APPENDIX D - USGS REGRESSION EQUATIONS FOR ARID REGIONS OF RURAL EASTERN OREGON

1.0 Introduction

Regression equations for arid regions of the United States are presented in the 1994 United States Geological Survey (USGS) Open-File Report 93-419 by Blakemore E. Thomas et al titled "Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States." The report presents regression equations and flood data for sixteen Flood Regions in ten western states. These guidelines address the two Flood Regions in Oregon, the Northwest Flood Region and the High Elevation Flood Region.

2.0 Flood Regions

The Northwest Flood Region is shown in Plate 1. Areas of this region at high altitudes are in the High Elevation Flood Region. The boundary between the two regions is based on the study site location and elevation, as shown in Figure 1. The Northwest Flood Region equations are used for study sites with elevations lower than the boundary elevation, and the High Elevation Flood Region equations are used for study sites with elevations higher than the boundary. A weighted average of the regression results from both regions is used if the study site is near the boundary. Peak flows within these flood regions can be estimated for gaged sites, sites near gages on the same stream, and ungaged sites.

Note: The study site is the point on the stream where the discharge versus recurrence interval relationships are needed.

3.0 Gaged Sites

Peak flow versus recurrence interval relationships at gaged sites can be estimated using the relationships in Table 1. An exception would be gaged sites where there are more recent records than Water Year 1986. In these cases, the entire period of record should be analyzed using the log-Pearson Type III method described in Chapter 7.

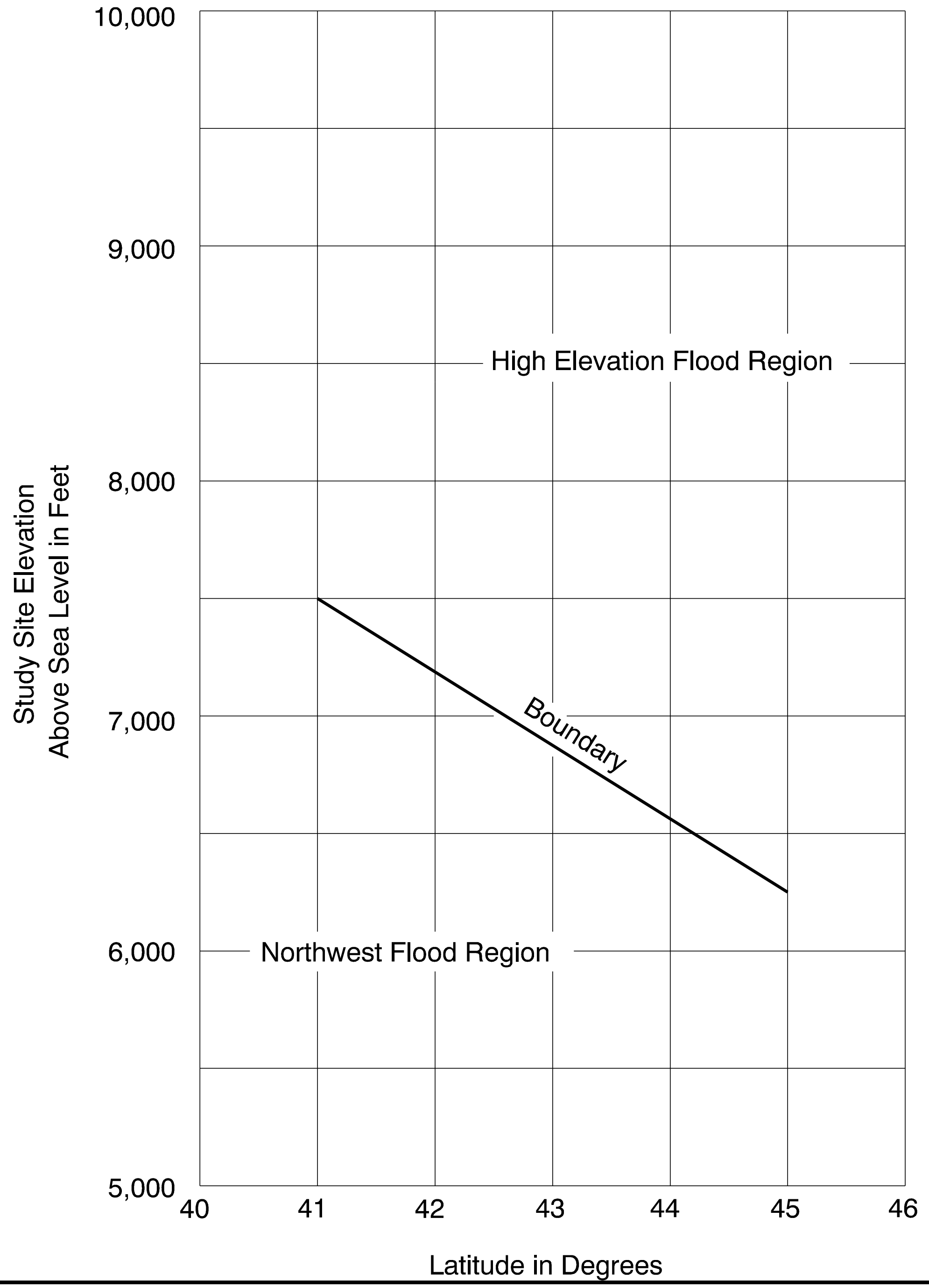


Figure 1 Boundary of High Elevation Flood Region

4.0 Sites Near Gaged Sites on Same Stream

Flood flow versus recurrence interval relationships can be estimated for ungaged study sites near gaged sites on the same stream. The ratio of the ungaged to gaged drainage areas should be between 0.5 and 1.5, and the two drainages should have similar characteristics which affect flood magnitudes, such as topography, geology, and vegetation. The following equation can be used:

$$Q_{T(u)} = Q_{T(g)} \left(\frac{A_u}{A_g} \right)^x \qquad \text{(Equation 1)}$$

