Oregon
John A. Kitzhaber, M.D., Governor

Department of Land Conservation and Development
635 Capitol Street NE, Suite 150
Salem, OR 97301-2540
(503) 373-0050
Director's Office Fax (503) 378-5518
Main Fax: (503) 378-6033
Web Address: http://www.lcd.state.or.us

NOTICE OF ADOPTED AMENDMENT

January 27, 2012

TO: Subscribers to Notice of Adopted Plan
or Land Use Regulation Amendments

FROM: Angela Houck, Plan Amendment Program Specialist

SUBJECT: Crook County Plan Amendment
DLCD File Number 006-11

The Department of Land Conservation and Development (DLCD) received the attached notice of adoption. A copy of the adopted plan amendment is available for review at the DLCD office in Salem and the local government office.

Appeal Procedures*

DLCD ACKNOWLEDGMENT or DEADLINE TO APPEAL: Friday, February 10, 2012

This amendment was submitted to DLCD for review 35 days prior to adoption and the jurisdiction determined that emergency circumstances required expedited review. Pursuant to ORS 197.830 (2)(b) only persons who participated in the local government proceedings leading to adoption of the amendment are eligible to appeal this decision to the Land Use Board of Appeals (LUBA).

If you wish to appeal, you must file a notice of intent to appeal with the Land Use Board of Appeals (LUBA) no later than 21 days from the date the decision was mailed to you by the local government. If you have questions, check with the local government to determine the appeal deadline. Copies of the notice of intent to appeal must be served upon the local government and others who received written notice of the final decision from the local government. The notice of intent to appeal must be served and filed in the form and manner prescribed by LUBA, (OAR Chapter 661, Division 10). Please call LUBA at 503-373-1265, if you have questions about appeal procedures.

***NOTE:** **THE APPEAL DEADLINE IS BASED UPON THE DATE THE DECISION WAS MAILED BY LOCAL GOVERNMENT. A DECISION MAY HAVE BEEN MAILED TO YOU ON A DIFFERENT DATE THAN IT WAS MAILED TO DLCD. AS A RESULT YOUR APPEAL DEADLINE MAY BE EARLIER THAN THE ABOVE DATE SPECIFIED.**

Cc: Bill Zelenka, Crook County
Jon Jinings, DLCD Community Services Specialist
Karen Swirsky, DLCD Regional Representative
Christine Shirley, National Hazards/Floodplain Specialist

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FORM 2 DLCD Notice of Adoption

This Form 2 must be mailed to DLCD within **5-Working Days after the Final Ordinance is signed** by the public Official Designated by the jurisdiction and all other requirements of ORS 197.615 and OAR 660-018-000

☐ In person ☐ electronic ☐ mailed

DATE STAMP

DEPT OF

JAN 23 2012

LAND CONSERVATION AND DEVELOPMENT

For Office Use Only

Jurisdiction: **Crook County** Local file number: **AM-11-0126**

Date of Adoption: **1/18/2012** Date Mailed: **1/20/2012**

Was a Notice of Proposed Amendment (Form 1) mailed to DLCD? ☒ Yes ☐ No Date: 10/26/2011

☒ Comprehensive Plan Text Amendment ☐ Comprehensive Plan Map Amendment

☒ Land Use Regulation Amendment ☐ Zoning Map Amendment

☐ New Land Use Regulation ☒ Other: **Floodplain Zone Overlay update**

Summarize the adopted amendment. Do not use technical terms. Do not write "See Attached".

At the request of FEMA, Crook County adopted the new Flood Insurance Study (FIS) and new digital Flood Insurance Rate Maps (d-firm), and updated the County Comprehensive Plan and County Land Use Code making the Crook County National Flood Insurance Program (NFIP) contemporary.

Does the Adoption differ from proposal? No, no explaination is necessary

n/a

Plan Map Changed from: to:

Zone Map Changed from: to:

Location: Acres Involved:

Specify Density: Previous: New:

Applicable statewide planning goals:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Was an Exception Adopted? ☐ YES ☒ NO

Did DLCD receive a Notice of Proposed Amendment...

35-days prior to first evidentiary hearing?	☒ **Yes**	☐ **No**
If no, do the statewide planning goals apply?	☐ **Yes**	☐ **No**
If no, did Emergency Circumstances require immediate adoption?	☐ **Yes**	☐ **No**

DLCD File No. 006-11 (19029) [16906]

DLCD file No. _____

Please list all affected State or Federal Agencies, Local Governments or Special Districts:

Department of Homeland Security, Federal Emergency Management Agency (FEMA)

Local Contact: **Bill Zelenka or Phil Stenbeck** Phone: **(541) 447-8156** Extension:

Address: **300 NE Third Street, Room 11** Fax Number: **541-416-3905**

City: **Prineville** Zip: **97754-** E-mail Address: **phil.stenbeck@co.crook.or.us**

ADOPTION SUBMITTAL REQUIREMENTS

This Form 2 must be received by DLCD no later than 5 working days after the ordinance has been signed by the public official designated by the jurisdiction to sign the approved ordinance(s)

per ORS 197.615 and OAR Chapter 660, Division 18

1. This Form 2 must be submitted by local jurisdictions only (not by applicant).
2. When submitting the adopted amendment, please print a completed copy of Form 2 on light **green paper if available.**
3. Send this Form 2 and **one complete paper copy** (documents and maps) of the adopted amendment to the address below.
4. Submittal of this Notice of Adoption must include the final signed ordinance(s), all supporting finding(s), exhibit(s) and any other supplementary information (ORS 197.615).
5. Deadline to appeals to LUBA is calculated **twenty-one (21) days** from the receipt (postmark date) by DLCD of the adoption (ORS 197.830 to 197.845).
6. In addition to sending the Form 2 - Notice of Adoption to DLCD, please also remember to notify persons who participated in the local hearing and requested notice of the final decision. (ORS 197.615).
7. Submit **one complete paper copy** via United States Postal Service, Common Carrier or Hand Carried to the DLCD Salem Office and stamped with the incoming date stamp.
8. Please mail the adopted amendment packet to:

ATTENTION: PLAN AMENDMENT SPECIALIST
DEPARTMENT OF LAND CONSERVATION AND DEVELOPMENT
635 CAPITOL STREET NE, SUITE 150
SALEM, OREGON 97301-2540

9. **Need More Copies?** Please print forms on **8½ -1/2x11 green paper only if available.** If you have any questions or would like assistance, please contact your DLCD regional representative or contact the DLCD Salem Office at (503) 373-0050 x238 or e-mail **plan.amendments@state.or.us**.

RECORDING COVER SHEET

Any errors in this cover sheet DO NOT affect the transactions(s) contained in the instrument itself.

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AFTER RECORDING RETURN TO:

CLERK'S VAULT

NAME OF TRANSACTION

Ordinance 253, Adopting a new Flood Insurance Study and Maps, amending the Comprehensive Plan and Crook County Code, and declaring an emergency

GRANTOR: CROOK COUNTY

STATE OF OREGON } ss 2012004
COUNTY OF CROOK }
I CERTIFY THAT THE WITHIN INSTRUMENT WAS RECEIVED FOR RECORD ON THE 20th DAY OF January, 2012 AT 11:40 AM. AND RECORDED IN CJRNL RECORDS OF SAID COUNTY MF NO. 2012-004
DEANNA E. BERMAN, CROOK COUNTY CLERK
BY Jessie Trammell DEPUTY

N/C

55

IN THE COUNTY COURT OF THE STATE OF OREGON
FOR THE COUNTY OF CROOK

AN ORDINANCE ADOPTING A NEW FLOOD INSURANCE STUDY AND MAPS, AMENDING THE COMPREHENSIVE PLAN AND CROOK COUNTY CODE, AND DECLARING AN EMERGENCY.

Ordinance No. 253

WHEREAS, after due deliberation and requisite hearings, the Crook County Planning Commission recommends to the County Court that the Court adopt the new Flood Insurance Study for Crook County, and its associated digital Flood Insurance Rate Maps, both of which are attached hereto as Exhibit A; and

WHEREAS, the Planning Commission also recommends the adoption of certain revisions to the Crook County Comprehensive Plan, specifically as relates to Chapter IX (Natural Resources/Hazards and Development Limitations-Floodplains), with such revisions attached hereto as Exhibit B; and

WHEREAS, the Planning Commission also recommends the adoption of certain revisions to Chapters 15.08 (Flood Damage Prevention) and 18.84 (Flood Plain Combining Zone) of the Crook County Code, such proposed revisions being attached hereto as Exhibit C; and

WHEREAS, the Federal Emergency Management Agency has requested that the County adopt these new studies, maps, plan amendments and code amendments by February 2, 2012.

NOW, THEREFORE, the Crook County Court ordains as follows:

SECTION ONE: The Flood Insurance Study and associated Flood Insurance Rate Maps attached to this ordinance as Exhibit A are adopted, and County staff members are directed to take those steps necessary and convenient to implement such adoption.

SECTION TWO: The revisions to Chapter IX of the Crook County Comprehensive Plan attached to this ordinance as Exhibit B are hereby adopted, and County staff members are directed to take those steps necessary and convenient to implement such adoption.

SECTION THREE: The proposed revisions to Chapters 15.08 and 18.84 attached to this Ordinance as Exhibit C are hereby adopted, and County staff members are directed to take those steps necessary and convenient to implement such adoption.

SECTION FOUR: This Ordinance being necessary for the health, welfare and safety of the people of Crook County, an emergency is hereby declared to exist, and this Ordinance shall become effective upon signing.

First Reading: 1-18-2012

Second Reading: 1-18-2012

DATED this 18 day of JANUARY, 2012.

CROOK COUNTY COURT

Judge Mike McCabe

Commissioner Ken Fahlgren

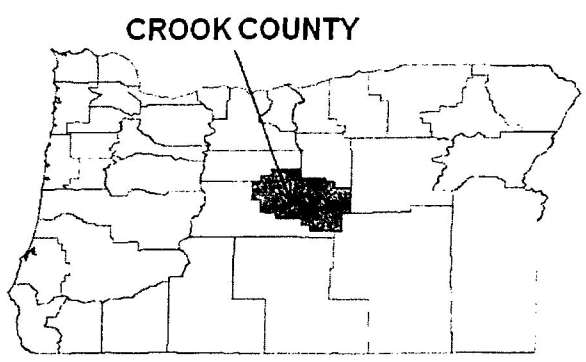
Commissioner Seth Crawford

EXHIBIT A

FLOOD INSURANCE STUDY

CROOK COUNTY, OREGON
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
CROOK COUNTY	
UNINCORPORATED AREAS	410050
PRINEVILLE, CITY OF	410051



REVISED

FEBRUARY 2, 2012

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
41013CV000A

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. It is advisable to contact the community repository for any additional data.

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

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X
C	X

Part or all of this Flood Insurance Study may be revised and republished at any time. In addition, part of this Flood Insurance Study may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the Flood Insurance Study. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current Flood Insurance Study components.

This FIS report was revised on February 2, 2012. Users should refer to Section 10.0, Revisions Description, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this report should be aware that the information presented in Section 10.0 supersedes information in Sections 1.0 through 9.0 of this FIS report.

Initial FIS Effective Date: July 17, 1989

Revised FIS Effective Date: February 2, 2012

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PUBLISHED SEPERATELY

FLOOD INSURANCE STUDY
CROOK COUNTY, OREGON AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

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

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

1.2 Authority and Acknowledgments

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

The hydrologic and hydraulic analyses for this FIS were performed by the U.S. Army Corps of Engineers (USACE), Portland District (the study contractor), for the Federal Emergency Management Agency (FEMA), under Interagency Agreement No. IAA-EMW-E-II53, Project Order No.1. This FIS was completed in March 1986.

1.3 Coordination

A pre-contract coordination meeting was held on July 12, 1983, at the courthouse in the City of Prineville. The meeting was attended by Crook County and the City of Prineville officials, representatives from FEMA, and the USACE, Portland District. The purpose of the meeting was to: (1) inform the communities on their status in the flood insurance program; (2) gather all available pertinent data on flooding in the community; and (3) reach an agreement on the areas to be studied. Also discussed at the meeting were flood hazards and possible locations of high water marks.

In November 1983, public announcements of the proposed FIS reports were made available to the local news agencies and communities. The announcements informed residents in the area of the studies and requested any information that would help identify flood hazard areas such as high-water marks and photographs of past floods.

Coordination continued throughout the study. In November and December 1983, letters were sent to the U. S. Department of the Interior, Bureau of Reclamation, U.S. Geological Survey (USGS), Natural Resources Conservation Services (NRCS), formerly U.S. Soil Conservation Service (SCS), Oregon Water Resources Department, Oregon Department of Transportation (ODOT), and the State Director of the Bureau of Land Management in order to gather available flood information.

An intermediate Consultation and Coordination Officer's (CCO) meeting was held on July 27, 1987, in Prineville, at which time the work maps and profiles, showing flooded areas and flood (water-surface) elevations were presented by the study contractor for review by community officials.

The final CCO meeting was held on August 25, 1988 to review results of the work. It was attended by representatives of FEMA, the study contractor, and the community. No problems with the study contents were raised at the meeting.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS report covers the geographic area of Crook County, Oregon, including the incorporated communities listed in Section 1.1. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through March 1991.

The Crooked River was studied by detailed methods from just below the confluence with Ochoco Creek, upstream for a reach of 4.6 miles. Ochoco Creek was studied by detailed methods from its mouth, upstream for a reach of 10.3 miles.

Approximate methods were used to study Ochoco Creek from its upstream limit of detailed study to the base of Ochoco Reservoir, about 0.9 miles. Juniper Canyon Creek was also studied by approximate methods. The scope and methods of study were proposed to, and agreed upon by, FEMA and Crook County officials.

2.2 Community Description

Crook County is located in north-central Oregon and is almost completely contained within the Crooked River sub-basin of the Deschutes River basin. It is bordered on the northwest and north by Jefferson County, on the northeast by Wheeler County, on the east by Grant County, on the southeast by Harney County, and on the south and west by Deschutes County.

