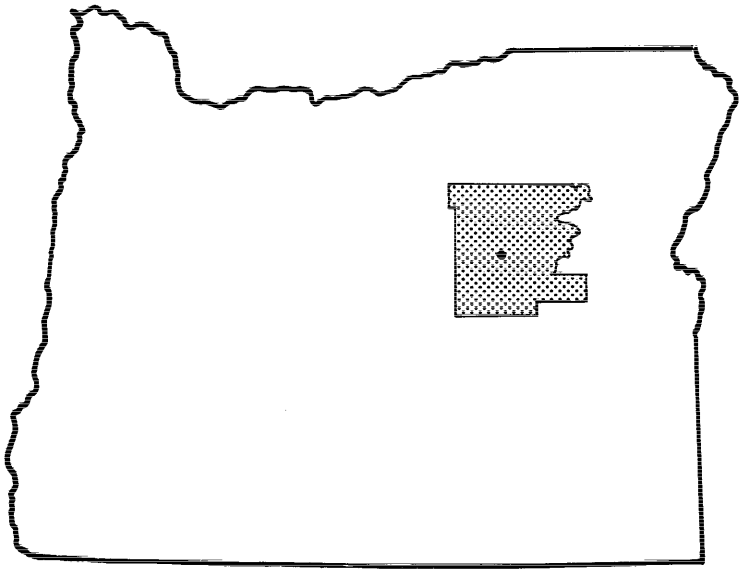
# FLOOD INSURANCE STUDY

## CITY OF MT. VERNON, OREGON

### GRANT COUNTY



SEPTEMBER 18,1987

Federal Emergency Management Agency

COMMUNITY NUMBER - 410080

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 may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
CITY OF MOUNT VERNON, GRANT COUNTY, OREGON

# 1.0 INTRODUCTION

## 1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Mt. Vernon, Grant County, Oregon, 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 Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE), Walla Walla District, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-E-1153, Project Order No. 1, Amendment No. 18. This study was completed in May 1985.

## 1.3 Coordination

Streams requiring detailed study were identified at an initial Consultation and Coordination Officer (CCO) meeting attended by representatives of the City of Mt. Vernon, FEMA, and the study contractor in July 1983.

On November 21, 1985, an intermediate CCO meeting was held and attended by the City of Mount Vernon and FEMA. No objections were brought forth at this meeting.

On August 26, 1986, the results of the study were reviewed at the final CCO meeting attended by representatives of the community, FEMA, and the study contractor. The study was acceptable to the community.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Mt. Vernon, Grant County, Oregon. The area of study is shown on the Vicinity Map (Figure 1).

John Day River was studied by detailed methods from the downstream corporate limits (approximately 750 feet downstream of the confluence with Beech Creek) to the upstream corporate limits (approximately 1,500 feet upstream of the Ingle Creek Road Bridge). Beech Creek was studied by detailed methods from its confluence with the John Day River to the upstream corporate limits (approximately 700 feet upstream of the diversion dam).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through May 1990. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Mt. Vernon.

### 2.2 Community Description

The City of Mt. Vernon is located in central Grant County, in north-central Oregon. The total land area contained within the corporate limits is 0.68 square mile. It is approximately 6 miles west of John Day, which is the largest city within Grant County. According to U.S. Census Bureau figures, the population increased from 423 in 1970 to 569 in 1980 (Reference 1).

The John Day River, which flows westerly through Mt. Vernon, is the major stream in Grant County. The stream orginates in the Blue Mountains in southeastern Grant County, is 42.3 miles long and has a drainage area of 589 square miles above Mt. Vernon.

Beech Creek, a tributary that flows southerly to its confluence with the John Day River at Mt. Vernon, is 18.8 miles long and has a drainage area of 112 square miles.

Approximately 35 percent of Mt. Vernon has been developed, with the remainder of the land being open fields. Within the floodplains studied, development is limited to single-family residences and a few businesses. The majority of the development is along Beech Creek upstream and downstream of U.S. Highway 26.

The climate of Mt. Vernon is influenced by moderate prevailing westerly flows of maritime air from the Pacific Ocean. Occasional influxes of polar airmasses will cause brief periods of extremely cold temperatures. Recorded extreme temperatures range from -24 degrees Fahrenheit to 112 degrees Fahrenheit at John Day (Reference 2).

