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PERTINENT CONSIDERATIONS IN THE DEVELOPMENT OF PROTECTED-STREAMFLOW CRITERIA FOR ILLINOIS STREAMS

by

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I. INTRODUCTION

The development of protected-streamflow standards is essential for the most desirable and equitable use of streamwaters for the well-being of the people. Such standards provide the basis for managing the optimal use of streamwaters for various purposes such as municipal and industrial water supply, aquatic habitats, and recreation. Protected streamflow at a given location along a stream is defined as that flow below which water withdrawals will usually not be permitted for offstream uses such as municipal and industrial water supply and irrigation. Protected-streamflow measures are needed to help maintain: 1) aquatic habitats without their being seriously affected by water withdrawals during critical low-flow periods; 2) assimilative capacity of a stream to receive effluents from wastewater plants without adverse effects on streamwater quality; 3) stream integrity in terms of diversity and strength of biotic communities; and 4) the potential for general recreation.

Offstream water uses may be continuous such as for municipal and industrial water supplies, or seasonal such as for irrigation purposes. Choosing a desirable protected flow involves a consideration of all the above objectives, offstream uses, conflicting needs, and economics. An overriding consideration is not to let the stream go through irreversible or serious ecological damage because of excessive withdrawals during dry periods with significantly low streamflow. A methodology has been developed and computerized for providing the necessary information to aid in objective selection of a certain protected-flow level

Protected-flow statistics basically consist of a month-by-month analysis of daily flow availability above a selected minimum flow or protected-flow level. These statistics provide information on average deficit or surplus flow available and the percentage of years and days during which these deficits or surpluses occur. This information is necessary for the optimal design of storage reservoirs in situations where established water need, such as for municipal potable water supply or irrigation, exists. The matrix of surpluses and deficits provides the data for optimizing the storage size of the reservoir.

Adoption of a protected-flow level for streams in Illinois is a policy decision that will be influenced by environmental considerations, offstream water needs, and economics. The protected-flow statistics

which provide the basic information for objective selection of a protected-flow level are derived by using the time series of daily-flow values measured at a gaging station. The time series is assumed to be stationary, thereby reflecting the flow variability to be expected in the future. However, some daily-flow time series have been rendered nonstationary by factors such as increasing effluents from municipal wastewater treatment plants in growing urban communities, policy changes such as establishment of minimum flow requirements in certain streams, decreases in the diversion of water from Lake Michigan, and other climatic changes. Flow-duration values calculated from a nonstationary time series may not represent existing or future conditions. Therefore the daily flow data at all gaging stations in Illinois have been examined for time trends, and relevant flow-duration values have been estimated for present conditions at 66 of the gaging stations.

Acknowledgments

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II. METHODOLOGY AND COMPUTER PROGRAM

The flow information needed for planning withdrawals from the stream and for designing storage to tide over a few weeks to many months of zero or low water availability from the stream under various protected-flow levels (four levels considered here) comprises:

- (1) Monthly flows for the period of record
- (2) Flows at specified probabilities for each month as well as for the whole record
- (3) 7-, 15-, 31-, and 61-day low flows and dates of their occurrence each year for zero protected flow as well as for the four protected flow levels
- (4) 5-, 9-, 13-, and 17-month-duration low flows with no protected flow as well as with the four protected flow levels
- (5) Days in each month of the record with available flow Q_a negative or positive ($Q_a = Q_s - Q_p$ in which Q_s is the streamflow and Q_p is the protected flow), and average values of Q_a (or \bar{Q}_a) in each month for both negative and positive flows, for each of the four protected flow levels

A computer program was developed to read the daily flows of record at a gaging station, stored on a tape. The output is printed in two formats. In the first format, the complete information developed, as mentioned above, is printed for in-depth review of the available flow Q_a during wet, normal, and dry years, considering various protected-flow levels. In the second format, the output is printed in five tables and is stored in the computer or transferred to a tape for future reference. The first table provides mean monthly and yearly flows, the departure of the mean yearly flows from the average (to help in identifying time trends, if any), and statistics of these mean monthly and yearly flows in terms of their averages, standard deviations, and serial correlation coefficients. The second table contains the discharges corresponding to 99,95,90,85,80,75,70,60,50,40, 30,25,20,15,10, 5, and 1% flow duration or exceedance probabilities for each of the 12 months as well as for the entire record.

The third table gives the values of lowest mean flow for 7-, 15-, 31-, and 61-day periods each year, ranked from low to high, together with a column for their associated probabilities. In the fourth table information on the mean low flows for 5-, 9-, 13-, and 17-month durations, similar to the information in the

third table, is provided. The last table contains the mean \bar{Q}_a values (both negative and positive) for each month for the days the Q_a was negative or positive, the percentage of days in that month with negative or positive flows over the years, and the percentage of years having days with negative or positive flows (obtained from the ratio of the number of years having days with negative or positive flows to the total years of record for a particular month).

An Example

The information developed at each gaging station is illustrated through an example. Consider the daily flow record available from October 1946 to September 1983 for Shoal Creek near Breese, in southern Illinois, with a drainage area of 735 square miles. The information developed for this gaging station is given in Tables 1 through 7. Similar information is provided in the appendix for eight other gaging stations in Illinois. The locations of these nine gaging stations in Illinois are shown in Figure 1.

The mean monthly and mean annual flows for the period of record are given in Table 1. The ' \bar{Q} ' and ' $\bar{Q}(s)$ ' values at the end of the table provide the averages and standard deviations of the mean monthly and annual flow series. The mean daily flow for the period of record is 514.9 cfs. With this value as a criterion, two noticeably dry periods may be discerned: 1953-1956 and 1963-1966. The years 1973, 1974, and 1983 were relatively wet years.

The results of the analyses of low flows are given in Table 2. The 7-, 15-, 31-, and 61-day low flows are computed for each year for the period of record. In computing low flows the year is defined as beginning in April and ending in March. The mid-point of occurrence of the low-flow period is also determined. The low-flow series is ranked in ascending order, and the probability of non-exceedance is determined for each value in the series. 'T-YR' provides the recurrence interval in years. Low flows generally occur during the period August through December. The ' μ ' and ' σ ' values provide the average and standard deviation of each of the low-flow variables.

Low-flow values for 5-month and 9-month durations were calculated for each year for the period of record and are given in Table 3. These flows are also referred to as drought flows because of the extended duration of the low-flow period. The low-flow year used to calculate the drought flows is the same as for

