FLOOD INSURANCE STUDY

THURSTON COUNTY, WASHINGTON

AND INCORPORATED AREAS

Community Name	Community Number
BUCODA, TOWN OF	530189
LACEY, CITY OF	530190
OLYMPIA, CITY OF	530191
RAINIER, CITY OF	530260
TENINO, CITY OF	530302
THURSTON COUNTY, UNINCORPORATED AREAS	530188
TUMWATER, CITY OF	530192
YELM, CITY OF	530310

PRELIMINARY
06/30/2016

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
53067CV000B

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

Initial Countywide FIS Effective Date: October 16, 2012

Revised Countywide Study:

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FLOOD INSURANCE STUDY
THURSTON COUNTY, WASHINGTON
AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in, or revises and updates previous FIS reports/Flood Insurance Rate Maps (FIRMs) for the geographic area of Thurston County, including the Cities of Lacey, Olympia, Rainier, Tenino, Tumwater, Yelm; the Town of Bucoda, and the unincorporated areas of Thurston County (hereinafter referred to collectively as Thurston County). Within Thurston County, the Nisqually Indian Reservation is not participating in the NFIP.

This FIS 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 county that will be used to establish actuarial flood insurance rates. This information will also be used by the communities of Thurston County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

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

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

1.2 Authority and Acknowledgments

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

Precountywide FIS Report

Bucoda, Town of:	The hydrologic and hydraulic analyses for this study were performed by the U.S. Geological Survey (USGS), for the Federal Insurance Administration (FIA), under Inter- Agency Agreement No. IAA-H-9-77, Project Order No.2. This work, which was completed in August 1979, covered all significant flooding sources affecting the Town of Bucoda.

Lacey, City of:	The hydrologic and hydraulic analyses for this study were performed by the USGS for the FIA, under Inter-Agency Agreement No. IAA-H-9-77, Project Order No. 2. This work, which was completed in April 1979, covered all significant flooding sources affecting the City of Lacey.
Olympia, City of:	The hydrologic and hydraulic analyses for this study were performed by the USGS, for the FEMA, under Inter- Agency Agreement No. IAA-H-9-77, Project Order No 2. This work, which was completed in July 1980, covered all significant flooding sources affecting the City of Olympia.
Tenino, City of:	The hydrologic and hydraulic analyses for this study were performed by the USGS, for the FIA, under Inter-Agency Agreement No. IAA-H-9-77, Project Order No. 2. This work, which was completed in November 1978, covered all significant flooding sources affecting the City of Tenino.
Thurston County, Unincorporated Areas:	The hydrologic and hydraulic analyses for this study were performed by the USGS, for the FEMA, under Inter- Agency Agreement No. IAA-H-9-77, Project Order No.2. This work, which was completed in November 1980, covered all significant flooding sources affecting Thurston County.
Tumwater, City of:	The hydrologic and hydraulic analyses for this study were performed by the USGS, for the FEMA, under Inter- Agency Agreement No. H-9-77, Project Order No. 2. This work, which was completed in March 1979, covered all significant flooding sources affecting Tumwater.
Yelm, City of:	The hydrologic and hydraulic analyses for this study were performed by Northwest Hydraulic Consultants, Inc., for the FEMA, under Contract No. EMW-93-C-4152, Task Order Nos. LMMP95-NHC-l and LMMP95-NHC-2. This study was completed in September 1997.

No previous FIS report was prepared for the City of Rainier, or the Nisqually Reservation; therefore the previous authority and acknowledgment information for these communities are not included in this FIS.

October 16, 2012
Initial Countywide FIS Report

For the October 16, 2012 countywide study, all flooding sources studied by detailed methods were redelineated on new topographic data derived from the 2002 Puget Sound

LiDAR Consortium (PSLC) Bare Earth LiDAR ASCII Points data, developed by TerraPoint, Inc. The LiDAR data has a Root Mean Square (RMS) vertical accuracy of approximately 30 centimeters.

In addition, the Nisqually River was converted to approximate zone due to the extreme stream channel migration occurring since the original models where developed.

The Deschutes River floodway and floodway data tables were removed, also due to the extreme channel migration within the floodplain.

Approximate areas were spatially adjusted to the new base maps, as necessary.

The orthophotography base mapping was provided in digital format by Thurston County Geodata Center, Washington Department of Natural Resources (DNR) and USGS. This information was compiled at scales of 1:2,400 to 1:24,000 during the time period of 1996 to 2007. The digital countywide Flood Insurance Rate Map (FIRM) was produced in Washington State Plane South Zone (FIPS Zone 4602) coordinate system with a Lambert Conformal Conic projection, units in feet, and referenced to the North American Datum of 1983, GRS80 spheroid. Differences in datum and spheroid used in the production of the FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on this FIRM.

Deschutes River
Physical Map Revision

For the Deschutes River physical map revision, the Deschutes River and select Zone A areas were restudied to include the use of newly acquired topography in the hydraulic analyses. The study was completed using approximate hydraulic analysis involving the use of LiDAR data and HEC-RAS hydraulic modeling software. The hydraulic analyses for this study were performed by the Strategic Alliance for Risk Reduction (STARR) for FEMA, under contract number HSFEHQ-09-D-0370, Task Order No. HSFE10-10-J-00106. The work was completed in March 2013.

Base map information shown on the FIRM was provided in digital format by FEMA, 2012. Digital orthophotography dated 2012 was provided by Thurston County.

Coastal Physical Map Revision

For this coastal physical map revision, the coastal analyses were restudied with new methods and to include the use of newly acquired LiDAR data. The study was completed using Simulating Waves Near-shore (SWAN) and FEMA's Wave Height Analysis for Flood Insurance Studies (WHAFIS) modeling software. The coastal analyses for this study were performed by the Strategic Alliance for Risk Reduction (STARR) for FEMA, under contract number HSFEHQ-09-D-0370, Task Order Nos. HSFE10-11-J-0085 and HSFE10-11-J-00105. The work was completed in April 2016.

This coastal physical map revision also includes the redelineation of Capitol Lake as determined by the validation of LOMR 03-10-0337P. The validation study consisted in verifying whether water surface elevations and flows resulting from the 2003 LOMR remained valid and consistent with the Deschutes River and Thurston County Coastal Physical Map Revisions. Validation was performed by the Strategic Alliance for Risk Reduction II (STARR II) for FEMA, and was completed in March 2016.

Base map information shown on the FIRM was provided in digital format by the Thurston Geodata Center, Thurston County, WA. This information was derived from digital orthophotography dated 2015.

1.3 Coordination

An initial Consultation Coordination Officer's (CCO) meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS and to identify streams to be studied by detailed methods. A final CCO meeting is held typically with the same representatives to review the results of the study. The initial and final meeting dates for the previous FIS reports for Thurston County and its communities are listed in Table 1, "Initial and Final CCO Meetings".

Precountywide FIS Report

Table 1 – Initial and Final CCO Meetings

Community Name	Initial Meeting	Intermediate Meeting	Final Meeting
Town of Bucoda	April 29, 1976	*	August 18, 1980
City of Lacey	April 29, 1976	*	July 26, 1979
City of Olympia	April 29, 1976	*	March 31, 1981
City of Tenino	April 29, 1976	*	May 15, 1979
Thurston County	April 29, 1976	May 1980	December 17, 1981
City of Tumwater	April 29, 1976	*	July 13, 1979
City of Yelm	April 30, 1996	*	May 13, 1998

*Data not available

October 16, 2012
Initial Countywide FIS Report

For the October 16, 2012, revision, the final CCO meeting was held on September 30, 2010 with representatives of FEMA, Michael Baker Jr. Inc., and the local communities of the Cities of Lacey, Olympia, Rainier, Tumwater, Yelm and Thurston County, Unincorporated Areas. All problems raised at that meeting have been addressed.

Deschutes River
Physical Map Revision

The FEMA Region X Watershed Discovery Meeting was held on October 2010, and attended by representatives of FEMA, Washington DNR, STARR and the communities.

A final CCO meeting was held on February 4, 2015, and was attended by representatives of FEMA, STARR, and the local communities of the Cities of Olympia, Tumwater, and Thurston County, Unincorporated Areas.

Coastal Physical Map Revision

The FEMA Region X Flood Risk Review Meeting was held on October 29, 2013 and attended by representatives of FEMA, Washington State Department of Ecology (SWRO), Thurston County Emergency Management, Washington DNR, STARR, Thurston County, Unincorporated Areas and the City of Olympia.

A second Flood Risk Review Meeting was held on December 1, 2015 and attended by representatives of FEMA, Washington State Department of Ecology (SWRO), Thurston County Emergency Management, STARR, Thurston County, Unincorporated Areas, the City of Olympia and the Squaxin Island Tribe.

A final CCO meeting was held on ________________, and was attended by representatives of FEMA, STARR, Thurston County, and representatives from local communities.

2.0 AREA STUDIED

2.1 Scope of Study

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

October 16, 2012
Initial Countywide FIS Report

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction. Table 2, "Streams Studied by Detailed Methods", lists the flooding sources which were studied by detailed methods and redelineated based on updated topography. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

Table 2 – Streams Studied by Detailed Methods

Streams	Downstream Limit of Study	Upstream Limit of Study
Black River	From the western boundary of Thurston County (River Mile (RM) 5.6) upstream	Black Lake
Chehalis River	From the western boundary of Thurston County (RM 52.1) upstream	Southern boundary of Thurston County (RM 60.7)
Deschutes River	Corporate Limits of the City of Tumwater (River Mile (RM) 3.4)	Approximately 7000 feet upstream of the confluence with Thurston Creek (RM 41.6)

Table 2 – Streams Studied by Detailed Methods (Continued)

Streams	Downstream Limit of Study	Upstream Limit of Study
Outlet of Black Lake	From Mottman Road Southwest	Black Lake
Percival Creek	Corporate limits of the City of Tumwater at Sapp Road upstream	Trosper Lake
Scatter Creek	From 11,250 downstream of Grand Mound Road crossing at Tenino	Approximately 4,700 feet upstream of the confluence of Scatter Creek Tributary
Scatter Creek Tributary	Confluence with Scatter Creek	State Highway 507
Skookumchuck River	Just upstream Tono-Bucoda Road (Thurston County boundary (RM 5.5)	(River Mile 20.7 (1.2 miles downstream of Skookumchuck Dam))
Woodland Creek	From Pleasant Glade Road NE	Approximately 500 feet downstream of Interstate 5
Yelm Creek	Just upstream Centralia Power Canal Flume	Approximately 2.7 miles upstream Centralia Power Canal Flume

Lakes and bays studied in detail include: Black Lake, Bigelow Lake, Budd Inlet, Capitol Lake, Chambers Lake, Clear Lake, Hicks Lake, Ken Lake, Lake Lawrence, Long Lake, Nisqually Reach, Pattison Lake, Setchfield Lake, Summit Lake, Tempo Lake, and Trosper Lake.

Table 3, “Areas Studied by Approximate Methods”, lists the flooding sources which were studied by approximate methods.

Table 3 – Streams Studied by Approximate Methods

Community	Limits of Study
Thurston County, Unincorporated Areas	Alder Lake, Bald Hill Lake, Barnes Lake, Beatty Creek, Beaver Creek, Beaver Creek tributaries, Black Lake tributaries, Black River downstream of Black Lake, Black River Tributaries, Blooms Ditch, Blooms Ditch Overflow to Salmon Creek, Chapman Run, Chehalis River areas along detailed study, Chehalis River Overflows, Chehalis River tributary, Coffee Creek, Coffee Creek West Branch, Deep Lake, Dempsey Creek, Deschutes River areas along detailed study, Deschutes River Overflows, Deschutes River tributaries, D'Miller Lake, Dry Creek, Eaton Creek, Eaton Creek Tributary, Edna Creek, Elbow Lake, Eld Inlet, Fry Cove, Gehrke Lake, Goose Pond, Grass Lake Outlet, Green Cove, Henderson Inlet, Henderson Inlet – Chapman Bay, Henderson Inlet – Woodward Bay, Indian Creek, Inmen Lake, Johnson Creek, Kennedy Creek, Lackamas Creek, Lagrande Reservoir, Lake Lawrence Outlet, Lake Lois, Lake Saint Clair, Laramie Creek Tributary, Little Deschutes River, Little Nisqually River, Long Lake Tributary, McAllister Creek, McAllister Creek Tributary, McLane Creek, McIntosh Lake, Medicine Creek, Mima Creek, Munn Lake, Nisqually River, North Hanaford Creek, Offutt Lake, Outlet of Black Lake Drainage Ditch, Outlet of Black Lake Tributary, Outlet of Grass Lake, Oyster Bay, Pattison Lake, Pattison Lake North, Pipeline Creek, Pitman Lake, Powell Creek, Puget Sound, Puget Sound – Big Fishtrap Cove, Reichel Lake, Reichel Lake Outlet, Salmon Creek, Scatter Creek (downstream of Tenino), Scatter Creek Tributaries, Scott Lake, Sheehan Lake, Skookumchuck Reservoir, Skookumchuck River (portions), Southwick Lake, Spurgeon Creek, Spurgeon Creek tributaries, Summit Lake Outlet, Susan Lake, Thompson Creek, Thompson Creek Overflow to Skookumchuck River, Thompson Creek Tributary, Toboton Creek, Totten Inlet, Trails End Lake, Trosper Lake, Waddell Creek, Ward Lake, Woodland Creek downstream of Pleasants Road SE, Woodward Creek, Yelm Creek outside of the Yelm City limits, Yelm Ditch, Young Cove, and numerous isolated ponding areas throughout the county.
Town of Bucoda	Skookumchuck River – Front Street Overflow, along the Burlington Northern Railroad in the vicinity of Main and Martina Streets
City of Lacey	Woodland Creek, upstream of Interstate Highway 5, and several unnamed ponding areas.
City of Olympia	Ellis Creek, Grass Lake, Grass Lake Outlet, Indian Creek, Ken Lake Tributary East, Ken Lake Tributary West, Mission Creek, Outlet of Black Lake, Percival Creek, Percival Cove, Setchfield Lake, Ward Lake, Woodward Creek, and various unnamed ponding areas.
City of Tenino	Scatter Creek Tenino Tributary 1 and Scatter Creek Tenino Tributary 2

Table 3 – Streams Studied by Approximate Methods (Continued)

Community	Limits of Detailed Study
City of Tumwater	Barnes Lake, Deschutes River along the edge of the detailed study, Percival Creek, Trosper Lake, and various unnamed ponding areas
City of Yelm	Thompson Creek

Approximate methods of analyses were used to study those areas having a low development potential or minimal flood hazards.

Approximate methods of 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 the FEMA and the study contractor.

Town of Bucoda

Approximate analyses were performed by field survey and engineering judgment. The Skookumchuck River – Front Street Overflow, along the Burlington Northern Railroad in the vicinity of Main and Martina Streets was studied by approximate methods.

City of Lacey

Approximate methods of analyses were used to study those areas having a low development potential or minimal flood hazards. Woodland Creek, upstream of Interstate Highway 5, and several swampy areas were studied by approximate methods.

City of Olympia

Shallow flooding or ponded areas studied by approximate methods were Percival Cove and an area north of Setchfield Lake. Riverine flooding was studied by approximated methods along Percival Creek, from Percival Cove upstream to the corporate limits and from Mottman Road Southwest upstream to the corporate limits; Ellis Creek northeast of East Bay Drive; and Indian Creek, from Interstate Highway 5 upstream to the corporate limits. Additional streams are listed in Table 3.

Approximate methods of 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 the FEMA and the City of Olympia.

City of Tumwater

Shallow flooding or ponded areas of Barnes Lake were studied by approximate methods. These included areas west of Tumwater Junior High School; east of Miner Drive Southwest; south of Trosper Road in the vicinity of Schoth Street; south of Hartman Street and north of the Union Pacific Railroad tracks; north of Trosper Road and west of Lake Park Road; at the east end of E Street and east of the Union Pacific Railroad; east of M, N, and O Streets; and, north of East T Street.

Two areas of riverine flooding were studied by approximate methods. These include Percival Creek, upstream from U.S. Highway 101 to Mottman Road and from Dacatur

Street Southwest to Sapp Road (Thurston County-Tumwater corporate limits); and Deschutes River, from Capitol Lake upstream to the dam at Olympia Brewery.

City of Tenino

Shallow flooding areas studied by approximate methods were; ditch from culvert outfall at schoolyard to Scatter Creek, north of Garfield Avenue, fields north of Sussex Avenue, from Reynolds Street to Olympia-Tenino highway, and a residential area from Olympia- Tenino Highway to Custer Street.

Nisqually Reservation

Within the Thurston County portion of the Nisqually Reservation, the Nisqually River is unstudied. Effective work maps for the Nisqually River exclude the portion of the floodplain within the reservation. These areas are mapped as Zone D. Nisqually Reservation is a non-participating community.

Thurston County, Unincorporated Areas

Some overflow areas of the Black, Chehalis, Deschutes, and Skookumchuck Rivers; Indian, a portion of Woodland, a portion of Percival, Mima, Scatter, Waddell, Dempsey, Johnson, Thompson, Spurgeon, North Hanaford, and Toboton Creeks; the outlets of Grass Lake and Reichel Lake were studied by approximate methods.

Offut, Barnes, Sheehan, Munn, Susan, and Trails End Lakes; Totten, Eld, and Henderson Inlets; and Puget Sound along the coast of Thurston County were also studied by approximate methods.

The October 16, 2012, countywide FIS incorporates the determinations of Letter of Map Revisions (LOMRs) issued by FEMA, for the projects listed by community in Table 4, "Letters of Map Change (LOMCs)".

Table 4 – Letters of Map Change

Community Name	**Case Number**	**Streams**	**Date**
Thurston County	94-10-058P	Zone A along Scatter Creek	August 31, 1994
Thurston County	94-10-031P	Zone A along Scatter Creek	December 5, 1994
Thurston County	96-10-013P	Unnamed Zone A along Chehalis River	April 24, 1996
Thurston County	97-10-112P	Unnamed Zone A along Chehalis River	January 21, 1997
City of Olympia, City of Tumwater, and Thurston County	03-10-0337P	Capitol Lake, Budd Inlet south of 4th Street	December 26, 2003
City of Olympia	06-10-B326P	Unnamed Zone A	May 31, 2006

One LOMR (89-10-06P) was superseded based on engineering judgment during the floodplain redelineation using updated LiDAR topographic data. Another LOMR (94-10-058P) was superseded due to insufficient information. The Capitol Lake LOMR (03-10-0337P) was incorporated with the associated base flood elevation (BFE) change from 14 feet to 15 feet North American Vertical Datum of 1988 (NAVD88), but was redelineated on new LiDAR-derived elevation data.

Deschutes River
Physical Map Revision

The Deschutes River was restudied by detailed methods and the Deschutes River Tributaries 3, 3.1, 9, 11, 12, 14, 16, and 17, Little Deschutes River, Spurgeon Creek, and Offut Lake were restudied by approximate methods for this coastal revision. No new LOMRs were incorporated.

Coastal Physical Map Revision

The wave height analysis for the entire Thurston County coastline has been revised. In addition, frequency analyses of water surface elevations and flows were performed to validate Capitol Lake effective flood elevations as determined by LOMR 03-10-0337P. Since the LOMR remains valid, Capitol Lake flood elevations were used to redelineate the associated floodplain based on updated LiDAR information dated 2011 (Fugro EarthData Company 2011).

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

FIRM Notes to Users

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-annual-chance and 0.2-percent-annual-chance floodplains; and 1-percent-annual-chance floodway. This information is presented on the FIRM and/or in many components of the FIS report, including Flood Profiles and Floodway Data tables. The FIRM Notes to Users is provided in Appendix 1.

Map Legend for FIRM

Each FIRM panel contains an abbreviated legend for the features shown on the maps. However, the FIRM panel does not contain enough space to show the legend for all map features. Map Legend for FIRM shows the full legend of all map features. Note that not all of these features may appear on the FIRM panels in Thurston County. The Map legend for FIRM is provided in Appendix 1.

2.2 Community Description

Thurston County is located in the west-central area of Washington, just south of Budd Inlet – a southern arm of Puget Sound. Thurston County is bordered by Mason County to the northwest, Gray's Harbor County to the immediate west, Lewis County to the south and Pierce County to the east.

Thurston County is comprised of seven incorporated communities (six cities, one town) and the unincorporated areas. According to the 2010 U.S. Census Bureau, the population for Thurston County was 252,264 with land and water area totaling 773.6 square miles (U.S. Census Bureau, 2014).

The climate of Thurston County is Marine West Coast Climate with an annual precipitation ranging from approximately 40 inches on the eastern lowland prairies to approximately 60 inches in the southeastern and northwestern hills. In the Olympia area, the average annual precipitation is approximately 50 inches, 39 inches of which fall from October to March (National Oceanic and Atmospheric Administration, 2016).

During summer months, the average monthly mean temperature is around 60 degrees Fahrenheit (ºF). The highest temperatures are usually recorded during the month of August and the lowest temperatures are usually recorded during the month of December (National Oceanic and Atmospheric Administration, 2016).

The five main river systems in Thurston County are Nisqually, Deschutes, Black, Skookumchuck, and Chehalis Rivers. Black and Skookumchuck Rivers are major tributaries to Chehalis River (FEMA, Thurston County Unincorporated Areas, 1999).

Nisqually River meanders along Thurston County's eastern boundary with Pierce County. Deschutes River flows northwesterly for approximately 41 miles within Thurston County towards its mouth at Capitol Lake in Olympia. Black River is a slow, meandering stream that extends from Black Lake south for approximately 19 miles in Thurston County. Skookumchuck River extends for approximately 24.7 miles in south central Thurston County and has a wide flood plain from the county line upstream for 15 miles. Chehalis River extends for only 8.6 miles in Thurston County, but has an extensive flood plain, covering at least 12 square miles (Thurston Regional Planning Council, 1975).

2.3 Principal Flood Problems

Flooding in Thurston County has been a result of heavy rainfall, sometimes augmented with runoff contributions from snowmelt. Flooding generally occurs during the winter months, November through February, when storms bring intense precipitation. The major flood problems are those of inundation and damage to private property from out-of-bank floodwaters.

The history of flooding in Lacey indicates that flooding occurs along Woodland Creek, in local depressions and marshes, and along the lakes.

For the City of Olympia, rain coupled with storm-driven high tide has caused inundation and property damage. The business and industrial areas around Budd Inlet and Capitol Lake suffer the most damage, with additional impacts from the overflow of Outlet of Black Lake and Ken, Setchfield, and Chambers Lakes. A historical high tide (approximately 1-percent-annual-chance) occurred on December 15, 1977, when many businesses along Budd Inlet and Capitol Lake were inundated.

Flood damage on Nisqually River in the unincorporated portions of Thurston County is generally limited to an area near McKenna in Pierce County. A discharge flow of approximately 18,000 cubic feet per second (cfs) at McKenna is associated with zero-flood damage on Nisqually River (Pacific Northwest River Basins Commission, 1970). This flow has been exceeded six times during the period of record (1947-78) at the USGS gaging station on Nisqually River below Powell Creek near McKenna (No. 12088400), at RM 31.6. The three most severe floods occurred in December 1975 (30,700 cfs), January 1965 (25,700 cfs), and January 1974 (23,200 cfs) (U.S. Department of the Interior, - 1971, 1971-74, 1975-1978). The December 1933 flood, estimated at 42,000 cfs, inundated most of the delta (Pacific Northwest River Basins Commission, 1971).

Near the mouth of Deschutes River, a discharge of 3,600 cfs is considered to represent zero-damage flow (Pacific Northwest River Basins Commission, 1970). This flow has been exceeded at least 31 times between 1945 and 2007. On January 15, 1974, a flood with a recurrence interval of approximately 100 years occurred on the Deschutes River. The Tumwater Valley Golf Course was inundated, and the Olympia Brewing Company incurred some property damage during this flood. The most severe floods, as recorded at the gaging station on Deschutes River near Rainier (No. 12079000), at RM 25.9, are 9,600 cfs in January 1990, 7,850 cfs in February 1996, and 7,780 cfs in January 1974 (U.S. Department of the Interior, prior to 1971, 1971-74, 1975-1978).

No extensive records are available describing historic flooding on Black River. However, it is known that, during periods of flooding, Black River is inundated by floodwaters of Chehalis River as far as 5 miles upstream of the Thurston County limits (Thurston Regional Planning Council, 1975).

The three most severe floods on Skookumchuck River occurred in February 1996 (9,020 cfs), January 1990 (7,800 cfs), and December 1953 (6,710 cfs), as recorded by the gaging station below Bloody Run Creek (No. 12026150) (U.S. Department of the Interior, - 1971, 1971-74, 1975-1978).

In December 2007, almost the entire Chehalis River flood plain was inundated by the largest flow (79,100 cfs) in 80 years (1928-2007) of record at the gaging station near Grand Mound (No. 12027500). The second and third most severe floods on the Chehalis River occurred in February 1996 (74,800 cfs), and January 1990 (68,700 cfs).

On February 8, 1996, an intense rainstorm occurred in Thurston County following several months of above-average precipitation. Eight inches of rain were recorded at the nearby Olympia Airport gage for the period from February 5-8, 1996. Observed rainfall at the Olympia gage for the period from November 1995 through January 1996 was approximately 40 percent higher than normal. Freezing temperatures and some snow accumulation were observed in the basin from late January through approximately February 4. This combination of meteorological inputs resulted in high flows and significant flooding along portions of Yelm Creek within the City of Yelm City limits.

Much of the floodplain along Yelm Creek was inundated, with large ponding areas upstream of several road crossings. Of the five roads crossed by Yelm Creek in the study reach, four were overtopped during the February 1996 event, including Crystal Springs Road, First Street, 103rd Avenue, and Bald Hills Road.

A slightly smaller flood event occurred from December 31, 1996, through January 2, 1997. Again, a moderately intense rainfall event occurred following an extended period of above-average precipitation. Just prior to this flood, significant snowfall accumulations were present over the entire Yelm Creek basin. The combination of high groundwater, rainfall runoff, and snowmelt caused high flows and significant flooding on Yelm Creek. It took several months for the water to recede, which indicates that the flooding was closely linked to high groundwater levels in the basin. Flooding throughout much of Thurston County was more severe for the December 1996 through January 1997 flood than for any event in recent history, although the February 1996 event was larger on Yelm Creek.

Prior to these two events, significant flooding occurred on Yelm Creek most recently in January 1990. Reports provided by the City of Yelm (Puget Land Consultants, 1994) indicate that the January 1990 flood overtopped at least one road in the study reach (103^{rd} Avenue).

2.4 Flood Protection Measures

There are no physical flood protection measures in the Cities of Lacey, Olympia, and Yelm; and City of Tenino.

The Skookumchuck Dam, completed in 1971, is located on Skookumchuck River approximately 8 miles upstream of Bucoda and has a capacity of 42,000 acre-feet. Its major function is water supply for the Centralia Steam-Electric Project and provides little protection from large floods.

Two reservoirs with a combined storage capacity of 234,700 acre-feet (Alder Reservoir, 232,000 acre-feet, and LaGrande Reservoir, 2,700 acre-feet) are located in the Nisqually River basin. Firm flood-control storage is not provided by either reservoir, although the operation at Alder can be adjusted when a flood is expected to provide for 10,000 to 15,000 acre-feet of storage. This can reduce flood peaks on Nisqually River by an estimated 3,000 to 5,000 cfs (Pacific Northwest River Basins Commission, 1970).

Several flood control structures have been constructed on Nisqually, Chehalis, Deschutes, and Skookumchuck Rivers, but none are adequate to protect against the 1-percent-annual- chance flood and are not shown on the maps.

Flood protective works consist of a non-accredited levee and fill on the right bank of the Deschutes River at the Olympia Brewing Company, and stream revetments at several bridges. These structures were topped by the 1974 flood and offer little protection from floods greater than or equal to the 1-percent-annual-chance event. The Olympia Brewing Company Dam, located in the City of Tumwater, has no effect on flooding.

Limited regulation of flood plain development is provided by the Shoreline Master program of Thurston County and the Washington State Department of Ecology.

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-, 2-, 1-, 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-, 2-, 1-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent-annual- chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance (100-year) flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied by detail methods affecting the communities within Crawford County. Information on the methods used to determine the peak discharge-frequency relationships for each flooding source studied by detailed methods is shown below.

Precountywide Analysis

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

For each community within Thurston County that had a previous printed FIS report, the unrevised hydrologic analysis described in those reports have been compiled and are summarized below by city or town.

In the Town of Bucoda, the peak discharge-frequency relationship for Skookumchuck River was computed from regression equations that relate peak discharge-frequency data to drainage area and mean annual precipitation. Fifty-one continuous-record stream gaging stations, with 6 to 47 years of peak-discharge records, and 14 peak-stage partial-record stations, with 7 to 26 years of peak-discharge records, located mostly in Thurston and Pierce Counties, were used as the source of peak-discharge and drainage area data (U.S. Department of Interior, 1971, 1971-1974, 1975-1977). Precipitation data for each drainage basin were based on information from the U.S. Weather Bureau (U.S. Department of Commerce, 1965). Values of the 10-, 2-, 1-, 0.2-percent-annual-chance peak discharges were obtained for the regression equations from a log-Pearson Type III distribution of annual peak discharges at each station in accordance with guidelines set forth in U.S. Water Resources Council Bulletin 17 (U.S. Water Resources Council, 1976).

The possibility of using previously developed regional peak discharge-frequency relationships (U.S. Department of the Interior, 1964, 1975) was investigated before developing the regression equations used in this study. However, these relationships were not used because additional peak-discharge data have since become available, the log-Pearson Type III method of analysis has since been improved and standardized, and relationships for a smaller region were needed to more accurately reflect localized flood flow conditions.

In the City of Lacey, the regional relationships in existing publications (U.S. Department of the Interior, 1964; Collings, Cummans, Nassar, 1975) were compared to Woodland Creek relationships developed from gage data for the 10-, 2-, 1-, 0.2-percent-annual-chance peak discharges. The regional relationships were not used because they do not define the local conditions. A series of lakes in the headwater temporarily stores water which decreases the peaks. For defining the peak discharge-frequency relationship, a USGS stream-gaging station on Woodland Creek, with a 19-year record (Collings et al.1975), was used as the source of data. This station is located 1.25 miles downstream of the corporate limits. Values of the 10-, 2-, 1-, 0.2-percent-annual-chance peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data at this station in accordance with guidelines set forth by the U.S. Water Resources Council (1976). To represent the discharges of Woodland Creek at Draham Street NE, the station discharges were adjusted for the difference in drainage area at the station and at Draham Street NE by a power factor (0.8) found typical for western Washington streams.

Regional relationships used for several lakes in Lacey, Olympia, and Thurston County were developed for estimating the differences between mean lake elevation and the 10-, 2-, 1-, 0.2-percent-annual-chance peak elevations, based on log-Pearson Type III analysis of records (7 to 35 years in length) for nine lakes in western Washington with similar hydrologic settings ("Surface Water Supply", 1955, 1964, 1971; U.S. Department of the Interior, 1971-1974; "Water Resources Data", 1971-1974). These relationships were applied to determine the flood-peak elevations of Bigelow, Clear, Chambers, Hicks, Ken, Lawrence, Long, Pattison, Setchfield, Summit, and Tempo Lakes by adding difference values to lake elevations at time of photography in March and April 1977 (Walker and Associates), which were considered to be at the mean levels.

In the City of Olympia, Tumwater, and Tenino; fifty-one continuous-record stream-gaging stations, with record lengths of 6 to 62 years, and 14 peak-stage, partial record stations, with from 7 to 26 years of peak data, from hydrologically similar sites (U.S. Department of the Interior, -1971; 1971-1974; 1975; 1976; 1977) were used as the source of data for defining the peak discharge-frequency relationship for Outlet of Black Lake and for each stream studied in the City of Tenino. Values of the 10-, 2-, 1-, 0.2-percent- annual-chance peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data at these sites in accordance with the guidelines set forth in U.S. Water Resources Council Bulletin 17 (1976).

In the City of Olympia, tidal peak elevation-frequency relationship was developed by analyzing 71 years of annual peak tides, as recorded at the Seattle Tidal Station (U.S. Department of Commerce, 1975), with the log-Pearson Type III method, using +0.2 skew. Values of the 10-, 2-, 1-, 0.2-percent-annual-chance tidal peak elevations were then transferred to Olympia using the tide prediction tables (U.S. Department of Commerce, 1974). These relationships were applied to the Budd Inlet area.

Capitol Lake was created in 1951 by construction of an earth-fill dam on the intertidal estuary where Deschutes River and Percival Creek formerly joined Budd Inlet. Tide gates are used to fill the lake to approximately the elevation of the mean-higher-high tide, but an extreme high tide or riverflow can cause much higher elevations in the lake, just as they did in the former estuary. There is some difference between flood elevations for Capitol Lake and Budd Inlet, but elevations obtained during the extreme high tide of December 15, 1977, demonstrate that the difference is small. That difference was added to the 10-, 2-, 1-, 0.2-percent-annual-chance tidal elevations for Budd Inlet and used for Capitol Lake.

The analyses reported herein reflect the stillwater elevations due to tidal and wind setup effects, but do not include the contributions from wave action effects, such as the wave- crest height and wave runup. Nevertheless, this additional hazard due to wave action effects should be considered in planning of future development.

Tidal and wind setup effects for Budd Inlet were determined by comparing the high- water mark elevations of the December 1977 storm against the recorded high tide levels as transferred from Seattle. These effects were added to the values of the 10, 2-, 1-, 0.2- percent-annual-chance tidal peak elevations.

In the City of Tenino, regional relationships in existing publications (U.S. Department of the Interior, 1964; Magnitude and Frequency, 1975) did not produce satisfactory results for the 10-, 2-, 1-, 0.2-percent-annual-chance peak discharges in comparison with those obtained for the gaged sites by the log-Pearson Type III distribution. Therefore, new regional relationships of basin characteristics (drainage area and precipitation) to streamflow characteristics (10-, 2-, 1-, 0.2-percent-annual-chance peak discharges) were developed for determining peak discharges at all sites in the study areas. A list of published gage records used as the source of data for defining peak discharge-frequency relationship are listed below in Table 5, "USGS Gages Used in the Hydrologic Analysis."

Table 5 – USGS Gages used in Hydrologic Analysis

STREAM NAME AND LOCATION	GAGE NUMBER	PERIOD OF RECORD
Black River near Littlerock	12029000	1942 - 1950
Chehalis River near Grand Mound	12027500	1928 - 1978
Deschutes River near Tumwater	12080000	1945 - 1964
Deschutes River near Rainier	12079000	1949 - 1975
Nisqually River near McKenna	12088400	1947 - 1978
Skookumchuck River below Bloody Run Creek	12026150	1929 - 1933
Skookumchuck River near State Highway 507	12026400	1967 - Present
Woodland Creek near Pleasant Glade Road, NE	12081000	1949 - 1969

A total of 43 other continuous-record stream-gaging stations and 14 peak-stage partial- record stations from hydrologically similar sites, most of which were in Pierce and Thurston Counties (U.S. Department of the Interior, -1971; 1971-74; 1975-78), were also used in the hydrologic analyses.

Values of the 10-, 2-, 1-, 0.2-percent-annual-chance peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data at these sites in accordance with the guidelines set forth in U.S. Water Resources Council-Bulletin 17 (U.S. Water Resources Council, 1976).

The possibility of using previously developed regional peak discharge frequency relationships was investigated (U.S. Department of the Interior, 1964; 1975). However, these relationships were not used because of additional flood-frequency data available since they were developed, modifications to the accepted methodology of computing flood-frequency data using log-Pearson Type III analysis, and the need for relationships that would more accurately reflect localized conditions. Therefore, new regional relationships of basin characteristics (drainage area and precipitation) to stream flow characteristics (10-, 2-, 1-, 0.2-percent-annual-chance peak discharges) were developed for determining peak discharges at all sites in the study area. Between these values, peak discharges were prorated by distance, which is approximately proportional to drainage area.

Analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for each tidal or lacustrine flooding source studied in detail affecting the county.

Elevations for Trosper Lake were developed from a culvert rating on Percival Creek using discharges from the peak discharge-frequency relationships (U.S. Department of the Interior, 1968). Elevations were verified by information supplied by long-time residents of the area.

Elevations for Black Lake are controlled by outlets at the north and south ends of the lake and were derived by hydraulic analyses of Black River and Outlet of Black Lake.

The tidal peak elevation-frequency relationships for Budd Inlet were developed by analyzing 71 years of annual peak tides as recorded at the Seattle Tidal Station by the National Oceanic and Atmospheric Administration or, with the log-Pearson Type III method (U.S. Water Resources Council, 1976), using +0.2 skew. Values of the 10-, 2-, 1-, 0.2-percent-annual-chance tidal peak elevations were then transferred to Budd Inlet and Nisqually Reach by applying adjustments determined from tide prediction tables (U.S. Department of Commerce, 1978) and the high tide of December 15, 1977.

In the City of Yelm, the basin area for the study reach is approximately 9.3 square miles at the upper end and approximately 11.2 miles at the downstream study limit, and varies in elevation from approximately 560 feet in the hills near the City of Rainier to approximately 120 feet at the Nisqually River. Average annual rainfall over the basin is approximately 44 inches. Portions of Yelm Creek run dry in most years, particularly in late summer and early fall. Typical winter flows are low, and appear to result primarily from discharge from the groundwater system. The USGS operated a flow gage on Yelm Creek near the City of Yelm (Gage No. 12089700) from 1968 through 1976. The gage was located in the upper watershed, just downstream of Morris Road, and had a drainage area of 1.7 square miles. Because of the short period of record at the gage and the small portion of the study basin measured, this gage was not applicable to this study.

Peak discharge estimates for the 10-, 2-, and 1-percent-annual-chance floods were computed using USGS regional flood-frequency equations (U.S. Department of the Interior, 1975). The 0.2-percent-annual-chance discharge was determined by estimating the parameters of a log-Pearson Type III fit to the 50-, 10-, 4-, 2-, and 1-percent-annual- chance USGS floodflow quantities. This equation was then used to compute the 0.2- percent-annual-chance discharge. This analysis was done using the U.S. Army Corps of Engineers (USACE) PEARSN subroutine (USACE, 1990). Although no significant tributaries enter the study reach, modeled discharges were adjusted at the First Street culvert and 103rd Avenue bridge to reflect the variation in drainage area and contributions by a City storm drain that discharges to Yelm Creek upstream of First Street. No direct measurement of streamflow has ever been made within the study reach of Yelm Creek during a significant flood event. The flood of February 8-9, 1996, ranged between 10- and 0.5-percent-annual-chance events on basins in western Washington. Information from long-time residents of the City of Yelm indicates that flooding along Yelm Creek during the February storm was the worst that had ever been experienced on this reach of Yelm Creek. For purposes of calibration of the hydraulic model, it was assumed that the flow during the February 1996 flood was approximately equal to the 1-percent-annual- chance discharge as computed using the USGS regression equations because of the similar hydro-meteorological conditions, regional observations of flooding, and anecdotal information.

October 16, 2012
Initial Countywide Analyses

No new hydrologic analyses were conducted as part of the initial countywide FIS.

Water surface elevations for the 10-, 4 -, 2-, 1-, and 0.2-percent- annual- chance floods for each stream studied by detailed methods are presented in Table 6, "Summary of Stillwater Elevations."

Table 6 - Summary of Stillwater Elevations

	Water Surface Elevations (Feet NAVD88)			
Flooding Source	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Black Lake	131.6	132.2	132.5	132.8
Bigelow Lake	164.3	164.6	164.7	164.9
Budd Inlet	13.6	13.9	14.1	14.3
Capitol Lake	13.9	14.8	15.0	15.7
Chambers Lake	199.2	199.4	199.5	199.7
Clear Lake	523.0	523.2	523.3	523.5
Hicks Lake	159.9	160.2	160.3	160.4
Ken Lake	140.3	140.6	140.7	140.9
Lake Lawrence	422.2	422.4	422.5	422.7
Long Lake	156.3	156.6	156.7	156.9
Nisqually Reach	12.9	13.3	13.4	13.7
Pattison Lake	156.5	156.8	156.9	157.2
Setchfield Lake	170.6	170.9	171.0	171.4
Summit Lake	462.7	462.9	463.1	463.3
Tempo Lake	259.1	259.3	259.4	259.6
Trosper Lake	159.9	160.9	161.1	161.7

Deschutes River
Physical Map Revision

The peak discharge-frequency relationship for Deschutes River was estimated from analysis of USGS gages and regional regression equations (USGS, 1997). Regional regression equations were used to estimate discharges on Deschutes River upstream of its confluence with Mitchell Creek. From the confluence with Michel Creek to Vail Road Crossing, estimated discharges on the Deschutes River are based on a gage weighting analysis of USGS gage 12079000 with regional regression equations. A drainage area-discharge relationship was developed from analysis of USGS gages 12079000 (USGS, 2013a), 12080000 (USGS, 2013b) & 12080010 (USGS, 2013c). This relationship was used to estimate discharges on Deschutes River between Vail Road Crossing and Olympia Brewery Dam. The gage data was analyzed by Bulletin 17B (WRC, 1981) methodology and the log-Pearson Type III distribution, using the USGS PeakFQ computer program (Flynn, et al, 2006). Gage data showed no significant evidence of mixed population.

