

## **Revision History**

Publication Series and Series Number: Scientific Investigations Report 2008-5230

Publication Title: Methods for Estimating Monthly and Annual Streamflow Statistics at Ungaged Sites in Utah

Publication Authorship: Chris D. Wilkowske, Terry A. Kenney, and Shane J. Wright

First Version and Date of Release: 1.0 January 15, 2009

Current Version and Date of Current Release: 2.0 April 2, 2011

### **List of Changes for Revision 2.0**

#### **On Cover:**

Addition of “Version 2.0, April 2, 2011” under report series and number.

#### **On Title page:**

Addition of “Version 2.0, April 2, 2011” under report series and number.

#### **On page 9, table 3:**

The data set for table 3 was revised.

#### **On page 10, table 4:**

The data set for table 4 was revised.

#### **On page 12, table 6:**

The data set for table 6 was revised.

#### **On page 14, table 8:**

The data set for table 8 was revised.

#### **On page 15, table 9:**

The data set for table 9 was revised.

#### **On page 18, table 11:**

The data set for table 11 was revised.

**Table 3. Regression equations and their associated uncertainty for estimating monthly 80-, 50-, and 20-percent exceedance streamflows for natural streams in region 1 in Utah.**

[Regression variables:  $Q_{P80}$ , daily mean discharge exceeded 80 percent of the time during the specified month, in cubic feet per second;  $Q_{P50}$ , daily mean discharge exceeded 50 percent of the time during the specified month, in cubic feet per second;  $Q_{P20}$ , daily mean discharge exceeded 20 percent of the time during the specified month, in cubic feet per second; DRNAREA, drainage area, in square miles; BSLDEM10M, average basin slope, in percent; PRECIP, mean annual precipitation, in inches; SLOP30, basin slope that exceeds 30 percent, in percent; PRC12, mean December precipitation, in inches; PRC2, mean February precipitation, in inches; ELEV, mean basin elevation, in feet; PRC6, mean June precipitation, in inches; FOREST, area covered by forest, in percent;  $Q_{ANNMEAN}$ , annual mean discharge, in cubic feet per second]

Regression equation for given monthly exceedance (80, 50, and 20 percent exceedance)	Root mean square error (percent)	Number of streamflow-gaging stations used in regression analysis
<b>October</b>		
$Q_{P80} = 5.5463E-03 \text{ DRNAREA}^{0.3643} (\text{BSLDEM10M}+0.001)^{1.0454} 10^{0.0386} \text{ PRECIP}$	105	
$Q_{P50} = 1.8088E-02 \text{ DRNAREA}^{0.3914} (\text{BSLDEM10M}+0.001)^{0.9229} 10^{0.0309} \text{ PRECIP}$	96.9	39
$Q_{P20} = 8.6139E-02 \text{ DRNAREA}^{0.4283} (\text{BSLDEM10M}+0.001)^{0.6905} 10^{0.0229} \text{ PRECIP}$	83.2	
<b>November</b>		
$Q_{P80} = 7.2879E-02 \text{ DRNAREA}^{0.4551} 10^{0.0368} \text{ PRECIP} + 0.0068 (\text{SLOP30}+0.001)$	103	
$Q_{P50} = 2.5038E-01 \text{ DRNAREA}^{0.4555} 10^{0.0252} \text{ PRECIP} + 0.0064 (\text{SLOP30}+0.001)$	93.6	39
$Q_{P20} = 5.8063E-01 \text{ DRNAREA}^{0.4765} 10^{0.0165} \text{ PRECIP} + 0.0064 (\text{SLOP30}+0.001)$	85.9	
<b>December</b>		
$Q_{P80} = 1.8724E-01 \text{ DRNAREA}^{0.3929} 10^{0.3916} \text{ PRC12}$	84.7	
$Q_{P50} = 3.6568E-01 \text{ DRNAREA}^{0.4040} 10^{0.3270} \text{ PRC12}$	81.2	39
$Q_{P20} = 5.6925E-01 \text{ DRNAREA}^{0.4354} 10^{0.2794} \text{ PRC12}$	78.8	
<b>January</b>		
$Q_{P80} = 1.3231E-02 \text{ DRNAREA}^{0.4043} (\text{BSLDEM10M}+0.001)^{1.5926}$	83.1	
$Q_{P50} = 3.7566E-02 \text{ DRNAREA}^{0.4168} (\text{BSLDEM10M}+0.001)^{1.3357}$	81.1	37
$Q_{P20} = 9.6962E-02 \text{ DRNAREA}^{0.4215} (\text{BSLDEM10M}+0.001)^{1.1148}$	78.6	
<b>February</b>		
$Q_{P80} = 1.9463E-01 \text{ DRNAREA}^{0.3956} 10^{0.3661} \text{ PRC2}$	85.1	
$Q_{P50} = 3.0186E-01 \text{ DRNAREA}^{0.4320} 10^{0.3181} \text{ PRC2}$	82.2	37
$Q_{P20} = 4.6752E-01 \text{ DRNAREA}^{0.4296} 10^{0.2930} \text{ PRC2}$	81.2	
<b>March</b>		
$Q_{P80} = 3.7827E-01 \text{ DRNAREA}^{0.5301} 10^{0.0072} \text{ PRECIP} + 0.0100 (\text{SLOP30}+0.001)$	97.7	
$Q_{P50} = 8.0168E-01 \text{ DRNAREA}^{0.5516} 10^{0.0005} \text{ PRECIP} + 0.0101 (\text{SLOP30}+0.001)$	91.7	39
$Q_{P20} = 2.2167E+00 \text{ DRNAREA}^{0.5521} 10^{-0.0090} \text{ PRECIP} + 0.0108 (\text{SLOP30}+0.001)$	92.5	
<b>April</b>		
$Q_{P80} = 5.7836E+08 \text{ DRNAREA}^{0.5743} \text{ ELEV}^{-2.1732}$	93.8	
$Q_{P50} = 3.9382E+11 \text{ DRNAREA}^{0.6543} \text{ ELEV}^{-2.8657}$	73.8	37
$Q_{P20} = 5.4702E+12 \text{ DRNAREA}^{0.7783} \text{ ELEV}^{-3.1417}$	62.7	