The county was established on October 24, 1882, from Wasco County and named for Major General George Crook, U.S. Army. It originally included the present area of Jefferson and Deschutes Counties and part of Wheeler County. It now covers a total area of 2,991 square miles (Reference 1). The population of Crook County in 2000 was 19,182. The climate is semiarid with abundant sunshine, cool nights, light rainfall, and low humidity. The annual precipitation ranges from slightly more than 8 inches in the lower valley to about 19 inches in the Ochoco Mountains. Approximately 75 percent of

the precipitation occurs as snowfall. Snow cover rarely exceeds 26 inches in the valleys but has reached 80 inches in the mountains.

The City of Prineville is located in northwestern Crook County, approximately 150 miles southeast of Portland. It was founded in 1868 and is the only incorporated community in the county. Prineville had a population of 7,356 in 2000. It is situated on the central Oregon plateau at an elevation of over 2,850 feet. The annual precipitation is 10.5 inches, and the average temperature in January is 31.8° F and in July is 64.5° F. Other communities in this sparsely settled county are Powell Butte, Post, and Paulina.

2.3 Principal Flood Problems

The annual flood season for Crook County occurs from November through June. Crooked River and Ochoco Creek are primarily snow-fed streams, with their peak flows occurring in the spring and early summer when the snow melts in the surrounding mountains. Snowmelt floods occur when the temperature rises rapidly causing a sudden melting of accumulated snow. Occasionally during the winter months, a flood will result from intense rain augmented by snowmelt. Such flash floods have a smaller volume than the spring freshet because of their shorter duration. Flows in Crooked River and its tributaries are generally low from July through October. Cyclonic rainstorms do occur from spring through fall months; however, two storage reservoirs, one on Crooked River and one on Ochoco Creek, provide enough flood control storage so that those floods are not a major concern. When flooding occurs during a winter thaw, ice may obstruct flood flows by lodging against bridges or other obstructions along the streams.

The largest recorded flood occurred on Crooked River in 1890. According to reports, there were major monthly floods during that year from January through May. In one of these floods, the river changed a major channel in the vicinity of Prineville. Exact magnitudes are not known, but floods larger than 8,000 cubic feet per second (cfs) are believed to have occurred in 1890, 1894, 1897, 1901, and 1904 (Reference 14). The largest flood, since the beginning of formal stream flow records in 1909, occurred in March 1952 and had a peak discharge of 8,410 cfs (17-year flood). Prineville Reservoir, operated by the USACE, approximately 27 miles upstream of Prineville, began flood control regulation in December 1960. Since that time, all outflows have been limited to a maximum of 3,000 cfs. It is estimated that all recorded floods could have been regulated to 3,000 cfs or less (Reference 15).

The 1964 flood peak would have been more than twice the magnitude of the 1952 flood on Crooked River without regulation. Prineville Reservoir's flood storage was used to reduce the 1964 flood from an estimated natural peak of 20,000 cfs, (roughly 500-year) to an actual peak release of 3,000 cfs; which is considered to be bank-full capacity.

No continuous stream flow record exists for Ochoco Creek. Ochoco Reservoir flood control storage was used to reduce the December 1964 peak flow from an estimated unregulated release of 5,350 cfs (0.5-percent-annual-chance flood) to an actual release of 1,250 cfs.

The study reach of Ochoco Creek including the City of Prineville, has 22 bridges that would be affected by the 1-percent-annual-chance flood. These constrictive bridges increase flood levels and are subject to overtopping or structural damage which could result

in disruption of transportation systems. Six irrigation diversion dams, located upstream of Prineville tend to increase flood levels in the immediate area upstream of those structures.

Juniper Canyon Creek drains an area between Ochoco Creek and Crooked River drainages, to the south of Prineville. Flooding can occur from rainfall or from sudden snowmelt with a large snowpack on frozen soils. Since floods occur in winter, crop damage is slight but sediment and debris are deposited on pastures and cropland. In 1979, flood waters from the South Fork washed out the Juniper Canyon Highway crossing and flooded across the Paulina Highway. Water standing over septic tank fields and wells was a sanitation concern (Reference 22).

2.4 Flood Protection Measures

Two storage reservoirs afford considerable flood protection along the study reaches of Crooked River and Ochoco Creek. Prineville Dam, approximately 27 miles upstream of Prineville on Crooked River, has a drainage area of over 2,700 square miles. Since December 1961, it has provided 60,000 acre feet of flood control storage. The project is operated during floods to control releases to reach a maximum of 3,000 cfs after the local inflow below the dam recedes. It accomplished this goal during the December 1964 flood, which would have peaked at about 20,000 cfs without regulation (Reference 15).

Ochoco Reservoir, also upstream of Prineville, has a drainage area of 300 square miles. It provides a minimum of 16,500 acre feet of available flood control storage. It would greatly reduce peak flows during floods of 1-percent-annul-chance recurrence intervals or smaller, but has little effect on peak flows for extremely rare floods such as the 0.2-percent-annual-chance event. At the beginning of the 1961 flood, a 31,500 acre foot of storage was available. Actual regulation used 25,000 acre feet of storage to control outflow to a peak of 1,250 cfs. It is estimated the 1961 flood would have peaked at 5,350 cfs without regulation (Reference 15).

There are several small dams on Ochoco Creek, most of which are used to divert water for irrigation. They are not considered flood control devices and generally increase flood levels for a short distance upstream.

There are no proposed levees or other projects which would reduce flooding on the study reaches of Crooked River or Ochoco Creek. A low levee (2 to 4 feet) was constructed by Crook County in 1952 along the right bank of Crooked River to protect the Riverside Addition, but it is no longer of any significance following the construction of Prineville reservoir. The NRCS prepared a plan to reduce flooding from Juniper Canyon Creek (Reference 22). That project, completed in February 1987, conveys water from Paulina Highway to Crooked River, thereby reducing downstream flooding.

Non-structural measures are being used to aid in the prevention of the future flood damage. Crook County has a floodplain combining zone ordinance which follows NFIP guidelines for controlling development within the 1-percent-annual-chance floodplain. It requires, as a part of the building permit process, that the first level of any new structure be elevated at least two feet above the 1-percent-annual-chance flood elevation (Reference 22). A flood hazard zoning ordinance which follows NFIP guidelines is also in effect in Prineville. Additionally, in areas where the 1-percent-annual-chance elevation has not been calculated, the combined county and city planning department

reviews building permits for construction to ensure that the sites are reasonably safe from flooding.

3.0 ENGINEERING METHODS

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

3.1 Hydrologic Analyses

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

Crooked River has a drainage area of approximately 4,500 square miles, of which 345 square miles on Ochoco Creek and approximately 2,810 square miles on Crooked River are located above the City of Prineville. Most of the drainage area above Prineville is mountainous and a large portion lies in the Ochoco National Forest. The highest point in Crooked River Basin is 7,190 feet, on Snow Mountain. Prineville is situated at the confluence of Crooked River and Ochoco Creek, at the upper end of the largest plain in the basin. Ochoco Creek flows through the heart of the city and Crooked River skirts its southwestern edge.

Peak discharges developed for the studied reaches of Crooked River and Ochoco Creek are based on frequency curves for natural and regulated flows from the Prineville and Ochoco Reservoirs' Regulation Report (Reference 15). The Crooked River frequency curve is based on a combination of observed and estimated record for a 57-year period, 1909 through 1965. The Ochoco Creek frequency curve was derived by the generalized regional method correlated with nearby stream flow records; computed probability was used. Peak discharges for the studied reach of Crooked River upstream of Ochoco Creek were developed by adding local inflow to releases obtained from the regulated frequency curve for Prineville Reservoir. The local inflow between Prineville Reservoir and the study area was estimated using a discharge drainage area relationship. Immediately downstream of the confluence with Ochoco Creek, Crooked River's 10-, 2-, and 1-percent-annual-chance flood peak discharges were increased by 500 cfs for Ochoco Reservoir releases. The 0.2-percent-annual-chance flood peak discharge downstream of the confluence is the Ochoco Creek's 0.2-percent-annual-chance flood peak discharge plus 1,000 cfs from Prineville Reservoir. No increase was made for Juniper Canyon

Creek inflow because that flow would have peaked and receded by the time it merged with the peak Ochoco Reservoir release. Peak discharges are summarized on Table 1, "Summary of Discharges"

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 Flood Insurance Rate Map (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.

Cross section data for the backwater analyses were obtained from topographic maps compiled from aerial photographs (References 16 and 17). Below-water sections were obtained by field survey. All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 18). Starting water-surface elevations for both Crooked River and Ochoco Creek were determined by the lope-area method.

Channel roughness values (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the stream and floodplain areas. The channel "n" values for Crooked River ranged from 0.035 to 0.045 and the overbank "n" values from 0.045 to 0.095. The channel "n" values for Ochoco Creek ranged from 0.030 to 0.040 and the overbank "n" values from 0.030 to 0.150.

The hydraulic analyses for this FIS 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.

The approximate flooded area on the 0.7 mile reach of Ochoco Creek downstream of Ochoco Dam was estimated from a field surveyed cross section at the downstream end, a HEC-2 derived 1-percent-annual-chance flood elevation at that section, aerial photographs at 1:4,800 scale, and a 15-minute quadrangle map (References 18 and 23). Additionally, the reach was field-inspected prior to mapping.

Eight channel cross sections were field surveyed for the Juniper Canyon Creek approximate analysis and mapping. The entire stream reach was inspected on foot and preliminary hydraulic computations were made.

TABLE 1. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
CROOKED RIVER					
Downstream of Ochoco Creek	3,180	3,500	4,000	4,100	7,600
Upstream of Ochoco Creek	2,820	3,010	3,490	3,580	3,820
OCHOCO CREEK					
Ochoco Creek above Third Street	300	500	1,120	2,750	6,600
Ochoco Creek below Third Street		500	1,120	2,750	4,721
Flowsplit		0	0	0	1,879

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs, including are being prepared using NAVD88 as the referenced vertical datum.

To accurately convert flood elevations for Crook County from the current NGVD29 datum to the newer NAVD88 datum, a single countywide conversion factor was calculated by averaging the conversion factor at all quadrangle corners within the county and within 2.5 miles of the county boundary. The conversion factor for the entire county was determined to be an increase of 3.66 feet.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVD29 and NAVD88, or to obtain current elevation, description, and/or location information for bench marks, 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
(301) 713-4172 (fax)

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this county. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS report provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplains; and a 1-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles and Floodway Data tables. Users should reference the data presented in the FIS report as well as additional information that may be available at the local community 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 county. For the streams studied in detail, the 1- and 0.2- percent-annual-chance floodplain boundaries were delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of four feet (References 16 and 17).

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 with moderate flood hazards. In cases where the 1- and 0.2- percent-annual-chance floodplain boundaries are close together, only the 1- percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

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

Approximate 1- percent-annual-chance floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Maps (FHBM) for Crook County and the City of Prineville (References 12 and 13).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard.

For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1- percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1- percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS report and on the FIRM were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections in Table 2, "Floodway Data". The computed floodways are shown on the FIRM. In cases where the floodway and 1- percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The 1-foot maximum rise in the water surface was exceeded at Ochoco Creek cross sections X and CB where critical depth has been indicated for the unencroached HEC-2 computations. Because of the instability of the model at those locations, heavy reliance was placed on results determined at the adjacent cross sections. The resulting floodway limits are considered acceptable because the difference in the energy grade line was held to less than 1 foot.

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S)	REGULATORY (NAVD)	WITHOUT FLOODWAY (NAVD)	WITH FLOODWAY (NAVD)	INCREASE (FT.)
Crooked River								
A	45.323	173	870	4.7	2,832.6	2,832.6	2,832.6	0.0
B	45.600	106	625	5.6	2,833.4	2,833.7	2,833.8	0.1
C	45.942	138	435	4.3	2,836.5	2,836.2	2,836.7	0.5
D	46.153	151	792	4.5	2,838.9	2,839.4	2,839.4	0.0
E	46.532	106	718	5.0	2,842.1	2,842.2	2,842.2	0.0
F	46.785	127	686	5.2	2,844.0	2,844.1	2,844.2	0.1
G	47.038	122	851	4.2	2,845.6	2,845.6	2,845.9	0.2
H	47.272	117	666	5.4	2,847.1	2,847.2	2,847.3	0.1
I	47.500	120	661	5.4	2,849.3	2,849.4	2,849.4	0.0
J	47.683	97	709	5.1	2,850.9	2,851.0	2,851.0	0.0
K	47.953	101	771	4.6	2,853.0	2,853.1	2,853.1	0.0
L	47.970	101	776	4.6	2,853.1	2,853.2	2,853.2	0.0
M	48.119	134	819	4.4	2,854.3	2,854.4	2,854.4	0.0
N	48.436	112	825	4.3	2,856.3	2,856.3	2,856.5	0.1
O	48.766	98	715	5.1	2,858.1	2,856.2	2,858.6	0.4
P	49.059	107	749	4.8	2,860.5	2,860.6	2,860.6	0.5
Q	49.292	100	755	4.7	2,862.2	2,862.3	2,864.9	0.5
R	49.632	107	911	3.9	2,863.8	2,863.9	2,864.9	1.0
S	49.857	96	707	5.1	2,865.5	2,865.6	2,866.2	0.6