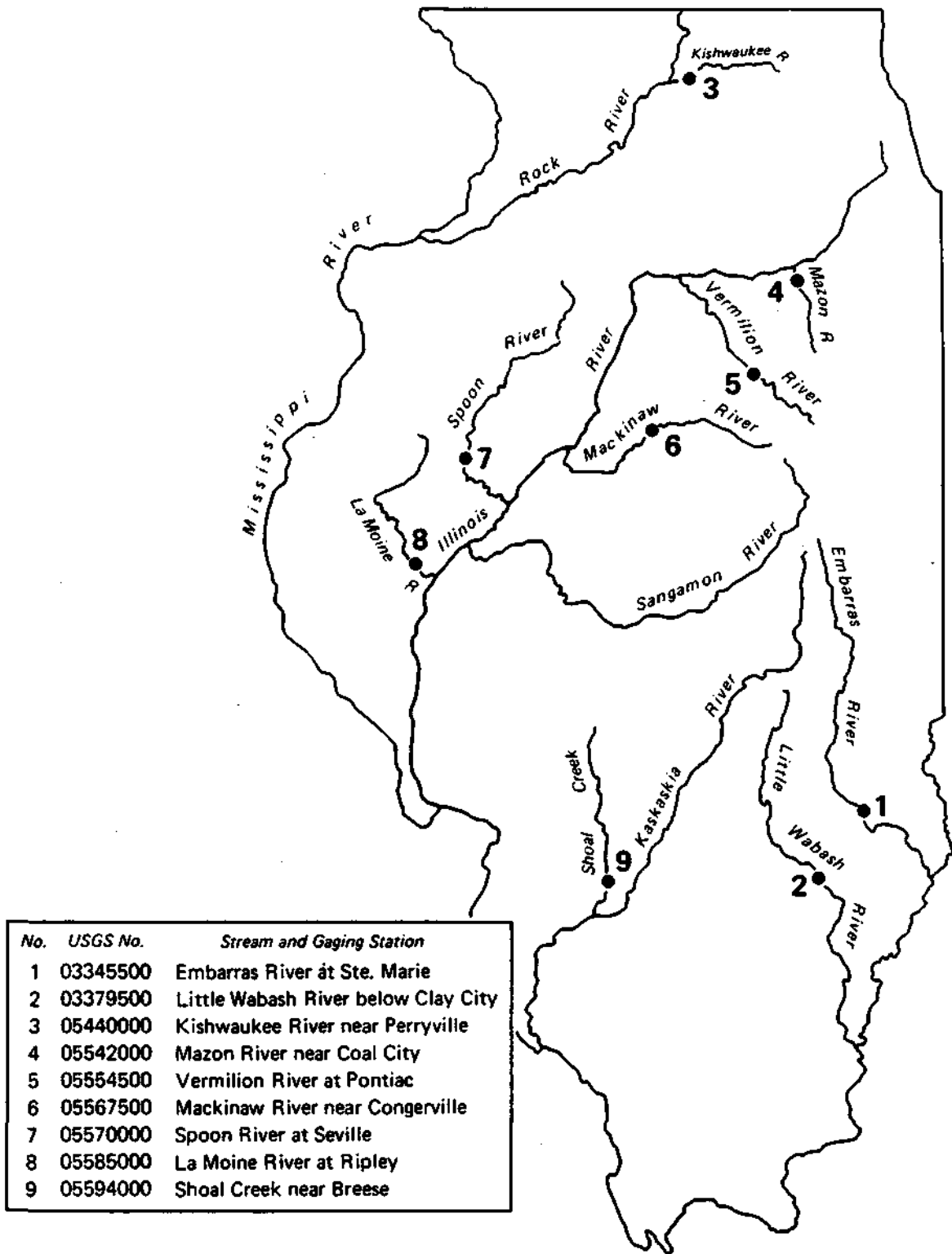


Figure 1. Locations of selected streamgaging stations in Illinois

Table 1. Monthly and Annual Mean Flows in cfs, Shoal Creek near Breese

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1946	487.3	249.4	309.4	990.9	1191.4	1015.5	129.7	1372.2	692.4	214.1	1493.4	117.1	688.7
1947	141.8	2557.1	821.1	606.6	532.2	269.5	1933.5	1079.2	675.4	374.5	21.2	30.5	749.4
1948	21.1	47.9	38.0	193.7	477.3	1680.9	633.4	670.0	236.8	751.9	129.9	37.2	411.3
1949	31.8	569.7	351.3	3196.6	2273.1	699.9	375.6	267.5	252.6	98.6	167.0	86.1	688.7
1950	538.1	58.7	880.1	4170.8	2189.1	1153.5	1053.9	195.6	1080.2	92.6	38.1	74.0	954.6
1951	75.9	150.6	72.2	368.1	2978.1	1560.2	1579.6	124.4	486.7	1518.4	78.6	32.7	735.9
1952	54.6	282.9	177.7	610.8	923.8	1318.0	1762.5	133.3	170.8	120.1	16.8	22.6	462.6
1953	3.8	10.8	19.0	26.7	69.3	666.9	428.4	528.2	448.9	51.2	7.4	2.3	189.2
1954	6.7	21.0	16.5	11.7	9.0	11.9	56.0	12.3	77.4	2.5	23.4	95.7	28.5
1955	116.0	4.6	8.0	137.8	310.3	289.3	487.6	68.5	56.1	350.7	54.8	50.7	160.1
1956	43.7	127.4	13.4	14.7	509.1	161.2	222.5	227.0	298.6	93.3	181.6	14.8	157.0
1957	1.2	7.8	166.8	36.4	241.4	246.5	2070.4	2237.0	3697.2	1853.4	384.9	17.1	913.0
1958	72.9	308.0	521.3	308.5	198.6	897.8	346.7	406.6	382.9	794.4	1328.2	134.7	479.3
1959	47.5	283.7	86.0	328.5	1723.5	598.5	263.1	518.4	312.6	25.6	166.2	11.3	354.2
1960	298.3	263.0	398.2	769.6	841.7	749.5	1750.8	400.0	618.9	634.8	39.9	41.2	564.5
1961	9.5	50.5	42.6	21.8	356.7	1404.2	283.2	2075.8	91.8	260.8	468.4	67.2	431.6
1962	23.8	228.0	401.0	1387.9	1616.0	1690.3	318.3	794.4	571.7	278.1	66.0	59.0	614.9
1963	109.0	70.3	51.3	38.0	30.1	1333.7	210.7	1112.9	148.2	109.6	30.0	19.0	275.7
1964	17.7	39.6	9.6	99.0	66.2	385.9	893.8	119.5	484.8	16.3	21.6	6.0	178.7
1965	3.0	11.8	18.5	56.0	85.4	111.5	341.5	104.4	80.3	102.5	13.1	175.1	91.3
1966	19.7	12.5	22.8	161.3	851.2	380.3	738.5	1044.1	106.3	98.9	163.2	139.2	307.7
1967	112.9	269.8	1761.7	759.4	1028.4	880.0	357.5	593.0	425.4	868.3	455.8	23.4	628.6
1968	80.1	82.7	3353.4	604.6	1633.4	224.8	336.9	1570.5	601.0	65.7	195.4	19.7	730.9
1969	12.7	118.8	167.7	947.2	2147.1	802.9	2012.5	163.8	211.0	1373.9	63.3	418.2	691.5
1970	1704.3	194.0	118.3	337.6	350.1	391.7	2193.7	733.8	1302.6	113.2	37.2	73.1	628.0
1971	33.4	34.4	59.3	74.4	1192.7	470.9	193.1	230.5	368.1	85.7	18.6	11.8	224.0
1972	15.2	14.8	1914.4	185.1	103.3	219.6	1499.3	196.1	65.7	65.5	78.1	62.9	369.3
1973	22.8	780.3	1024.8	1696.7	403.6	3460.7	2376.6	339.8	1336.8	831.0	339.2	143.1	1067.3
1974	177.0	346.4	1317.6	2925.5	1685.4	1173.1	1721.0	469.2	2549.7	67.1	127.8	329.4	1067.3
1975	88.5	219.6	194.9	1675.4	2584.7	1247.9	1542.5	741.0	258.4	120.7	61.8	187.8	730.6
1976	24.6	33.0	196.0	154.3	270.3	707.8	159.7	65.8	51.2	19.0	70.9	8.3	147.0
1977	42.8	18.2	12.9	6.3	281.0	899.4	567.2	182.5	241.5	141.2	198.4	126.4	225.9
1978	184.0	166.2	1179.3	35.5	31.7	4333.5	627.3	1363.3	245.2	103.7	26.1	17.8	702.9
1979	11.1	44.2	77.7	119.8	1018.4	2348.9	3061.6	296.5	80.0	244.1	285.0	16.0	628.6
1980	11.2	27.8	63.7	30.2	123.5	269.5	619.0	225.9	146.1	165.6	102.0	74.9	154.4
1981	19.4	25.6	46.1	17.7	172.7	89.4	154.8	702.9	364.2	762.8	482.9	185.1	253.4
1982	57.5	56.1	140.0	760.0	4385.4	1240.1	791.9	155.8	1322.3	960.5	80.0	434.4	838.7
1983	457.3	501.4	3925.1	376.6	559.0	1284.2	2345.6	2012.5	819.8	103.9	20.3	12.5	1040.0
\bar{Q}	136.3	218.1	525.7	637.9	932.7	965.0	958.9	619.3	562.1	366.7	198.3	88.9	514.9
$\bar{Q}(e)$	293.7	427.0	894.2	956.1	993.5	892.4	818.6	598.5	719.8	458.4	320.0	106.0	297.6

Table 2. Results of Low-Flow Analyses, Shoal Creek near Breese

PROB	T-YR	Low Flows in cfs				Month* and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
2.63	38.00	0.00	0.01	0.46	2.95	Nov 1954	Sep 1954	Oct 1956	Oct 1964
5.26	19.00	0.04	0.08	1.62	3.27	Oct 1956	Oct 1956	Oct 1964	Sep 1953
7.89	12.67	0.11	0.71	1.98	3.78	Sep 1955	Sep 1955	Dec 1954	Oct 1956
10.53	9.50	0.40	0.95	2.01	5.07	Oct 1964	Sep 1953	Sep 1953	Nov 1954
13.16	7.60	0.71	1.03	2.53	6.72	Sep 1953	Oct 1964	Sep 1955	Oct 1952
15.79	6.33	1.89	1.95	3.43	8.61	Oct 1952	Oct 1952	Oct 1952	Jan 1976
18.42	5.43	2.37	3.15	6.28	10.45	Sep 1976	Sep 1976	Jan 1976	Sep 1971
21.05	4.75	4.60	4.80	8.18	11.69	Aug 1965	Aug 1965	Oct 1971	Oct 1979
23.68	4.22	4.60	5.47	8.47	12.19	Oct 1979	Oct 1979	Oct 1960	Nov 1965
26.32	3.80	4.80	6.00	8.60	13.72	Sep 1959	Sep 1959	Oct 1979	Oct 1978
28.95	3.45	5.44	6.24	8.76	13.93	Oct 1960	Oct 1960	Oct 1965	Jan 1955
31.58	3.17	5.74	7.27	9.04	14.65	Nov 1971	Oct 1971	Dec 1963	Oct 1960
34.21	2.92	6.14	7.39	9.61	15.50	Oct 1978	Oct 1978	Sep 1959	Oct 1963
36.84	2.71	6.63	7.80	10.89	16.03	Aug 1980	Dec 1963	Oct 1978	Oct 1968
39.47	2.53	6.94	8.01	11.25	19.28	Oct 1947	Oct 1947	Oct 1947	Jan 1980
42.11	2.38	7.07	8.37	12.65	20.02	Dec 1963	Oct 1957	Oct 1968	Sep 1947
44.74	2.24	7.64	9.27	13.05	25.57	Oct 1957	Aug 1980	Oct 1957	Sep 1957
47.37	2.11	9.20	11.09	15.77	27.62	Sep 1968	Sep 1968	Jan 1980	Oct 1975
50.00	2.00	9.29	11.18	15.77	32.48	Oct 1972	Oct 1961	Sep 1948	Nov 1970
52.63	1.90	9.53	11.60	17.87	32.89	Oct 1961	Oct 1972	Oct 1951	Feb 1977
55.26	1.81	9.60	13.47	20.29	33.13	Sep 1966	Sep 1948	Oct 1958	Sep 1951
57.89	1.73	9.74	14.13	22.77	33.30	Oct 1949	Oct 1951	Oct 1972	Feb 1962
60.53	1.65	10.43	15.40	23.45	33.92	Dec 1962	Jan 1962	Sep 1967	Sep 1948
63.16	1.58	12.43	16.00	23.45	42.50	Sep 1948	Nov 1958	Oct 1975	Jul 1959
65.79	1.52	13.57	17.27	23.80	42.51	Oct 1951	Sep 1949	Oct 1961	Oct 1972
68.42	1.46	14.86	18.27	24.58	45.16	Oct 1975	Sep 1970	Aug 1970	Oct 1961
71.05	1.41	15.14	18.40	25.65	49.54	Nov 1958	Oct 1975	Feb 1962	Sep 1967
73.68	1.36	16.43	19.20	29.52	50.62	Sep 1970	Oct 1950	Jan 1977	Aug 1950
76.32	1.31	16.71	21.13	37.45	56.16	Oct 1950	Sep 1967	Aug 1950	Oct 1981
78.95	1.27	18.14	27.27	38.94	71.05	Sep 1977	Nov 1966	Apr 1981	Sep 1949
81.58	1.23	19.00	28.33	42.84	73.70	Oct 1946	Jan 1977	Nov 1949	Jul 1974
84.21	1.19	20.57	31.73	58.06	87.64	Sep 1967	Apr 1981	Jul 1974	Oct 1958
86.84	1.15	28.14	34.33	58.65	94.48	Sep 1969	Oct 1946	Aug 1969	Jul 1966
89.47	1.12	30.29	35.93	69.97	100.56	Apr 1981	Aug 1969	Oct 1946	Dec 1969
92.11	1.09	34.14	37.60	72.10	129.66	Jul 1974	Jul 1974	Nov 1973	Oct 1946
94.74	1.06	36.00	43.07	73.94	147.72	Aug 1982	Aug 1982	Aug 1982	Oct 1973
97.37	1.03	38.57	53.00	82.46	243.49	Sep 1973	Sep 1973	Sep 1966	Sep 1982
μ		11.81	15.05	24.22	44.10				
σ		10.39	13.22	22.90	48.98				

* Month in which the midpoint of the low-flow period occurred

**Table 3. Results of Low-Flow Analyses
for 5- and 9-Month Droughts,
Shoal Creek near Breese**

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month*	Year	Flow, cfs	Month*	Year
2.56	39.00	10.76	Oct	1953	15.28	Nov	1953
5.13	19.50	11.71	Sep	1964	32.75	Sep	1976
7.69	13.00	14.58	Oct	1952	36.64	Nov	1964
10.25	9.75	17.64	Nov	1976	43.97	Aug	1954
12.82	7.80	20.16	Mar	1954	51.07	Oct	1952
15.38	6.50	23.17	Oct	1963	59.86	Oct	1963
17.95	5.57	29.18	Sep	1971	76.80	Sep	1965
20.51	4.88	29.70	Nov	1979	77.98	Dec	1980
23.08	4.33	31.73	Oct	1947	86.65	Sep	1955
25.64	3.90	33.10	Nov	1960	97.86	Oct	1979
28.21	3.55	35.33	Oct	1978	109.97	Nov	1956
30.77	3.25	36.68	Nov	1980	141.47	Oct	1962
33.33	3.00	45.39	Nov	1956	145.15	Oct	1975
35.90	2.79	47.45	Oct	1970	156.46	Jul	1971
38.46	2.60	48.42	Sep	1954	184.81	Oct	1978
41.03	2.44	48.60	Oct	1965	201.74	Oct	1960
43.59	2.29	49.98	Nov	1955	208.84	Oct	1947
46.15	2.17	58.94	Aug	1972	238.57	Sep	1950
48.72	2.05	59.73	Dec	1962	250.72	Aug	1959
51.28	1.95	73.26	Jun	1976	255.94	Oct	1977
53.85	1.86	82.14	Oct	1950	256.96	Jun	1972
56.41	1.77	82.41	Sep	1968	273.44	Sep	1970
58.97	1.70	85.54	Sep	1975	282.66	Jul	1949
61.54	1.63	122.56	Feb	1965	339.19	Jul	1966
64.10	1.56	124.06	Aug	1966	339.52	Dec	1957
66.67	1.50	125.27	Oct	1951	343.10	Aug	1968
69.23	1.44	152.87	Sep	1959	374.05	Sep	1951
71.79	1.39	163.17	Sep	1977	379.10	Aug	1948
74.36	1.34	166.42	Sep	1974	390.08	Sep	1981
76.92	1.30	174.35	Jul	1949	418.43	Jul	1967
79.49	1.26	176.07	Nov	1958	421.36	Sep	1958
82.05	1.22	182.39	Aug	1961	433.31	Aug	1961
84.62	1.18	184.26	Oct	1981	509.33	Sep	1969
87.18	1.15	200.50	May	1956	635.66	Sep	1974
89.74	1.11	203.52	Jun	1955	660.32	Jul	1982
92.31	1.08	223.97	Oct	1948	685.00	Mar	1946
94.87	1.05	245.56	Nov	1957	800.77	Aug	1973
97.44	1.03	251.66	Jun	1980	837.06	May	1983

* Middle month of the drought period

the 7- to 61-day low flows. The middle month of the 5-month and 9-month period for each year is also determined. The 5-month low-flow period generally occurs from August through December.