May			
$Q_{P80} = 2.8268E-01$ DRNAREA <sup>0.7487</sup> 10 <sup>0.0302</sup> PRECIP		77.4	
$Q_{P50} = 3.6559E-01$ DRNAREA <sup>0.8340</sup> 10 <sup>0.0322</sup> PRECIP		62.8	39
$Q_{P20} = 8.5921E-01$ DRNAREA <sup>0.8282</sup> 10 <sup>0.0290</sup> PRECIP		57.9	
June			
$Q_{P80} = 1.7203E+00$ DRNAREA <sup>-0.0444</sup> 10 <sup>0.7648</sup> PRC6 + 0.0061 (FOREST+0.001)		149	
$Q_{P50} = 3.2516E+00$ DRNAREA <sup>0.0124</sup> 10 <sup>0.7813</sup> PRC6 + 0.0041 (FOREST+0.001)		140	39
$Q_{P20} = 8.5251E-00$ DRNAREA <sup>0.0543</sup> 10 <sup>0.6672</sup> PRC6 + 0.0030 (FOREST+0.001)		141	
July			
$Q_{P80} = 5.7876E-16$ DRNAREA <sup>0.2398</sup> ELEV <sup>3.5772</sup> (BSLDEM10M+0.001) <sup>1.5323</sup>		119	
$Q_{P50} = 5.4488E-15$ DRNAREA <sup>0.2913</sup> ELEV <sup>3.5357</sup> (BSLDEM10M+0.001) <sup>1.0531</sup>		105	38
$Q_{P20} = 1.7346E-15$ DRNAREA <sup>0.3558</sup> ELEV <sup>3.8161</sup> (BSLDEM10M+0.001) <sup>0.7038</sup>		102	
August			
$Q_{P80} = 4.0244E-12$ DRNAREA <sup>0.2355</sup> ELEV <sup>2.5456</sup> (BSLDEM10M+0.001) <sup>1.5444</sup>		94.4	
$Q_{P50} = 1.6535E-11$ DRNAREA <sup>0.2693</sup> ELEV <sup>2.5251</sup> (BSLDEM10M+0.001) <sup>1.2482</sup>		93.2	37
$Q_{P20} = 7.2410E-12$ DRNAREA <sup>0.3286</sup> ELEV <sup>2.7303</sup> (BSLDEM10M+0.001) <sup>0.9900</sup>		91.6	
September			
$Q_{P80} = 1.3140E-02$ DRNAREA <sup>0.2456</sup> (BSLDEM10M+0.001) <sup>1.0630</sup> 10 <sup>0.0319</sup> PRECIP		95.1	
$Q_{P50} = 3.4340E-02$ DRNAREA <sup>0.3116</sup> (BSLDEM10M+0.001) <sup>0.7939</sup> 10 <sup>0.0319</sup> PRECIP		95.4	37
$Q_{P20} = 8.6139E-02$ DRNAREA <sup>0.3815</sup> (BSLDEM10M+0.001) <sup>0.7265</sup> 10 <sup>0.0313</sup> PRECIP		96.6	
Annual Mean			
$Q_{ANNMEAN} = 6.5751E-02$ DRNAREA <sup>0.7838</sup> 10 <sup>0.0453</sup> PRECIP		44.2	39

**Table 4. Regression equations and their associated uncertainty for estimating monthly 80-, 50-, and 20-percent exceedance streamflows for natural streams in region 2 in Utah.**

[Regression variables:  $Q_{P80}$ , daily mean discharge exceeded 80 percent of the time during the specified month, in cubic feet per second;  $Q_{P50}$ , daily mean discharge exceeded 50 percent of the time during the specified month, in cubic feet per second;  $Q_{P20}$ , daily mean discharge exceeded 20 percent of the time during the specified month, in cubic feet per second; DRNAREA, drainage area, in square miles; ELEV, mean basin elevation, in feet; PRECIP, mean annual precipitation, in inches; PRC8, mean August precipitation, in inches;  $Q_{ANNMEAN}$ , annual mean discharge, in cubic feet per second]