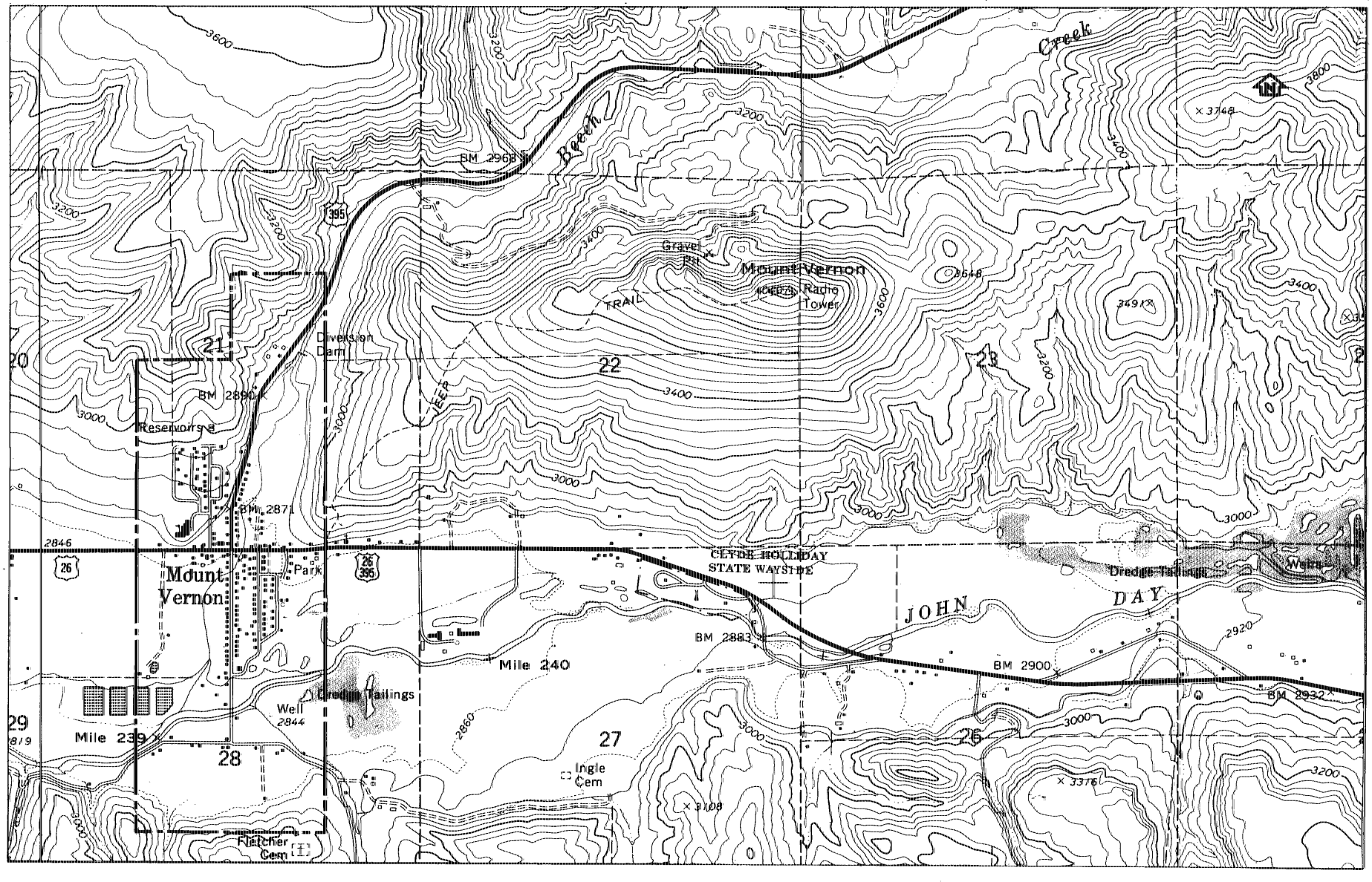



FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

# CITY OF MT. VERNON, OR

## (GRANT COUNTY)

APPROXIMATE SCALE

1 ½ 0 ½ 1 MILE

## VICINITY MAP

The seasonal distribution of precipitation is similar to that observed over the interior of the Pacific Northwest, with the greater portion falling during the winter. The mean annual precipitation at John Day is 11.37 inches, with a mean annual snowfall ranging from 10.8 inches to 47.3 inches at Prairie City (Reference 3).

## 2.3 Principal Flood Problems

Past flooding on streams within Mt. Vernon follows the pattern of a typical snowmelt stream, with low flows generally occurring between July and February and high flows generally occurring March through June. Annual peak flows, however, are distributed from December through June as a result of rainstorms, a combination of rain and snowmelt, or, in the case of some of the later season peaks, snowmelt alone. Summer thunderstorm floods can occur but are usually centered over the smaller side drainages of the John Day River.

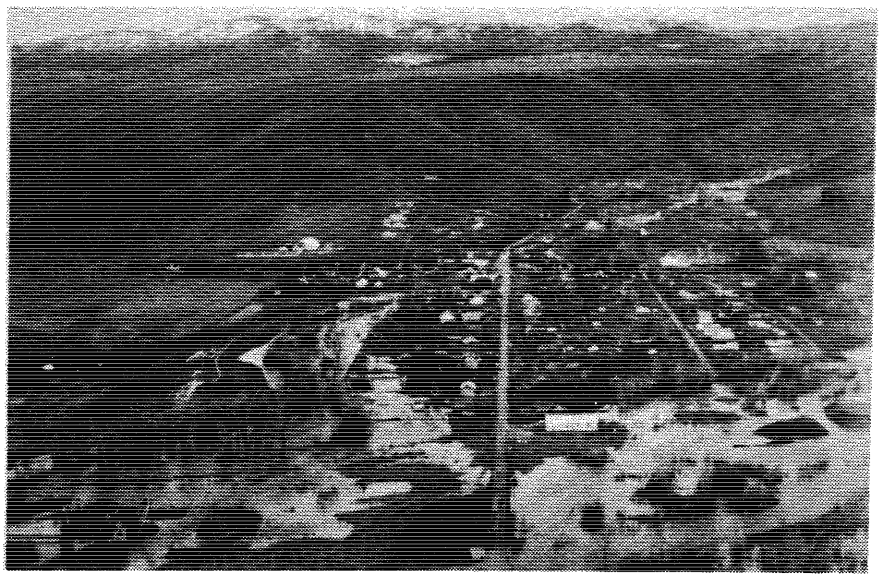
Severe floods on the John Day River result from general rainstorms augmented by snowmelt. Annual peaks from snowmelt usually are not large enough to cause damage. The largest recorded flood on the John Day River occurred on December 22, 1964. The peak discharge on the John Day River below Canyon Creek at John Day was about 3,600 cubic feet per second (cfs), which has an estimated 40-year recurrence interval. A general 3-day rain, frozen ground, and warm temperatures, which melted most of the snow below the 5,000-foot elevation, caused this flood. In January 1965, another flood occurred; it was not as severe, but conditions were similar to the December 1964 flood (Figure 2).