Where:

$Q_{T(u)}$ = Peak discharge at the ungaged study site for T-year recurrence interval in cubic feet per second (cfs)

$Q_{T(g)}$ = Peak discharge at the gaged site for T-year recurrence interval in cubic feet per second

A_u = Drainage area of ungaged site in square miles

A_g = Drainage area of gaged site in square miles

x = Exponent for the flood region, as follows:

x = 0.7 for Northwest Flood Region

x = 0.8 for High Elevation Flood Region

5.0 Ungaged Sites

Peak flow versus recurrence interval relationships can be estimated by regression equations at ungaged study sites and sites on gaged streams with ungaged to gaged watershed ratios less than 0.5 or greater than 1.5. The equations for the Northwest Flood Region are:

Average Recurrence interval, in years	Equation	standard error of prediction, in percent	Equivalent years of record
2	$Q = 13.1\ (AREA^{0.713})$	72	0.96
5	$Q = 22.4\ (AREA^{0.723})$	66	1.80
10	$Q = 55.7\ (AREA^{0.727})\ (ELEV/1{,}000)^{-0.353}$	61	3.07
25	$Q = 84.7\ (AREA^{0.737})\ (ELEV/1{,}000)^{-0.438}$	61	4.64
50	$Q = 113\ (AREA^{0.746})\ (ELEV/1{,}000)^{-0.511}$	64	5.47
100	$Q = 148\ (AREA^{0.752})\ (ELEV/1{,}000)^{-0.584}$	68	6.05

The equations for the High Elevation Flood Region are:

Recurrence interval, in years	Equation	Average standard error of prediction, in percent	Equivalent years of record
2	$Q = 0.124\ (AREA^{0.845})\ (PREC^{1.44})$	59	0.16
5	$Q = 0.629\ (AREA^{0.807})\ (PREC^{1.12})$	52	0.62
10	$Q = 1.43\ (AREA^{0.786})\ (PREC^{0.958})$	48	1.34
25	$Q = 3.08\ (AREA^{0.768})\ (PREC^{0.811})$	46	2.50
50	$Q = 4.75\ (AREA^{0.758})\ (PREC^{0.732})$	46	3.37
100	$Q = 6.78\ (AREA^{0.750})\ (PREC^{0.668})$	46	4.19

Where the explanatory variables are determined as follows:

AREA = Drainage basin area upstream from the study site in square miles (mi^2)

ELEV = Mean drainage basin elevation in feet above sea level, determined by placing a transparent grid over the drainage basin drawn on the largest scale topographic map available. The elevations of a minimum of 20 equally spaced points are determined, and the average elevation is calculated. As many as 100 points may be needed for large basins.

Note: ELEV is always higher than the study site elevation.

PREC = Mean annual precipitation in inches determined by placing a grid over an isohyetal map of mean annual precipitation. The drainage area boundary is drawn on the map, the mean annual precipitation is determined at each grid intersection, and the values are averaged for the basin. The mean annual precipitation map is shown in Plate 2.

6.0 Limits of Equations

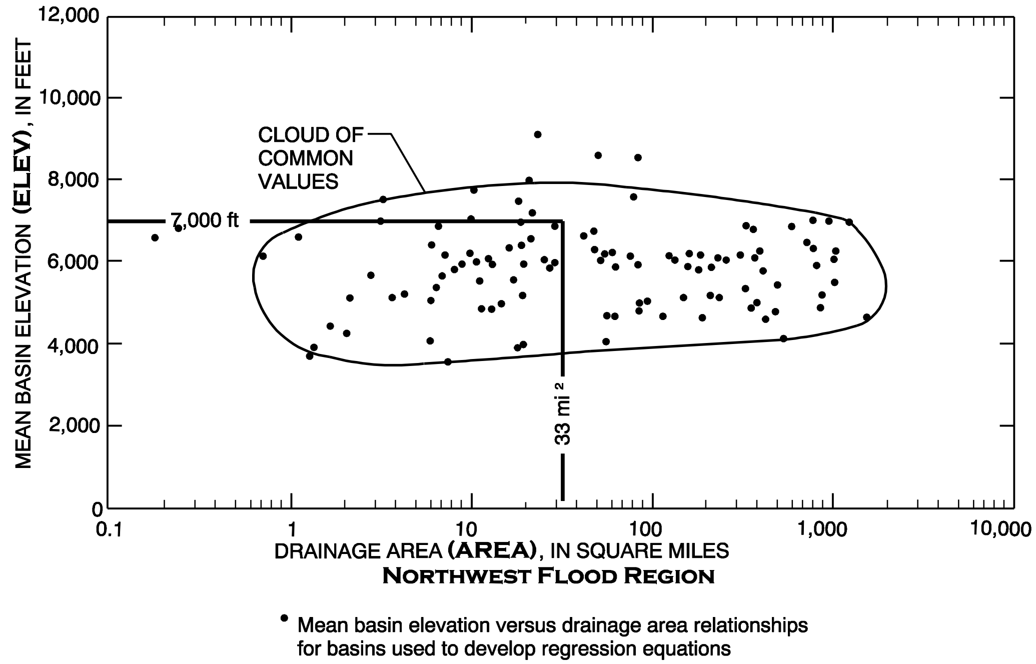
The peak flow versus recurrence interval relationships are assumed to represent most streams in the arid region with 200 square miles or less drainage basin areas. Streams that may not be represented by the relationships are: streams with watershed areas more than 200 square miles, streams with significant upstream storage or diversion, streams in watersheds containing large areas of highly permeable rocks, and streams with less base flow than nearby gaged streams. The equations also may overestimate the discharges from streams with greater flood flow attenuation from overbank storage than nearby gaged streams. This overbank storage can often be significant on streams with small channels and large hydraulically rough floodplains.