Monthly and annual flow-duration values are given in Table 4. The daily flows for each month as well as for the whole year for the period of record (a total of 13 daily-flow series) are ranked in ascending order. The flow values at different exceedance probabilities are determined through interpolation. Also given in Table 4 are the average monthly and annual flow values (\bar{Q} in table 1) and their associated exceedance probabilities. For Shoal Creek near Breese the \bar{Q} is 514.88 cfs and the associated exceedance probability is 20.81%. This means that the average flow of 514.88 cfs is exceeded only 20.81% of the time. The distribution of the daily-flow series is skewed to the left

The available flow Q_a equals $Q_s - Q_p$ or the streamflow minus the protected flow. The four protected-flow levels considered are $Q(90)$, $Q(85)$, $Q(80)$, and $Q(75)$ corresponding to 90, 85, 80, and 75% flow durations.

An example of protected-flow statistics developed for the month of October by using $Q_p = Q_m(90)$ (the monthly flow duration corresponding to the 90% exceedance probability) is given in Table 5. With $Q_p = Q_m(90)$, there are 10 years (out of a total of 38 years) in which Q_a is negative on some days in October. Thus the percentage of years (% YEAR) with negative Q_a during October is 26.32. The number of days in October with negative Q_a is 117 out of a total of $31 \times 38 = 1178$ days. Therefore the percentage of days (% DAYS) in October with negative available flow is $100 \times (117/1178)$ or 9.93%. The sum of negative flows (ΣQ_a) over the 117 days is -343.68 cfs. Thus the average Q_a , or \bar{Q}_a , equals $-343.68/117$ or -2.94 cfs.

However, all 38 years have at least one day in October during which Q_a is positive ($Q_s > Q_p$, or $Q_a > 0$). The percentage of years (% YEAR) with positive Q_a during October is thus 100%. The number of days in October with such flows is 1061 out of a total of 1178 days. Therefore the percentage of days (% DAYS) in October with positive available flow is $100 \times (1061/1178)$ or 90.07%. The sum of positive flows (ΣQ_a) over the 1061 days is 154,757.46 cfs. Thus the average Q_a , or \bar{Q}_a , equals 145.86 cfs.

Table 4. Monthly and Annual Flow-Duration Values, Shoal Creek near Breese

PROB ≥	Flows in cfs												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
99	0.09	0.04	0.16	2.97	5.67	9.86	16.34	7.07	14.07	0.35	3.89	0.02	0.90
95	2.10	4.90	7.98	8.89	10.96	39.94	55.00	34.94	22.00	9.98	6.00	2.40	7.60
90	5.19	9.70	11.99	11.99	16.08	79.86	87.00	54.93	30.00	17.97	10.98	5.40	12.00
85	6.59	13.00	14.98	14.98	29.73	98.90	110.00	65.94	37.00	20.98	12.99	8.20	16.00
80	7.79	16.00	20.96	18.97	38.18	130.78	133.00	77.92	45.00	26.96	15.98	10.00	22.00
75	9.49	19.00	25.96	24.95	54.47	163.72	162.00	91.88	54.00	31.96	18.97	12.00	29.00
70	12.05	24.00	34.21	35.20	83.83	219.01	194.00	114.42	65.00	38.17	22.09	13.00	37.01
60	16.06	32.00	52.28	60.41	160.70	304.24	267.00	149.57	98.00	52.22	30.10	17.00	61.02
50	22.10	50.00	80.34	100.85	239.89	426.14	355.00	205.80	131.00	74.22	40.13	23.00	98.02
40	34.12	69.00	120.58	201.11	386.35	561.63	482.00	301.02	208.00	100.42	55.17	32.00	162.04
30	52.14	102.00	206.92	365.38	619.04	801.73	676.00	450.80	365.00	162.54	80.16	48.00	297.04
25	66.19	127.00	298.33	501.61	776.37	973.56	860.00	529.89	506.00	215.78	96.30	66.00	400.05
20	88.28	185.00	455.28	692.03	1155.76	1393.73	1180.00	635.64	662.00	308.38	132.60	86.00	537.06
15	130.39	322.00	646.24	993.71	1920.24	1943.51	2000.00	879.48	960.00	511.88	221.98	121.00	742.11
10	206.87	490.00	1285.32	1725.39	2954.22	2632.78	2820.00	1563.90	1410.00	883.49	415.31	210.00	1270.00
5	466.97	924.00	2860.27	3318.91	4258.17	3461.00	3920.00	2717.10	2570.00	1914.96	805.04	447.00	2680.00
1	1866.53	3209.95	7702.61	7519.61	8939.45	8644.20	7815.82	6065.63	4978.87	4250.90	3181.09	1044.76	6381.40
\bar{Q} , cfs	136.27	218.13	525.72	637.94	929.53	964.99	958.93	619.32	562.10	366.69	198.33	88.90	514.88
$v(\bar{Q})$, %	14.62	18.79	18.16	21.42	22.98	25.25	23.45	20.77	23.20	18.57	16.32	19.59	20.81

Table 5. Protected-Flow Statistics for Month of October

with $Q_p = Q_m(90)$, Shoal Creek near Breese

Year	<i>If Available Flow ≤ 0</i>				<i>If Available Flow > 0</i>			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1946	0.00	0	0.00	0.00	14945.07	31	482.10	2714.81
1947	0.00	0	0.00	0.00	4236.12	31	136.65	825.81
1948	0.00	0	0.00	0.00	491.83	31	15.87	125.81
1949	0.00	0	0.00	0.00	826.13	31	26.65	136.81
1950	0.00	0	0.00	0.00	16520.19	31	532.91	2324.81
1951	0.00	0	0.00	0.00	2192.13	31	70.71	381.81
1952	0.00	0	0.00	0.00	1531.13	31	49.39	438.81
1953	-60.87	22	-2.77	-4.29	17.49	9	1.94	3.41
1954	-18.04	6	-3.01	-4.69	63.56	25	2.54	8.81
1955	-33.17	12	-2.76	-4.79	3466.80	19	182.46	872.81
1956	0.00	0	0.00	0.00	1194.33	31	38.53	198.81
1957	-124.88	30	-4.16	-5.19	0.81	1	0.81	0.81
1958	0.00	0	0.00	0.00	2099.63	31	67.73	779.81
1959	0.00	0	0.00	0.00	1312.13	31	42.33	268.81
1960	0.00	0	0.00	0.00	9087.09	31	293.13	1374.81
1961	-4.65	5	-0.93	-0.99	138.37	26	5.32	39.81
1962	0.00	0	0.00	0.00	576.83	31	18.61	84.81
1963	0.00	0	0.00	0.00	3219.13	31	103.84	789.81
1964	0.00	0	0.00	0.00	389.13	31	12.55	34.81
1965	-78.86	23	-3.43	-4.99	11.28	8	1.41	4.21
1966	-1.18	2	-0.59	-0.59	450.50	29	15.53	45.81
1967	0.00	0	0.00	0.00	3338.13	31	107.68	253.81
1968	0.00	0	0.00	0.00	2323.13	31	74.94	246.81
1969	0.00	0	0.00	0.00	231.33	31	7.46	17.81
1970	0.00	0	0.00	0.00	52672.09	31	1699.10	12794.81
1971	0.00	0	0.00	0.00	875.13	31	28.23	58.81
1972	-0.39	1	-0.39	-0.39	312.12	30	10.40	62.81
1973	0.00	0	0.00	0.00	545.13	31	17.58	77.81
1974	0.00	0	0.00	0.00	5326.09	31	171.81	688.81
1975	0.00	0	0.00	0.00	2583.13	31	83.33	424.81
1976	0.00	0	0.00	0.00	603.13	31	19.46	62.81
1977	-12.12	8	-1.51	-3.29	1177.04	23	51.18	448.81
1978	0.00	0	0.00	0.00	5542.09	31	178.78	1164.81
1979	0.00	0	0.00	0.00	182.63	31	5.89	55.81
1980	-9.52	8	-1.19	-2.29	196.64	23	8.55	17.81
1981	0.00	0	0.00	0.00	440.13	31	14.20	63.81
1982	0.00	0	0.00	0.00	1623.13	31	52.36	95.81
1983	0.00	0	0.00	0.00	14015.08	31	452.10	2664.81
μ	-2.94				145.86			
σ	2.53				323.24			
% YEAR =	26.32	% DAYS =	9.93	% YEAR =	100.00	% DAYS =	90.07	

An example of protected-flow statistics developed by using $Q_p = Q_y(90)$ for the month of October is given in Table 6. The statistics are different when Q_y , or the yearly flow-duration value, is used instead of Q_m .

Table 7 is a summary of protected-flow statistics for Shoal Creek near Breese, developed on the basis of the data in Tables 5 and 6. The flow information needed for planning withdrawals from the stream and for designing storage during periods of zero or low water availability from the stream under various protected-flow levels (four levels considered here) is provided in this table. This information consists of:

- (1) Average monthly and yearly mean flows for the period of record
- (2) Standard deviation of monthly and yearly mean flows
- (3) Flows at 90, 85, 80, and 75 percent exceedance probabilities (or flow durations) for each month as well as for the whole year
- (4) Average values of both negative and positive Q_a for each of the four protected-flow levels
- (5) Percent years for each month of the record with Q_a negative or positive
- (6) Percent days in each month of the record with Q_a negative or positive

Generally, the flows corresponding to 90-75% flow durations for the yearly data are higher than those for the monthly data for the months August through December, and they will provide higher protected flows. However, during March through June the monthly flow-duration values are much higher than the yearly flow duration, and use of the yearly flow duration considerably lowers the protected flow. This interaction between monthly and total flow-duration values is further illustrated in Section IV.

In the first row of Table 7 is provided information on the averages of the mean monthly and yearly flows (\bar{Q}) for the period of record. The standard deviations of the mean monthly and mean yearly flows are given under $\bar{Q}(s)$. \bar{Q} and $\bar{Q}(s)$ are indicators of the variability of flow over the period of record as well as within each year. The available flow Q_a equals $Q_s - Q_p$ or the streamflow minus the protected flow.