[1] Miles above Mouth

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OREGON

AND INCORPORATED AREAS

FLOODWAY DATA

CROOKED RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S)	REGULATORY (NAVD)	WITHOUT FLOODWAY (NAVD)	WITH FLOODWAY (NAVD)	INCREASE (FT.)
Ochoco Creek								
A	0.155	61	328	8.4	2836.6	2836.6	2837.0	0.4
B	0.478	74	566	4.9	2840.4	2840.4	2841.0	0.6
C	0.601	141	773	3.6	2840.9	2840.9	2841.8	0.9
D	0.801	175	1129	2.4	2842.3	2842.3	2842.8	0.5
E	0.975	240	773	3.7	2842.7	2842.7	2843.4	0.7
F	1.463	135	931	3.0	2844.3	2844.3	2845.3	1.0
G	1.920	150	843	3.3	2845.9	2845.9	2846.8	0.9
H	2.130	180	843	3.3	2846.9	2846.9	2847.7	0.8
I	2.467	260	1116	2.9	2848.5	2848.5	2849.5	1.0
J	2.660	177	625	4.4	2849.6	2849.6	2850.4	0.8
K	2.861	188	667	4.1	2852.4	2852.4	2852.6	0.2
L	3.009	290	1378	2.0	2853.1	2853.1	2853.8	0.7
M	3.121	320	1129	2.9	2853.8	2853.8	2854.5	0.7
N	3.219	190	828	3.3	2854.3	2854.3	2855.2	0.9
O	3.437	250	631	4.4	2856.6	2856.6	2857.3	0.7
P	3.478	230	812	4.2	2857.4	2857.4	2858.3	0.9
Q	3.685	235	740	3.7	2860.4	2860.4	2861.1	0.7
R	3.721	235	638	4.3	2861.0	2861.0	2862.0	1.0
S	3.784	150	632	4.4	2863.2	2863.2	2863.9	0.7
T	3.861	160	763	3.6	2863.8	2863.8	2864.7	0.9
U	3.970	95	398	6.9	2866.8	2866.8	2866.8	0.0
V	4.185	110	562	4.9	2870.2	2870.2	2870.4	0.2
W	4.356	170	762	3.6	2872.8	2872.8	2873.5	0.7
X	4.474	130	553	5.0	2874.8	2874.8	2875.3	0.5
Y	4.590	100	484	5.7	2878.3	2878.3	2879.1	0.8

[1] Miles above Confluence with Crooked River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OREGON

AND INCORPORATED AREAS

FLOODWAY DATA

OCHOCO CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S)	REGULATORY (NAVD)	WITHOUT FLOODWAY (NAVD)	WITH FLOODWAY (NAVD)	INCREASE (FT.)
Ochoco Creek (Continued)								
Z	4.674	118	453	6.1	2880.6	2880.4	2880.4	0.0
AA	4.852	90	389	7.1	2884.1	2884.0	2884.1	0.1
AB	4.961	80	355	7.8	2886.5	2886.5	2886.9	0.4
AC	5.060	108	736	4.2	2888.9	2888.9	2889.1	0.2
AD	5.116	85	685	4.0	2891.0	2891.4	2891.4	0.0
AE	5.220	77	850	3.2	2894.6	2893.2	2893.2	0.0
AF	5.319	170	992	2.8	2895.5	2893.5	2893.5	0.0
AG	5.492	230	1288	2.8	2899.8	2899.8	2900.6	0.8
AH	5.672	190	730	3.8	2901.3	2901.3	2901.9	0.6
AI	5.771	145	526	5.2	2903.3	2903.3	2903.8	0.5
AJ	6.073	100	452	6.1	2909.2	2909.2	2909.6	0.4
AK	6.273	133	514	5.4	2913.8	2913.8	2914.7	0.9
AL	6.486	100	438	6.3	2918.9	2918.9	2919.1	0.2
AM	6.783	70	346	8.0	2924.8	2924.8	2925.6	0.8
AN	7.073	100	411	6.7	2931.3	2931.3	2931.9	0.6
AO	7.346	90	416	6.6	2938.6	2938.6	2939.4	0.8
AP	7.472	80	397	6.8	2942.8	2942.6	2943.0	0.4
AQ	7.632	70	342	8.0	2947.2	2947.2	2947.5	0.3
AR	7.905	100	465	5.9	2954.0	2954.0	2954.7	0.7
AS	8.078	170	537	5.1	2958.2	2958.2	2958.6	0.4
AT	8.202	159	593	4.6	2961.7	2961.7	2962.0	0.3
AU	8.234	160	799	3.4	2963.6	2963.6	2963.7	0.1
AV	8.517	80	453	6.1	2969.1	2969.1	2969.7	0.6
AW	8.553	170	877	3.1	2970.8	2970.8	2971.7	0.9

[1] Miles above Confluence with Crooked River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OREGON

AND INCORPORATED AREAS

FLOODWAY DATA

OCHOCO CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S)	REGULATORY (NAVD)	WITHOUT FLOODWAY (NAVD)	WITH FLOODWAY (NAVD)	INCREASE (FT.)
Ochoco Creek (Continued)								
AX	8.737	294	898	5.4	2972.7	2972.7	2973.1	0.4
AY	8.861	130	661	4.2	2974.5	2974.5	2975.0	0.5
AZ	8.933	120	698	3.9	2977.0	2977.0	2977.8	0.8
BA	9.113	95	460	6.0	2979.1	2979.1	2979.8	0.7
BB	9.201	240	1477	3.1	2981.4	2981.4	2982.1	0.7
BC	9.299	100	622	4.4	2984.0	2984.0	2985.0	1.0
BD	9.471	100	505	5.5	2986.3	2986.3	2987.2	0.9
BE	9.625	170	646	6.1	2990.5	2990.5	2991.0	0.5
BF	9.647	250	615	4.5	2991.1	2991.1	2992.0	0.9
BG	9.667	200	667	3.8	2992.6	2992.4	2993.2	0.8
BH	9.856	130	400	7.3	2996.6	2996.6	2996.9	0.3
BI	9.942	230	556	5.0	2998.5	2998.5	2999.4	0.9
BJ	10.043	225	567	4.9	3001.2	3001.2	3002.2	1.0
BK	10.138	160	563	4.9	3004.2	3004.2	3004.2	0.0
BL	10.158	160	573	4.8	3005.1	3005.1	3005.6	0.5

[1] Miles above Confluence with Crooked River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OREGON

AND INCORPORATED AREAS

FLOODWAY DATA

OCHOCO CREEK

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 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

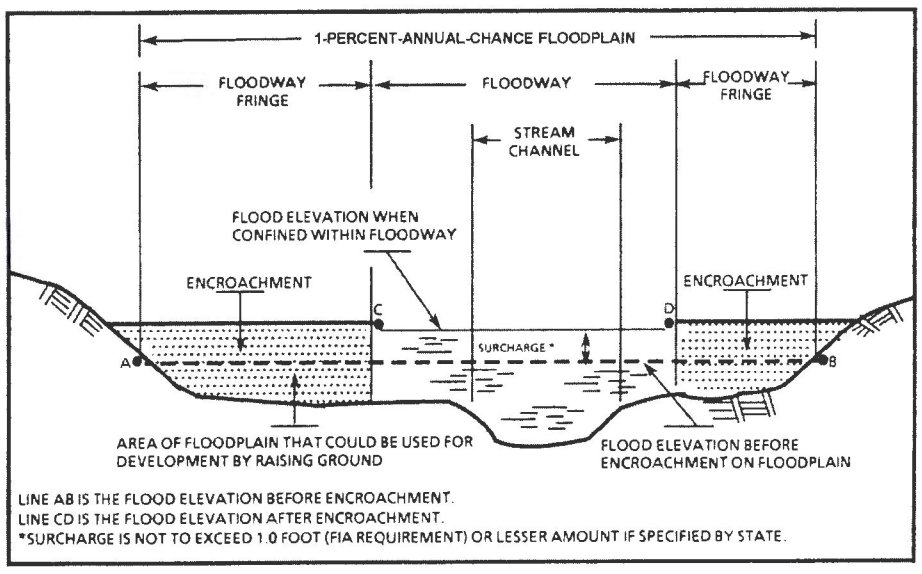

Figure 1. Floodway Schematic

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. The zones are as follows:

Zone A

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

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

Zone AH

Zone AH is the flood insurance rate zone that corresponds to areas of 1-percent-annual-chance shallow flooding (usually areas of ponding) where average

depths are between 1 foot and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

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

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, and to 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 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 rate zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole foot BFEs or average depths. Insurance agents use 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 current FIRM presents flooding information for the entire geographic area of Crook County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the county identified flood-prone. This countywide FIRM also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community are presented in Table 3, "Community Map History".

7.0 OTHER STUDIES

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

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this Flood Insurance Study can be obtained by contacting the Chief, Natural and Technological Hazards Division, FEMA, Federal Regional Center, 130-228th Street, S.W., Bothell, Washington 98021-9796.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATES	FIRM EFFECTIVE DATES	FIRM REVISIONS DATES
CROOK COUNTY UNINCORPORATED AREAS	August 16, 1977	NONE	July 17, 1989	None
PRINEVILLE, CITY OF	November 30, 1973	February 6, 1976	July 17, 1989	None

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
CROOK COUNTY, OREGON
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

9.0 BIBLIOGRAPHY AND REFERENCES

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9. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Grant County, Oregon, (Unincorporated Areas), May 18, 1982.

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12. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Crook County, Oregon, (Unincorporated Areas), revised August 16, 1977.

13. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Prineville, Oregon, revised February 6, 1976.

14. U.S. Army Corps of Engineers, Portland District, Justification Report on Crooked River, Prineville, Oregon, July 1956.

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16. U.S. Army Corps of Engineers, Portland District, Flood Insurance Study Work Maps – Crooked River, Contour Interval of 4 feet, Scale 1:4,800, September 1986, Sheets 1 to 2 of 2.

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10.0 REVISIONS DESCRIPTION

This section has been added to provide information regarding significant revisions made since the original FIS report and FIRM were printed. Future revisions may be made that do not result in the republishing of the FIS report. All users are advised to contact the Community Map Repository at the address below to obtain the most up-to-date flood hazard data.

CROOK COUNTY
Crook County Courthouse
300 East Third Street
Prineville, Oregon 97754

CITY OF PRINEVILLE
City Hall
400 East Third Street
Prineville, Oregon 97754

10.1 First Revision (Revised February 2, 2012)

Introduction

The Flood Insurance restudy for Ochoco Creek in Crook County Oregon was performed by USACE, Portland District (CENWP) in April 2008 at the request of the City of Prineville (Reference 5). The restudy was requested to look at changes in the hydrology and hydraulics with the occurrence of the 1998 flood and subsequent bridge replacements.

The purpose of this restudy was to look at the changes in hydrology and hydraulics with the occurrence of the 1998 flood and subsequent bridge replacements. An initial CCO meeting was held on September 25, 2009, with representatives of FEMA, and officials from Crook County and the City of Prineville to discuss the nature and purpose of this FIS restudy.

In addition to the USACE restudy, the impact on flooding by the inclusion of two wetland areas: one associated with the Crooked River studied by the Oregon Department of Transportation (ODOT); one associated with the Ochoco River conducted by Bussard Engineering, LLC; and the replacement of the bridge at Third Street and Knowledge conducted by URS for ODOT, are included with this revision to the Crook County FIS.

The results of these studies were reviewed at the final CCO meeting held on September 28, 2010, and attended by representatives of Crook County, City of Prineville, State of Oregon and FEMA Region X. All problems raised at that meeting have been addressed in this study.

Areas Studied

The area of the USACE restudy for Ochoco Creek is approximately 10 miles of stream from below the Ochoco Dam to its confluence with the Crooked River. This area is located in the City of Prineville and the unincorporated areas of Crook County, Oregon.

The wetlands area associated with Ochoco Creek is approximately 2,000 feet in length, extending from Cambo Flat Road to Willowdale Road. The wetland around Crooked River is approximately 0.66 miles long and extends from approximately 0.3 miles downstream of the confluence with Ochoco Creek to approximately 0.33 miles upstream of the confluence with Ochoco Creek.

Flood History

Since the construction of the Ochoco dam in 1918, only three floods have resulted in flows exceeding backfull capacity in Ochoco Creek below the dam. The largest flood recorded at Ochoco Dam was the December 1964 flood, which was estimated at 5,350 cfs inflow. With maximum flood storage capacity available behind the dam, the flow was reduced to an estimated 1,250 cfs below the dam (Reference 17). The second largest flood since the dam's construction was in May 1956 when inflows to the dam exceeded 2,600 cfs. Due to

reduced flood storage capacity behind the dam, the flood quickly filled the reservoir and topped the spillway crest, exceeding bankfull capacity below the dam (Reference 6). The flood-of-record below the dam happened May 30, 1998 when a combined release of more than 2,046 cfs flowed through the outlet works and over the spillway. The inflow to the reservoir was a relatively small flood of 2,100 cfs, but the available flood storage was almost none.

Flood Frequencies

The effective FIS uses flood frequencies from the original flood presented in the Ochoco Reservoir water control manual (Reference 6). The original analysis included two Flood Frequency Analysis (FFA) curves: an unregulated or "natural" flood frequency curve and a regulated curve for flows downstream of Ochoco Dam. The unregulated curve was created using the few years of gauge data and data collected at the reservoir correlated with gauge data from nearby streams. The regulated curve was based on the unregulated curve but assumed 16,500 acre-feet of available flood storage. The Annual Exceedance Probability (AEP) used in the FIS are based on the regulated curve. The report does not discuss the analysis in detail, nor does it present confidence limits or the complete set of data used to generate the curves.

The Bureau of Reclamation (BOR) (Reference 16) conducted a more recent FFA of inflows at Ochoco Dam as a part of a review process for dam safety. The analysis used the three USGS gages from the area (two on Ochoco Creek with a combined 18 years of data, and one on Beaver Creek about 40 miles southwest of Ochoco Dam with 33 years of data) for a combined 51 years of peak annual flow data from 1909 to 1975. "This combined record was adjusted by the square root of the drainage areas and analyzed by the computer program FLDFRQ3 using Bayesian maximum likelihood estimation" (Reference 14). It also uses the 1862 flood event, assumed to be similar to the flood of record of 1964, and three paleofloods. The results of the 2002 FFA plot very closely to the effective unregulated flood frequency curve. The effective curve is slightly less sloped but falls within the 95% confidence limits of the recent analysis.