The equations may overestimate flow in a stream that is part of a network of distributary flow channels, or a stream with a drainage basin having large areas of distributary flow. In these areas, discharge from a single channel flows into two or more distributary flow channels. This flow separation most often occurs on the relatively flat piedmont plains downslope from steeper mountain streams. These distributary flow channels often have an erratic flow pattern and they divide and join over wide areas of the alluvial plain. In these instances, the equations are most suited for determining discharges in the main stem channel upstream from the junction with the distributary channels.

The equations also may not represent streams with basin and climatic conditions outside the range of watershed characteristics used to develop the equations. The characteristics of the study watershed and the watersheds used to develop the equations can be compared using "clouds of common values." The clouds represent the ranges of the explanatory variables common to most of the watersheds used to develop the equations, as shown in Figure 2. It is likely that the regression equations represent flows from the watershed if the lines representing the explanatory variables intersect within the clouds. The regression equations should be used with caution if the lines intersect at a point outside of the clouds. This process is shown in the example.

Another comparison can be made to see if the predicted discharges are reasonable. It is to compare the 100-year discharge predicted by the equations to the 100-year flows from the watersheds used to develop the equations. The 100-year discharge versus drainage area relationships for the basins used to develop the equations are shown by dashed lines in Figure 3 for the Northwest Flood Region and Figure 4 for the High Elevation Flood Region. The regression equations should be used with caution if the predicted 100-year discharge is significantly above or below the dashed lines.

The maximum historical discharge can be calculated at some study sites. It can be compared to the maximum recorded discharges from the basins used to develop the equations using Figures 3 and 4. The maximum peak discharges of record for the basins used to develop the equations are shown as dots on the figures. If the estimated historical peak discharge is significantly higher than the maximum recorded peak flows from basins of similar size, the reason should be investigated. Possible reasons can be deluges of water caused by the sudden failure of debris dams that have impounded water in the upstream basin, deluges caused by the failure of roadway embankments that have impounded water (usually due to plugged culverts), flash floods, or drainages with characteristics markedly different than the basins used to develop the equations.