The second largest flood on record on the John Day River occurred on March 25, 1952, with a peak discharge at John Day of approximately 3,000 cfs and a 30-year recurrence interval. This flood was the result of a scattered 2-day rain and warm temperatures, which melted much of the snow below the 5,000-foot elevation.

On Beech Creek, the largest flood on record occurred on December 22, 1964, and was generated by the same weather conditions as the December 1964 flood on the John Day River. Another severe flood on Beech Creek occurred on July 10, 1956. This flood resulted from a thunderstorm and had a peak estimated flow of 930 cfs at Mt. Vernon.

## 2.4 Flood Protection Measures

No designed flood protection measures, such as levees or control structures, exist along Beech Creek or the John Day River study reaches.



Looking upstream on Beech Creek at Mt. Vernon.

Looking upstream on John Day River at Mt. Vernon.

Note: Photos taken after flood peak.

FIGURE 2 - JANUARY 30, 1965 FLOOD SCENES

Nonstructural flood protection measures are being used to aid in the prevention of future flood damage. These are in the form of land-use regulations, adopted from the Code of Federal Regulations, which control building within areas that have a high risk of flooding (Reference 4).

## 3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1 and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

### 3.1 Hydrologic Analyses

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

Nine gaging stations in the John Day River Basin were used for defining discharge-frequency relationships for the John Day River and Beech Creek at Mt. Vernon. Periods of record for the nine gaging stations are as follows:

| | |
|---|---|
| John Day River at McDonald Ferry | 1905-83 |
| John Day River at Service Creek | 1914-15, 1921-23, 1930-83 |
| North Fork John Day River near Monument | 1925-83 |
| Middle Fork John Day River near Ritter | 1930-83 |
| North Fork John Day River near Dale | 1930-58 |
| Camas Creek near Ukiah | 1930-83 |
| John Day River at Picture Gorge | 1927-83 |
| John Day River near Prairie City | 1926-68 |
| Strawberry Creek near Prairie City | 1931-83 |

To define frequency-discharge data for John Day River and Beech Creek at Mt. Vernon, the following method of analysis was used. Values of the 10-, 50-, 100-, and 500-year peak discharges for the gaged stations were obtained from a log-Pearson Type III distribution of annual peak flow data (Reference 5). The coefficients obtained for the gaged areas were correlated with basin parameters, and like coefficients were selected for the ungaged area parameters (Reference 6).

Peak discharge-drainage area relationships for the John Day River and Beech Creek are shown in Table 1.

TABLE 1. SUMMARY OF DISCHARGES

| Flooding Source and Location | Drainage Area (square miles) | Peak Discharge (cfs) 10-Year | 50-Year | 100-Year | 500-Year |
|---|---|---|---|---|---|
| John Day River below Beech Creek | 701 | 3,350 | 5,200 | 6,200 | 8,900 |
| John Day River above Beech Creek | 589 | 2,850 | 4,650 | 5,600 | 8,000 |
| Beech Creek at Mt. Vernon | 112 | 812 | 1,270 | 1,490 | 2,050 |

## 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.

Cross sections for backwater analysis of the streams in the study area were obtained from aerial photographs (Reference 7) and field surveys. The below-water sections were obtained by field measurement. All bridges, dams, and culverts were field checked to obtain elevation data and structural geometry.

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

Water-surface elevations for floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program (Reference 8). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the John Day River were those used in the Flood Insurance Study for the unincorporated areas of Grant County, Oregon (Reference 9). The starting water-surface elevations for that study were calculated using the normal-depth method. The starting water-surface elevations for Beech Creek were also calculated using the normal-depth method.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness values for the main channel of the John Day River ranged from 0.030 to 0.085; floodplain roughness values ranged from 0.060 to 0.150 for all floods. The roughness value for the main channel of Beech Creek was 0.035, and a floodplain roughness value of 0.050 was used for all floods.

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

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

## 4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

### 4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400, with a contour interval of 5 feet (Reference 7).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones AE and AO); and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year 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.

## 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 100-year 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 100-year 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 study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated at selected cross sections (Table 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year 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 100-year 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 3.

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH[2] (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE[3] |
| | | | | | (FEET NGVD) | | | |
| John Day River | | | | | | | | |
| A | 928 | 557 | 1190 | 4.7 | 2835.5 | 2835.5 | 2836.5 | 1.0 |
| B | 1404 | 819 | 1249 | 4.5 | 2836.8 | 2836.8 | 2837.6 | 1.0 |
| C | 1582 | 987 | 3355 | 1.7 | 2840.6 | 2840.6 | 2841.6 | 1.0 |
| D | 2135 | 363 | 776 | 7.2 | 2841.1 | 2841.1 | 2841.5 | 0.4 |
| E | 2751 | 485 | 1284 | 4.4 | 2843.4 | 2843.4 | 2844.3 | 0.9 |

[1] Stream distance in feet above downstream corporate limits of Mt. Vernon, Oregon.
[2] Distance measured along cross-section alignment.

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MT. VERNON, OR
(GRANT CO.)

