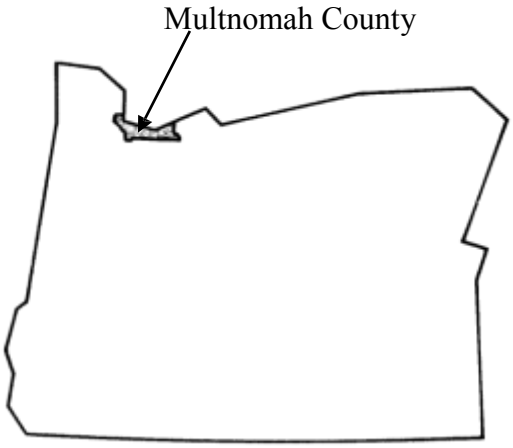
FLOOD INSURANCE STUDY

Notice

This preliminary FIS report includes only revised Flood Profiles and Floodway Data tables. See "Notice to Flood Insurance Study Users" page for additional details.

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS



COMMUNITY NAME	COMMUNITY NUMBER
FAIRVIEW, CITY OF	410180
GRESHAM, CITY OF	410181
*MAYWOOD PARK, CITY OF	410068
MULTNOMAH COUNTY UNINCORPORATED AREAS	410179
TROUTDALE, CITY OF	410184
*WOOD VILLAGE, CITY OF	410185

*No Special Flood Hazard Data

Preliminary: March 28, 2016

Federal Emergency Management Agency

Flood Insurance Study Number

41051CV000B

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.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

This preliminary FIS report does not include unrevised Floodway Data Tables or unrevised Flood Profiles. These Floodway Data Tables and Flood Profiles will appear in the final FIS report.

Initial Countywide FIS Effective Date: December 18, 2009
Revised Countywide Date: To Be Determined

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Purpose of Study 1
1.2 Authority and Acknowledgments 1
1.3 Coordination 5

2.0 AREA STUDIED 7
2.1 Scope of Study 7
2.2 Community Description 17
2.3 Principal Flood Problems 23
2.4 Flood Protection Measures 26

3.0 ENGINEERING METHODS 29
3.1 Hydrologic Analyses 29
3.2 Hydraulic Analyses 39
3.3 Vertical Datum 47

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS 48
4.1 Floodplain Boundaries 49
4.2 Floodways 50

5.0 INSURANCE APPLICATIONS 63

6.0 FLOOD INSURANCE RATE MAP 64

7.0 OTHER STUDIES 66

8.0 LOCATION OF DATA 66

9.0 BIBLIOGRAPHY AND REFERENCES 67

10.0 REVISION DESCRIPTIONS 73

FIGURES

Figure 1 – FIRM Note to Users 11
Figure 2 - FIRM Legend ……...13
Figure 3 - Floodway Schematic ……62

TABLES

Table 1 – Initial and Final CCO Meetings……...6
Table 2 – Limits of Detailed Study ……..……...……7
Table 3 – Approximate Studies……....9
Table 4 – Community Map Repositories……...17
Table 5 – Summary of Discharges…….…....35
Table 6 – Summary of Stillwater Elevations…… 40
Table 7 – Roughness Coefficients (Manning's "n" Values)……..42
Table 8 – Vertical Datum Conversions…….……...…..48
Table 9 - Floodway Data……52
Table 10 - Community Map History……..65
Table 11 - Listing of NFIP Jurisdictions……66
Table 12 - Revised Study Descriptions……..78

~~EXHIBITS~~

Exhibit 1 - Flood Profiles	Panels
Beaver Creek	01P-04P
Brick Creek	05P
Burlingame Creek	06-P
Columbia River	07P – 11P
Fairview Creek	12P-23P
Fairview Creek - East Pond	24P
Fairview Creek – NE Glisan Street Overflow	25P – 26P
Hogan Creek	27P – 29P
Johnson Creek City Park Side Channel	30P – 48P
Kelley Creek	49P – 54P
Kelly Creek	55P – 58P
MacDonald Creek	59P
Multnomah Channel	60P – 61P
North Fork Johnson Creek	62P – 64P
North Fork Johnson Creek Split Flow	65P

Exhibit 1 - Flood Profiles (continued)

Sandy River	69P – 75P
Sunshine Creek	76P – 77P
Unnamed Tributary to Rock Creek	78P
Willamette River	79P – 80P

PUBLISHED SEPARATELY

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

FLOOD INSURANCE STUDY
MULTNOMAH COUNTY AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and updates information on the existence and severity of flood hazards in the geographic area of Multnomah County, including the Cities of Fairview, Gresham, Maywood Park, Troutdale and Wood Village, Oregon; and the unincorporated areas of Multnomah County (referred to collectively herein as Multnomah 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.

This Flood Insurance Study (FIS) revises and updates a previous FIS/Flood Insurance Rate Map for Multnomah County, Oregon. This information will be used by Multnomah County, Oregon to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.

Please note that the City of Portland is geographically located in Multnomah, Clackamas, and Washington Counties. The City of Portland is included in its own FIS report 410183V000A dated October 19th, 2004. The cities of Milwaukee and Lake Oswego are covered in the Clackamas County FIS report dated June 17, 2008. The Cities Maywood Park and Wood Village have no SFHA. This does not preclude future determinations of Special Flood Hazard Areas (SFHA) that could be necessitated by changed conditions affecting the community (i.e., annexation of new lands) for the availability of new scientific or technical data about flood hazards.

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

1.2 Authority and Acknowledgments

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

Pre-Countywide Analyses

Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below:

Gresham, City of:

The hydrologic and hydraulic analyses for the unincorporated areas were performed by the U.S. Army Corps of Engineers (USACE), Portland District, for FEMA, under Inter- Agency Agreement Nos. IAA-H-16-75, IAA-H-7-76, and IAA-H-10-77, Project Order Nos. 14, 1, and 23, respectively. This study was completed in July 1980.

Portland, City of

Hydraulic analyses for Johnson Creek were revised in January 1983 by the USACE, Portland District, for the City of Portland, to reflect channel improvements between River Miles (RMs) 6.8 and 7.3. Hydrologic analyses for Multnomah County Drainage District No. 1 were revised in a July 1984 report entitled "Multnomah Drainage District No. 1 Hydrology Study". This work was incorporated into the January 3, 1986, revision to this FIS.

Fairway, City of

The hydrologic and hydraulic analyses for the City of Fairview were performed by USACE, Portland District, for FEMA, under Inter-Agency Agreement No. EMW-E-1153, Project Order No. 1, Amendment No. 21. This study was completed in May 1985.

Troutdale, City of	The hydrologic and hydraulic analyses of Sandy River and the lower reach of Beaver Creek within the City of Troutdale were performed by USACE, Portland District, for the FEMA, under Inter-Agency Agreement No. IAA-EMW-E-1153, Project Order No. 1, Amendment No. 21. The analyses for the two upper reaches of Beaver Creek were performed by the USACE for the Flood Insurance Study for the City of Gresham, Oregon. This study was completed in November 1985. Hydrologic and hydraulic analyses for Sandy River and Beaver Creek that were performed by the U.S. Soil Conservation Service (SCS) in October 1977 were adjusted by the USACE to produce this study.

December 18, 2009
The Initial Countywide FIS Report

The hydrologic and hydraulic analyses for the initial study of the City of Gresham were performed by the USACE, Portland District, for FEMA, under Inter-Agency Agreement Nos. IAA-H-16-75 and IAA-H-7-76, Project Order Nos. 16 and 1, respectively. This work, which was completed in June 1977, covered all significant flooding sources affecting the City of Gresham. Additional analyses for this study were performed by the USACE, Portland District, for Multnomah County, Oregon. Information on Fairview Creek was incorporated into this study.

The hydrologic and hydraulic analyses for the unincorporated areas were performed by the USACE, Portland District, for FEMA, under Inter-Agency Agreement Nos. IAA-H-16-75, IAA-H-7-76, and IAA-H-10-77, Project Order Nos. 14, 1, and 23, respectively. This study was completed in July 1980.

Hydraulic analyses for Johnson Creek were revised in January 1983 by the USACE, Portland District, to reflect channel improvements between River Miles 6.8 to 7.3. Hydrologic analyses within Multnomah County Drainage District No. 1 were revised in a July 1984 report titled Multnomah Drainage District No. 1 Hydrology Study.

The hydrologic and hydraulic analyses for the unincorporated areas were performed by USACE, Portland District, for FEMA, under Inter-Agency Agreement Nos. IAA-H-16-75, IAA-H-7-76, and IAA-H-10-77, Project Order Nos. 14, 1, and 23, respectively. This study was completed in July 1980.

The hydrologic and hydraulic analyses for the City of Fairview were performed by the USACE, Portland District, for FEMA, under Inter-Agency Agreement No. EMW-E-1153, Project Order No. 1, Amendment No. 21. This study was completed in May 1985.

The hydrologic and hydraulic analyses of Sandy River and the lower reach of Beaver Creek within the City of Troutdale were performed by USACE, Portland District,

for FEMA, under Inter-Agency Agreement No. IAA-EMW-E-1153, Project Order No. 1, Amendment No. 21. The analyses for the two upper reaches of Beaver Creek were performed by the USACE for the Flood Insurance Study for the City of Gresham, Oregon. This study was completed in November 1985. Hydrologic and hydraulic analyses for Sandy River and Beaver Creek that were performed by the U.S. Soil Conservation Service (SCS) in October 1977 were adjusted by the USACE to produce this study.

In 1985, additional USACE approximate analyses were added for Fairview Creek along the northern corporate limits of Gresham.

In 1988, the USACE revised the reach of Fairview Creek from a point located approximately 2,200 feet upstream of Barr Street upstream to NE. Glisan Street toincorporate changes made in topography and removal of culverts and to model a split flow that would occur on the upstream side of and east of NE Glisan Street.

In 1988, the USACE performed a revised study to upgrade the approximate analysis for Fairview Creek to a detailed study for the reach from approximately 1,000 feet downstream of Northeast Glisan Street to about 2,400 feet upstream of Southeast Division Street. The revised study was authorized under Inter-Agency Agreement No.EMW-E-2549, Project Order No. 9.

In 1995, the USACE revised the reach of Fairview Creek from Bridge Street to Fairview Lake. The hydraulic analysis was performed under Contract No. EMW-90-E-3286. The analysis supporting the revision was completed in June 1991. In February 1996, the USACE revised a portion of Kelly Creek from the Mount Hood Community College (MHCC) dam upstream to Southeast Division Street. The revised analysis was performed by the USACE, Portland District, for FEMA, under Inter-Agency Agreement No. EMW-91-E-3529, Project Order No. 8A. The analysis supporting the revision was completed in June 1992.

The Beaver Creek study was revised on August 3, 1998 to add detailed flood information, including the adoption of a regulatory floodway, from just upstream of Jackson Park Road to approximately 200 feet downstream of Southeast Stark Street. The analyses supporting this revision were performed by the USACE, Portland District, for FEMA, under Contract No. EMW-94-E-4432, and was completed in April 1995.

The Kelly Creek study was revised on May 2, 2002 to show modifications to floodhazards along an approximate 3 mile reach from the crossing at NE Division Street upstream to approximately 600 feet upstream of 282nd Street. The hydrologic and hydraulic analyses for the restudy were performed by Odgen Beeman and Associates, Inc., for FEMA, under contract No. EMS-96-CO-0078-TA05. This study was completed in September 1998. Water-surface elevations immediately upstream of Kane Road and the Kelly Creek Storm Water Detention Facility were adjusted by FEMA in October 2000 utilizing data approved by the City of Gresham.

The countywide update was performed by WEST Consultants, Inc. for FEMA, under Contract No. EMS-2001-CO-0068 and was completed in August 2008.

A physical map revision for the City of Gresham was performed by WEST Consultants, Inc. for the City of Gresham, under Contract No. 5237 and was completed in September 2012. Base map information shown on the FIRM panels was derived from multiple sources. Base map files were provided in digital format by Multnomah County (2004), City of Portland (2008), State of Oregon (2006), and USDA-FSA (2005). This information was compiled at a scale of 1:24,000.

This Physical Map Revision

For this Physical Map Revision (PMR) base map information shown on the Flood Insurance Rate Map (FIRM)was derived from multiple sources in digital format provided by Multnomah County and the USGS produced at a scale of 1:24,000 from National Agricultural Imagery Program mosaic photography dated 2014 or later. The projection used in the preparation of this map is Universal Transverse Mercator (UTM) Zone 10, and the horizontal datum used is North American Datum 1983, GRS 1980 spheroid.

This PMR for the City of Gresham was performed by WEST Consultants, Inc. for the City of Gresham, under Contract No. 5237 and was completed in September 2012. Base map information shown on the FIRM panels was derived from multiple sources. Base map files were provided in digital format by Multnomah County (2004), City of Portland (2008), State of Oregon (2006), and USDA-FSA (2005). This information was compiled at a scale of 1:24,000.

1.3 Coordination

An initial meeting is held with representatives from FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied or restudied. A final meeting is held with representatives from FEMA, the communities, and the study contractor to review the results of the study.

Pre-Countywide Analyses

The initial and final meeting dates for previous FIS reports for Multnomah County and its communities are listed in the following table:

Table 1 - Initial and Final CCO Meetings

Community	FIS Date	Initial Meeting	Final Meeting
Fairview, City of	September 1982	May 28, 1985 July 14, 1988	September 3,1986 April 19, 1990
Gresham, City of	March 5, 1975	July 14, 1988	July 13, 1978 December 14, 1989 July 30, 2013
Multnomah County, Unincorporated Areas	November 8, 1974	May 13, 1979	July 20, 1981
Troutdale, City of	September 1982	November 24, 1986	November 24, 1987

December 18, 2009
The Initial Countywide FIS Report

An initial community coordination meeting for Multnomah County was held on December 14, 2005. This meeting was attended by representatives of the, cities and county. State of Oregon, FEMA and WEST Consultants. The results of the study were reviewed at the final Consultation Coordination Officer (CCO) meeting held on November 18, 2008, and attended by representatives of City of Fairview, City of Gresham, City of Troutdale, Multnomah County, FEMA, Department of Land Conservation and Development and WEST Consultants. All problems raised at that meeting have been addressed in this study

An initial community coordination meeting for the City of Gresham PMR was held on November 4, 2009. This meeting was attended by representatives of the City of Gresham, Multnomah County, and WEST Consultants. The results of the study were reviewed at the final Consultation Coordination Officer (CCO) meeting held on July 30, 2013 at 3:00pm and 6:00pm at Gresham City Hall, 1333 NW Eastman Parkway, Gresham, Oregon 97030, and attended by representatives of FEMA, the City of Gresham, Multnomah County and State of Oregon. All problems raised at that meeting have been addressed in this study.

This Physical Map Revision

The results of this study were revised at the final meeting held on _____, and attended by representatives of _____, All issues and/or concerns raised at the meeting have been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the geographic area of Multnomah County, Oregon, including the incorporated communities listed in Section 1.1.

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through June 2013.

The limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

The following streams were studied by detailed methods in this FIS report:

Table 2 – Limits of Detailed Study

Stream Name	Limits of Detailed Study
Beaver Creek	From confluence with Sandy River upstream to RM 3.3
Brick Creek	From confluence with Johnson Creek to approximately 700 feet upstream of Southeast 242nd Avenue.
Columbia River	From the Multnomah-Columbia County Limits to approximately RM 126.5
Fairview Creek	From its mouth upstream to RM 5.6 Note: The reach of Fairview Creek from approximately 1,000 feet downstream of Northeast Glisan Street to approximately 2,400 feet upstream of Southeast Division Street, a distance of approximately 2.6 miles, was restudied by the Corps in 1988. Note: The reach of Fairview Creek from Northeast Glisan Street to West Powell Boulevard., a distance of approximately 3.3 miles, was restudied by WEST Consultants, Inc. in 2012

Table 2 – Limits of Detailed-Study (continued)

Stream Name	Limits of Detailed Study
Fairview Creek- East Pond	From its divergence from Fairview Creek to its confluence with Fairview Creek
Fairview Creek Northeast Glisan Overflow	From upstream end of culvert at Northeast Glisan Street to its overflow of Northeast Glisan Street near the intersection of Northeast West Pond Drive
Hogan Creek	From Southeast Butler Road to Southeast 46th Drive
Johnson Creek	From the Multnomah-Clackamas County boundary near 82nd Avenue upstream to Southeast Pleasant Home Road Note: The reach of Johnson Creek from the City of Gresham Corporate Limits to the City of Gresham Urban Growth Boundary, a distance of approximately 8.0 miles was restudied by WEST Consultants, Inc. in 2012
Johnson Creek City Park Side	From its divergence from Johnson Creek to its confluence with Johnson Creek.
Johnson Creek Telford Split Flow	From its divergence from Johnson Creek to its confluence with Johnson Creek
Kelley Creek	From City of Gresham Urban Growth Boundary to City of Gresham corporate limits
Kelly Creek	From Kane Road upstream to approximately 640 feet upstream of 282nd Avenue. Note: The upstream end of Kelly Creek was extended approximately 1,500 feet to the City of Gresham corporate limits by WEST Consultants, Inc. in 2012
MacDonald Creek	From confluence with Johnson Creek to Multnomah/Clackamas County boundary
Multnomah Channel	From the Multnomah-Columbia County boundary to its divergence from the Willamette River
Johnson Creek	From the Multnomah-Clackamas County boundary near 82nd Avenue upstream to Southeast Pleasant Home Road Note: The reach of Johnson Creek from the City of Gresham Corporate Limits to the City of Gresham Urban Growth Boundary, a distance of approximately 8.0 miles was restudied by WEST Consultants, Inc. in 2012

Table 2 - Detailed-Study Streams (continued)

Stream Name	Limits of Detailed Study
Johnson Creek City Park Side	From its divergence from Johnson Creek to its confluence with Johnson Creek.
North Fork Johnson Creek	From confluence with Johnson Creek to Southeast 282nd Avenue
North Fork Johnson Creek Split Flow	From its divergence from North Fork Johnson Creek to it confluence with North Fork Johnson Creek
Ponding	Within Multnomah Drainage District No. 1
Sandy River	From its mouth to RM 6.17
Sunshine Creek	From confluence with Johnson Creek to Multnomah/Clackamas County boundary
Unnamed Tributary to Rock Creek	From the Multnomah - Washington County boundary near Germantown Road to a point approximately 0.5 miles east
Willamette River	From its mouth to the Multnomah/Clackamas County boundary

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, Multnomah County and the incorporated communities listed in Section1.1. Table 3 lists the streams and their included segments studied by approximate methods:

Table 3. Approximate-Study Streams

Stream Name	Limits of Approximate Study
Arata Creek	Between the downstream corporate limits at Marine Drive and the upstream corporate limits (western edge) west of Arata School and the Edgefield McMenamins' golf course
Beaver Creek	From Troutdale Corporate limits to approximately 1350 feet upstream from Division Drive culvert
Butler Creek	Individual areas in the following locations: upstream of SW 14th Drive, along Southwest Binford Lake Parkway, and within Butler Creek Park

Table 3. Approximate-Study Streams (continued)

Stream Name	Limits of Approximate Study
Burlingame Creek	From its confluence with Kelly Creek to Country Club Estates Court
Columbia River	From the Limit of detailed study to the Multnomah-Hood River County Boundary
Fairview Creek Right Bank Overflow	Fairview Creek Right Bank Overflow
Kelley Creek	From the City of Portland Corporate limits to 190th Ave and from approximately 1000 feet downstream of Northeast Kane Road to Northeast Kane Road
Mitchell Creek	From its confluence with Kelley Creek to approximately 700 feet upstream of Baxter Road
Sandy River	From Dabney State Park to the Multnomah-Clackamas County boundary
Small drainage area upstream of Kaiser Road	From approximately 600 feet upstream of its confluence with Unnamed Tributary to Rock Creek to its mouth
Unnamed Tributary to Johnson Creek	From Southwest 14th Drive to approximately 580 feet upstream of Southwest 14th Drive
Unnamed Tributary to the East of Fairview Creek	From its confluence with Fairview Creek to approximately 670 feet upstream from Northeast Glisan Street.

Each FIS report provides floodplain data, which may include a combination of the following: 10-, 4-, 2-, 1-, and 0.2-percent-annual-chance flood elevations (the 1-percent-annual-chance flood elevation is also referred to as the Base Flood Elevation (BFE)); delineations of the 1-percent-annualchance and 0.2-percent -annual-chance-floodplains; and 1-percent-annualchance floodway. This information is presented on the FIRM and/or in many components of the FIS report, including Flood Profiles and Floodway Data tables.

Figure 1 presents important considerations for using the information contained in this FIS report and the FIRM and is provided in response to changes in format and content.

Figure 1 – FIRM Note to Users

NOTES TO USERS

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

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

For community and countywide map dates, refer to Table 9 in this FIS Report.

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

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

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

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

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

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

PROJECTION INFORMATION: The projection used in the preparation of the map was Universal Transverse Mercator. The horizontal datum was North American Datum 1983. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM

Figure 1 – FIRM Notes to Users (Continued)

ELEVATION DATUM: Flood elevations on the FIRM are referenced to NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

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

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

BASE MAP INFORMATION: Base map information shown on this FIRM was developed and/or compiled in digital format by the Oregon Department of Geology and Mineral Industries (DOGAMI). Data sources include DOGAMI, Oregon Lidar Consortium, Bureau of Land Management, U. S. Geological Survey, and Multnomah County GIS. Base map information was rectified to 3-foot resolution LIDAR topographic data acquired in 2002.