Peak discharge-drainage area relationships for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for each stream studied by detailed methods are presented in Table 7, “Summary of Discharges”.

Table 7 – Summary of Discharges

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual Chance	4-Percent-Annual Chance	2-Percent-Annual- Chance	1-Percent-Annual Chance	0.2-Percent-Annual Chance
BLACK RIVER						
At County Limits	124.0	2,820[1]	*	4,100[1]	4,940[1]	6,790[1]
Downstream of Confluence with Waddell Creek	99.0	1,550	*	2,220	2,490	3,200
CHEHALIS RIVER						
At USGS Gage No. 12027500 Near Grand Mound	895.0	38,600	*	38,600	55,000	66,600
DESCHUTES RIVER						
At Olympia Brewery Dam	161.0	7,475	9,116	10,379	11,631	14,733
At State Highway 507	99.3	6,525	7,756	8,702	9,580	11,890
At Vail Loop Southeast	91.2	6,371	7,539	8,436	9,258	11,449
At Cougar Mountain Trail Southeast	66.9	4,747	5,613	6,278	6,886	8,511
At Weyhauser Truck Road Southeast	57.2	4,069	4,812	5,382	5,904	7,297
OUTLET OF BLACK LAKE						
At Mouth	10.5	376	*	523	591	749
At Black Lake	5.0	219	*	303	303	431
PERCIVAL CREEK						
At Sapp Road, SW	1.8	94	*	128	145	180
At 54th Avenue, SW	0.5	33	*	45	50	62

[1]Includes effect of overflow from Chehalis River
* Data not available

Table 7 – Summary of Discharges (continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual Chance	4-Percent-Annual Chance	2-Percent-Annual- Chance	1-Percent-Annual Chance	0.2-Percent-Annual Chance
SCATTER CREEK						
At Downstream Limit of Detailed Study	15.5	403	*	561	633	803
At Grand Mound Road	14.6	364	*	508	572	725
At Olympia-Tenino Highway			*			
At Confluence With Scatter	11.0	314	*	436	492	622
Creek Tributary			*			
Upstream of Confluence with Scatter Creek Tributary	4.6	167	*	230	258	324
SCATTER CREEK						
At Downstream Limit of Detailed Study	15.5	403	*	561	633	803
At Grand Mound Road	14.6	364	*	508	572	725
At Olympia-Tenino Highway			*			
At Confluence With Scatter	11.0	314	*	436	492	622
Creek Tributary			*			
Upstream of Confluence with Scatter Creek Tributary	4.6	167	*	230	258	324
SCATTER CREEK TRIBUTARY						
At Confluence with Scatter Creek	6.4	212	*	293	330	415
At State Highway 507	1.3	66	*	90	102	126
SKOOKUMCHUCK RIVER						
At State Highway 507	113.0	6,990	*	9,100	9,980	12,100
Upstream of Bucoda	90.2	6,400	*	8,290	9,060	10,900
Upstream of Confluence with Thompson Creek	65.9	5,790	*	7,440	8,110	9,700

*Data not available

Table 7 – Summary of Discharges (continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual Chance	4-Percent-Annual Chance	2-Percent-Annual- Chance	1-Percent-Annual Chance	0.2-Percent-Annual Chance
WOODLAND CREEK						
At Pleasant Glade Road, NE	24.6	151	*	205	228	284
At Draham Street NE	13.6	94	*	127	142	176
YELM CREEK						
From First Street to Centralia Canal	11.2	220	*	310	350	445
From 103rd Avenue to First Street	9.8	200	*	285	325	410
From Upstream End of Study Reach to 103rd Avenue	9.3	185	*	265	300	375

*Data not available

Coastal Physical Map Revision

Recent flood studies immediately upstream and downstream of Capitol Lake required that LOMR 03-10-0337P (effective December 26 2003) was validated. The original LOMR included analyses based on continuous hydrologic simulation of flows into Capitol Lake using the Hydrological Simulation Program-Fortran (HSPF), and unsteady flow simulation of lake elevations using the Full Equations (FEQ) program. Procedure for hydrologic validation was based on Bulletin 17B frequency analysis of Deschutes River flows, comparing the 1962-1999 FEQ simulated peak flows into Capitol Lake against 1991-2014 observed peak flows at the USGS gage at E. Street Bridge at Tumwater (12080010). Resulting peak flow estimates from the FEQ simulated series are virtually the same as those obtained using data from the USGS gage. Results were also compared and found to be consistent with preliminary flows from the Deschutes River PMR.

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

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5-foot for floods of the selected recurrence intervals. 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 is computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Exhibit 2). Unless specified otherwise, the hydraulic analyses for these studies were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations shown on the Flood Profiles and FIRM (Exhibits 1 and 2) are referenced to the NAVD88.

Precountywide Analyses

For each incorporated community within Thurston County that had a previously printed FIS report, the hydraulic analyses described in those reports have been compiled and are summarized below.

In the Town of Bucoda, Skookumchuck River was studied by detailed methods.

Water-surface elevations for floods of the selected recurrence intervals were computed through use of the USGS step-backwater computer program (U.S. Department of the Interior, 1976).

Much of the cross section data for the backwater analyses of Skookumchuck River were obtained from aerial photographs taken in April 1977 at a scale of 1:9600 (Walker and Associates, 1977). The underwater portions of the cross sections and the elevations and geometry of the Tono-Bucoda Road Bridge were obtained by field survey.

The approximate analysis in the vicinity of Main and Martina Streets was performed by field survey and engineering judgment.

In the City of Lacey, Woodland Creek was studied by detailed methods.

Water-surface elevations for floods of the selected recurrence intervals were computed for Woodland Creek using a combination of the USGS step-backwater computer program (U.S. Department of the Interior, 1976), and computation of an elevation-discharge recurrence at a culvert ("Measurement of Peak Discharge at Culverts", 1968).

Cross section data used for the backwater analyses for the Cities of Lacey, Olympia, Tumwater; City of Tenino and Thurston County were obtained from aerial photographs taken in April 1977, at a scale of 1:9,600 (Walker and Associates, 1977). These data were supplemented by field measurement of the underwater portions. Elevation data and geometry for bridges, culverts, road overflow, and a few additional channel cross sections were obtained by field survey. The underwater portions of the cross sections, elevations, and geometry of the Draham Street NE culvert were obtained by field survey.

The hydraulic analyses for areas studied by approximate methods were based on flood- depth information, topographic maps (Harl Pugh and Associates, 1978), photographs (Walker and Associates, 1977), and field inspection.

In the City of Olympia, the Outlet of Black Lake was studied by detailed methods.

Water-surface elevations of floods for the selected recurrence intervals were computed through use of a combination of the culvert rating analyses (U.S. Department of the Interior, 1968) and USGS step-backwater computer program (U.S. Department of the Interior, 1976).

Approximate flooding was determined using historical flooding information provided by local residents and field inspection of the area.

In the City of Tenino, Scatter Creek and Scatter Creek Tributary were studied by detailed methods.

Starting water-surface elevations for the first cross section of Scatter Creek and Scatter Creek Tributary (in the City of Tenino) were computed from profile convergence from downstream cross sections and culvert ratings where an approach section was the section farthest downstream.

In Thurston County, Unincorporated Areas, the following streams were studied by detailed methods: Deschutes River, Skookumchuck River, Scatter Creek, Scatter Creek Tributary, Chehalis River, Black River, Outlet of Black Lake, Percival Creek, Woodland Creek, Nisqually River, and Yelm Creek. Nisqually River has been converted to Zone A both in Thurston and Pierce County due to the extreme channel migration that has occurred since the effective models were created.

Water-surface elevations of floods of the selected recurrence intervals for the City of Tumwater; Scatter Creek and Scatter Creek Tributary (in the City of Tenino); and Thurston County were computed through use of a combination of the USGS E-431 step- backwater computer program ("Computer Applications for Step-Backwater", 1976), culvert rating analyses ("Techniques of Water-Resources Investigations", 1968), and computations of road overflows (U.S. Department of the Interior, 1967).

Starting water-surface elevations for the first cross section of Skookumchuck River, Black River, Scatter Creek, Scatter Creek Tributary, and Chehalis River were determined by profile convergence from downstream cross sections. Starting water-surface elevations for Outlet of Black Lake, Percival Creek, and Woodland Creek were determined by flow over dam ratings or culvert ratings, where an approach section was the section farthest downstream. For Deschutes River, starting water-surface elevations were the ending elevations in the City of Tumwater Flood Insurance Study (FEMA, City of Tumwater, 1980).

Due to the meandering nature of the rivers in Thurston County, a profile base line, rather than the actual stream channel, was used to measure the distance between many cross sections on Deschutes River, Skookumchuck River, Scatter Creek, Chehalis River, Black River, and Nisqually River.

The Pacific Northwest River Basins Commission has established standard stationing points in River Miles along Deschutes River, Nisqually River, Skookumchuck River, Chehalis River, and Black River (Pacific Northwest River Basins Commission, 1969). River Mile stationing was not adopted for purposes of this study, however.

The acceptability of all assumed hydraulic factors, cross sections, and hydraulic structure data was verified by computations that duplicated the profiles of the January 1972 flood for Chehalis River, the February 1972 flood for Nisqually River, the January 1974 flood for Deschutes River, and the December 1977 flood for Skookumchuck River.

During a 1-percent-annual-chance flood, Black Lake inundates Black River for approximately 4 miles downstream to Littlerock. In this reach, Black River essentially acts as an extension of Black Lake at the lake elevation of 133 feet until 123rd Avenue SW at Littlerock. Downstream of Littlerock at the Burlington Northern Railroad crossing, Black River flows out of its channel (for approximately 1 mile) southwestward over a small rise, where shallow flooding results. Once crossing this hill, the water collects in a deeper side channel, combining with backwater from a point further downstream along Black River.

Downstream of the Chicago, Milwaukee, St. Paul and Pacific Railroad, 1-percent-annual-chance flows from Chehalis River travel northward to Black River. Floodwaters flow through Chehalis Indian Reservation and across 183rd Avenue SW, combining with Black River flow. Most inundation is less than 1 foot deep; however, depths exceed 1 foot in the incised channels that connect Chehalis River and Black River. Discharge from this flow does not enter Black River at any one point; therefore, effects from the additional inflow are not substantial on Black River within Thurston County.

The extent of approximate flooding was determined by field observation, stereo-photography, and historical flooding observations through interviews with local residents.

In the City of Tumwater, the following streams were studied by detailed methods: Deschutes River, Outlet of Black Lake, and Percival Creek.

Approximate flood boundaries were determined using historical flooding information provided by local residents and field inspection of the area.

In the City of Yelm, Yelm Creek was studied by detailed methods.

Hydrologic and hydraulic analyses were performed to determine flood elevations for the 10-, 2-, 1-, 0.2-percent-annual-chance flows, as well as the 1- and 0.2-percent-annual- chance floodplain boundaries and floodway boundary. All detailed hydraulic analyses were computed using the USACE HEC-RAS computer program (USACE, 1997). The flooding is a function of flat topography, a highly vegetated channel, several under-sized culverts and bridges, road fills that encroach on the floodplain and in-stream fences that restrict flows.

Six road-crossing structures, consisting of two culverts and four bridges, influence hydraulic conditions in the study reach. Additional field data were surveyed at each crossing to ensure accurate representation within the HEC-RAS model.

The topography of Yelm Creek and its floodplain is represented in the HEC-RAS model using 28 cross sections surveyed by Northwest Hydraulic Consultants, Inc., in May 1997. The cross sections were extended using topographic mapping at a scale of 1:4,800, with a contour interval of 2 feet (DeGross Aerial Mapping, 1997), taken from aerial photographs flown in January 1997. Several additional cross sections were interpolated to improve the model's stability and accuracy, especially through the bridges and culverts. Vertical control for the surveys and mapping was achieved using four local monuments referenced to Thurston County survey control.

Starting water-surface elevations at the downstream end of the modeled reach were determined using the slope-area method.

The main channel is typically filled with thick grass and brush throughout the study reach, although some small sections are clear of vegetation (U.S. Department of the Interior, 1987; Chow, 1959). In addition to the dense vegetation, many fences cross the channel and floodplain and further restrict flow. The channel banks in many locations are covered with blackberry bushes, while the floodplain varies between cropped pasture and dense brush.

October 16, 2012
Initial Countywide Analyses

For the October 16, 2012, countywide study, all flooding sources studied by detailed methods with were redelineated on new topographic data derived from the 2002 PSLC Bare Earth LiDAR ASCII Points data, developed by TerraPoint, Inc. The LiDAR data has a RMS vertical accuracy of approximately 30 centimeters.

Some approximate study boundaries were adjusted spatially to match current base map information, including the Thurston County 2006 orthophotography, the 2010 GIS road layer, and the 2002 PSLC LiDAR elevation data.

In addition, the Nisqually River special flood hazard area was converted to approximate zone due to the extreme stream channel migration occurring since the original models where developed.

The Deschutes River floodway and floodway data tables were removed, also due to the extreme channel migration within the floodplain.

All qualifying benchmarks within a given jurisdiction that are catalogued by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.
Benchmarks catalogued by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position elevation (e.g. mounted in bedrock)
- Stability B: Monuments which generally hold their position/elevation (e.g. concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g. concrete monument below frost line)
- Stability D: Mark of questionable or unknown vertical stability (e.g. concrete monument above frost line, or steel witness post)

In addition to NSRS benchmarks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

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

It is important to note that 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 (TSDN) associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

Deschutes River
Physical Map Revision

Water surface elevations of the approximate and 10-, 4-, 2-, 1-, and 0.2-percent- annual-chance floods on the Deschutes River were estimated using of the USACE HEC-RAS 4.1.1 computer program (USACE, 2011). Cross sectional geometries for the detailed analysis Deschutes River were comprised of field run survey data and a digital terrain model (DTM) generated from LiDAR data from the Thurston Geodata Center (Thurston Geodata Center, 2011). 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.

Starting water surface elevations were calculated based on normal depth boundary condition.

Coastal Physical Map Revision

For this coastal revision, Capitol Lake was redelineated based on new topographic data derived from the DTM generated from LiDAR data from the Thurston Geodata Center (Thurston Geodata Center, 2011).

Procedure for hydraulic validation of the Capitol Lake LOMR (LOMR 03-10-0337P, effective December 26 2003) was based on frequency analysis of water surface elevations simulated by the Capitol Lake FEQ model. The 1962-1999 series of simulated maximum annual lake elevations was analyzed using a Log Pearson Type III distribution. Resulting stillwater elevations were consistent with flood elevations for Budd Inlet downstream of Capitol Lake as estimated in the Thurston County Coastal PMR.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by respective contractors who performed the original studies.

Channel and overbank roughness factors used in the hydraulic computations were estimated by field observation. Table 8, "Manning's "n" Values", shows the channel and overbank "n" values for the streams studied by detailed methods.

Table 8 – Manning's "n" Values

Stream	Channel "n"	Overbank "n"
TOWN OF BUCODA		
Skookumchuck River	0.046	0.059-0.078
CITY OF LACEY		
Woodland Creek	0.042-0.044	0.050-0.055
CITY OF OLYMPIA		
Outlet of Black Lake	0.032-0.038	0.040-0.050
CITY OF TENINO		
Scatter Creek	0.038-0.055	0.040-0.055
Scatter Creek Tributary	0.038-0.055	0.040-0.055
THURSTON COUNTY	0.030-0.045	0.020-0.080
Deschutes River Skookumchuck River	0.032-0.058	0.040-0.150
Scatter Creek	0.032-0.058	0.040-0.150
Scatter Creek Tributary	0.032-0.058	0.040-0.150
Chehalis River	0.032-0.058	0.040-0.150
Black River	0.032-0.058	0.040-0.150
Outlet of Black Lake	0.032-0.058	0.040-0.150
Percival Creek	0.032-0.058	0.040-0.150
Woodland Creek	0.032-0.058	0.040-0.150
Yelm Creek	0.040-0.100	0.040-0.150
CITY OF TUMWATER		
Deschutes River	0.030-0.045	0.020-0.080
Outlet of Black Lake	0.035-0.050	0.040-0.055
Percival Creek	0.035-0.050	0.040-0.055
CITY OF YELM		
Yelm Creek	0.040-0.100	0.040-0.150

3.3 Wave Height Analyses

The Thurston County Coastal Flood Hazard Analysis and Mapping study included field reconnaissance to determine representative shoreline reaches. Each reach was represented by a cross-shore transect, placed perpendicular to the mean shoreline or parallel to the mean direction of wave propagation. A total of 49 transects were placed throughout Thurston County to represent the coastal flood hazard. Figure 1, "Transect Location Map", illustrates the location of transects within Thurston County.

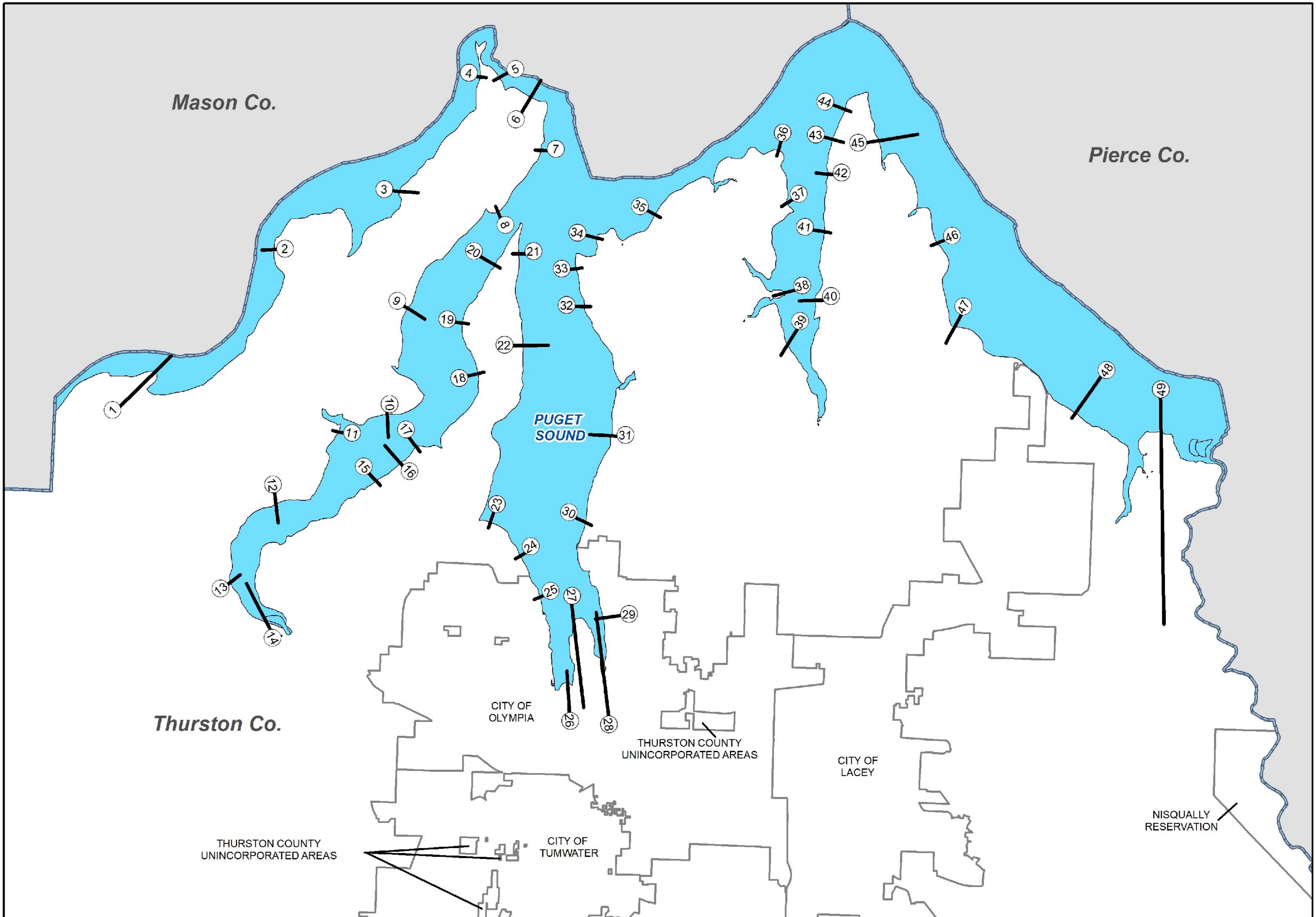

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
THURSTON COUNTY
AND INCORPORATED AREAS

TRANSECT LOCATION MAP

0 0.5 1 2 Miles

N

Since extreme tides would most likely be associated with a severe winter storm, the probability of the extreme tides and heavy wind wave action occurring simultaneously is likely. Under these circumstances, the possibility of wave damage should be considered when determining the flood potential.

An extensive two-dimensional storm surge propagation model was developed for the entire Puget Sound. This model was run for 150 selected high water level events identified by the highest water level peaks between 1959 and 2010 at NOAA's Seattle tide gage station which had no corresponding gaps in the measured data at Neah Bay. Water levels were pulled from representative model locations to inform the coastal flood hazard analysis at each of the 49 transects. The Generalized Pareto Distribution was applied to each transect to extrapolate the extreme water levels for the 1- and 0.2-percent annual-chance stillwater levels. Table 9, "Transect Data," shows the stillwater elevations of the 49 transects along Thurston County.

Once the water level modeling for the Puget Sound study was complete, background data was collected and transect locations were finalized, a detailed wave model for the complex geometry of Thurston County was generated in order to extract transect wave data at the south end of Puget Sound, where waves from the Pacific Coast cannot penetrate. Simulating Waves Near-shore (SWAN) modeling methodology was the chosen model for this sheltered area of Thurston County.

The Thurston County Coastal Flood Hazard Analysis and Mapping study included field reconnaissance, a wave model for the intricate geometry of the Thurston County shoreline on the south end of Puget Sound, coastal analysis in the form of transect analysis, including wave setup, wave run-up and overtopping, overland wave propagation, and statistical analysis to determine base flood elevations and coastal flood hazard zone mapping.

Wave setup can be a significant contributor to the total water level at the shoreline and was included in the determination of coastal base flood elevations. Wave setup is defined as the increase in total stillwater elevation against a barrier caused by the attenuation of waves in shallow water. Wave setup is based upon wave breaking characteristics and profile slope.

Wave setup for Thurston County was calculated using the Direct Integration Method (DIM). The DIM setup equations can be found in the Pacific Coast Guidelines Equations (FEMA, 2005). Static setup was calculated for the each run at every transect based on the near-shore slope, as defined in the guidelines and specifications. Since Puget Sound is considered to be a sheltered water body, the dynamic component of setup was not included in the total water level, as it is said to be negligible in the sheltered waters guidance (FEMA, 2008).

Wave run-up is the uprush of water caused by the interaction of waves with the area of shoreline where the stillwater hits the land or other barrier intercepting the stillwater level. The wave run-up elevation is the vertical height above the stillwater level ultimately attained by the extremity of the up-rushing water. Wave run-up at a shore barrier can provide flood hazards above and beyond those from stillwater inundation.

Wave run-up for Thurston County was calculated for all 150 storm events at each transect; however the method varied based on the type of shoreline. The Type 1 (beaches) spreadsheet used the DIM method for calculating run-up, as detailed in the guidelines. The DIM run-up equations are contained in the FEMA Pacific Coast Guidelines as equation D.4.5-19 (FEMA, 2005) DIM is a one-dimensional empirical method that calculates static and dynamic setup, with the option to include the influence of variable spectral width in the dynamic setup. The setup parameters calculated through DIM are then statistically added to the incident run-up on a natural beach.

Run-up on barriers is dependent on wave height and steepness, as well as structure geometry. The Type 2 (barriers) spreadsheets calculated run-up using the TAW (Technical Advisory Committee for Water Retaining Structures) method, based on the structure slope, Iribarren number and reduction factors developed by Battjes (1974), Van der Meer (1988), and de Waal & Van der Meer (1992). The reduction factors include surface roughness, influence of a berm, porosity and oblique wave incidence. The Van der Meer relationship is recommended for use due to its wide range of applicability and long established international acceptance. The run-up equation recommended for use as the TAW methodology (Van der Meer 2002) is provided in the Pacific Coast Guidelines (FEMA, 2005).

The Type 3 spreadsheet for vertical walls was set up to calculate run-up using methods provided in the Shore Protection Manual as there was no clear guidance in the Pacific Coast Guidelines for run-up on vertical structures (USACE, 1984). The SPM nomograph for run-up on vertical walls was digitized and an interpolation routine was developed to calculate runup from this figure (USACE, 1984).

Once the wave setup and wave run-up were computed for each run, the total water level elevation could be calculated for all 150 storms for each transect. The total water level is the combination of still water, including storm surge for each event, and wave components, including setup and run-up.

Overtopping occurs when a barrier crest is lower than the potential run-up elevation, or total water level. Since a barrier is required, overtopping was only calculated for Type 2 (steeply sloping barriers) and Type 3 (vertical structure) spreadsheets. Equations were provided in the guidelines for both Type 2 and 3 shorelines. Overtopping was calculated using the Van der Meer method and the Besley and Allsop method (Van der Meer, 2002).

The total water level (TWL) is comprised of the still water elevation including storm surge, in addition to the wave setup and run-up components. A TWL is calculated for each of the 150 storm event runs at each transect, with a total of 49 transects. The Generalized Pareto Distribution was applied to each transect to extrapolate the extreme water levels for the 1- and 0.2-percent annual-chance total water levels. These extreme water levels were used to determine the coastal flood hazard zones for the coastal mapping.

The fundamental analysis of overland wave effects is provided by FEMA's Wave Height Analysis For Flood Insurance Studies (WHAFIS) computer program (Divoky, D. 2007), a computer program that uses representative transects to compute wave crest elevations in a given study area. The wave energy (equivalently, wave height) and wave period respond to changes in wind conditions, water depths, and obstructions as a wave propagates. These equations are solved as a function of distance along the wave analysis transect.

Consideration of overland wave propagation is usually not required on the Pacific Coast due to the relatively steep nearshore profile; coastal flood hazards are typically dominated by wave runup and overtopping. However, there were 11 transect locations within Thurston County where wave propagation was considered. These transects were located in areas considered to be low-lying, where overland wave propagation could present a significant hazard. A joint probability method (JPM) was used to identify three combinations of wave heights and water levels, based on the 150 simulated events, which have a 1-percent annual chance of occurrence. The JPM analysis was informed by fitting extremal distributions to the SWL and wave height datasets independently. Three theoretical combinations of SWL and wave height were chosen to represent 1-percent annual chance flood scenario simulated. Similar to the wave runup analysis, a corresponding wave setup term was computed using the DIM method for the three selected combinations of wave height and SWL. Due to the sheltered nature of Thurston County, dynamic wave setup, erosion, and structural failure were not considered in this analysis. The wave setup, SWEL, and wave height values were used to populate the WHAFIS analysis and define the overland wave propagation hazard.

Figure 2 is a profile for a hypothetical transect showing the effects of energy dissipation on a wave as it propagates inland. This figure shows the wave elevations being decreased by obstructions, such as buildings, vegetation, and rising ground elevations and being increased by open, unobstructed wind fetches. Actual wave conditions may not necessarily include all of the situations shown in Figure 2.

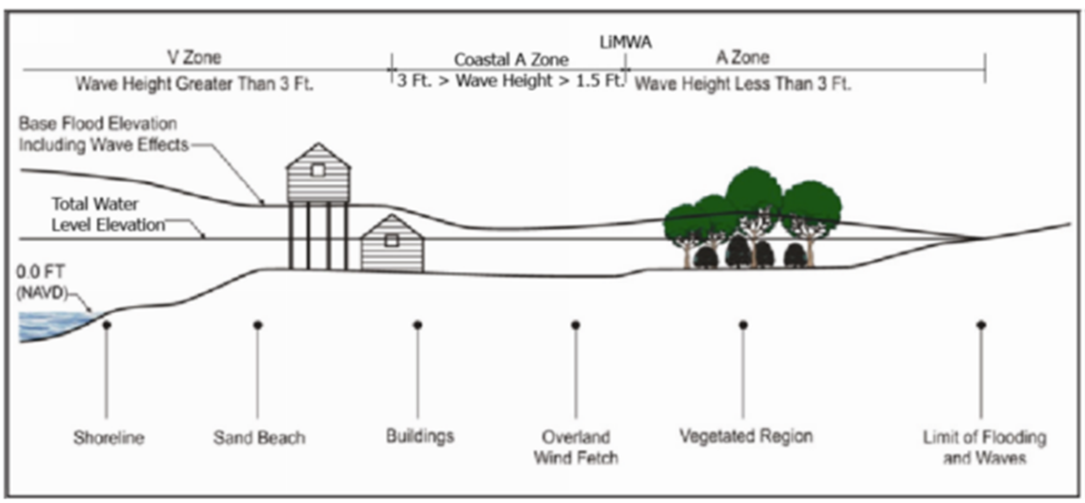

Figure 2: Transect Schematic

Extreme water levels were used to map the coastal flood hazard zones as detailed in the Pacific Coast Guidelines (FEMA 2005). VE zones were mapped at the shoreline when the wave action was large enough that there could be structural damage due to wave energy. Coastal AE zones were mapped when the wave height and run-up were too low to meet the velocity zone criteria, which occurred on the more sheltered and more gradually sloping shorelines of Thurston County. The base flood elevation for these zones was dependent on the 1-percent-annual-chance total water level determined through the transect analysis spreadsheets and statistical analysis for each transect.

In Thurston County, the majority of the shoreline consisted of steeply sloping bluffs. For this shoreline type, the VE zone (or coastal AE zone) was mapped to the elevation contour that matches the BFE calculated by the analysis on the shoreline at that transect. In the case of an overtopped barrier, the extent of overtopping was represented. Mapping procedures for a shoreline consisting of primary frontal dune are not discussed here because primary frontal dunes were not found to be present in Thurston County.

Once the landward extent of the flood zones was determined for each transect, it was necessary to interpolate between transects to create a smooth and continuous coastal flood hazard zone extent. The smooth transition between transects had to be made based on engineering judgment in evaluating shoreline type, topography, land cover, changes to wave and water level conditions, and upland development type.

The Limit of Moderate Wave Action (LiMWA) is determined and defined as the location of the 1.5-foot wave. Typical constructions in areas of wave heights less than 3-feet high have experienced damage, suggesting that construction requirements within some areas of the AE zone should be more like those requirements for the VE zone. Testing and investigations have confirmed that a wave height greater than 1.5 feet can cause structure failure. The LiMWA was determined for all areas subject to significant wave attack in accordance with "Procedure Memorandum No. 50 - Policy and Procedures for Identifying and Mapping Areas Subject to Wave Heights Greater than 1.5 feet as an Informational Layer on FIRMs" (FEMA, 2008). The LiMWA may not be visible on the flood hazard maps in areas where it coincides with flood zone delineations.

Table 9 - Transect Data

Transect Number	Flooding Source	Transect Locations	Hazard Mapped	Stillwater Elevations: 1% Annual Chance (ft NAVD88)	Stillwater Elevations: 0.2% Annual Chance (ft NAVD88)	1% Annual Total Water Elevations (ft NAVD88)	Shoreline Zone	Shoreline Base Flood Elevation (feet NAVD88)
1	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Totten Inlet), north of Ellison Loop NW	Runup	13.6	13.7	17.62	VE	18
2	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Totten Inlet), 2500 feet southwest of the terminus of 78TH Ave NW	Runup	13.6	13.6	19.05	VE	19
3	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Totten Inlet), west of the terminus of 85TH Ave NW	Runup	13.5	13.6	19.11	VE	19
4	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Totten Inlet), 500 feet south of the intersection of Steamboat Island Road NW and Island Drive NW	Runup	13.4	13.5	19.71	VE	20
5	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Pickering Passage), 700 feet north of Seaview Drive NW	Runup	13.3	13.3	16.46	VE	16

Table 9 - Transect Data (continued)

Transect Number	Flooding Source	Transect Locations	Hazard Mapped	Stillwater Elevations: 1% Annual Chance (ft NAVD88)	Stillwater Elevations: 0.2% Annual Chance (ft NAVD88)	1% Annual Total Water Elevations (ft NAVD88)	Shoreline Zone	Shoreline Base Flood Elevation (feet NAVD88)
6	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Pickering Passage), 850 north of the terminus of Hunter Point Road NW	Overland Wave Propagation	13.3	13.3	16	VE	16
7	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Pickering Passage), 1000 feet north of W Beach Lane NW	Runup	13.2	13.3	19.89	VE	20
8	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 1200 feet south of the terminus of Schrim Road NW along Schrim Loop Road NW	Runup	13.3	13.3	21.41	VE	21
9	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 800 feet east of Young Road NW	Runup	13.3	13.4	17.72	VE	18
10	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 450 feet south of Gravelly Beach Loop NW	Runup	13.4	13.4	18.98	VE	19
11	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 120 feet east of the terminus of Keating Road NW	Runup	13.4	13.4	18.42	VE	18

Table 9 - Transect Data (continued)

Transect Number	Flooding Source	Transect Locations	Hazard Mapped	Stillwater Elevations: 1% Annual Chance (ft NAVD88)	Stillwater Elevations: 0.2% Annual Chance (ft NAVD88)	1% Annual Total Water Elevations (ft NAVD88)	Shoreline Zone	Shoreline Base Flood Elevation (feet NAVD88)
12	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 280 feet east of the terminus of Tag Lane NW	Runup	13.4	13.4	17.96	VE	18
13	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 3500 feet north of the intersection of US Highway 101 and State Highway 8	Runup	13.4	13.4	16.48	VE	16
14	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 1800 feet northwest of the intersection of Madrona Beach Road NW and Garden Lane NW	Runup	13.4	13.4	15.12	AE	15
15	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 1500 feet north of the terminus of Overhulse Road NW	Runup	13.4	13.4	18.69	VE	19
16	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 2200 feet southwest of the intersection of Sunset Beach Drive NW and Biscay Street NW	Runup	13.4	13.4	18.72	VE	19

Table 9 - Transect Data (continued)

Transect Number	Flooding Source	Transect Locations	Hazard Mapped	Stillwater Elevations: 1% Annual Chance (ft NAVD88)	Stillwater Elevations: 0.2% Annual Chance (ft NAVD88)	1% Annual Total Water Elevations (ft NAVD88)	Shoreline Zone	Shoreline Base Flood Elevation (feet NAVD88)
17	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 1200 feet northwest of the intersection of Sunset Beach Drive NW and Biscay Street NW	Overland Wave Propagation	13.4	13.4	17	VE	17
18	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 800 feet southwest of the intersection of 58TH Ave NW and Countryside Court NW	Runup	13.3	13.4	19.38	VE	19
19	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 800 feet west of the terminus of 64TH Ave NW	Runup	13.3	13.4	21.08	VE	21
20	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Eld Inlet), 270 feet northwest of the terminus of Hidden Cove Lane NW	Runup	13.3	13.3	19.08	VE	19
21	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), 600 feet northeast of the intersection of 74TH Ave NW and Huckleberry Street NW	Runup	13.3	13.3	18.96	VE	19

Table 9 - Transect Data (continued)

Transect Number	Flooding Source	Transect Locations	Hazard Mapped	Stillwater Elevations: 1% Annual Chance (ft NAVD88)	Stillwater Elevations: 0.2% Annual Chance (ft NAVD88)	1% Annual Total Water Elevations (ft NAVD88)	Shoreline Zone	Shoreline Base Flood Elevation (feet NAVD88)
22	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), 200 feet north of the terminus of Beverly Beach Drive NW	Runup	13.3	13.3	18.61	VE	19
23	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), 1800 feet northeast of the intersection of French Road NW and Country Club Drive NW	Runup	13.3	13.3	16.4	VE	16
24	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), 600 feet northeast of the terminus of 27TH Ave NW	Runup	13.3	13.3	16.73	VE	17
25	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), the marina parking lot located at the northern terminus of W BAY Drive NW	Overland Wave Propagation	13.3	13.3	16	VE	16
26	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), Marina between Simmons Street SW and Sylvester Street SW	Overland Wave Propagation	13.3	13.3	15	VE	15

Table 9 - Transect Data (continued)

Transect Number	Flooding Source	Transect Locations	Hazard Mapped	Stillwater Elevations: 1% Annual Chance (ft NAVD88)	Stillwater Elevations: 0.2% Annual Chance (ft NAVD88)	1% Annual Total Water Elevations (ft NAVD88)	Shoreline Zone	Shoreline Base Flood Elevation (feet NAVD88)
27	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), at the parking lot at the northern terminus of Washington Street NE	Overland Wave Propagation	13.3	13.3	16	VE	16
28	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), north of the terminus of Chestnut Street SE	Runup	13.3	13.3	15.27	AE	15
29	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), 310 feet north of the intersection of east Bay Drive NE and Berry ST NE	Runup	13.3	13.3	18.16	VE	18
30	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), 400 feet south of 35TH Ave NE extended to shoreline	Runup	13.3	13.3	20.1	VE	20
31	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), 470 feet north of the terminus of 47TH Ave NE	Runup	13.3	13.3	18.92	VE	19

Table 9 - Transect Data (continued)

Transect Number	Flooding Source	Transect Locations	Hazard Mapped	Stillwater Elevations 1% Annual Chance (ft NAVD88)	Stillwater Elevations 0.2% Annual Chance (ft NAVD88)	1% Annual Total Water Elevations (ft NAVD88)	Shoreline Zone	Shoreline Base Flood Elevation (feet NAVD88)
32	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), 600 feet south of Bromley Lane NE extended to shoreline	Runup	13.3	13.3	22.41	VE	22
33	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Budd Inlet), 400 feet west of the intersection of Bayview Drive NE and 71ST WAY NE	Runup	13.3	13.3	21.77	VE	22
34	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Pickering Passage), west of the terminus of 76TH Way NE	Runup	13.2	13.3	19.46	VE	19
35	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Data Passage), 500 feet northwest of the intersection of Zangler Road NE and 81ST Ave NE	Runup	13.2	13.2	19.4	VE	19
36	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Henderson Inlet), north of Lovejoy CT NE	Runup	13.1	13.3	17.69	VE	18

Table 9 - Transect Data (continued)

Transect Number	Flooding Source	Transect Locations	Hazard Mapped	Stillwater Elevations: 1% Annual Chance (ft NAVD88)	Stillwater Elevations: 0.2% Annual Chance (ft NAVD88)	1% Annual Total Water Elevations (ft NAVD88)	Shoreline Zone	Shoreline Base Flood Elevation (feet NAVD88)
37	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Henderson Inlet), 700 feet north of the Point due east of the intersection of Fishtrap Loop NE and Libby Road NE	Runup	13.1	13.2	17.81	VE	18
38	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Henderson Inlet), just NE of the terminus of Whitham Road NE	Overland Wave Propagation	13.1	13.2	16	VE	16
39	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Henderson Inlet), 700 feet east of the intersection of Chuck Lane NE and Snug Harbor Drive NE	Overland Wave Propagation	13.1	13.2	16	VE	16
40	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Henderson Inlet), 1440 feet southwest of the intersection of Kellogg DR NE and 72ND Ave NE	Runup	13.1	13.2	17.29	VE	17
41	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Henderson Inlet), 2500 feet northwest of the intersection of Kerbaugh Street NE and 7TH Ave NE	Runup	13.1	13.2	17.49	VE	17

Table 9 - Transect Data (continued)

Transect Number	Flooding Source	Transect Locations	Hazard Mapped	Stillwater Elevations: 1% Annual Chance (ft NAVD88)	Stillwater Elevations: 0.2% Annual Chance (ft NAVD88)	1% Annual Total Water Elevations (ft NAVD88)	Shoreline Zone	Shoreline Base Flood Elevation (feet NAVD88)
42	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Henderson Inlet), 600 feet north of the terminus of 86TH Ave NE	Runup	13.1	13.1	18.34	VE	18
43	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Henderson Inlet), 1110 feet northwest of the intersection of 92ND Ave NE and Otis Beach ST NE	Runup	13.1	13.1	21	VE	21
44	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Case Inlet), 1300 feet southwest of the intersection of Johnson Point Loop NE and Point View ST NE	Runup	13.1	13.1	18.35	VE	18
45	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Nisqually Reach), 1060 feet northeast of the intersection of 92ND Ave NE and Lohrer Lane NE	Runup	13.1	13.1	16.99	VE	17
46	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Nisqually Reach), east of the terminus of 78TH Ave NE	Runup	13	13.1	16.97	VE	17

Table 9 - Transect Data (continued)

Transect Number	Flooding Source	Transect Locations	Hazard Mapped	Stillwater Elevations: 1% Annual Chance (ft NAVD88)	Stillwater Elevations: 0.2% Annual Chance (ft NAVD88)	1% Annual Total Water Elevations (ft NAVD88)	Shoreline Zone	Shoreline Base Flood Elevation (feet NAVD88)
47	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Nisqually Reach), along Sandy Point Road NE 1700 feet east of the intersection of Sandy Point Road NE and Puget Beach Road NE	Runup	13	13.1	15.64	AE	16
48	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Nisqually Reach), 400 feet southeast of Illahee Lane NE extended to shoreline	Runup	13	13	16.21	VE	16
49	Pacific Ocean (Puget Sound)	At the shoreline of Puget Sound (Nisqually Reach), in the Nisqually River Delta between McAllister Creek and the Nisqually River	Overland Wave Propagation	13	13	15	VE	15

3.4 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the completion of the NAVD88, many FIS reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. Some of the data used in this revision were taken from the prior effective FIS reports and FIRMs and adjusted to NAVD88. The datum conversion factor from NGVD29 to NAVD88 in Thurston County is 3.47 feet.

