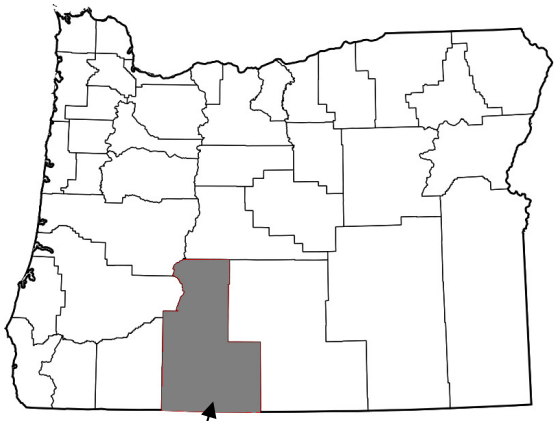
FLOOD INSURANCE STUDY

KLAMATH COUNTY, OREGON

AND INCORPORATED AREAS



Community Name	*Community Number*
Bonanza, City of	410110
Chiloquin, City of	410111
Klamath County (Unincorporated Areas)	410109
Klamath Falls, City of	410112
*Malin, City of	410127
Merrill, City of	410104

*No Special Flood Hazard Areas Identified

Preliminary: **July 21, 2014**

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
41035CV000A

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.

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

Old Zone(s)	New Zone
Al through A30	AE
B	A
C	X

Initial Countywide FIS Effective Date: To Be Determined

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FLOOD INSURANCE STUDY
KLAMATH COUNTY, OREGON AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Klamath County, including the Cities of Bonanza, Chiloquin, Klamath Falls, Malin, Merrill, and the Unincorporated Areas of Klamath County (referred to collectively herein as Klamath County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that on the effective date of this study, the City of Malin has no identified Special Flood Hazard Areas (SFHA). This does not preclude future determinations of SFHAs that could be necessitated by changed conditions affecting the community (i.e., annexation of new lands) or 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 will be able to explain them.

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

1.2 Authority and Acknowledgments

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

Precountywide 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:

Chiloquin, City of:	The hydrologic and hydraulic analyses for Williamson River for the February 15, 1984, FIS report (FEMA, 1984a) were performed by CH2M Hill Northwest, Inc., for FEMA, under Contract No. EMW-C-0283. The work was completed in March 1982.
Klamath County (Unincorporated Areas):	The hydrologic and hydraulic analyses for Fourmile Creek; the Sprague Rivers Near Braymill, Council Butte, Lone Pine; and Klamath and Williamson Rivers for the June 18, 1984, FIS report (FEMA, 1984b) were performed by CH2M Hill Northwest, Inc., for FEMA, under Contract No. EMW-C-0283. The work was completed in March 1982.
Klamath Falls, City of	The hydrologic and hydraulic analyses for Lake Ewauna and Link River for the December 5, 1984, FIS report (FEMA, 1984c) were performed by CH2M Hill Northwest, Inc., for FEMA, under Contract No. EMW-C-0283. The work was completed in March 1982.

The Cities of Bonanza, Malin, and Merrill have no previously printed FIS reports.

This Countywide FIS Report

For this countywide FIS, the hydrologic and hydraulic analyses for all streams newly studied or revisedwere performed by the Strategic Alliance for Risk Reduction (STARR), for FEMA, under Contract No. HSFEHQ-09-D-0370, Task Order No. HSFE10-09-J-0087. The work was completed in May 2013.

Base map information shown on the Flood Insurance Rate Map (FIRM) was provided by the U.S. Department of Agriculture Farm Service Agency Aerial Photography Field Office, produced at a scale of 1:12,000, from aerial photography dated 2012 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 of 1983 (NAD83).

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 community, and the study contractor to review the results of the study.

Precountywide Analyses

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

Community	FIS Date	Initial Meeting	Final Meeting
Chiloquin, City of	February 15, 1984	June 1979	*
Klamath County (Unincorporated Areas)	June 18, 1984	June 1979 and November 1980	*
Klamath Falls, City of	December 5, 1984	June 1979	*

* Data not available

This Countywide FIS Report

The initial meeting was held on April 1, 2010, and attended by representatives of FEMA, STARR, and the communities.

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

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Klamath 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.

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

Fourmile Creek	Sprague River Near Council Butte
Klamath River	Sprague River Near Lone Pine
Lake Ewauna	Upper Klamath Lake
Link River	Williamson River
Sprague River Near Braymill	

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

For this countywide FIS, all streams and lakes studied by detailed methods were redelineated based on updated topography. The hydrologic and hydraulic models were not revised; instead, more up-to-date topography was used with the effective flood elevations to provide more accurate floodplain delineations.

Aspen Creek, Buck Creek, Buck Creek Tributary 1, Deep Creek, Fourmile Creek, Gordon Lake, Haystack Draw, Hog Creek, Hoyt Creek, Klamath River, Lost River, Lost River Tributary 1, Sprague River, Sprague River Tributary, Spring Creek, Unnamed Tributary, Varney Creek, Williamson River, and Williamson River Tributaries 1, 7, and 8 were either newly studied or revised by approximate methods.

All other streams studied by approximate methods were digitally captured from the effective FIRMs.

For this countywide FIS, the FIS report and FIRM were converted to countywide format, and the flooding information for the entire county, including both incorporated and unincorporated areas, is shown. Also, the vertical datum was converted from the National Geodetic Vertical Datum of 1929 (NGVD) to the North American Vertical Datum of 1988 (NAVD). In addition, the UTM coordinates, previously referenced to the North American Datum of 1927 (NAD 27), are now referenced to the NAD83.

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

The following tabulation lists streams that have names in this countywide FIS other than those used in the previously printed FIS reports for the communities in which they are located.

Community	Old Name	New Name	Reach
Klamath County (Unincorporated Areas) Klamath Falls, City of	Klamath River	Lake Ewauna	From approximately 1,840 feet upstream of South Side Bypass to approximately 3,900 feet upstream of Burlington Northern – Santa Fe Railroad.

2.2 Community Description

Klamath County is located in the south-central portion of Oregon. It is bordered by Jackson County to the west, Douglas and Lane Counties to the northwest, Deschutes County to the north, Lake County to the east, and Siskiyou and Modoc Counties, California to the south.

According to the 2010 Census, the population for Klamath County was 66,380. The total area within Klamath County consists of approximately 5,944 square miles (U.S. Census Bureau, 2012).

Klamath County has a semi-arid climate characterized by dry summers with high temperatures and wet winters with moderately low temperatures. Temperatures in the county range from an average high of 80 degrees Fahrenheit (°F) to an average low of 46°F in the summer and from an average daily high of 41°F to an average daily low of 22°F in the winter. The average annual precipitation is 15.02 inches, with the maximum average precipitation occurring in the month of November (The Weather Channel, 2013).

The Sprague River drains approximately 1,600 square miles of the central portion of Klamath County. It flows in a westerly direction to its confluence with the Williamson River near the City of Chiloquin. The Williamson River flows from the north-east to its mouth on Upper Klamath Lake, draining approximately 3,070 square miles. Upper Klamath Lake is connected to Lake Ewauna by the Link River, which flows through the City of Klamath Falls. Lake Ewauna is the source for the Klamath River, which flows southwesterly through the State of California to its mouth at the Pacific Ocean near the Town of Klamath.

The predominant rock and soil formations in Klamath County are volcanic in origin. These consist mostly of basalt lava flows, volcanic ash, and cinders. Alluvial materials found in the area include sands, gravels, silts, peat, and chalk. The topography of Klamath County is characterized by wide flat valleys with marshes, discontinuous fault block mountains, and volcanic formations.

2.3 Principal Flood Problems

The larger magnitude floods are normally the result of a storm of several days duration reaching maximum intensity after the infiltration capacity of the soil has been decreased. Floods can also occur from a series of storms culminated by a

severe storm. Floods that occur in the spring are usually caused by rain augmented by rapid snowmelt.

The largest magnitude and most damaging flood of record in Klamath County was the 1964 flood. According to a report prepared by the U.S. Army Corps of Engineers (USACE), $2,462,000 in damage (1970 prices) resulted from this flood along the Klamath River (between Keno and Lake Ewauna), Sprague River, and Williamson River. The 1964 flood on the Sprague and Williamson Rivers were equivalent to a 1.7-percent-annual-chance flood. For the Link and Klamath Rivers, this flood was equivalent to a 6.7-percent-annual-chance flood. This lesser magnitude flood was a result of regulation of flow at the Link River Dam. The 1964 flood on Fourmile Creek is estimated to be the 1-percent-annual-chance flood. During this flood, Fourmile Creek overflowed into Varney Creek and washed out parts of Westside Road. Floodwaters surrounded some residences near Rocky Point and washed out a bridge at Rocky Point Road crossing.

For the City of Klamath Falls, the highest annual flows in the Klamath River basin usually occur during the months of December through May as a result of heavy rains augmented by snowmelt. The most severe flooding is caused by a storm system of several days duration reaching maximum intensity after the infiltration capacity of the soil has been decreased.

2.4 Flood Protection Measures

Link River Dam controls water-surface elevations on Upper Klamath Lake and regulated flows on the Link River, Lake Ewauna, and Klamath River. The reservoir provides 525,000 acre-feet of flood control storage.

The Klamath River between Keno and Lake Ewauna was dredged by Pacific Power and Light Company following the 1964 flood. This was to provide more flow capacity for this reach of stream. There are also private levees along this reach to protect agricultural lands. Some of these were overtopped in 1964, and none were considered as providing protection in this study.

Levees exist in the study area that provides 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.

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.

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.

Precountywide Analyses

Flood flows for the Williamson River were determined by analyzing the 58 years of stream-flow records of the U.S. Geological Survey (USGS) gages near the confluence with Sprague River (No. 11502500) and on the Sprague River near Chiloquin (No. 11501000) (USGS, undated; 1964-1980). It was determined, by comparing corresponding flows of the two gages, that there was no significant difference between mean daily discharges and peak discharges for a given day. Therefore, the largest difference between corresponding annual mean daily discharges of the gages was used for the statistical analysis of the Williamson River upstream of the Sprague River. This analysis followed the standard Log-Pearson Type III method as outlined by the Water Resources Council (WRC) (WRC, 1977).

Streamflow records for the USGS gaging station on Link River at Klamath Falls (No. 11507500) were used for the statistical analysis to compute flood discharges for the Link River, Lake Ewauna, and the Klamath River above the Lost River diversion (USGS, undated, 1964-1980). A statistical analysis of 59 years of records was prepared at this gage. The analysis followed the standard log-Pearson Type III method as outlined by the WRC (WRC, 1977). Since streamflow at this gage is regulated, the computed skew coefficient was used.

Analysis of elevations of Upper Klamath Lake was based on records for the Upper Klamath Lake near Klamath Falls gage (No. 11507001). This gage has 54 years of record and is located within the detailed study limits for the lake. The analysis of annual peak elevations included the effects of wind setup at the gage. The 1-percent-annual-chance flood elevations were based on the analysis of the records using a standard log-Pearson Type III method.

Flood discharges for Sprague River are based on statistical analysis of streamflow records of USGS gaging stations at Sprague River near the City of Chiloquin (No. 11501000) and Sprague River near the City of Beatty (No. 11497500) (USGS undated; 1964-1980). The analysis was performed by the USGS following the standard log-Pearson Type III method as outlined by the WRC (WRC, 1977). Discharges were transferred from the gage near the City of Chiloquin using an exponential ratio of drainage areas and solving for streamflow at the ungaged site (USGS, 1977). The exponent for the drainage area ratio was derived by using the same equation for the 1964 observed flood peaks for the two streamflow gages.

Streamflow records for Klamath River at Keno gage (No. 11509500) were used for computing flood discharges for the Klamath River below the Lost River Diversion. The analysis of these records was based on 51 years of annual peaks. The procedure used is the same as described above for the Link River gage.

Flood discharges for Fourmile Creek are based on the statistical analysis for the Lost Creek gage (No. 11505505). Lost Creek is a tributary to Fourmile Creek with a drainage area of approximately 13 square miles and 15 years of record. The analysis for Lost Creek is based on the standard log-Pearson Type III method. Flood discharges were computed for Fourmile Creek at Westside Road by adjusting Lost Creek flood discharges based on differences in precipitation and drainage area. The drainage area includes the area contributing to Varney Creek because of overflows above Westside Road are prorated between Fourmile Creek and Varney Creek based on stage versus discharge curves for each of several culverts. During floods of the magnitude equal to the 2-percent-annual-chance flood or greater, weir flow occurs over Westside Road and contributes only to Varney Creek. Therefore, during flood flow equal or greater than this magnitude, a larger percentage of the flow is distributed to Varney Creek.