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

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

NOTES FOR FIRM INDEX

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

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

Figure 2 – FIRM Legend

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

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

OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Zone X Protected by Accredited Levee: Areas protected by an accredited levee, dike or other flood control structures. See Notes to Users for important information.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible
NO SCREEN	Unshaded Zone X: Areas determined to be outside the 0.2% annual chance floodplain
FLOOD HAZARD AND OTHER BOUNDARY LINES	
	Flood Zone Boundary (white line)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
Aqueduct *Channel* *Culvert* *Storm Sewer*	Channel, Culvert, Aqueduct, or Storm Sewer
Dam *Jetty* *Weir*	Dam, Jetty, Weir
	Levee, Dike or Floodwall accredited or provisionally accredited to provide protection from the 1% annual chance flood
	Levee, Dike or Floodwall not accredited to provide protection from the 1% annual chance flood.
Bridge	Bridge

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas. See Notes to Users for important information.*	
CBRS AREA **09/30/2009**	Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.
OTHERWISE PROTECTED AREA **09/30/2009**	Otherwise Protected Area
REFERENCE MARKERS	
22.0	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
B 20.2	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
5280 21.1	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
17.5	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
8	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
513	Base Flood Elevation Line (shown for flooding sources for which no cross sections or profile are available)
ZONE AE **(EL 16)**	Static Base Flood Elevation value (shown under zone label)
ZONE AO **(DEPTH 2)**	Zone designation with Depth
ZONE AO **(DEPTH 2)** **(VEL 15 FPS)**	Zone designation with Depth and Velocity

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

Table 4 is a list of the locations where FIRMs for Multnomah County can be viewed. Please note that the maps at these locations are for reference only and are not for distribution. Also, please note that only the maps for the community listed in the table are available at that particular repository. A user may need to visit another repository to view maps from an adjacent community.

Table 4 – Community Map Repositories

Community	Address	City	State	Zip Code
City of Fairview	City of Fairview Planning Department 1300 Northeast Village Street	Fairview	OR	97024
City of Gresham	City Hall Community Development Office 1333 Northwest Eastman Parkway	Gresham	OR	97030
City of Maywood Park	City Hall 10100 Northeast Prescott Street Suite 147	Gresham	OR	97220
Multnomah County (Unincorporated Areas)	Multnomah County Office of Land Use and Planning 1600 Southeast 190th Avenue	Portland	OR	97233
City of Troutdale	City of Troutdale City Hall 104 Southeast Kibling Street	Troutdale	OR	97060
City of Wood Village	City of Wood Village City Hall 2055 NE 238th Drive	Wood Village	OR	97060

2.2 Community Description

The City of Fairview is located along the southern banks of the Columbia River, 10 miles due east of downtown Portland, in northern-central Multnomah County, in northwestern Oregon. Fairview is bordered by the City of Gresham to the south and west. To the east, Fairview is bordered by the Cities of Wood Village and Troutdale. The remainder of Fairview is bordered by unincorporated areas of Multnomah County.

Fairview was incorporated in 1908 and is primarily a residential community. Local Employment is limited to shops and businesses that serve area residents. Employment for the majority of Fairview residents is elsewhere in the Portland metropolitan area.

The population of the city was 7,561 in 2000. As of 2010, the population number was 8,920.

The climate of Fairview is characterized by mild, wet winters and dry, warm summers. The average annual precipitation for the area is 45 inches. Average temperatures range from 38°F in January to 68°F in July.

The surrounding area ranges from a busy metropolis west of the city to picturesque rural land to the south and east. The Columbia River lies to the north of the city. The area provides a wide choice of recreational opportunities, from fishing and backpacking to kite flying in the westerly winds that blow in from the Pacific Ocean.

Fairview Creek flows north from its source near Grants Butte, through Gresham and Fairview, and empties into Fairview Lake near the Columbia River. It drains rolling pastureland mixed with residential subdivisions. South of Fairview, Fairview Creek slopes gently as it passes through a thickly wooded area.

Multnomah County Drainage District No. 2 fronts the Columbia River approximately between 20th Avenue and Fairview Avenue. There is both agricultural and industrial development in its floodplain.

The Columbia River flows along the northern corporate limits of Gresham. Its flow is contained by the Multnomah Drainage District No. 1 levee. From its origin in Canada, the Columbia River flows over 1,100 miles to Fairview, while draining approximately 241,000 square miles of the western slope of the Continental Divide in the northwestern United States and southwestern Canada. The basin terrain varies from gently rolling farmland to high, timbered mountains.

The City of Gresham, a rapidly growing suburb of Portland, Oregon, is located to the east of Portland, along U.S. Highway 26 and Interstate Highway 84. It was incorporated in 1905. It is bordered on the northeast by the Cities of Fairview, Troutdale, and Wood Village. Gresham is bordered to the west by the City of Portland. Unincorporated areas of Multnomah County about the remaining corporate limits of Gresham, except the southernmost point where it borders Clackamas County. Gresham is located in central Multnomah County, in northwestern Oregon, on the left bank of the Columbia River. Gresham's population in 2000 was 90,205 as compared to 63,845 in 1989, 33,005 in 1980, 10,300 in 1970, and 3,944 in 1960

The City of Gresham is located on a low divide between Johnson Creek, the Sandy River, and the Columbia River. Johnson Creek, a tributary of the Willamette River, flows east to west through the southern portions of the urbanized area of Gresham. Beaver, Kelly, and Burlingame Creeks flow into the Sandy River to the east, draining the eastern portion of Gresham where substantial residential development has occurred. Fairview Creek, flowing northerly toward the Columbia River, drains the northern and central parts of Gresham. Butler Creek, a tributary of Johnson Creek, flows north draining the southwest section of Gresham.

The Columbia River flows along the northern corporate limits of Gresham. Its flow is contained by the Multnomah Drainage District No. 1 levee. Multnomah Drainage District No. 1 fronts the Columbia River along Marine Drive and Interlachen Lane. From its origin in Canada, the Columbia River flows more than 1,100 miles to Gresham, while draining approximately 241,000 square miles of the western slope of the Continental Divide in the northwestern United States and southwestern Canada. The basin terrain varies from gently rolling farmland to high, timbered mountains. Agricultural development exists along the floodplain within Gresham.

The major commercial development in the community has occurred along Powell Boulevard (U.S. Highway 26), with newer development occurring along Southeast Burnside Road. Residential development of various densities has occurred throughout the area. Land use along Johnson Creek is primarily residential.

The area consists of rolling benchlands and low hills. Vegetation varies from agricultural row crops and grain fields to the urban landscape associated with residential development; the steeper undeveloped terrain is covered with scattered fir and deciduous trees. The soil of the study area is largely of the Powell silt loam variety, derived by the weathering of old, unconsolidated deposits of mixed origin. The soil has a rich brown, smooth-textured surface over afriable light-brown, gray-mottled subsoil. It is partly residual and partly transported in origin, with variable drainage rates. The climate of Gresham is characterized by warm, dry summers and mild, wet winters. Temperatures are usually moderate, ranging from an average monthly minimum in January between 30°F and 35°F to an average summer maximum between 75°F and 80°F. The average annual precipitation is 45 inches with 80 percent occurring between October and March.

Multnomah County is in northwestern Oregon. It is bounded by Columbia River on the north, by the Tualatin Mountains on the west, and by the Cascade Mountain Range on the east. Along the southern county boundary, Johnson Creek flows westerly to Willamette River. Willamette River, as it flows northerly through Portland to join Columbia River, bisects western Multnomah County.

Multnomah County is bordered by Clark County, Washington, to the north, Skamania County, Washington, to the northeast, Hood River County to the east, Clackamas, County to the south, Washington County to the west, and Columbia County to the northwest. Encompassing nearly all of the Portland metropolitan area in its approximately 460square miles, Multnomah County is the most populated and developed county in Oregon.

Since establishment of the county in 1854, its population has grown rapidly, from 338,241 in 1930 to 522,813 in 1960. In 1978, the population was estimated at 549,000. In 2010, the population was at 735,334. Most of that population resides in Portland and its adjacent communities within the Willamette Valley of western Multnomah County. Eastern Multnomah County is sparsely settled. Portland, the county seat and the largest city in Multnomah County, had an estimated 2010 population of 583,776.

Columbia, Willamette, and Sandy Rivers are the largest rivers in Multnomah County. Columbia River, with its headwaters on the eastern slope of the Continental Divide in southwestern Canada, drains approximately 241,000 square miles. The basin terrain varies from steep mountain slopes to gently rolling farmland. Willamette and Sandy Rivers, with drainage areas of 11,200 and 502 squares miles, respectively, have their origin on the western slope of the Cascade Mountain Range. Willamette River originates in a steep, timbered, mountainous watershed and flows through the flat, wide, agricultural Willamette Valley for 185 miles to its mouth. Willamette River passes through Portland approximately 3 miles upstream of its confluence with Columbia River. Sandy River emerges from melting glaciers on Mount Hood, and then follows a steep and timbered valley until it meets Columbia River near Troutdale. Demand for recreated usage along the lower portion of the Sandy River is high. For example, Dabney and Lewis and Clark State Parks received 346,000 and 319,000 visitor days of use, respectively, in 1975.

Flood plain development varies widely along Columbia River in the unincorporated portions of Multnomah County. Scenic Columbia River Gorge, upstream of Sandy River, is sparsely developed. From downstream of Sandy River to the Burlington Northern Railroad bridge, the south bank of the Columbia River has a broad flood plain protected by levee systems. Within those levee systems are agricultural lands, scattered industrial, commercial, and residential development. South of Columbia River, between the Burlington Northern Railroad and Willamette River, is Rivergate Industrial District, a recent development on dredged fill material that elevates previously low-lying land above expected flood levels. Farther downstream, Sauvie Island is bounded by Willamette River, Multnomah Channel, and Columbia River. The island is agricultural bottom land; most of the area is protected by levees.

The unincorporated portion of the Willamette River floodplain in Multnomah County extends upstream and downstream of the City of Portland. Flood plain development upstream of Portland is limited to residences along a narrow 2-mile-long strip on the west riverbank. The downstream portion is a 3-mile stretch, with the Sauvie Island perimeter levee on the west bank and the elevated Rivergate Industrial District on the east bank.

There are only a few homes and small businesses located along the riverbanks of Sandy River immediately upstream of the Troutdale corporate limits. But, because of its nearness to the Portland metropolitan area, it has considerable development potential.

Farther upstream, much of the river is within a forested canyon with moderately steep sides and a small flood-prone area. Downstream of the Troutdale corporate limits, there is no development within the flood plain.

Johnson Creek flows westerly for approximately 23 miles in southern Multnomah County and enters Willamette River at the county's southern boundary. The Johnson Creek floodplain is heavily developed in the study area between the corporate limits

of Portland and Gresham. A wide flood-prone area extending from 100th Avenue to 136th Avenue and as far north of Johnson Creek as Holgate Boulevard includes many homes and some industries and warehouses. Upstream of Gresham, residences are scattered along the stream.

Columbia Slough enters Willamette River near its confluence with Columbia River in Portland. High-water levels in the slough and surrounding area are caused by Willamette River backwater. The detailed-study area within the unincorporated portions of Multnomah County is west of North Portland Road and almost entirely within the growing Rivergate Industrial District. Historically, the flood risk in that area has been too great to attract much development. Therefore, the bordering lowlands are still open for future land-use consideration.

Multnomah Channel is a natural bypass channel for Willamette River to the Columbia River. The channel leaves the Willamette River approximately 3 miles upstream of the mouth of the Willamette River and travels northerly along the west side of Sauvie Island for approximately 20 miles to its confluence with the Columbia River. The portion of the Multnomah County within unincorporated Multnomah County has limited development. Houseboats, several boat moorages, a marina, and a golf course are in the floodplain. Because of its proximity to Portland and major transportation routes, future floodplain development is probable.

Fairview Creek flows northerly from its source near Grants Butte, through the populated suburban area east of Portland, and empties into Fairview Lake near the Columbia River. It drains rolling pastureland interspersed with residential subdivisions. Fairview Creek has been channelized through a large subdivision between Burnside Road and Stark Street. South of the City of Fairview, the stream slopes gently as it passes through a thickly wooded area where a large planned-community development is under construction.

Beaver Creek, a tributary to Sandy River, flows northerly in a canyon with steep and forested side slopes. Because of the steep terrain, only a few areas are suitable for development within the Beaver Creek flood plain.

Kelley Creek enters Johnson Creek at 160th Avenue from low hills south of Johnson Creek. It drains an area of rolling farmlands with scattered residences. Mitchell Creek flows into Kelley Creek approximately 900 feet downstream of the Kelley Creek crossing of Foster Road.

Kelley Creek enters Johnson Creek at 160th Avenue from low hills south of Johnson Creek. It drains an area of rolling farmlands with scattered residences. Mitchell Creek flows into Kelley Creek approximately 900 feet downstream of the Kelley Creek crossing of Foster Road.

The only stream studied west of Willamette River is Unnamed Tributary to Rock Creek, which is within the Tualatin River drainage basin. That stream flows from the steep and forested slopes of the low Tualatin Range and enters the flat pastured

area of the study area south of Germantown Road. There is no development in the flood plain except for Kaiser Road. Just upstream of the Kaiser Road crossing, Unnamed Tributary to Rock Creek is joined by a small stream flowing southerly to its confluence.

Multnomah County Drainage District No. 1 fronts the Columbia River between approximately 20th Avenue and Fairview Avenue. There is both agricultural and industrial development in its flood plain.

Multnomah County has a temperate climate that is influenced by the Pacific Ocean, which is approximately 70 miles to the west. Summers are dry with pleasant temperatures; in the lower elevations, winters are rainy and mild with a narrow temperature range. Temperatures in Portland range from an average January minimum of 35°F to an average July maximum of 79°F. Near Willamette River, average annual precipitation is approximately 39 inches, with over one-half falling during the months of November through February. From Willamette River toward the east, average annual precipitation increases drastically. In the foothills of the Cascade Mountain Range, over 100 inches have been recorded. Soil drainage characteristics in the eastern portion of the county are generally good, while they are poor west of the Willamette River.

The City of Troutdale is located near the confluence of the Sandy and Columbia Rivers in Multnomah County, Oregon, approximately 15 miles east of Portland, at the mouth of the Columbia River Gorge, and 19 miles southeast of Vancouver, Washington. Troutdale is also bordered to the west by the City of Gresham and to the north, southwest and southeast by unincorporated Multnomah County. The city was founded in 1890 and incorporated in 1907. Troutdale's location at the western gateway of the Columbia River Gorge influenced its development as a river and railroad commerce center. Shipping, railroading and logging remained the primary commercial industries of Troutdale until the late 1940s. The economic character of Troutdale has changed dramatically since 1960.Troutdale is currently classified as a bedroom community in the greater Portland metropolitan area. As a result, it's economic base is now very similar to the highly economic base of Portland. The three largest employers in the urban service area of Troutdale are the Portland-Troutdale Airport, the Reynolds School district, and Home Depot.

The population of Troutdale in the 1990 census was 7,852; in the 2000 census was 13,777; and as of 2010, the population for Troutdale was 15,962. Population increase has primarily been through construction of new housing on land previously farmed: 3,587 new dwelling units have been constructed in Troutdale since 1994.

The climate of Troutdale is characterized by mild, wet winters and dry, pleasant summers. However, due to its proximity to the Columbia River Gorge and the Cascade Mountains, winter wind speeds and precipitation are higher than in Portland. Troutdale averages 45 inches of yearly precipitation compared to 39 inches in Portland.

Sandy River, the third largest river in Multnomah County, drains an area of 502.3 square miles. Its origin is the Reed, Zigzag, and Palmer Glaciers on Mt. Hood. The Mt. Hood Wilderness Area, the Mt. Hood National Forest and the Bull Run Watershed Preserve comprise approximately 70 percent of the watershed area. Beaver Creek is a tributary of Sandy River and Drains an area of approximately 13 square miles.

Both the Sandy River and Beaver Creek are characterized by deeply entrenched river valleys. The elevation variation of the Sandy River Basin is 10 to 11,245 feet mean sea level (msl). The elevation range is 15 to 600 feet msl for the Beaver Creek Basin. The steep slopes of Beaver Creek preclude any significant development within its floodplain except in the lower one-half mile. A similar condition exists for all but the first six miles of the Sandy River.

Recreational usage along the lower portion of the Sandy River and Beaver Creek remains high. The City owns and maintains Glenn Otto Park, a 6.38 acre park with picnic areas, restroom, conference buildings and caretaker lodging. The park is located on the west bank of the Sandy River and the east bank of Beaver Creek. The entrance to the park is on the south side of East Historic Columbia River Highway just west of the Troutdale Bridge over the Sandy River.

A small City park (Depot Park) north of East Historic Columbia River Highway and south of the Union Pacific Railroad, has frontage on both banks of Beaver Creek at its confluence with the Sandy River.

The City also owns property fronting on the Sandy River north of the East Historic Columbia River Highway and south of I-84 that is proposed for mixed-use development including a riverfront promenade.

Arata Creek flows into Troutdale from Wood Village several times along their common boundary along the western edge of Troutdale. From Halsey Street upstream the drainage area is less than one square mile. At both the northwestern corporate limits and Marine Drive, where Arata Creek leaves the city for the final time, the drainage area is about 1.5 square miles.

The City of Wood Village is located in north-central Multnomah County. Wood Village is bounded by the City of Troutdale to the east, by the City of Gresham to the south, and by The City of Fairview to the west. It was incorporated in 1951 and had an approximate population of 3,878 as of the 2010 Census. The approximate land area of the community is 0.9 square miles. The City of Wood Village is currently identified as non-flood-prone.

2.3 Principal Flood Problems

Columbia River flooding in Multnomah County usually occurs in spring during the Columbia River Basin snowmelt freshet. However, intense winter rainstorms are the primary cause of flooding on the remaining Multnomah County streams, and they

occasionally cause Columbia River flooding. Additionally, several localized ponding areas in the county are subject to flooding from seepage through levees during prolonged high Columbia River stages. Intense winter-storm runoff is the primary cause of flooding the large ponding area along Johnson Creek.

The annual Columbia River snowmelt freshet occurs in May or June and has caused flooding in Portland during high-runoff years. The Willamette River floods during the spring freshet primarily as a result of backwater from the Columbia River. The June 1894, 1948, and 1956 floods, with recurrence intervals of 80, 48, and 18 years, respectively, were snowmelt freshets. Those flood events had peak discharges at The Dalles, Oregon, the nearest gaging station with a reliable discharge measurement of 1,240,000, 1,010,000 and 823,000 cubic feet per second (cfs), respectively.

Minor flooding in Multnomah County begins when flows at The Dalles reach 450,000 cfs, and major damage begins when flows reach 600,000 cfs.

Multnomah County flood damage from the June 1894 flood, the largest recorded on Columbia River, is not well documented. However, that flood is estimated to have covered the broad, flat area on the south bank of Columbia River from Sandy River to Willamette River below the elevation of approximately 36 feet. Additionally, on Sauvie Island and Hayden Island, only a few isolated knolls were above water. The Willamette River, backed up from the high Columbia River stage, caused damage primarily to development in the incorporated area of Portland.

The June 1948 flood, the second largest of record on Columbia River, resulted in Willamette River backwater that crested 12 feet above bankfull stage at the Morrison Street Bridge and inundated many riverside establishments. Multnomah County Drainage District No. 1 was flooded when the levee system failed. Flood depths in the drainage district ranged from 10 to 20 feet.

Damage in the unincorporated portion of the district included farm crops, farm buildings, and residences. Sandy Drainage District, which adjoins Multnomah Drainage District No. 1 on the east and extends to the Sandy River, was not flooded. However, the aluminum plant within the district suspended operations and provided approximately 600 people for flood fighting. Willamette River flooding downstream of Portland included the side of Oregon Shipbuilding Corporation, immediately downstream from Portland Terminal Four, and the lowlands that are now filled for Rivergate Industrial District. The area within Sauvie Island is divided roughly in half by two diking districts.

The northern half, which contains the Columbia Diking District, was flooded. The floodwaters caused damage to farmland, residences, and farm structures. The southernhalf, protected by the Sauvie Island Drainage District, was nearly flooded. Sandbags were added to approximately 4 miles of levee crest to reinforce the levees, which were seeping heavily.

The December 1964 winter flood resulted from intense rainfall augmented by snowmelt. High concurrent discharges on both the Willamette and Columbia Rivers resulted in unusually high flood stages in Multnomah County. Along the Willamette River in the southern portion of the county, damage to residences was heavy. However, downstream of Portland, flood heights were less than in 1948, and damage to property fronting on the Columbia and Willamette Rivers and Multnomah Channel was limited to houseboats, boat moorages, and a lumber mill. A Hayden Island mobile home court was partially inundated, and adjacent areas of the island were flooded. Without reservoir control, the 1964 flood would have exceeded the 1894 and 1948 floods at the Morrison Street Bridge gage.