The flow statistics for the different levels of protected flow -- $Q(90)$, $Q(85)$, $Q(80)$, and $Q(75)$ - are given in two blocks. In the first block (under $T = M$) the monthly flow-duration values are used, while in the second block (under $T = Y$) the yearly flow-duration values are used. The first three rows in each block

Table 6. Protected-Flow Statistics for Month of October

with $Q_p = Q_y(90)$, Shoal Creek near Breese

Year	<i>If Available Flow ≤ 0</i>				<i>If Available Flow > 0</i>			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1946	0.00	0	0.00	0.00	14734.00	31	475.29	2708.00
1947	0.00	0	0.00	0.00	4025.00	31	129.84	819.00
1948	-88.30	25	-3.53	-6.30	369.00	6	61.50	119.00
1949	0.00	1	0.00	0.00	615.00	30	20.50	130.00
1950	-11.90	4	-2.97	-4.30	16321.00	27	604.48	2318.00
1951	0.00	0	0.00	0.00	1981.00	31	63.90	375.00
1952	0.00	0	0.00	0.00	1320.00	31	42.58	432.00
1953	-254.50	31	-8.21	-11.10	0.00	0	0.00	0.00
1954	-173.60	27	-6.43	-11.50	8.00	4	2.00	2.00
1955	-126.50	16	-7.91	-11.60	3349.00	15	223.27	866.00
1956	-22.80	6	-3.80	-5.50	1006.00	25	40.24	192.00
1957	-335.20	31	-10.81	-12.00	0.00	0	0.00	0.00
1958	-56.50	17	-3.32	-4.50	1945.00	14	138.93	773.00
1959	0.00	0	0.00	0.00	1101.00	31	35.52	262.00
1960	0.00	0	0.00	0.00	8876.00	31	286.32	1368.00
1961	-118.40	27	-4.39	-7.80	41.00	4	10.25	33.00
1962	-27.30	11	-2.48	-5.60	393.00	20	19.65	78.00
1963	0.00	0	0.00	0.00	3008.00	31	97.03	783.00
1964	-21.00	13	-1.62	-3.00	199.00	18	11.06	28.00
1965	-278.70	31	-8.99	-11.80	0.00	0	0.00	0.00
1966	-69.80	14	-4.99	-7.40	308.00	17	18.12	39.00
1967	0.00	0	0.00	0.00	3127.00	31	100.87	247.00
1968	0.00	0	0.00	0.00	2112.00	31	68.13	240.00
1969	-26.80	16	-1.67	-4.00	47.00	15	3.13	11.00
1970	0.00	0	0.00	0.00	52461.00	31	1692.29	12788.00
1971	0.00	0	0.00	0.00	664.00	31	21.42	52.00
1972	-89.40	23	-3.89	-7.20	190.00	8	23.75	56.00
1973	-19.00	11	-1.73	-4.20	353.00	20	17.65	71.00
1974	0.00	0	0.00	0.00	5115.00	31	165.00	682.00
1975	0.00	0	0.00	0.00	2372.00	31	76.52	418.00
1976	0.00	0	0.00	0.00	392.00	31	12.65	56.00
1977	-106.20	18	-5.90	-10.10	1060.00	13	81.54	442.00
1978	0.00	0	0.00	0.00	5331.00	31	171.97	1158.00
1979	-116.50	25	-4.66	-6.10	88.00	6	14.67	49.00
1980	-100.00	17	-5.88	-9.10	76.00	14	5.43	11.00
1981	-37.00	15	-2.47	-5.00	266.00	16	16.63	57.00
1982	0.00	0	0.00	0.00	1412.00	31	45.55	89.00
1983	0.00	0	0.00	0.00	13804.00	31	445.29	2658.00
μ	-5.49				185.82			
σ	5.41				340.07			
% YEAR =	55.26	% DAYS =	32.17		% YEAR =	92.11	% DAYS =	67.83

Table 7. Summary of Protected-Flow Statistics
USGS NO. 05594000 Shoal Creek near Breese
Drainage Area 735.00 sq mi Period of Record (1945-1983) 38 years

T	Item	Mean Flow, Flow Duration, and Selected Protected-Flow Statistics												
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
	\bar{Q}	136.27	218.13	525.72	637.94	932.75	964.99	958.93	619.32	562.10	366.69	198.33	88.90	514.88
	$\bar{Q}(S)$	293.68	426.98	894.23	956.15	993.49	892.43	818.64	598.54	719.78	458.42	319.98	105.99	297.63
	Q(90)	5.19	9.70	11.99	11.99	16.08	79.86	87.00	54.93	30.00	17.97	10.98	5.40	12.00
M	AVQ(-)	-2.94	-5.07	-5.21	-4.62	-5.13	-40.77	-34.70	-22.17	-8.02	-8.62	-4.80	-2.99	
	% years	26.32	23.68	23.68	18.42	31.58	36.84	28.95	28.95	39.47	21.05	28.95	21.05	
	% days	9.93	10.00	9.42	8.83	10.15	9.42	10.09	9.85	10.26	9.25	9.85	10.09	
	AVQ(+)	145.86	232.15	567.72	687.02	1017.33	981.44	973.65	628.46	593.87	385.15	208.33	93.21	
	% years	100.00	100.00	100.00	97.37	97.37	97.37	100.00	97.37	100.00	97.37	100.00	97.37	
	% days	90.07	90.00	90.58	91.17	89.85	90.58	89.91	90.15	89.74	90.75	90.15	89.91	
Y	AVQ(-)	-5.49	-5.58	-4.26	-3.91	-3.66	-1.81	-0.71	-4.49	-2.70	-5.20	-4.43	-5.19	
	% years	55.26	28.95	28.95	23.68	18.42	2.63	2.63	7.89	15.79	34.21	57.89		
	% days	32.17	13.86	11.54	10.44	6.06	1.95	0.61	1.78	0.70	6.37	13.24	26.67	
	AVQ(+)	185.82	240.19	581.33	699.38	976.94	972.00	952.79	618.42	554.01	379.16	215.45	106.76	
	% years	92.11	97.37	100.00	97.37	100.00	100.00	100.00	100.00	100.00	97.37	100.00	97.37	
	% days	67.83	86.14	88.46	89.56	93.94	98.05	99.39	98.22	99.30	93.63	86.76	73.33	
	Q(85)	6.59	13.00	14.98	14.98	29.73	98.90	110.00	65.94	37.00	20.98	12.99	8.20	16.00
M	AVQ(-)	-3.09	-5.72	-6.09	-5.88	-15.65	-41.38	-41.48	-24.40	-11.16	-8.38	-5.42	-4.22	
	% years	36.84	31.58	28.95	26.32	34.21	44.74	42.11	50.00	44.74	34.21	34.21	36.84	
	% days	14.94	15.96	14.43	12.90	14.91	14.94	15.18	14.69	15.26	13.75	13.24	15.00	
	AVQ(+)	153.00	245.18	597.90	716.12	1060.23	1025.48	1008.23	652.83	621.69	402.16	214.46	95.69	
	% years	97.37	97.37	100.00	97.37	97.37	97.37	100.00	97.37	100.00	97.37	100.00	97.37	
	% days	85.06	84.04	85.57	87.10	85.09	85.06	84.82	85.31	84.74	86.25	86.76	85.00	
Y	AVQ(-)	-8.00	-7.58	-6.64	-5.52	-5.40	-5.24	-3.80	-7.88	-3.87	-7.48	-6.42	-7.36	
	% years	65.79	36.84	31.58	34.21	31.58	2.63	2.63	2.63	10.53	21.05	39.47	63.16	
	% days	39.90	18.95	15.62	16.81	9.51	2.29	0.88	1.95	1.67	8.32	19.35	35.96	
	AVQ(+)	205.42	251.15	605.31	748.72	1010.07	971.37	951.31	615.49	555.42	383.19	227.63	117.99	
	% years	89.47	97.37	100.00	97.37	97.37	100.00	100.00	100.00	100.00	97.37	97.37	94.74	
	% days	60.10	81.05	84.38	83.19	90.49	97.71	99.12	98.05	98.33	91.68	80.65	64.04	
	Q(80)	7.79	16.00	20.96	18.97	38.18	130.78	133.00	77.92	45.00	26.96	15.98	10.00	22.00
M	AVQ(-)	-3.43	-6.83	-9.76	-7.54	-19.22	-58.50	-51.20	-28.62	-15.17	-11.25	-6.40	-4.42	
	% years	44.74	36.84	36.84	34.21	47.37	57.89	52.63	60.53	55.26	50.00	39.47	50.00	
	% days	19.52	21.05	19.78	19.86	20.04	19.95	20.18	19.95	20.61	19.35	19.35	21.14	
	AVQ(+)	160.48	257.85	631.62	774.27	1119.53	1056.67	1047.63	683.45	655.31	423.96	227.65	101.24	
	% years	97.37	97.37	94.74	94.74	97.37	97.37	100.00	97.37	100.00	97.37	97.37	97.37	
	% days	80.48	78.95	80.22	80.14	79.96	80.05	79.82	80.05	79.39	80.65	80.65	78.86	
Y	AVQ(-)	-12.08	-10.73	-10.17	-9.67	-9.28	-10.55	-8.00	-10.10	-5.79	-8.64	-9.28	-10.96	
	% years	76.32	50.00	39.47	36.84	34.21	2.63	2.63	7.89	21.05	39.47	63.16	81.58	
	% days	48.56	27.11	21.14	22.16	13.24	2.55	1.32	2.89	4.30	15.11	29.20	47.37	
	AVQ(+)	233.54	273.05	641.46	794.01	1047.37	967.91	949.53	615.37	564.62	407.58	252.89	136.99	
	% years	89.47	92.11	94.74	94.74	97.37	100.00	100.00	100.00	100.00	97.37	97.37	92.11	
	% days	51.44	72.89	78.86	77.84	86.76	97.45	98.68	97.11	95.70	84.89	70.80	52.63	
	Q(75)	9.49	19.00	25.96	24.95	54.47	163.72	162.00	91.88	54.00	31.96	18.97	12.00	29.00
M	AVQ(-)	-4.24	-8.40	-12.44	-11.78	-30.73	-76.23	-67.01	-36.00	-20.54	-13.86	-8.09	-5.19	
	% years	32.63	42.11	42.11	36.84	50.00	65.79	60.53	65.79	60.53	57.89	52.63	57.89	
	% days	24.79	25.26	24.79	24.02	24.98	24.96	25.18	24.70	25.18	23.60	23.34	26.67	
	AVQ(+)	169.96	269.28	668.57	810.55	1176.62	1093.10	1087.62	712.29	685.96	442.41	236.44	106.76	
	% years	92.11	94.74	89.47	92.11	92.11	97.37	100.00	97.37	100.00	97.37	97.37	97.37	
	% days	75.21	74.74	75.21	75.98	75.02	75.04	74.82	75.30	74.82	76.40	76.66	73.33	
Y	AVQ(-)	-17.22	-14.26	-14.43	-14.79	-14.92	-16.17	-11.38	-14.46	-8.42	-12.25	-13.38	-15.69	
	% years	84.21	60.53	44.74	39.47	34.21	7.89	5.26	7.89	34.21	55.26	73.68	86.84	
	% days	55.69	36.23	26.83	26.15	14.91	2.80	1.84	3.57	8.68	21.22	38.37	56.84	
	AVQ(+)	263.72	304.68	684.11	829.76	1060.97	963.43	947.60	612.68	584.60	431.96	283.09	159.48	
	% years	84.21	89.47	89.47	92.11	97.37	97.37	100.00	100.00	100.00	97.37	97.37	89.47	
	% days	44.31	63.77	73.17	73.85	85.09	97.20	98.16	96.43	91.32	78.78	61.63	43.16	

provide the protected-flow statistics for deficit periods when $Q_a \leq 0$. The next three rows provide the protected-flow statistics for surplus periods when $Q_a > 0$.

The availability of water at two protected-flow levels for Shoal Creek near Breese is shown in Figure 2. The availability of water is measured in terms of the percent days (% DAYS) during which the observed flow exceeds the protected flow. The flow availability depends on the protected-flow level and also on whether the monthly or yearly flow-duration value is used as the protected flow. Using a monthly flow-duration value provides a relatively constant protection in terms of percentage of days with positive Q_a for each month. The yearly flow-duration value is the same for each month, but it provides less protection in high-flow months. The availability of water under protected flows corresponding to yearly flow-duration values varies for each month as shown in the figure.

The information provided in Table 7 gives a matrix of flow surpluses and deficits from month to month for the protected-flow levels under consideration. The decision analysis to define desirable protected flow may also make use of information on improvement in suitability of aquatic habitats with increase in protected flow during various months of the year (in terms of diversity and strength of biotic communities and fish species), existing established uses, potential municipal and industrial demands, and seasonal irrigation requirements.

Protected-flow statistics have been computed for 217 gaging stations in Illinois, and were presented in tabular form by Singh and Ramamurthy (1987). The flow-duration values used in developing protected-flow statistics for the 217 gaging stations have been calculated by using daily-flow data. The flow-duration values were not modified to represent present conditions. In the next section we examine the daily-flow series at each of the 217 gaging stations for time trends and outline several simple procedures for estimating the yearly flow-duration values for present conditions.