No routing of flood discharges was performed on Fourmile Creek because of lack of topographic data upstream of Westside Road. However, the difference in water-surface elevations between the 10-percent-annual-chance food and the 0.2-percent-annual-chance flood is only 0.5 foot. This is a 30 percent reduction in peak flow. Therefore, if flood routing would have reduced the peak, the change in water surface the peak, the change in water surface elevation would be insignificant.

Peak discharge-drainage area relationships for each flooding source studied in detail are shown in Table 1.

Table 1 - Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Fourmile Creek					
At Rocky Point Road	83	1,080	1,470	1,530	1,620
Klamath River					
Just downstream of confluence of Lost River Diversion	*	7,790	11,300	12,900	16,900
Just upstream of confluence of Lost River Diversion	*	6,500	9,590	11,100	15,000
Lake Ewauna	**	**	**	**	**
Link River					
At Lake Ewauna	*	**	**	11,100	**
Sprague River Near Braymill	1,573	5,400	10,100	12,600	20,000
Sprague River Near Council Butte	1,286	4,700	8,790	10,970	17,410
Sprague River Near Lone Pine	1,451	5,100	9,540	11,900	18,880
Williamson River					
Just downstream of confluence of Sprague River	3,000	6,400	11,200	13,800	21,300
Just upstream of confluence Lost River Diversion	1,400	1,610	2,190	2,440	3,050

*Regulated flow below Upper Klamath Lake (drainage area of 3,810 square miles)
**Data not available

Stillwater elevations for Klamath County are shown in Table 2.

Table 2- Summary of Stillwater Elevations

Flooding Source	Water Surface Elevations (Feet NAVD[1]) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Upper Klamath Lake (southeast portion)	*	*	4,145.8	*

* Data not available
[1] North American Vertical Datum of 1988

This Countywide FIS Report

For the approximately studied streams newly studied or revised for this countywide FIS report, peak discharges generally were estimated using the published State of Oregon Water Resources Department (OWRD) regional regression equations report (OWRD, 2006). Regression equations estimate peak discharges for ungaged streams based on characteristics of nearby gauged streams. Drainage areas were developed from USGS 10-meter Digital Elevation Models.

Peak discharges for Sprague River were developed using the drainage area ratio methodology based on a Log-Pearson Type III probability distribution analysis, following the procedures outlined in WRC Bulletin 17B (WRC, 1981). The statistical analysis was performed using the USGS, computer program, PeakFQ for USGS gage station number 11501000 near Chiloquin, Oregon using the annual peak records from 1921 to 2010. The peak flows for USGS gage station number 11497500 near Beatty, Oregon were taken from the published OWRD regional regression equations report (OWRD, 2006).

Peak discharges for the Klamath River were taken from an effective detailed flood insurance study on Klamath River from the Klamath County, Oregon, (Unincorporated Areas) FIS (FEMA, 1984).

For Lost River unit peak discharges (in cfs/sq. mi) were calculated for gage data available within the Lost River watershed (USGS station, 11484000, on Miller Creek near Lorella, Oregon), and similar watersheds in hydrologic Region 5 as defined in the regional regression study for western Oregon (OWRD, 2006), (USGS station, 11501000, on Sprague River near Chiloquin, Oregon). The two unit peak discharges were weighted with the number of years of record available at each gage to obtain a weighted unit peak discharge, 9.577 cfs/sq. mi. This unit peak discharge was used in the determination of the peak flows for Lost River. Based upon complex hydrologic conditions, dam operation criteria's, evaluation of available historic datasets, and flooding season the drainage areas were adjusted to exclude total drainage areas at Clear Lake Dam and Gerber Dam.

For Williamson River and its tributaries, watershed specific hydrologic computations were performed using annual peak records available for four gages within the watershed: 11502500 (Williamson River below Sprague River Near Chiloquin, Oregon, 1917-2011); 11493500 (Williamson River Near Klamath Agency, Oregon, 1910, 1955-2011); 11491400 (Williamson River below Sheep Creek Near Lenz, Oregon, 1980-1991); and 11491800 (Mosquito Creek Near Shevlin, Oregon, 1965-1981). The regional regression equations are not applicable within this watershed due to natural flow regulations and deep pumice deposits which makes this watershed highly unproductive.

3.2 Hydraulic Analyses

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

Precountywide Analyses

For cross sections in Klamath County, the backwater analyses of all streams studied by detailed methods were obtained by photogrammertric methods, using aerial photographs at a scale of 1:12,000 (CH2M Hill Northwest, Inc., 1980). Underwater sections were taken in the field by depth soundings or direct measurement in shallow areas. Structural geometry for bridges was obtained by field measurements.

Water-surface elevations of floods of selected recurrence intervals were computed using the USACE, Hydrologic Engineering Center (HEC) computer program, HEC-2 (HEC, 1968). Flood profiles were drawn showing computed water-surface elevations for all flooding sources studied in detail were calculated using slope-area method. The slope used in this computation for Klamath River, Sprague River, and Williamson River was based on calibration to 1964 flood high water marks (USACE, 1964).

The Manning's "n" values for all detailed studied streams are listed in the following tabulation:

Manning's "n" Values

Stream	Channel "n"	Overbank "n"
Fourmile Creek	0.035 to 0.060	0.075 to 0.095
Klamath River	0.025 to 0.045	0.060
Link River	0.040 to 0.060	0.060 to 0.080
Sprague River	0.040 to 0.065	0.060 to 0.085
Williamson River	0.036 to 0.098	*

* Data Not Available

This Countywide FIS Report

The USACE, HEC computer program, HEC-RAS, version 4.1.0 (HEC, 2010) was used in computing the flood elevations for approximate Zone A streams newly studied or revised for this countywide FIS report. Channel and overbank area cross sections were based upon the Light Detection and Ranging (LiDAR) topography acquired by DOGAMI, Klamath Bureau of Reclamation, Klamath Tribes and Klamath Basin Rangeland Trust. The slope-area/normal depth was used for the starting conditions. For streams starting at limit of detail studies, known elevations from the published flood studies were utilized. A channel Manning's "n" ranging between 0.04 and 0.045 was used based upon aerials and effective FIS reports. The Manning's "n" values for overbank areas were estimated by classifying land cover information from aerial imagery to the closest descriptions listed in Table 3.1 in HEC-RAS Reference Manual (HEC, 2010) and ranged from 0.03 to 0.1.

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).

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 SFHA.

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.

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.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD. Structure and ground elevations in the community must, therefore, be referenced to NAVD. It is important to note that adjacent communities may be referenced to NGVD. This may result in differences in Base Flood Elevations (BFEs) across the corporate limits between the communities.

Table 3 – Vertical Datum Conversion

Stream Name	Minimum Conversion (Feet)	Maximum Conversion (Feet)	Average Conversion (Feet)	Maximum Offset (Feet)
Fourmile Creek	3.799	3.809	3.802	0.007
Klamath River	3.573	3.658	3.612	0.046
Lake Ewauna	3.576	3.586	3.580	0.006
Link River	3.589	3.593	3.590	0.003
Sprague River Near Braymill	3.711	3.740	3.725	0.015
Sprague River Near Council Butte	3.671	3.691	3.683	0.008
Sprague River Near Lone Pine	3.704	3.730	3.716	0.014
Williamson River	3.730	3.770	3.746	0.024

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:

Vertical Network Branch, N/CG13
National Geodetic Survey, NOAA
Silver Spring Metro Center 3
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

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 Stillwater Elevations 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 Fourmile Creek, Klamath River, Lake Ewauna, Link River, Sprague River Near Braymill, Council Butte, and Lone Pine, Upper Klamath Lake, and Williamson River the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated utilizing the resampled/reprojected, 10-foot cell-size LiDAR rasters. The hydrologic and hydraulic models were not revised; instead, more up-to-date topography was used with the effective flood elevations to provide more accurate floodplain delineations. The flood elevations at lettered cross sections and other inflection points on the effective profiles were utilized to delineate flood boundaries from the 10-foot LiDAR raster dataset. Between the lettered cross sections and inflection points the elevations were interpolated. As expected, the LiDAR generated redelineated flood boundaries consisted of numerous small holes. All holes where the maximum width was less than 0.1-inch on the printed FIRM map scale were filled in (Watershed Sciences, 2005; 2011a-i).

The redelineated floodplain boundaries were compared to the effective floodway delineations and water bodies on aerial imagery. The effective floodway boundaries were revised to match the redelineated base flood boundaries in order to reconcile the effective floodway with the redelineated 1-percent-annual-chance floodplains. Further, the floodway boundaries were updated to include the streamlines depicted on the aerial imagery.

Following the guidance from FEMA's Procedure Memorandum 51 (PM51) (FEMA, 2012), the redelineated flood boundaries for Klamath River and Lake Ewauna were extended beyond the high embankments of the Union Pacific Railroad and Burlington Santa Fe Railroad. The redelineation has included large areas, especially in the City of Klamath Falls, within the special flood hazard areas.

For new approximate flood studies the flood boundaries were mapped, utilizing the resampled/reprojected, 10-foot cell-size raster, LiDAR (Watershed Sciences, 2005; 2011a-i) topographic information, based on elevations at modeled cross sections. The water surface elevations were interpolated between the modeled cross sections. The small holes where the maximum width was smaller than 0.1-inch on the printed FIRM map scale were filled in. Further, following guidance from the FEMA's PM 51 (FEMA, 2012) the mapping on the left overbanks of Klamath River was extended past the embankments of Highway 97/ Union

Pacific Railroad. This has resulted in large areas especially within Klamath National Wildlife Refuge to be now included within the Zone A floodplains.

Streams studied by approximate methods where LiDAR was not available were digitally captured from the effective FIRMs.

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 (Zones A and AE), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 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).

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 FIS report and on the FIRM 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 have been tabulated for selected cross sections (Table 4). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
FOURMILE CREEK									
A	0	76	429	3.6	9	4,147.5	4,147.5	4,148.4	0.9
B	160	118	397	3.9	N/A	4,147.9	4,147.9	4,148.6	0.7
C	1,280	543	1,070	1.4	N/A	4,150.7	4,150.7	4,151.6	0.9
D	3,200	506	1,876	0.8	139	4,151.5	4,151.5	4,152.5	1.0
E	3,870	110	1,816	0.8	559	4,151.7	4,151.7	4,152.7	1.0

[1]Feet above limit of detailed study
(Limit of detailed study is approximately 115 feet downstream of Rocky Point Road)

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

FOURMILE CREEK

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
KLAMATH RIVER									
A	0	859	8,971	1.4	20	4,087.8	4,087.8	4,088.8	1.0
B	1,980	690	6,556	2.0	N/A	4,087.8	4,087.8	4,088.8	1.0
C	3,730	506	4,939	2.6	13	4,087.9	4,087.9	4,088.9	1.0
D	5,550	557	7,439	1.7	22	4,088.0	4,088.0	4,089.0	1.0
E	7,390	750	9,130	1.4	85	4,088.1	4,088.1	4,089.1	1.0
F	9,150	523	6,626	1.9	156	4,088.1	4,088.1	4,089.1	1.0
G	11,070	672	9,563	1.3	89	4,088.2	4,088.2	4,089.2	1.0
H	12,830	766	10,776	1.2	95	4,088.2	4,088.2	4,089.3	0.9
I	14,430	1,037	8,937	1.4	N/A	4,088.3	4,088.3	4,089.3	1.0
J	16,080	720	7,341	1.8	N/A	4,088.4	4,088.4	4,089.4	1.0
K	18,350	1,750	10,676	1.2	44	4,088.5	4,088.5	4,089.4	0.9
L	20,180	650[2]	4,637	2.4	N/A	4,088.8	4,088.8	4,089.6	0.8
M	22,970	1,537	11,083	1.0	257	4,089.1	4,089.1	4,089.9	0.8
N	24,510	1,332	9,262	1.2	68	4,089.2	4,089.2	4,090.0	0.8
O	26,070	680	8,339	1.3	N/A	4,089.3	4,089.3	4,090.1	0.8

[1]Feet above limit of detailed study

(Limit of detailed study is approximately 16,500 feet downstream of U.S. Highway 97)

[2]Floodway may differ from FIRM. See FIRM for regulatory width.