# FLOODWAY DATA

JOHN DAY RIVER

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH[2] (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE[3] |
| | | | | | (FEET NGVD) | | | |
| Beech Creek | | | | | | | | |
| A | 285 | 244 | 278 | 5.4 | 2837.1 | 2837.1 | 2837.2 | 0.1 |
| B | 634 | 200 | 269 | 5.5 | 2839.6 | 2839.6 | 2839.6 | 0.0 |
| C | 904 | 187 | 175 | 8.5 | 2842.9 | 2842.9 | 2842.9 | 0.0 |
| D | 1167 | 163 | 237 | 6.3 | 2845.4 | 2845.4 | 2845.4 | 0.0 |
| E | 1543 | 94 | 198 | 7.5 | 2849.0 | 2849.0 | 2849.0 | 0.0 |
| F | 1792 | 77 | 165 | 9.0 | 2853.0 | 2853.0 | 2853.0 | 0.0 |
| G | 2253 | 56 | 212 | 7.0 | 2855.7 | 2855.7 | 2856.1 | 0.4 |
| H | 2477 | 55 | 183 | 8.1 | 2857.4 | 2857.4 | 2857.6 | 0.2 |
| I | 2741 | 75 | 163 | 9.1 | 2859.6 | 2859.6 | 2859.6 | 0.0 |
| J | 3010 | 49 | 179 | 8.3 | 2861.8 | 2861.8 | 2861.8 | 0.0 |
| K | 3332 | 119 | 216 | 6.9 | 2865.7 | 2865.7 | 2865.9 | 0.2 |
| L | 3909 | 60 | 202 | 7.4 | 2869.7 | 2869.7 | 2869.7 | 0.0 |
| M | 4193 | 66 | 195 | 7.6 | 2871.5 | 2871.5 | 2871.5 | 0.0 |
| N | 4657 | 63 | 173 | 8.6 | 2874.8 | 2874.8 | 2874.8 | 0.0 |
| O | 5255 | 56 | 154 | 9.7 | 2881.5 | 2881.5 | 2881.5 | 0.0 |
| P | 5796 | 179 | 246 | 6.0 | 2888.4 | 2888.4 | 2888.8 | 0.4 |
| Q | 6014 | 222 | 549 | 2.7 | 2891.4 | 2891.4 | 2891.9 | 0.5 |
| R | 6561 | 157/67[3] | 210 | 7.1 | 2894.2 | 2894.2 | 2895.1 | 0.9 |

1 Stream distance in feet above confluence with John Day River.
2 Distance measured along cross-section alignment.
3 Floodway that lies within corporate limits.

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MT. VERNON, OR
(GRANT CO.)

# FLOODWAY DATA

BEECH CREEK

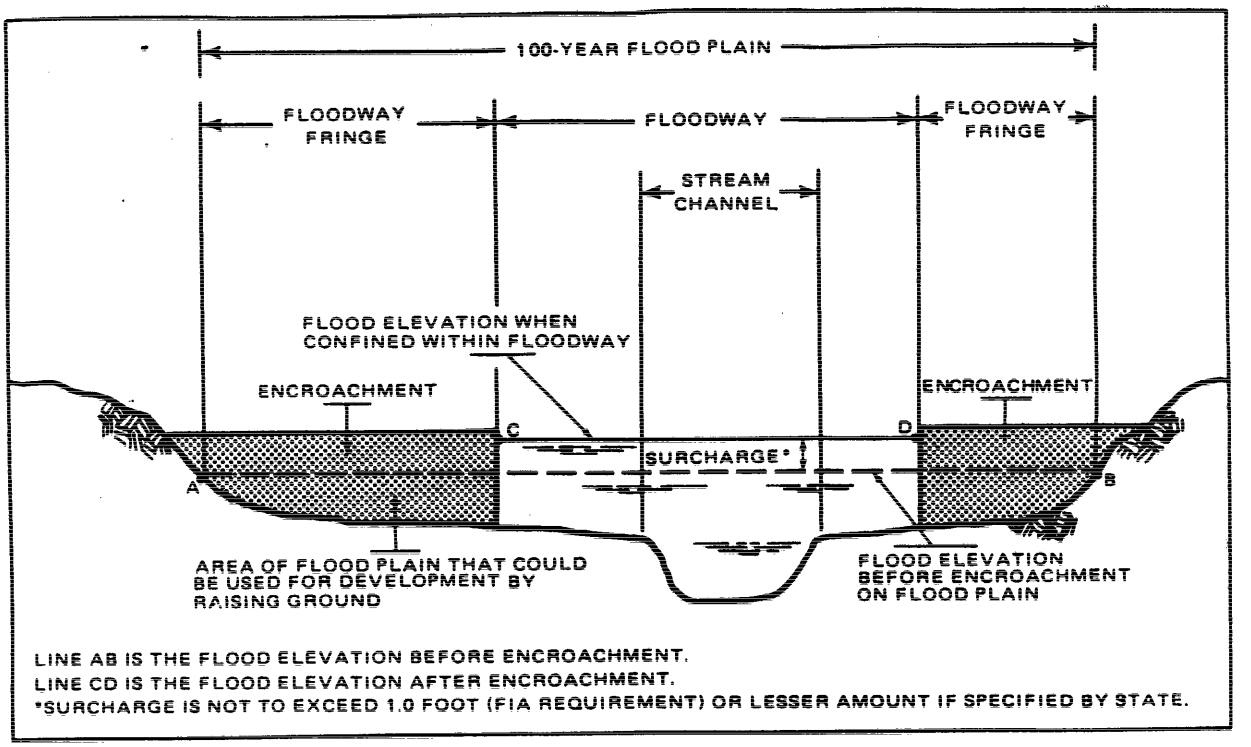



Figure 3. Floodway Schematic

## 5.0 INSURANCE APPLICATION

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

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations 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 100-year 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 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

## 6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map 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 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations 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 100- and 500-year floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

## 7.0 OTHER STUDIES

A Flood Insurance Study has been published for the unincorporated areas of Grant County (Reference 9). The results of this study will match exactly the results of the Grant County study.

