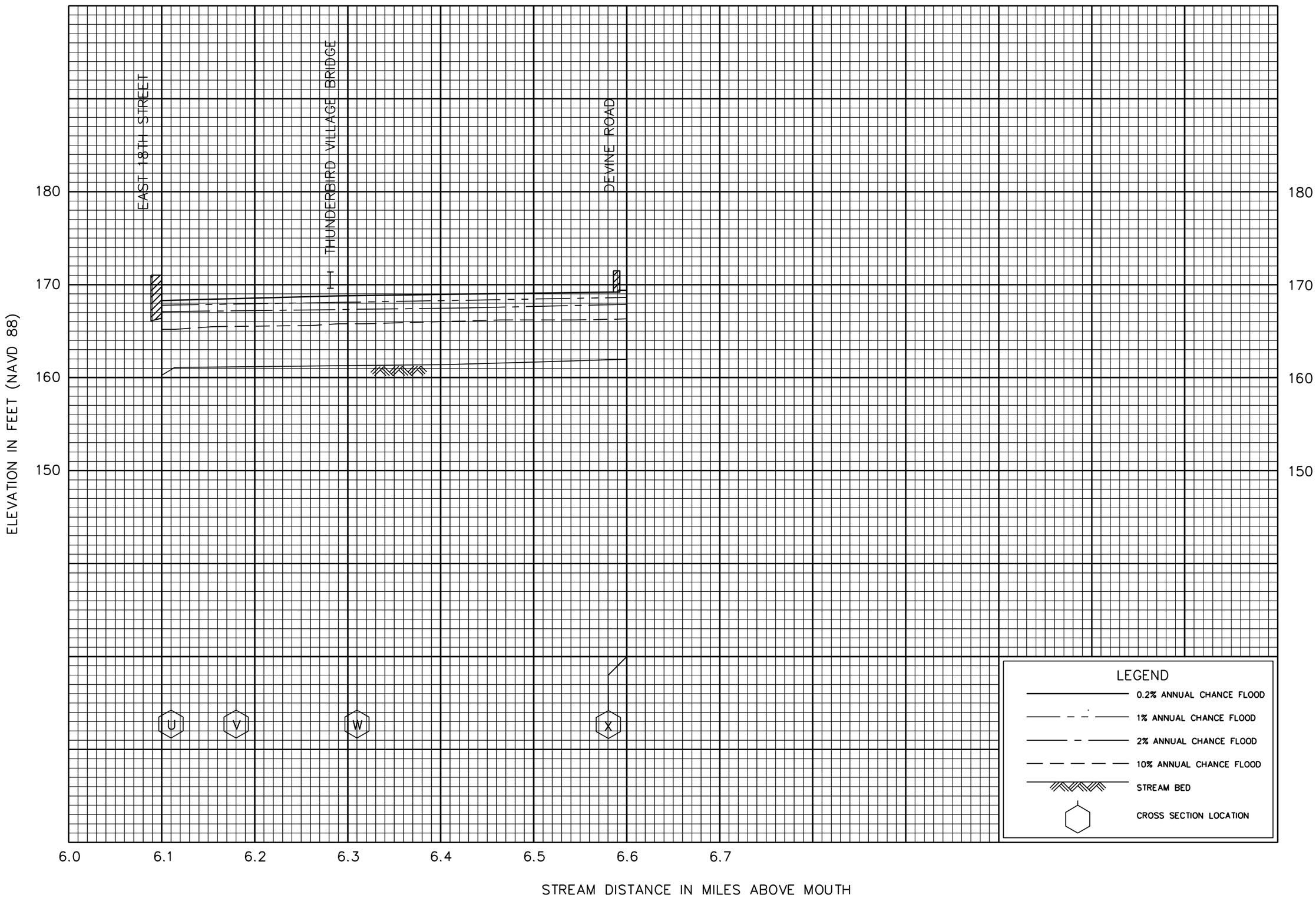

FLOOD PROFILES

BURNT BRIDGE CREEK

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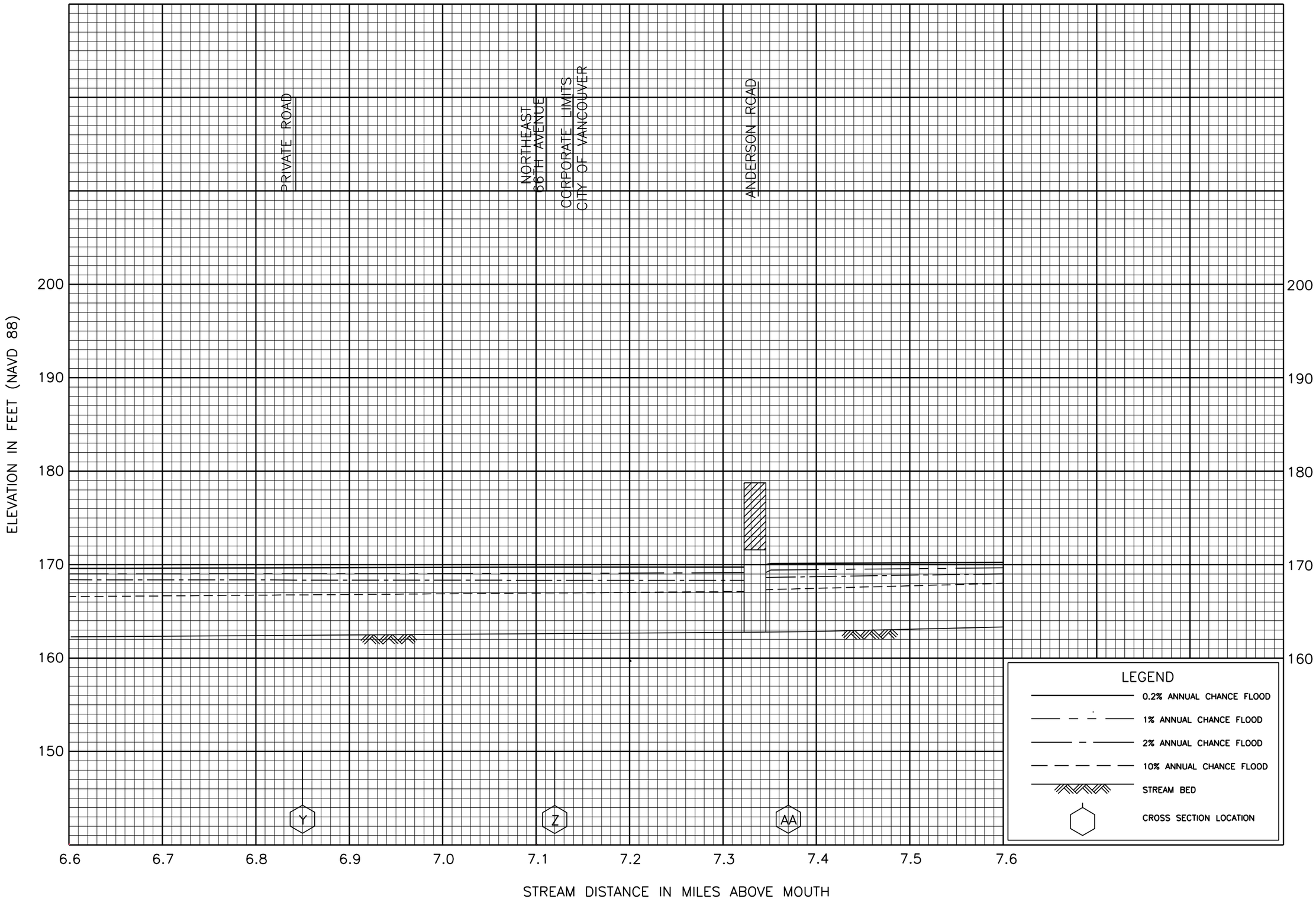

FLOOD PROFILES

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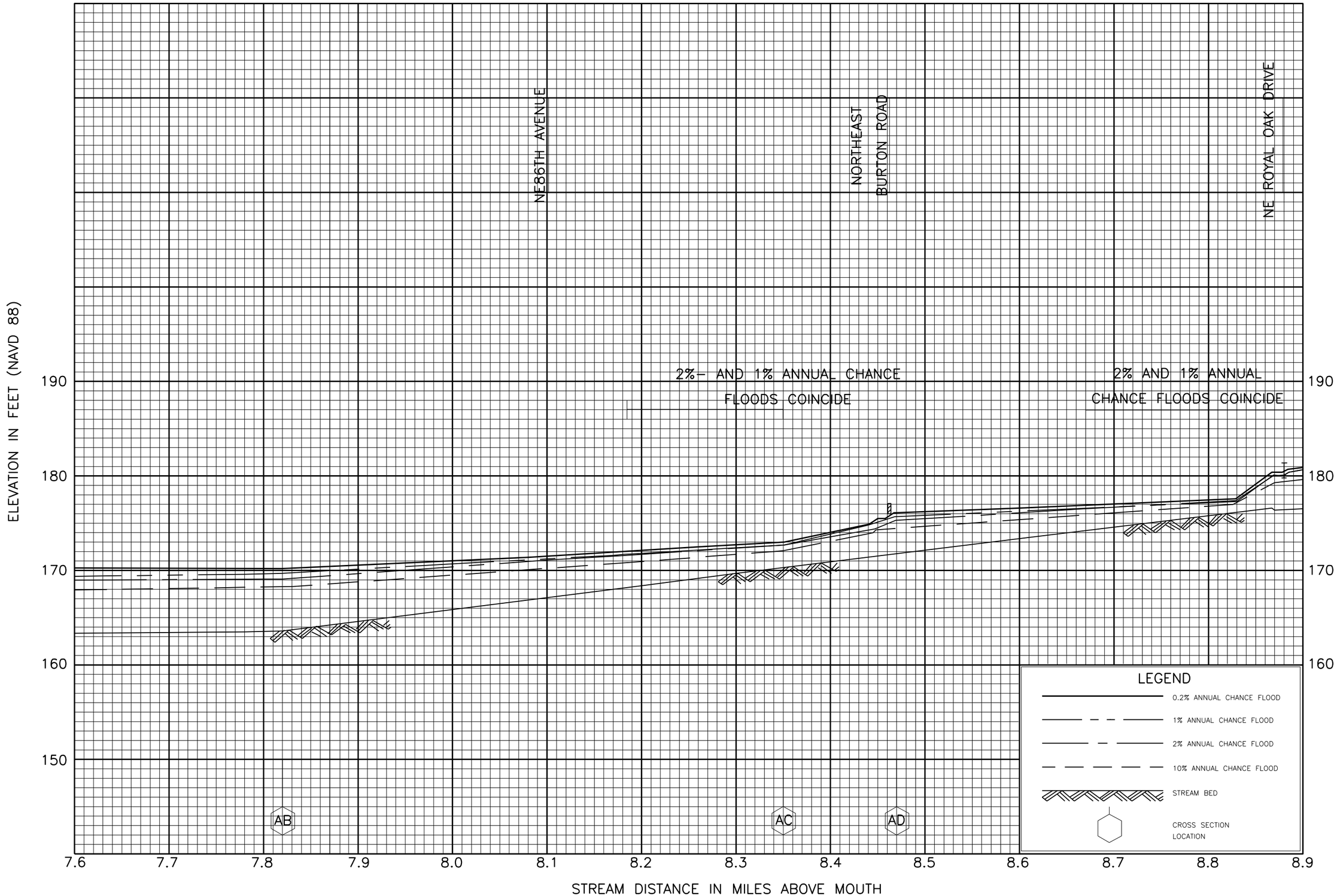

FLOOD PROFILES

BURNT BRIDGE CREEK

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CLARK COUNTY, WA
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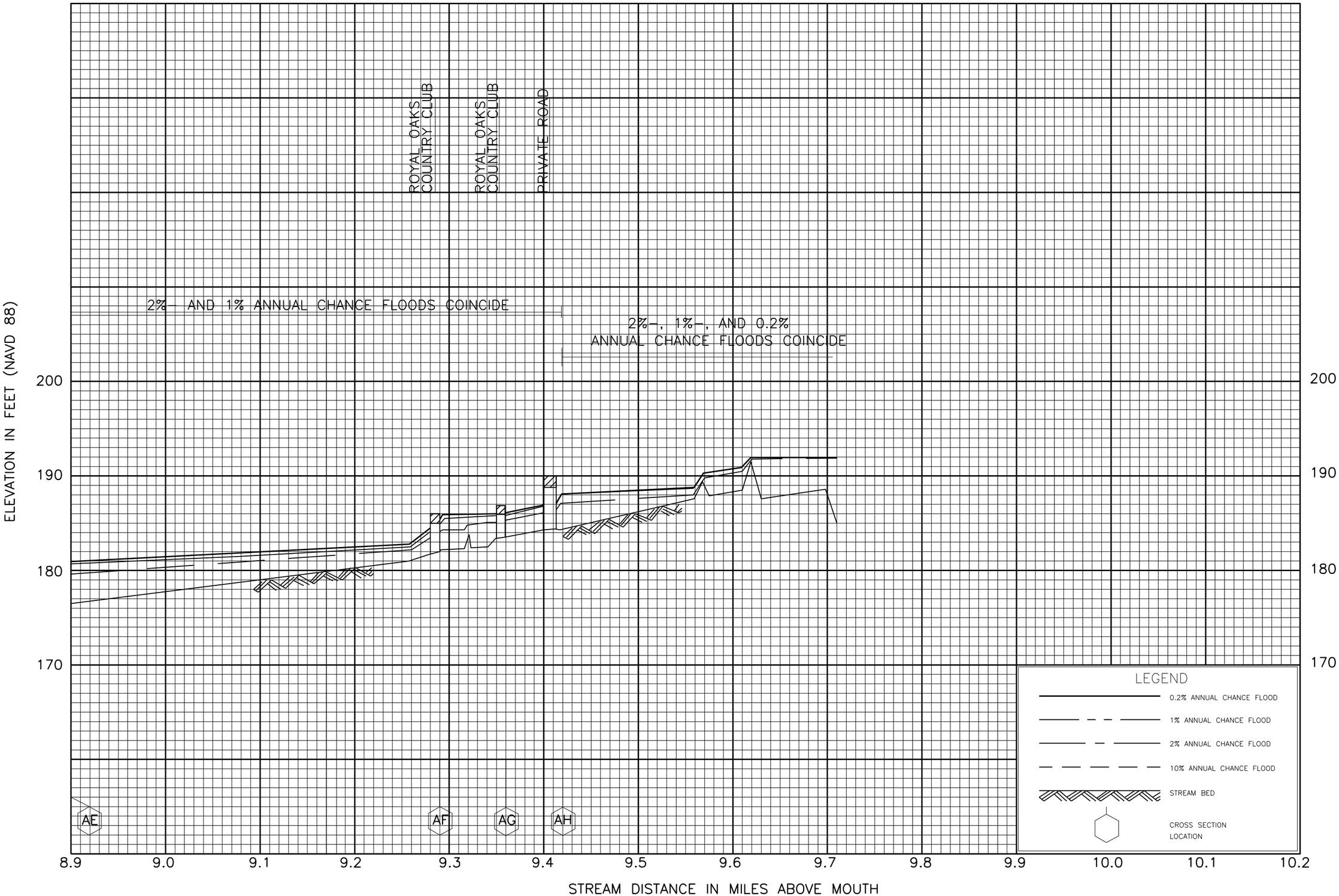