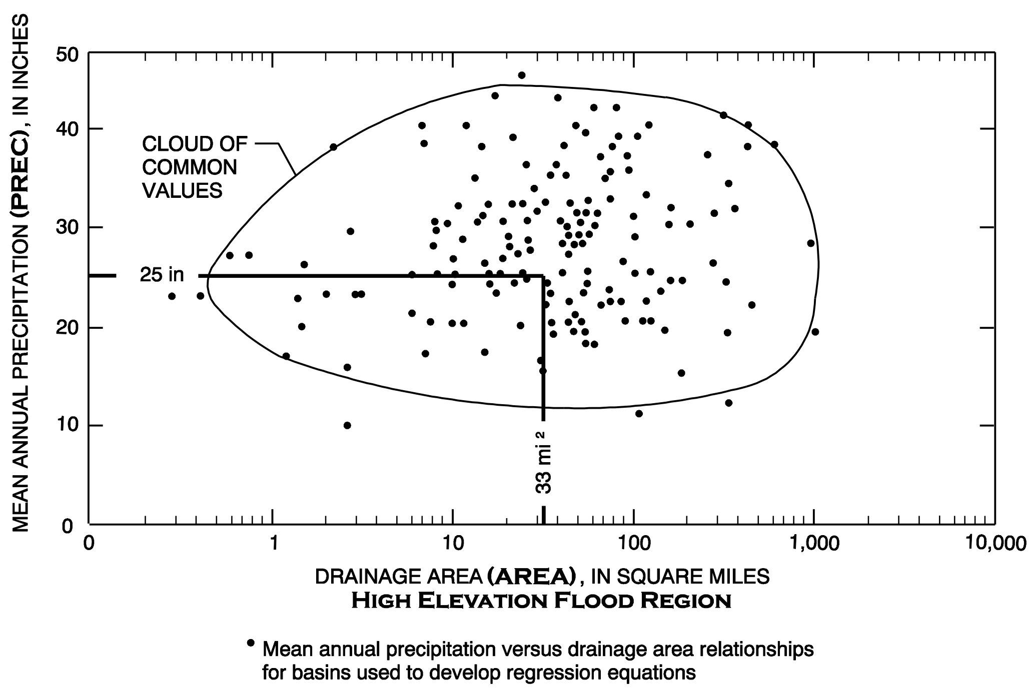


Figure 2 Clouds of Common Values

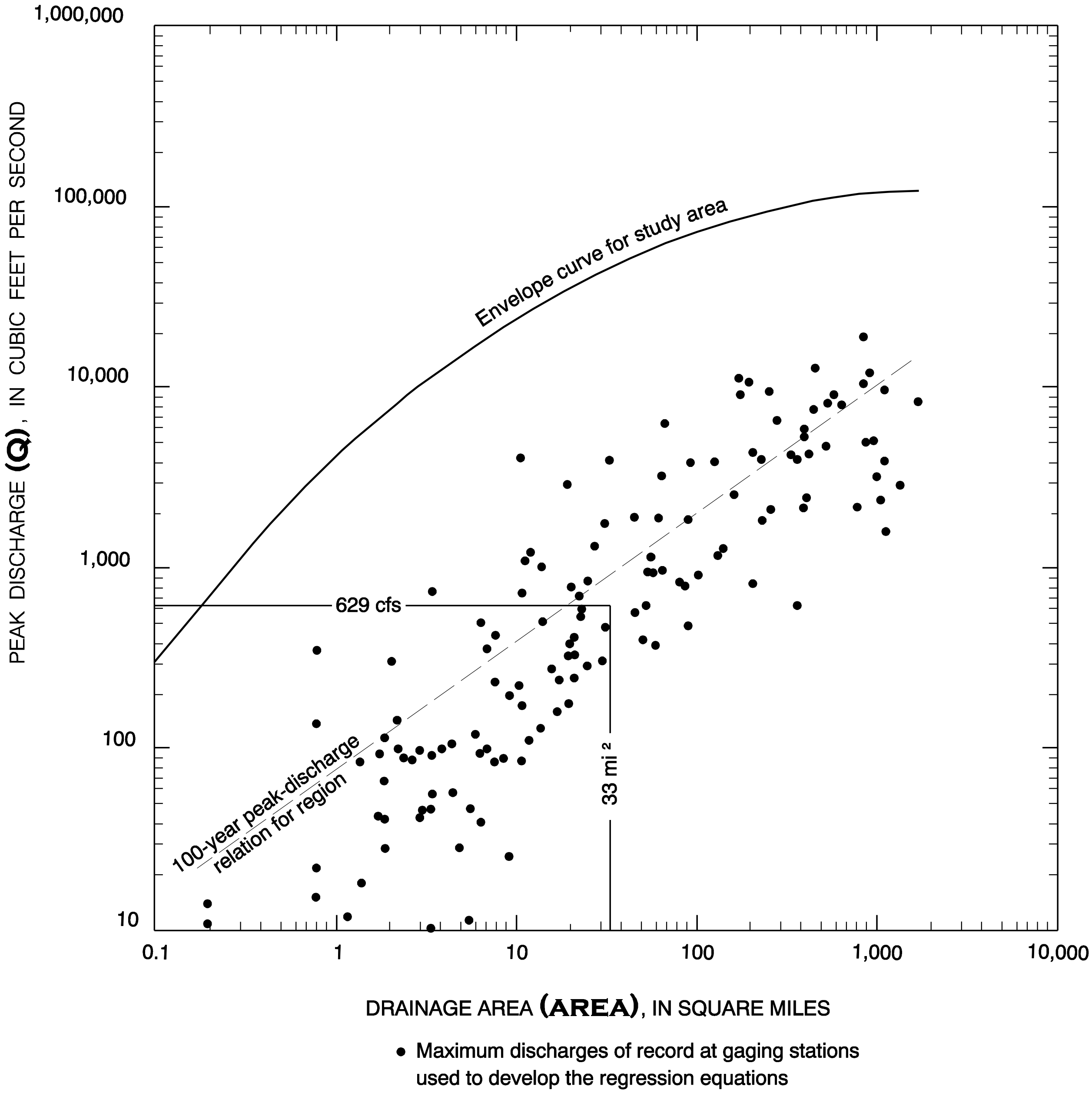


Figure 3 Relationship Between Drainage Areas and 100-Year Peak Discharges, Maximum Peak Discharges of Record, and Maximum Potential Flood Flows in the Northwest Flood Region