Due to the more detailed analysis performed, this supersedes a Special Flood Hazard Information Report for Beech Creek requested by the State of Oregon Water Resources Board (Reference 10) and a Flood Hazard Boundary Map for Mt. Vernon (Reference 11) which were previously printed.

## 8.0 LOCATION OF DATA

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

## 9.0 BIBLIOGRAPHY AND REFERENCES


1. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population Inhabitants, Idaho, Washington, D.C., 1981.

2. Pacific Northwest River Basins Commission, Meteorology Committee, Climatological Handbook Columbia Basin States, Temperature, Vol.1 Part A, June 1969.

3. Pacific Northwest River Basins Commission, Meteorology Committee, Climatological Handbook Columbia Basin States, Precipitation, Vol. 2, September 1969.

4. U.S. Department of Housing and Urban Development, Federal Insurance Administration, "Code of Federal Regulations, Title 24, Chapter 10, Parts 1910.3A and 3B," Federal Register, Vol 41, No. 207, Revised 1976.

5. U.S. Water Resources Council, Bulletin 17B, "Guidelines for Determining Flood Flow Frequency," September 1981.

6. U.S. Army Corps of Engineers, Statistical Methods in Hydrology, Sacramento, California, January 1962.

7. U.S. Army Corps of Engineers, Walla Walla District, Topographic Mapping Scale 1:2,400, Contour Interval 5 feet, Aerial Photography by Aerial Mapping Company, Boise, Idaho, April 1984.

8. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis, California, September 1982.

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

10. U.S. Army Corps of Engineers, Walla Walla District, Special Flood Hazard Information Report for Beach Creek at Mt. Vernon, Oregon, 1970.

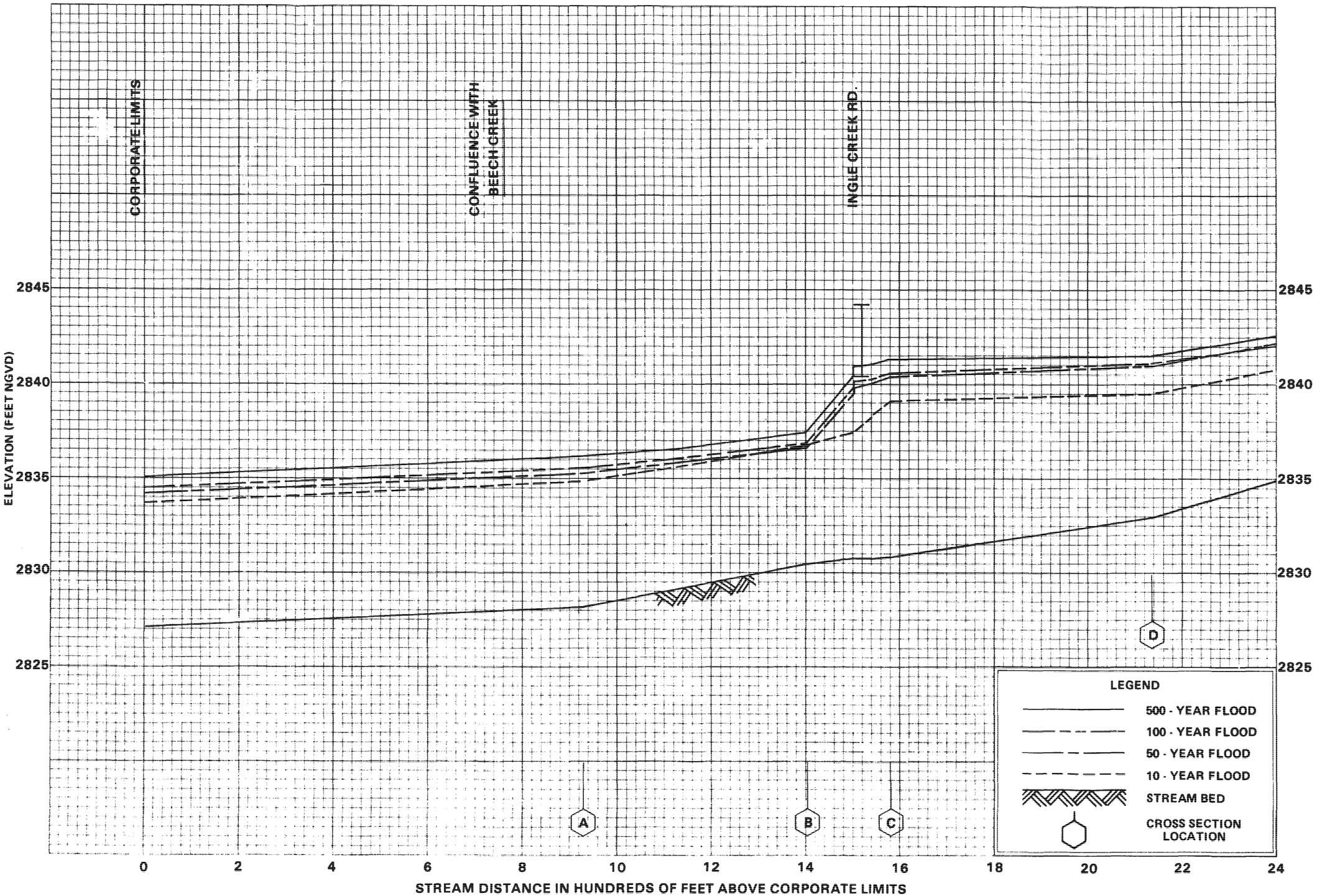
11. Federal Emergency Management Agency, Flood Hazard Boundary Map, City of Mt. Vernon, Grant County, Oregon, December 20, 1974.

Chow, Ven Te, Open Channel Hydraulics, New York: McGraw-Hill Book Company, 1959.