FLOOD PROFILES

BURNT BRIDGE CREEK

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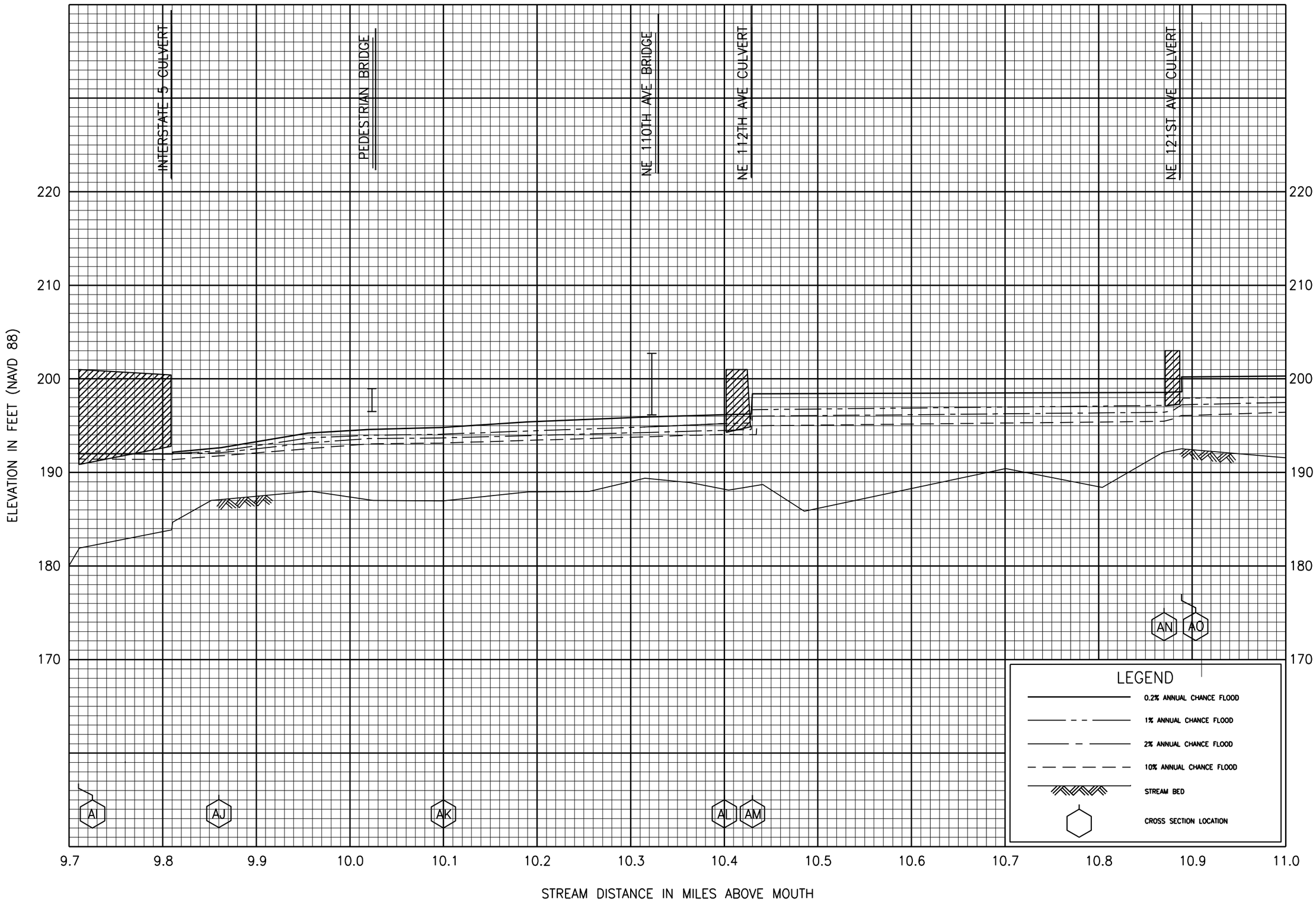

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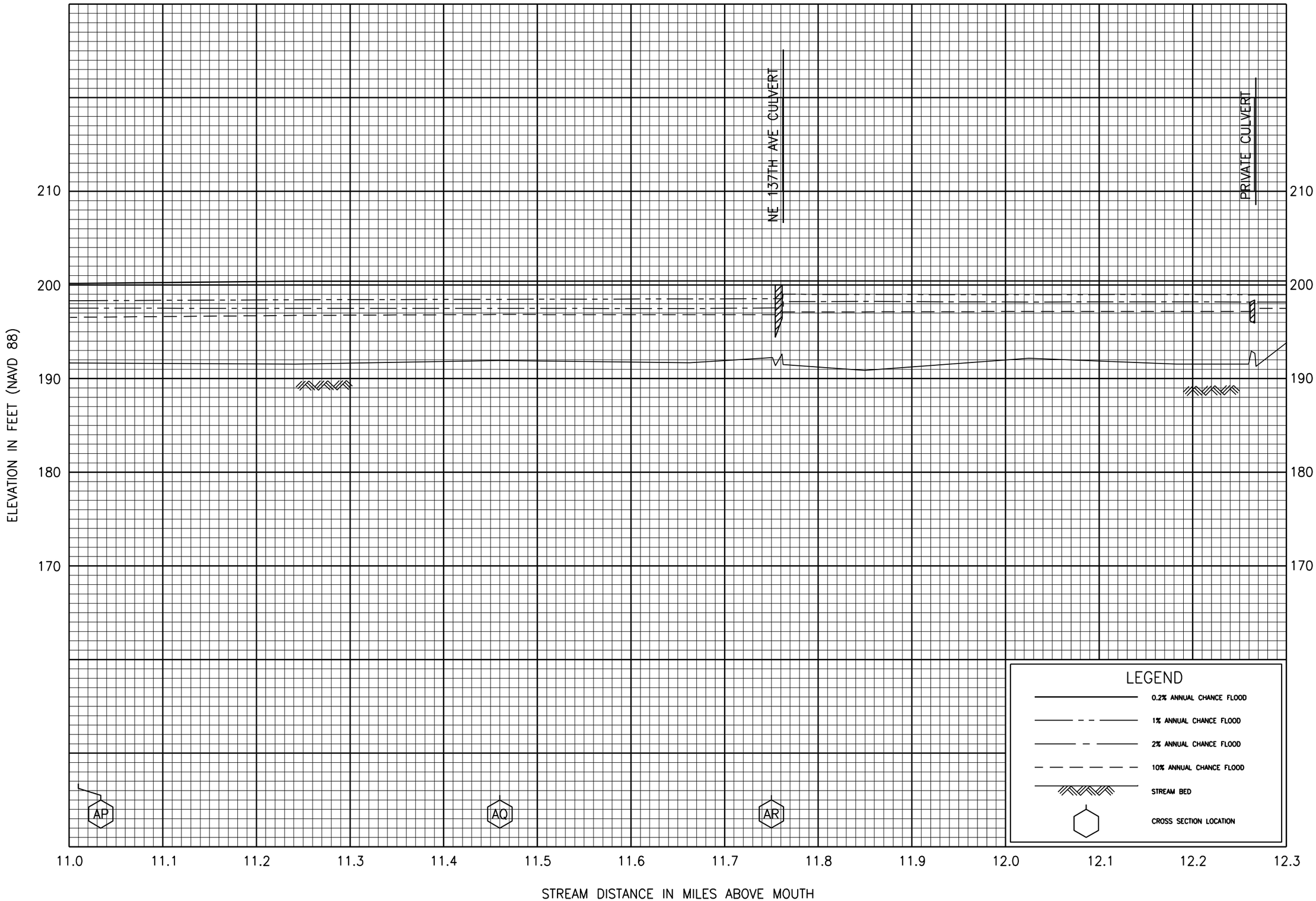

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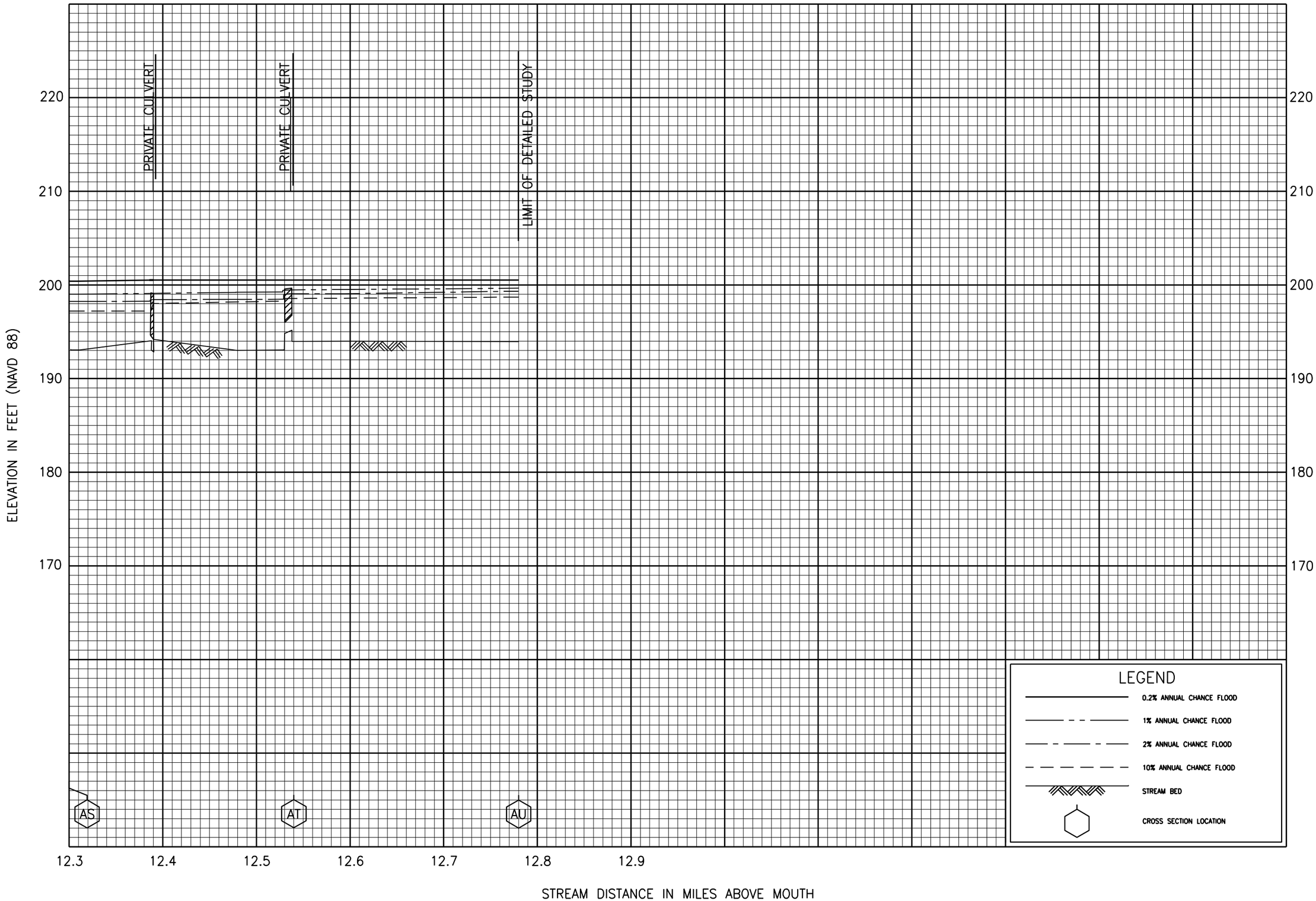

FLOOD PROFILES

BURNT BRIDGE CREEK

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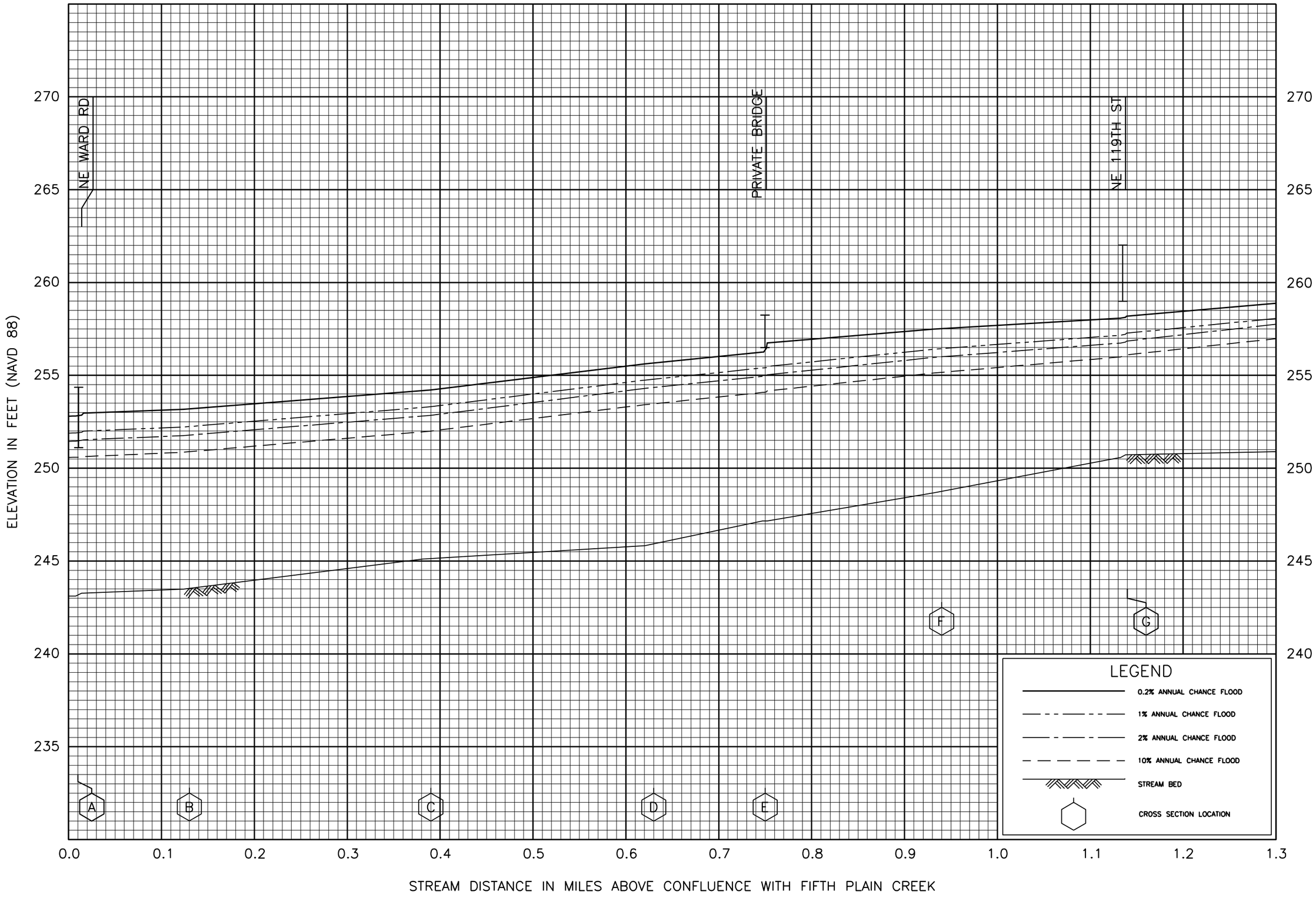

FLOOD PROFILES

CHINA DITCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
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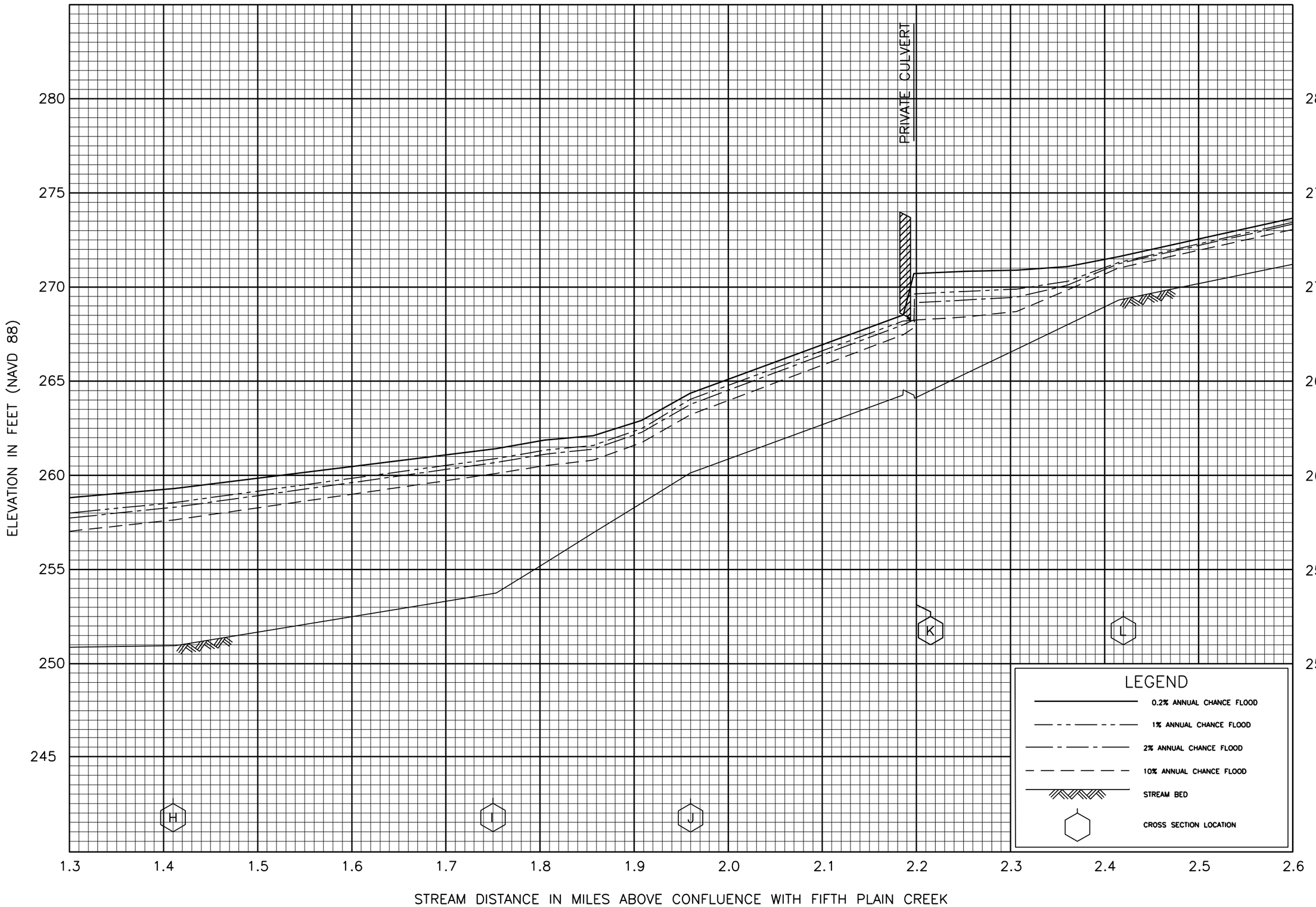