Flooding along the Sandy River can occur as a result of spring snowmelt runoff from the Mt. Hood watershed. However, intense winter rainstorms are the primary cause of flooding. The Sandy River watershed has experienced many flood events. Recent significant floods occurred in December 1964, January 1956, and January 1972. These floods had recurrence intervals of 300, 10, and 30 years, respectively. Flows of 61,400, 23,900, and 36,200 cfs, respectively, were recorded at the U.S. Geological Survey (USGS) Sandy River near Marmot gage (No. 14137000). This gage was established in 1911, and measures data from a drainage area of 263 square miles. Because the floodplain was only lightly developed, damage in the unincorporated portions of the county was relatively minor. Most of the damage consisted of severe bank erosion, as most of the homes along the stream were above the flood levels. Downstream of the Troutdale corporate limits, Sandy River flood elevations are controlled by Columbia River stages.

The Johnson Creek Flood season extends from October through March. Streamflow records at the Sycamore gage, located 2 miles downstream from the Gresham corporate limits, show that flows have exceeded the major flood stage 10 or more times during the period of record commencing in 1940. Recent floods include January 1972 and December 1977, which had peak discharges of 2,190 and 2,230 cfs, respectively, and average recurrence intervals of approximately 10 years. Flood shaving average recurrence intervals larger than 10 years inundate the low-lying area between 100th Avenue and 122nd Avenue as far north as Harold Street. During a 100-year (1-percent-annual-chance) flood, this inundated area is expected to extend as far east as 140th Avenue and Holgate Street. The December 1964 flood had a peak discharge of 2,620 cfs and an average recurrence interval of approximately 15 years. Overbank flows occurred at Southeast Regner Road and continued downstream along the Portland Traction Company Railroad right-of-way. The largest area flooded included the Gresham City Park, where Johnson Creek makes a deep bend; the bend has since been bypassed by a short excavated channel. Downstream of Southwest Walters Avenue, flooding was confined between the Portland Traction Company Railroad right-of-way to the north and the slopes of Walters Hill to the south. Areas of sparse residential development and agricultural lands were flooded along Johnson Creek within the City of Gresham.

The main concern is the flooding of Fairview Creek in the downtown Fairview area. Most floods occur as a result of excessive rainfall from October to March. Snowmelt

is usually an insignificant factor. Because Fairview is located at the lowest elevation in the Fairview Creek drainage basin, flood problems within the city will be influenced by any upstream development unless proper stormwater retention facilities are constructed.

Constrictions of Fairview Creek by partially plugged or undersized culverts at Southeast Burnside Road, at an unnamed road immediately upstream of the Tri-Met Lightrail bridge, at Southeast 202nd Avenue, and at the Portland Traction Company Railroad crossing upstream of Southeast 202nd Avenue have created backwater flooding over a wide area extending from Southeast Burnside to upstream of Northwest Division Street.

Flooding along Burlingame Creek have occurred frequently in the past and have been characterized by shallow overflows near the intersection of Hogan Place and Burnside Road.

Flooding along the Columbia River is caused in spring by the Columbia River Basin snowmelt freshet and in winter by intense rainstorms that result in high flows in the Columbia and Willamette Rivers. Flooding also occurs in more localized areas as a result of ponding from seepage through levees during prolonged high-river stages.

Past flood damage along the remaining streams studied is not well documented. Damage has been relatively low, however, because these streams are small and located in partially developed areas.

2.4 Flood Protection Measures

Levees exist in the study area that provide the county with some degree of protection against flooding. However, it has been ascertained that some of these levees may not protect the community from rare events such as the 1-percent-annual-chance flood. The criteria used to evaluate protection against the 1-percent-annual-chance flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the 1-pecent-annual-chance flood are not considered in the hydraulic analysis of the 1-percent-annual-chance floodplain.

A significant flood elevation reduction of Columbia and Willamette Rivers, and Multnomah Channel, has been achieved through the use of flood-control storage reservoirs. There are 22 major reservoirs in the Columbia River Basin upstream of Multnomah County, with a total food-control storage volume of approximately 40 million acre-feet. There are 11 major flood-control reservoirs in the Willamette River Basin, with approximately 1.7 million acre-feet of flood storage. The stage-reduction effect of the Columbia and Willamette River flood-control storage reservoirs.

The drainage districts along the Columbia River in the unincorporated portions of Multnomah County have levees of varying flood-protection capabilities. Thus,

safe-water levels have been established by the USACE. The safe-water levels 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 criteria used to evaluate protection against the 1-percent-annual-chance flood are: (*1) adequate design, including freeboard; (2) structural stability; and (3) proper operation and maintenance*. Levees that do not protect against the 1-percent-annual-chance flood are not considered in the hydraulic analysis of the 1-percent-annual-chance flood plain. Columbia Drainage District levees on the northern end of Sauvie Island would be overtopped by a 1-percent- annual-chance flood, whereas Sauvie Island Drainage District, Multnomah Drainage District No. 1, and Sandy Drainage District, with proper surveillance and maintenance, are expected to withstand the 0.2-percent-annual-chance flood event. However, these levees are currently certified for the 1-percent-annual-chance flood. 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.

There are no flood-control structures on Sandy River, Johnson Creek, Fairview Creek, Beaver Creek, Arata Creek or Unnamed Tributary to Rock Creek.

Another measure for providing flood protection from future floods is floodplain management. By restricting development in hazardous floodplain areas, flood related damage is prevented from occurring from all but the extremely large floods. Multnomah County has enacted floodplain management regulations. The regulations require that the county use existing flood plain information to determine whether new developments are reasonably safe from flooding. The regulations requires new developments to have first-floor elevations at least one foot above the 1-percent-annual-chance flood levels and discourages development within the floodway.

Elected officials of the tri-county Metropolitan Service District, formed in May 1978, have established a Johnson Creek Task Force representing the six counties and communities within that drainage basin. The task force has proposed storm water runoff management guidelines for adoption by the six political bodies. These guidelines apply to new development and are intended to control the rate of storm water runoff, thereby stemming.

Flood protection measures in the City of Fairview consist primarily of minor channelization. The National Weather Service in Portland, Oregon, is responsible for flood-warning and river-forecasting services in Multnomah County. General weather forecasts are also available. No flood-control structures have been built on Fairview Creek or on Unnamed Tributary east of Fairview Creek.

Nonstructural measures (a comprehensive land use plan, a zoning ordinance, and building permits) are being used to aid in the prevention of future flood damage in the City of Fairview. Zoning Ordinance No. 9-1974, enacted on November 10,

1974, follows Federal guidelines for controlling development within the 1-percent-annual-chance floodplain. The City of Fairview requires building permits, and it reviews those permits for compliance with the provisions of the zoning ordinance to ensure that sites are reasonably safe from flooding. The Comprehensive Land Use Plan was approved by the Oregon Land Conservation and Development Commission of July 10, 1980.

Storm runoff facilities are located throughout the City of Gresham urban area. A major diversion structure, built by the City of Gresham in 1976, diverts high flow through a 6-foot diameter underground pipe from Burlingame Creek to Kelly Creek. The intake facility is located on Southeast Burnside Road between Bull Run Road and Northeast Division Street and is designed to divert up to 200 cfs to Kelly Creek when flows in Burlingame Creek are greater than 100 cfs.

Gresham's comprehensive plan is used to limit development in the floodplain. It recommends areas of bordering streams as greenways and, within the greenway, only minimal new construction is allowed. In areas adjacent to those streams, the zoning ordinance, adopted as a prerequisite to participation in the NFIP, requires developers to furnish floodplain information to substantiate that proposed new development will not be subject to flooding.

The City of Troutdale has flood protection development standards. The most recent standards were adopted in the Troutdale Development Code November 24, 2000. The most significant standards include: balanced cut and fill within the 100-year floodplain; limitations of impervious area to not more than 30% of the 100-year floodplain; no new land division is permitted that would create a lot that is exclusively within the 100-year floodplain; residential construction is required to be elevated one foot above the Base Flood Elevation; and non-residential construction must either be elevated one foot above the BFE or dry-floodproofed. The City requires that detention facilities be designed for the control of stormwater and floodwater runoff in accordance with the Construction Standards for Public Works Facilities.

The Sandy Drainage Improvement Company maintains drainage ditches and levees within the City of Troutdale for flood control north of I-84 to the Columbia and Sandy Rivers.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 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.

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 100-year flood (1-percent chance of annual exceedance) during the term of a 30-year mortgage is approximately 26 percent (about 3 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.

The engineering analyses described here incorporate the results of previously issued Letters of Map Change (LOMCs) listed in Table 3, “Incorporated Letters of Map Change”, which include Letters of Map Revision (LOMRs). For more information about LOMRs, refer to Section 2.0, “FIRM Revisions.”

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Pre-Countywide FIS Reports

Due to new detailed study data, pre-countywide study data have been superseded. No other detailed studies were included previously.

The stage-discharge relationship for the Columbia River and Multnomah Channel near Multnomah County is influenced by ocean tides and by stages on the Willamette River. Similarly, the stage-discharge relationship of Willamette River in the study area is influenced by stages on the Columbia River. Thus, flood frequencies on both rivers and Multnomah Channel are more reliably determined for stages than for discharges. Combined stage-frequency curves were developed for seven locations on the Willamette River. Those locations include USGS gage No. 14144700 on Columbia River at Vancouver, Washington, and USGS gage No. 1421172 on Willamette River at the Morrison Street Bridge. Both gages were established in 1876. These curves were based on the statistical combination for stage-frequency curves for fall-winter floods and spring-summer floods.

Multnomah Channel discharges were estimated using the USACE HEC-2 step-backwater computer program. The HEC-2 computer model was calibrated to Columbia and Willamette River flood profiles, and Multnomah Channel discharges were derived by a trial-and-correction process.

Elevations for floods of the selected recurrence intervals on the Columbia River, the Willamette River, and Multnomah Channel are shown in Table 4.

The hydrologic analysis for Sandy River was performed by the SCS, Oregon State Office. The analysis used the standard log-Person Type III methods as outlined by the U.S. Water Resources Council. It was based on records for the Sandy River gage below Bull River, Oregon. That gage has a drainage area of 440 square miles and was in existence from 1929 to 1966. Flows computed at the gage were adjusted to compensate for the increase in drainage area downstream of the gage to the study area.

Discharges for the 1-percent-annual-chance flood were determined at several locations on Discharges for Arata Creek and Unnamed Tributary to Fairview Creek were developed 21 by the regional analysis presented in the U.S. Geological Survey Open-File Report 79- 553, Magnitude and Frequency of Foods in Western Oregon. Those discharges were modified based on culvert capacity and overflow computations.

Stream gage records for Johnson Creek were statistically analyzed using the standard log-Pearson Type III distribution. A discharge-frequency curve for the Johnson Creek stream gage at Sycamore was developed using records from 1941 to 1972. Peak discharges were adjusted downstream of the Sycamore gage to account for overbank storage in a large depression that extends from Interstate Highway 205 east to 140th Avenue and from Johnson Creek north to Holgate Street. The 10- and 2-percentannual-chance discharges were reduced to compensate for flood storage

available in that depression. The depression was considered to fill before peak 1- and 0.2-percent-annualchance flood flows occur.

Discharges for Fairview Creek and Unnamed Tributary to Rock Creek were determined by correlations with available stream discharge-frequency relationships for similar watersheds. The discharges for Fairview Creek were correlated with Beaver Creek and Johnson Creek based on drainage area and slope on the discharge-frequency curves. The Unnamed Tributary to Rock Creek 1-percent-annual-chance discharges were computed using a USACE standardization procedure for ungaged streams. The discharge-frequency curve slope was correlated with an existing curve for Burnt Bridge Creek.

Flow estimates for the reach of Fairview Creek above River Mile 2.13 were developed by Kramer, Chin & Mayo, Inc. in Portland, Oregon, doing a drainage master plan on Fairview Creek for the City of Gresham. The method used was the U.S. Geological Survey (USGS) technique described in Open File Report 80-689, "Storm Runoff as Related to Urbanization in the Portland, Oregon – Vancouver, Washington Area". Peaks were determined for each drainage area by placing a storm pattern on each one and computing the hydrograph. Then HEC-1 and HEC-2 models were used to route hydrographs and compute peak discharges along the creek. These peak discharges were larger than those developed by the USACE in January 1979 and used in the 1984 detailed study of 0.6 mile on Fairview Creek in Gresham and in the detailed study for the City of Fairview downstream of NE. Glisan Street. The newer discharges for the 1-percent-annual-chance flood were about 13 percent larger at NE. Glisan Street. The larger discharges developed for the drainage master plan were considered to be more accurate due to the more detailed analysis and therefore were used by the USACE for the restudy. Because split flow leaves the main channel of Fairview Creek at two locations, the discharges were reduced at Northeast Glisan Street and from the Portland Traction Company Railroad crossing downstream across Southeast 202nd Avenue to the private driveway crossing located approximately 1,500 feet upstream of Burnside Road.

Flow estimates for Kelly Creek were developed by the USACE using the HEC-1 computer program. The input parameters were estimated based on correlation with a study done by URS Corporation of Kelly Creek in 1988, and a Master Drainage Plan Report done by KCM, Inc., in 1988 for Fairview Creek, which is just west of Kelly Creek basin in Gresham.

Kelly Creek discharges used for the May 2, 2002 restudy were taken from a previous study of Kelly Creek, based on HEC-1 modeling, performed by the USACE. The reach of the previous study extended from the downstream crossing of Kane Road, near Mount Hood Community College, upstream to NE Division Street. The discharge values in this reach were compared with the U.S. Geological Survey (USGS) regression equations to verify their accuracy. They were then adjusted by a drainage area ratio at seven locations on the restudy reach. The peak discharges used

in this restudy for the 10-, 2-, and 1-, and 0.2-percent-annual-chance floods are shown in Table 4, "Summary of Discharges".

Flow estimates for the 1-percent-annual-chance flood on Beaver Creek were correlated with flow records of the Sandy River stream gage, located 2 miles northwest of the community of Bull Run. The data were based on reading from 1910 to 1914 and from 1929 to the present. However, flood recurrence interval relationships for the 10-, 2-, and 0.2-percent-annual-chance flows were based on the data from the Johnson Creek gage near Sycamore.

Peak discharge-drainage area relationships for Sandy River, Arata Creek, Unnamed Tributary Fairview Creek, Johnson Creek, Fairview Creek, Unnamed Tributary to Rock Creek, and Beaver Creek are shown in Table 6.

The rate and volume of runoff for the 1-percent-annual-chance flood within Multnomah County Drainage District No. 1 were determined using the Environmental Protection Agency Stormwater Management Model. The model calculates the rate of runoff at specific time intervals throughout the storm based on characteristics of rainfall and the physical characteristics of the drainage basin. The computed runoff draining into Columbia Slough was then balanced against the ability of the drainage district pumps to discharge water from the slough. The volume of runoff draining to the slough that exceeded district pumping capabilities was calculated at specific time intervals throughout the storm. The peak water-surface elevation for the 1-percent-annual-chance storm was then determined using the volume of storage at various elevations in the slough.

Discharges used for approximate-study stream lengths were derived by correlations with similar drainage basins and based on a comparison of drainage areas.

For the updated Sandy River watershed analysis, any years with maximum value discharges in April-September were analyzed to determine if there was a separate population within the data. This was not the case for the gages within the Sandy River watershed. Either all annual peak flood events occurred in the winter season, October-March, or there were a small number of years where the annual maximum occurred in the spring season, April-September, and therefore observations were not in the magnitude of the period of record maximum. The exception was the Sandy River where 10 years of the 99 years of recorded annual flood peaks occurred outside of the winter season. Again, the annual maxima did not approach the magnitude of the period of record observed peaks. This proved to have minimal affect on the outcome of the statistical analysis.

Eight USGS gages within the Sandy River watershed were used to develop discharges along the study reaches: USGS gage 14131400 Zigzag River near Rhododendron Oregon (USGS, 2011c), USGS gage 14135000 Salmon River at Welches Oregon (USGS, 2011d), USGS gage 14135500 Salmon River at Boulder Creek near Brightwood Oregon (USGS, 2011e), USGS gage 14137000 Sandy River upstream of Marmot Dam (USGS, 2011f), USGS gage 14140000 Bull Run

River near Bull Run, Oregon (USGS, 2011g), USGS gage 14141500 Little Sandy River near Bull Run, Oregon (USGS, 2011h), USGS gage 14142500 Sandy River below Bull Run River (USGS, 2011i), and USGS gage 14142800 Beaver Creek at Troutdale Oregon (USGS, 2011j).

The gage data was analyzed by Bulletin 17B (WRC, 1981) methodology and the log-Pearson Type III distribution, using the USGS PeakFQ computer program. The Sandy River gage (14137000), discharges below 5,000 cubic feet per second (cfs) were considered to be outliers, based on information provided in the USGS regional regression equation report for Oregon. Additionally, the State of Oregon has a specific mean square error value of 0.112 which was used in the PeakFQ program.

For streams which had a USGS gage, the final discharge was a combination of the gage discharge weighted with the regression discharge. The regression discharges were obtained from the USGS regression report (Cooper, 2005). To determine discharges for segments which are outside the tolerance range of 50-150% of the drainage area at the gage, a discharge–drainage area curve was developed for each flood event based on the stream gage regional regression equations weighted discharge values.

Salmon River had two separate gages with similar drainage areas, and slightly different periods of record. To determine the discharges for the Salmon River, the two weighted discharges were weighted with each other to produce a single discharge- drainage area relationship to be used for the Salmon River. This relationship was applied to the Salmon River only.

This Physical Map Revision

Based on historical data, and USGS documentation, October-March is the winter storm season. The USGS investigated the seasonal occurrence of 9,372 observed peak discharges for western Oregon. The peak discharges were grouped by season, with winter defined as November through March (rain or rain on snow) and spring as April through June (snowmelt). The data clearly demonstrated that the majority of annual peak floods occur in the winter season (93.5 percent) with only 6.2 percent occurring in the spring season.

Additionally, the drainage area for Burlingame Creek was verified against culvert information obtained from the City of Gresham to validate the delineation around SE Burnside Street (City of Gresham, 2012).

The 24-hour rainfall depths were based on the Oregon Department of Transportation's precipitation-frequency analysis for 24-hour precipitation for Oregon (ODOT, 2008). The total rainfall depths were distributed following a Natural Resource Conservation Service (NRCS) Type 1A storm distribution.

The rainfall losses were estimated using the NRCS approach presented in Technical Release 55. A curve number was determined for each sub-basin based on the soil type, hydrologic soil group, and land use.

The Sub-basin response for Beaver Creek, Burlingame Creek, and Kelly Creek were estimated using methodology described in U.S. Geological Survey Water Investigations Report 80-689 (USGS, 1980). The lag time (tL) was used to transform the unit hydrograph for a sub-basin to a hydrograph of direct runoff for the estimate of peak discharge. The lag time was based on the channel being considered fully developed (F) or natural (N).

Sub-basin reach routings were estimated using the Muskingum-Cunge Method.

One storage areas was modeled in the analysis. The storage area was routed based on stage-discharge outlet relationships and stage-storage relationships. The outlet structure information was provided by the City of Gresham.

The model was verified by obtaining real-time climatic data as well as observed stream gage data for two storm events along Beaver Creek which produced the maximum discharges in the 11-year gage record period. The precipitation data was obtained from NOAA and the data was captured at the Troutdale Regional Airport in 1-hour increments. The gage data was obtained from the USGS Instantaneous Data Archive (USGS, 2012a).

Peak discharge-drainage area relationships for each flooding source studied in detail are shown in Table 5.