NAVD88 = NGVD29 + 3.47 feet

The BFEs shown on the FIRM represent whole-foot rounded values. For example, a BFE of 102.4 will appear as 102.0 on the FIRM and 102.6 will appear as 103.0. Therefore, users that wish to convert the elevations in this FIS to NGVD29 should apply the conversion factor to elevations shown on the Flood Profiles and supporting data tables in this FIS report, which are shown at a minimum to the nearest 0.1 foot.

For additional information regarding conversion between the NGVD29 and NAVD88, visit the NGS website at http://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 TSDN 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 http://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 and Floodway Data Table. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

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

Approximate flood boundaries were delineated using aerial photographs at a scale of 1:9,600 (Walker and Associates, 1977), topographic maps at a scale of 1:4800, 4 feet contour interval (Harl Pugh and Associates, 1978); Flood Hazard Boundary Maps, and field inspection.

For the October 16, 2012, countywide study, all flooding sources studied by detailed methods with were redelineated on new topographic data derived from the 2002 PSLC Bare Earth LiDAR ASCII Points data, developed by TerraPoint, Inc. The LiDAR data has a RMS vertical accuracy of approximately 30 centimeters. Adjustments were made to approximate flood boundaries as well where necessary to tie into the redelineated detailed flood boundaries.

Before the October 16, 2012, countywide study, the detailed study flood boundaries were delineated on 2 and 4 foot topographic contour maps ranging in scales from 1:1,200 to 1:4,800.

For the Deschutes River physical map revision, the detailed portion of Deschutes River and steams studied by approximate methods were delineated using LiDAR data from the Thurston Geodata Center (Thurston Geodata Center, 2011). Topographic data was converted into a 3 meter digital elevation model (DEM).

For this coastal revision, entire coastline and Capitol Lake were delineated using LiDAR data from the Thurston Geodata Center (Fugro EarthData Compnay, 2011). Topographic data was converted into a 6 foot elevation model (DEM).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A 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.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections Table 10, "Floodway Data." In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 10, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

The floodway for Woodland Creek and a portion of Outlet of Black Lake (from cross sections E to H) coincide with the 1-percent-annual-chance boundary because the channel velocity is high (at or near critical) and the flow is confined to the high-water channel. For these reasons, no information is presented for either Woodland Creek or a portion of Outlet of Black Lake in Table 10.

A floodway is not appropriate along Percival Creek upstream of 54th Avenue SW. This road impounds water from Trosper Lake; thus, there is no conveyance until floodwaters pass through the culvert.

The floodway along Nisqually River was removed for the October 16, 2012, countywide study due to the significant amount of stream channel migration which has occurred since the original flood hazard study was performed.

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.

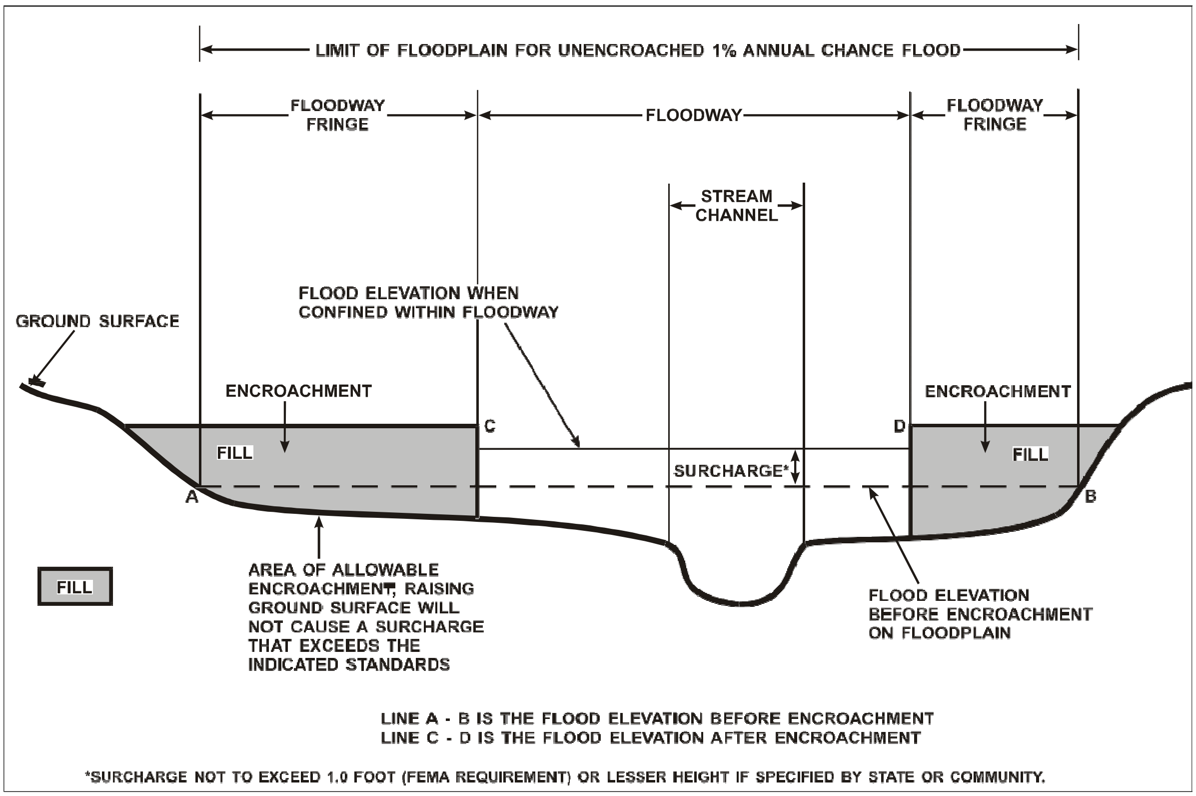

Figure 3 - Floodway Schematic

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
BLACK RIVER								
A	-4,762	300	2,619	1.5	101.6	101.6	102.4	0.8
B	-2,622	300	2,660	1.5	101.7	101.7	102.6	0.9
C	-772	300	2,238	1.8	102.0	102.0	102.9	0.9
D	0	300	1,774	2.2	102.2	102.2	103.0	0.8
E	220	285	1,886	2.1	102.3	102.3	103.1	0.8
F	1,014	300	1,944	2.0	102.7	102.7	103.4	0.7
G	3,417	291	1,052	3.8	104.1	104.1	104.5	0.4
H	7,929	214	1,568	2.5	106.8	106.8	107.0	0.2
I	11,107	160	1,053	3.7	108.2	108.2	108.5	0.3
J	11,271	244	1,273	3.1	108.8	108.8	109.0	0.2
K	17,774	300	2,870	1.0	109.6	109.6	109.9	0.3
L	22,532	300	3,115	0.9	109.8	109.8	110.2	0.4
M	27,756	300	2,651	0.9	109.9	109.9	110.3	0.4
N	33,086	300	2,732	0.9	110.0	110.0	110.5	0.5
O	38,675	300	2,757	0.9	110.2	110.2	110.8	0.6
P	44,338	300	2,526	1.0	110.4	110.4	111.0	0.6
Q	52,164	500	2,259	1.0	111.1	111.1	111.6	0.5
R	55,644	260	512	2.1	113.7	113.7	113.7	0.0
S	56,929	320	451	2.4	116.1	116.1	116.1	0.0
T	58,181	370	319	4.1	118.5	118.5	118.5	0.0
U	59,371	150	436	3.4	121.5	121.5	121.5	0.0
V	60,584	131	409	4.9	124.9	124.9	124.9	0.0
W	60,704	137	351	5.7	125.6	125.6	125.6	0.0
X	61,214	180	363	5.5	128.5	128.5	128.5	0.0
Y	61,909	140	477	4.2	131.3	131.3	131.3	0.0
Z	62,014	102	437	4.6	131.5	131.5	131.5	0.0

[1] Stream Distance in Feet from Moon Road Southwest

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
BLACK RIVER (Continued) AA								
AB	62,359	90	564	1.2	132.1	132.1	132.1	0.0
AC	62,744	123	411	1.7	132.1	132.1	132.1	0.0
AD	63,559	200	654	1.0	132.2	132.2	132.2	0.0
	64,979	200	1,390	0.5	132.3	132.3	132.3	0.0

[1] Stream Distance in Feet from Moon Road Southwest

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

BLACK RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
CHEHALIS RIVER								
A	-12,208	1318/990[2]	7,578	6.8	109.3	110.0 [3]	110.0 [3]	0.0
B	-11,448	1300/756[2]	11,353	4.5	112.2	112.8 [3]	112.8 [3]	0.0
C	-10,638	1484/694[2]	11,481	4.5	112.8	113.4 [3]	113.6 [3]	0.2
D	-9,358	1880/880[2]	23,274	2.2	114.1	114.8 [3]	114.9 [3]	0.1
E	-8,578	1800/960[2]	16,835	3.1	114.3	115.0 [3]	115.1 [3]	0.1
F	-7,788	2040/1254[2]	19,354	2.7	114.8	115.5 [3]	115.6 [3]	0.1
G	-7 ,018	2400/1702[2]	21,177	2.7	115.1	115.9 [3]	116.0 [3]	0.1
H	-6,248	3040/2040[2]	20,939	2.7	115.6	116.4 [3]	116.5 [3]	0.1
I	-5,378	3583	23,240	2.4	116.3	117.1 [3]	117.2 [3]	0.1
J	-4,578	4068	32,031	1.8	116.8	117.6 [3]	117.6 [3]	0.0
K	-4,008	3906	28,755	2.0	117.0	117.7 [3]	117.8 [3]	0.1
L	-3,328	4240	28,463	2.0	117.2	118.0 [3]	118.0 [3]	0.0
M	-2,528	3652	25,078	2.3	117.6	118.3 [3]	118.3 [3]	0.0
N	-1,668	3120	19,373	2.9	118.1	118.8 [3]	118.8 [3]	0.0
O	-998	2760	16,160	3.5	118.9	119.4 [3]	119.4 [3]	0.0
P	-158	2460	14,545	3.9	119.7	120.1 [3]	120.1 [3]	0.0
Q	300	1850[4]	12,452	4.5	119.9	119.9	120.5	0.6
R	950	1760	12,538	4.5	120.5	120.5	121.3	0.8
S	1,620	1670	10,723	5.3	121.2	121.2	121.8	0.6
T	2,360	1610	10,054	5.6	122.2	122.2	122.7	0.5
U	3,155	1400	12,823	4.4	123.1	123.1	124.0	0.9
V	3,865	1190	8,951	6.3	123.4	123.4	124.4	1.0
W	4,615	1000	10,202	5.5	124.9	124.9	125.8	0.9
X	5,400	1000	10,442	5.4	125.9	125.9	126.6	0.7
Y	6,230	1000	11,912	4.7	126.9	126.9	127.5	0.6
Z	7,020	1150	9,937	5.7	127.7	127.7	128.0	0.3

[1] Stream Distance in Feet from Chicago, Milwaukee, St. Paul & Pacific Railroad

[2] Width/Width Within County Limits

[3] Elevations Computed Assuming Containment of Right Overbank Losses

[4] Width Including Island

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

CHEHALIS RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
CHEHALIS RIVER (Continued)								
AA	7,800	1350	12,338	4.5	128.3	128.3	129.2	0.9
AB	8,590	1300	13,668	4.0	128.9	128.9	129.9	1.0
AC	9,375	1250	11,243	4.9	129.5	129.5	130.4	0.9
AD	10,210	1230	12,738	4.3	130.4	130.4	131.2	0.8
AE	11,015	1070	11,388	4.8	130.9	130.9	131.6	0.7
AF	11,820	1000	12,333	4.5	131.8	131.8	132.4	0.6
AG	12,630	1200	12,509	4.4	132.3	132.3	133.0	0.7
AH	13,380	1500	13,554	4.1	132.9	132.9	133.6	0.7
AI	14,240	1840	19,002	2.9	133.2	133.2	134.2	1.0
AJ	15,010	2000	14,697	3.7	133.5	133.5	134.5	1.0
AK	15,780	1850	16,785	3.3	134.2	134.2	135.2	1.0
AL	16,545	1550	15,225	3.6	134.6	134.6	135.5	0.9
AM	17,315	1550	15,551	3.5	135.2	135.2	136.0	0.8
AN	18,040	1600	16,217	3.4	135.6	135.6	136.4	0.8
AO	18,980	2050	18,632	3.0	136.0	136.0	136.9	0.9
AP	21,000	2750	15,803	3.5	137.7	137.7	138.4	0.7
AQ	22,840	3400	22,178	2.5	139.6	139.6	140.6	1.0
AR	24,880	3370[2]	12,102	4.5	141.5	141.5	142.4	0.9
AS	26,930	2230	13,007	4.2	144.6	144.6	145.6	1.0
AT	27,730	1630	11,252	4.9	145.2	145.2	146.2	1.0
AU	28,510	950	9,092	6.1	145.8	145.8	146.7	0.9
AV	28,860	850	7,916	7.0	146.3	146.3	147.0	0.7
AW	29,610	725	8,238	6.7	147.0	147.0	147.7	0.7
AX	30,555	825	9,060	6.1	148.1	148.1	148.5	0.4
AY	31,325	1200	12,932	4.3	149.0	149.0	149.6	0.6
AZ	31,975	1500	13,795	4.0	149.6	149.4	150.1	0.7

[1] Stream Distance in Feet from Chicago, Milwaukee, St. Paul & Pacific Railroad

[2] Width Including Island

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

CHEHALIS 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)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
DESCHUTES RIVER								
A	215	91	727	16.0	44.5	44.5	44.5	0.0
B	2,323	136	1,180	9.9	99.5	99.5	99.5	0.0
C	5,384	975	4,379	2.7	104.3	104.3	105.2	0.9
D	7,798	360	2,448	4.8	108.6	108.6	109.3	0.7
E	10,799	860	4,320	2.7	112.1	112.1	113.0	0.9
F	13,182	720	3,251	3.5	114.9	114.9	115.7	0.8
G	15,789	550	3,032	3.8	122.5	122.5	123.1	0.6
H	17,824	635	2,211	5.0	124.5	124.5	124.8	0.3
I	19,839	350	1,695	6.5	130.1	130.1	130.7	0.6
J	22,052	453	2,381	4.7	136.5	136.5	137.1	0.6
K	24,342	325	1,641	6.7	141.8	141.8	142.6	0.8
L	26,856	600	2,525	4.4	148.2	148.2	148.5	0.3
M	29,651	1,275	2,582	4.3	151.6	151.6	152.4	0.8
N	31,843	500	1,996	5.5	155.5	155.5	156.5	1.0
O	34,750	675	3,059	3.6	160.1	160.1	161.0	0.9
P	36,627	640	1,878	5.8	164.8	164.8	165.4	0.6
Q	39,729	500	2,322	4.7	171.9	171.9	172.5	0.6
R	41,619	390	2,185	5.0	175.4	175.4	176.2	0.8
S	44,489	104	1,345	8.1	180.2	180.2	181.1	0.9
T	46,841	554	3,515	3.1	185.0	185.0	185.8	0.8
U	48,210	410	2,582	4.2	186.1	186.1	187.0	0.9

[1]Feet above Capitol Lake

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

DESCHUTES 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)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
DESCHUTES RIVER (CONTINUED)								
V	50,247	530	3,160	3.4	189.0	189.0	190.0	1.0
W	53,524	668	3,828	2.8	193.0	193.0	193.9	0.9
X	55,754	1,260	4,302	2.5	194.7	194.7	195.6	0.9
Y	57,566	915	2,262	4.7	197.7	197.7	198.6	0.9
Z	60,208	403	2,191	4.8	204.7	204.7	205.4	0.7
AA	62,167	700	2,439	4.3	208.6	208.6	209.2	0.6
AB	64,558	245	1,836	5.7	215.4	215.4	216.1	0.7
AC	66,618	322	2,229	4.7	221.9	221.9	222.7	0.8
AD	69,475	746	2,664	3.9	225.1	225.1	225.6	0.5
AE	72,008	142	1,236	8.5	232.5	232.5	232.5	0.0
AF	74,537	750	2,981	3.5	235.4	235.4	235.9	0.5
AG	77,780	149	1,160	8.9	245.9	245.9	246.1	0.2
AH	79,608	727	1,608	6.4	252.1	252.1	252.2	0.1
AI	81,511	185	1,136	9.1	257.9	257.9	258.9	1.0
AJ	84,243	300	1,912	5.4	268.8	268.8	269.8	1.0
AK	86,418	270	1,881	5.5	273.7	273.7	274.1	0.4
AL	88,733	798	3,284	3.1	277.1	277.1	277.3	0.2
AM	91,267	120	1,160	8.5	283.2	283.2	283.7	0.5
AN	94,302	180	1,520	6.5	290.4	290.4	291.0	0.6
AO	106,521	700	3,161	3.0	313.5	313.5	314.3	0.8

[1]Feet above Capitol Lake

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

DESCHUTES 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)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
DESCHUTES RIVER (CONTINUED)								
AP	109,284	430	2,290	4.2	319.9	319.9	320.2	0.3
AQ	112,735	95	990	9.5	324.3	324.3	325.0	0.7
AR	114,967	98	1,049	8.9	329.0	329.0	329.9	0.9
AS	117,162	132	1,408	6.7	337.2	337.2	337.3	0.1
AT	119,780	240	2,033	4.6	340.7	340.7	341.2	0.5
AU	122,886	265	1,410	6.6	345.8	345.8	346.6	0.8
AV	126,651	120	1,322	7.1	353.7	353.7	354.6	0.9
AW	129,641	100	1,220	7.7	361.6	361.6	361.9	0.3
AX	134,085	100	912	10.2	370.9	370.9	371.7	0.8
AY	137,311	114	949	8.7	383.8	383.8	383.8	0.0
AZ	140,654	139	1,097	7.4	391.8	391.8	391.8	0.0
BA	142,627	84	759	10.6	397.2	397.2	397.5	0.3
BB	145,343	88	945	8.5	405.9	405.9	406.7	0.8
BC	148,659	102	894	9.0	413.7	413.7	414.0	0.3
BD	151,672	500	2,830	2.7	419.6	419.6	420.2	0.6
BE	154,482	101	781	9.3	424.6	424.6	424.6	0.0
BF	156,129	97	689	10.5	429.5	429.5	429.5	0.0
BG	157,493	255	1,216	5.9	434.2	434.2	434.3	0.1
BH	168,666	99	805	8.6	457.9	457.9	458.4	0.5
BI	173,735	101	633	10.9	469.6	469.6	469.7	0.1

[1]Feet above Capitol Lake

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

DESCHUTES 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)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
DESCHUTES RIVER (CONTINUED)								
BJ	175,648	280	1,030	6.4	473.5	473.5	474.5	1.0
BK	178,702	88	683	9.7	482.5	482.5	483.3	0.8
BL	181,553	133	865	7.6	492.6	492.6	492.7	0.1
BM	184,354	176	879	7.2	500.9	500.9	501.0	0.1
BN	187,214	160	717	8.9	511.2	511.2	511.3	0.1
BO	188,956	147	613	10.4	521.0	521.0	521.0	0.0
BP	190,955	92	658	9.0	529.2	529.2	529.6	0.4
BQ	192,913	493	1,203	4.9	538.4	538.4	538.4	0.0
BR	196,118	109	717	8.2	552.6	552.6	552.7	0.1
BS	198,853	91	457	12.9	566.7	566.7	566.7	0.0
BT	201,509	135	776	7.6	584.3	584.3	584.4	0.1
BU	203,529	102	592	10.0	596.6	596.6	596.6	0.0
BV	205,761	91	559	8.7	608.7	608.7	609.4	0.7
BW	207,522	121	505	8.8	617.3	617.3	617.3	0.0
BX	210,471	91	378	11.6	638.3	638.3	638.6	0.3
BY	212,615	129	444	9.4	655.2	655.2	655.2	0.0
BZ	214,869	141	560	6.7	668.6	668.6	668.9	0.3
CA	217,215	77	322	11.7	684.7	684.7	684.7	0.0
CB	219,304	323	722	5.2	702.0	702.0	702.0	0.0
CC	221,391	75	380	9.4	715.0	715.0	715.0	0.0

[1]Feet above Capitol Lake

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

DESCHUTES RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
OUTLET OF BLACK LAKE								
A	140	28	66	8.9	98.2	98.2	98.2	0.0
B	656	39	109	5.4	104.3	104.3	104.3	0.0
C	1,197	35	74	8.0	115.3	115.3	115.3	0.0
D	1,322	31	115	5.2	117.0	117.0	117.0	0.0
E	1,565	50	182	3.3	117.7	117.7	117.7	0.0
F-G[2]								
H	2,605	29	113	5.2	125.5	125.5	125.5	0.0
I	3,091	39	116	5.1	126.9	126.9	127.0	0.1
J	3,616	90	245	2.4	127.5	127.5	127.9	0.4
K	4,129	90	284	2.1	127.7	127.7	128.2	0.5
L	4,517	70	182	3.2	127.8	127.8	128.3	0.5
M	4,956	65	177	3.3	128.4	128.4	128.7	0.3
N	5,632	80	239	1.7	128.9	128.9	129.5	0.6
O	6,241	49	156	2.6	129.0	129.0	129.9	0.9
P	6,790	65	166	2.4	129.8	129.8	130.4	0.6
Q	7,227	52	135	3.0	130.2	130.2	130.7	0.5
R	7,586	55	110	3.7	130.8	130.8	131.1	0.3
S	7,646	42	153	2.7	131.0	131.0	131.3	0.3
T	8,196	95	266	1.5	131.4	131.4	131.6	0.2
U	8,731	143	261	1.6	131.6	131.6	131.8	0.2
V	9,256	135	287	1.4	131.7	131.7	131.9	0.2
W	9,852	170	232	1.5	132.0	132.0	132.1	0.1
X	10,321	160	262	1.3	132.2	132.2	132.3	0.1
Y	10,874	180	433	0.8	132.2	132.2	132.4	0.2
Z	11,345	185	428	0.8	132.3	132.3	132.5	0.2
AA	11,855	145	393	0.9	132.3	132.3	132.5	0.2

[1] Stream Distance in Feet Above Mouth

[2] No Floodway

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

OUTLET OF BLACK LAKE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
PERCIVAL CREEK								
A	40	53	258	0.6	144.4	144.4	145.2	0.8
B	338	54	230	0.6	144.4	144.4	145.2	0.8
C	908	55	159	0.9	144.5	144.5	145.3	0.8
D	1,538	53	155	0.9	144.6	144.6	145.4	0.8
E	2,118	13	29	2.8	145.2	145.2	145.9	0.7
F	2,598	15	39	2.0	147.4	147.4	147.5	0.1
G	3,118	35	35	2.3	148.6	148.6	149.1	0.5
H	3,528	25	39	2.1	150.3	150.3	150.7	0.4
I	3,958	20	25	3.2	152.7	152.7	152.7	0.0
J	4,073	104	342	0.2	160.5	160.5	160.5	0.0
K	4,533	159	283	0.2	160.5	160.5	160.5	0.0
L-O[2]								

[1] Stream Distance in Feet Above Sapp Road

[2] No Floodway

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

PERCIVAL CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SCATTER CREEK								
A	-11,229	75	306	2.1	240.6	240.6	241.5	0.9
B	-10,942	75	250	2.5	240.9	240.9	241.7	0.8
C	-10,326	50	188	3.4	241.7	241.7	242.4	0.7
D	-9,634	50	254	2.5	242.5	242.5	243.2	0.7
E	-8,898	50	217	2.9	243.1	243.1	243.9	0.8
F	-8,331	50	166	3.8	244.5	244.5	244.9	0.4
G	-7,681	60	238	2.7	245.6	245.6	246.1	0.5
H	-6,972	60	234	2.7	246.3	246.3	246.9	0.6
I	-6,330	70	263	2.4	247.3	247.3	247.7	0.4
J	-5,874	120	179	3.4	248.0	248.0	248.4	0.4
K	-5,202	120	252	2.4	249.5	249.5	250.2	0.7
L	-4,616	120	411	1.5	250.0	250.0	250.7	0.7
M	-3,982	100	344	1.8	250.4	250.4	251.0	0.6
N	-3,299	109	196	3.1	251.0	251.0	251.6	0.6
O	-2,750	130	373	1.6	251.8	251.8	252.4	0.6
P	-2,033	190	278	2.2	252.9	252.9	253.6	0.7
Q	-1,467	140	343	1.8	253.9	253.9	254.8	0.9
R	-996	106	286	2.2	254.4	254.4	255.2	0.8
S	-425	155	200	3.2	255.9	255.9	256.5	0.6
T	0	53	234	2.7	257.1	257.1	257.6	0.5
U	74	110	383	1.7	257.1	257.1	257.7	0.6
V	296	70	245	2.3	257.3	257.3	257.8	0.5
W	640	90	257	2.2	257.7	257.7	258.3	0.6
X	733	100	316	1.8	257.8	257.8	258.4	0.6
Y	911	110	225	2.5	257.9	257.9	258.5	0.6
Z	980	100	136	4.2	258.0	258.0	258.6	0.6

[1] Stream Distance in Feet from Grand Mound Road

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SCATTER CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SCATTER CREEK (Continued)								
AA	1,113	64	178	3.2	258.5	258.5	259.4	0.9
AB	1,192	65	142	4.0	259.1	259.1	259.6	0.5
AC	1,524	145	351	1.6	259.9	259.9	260.4	0.5
AD	2,100	175	376	1.5	260.1	260.1	260.9	0.8
AE	2,557	110	215	2.7	260.5	260.5	261.4	0.9
AF	2,587	140	344	1.7	261.0	261.0	261.6	0.6
AG	2,861	85	232	2.5	261.2	261.2	261.8	0.6
AH	3,211	60	136	4.2	261.7	261.7	262.3	0.6
AI	3,386	220	1,664	0.3	266.4	266.4	267.4	1.0
AJ	3,557	170	1,237	0.5	266.4	266.4	267.4	1.0
AK	3,836	160	1,145	0.5	266.4	266.4	267.4	1.0
AL	3,916	200	1,254	0.5	266.4	266.4	267.4	1.0
AM	4,417	160	785	0.7	266.4	266.4	267.4	1.0
AN	5,014	130	564	1.0	266.4	266.4	267.4	1.0
AO	5,264	125	602	0.9	266.4	266.4	267.4	1.0
AP	5,696	100	414	1.3	266.5	266.5	267.5	1.0
AQ	6,112	70	289	1.9	266.8	266.8	267.6	0.8
AR	6,512	70	194	2.9	267.5	267.5	268.1	0.6
AS	7,066	100	229	2.4	268.5	268.5	269.4	0.9
AT	7,546	80	169	3.3	269.6	269.6	270.5	0.9
AU	7,885	80	140	4.0	271.9	271.9	272.0	0.1
AV	7,920	50	125	4.4	272.1	272.1	272.2	0.1
AW	8,441	60	176	3.2	273.7	273.7	273.9	0.2
AX	9,073	80	281	2.0	274.2	274.2	274.7	0.5
AY	9,654	90	317	1.8	274.5	274.5	275.1	0.6
AZ	10,310	90	167	3.3	275.3	275.3	276.0	0.7

[1] Stream Distance in Feet from Grand Mound Road

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SCATTER CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SCATTER CREEK (Continued)								
BA	10,790 [1]	70	167	3.0	277.1	277.1	277.8	0.7
BB	11,390 [1]	40	49	5.3	283.0	283.0	283.1	0.1
BC	11,926 [1]	40	109	2.4	285.2	285.2	286.0	0.8
BD	12,439 [1]	40	62	4.2	286.9	286.9	287.6	0.7
BE	12,881 [1]	40	63	4.1	290.3	290.3	290.5	0.2
BF	13,576 [1]	40	85	3.1	292.9	292.9	293.3	0.4
BG	14,060 [1]	40	71	3.6	294.3	294.3	295.0	0.7
BH	14,604 [1]	50	85	3.0	296.5	296.5	297.2	0.7
BI	15,166 [1]	20	45	5.8	299.7	299.7	300.0	0.3
BJ	15,650 [1]	20	63	4.1	303.2	303.2	303.6	0.4
SCATTER CREEK TRIBUTARY								
A	635 [2]	60	134	2.5	278.8	278.8	279.4	0.6
B	1,340 [2]	50	98	3.4	280.3	280.3	281.1	0.8
C	1,397 [2]	60	74	4.4	280.5	280.5	281.4	0.9
D	2,005 [2]	54	118	2.8	283.6	283.6	284.6	1.0
E	2,637 [2]	50	173	1.4	284.6	284.6	285.2	0.6
F	3,255 [2]	65	115	2.0	285.1	285.1	285.5	0.4
G	3,311 [2]	65	132	1.8	285.2	285.2	285.6	0.4
H	3,887 [2]	55	81	1.3	285.8	285.8	286.2	0.4
I	4,489 [2]	14	38	2.7	286.7	286.7	286.9	0.2
J	5,075 [2]	16	32	3.2	288.3	288.3	288.3	0.0
K	5,428 [2]	34	66	1.5	289.0	289.0	289.0	0.0
L	6,024 [2]	22	26	4.0	290.8	290.8	290.8	0.0
M	6,549 [2]	115	79	1.3	293.3	293.3	293.3	0.0

[1] Stream Distance in Feet from Grand Mound Road

[2] Stream Distance in Feet Above Mouth

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SCATTER CREEK and SCATTER CREEK TRIBUTARY

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SKOOKUMCHUCK RIVER								
A	-5,284	187/130 [2]	1,807	5.5	210.7	210.7	211.5	0.8
B	-4,709	180	1,521	6.6	211.2	211.2	212.0	0.8
C	-4,059	180	1,310	7.6	211.8	211.8	212.7	0.9
D	-3,500	156	1,547	6.5	213.2	213.2	213.8	0.6
E	-1,677	150	1,850	5.4	215.3	215.3	215.6	0.3
F	-1,111	150	1,831	5.5	215.8	215.8	216.0	0.2
G	-590	150	1,785	5.6	216.0	216.0	216.3	0.3
H	-83	150	2,167	4.6	216.4	216.4	216.7	0.3
I	0	155	1,742	5.7	216.4	216.4	216.7	0.3
J	204	160	1,791	5.6	216.6	216.6	216.8	0.2
K	802	200	1,456	6.9	216.9	216.9	217.2	0.3
L	2,046	200	1,288	7.8	219.3	219.3	219.7	0.4
M	2,666	200	1,617	6.2	222.1	222.1	222.1	0.0
N	3,249	200	1,330	7.5	222.9	222.9	222.9	0.0
O	3,854	174	1,264	7.9	224.2	224.2	224.3	0.1
P	4,473	259	1,831	5.5	225.7	225.7	226.2	0.5
Q	4,518	240	1,560	6.4	225.8	225.8	226.3	0.5
R	5,157	240	2,112	4.7	226.8	226.8	227.3	0.5
S	5,668	203	2,005	5.0	227.1	227.1	227.6	0.5
T	6,703	200	1,683	5.9	228.0	228.0	228.4	0.4
U	7,166	200	1,732	5.8	228.6	228.6	228.9	0.3
V	7,831	200	1,968	5.1	229.1	229.1	229.7	0.6
W	8,483	200	1,984	5.0	229.4	229.4	230.1	0.7
X	9,597	204	1,857	5.4	230.5	230.5	231.2	0.7
Y	10,817	166	2,186	4.6	232.1	232.1	232.8	0.7
Z	11,370	180	1,998	5.0	232.6	232.6	233.2	0.6

[1] Stream Distance in Feet from State Highway 507

[2] Width/Width Within Thurston County

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SKOOKUMCHUCK RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SKOOKUMCHUCK RIVER (Continued)								
AA	12,560	200	1,748	5.7	234.1	234.1	234.8	0.7
AB	13,113	200	2,275	4.4	235.0	235.0	235.5	0.5
AC	14,283	200	2,123	4.7	236.1	236.1	236.6	0.5
AD	14,938	220	2,439	4.1	236.7	236.7	237.1	0.4
AE	15,622	250	2,238	4.5	237.2	237.2	237.6	0.4
AF	16,833	250	1,671	6.0	239.1	239.1	239.6	0.5
AG	17,400	230	2,091	4.8	239.8	239.8	240.7	0.9
AH	17,673	125	1,631	6.1	240.1	240.1	240.9	0.8
AI	18,117	120	1,420	7.0	240.9	240.9	241.6	0.7
AJ	18,663	115	1,562	6.4	242.1	242.1	242.6	0.5
AK	19,443	110	1,519	6.6	243.3	243.3	243.8	0.5
AL	20,043	110	1,563	6.4	244.2	244.2	244.7	0.5
AM	20,629	110	1,315	7.6	245.2	245.2	245.7	0.5
AN	21,600	110	1,197	8.3	247.6	247.6	248.1	0.5
AO	22,089	110	1,472	6.8	249.6	249.6	249.6	0.0
AP	22,380	115	2,092	4.8	250.3	250.3	250.3	0.0
AQ	22,848	120	1,512	6.6	250.9	250.9	250.9	0.0
AR	23,006	150	1,770	5.6	251.2	251.2	251.5	0.3
AS	23,585	200	1,937	5.2	252.0	252.0	252.2	0.2
AT	24,367	200	1,701	5.9	252.7	252.7	253.1	0.4
AU	25,099	200	1,874	5.3	253.9	253.9	254.5	0.6
AV	25,720	200	2,179	4.6	254.9	254.9	255.6	0.7
AW	26,290	200	2,296	4.4	255.3	255.3	256.1	0.8
AX	27,337	300	2,602	3.8	256.2	256.2	257.1	0.9
AY	27,938	300	3,610	2.5	256.6	256.6	257.5	0.9
AZ	28,507	300	3,260	2.8	256.8	256.8	257.7	0.9

[1] Stream Distance in Feet from State Highway 507

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SKOOKUMCHUCK RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SKOOKUMCHUCK RIVER (Continued)								
BA	29,088	232	3,183	2.9	257.0	257.0	257.9	0.9
BB	30,316	320	2,026	4.5	257.6	257.6	258.4	0.8
BC	31,492	350	2,442	3.7	259.0	259.0	260.0	1.0
BD	32,292	240	2,272	4.0	260.0	260.0	260.7	0.7
BE	33,149	300	2,533	3.6	260.9	260.9	261.4	0.5
BF	33,881	300	2,716	3.3	261.7	261.7	262.1	0.4
BG	34,381	257	2,753	3.3	262.0	262.0	262.5	0.5
BH	35,080	300	3,108	2.9	262.4	262.4	262.8	0.4
BI	36,029	219	2,752	3.3	263.0	263.0	263.4	0.4
BJ	36,963	179	1,905	4.8	263.6	263.6	263.9	0.3
BK	37,472	270	2,140	4.2	264.1	264.1	264.3	0.2
BL	38,105	550	4,058	2.2	264.7	264.7	265.1	0.4
BM	39,095	600	2,969	3.1	265.3	265.3	265.9	0.6
BN	40,165	303	2,145	4.2	266.4	266.4	267.4	1.0
BO	40,465	508	2,355	3.9	267.1	267.1	267.8	0.7
BP	41,594	350	1,859	4.9	269.7	269.7	269.8	0.1
BQ	42,204	300	1,368	6.6	271.1	271.1	271.1	0.0
BR	43,138	270	1,722	5.3	273.4	273.4	274.2	0.8
BS	43,499	270	2,032	4.5	274.5	274.5	275.0	0.5
BT	44,550	270	1,657	5.5	275.9	275.9	276.3	0.4
BU	45,826	270	1,947	4.7	278.0	278.0	278.6	0.6
BV	46,501	270	2,420	3.7	278.6	278.6	279.5	0.9
BW	47,637	200	1,763	5.1	280.0	280.0	280.8	0.8
BX	48,294	220	1,582	5.7	281.5	281.5	282.0	0.5
BY	48,943	250	2,006	4.5	283.0	283.0	283.6	0.6
BZ	50,372	220	1,640	5.5	284.8	284.8	285.6	0.8

[1] Stream Distance in Feet from State Highway 507

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SKOOKUMCHUCK RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SKOOKUMCHUCK RIVER (Continued)								
CA	51,648	220	1,448	6.3	287.6	287.6	288.2	0.6
CB	52,802	220	1,454	6.2	290.8	290.8	291.3	0.5
CC	53,198	220	1,390	6.5	292.1	292.1	292.3	0.2
CD	53,817	280	1,967	4.6	293.2	293.2	293.8	0.6
CE	54,835	250	2,236	4.1	294.3	294.3	295.2	0.9
CF	55,487	250	1,724	5.3	295.2	295.2	295.9	0.7
CG	56,162	250	1,749	5.2	296.6	296.6	297.4	0.8
CH	57,373	254	2,039	4.4	298.7	298.7	299.2	0.5
CI	57,878	270	2,169	4.2	299.6	299.6	300.0	0.4
CJ	58,377	400	2,698	3.4	300.2	300.2	300.5	0.3
CK	59,898	240	1,632	5.6	302.2	302.2	302.6	0.4
CL	60,784	200	1,530	5.9	303.7	303.7	304.5	0.8
CM	61,061	230	1,535	5.9	304.2	304.2	304.9	0.7
CN	61,703	210	1,425	6.4	305.6	305.6	306.1	0.5
CO	62,577	250	1,925	4.7	307.1	307.1	307.9	0.8
CP	62,852	250	1,819	4.7	307.5	307.5	308.3	0.8
CQ	63,152	122	1,141	7.5	308.2	308.2	308.7	0.5
CR	63,253	135	1,364	6.3	309.2	309.2	309.5	0.3
CS	63,412	185	2,100	3.9	309.6	309.6	310.0	0.4
CT	63,666	250	2,525	3.2	309.8	309.8	310.3	0.5
CU	64,071	320	1,967	4.1	310.1	310.1	310.7	0.6
CV	64,466	370	2,826	2.9	310.3	310.3	311.1	0.8
CW	65,343	304	2,092	3.9	311.0	311.0	311.9	0.9
CX	66,343	350	2,317	3.5	312.4	312.4	312.9	0.5
CY	67,020	350	2,053	4.0	313.4	313.4	313.9	0.5
CZ	68,324	350	2,416	3.4	315.5	315.5	315.9	0.4

[1] Stream Distance in Feet from State Highway 507

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SKOOKUMCHUCK RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SKOOKUMCHUCK RIVER (Continued)								
DA	69,956	350	1,826	4.4	317.9	317.9	318.1	0.2
DB	70,511	400	1,774	4.6	319.2	319.2	319.6	0.4
DC	71,050	400	2,194	3.7	320.2	320.2	321.0	0.8
DD	71,592	370	1,963	4.1	321.2	321.2	321.8	0.6
DE	72,153	314	2,319	3.5	322.1	322.1	322.7	0.6
DF	73,757	300	1,415	5.7	324.6	324.6	324.8	0.2
DG	74,698	269	1,513	5.4	327.3	327.3	327.4	0.1
DH	75,221	320	1,339	6.1	328.9	328.9	329.1	0.2
DI	76,367	225	1,445	5.6	332.4	332.4	333.4	1.0
DJ	76,940	250	1,473	5.5	334.2	334.2	334.9	0.7

[1] Stream Distance in Feet from State Highway 507

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

SKOOKUMCHUCK RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
WOODLAND CREEK								
A	55	29	36	6.35	33.7	31.2	31.2	0.0
B	220	43	90	2.52	33.7	32.7	32.7	0.0
C	420	79	137	1.66	33.7	33.0	33.0	0.0
D	745	89	119	1.92	33.7	33.4	33.4	0.0
E	1,140	48	76	2.99	34.6	31.1	31.1	0.0
F	1,630	47	54	3.52	37.5	34.0	34.0	0.0
G	1,910	48	31	3.09	39.5	36.0	36.0	0.0
H	2,475	91	63	2.89	41.5	38.0	38.0	0.0
I	2,875	42	55	3.45	43.2	39.7	39.7	0.0
J	3,350	35	53	3.58	46.5	43.1	43.1	0.0
K	3,900	56	96	2.22	49.0	45.5	45.5	0.0
L	4,300	44	60	3.15	50.3	46.9	46.9	0.0
M	4,745	39	47	4.02	53.4	49.9	49.9	0.0
N	5,060	43	65	2.93	55.4	51.9	51.9	0.0
O	5,160	62	99	1.93	57.3	52.2	52.2	0.0
P	5,530	30	32	5.94	57.8	54.3	54.3	0.0
Q	6,280	15	49	3.84	64.2	60.7	60.7	0.0
R	6,340	25	47	4.01	64.4	60.9	60.9	0.0
S	6,665	30	45	4.19	66.6	63.1	63.1	0.0
T-Z[2]								

[1] Stream Distance in Feet above Pleasant Glade Road Northeast

[2] No Floodway

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

WOODLAND CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
YELM CREEK								
A	0	22	77	4.6	305.3	305.3	305.9	0.6
B	545	17	53	6.6	311.0	311.0	311.0	0.0
C	695	25	85	4.1	314.4	314.4	315.3	0.9
D	1,405	26	119	3.0	321.9	321.9	322.9	1.0
E	2,190	34	133	2.6	326.7	326.7	327.6	0.9
F	3,165	87	279	1.3	329.5	329.5	330.3	0.8
G	3,615	90	295	1.2	330.2	330.2	331.0	0.8
H	4,225	37	208	1.7	332.2	332.2	333.0	0.8
I	4,277	80	375	0.9	332.7	332.7	333.7	1.0
J	4,642	65	231	1.5	333.0	333.0	334.0	1.0
K	5,342	35	171	2.1	334.2	334.2	335.0	0.8
L	5,642	43	177	2.0	334.7	334.7	335.6	0.9
M	5,698	43	169	2.1	335.1	335.1	335.8	0.7
N	5,838	33	180	2.0	335.3	335.3	336.0	0.7
O	5,915	52	273	1.3	335.7	335.7	336.4	0.7
P	6,430	134	674	0.5	335.7	335.7	336.5	0.8
Q	7,200	135	529	0.6	335.7	335.7	336.6	0.9
R	7,985	147	389	0.8	335.9	335.9	336.9	1.0
S	8,685	135	260	1.3	336.5	336.5	337.4	0.9
T	9,400	102	233	1.4	338.8	338.8	339.8	1.0
U	9,645	30	93	3.5	340.8	340.8	341.4	0.6
V	9,680	45	178	1.8	341.7	341.7	342.6	0.9
W	9,850	59	232	1.4	342.1	342.1	343.0	0.9
X	10,360	37	167	2.0	343.6	343.6	344.5	0.9
Y	10,670	92	229	1.4	344.1	344.1	345.1	1.0
Z	11,160	82	240	1.3	344.5	344.5	345.5	1.0

[1] Stream Distance in Feet From Upstream Face of Centralia Power Canal Flume

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

YELM CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET, NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
YELM CREEK (Continued)								
AA	11,700	64	166	1.8	345.2	345.2	346.2	1.0
AB	12,000	28	88	3.8	346.7	346.7	347.3	0.6
AC	12,062	28	104	3.2	347.6	347.6	347.8	0.2
AD	12,262	42	130	2.3	348.1	348.1	348.8	0.7
AE	12,762	109	341	0.9	348.4	348.4	349.3	0.9
AF	13,012	62	166	1.9	348.6	348.6	349.5	0.9
AG	13,064	23	101	3.2	349.7	349.7	350.0	0.3
AH	13,209	79	254	1.2	349.7	349.7	350.7	1.0
AI	13,714	106	268	1.1	350.4	350.4	351.4	1.0
AJ	14,250	30	95	3.2	351.4	351.4	352.4	1.0

[1] Stream Distance in Feet From Upstream Face of Centralia Power Canal Flume

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

FLOODWAY DATA

YELM CREEK

5.0 INSURANCE APPLICATIONS

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

Zone A

Zone A is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no (1-percent-annual-chance) 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 VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. 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 geographic area of Thurston County. Previously, separate Flood Hazard Boundary Maps (FHBMs) and/or FIRMs were prepared for each incorporated community with identified flood hazard areas. Historical map dates relating to pre-countywide maps prepared for each community are presented in Table 11, “Community Map History”.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Town of Bucoda	November 15, 1974	October 24, 1975	September 2, 1981	
City of Lacey	June 28, 1974	October 3, 1975	July 16, 1980	
City of Olympia	June 28, 1974	May 7, 1976	February 17, 1982	
City of Rainier[1]	N/A	N/A	N/A	
City of Tenino	June 27, 1975	N/A	June 4, 1980	
Thurston County	September 13, 1977	January 17, 1979	December 1, 1982	June 16, 1999
City of Tumwater	January 23, 1974	August 13, 1976	August 1, 1980	April 3, 1984
City of Yelm	October 22, 1976	N/A	June 16, 1999	

[1]This community does not have map history prior to the first countywide mapping

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

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

FIS reports were previously published for 8 cities and towns in Thurston County (References FEMA, December 1979; January 1980; March 1981; August 1981; April 1984; and June 1999).