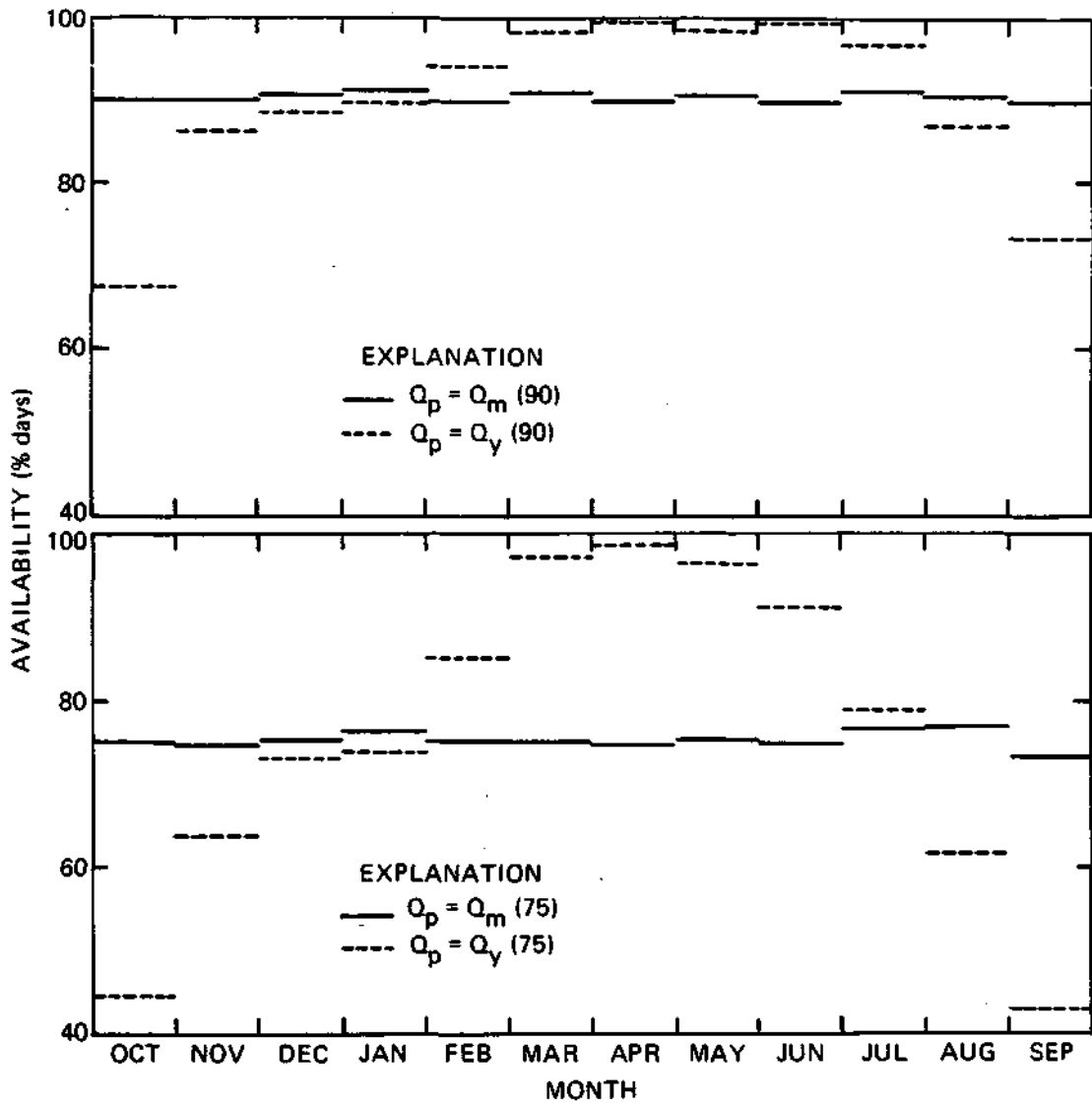


Figure 2. Availability of water at two protected-flow levels, Shoal Creek near Breese

III. FLOW REGIME CHANGES AND FLOW DURATION: IMPLICATIONS FOR PROTECTED-FLOW INFORMATION DEVELOPMENT

Protected-flow statistics provide the basic information needed for objective analyses and adoption of protected-flow levels for streams in Illinois. It is important to ensure that the protected-flow statistics developed represent present conditions. Since protected-flow level is made to correspond to some flow-duration value, the flow-duration series must represent present conditions. This requires that the time series of daily-flow data be stationary. In other words, the series of daily-flow values should be free from time trends.

Gaging stations with a period of record greater than 30 years are particularly susceptible to time trends in the data. The flow regimes can change over a long time period through a combination of several factors. These factors can be considered under four categories.

Urbanization Increasing population in urban areas changes the flow regime in two ways. First, the flow routing is altered because of storm sewers. This affects the time of travel to the receiving stream and produces higher peak flows. Second, the effluents from municipal (and industrial) wastewater treatment plants increase with population and increase the low flows in the receiving stream. Also, if increased water withdrawals are made from the stream to serve the growing population or the industrial sector, this will reduce the low flows.

Regulation Mandatory minimum flow releases from reservoirs can significantly increase the low flows downstream of the reservoir. In such cases the daily flow values prior to the regulatory changes - especially the values for flows with high probabilities of exceedance, or low flows - should not be used to calculate flow-duration values.

Water Use Water withdrawals from streams for different uses such as potable water supply, industrial cooling, irrigation, and recreation change over time. This affects the low-flow regime.

Climate Northeastern Illinois has been experiencing a wetter and cooler climate during the last 20 years than was experienced in the past (Changnon, 1984, 1985). This has increased the average flows in that region during the last 20 years.

The amount of flow diverted from Lake Michigan to the Illinois River through the Chicago Sanitary and Ship Canal changed significantly in 1940. The flows along the Illinois River prior to 1940 were much

higher than present flows. Most of the dams on the Illinois River were also completed by 1940. Flow data prior to 1940 at the Illinois River gaging stations should not be considered in computing the flow duration. Also, several large lakes were constructed from 1965 to 1970, most notably Lake Shelbyville and Lake Carlyle on the Kaskaskia River and Rend Lake on the Big Muddy River. The specification of minimum low-flow releases from the impounding structures has significantly changed the flow regime downstream along these rivers. Again, flow data for downstream gaging stations for the period prior to construction of these lakes should not be used, or should be modified, for computing the flow duration.

The existence of time trends in the data produces a flow-duration curve that may not represent present conditions. This is generally true of streams that are in urbanizing areas such as northeastern Illinois and thus receive increasing effluent discharges from municipal and industrial wastewater treatment plants. In such cases the flow-duration values need to be modified to represent present conditions. Five examples are provided that illustrate the methodology used to analyze for time trends in the daily-flow data and to adjust the yearly flow-duration values to reflect present conditions. The procedure basically involves computing the relevant flow parameters - Q , $Q(90)$, $Q(85)$, $Q(80)$, and $Q(75)$ - for different time periods and plotting these values with respect to time. A trend curve is drawn to determine the value of the flow parameter for present (1986) conditions.

1. *Vermilion River near Danville*

Flow-duration values calculated at 10-year intervals for the period of record at this gaging station (1929 to 1983) are shown in Table 8. Effluents from Rantoul, Champaign-Urbana, and Danville have changed substantially over the last 30 years and have changed the low-flow regime of the receiving streams. Water use in Danville levelled off in 1973, and the increased flows during 1974 to 1983 are due to increased precipitation in the region. The flow-duration values estimated for present conditions correspond to the values obtained for the period 1964 to 1973.

2. *Embarras River at Ste. Marie*

The period of record at this gaging station is 1915 to 1986. The change in effluents over the last 15 years has been of the order of 1 to 2 cfs, which is relatively small compared to the low flows at the station. The flows have been higher than average during the last 10 years,

Table 8. Mean Flow and Flow-Duration Values for Various Periods

USGS No. 03339000 Vermilion River near Danville
Drainage Area 1290.00 sq mi Period of Record (1928-1983) 55 years

FP*	Period	Mean Flow and Flow Durations for Various Periods												
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
Q̄	1929-83	325.04	465.88	789.30	1158.81	1419.10	1659.06	1920.03	1598.03	1204.55	786.26	415.17	245.30	996.23
	1929-43	219.73	618.87	599.93	1184.74	1429.29	1561.50	1557.13	1788.53	845.11	658.37	216.24	138.32	898.84
	1944-53	370.35	372.93	685.73	1937.43	1706.04	1803.98	2264.63	1558.36	1632.25	926.42	175.20	201.84	1132.32
	1954-63	149.35	308.46	443.01	515.20	1154.24	1420.65	1373.74	1279.48	1329.04	1100.25	402.49	108.51	796.18
	1964-73	320.53	522.42	1138.72	1011.11	1167.83	1194.13	2569.30	1424.63	1074.39	500.15	359.59	335.96	965.00
	1974-83	617.90	430.21	1173.78	1132.62	1632.86	2363.85	2016.82	1843.89	1321.70	810.04	1021.77	495.39	1237.49
Q(90)	1929-83	35.96	46.00	48.95	49.93	82.12	251.30	353.00	305.45	168.00	61.87	40.92	32.00	52.00
	1929-43	27.88	42.00	50.77	43.81	80.49	127.67	283.00	204.79	90.00	28.83	20.88	22.00	37.99
	1944-53	40.00	56.00	62.00	50.00	79.06	626.00	643.00	486.00	269.00	158.00	46.00	35.00	58.02
	1954-63	30.00	35.00	42.00	55.00	65.21	179.00	317.00	212.00	168.00	54.00	48.00	30.00	45.01
	1964-73	40.00	46.00	42.00	140.00	107.06	370.00	362.00	335.00	204.00	90.00	57.00	53.00	67.02
	1974-83	58.00	56.00	56.00	32.00	85.93	221.00	390.00	336.00	187.00	95.00	66.00	55.00	74.03
Q(85)	1929-83	41.04	53.86	62.16	80.24	113.57	355.75	423.71	374.72	210.23	80.23	51.05	39.86	67.02
	1929-43	31.12	50.44	66.42	101.84	114.99	190.81	349.56	317.98	118.13	36.27	25.24	26.69	49.99
	1944-53	41.82	65.00	75.68	70.97	174.13	775.53	730.00	573.53	301.00	194.47	58.76	40.00	70.93
	1954-63	36.38	39.00	47.47	65.94	80.41	307.56	364.00	267.62	215.00	67.68	51.65	33.00	54.93
	1964-73	47.29	63.00	67.53	158.24	249.28	438.38	520.00	448.97	229.00	103.68	62.47	56.00	79.93
	1974-83	64.38	63.00	100.68	50.24	150.24	356.85	502.00	447.24	235.00	121.44	73.29	64.00	99.83
Q(80)	1929-83	45.94	64.00	79.79	107.68	170.38	441.00	510.00	456.05	250.00	106.69	56.93	45.00	84.99
	1929-43	34.84	60.00	79.44	127.88	162.00	308.92	405.00	379.36	164.00	44.64	32.68	30.00	64.98
	1944-53	45.00	79.00	90.00	91.00	209.89	880.00	800.00	628.00	346.00	223.00	66.00	45.00	93.12
	1954-63	41.00	42.00	52.00	78.00	99.37	350.00	410.00	315.00	254.00	86.00	54.00	39.00	71.03
	1964-73	64.00	69.00	101.00	180.00	319.37	486.00	585.00	527.00	257.00	115.00	67.00	59.00	100.10
	1974-83	72.00	74.00	146.00	100.00	161.54	444.00	643.00	477.00	293.00	148.00	96.00	78.00	134.10
Q(75)	1929-83	54.11	75.65	101.59	150.60	219.88	511.36	591.53	505.83	291.74	137.53	65.11	50.82	109.07
	1929-43	42.36	73.50	102.55	156.25	232.00	451.65	463.50	433.45	190.10	58.89	36.48	33.60	83.97
	1944-53	50.17	96.00	115.83	166.78	256.68	958.36	850.00	715.83	383.00	259.17	75.47	50.00	128.66
	1954-63	43.58	49.00	66.64	84.89	113.22	371.53	476.00	373.56	301.00	115.28	58.31	41.00	85.84
	1964-73	66.58	73.00	164.72	197.22	351.32	519.58	675.00	557.14	284.00	135.67	72.17	63.00	131.70
	1974-83	78.89	86.00	195.08	203.33	181.09	559.39	812.00	526.08	340.00	179.00	127.00	95.00	179.50

* FP = Flow Parameter

but this is mainly because of increased precipitation in this watershed. No change is needed for the flow-duration values determined at this station from the daily flows of record.