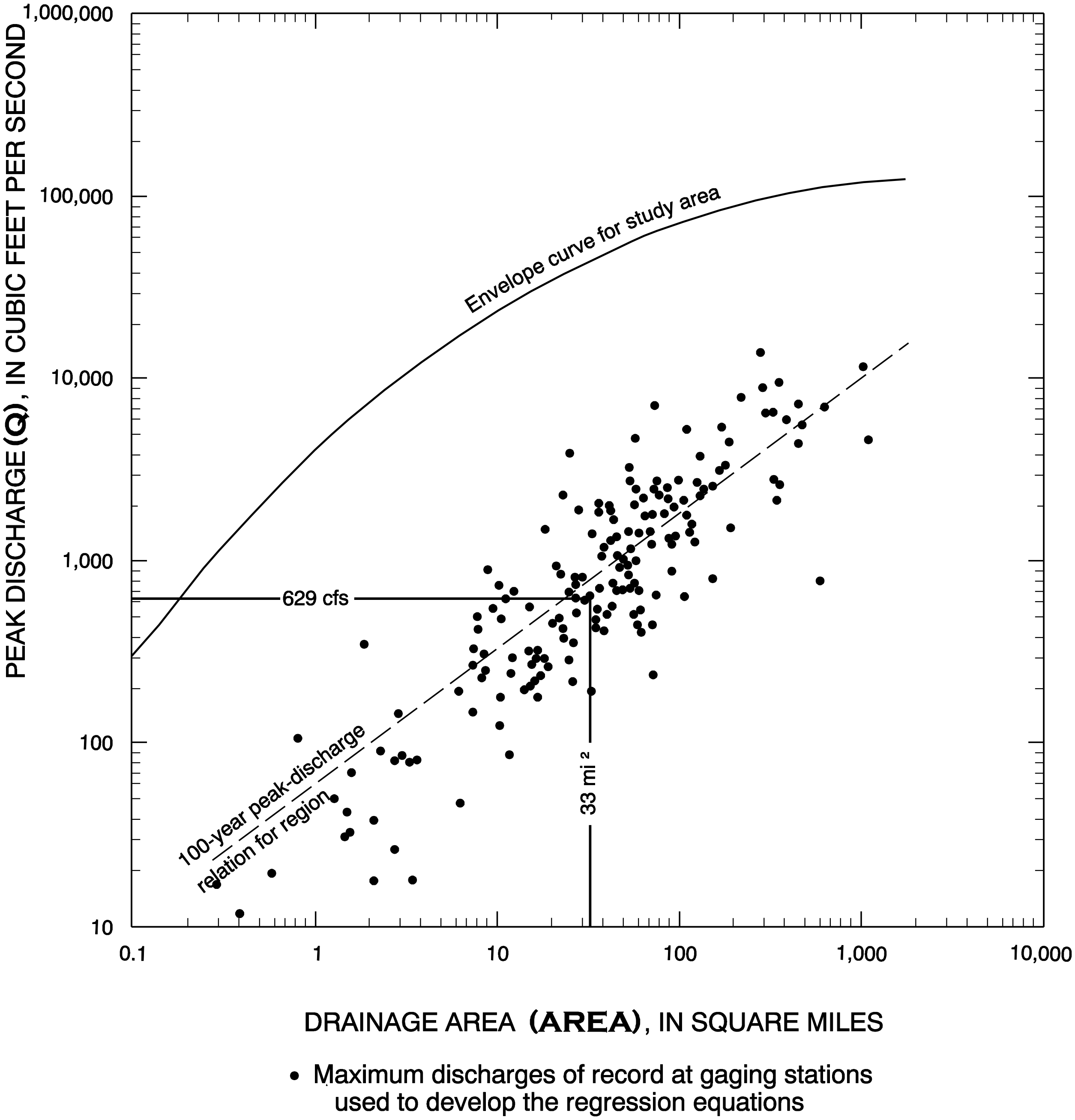


Figure 4 Relationship Between Drainage Areas and 100-Year Peak Discharges, Maximum Peak Discharges of Record, and Maximum Potential Flood Flow in the High Elevation Flood Region

A further comparison can be made between calculated discharges at the study site and discharges from the basins used to develop the equations. Envelope curves that enclose the maximum potential flood flows expected in the region are also shown in Figures 3 and 4. These curves are based on data from the gaged sites. The maximum potential flood flow for a basin of a given size is considerably larger than the 100-year flow. The predicted discharges may be erroneous and the cause should be investigated if the 100-year flow calculated by the regression equations for a basin is outside of the envelope curve. There may be an error in the calculations or the input to the equations.

7.0 Procedure

The procedure for using the equations is as follows:

Step 1 - Use the weighted peak flow versus recurrence interval values in Table 1 if the study site is a gaged site and the period of record does not extend later than Water Year 1986.

Step 2 - Analyze the gage data using a log-Pearson Type III distribution if the study site is a gaged location and there are records later than Water Year 1986. The procedure is outlined in Chapter 7.

Step 3 - Measure the study site drainage area, AREA or A_u, in square miles. Determine the gage drainage area (if there is a gage), A_g in square miles. Determine the study site latitude and longitude in degrees. Determine the study site elevation (E) in feet.

Step 4 - Determine the ratio of the ungaged to gaged drainage areas if the study site is near a gaged site on the same stream. Use Equation 1 to determine the discharges from the ungaged basin if the area ratio is between 0.5 and 1.5.

It may be possible to analyze study sites on ungaged streams, or gaged streams with drainage area ratios less than 0.5 or greater than 1.5, with the regression equations. The remaining steps in this procedure apply to the regression equations.

Step 5 - Determine if the study site is within the boundaries of the Northwest or High Elevation Flood Regions using information from Step 3, Figure 1, and Plate 1.

Step 6 - Verify the site is suitable for a regression equation analysis. The equations may be appropriate if the drainage basin characteristics meet the listed requirements and the explanatory variables are within the clouds of common values. The equation results should be used with extreme caution, or another hydrologic method should be used, if the basin does not meet the listed requirements or the variables are outside of the clouds.

Step 6a - Verify the stream has:

- a 200 square mile or less drainage area,
- no significant upstream flow detention in reservoirs,
- no significantly greater overbank storage than typical nearby gaged streams,
- no significant upstream flow diversion, and
- the stream is not part of a distributary flow pattern.

Step 6b - Determine the required explanatory variables as applicable, ELEV or PREC.

Step 6c - Verify the explanatory variables are within the appropriate clouds of common values shown on Figure 2.

Step 7 - Use the regression equations for the Northwest Flood Region if the study site elevation is 700 or more feet lower than the region boundary elevation. Use the High Elevation Flood Region equations if the study site elevation is equal to or higher than the region boundary elevation. Use a weighted discharge based on both the Northwest and the High Elevation Flood Regions if the study site elevation is within 700 feet below the boundary of the High Elevation Flood Region. The characteristics of the entire basin should be used in both computations. The weighted discharge should be computed as follows:

$$Q_{T(w)} = Q_{T(n)}\left[\frac{(B - E)}{700}\right] + Q_{T(h)}\left[1 - \left(\frac{B - E}{700}\right)\right] \quad \text{(Equation 2)}$$

Where:

$Q_{T(w)}$ = Weighted discharge for T-year recurrence interval in cubic feet per second (cfs)

$Q_{T(n)}$ = Discharge from Northwest Flood Region equations for T-year recurrence interval in cubic feet a second

$Q_{T(h)}$ = Discharge from High Elevation Flood Region equations for T-year interval in cubic feet a second

B = Boundary elevation of the High Elevation Flood Region in feet

E = Elevation of the study site in feet

Step 8 - Check to see if the predicted discharges are reasonable compared to the typical 100-year discharge versus drainage area relationship, peak discharges of record, and the maximum potential flood flows shown in Figures 3 or 4 for the applicable region.

8.0 Example Problem #1

The 50-year flow is needed for Bryson Brook. There is a gage on the stream near the study site.

Steps 1 and 2 - The peak flow versus recurrence interval relationship for the stream gage cannot be directly used. The gage is too far from the study site. These steps cannot be done.

Step 3 - The study site has a 64 square mile drainage area. AREA = A_u = 64 square miles. The gage has a 58.0 square mile drainage area. A_g = 58.0 square miles. The study site latitude is 45 degrees 10 minutes north, and the longitude is 118 degrees 53 minutes west. The study site elevation is 3,500 feet. E = 3,500 feet.

Step 4 - The ratio of ungaged to gaged areas is: A_u/A_g = 64.0 / 58 = 1.1. The gaged flow can be adjusted to represent the discharge at the study site.

The study site, using Figure 1, is within the Northwest Flood Region based on its elevation, latitude, and longitude.

The exponent for the Northwest Flood Region is: x = 0.7

The 50-year discharge at the gage is: $Q_{50(g)}$ = 2,450 cubic feet per second.