Because it is based on more up-to-date analyses, this FIS supersedes the previously printed FISs for the communities within Thurston County.

8.0 LOCATION OF DATA

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

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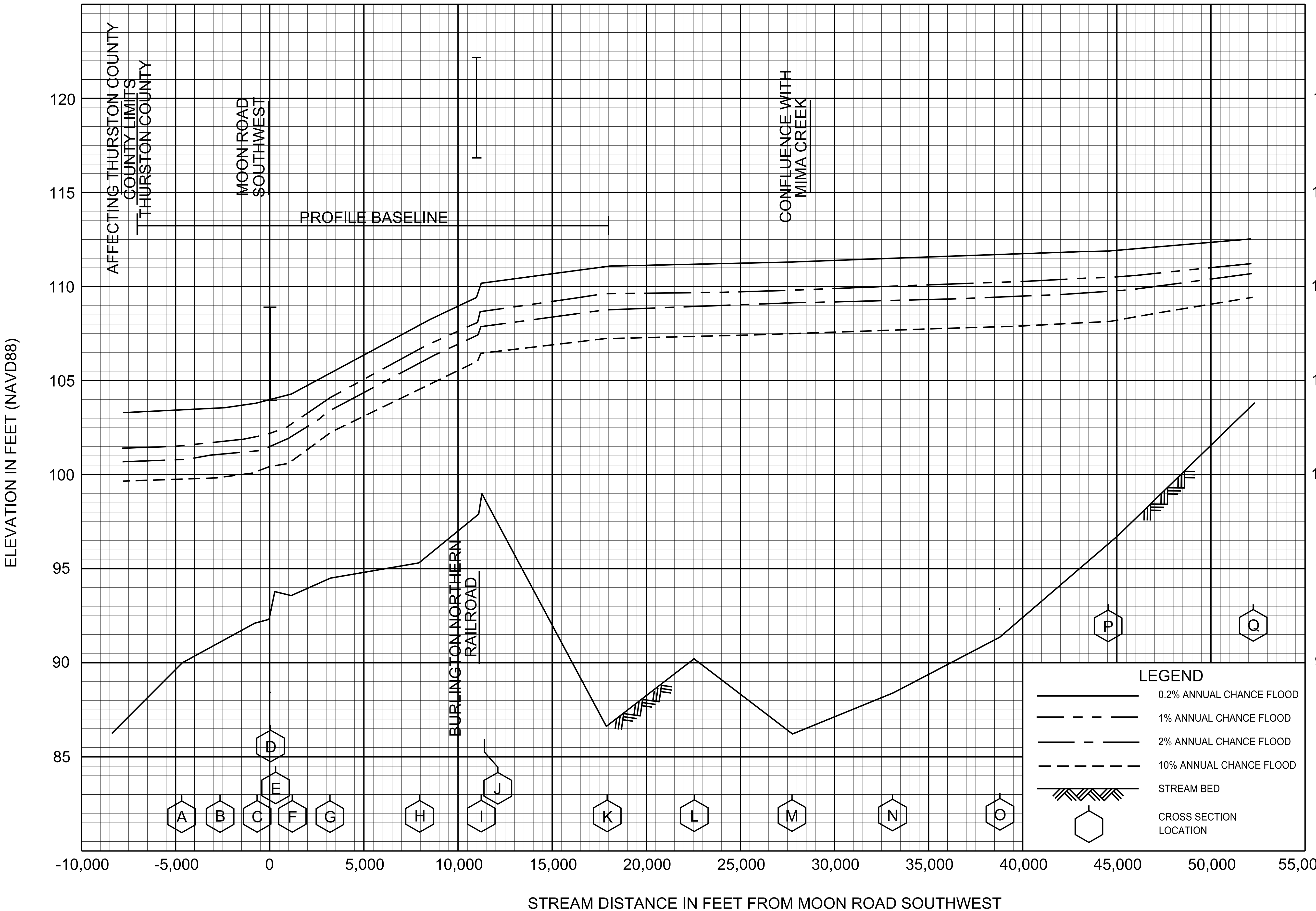


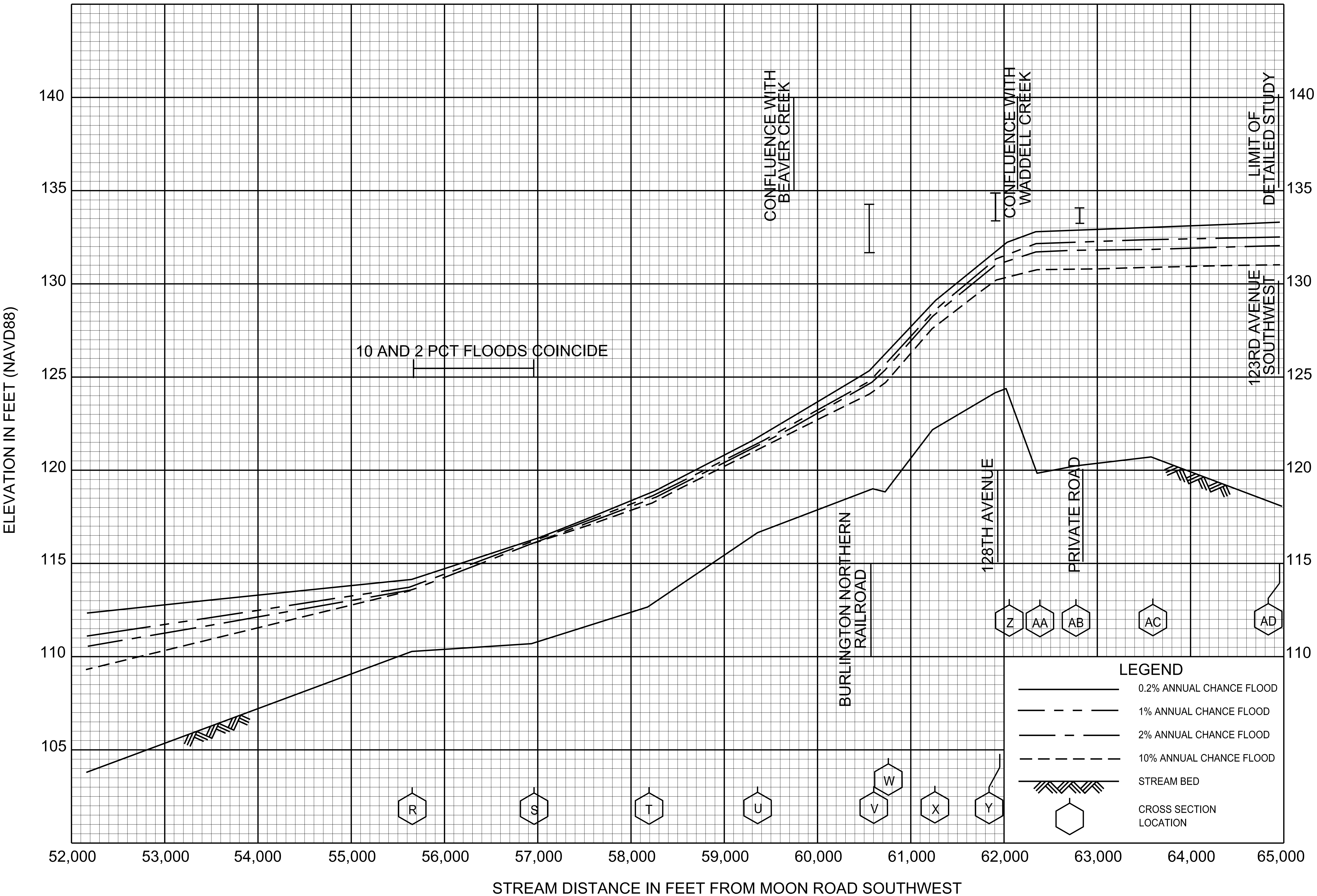
FLOOD PROFILES

BLACK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA AND INCORPORATED AREAS

01P



FLOOD PROFILES

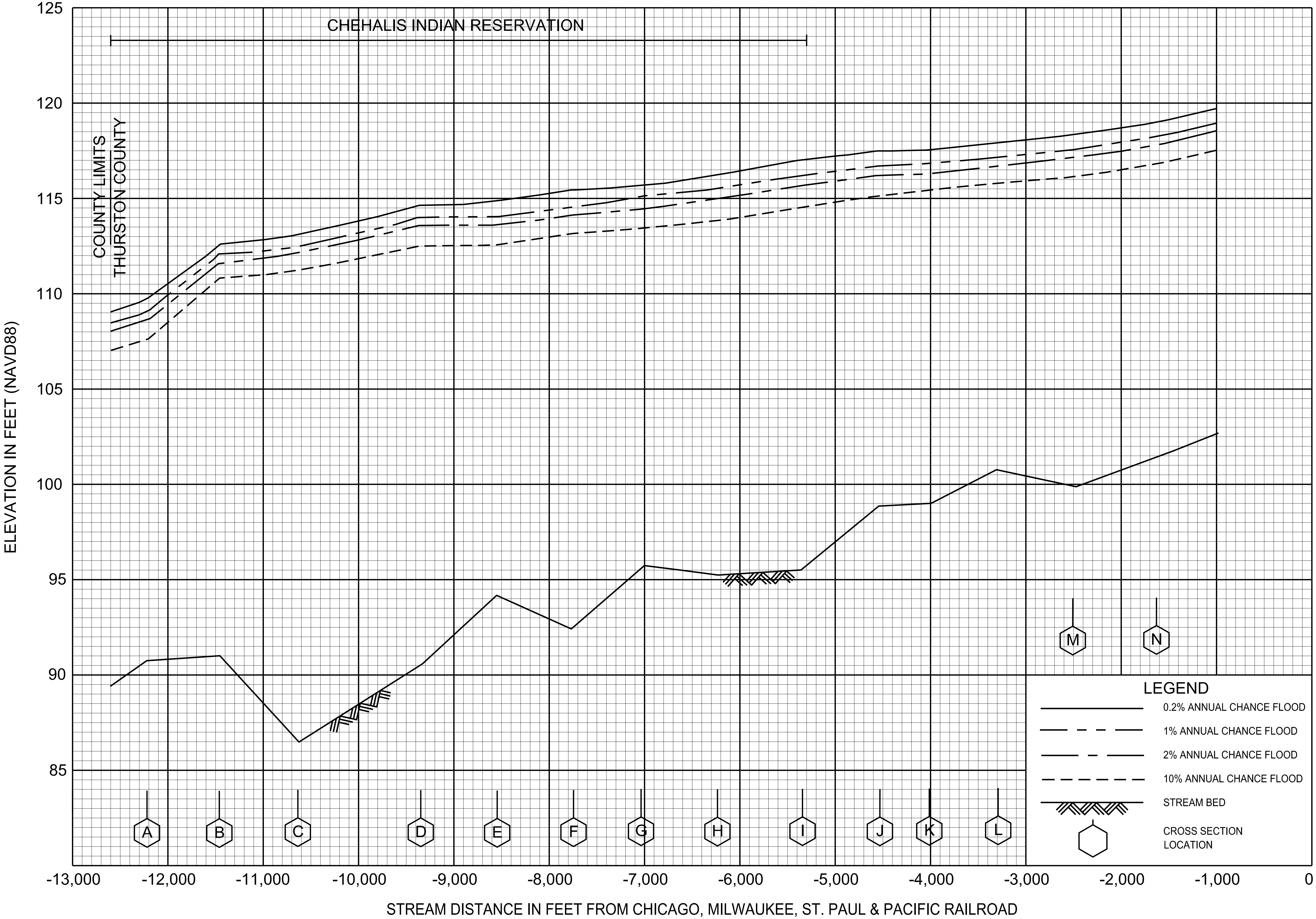
BLACK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

02P



FLOOD PROFILES

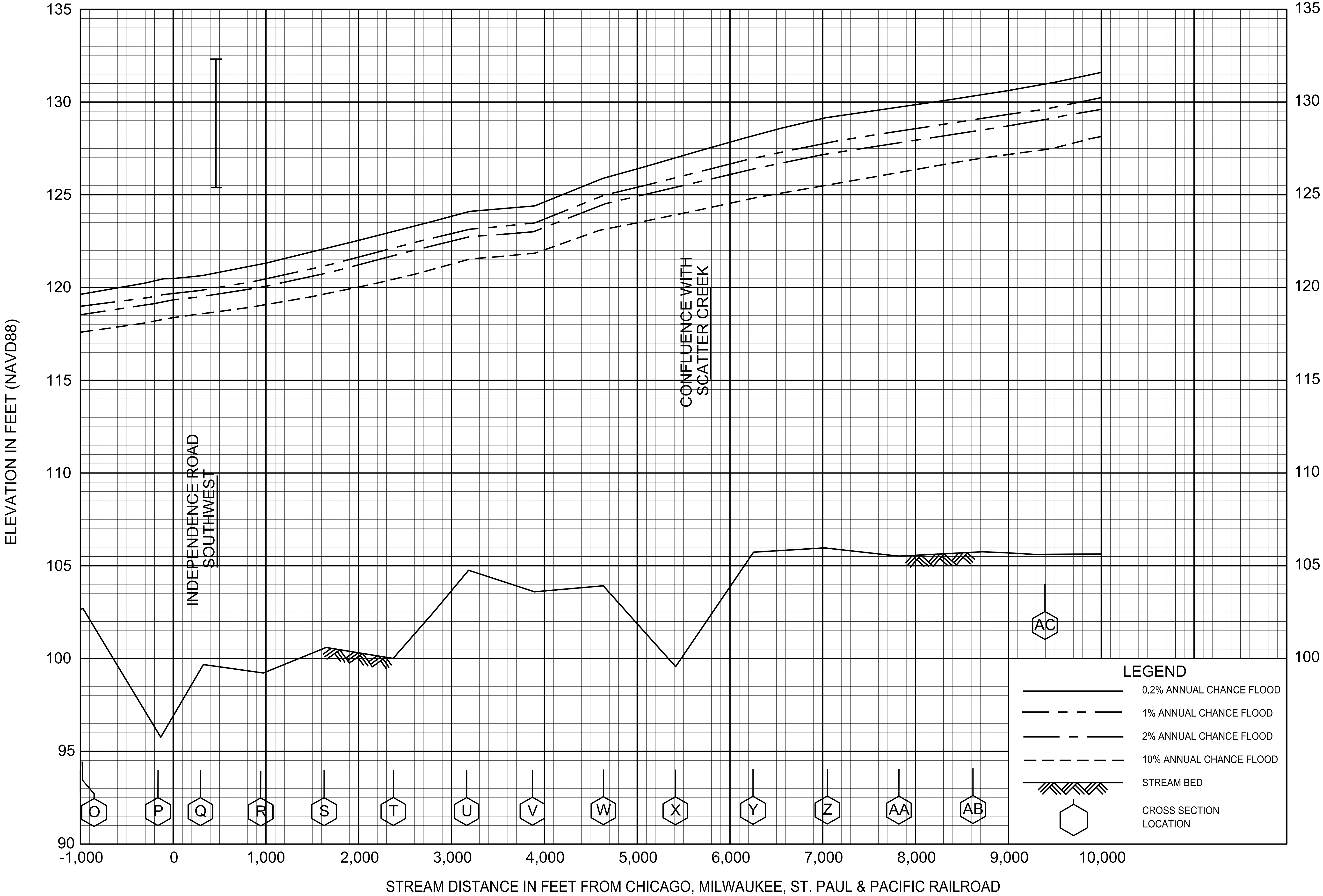
CHEHALIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

03P



FLOOD PROFILES

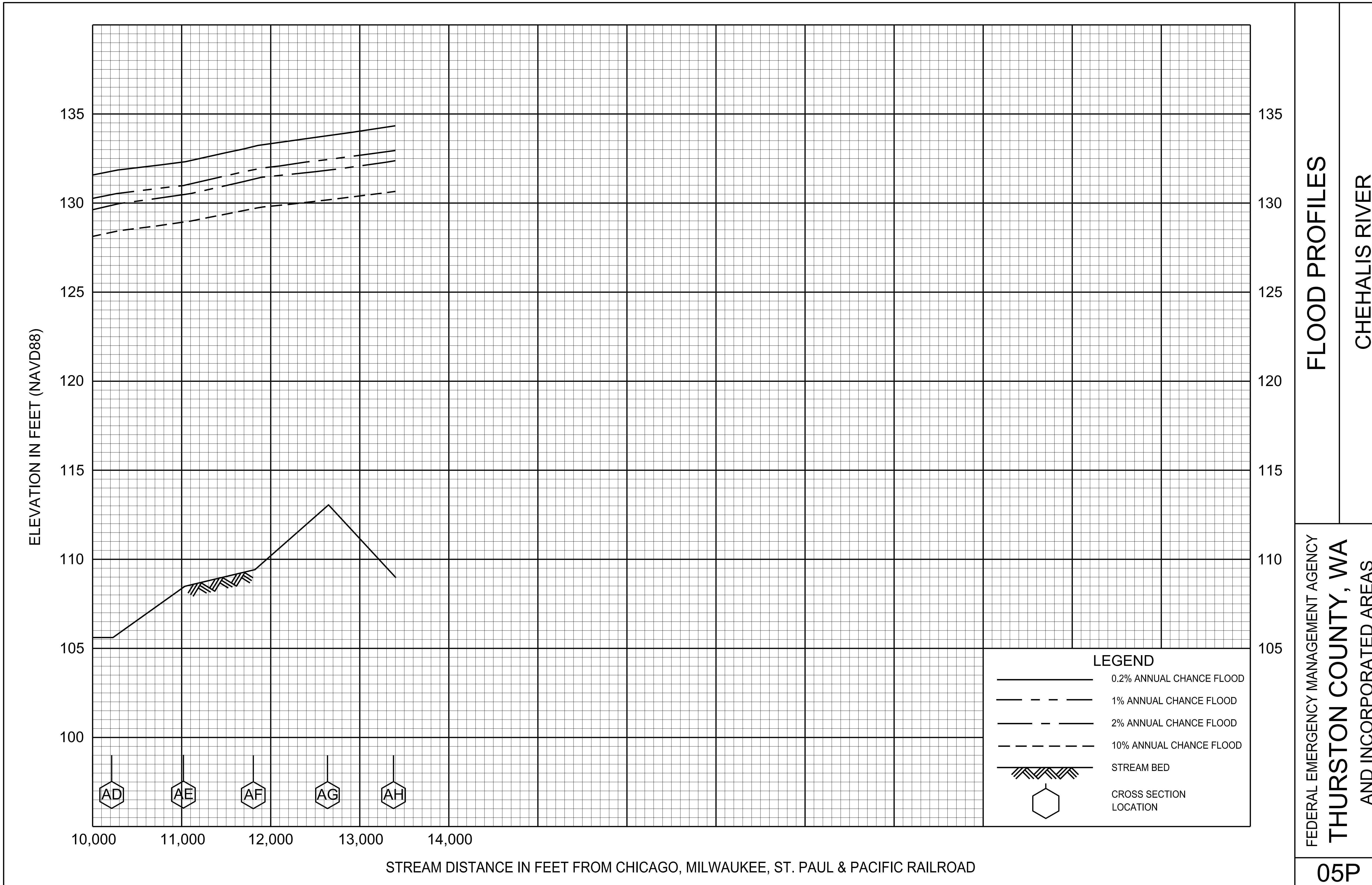
CHEHALIS RIVER

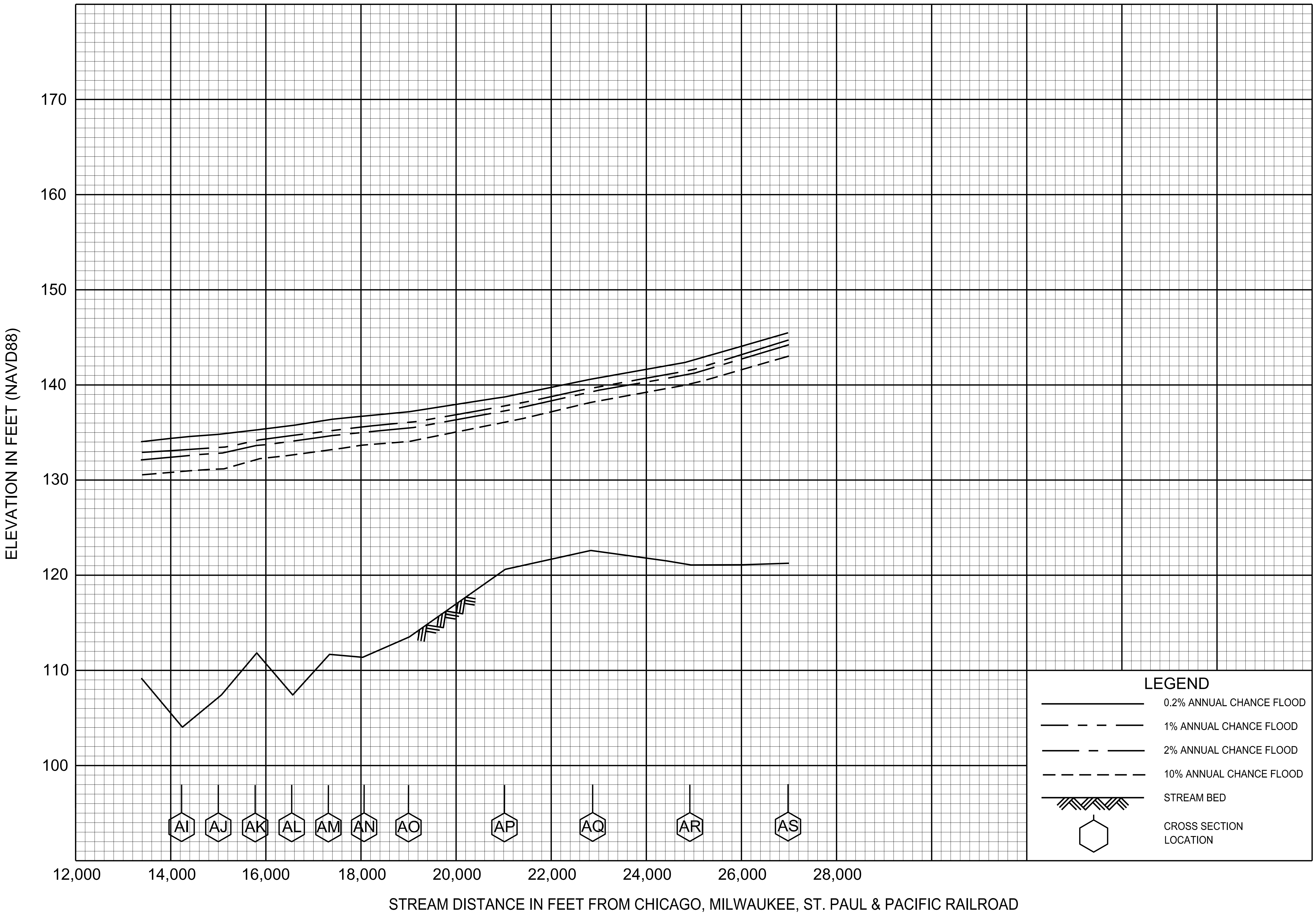
FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

04P


135
130
125
120
115
110
105
100
ELEVATION IN FEET (NAVD88)
AD
AE
AF
AG
AH
10,000
11,000
12,000
13,000
14,000
STREAM DISTANCE IN FEET FROM CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC RAILROAD
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION
FLOOD PROFILES
CHEHALIS RIVER
FEDERAL EMERGENCY MANAGEMENT AGENCY
THURSTON COUNTY, WA
AND INCORPORATED AREAS
05P



FLOOD PROFILES

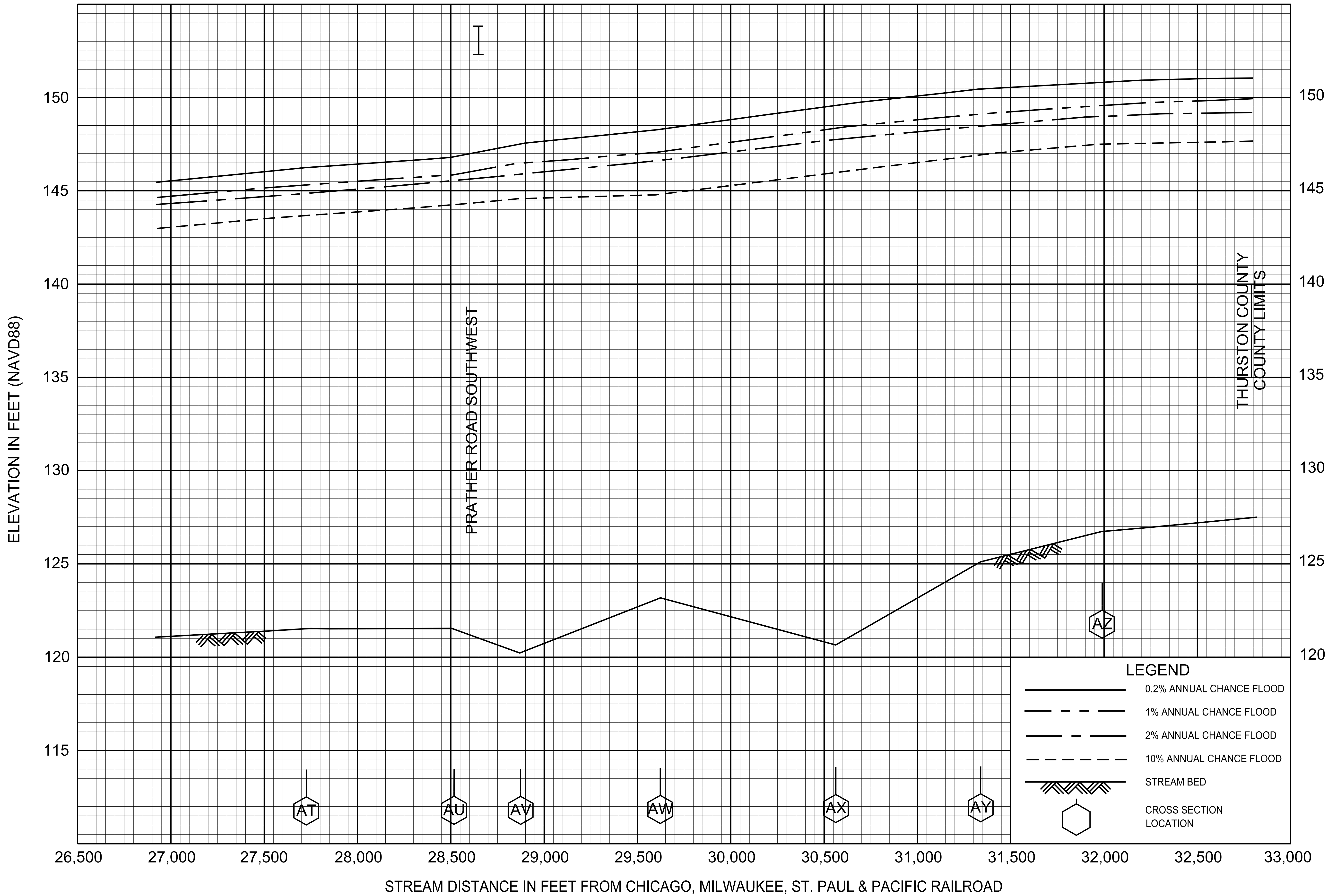
CHEHALIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

06P



FLOOD PROFILES

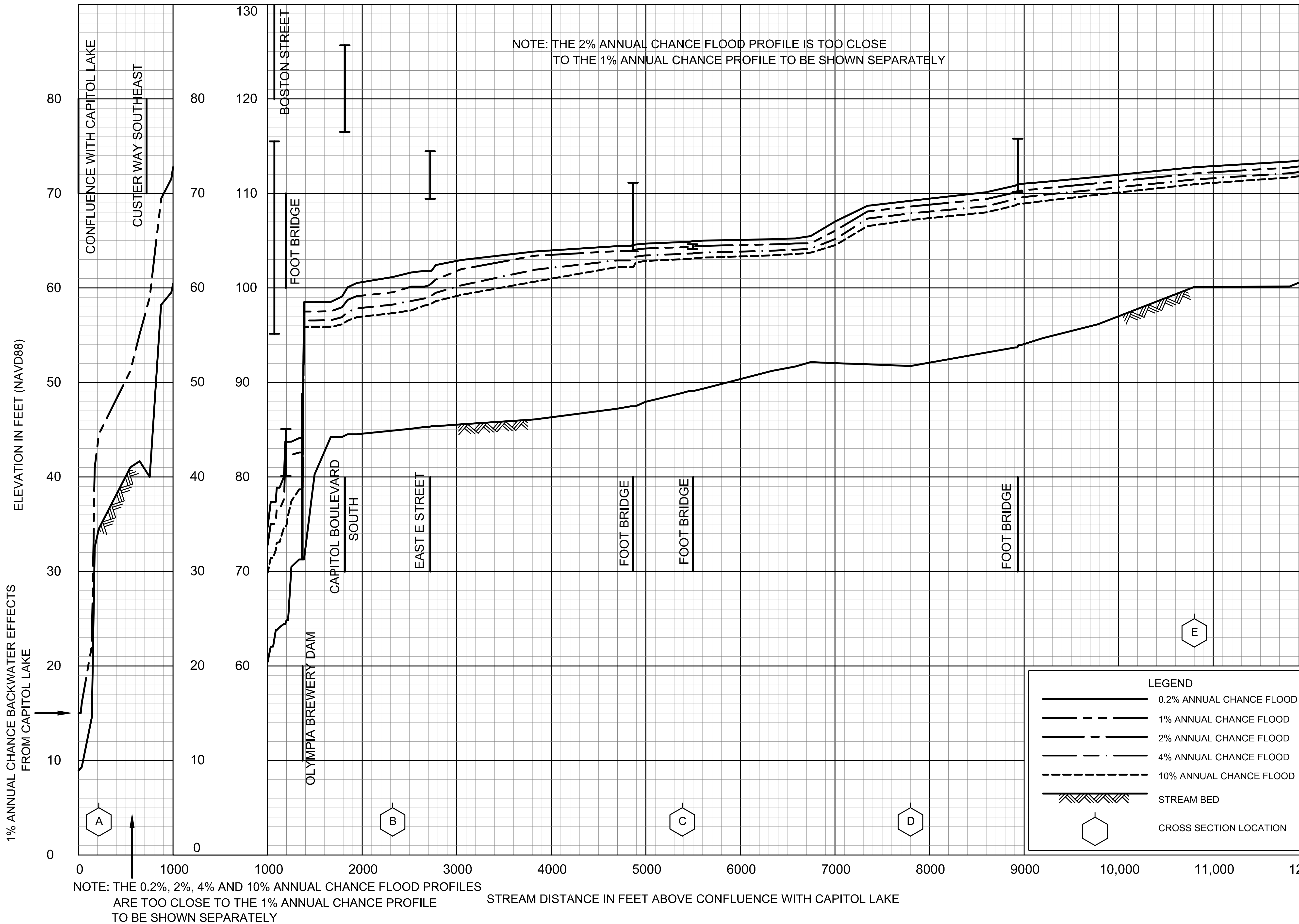
CHEHALIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

07P



FLOOD PROFILES

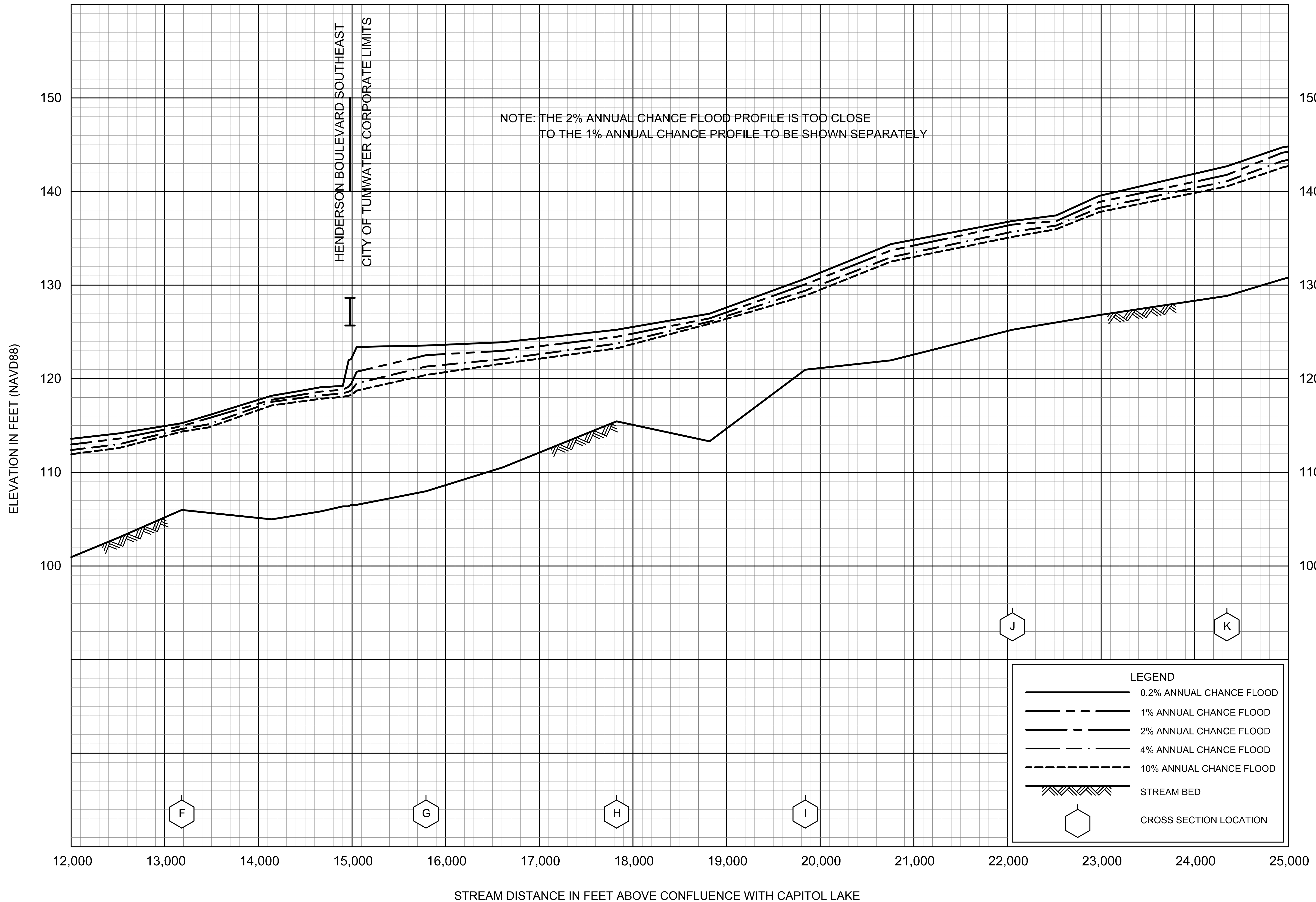
DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