Regression equation for given monthly exceedance (80, 50, and 20 percent exceedance)	Root mean square error, (percent)	Number of streamflow-gaging stations used in regression analysis
<b>October</b>		
$Q_{P80} = 5.1251E-30 \text{ DRNAREA}^{0.5944} \text{ ELEV}^{7.4972}$	106	
$Q_{P50} = 4.2511E-25 \text{ DRNAREA}^{0.6323} \text{ ELEV}^{6.2574}$	83.0	25
$Q_{P20} = 1.1874E-21 \text{ DRNAREA}^{0.6757} \text{ ELEV}^{5.3919}$	75.9	
<b>November</b>		
$Q_{P80} = 1.9151E-26 \text{ DRNAREA}^{0.6486} \text{ ELEV}^{6.5661}$	95.7	
$Q_{P50} = 4.1524E-23 \text{ DRNAREA}^{0.6754} \text{ ELEV}^{5.7309}$	79.6	25
$Q_{P20} = 2.7064E-18 \text{ DRNAREA}^{0.7286} \text{ ELEV}^{4.5052}$	69.9	
<b>December</b>		
$Q_{P80} = 1.7624E-27 \text{ DRNAREA}^{0.6322} \text{ ELEV}^{6.8263}$	113	
$Q_{P50} = 5.8318E-23 \text{ DRNAREA}^{0.6731} \text{ ELEV}^{5.6834}$	88.9	25
$Q_{P20} = 3.1434E-17 \text{ DRNAREA}^{0.7165} \text{ ELEV}^{4.2252}$	73.3	
<b>January</b>		
$Q_{P80} = 4.3481E-26 \text{ DRNAREA}^{0.6459} \text{ ELEV}^{6.4596}$	111	
$Q_{P50} = 2.2162E-22 \text{ DRNAREA}^{0.6699} \text{ ELEV}^{5.5287}$	93.3	25
$Q_{P20} = 4.1562E-16 \text{ DRNAREA}^{0.7227} \text{ ELEV}^{3.9290}$	77.3	
<b>February</b>		
$Q_{P80} = 1.0083E-25 \text{ DRNAREA}^{0.6877} \text{ ELEV}^{6.3584}$	114	
$Q_{P50} = 1.5470E-19 \text{ DRNAREA}^{0.7172} \text{ ELEV}^{4.7870}$	90.2	26
$Q_{P20} = 2.9208E-09 \text{ DRNAREA}^{0.7971} \text{ ELEV}^{2.1504}$	84.0	
<b>March</b>		
$Q_{P80} = 1.5392E-01 \text{ DRNAREA}^{0.8798} 10^{0.0111} \text{ PRECIP}$	76.9	
$Q_{P50} = 1.5603E-01 \text{ DRNAREA}^{0.8950} 10^{0.0151} \text{ PRECIP}$	62.1	25
$Q_{P20} = 1.4894E-01 \text{ DRNAREA}^{0.9379} 10^{0.0204} \text{ PRECIP}$	63.1	

April					
$Q_{P80} = 1.2238E-01$	DRNAREA <sup>0.7886</sup>	10 <sup>0.0246</sup>	PRECIP	102	
$Q_{P50} = 1.6730E-01$	DRNAREA <sup>0.8439</sup>	10 <sup>0.0263</sup>	PRECIP	71.9	25
$Q_{P20} = 3.4190E-01$	DRNAREA <sup>0.8179</sup>	10 <sup>0.0261</sup>	PRECIP	54.3	
May					
$Q_{P80} = 8.0482E-02$	DRNAREA <sup>0.7769</sup>	10 <sup>0.0393</sup>	PRECIP	92.7	
$Q_{P50} = 1.7246E-01$	DRNAREA <sup>0.7702</sup>	10 <sup>0.0379</sup>	PRECIP	71.9	27
$Q_{P20} = 4.4771E-01$	DRNAREA <sup>0.7525</sup>	10 <sup>0.0337</sup>	PRECIP	59.5	
June					
$Q_{P80} = 9.0407E-02$	DRNAREA <sup>0.7945</sup>	10 <sup>0.0310</sup>	PRECIP	104	
$Q_{P50} = 1.3877E-01$	DRNAREA <sup>0.7652</sup>	10 <sup>0.0351</sup>	PRECIP	84.7	26
$Q_{P20} = 3.1369E-01$	DRNAREA <sup>0.6974</sup>	10 <sup>0.0345</sup>	PRECIP	70.3	
July					
$Q_{P80} = 6.7267E-37$	DRNAREA <sup>0.6244</sup>	ELEV <sup>9.3200</sup>		104	
$Q_{P50} = 1.3065E-32$	DRNAREA <sup>0.5978</sup>	ELEV <sup>8.2849</sup>		91.1	26
$Q_{P20} = 6.7097E-30$	DRNAREA <sup>0.5839</sup>	ELEV <sup>7.6459</sup>		85.6	
August					
$Q_{P80} = 5.5233E-02$	DRNAREA <sup>0.1122</sup>	10 <sup>1.1410</sup>	PRC8	163	
$Q_{P50} = 1.3605E-01$	DRNAREA <sup>0.1463</sup>	10 <sup>0.9838</sup>	PRC8	142	26
$Q_{P20} = 3.2278E-01$	DRNAREA <sup>0.1876</sup>	10 <sup>0.8139</sup>	PRC8	131	
September					
$Q_{P80} = 1.9112E-33$	DRNAREA <sup>0.5914</sup>	ELEV <sup>8.3741</sup>		105	
$Q_{P50} = 2.8301E-30$	DRNAREA <sup>0.6037</sup>	ELEV <sup>7.5980</sup>		91.4	25
$Q_{P20} = 1.1790E-25$	DRNAREA <sup>0.6320</sup>	ELEV <sup>6.4391</sup>		88.1	
Annual Mean					
$Q_{ANNMEAN} = 1.2954E-01$	DRNAREA <sup>0.8559</sup>	10 <sup>0.0264</sup>	PRECIP	63.1	25