Hydrologic Data

There are no functional gauges or sources of peak instantaneous flow data for Ochoco Creek; however, there are two sources of daily data that are used presently as a check on the FFAs described in the previous section. There are inflow hydrographs for 40 years (1921-1960) of maximum daily inflow at the dam found on plates 6&7 of the water control manual, and 23 years of average daily unregulated flow (1983-present) from the US Department of the Interior, Bureau of Reclamation, Pacific Northwest Region historical data website (Reference 20). Both of these datasets are calculated from reservoir operations using daily change in reservoir storage and outflow data. These daily data are compared with instantaneous data from the 2002 FFA. The BOR website also contains 41 years of average daily discharge data (1966-present).

The data show that the inflow that caused the 1998 flood was not as unusual as the regulated discharge. Based on the effective FFA, the inflow to the dam in 1998 was equivalent to a 0.15 AEP event, but the regulated discharge was equivalent to a 0.013 AEP event. This difference is a result of using a regulated frequency curve that assumed a design 16,500 acre-feet of flood storage, where in actuality, variable amount of flood storage are

available throughout the flood season and from year to year. A summary of 23 years of daily storage data (1983-2007) in comparison with the rule curve shows less than the design 16,500 acre-feet of flood storage regularly occurring in the spring where large events have occurred in the past. The frequency of floods downstream of the dam would ideally be created as a composite of the probability of flooding during the winter months with full storage capacity and flooding during the late spring with variable storage capacity; however, there are insufficient data available for such an analysis.

Model Development

CENWP conducted a field investigation in July 2007 to gather structure and cross-section data reflecting the existing conditions on Ochoco Creek (Reference 5). Several structures damaged during the 1998 flood have since been either abandoned, reset, or replaced. Preliminary investigations using recent aerial photography revealed the presence of several new structures and/or structures that were not included in the original model study. The total effort included surveying 17 bridges, 7 diversion dams, and 51 cross-sections along Ochoco Creek.

Cross-sections and the stream centerline from the existing HEC-2 model were georeferenced in HEC-RAS over scanned and georeferenced work maps. New cross-sections from the CENWP survey were drawn in ArcMap. The complete set of old and new cross-sections with topographic data from Light Detection and Ranging (LIDAR) were imported into a new HEC-RAS version 3.1.3 geometry using HEC-GeoRAS software.

New structure data were sorted using GIS. The surveyed high and low cord data were combined with LIDAR data (Reference 22) in the overbanks to extend the cross-sections beyond the 500 year floodplain. For structures that have not been modified in recent past, bridge and inline structure data from the existing HEC-2 model were copied into the current model.

New channel cross-section and bathymetry data were processed similar to the structure data. The surveyed channel geometries were merged with the imported cross-sections cut from the LIDAR data. The new survey data were used wherever possible to describe bathymetry; otherwise, cross-section data from the existing model were used.

Manning's n-values were assigned using aerial photography and photographs from the CENWP survey. Roughness values were typically assigned to the channel bottom, channel banks, and overbank areas, with horizontal variations delimited using aerial photography. Large buildings significantly impacting flow were identified with aerial photography and incorporated into the sections as blocked areas. Ineffective flow areas were used frequently in the overbanks to confine conveyance to the applicable areas.

Similar to the existing model, the Crooked River stage at its confluence with Ochoco Creek was used for the downstream boundary condition, with each profile on Ochoco corresponding to a similar event on the Crooked River, i.e. the .01 AEP event on Ochoco Creek used the Crooked River stage corresponding to the 0.01 AEP event on the Crooked River at the confluence.

The modeling approach at the structures was either energy only or pressure with weir flow. The method chosen at each structure varied depending on geometry and flow conditions. Multiple opening analysis was performed at several locations with conveyance method used in the overbanks and pressure with weir flow at the structure.

A large flow-split occurring with the 0.002 AEP flow was identified near the middle school upstream of the Third Street Bridge. The flow-split was modeled using a separate river reach flowing through a low area south of downtown Prineville to the Crooked River near the golf course. The reach was connected to Ochoco Creek with using lateral weir along the left bank between Third Street and Combs Flat Road.

Model Results

There were no available data to calibrate a large flood event to. Expansion and contraction coefficients, bridge modeling approach, and ineffective areas were adjusted as necessary to realistically convey right, left, and channel flow through the model. The 0.01 and 0.002 AEP profiles were compared with the effective AEP profiles and found to vary both higher and lower throughout.

Changes in the flood profiles between the current and effective studies are a result of the large amount of new physical data as well as modeling differences inherent in the two different models (HEC-2 and HEC-RAS), notably in the calculations at bridges and inline structures. The largest changes in the AEP profiles are attributed to the multiple structures newly constructed and/or added to the model including the bridges at the Mill Property, Resort Lane, and Orchard Lane and the City Park diversion dam. The addition of fill material in the floodplain, reflected in the LIDAR data, was a cause of increases in the AEP profiles at several locations. The increased detail in horizontal variations of Manning's n-values supported by recent photography resulted in a slightly higher composite roughness in the channel, which likely produced a small increase in flood profiles over the entire reach. Several sections showed slight degradation (less than a foot), and noticeable aggradation was only found behind the City Park diversion dam to the Third Street Bridge.

The study for the Ochoco Creek wetland area updated the topography data thereby channelizing Ochoco Creek to a greater extent within the reach of the study area. This updated topographical data, along with the removal of a railroad bridge from considerations, has increased the conveyance for Ochoco Creek and the redelineation of the 1, and 0.2-percent-annual-chance-flood boundaries.

The study for the bridge at Third Street and Knowledge was a single arch bridge and was replaced by a single span bridge with the following geometry: low chord 2,881.4 feet; bridge opening width 44.5 feet; Bridge opening area 440 square feet, and Bridge Deck Width 77 feet.

Crooked River

The study area for Crooked River was updated by using updated LiDAR topography supplied by the U.S. Geological Survey by performing a redelineation of the 1–percent annual-chance- flood and 0.2-percent-annual-chance flood boundaries. After performing the redelineation from the LiDAR topography, a wetland was also included into the study area between cross-sections A and D with topographic data that came from the engineer of

record for the wetland. The inclusion of the wetland area changed the size and shape of the regulated floodway, 1–percent-annual-chance flood and 0.2-percent-annual-chance flood boundaries, and the elevations of the BFEs and expanded the backwater ponding in this area.

Hydrologic Inputs and Frequency Flood Profile Runs

The AEP flows remain unchanged from the previous FIS, except for the flowsplit that occurs with the 0.002 AEP flow upstream of Third Street.

Floodway Analysis

The floodway profile was achieved by starting with a type 4 analysis targeting 0.5-ft of water surface change and working toward a type 1 analysis with a maximum of 1.0-ft of rise at each cross-section. The 1.0-ft rise was a comparison of the encroached profile to the new 0.01 AEP profile. The floodway location was not reduced or moved in areas where fill material has been added inside the effective floodway. The encroachment analysis routine occasionally required that encroachments immediately upstream and downstream of some bridges be entered into the model geometry as obstructed areas in lieu of utilizing the encroachment.

Mapping

For the Crooked River, the cross sections, BFE's, the 1-percent annual-chance flood and the 0.2- percent-annual-chance flood boundaries were digitized from the effective maps. Upon investigation, it was discovered that a profile baseline had not been established on the effective maps or work maps. When considering priorities for future studies, this could be an additional item for consideration.

Flood inundation areas were mapped using the HEC-GeoRAS 3.1.1 ArcView Extension. Terrain data was based on LIDAR data to create a contiguous surface covering the complete study area.

The effective FIS, work maps, and HEC-2 model geometries were referenced to the NGVD 29 vertical datum. *Converting to the North American Vertical Datum of 1988*, of the *Guidelines and Specifications* methods were used to determine a conversion factor for the project area. A conversion factor of 3.66 ft (0.00 ft NGVD29 = 3.66 ft NAVD88) was computed for the project area (Prineville, OR). The terrain and the HEC-RAS model were converted to NAVD prior to mapping.

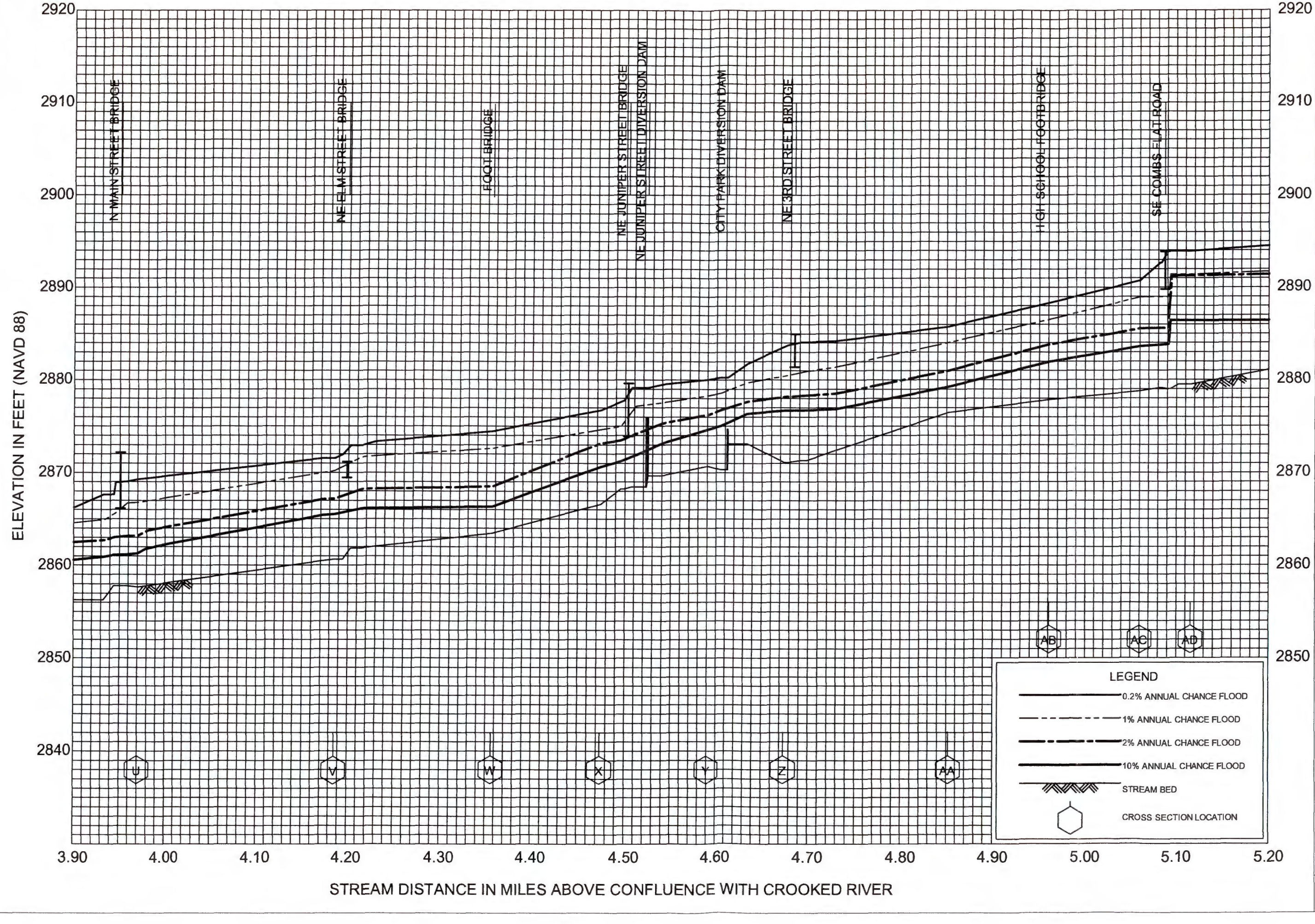
TABLE 4. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
OCHOCO CREEK					
Ochoco Creek above Third Street	300	500	1,120	2,750	6,600
Ochoco Creek below Third Street		500	1,120	2,750	4,721
Flowsplit		0	0	0	1,879

This countywide FIS also incorporates the determination of letters issued by FEMA resulting in LOMCs. All LOMCs in Crook County for which information could be found are summarized in the Summary of Map Amendment (SOMA) included in the Technical Support Data Notebook (TSDN) associated with this FIS update and in Table 5. Copies of the SOMA may be obtained from the Community Map Repository.