U.S. Department of the Interior, Geological Survey, Water-Supply Paper 1849, Roughness Characteristics of Natural Channels, H.H. Barnes, Jr., 1967.

EXHIBIT 3 - ELEVATION REFERENCE MARKS
CITY OF MOUNT VERNON, GRANT COUNTY, OREGON

| Reference Mark | Elevation (feet NGVD) | Description of Location |
|---|---|---|
| RM 1 | 2864.5 | Top of north bolt of flange of fire hydrant at west end of bridge 150 feet east of the intersection of Highways 395 and 26. |
| RM 2 | 2841.2 | Top of screw and washer set in pavement at center of intersection of Ingle Creek Road and County Road, approximately 380 feet south of the John Day River Bridge. |
| RM 3 | 2865.2 | Top of screw and washer set in the center of the pavement on Highway 395, approximately 600 feet north of the intersection of Highways 395 and 26. |



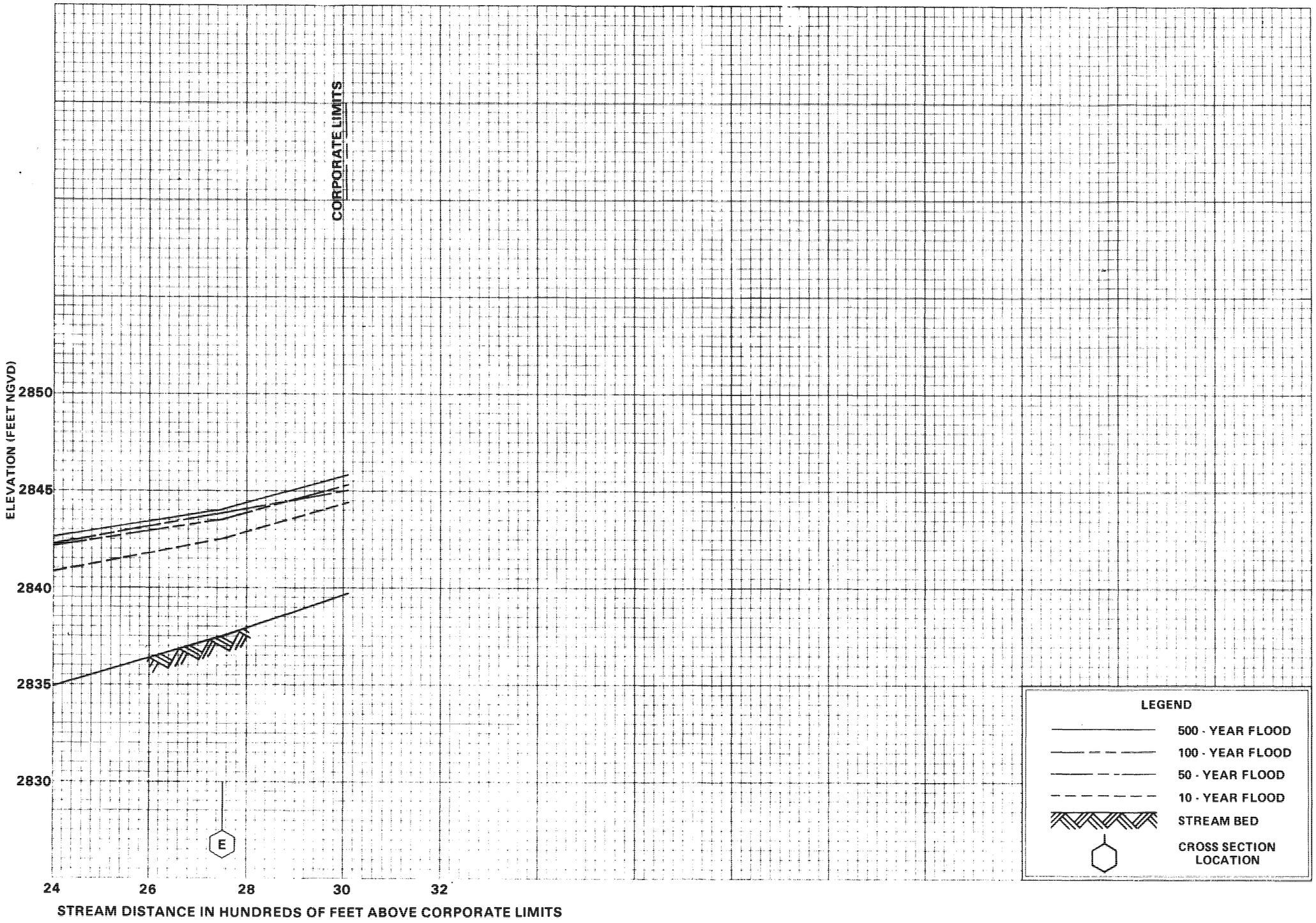

# FLOOD PROFILES

JOHN DAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MT. VERNON, OR
(GRANT COUNTY)