Using Equation 1, the discharge at the study site, $Q_{50(u)}$ is:

$$Q_{50(u)} = 2{,}450 \text{ x} \left(\frac{64}{58.0}\right)^{0.7} = 2{,}620 \text{ cubic feet per second}$$

9.0 Example Problem #2

The 50-year discharge is needed for Lenz Creek.

Steps 1 and 2 - These steps are not done. There is no gage on the stream.

Step 3 - The study site drainage area is plotted on a USGS 7-1/2 minute quadrangle map. The drainage area is: AREA = 33 square miles.

The study site latitude is 44 degrees 20 minutes north. The longitude is 118 degrees 30 minutes west.
The study site elevation is: E = 6,000 feet.

Step 4 - Not done. There is no gage on the stream.

Step 5 - The site is within the region covered by the arid region regression equations shown on Plate 1, based on the study site longitude and latitude. The boundary between the Northwest and High Elevation Flood Regions is 6,400 feet at latitude 44 degrees 20 minutes north, according to Figure 1. The study site elevation is 6,000 feet, so the site is within the Northwest Flood Region.

Step 6a - The basin is small enough to be represented by the equations because it is smaller than the maximum recommended size of 200 square miles. In the upstream watershed there are no storage reservoirs or flow diversions. The stream is not part of a distributary flow pattern. In addition, the overbank storage on this stream is not significantly greater than nearby gaged streams. As a result, the equations may be applicable.

Step 6b - A grid was laid out across the drainage basin boundaries drawn on the USGS quadrangle map, and the elevations of 23 grid intersection points are measured. These elevations are averaged to determine the mean basin elevation, ELEV.

ELEV = 7,000 feet

A grid is placed over the isohyetal map of mean annual precipitation in Plate 2 and rainfall is measured at each grid intersection. These rainfall values are averaged to determine the mean annual precipitation, PREC.

PREC = 25 inches

Step 6c - Lines corresponding to AREA and ELEV are plotted on the cloud of common values for the Northwest Flood Region. The intersection point is within the cloud, as shown in Figure 2. Lines corresponding to AREA and PREC are also plotted on the cloud for the High Elevation Flood Region. The intersection points of these lines are also within the cloud, as shown in Figure 2. As a result, the basin characteristics are within the range of explanatory variables applicable for the equations, and the equations may be appropriate for the drainage basin.

Step 7 - The 6,000 foot study site elevation is 400 feet lower than the High Elevation Flood Region boundary. A weighted discharge based on both the Northwest and High Elevation Flood Regions equations is needed because the study site is within 700 feet below the boundary. Using the Northwest Flood Region regression equation for the 50-year flow:

$$Q_{50}\ (113)\ (33^{0.746}) \left(\frac{7000}{1000}\right)^{-0.511} = 568 \text{ cubic feet per second}$$

Using the High Elevation Flood Region equation:

$$Q_{50} = (4.75)\ (33^{0.758})\ (25^{0.732}) = 710 \text{ cubic feet per second}$$

The weighted discharge using Equation 2 is:

$$Q_{50(w)} = 568 \left(\frac{6{,}400 - 6{,}000}{700}\right) + 710 \left[1 - \left(\frac{6{,}400 - 6{,}000}{700}\right)\right] = 629 \text{ cubic feet per second}$$

Step 8 - Lines representing the weighted 50-year discharge and the drainage area are plotted on the relationship graphs for each flood region, as shown in Figures 3 and 4. The points where the lines intersect are fairly close to, and below, the dashed lines representing the 100-year discharge versus drainage area relationship. This is expected, because the 50-year discharge is usually lower than the 100-year discharge. The input data and calculations will need a careful review if the 50-year discharge intersection points are higher than the typical 100-year flow relationship lines.

The intersection points are well below the envelope curves. This is expected. The input data and calculations will likely be in error if the intersection points are near or above the envelope curves.

The drainage basin is suitable for the regression analysis and the calculations produce reasonable results. As a result, the estimated 50-year discharge in Lenz Creek at the study site is 629 cubic feet per second.

Table 1 Weighted Peak Flow Versus Recurrence Interval Relationships for Gaged Sites in Oregon

Station Number[1]	Station Name	Latitude In Decimal Degrees	Longitude In Decimal Degrees	Years of Record	Drainage Area In Square Miles	Mean Basin Elevation In Feet	Mean Annual Precipitation In Inches
10366000	Twentymile Creek near Adel, OR	42.072	119.962	56	194.00	5,800	15.0
10370000	Camas Creek near Lakeview, OR	42.216	120.101	25	63.00	6,210	20.0
10371000	Drake Creek near Adel, OR	42.200	120.011	26	67.00	5,880	15.0
10371500	Deep Creek above Adel, OR	42.189	120.001	57	249.00	6,110	17.0
10378500	Honey Creek near Plush, OR	42.425	119.922	65	170.00	5,910	20.0
10384000	Chewaucan River near Paisley, OR	42.685	120.569	72	275.00	6,050	18.0
10390400	Bridge Creek near Thompson Reservoir, OR	43.025	121.200	16	10.60	6,170	25.0
10392300	Silvies River near Seneca, OR	44.175	119.214	15	18.40	5,530	30.0
10392800	Crowsfoot Creek near Burns, OR	43.899	119.497	14	8.50	5,790	25.0
10393500	Silvies River near Burns, OR	43.715	119.176	79	934.00	5,200	19.0
10393900	Devine Canyon near Burns, OR	43.772	119.004	17	4.96	5,410	15.0
10396000	Donner und Blitzen River near Frenchglen, OR	42.791	118.867	60	200.00	6,160	14.0
10397000	Bridge Creek near Frenchglen, OR	42.844	118.849	39	30.0	5,890	12.0
10403000	Silver Creek near Riley, OR	43.692	119.658	29	228.00	5,180	20.0
13178000	Jordan Creek above LN Tree Creek near Jordan Valley, OR	42.874	116.953	24	440.00	5,780	15.0
13182100	Dago Gulch near Rockville, OR	43.294	117.254	12	3.09	4,560	12.0
13182150	Long Gulch near Rockville, OR	43.321	117.195	10	1.38	5,030	12.0
13213900	Malheur River Tributary near Drewsey, OR	43.780	118.358	17	2.28	3,820	10.0
13214000	Malheur River near Drewsey, OR	43.785	118.331	61	910.00	4,900	16.3
13216500	Near Fork Malheur River above Beulah Res. near Beulah, OR	43.948	118.173	49	355.00	5,360	19.0
13227000	Bully Creek near Vale, OR	43.958	117.342	26	570.00	4,150	17.8
13228300	Lytle Creek near Vale, OR	43.957	117.226	13	6.46	2,700	10.0
13229400	Lost Valley Creek Tributary near Ironside, OR	44.314	117.903	12	1.86	4,050	10.0
14036800	John Day River near Prairie City, OR	44.319	118.557	14	17.40	6,320	28.0
14037500	Strawberry Creek above Slide Creek near Prairie City, OR	44.342	118.656	56	7.00	6,900	37.0
14038530	John Day River near John Day, OR	44.419	118.903	18	386.00	4,900	25.0
14038550	East Fork Canyon Creek near Canyon City, OR	44.246	118.911	15	24.80	5,780	25.0
14038600	Vance Creek near Canyon City, OR	44.289	118.978	14	6.54	5,060	20.0
14038750	Beech Creek near Fox, OR	44.568	119.108	12	1.94	5,190	20.0