TABLE 5. Letters of Map Change Incorporated

Community	Project Identifier	Case No.	Date Issued	Type
Crook County, OR	Bend Trap Club	06-10-B358P	05/31/2006	LOMR
Crook County, OR	Cimmeron Hills	06-10-B006P	06/30/2006	LOMR
Crook County, OR	Roundtree Estates P.U.D.	08-10-0106P	04/01/2008	LOMR



FLOOD PROFILES

OCHOCO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

08P

ELEVATION IN FEET (NAVD 88)

2870 2880 2890 2900 2910 2920 2930 2940 2950

STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH CROOKED RIVER

5.20 5.30 5.40 5.50 5.60 5.70 5.80 5.90 6.00 6.10 6.20 6.30 6.40 6.50

AE AF AG AH AI AJ AK AL

LUMBER MILL BRIDGE

CITY OF PRINEVILLE
CROOK COUNTY

SE WILLOWDALE DRIVE BRIDGE

CROOK COUNTY
CITY OF PRINEVILLE

CITY OF PRINEVILLE
CROOK COUNTY

CROOK COUNTY
CITY OF PRINEVILLE

CITY OF PRINEVILLE
CROOK COUNTY

DIVERSION DAM

CONFLUENCE WITH JOHNSON CREEK

LEGEND

- 0.2% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

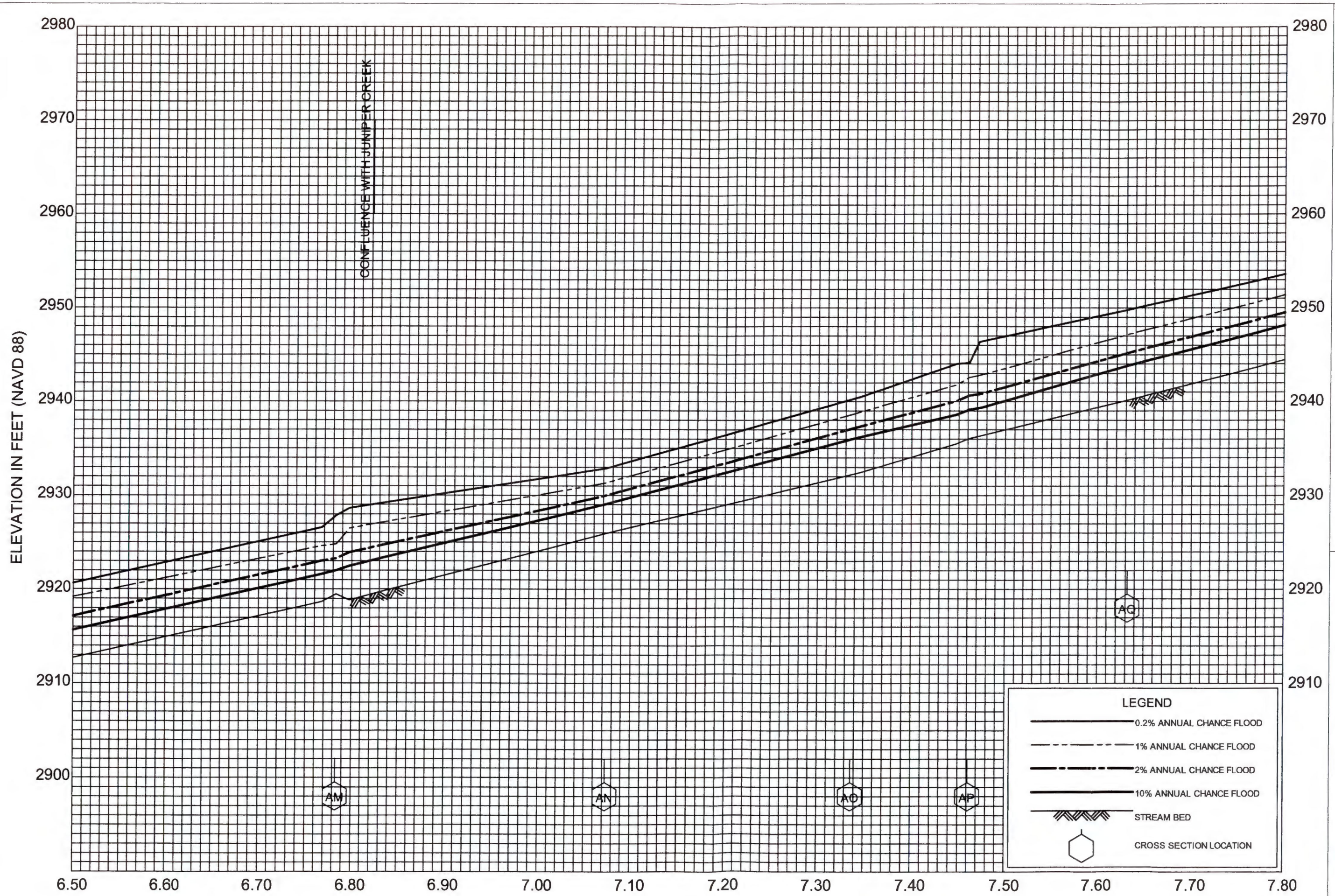
09P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

FLOOD PROFILES

OCHOCO CREEK



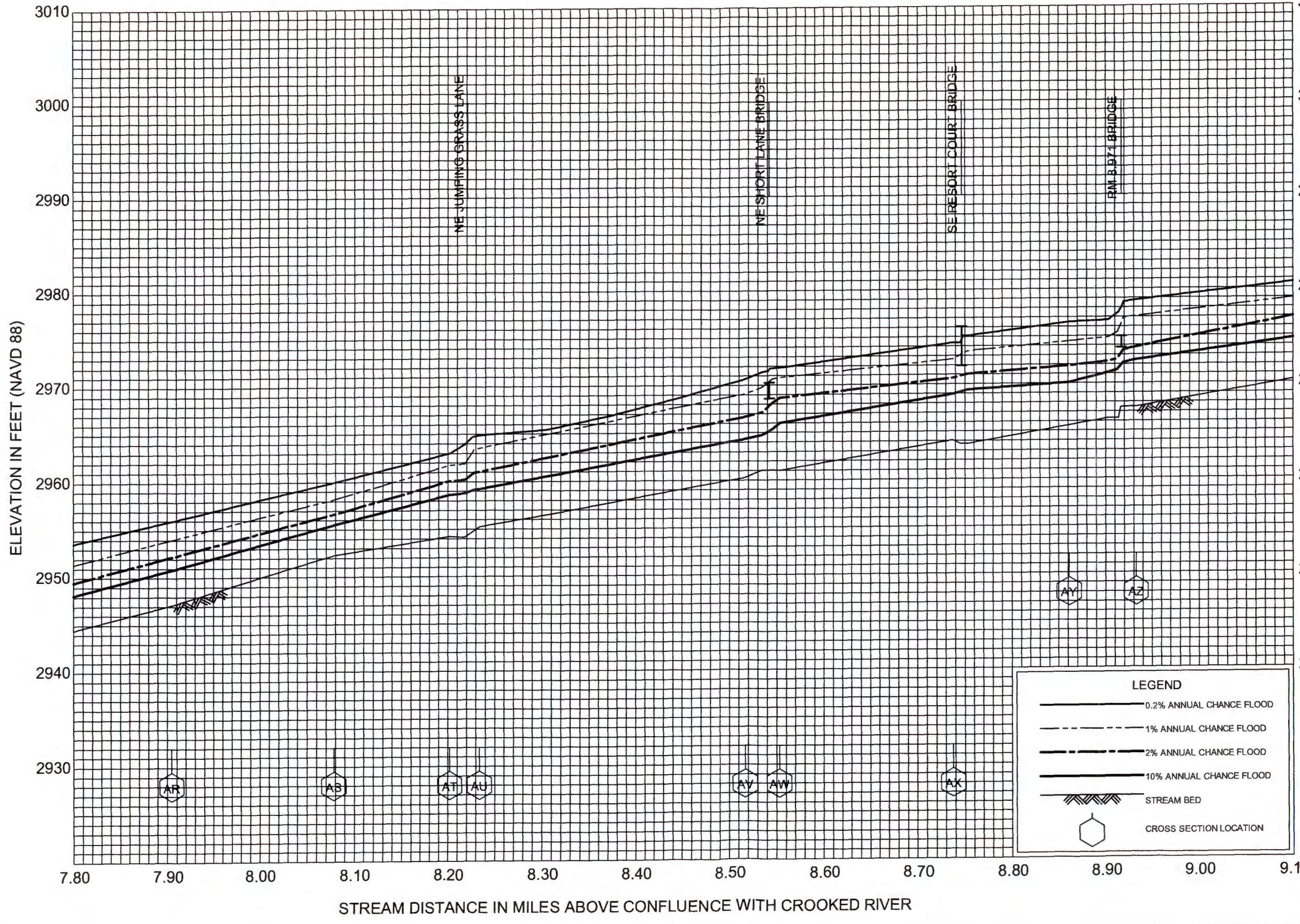
FLOOD PROFILES

OCHOCO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

10P



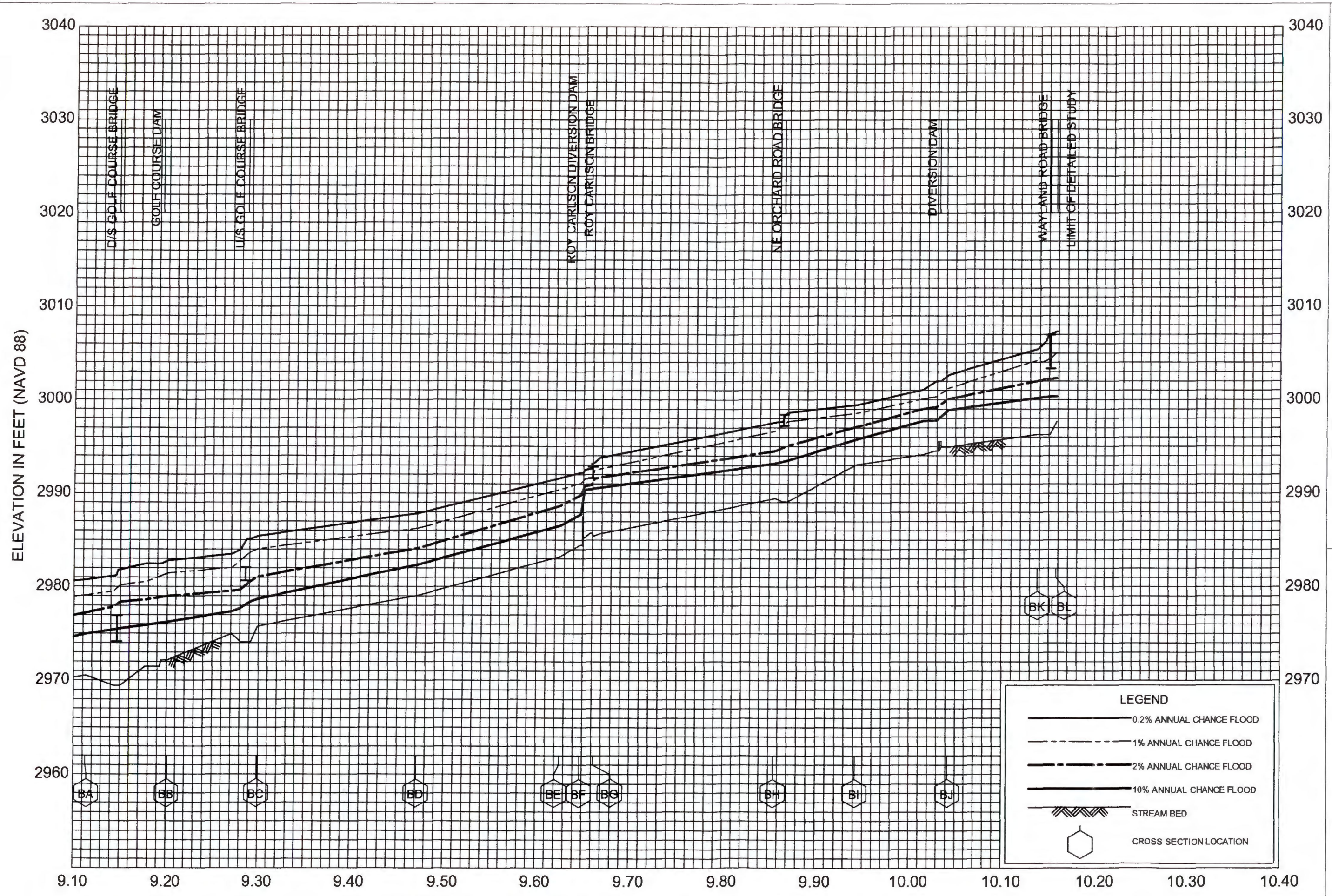
FLOOD PROFILES

OCHOCO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

11P



FLOOD PROFILES

OCHOCO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

12P

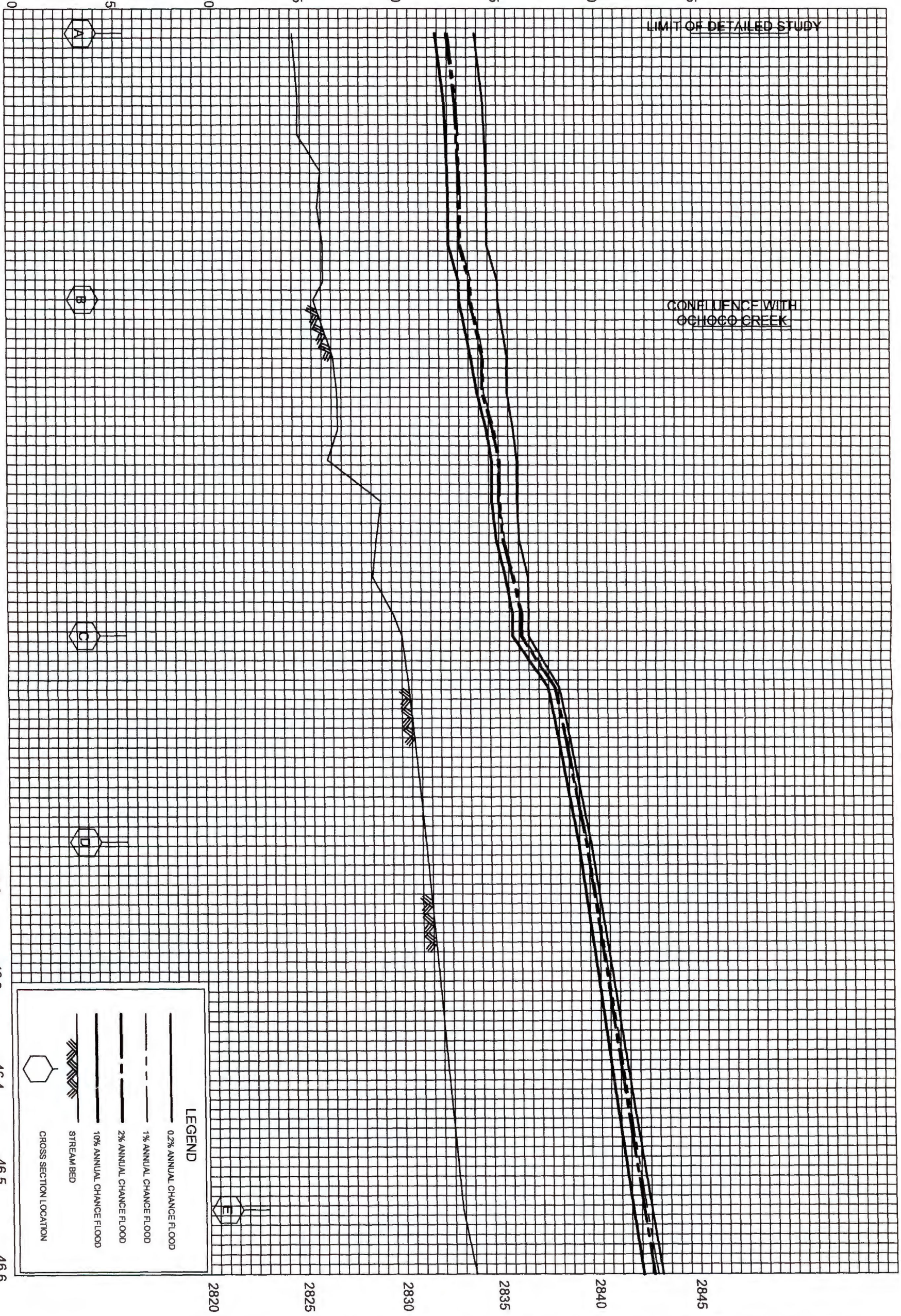
ELEVATION IN FEET (NAVD 88)