Table 5 - Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharge (cfs) 10- Percent - Annual Chance	2-Percent- Annual Chance	1-Percent Annual Chance Existing	0.2 - Percent Annual Chance
Beaver Creek	13	1,200	1,800	2,100	3,300
At Crown Point Road	11.7	551	871	1,038	1,485
At SE Stark Street	6.6	329	520	620	887
At Kelly Creek	6.12	*	*	1,694	*
Confluence					
Beaver Creek - Reach 1	6.12	*	*	1,694	*
With Kelly Creek					
Beaver Creek – Reach 1	10.93	1,457	2,143	2,317	3,024
At USGS Gage Station 1412800					
Brick Creek	0.1	17	24	27	33
At Mouth confluence					
Burlingame Creek	2.01	360	564	618	832
Confluence with Kelly Creek					
Burlingame Creek	0.89	227	346	377	504
At Powell Valley Road					
Columbia River below Gresham,	241,000	22.3	26.4	28.1	31.7
Oregon					
Fair Creek At Mouth 1	5.2	280	420	490	640
At Sandy Boulevard 1	4.5	260	370	430	560
At Banfield	4.4	185	295	350	505
At NE Halsey Street 1	4.3	180	290	345	495
At NE Glisan Street, below split flow 1	3.28	134	139	145	153

*Not calculated for this FIS project

Table 5 - Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharge (cfs) 10- Percent - Annual Chance	2-Percent- Annual Chance	1-Percent Annual Chance Existing	0.2 - Percent Annual Chance
At NE Glisan above split flow 1	3.28	155	216	245	318
Upstream of Fujitsu Ponds1	3.08	203	262	287	349
At NE Start Street1	2.87	162	203	221	262
At NE Stark Street1	2.25	124	165	185	235
At NW Burnside Road1					
Downstream of Birdsdale Ave1	2.15	178	218	232	264
At NE Division Street 1	0.60	19	28	33	44
Above NE Division Street	0.55	69	106	124	171
Hogan Creek	1.0	181	225	286	356
At Month					
Johnson Creek	46	2,450	4, 050	5,400	7,700
At 82nd Avenue					
At Gage 14211500	26.3	2,554	3,497	3,869	4,680
At Southeast 174th Avenue					
(Gresham corporate limits)	21	2,2005	2,808	3,142	3,908
At USGS Gage 1421140	15.5	1,641	2,261	2,504	3,029
At Southeast 252nd Avenue	12.7	1,461	2,005	2,212	2,645
Below Confluence with MacDonald Creek					
Below Highway 26 (Above Confluence with MacDonald Creek)	7.2	839	1,174	1,301	1,567
A	4.8	587	818	905	1,084

*Not calculated for this FIS project

Table 5 - Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharge (cfs) 10- Percent - Annual Chance	2-Percent- Annual Chance	1-Percent Annual Chance Existing	0.2 - Percent Annual Chance
Kelley Creek					
At Study Limit, approximately 900 feet downstream of SE Foster Road	3.0	508	745	849	102
At SE Ritchey Road	1.1	203	287	321	399
Kelly Creek Confluence with Beaver Creek Just Upstream of Confluence with Burlingame Creek	4.34	496	720	780	961
Kelly Creek	2.12	187	295	325	451
Burlingame Creek					
Kelly Creek					
At Northeast Kane Road	8.66	504	662	742	959
Approximately 400 feet Downstream of Kane Road	1.77	206	271	303	392
Upstream of Burlingame Creek At Powell	4.33	301	406	455	593
At Powell Valley Road	1.29	148	195	398	283
Just Upstream of Ironwood Way	0.91	106	140	156	202
Upstream of 282nd Avenue	0.51	59	78	87	113
MacDonald Creek	2.4	275	410	463	579
At Mouth					

*Not calculated for this FIS project

Table 5 - Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharge (cfs) 10- Percent - Annual Chance	2-Percent- Annual Chance	1-Percent Annual Chance Existing	0.2 - Percent Annual Chance
North Fork Johnson Creek At Mouth	1.2	133	188	210	258
Sandy River At Mouth	502	48,000	72,000	85,139	129, 200
Sandy River At Dabney Park	483	*	*	*	81,853
Sunshine Creek At Mouth	3.8	486	660	726	861
Unnamed Tributary To Rock Creek At Kaiser Road	3.2	160	240	260	340

*Not calculated for this FIS project

3.2 Hydraulic Analyses

Pre-Countywide Analyses

Due to new detailed study data, pre-countywide study data have been superseded. No other detailed studies were included previously

December 18, 2009
Initial Countywide FIS Report

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

Water-surface elevations were computed through the use of the USACE HEC-2 stepbackwater program.

Columbia River flood profiles for specific recurrence intervals were plotted directly from the combined stage-frequency curves described in Section 3.1. The HEC-2 computer program was calibrated to the plotted 1-percent-annual-chance flood profile and used for the Columbia River floodway determination. Discharges used in the floodway computations were correlated, based on data at USGS gage No. 14105700 (established in1857) at The Dalles, Oregon, to yield water-surface elevations similar to the combined stage-frequency curves.

Table 6 - Summary of Stillwater Elevations
Elevation (Feet, NAVD 88)

Flooding Sources and Location	Drainage Area (Square Miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Columbia River At Vancouver, Washington (River Mile 106.5)	241,000	25.8	29.9	31.6	35.2
Willamette River At Morrison Street Bridge (River Mile 12.8)	11,200	25.5	30.2	32.3	37.2
Multnomah Channel At Sauvie Island Bridge	-[1]	25.1	29.2	30.8	34.9

[1]Not Applicable
Vancouver gage vertical conversion to NAVD88 +3.46 ft.
Portland gage vertical conversion to NAVD88 +3.48 ft.
Multnomah Channel vertical conversion to NAVD88 +3.39 ft.

Willamette River flood profiles are referenced to combined frequency computations for the Morrison Street Bridge gage.

A HEC-2 computer model was used to estimate flood elevations upstream and downstream of the gage. Discharges used in the HEC-2 model were correlated, based on data at USGS gage No. 1419100 (established in 1892) at Salem, OR, to yield water-surface elevations similar to the combined stage-frequency curves.

The HEC-2 program was used to prepare Multnomah Channel flood profiles that connect corresponding Columbia and Willamette River combined frequency flood profiles downstream and upstream of the study reach.

Flood profiles for Sandy River were originally computed by the SCS. The analysis used the SCS Water Surface Profile Computer Program (WSP2) to compute flood stages at each cross section. The profiles were prepared by SCS for a 1977 report.

Hydraulic analyses performed by the SCS, were regenerated using the USACE's HEC-2 program. The WSP2 program used elevation-discharge-velocity information to plot rating curves for each cross section. The rating curves were used with peak flow-frequency information from the hydrologic studies and with historic high water information to obtain water-surface elevations for the 10-, 2-, and 1-percentannual-chance floods at each cross section. Some adjustments in the Computed Waters Surface Elevations (CWSEL) occurred as a result of conversion from the WSP2 to the HEC-2 program. Primarily, CWSELs were lowered in the vicinity upstream of the bridges. In the beginning downstream reach, the 0.2-percent-annual-chance flood CWSEL was higher in the HEC-2 data due to a different starting technique. The SCS used the same starting water-surface elevation (SWSEL) for both the 1- and 0.2-percentannual-chance floods (elevation of December 1964 flood) while the USACE used the slope-area method. However, both the WSP2 and the HEC-2 0.2-percent-annual-chance flood SWSEL were submerged by the backwater from the Columbia River combined probability flood profiles up to the I-84 bridges. Johnson Creek Flood profiles were computed using the HEC-2 step-backwater computer program, with the exception of the stream length between Telford Road and U.S. Highway 26. There are three complex bridges in that area that could not be modeled reliably by computer; thus, manual computations were made.

Fairview Creek flood profiles were also computed using the HEC-2 step-backwater program with the exception of the area near the Stark Street culvert. Manual calculations were used to determine the hydraulic losses through this culvert.

The Fairview Creek study was revised on July 3, 1995, to add base flood elevations, and to update the flood boundary delineations from Bridge Street to Fairview Lake. The hydraulic analysis conducted for this restudy utilized the HEC-2 step-backwater program. Cross-sectional data were obtained from the field surveys performed in May 1991, and were supplemented with topographic maps provided by Multnomah County. The 1- percent-annual-chance flood elevation calculated at the farm road crossing, which acts as a weir, at the outlet of Fairview Lake was used as the starting-water surface elevation. The revised floodway was established using equal conveyance. The results are shown on Table 9.

This Physical Map Revision

Water surface elevations (WSELs) of the 10-, 4-, 2-, 1-, and 0.2-percent-annual-chance floods for Beaver Creek, Burlingame Creek, Kelly Creek, and Sandy River in Multnomah County, Oregon were estimated using of the USACE HEC-RAS 4.1.0 computer program (HEC, 2010). Cross sectional geometries for the detailed analysis of these streams were comprised of field run survey data and a digital terrain model (DTM) generated from Light Detection and Ranging (LIDAR) data collected by the Oregon Department of Geology & Mineral Industries (DOGAMI) in 2011 (DOGAMI 2011). Topography for the upper portion of Kelly Creek was based on LIDAR from 2007 (DOGAMI 2009). Surveyed channel sections were transferred upstream and downstream to LIDAR generated cross sections and were blended with the LIDAR data to create a consistent channel profile. Floodway encroachment stations were established, first using Method 4. The Method 4 encroachment stations were imported and the Method 1 encroachment analysis was then executed to create the final floodway.

For counties with community topo:
For the streams studied by approximate methods, cross section data was obtained from the topography. Roads were modeled as weirs, using elevations from the topography. The studied streams were modeled using HEC-RAS version 3.1.3 (HEC, 2005).

Manning's Roughness were determined based on surface conditions in the channel and on the overbanks based on site visit, aerial photography and photographs. Manning's roughness used in the modeling is summarized in Table 7.

Table 7– Roughness Coefficients - Manning's "n" Values

Stream	Channel "n"	Overbank "n"
Beaver Creek	0.050	0.050-0.120
Brick Creek	0.050 – 0.055	0.800 – 0.100
Burlingame Creek	0.035 -0.050	0.035 – 0.100
Columbia River	0.025 – 0.038	0.050 – 0.100
Fairview Creek	0.025 – 0.038	0.050 – 0.100
Fairview Creek – East Pond	0.250 – 0.050	0.080
Fairview Creek – NE Glisan Street Overflow	0.160 – 0.080	0.040 – 0.080
Hogan Creek	0.040 – 0.085	0.045 – 0.100
Johnson Creek	0.030 – 0.050	0.035 – 0.100
Johnson Creek Park Side Channel	0.040	0.040 – 0.080
Johnson Creek City Telford Split	.0400 - .0700	0.040 – 0.080

Table 7 – Roughness Coefficients - Manning's "n" Values (continued)

Stream	Channel "n"	Overbank "n"
Kelly Creek	0.035-0.060	0.035 – 0.120
MacDonald Creek	0.040	0.050 – 0.070
Multnomah Channel	0.030	0.050 – 0.100
North Fork Johnson Creek	0.045 – 0.050	0.060 – 0.100
North Fork Johnson Creek - Split Flow	0.040	0.060
Sandy River	0.030 – 0.040	0.035 – 0.120
Sunshine Creek	0.025 – 0.050	0.040 – 0.090
Unnamed Tributary to Rock Creek	0.015 – 0.080	0.050 – 0.100
Willamette River	0.030 – 0.050	0.050 – 0.100

The starting water-surface elevations for Columbia River flood profiles were based on the appropriate combined stage-frequency curve, while Willamette River and Multnomah Channel starting elevations were on coinciding Columbia River flood elevations.

The starting water surface elevations for the Sandy River were based on a slope-area method with a starting slope of approximately 0.00029 to 0.00025. There is overflow from Sandy River and interflow with Beaver Creek from Crown Point Highway downstream to their confluence, and Beaver Creek computed water surface elevations reflect the increase in the discharge because it was assumed that the two streams will peak together. A split-flow analysis was made to determine the quantity of overflow into Beaver Creek for the 2- and 1-percent-annual-chance floods. The 0.2-percent-annualchance flow was so great that the cross sections were extended to include Beaver Creek in the Sandy River floodplain.

Backwater from Columbia River controls flood crests in the reach of the Sandy River downstream of I-84 bridges for the 1- and 0.2-percent-annual-chance floods and for the reach downstream of the UPRR trestle for the 10- and 2-percent-annual-chance floods.

Johnson Creek starting elevations were obtained from the Flood Insurance Study for the City of Portland. Previous flood elevations, channel slopes, and bank elevations were considered when the starting water-surface elevations were determined for Sandy River, and Unnamed Tributary to Rock Creek.

Starting water-surface elevations for Fairview Creek were based on normal-depth calculations. Starting water-surface elevations for the reach being revised, from River Mile 2.13 upstream to NE. Gilsan Street, were obtained by using the computed energy grade slope at cross section 2.13 from the last Flood Insurance Study for Fairview, Oregon, dated September 30, 1987.

Water-surface elevations within Multnomah County Drainage District No. 1 are based on a July 1984 hydrology study for the district. As a result of this study, the 100-year water-surface elevation within the district was reduced from 17 feet to 14 feet (NGVD 29).

A detailed hydrologic and hydraulic analysis of Kelly Creek was completed in June 1992 and became effective on February 16, 1996. The detailed study was performed for Kelly Creek from the Mount Hood Community College (MHCC) dam, located approximately 1,100 feet downstream of Northeast Kane Road, upstream to Southeast Division Street, a 29 distance of approximately 0.8 miles.

The hydraulic analysis for the revised study was performed using the USACE HEC-2 step-backwater computer program. Data for the cross section, including overbank areas, were taken from topographic maps at a scale of 1”=100’, with a contour interval of 2 feet. Data at the Kane Road culvert and MHCC outlet structure were surveyed in past years and verified by a field visit in March 1992. Channel and overbank roughness coefficients (Manning’s “n”) used in the computer program were estimated from experience and field observations. A value of 0.035 was used for the channel and values ranged from 0.038 to 0.042 for the overbank areas. The starting watersurface elevation was obtained from a rating curve computed at the upstream end of the culvert at Kane Road. The hydraulic study included the backwater effect from the MHCC dam on the culvert outlet at Kane Road.

The floodway was computed using Method 4 of the HEC-2 computer model from Kane Road to approximately 522 feet upstream. Method 6, with a 1.0-foot allowable rise in the energy grade line, was used from this point to approximately 3,161 feet upstream. Method 6, with a 0.1-foot allowable rise in the energy grade line, was used from this point to the limit of detailed study at Division Street. The floodway and 1- and 0.2-percent-annual-chance floodplain boundaries were delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps. In cases where the lines are collinear, only the floodway boundary has been shown.

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

Table 5, "Summary of Discharges," Table 9 "Floodway Data," and the Profile Panels were also revised to reflect the results of this detailed study.

The Kelly Creek study was revised on May 2, 2002 to show modifications to flood hazards along an approximate 3 mile reach from the crossing at NE Division Street upstream to approximately 600 feet upstream of 282nd Street. Water-surface elevations immediately upstream of Kane Road and the Kelly Creek Storm Water Detention Facility were adjusted by FEMA in October 2000 utilizing data approved by the City of Gresham.

The hydraulic analysis for Kelly Creek was performed using the HEC-RAS stepbackwater computer program, Version 2.1, to provide the water-surface elevations along the study reach. The starting water-surface elevation was taken from the results of the previous hydraulic study performed by the USACE, directly downstream of the restudy reach. The model was run in a sub-critical flow regime to estimate the flood profiles.

Cross section locations were chosen based on field investigations and USGS quadrangle maps. Chase, Jones & Associates, Inc. surveyed fourteen cross sections in the restudy reach. Other cross sections were taken from the City of Gresham's 1"=200', two foot contour interval, topographic maps. The first three downstream cross sections were repeated from the previous study completed on Kelly Creek, directly downstream of the restudy reach. All of the culverts, roads, detention facilities, and bridges were surveyed by Chase Jones and Associates, Inc.

The hydraulic analyses for this study were based on unobstructed flow, except for the culverts at Birdsdale Avenue and the Tri-Met Lightrail, which were modeled as found, half-filled with sediment. The culvert at Division Street, which was submerged and assumed mostly filled with sediment during surveys in 1985, was modeled as being open because it was reported as being cleaned out in 1987. The flood elevations shown on the profiles are thus considered valid for these conditions (with noted exceptions) only if hydraulic structures remain unobstructed, operate properly, and do not fail.

The profile baselines depicted on the FIRM represent the hydraulic modeling baselines that match the flood profiles on this FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the Special Flood Hazard Area.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Manning's "n" values chosen varied from 0.06 to 0.08 for the left and right overbanks and 0.04 for the channel, based on field observations. The Manning's "n" values were repeated for the cross sections duplicated from the downstream study.

The floodway corresponding to the 1-percent-annual-chance flood was initially determined using method 4 encroachment analysis in HEC-RAS, with a water-surface rise of one foot. The method 4 approach was then converted to method 1 and modified to ensure the floodway did not encroach inside the channel banks. The Beaver Creek study was revised on August 3, 1998 to add detailed flood information, including the adoption of a regulatory floodway, from just upstream of Jackson Park Road to approximately 200 feet downstream of Southeast Stark Street.

Flooding along Beaver Creek occurs from two sources. Overflow from Sandy River creates a backwater effect along Beaver Creek from its confluence point with the Sandy River to approximately 6,200 feet upstream. Flooding along the remainder of Beaver Creek is due only to flow originating from the Beaver Creek watershed. Because of the backwater effects from the Sandy River, the lower portion of Beaver Creek is a level pool with essentially constant elevations. From approximately 6,200 feet upstream, the steep slope of the basin results in supercritical flow.

The hydrologic analyses for this portion of Beaver Creek were obtained from the FIS report for the City of Troutdale. This analysis was performed by the National Resources Conservation Service (formerly the SCS), Oregon State Office. Streamflow data at gaging stations in the Sandy River basin were processed in accordance with the method described by the Water Resources Council. A regional analysis of the peak flow-frequency characteristics as a function of the drainage area was made and used to determine the unit peak discharge-frequency for Beaver Creek as shown in Table 6. The discharge at Troutdale Road was obtained by prorating the discharge at Southeast Stark Street to account for the reduction in drainage area.

The hydraulic analysis of Beaver Creek was performed using the USACE HEC-2 stepbackwater program. Starting water-surface elevations just upstream of Jackson Park Road were taken from the previous published FIS. Cross-section information was developed from topographic work maps at a scale of 1”=100’, with a contour interval of 2 feet. Roughness factors (Manning’s “n”) used in the hydraulic computations were chosen based on engineering judgment and field observations of the channel and overbank areas. Manning’s “n” values of 0.04 and 0.07 were chosen for the channel and overbanks, respectively.

The floodway along the studied portion of Beaver Creek was computed on the basis of equal conveyance reduction from each side of the floodplain. From just upstream of Jackson Park Road to approximately 3,100 feet upstream, and from Troutdale Road to Southeast Stark Street, the floodway width was determined by the width of the encroachment needed to cause a 1-foot rise in the water surface. From 3,100 feet upstream of Jackson Park Road to Troutdale Road, the floodway width was determined by the width of the encroachment needed to cause a 1-foot rise in the energy gradeline.

The approximate analysis on Columbia River upstream of the Sandy River was based on existing 1-percent-annual-chance profiles and existing topographic maps. Sandy

River approximate analysis included field investigations to recover the 1964 high-water marks and normal-depth calculations to define the flood plain, using available topographic information.

Kelly, Beaver, and Fairview Creek approximate analyses were completed based on existing topographic information and normal-depth calculations. Burlingame, Kelley, and Butler Creeks and Unnamed Tributary to Johnson Creek approximate elevations were derived from field analysis and using 2-foot contour interval maps.

The approximate analysis on Arata Creek was based upon existing topographic maps, culvert analyses, and normal depth computations. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

The hydraulic analyses for this study were based on unobstructed flow, except for the culverts at Birdsdale Avenue and the Tri-Met Lightrail, which were modeled as found, half-filled with sediment. The culvert at Division Street, which was submerged and assumed mostly filled with sediment during surveys in 1985, was modeled as being open because it was reported as being cleaned out in 1987. The flood elevations shown on the profiles are thus considered valid for these conditions (with noted exceptions) 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 in use for newly created or revised FIS reports and FIRMs was NGVD. With the finalization of NAVD, many FIS reports and FIRMs are being prepared using NAVD as the referenced vertical datum.

Flood elevations shown in this FIS Report and on the FIRMs are referenced to NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum.

For additional information regarding conversion between NGVD and NAVD, visit the 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, Maryland 20910-3282
(301) 713-3242

Table 8 – Vertical Datum Conversions

Quadrangle Name	Quadrangle Corner	Latitude	Longitude	Conversion from NGVD29 to NAVD88 (feet)
Damascus	NE	45.500	-122.375	3.423
Sandy	NE	45.500	-122.250	3.424

Average Conversion from NGVD29 to NAVD88 = 3.423 (FEET)

The conversion factor from NGVD to NAVD for all streams in this report is +3.423 feet. 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.

To obtain current elevation, description, and/or location information for benchmarks shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

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, Floodway Data Table, and Summary of Discharges 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 at a scale of 1:1,200, with a contour interval of 2 feet.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zone A and AE), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2).

Base map aerial imagery shown on this FIRM is from the Metro Data Resource Center and was collected during July 2004. Non-revised floodplains were compared to this new base map data and adjusted where appropriate.

In accordance with FEMA Procedure Memo 36, profile base lines have been included in all areas of detailed study. Profile base lines are shown in the location of the original stream centerline or original profile base line without regard to the adjusted floodplain position on the new base map. This was done to maintain the relationship of distances between cross sections along the profile base line between the hydraulic models, profiles and floodway data tables.

For the revised Kelly Creek study of May 2, 2002 the City of Gresham provided two-foot contour interval topographic maps, based on aerial photography from 1990. These maps were used as the base map and to delineate the floodplain based on the flood profiles.

As part of the countywide update, floodplain boundaries within the City of Fairview for portions of the Columbia River, Fairview Lake, Blue Lake, and Fairview Creek were revised based on topographic maps at a scale of 1:1,200 with a contour interval of 2 feet. Additionally, portions of the Columbia River, Sandy

River, Willamette River, and Multnomah Channel were revised based on 2 foot contour interval topographic data developed from LiDAR data created by the Puget Sound LiDAR Consortium. The data can be used at a horizontal scale of 1:12,000 (1inch=1,000 feet) or smaller.

The floodplain boundaries for the remaining streams were digitized from the effective FIRM and Floodway panels. Aerial photography was used to adjust floodplain and floodway boundaries where appropriate.

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 1-percent-annual-chance 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 9). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Portions of the floodways of Columbia River, Willamette River, and Johnson Creek are outside of the unincorporated areas of Multnomah County.