**Table 6. Regression equations and their associated uncertainty for estimating monthly 80-, 50-, and 20-percent exceedance streamflows for natural streams in region 6 in Utah.**

[Regression variables:  $Q_{P80}$ , daily mean discharge exceeded 80 percent of the time during the specified month, in cubic feet per second;  $Q_{P50}$ , daily mean discharge exceeded 50 percent of the time during the specified month, in cubic feet per second;  $Q_{P20}$ , daily mean discharge exceeded 20 percent of the time during the specified month, in cubic feet per second; DRNAREA, drainage area, in square miles; PRECIP, mean annual precipitation, in inches; PRC11, mean November precipitation, in inches; PRC12, mean December precipitation, in inches; PRC1, mean January precipitation, in inches; PRC2, mean February precipitation, in inches; PRC3, mean March precipitation, in inches; PRC7, mean July precipitation, in inches;  $Q_{ANNMEAN}$ , annual mean discharge, in cubic feet per second]

Regression equation for given monthly exceedance (80, 50, and 20 percent exceedance)	Root mean square error (percent)	Number of streamflow-gaging stations used in regression analysis
<b>October</b>		
$Q_{P80} = 1.1708E-03 \text{ DRNAREA}^{0.9941} 10^{0.0662} \text{ PRECIP}$	292	
$Q_{P50} = 3.5514E-03 \text{ DRNAREA}^{1.0099} 10^{0.0549} \text{ PRECIP}$	211	46
$Q_{P20} = 8.0686E-03 \text{ DRNAREA}^{1.0283} 10^{0.0487} \text{ PRECIP}$	172	
<b>November</b>		
$Q_{P80} = 1.0508E-04 \text{ DRNAREA}^{1.4673} 10^{0.7772} \text{ PRC11}$	224	
$Q_{P50} = 4.9808E-04 \text{ DRNAREA}^{1.3511} 10^{0.6665} \text{ PRC11}$	158	38
$Q_{P20} = 3.0641E-03 \text{ DRNAREA}^{1.2155} 10^{0.5145} \text{ PRC11}$	120	
<b>December</b>		
$Q_{P80} = 3.2984E-24 \text{ DRNAREA}^{1.1941} \text{ ELEV}^{5.5024}$	320	
$Q_{P50} = 3.6299E-21 \text{ DRNAREA}^{1.1740} \text{ ELEV}^{4.7986}$	183	44
$Q_{P20} = 5.0073E-19 \text{ DRNAREA}^{1.1158} \text{ ELEV}^{4.3337}$	140	
<b>January</b>		
$Q_{P80} = 5.3765E-24 \text{ DRNAREA}^{1.1670} \text{ ELEV}^{5.4604}$	305	
$Q_{P50} = 1.5191E-21 \text{ DRNAREA}^{1.1481} \text{ ELEV}^{4.9070}$	173	44
$Q_{P20} = 3.2734E-18 \text{ DRNAREA}^{1.0843} \text{ ELEV}^{4.1362}$	132	
<b>February</b>		
$Q_{P80} = 2.9424E-20 \text{ DRNAREA}^{1.1077} \text{ ELEV}^{4.5472}$	242	
$Q_{P50} = 1.1264E-17 \text{ DRNAREA}^{1.0214} \text{ ELEV}^{3.9928}$	151	46
$Q_{P20} = 1.2067E-14 \text{ DRNAREA}^{0.9839} \text{ ELEV}^{3.2896}$	109	
<b>March</b>		
$Q_{P80} = 9.2087E-05 \text{ DRNAREA}^{1.4806} 10^{0.6759} \text{ PRC3}$	182	
$Q_{P50} = 8.4898E-04 \text{ DRNAREA}^{1.2650} 10^{0.5613} \text{ PRC3}$	143	42
$Q_{P20} = 9.1685E-03 \text{ DRNAREA}^{1.0687} 10^{0.4046} \text{ PRC3}$	129	