FLOOD PROFILES

CHINA DITCH

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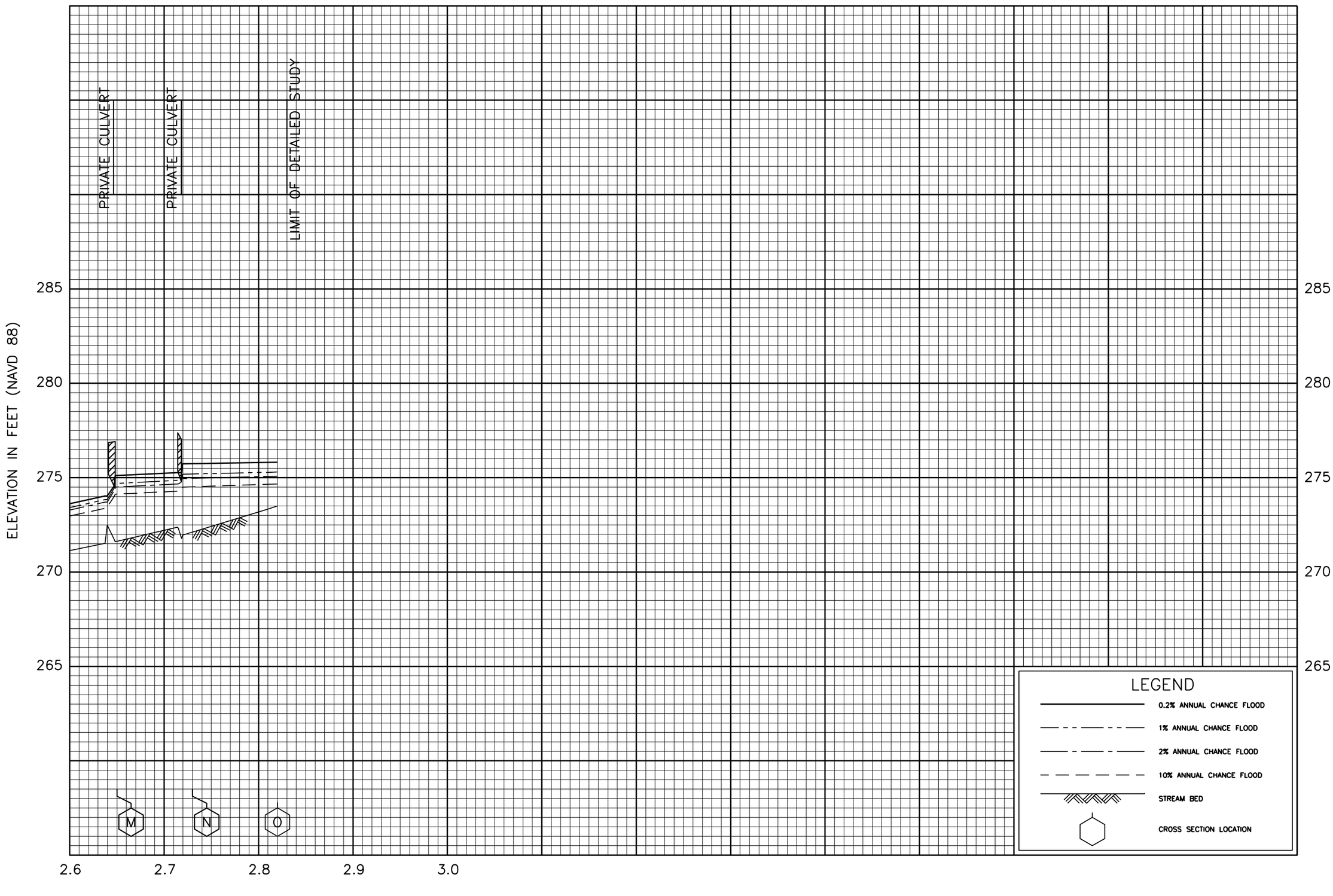

FLOOD PROFILES

CHINA DITCH

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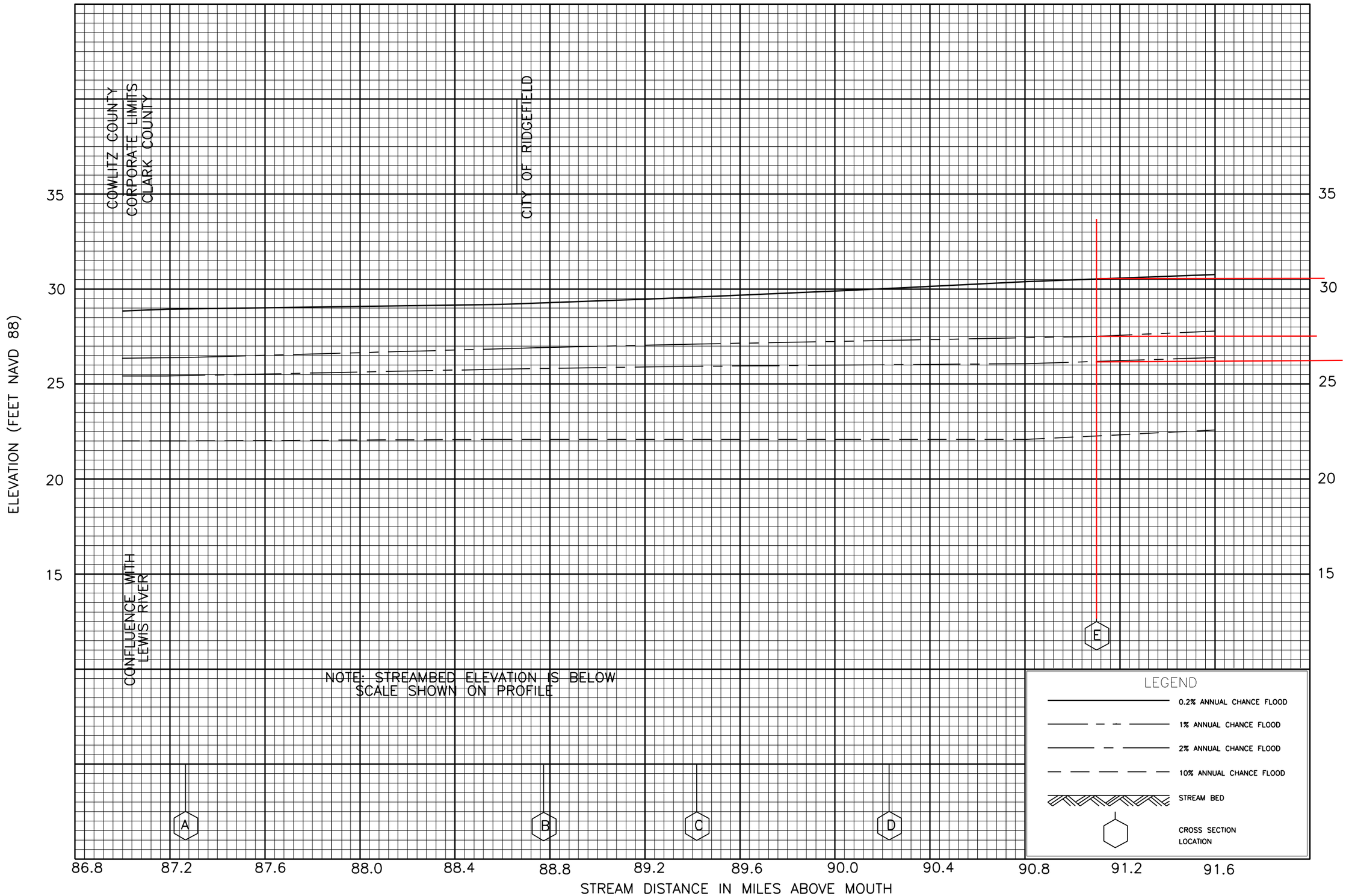

FLOOD PROFILES

COLUMBIA RIVER

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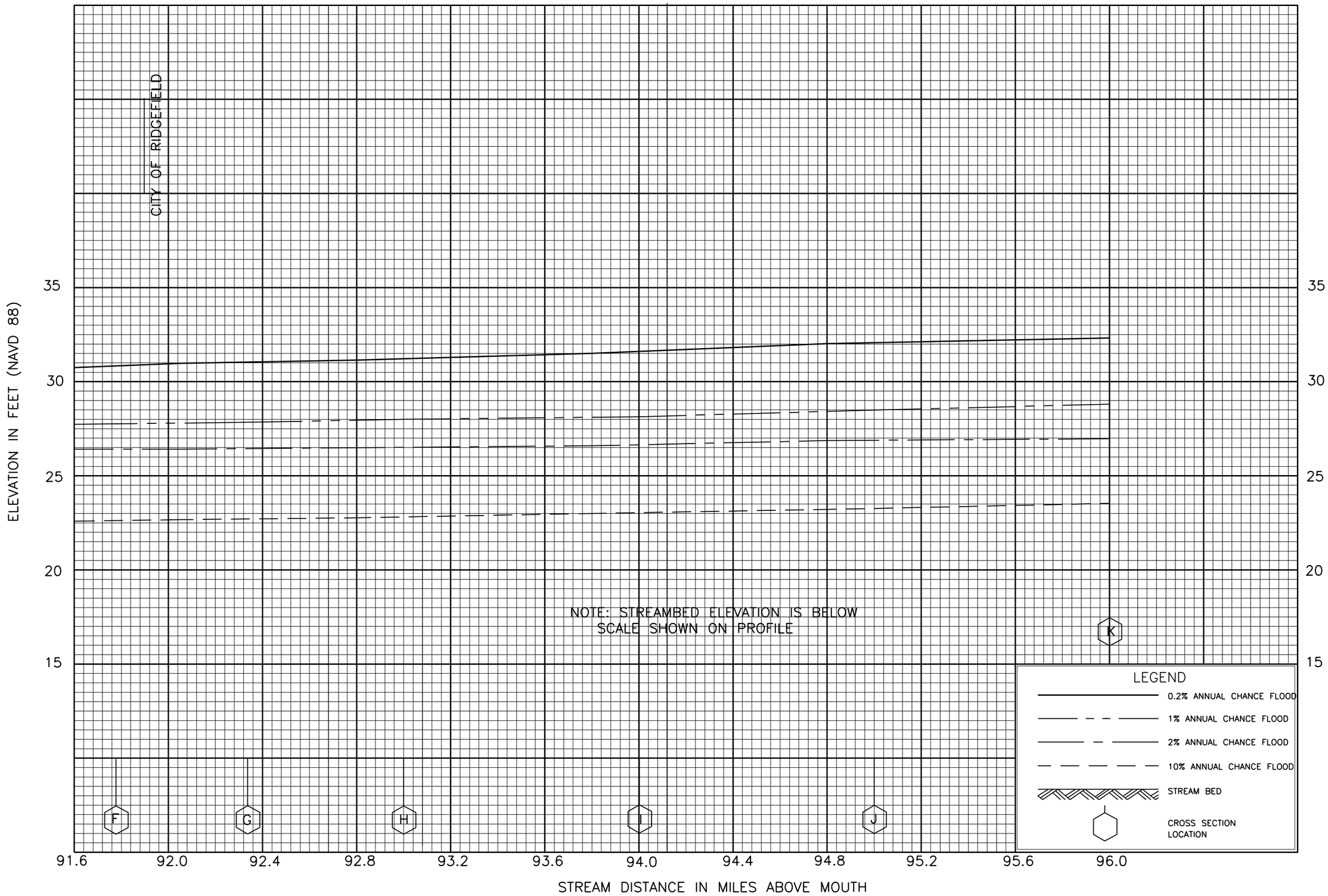

FLOOD PROFILES

COLUMBIA RIVER

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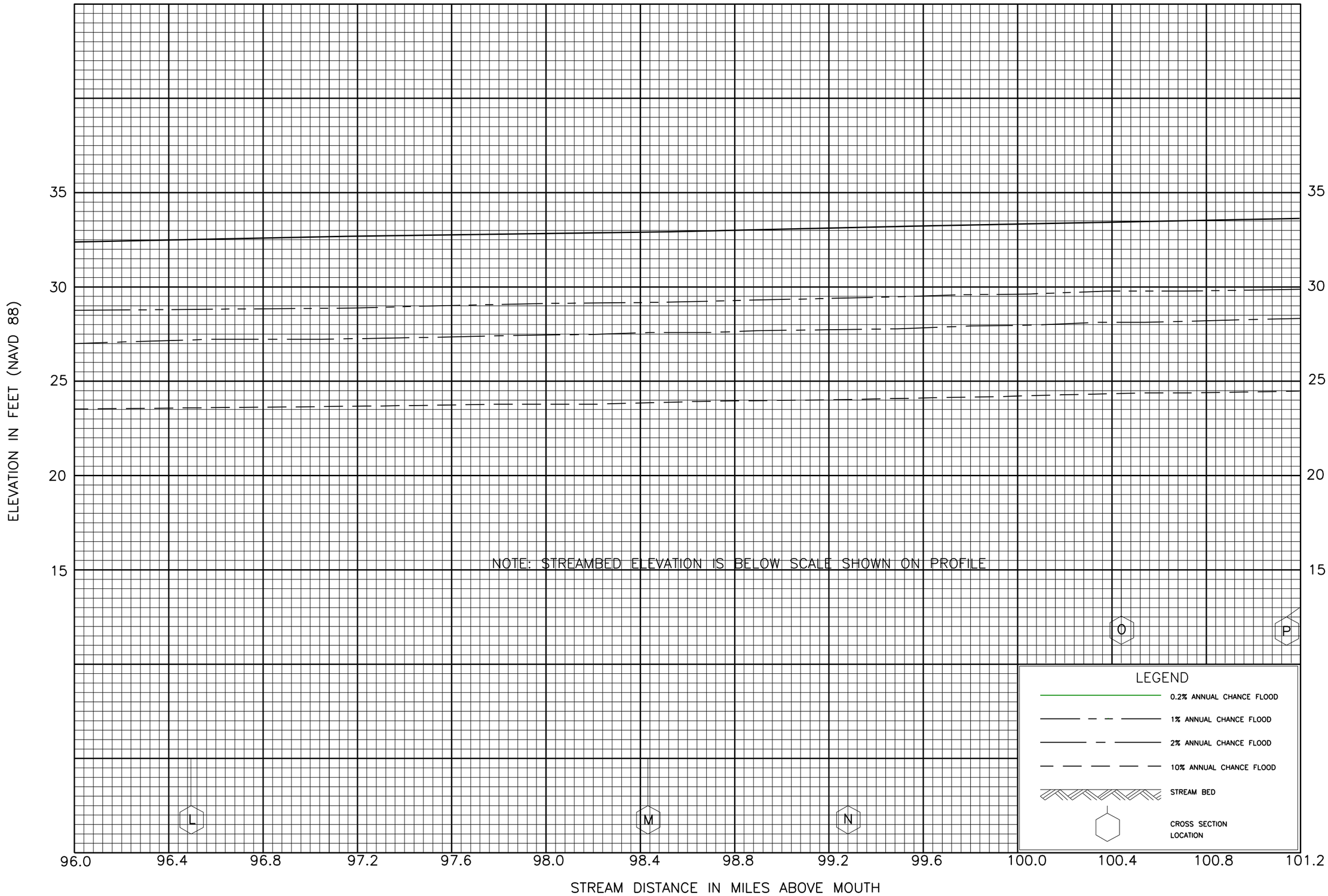