No floodway is delineated for Sandy River downstream of the Union Pacific Railroad bridge due to the low development potential of that area. No floodway is delineated upstream of Clark Road on Johnson Creek due to the steep stream gradient in that area. Both of these decisions were agreed upon by the study contractor and FEMA.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance flood 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 3.

The floodway width at cross section F on the Sandy River was revised as part of the countywide update where new topography resulted in a mapped 1-percent annual chance floodplain that was narrower than the effective floodway. The floodway was mapped as coincident with the 1-percent annual chance floodplain. In accordance with FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, floodways which abut certified levees are to be mapped to the landward toe of the levee. Several locations where the effective mapping did not reflect this were revised and the floodway boundary was moved to the landward toe as determined by new topographic data. This was done for the Columbia River at cross sections C, D, and Q and for the Multnomah Channel at cross sections D and E. Floodway widths shown in Table 9 were updated to reflect the revised floodway boundary

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LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Square Feet)	MEAN VELOCITY (Feet / Second)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	633	144 / 0	2,080	0.0	38.0	38.0	0.0	0.0
B	1,373	151 / 0	2,000	0.0	39.3	0.0	0.0	0.0
C	1,848	117 / 0	1,720	0.0	39.5	0.0	0.0	0.0
D	2,006	66 / 0	690	0.0	39.5	0.0	0.0	0.0
E	2,270	111 / 0	1,130	0.0	42.9	0.0	0.0	0.0
F	2,798	101 / 0	2,050	1.0	43.0	43.0	0.0	0.0
G	3,115	74 / 0	485	0.0	43.1	0.0	0.0	1.0
H	3,500	101 / 0	1,042	0.0	43.4	0.0	0.0	1.0
I	6,350	42 / 0	173	0.0	47.1	0.0	0.0	0.0
J	8,150	36 / 0	170	0.0	114.6	0.0	0.0	0.0
K	9,350	48 / 0	170	0.0	157.5	0.0	0.0	0.0
L	10,530	44 / 0	316	0.0	186.9	0.0	0.0	0.0
M	12,290	44 / 0	148	7.0	198.2	0.0	0.0	0.0
N	12,778	30 / 0	133	0.0	214.1	0.0	0.0	1.0
O	12,988	120 / 0	1,520	0.0	215.4	0.0	0.0	0.0
P	13,593	163 / 0	955	0.0	215.5	0.0	0.0	0.0
Q	13,886	43 / 0	167	0.0	215.6	0.0	0.0	0.0
R	14,362	12 / 0	142	0.0	219.9	0.0	0.0	0.0
S	14,679	14 / 0	206	0.0	223.5	0.0	0.0	0.0
T	14,995	62 / 0	140	0.0	228.9	0.0	0.0	0.0
U	15,523	61 / 0	207	0.0	233.3	0.0	0.0	0.0

[1]DISTANCES ARE MEASURED IN FEET FROM CONFLUENCE WITH SANDY RIVER

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON

ALL JURISDICTIONS

FLOODWAY DATA

FLOODING SOURCE: BEAVER CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Square Feet)	MEAN VELOCITY (Feet / Second)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
V	15,787	28 / 0	163	0.0	234.2	0.0	0.0	1.0
W	16,421	36 / 0	119	0.0	237.3	0.0	0.0	0.0
X	16,843	30 / 0	143	0.0	240.2	0.0	0.0	0.0
Y	16,896	7 / 0	59	0.0	241.1	0.0	0.0	0.0
Z	16,949	65 / 0	285	0.0	243.1	0.0	0.0	0.0
AA	17,160	39 / 0	95	0.0	243.2	0.0	0.0	0.0
AB	17,449	60 / 0	291	0.0	245.2	0.0	0.0	0.0
AC	17,655	108 / 0	1,199	0.0	258.7	0.0	0.0	0.0
AD	18,784	133 / 0	460	0.0	259.0	259.0	0.0	0.0

[1]DISTANCES ARE MEASURED IN FEET FROM CONFLUENCE WITH SANDY RIVER

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON

ALL JURISDICTIONS

FLOODWAY DATA

FLOODING SOURCE: BEAVER CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Square Feet)	MEAN VELOCITY (Feet / Second)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	63	49 / 0	115	0.0	314.2	0.0	0.0	0.0
B	366	39 / 0	117	0.0	316.0	316.0	316.0	0.0
C	912	60 / 0	273	0.0	317.0	317.0	0.0	0.0
D	1,577	60 / 0	337	0.0	317.1	0.0	0.0	0.0
E	2,351	60 / 0	321	0.0	317.1	0.0	0.0	0.0
F	3,000	60 / 0	250	0.0	317.2	0.0	0.0	1.0
G	3,278	61 / 0	325	0.0	317.5	0.0	0.0	0.0

[1]DISTANCES ARE MEASURED IN FEET FROM THE CONFLUENCE WITH KELLY CREEK

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON

ALL JURISDICTIONS

FLOODWAY DATA

FLOODING SOURCE: BURLINGAME CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Square Feet)	MEAN VELOCITY (Feet / Second)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
R	120	0 / 0	0	0.0	34.7	0.0	0.0	0.0
S	121	0 / 0	0	0.0	35.0	0.0	0.0	0.0
T	123	0 / 0	0	0.0	35.2	0.0	0.0	0.0
U	123	0 / 0	0	0.0	35.4	0.0	0.0	0.0
V	124	0 / 0	0	0.0	35.5	0.0	0.0	0.0
W	126	0 / 0	0	0.0	35.7	0.0	0.0	0.0
X	127	0 / 0	0	0.0	35.9	0.0	0.0	0.0

[1]DISTANCES ARE MEASURED IN MILES ABOVE MOUTH.

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON

ALL JURISDICTIONS

FLOODWAY DATA

FLOODING SOURCE: COLUMBIA RIVER

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Square Feet)	MEAN VELOCITY (Feet / Second)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
F	1,771	38 / 0	144	0.0	20.3	0.0	0.0	0.0
G	2,041	35 / 0	137	0.0	20.5	0.0	0.0	0.0
H	2,601	50 / 0	119	0.0	21.0	21.0	0.0	0.0
I	2,870	0 / 0	0	0.0	21.9	0.0	0.0	0.0
J	2,930	0 / 0	0	0.0	28.5	0.0	0.0	0.0
K	3,320	0 / 0	0	0.0	28.9	0.0	0.0	0.0
L	3,610	0 / 0	0	0.0	31.2	0.0	0.0	0.0
M	3,800	0 / 0	0	0.0	31.2	0.0	0.0	0.0
N	3,980	0 / 0	0	0.0	31.7	0.0	0.0	0.0
O	4,100	0 / 0	0	0.0	34.4	0.0	0.0	0.0
P	4,160	0 / 0	0	0.0	38.9	0.0	0.0	0.0
Q	4,200	0 / 0	0	0.0	45.4	0.0	0.0	0.0
R	4,380	0 / 0	0	0.0	45.7	0.0	0.0	0.0
S	4,540	0 / 0	0	0.0	48.9	0.0	0.0	0.0
T	4,850	0 / 0	0	0.0	56.9	0.0	0.0	0.0
U	5,150	0 / 0	0	0.0	88.4	0.0	0.0	0.0
V	5,340	0 / 0	0	0.0	94.8	0.0	0.0	0.0
W	5,780	0 / 0	0	0.0	102.3	0.0	0.0	0.0
X	6,060	0 / 0	0	0.0	110.9	0.0	0.0	0.0
Y	6,250	0 / 0	0	0.0	115.8	0.0	0.0	0.0
Z	6,300	0 / 0	0	0.0	122.9	0.0	0.0	0.0

[1]DISTANCES ARE MEASURED IN FEET FROM A POINT APPROXIMATELY 1,400 FEET DOWNSTREAM OF NE 223RD AVE.

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON

ALL JURISDICTIONS

FLOODWAY DATA

FLOODING SOURCE: FAIRVIEW CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Square Feet)	MEAN VELOCITY (Feet / Second)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
AA	6,625	0 / 0	0	0.0	128.1	0.0	0.0	0.0
AB	6,748	0 / 0	0	0.0	130.9	0.0	0.0	0.0
AC	6,965	0 / 0	0	0.0	132.7	0.0	0.0	0.0
AD	7,180	0 / 0	0	0.0	134.9	0.0	0.0	0.0
AE	7,305	0 / 0	0	0.0	143.8	0.0	0.0	0.0
AF	7,532	30 / 0	71	0.0	150.8	0.0	151.0	0.0
AG	7,665	50 / 0	227	0.0	151.3	0.0	0.0	0.0
AH	7,835	45 / 0	168	0.0	151.5	0.0	152.0	0.0
AI	8,185	30 / 0	95	0.0	152.4	0.0	0.0	0.0
AJ	8,337	37 / 0	74	0.0	158.9	0.0	0.0	0.0
AK	8,392	56 / 0	369	1.0	159.4	0.0	0.0	0.0
AL	8,527	55 / 0	128	0.0	159.5	0.0	160.0	0.0
AM	8,697	65 / 0	138	0.0	159.7	0.0	0.0	0.0
AN	8,727	70 / 0	157	0.0	160.2	0.0	0.0	1.0
AO	9,117	86 / 0	223	0.0	162.6	0.0	0.0	0.0
AP	9,517	48 / 0	77	0.0	165.4	0.0	0.0	0.0
AQ	9,757	48 / 0	139	0.0	169.6	0.0	0.0	0.0
AR	10,137	54 / 0	101	0.0	174.3	0.0	0.0	0.0
AS	10,672	66 / 0	106	0.0	182.2	0.0	0.0	0.0

[1]DISTANCES ARE MEASURED IN FEET FROM A POINT APPROXIMATELY 1,400 FEET DOWNSTREAM OF NE 223RD AVE.

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON

ALL JURISDICTIONS

FLOODWAY DATA

FLOODING SOURCE: FAIRVIEW CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Square Feet)	MEAN VELOCITY (Feet / Second)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
DF	18	75 / 0	377	0.0	359.7	0.0	0.0	0.0
DG	18	44 / 0	269	0.0	363.0	363.0	364.0	1.0
DH	19	123 / 0	699	0.0	376.2	0.0	0.0	1.0
DI	19	60 / 0	329	0.0	377.7	0.0	0.0	0.0

[1]DISTANCES ARE MEASURED IN FEET FROM A POINT APPROXIMATELY 1,434 FEET DOWNSTREAM OF SE 252ND AVEUNE.

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON

ALL JURISDICTIONS

FLOODWAY DATA

FLOODING SOURCE: JOHNSON CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Square Feet)	MEAN VELOCITY (Feet / Second)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	136	34 / 0	93	0.0	239.5	0.0	0.0	0.0
B	521	31 / 0	83	0.0	251.8	0.0	0.0	0.0
C	1,054	199 / 0	746	0.0	294.2	0.0	0.0	0.0
D	1,778	49 / 0	146	6.0	294.2	0.0	0.0	0.0
E	2,113	44 / 0	279	0.0	304.1	0.0	0.0	0.0
F	2,625	36 / 0	130	0.0	310.8	0.0	0.0	0.0
G	2,734	47 / 0	170	0.0	313.3	0.0	0.0	0.0
H	2,894	25 / 0	38	0.0	314.5	0.0	0.0	0.0
I	2,995	30 / 0	51	0.0	317.0	317.0	317.0	0.0
J	3,506	21 / 0	63	0.0	324.8	0.0	0.0	0.0
K	4,097	29 / 0	69	0.0	330.7	0.0	0.0	0.0
L	5,294	23 / 0	72	0.0	339.1	0.0	0.0	0.0
M	5,534	30 / 0	99	0.0	341.6	0.0	0.0	0.0
N	6,251	19 / 0	69	0.0	345.1	0.0	0.0	0.0
O	6,392	34 / 0	189	0.0	348.4	0.0	349.0	0.0
P	7,417	28 / 0	130	0.0	349.3	0.0	0.0	0.0
Q	7,698	18 / 0	180	0.0	358.1	0.0	0.0	0.0
R	8,742	38 / 0	206	0.0	358.2	0.0	0.0	0.0
S	9,815	32 / 0	72	0.0	359.8	0.0	0.0	0.0
T	10,263	23 / 0	214	0.0	370.6	0.0	0.0	0.0
U	11,039	34 / 0	170	0.0	370.8	0.0	0.0	0.0

[1]DISTANCES ARE MEASURED IN FEET FROM THE CONFLUENCE WITH BEAVER CREEK

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON

ALL JURISDICTIONS

FLOODWAY DATA

FLOODING SOURCE: KELLY CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Square Feet)	MEAN VELOCITY (Feet / Second)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
V	11,782	21 / 0	62	0.0	375.9	0.0	0.0	0.0
W	12,119	26 / 0	62	0.0	378.2	0.0	0.0	0.0
X	12,781	22 / 0	52	0.0	385.3	0.0	0.0	0.0
Y	12,967	40 / 0	86	0.0	388.5	0.0	0.0	0.0
Z	14,117	32 / 0	42	0.0	392.9	0.0	0.0	0.0
AA	15,339	25 / 0	45	0.0	403.8	0.0	0.0	0.0
AB	15,497	269 / 0	1,588	0.0	414.9	0.0	0.0	0.0
AC	16,274	127 / 0	591	0.0	414.9	0.0	0.0	0.0
AD	16,808	96 / 0	159	1.0	414.9	0.0	0.0	0.0
AE	17,265	49 / 0	355	0.0	424.0	424.0	424.0	0.0
AF	17,756	40 / 0	206	0.0	424.1	0.0	0.0	0.0
AG	18,250	17 / 0	58	0.0	428.0	428.0	0.0	0.0
AH	18,401	30 / 0	176	0.0	431.9	0.0	0.0	0.0
AI	18,948	22 / 0	85	0.0	433.8	0.0	0.0	1.0
AJ	19,749	28 / 0	85	0.0	442.5	0.0	0.0	0.0
AK	20,019	35 / 0	340	0.0	453.5	0.0	454.0	0.0
AL	20,549	43 / 0	250	1.0	453.5	0.0	0.0	0.0
AM	20,696	42 / 0	284	0.0	455.0	455.0	0.0	0.0
AN	21,535	25 / 0	48	0.0	459.3	0.0	0.0	0.0

[1]DISTANCES ARE MEASURED IN FEET FROM THE CONFLUENCE WITH BEAVER CREEK

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON

ALL JURISDICTIONS

FLOODWAY DATA

FLOODING SOURCE: KELLY CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (Feet NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (Feet)	SECTION AREA (Square Feet)	MEAN VELOCITY (Feet / Second)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
A	12,656	906 / 0	15,597	0.0	35.7	0.0	36.0	0.0
B	13,839	519 / 0	8,114	0.0	35.7	0.0	0.0	0.0
C	14,151	826 / 0	12,778	0.0	37.8	0.0	0.0	0.0
D	15,120	333 / 0	6,128	0.0	37.8	0.0	0.0	0.0
E	15,818	336 / 0	6,658	0.0	39.1	0.0	0.0	0.0
F	16,088	514 / 0	10,236	8.0	41.2	0.0	0.0	0.0
G	17,153	1,124 / 0	12,459	0.0	41.5	0.0	0.0	0.0
H	18,098	861 / 0	14,044	0.0	43.5	0.0	0.0	0.0
I	19,066	359 / 0	7,309	0.0	43.5	0.0	0.0	0.0
J	21,054	446 / 0	9,678	0.0	45.7	0.0	0.0	0.0
K	21,948	358 / 0	8,160	10.0	46.7	0.0	0.0	0.0
L	22,765	345 / 0	8,034	0.0	47.2	0.0	0.0	0.0
M	23,904	529 / 0	10,850	0.0	48.7	0.0	0.0	0.0
N	26,030	264 / 0	6,012	0.0	48.9	0.0	0.0	0.0
O	27,116	465 / 0	9,747	0.0	51.6	0.0	52.0	0.0
P	29,155	288 / 0	7,030	0.0	53.0	53.0	0.0	0.0
Q	30,853	287 / 0	6,556	0.0	54.8	0.0	0.0	0.0
R	31,106	280 / 0	7,436	11.0	56.0	56.0	0.0	0.0
S	31,955	379 / 0	9,699	0.0	57.4	0.0	0.0	0.0
T	33,085	678 / 0	16,240	5.0	58.5	0.0	0.0	0.0

[1]STREAM DISTANCE IN MILES ABOVE MOUTH.

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON

ALL JURISDICTIONS

FLOODWAY DATA

FLOODING SOURCE: SANDY RIVER

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water surface elevation WSEL of the 1-percent-annual-chance 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 3.

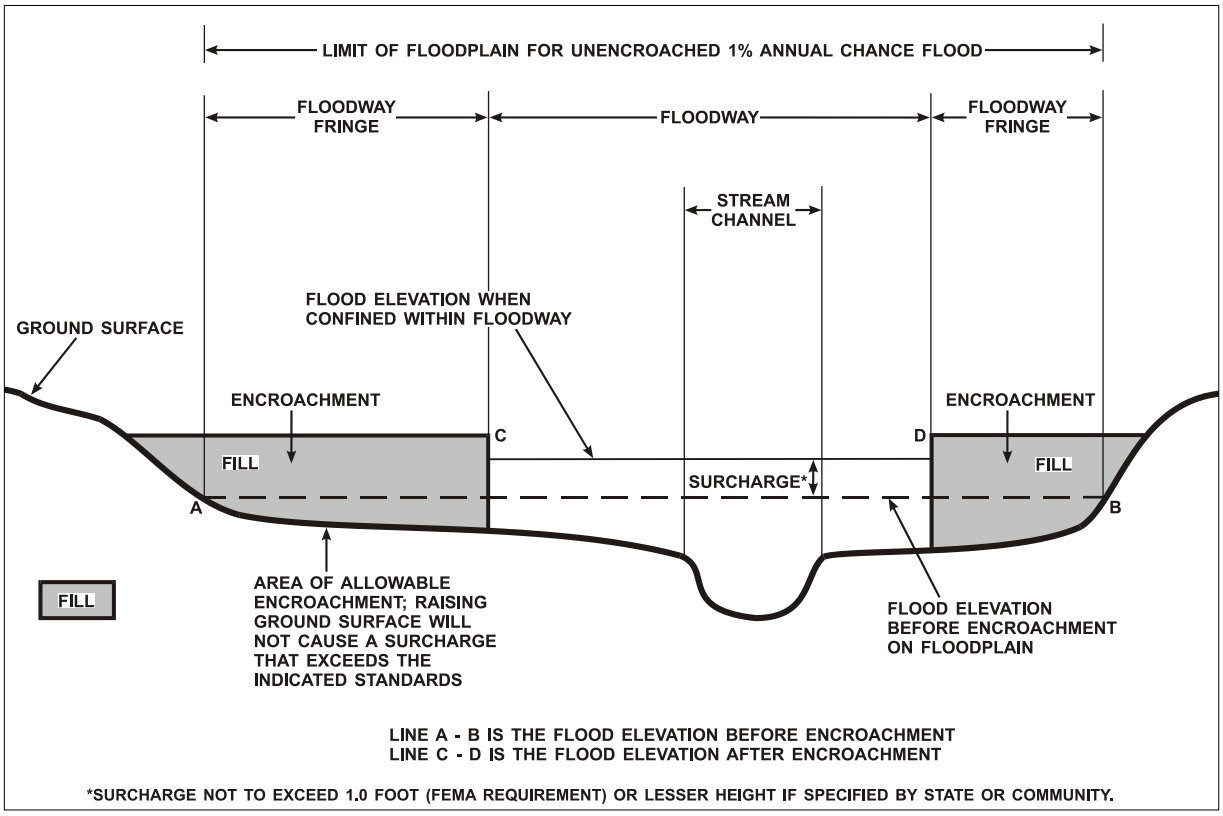

Figure 3 - Floodway Schematic

5.0 INSURANCE APPLICATIONS

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

Zone A

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

Zone AE

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

Zone AH

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

Zone AO

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

Zone X

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

6.0 FLOOD INSURANCE RATE MAP

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

For flood insurance applications, the map designates flood insurance risk zones 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 the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

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

The countywide FIRM presents flooding information for the entire geographic area of Multnomah County, Oregon (Excluding the City of Portland). 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 10.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE
Fairview, City of	May 10, 1974	May 10, 1974	September 30, 1987	June 17, 1991 July 3, 1995
Gresham, City of	December 7, 1973	December 7, 1973	July 16, 1979	January 18, 1984 June 17, 1986 September 28, 1990 February 16, 1996 May 2, 2002
Maywood, City of [1, 2]	None	None	None	None
Multnomah County (Incorporated Areas)	February 4, 1972	None	June 15, 1982	March 18, 1986
Troutdale, City of	December 7, 1973	December 7, 1973 March 20, 1979	September 30, 1988	August 3, 1988
Wood Village, City of [1, 2]	None	None	None	None

[1]No special flood hazard areas identified
[2]This community does not have map history prior to the first countywide mapping

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

Table 11: Listing of NFIP Jurisdictions

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
City of Fairview	410180	*	41051C0205H, 41051C0210J, 41051C0212H, 41051C0214H, 41051C0216J, 41051C0218J	
City of Gresham	410181	*	41051C0214H, 41051C0218J, 41051C0219J, 41051C0402H, 41051C0406H, 41051C0407J, 41051C0426J	
City of Maywood Park	410068	*	41051C0190H, 41051C0195H	
Multnomah County (Unincorporated Areas)	410079	*	41051C0210J, 41051C0216J, 41051C0217J, 41051C0219J, 41051C0228J, 41051C0238J, 41051C0240J, 41051C0245J, 41051C0275H, 41051C0406H, 41051C0407J, 41051C0408H, 41051C0409H, 41051C0426I, 41051C0427J, 41051C0428H, 41051C0429H, 41051C0435J, 41051C0475H	
City of Troutdale	410184	*	41051C0210J, 41051C0216J, 41051C0217J, 41051C0218J, 41051C0219J, 41051C0238J, 41051C0240J	
City of Wood Village[1]	410185	*	41051C0216J, 41051C0218J	

[1] No Special Flood Hazard Areas Identified

*Data not available for this study

7.0 OTHER STUDIES

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

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Mitigation Division, Federal Regional Center, 130 228th Street, SW, Bothell, Washington 98021-9796.