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

KLAMATH RIVER

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
LAKE EWAUNA									
A	0	719	8,058	1.4	N/A	4,089.4	4,089.4	4,090.2	0.8
B	1,620	1,233	12,560	0.9	N/A	4,089.5	4,089.5	4,090.3	0.8
C	4,995	1,728	17,957	0.6	69	4,089.7	4,089.7	4,090.7	1.0
D	6,785	2,177	22,034	0.5	N/A	4,089.7	4,089.7	4,090.7	1.0
E	8,565	2,678	30,903	0.4	N/A	4,089.7	4,089.7	4,090.7	1.0
F	10,425	233	2,582	4.3	N/A	4,090.3	4,090.3	4,091.2	0.9

[1]Feet above confluence with Klamath River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

LAKE EWAUNA

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
SPRAGUE RIVER NEAR BRAYMILL								
A	0	418	5,255	2.4	4,263.0	4,263.0	4,264.0	1.0
B	1,500	428	5,888	2.1	4,263.4	4,263.4	4,264.4	1.0
C	3,180	636	7,119	1.8	4,263.7	4,263.7	4,264.7	1.0
D	5,220	837	11,062	1.1	4,264.4	4,264.4	4,265.4	1.0
E	8,590	507	6,291	2.0	4,265.0	4,265.0	4,266.0	1.0

[1]Feet above limit of detail study

(Limit of detailed study is approximately 5,100 feet downstream of Sprague River Road)

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

SPRAGUE RIVER NEAR BRAYMILL

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
SPRAGUE RIVER NEAR COUNCIL BUTTE									
A	0	1,409	12,087	0.9	N/A	4,304.0	4,304.0	4,305.0	1.0
B	2,440	2,275	24,041	0.5	N/A	4,304.1	4,304.1	4,305.1	1.0
C	6,680	2,397	23,584	0.5	N/A	4,304.1	4,304.1	4,305.1	1.0
D	8,760	2,570	20,873	0.5	N/A	4,304.2	4,304.2	4,305.2	1.0
E	13,400	2,878	24,357	0.5	N/A	4,304.2	4,304.2	4,305.2	1.0
F	17,400	2,750	22,096	0.5	N/A	4,304.3	4,304.3	4,305.3	1.0
G	19,080	2,484	19,270	0.6	N/A	4,304.3	4,304.3	4,305.3	1.0
H	22,920	1,709	14,685	0.7	N/A	4,304.4	4,304.4	4,305.4	1.0
I	25,520	1,875	12,964	0.8	N/A	4,304.6	4,304.6	4,305.6	1.0
J	27,960	2,805	18,612	0.6	N/A	4,304.8	4,304.8	4,305.8	1.0
K	29,800	2,279	15,318	0.7	N/A	4,304.9	4,304.9	4,305.9	1.0
L	31,520	2,153	14,196	0.8	N/A	4,305.0	4,305.0	4,306.0	1.0
M	33,720	1,969	12,916	0.8	N/A	4,305.3	4,305.3	4,306.3	1.0
N	35,400	1,587	12,111	0.9	N/A	4,305.5	4,305.5	4,306.5	1.0
O	37,200	1,669[2]	11,956	0.9	N/A	4,305.8	4,305.8	4,306.8	1.0
P	43,940	4,768	34,385	0.3	N/A	4,306.0	4,306.0	4,307.0	1.0
Q	46,340	2,513	16,880	0.6	N/A	4,306.1	4,306.1	4,307.1	1.0
R	48,060	2,948[2]	18,070	0.6	N/A	4,306.1	4,306.1	4,307.1	1.0
S	49,340	3,703	20,875	0.5	N/A	4,306.2	4,306.2	4,307.2	1.0

[1]Feet above limit of detailed study

(Limit of detailed study is approximately 51,740 feet downstream of confluence of Whiskey Creek)

[2]Floodway width may differ from FIRM. See FIRM for regulatory width.

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

SPRAGUE RIVER NEAR COUNCIL BUTTE

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
SPRAGUE RIVER NEAR COUNCIL BUTTE (CONTINUED)									
T	54,260	4,470	22,983	0.5	N/A	4,306.3	4,306.3	4,307.3	1.0
U	56,300	4,136	21,364	0.5	N/A	4,306.3	4,306.3	4,307.3	1.0
V	58,660	3,923	16,199	0.7	N/A	4,306.5	4,306.5	4,307.5	1.0
W	60,620	2,397	12,781	0.9	792	4,306.7	4,306.7	4,307.7	1.0
X	63,020	2,507	12,220	0.9	N/A	4,307.1	4,307.1	4,308.1	1.0
Y	67,820	3,887	11,675	0.9	N/A	4,307.8	4,307.8	4,308.7	0.9

[1]Feet above limit of detailed study

(Limit of detailed study is approximately 51,740 feet downstream of confluence of Whiskey Creek)

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

SPRAGUE RIVER NEAR COUNCIL BUTTE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
SPRAGUE RIVER NEAR LONE PINE								
A	0	240	4,272	2.8	4,289.1	4,289.1	4,290.1	1.0
B	1,780	781	11,916	1.0	4,289.3	4,289.3	4,290.3	1.0
C	2,720	722	10,699	1.1	4,289.4	4,289.4	4,290.4	1.0
D	3,980	1,000	13,088	0.9	4,289.4	4,289.4	4,290.4	1.0
E	5,875	1,683	17,358	0.7	4,289.6	4,289.6	4,290.6	1.0
F	9,295	1,400	18,687	0.6	4,289.6	4,289.6	4,290.6	1.0
G	12,335	1,200	12,313	1.0	4,289.8	4,289.8	4,290.8	1.0

[1]Feet above limit of detailed study

(Limit of detailed study is approximately 5,755 feet downstream of Saddle Mountain Pit Road)

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

SPRAGUE RIVER NEAR LONE PINE

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
WILLIAMSON RIVER									
A	26,400	565	5,518	2.5	N/A	4,151.5	4,151.5	4,152.5	1.0
B	28,250	593	5,113	2.7	N/A	4,151.9	4,151.9	4,152.9	1.0
C	30,080	218	4,343	3.2	N/A	4,152.4	4,152.4	4,153.4	1.0
D	31,380	891	6,252	2.2	38	4,152.6	4,152.6	4,153.6	1.0
E	32,960	436	4,842	2.9	1,213	4,153.1	4,153.1	4,154.1	1.0
F	34,430	220	3,916	3.5	501	4,153.8	4,153.8	4,154.8	1.0
G	36,900	175	3,600	3.8	N/A	4,154.7	4,154.7	4,155.7	1.0
H	40,470	483	4,719	2.9	N/A	4,157.7	4,157.7	4,158.7	1.0
I	42,090	446	4,275	3.2	N/A	4,158.5	4,158.5	4,159.5	1.0
J	43,790	497	5,682	2.4	N/A	4,159.0	4,159.0	4,160.0	1.0
K	45,420	869[2]	5,090	2.7	43	4,159.6	4,159.6	4,160.6	1.0
L	47,040	546	4,934	2.8	N/A	4,160.4	4,160.4	4,161.3	0.9
M	48,690	402	4,963	2.8	N/A	4,160.9	4,160.9	4,161.9	1.0
N	50,340	187	3,221	4.3	N/A	4,161.4	4,161.4	4,162.4	1.0
O	51,690	439	5,276	2.6	N/A	4,162.1	4,162.1	4,163.1	1.0
P	53,365	351	3,729	3.7	N/A	4,163.9	4,163.9	4,164.7	0.8
Q	54,525	287	2,723	5.1	N/A	4,165.7	4,165.7	4,166.5	0.8
R	56,155	375	4,102	3.4	9	4,167.3	4,167.3	4,168.1	0.8
S	57,815	241	2,288	6.0	N/A	4,169.1	4,169.1	4,169.9	0.8
T	58,895	404	2,835	4.9	N/A	4,171.6	4,171.6	4,172.4	0.8
U	59,255	170	699	3.5	N/A	4,172.6	4,172.6	4,173.6	1.0

[1]Feet above confluence with Upper Klamath Lake

[2]Floodway width may differ from FIRM. See FIRM for regulatory width.

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

WILLIAMSON RIVER

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
WILLIAMSON RIVER (CONTINUED)									
V	59,655	124	528	4.6	11	4,176.3	4,176.3	4,177.2	0.9
W	60,915	111	792	3.1	N/A	4,179.3	4,179.3	4,180.3	1.0
X	64,045	168	1,404	1.7	N/A	4,181.2	4,181.2	4,182.1	0.9
Y	65,620	180	1,640	1.5	N/A	4,181.4	4,181.4	4,182.3	0.9
Z	67,120	229	1,728	1.4	N/A	4,181.6	4,181.6	4,182.4	0.8
AA	70,400	139	1,200	2.0	N/A	4,182.7	4,182.7	4,183.5	0.8
AB	71,990	161	1,474	1.7	N/A	4,183.2	4,183.2	4,184.0	0.8
AC	73,640	222	2,119	1.2	N/A	4,183.5	4,183.5	4,184.3	0.8
AD	75,280	124	1,297	1.9	N/A	4,183.8	4,183.8	4,184.6	0.8
AE	76,905	169	1,690	1.4	N/A	4,184.2	4,184.2	4,185.1	0.9
AF	78,635	198	1,815	1.3	N/A	4,184.5	4,184.5	4,185.4	0.9
AG	79,790	186	1,447	1.7	N/A	4,184.8	4,184.8	4,185.7	0.9
AH	81,905	254	1,925	1.3	N/A	4,185.3	4,185.3	4,186.2	0.9
AI	83,455	166	1,421	1.7	N/A	4,185.7	4,185.7	4,186.6	0.9
AJ	85,265	180	1,460	1.7	N/A	4,186.3	4,186.3	4,187.2	0.9
AK	87,185	389	2,053	1.2	N/A	4,186.9	4,186.9	4,187.8	0.9

[1]Feet above confluence with Upper Klamath Lake

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR
AND INCORPORATED AREAS

FLOODWAY DATA

WILLIAMSON 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 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 1.

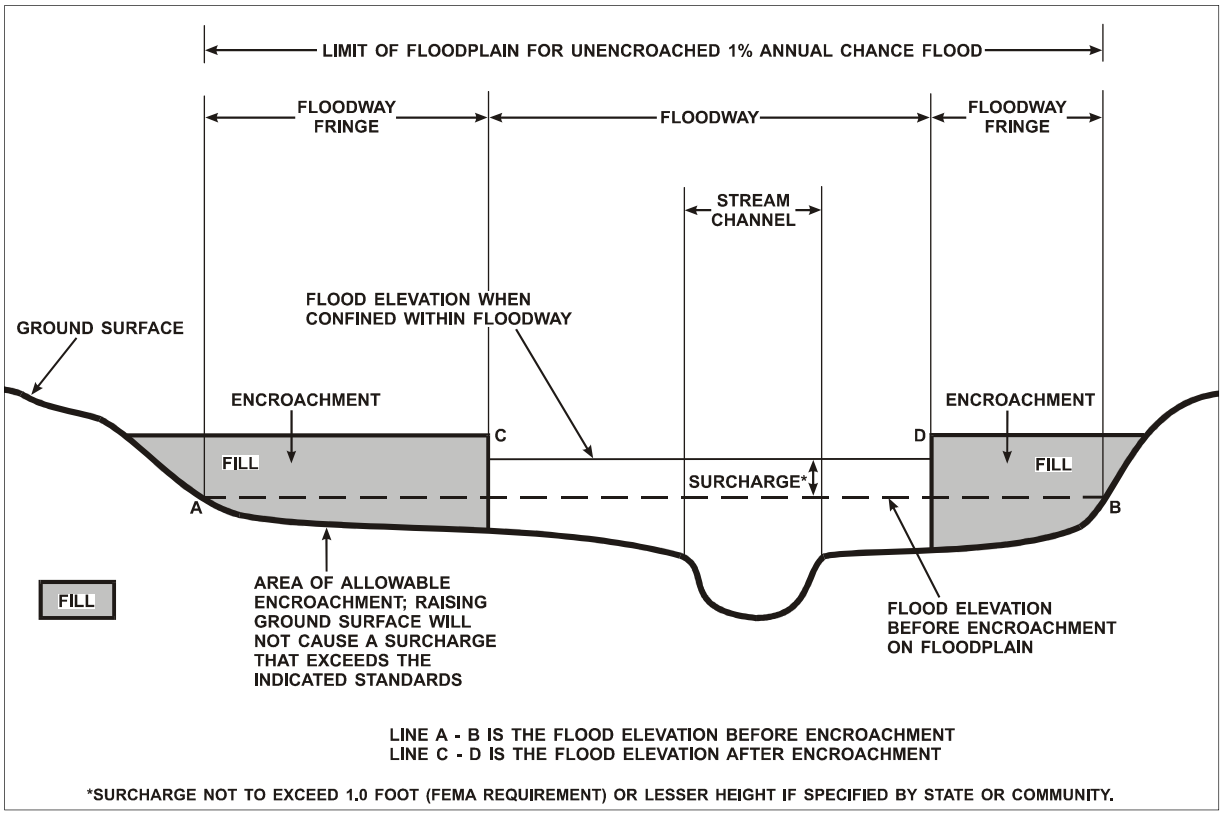

Figure 1 - Floodway Schematic

No floodways were computed for Link River because the 1-percent-annual-chance flood is confined to a narrow channel of less than 400 feet in width.