FLOOD PROFILES

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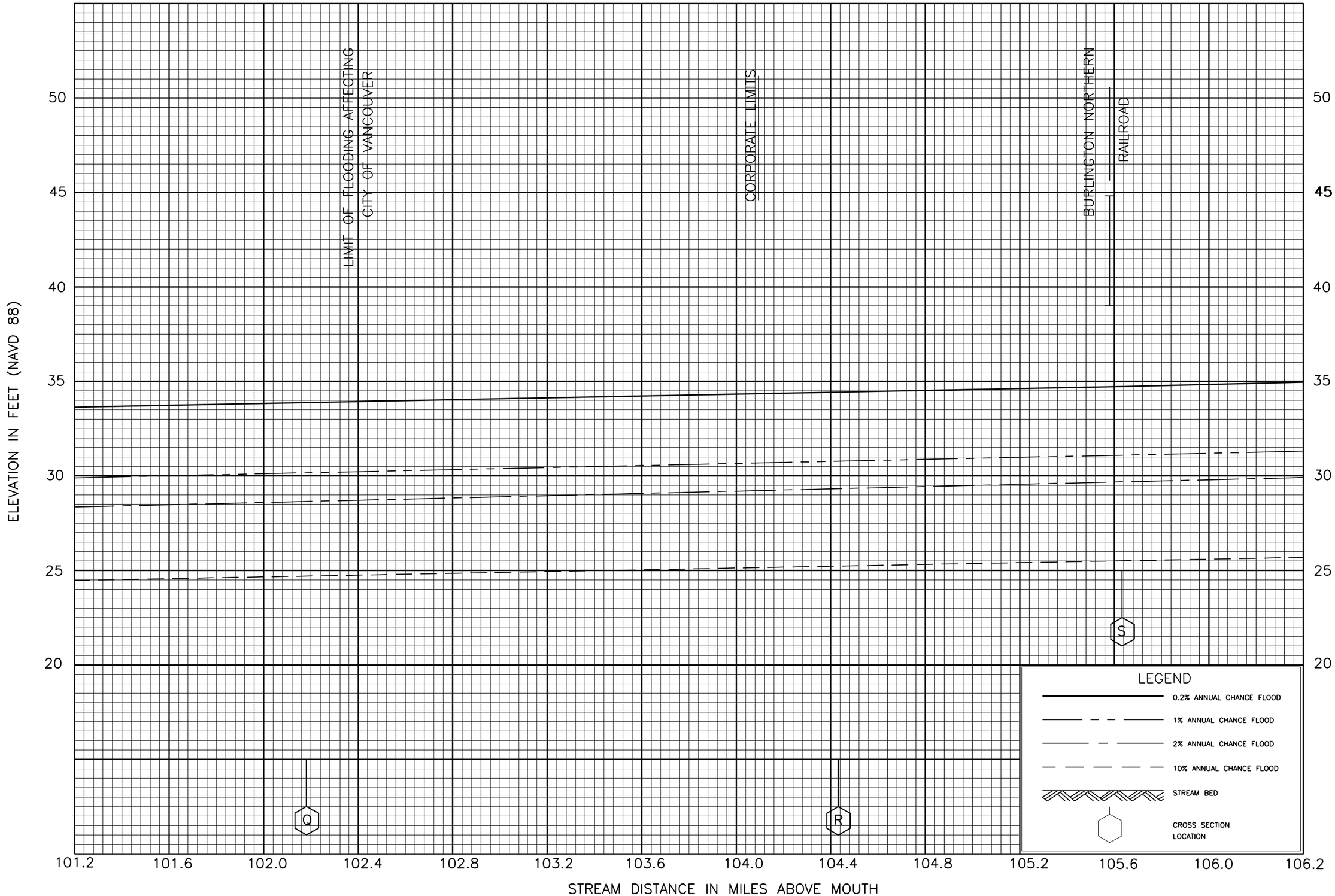

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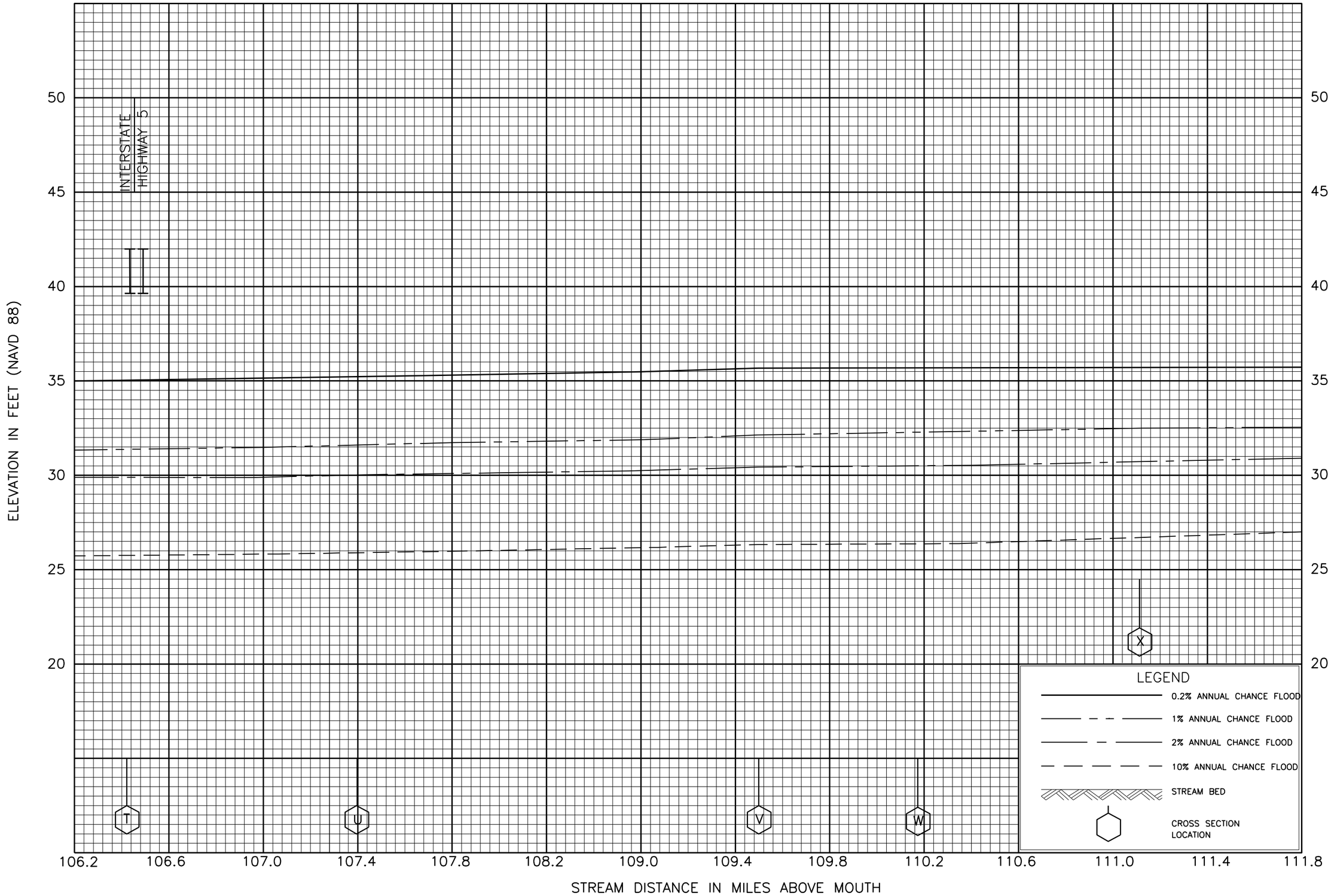

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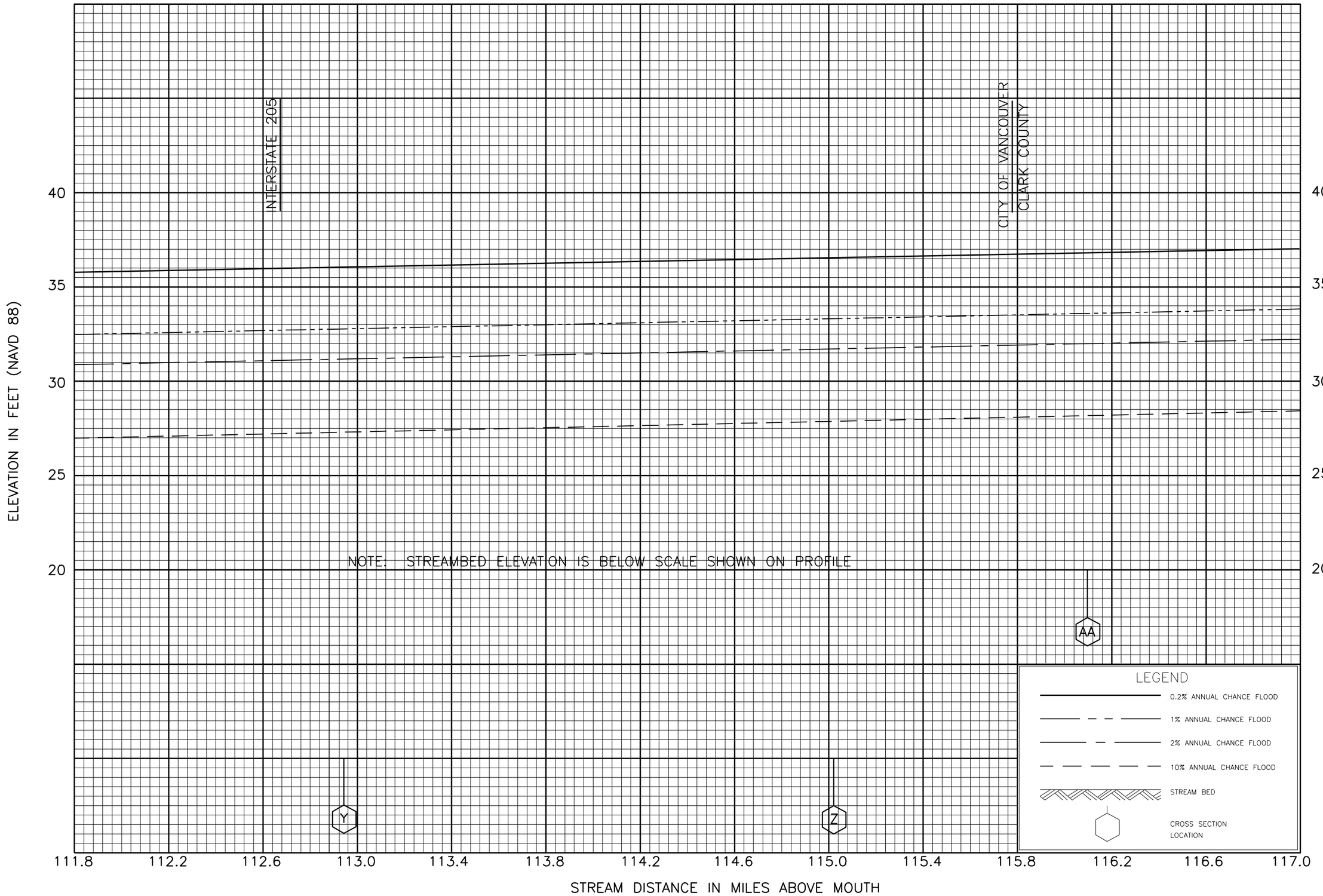

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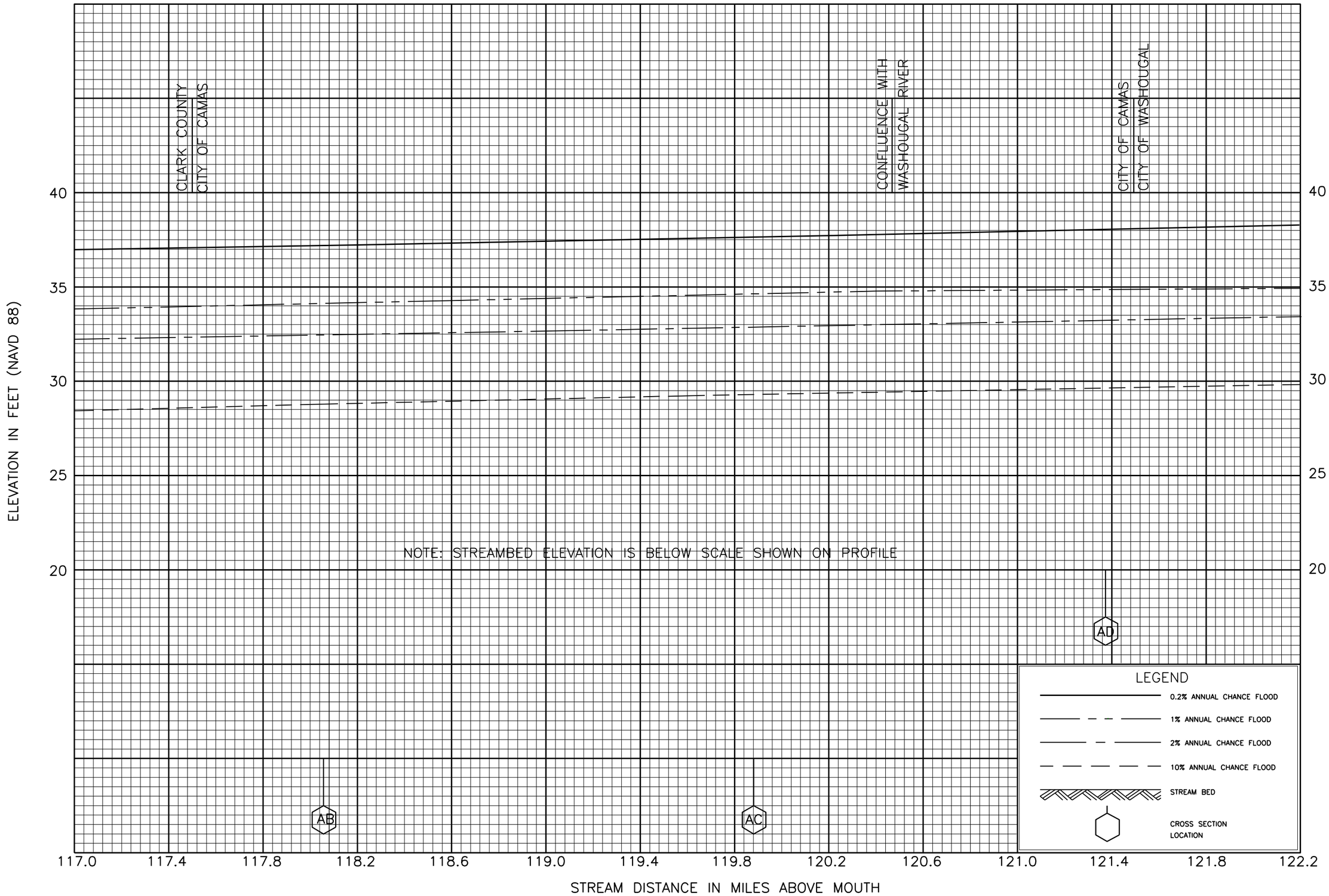