2810 2815 2820 2825 2830 2835 2840 2845

45.3 45.4 45.5 45.6 45.7 45.8 45.9 46.0 46.1 46.2 46.3 46.4 46.5 46.6

STREAM DISTANCE IN MILES ABOVE MOUTH

2820 2825 2830 2835 2840 2845



FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

FLOOD PROFILES

CROOKED RIVER

01P

ELEVATION IN FEET (NAVD 88)

2820 2825 2830 2835 2840 2845 2850 2855

46.6 46.7 46.8 46.9 47.0 47.1 47.2 47.3 47.4 47.5 47.6 47.7 47.8 47.9

CROOK COUNTY
CITY OF PRINEVILLE

CITY OF PRINEVILLE
CROOK COUNTY

CROOK COUNTY
CITY OF PRINEVILLE

CITY OF PRINEVILLE
CROOK COUNTY

CROOK COUNTY
CITY OF PRINEVILLE

F G H I J

LEGEND

- 0.2% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

2830 2835 2840 2845 2850 2855

STREAM DISTANCE IN MILES ABOVE MOUTH

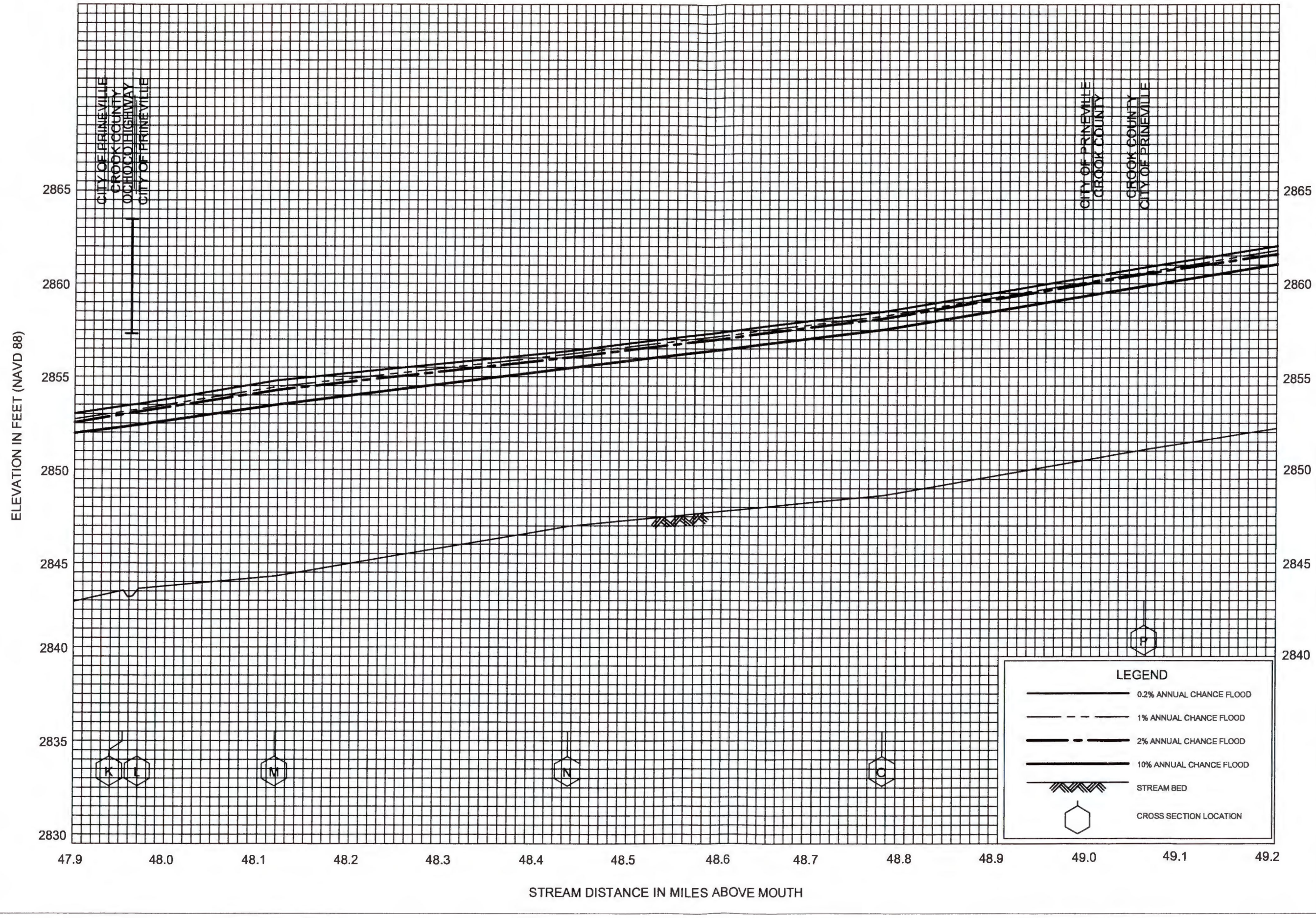
02P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