01P



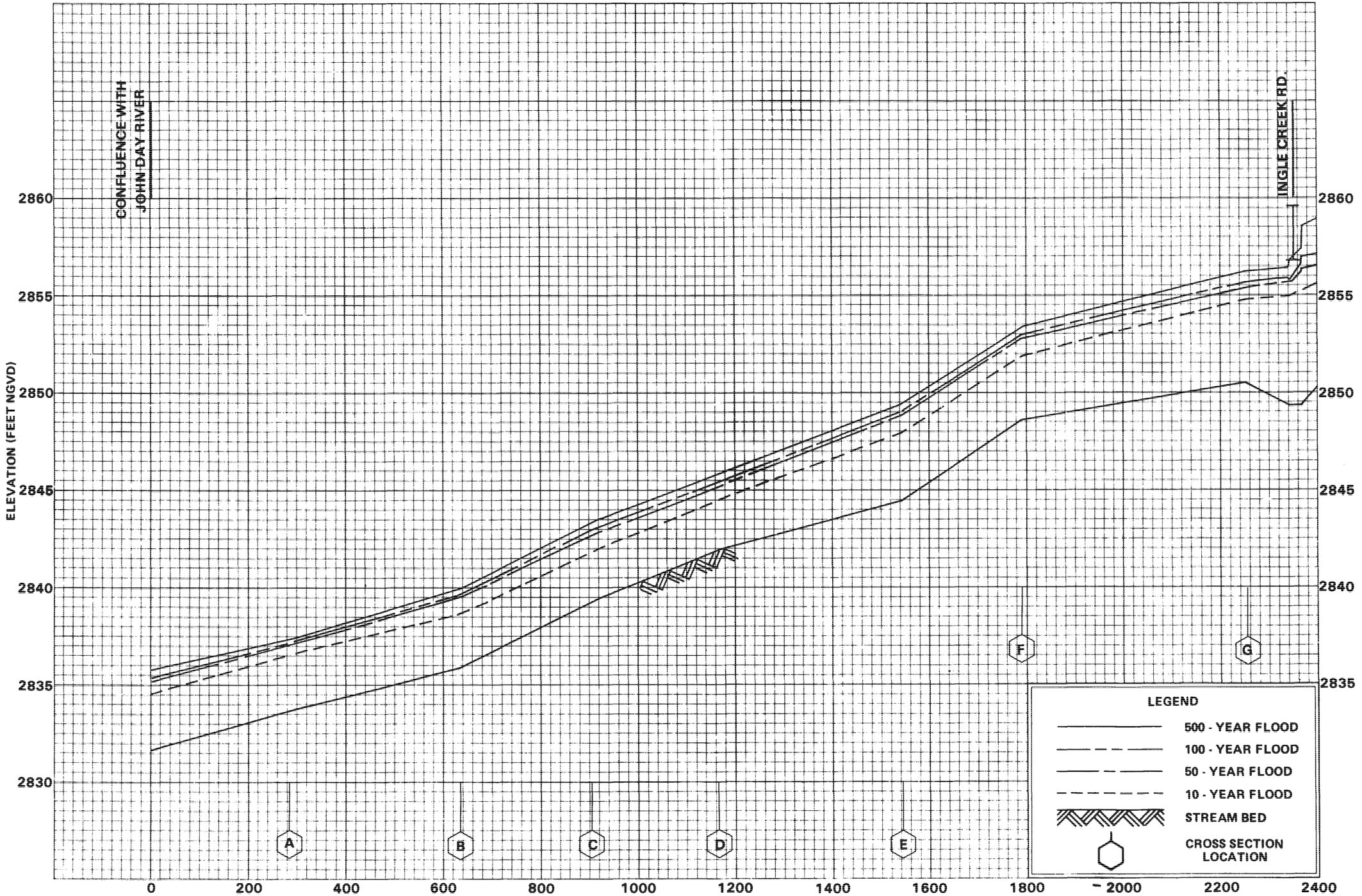

# FLOOD PROFILES

JOHN DAY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MT. VERNON, OR
(GRANT COUNTY)