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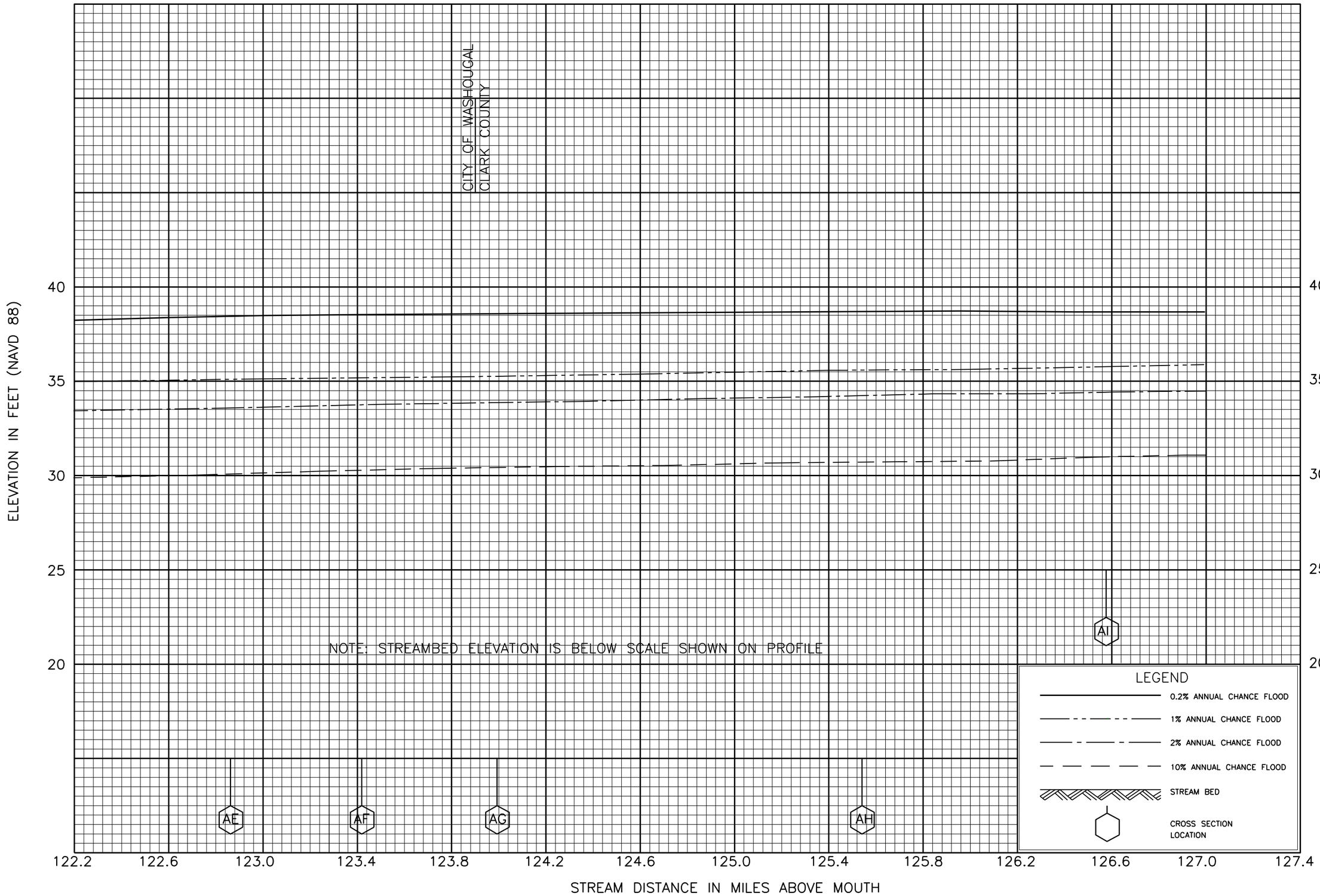

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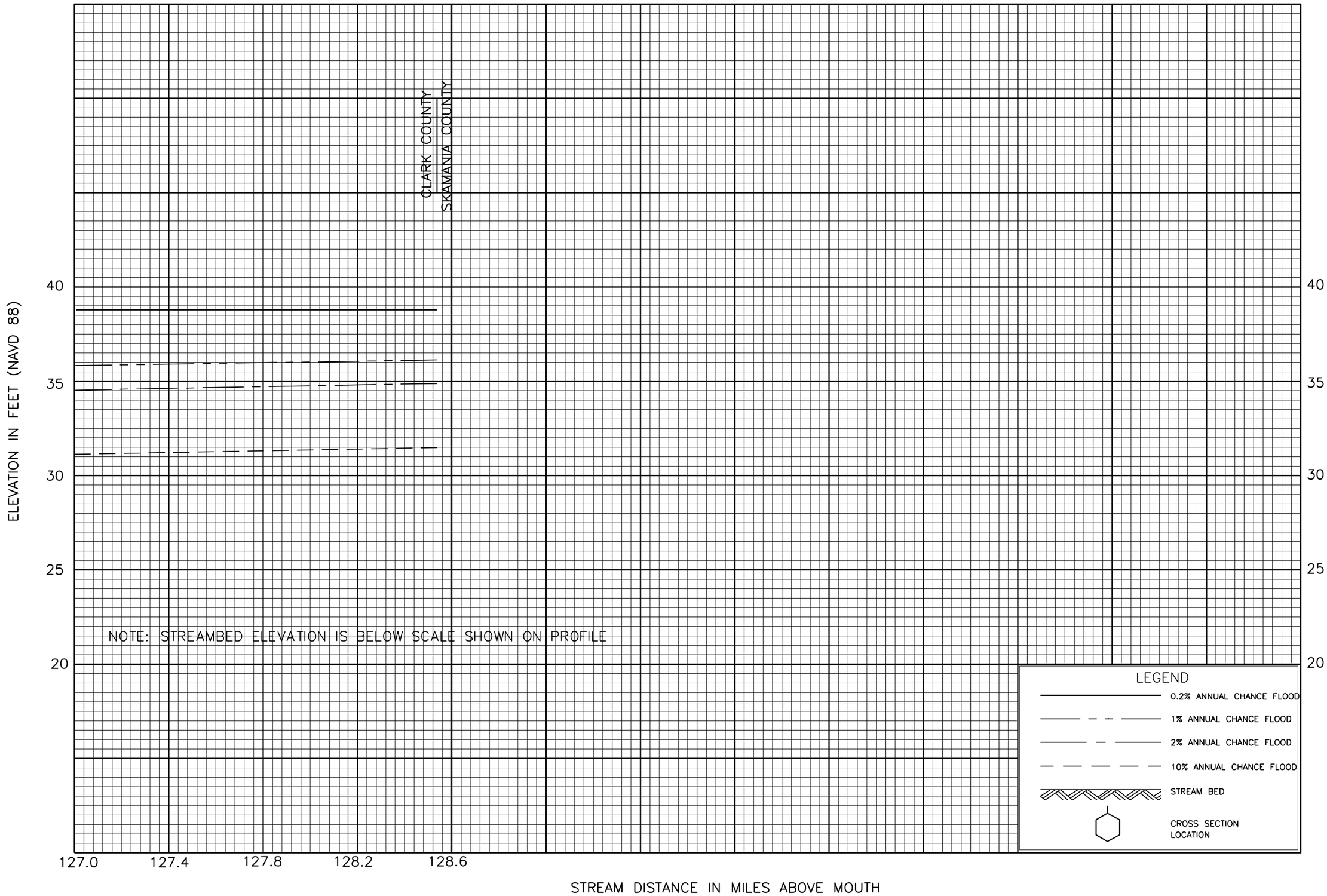

FLOOD PROFILES

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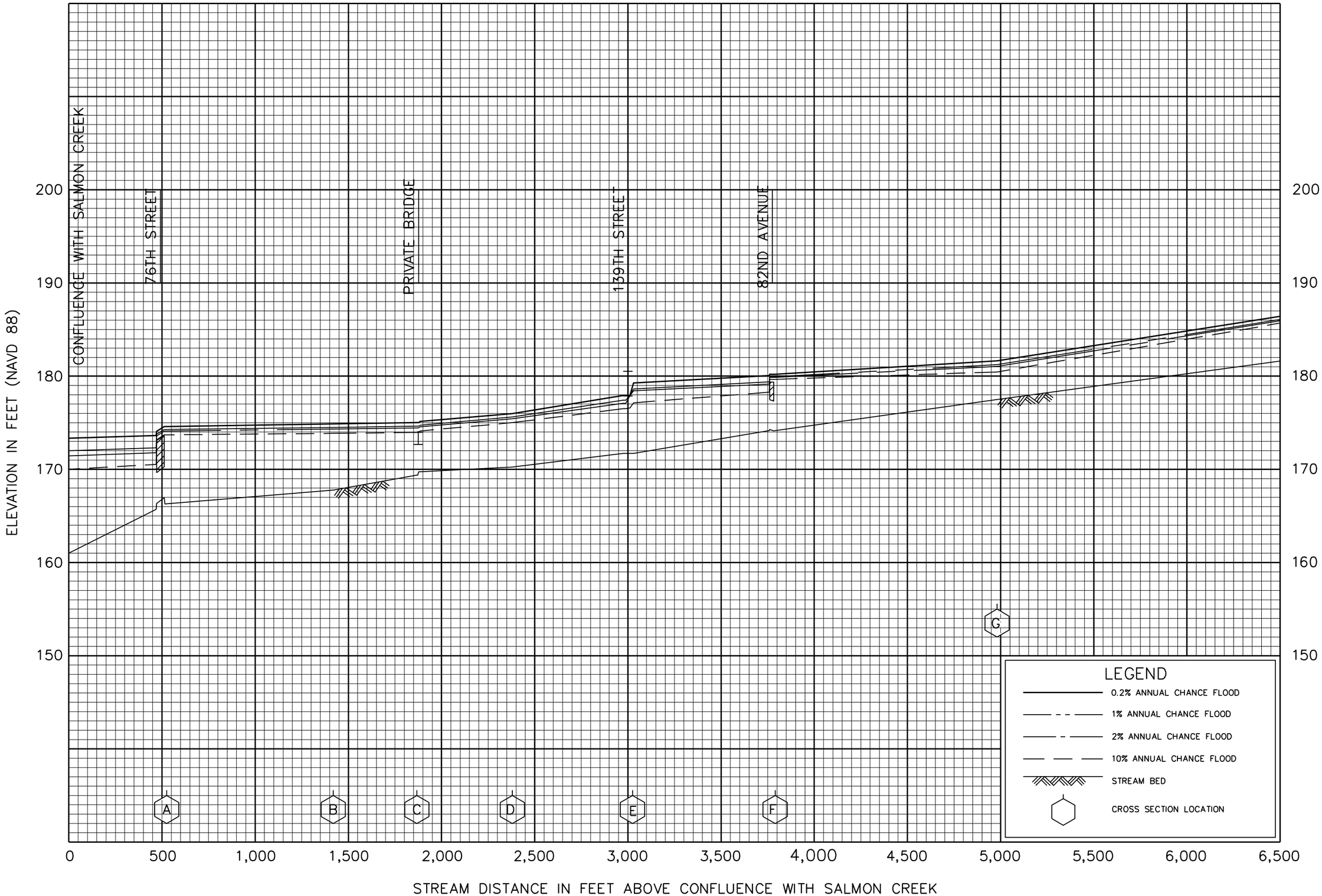
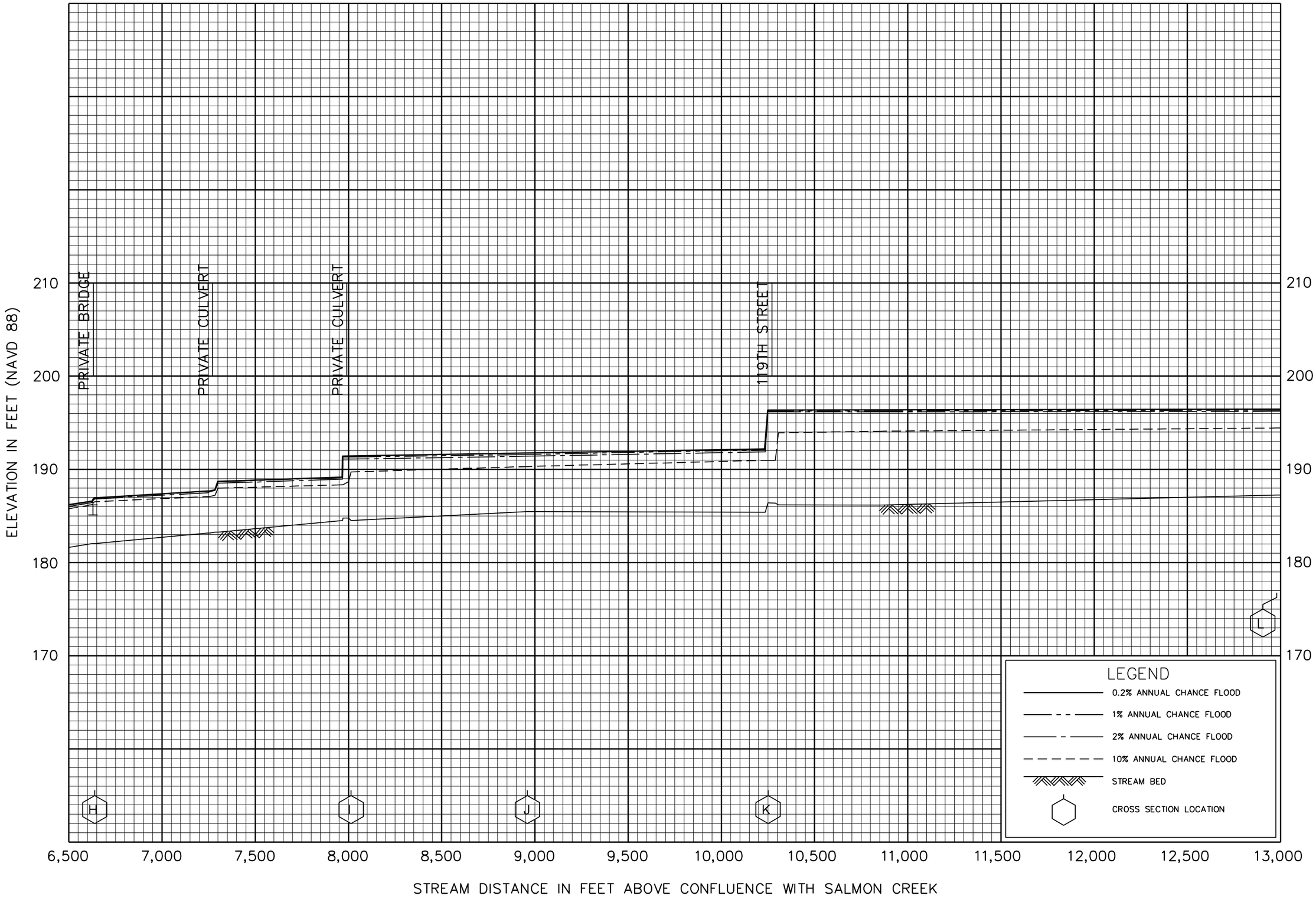


FLOOD PROFILES

CURTIN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

CURTIN CREEK

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CLARK COUNTY, WA
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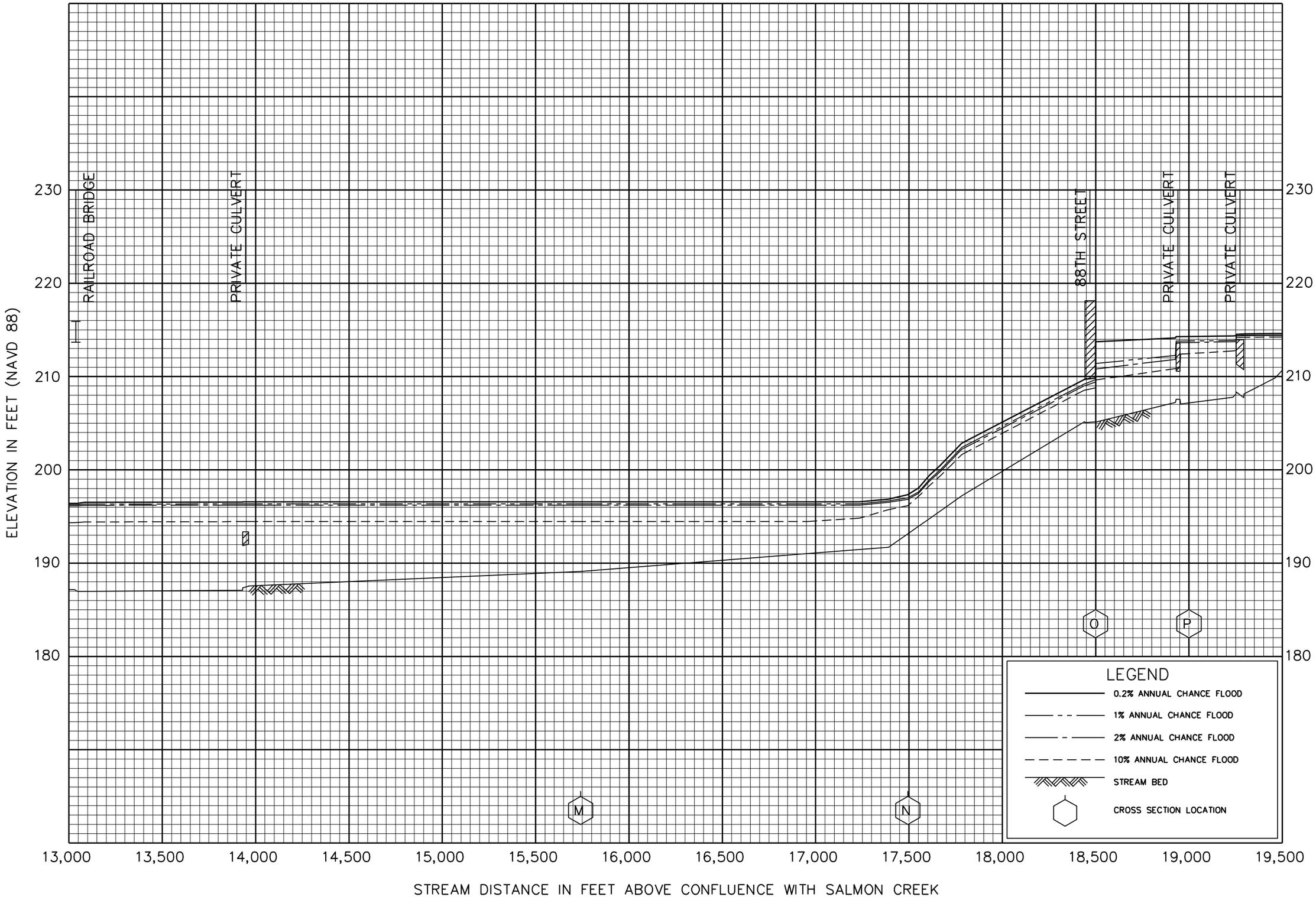