Information in this table is from USGS Open-File Report 93-419.

Notes: [1]All stations in Northwest or High Elevation flood regions

Table 1, Contd. Weighted Peak Flow Versus Recurrence Interval Relationships for Gaged Sites in Oregon

Station Number[1]	Relation Characteristic[2]					Peak Discharge (cubic feet per second) For Indicated Recurrence Interval (years)[3]						Maximum Peak Discharge of Record (cubic feet per second)
	L	H	D	O	U	2	5	10	25	50	100	
10366000	1	0	1	0	0	1,450	2,960	4,310	6,460	8,450	10,800	3,670
10370000	0	1	0	0	0	464	796	1,070	1,510	1,910	2,370	3,190
10371000	0	0	0	0	0	474	1,220	1,980	3,340	4,720	6,490	6,210
10371500	0	0	0	0	0	1,270	2,530	3,590	5,220	6,640	8,250	9,420
10378500	0	0	1	0	0	466	1,190	1,920	3,180	4,400	5,880	11,000
10384000	1	1	0	0	0	952	1,570	2,100	2,880	3,570	4,360	6,490
10390400	0	0	0	0	0	66	111	150	208	257	312	218
10392300	1	0	0	0	0	74	113	148	200	241	283	152
10392800	0	0	1	0	0	50	76	97	127	150	174	88
10393500	1	0	0	0	0	1,350	2,240	2,970	4,020	4,900	5,840	4,960
10393900	-	-	-	-	1	41	71	98	132	157	184	28
10396000	0	0	1	0	0	1,370	2,140	2,630	3,230	3,660	4,100	4,270
10397000	1	0	0	0	0	109	178	231	302	358	414	301
10403000	1	0	1	0	0	612	1,030	1,340	1,770	2,110	2,460	1,810
13178000	0	1	0	0	0	1,900	2,930	3,640	4,650	5,480	6,350	7,530
13182100	-	-	-	-	1	29	51	74	100	121	143	46
13182150	-	-	-	-	1	16	28	40	53	63	73	18
13213900	-	-	-	-	1	24	41	63	86	105	126	100
13214000	1	0	0	0	0	2,070	3,870	5,360	7,590	9,510	11,600	12,000
13216500	1	0	0	0	0	938	1,490	1,930	2,550	3,070	3,620	3,970
13227000	0	0	0	0	0	848	2,320	3,830	6,290	8,560	11,200	8,980
13228300	0	0	0	0	0	97	178	247	343	429	527	497
13229400	-	-	-	-	1	20	35	53	73	88	104	41
14036800	0	0	1	0	0	74	122	160	213	254	294	155
14037500	1	1	0	0	0	90	133	164	211	251	295	354
14038530	1	0	0	0	0	1,690	2,700	3,470	4,590	5,570	6,640	5,830
14038550	-	-	-	-	1	129	228	310	419	506	594	285
14038600	0	0	0	0	0	20	35	51	75	94	114	39
14038750	-	-	-	-	1	21	36	50	67	80	93	28

Notes: [2]Relation characteristics:
L, low-discharge threshold used to compute station relation
H, high outlier detected in station record
D, relation fit through the plotted annual peak flows has the appearance of a dogleg or jump
O, station is regional outlier deleted from generalized least-squares regression analysis
U, relation was undefined
1, code applies
0, code does not apply
-, code is not applicable

[3]Peak discharges weighted using station and regional skews

Table 1, Contd. Weighted Peak Flow Versus Recurrence Interval Relationships for Gaged Sites in Oregon