3. *Kankakee River at Momence*

Flow-duration values calculated at 10-year intervals for the period of record at this gaging station (1916 to 1983) are shown in Table 9. The flow-duration values calculated for the period 1916-1923 are very low and do not represent the present flow levels in the stream. On the other hand, the flow values for the period 1974-1983 are too high, mainly because of above-normal precipitation during those years, and again do not represent normal present conditions. The flow-duration values estimated for present (1986) conditions are lower than the values calculated for the period 1974-1983.

4. *Salt Creek at Western Springs*

Flow-duration values calculated at 10-year intervals for the period of record at this gaging station (1946 to 1983) are shown in Table 10. The stream receives effluents from a number of urban townships with populations that have increased substantially during the last 25 years. Since the flows have increased steadily over the years the low-flow regime has changed significantly. Flow values prior to 1970 are no longer representative of present conditions. The flow-duration values estimated for present (1986) conditions are higher than the values calculated for the period 1974-1983.

5. *Sangamon River at Riverton*

The period of record at this gaging station is from 1915 to 1955. Flow conditions have changed along the Sangamon River during the last 20 to 30 years. Since daily-flow values at this gaging station are not available for current years, the streamflow assessment model for the Sangamon River Basin (Knapp et al., 1985) was used to determine present flow conditions. Streamflow assessment models for the Fox, Kaskaskia, and Kankakee River basins are under development at the State Water Survey. These streamflow assessment models will provide a scientific procedure for determining flow-duration values for present conditions when the flow regime is changing with time.

Table 9. Mean Flow and Flow-Duration Values for Various Periods

USGS No. 05520500 Kankakee River at Momence
Drainage Area 2294.00 sq mi Period of Record (1916-1983) 67 years

FP*	Period	Mean Flow and Flow Durations for Various Periods												Year
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Q̄	1916-83	1108.68	1378.76	1815.31	2060.08	2347.07	3178.59	3532.48	2918.53	2047.01	1388.39	998.82	906.70	1970.63
	1916-23	722.87	1024.30	1468.53	1576.31	1774.80	3063.59	3225.08	2424.82	1406.08	912.95	564.97	585.65	1560.80
	1924-33	1138.29	1464.49	2333.24	2602.75	2623.49	2824.43	3514.43	2540.41	1879.81	1261.51	893.62	826.18	1987.78
	1934-43	969.65	1268.85	1228.73	1652.98	2221.49	2751.32	2567.10	2492.75	1860.67	1171.73	930.48	901.32	1664.33
	1944-53	992.66	1274.94	1486.45	2392.61	2481.38	3248.52	3722.13	3160.16	2428.30	1627.73	1032.92	812.17	2051.64
	1954-63	1311.54	1561.06	1369.00	1646.39	2068.88	3001.77	2970.72	2634.04	1895.50	1518.82	1090.21	811.98	1821.50
	1964-73	1425.87	1662.71	2461.81	2557.06	2766.40	2966.77	3878.90	3254.31	1959.48	1488.31	1156.33	1143.86	2223.79
	1974-83	1122.71	1324.08	2290.09	1895.68	2376.49	4370.74	4787.53	3824.45	2771.05	1642.62	1236.47	1201.49	2402.65
Q(90)	1916-83	539.89	640.00	703.83	679.75	790.12	1389.43	1590.00	1289.49	880.00	658.79	503.89	502.00	639.98
	1916-23	417.75	590.00	638.92	498.31	763.33	1388.15	1500.00	1147.08	685.00	486.92	394.65	372.00	478.10
	1924-33	590.00	646.00	928.00	730.00	820.29	1660.00	1500.00	1080.00	815.00	646.00	540.00	547.00	690.15
	1934-43	594.00	722.00	760.00	650.00	702.14	1070.00	1380.00	1010.00	660.00	504.00	445.00	450.00	626.09
	1944-53	586.00	668.00	680.00	600.00	854.07	1620.00	1900.00	1600.00	1290.00	931.00	626.00	507.00	652.15
	1954-63	482.00	562.00	615.00	620.00	562.69	1060.00	1380.00	1220.00	1060.00	949.00	668.00	518.00	620.08
	1964-73	445.00	484.00	662.00	820.00	834.57	1570.00	1910.00	1320.00	880.00	755.00	638.00	560.00	666.13
	1974-83	651.00	810.00	900.00	880.00	901.43	1880.00	2770.00	1830.00	1150.00	780.00	648.00	641.00	775.08
Q(85)	1916-83	584.37	696.00	816.49	787.28	905.27	1622.02	1770.00	1481.35	996.00	740.79	586.43	546.00	717.97
	1916-23	464.23	630.00	745.14	749.43	794.15	1401.14	1680.00	1352.00	745.00	537.37	403.37	380.00	550.08
	1924-33	657.47	960.00	1011.88	780.15	1296.75	1723.82	1690.00	1198.53	928.00	740.82	616.59	580.00	784.46
	1934-43	636.85	755.00	887.65	896.18	852.36	1215.88	1480.00	1192.35	755.00	525.88	475.09	550.00	707.47
	1944-53	606.06	704.00	743.82	873.53	1041.61	1847.94	1990.00	1709.41	1470.00	1012.15	649.71	525.00	741.49
	1954-63	500.24	570.00	646.91	638.24	749.67	1552.35	1560.00	1420.59	1180.00	1004.62	701.74	536.00	695.50
	1964-73	522.50	524.00	833.41	984.12	1503.21	1679.41	2100.00	1575.29	951.00	796.03	679.03	608.00	745.54
	1974-83	683.82	843.00	1036.76	989.41	1001.29	2098.82	2970.00	2094.41	1430.00	873.91	683.56	675.00	847.52
Q(80)	1916-83	616.88	750.00	859.84	899.57	1080.27	1799.33	1920.00	1599.55	1090.00	809.74	623.86	566.00	799.96
	1916-23	487.26	650.00	798.29	846.86	846.31	1516.29	1780.00	1476.00	800.00	582.54	417.54	395.00	590.14
	1924-33	697.00	960.00	1100.00	1100.00	1506.86	1830.00	1800.00	1340.00	990.00	870.00	667.00	595.00	850.25
	1934-43	668.00	800.00	930.00	1020.00	963.43	1330.00	1560.00	1420.00	880.00	588.00	528.00	570.00	800.16
	1944-53	618.00	735.00	820.00	931.00	1094.71	2020.00	2100.00	1850.00	1580.00	1080.00	690.00	542.00	850.26
	1954-63	518.00	600.00	688.00	680.00	831.83	1760.00	1610.00	1520.00	1300.00	1030.00	740.00	568.00	760.17
	1964-73	578.00	614.00	1200.00	1220.00	1604.29	1850.00	2270.00	1760.00	1010.00	832.00	704.00	625.00	840.42
	1974-83	717.00	867.00	1170.00	1100.00	1062.57	2420.00	3300.00	2380.00	1520.00	936.00	717.00	697.00	916.20
Q(75)	1916-83	650.72	800.00	921.51	1002.83	1210.49	1954.34	2120.00	1702.26	1210.00	885.34	668.60	590.00	884.95
	1916-23	522.23	683.00	850.77	940.00	1022.50	1683.85	2030.00	1535.38	878.00	601.92	437.62	402.00	640.34
	1924-33	725.42	985.00	1203.33	1203.33	1675.44	1993.61	1920.00	1495.00	1050.00	895.83	685.94	620.00	927.26
	1934-43	704.17	850.00	951.53	1054.44	1081.25	1502.22	1630.00	1523.33	1080.00	710.28	579.67	588.00	871.22
	1944-53	642.11	750.00	845.83	990.42	1206.18	2304.17	2180.00	1970.56	1670.00	1131.67	741.67	562.00	928.25
	1954-63	627.36	760.00	724.17	705.83	1034.06	1854.72	1740.00	1597.50	1380.00	1064.44	774.44	584.00	839.14
	1964-73	603.83	726.00	1355.00	1461.11	1704.41	2073.89	2620.00	1932.22	1150.00	907.78	728.11	655.00	968.77
	1974-83	734.22	884.00	1238.89	1143.06	1152.81	2902.22	3700.00	2560.83	1610.00	1008.33	789.33	717.00	1008.98

* FP = Flow Parameter

Table 10. Mean Flow and Flow-Duration Values for Various Periods

USGS No. 05531500 Salt Creek at Western Springs
Drainage Area 114.00 sq mi Period of Record (1946-1983) 37 years

FP*	Period	Mean Flow and Flow Durations for Various Periods												
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
Q̄	1946-83	60.36	66.80	89.68	94.93	107.08	204.19	229.28	144.60	121.01	84.24	69.08	71.65	111.83
	1946-53	20.15	38.58	40.06	126.58	123.92	244.40	221.58	112.16	86.52	31.34	9.44	8.69	88.34
	1954-63	71.38	56.62	43.22	66.57	70.31	156.28	147.35	121.54	98.10	80.35	39.50	51.96	83.64
	1964-73	68.41	80.97	102.27	91.33	112.55	159.14	246.63	149.30	160.45	86.95	85.28	109.65	120.84
	1974-83	73.47	85.41	163.24	101.58	124.85	264.96	300.04	188.90	132.06	127.73	130.15	103.70	149.81
Q(90)	1946-83	5.59	7.10	8.99	10.99	15.02	36.97	52.00	33.97	22.00	12.98	4.60	4.60	11.00
	1946-53	2.50	4.00	5.79	15.94	12.80	43.80	46.00	28.95	12.00	4.98	2.80	2.60	3.90
	1954-63	7.90	6.80	7.00	5.50	11.01	29.00	34.00	34.00	21.00	13.00	9.80	7.20	9.30
	1964-73	14.00	17.00	19.00	22.00	19.21	37.00	61.00	37.00	23.00	20.00	18.00	16.00	19.01
	1974-83	34.00	38.00	36.00	33.00	37.03	61.00	91.00	66.00	51.00	44.00	41.00	30.00	40.00
Q(85)	1946-83	7.89	11.00	11.98	13.98	17.94	46.95	60.00	39.97	25.00	15.98	6.59	6.10	16.00
	1946-53	2.93	4.20	7.25	17.26	16.48	50.77	54.00	25.51	15.00	6.01	3.02	2.80	5.00
	1954-63	9.45	8.60	8.09	6.87	12.02	32.65	40.00	37.65	25.00	14.82	12.72	8.20	11.98
	1964-73	14.91	18.00	25.38	23.82	29.19	44.29	73.00	43.38	26.00	24.56	20.74	18.00	22.98
	1974-83	36.74	40.00	50.59	40.29	39.02	67.38	105.00	69.65	56.00	51.29	44.65	34.00	43.97
Q(80)	1946-83	11.97	15.00	14.98	19.96	24.05	56.93	70.00	45.96	30.00	18.98	10.97	7.90	20.00
	1946-53	3.19	5.20	8.85	19.91	22.57	58.74	60.00	30.83	17.00	8.13	3.19	3.10	6.31
	1954-63	11.00	15.00	11.00	8.40	13.03	40.00	48.00	41.00	28.00	18.00	14.00	8.80	14.01
	1964-73	16.00	22.00	30.00	27.00	35.17	54.00	84.00	49.00	30.00	27.00	23.00	19.00	27.01
	1974-83	40.00	43.00	57.00	44.00	40.06	80.00	114.00	75.00	60.00	56.00	47.00	38.00	48.01
Q(75)	1946-83	13.98	18.00	18.97	22.97	28.84	64.93	81.00	52.94	39.00	23.96	14.97	11.00	25.00
	1946-53	3.48	5.80	9.15	21.31	29.05	68.15	65.00	34.77	21.00	9.73	3.25	3.40	8.21
	1954-63	12.72	16.00	12.72	9.35	14.03	47.75	56.00	45.31	31.00	21.44	15.72	10.00	16.97
	1964-73	16.86	25.00	36.89	30.44	39.13	62.61	99.00	56.75	34.00	33.03	24.72	21.00	30.96
	1974-83	42.58	45.00	63.03	45.72	42.06	89.47	123.00	78.44	64.00	57.72	51.31	41.00	51.96

* FP = Flow Parameter

The flow data at all gaging stations in Illinois were examined for time trends, and the data for the gaging stations showing significant time trends were analyzed. Flow-duration values for present conditions were developed for 66 gaging stations. These flow-duration values (both unmodified and adjusted for present conditions) at 90, 85, 80, and 75% exceedance probabilities are given in Table 11.