FLOOD PROFILES

CURTIN CREEK

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CLARK COUNTY, WA
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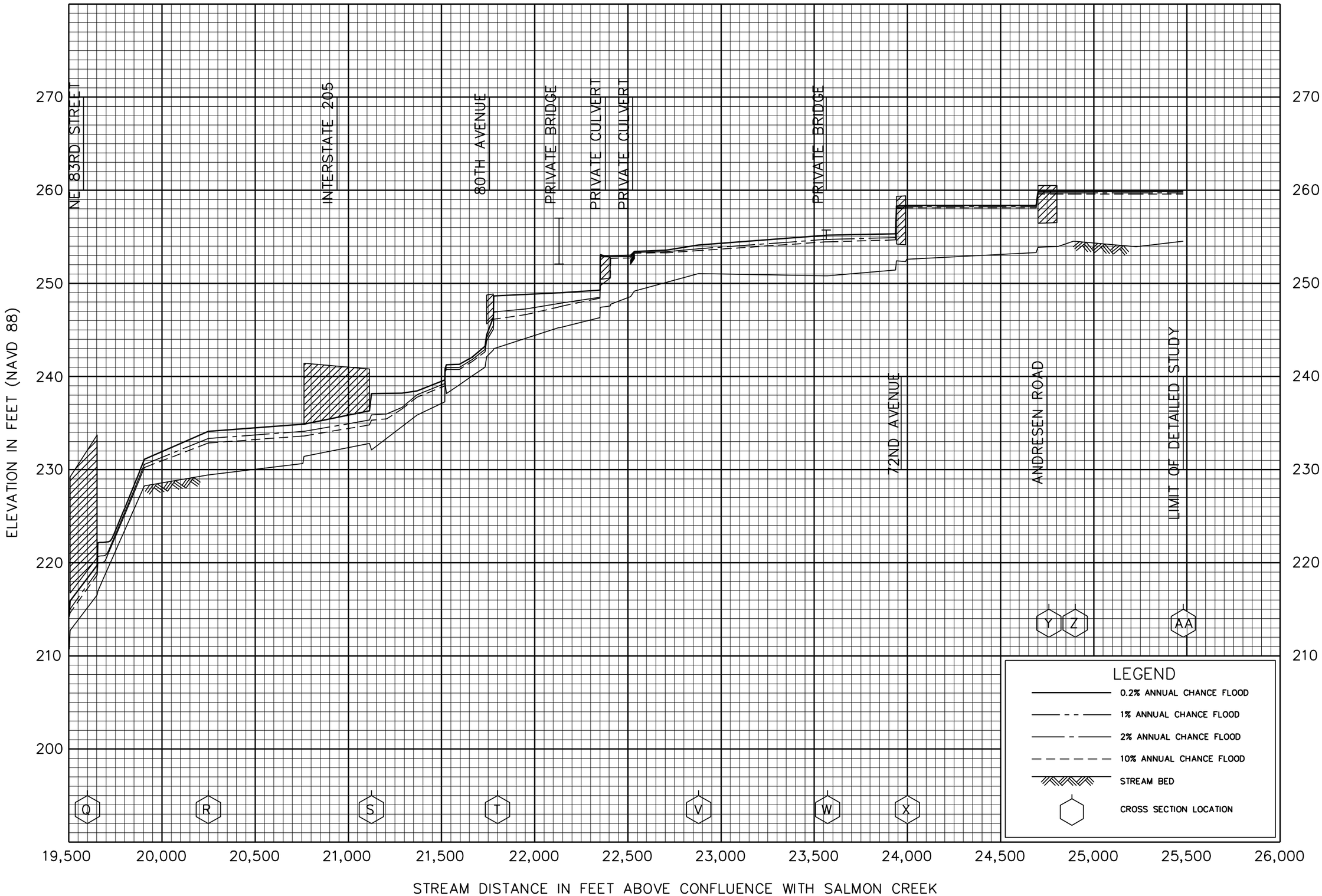

FLOOD PROFILES

CURTIN CREEK

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CLARK COUNTY, WA
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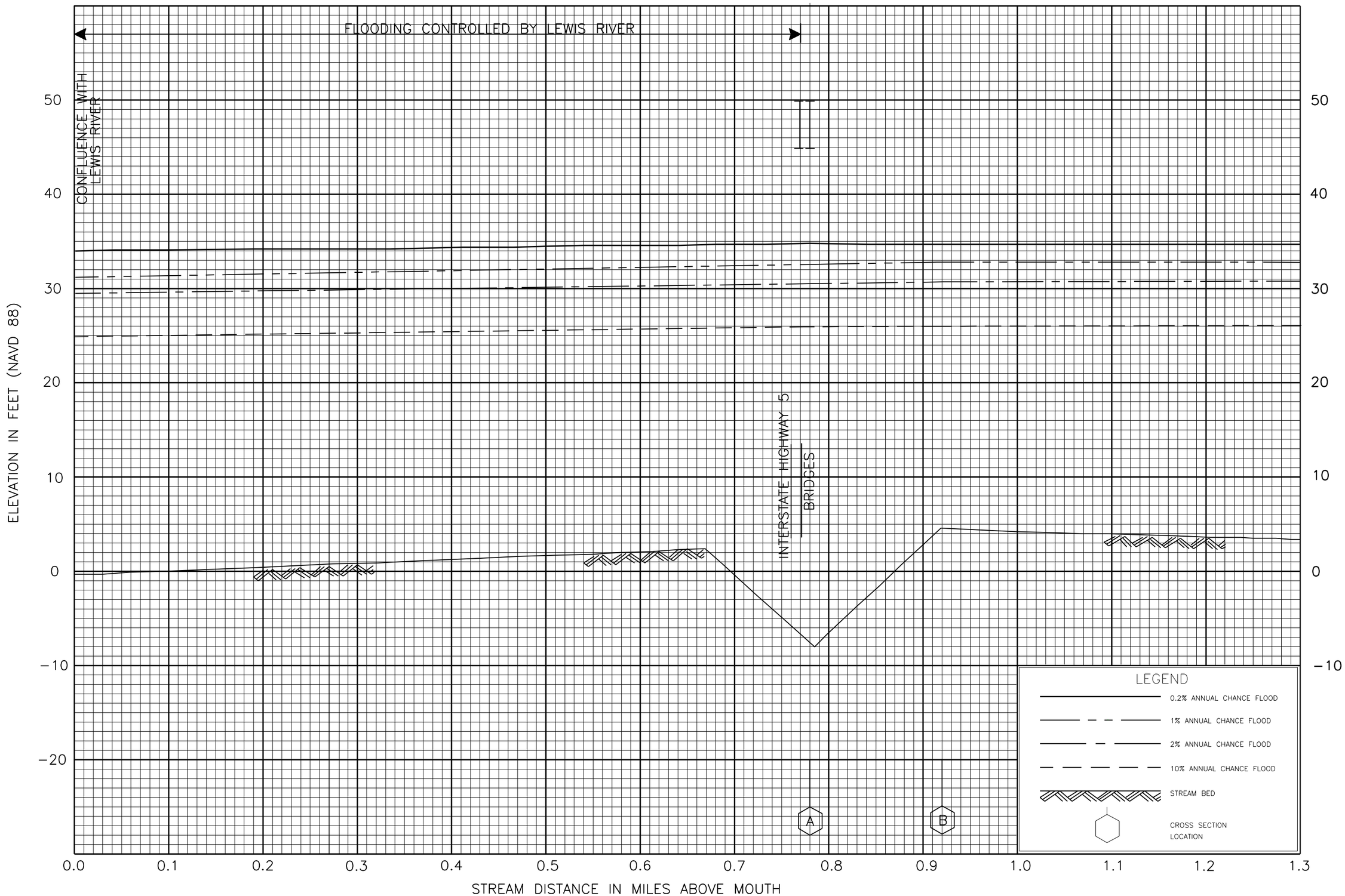
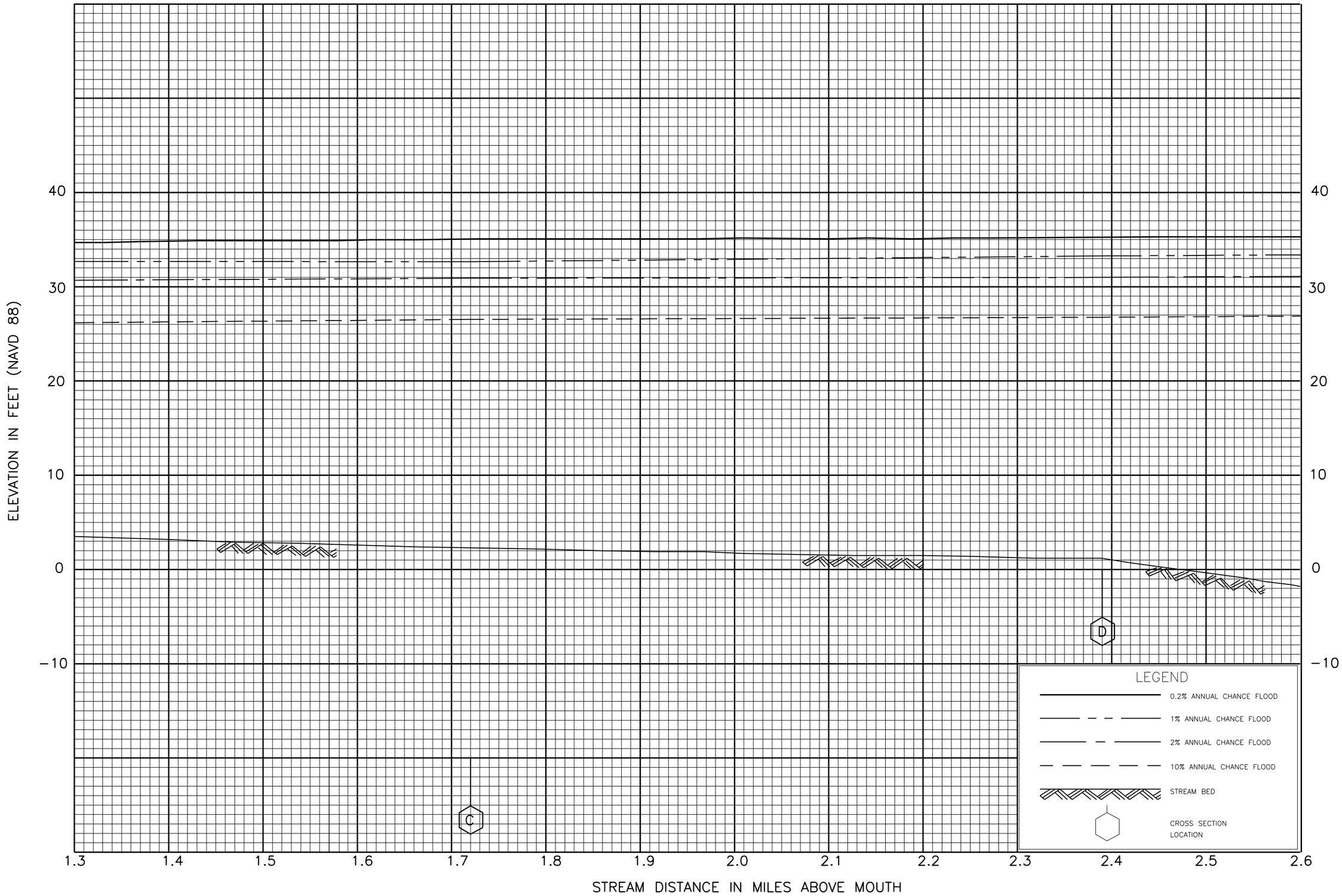


FLOOD PROFILES

EAST FORK LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

EAST FORK LEWIS RIVER

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CLARK COUNTY, WA
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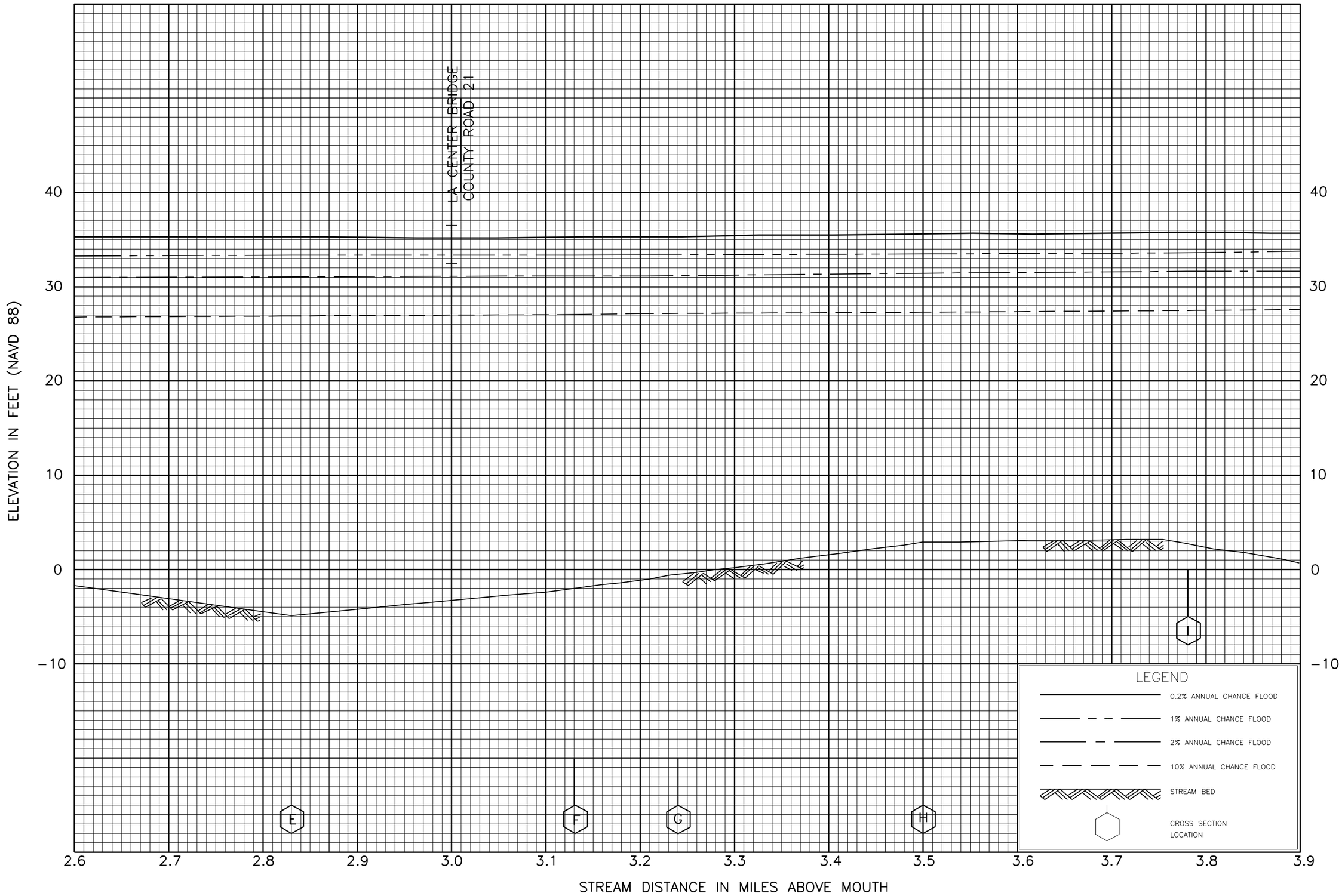
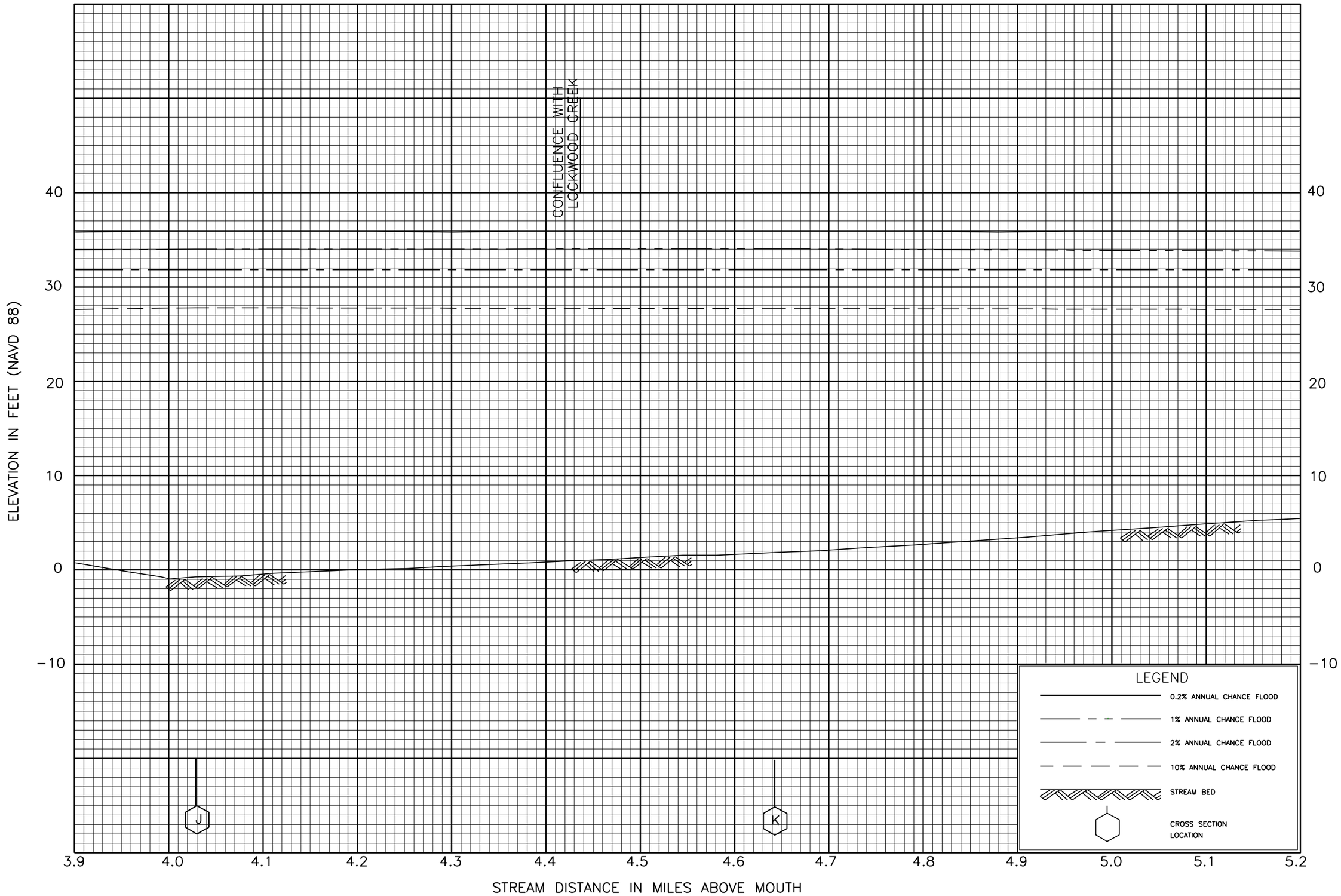