<b>April</b>					
$Q_{P80} = 6.0730E-03$	DRNAREA <sup>0.8519</sup>	10 <sup>0.0574</sup>	PRECIP	243	
$Q_{P50} = 2.0328E-02$	DRNAREA <sup>0.7809</sup>	10 <sup>0.0589</sup>	PRECIP	156	50
$Q_{P20} = 5.4563E-02$	DRNAREA <sup>0.7689</sup>	10 <sup>0.0578</sup>	PRECIP	149	
<b>May</b>					
$Q_{P80} = 1.4421E-26$	DRNAREA <sup>0.9596</sup>	ELEV <sup>6.3486</sup>		379	
$Q_{P50} = 2.9874E-22$	DRNAREA <sup>0.7411</sup>	ELEV <sup>5.4577</sup>		258	50
$Q_{P20} = 3.3861E-23$	DRNAREA <sup>0.7185</sup>	ELEV <sup>5.8287</sup>		179	
<b>June</b>					
$Q_{P80} = 9.9243E-03$	DRNAREA <sup>0.8338</sup>	10 <sup>0.0499</sup>	PRECIP	353	
$Q_{P50} = 2.4609E-02$	DRNAREA <sup>0.7826</sup>	10 <sup>0.0536</sup>	PRECIP	247	47
$Q_{P20} = 3.2802E-02$	DRNAREA <sup>0.7863</sup>	10 <sup>0.0680</sup>	PRECIP	153	
<b>July</b>					
$Q_{P80} = 2.7139E-01$	DRNAREA <sup>0.5124</sup>			346	
$Q_{P50} = 6.1944E-01$	DRNAREA <sup>0.5096</sup>			267	43
$Q_{P20} = 1.0854E+00$	DRNAREA <sup>0.5587</sup>			223	
<b>August</b>					
$Q_{P80} = 9.4102E-02$	DRNAREA <sup>0.7404</sup>			268	
$Q_{P50} = 1.4973E-01$	DRNAREA <sup>0.8195</sup>			201	43
$Q_{P20} = 2.6835E-01$	DRNAREA <sup>0.8425</sup>			161	
<b>September</b>					
$Q_{P80} = 6.7936E-23$	DRNAREA <sup>0.8943</sup>	ELEV <sup>5.3288</sup>		218	
$Q_{P50} = 5.6689E-22$	DRNAREA <sup>0.9777</sup>	ELEV <sup>5.1296</sup>		191	42
$Q_{P20} = 4.7304E-20$	DRNAREA <sup>0.9777</sup>	ELEV <sup>4.7092</sup>		164	
<b>Annual Mean</b>					
$Q_{ANNMEAN} = 1.2067E-02$	DRNAREA <sup>0.8196</sup>	10 <sup>0.0659</sup>	PRECIP	122	59

**Table 8. Regression equations and their associated uncertainty for estimating monthly 80-, 50-, and 20-percent exceedance streamflows for natural streams in combined region 3 and region 5 in Utah.**

[Regression variables:  $Q_{P80}$ , daily mean discharge exceeded 80 percent of the time during the specified month, in cubic feet per second;  $Q_{P50}$ , daily mean discharge exceeded 50 percent of the time during the specified month, in cubic feet per second;  $Q_{P20}$ , daily mean discharge exceeded 20 percent of the time during the specified month, in cubic feet per second; DRNAREA, drainage area, in square miles; PRC10, mean October precipitation, in inches; PRC11, mean November precipitation, in inches; PRC12, mean December precipitation, in inches; PRC1, mean January precipitation, in inches; PRC2, mean February precipitation, in inches; HERBNAT\_NLCD92, area covered by herbaceous upland, in percent; FOREST, area covered by forest, in percent; ELEV, mean basin elevation, in feet; PRECIP, mean annual precipitation, in inches; PRC9, mean September precipitation, in inches;  $Q_{ANNMEAN}$ , annual mean discharge, in cubic feet per second]