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10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data located at Map Repository, 1600 SE 190th, 1st Floor, Gresham, OR 97233.

10.1 First Revision

This City of Fairview study was revised on July 3, 1995, to add base flood elevations, and to update the flood boundary delineations for Fairview Creek from Bridge Street to Fairview Lake.

The hydrologic analysis from the 1991 Flood Insurance Study for the City of Fairview was used for this version.

The hydraulic analysis was performed by the U.S. Department of the Army, Corps of Engineers (USACE), Portland District, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-90-E-3286. The study was completed in June 1991.

The results of this study were reviewed at the Final Consultation and Coordination Officer meeting held on April 28, 1994, and attended by representatives of the City of Fairview, FEMA, and the U.S. Army Corps of Engineers, Portland District.

The hydraulic analysis conducted for this study utilized the USACE HEC-2 computer model. Cross-sectional data were obtained from the field surveys performed in May 1991, and were supplemented with topographic maps provided by Multnomah County. The 1-percent-annual-chance flood elevation calculated at the farm road crossing, which acts as a weir, at the outlet of Fairview Lake was used as the starting-water surface elevation. The revised floodway was established using equal conveyance. The results are shown on Table 9.

The City of Gresham Flood Insurance Study was revised on February 16, 1996, to incorporate the results of a detailed hydrologic and hydraulic analysis of Kelly Creek affecting the City of Gresham and Multnomah County, Oregon. The revised analysis was performed by the USACE, Portland District, for FEMA, under Inter-Agency Agreement No. EMW-91-E-3529, Project Order No. 8A. This work was completed in June 1992.

A detailed study was performed for Kelly Creek from the Mount Hood Community College (MHCC) dam, approximately 1,100 feet downstream of Northeast Kane Road, upstream to Northeast Division Street, a distance of approximately 0.8 miles. The flow estimates were developed by the USACE using the HEC-1 computer program. The input parameters were estimated based on correlation with a study done by URS Corporation of Kelly Creek in 1988, and a Master Drainage Plan Report done by KCM, Inc., in 1988 for Fairview Creek, which is just west of Kelly Creek basin in Gresham.

The hydraulic analysis for the revised study was performed using the USACE HEC-2 step- backwater computer program. Data for the cross section, including overbank areas, were taken from topographic maps at a scale of 1”=100’, with a contour interval of 2 feet. Data at the Kane Road culvert and MHCC outlet structure were surveyed in past years and verified by a field visit in March 1992.

Channel and overbank roughness coefficients (Manning’s “n”) used in computer program were estimated from experience and field observations. A value of 0.035 was used for the channel and values ranged from 0.038 to 0.042 for the overbank areas. The starting water-surface elevation was obtained from a rating curve computed at the upstream end of the culvert at Kane Road. The hydraulic study included the backwater effect from the MHCC dam on the culvert outlet at Kane Road.

The floodway was computed using Method 4 of the HEC-2 computer model from Kane Road to approximately 522 feet upstream. Method 6, with a 1.0-foot allowable rise in the energy grade line, was used from this point to approximately 3,161 feet upstream. Method 6, with a 0.1-foot allowable rise in the energy grade line, was used from this point to the limit of detailed study at Division Street.

The floodway and 1- and 0.2-percent-annual-chance floodplain boundaries were delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps. In cases where the lines are collinear, only the floodway boundary has been shown.

Table 5, “Summary of Discharges,” Table 9 “Floodway Data,” and the Profile Panels were also revised to reflect the results of this detailed study

10.2 Second Revision

The City of Gresham Flood Insurance Study was revised on May 2, 2002, to show modifications to flood hazards along an approximate 3 mile reach of Kelly Creek. Kelly Creek was restudied from the crossing at NE Division Street upstream to approximately 600 feet upstream of 282nd Street.

The hydrologic and hydraulic analyses for the restudy were performed by Odgen Beeman and Associates, Inc., for the Federal Emergency Management Agency (FEMA), under contract No. EMS-96-CO-0078-TA05. This study was completed in September 1998. Water- surface elevations immediately upstream of Kane Road and the Kelly Creek Storm Water Detention Facility were adjusted by FEMA in October 2000 utilizing data provided by the City of Gresham.

Contacts made to acquire historical data for the restudy included, the City of Gresham, U.S. Army Corps of Engineers (USACE), Portland District, and FEMA.

The results of the study were reviewed at the final Consultation Coordination Officer meeting held on May 3, 2001, and attended by representatives of the City of Gresham, Parsons Brinkerhoff/Odgen Beeman, and FEMA. All problems raised at the meeting have been addressed in the restudy.

Discharges used in the restudy were taken from a previous study of Kelly Creek, based on HEC-1 modeling, performed by the USACE. The reach of the previous study extended from the downstream crossing of Kane Road, near Mount Hood Community College, upstream to NE Division Street. The discharge values in this reach were compared with the U.S. Geological Survey (USGS) regression equations to verify their accuracy. They were then adjusted by a drainage area ratio at seven locations on the restudy reach. The peak discharges used in this restudy for the 10-, 2-, and 1-, and 0.2-percent-annual-chance floods are shown in Table 6, "Summary of Discharges".

The hydraulic analysis for Kelly Creek was performed using the HEC-RAS step-backwater computer program, Version 2.1, to provide the water-surface elevations along the study reach. The starting water-surface elevation was taken from the results of the previous hydraulic study performed by the USACE, directly downstream the restudy reach. The model was run in a sub-critical flow regime to estimate the flood profiles.

Cross section locations were chosen based on field investigations and USGS quadrangle maps. Chase, Jones & Associates, Inc. surveyed fourteen cross sections in the restudy reach. Other cross sections were taken from the City of Gresham's 1"=200' two foot contour interval topographic maps. The first three downstream cross sections were repeated from the previous study completed on Kelly Creek, directly downstream of the restudy reach. All of the culverts, roads, detention facilities, and bridges were surveyed by Chase Jones and Associates, Inc.

Manning's "n" values chosen varied from 0.06 to 0.08 for the left and right overbanks and 0.04 for the channel, based on field observations. The Manning's "n" values were repeated for the cross sections duplicated from the downstream study.

The City of Gresham provided two-foot contour interval topographic maps, based on aerial photography in 1990. These maps were used as the base map and to delineate the floodplain based on the flood profiles.

The floodway corresponding to the 1-percent-annual-chance flood was initially determined using method 4 encroachment analysis in HEC-RAS, with a water-surface rise of one foot. The method 4 approach was then converted to method 1 and modified to ensure the floodway did not encroach inside the channel banks.

Table 5, "Summary of Discharges," Table 9, "Floodway Data," and Exhibit 1, "Flood Profiles," were revised as a result of the restudy.

The City of Troutdale Flood Insurance Study was revised on August 3, 1998, to add detailed flood information, including the adoption of a regulatory floodway, along Beaver Creek, from just upstream of Jackson Park Road to approximately 200 feet downstream of Southeast Stark Street. This revision also included updating the corporate limits for the City of Troutdale and adding flood information for Sandy River previously shown on the Multnomah County, Oregon, Flood Insurance Rate Map dated March 18, 1986. The analyses for this revision were performed by the USACE, Portland District, for FEMA, under Contract No. EMW-94-E-4432, and was completed in April 1995.

Flooding along Beaver Creek occurs from two sources Overflow from Sandy River creates a backwater effect along Beaver Creek from its confluence point with the Sandy River to approximately 6,200 feet upstream. Flooding along the remainder of Beaver Creek is due only to flow originating from the Beaver Creek watershed. Because of the backwater effects from the Sandy River, the lower portion of Beaver Creek is a level pool with essentially constant elevations. From approximately 6,200 feet upstream, the steep slope of the basin results in supercritical flow.

The hydrologic analyses for this portion of Beaver Creek were obtained from the FIS report for the City of Troutdale. This analysis was performed by the National Resources Conservation Service (formerly the SCS), Oregon State Office. Stream flow data at gaging stations in the Sandy River basin were processed in accordance with the method described by the Water Resources Council. A regional analysis of the peak flow-frequency characteristics as a function of the drainage area was made and used to determine the unit peak discharge-frequency for Beaver Creek as shown in Table 5. The discharge at Troutdale Road was obtained by prorating the discharge at Southeast Stark Street to account for the reduction in drainage area.

The hydraulic analysis of Beaver Creek was performed using the USACE HEC-2 step- backwater program. Starting water-surface elevations just upstream of Jackson

Park Road were taken from the previous published FIS. Cross-section information was developed from topographic work maps at a scale of 1”=100’, with a contour interval of 2 feet. Roughness factors (Manning’s “n”) used in the hydraulic computations were chosen based on engineering judgment and field observations of the channel and overbank areas. Manning’s “n” values of 0.04 and 0.07 were chosen for the channel and overbanks, respectively.

The floodway along the studied portion of Beaver Creek was computed on the basis of equal conveyance reduction from each side of the floodplain. From just upstream of Jackson Park Road to approximately 3,100 feet upstream, and from Troutdale Road to Southeast Stark Street, the floodway width was determined by the width of the encroachment needed to cause a 1-foot rise in the water surface. From 3,100 feet upstream of Jackson Park Road to Troutdale Road, the floodway width was determined by the width of the encroachment needed to cause a 1-foot rise in the energy gradeline.

The boundaries of the base floodplain and regulatory floodway and the flood boundaries associated with a flood having a 0.2-percent chance of being equaled or exceeded in any given year have been delineated using the flood elevations determined at each cross section, on topographic maps at a scale of 1”=100’, with a contour interval of 2 feet. The flood profiles for Beaver Creek were based on elevations obtained from the HEC-2 model. In the portion of Beaver Creek where supercritical flow occurs, critical depth elevations were plotted on the profile.

Table 11 summarizes the flooding sources updated since the original study was completed.

Changes due to LOMR

LOMR 00-10-462P revised the hydraulic analysis and floodplain mapping along Johnson Creek from its confluence with the Willamette River to approximately 2,000 feet upstream of 174th Avenue. The effective date was December 21, 2000. This LOMR superseded LOMR 00-10-173P.

LOMR 06-10-B082P revised the hydraulic analysis and floodplain mapping for Fairview Creek from approximately 1,130 feet downstream to approximately 300 feet downstream of Fairview Avenue and from approximately 400 feet upstream to approximately 4,250 feet upstream of NE Barr Road. The effective date was March 28, 2007.

Table 12. Revised Study Descriptions

Flooding Sources(s)	Community	Limits of Study	Date of Revision	Panel No.
Fairview Creek	City of Fairview	Bridge Street to Fairview Lake Mount Hood Community College dam to NE Division Street	July 3, 1995	0212, 0216
Kelly Creek	City of Gresham, Multnomah County Unincorporated Areas	NE Division Street to 282nd Street	May 2, 2002	0219, 0407, 0426
Beaver Creek	City of Troutdale	Jackson Park Road to Southeast Stark Street	August 3, 1998	0217, 0219

Countywide Update

The countywide update was performed by WEST Consultants, Inc. for the Federal Emergency Management Agency (FEMA), under Contract No. EMS-2001-CO-0068 and was completed in August 2008.

This update combined the Flood Insurance Rate Maps and Flood Insurance Study reports for Multnomah County and incorporated communities into the countywide format. Under the countywide format, Flood Insurance Rate Map panels have been produced using a single layout format for the entire area within the County instead of separate layout formats for each community. The single-layout format facilitates the matching of adjacent panels and depicts the flood-hazard area within the entire panel border, even in areas beyond a community's corporate boundary line. In addition, under the countywide format, this single Flood Insurance Study report provides all Flood Insurance Study information and data for the entire County area.

All flood elevations shown in this FIS report and on the FIRM panels were converted from NGVD 29 to NAVD 88. The conversion factor from NGVD to NAVD for all streams in this report is +3.43 feet.

As part of the countywide update, floodplain boundaries within the City of Fairview for portions of the Columbia River, Fairview Lake, Blue Lake, and Fairview Creek

were revised based on topographic maps at a scale of 1:1,200 with a contour interval of 2 feet. Additionally, portions of the Columbia River, Sandy River, Willamette River, and Multnomah Channel were revised based on 2 foot contour interval topographic data developed from LiDAR data created by the Puget Sound LiDAR Consortium. The data can be used at a horizontal scale of 1:12,000 (1inch=1,000 feet) or smaller.

The floodway width at cross section F on the Sandy River was revised as part of the countywide update where new topography resulted in a mapped 1-percent annual chance floodplain that was narrower than the effective floodway. The floodway was mapped as coincident with the 1-percent annual chance floodplain.

In accordance with FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, floodways which abut certified levees are to be mapped to the landward toe of the levee. Several locations where the effective mapping did not reflect this were revised and the floodway boundary was moved to the landward toe as determined by new topographic data. This was done for the Columbia River at cross sections C, D, and Q and for the Multnomah Channel at cross sections D and E. Floodway widths shown in Table 9 were updated to reflect the revised floodway boundary.

The floodplain boundaries for the remaining streams were digitized from the effective FIRM and Floodway panels. Aerial photography was used to adjust floodplain and floodway boundaries where appropriate.

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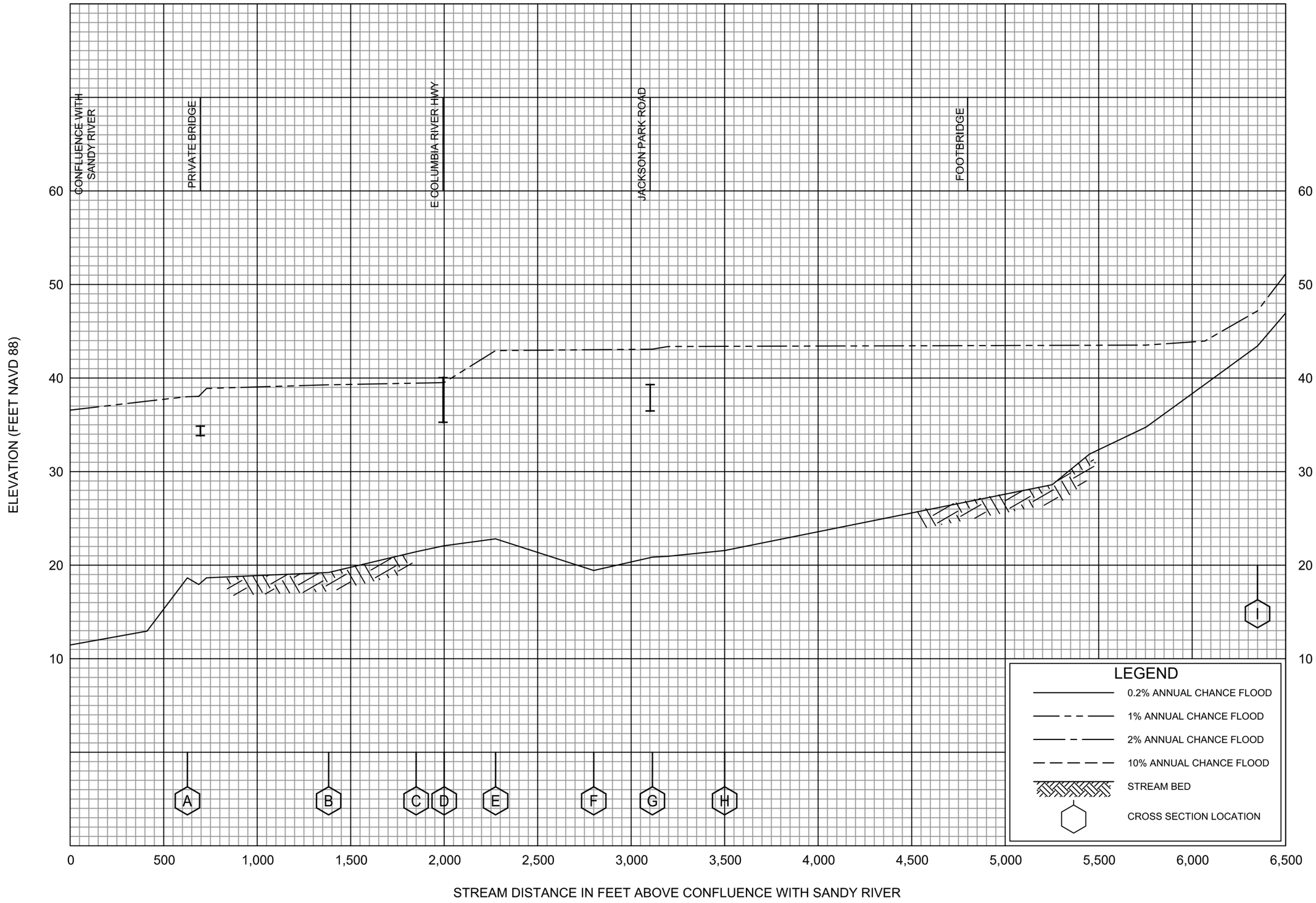

FLOOD PROFILES

BEAVER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

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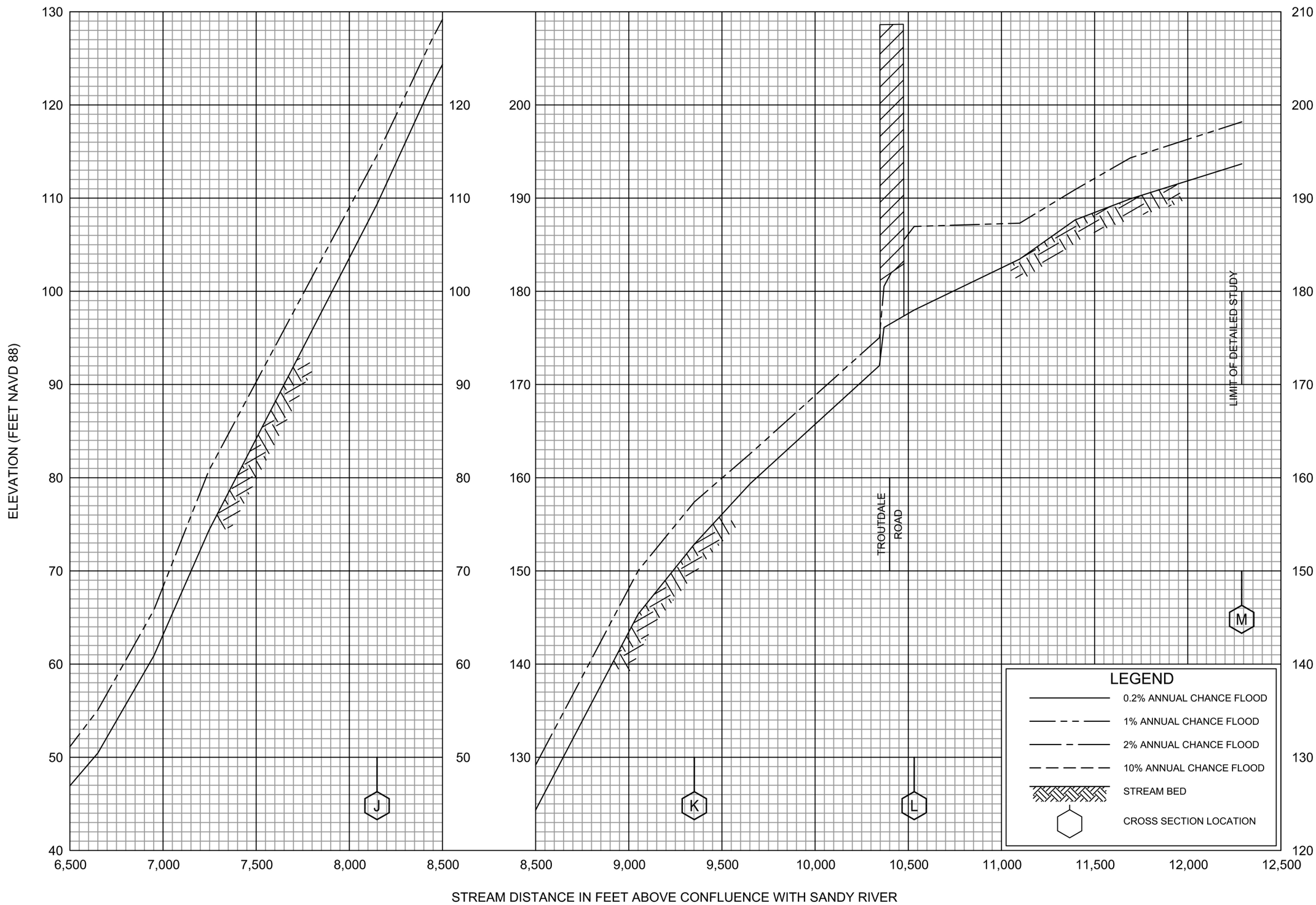