The procedure used is simplistic and applies only to the modification of yearly flow-duration values. More detailed analyses are needed to improve the estimates of yearly flow duration for present conditions and to calculate the monthly flow-duration values as well. Such a detailed analysis is beyond the scope of this project

Table 11. Estimated Flow-Duration Values in cfs for Present Conditions, P,
at Selected Gaging Stations

USGS No.	Stream and Gaging Station	Period	Q(90)	Q(85)	Q(80)	Q(75)
03337500	Saline Branch at Urbana	1936-58	4.00	4.70	5.40	6.40
		P	15.20	15.70	16.30	16.90
03338500	Vermilion River near Catlin	1939-58	32.00	37.00	44.00	64.00
		P	43.00	48.00	55.00	75.00
03339000	Vermilion River near Danville	1928-83	52.00	67.02	84.99	109.07
		P	67.00	80.00	100.00	132.00
03382100	South Fork Saline River near Carrier Mills	1965-83	4.20	5.40	7.00	8.49
		P	5.50	6.70	8.30	9.80
03382500	Saline River near Junction	1939-71	6.60	10.01	15.00	21.03
		P	8.10	11.50	16.50	22.50
05414820	Sinsinawa River near Menominee	1967-83	9.10	10.00	11.00	12.00
		P	9.70	11.00	12.00	13.00
05437500	Rock River at Rockton	1939-83	1200.00	1369.71	1540.05	1729.47
		P	1253.00	1392.00	1567.00	1801.00
05438500	Kishwaukee River at Belvidere	1939-83	62.00	72.98	87.00	101.96
		P	67.50	86.10	109.00	124.00
05439500	S. Br. Kishwaukee River near Fairdale	1939-83	17.00	20.99	27.00	34.98
		P	21.80	30.10	37.10	48.00
05440000	Kishwaukee River near Perryville	1939-83	116.00	134.97	160.01	187.92
		P	140.00	171.00	202.00	235.00
05443500	Rock River at Como	1914-71	1550.00	1770.00	1980.00	2199.95
		P	1540.00	1725.00	1897.00	2104.00
05445500	Rock Creek near Morrison	1942-58	20.00	22.00	24.01	26.01
		P	22.80	25.70	28.10	29.50
05446500	Rock River near Joslin	1939-83	1860.00	2099.60	2350.07	2639.19
		P	1780.00	1972.00	2210.00	2428.00
05447000	Green River at Amboy	1939-58	10.00	12.00	14.00	16.00
		P	11.40	14.10	16.40	18.20
05448000	Mill Creek at Milan	1941-83	1.50	2.30	3.30	4.40
		P	1.90	2.70	3.80	5.20
05466000	Edwards River near Orion	1940-83	5.60	7.80	10.00	13.01
		P	5.70	8.10	11.10	15.00
05466500	Edwards River near New Boston	1934-83	20.00	25.00	32.00	39.99
		P	20.00	26.00	34.00	44.20
05467000	Pope Creek near Keithsburg	1934-83	6.10	8.00	11.00	14.00
		P	6.50	8.80	11.60	15.20
05467500	Henderson Creek near Little York	1940-58	2.10	3.40	4.50	5.69
		P	2.10	3.50	5.20	7.30
05512500	Bay Creek at Pittsfield	1939-83	.20	.33	.48	.62
		P	.30	.45	.65	.95

Table 11. Continued.

<i>USGS No.</i>	<i>Stream and Gaging Station</i>	<i>Period</i>	<i>Q(90)</i>	<i>Q(85)</i>	<i>Q(80)</i>	<i>Q(75)</i>
05513000	Bay Creek at Nebo	1939-83 P	1.40 2.00	2.50 3.00	3.80 4.50	5.20 6.50
05520500	Kankakee River at Momence	1915-83 P	639.98 651.00	717.97 735.00	799.96 821.00	884.95 907.00
05527500	Kankakee River near Wilmington	1915-83 P	779.97 825.00	899.96 950.00	1039.93 1104.00	1199.90 1280.00
05528500	Buffalo Creek near Wheeling	1952-83 P	.20 .80	.47 1.40	.80 2.00	1.30 2.60
05529000	Des Plaines River near Des Plaines	1940-83 P	7.60 42.00	12.01 46.00	17.99 53.00	24.01 64.00
05529500	McDonald Creek near Mount Prospect	1952-83 P	0.00 .10	.07 .30	.20 .50	.40 .70
05530000	Weller Creek at Des Plaines	1950-83 P	.12 .20	.30 .40	.45 .65	.66 .90
05531500	Salt Creek at Western Springs	1945-83 P	11.00 52.00	16.00 56.00	20.00 60.00	25.00 64.00
05532000	Addison Creek at Bellwood	1951-83 P	1.90 4.00	2.70 5.00	3.30 5.50	3.80 6.00
05532500	Des Plaines River at Riverside	1943-83 P	26.00 136.00	37.98 148.00	53.00 172.00	72.93 212.00
05533000	Flag Creek near Willow Springs	1951-83 P	3.80 10.00	4.30 11.40	4.90 13.00	5.30 14.30
05533500	Des Plaines River at Lemont	1915-44 P	14.00 152.00	19.99 165.00	29.01 191.00	36.97 232.00
05535500	W. F. of N. Br. Chicago River at Northbrook	1952-83 P	1.30 2.90	1.80 3.20	2.30 3.60	2.90 4.00
05536000	N. Br. Chicago River at Niles	1950-83 P	9.30 21.50	12.99 23.20	16.00 25.00	18.99 26.60
05536215	Thorn Creek at Glenwood	1949-83 P	15.00 19.00	16.00 20.50	17.00 22.00	18.00 23.00
05536255	Butterfield Creek at Flossmoor	1948-83 P	.50 .20	.70 .35	1.00 .50	1.30 .76
05536265	Lansing Ditch near Lansing	1948-83 P	.50 .80	.90 1.30	1.30 1.80	1.70 2.30
05536270	North Creek near Lansing	1948-79 P	.60 1.30	1.10 1.80	1.60 2.40	2.10 3.10
05536275	Thorn Creek at Thornton	1948-83 P	21.00 30.00	24.00 32.00	26.00 34.00	28.00 37.00
05536290	Little Calumet River at South Holland	1947-83 P	34.00 42.00	38.01 45.00	43.00 48.00	47.02 54.00

Table 11. Continued.

<i>USGS No.</i>	<i>Stream and Gaging Station</i>	<i>Period</i>	<i>Q(90)</i>	<i>Q(85)</i>	<i>Q(80)</i>	<i>Q(75)</i>
05536325	Little Calumet River at Harvey	1916-33 P	27.00 44.00	36.06 48.00	50.99 52.00	63.06 59.00
05537500	Long Run near Lemont	1951-83 P	.05 .38	.10 .64	.26 1.02	.52 1.49
05539000	Hickory Creek at Joliet	1944-83 P	6.90 8.40	8.10 9.90	9.50 11.00	11.00 14.00
05539900	W. Br. Du Page River near West Chicago	1961-83 P	4.60 12.00	6.60 13.00	8.50 14.00	10.00 15.00
05540500	Du Page River at Shorewood	1940-83 P	41.00 90.00	48.01 97.00	55.99 106.00	68.02 120.00
05542000	Mazon River near Coal City	1939-83 P	1.20 4.00	2.60 5.50	4.70 7.20	7.49 12.90
05543500	Illinois River at Marseilles	1919-83 P	4579.83 4300.00	4979.79 4610.00	5449.68 4920.00	5909.61 5230.00
05548280	Nippersink Creek near Spring Grove	1966-83 P	43.00 46.00	51.03 55.00	58.00 63.00	64.04 70.00
05550000	Fox River at Algonquin	1915-83 P	172.99 192.00	211.99 237.00	252.98 280.00	288.98 321.00
05550500	Poplar Creek at Elgin	1951-83 P	1.00 1.80	1.40 2.50	2.00 3.10	2.70 3.80
05551200	Ferson Creek near St. Charles	1961-83 P	3.20 4.00	4.80 5.70	6.80 7.30	8.89 9.10
05551700	Blackberry Creek near Yorkville	1960-83 P	9.10 10.70	12.00 12.30	14.00 14.50	16.00 17.00
05552500	Fox River at Dayton	1924-83 P	342.00 392.00	406.07 454.00	465.00 521.00	531.15 586.00
05554500	Vermilion River at Pontiac	1942-83 P	6.20 8.00	9.50 11.50	13.00 15.50	18.99 23.00
05555500	Vermilion River at Lowell	1931-71 P	15.00 18.00	20.99 24.00	29.00 33.00	42.95 47.00
05556500	Bureau Creek at Princeton	1936-83 P	2.70 4.00	3.90 5.40	5.60 7.50	8.51 11.00
05562000	Farm Creek at East Peoria	1944-80 P	1.50 1.70	2.00 2.30	2.70 3.00	3.00 4.00
05567500	Mackinaw River near Congerville	1944-83 P	12.00 14.00	16.01 18.00	22.01 25.00	33.02 37.00
05568000	Mackinaw River near Green Valley	1921-56 P	44.01 56.00	53.01 63.00	63.02 76.00	78.03 90.00
05568500	Illinois River at Kingston Mines	1939-83 P	5020.00 5320.00	5628.98 5940.00	6220.14 6440.00	6768.46 6970.00

<i>USGS No.</i>	<i>Stream and Gaging Station</i>	<i>Period</i>	<i>Q(90)</i>	<i>Q(85)</i>	<i>Q(80)</i>	<i>Q(75)</i>
05570000	Spoon River at Seville	1914-83	60.00	81.01	108.01	140.02
		P	63.00	87.00	114.00	148.00
05572000	Sangamon River at Monticello	1914-83	12.00	16.00	23.00	31.01
		P	12.20	16.40	23.50	32.00
05576000	S. F. Sangamon River near Rochester	1949-83	8.60	15.00	23.99	35.99
		P	9.70	15.00	24.00	37.00
05576500	Sangamon River at Riverton	1914-55	46.99	63.98	88.97	123.94
		P	83.00	104.00	135.00	179.00
05578500	Salt Creek near Rowell	1942-83	11.00	14.00	17.99	23.99
		P	5.00	5.00	8.80	21.30
05585500	Illinois River at Meredosia	1938-83	6319.61	7099.43	7879.24	8788.89
		P	6540.00	7330.00	8180.00	9090.00

Note: P represents flows estimated for present conditions of effluents, withdrawals, and regulation

IV. ADOPTION OF A PROTECTED-FLOW STANDARD: OTHER CONSIDERATIONS

Monthly vs Yearly Flow Duration

Some states have defined protected flow as the flow corresponding to 90, 85, or 80% flow duration based on the entire daily flow record: Variation of such flows from month to month is shown in Figure 3 for Shoal Geek near Breese. $Q_y(90)$ exceeds $Q_m(90)$ for the months August through December, and $Q_y(85)$, $Q_y(80)$, and $Q_y(75)$ exceed $Q_m(85)$, $Q_m(80)$, and $Q_m(75)$, respectively, for the months August through January. For all intents and purposes, the flows corresponding to 90-75% yearly flow durations are higher than those corresponding to monthly flow durations for the months August through December, and they will provide higher protected flows. However, during June and July the monthly flow-duration values are much higher than those for the yearly flow duration, and use of the yearly flow duration considerably lowers the protected flow. This was illustrated earlier by using Figure 2. If the protected flow is to correspond to some flow-duration value, the interaction between monthly and yearly flow-duration values will have to be recognized in determining desirable protected flows for each month, season, or whole year.