02P



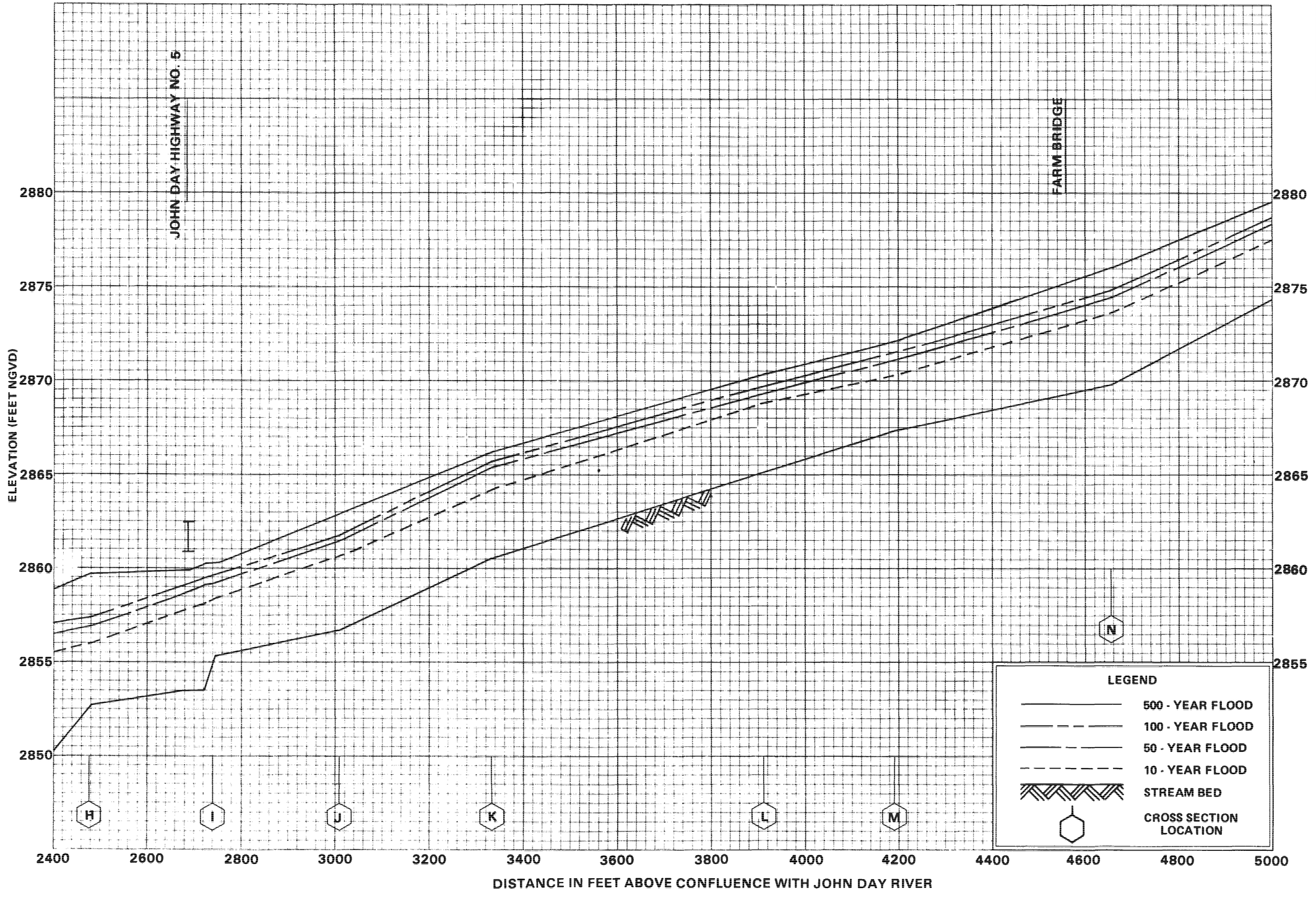

# FLOOD PROFILES

## BEECH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MT. VERNON, OR
(GRANT COUNTY)

03P



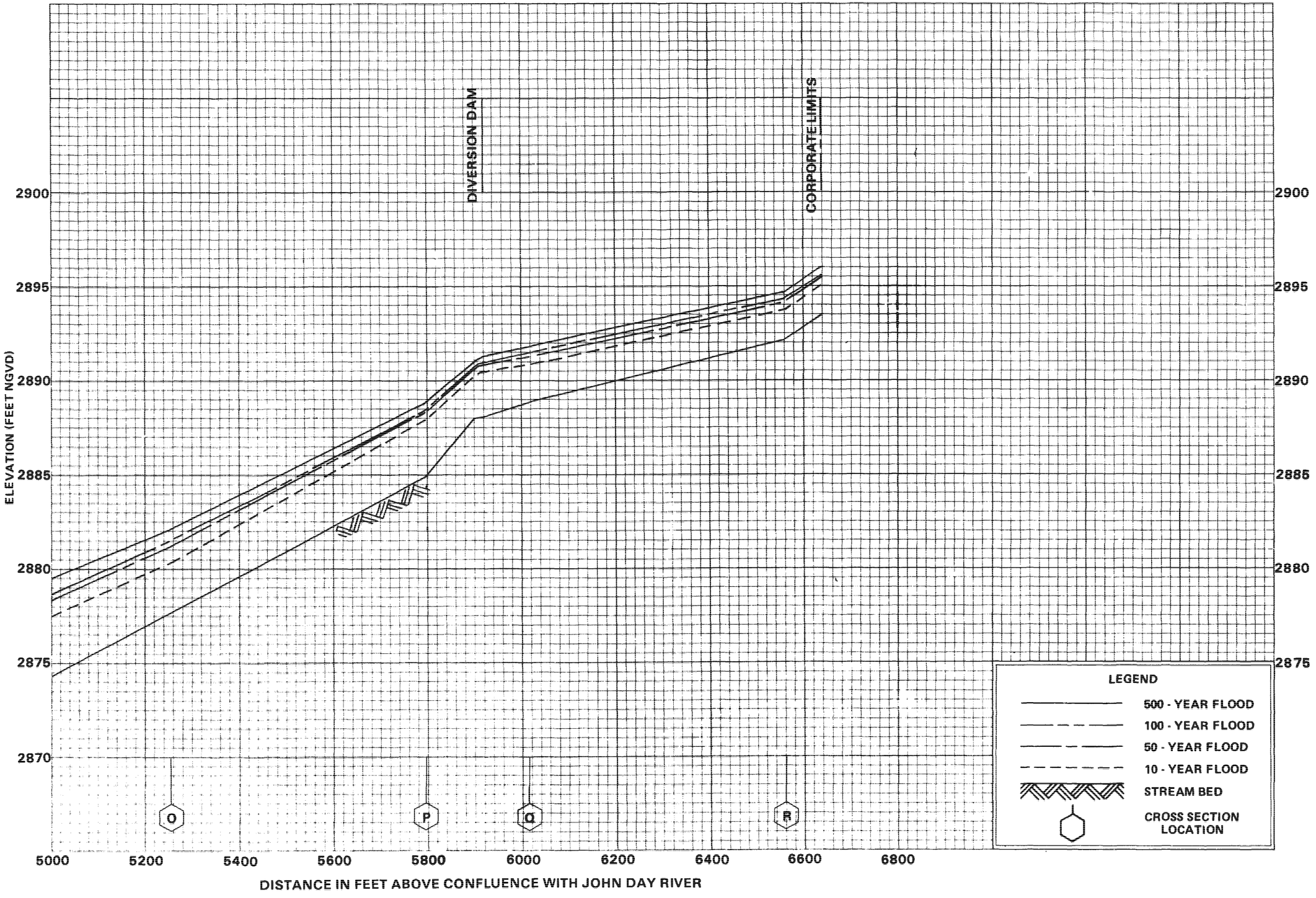

# FLOOD PROFILES

BEECH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MT. VERNON, OR
(GRANT COUNTY)

04P




# FLOOD PROFILES

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