FLOOD PROFILES

BEAVER CREEK

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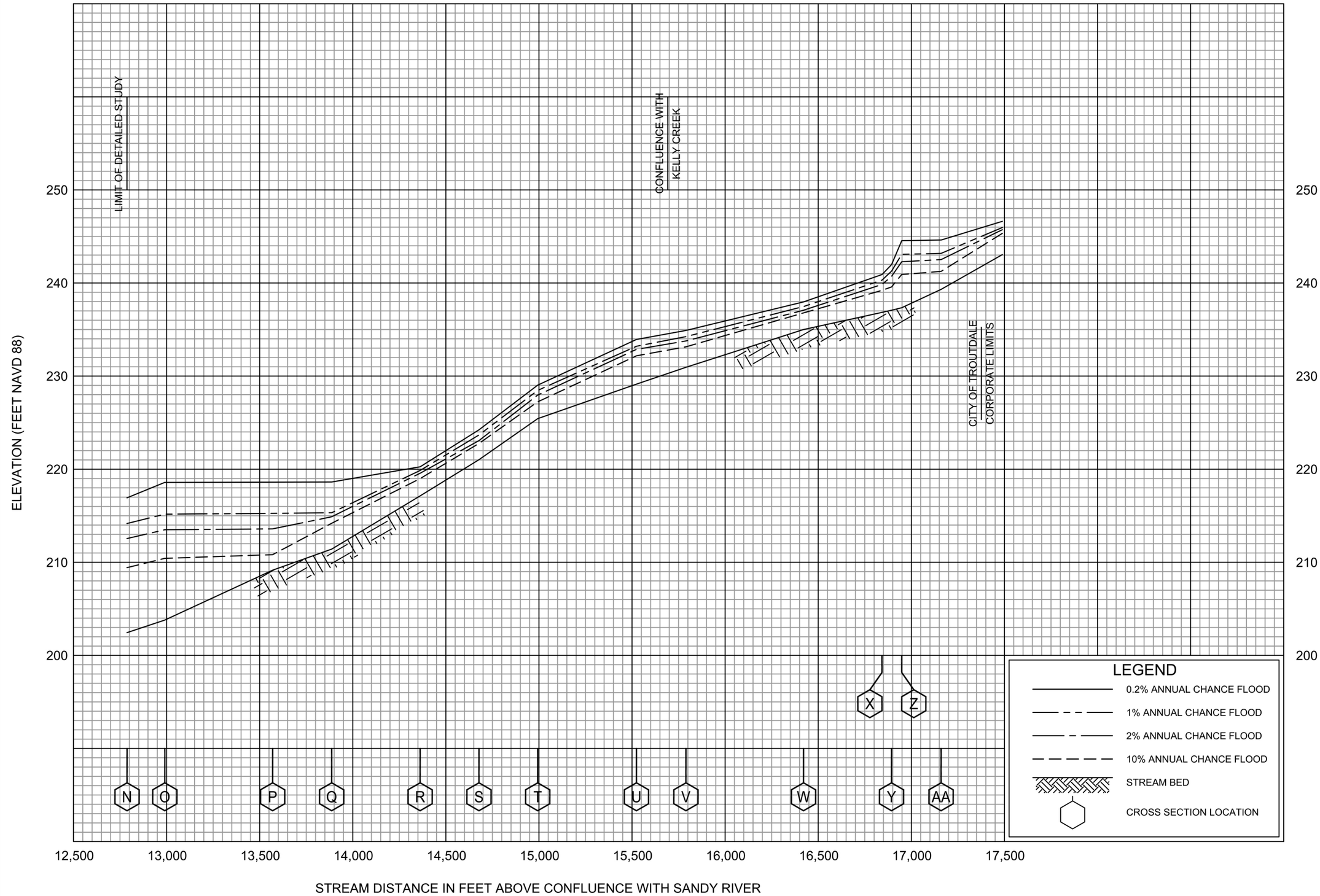

FLOOD PROFILES

BEAVER CREEK

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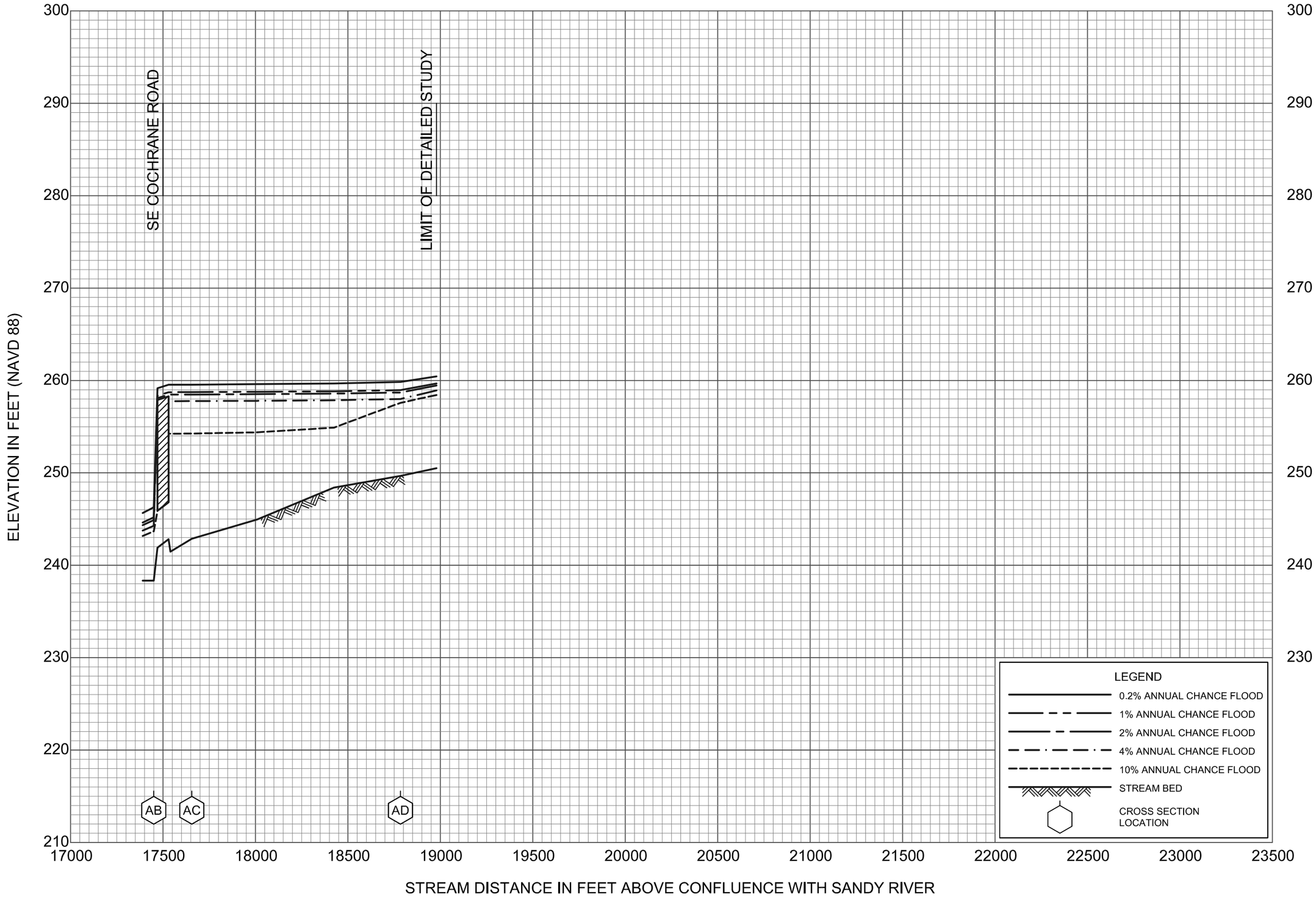

FLOOD PROFILES

BEAVER CREEK

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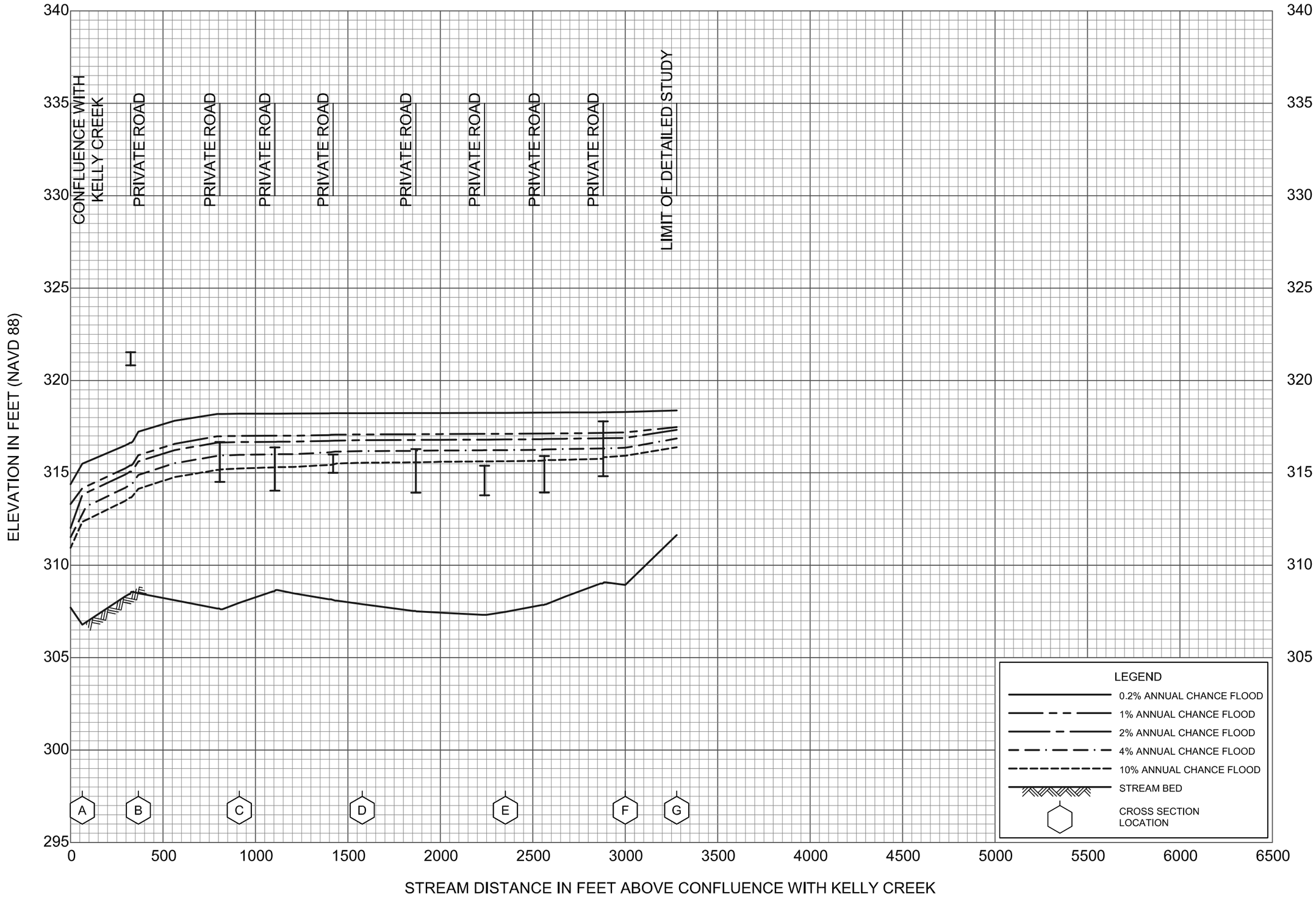

FLOOD PROFILES

BURLINGAME CREEK

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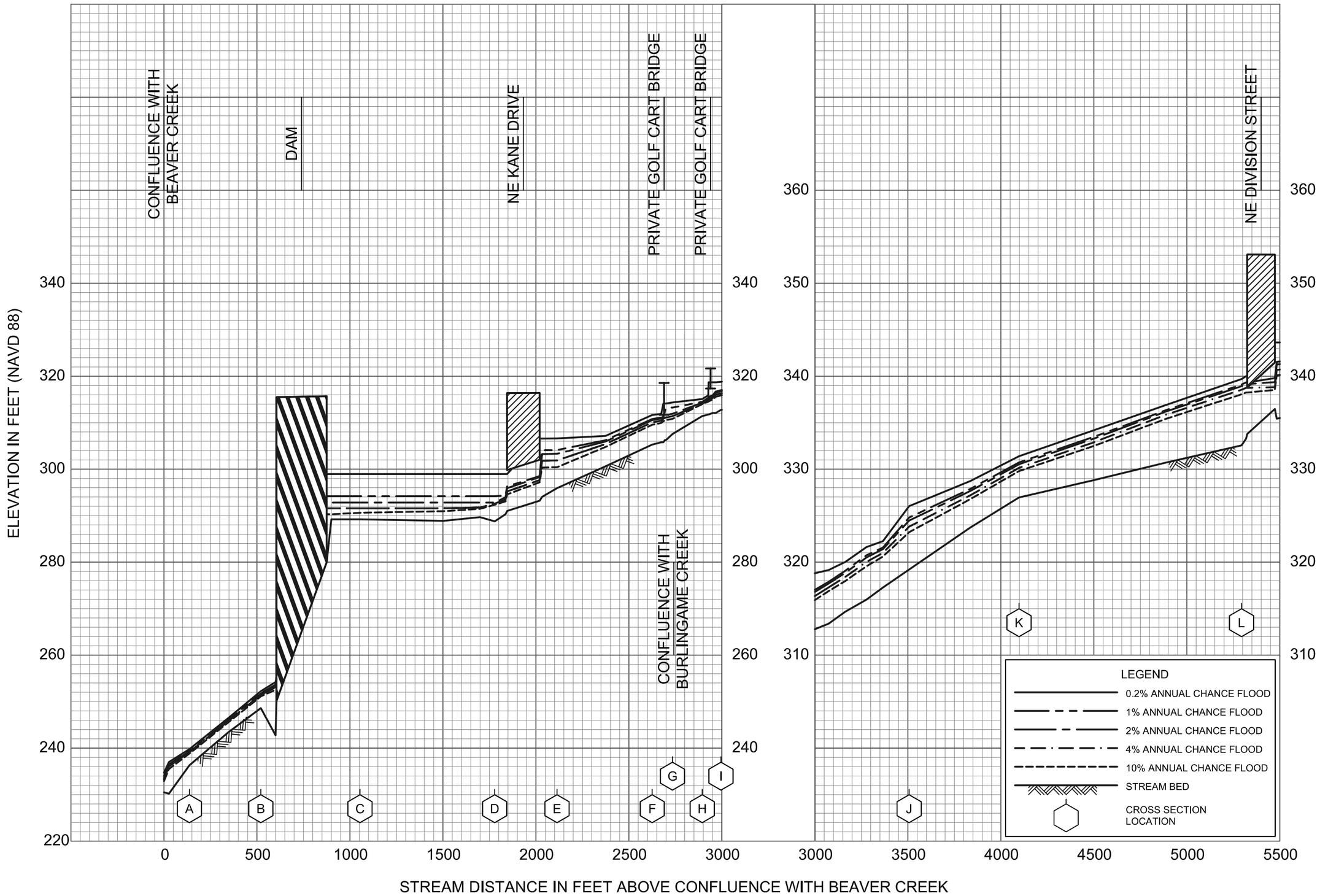

FLOOD PROFILES

KELLY CREEK

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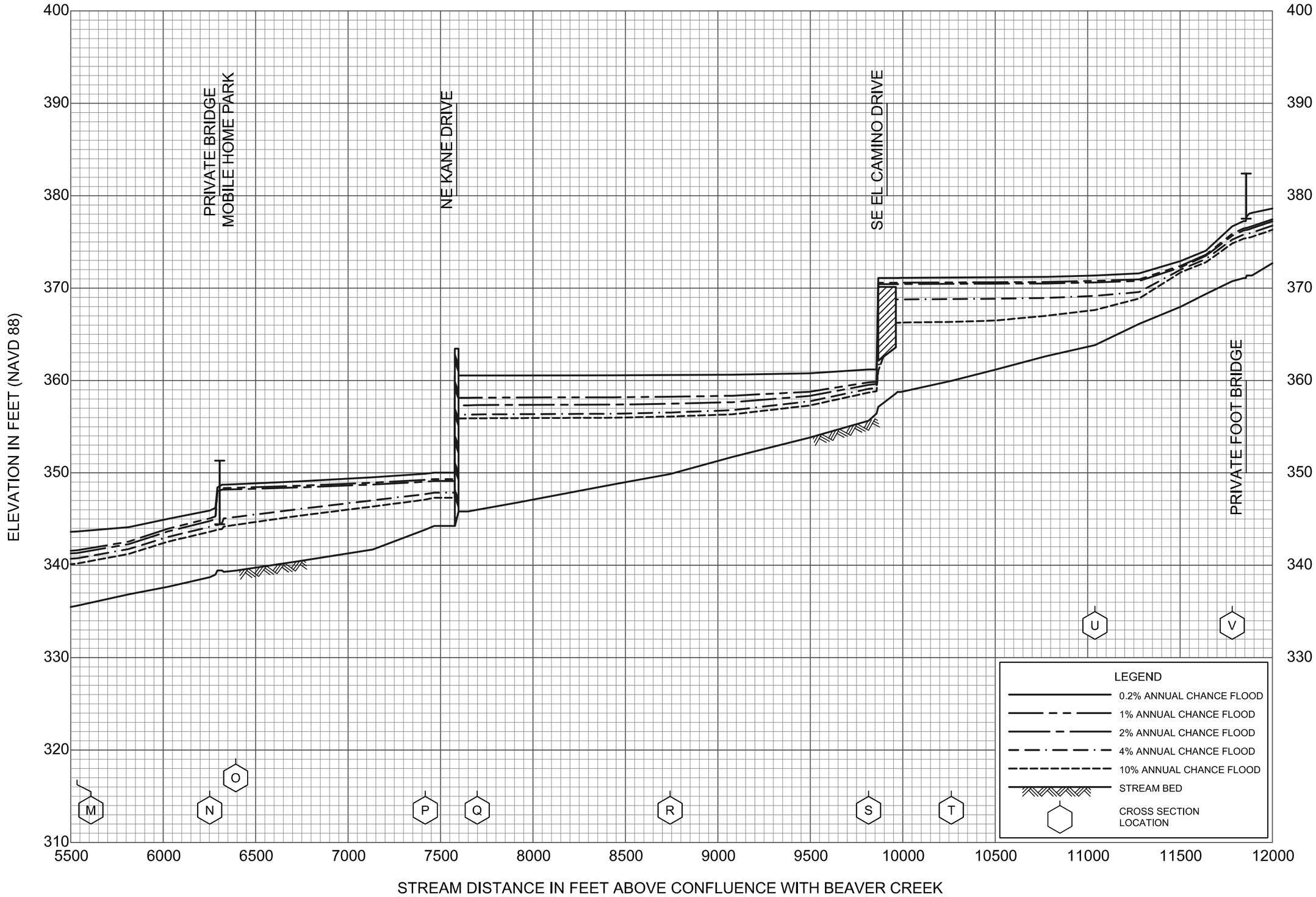