FLOOD PROFILES

EAST FORK LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS

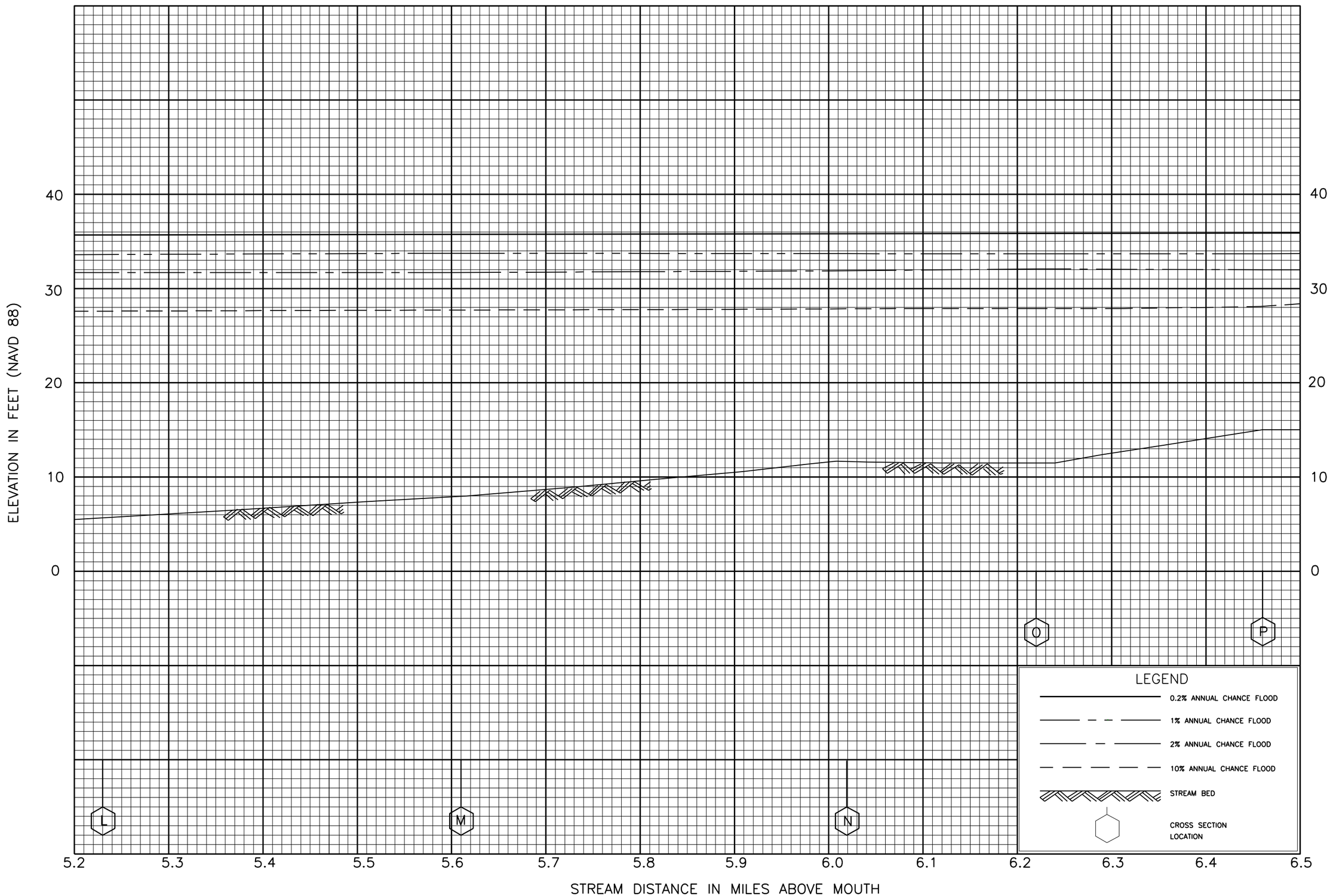


FLOOD PROFILES

EAST FORK LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CLARK COUNTY, WA
AND INCORPORATED AREAS



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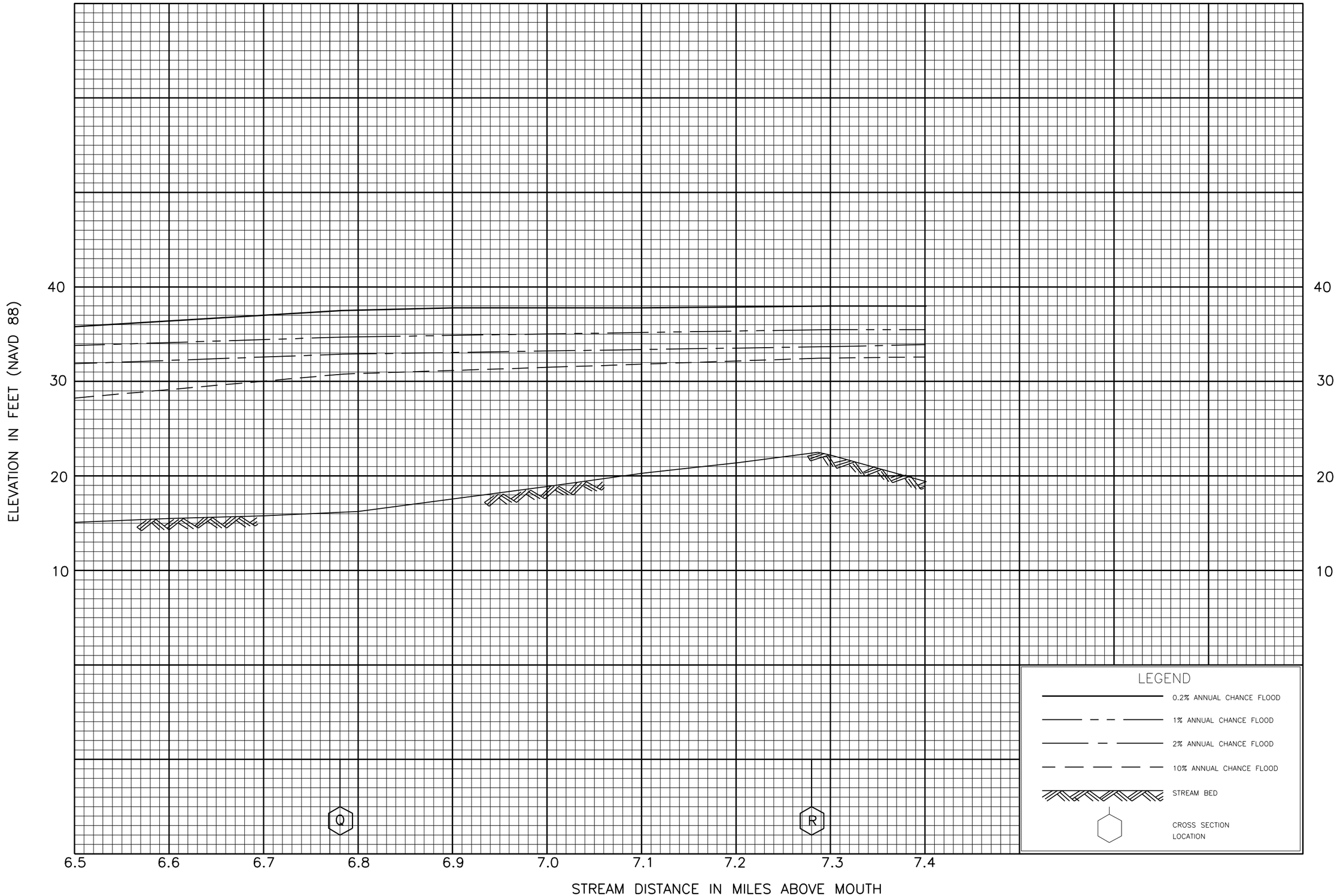

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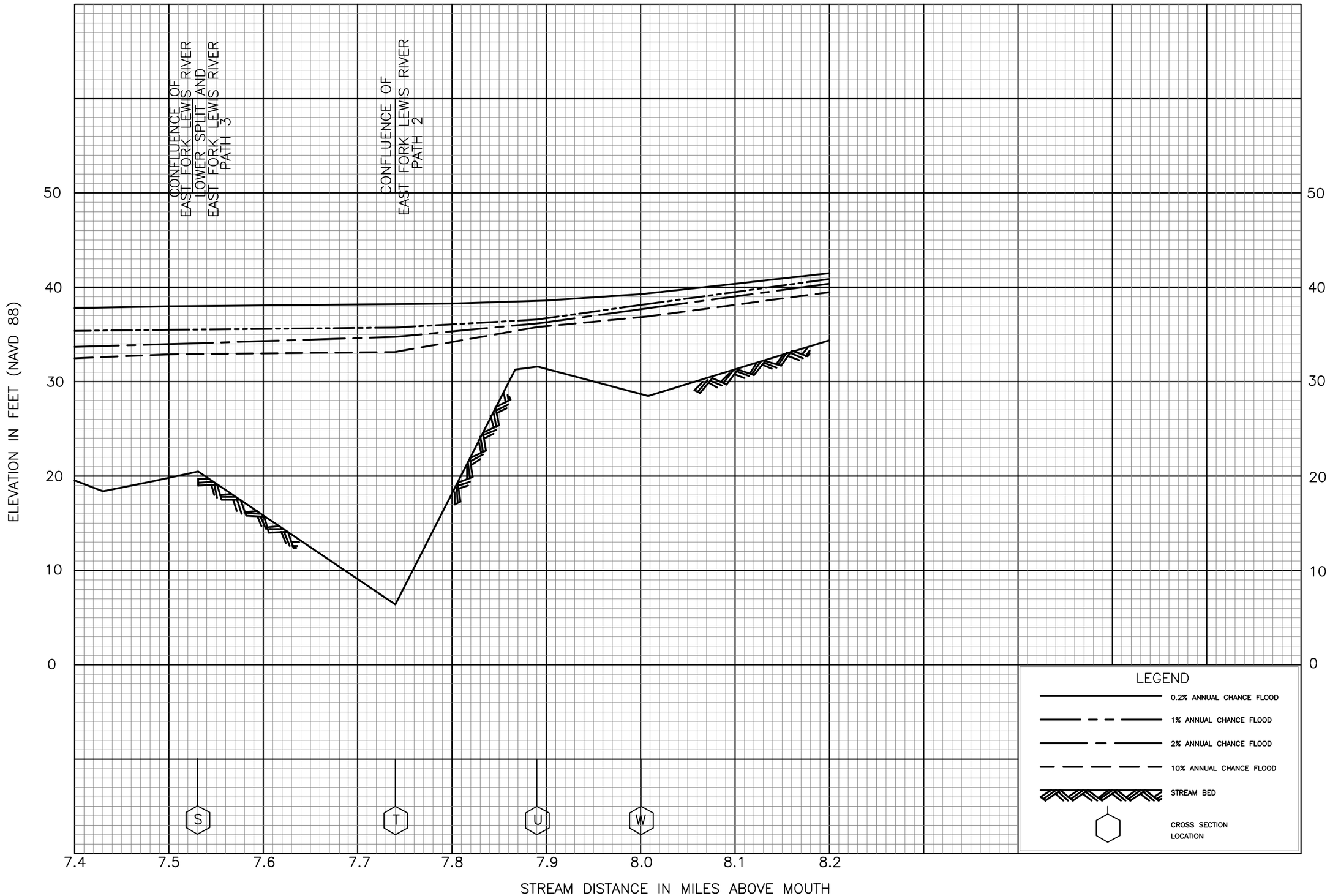

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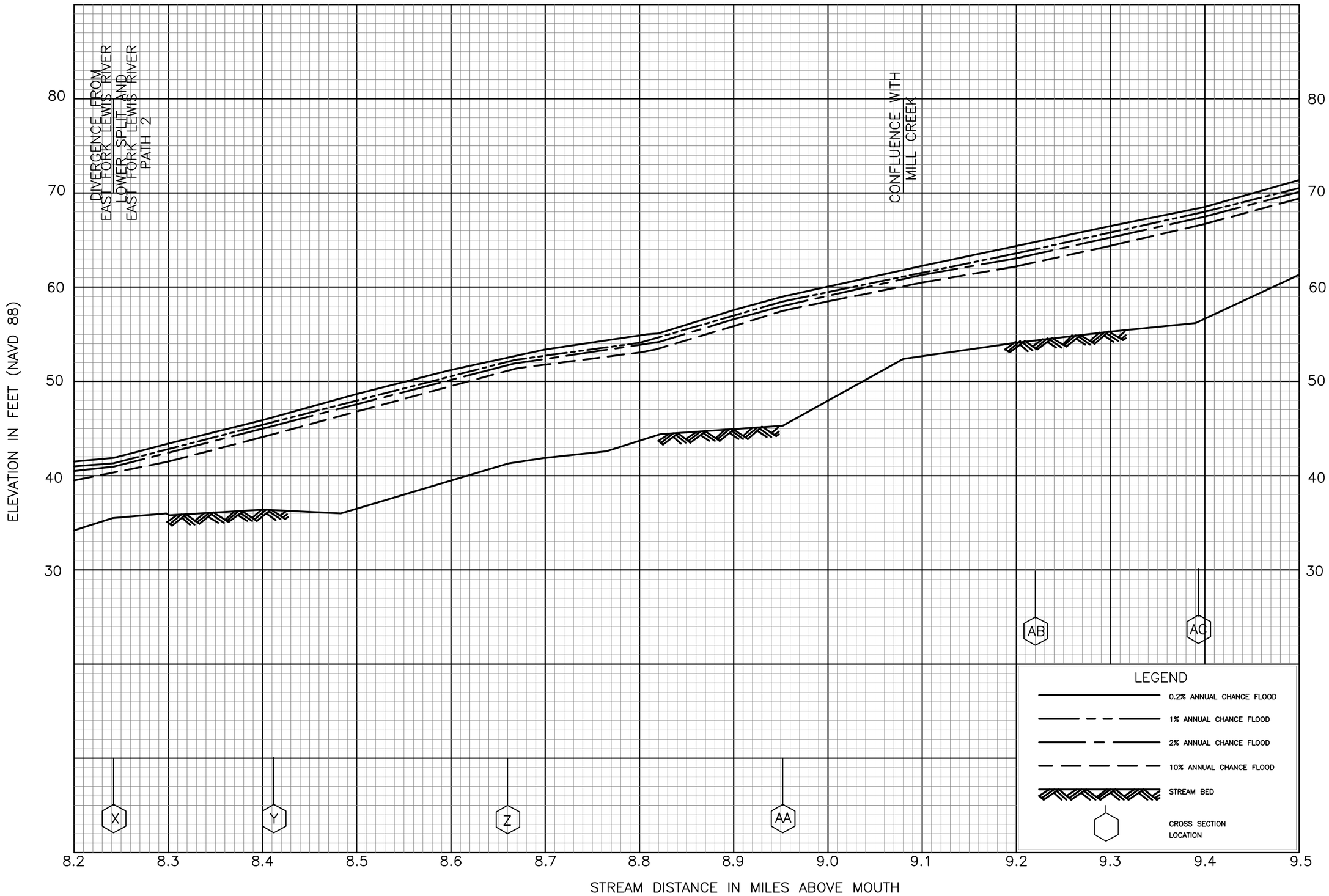