Regression equation for given monthly exceedance (80, 50, and 20 percent exceedance)	Root mean square error (percent)	Number of streamflow-gaging stations used in regression analysis
<b>October</b>		
$Q_{P80} = 1.9875E-02 \text{ DRNAREA}^{0.6634} 10^{0.6068} \text{ PRC10}$	74.6	32
$Q_{P50} = 2.9020E-02 \text{ DRNAREA}^{0.7255} 10^{0.5524} \text{ PRC10}$	70.5	
$Q_{P20} = 4.2717E-02 \text{ DRNAREA}^{0.7650} 10^{0.5013} \text{ PRC10}$	68.9	
<b>November</b>		
$Q_{P80} = 2.9771E-02 \text{ DRNAREA}^{0.6740} 10^{0.4882} \text{ PRC10}$	67.4	31
$Q_{P50} = 4.1591E-02 \text{ DRNAREA}^{0.7510} 10^{0.4300} \text{ PRC10}$	65.9	
$Q_{P20} = 5.9979E-02 \text{ DRNAREA}^{0.8020} 10^{0.3740} \text{ PRC10}$	66.1	
<b>December</b>		
$Q_{P80} = 4.1049E-02 \text{ DRNAREA}^{0.6739} 10^{0.4678} \text{ PRC12}$	67.9	32
$Q_{P50} = 6.3504E-02 \text{ DRNAREA}^{0.7198} 10^{0.3977} \text{ PRC12}$	67.1	
$Q_{P20} = 9.6161E-02 \text{ DRNAREA}^{0.7540} 10^{0.3360} \text{ PRC12}$	66.8	
<b>January</b>		
$Q_{P80} = 2.1553E-02 \text{ DRNAREA}^{0.7728} 10^{0.4439} \text{ PRC1}$	69.2	32
$Q_{P50} = 4.6196E-02 \text{ DRNAREA}^{0.7792} 10^{0.3537} \text{ PRC1}$	67.5	
$Q_{P20} = 7.0307E-02 \text{ DRNAREA}^{0.8020} 10^{0.3070} \text{ PRC1}$	67.2	
<b>February</b>		
$Q_{P80} = 2.5829E-02 \text{ DRNAREA}^{0.8425} 10^{0.3828} \text{ PRC2}$	70.4	32
$Q_{P50} = 4.7643E-02 \text{ DRNAREA}^{0.8504} 10^{0.3168} \text{ PRC2}$	68.7	
$Q_{P20} = 9.5786E-02 \text{ DRNAREA}^{0.8379} 10^{0.2420} \text{ PRC2}$	68.4	
<b>March</b>		
$Q_{P80} = 5.1737E-01 \text{ DRNAREA}^{0.5712} (\text{HERBNAT\_NLCD92}+0.001)^{0.2058}$	57.2	31
$Q_{P50} = 7.0681E-01 \text{ DRNAREA}^{0.5629} (\text{HERBNAT\_NLCD92}+0.001)^{0.2068}$	47.9	
$Q_{P20} = 9.4297E-01 \text{ DRNAREA}^{0.5826} (\text{HERBNAT\_NLCD92}+0.001)^{0.2156}$	41.8	



April			
$Q_{P80} = 8.0947E-01$	DRNAREA <sup>0.6539</sup>	56.2	
$Q_{P50} = 1.0990E+00$	DRNAREA <sup>0.7127</sup>	56.9	32
$Q_{P20} = 1.6761E+00$	DRNAREA <sup>0.7777</sup>	62.4	
May			
$Q_{P80} = 7.9122E-01$	DRNAREA <sup>0.6712</sup> 10 <sup>0.0046</sup> FOREST	79.0	
$Q_{P50} = 1.5929E+00$	DRNAREA <sup>0.6416</sup> 10 <sup>0.0055</sup> FOREST	68.4	33
$Q_{P20} = 2.2977E+00$	DRNAREA <sup>0.6579</sup> 10 <sup>0.0070</sup> FOREST	61.9	
June			
$Q_{P80} = 2.1702E-15$	DRNAREA <sup>0.7515</sup> ELEV <sup>3.7427</sup>	98.2	
$Q_{P50} = 1.7935E-16$	DRNAREA <sup>0.7307</sup> ELEV <sup>4.1047</sup>	82.6	33
$Q_{P20} = 5.4916E-18$	DRNAREA <sup>0.7387</sup> ELEV <sup>4.5531</sup>	71.8	
July			
$Q_{P80} = 1.2712E-02$	DRNAREA <sup>0.8789</sup> 10 <sup>0.0539</sup> PRECIP	112	
$Q_{P50} = 6.8407E-02$	DRNAREA <sup>0.7827</sup> 10 <sup>0.0407</sup> PRECIP	78.0	33
$Q_{P20} = 1.3684E-01$	DRNAREA <sup>0.7376</sup> 10 <sup>0.0395</sup> PRECIP	74.7	
August			
$Q_{P80} = 2.4289E-02$	DRNAREA <sup>0.6967</sup> 10 <sup>0.0488</sup> PRECIP	100	
$Q_{P50} = 5.7517E-02$	DRNAREA <sup>0.7091</sup> 10 <sup>0.0409</sup> PRECIP	83.0	32
$Q_{P20} = 8.9475E-02$	DRNAREA <sup>0.7145</sup> 10 <sup>0.0394</sup> PRECIP	70.8	
September			
$Q_{P80} = 6.2517E-03$	DRNAREA <sup>0.7145</sup> 10 <sup>1.0019</sup> PRC9	81.8	
$Q_{P50} = 8.8044E-03$	DRNAREA <sup>0.7537</sup> 10 <sup>0.9681</sup> PRC9	77.4	32
$Q_{P20} = 1.7092E-02$	DRNAREA <sup>0.7586</sup> 10 <sup>0.8725</sup> PRC9	73.4	
Annual Mean			
$Q_{ANNMEAN} = 1.3032E+00$	DRNAREA <sup>0.7025</sup>	68.6	34

**Table 9. Root mean square error percent associated with the monthly exceedance streamflow and annual mean streamflow regression equations for all regions, Utah.**