FLOOD PROFILES

CROOKED RIVER



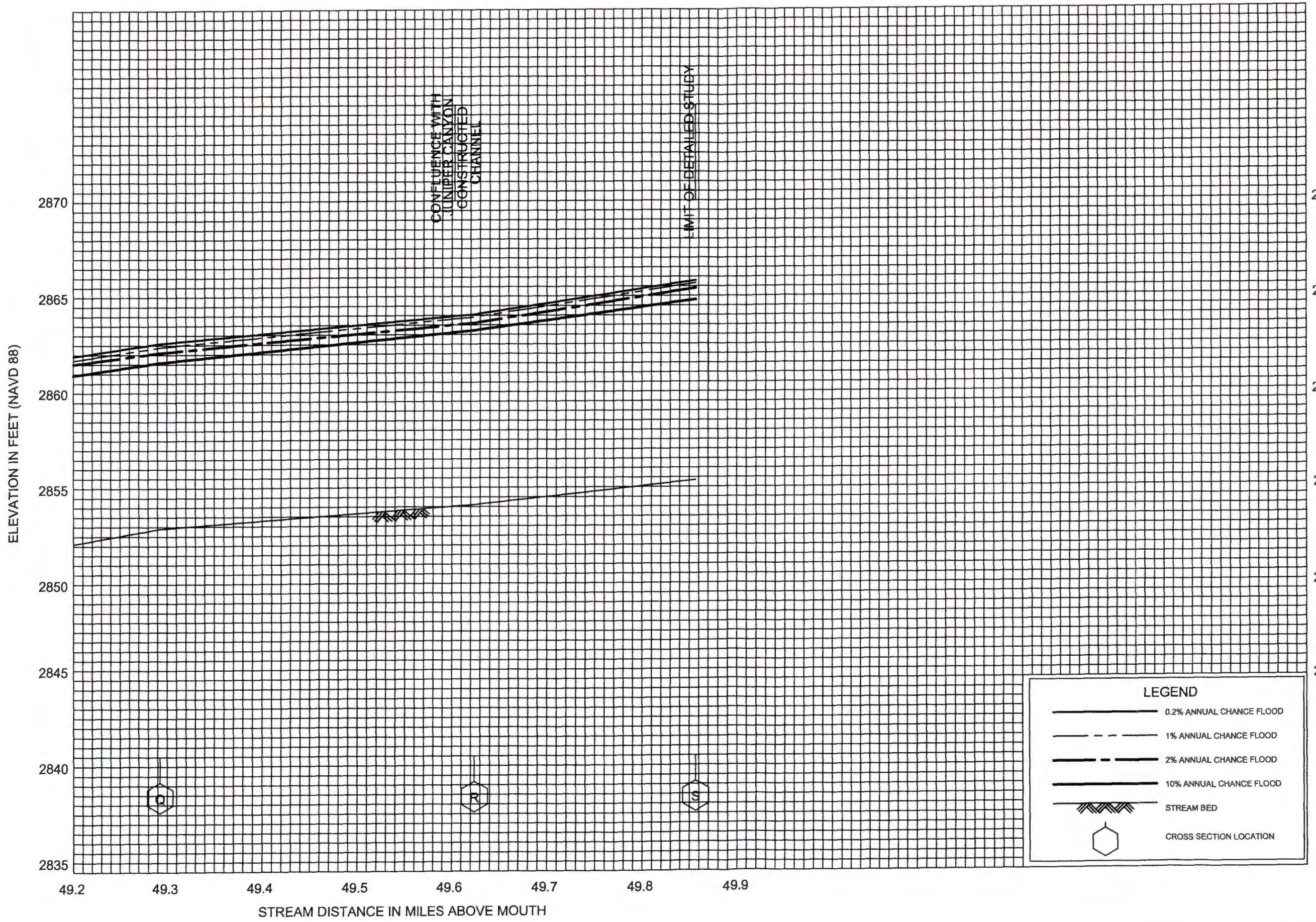
FLOOD PROFILES

CROOKED RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

03P



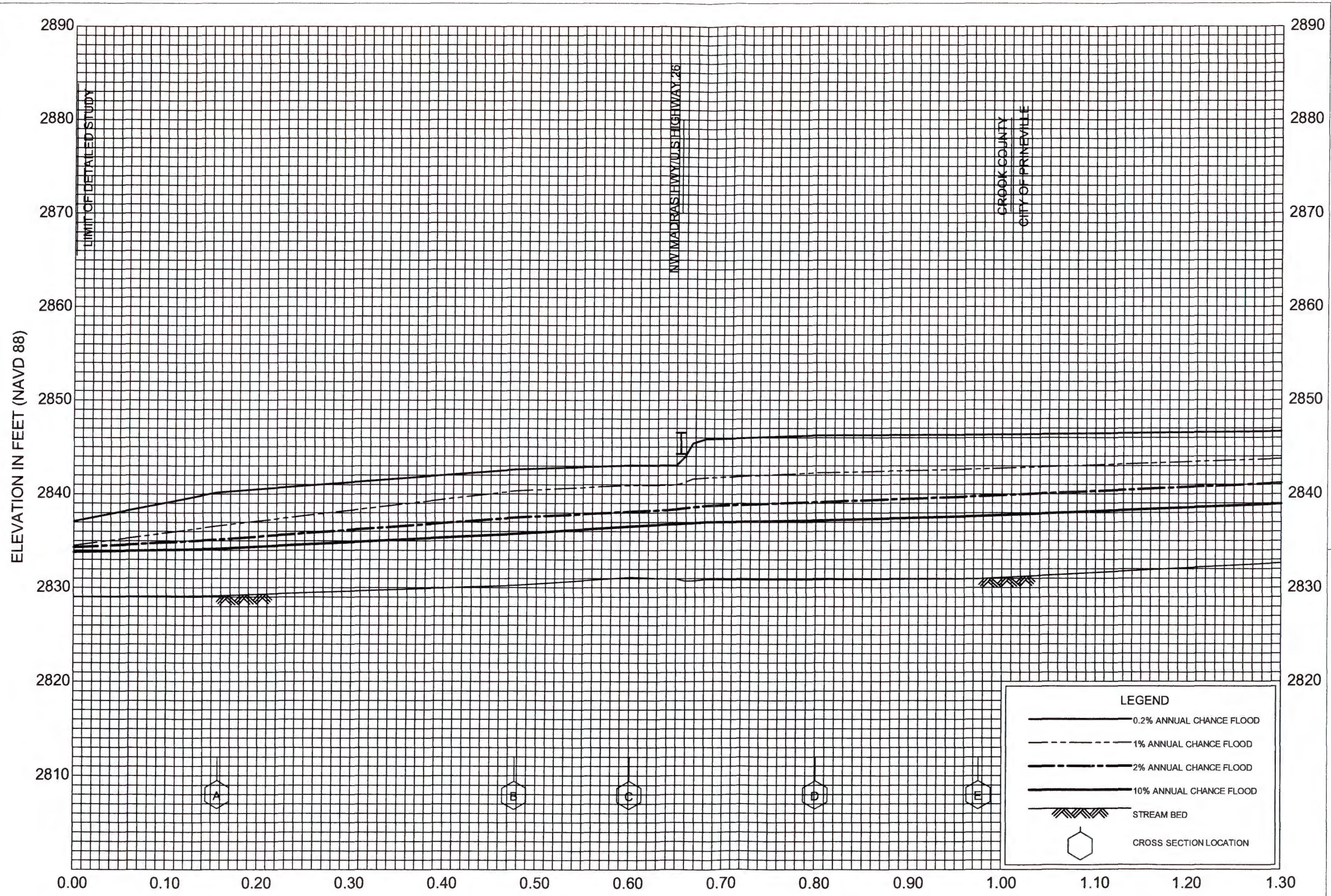
FLOOD PROFILES

CROOKED RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

04P



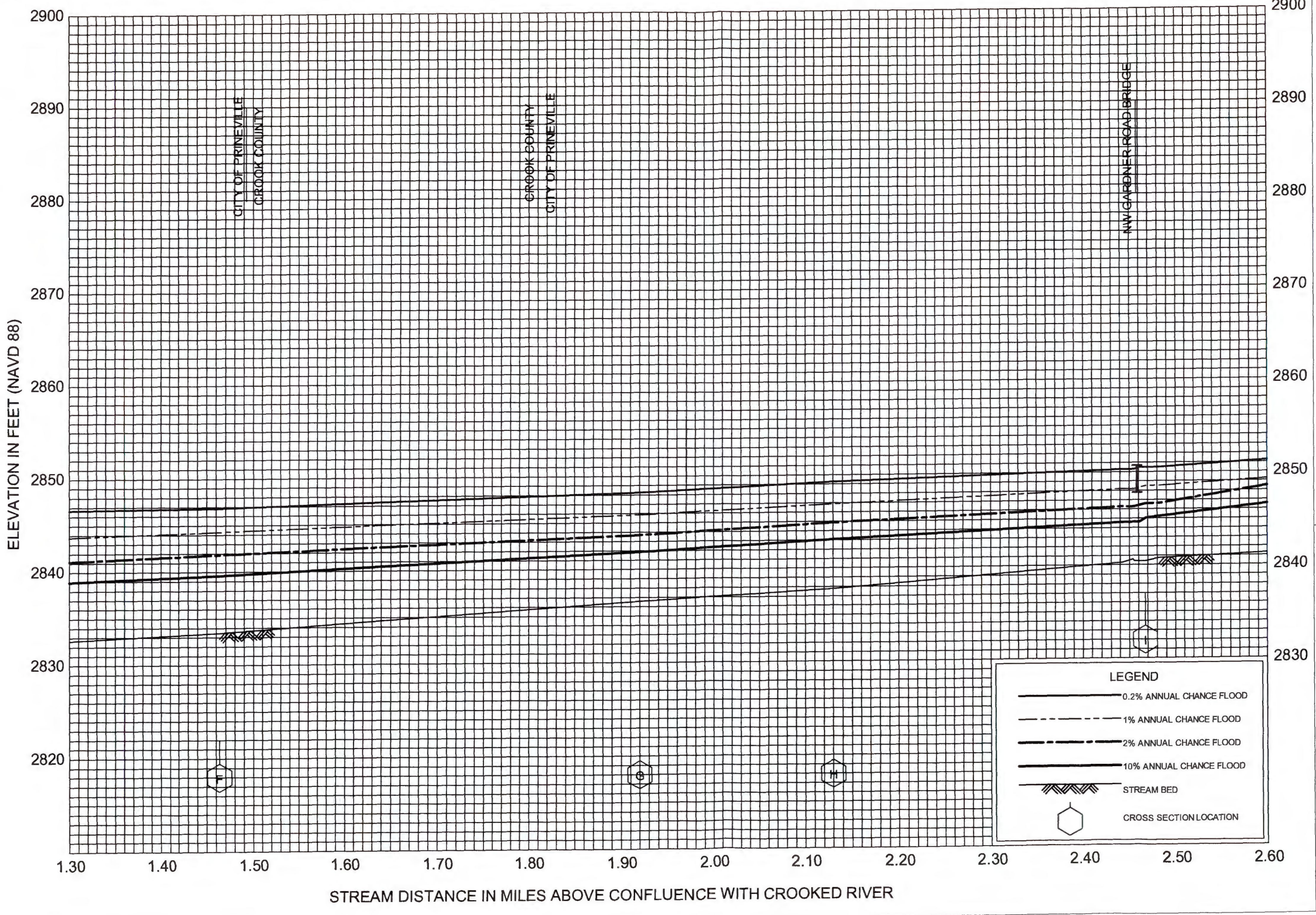
FLOOD PROFILES

OCHOCO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

05P



FLOOD PROFILES

OCHOCO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

06P

FLOOD PROFILES

OCHOCO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CROOK COUNTY, OR
(AND INCORPORATED AREAS)

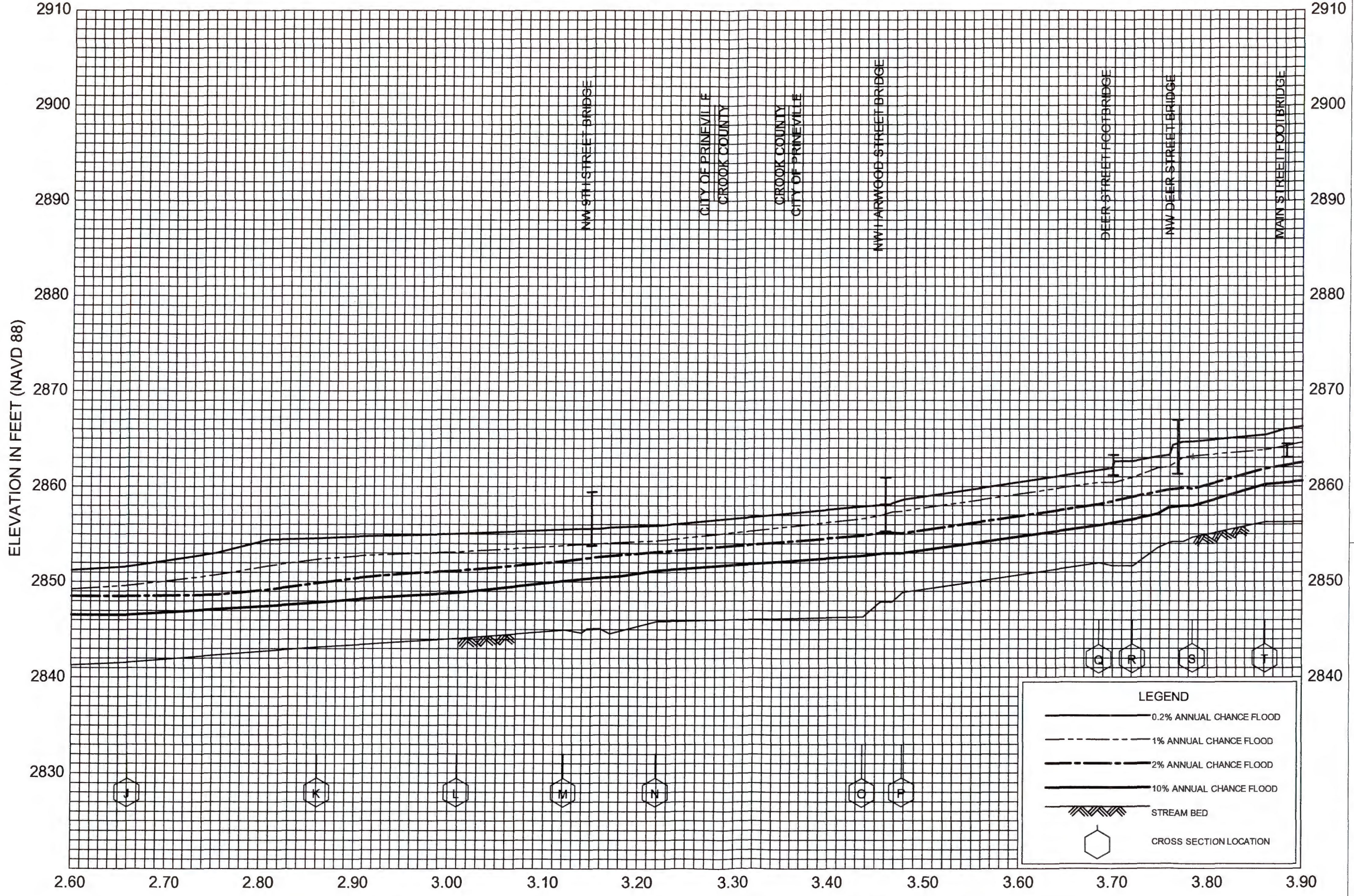


EXHIBIT B

3. Amendment to Crook County Comprehensive Plan - Chapter IX
Natural Resources/Hazards and Development Limitations
Floodplains (Pages 129 to 131.)

PURPOSE: The Crook County Comprehensive Plan, Chapter IX – Natural Resources/Hazards and Development Limitations was written in an effort to protect the citizens of Crook County from the threat of natural hazards, including flooding.

BACKGROUND: The 2011 update to the Crook County Comprehensive Plan flows from a request by the Federal Emergency Management Agency, a Department of Homeland Security (FEMA,DHS). FEMA,DHS is asking Crook County to adopt new Digital Flood Insurance Rate Maps and a new Flood Insurance Study for Crook County, Oregon and Incorporated Areas. The adoption process also requires a review and update of the Crook County Comprehensive Plan, Chapter IX - Natural Resources/Hazards and Development Limitations. The update makes the Crook County Comprehensive Plan and the Crook County Floodplain Program contemporary. The floodplain program was last updated in 1989.

AMENDMENT: This legislative amendment adopts updates to Chapter IX, Natural Resources/Hazards and Development Limitations, of the Crook County Comprehensive Plan.

Crook County Comprehensive Plan
Chapter IX
Pages 129 to 131

FLOODPLAINS
Crooked River, Ochoco Creek and their major tributaries comprise 99% of the flood area identified by Flood Hazard Boundary Maps for that portion..... High water table problems exist only in the summer months; other times of the year do not have the problem. ~~Flood Rate Maps (not available at this date), will, however, be based upon these maps and could refine the flood hazard boundaries using engineering principles.~~

The last 100-year magnitude flood .....waters. Ochoco Reservoir dam prevented major flooding downstream during this flood; however, "....should a more intense rainstorm occur in late spring or early summer when the reservoir is nearly full, as happened in the May, 1956 flood, downstream flooding could be expected" (Ochoco Creek Floodplain Study). **In 1998, this type of event did occur, and flooding affected areas throughout Crook County and in the City of Prineville.**

FLOODPLAIN POLICIES

It shall be the policy of Crook County to recognize the 100-year floodplain areas as the minimum areas which could be inundated by flood, and to require strict controls for development near, or presently within them. The following shall be considered in relation to development in floodplain areas:

1. High density development shall occur ~~as far from~~ **outside** the **100 year** floodplain **when** ~~as~~ possible.

2. Building and engineering requirements such as drainage systems, minimum floor elevations, and diking as set forth by federal regulations shall be required within ~~areas that could potentially have high water problems.~~ **the 100 year floodplain identified on the National Flood Insurance Rate Maps (FIRM) or on the Digital Flood Insurance Rate Maps (DFIRM).**

3. Construction standards established by the Federal ~~Insurance Agency for Emergency Program Aid~~ **Emergency Management Agency, a Department of Homeland Security (FEMA, DHS)** shall be observed; these include:

(a) Proper anchoring of structures.

(b) Use of construction materials that will minimize flood damage.

(c) Adequate drainage of new subdivisions.

(d) New or replacement utility systems are to be located and designed to ~~preclude flood loss.~~ **minimize or eliminate flood damage.**

(e) All new construction or improved/repaired structures in flood hazard areas are to be elevated or flood-proofed ~~to the 100-year elevation.~~ **in accordance with Crook County Code Chapter 15 and 18.**

It shall be the policy of Crook County to identify and maintain floodways in their natural undeveloped condition in order to:

1. Minimize meander and bank erosion damage.

2. Provide an unobstructed channel for flood**way** water~~s to provide conditions for minimum velocity~~ **conveyance** and stream flow.

3. ~~To r~~**R**educe flood damage in areas not protected by flood control structures.

EXHIBIT C

1. **Amendment to Crook County Code -**
   Chapter 15.08 - FLOOD DAMAGE PREVENTION

PURPOSE: The Crook County Flood Damage Prevention Code was written in an effort to protect the citizens of Crook County from the threat of Flooding.

BACKGROUND: The 2011 update to the Crook County Code flows from a request by the Federal Emergency Management Agency, a Department of Homeland Security (FEMA, DHS). FEMA, DHS is asking Crook County to adopt the new Digital Flood Insurance Rate maps and Flood Insurance Study for Crook County, Oregon and incorporated areas. The adoption process also requires a review and update of the Crook County Code, Chapter 15.08 - Flood Damage Prevention. The update makes the Crook County Code and the Crook County Floodplain Program contemporary. The floodplain program was last updated over ten years ago.

AMENDMENT: This legislative amendment adopts the new Digital Flood Insurance Rate Maps, the new Flood Insurance Study for Crook County and updates Chapter 15.08 (Flood Damage Prevention) of the Crook County Code.

15.08.030 Flood plain administrator and duties.
(2) Use of Other Base Flood Data. When base flood elevation data has not been provided in accordance with CCC 15.08.050, the planning director shall obtain **BFE information from the applicant**, **for** review and reasonably utilize any base flood elevation and floodway data available from a federal, state or other source, in order to administer specific standards and floodways.

15.08.040 Definitions.
"Base flood" means the flood having a one percent chance of being equaled or exceeded in any given year. Also referred to as the "100-year flood." Designation on maps always includes the letters A ~~or V~~ .

"Below-grade Crawlspace" means an enclosed area below the Base Flood Elevation in which the interior grade does not exceed 2 feet below the lowest adjacent exterior grade and the height, measured from the interior grade of the crawlspace to the bottom of the lowest horizontal structural member of the lowest floor does not exceed 4 feet at any point.

Note: this definition and appropriate crawlspace code must be included in the flood hazard development ordinance if below grade crawlspaces are allowed, otherwise below grade crawlspaces will be considered to be basements.

Structures built with below grade crawlspaces will have higher insurance premiums.