08P



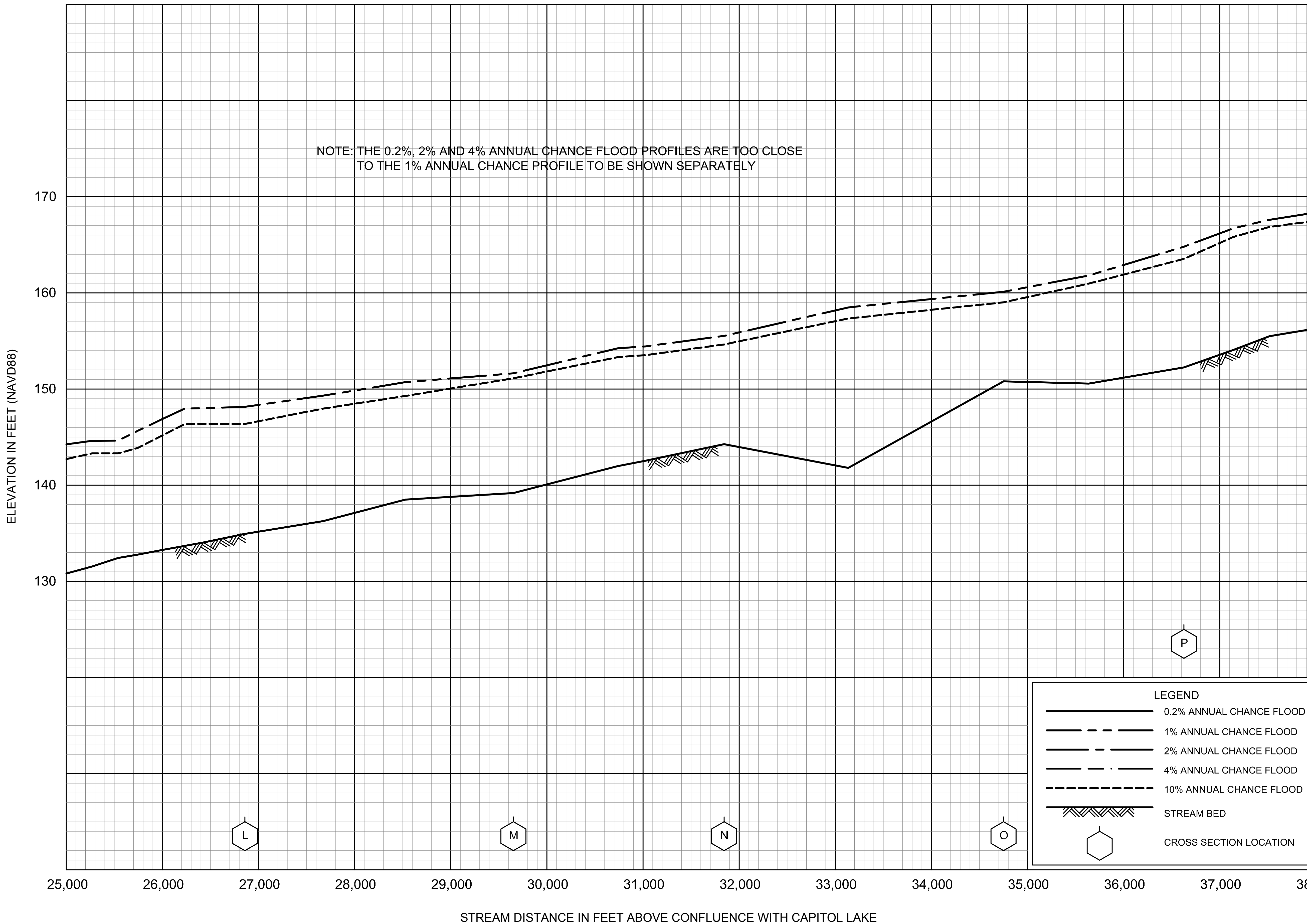
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



FLOOD PROFILES

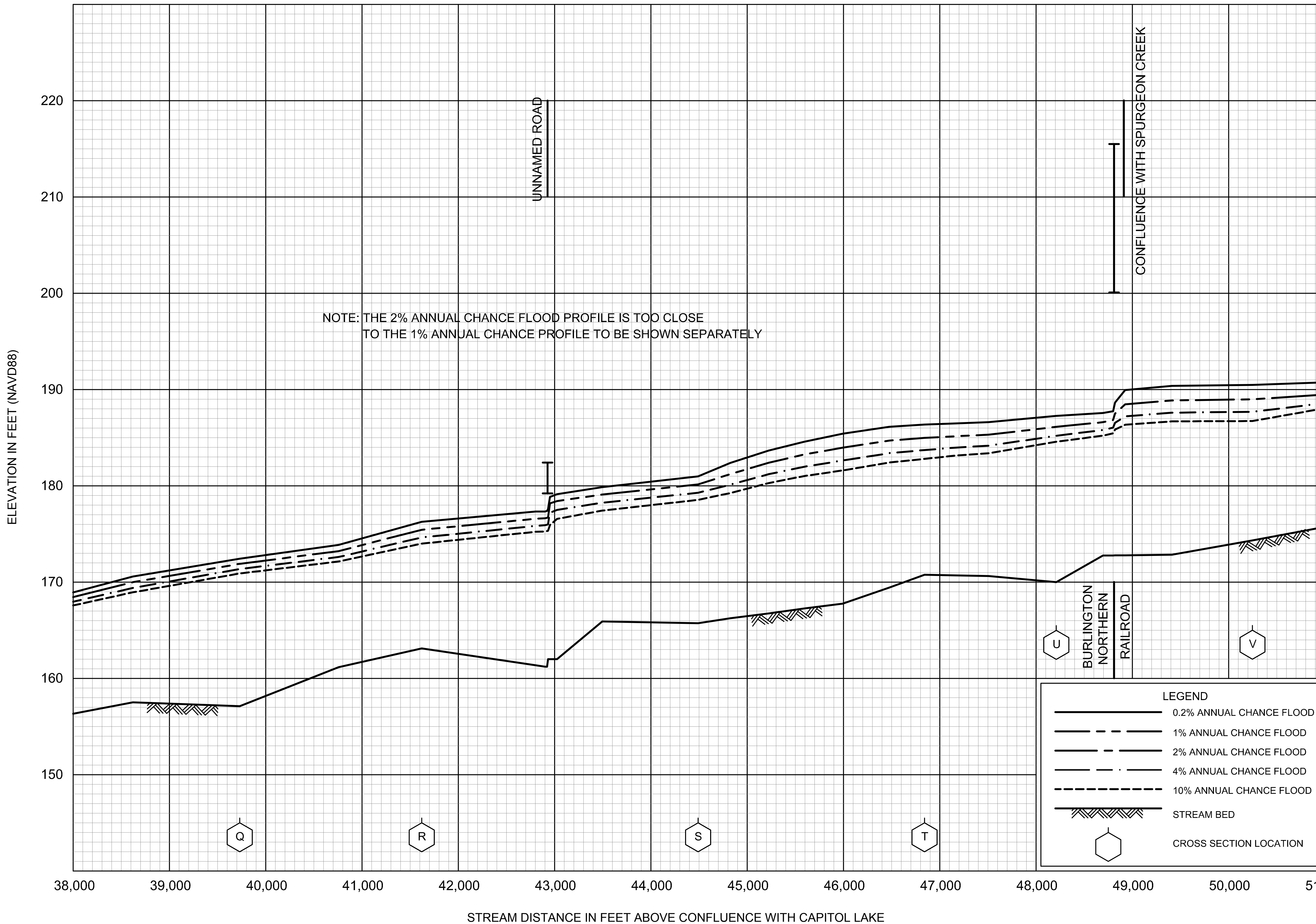
DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

10P



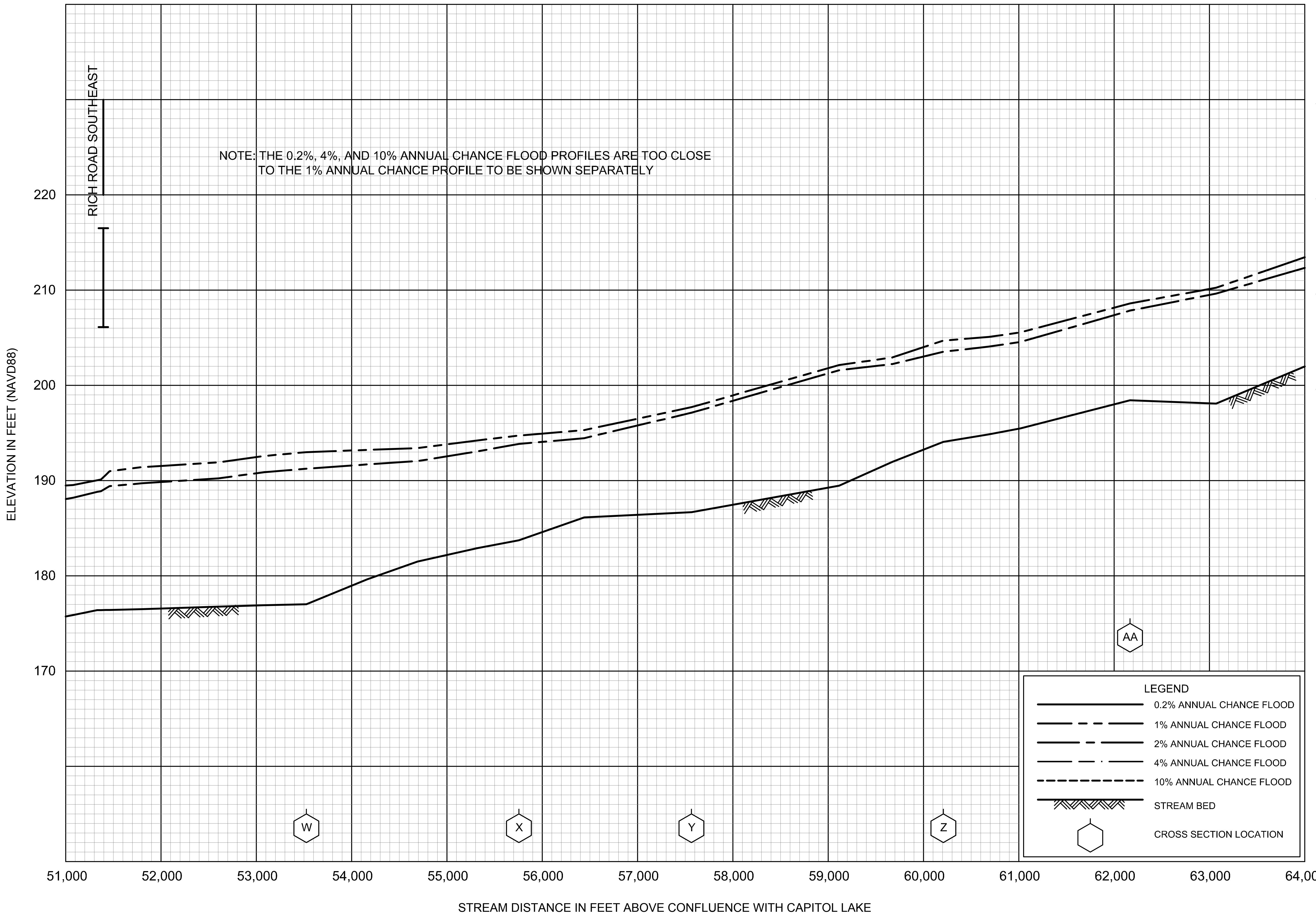
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



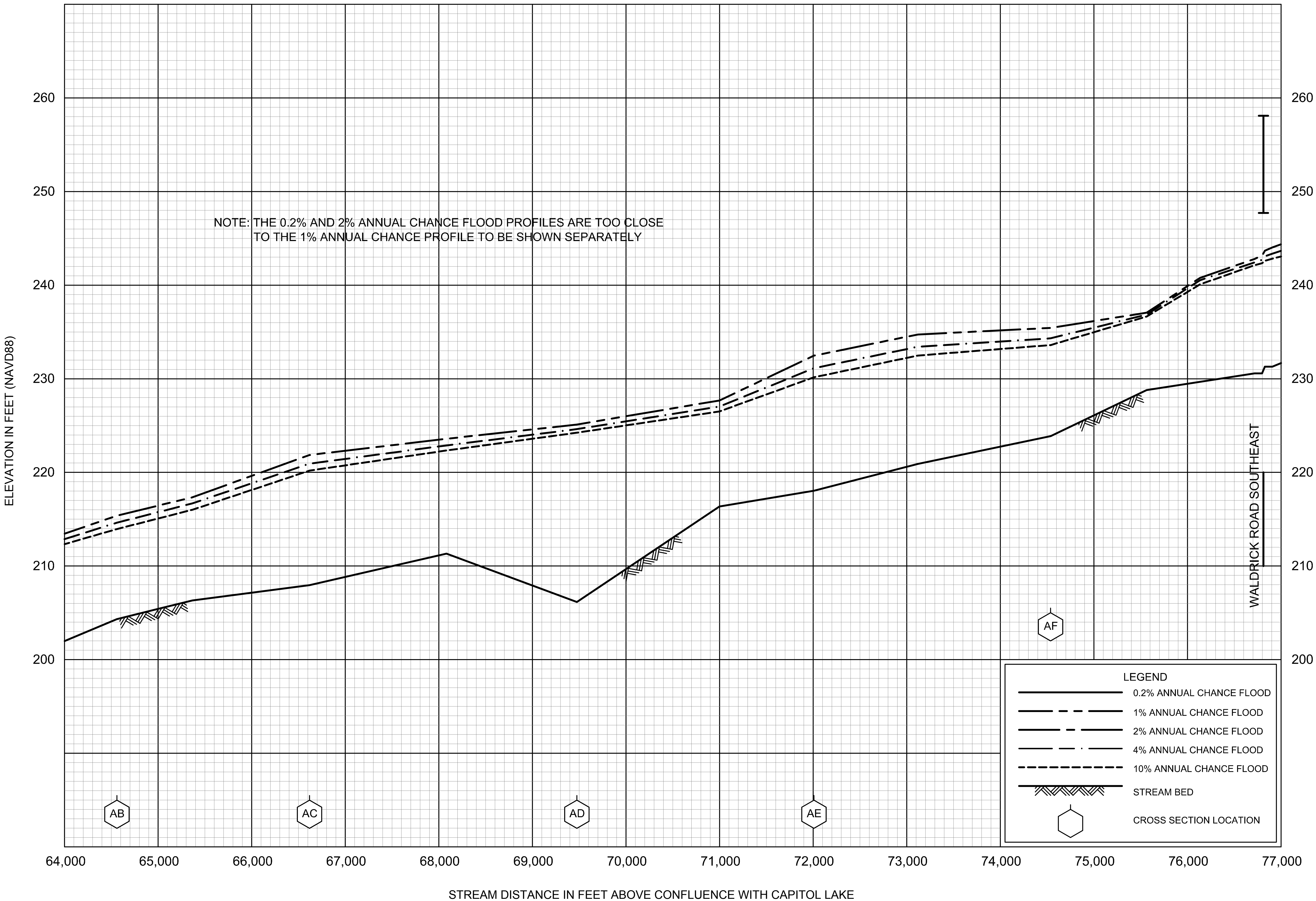
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



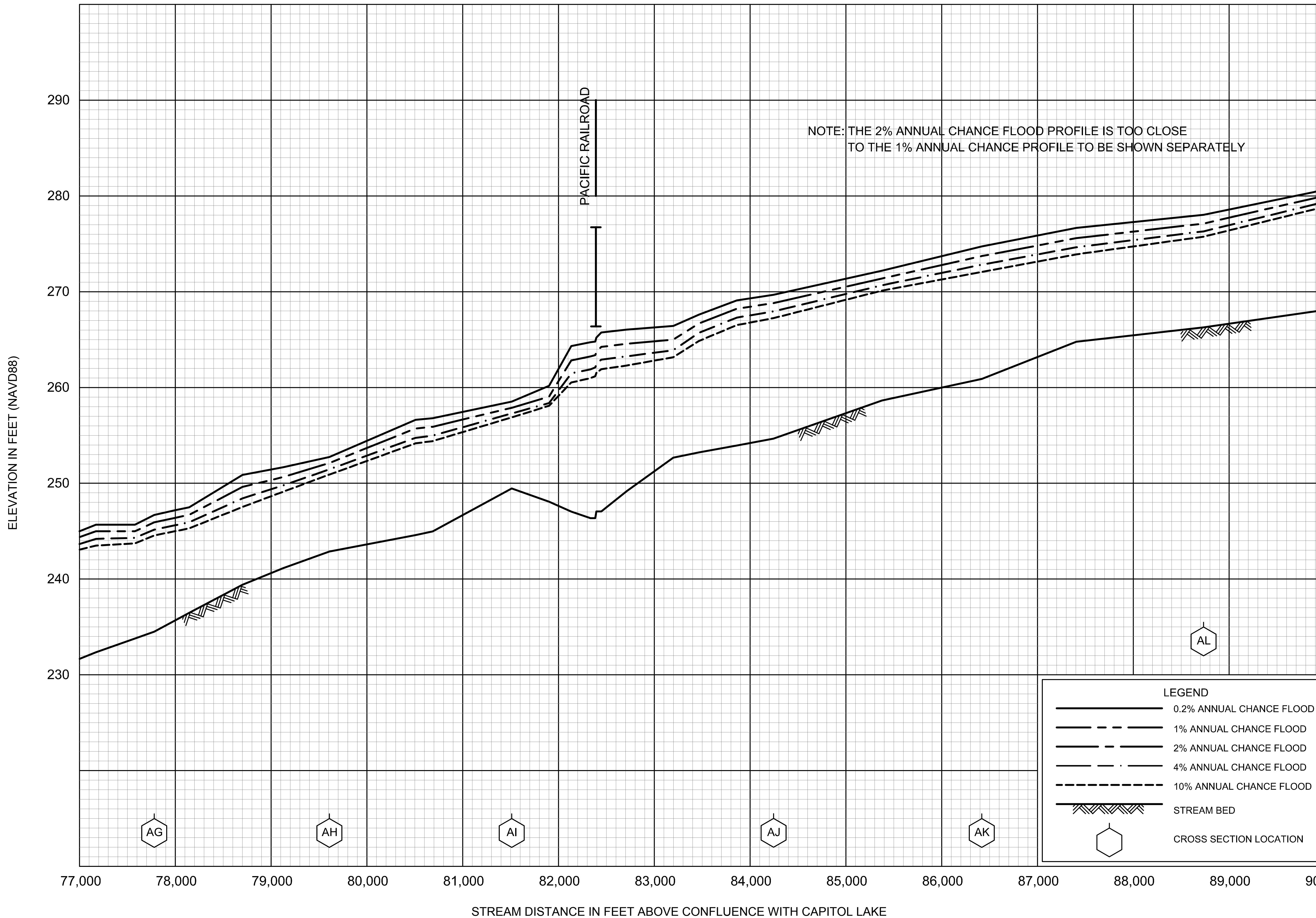
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



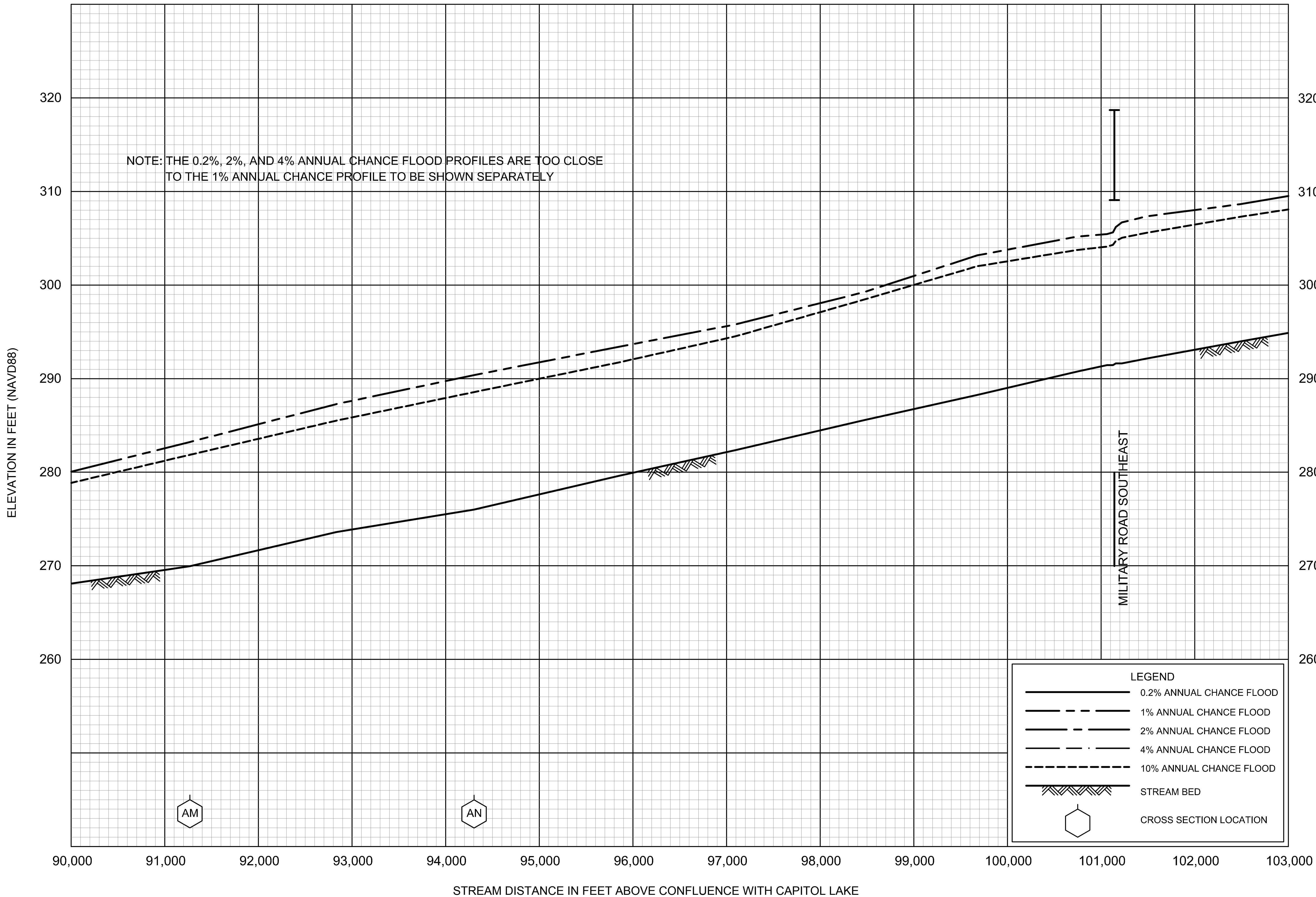
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



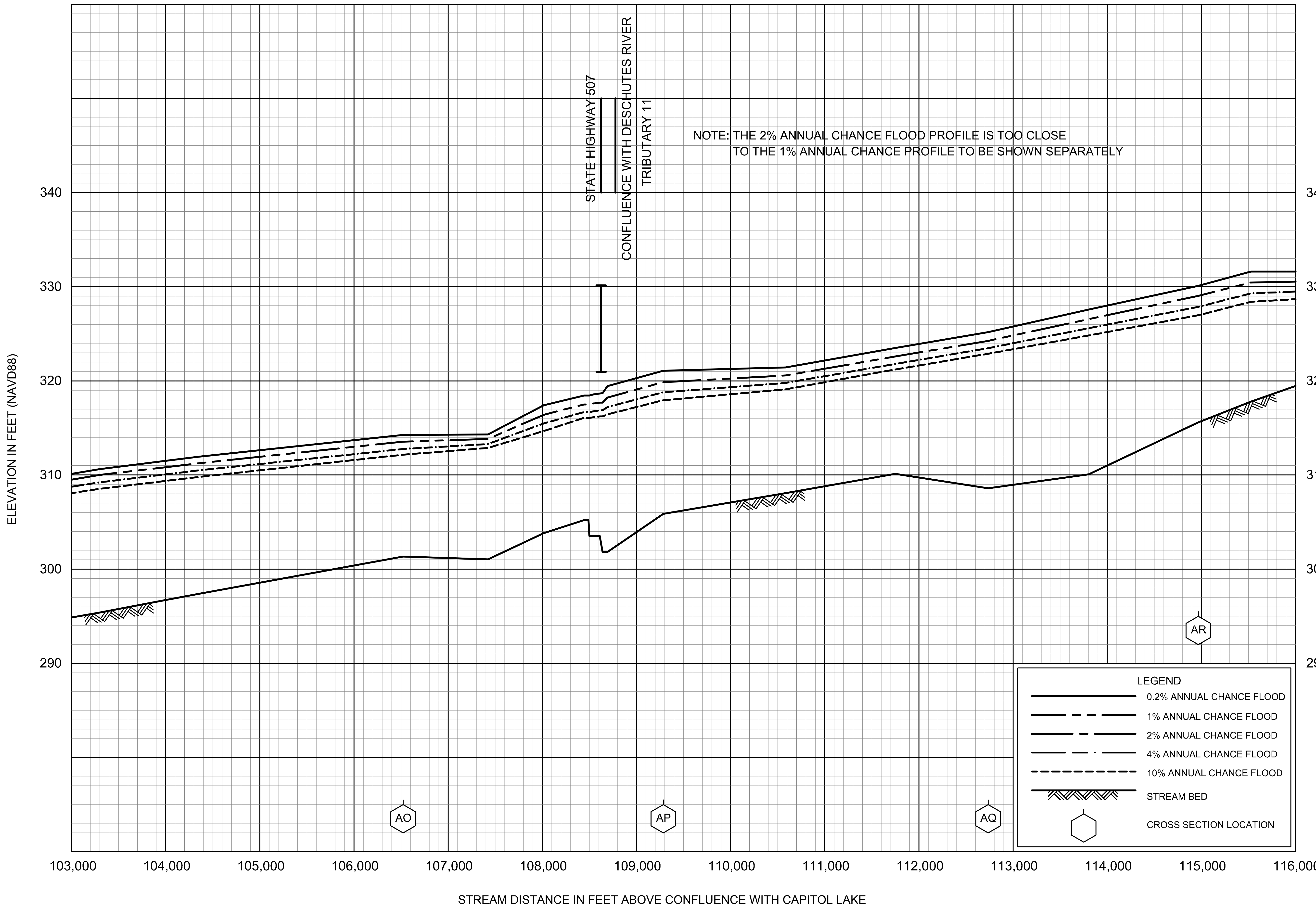
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



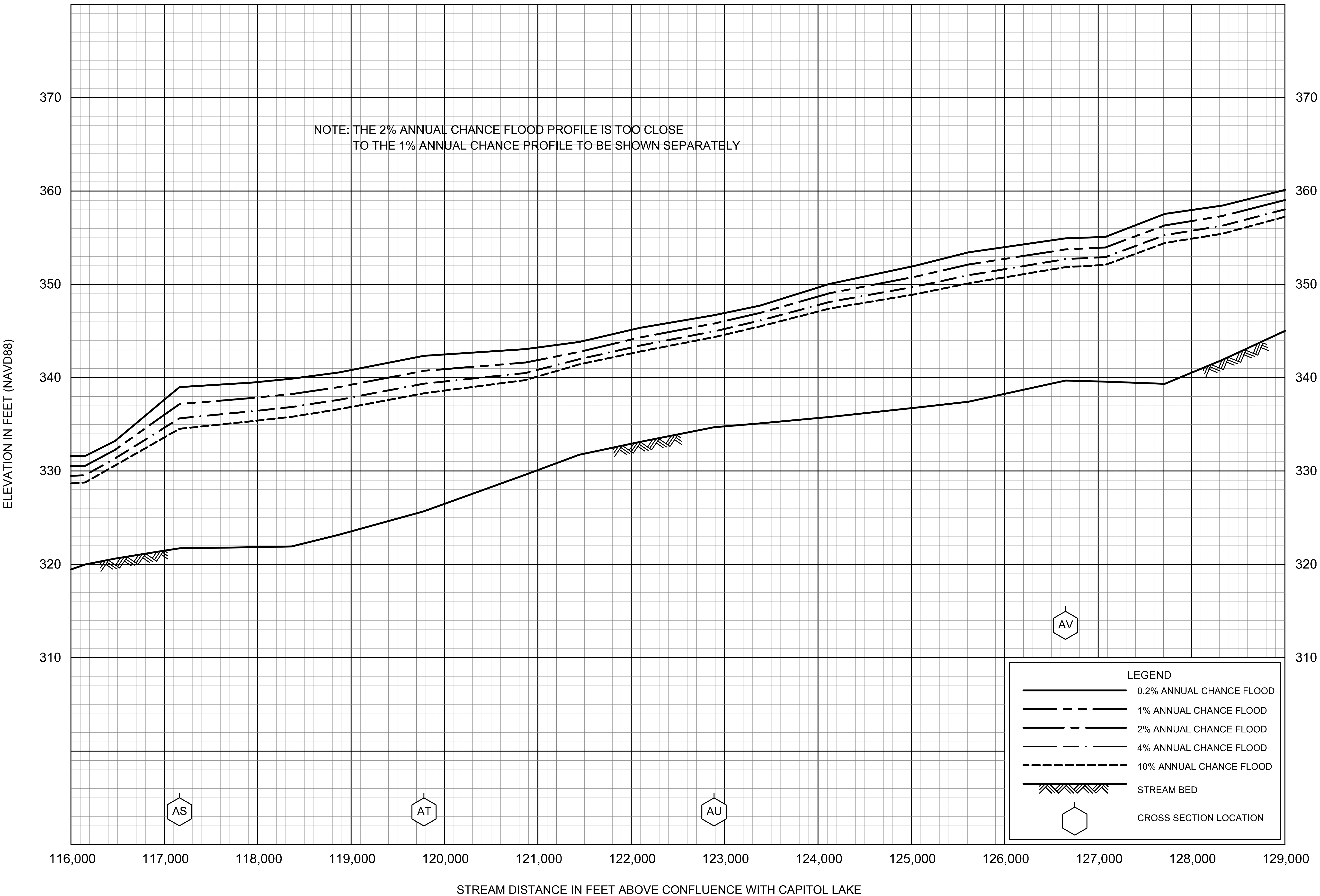
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



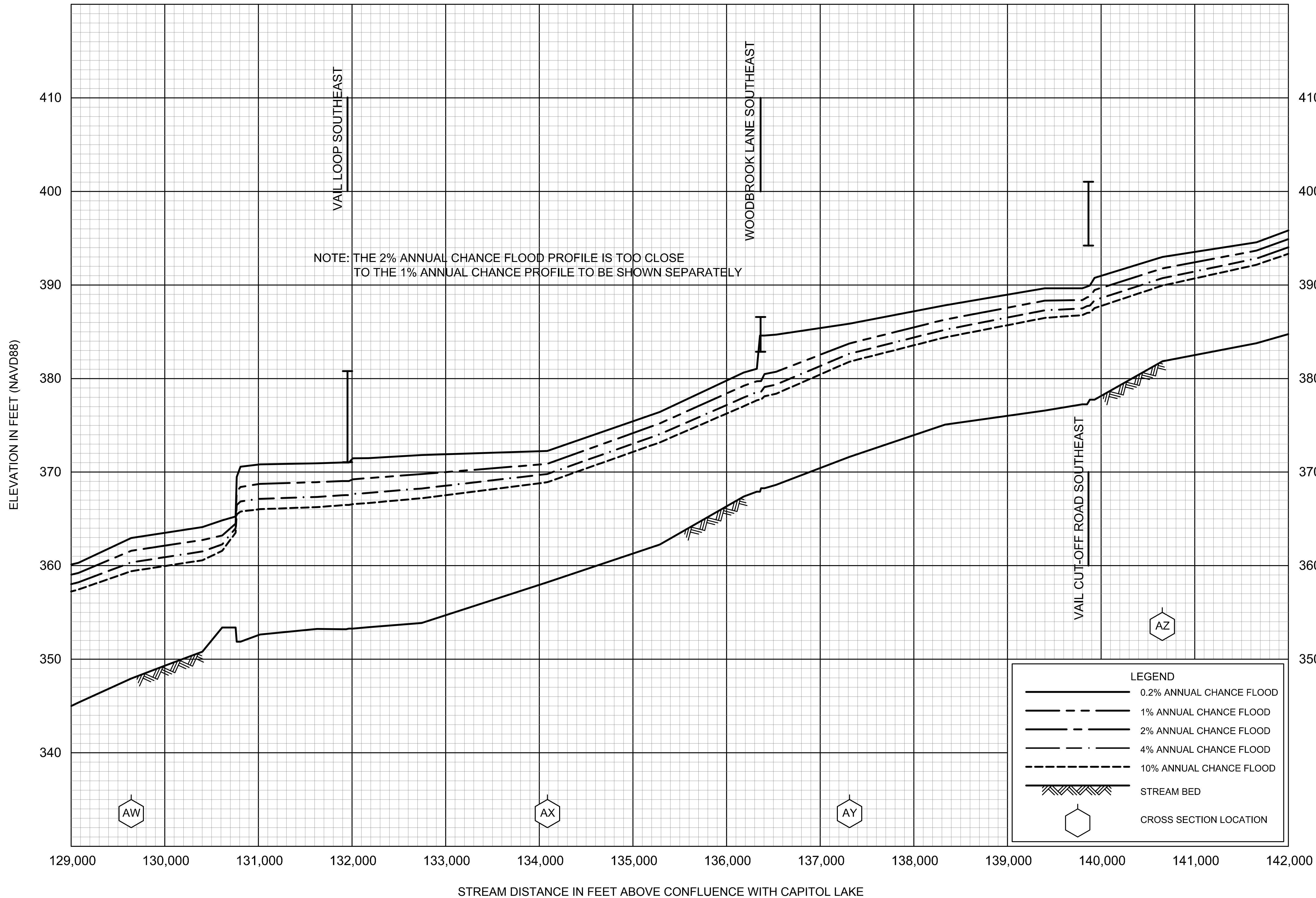
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



FLOOD PROFILES

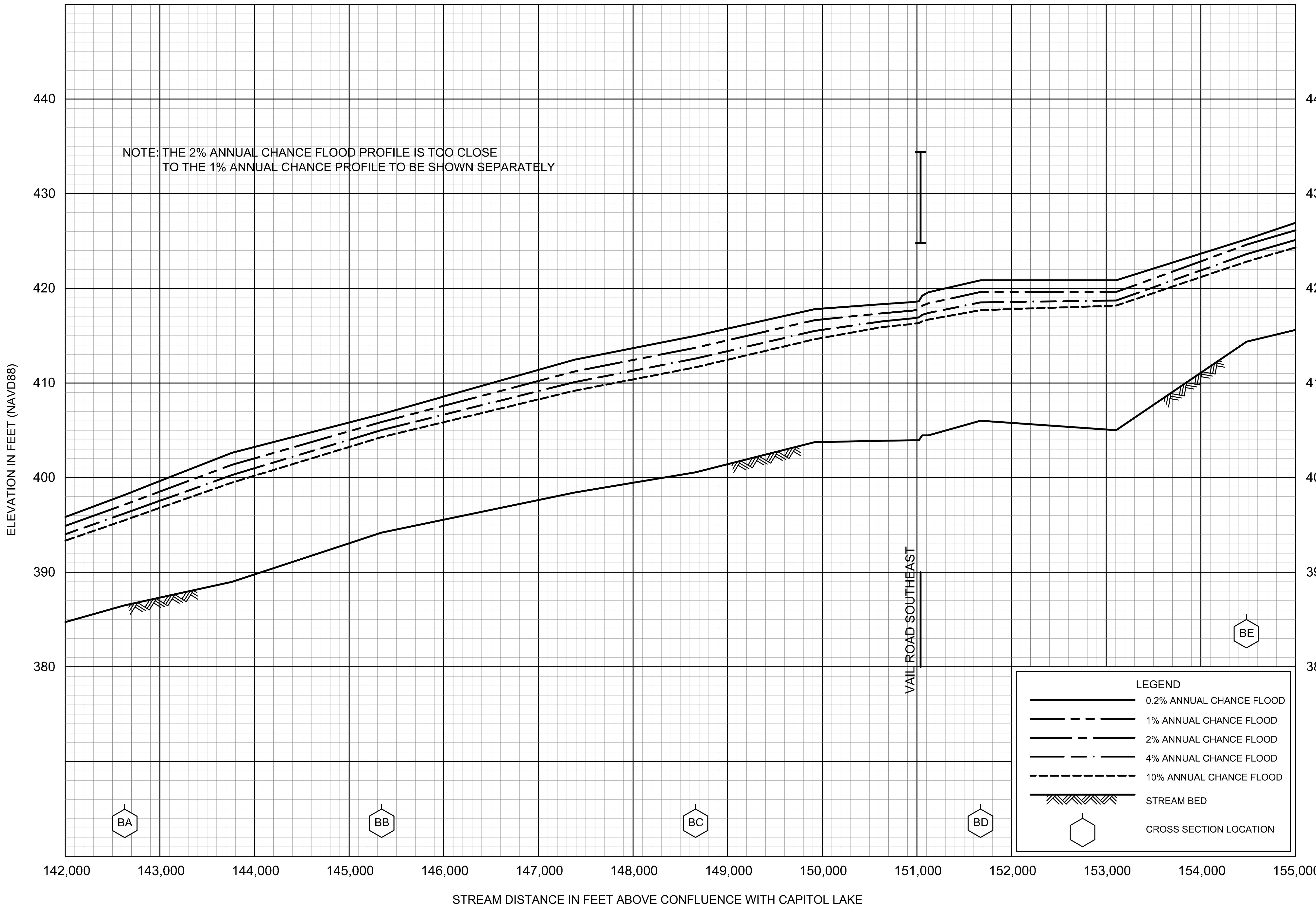
DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

18P



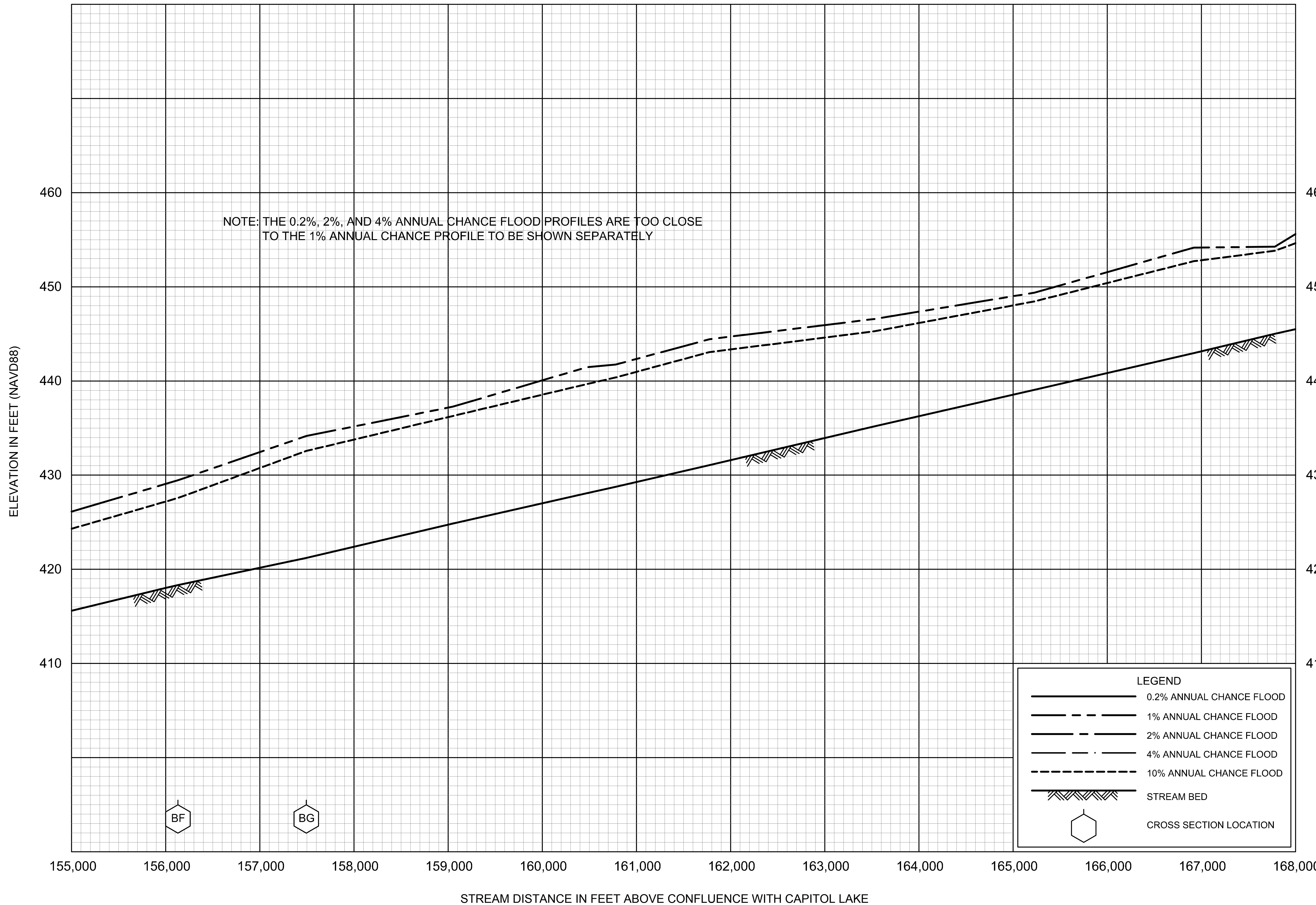
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