Station Number[1]	Station Name	Latitude In Decimal Degrees	Longitude In Decimal Degrees	Years of Record	Drainage Area In Square Miles	Mean Basin Elevation In Feet	Mean Annual Precipitation In Inches
14038900	Fields Cr near Mount Vernon, OR	44.393	119.307	13	17.50	5,310	22.0
14039200	Venator Creek near Silvies, OR	43.999	119.275	13	11.90	5,510	25.0
14040500	John Day River at Picture Gorge near Dayville, OR	44.521	119.625	59	1,680	4,580	22.0
14040700	Whisky Creek near Mitchell, OR	44.522	119.922	11	2.22	4,270	24.0
14040900	Bruin Creek near Dale, OR	44.897	118.793	12	4.63	5,220	25.0
14041500	N. Fork John Day near Dale, OR	44.999	118.940	29	5,200	5,450	27.0
14041900	Line Cr near Lehman Springs, OR	45.169	118.711	15	2.40	4,580	20.0
14042000	Camas Cr near Lehman Springs, OR	45.171	118.731	20	60.70	4,680	24.0
14042500	Camas Creek near Ukiah, OR	45.157	118.819	62	121.00	4,680	24.0
14043800	Bridge Creek near Prairie City, OR	44.542	118.540	15	6.93	5,350	30.0
14043850	Cottonwood Cr near Galena, OR	44.653	118.865	15	3.89	5,130	22.0
14043900	Granite Creek near Dale, OR	44.894	119.014	11	1.90	4,130	20.0
14044000	MF John Day River at Ritter, OR	44.889	119.140	56	515	4,800	23.0
14044100	Paul Creek near Long Creek, OR	44.724	119.132	11	3.5	4,490	18.0
14044500	Fox Creek at Gorge near Fox, OR	44.619	119.262	28	90.20	4,830	21.0
14046250	Ives Canyon near Spray, OR	44.860	119.714	12	2.73	3,460	18.0
14046300	Big Service Creek near Service Creek, OR	44.894	120.070	11	5.56	3,880	18.0
14046400	Donnely Creek Tributary near Service Creek, OR	44.772	120.003	18	1.85	2,880	16.0
14046900	John Day Riv Trib near Clarno, OR	44.906	120.568	21	1.36	3,730	15.0
14047350	Rock Cr Trib near Hardman, OR	45.078	119.569	14	6.25	4,100	20.0
14047450	W Fk Dry Cr near Gooseberry, OR	45.286	119.964	13	0.81	2,540	15.0
14077500	N Fk Beaver Cr near Paulina, OR	44.167	119.733	13	64.40	4,670	20.0
14077800	Wolf Cr Tributary near Paulina, OR	44.277	119.817	15	2.15	5,150	18.0
14078000	Beaver Creek near Paulina, OR	44.164	119.922	33	450	4,600	20.0
14078200	Lizard Gulch Tributary near Hampton, OR	43.589	119.983	16	19.60	5,000	15.0
14078400	Lookout Creek near Post, OR	44.311	120.240	14	7.53	5,670	25.0
14078500	N Fork Crooked River above Deep Creek, OR	44.333	120.083	11	159.00	5,130	21.0
14081800	Ahalt Creek near Mitchell, OR	44.433	120.351	22	2.28	5,130	25.0
14083000	Ochoco Creek above Mill Creek near Prineville, OR	44.308	120.644	13	200.00	4,654	21.0

Information in this table is from USGS Open-File Report 93-419.

Notes: [1]All stations in Northwest or High Elevation flood regions

Table 1 Contd. Weighted Peak Flow Versus Recurrence Interval Relationships for Gaged Sites in Oregon

Station Number[1]	Relation Characteristic[2]					Peak Discharge (cubic feet per second) For Indicated Recurrence Interval (years)[3]						Maximum Peak Discharge of Record (cubic feet per second)
	L	H	D	O	U	2	5	10	25	50	100	
14038900	-	-	-	-	1	101	177	248	336	407	480	240
14039200	1	1	0	0	0	57	80	103	138	165	194	108
14040500	0	0	1	0	0	2,820	4,590	5,950	7,850	9,410	11,000	8,170
14040700	0	0	1	0	0	33	70	103	150	192	240	143
14040900	1	0	0	0	0	34	47	60	79	94	109	57
14041500	0	0	0	0	0	3,020	4,360	5,170	6,190	6,980	7,770	8,170
14041900	-	-	-	-	1	24	42	62	83	100	118	90
14042000	0	0	0	0	0	614	947	1,200	1,540	1,840	2,170	1,880
14042500	0	0	0	0	0	1,050	1,580	1,970	2,490	2,920	3,370	3,840
14043800	0	0	0	0	0	40	62	82	109	131	155	98
14043850	0	0	0	0	0	47	67	82	103	120	137	98
14043900	-	-	-	-	1	21	36	54	73	88	105	66
14044000	0	0	0	0	0	1,640	2,420	2,970	3,700	4,280	4,870	4,730
14044100	-	-	-	-	1	32	55	81	110	134	158	56
14044500	1	0	0	0	0	407	785	1,120	1,630	2,090	2,620	1,860
14046250	-	-	-	-	1	27	46	75	103	127	153	86
14046300	0	0	0	1	0	7	17	33	58	77	97	11
14046400	-	-	-	-	1	20	35	60	84	104	127	42
14046900	0	0	0	0	0	30	47	60	76	88	101	83
14047350	1	0	1	0	0	56	88	114	148	175	203	117
14047450	-	-	-	-	1	11	19	34	48	60	73	134
14077500	0	0	1	0	0	587	741	844	989	1,120	1,240	955
14077800	-	-	-	-	1	23	39	54	73	87	101	300
14078000	0	1	1	0	0	1,360	2,700	3,950	5,980	7,910	10,200	12,800
14078200	-	-	-	-	1	109	193	275	375	457	542	177
14078400	1	0	1	0	0	49	74	94	121	142	164	85
14078500	0	0	1	0	0	1,320	1,650	1,870	2,180	2,460	2,770	2,500
14081800	1	1	0	0	0	38	56	70	89	105	122	122
14083000	1	0	0	0	0	371	600	834	1,190	1,490	1,790	821

Notes: [2]Relation characteristics:
L, low-discharge threshold used to compute station relation
H, high outlier detected in station record
D, relation fit through the plotted annual peak flows has the appearance of a dogleg or jump
O, station is regional outlier deleted from generalized least-squares regression analysis
U, relation was undefined
1, code applies
0, code does not apply
-, code is not applicable

[3]Peak discharges weighted using station and regional skews