[Q<sub>P80</sub>, 80-percent exceedance streamflow equation; Q<sub>P50</sub>, 50-percent exceedance streamflow equation; Q<sub>P20</sub>, 20-percent exceedance streamflow equation; Annual mean, Annual mean streamflow equation]

	Region 1	Region 2	Region 4	Region 3 and Region 5 combined	Region 6	Region 7	Minimum for all regions	Median for all regions	Maximum for all regions
<b>October</b>									
Q <sub>P80</sub>	105.0	106	95.3	74.6	292	86.5	74.6	100.2	292
Q <sub>P50</sub>	96.9	83	76.6	70.5	211	70.7	70.5	79.8	211
Q <sub>P20</sub>	83.2	75.9	67.4	68.9	172	69.7	67.4	72.8	172
<b>November</b>									
Q <sub>P80</sub>	103.0	95.7	82.9	67.4	224	73.3	67.4	89.3	224
Q <sub>P50</sub>	93.6	79.6	71.6	65.9	158	65.5	65.5	75.6	158
Q <sub>P20</sub>	85.9	69.9	65.4	66.1	120	63.2	63.2	68.0	120
<b>December</b>									
Q <sub>P80</sub>	84.7	113	90	67.9	320	75.4	67.9	87.4	320
Q <sub>P50</sub>	81.2	88.9	74.2	67.1	183	61.3	61.3	77.7	183
Q <sub>P20</sub>	78.8	73.3	67.4	66.8	140	60.7	60.7	70.4	140
<b>January</b>									
Q <sub>P80</sub>	83.1	111	89.4	69.2	305	91.4	69.2	90.4	305
Q <sub>P50</sub>	81.1	93.3	74.1	67.5	173	71.5	67.5	77.6	173
Q <sub>P20</sub>	78.6	77.3	68.4	67.2	132	61.6	61.6	72.9	132
<b>February</b>									
Q <sub>P80</sub>	85.1	114	86.3	70.4	242	85.9	70.4	86.1	242
Q <sub>P50</sub>	82.2	90.2	72.2	68.7	151	66.2	66.2	77.2	151
Q <sub>P20</sub>	81.2	84	63.9	68.4	109	57.8	57.8	74.8	109
<b>March</b>									
Q <sub>P80</sub>	97.7	76.9	89.1	57.2	182	91.5	57.2	90.3	182
Q <sub>P50</sub>	91.7	62.1	68.8	47.9	143	64.4	47.9	66.6	143
Q <sub>P20</sub>	92.5	63.1	61.5	41.8	129	68.5	41.8	65.8	129
<b>April</b>									
Q <sub>P80</sub>	93.8	102	131	56.2	243	81.3	56.2	97.9	243
Q <sub>P50</sub>	73.8	71.9	107	56.9	156	72.8	56.9	73.3	156
Q <sub>P20</sub>	62.7	54.3	111	62.4	149	77	54.3	69.9	149
<b>May</b>									
Q <sub>P80</sub>	77.4	92.7	222	79	379	103	77.4	97.9	379
Q <sub>P50</sub>	62.8	71.9	82.4	68.4	258	108	62.8	77.2	258
Q <sub>P20</sub>	57.9	59.5	53	61.9	179	102	53.0	60.7	179
<b>June</b>									
Q <sub>P80</sub>	149.0	104	60.7	98.2	353	126	60.7	115	353
Q <sub>P50</sub>	140.0	84.7	54.9	82.6	247	125	54.9	104.9	247
Q <sub>P20</sub>	141.0	70.3	49.8	71.8	153	129	49.8	100.4	153
<b>July</b>									
Q <sub>P80</sub>	119.0	104	222	112	346	222	104.0	171	346
Q <sub>P50</sub>	105.0	91.1	56.4	78	267	159	56.4	98.1	267
Q <sub>P20</sub>	102.0	85.6	34	74.7	223	121	34.0	93.8	223
<b>August</b>									
Q <sub>P80</sub>	94.4	163.0	128	100	268	223	94.4	146	268
Q <sub>P50</sub>	93.2	142.0	81	83	201	135	81.0	114.1	201
Q <sub>P20</sub>	91.6	131.0	53.9	70.8	161	113	53.9	102.3	161
<b>September</b>									
Q <sub>P80</sub>	95.1	105	114	81.8	218	153	81.8	110	218
Q <sub>P50</sub>	95.4	91.4	82	77.4	191	105	77.4	93.4	191
Q <sub>P20</sub>	96.6	88.1	67.6	73.4	164	85.5	67.6	86.8	164
<b>Annual mean</b>									
Annual mean	44.2	63.1	42.9	68.6	122	69.4			
<b>Regional minimum</b>	<b>57.9</b>	<b>54.3</b>	<b>34.0</b>	<b>41.8</b>	<b>109</b>	<b>57.8</b>			
<b>Regional median</b>	<b>92.1</b>	<b>88.5</b>	<b>74.2</b>	<b>68.8</b>	<b>187</b>	<b>85.7</b>			
<b>Regional maximum</b>	<b>149.0</b>	<b>163</b>	<b>222</b>	<b>112</b>	<b>379</b>	<b>223</b>			

Table 11. Minimum, median, and maximum values of basin characteristics used in the regional regression analysis for Utah.