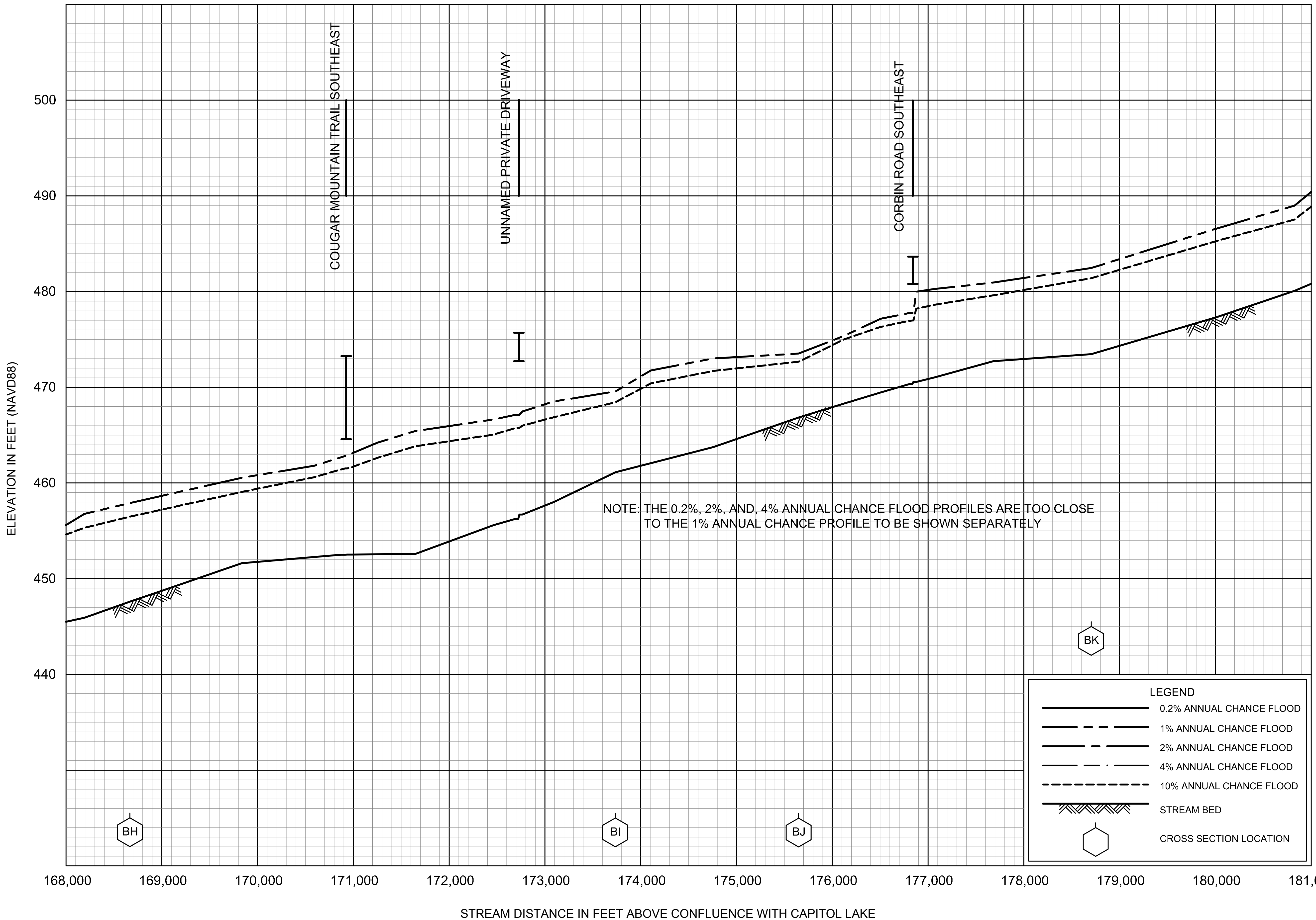
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



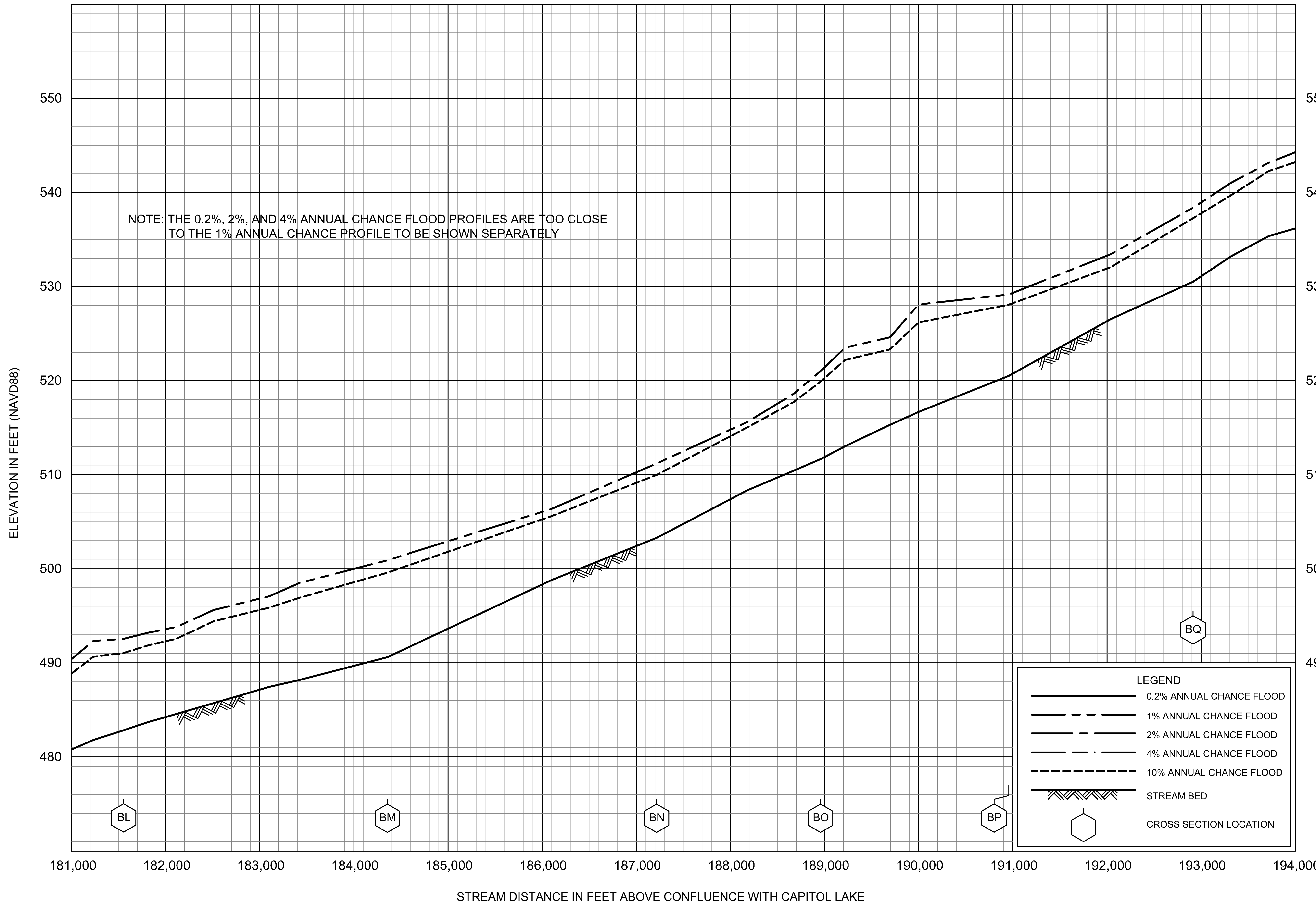
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



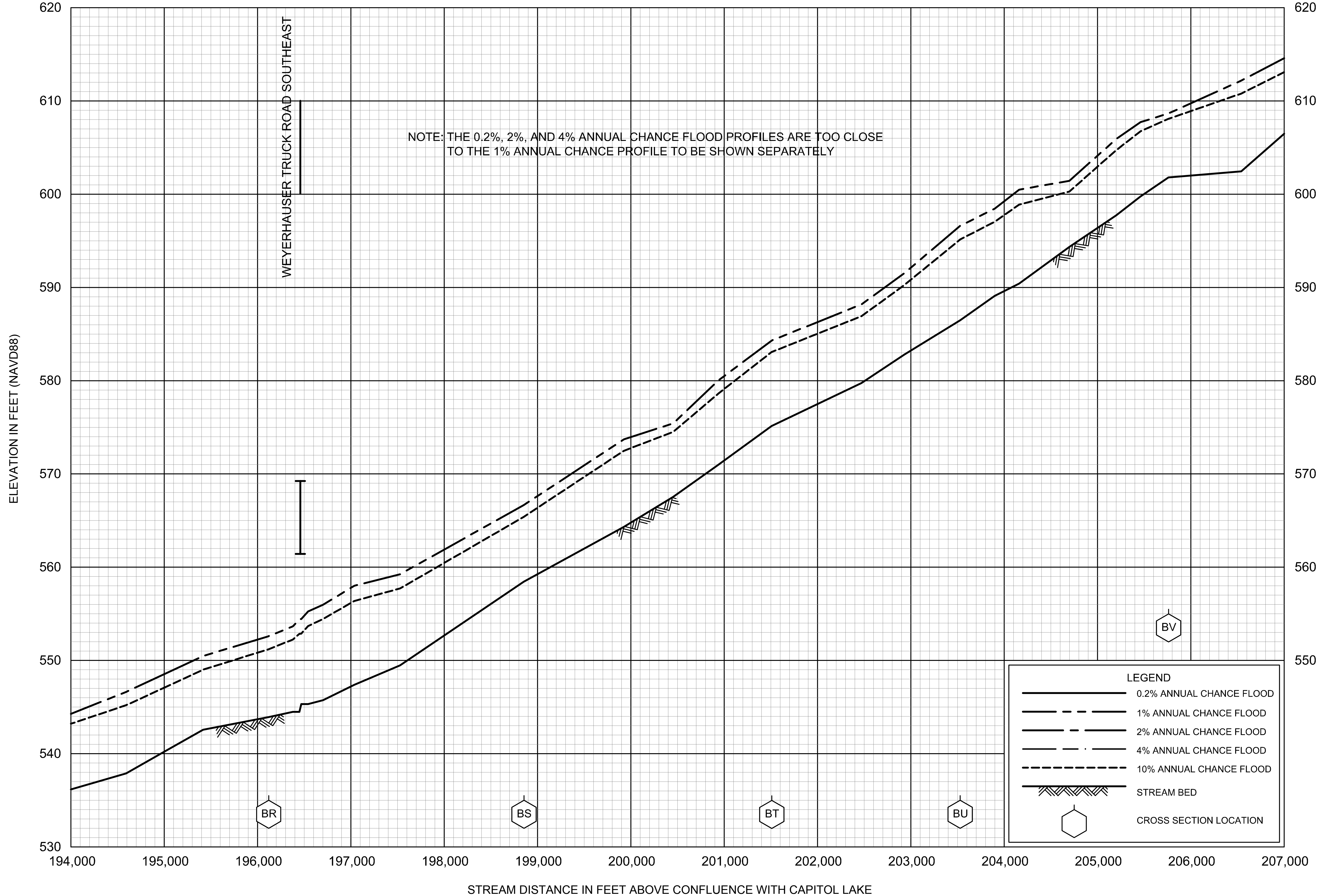
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



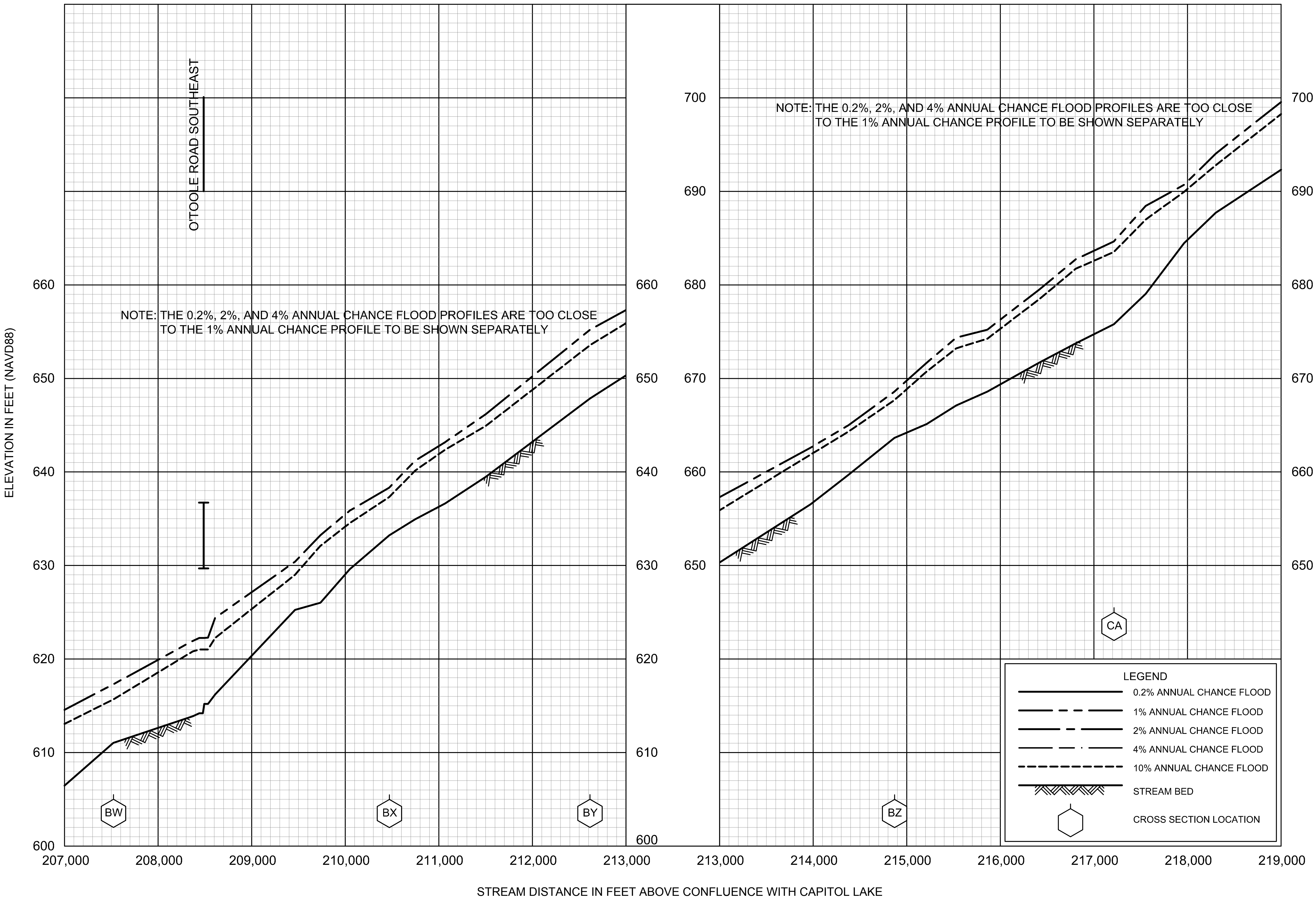
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



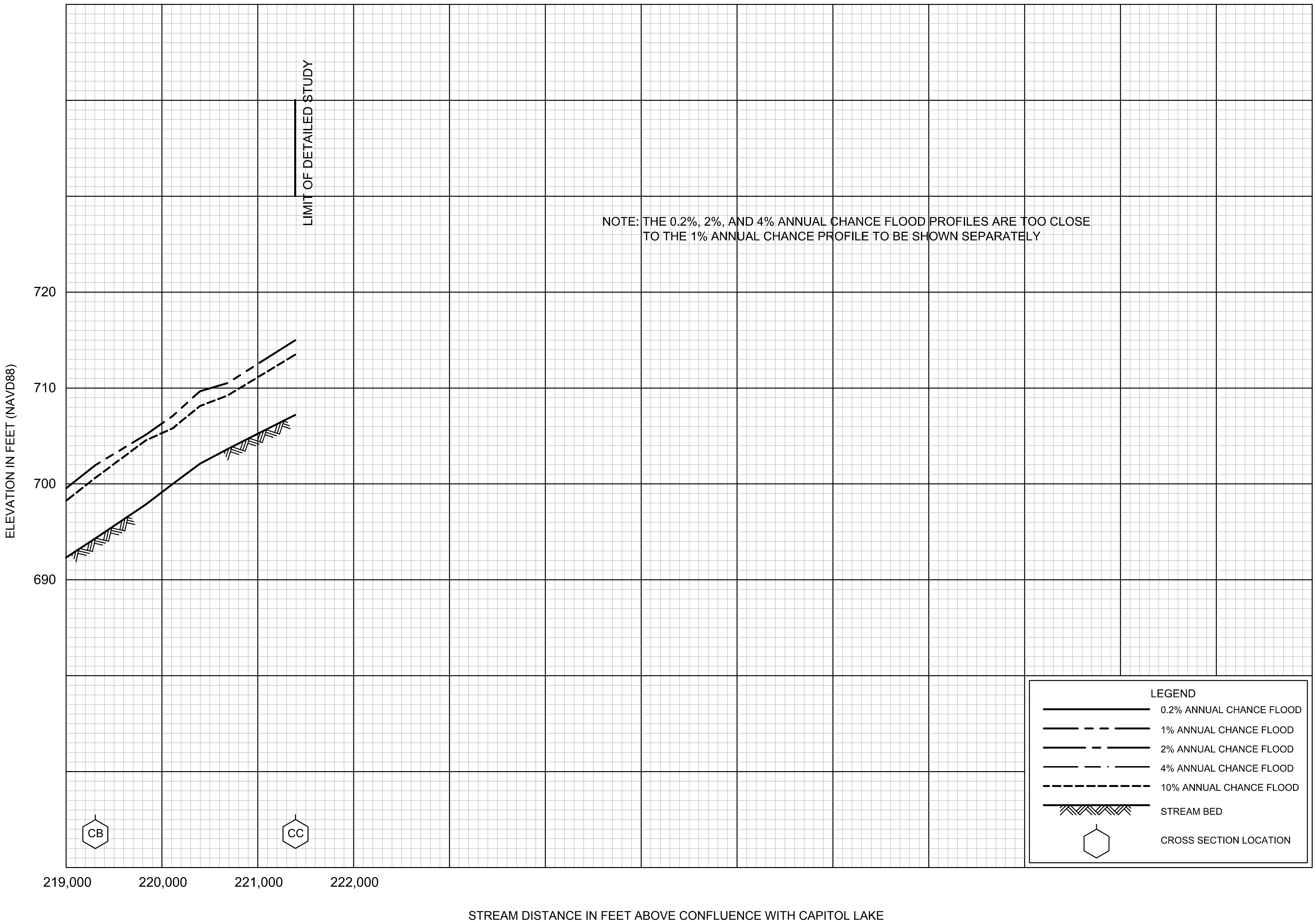
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



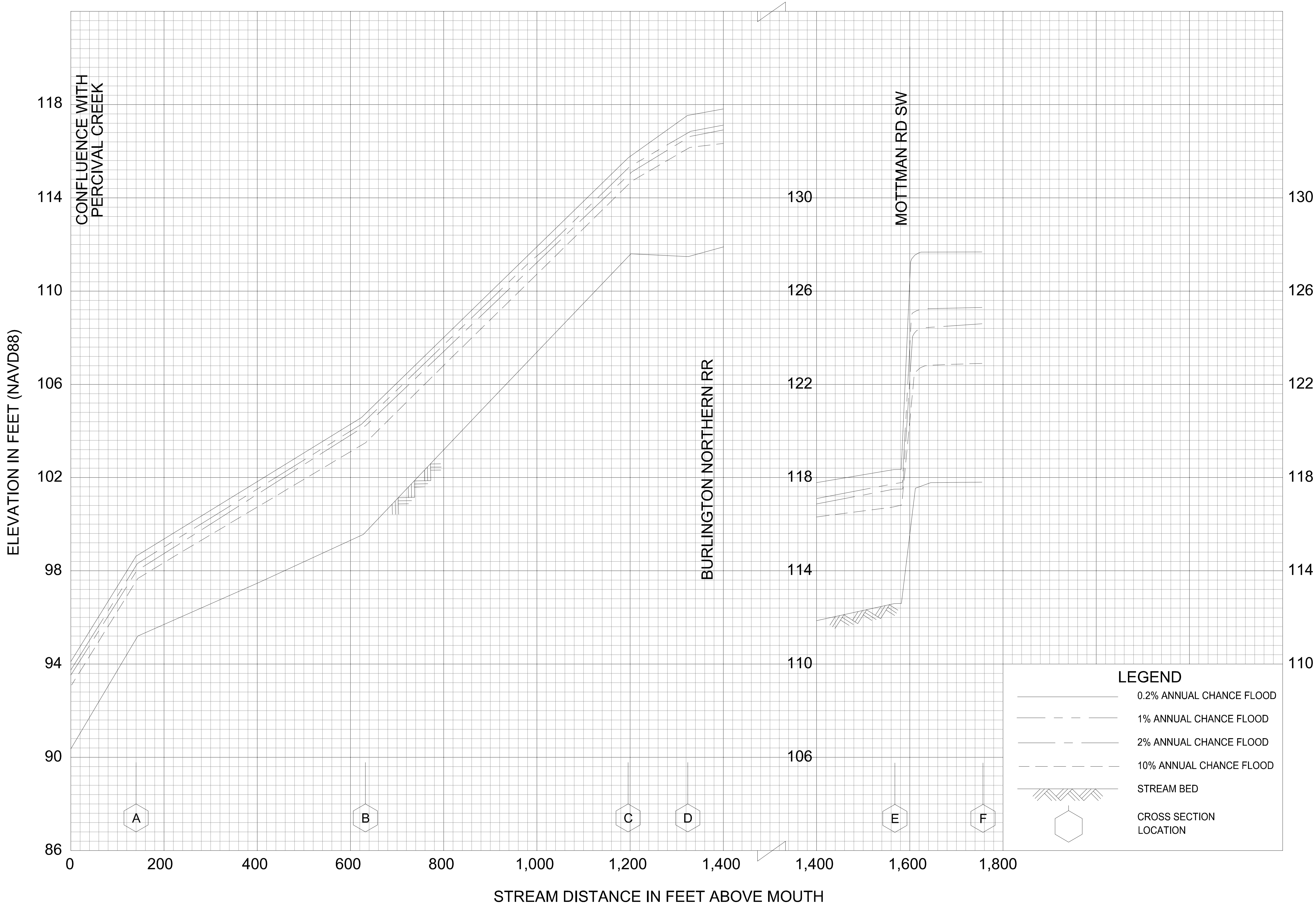
FLOOD PROFILES

DESCHUTES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

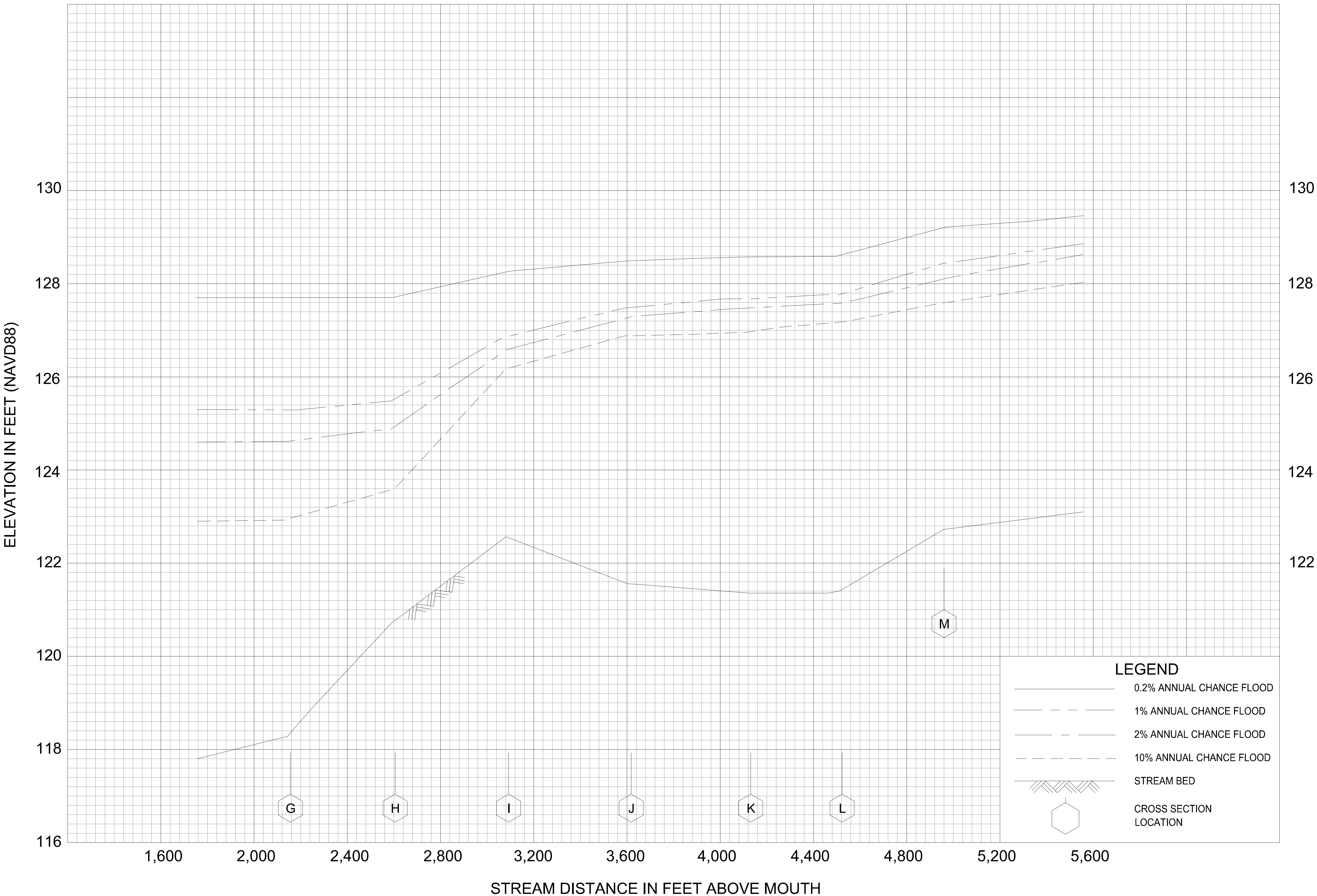


FLOOD PROFILES

OUTLET OF BLACK LAKE

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA AND INCORPORATED AREAS

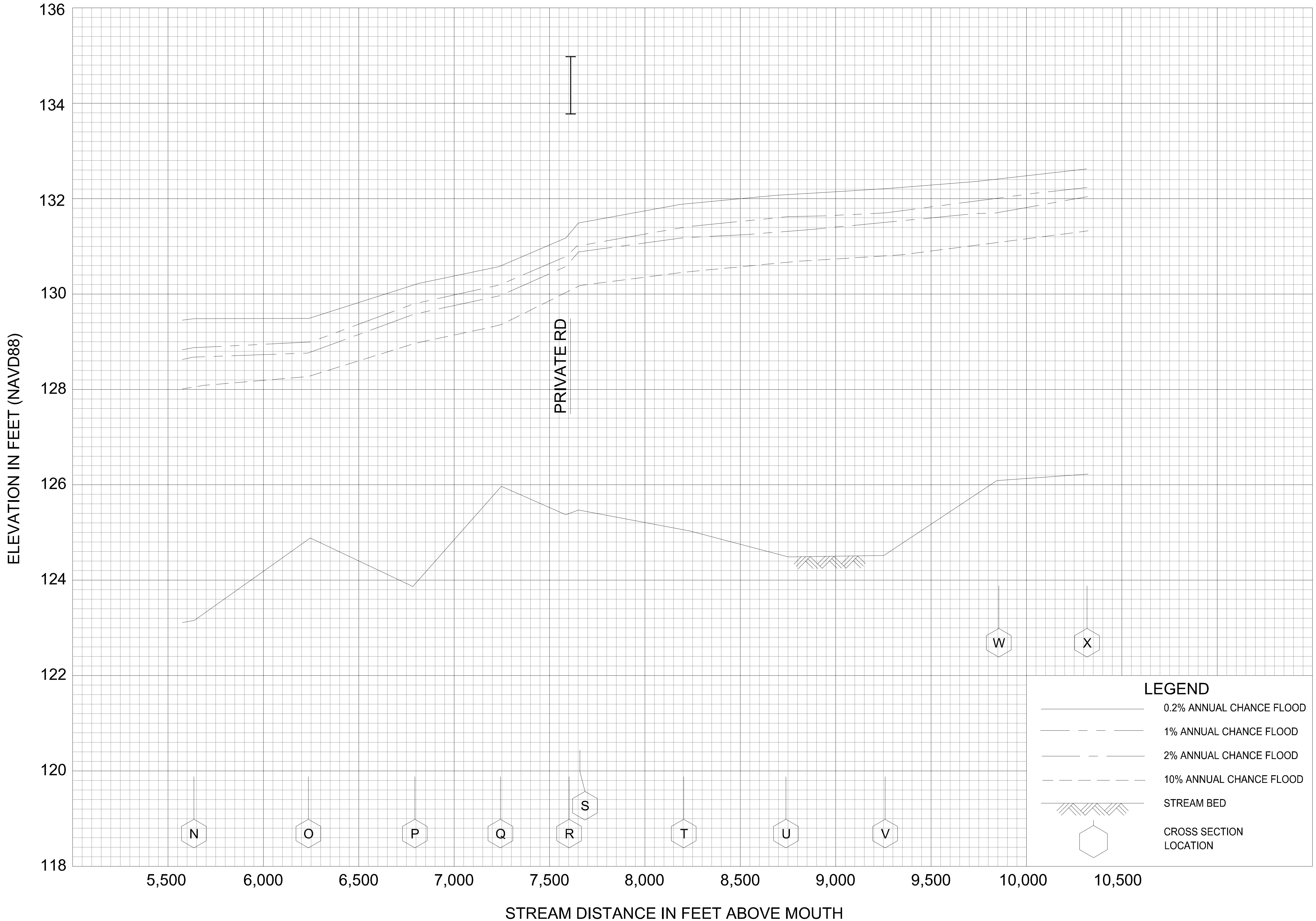


FLOOD PROFILES

OUTLET OF BLACK LAKE

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA AND INCORPORATED AREAS



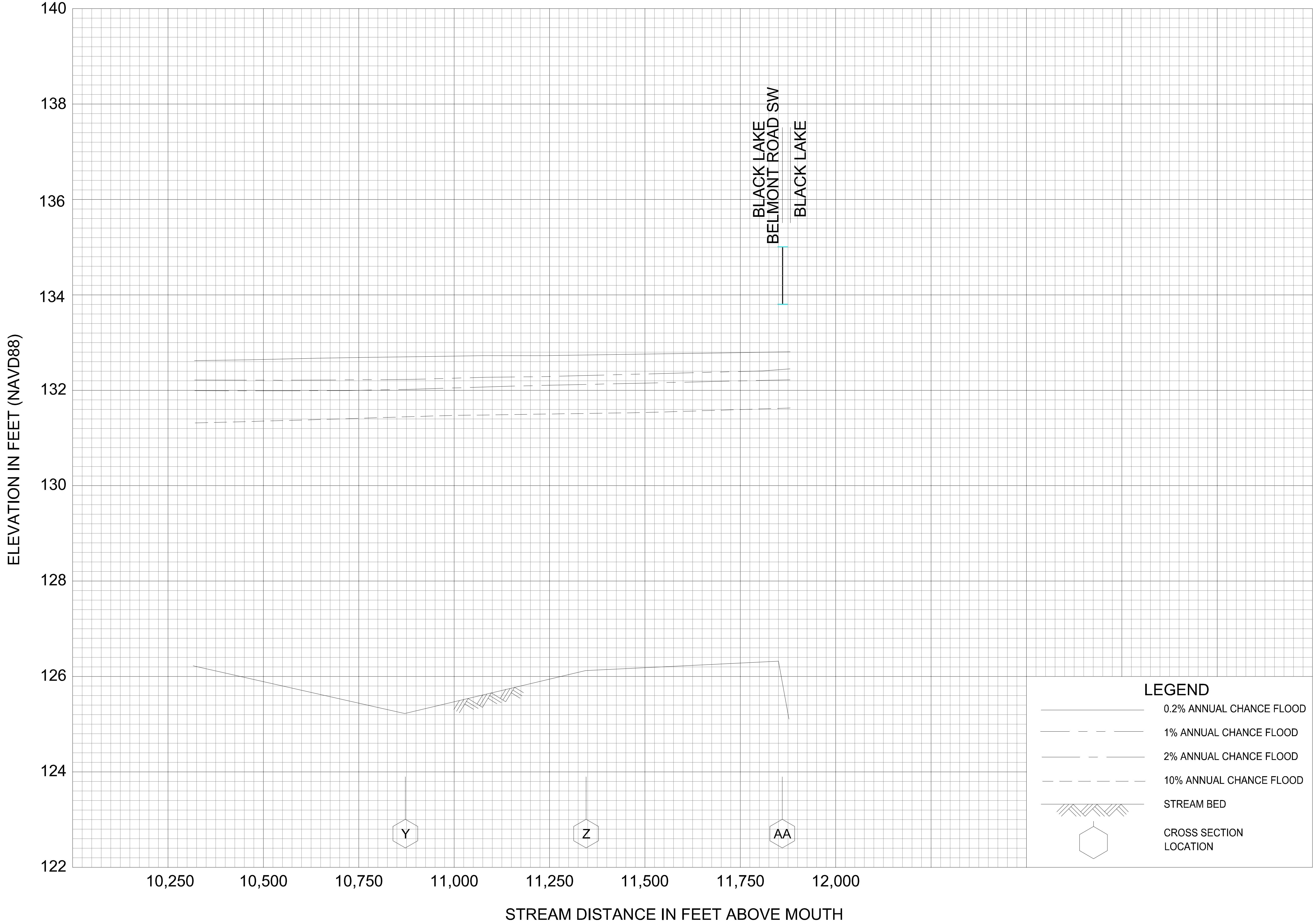
FLOOD PROFILES

OUTLET OF BLACK LAKE

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



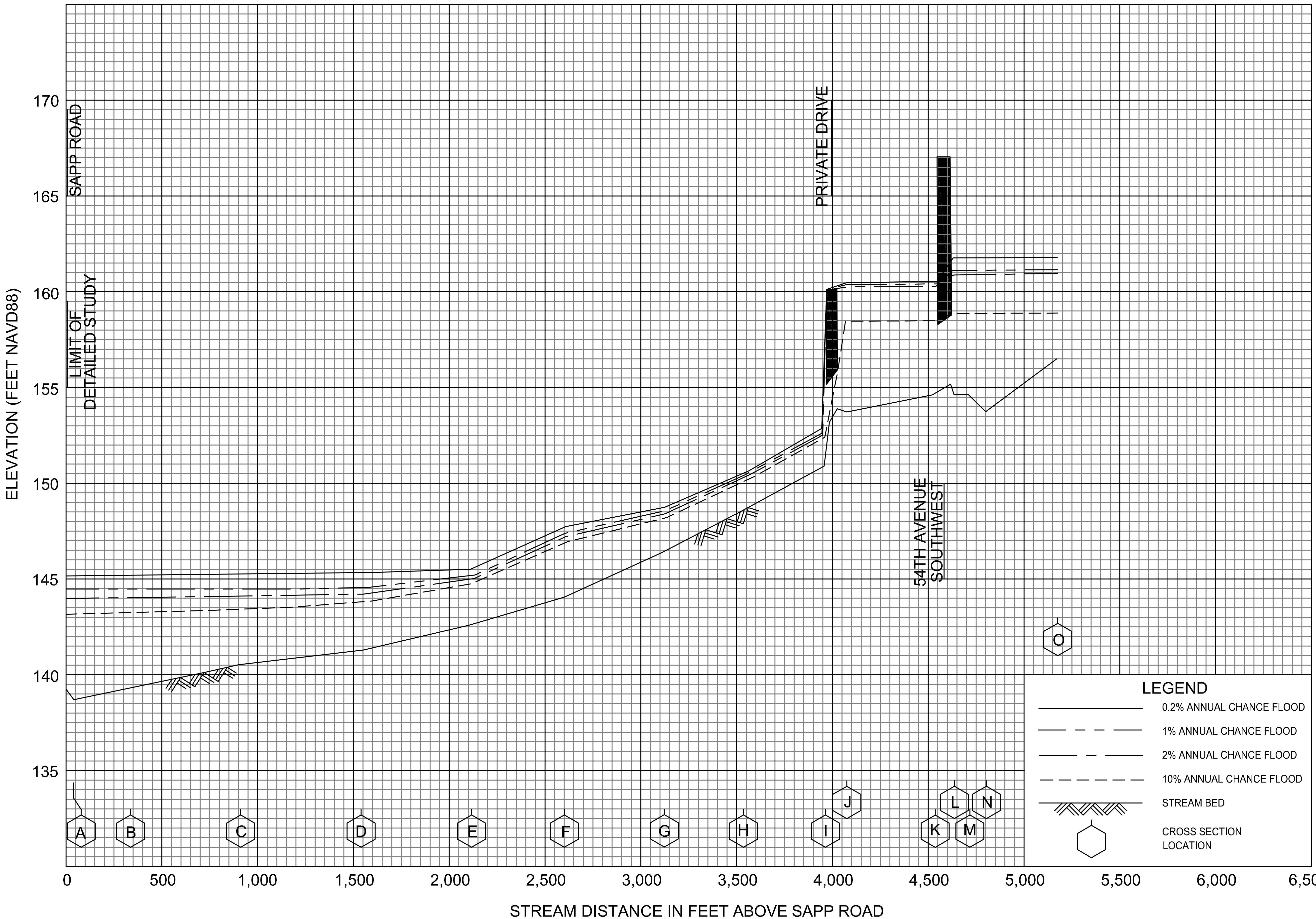
FLOOD PROFILES

OUTLET OF BLACK LAKE

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



FLOOD PROFILES

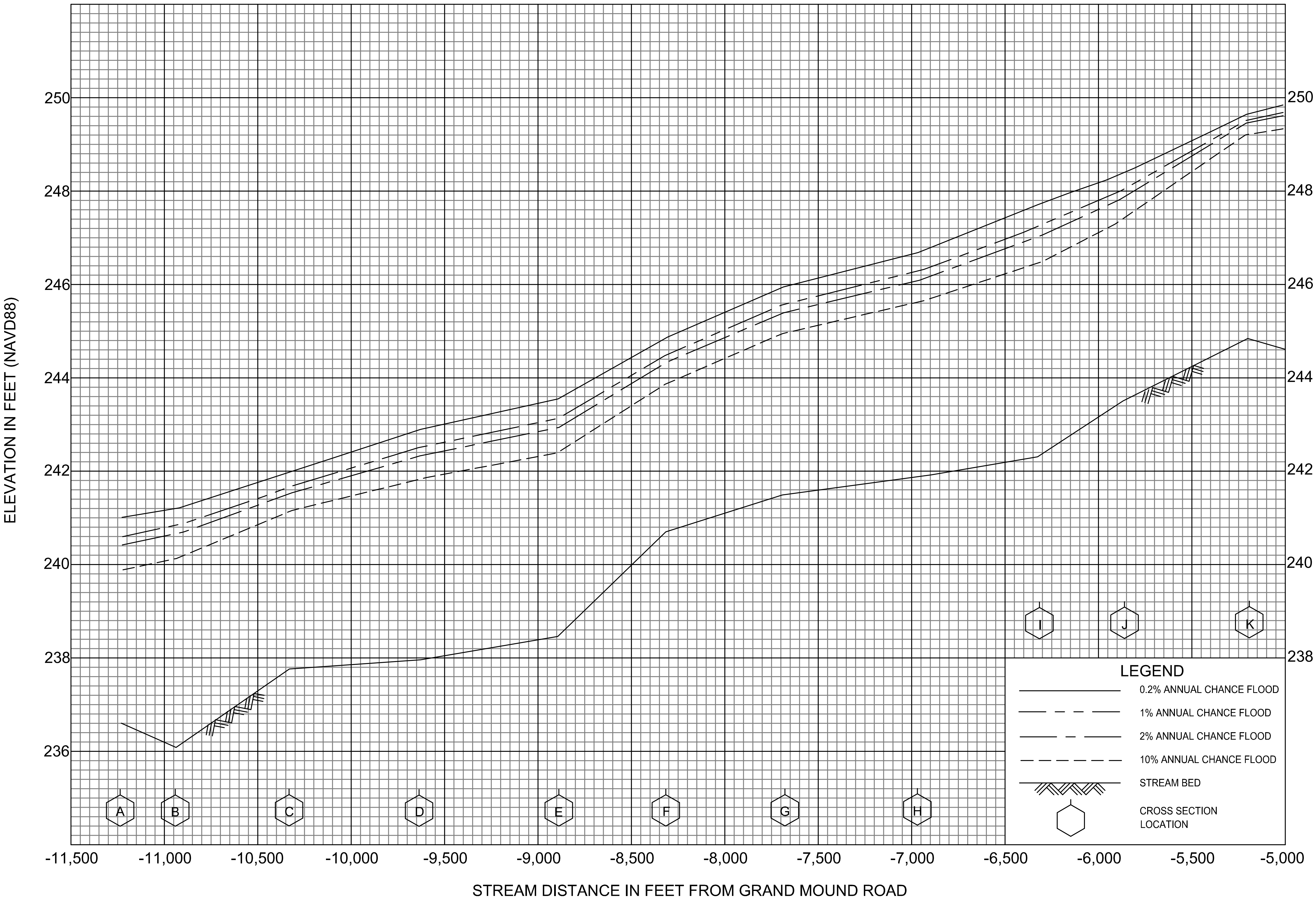
PERCIVAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