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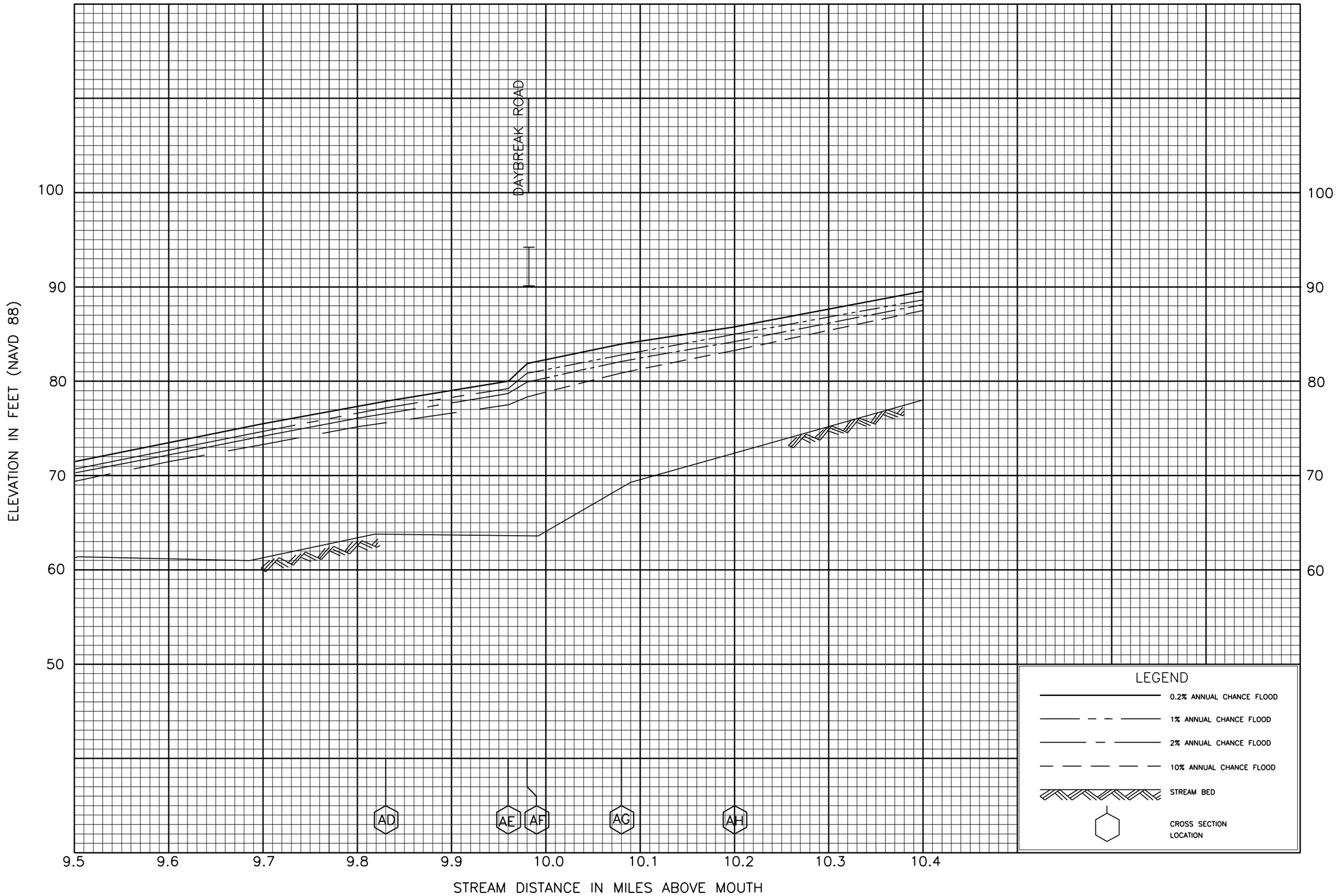

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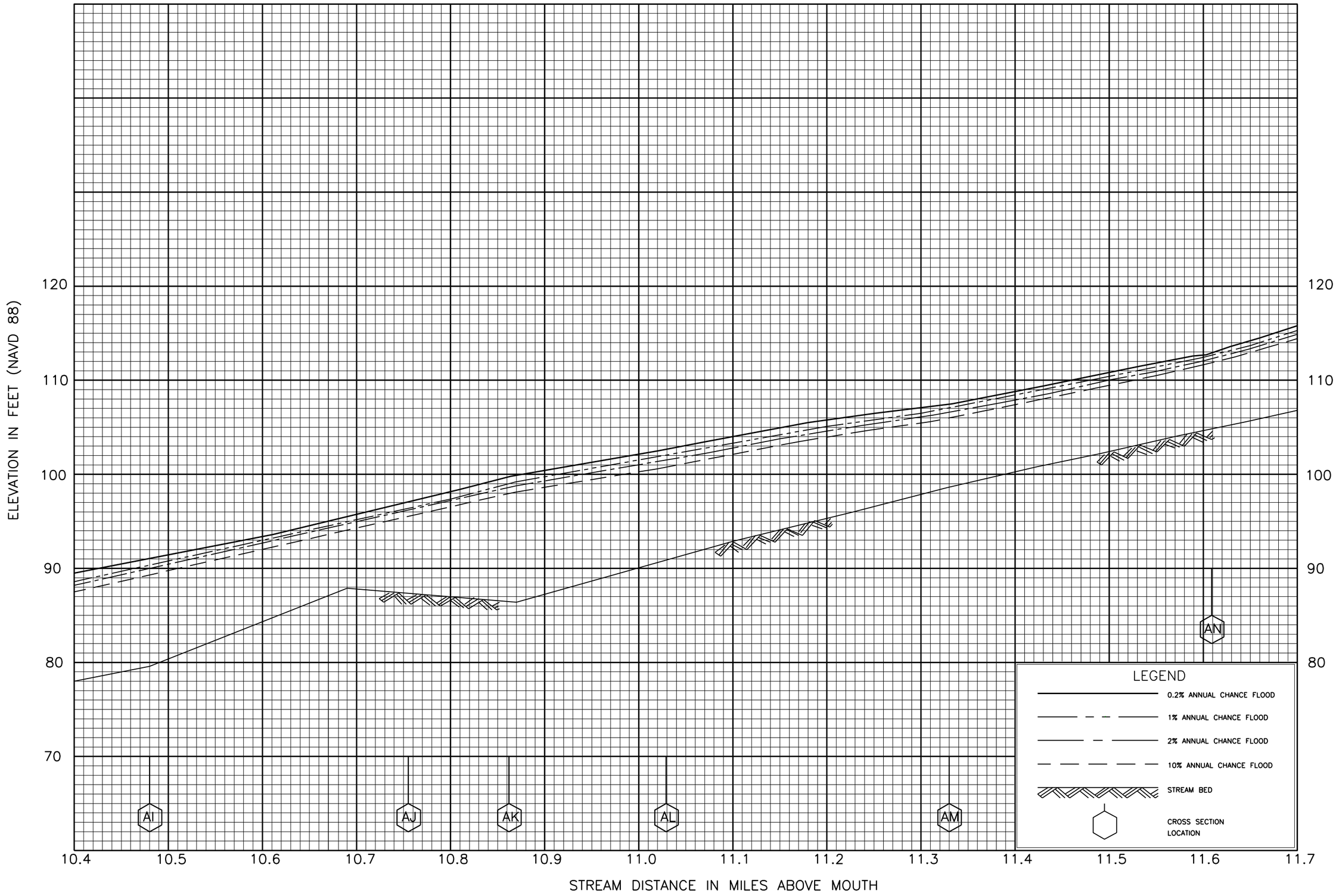

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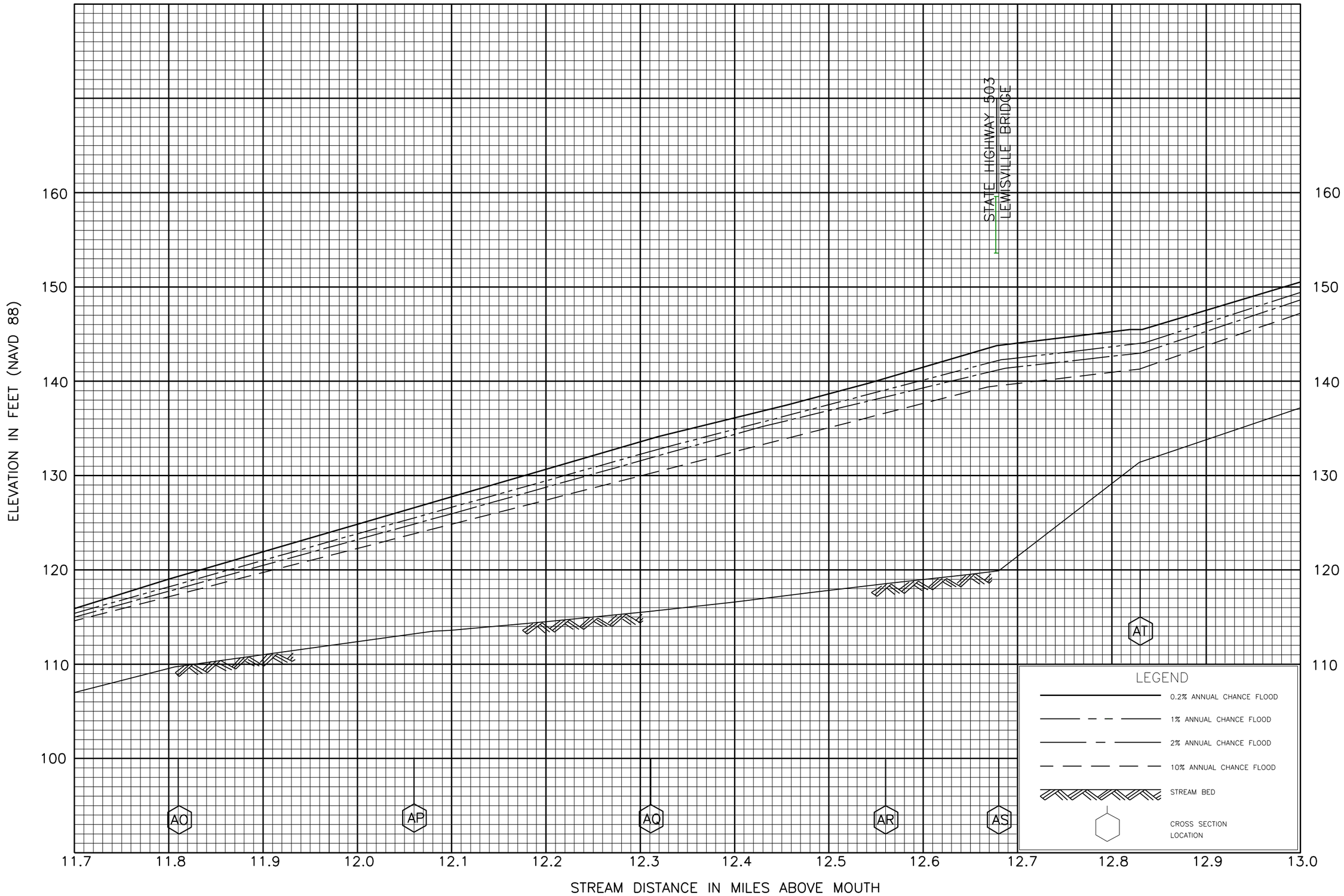

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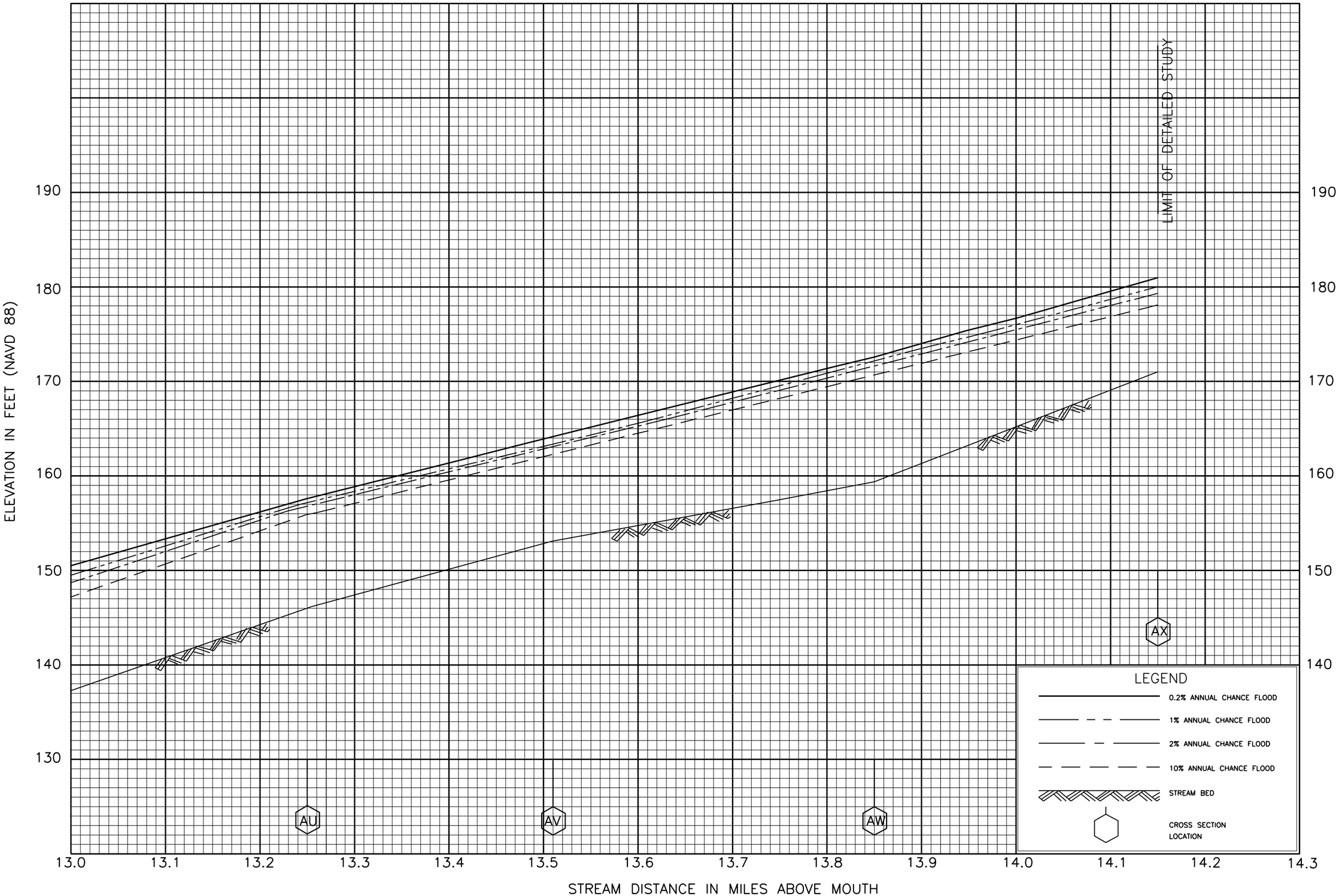

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