"Essential Facility" or "Critical Facility" means:
(a) hospitals and other medical facilities having surgery and emergency treatment areas;
(b) fire and police stations;
(c) tanks or other structures containing, housing or supporting water or fire-suppression materials or equipment required for the protection of essential or hazardous facilities or special occupancy structures;
(d) emergency vehicle shelters and garages;
(e) structures and equipment in emergency-preparedness centers;
(f) standby power generating equipment for essential facilities; and
(g) structures and equipment in government communication centers and other facilities required for emergency response. ***[ORS 455.447 and Table 1-1 of ASCE 24]***

"Development" means any manmade change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filing, grading, paving, excavation or drilling operations **or storage of equipment or materials located within the area of special flood hazard.** ***[44 CFR Part 59.1]***

"Flood Insurance Study" means the official report provided by the Federal Insurance Administration that includes flood profiles, the Flood Boundary-~~Floodway~~ Map , and the water surface elevation of the base flood.

"Recreational Vehicle" means a vehicle that is
(a) built on a single chassis;
(b) 400 square feet or less when measured at the largest horizontal projection;
(c) designed to be self-propelled or permanently towed by a light duty truck, and;
(d) designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use. ***[44 CFR Part 59.1]***

15.08.050 Application of provisions.
This chapter shall apply to the areas of special flood hazard identified by the Federal Insurance Administration in a scientific and engineering report entitled "The Flood Insurance Study for Crook County, Oregon and Incorporated Areas," dated July 17, 1989 **and February 2, 2012**, with accompanying Flood Insurance **Rate** Maps; the engineering **report** and accompanying maps are hereby adopted by reference and declared to be a part of this chapter. The Flood Insurance Study and **Flood Insurance Rate Maps** ~~is~~ **are** on file at the Planning Department, Room 11, Crook County Courthouse, Prineville, Oregon. (Ord. 38 Amd. 2 § 5, 2000)

15.08.080 Specific standards.

(2) Nonresidential Construction. New construction and substantial improvement of any commercial, industrial or other nonresidential structure shall either have the lowest floor, including basement, elevated to **a minimum of one foot above** the level of the base flood elevation or, together with attendant utility and sanitary facilities, shall:
(a) Be floodproofed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water.

(3) Manufactured Homes. All manufactured homes to be placed or substantially improved within zones Al-30, AH, and AE shall be elevated on a permanent foundation such that the ~~lowest floor of the~~ **bottom of the chasis on the** manufactured home is at or above the base flood elevation and be securely anchored to an adequately anchored foundation system in accordance with the provisions of CCC 15.08.070. **(Manufactured Dwelling Installation Specialty Code.)**

(5) Recreational vehicles placed on sites within the floodplain shall meet the placement requirements of (a.) or (b.) below, or the requirements of (c.) and (d.).

a. **Be on the site for fewer than 90 consecutive days, or**
b. **Be fully licensed and ready for highway use. A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions, or**
c. **Recreational vehicles in a space or on a lot, for more than 90 consecutive days, shall be elevated on compacted fill so that the lowest floor of the recreational vehicle will be a minimum of 18 inches above the base flood elevation; and**
d. **Adequate surface drainage and access for a hauler shall be provided.**

Below-grade crawlspaces

(1) The building must be designed and adequately anchored to resist flotation, collapse, and lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy. Hydrostatic loads and the effects of buoyancy can usually be addressed through the required openings stated in Section (2) below. Because of hydrodynamic loads, crawlspace construction is not recommended in areas with flood velocities greater than five (5) feet per second unless the design is reviewed by a qualified design professional, such as a registered architect or professional engineer.

(2) The crawlspace is an enclosed area below the Base Flood Elevation and, as such, must have openings that equalize hydrostatic pressures by allowing the automatic entry and exit of floodwaters. The bottom of each flood vent opening can be no more than one (1) foot above the lowest adjacent exterior grade.

(3) Portions of the building below the BFE must be constructed with materials resistant to flood damage. This includes not only the foundation walls of the crawlspace used to elevate the building, but also any joists, insulation, or other materials that extend below the BFE. The recommended construction practice is to elevate the bottom of joists and all insulation above BFE.

(4) Any building utility systems within the crawlspace must be elevated above BFE or designed so that floodwaters cannot enter or accumulate within the system components during flood conditions. Ductwork, in particular, must either be placed above the BFE or sealed from floodwaters.

(5) The interior grade of a crawlspace below the BFE must not be more than two (2) feet below the lowest adjacent exterior grade.

(6) The height of the below-grade crawlspace, measured from the interior grade of the crawlspace to the bottom of the structural support of the next higher floor must not exceed four (4) feet at any point.

(7) There must be an adequate drainage system that removes floodwaters from the interior area of the crawlspace. The enclosed area should be drained within a reasonable time after a flood event. The type of drainage system will vary because of the site gradient and other drainage characteristics, such as soil types. Possible options include natural drainage through porous, well-drained soils and drainage systems such as perforated pipes, drainage tiles or gravel or crushed stone drainage by gravity or mechanical means.

Include language advising citizens about the increased insurance cost Associated with below-grade crawlspaces. There is a charge added to the basic policy premium for a below-grade crawlspace.

Before Regulatory Floodway
(1)In areas within Zones A1-30 and AE on the community's FIRM with a Base Flood Elevation but where no regulatory Floodway has been designated, new construction, substantial improvements, or other development (including fill) shall be prohibited, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community.*[44 CFR Part 60.3(c)(10) & ORSC R324.1.3.2]*
(2) Applicants of proposed projects that increase the Base Flood Elevation more than one foot shall obtain from FEMA a Conditional Letter of Map Revision (CLOMR) before the project may be permitted. As soon as possible, but no later than 6 months after project completion, an application for a Letter of Map Revision (LOMR) shall be submitted by the applicant to FEMA. The applicant is

responsible for paying any costs associated with the CLOMR and LOMR process. ***[44 CFR Parts 60.3(c)(13), 65.3, and 65.12)]***

Habitat Restoration in Floodway
Projects for stream habitat restoration may be allowed without certification by a registered professional civil engineer provided:

(a) a development permit is obtained prior to initiating development activities;
(b) the project qualifies for a Department of the Army, Portland District Regional General Permit for Stream Habitat Restoration (NWP-2007-1023); and
(c) a qualified professional (a Registered Professional Engineer; or staff of NRCS; the county; or fisheries, natural resources, or water resources agencies) has provided a feasibility analysis and certification that the project was designed to keep any rise in 100-year flood levels as close to zero as practically possible given the goals of the project; and,
(d) no structures would be impacted by a potential rise in flood elevation; and,
(e) an agreement to monitor the project, correct problems, and ensure that flood carrying capacity remains unchanged is included as part of the local approval.
[Oregon Solutions Regulatory Streamlining Project 2009]

2. Amendment to Crook County Code -
Chapter 18.84 - FLOOD PLAIN COMBINING ZONE, FP

PURPOSE: The Crook County Flood Damage Prevention Code was written in an effort to protect the citizens of Crook County from the threat of Flooding.

BACKGROUND: The 2011 update to the Crook County Code flows from a request by the Federal Emergency Management Agency, a Department of Homeland Security (FEMA,DHS). FEMA,DHS is asking Crook County to adopt the new Digital Flood Insurance Rate maps and Flood Insurance Study for Crook County, Oregon and incorporated areas. The adoption process also requires a review and update of the Crook County Code, Chapter 18.84 - Flood Plain Combining Zone, FP. The update makes the Crook County Code and the Crook County Floodplain Program contemporary. The floodplain program was last updated over ten years ago.

AMENDMENT: This legislative amendment updates Chapter 18.84 (Flood Plain Combining Zone, FP) of the Crook County Code.

18.84.010 Application of provisions.
The provisions of this chapter shall apply to all areas of special flood hazard within the jurisdiction of the county. The areas of special flood hazard identified by the Federal Insurance Administration and set forth in Flood Hazard Boundary Maps dated August 16, 1977, **and the Flood Insurance Rate Maps dated July 17, 1989 and February 2, 2012** are hereby adopted by reference and declared to be a part of this title, and, thereof, the provisions of this chapter shall apply to all flood hazard areas identified by said maps. (Ord. 18 § 3.170(1), 2003)

18.84.020 Uses permitted outright.
(3) Recreational use that requires ~~no structures~~ **nonstructural improvements which have an** ~~or only structures that would have an~~ insignificant effect on flood waters such as structures associated with a golf course without related buildings, tennis court, driving range, archery range, picnic grounds, boat launching ramp, swimming area, wildlife or nature preserve, game farm, fish hatchery, shooting preserve, target range, trap or skeet range, hunting or fishing area, or hiking or riding trail.

18.84.030 Conditional uses permitted in the floodway of an FP zone.
In a zone with which the FP zone is combined, the following uses and their accessory uses are permitted within a floodway subject to provisions of this chapter, Chapter 18.160 CCC, and the zone with which the FP zone is combined.

(1) Marina, boat rental or boat sales; provided, if a building or other structure is required in the floodway, it shall be designed and constructed to withstand the waters of a base flood without obstruction of flow or significant damage to the structures or the property of others. **The building or structure shall be certified by a registered professional engineer or architect as demonstrating that the encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge.**

(2) A roadway, bridge or utility structure that will not impede the waters of a base flood. **The roadway, bridge or utility structure shall be certified by a registered professional engineer or architect as demonstrating that the encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge.**

18.84.070 Structural elevation data required.

(3) The information required by this subsection shall be **permanently** maintained in the files of the building department with the subject-building permit. (Ord. 18 § 3.170(7), 2003)

18.84.080 Regulation of structures in an FP zone.

(2) The lowest habitable floor and any basement floor, whether or not the basement is intended to be habitable, of a new or substantially improved residential structure and the floor of a newly installed mobile home shall be elevated at least one foot above the base flood level. ~~However, subject to the requirements of CCC 18.84.100, the floor level of a mobile home installed on a site existing on the effective date of the ordinance codified in this title may be at a lower level if compliance is not practical as determined by the building official and planning director.~~

~~(5) Unless the site on which a mobile home is to be installed is above the base flood level, a mobile home or an addition to a mobile home shall be anchored to resist flotation, collapse, and lateral movement as follows:~~

~~(a) Over-the-top ties shall be provided at each of the four corners of the mobile home, with two additional ties per side at intermediate locations except that a mobile home that is less than 50 feet long need have only one additional tie per side.~~

~~(b) Frame ties shall be provided at each corner of the home with five additional ties per side at intermediate points except that a mobile home less than 50 feet long need have only four additional ties per side.~~

~~(c) All components of the anchoring system, including ties, shall be capable of carrying a force of 4,800 pounds. (Ord. 18 § 3.170(8), 2003)~~ (Moved to 18.84.100)

18.84.090 Land development standards in a flood hazard area.

(2) A land development, which will alter or relocate a watercourse, shall be designed, constructed and maintained to retain the flood-carrying capacity of the watercourse **and shall meet the notification and maintenance requirements found in 15.080.030(4).**

18.84.100 Additional mobile home land development standards.

(1) ~~Except in the locations described in subsection (2) of this section, a~~ **A** site for a mobile home that is in a flood hazard area shall comply with the following:

(a) The mobile home stand on the site shall be elevated on compacted fill or on pilings so that the ~~floor~~ **bottom of the chasis** of the mobile home will be one foot above the base flood elevation level.

(2) Unless the site on which a mobile home is to be installed is above the base flood level, a mobile home or an addition to a mobile home shall be anchored to resist flotation, collapse, and lateral movement as follows:

(a) Over-the-top ties shall be provided at each of the four corners of the mobile home, with two additional ties per side at intermediate locations except that a mobile home that is less than 50 feet long need have only one additional tie per side.

(b) Frame ties shall be provided at each corner of the home with five additional ties per side at intermediate points except that a mobile home less than 50 feet long need have only four additional ties per side.

(c) All components of the anchoring system, including ties, shall be capable of carrying a force of 4,800 pounds. (Ord. 18 § 3.170(8), 2003)

~~Provisions of subsection (1) of this section are not applicable to a mobile home site in an existing mobile home park or in an existing subdivision which by deed restriction limits the use of lots to the installation of mobile homes; provided, that continuously since prior to the effective date of the ordinance codified in this title, the site has had the following improvements:~~

~~(a) It abuts a roadway suitable for all-weather travel.~~

~~(b) It has been leveled to permit a mobile home installation.~~

~~(c) Connections to a water supply and sewage disposal system exist on the site.~~

~~(3) A site for a mobile home also shall comply with subsection (1) of this section if it is in an existing mobile home park which has, after the effective date of the ordinance codified in this title, undergone repairs, reconstruction, or improvements of streets, utilities and pads that cost at least 50 percent of the value of the streets, utilities and pads before construction.~~

(4) (3) The placement of a mobile home in the regulatory floodway ~~or in a coastal high hazard area~~ is prohibited. However, a site existing within a mobile home park may be used provided that prior to the effective date of the ordinance codified in this section, the site has had the improvements described in subsection (2) of this section, or prior to the date the regulatory floodway hazard area was designated, the site has had such improvements and has been otherwise approved as complying with the standards of subsection (1) of this section. A mobile home installed on such a site shall be a singlewide unit with wheels and tongue in place. (Ord. 18 § 3.170(10), 2003)

18.84.110 Facility standards in a flood hazard area.
(1) A public utility or facility associated with a subdivision or other new land development within a flood hazard area shall be designed, located and constructed to minimize or eliminate flood damage and **shall be designed to not increase the height of the** ~~to avoid raising the water elevation in a~~ regulatory floodway.

18.84.180 Granting of variances.
(2) An applicant to whom a variance is granted shall be give written notice that the structure is permitted, **and the file will be permanently available for inspection in the Planning Department**. The notice shall designate the elevation of the lowest floor compared to the base flood elevation and shall advise the applicant that the cost of flood insurance will be commensurate with the increased risk resulting from any reduced floor elevation authorized by the variance. (Ord. 18 § 3.170(18), 2003)

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