5.0 INSURANCE APPLICATIONS

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

Zone A

Zone A is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by approximate methods. Because detailed

hydraulic analyses are not performed for such areas, no BFEs or base flood depths are shown within this zone.

Zone AE

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

Zone X

Zone X is the flood insurance risk zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less 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 Klamath County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. Historical data relating to the maps prepared for each community are presented in Table 5.

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.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE
Bonanza, City of	September 13, 1974	April 23, 1976	June 1, 1983	None
Chiloquin, City of	November 30, 1973	November 14, 1975	August 15, 1984	None
Klamath County (Unincorporated Areas)	December 27, 1974	July 18, 1978	December 18, 1984	None
Klamath Falls, City of	June 28, 1974	February 20, 1976	June 5, 1985	None
Malin, City of *,**	N/A	N/A	N/A	
Merrill, City of *	N/A	N/A	N/A	

*This Community did not have a FIRM prior to the first countywide FIRM for Klamath County
**No Special Flood Hazard Areas identified

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Federal Insurance and Mitigation Division, Federal Regional Center, 130-228th Street Southwest, Bothell, Washington, 98021-8627.

9.0 BIBLIOGRAPHY AND REFERENCES

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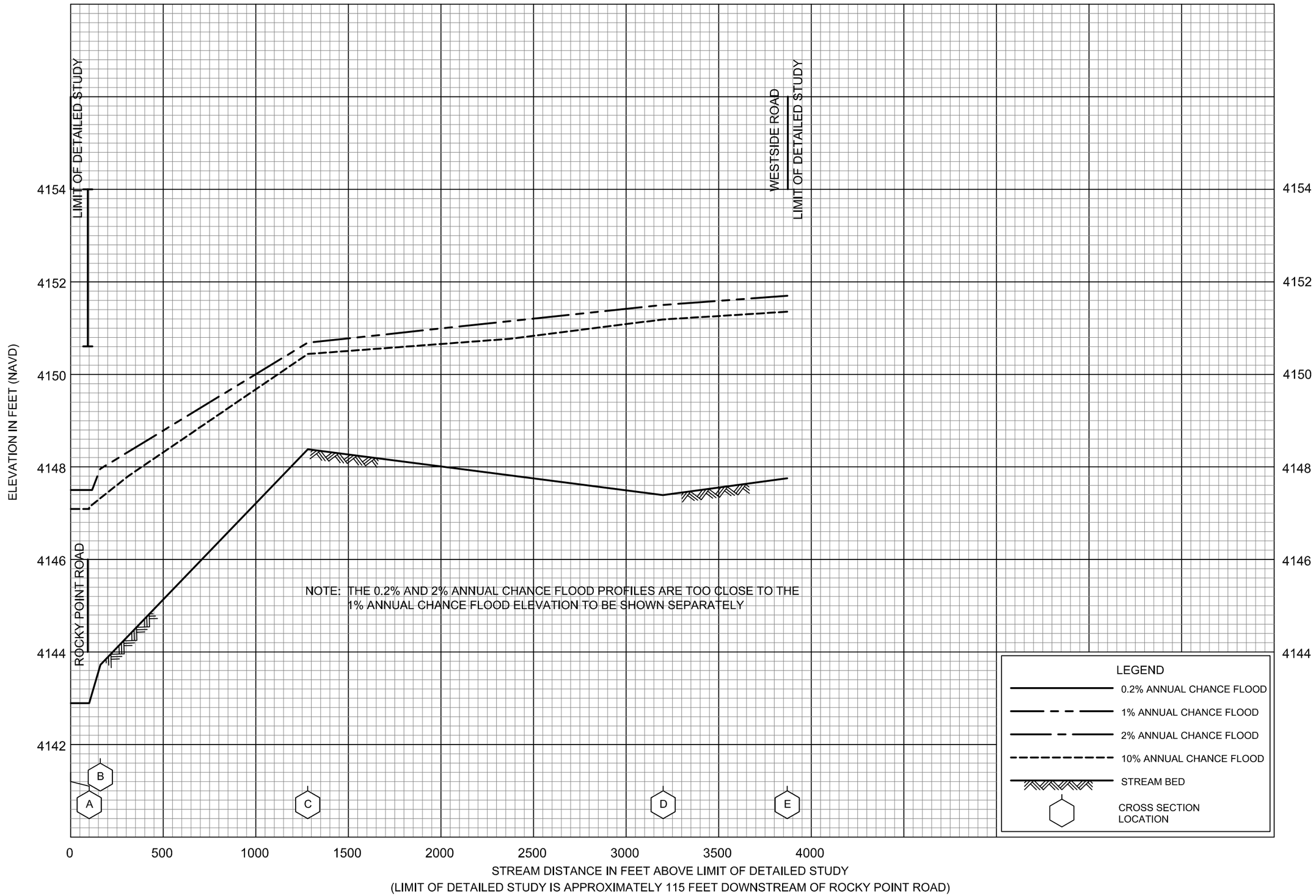


FLOOD PROFILES

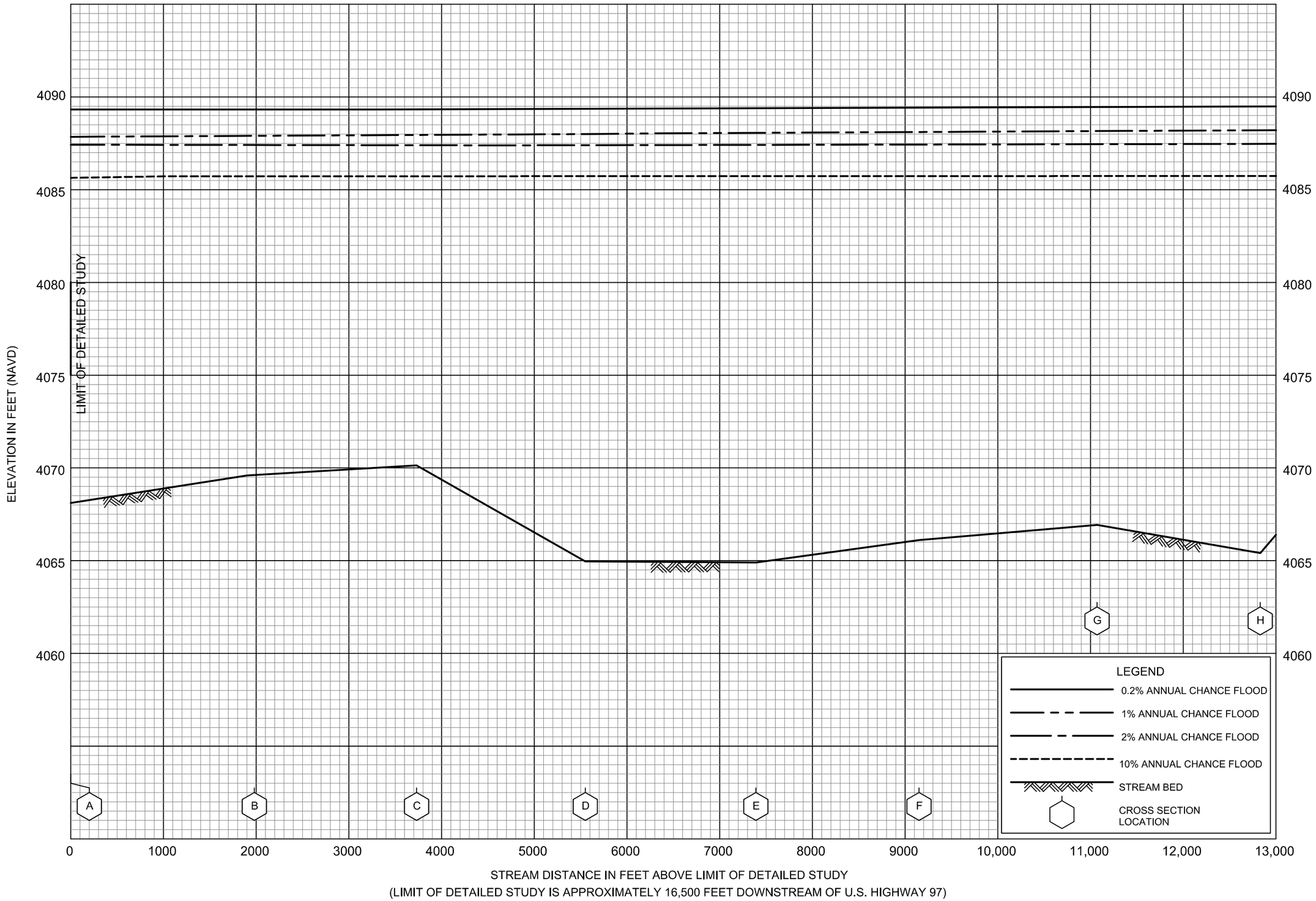
FOURMILE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS

01P



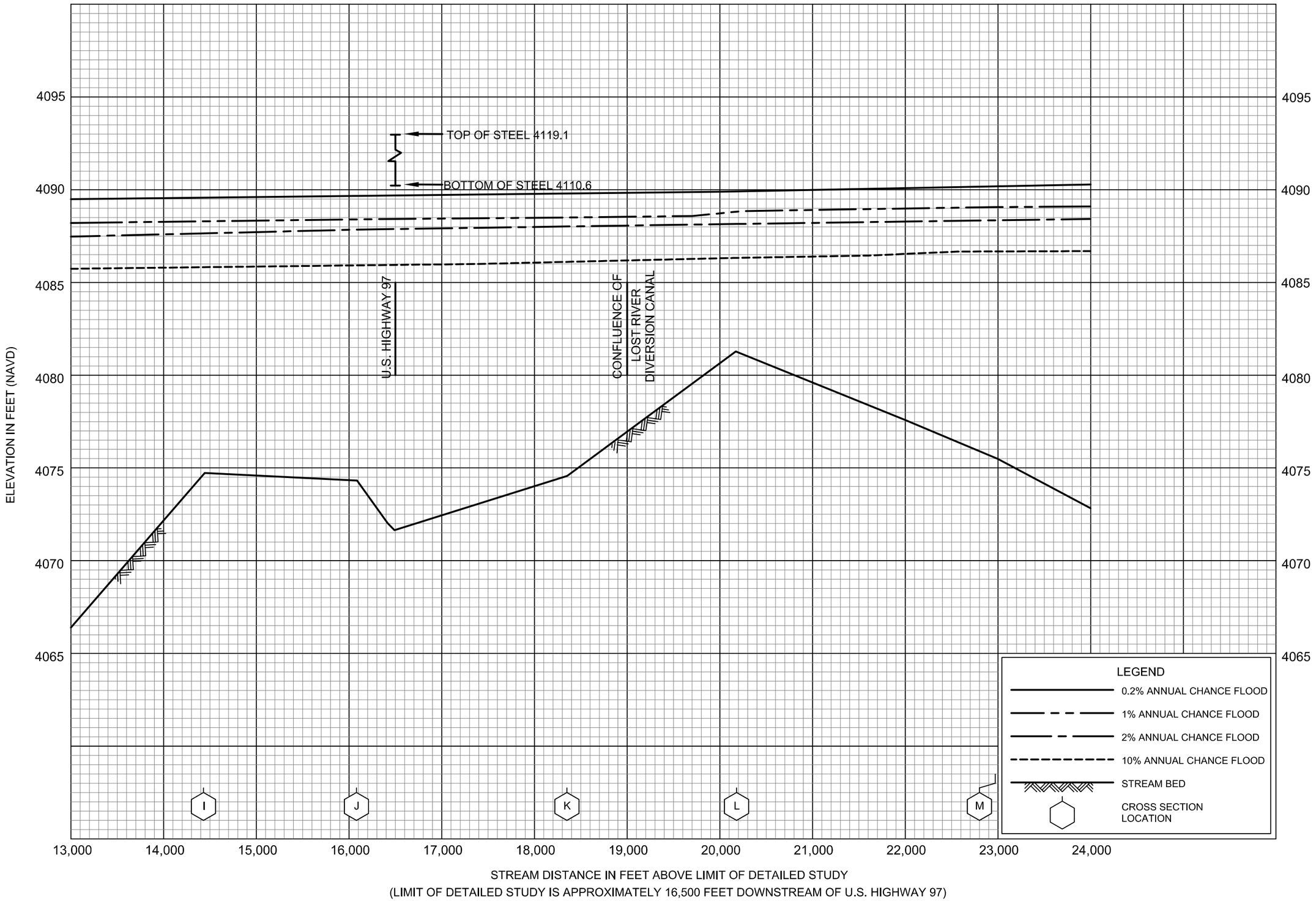
FLOOD PROFILES

KLAMATH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS



FLOOD PROFILES

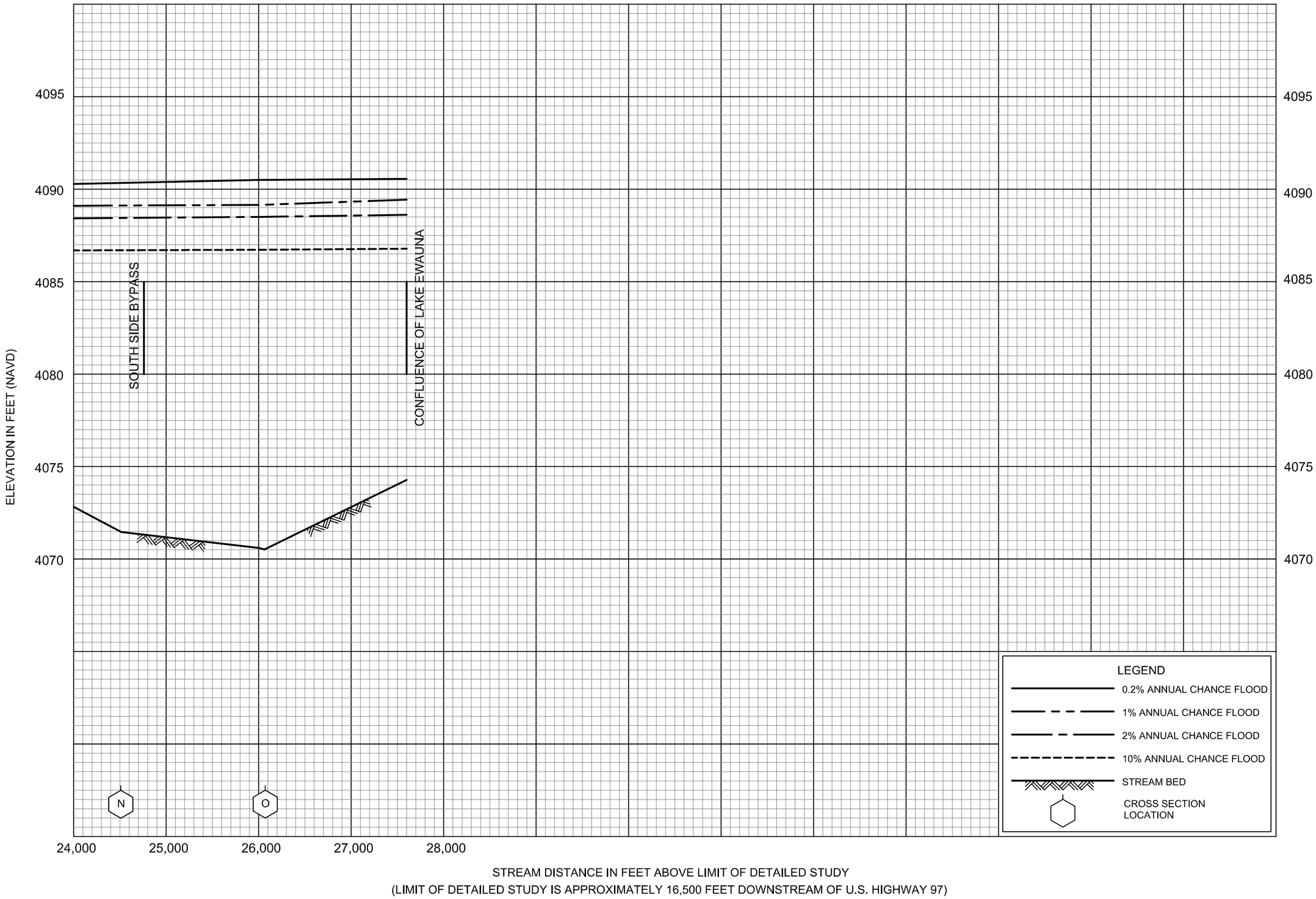
KLAMATH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS

03P



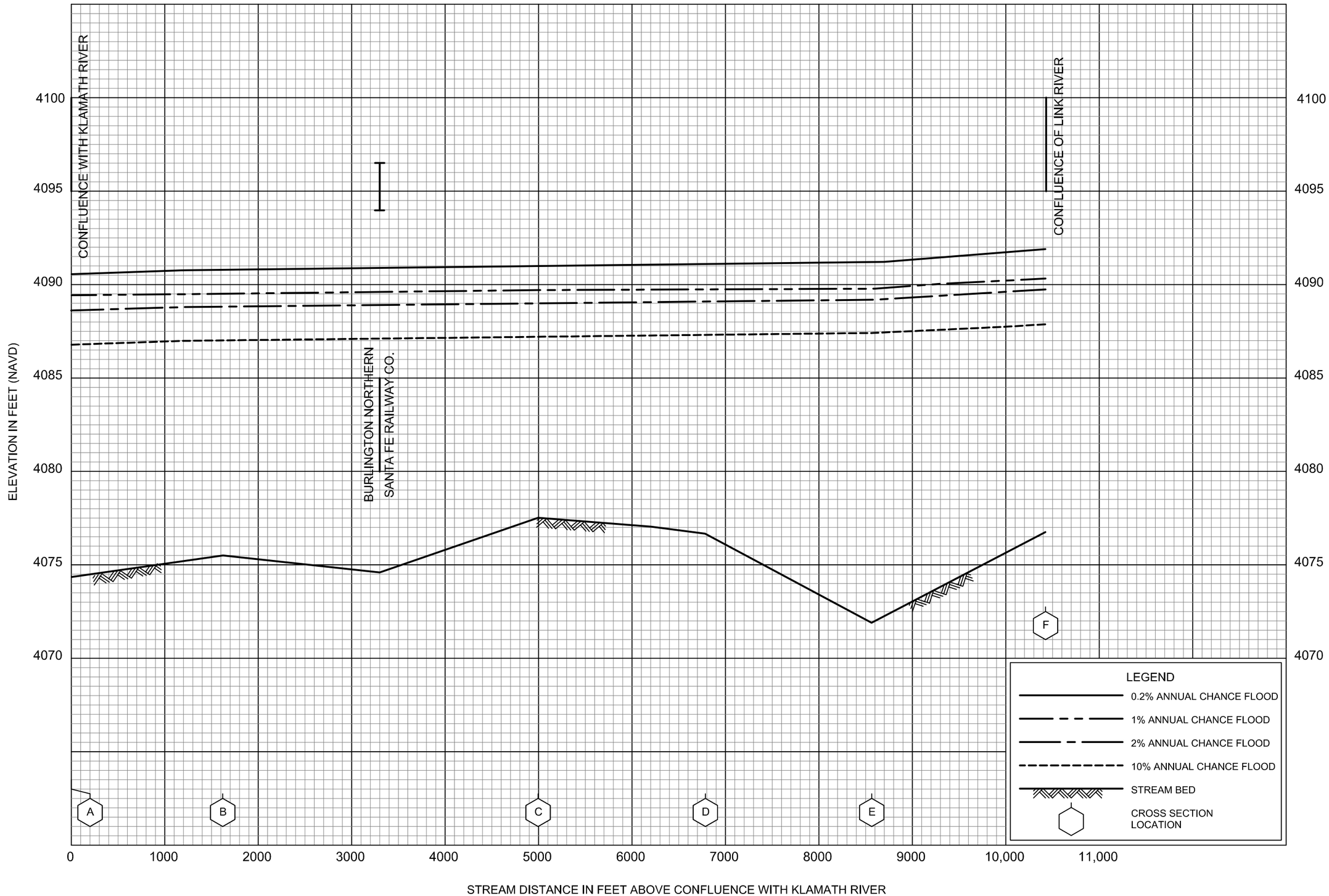
FLOOD PROFILES

KLAMATH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS



FLOOD PROFILES

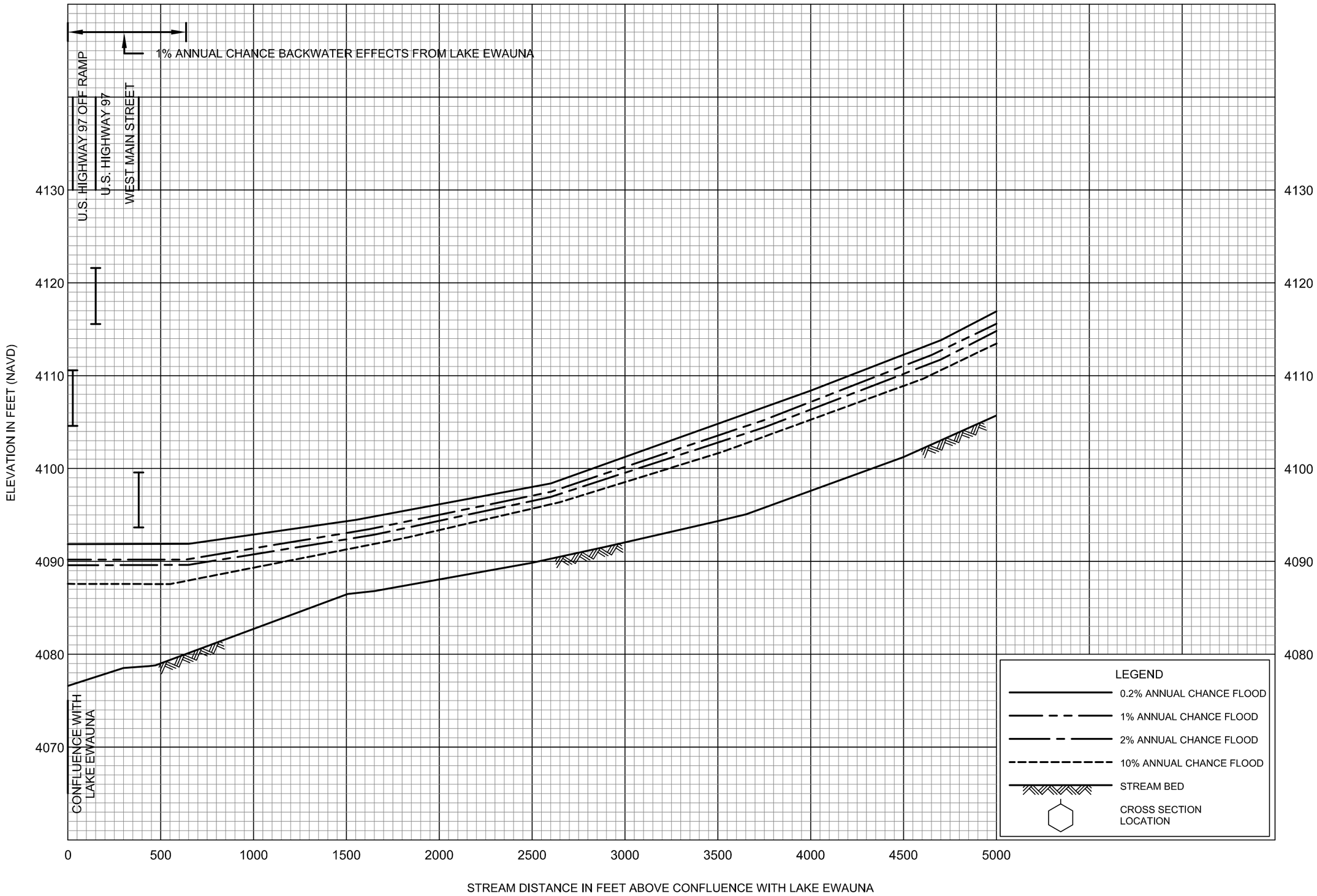
LAKE EWAUNA

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS

05P



FLOOD PROFILES

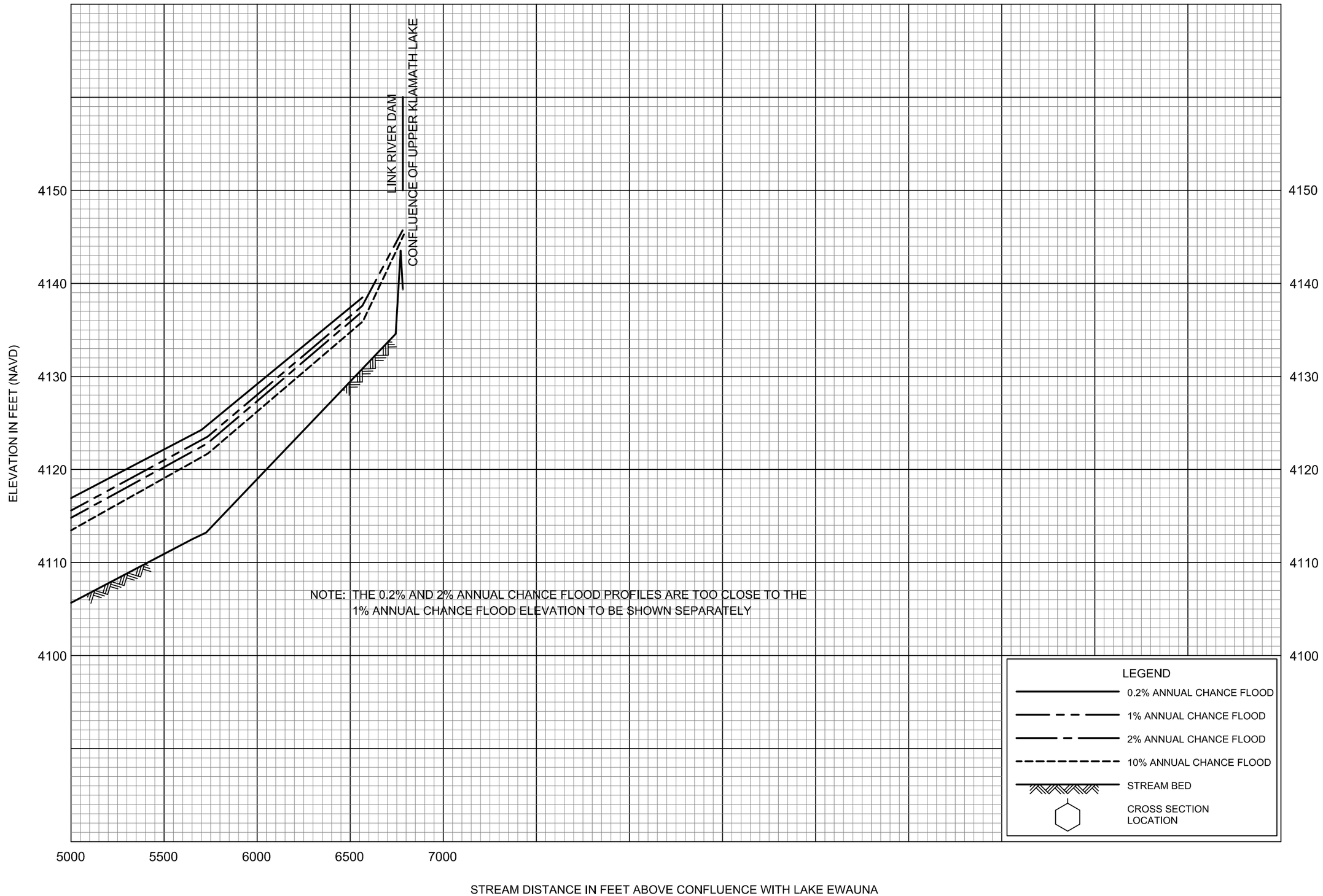
LINK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS

06P



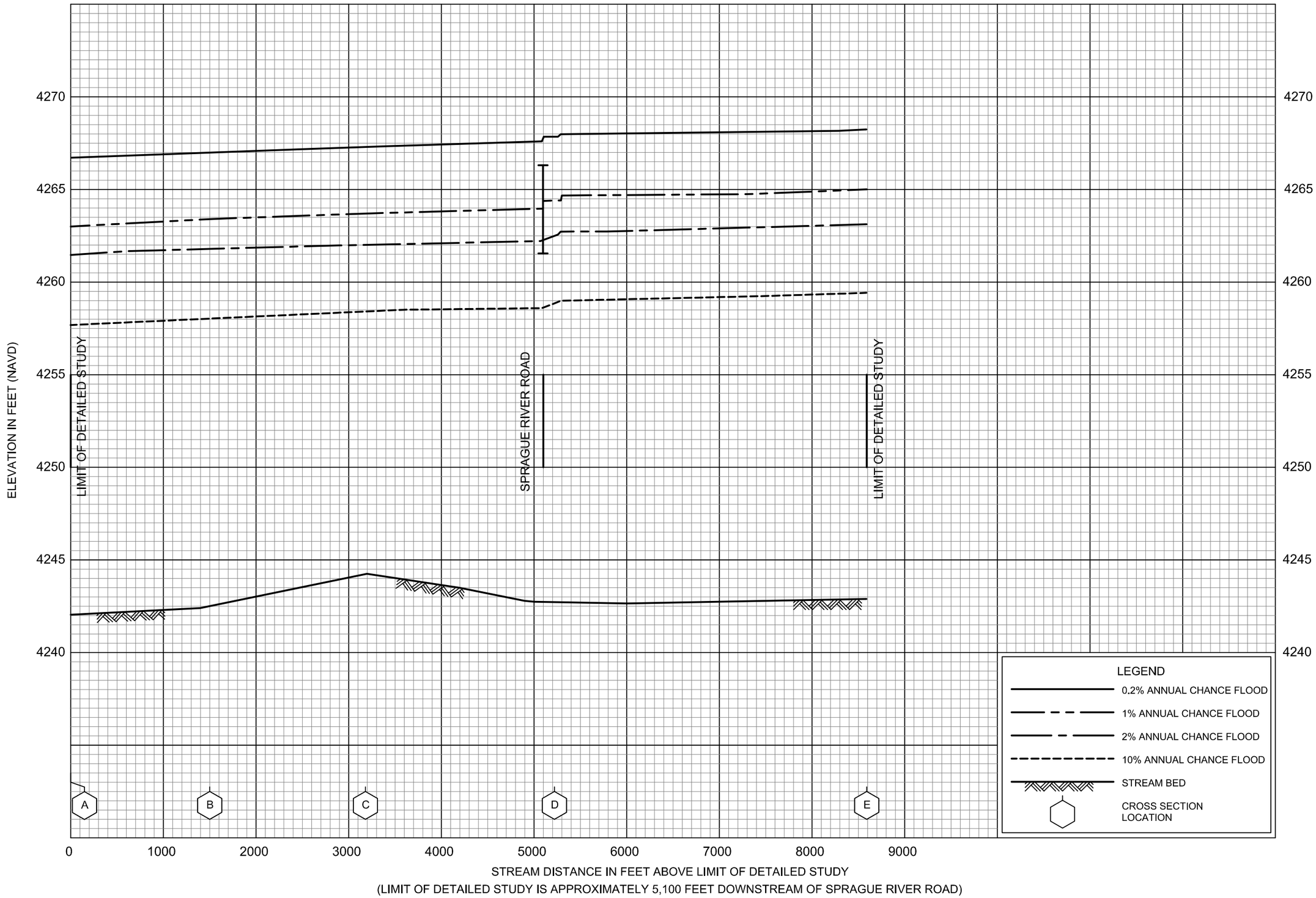
FLOOD PROFILES

LINK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS



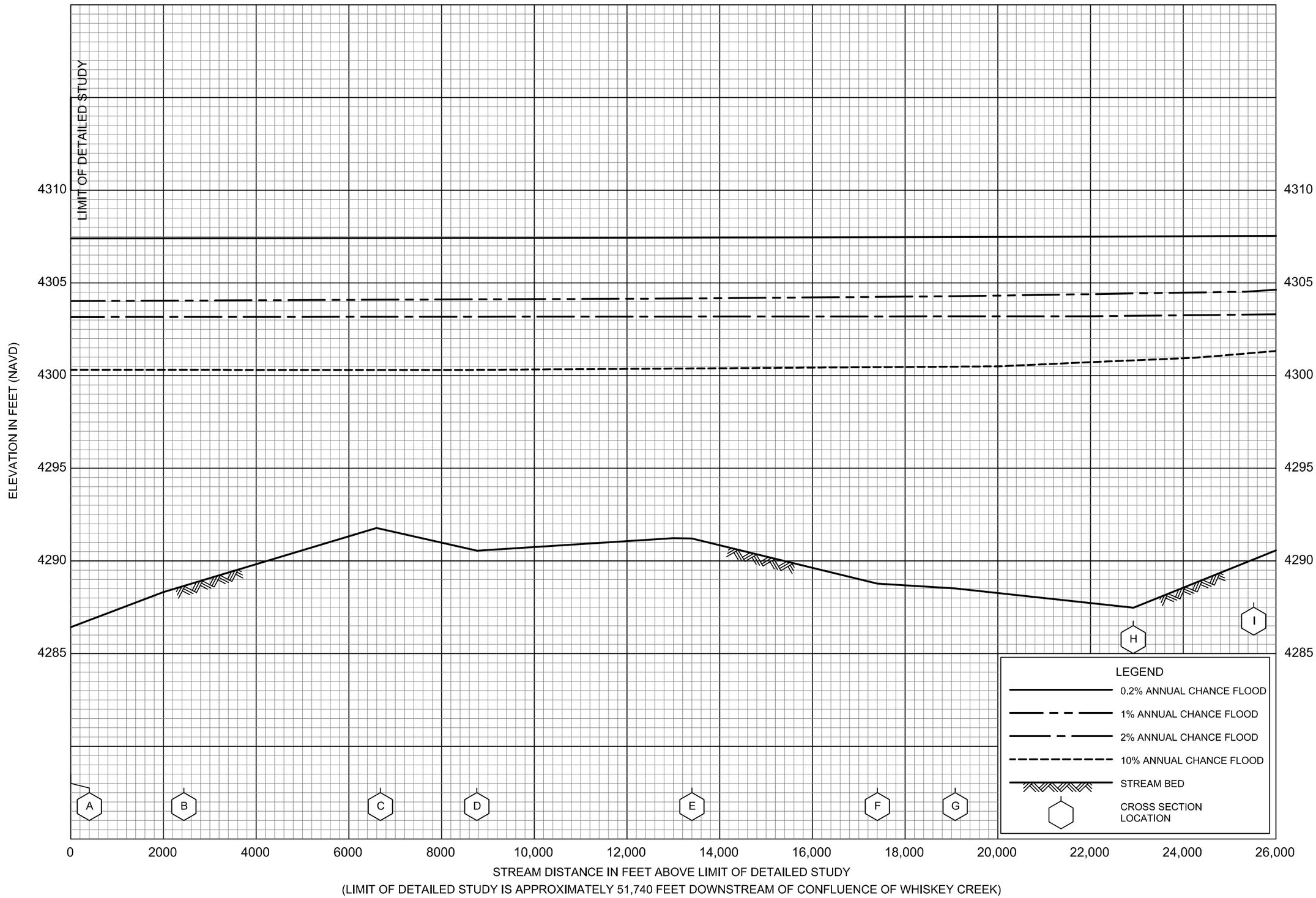
FLOOD PROFILES

SPRAGUE RIVER NEAR BRAYMILL

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS



FLOOD PROFILES

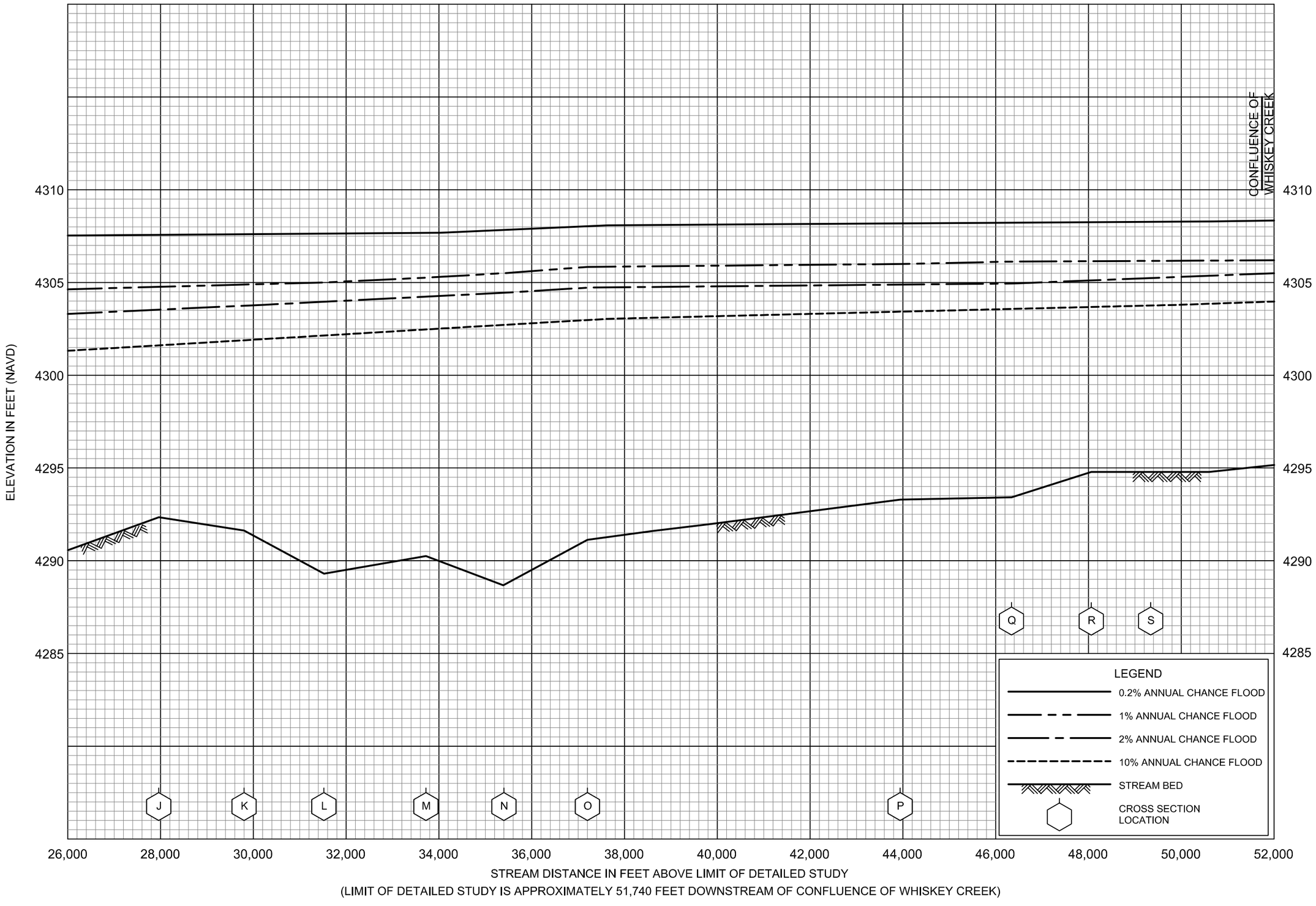
SPRAGUE RIVER NEAR COUNCIL BUTTE

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS

09P



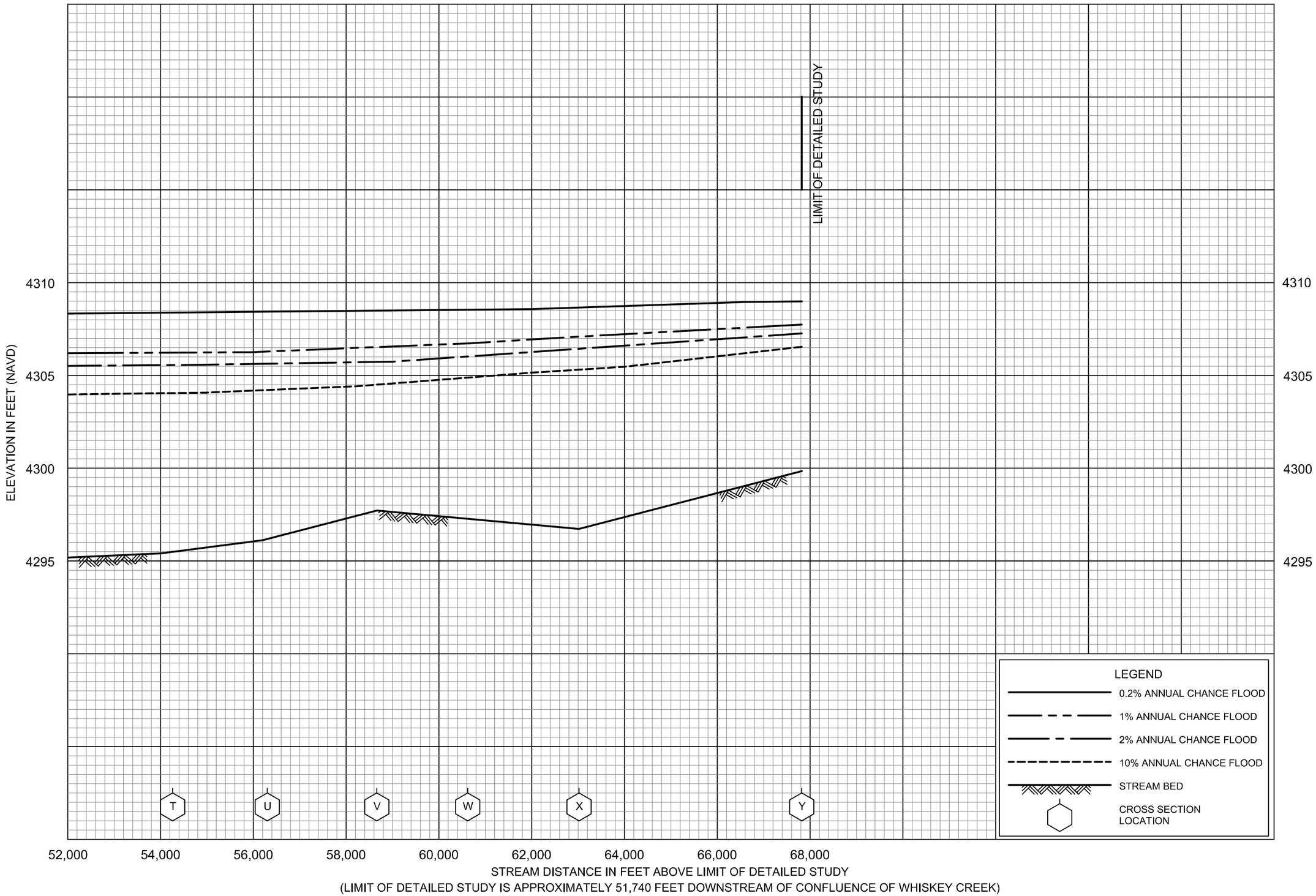
FLOOD PROFILES

SPRAGUE RIVER NEAR COUNCIL BUTTE

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS



FLOOD PROFILES

SPRAGUE RIVER NEAR COUNCIL BUTTE

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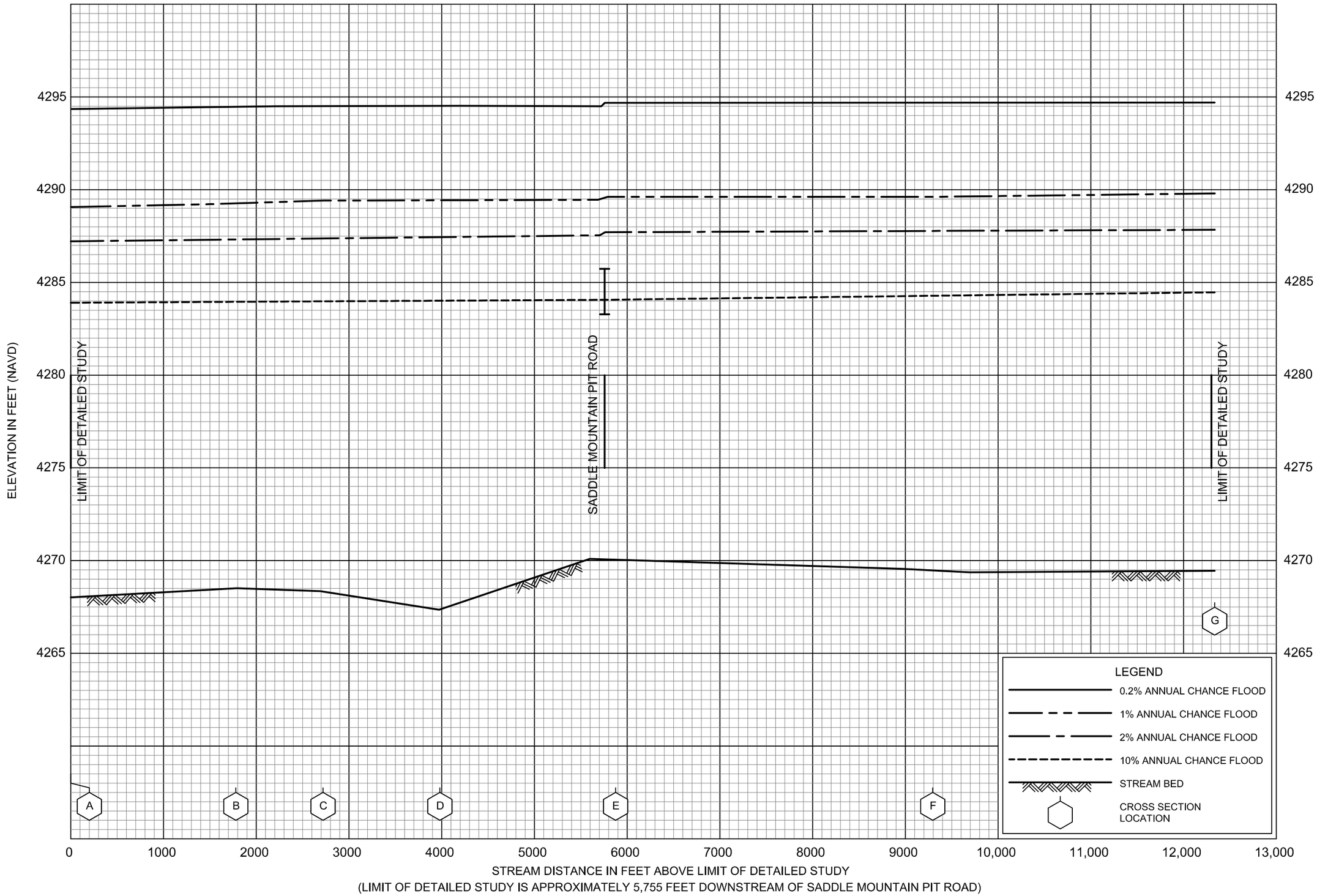