30P



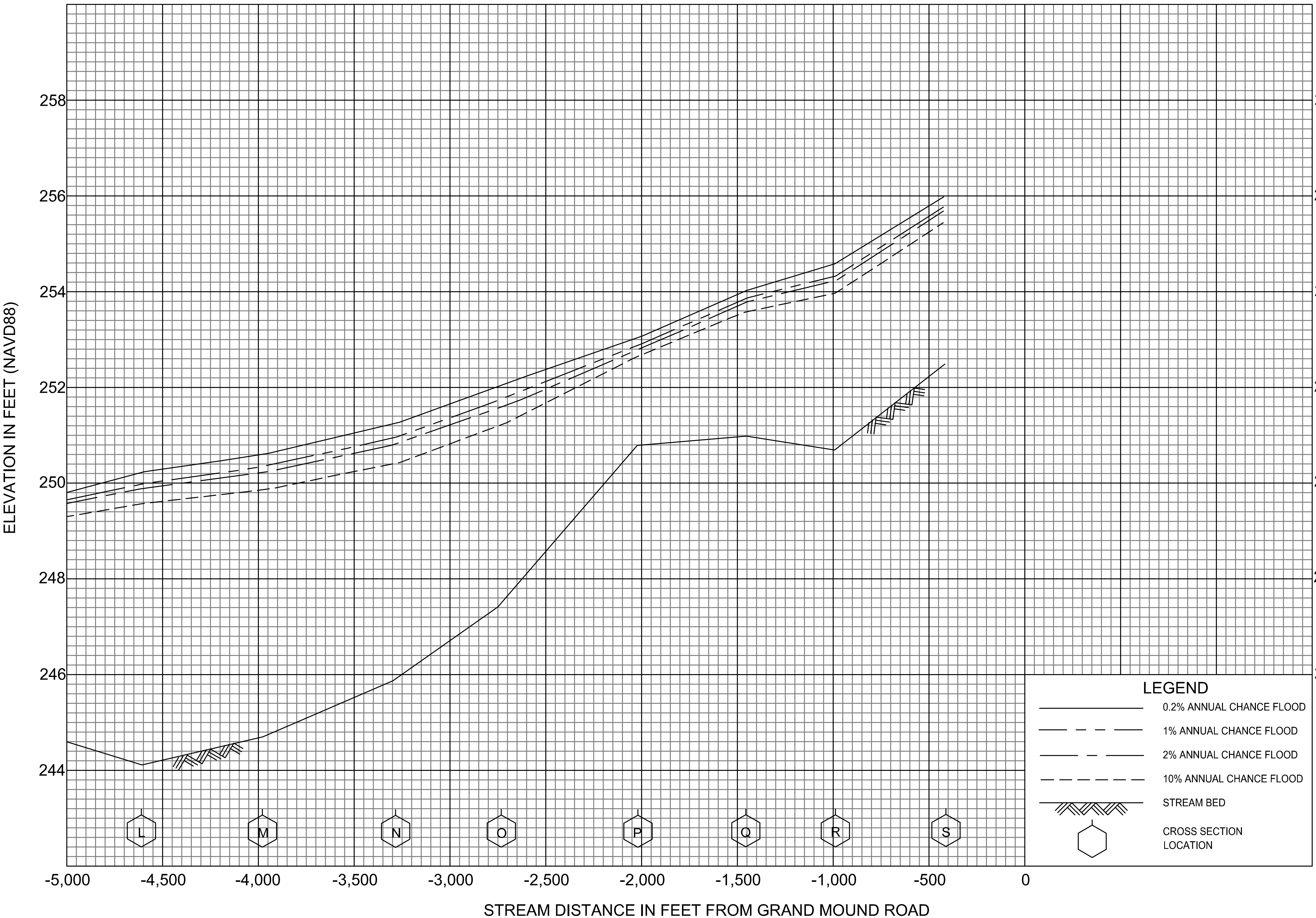
FLOOD PROFILES

SCATTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



FLOOD PROFILES

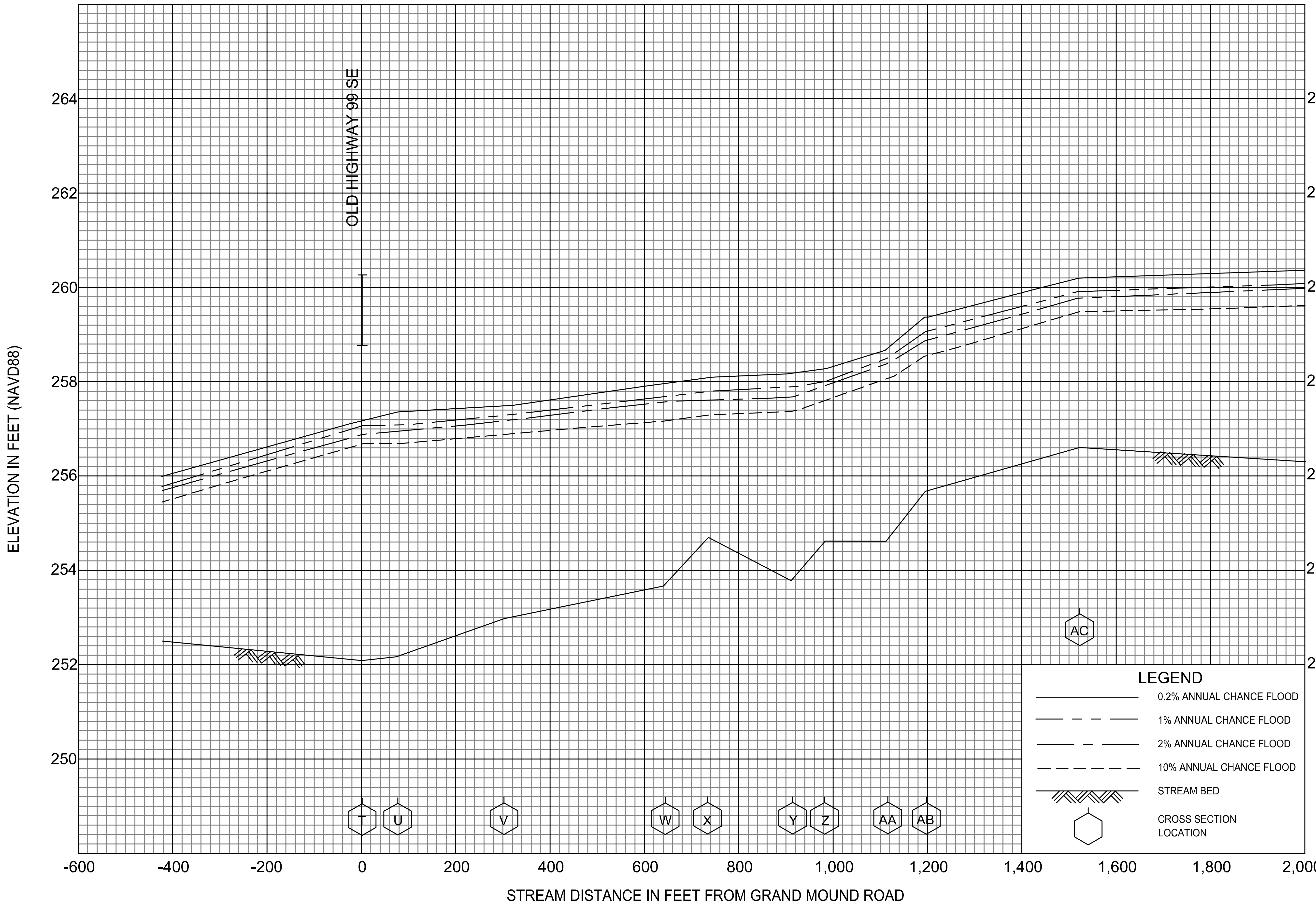
SCATTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

32P

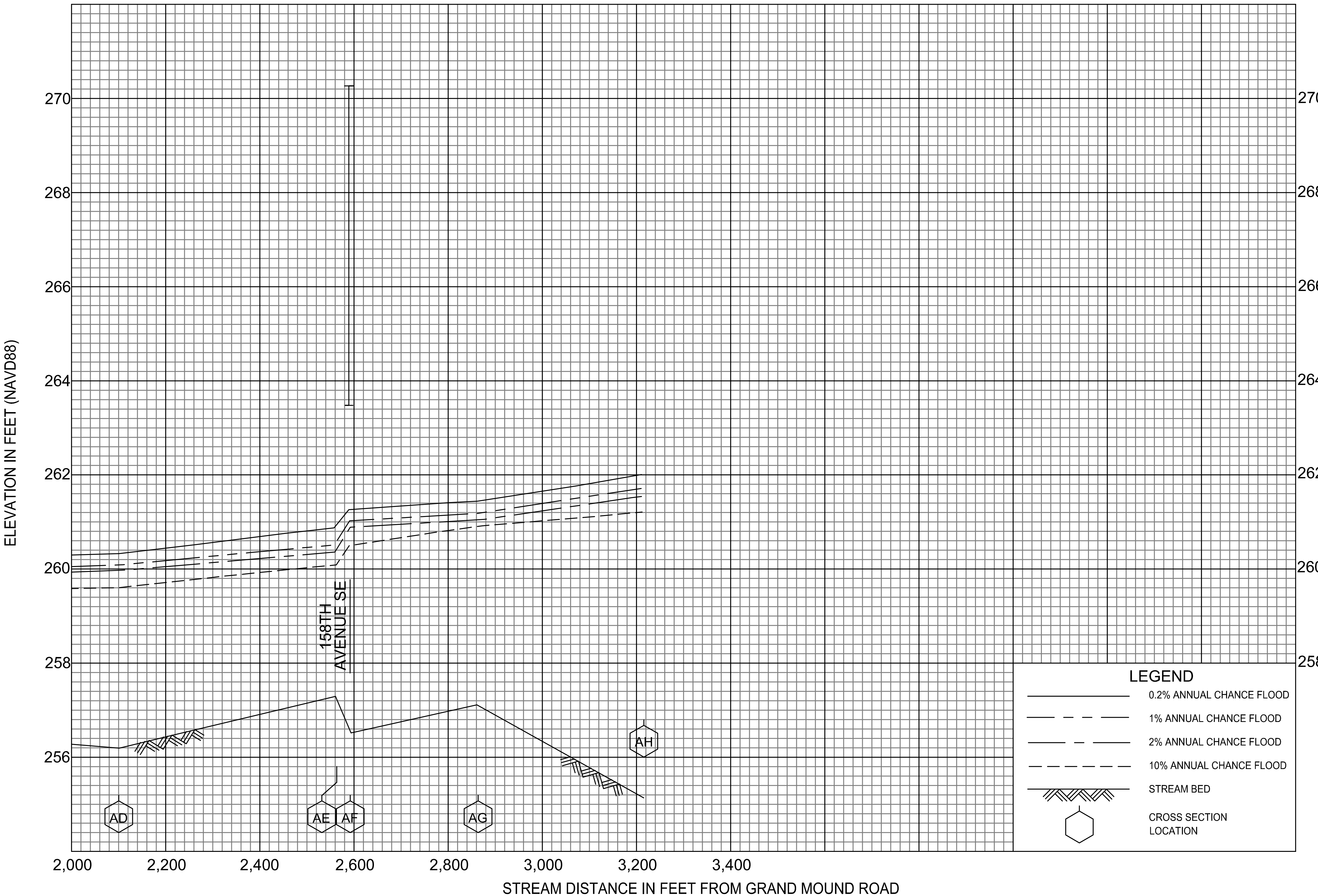


FLOOD PROFILES

SCATTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA
AND INCORPORATED AREAS