FLOOD PROFILES

KELLY CREEK

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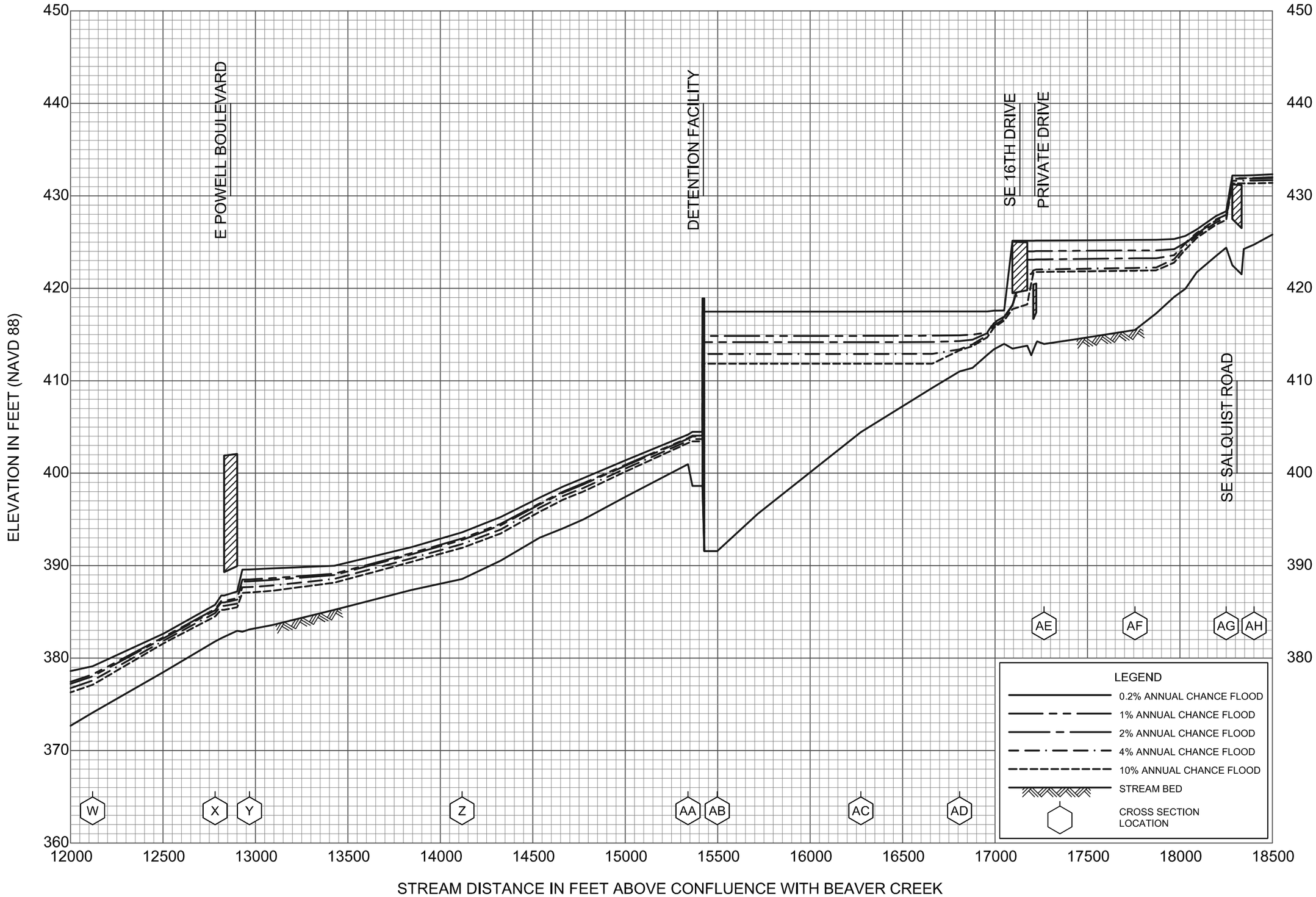

FLOOD PROFILES

KELLY CREEK

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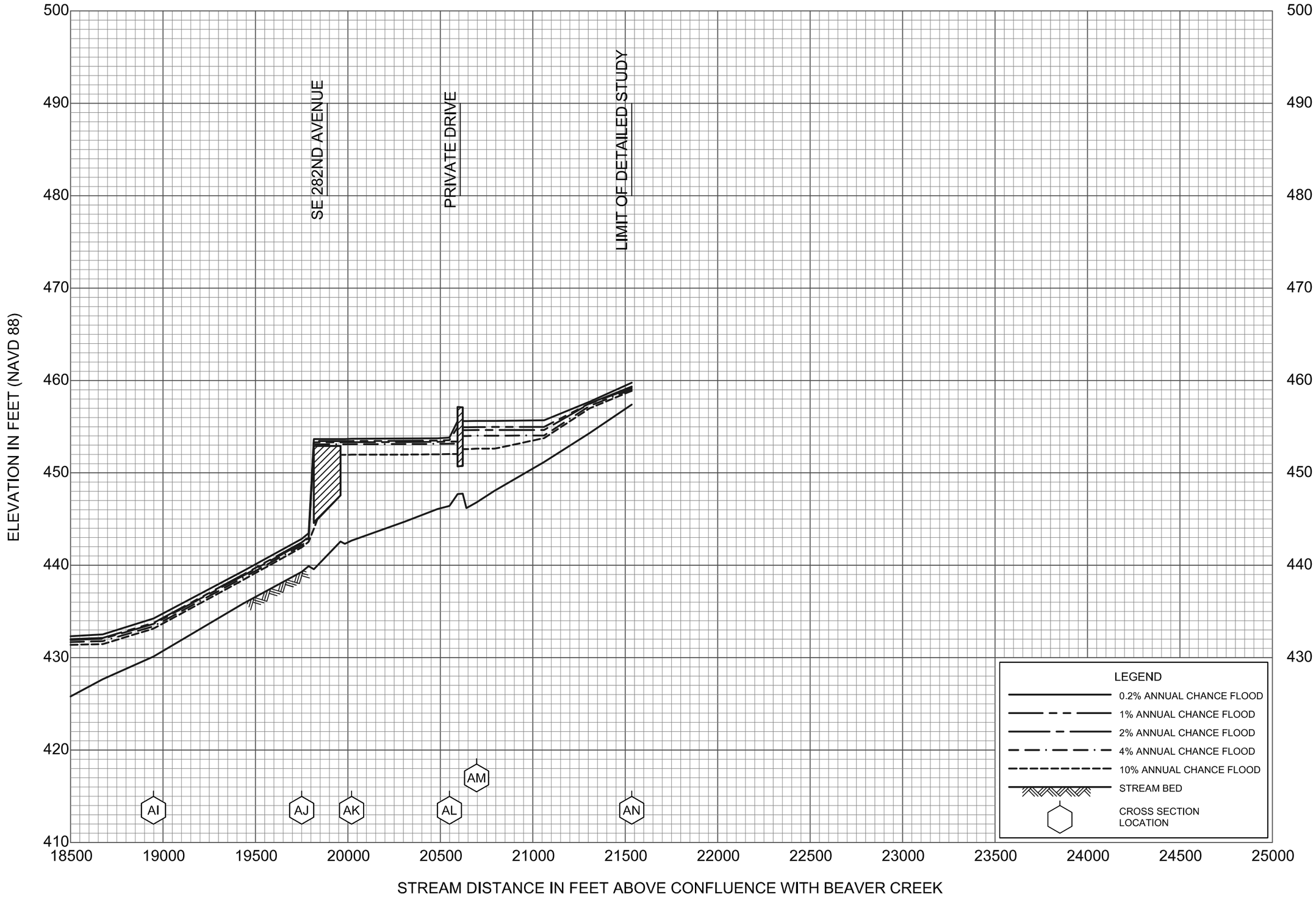

FLOOD PROFILES

KELLY CREEK

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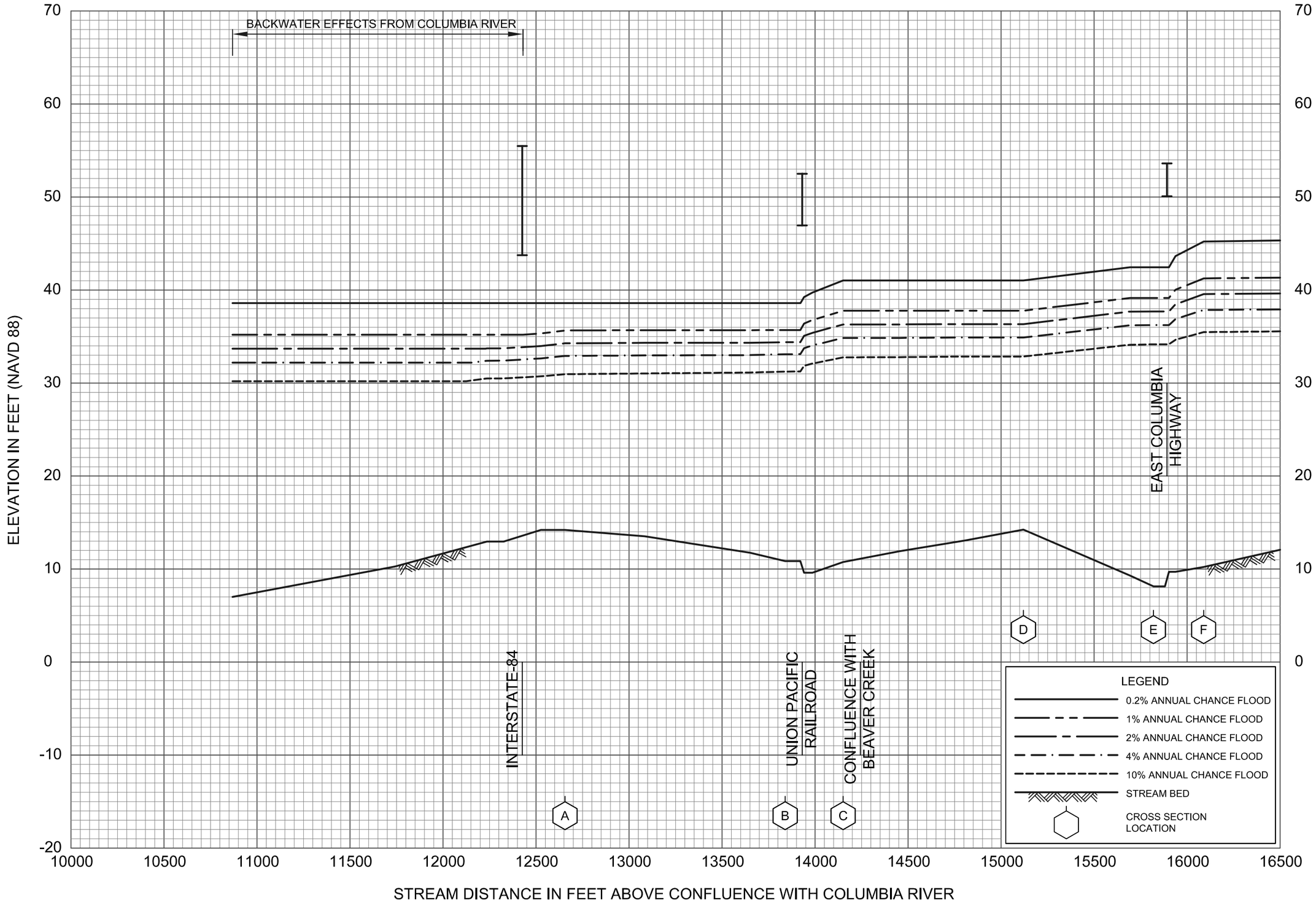


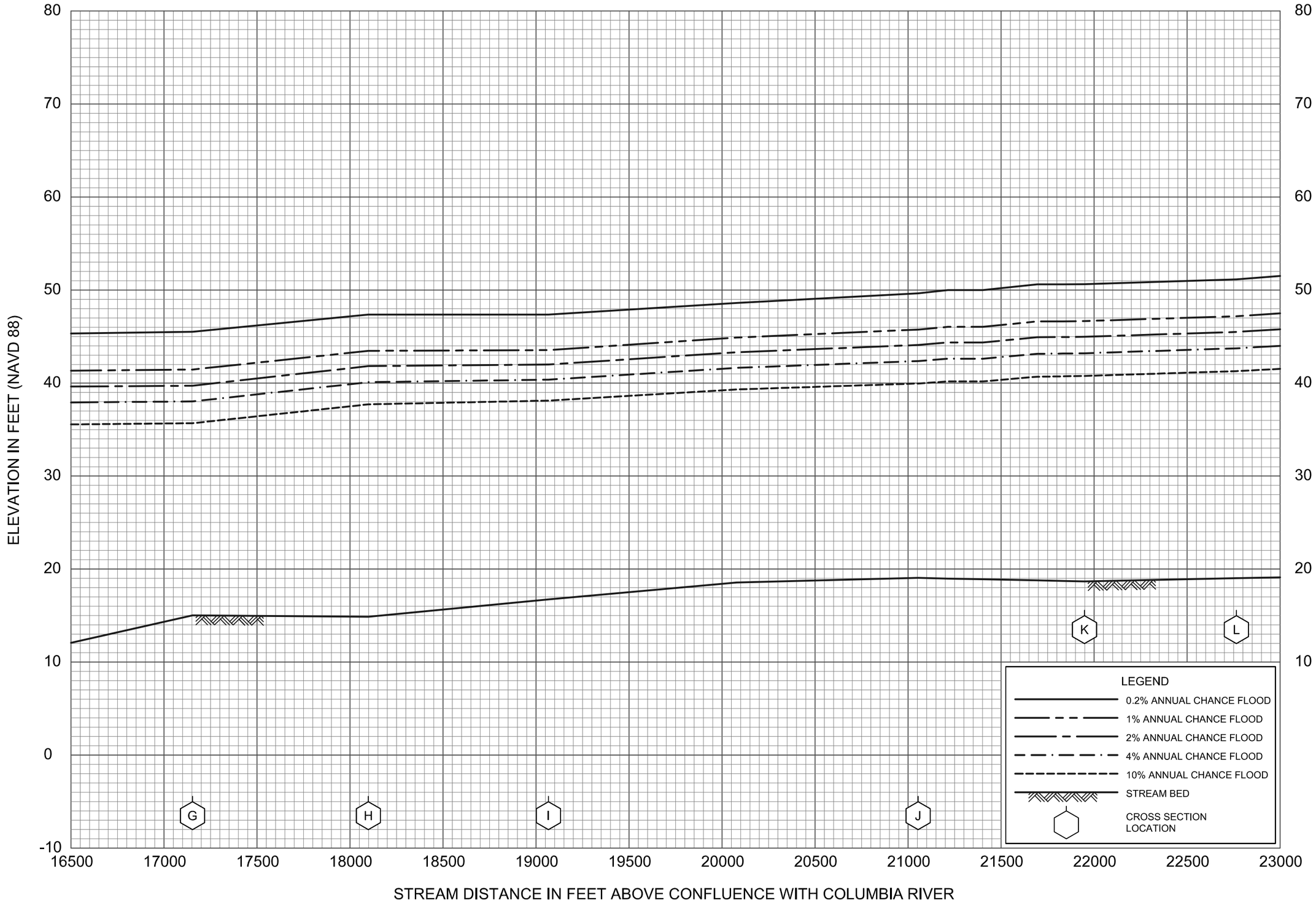
FLOOD PROFILES

SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

SANDY RIVER

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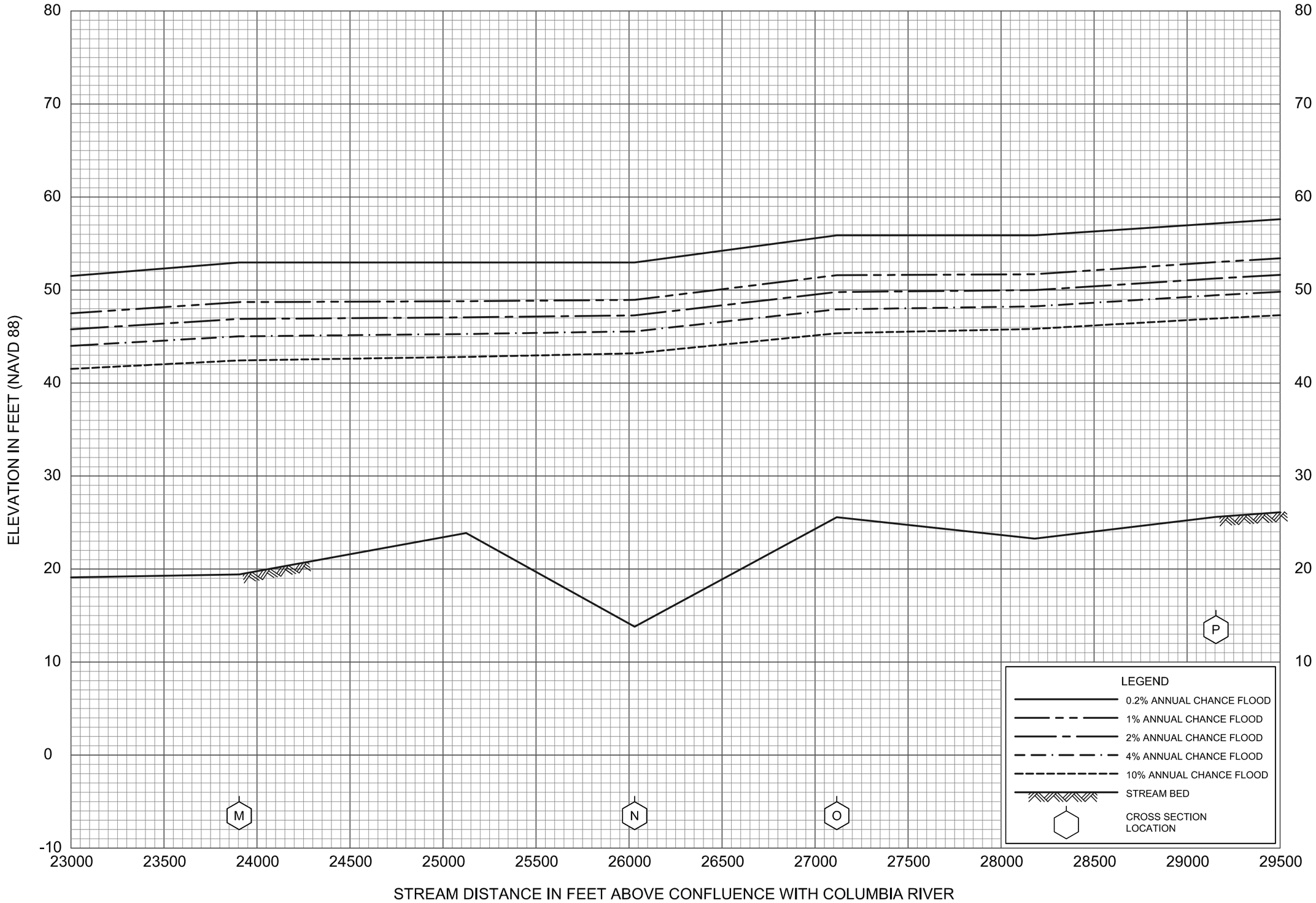

FLOOD PROFILES

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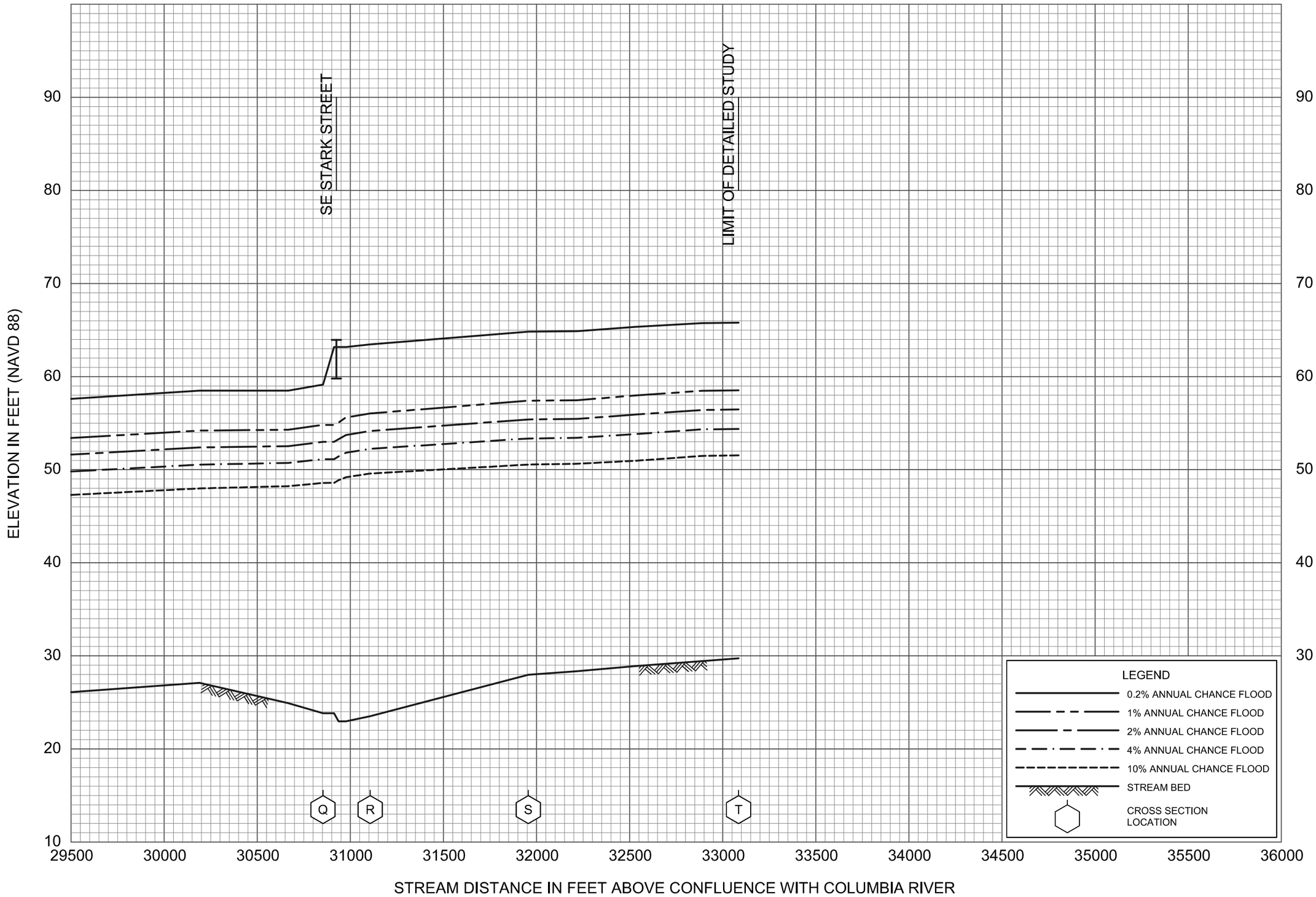

FLOOD PROFILES

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