[**Regression variables:** DRNAREA, drainage area, in square miles; ELEV, mean basin elevation, in feet; BSLDEM10M, average basin slope, in percent; SLOP30, basin slope that exceeds 30 percent, in percent; FOREST, area covered by forest, in percent; HERBNAT\_NLCD92, area covered by herbaceous upland, in percent; PRECIP, mean annual precipitation, in inches; PRC1, mean January precipitation, in inches; PRC2, mean February precipitation, in inches; PRC3, mean March precipitation, in inches; PRC4, mean April precipitation, in inches; PRC5, mean May precipitation, in inches; PRC6, mean June precipitation, in inches; PRC7, mean July precipitation, in inches; PRC8, mean August precipitation, in inches; PRC9, mean September precipitation, in inches; PRC10 mean October precipitation, in inches; PRC11, mean November precipitation, in inches; PRC12, mean December precipitation, in inches]

	DRNAREA	ELEV	BSLDEM 10M	SLOP30	FOREST	HERBNAT_ NLCD92	PRECIP	PRC1	PRC2	PRC3	PRC4	PRC5	PRC6	PRC7	PRC8	PRC9	PRC10	PRC11	PRC12
<b>Region 1</b>																			
Minimum	11.9	6420	9.17	3.08	14.0	1.35	22.0	1.80	1.74	2.18	1.95	2.31	1.31	0.90	1.10	1.49	1.68	1.93	1.48
Median	69.1	7700	25.3	29.7	46.0	13.8	32.7	3.07	2.64	3.38	3.12	3.02	1.69	1.27	1.36	2.04	2.52	2.98	2.60
Maximum	278	10700	41.6	74.1	82.3	23.1	40.9	4.70	4.17	4.29	4.16	3.84	2.16	2.10	2.40	2.48	3.07	4.17	4.08
<b>Region 2</b>																			
Minimum	2.14	6440	19.1	21.5	12.9	0.02	22.3	2.22	2.22	2.37	1.93	1.87	1.05	0.82	0.92	1.42	1.81	1.74	1.86
Median	12.4	7370	41.9	72.2	58.9	6.52	34.6	4.26	3.89	3.95	3.32	3.44	1.63	1.22	1.36	2.24	2.99	3.58	3.55
Maximum	70.1	8550	58.8	93.6	80.7	31.6	49.5	5.79	4.92	5.59	4.93	4.25	1.96	2.01	2.00	2.73	3.67	4.63	4.41
<b>Region 4</b>																			
Minimum	7.44	8130	9.67	3.34	40.7	0.20	19.9	1.00	1.33	2.05	1.54	1.56	0.94	1.17	1.70	1.54	1.86	1.51	0.89
Median	56.1	9700	25.6	31.5	70.5	4.79	30.0	2.55	2.69	3.23	3.10	3.04	1.80	1.90	2.16	2.42	2.56	2.68	2.14
Maximum	356	10900	39.9	65.9	89.7	11.5	36.4	4.36	4.30	4.14	4.23	3.62	2.11	2.30	2.63	2.89	3.08	3.72	3.80
<b>Region 3 and 5</b>																			
Minimum	1.98	5990	17.8	18.2	8.26	0.21	19.1	1.65	1.67	2.15	1.77	1.72	0.79	0.95	1.09	1.40	1.71	1.70	1.45
Median	21.6	8360	34.5	54.5	65.7	5.10	25.2	2.49	2.49	3.15	2.46	2.29	1.07	1.24	1.68	1.72	2.03	2.27	2.04
Maximum	450	9570	54.1	91.7	90.4	19.0	31.7	3.25	3.11	4.72	3.65	3.04	1.58	1.77	2.54	2.11	2.78	3.23	2.83
<b>Region 6</b>																			
Minimum	3.66	5220	8.69	2.90	0.38	1.27	9.58	0.84	0.56	0.87	0.68	0.73	0.32	0.86	0.89	0.98	1.23	0.64	0.60
Median	105	7640	25.1	31.6	51.8	6.90	18.9	1.50	1.49	2.25	1.71	1.58	0.85	1.38	1.63	1.51	2.04	1.92	1.25
Maximum	900	9700	40.2	67.4	92.7	37.8	28.9	3.41	2.87	4.38	3.13	2.28	1.17	2.97	3.56	2.35	3.13	3.09	2.97
<b>Region 7</b>																			
Minimum	5.43	5900	10.6	5.20	37.7	0.60	16.2	1.21	1.06	1.23	0.75	0.58	0.35	1.00	1.14	0.99	0.94	0.96	0.75
Median	71.4	7770	29.9	40.2	68.5	8.29	19.8	2.26	2.44	2.86	1.49	1.31	0.63	1.28	1.87	1.57	1.83	1.82	1.65
Maximum	948	9640	44.7	64.3	90.8	13.1	27.7	2.88	3.76	4.00	2.53	3.17	1.09	2.15	2.68	1.97	2.35	2.92	2.19