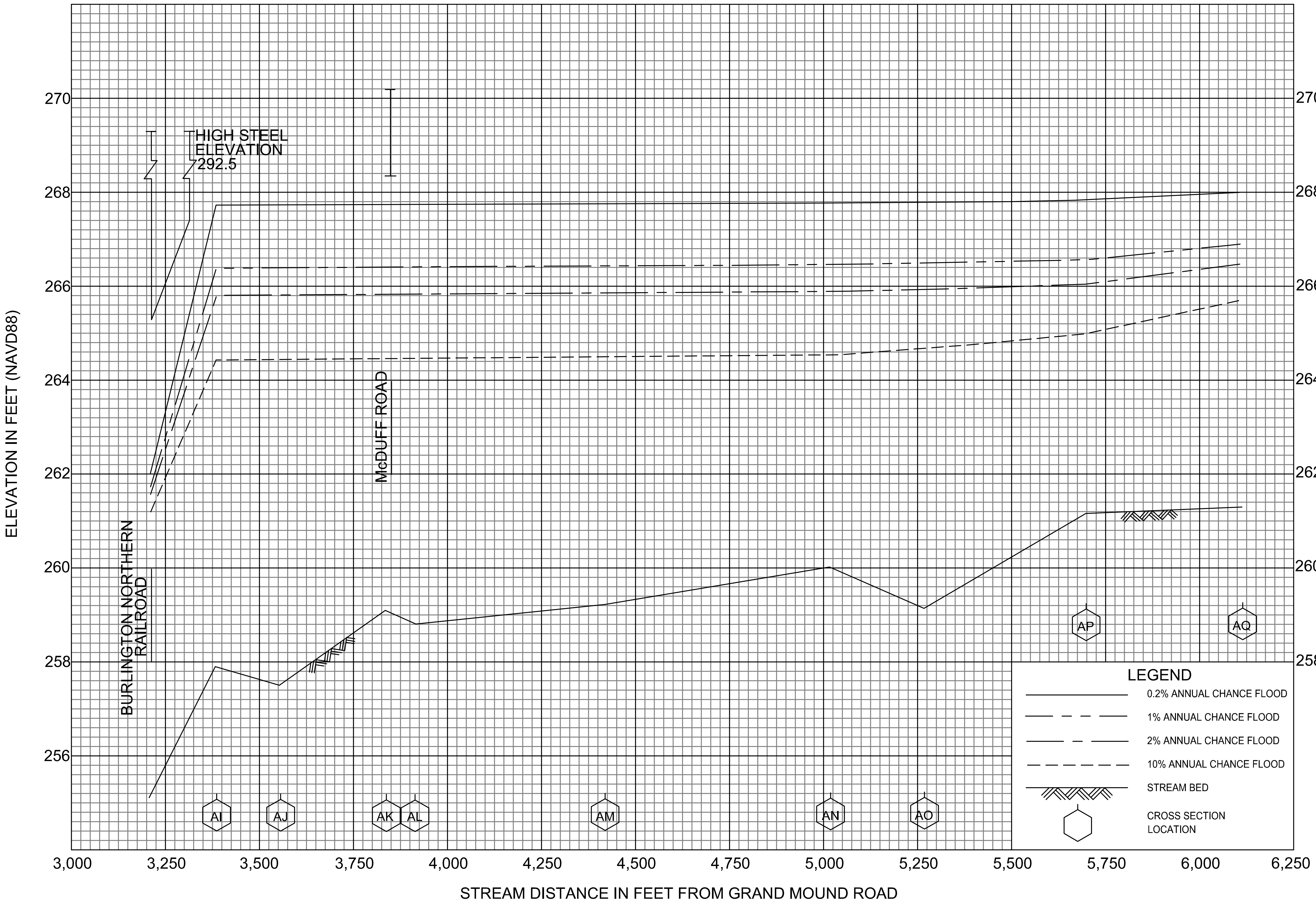
FLOOD PROFILES

SCATTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



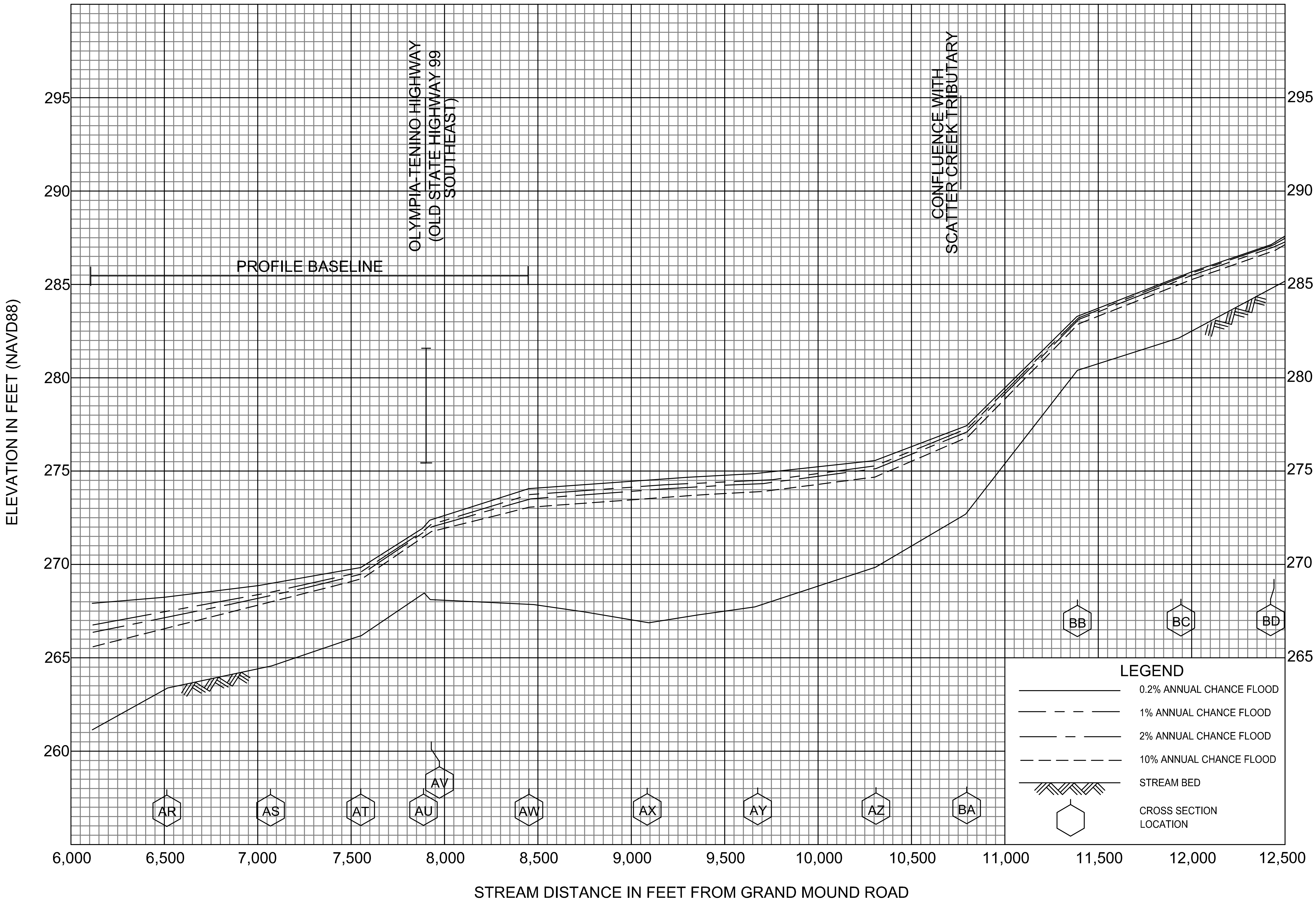
FLOOD PROFILES

SCATTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



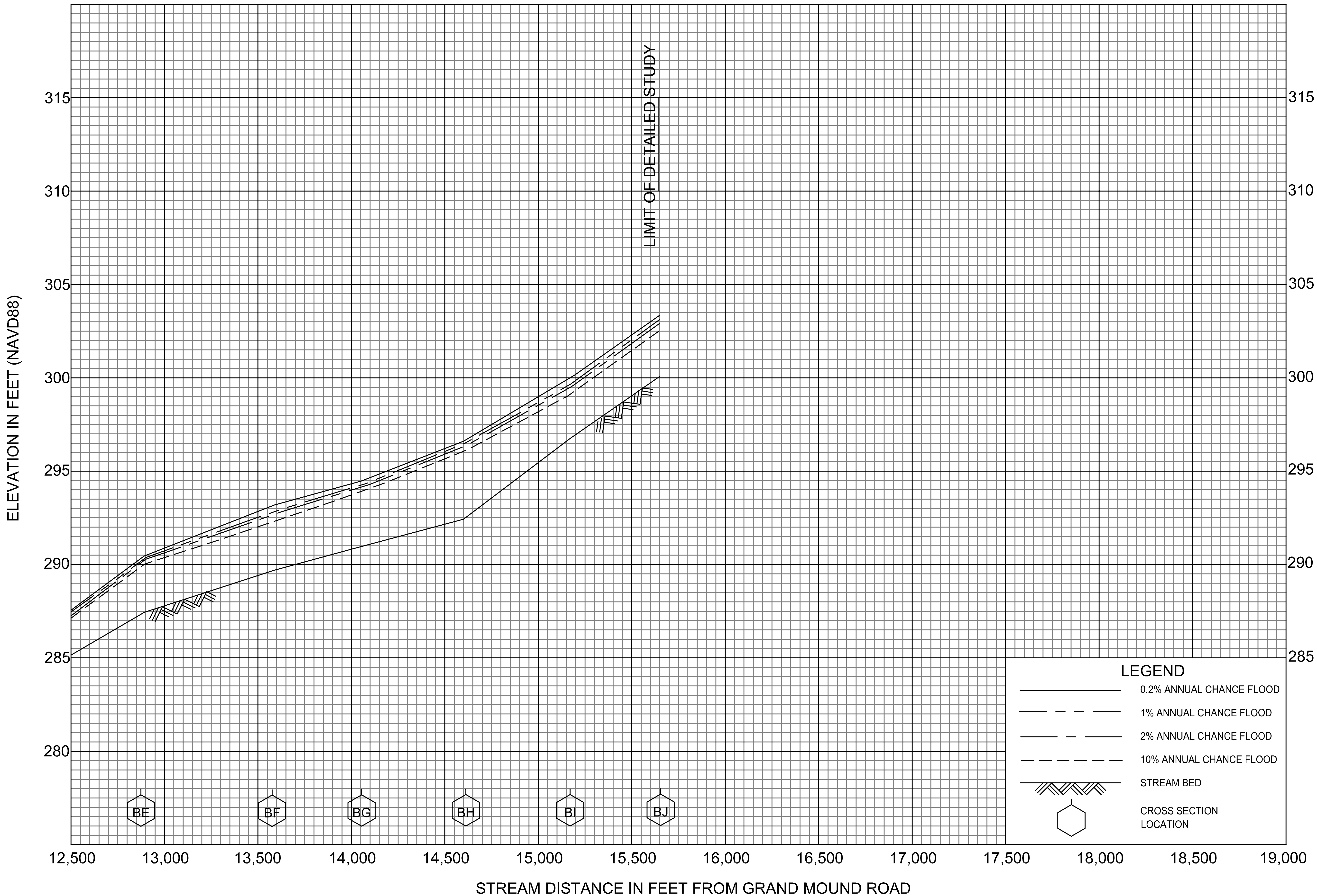
FLOOD PROFILES

SCATTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



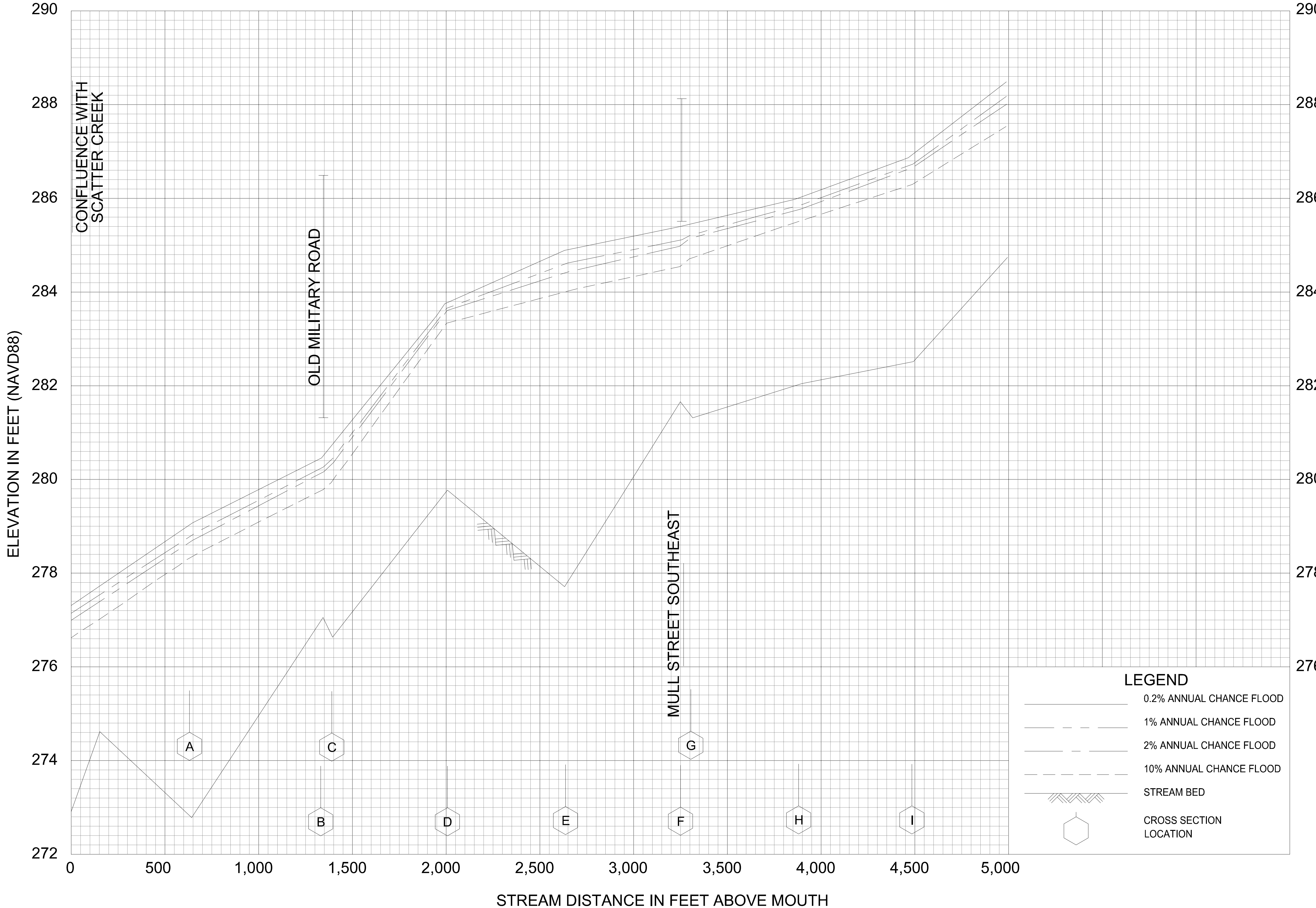
FLOOD PROFILES

SCATTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



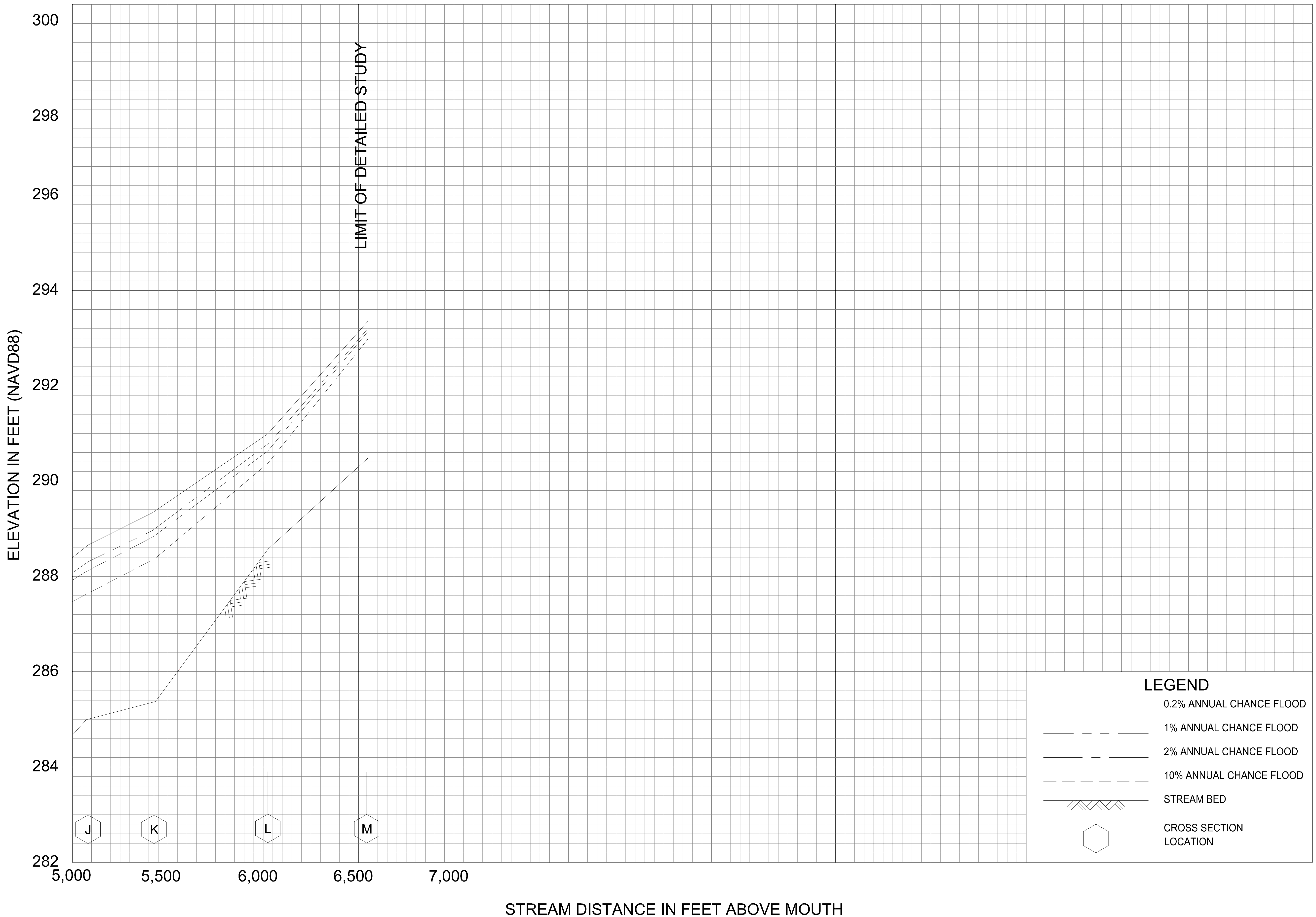
FLOOD PROFILES

SCATTER CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



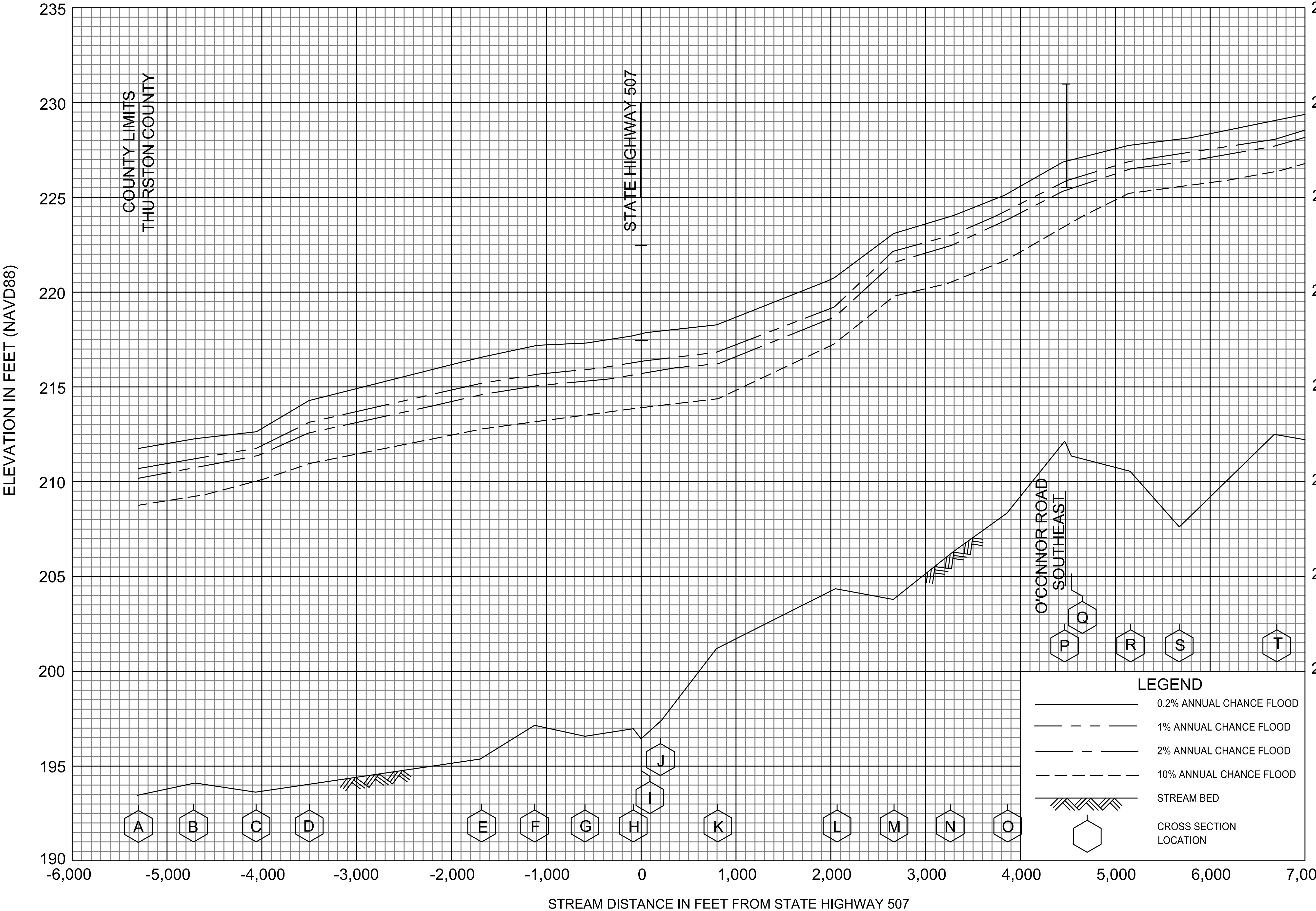
FLOOD PROFILES

SCATTER CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



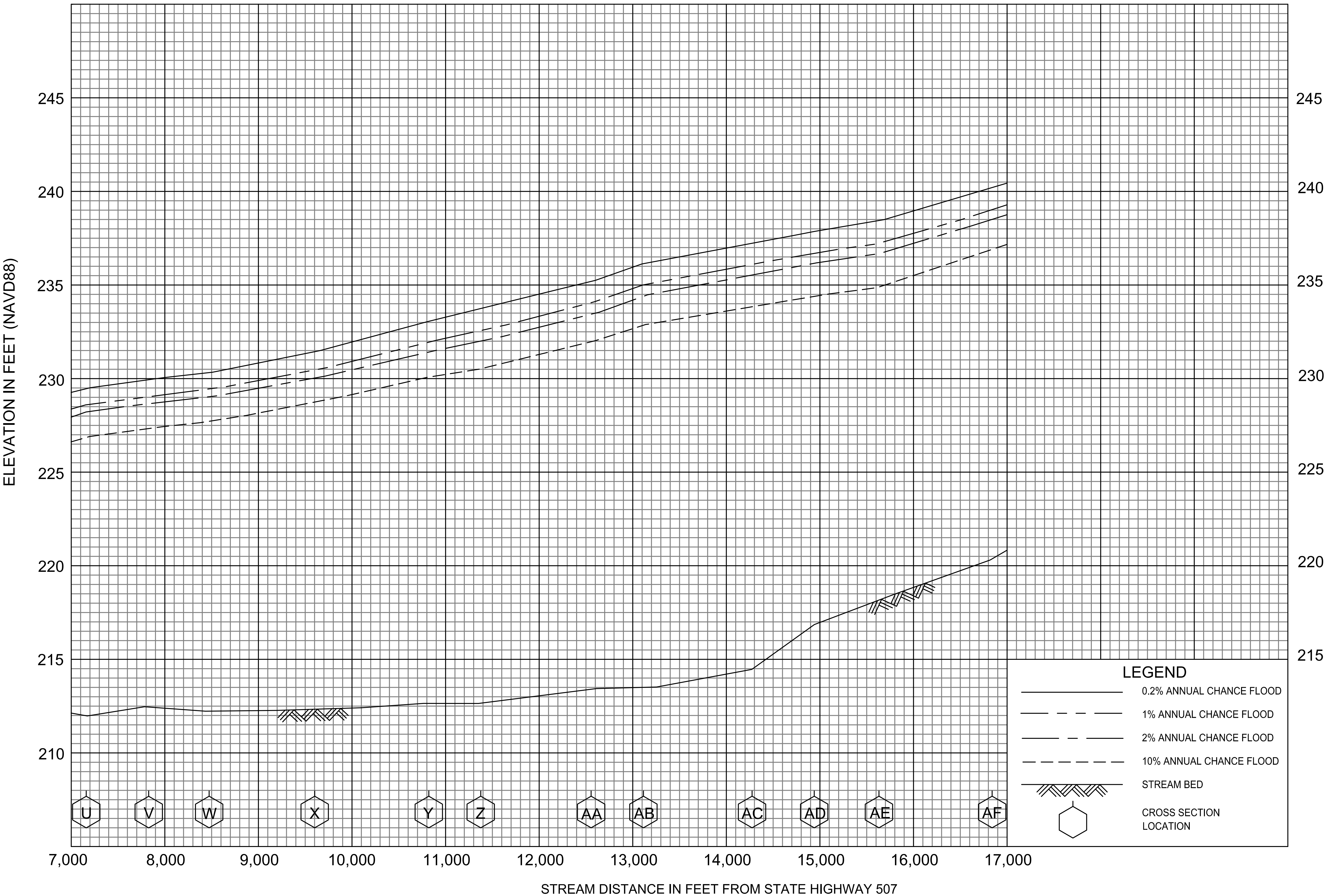
FLOOD PROFILES

SKOOKUMCHUCK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



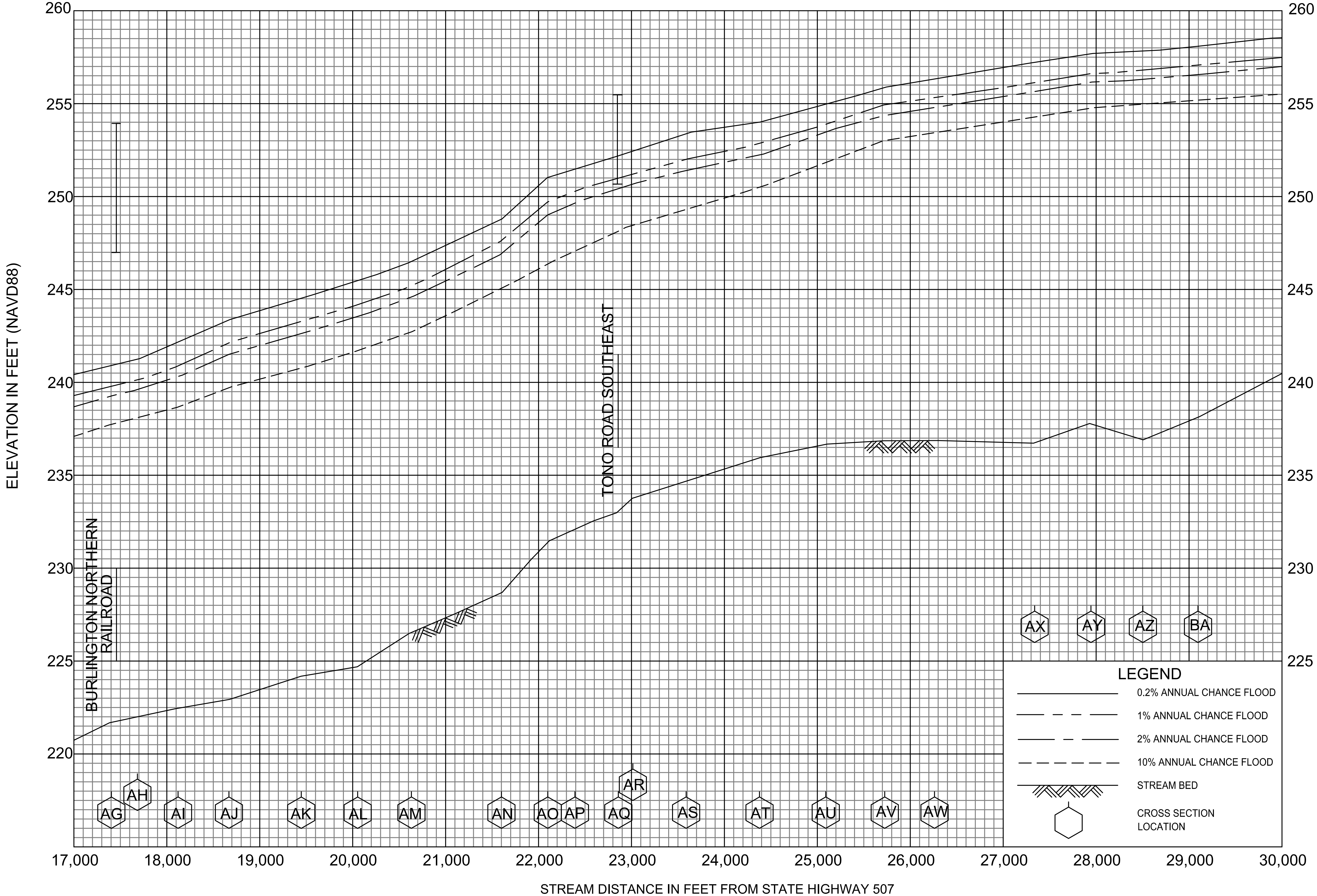
FLOOD PROFILES

SKOOKUMCHUCK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



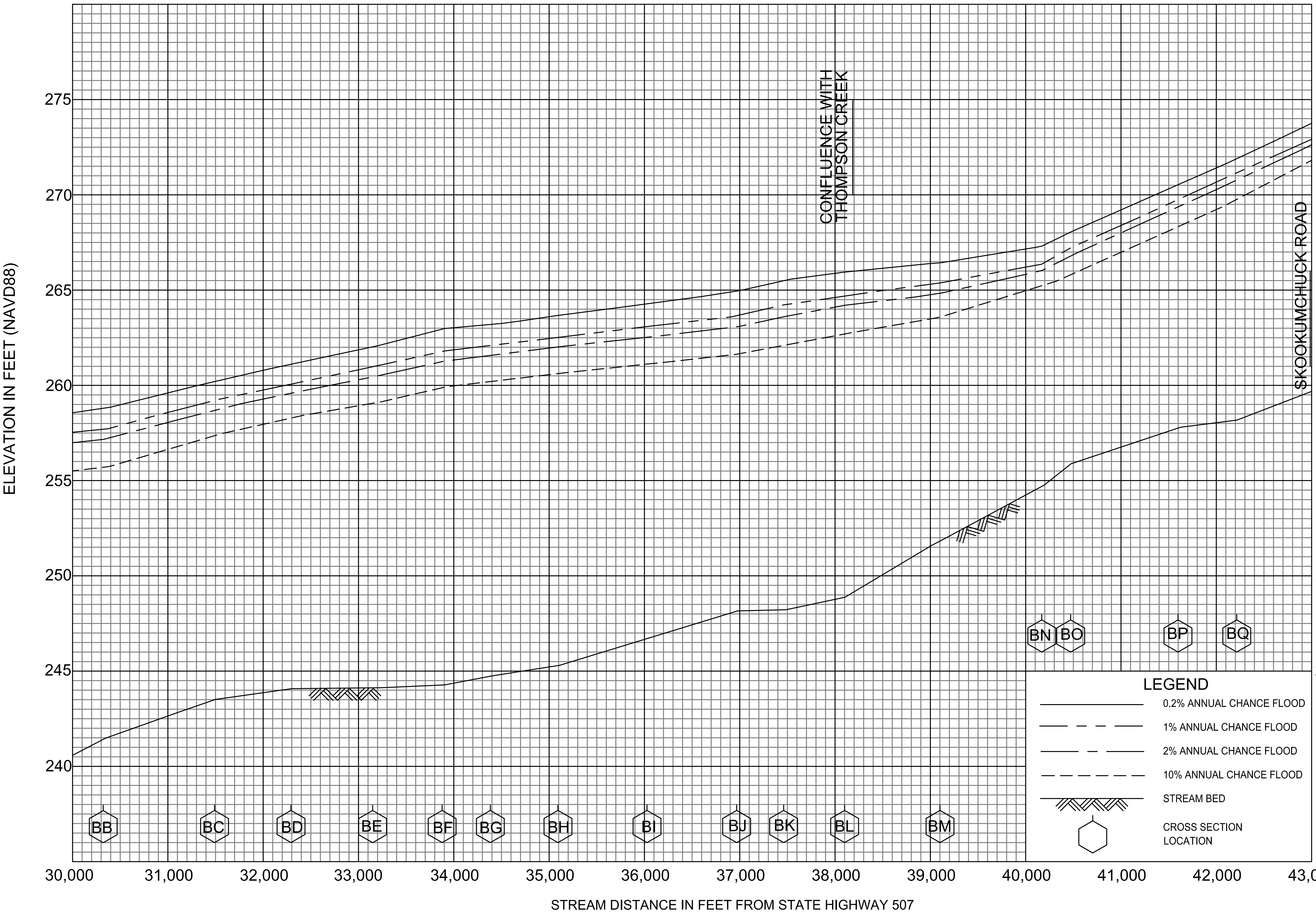
FLOOD PROFILES

SKOOKUMCHUCK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



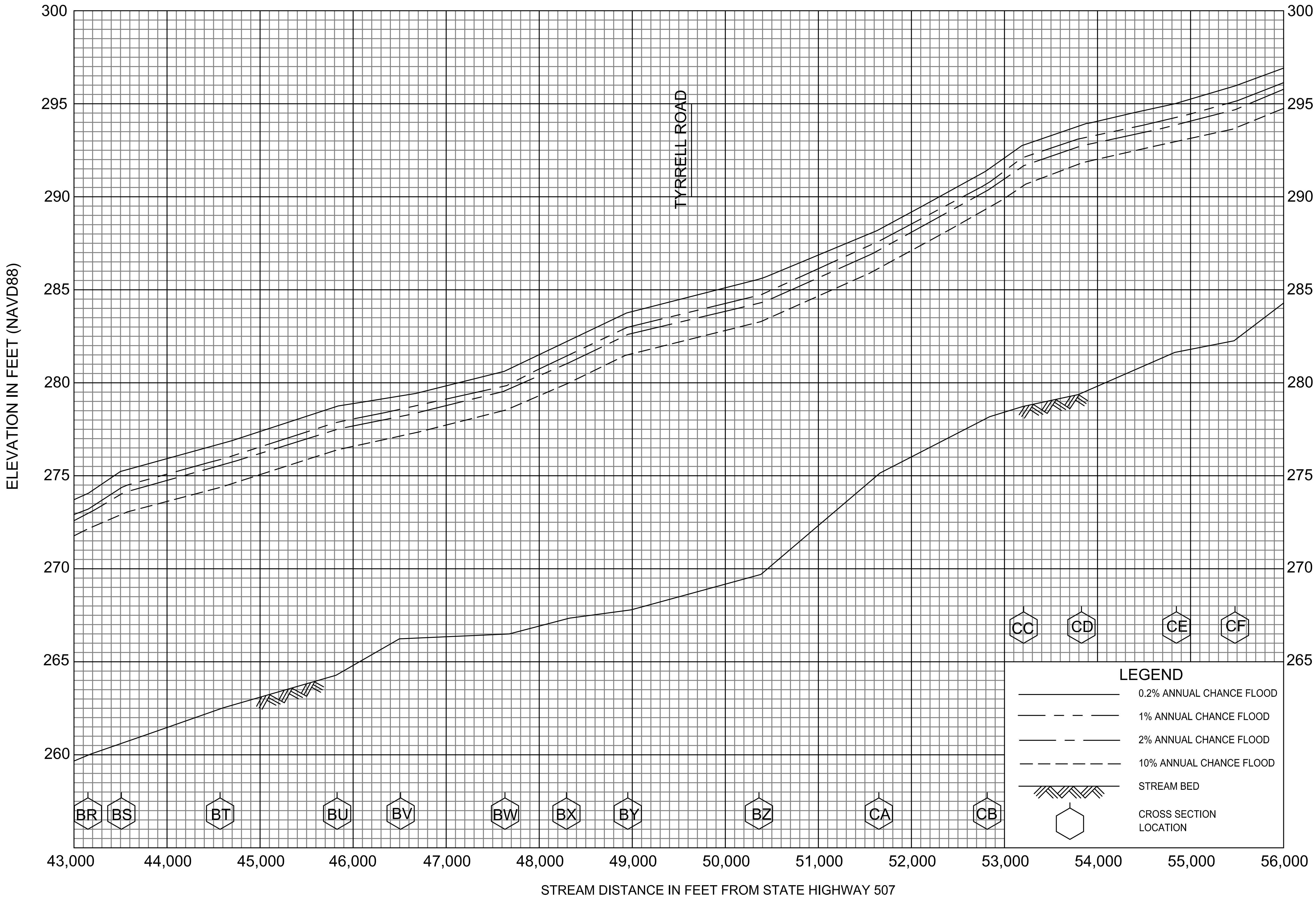
FLOOD PROFILES

SKOOKUMCHUCK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



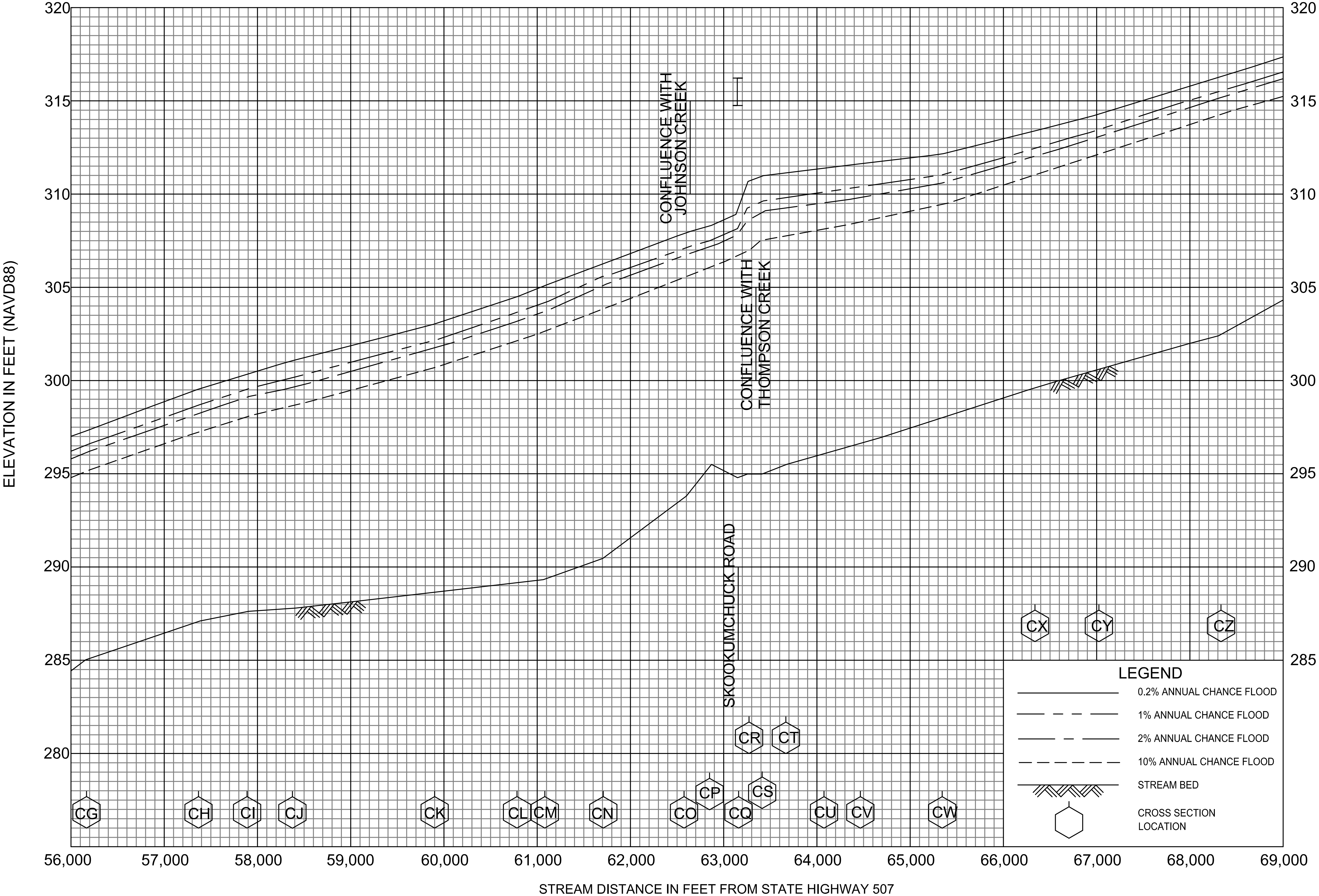
FLOOD PROFILES

SKOOKUMCHUCK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



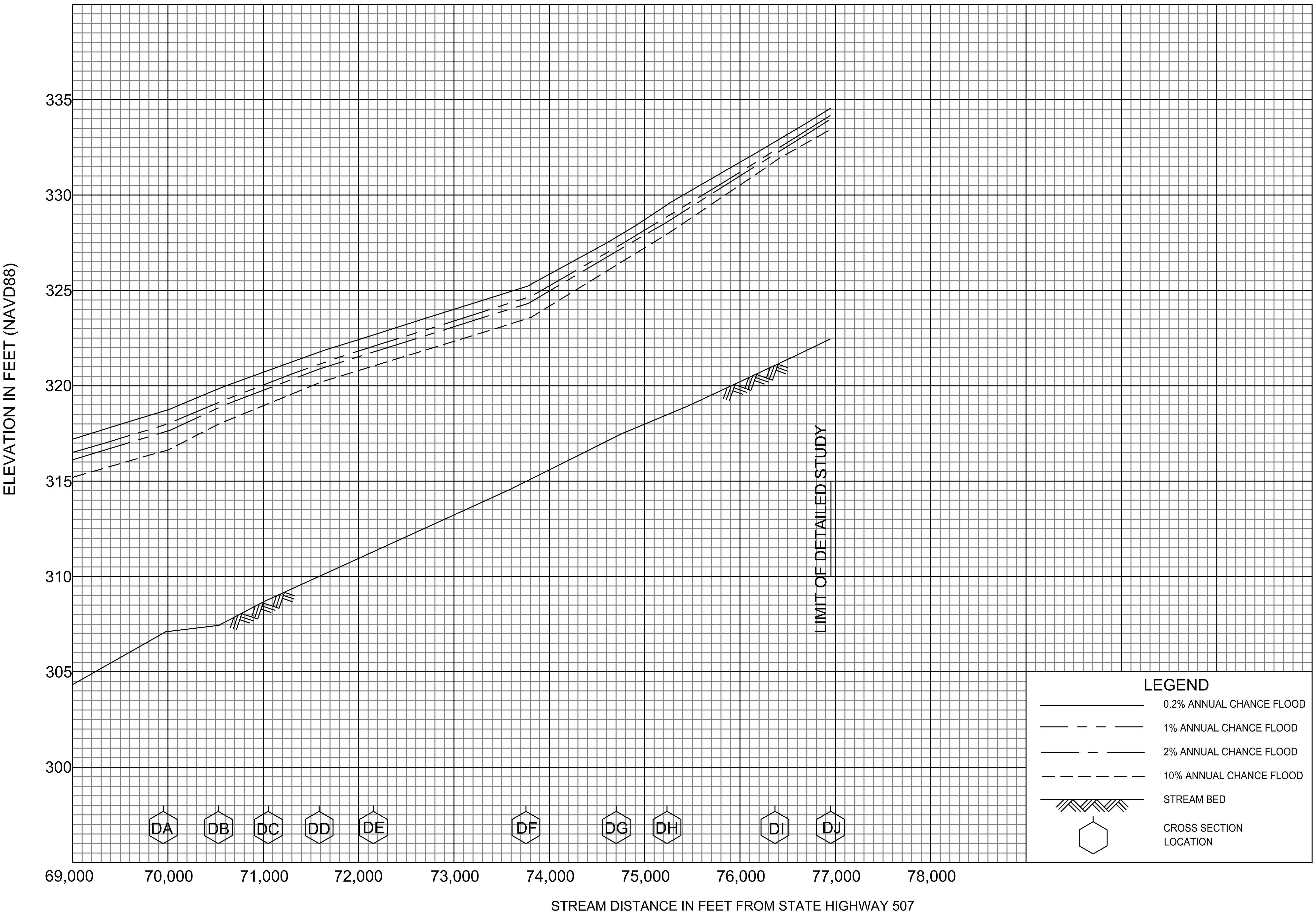
FLOOD PROFILES

SKOOKUMCHUCK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



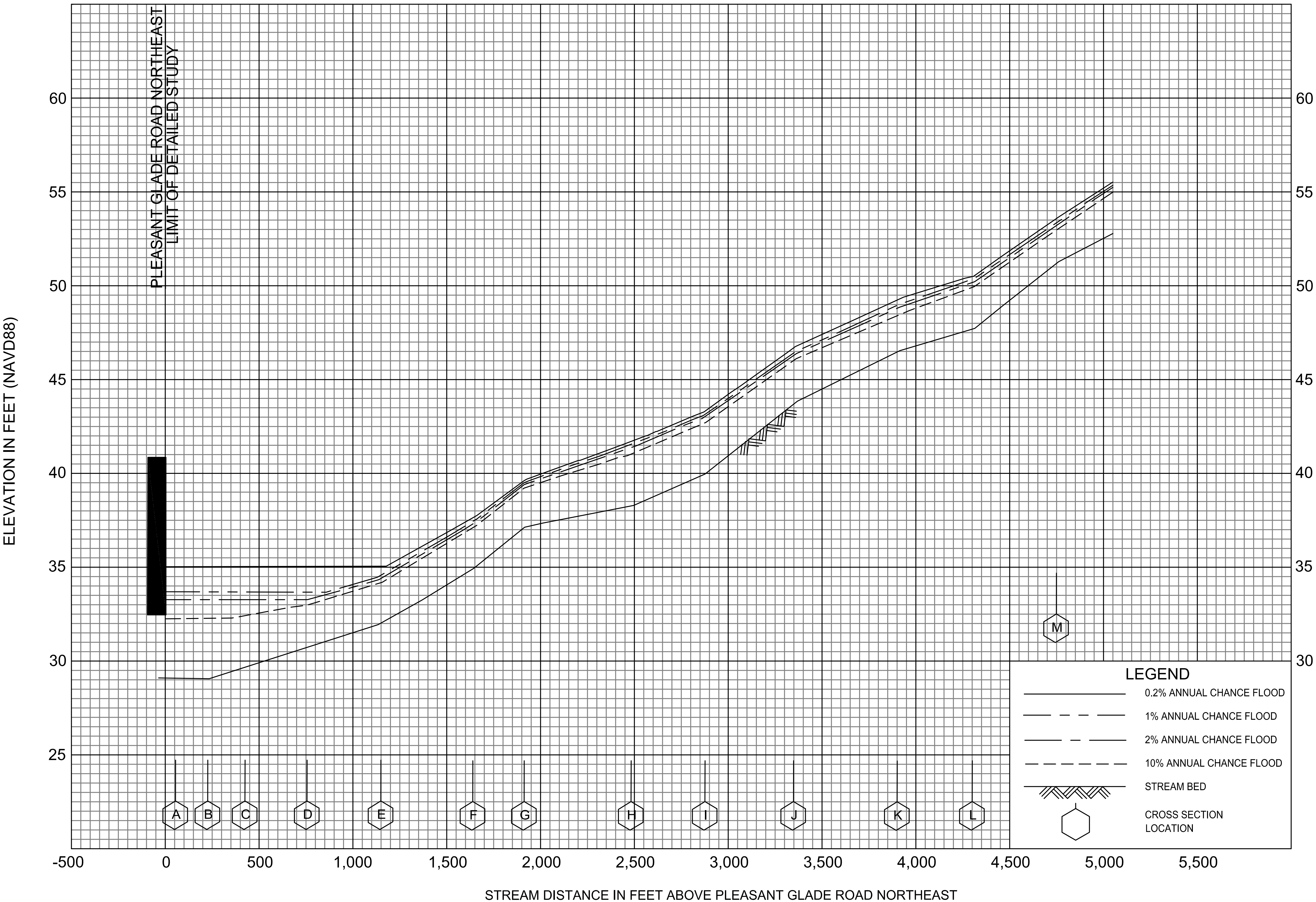
FLOOD PROFILES

SKOOKUMCHUCK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



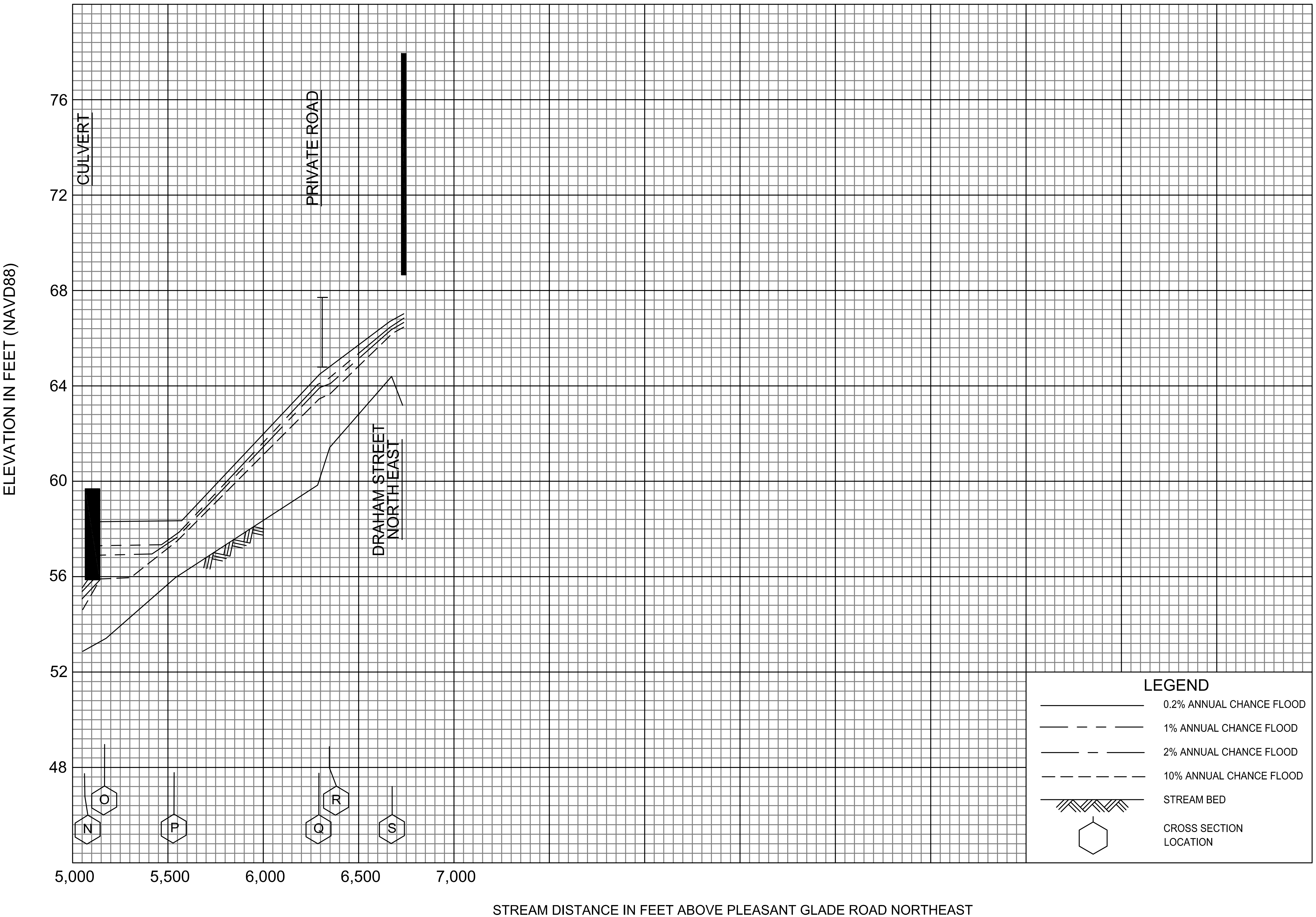
FLOOD PROFILES

WOODLAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



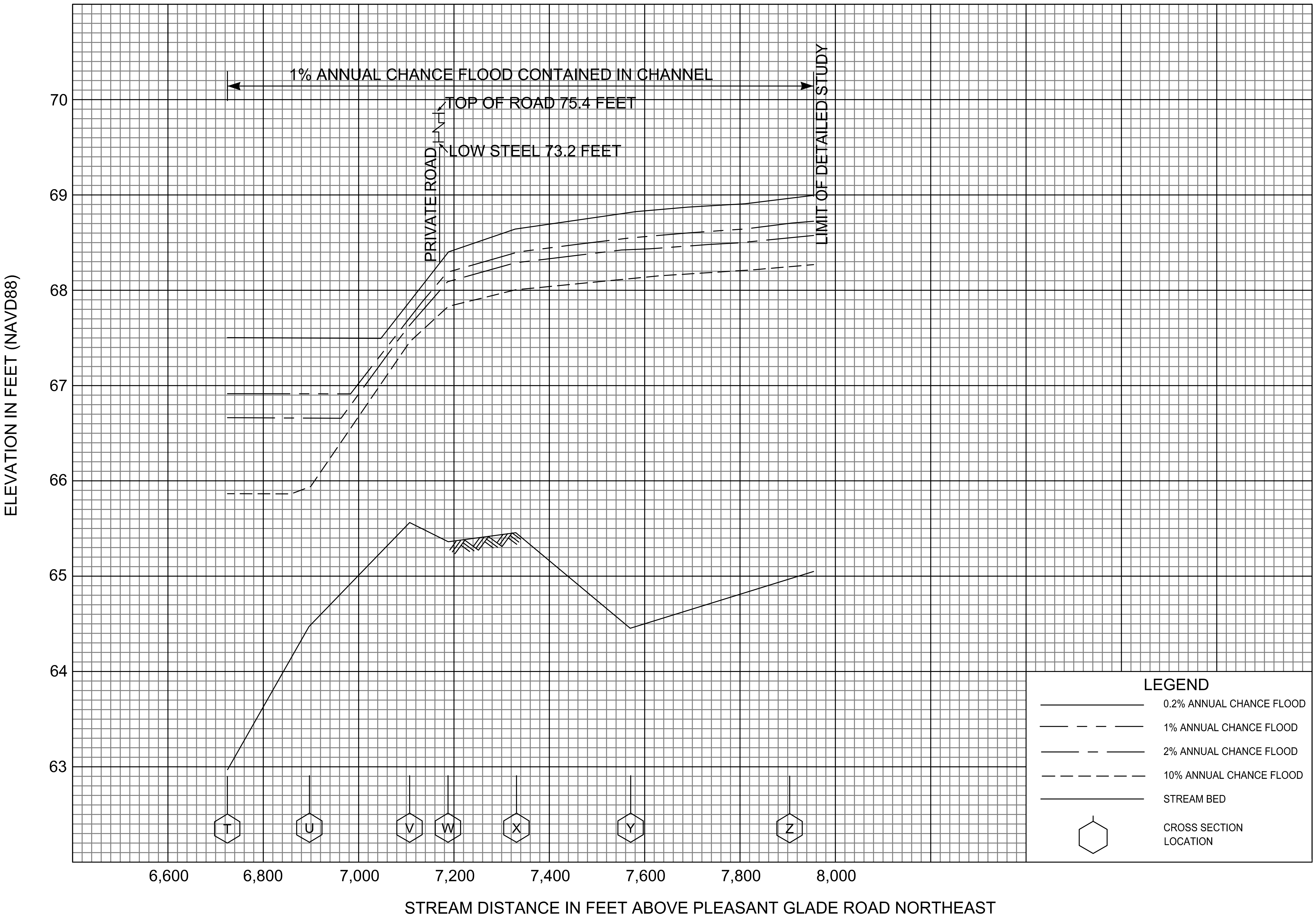
FLOOD PROFILES

WOODLAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



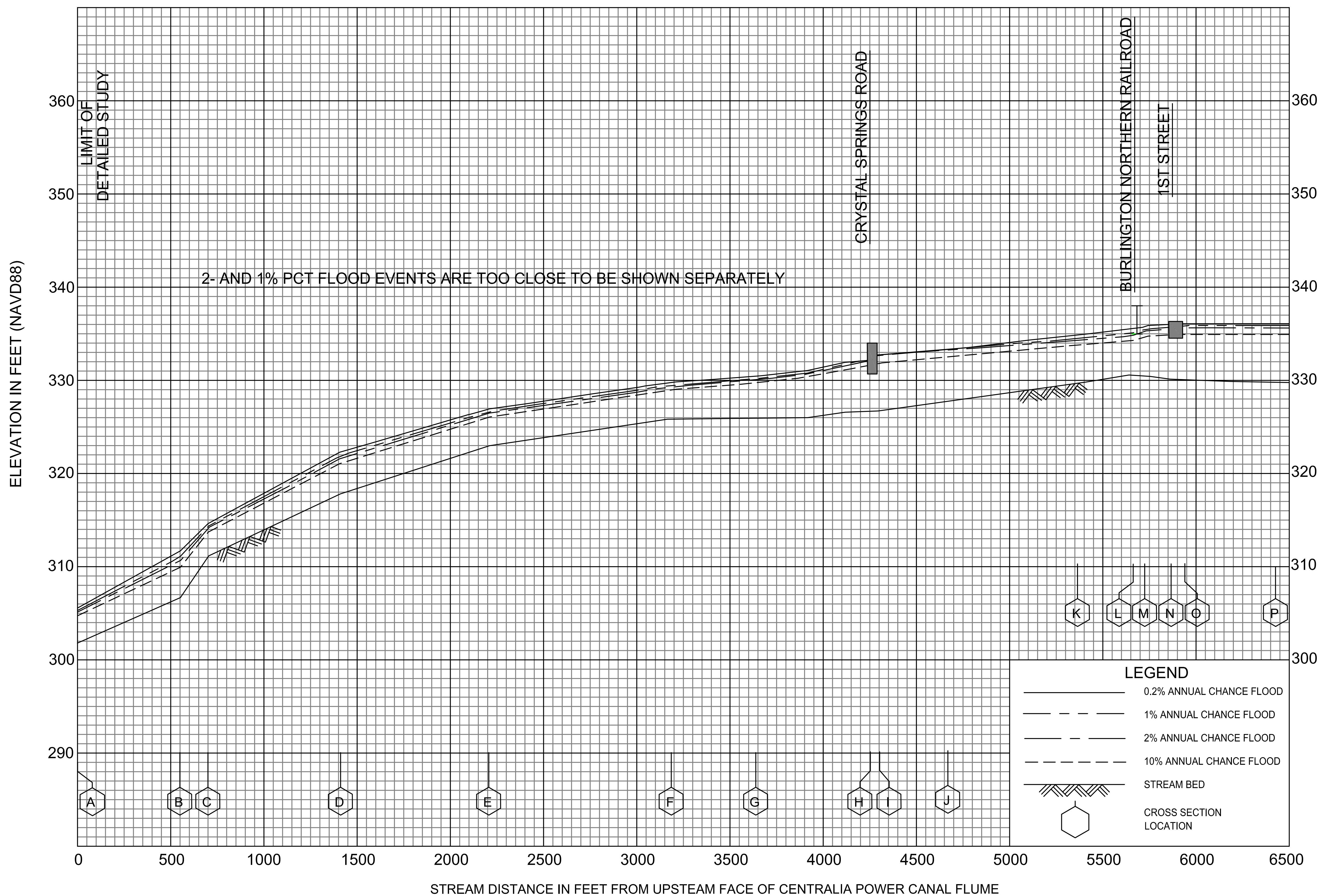
FLOOD PROFILES

WOODLAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



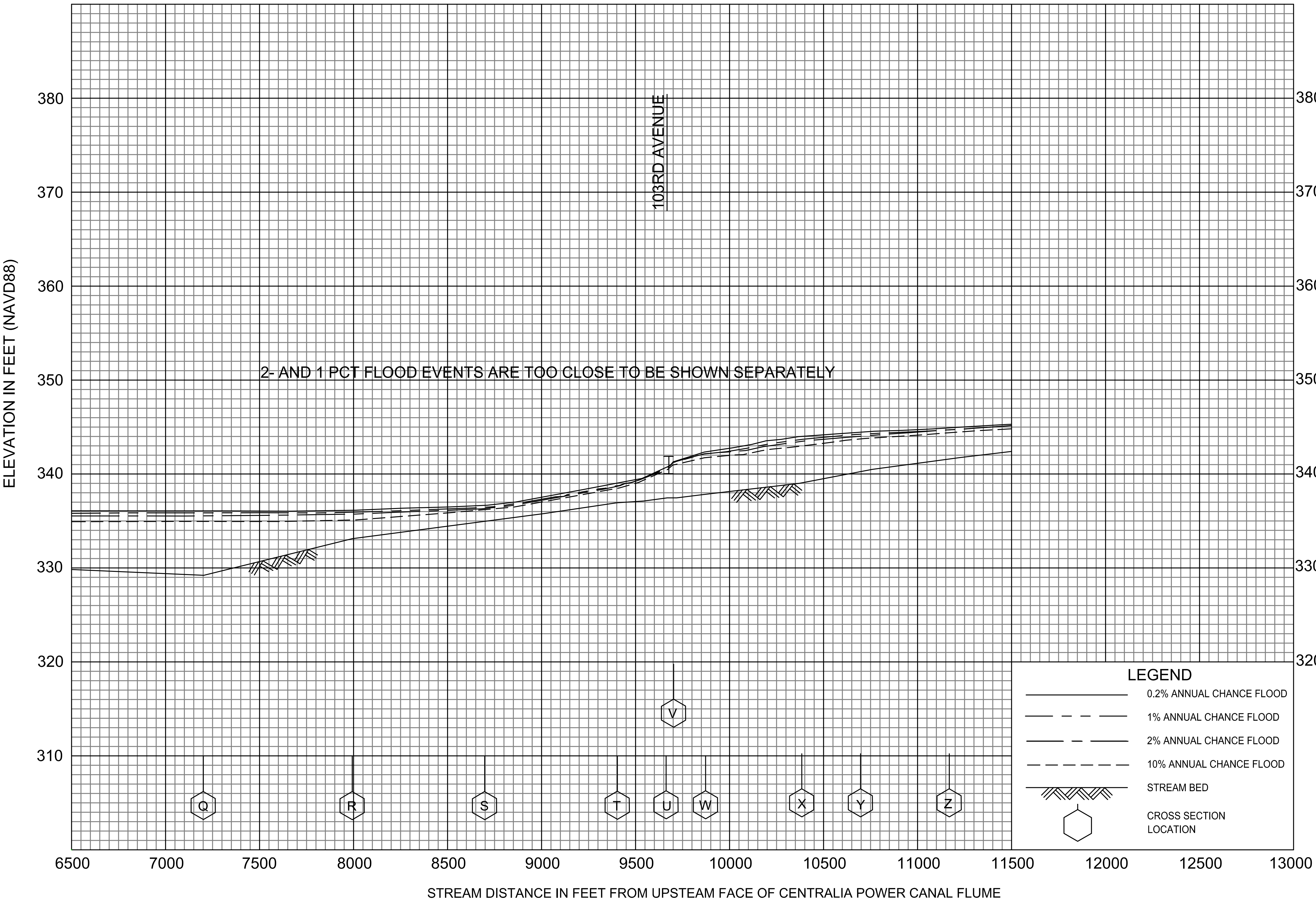
FLOOD PROFILES

YELM CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



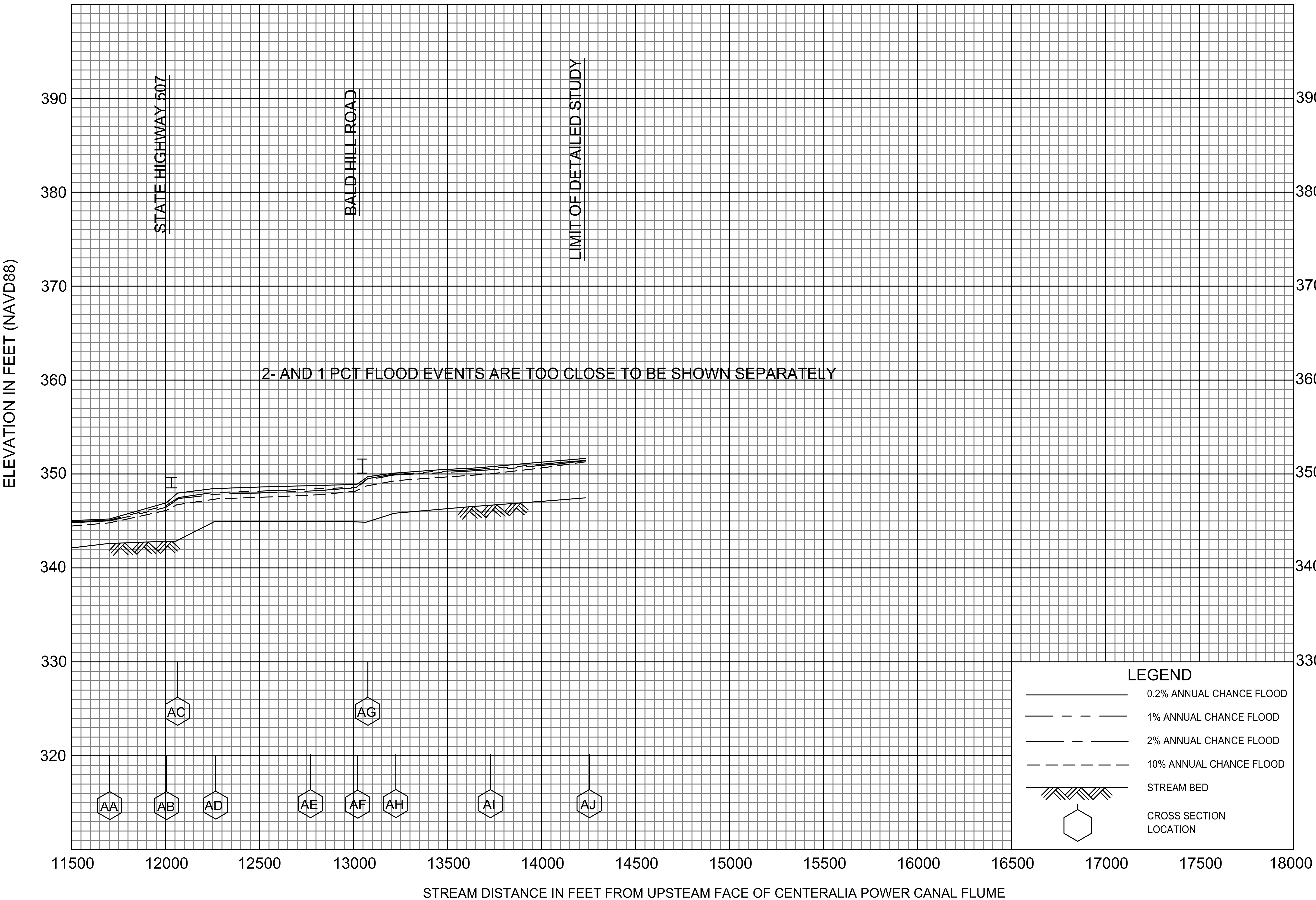
FLOOD PROFILES

YELM CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS



FLOOD PROFILES

YELM CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

THURSTON COUNTY, WA

AND INCORPORATED AREAS

Each FIRM panel may contain specific notes to the user that provide additional information regarding the flood hazard data shown on that map. However, the FIRM panel does not contain enough space to show all the notes that may be relevant in helping to better understand the information on the panel. FIRM Notes to Users contains the full list of these notes.

FIRM Notes 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 Flood Map Service Center website at msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Flood Map Service Center website or by calling the FEMA Map Information eXchange.

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

For community dates, refer to Table 11 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.

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.

Coastal Base Flood Elevations shown on the map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Coastal flood elevations are also provided in the Transect Data table in the FIS Report for this jurisdiction. Elevations shown in the Transect Data table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on the FIRM.

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.

Floodways restricted by anthropogenic features such as bridges and culverts are drawn to reflect natural conditions and may not agree with the model computed widths listed in the Floodway Data table in the Flood Insurance Study.

FIRM Notes to Users

In the State of Washington, any portion of a stream or watercourse that lies within the floodway fringe of a studied (AE) stream may have a state regulated floodway. The FIRM may not depict these state regulated floodways.

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

PROJECTION INFORMATION: The projection used in the preparation of the map was State Plane Lambert Conformal Conic, Washington South Zone 4602. 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.

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

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

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

BASE MAP INFORMATION: Base map information shown on the FIRM is panel-specific. The map panels should be referenced for this information.

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.

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Thurston County, WA, effective June 30, 2106.

LIMIT OF MODERATE WAVE ACTION: Zone AE has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between Zone VE and the LiMWA (or between the shoreline and the LiMWA for areas where Zone VE is not identified) will be similar to, but less severe than, those in Zone VE.

FIRM Notes to Users

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.

Each FIRM panel contains an abbreviated legend for the features shown on the maps. However, the FIRM panel does not contain enough space to show the legend for all map features. Map Legend for FIRM shows the full legend of all map features. Note that not all of these features may appear on the FIRM panels in Thurston County.

Map Legend for FIRM

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

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

Map Legend for FIRM

	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.
	Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced the flood risk from the 1% annual chance flood.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
NO SCREEN	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
(ortho) (vector)	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
Aqueduct Channel Culvert Storm Sewer	Channel, Culvert, Aqueduct, or Storm Sewer
Dam Jetty Weir	Dam, Jetty, Weir
	Levee, Dike, or Floodwall
Bridge	Bridge

Map Legend for FIRM

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.*

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
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

Map Legend for FIRM

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)