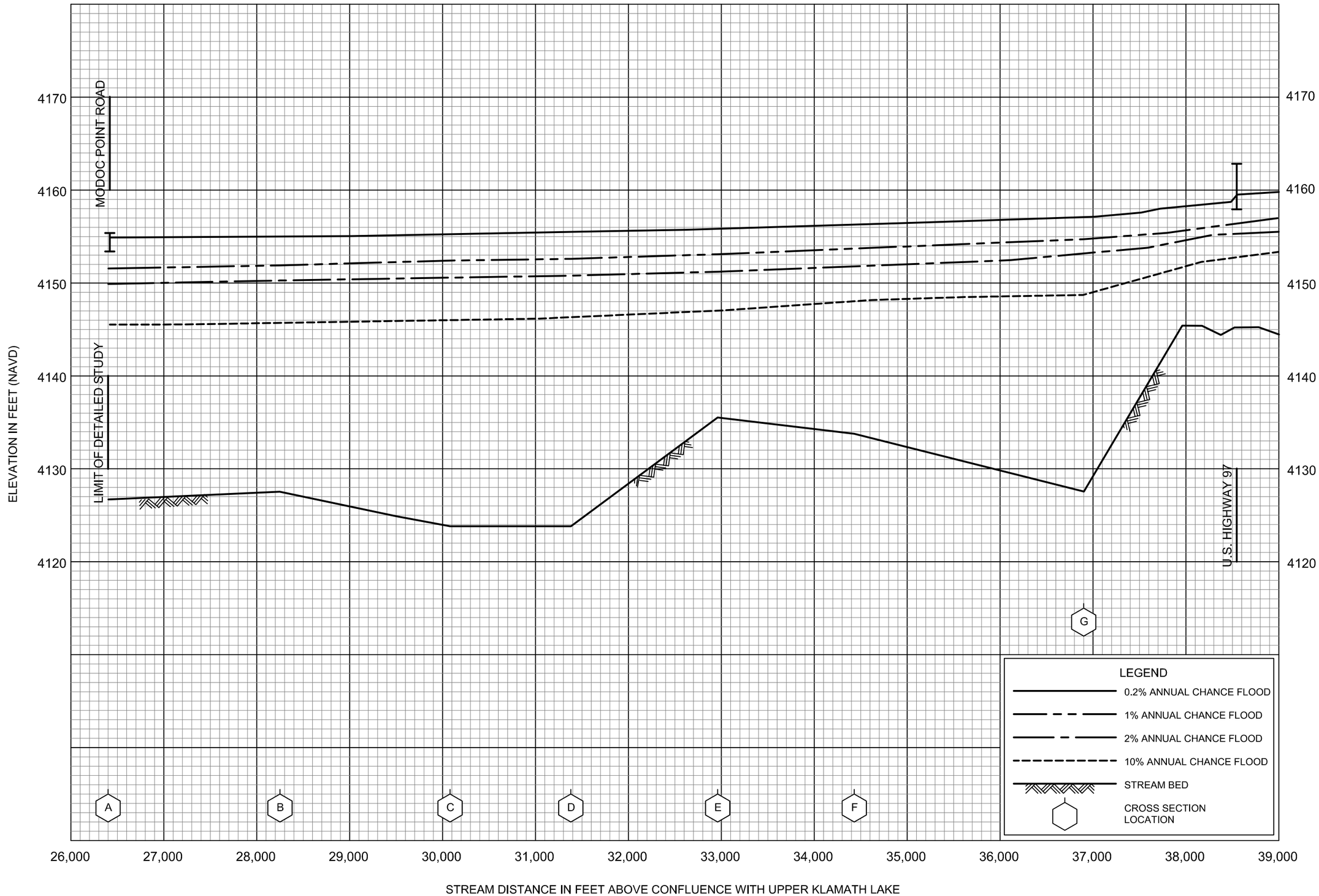
FLOOD PROFILES

SPRAGUE RIVER NEAR LONE PINE

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS



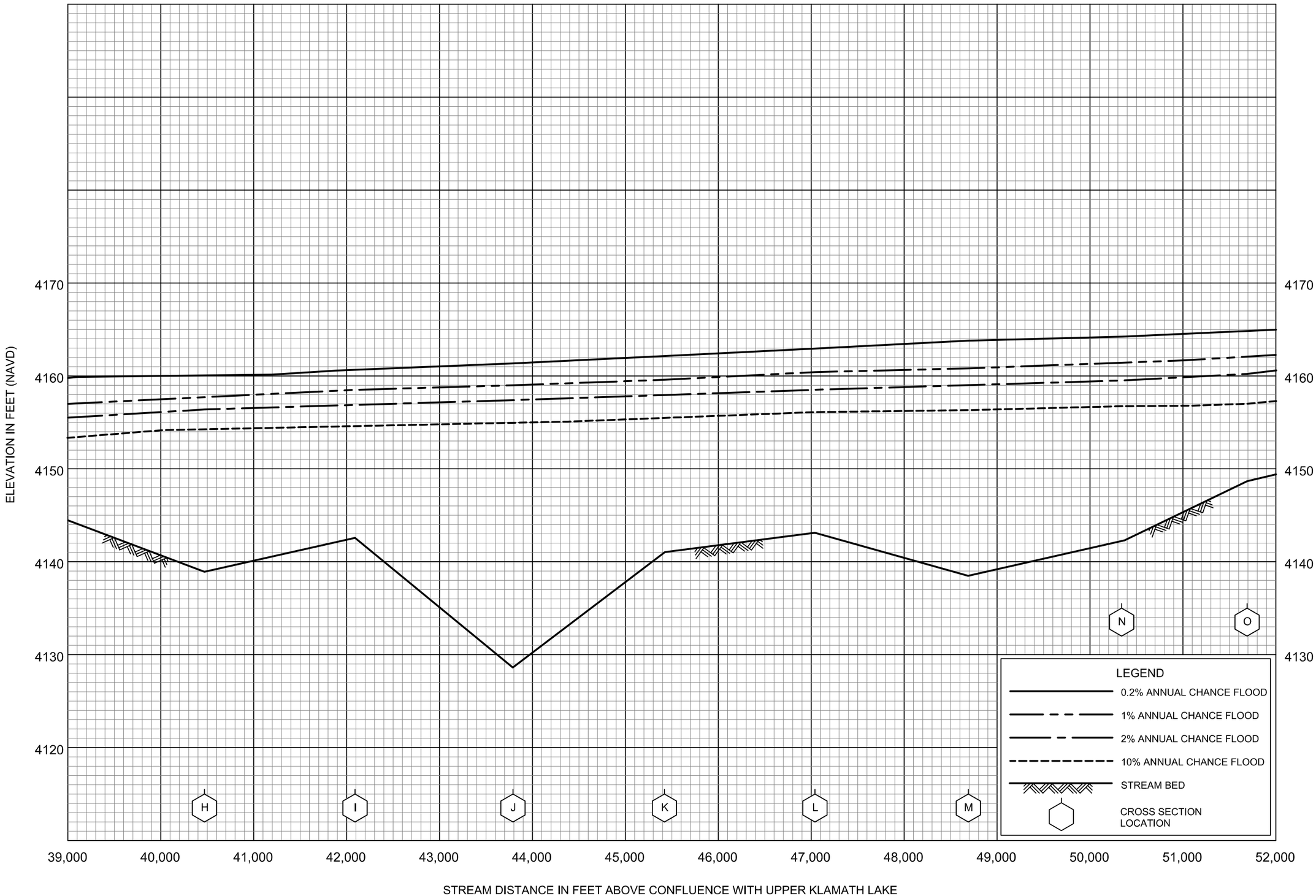
FLOOD PROFILES

WILLIAMSON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

AND INCORPORATED AREAS



FLOOD PROFILES

WILLIAMSON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

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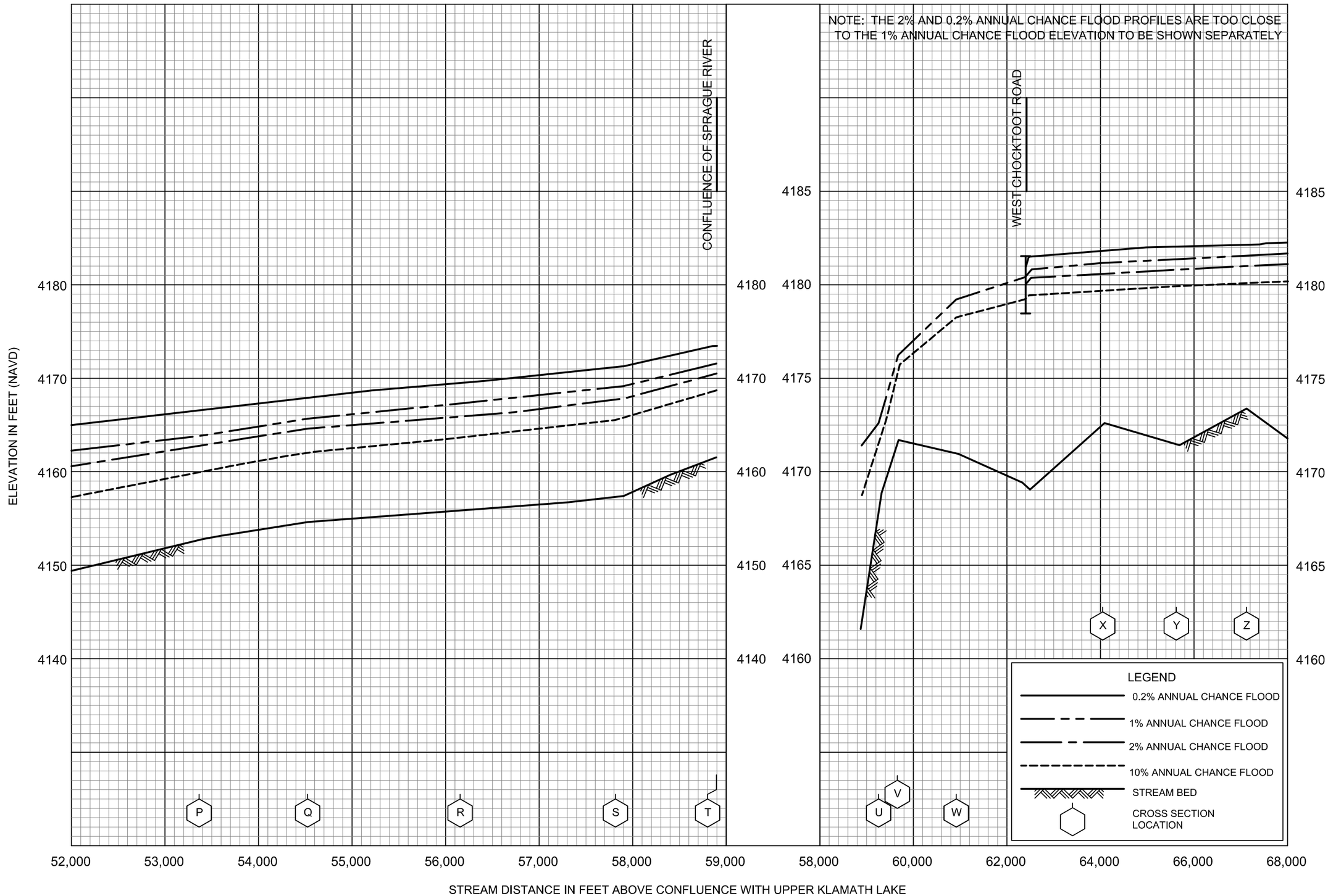

FLOOD PROFILES

WILLIAMSON RIVER

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KLAMATH COUNTY, OR

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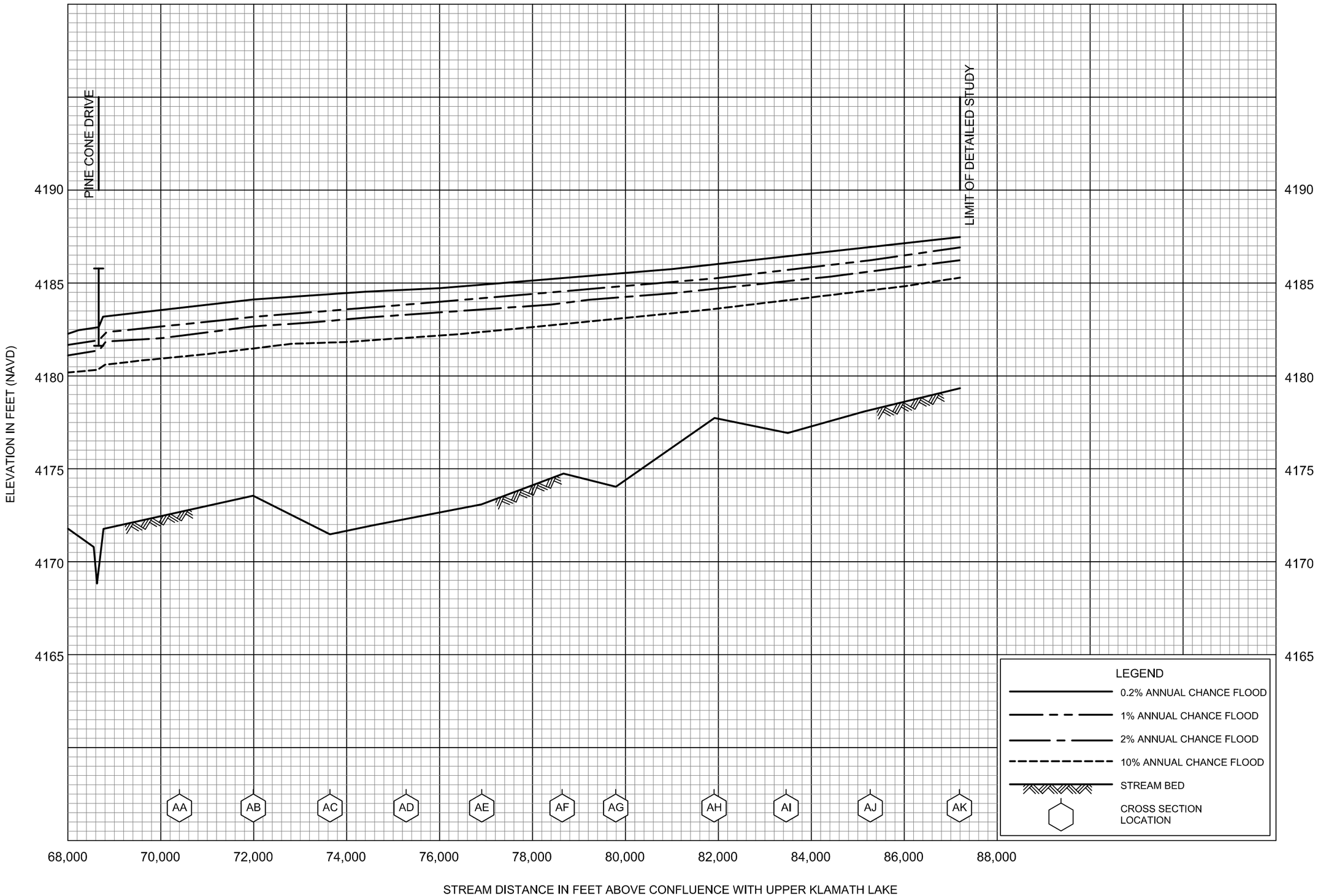

FLOOD PROFILES

WILLIAMSON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

KLAMATH COUNTY, OR

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