Aquatic Habitat Suitability

During low streamflows most fish are found in the pools of the riffle-pool sequences comprising the stream length. The average depth of the pool below the riffle bed increases with drainage area, although the relation needs validation for regional application. Singh and Ramamurthy (1981) and Singh (1983) have studied desirable low-flow releases from impounded streams in Illinois. Additional cost of storage to sustain low-flow releases during droughts was considered in their analyses. In natural stream systems, the desirable protected flows may be in the range of 85-80% flow duration.

Type of Water Use

About 90% of the water with drawn from a stream for municipal water supply is returned to the stream from the wastewater treatment plant, at some location downstream of the intake. Thus the low flow in the stream is decreased in the stream reach between the intake and the wastewater plant outfall. This distance can be reduced to minimize the affected length of the stream. In the Midwest water for irrigation

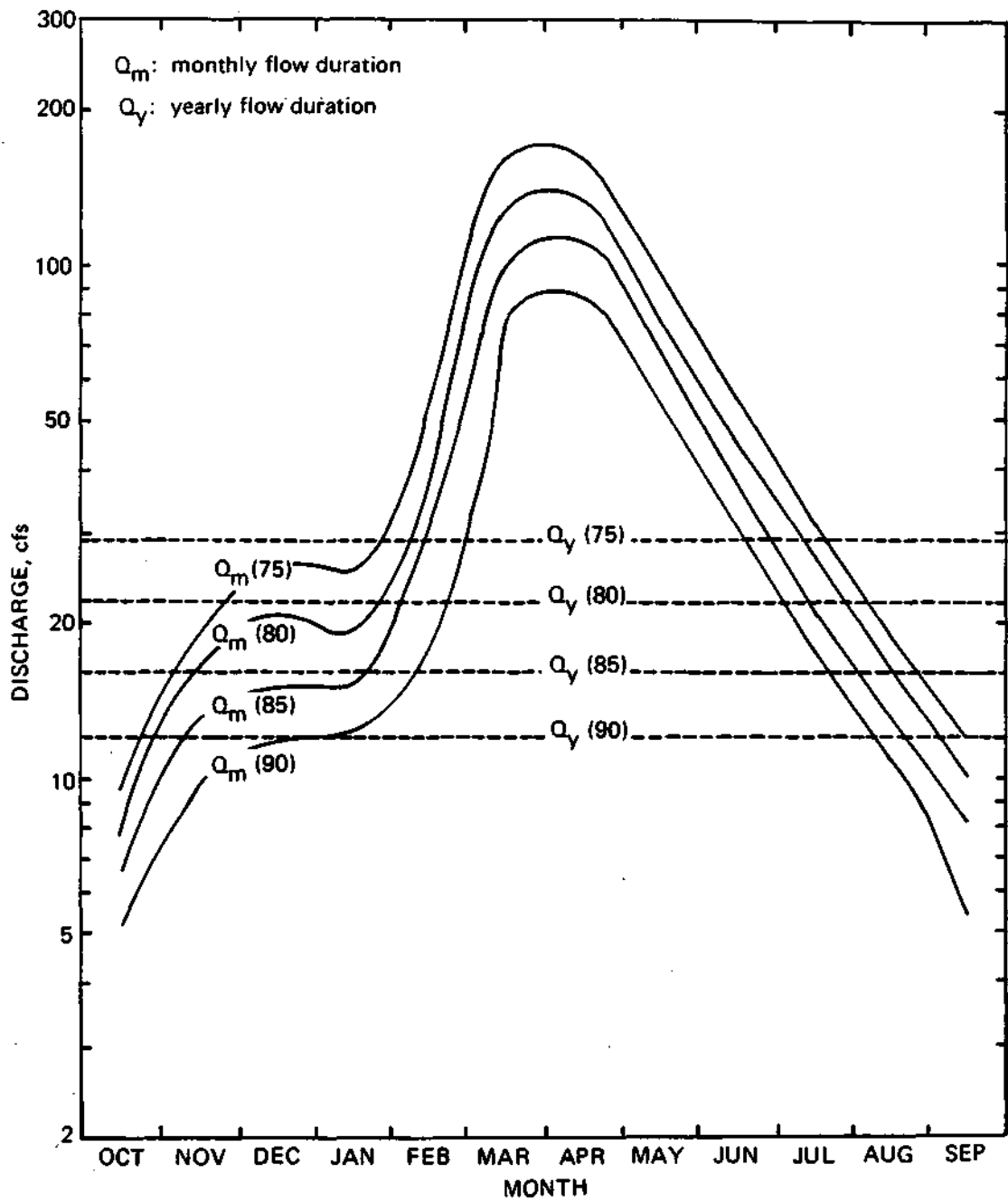


Figure 3. Monthly and yearly flow-duration values, Shoal Creek near Breese

is usually needed from mid-June to mid-August, and only a very small portion of this water reaches the stream in the form of baseflow during dry summer months. Although some water may be available for irrigation purposes in June and July, it may not be sufficient to meet expanding irrigation needs. Some on-farm storage ponds may be filled with water withdrawn from the stream during the relatively high-flow months of April and May.

Assimilative Capacity

During low-flow conditions, a stream usually consists of a series of pools and riffles. The riffles raise the dissolved oxygen (DO) level of the water in the stream, but the DO level in the pool may be reduced somewhat because of the presence of fish and other microorganisms. This aspect of stream behavior needs to be considered in determining the effect of various wastewater discharges on the DO.

Economics

As mentioned previously, the adoption of a suitable protected-flow standard involves consideration of conflicting goals and needs. Both tangible and intangible benefits are associated with a protected-flow level, and these benefits vary with the level of protection. There is also an associated cost for adopting and maintaining a protected-flow level in a stream. A cost-benefit approach using the information developed in this report will provide a framework for analyzing the economics of adopting a particular protected-flow level. This approach provides for an objective selection of a protected-flow level to meet the needs of the people in Illinois.

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APPENDIX

DEVELOPMENT OF PROTECTED-FLOW STATISTICS: SELECTED EXAMPLES

List of Tables

<i>Table</i>	<i>USGS No.</i>	<i>Period</i>	<i>Stream and Gaging Station</i>	<i>Drainage Area (sq mi)</i>
1	03345500	1914-83	Embarras River at Ste. Marie	1516.0
2	03379500	1914-83	Little Wabash River below Clay City	1131.0
3	05440000	1939-83	Kishwaukee River near Perryville	1099.0
4	05542000	1939-83	Mazon River near Coal City	455.0
5	05554500	1942-83	Vermilion River at Pontiac	579.0
6	05567500	1944-83	Mackinaw River near Congerville	767.0
7	05570000	1914-83	Spoon River at Seville	1636.0
8	05585000	1921-83	La Moine River at Ripley	1293.0

NOTES FOR TABLES 1 - 8

Definition: Protected flow is the flow below which water withdrawals are not permitted. The four levels of protected flow selected for this study are flows corresponding to 90, 85, 80, and 75 percent flow durations.

$$Q_a = Q_o - Q_p \quad \text{where}$$

Q_a = available flow

Q_o = observed flow

Q_p = protected flow

Deficit period refers to days when $Q_a \leq 0$

Surplus period refers to days when $Q_a > 0$

<i>Item</i>	<i>Explanation</i>
\bar{Q}	Average of monthly or yearly mean flows for period of record, in cfs
$\bar{Q}(s)$	Standard deviation of the monthly or yearly mean flows, in cfs
Q(90)	Flow in cfs corresponding to 90 percent flow duration
Q(85)	Flow in cfs corresponding to 85 percent flow duration
Q(80)	Flow in cfs corresponding to 80 percent flow duration
Q(75)	Flow in cfs corresponding to 75 percent flow duration
AVQ(-)	Average flow during deficit periods = $(\sum Q_a \text{ during deficit periods}) / (\text{total deficit days})$
% years	% of years during which there is at least 1 deficit day
% days	% of deficit days for period of record
AVQ(+)	Average flow during surplus periods = $(\sum Q_a \text{ during surplus periods}) / (\text{total surplus days})$
% years	% of years during which there is at least 1 surplus day
% days	% of surplus days for period of record
T	= M refers to the use of monthly flow-duration values as protected flows
T	= Y refers to the use of yearly flow-duration values as protected flows

Table 1.1 Monthly and Annual Mean Flows in cfs

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1915	56.1	4.4	4.8	127.1	2335.7	579.7	179.2	1634.2	1592.0	1933.7	4437.1	959.3	1149.0
1916	255.2	388.0	1420.6	6435.5	4094.5	1013.1	543.3	337.9	998.3	200.6	77.7	42.6	1311.1
1917	30.7	27.7	157.2	784.2	275.4	1386.7	1192.3	2174.8	4111.0	794.2	529.6	385.6	988.5
1918	165.6	397.7	141.1	177.6	2539.1	722.1	2436.7	2514.8	769.4	1689.5	241.8	1456.8	1090.8
1919	400.9	801.2	3501.0	1300.6	1255.2	2259.7	508.7	1352.4	1964.6	843.0	133.7	65.7	1202.4
1920	966.0	2681.3	1459.8	350.6	1739.1	2919.2	2235.0	2667.4	452.4	180.0	123.5	120.7	1321.8
1921	70.0	69.6	282.3	642.1	664.6	2318.8	1595.7	647.0	368.7	149.6	195.2	1237.7	685.5
1922	623.6	2143.9	2083.9	976.1	707.0	4692.7	7675.7	1099.4	436.2	285.1	59.5	23.1	1733.1
1923	24.9	21.3	237.7	393.9	576.8	4021.6	1678.3	1271.9	391.4	170.9	578.7	209.5	802.4
1924	593.2	441.3	3519.0	1362.3	3087.1	2075.2	1901.7	2109.8	2377.7	483.3	686.1	612.5	1598.9
1925	110.6	155.0	2095.2	956.5	1569.6	3225.8	578.0	182.3	369.4	230.2	106.8	42.0	801.1
1926	31.8	416.0	430.8	1132.1	1934.3	1524.7	3188.0	409.9	208.8	56.5	242.9	3809.5	1100.1
1927	3892.4	1392.2	642.6	2041.3	3258.7	5208.2	5221.0	5169.8	4119.0	421.5	826.0	222.5	2696.3
1928	2803.2	899.2	5315.2	2024.2	3947.2	1270.6	1012.9	1284.0	2430.6	610.0	471.0	110.2	1844.8
1929	359.7	381.4	1380.9	2805.3	708.0	2521.0	4286.7	6519.0	2128.2	1430.7	165.9	61.5	1907.4
1930	61.0	259.9	2304.5	7726.8	2520.0	1301.8	792.7	340.4	146.8	78.3	29.8	136.6	1308.9
1931	28.7	23.9	38.6	26.9	53.9	265.7	120.2	189.5	177.8	93.2	107.7	1055.2	181.1
1932	1064.2	1634.4	2356.9	4138.4	1761.1	522.9	307.5	220.9	483.0	329.4	129.7	225.7	1099.0
1933	31.0	298.7	1090.3	2627.1	1765.6	3872.5	3245.3	7054.8	682.8	121.5	401.1	45.4	1777.4
1934	79.9	36.5	55.7	133.7	103.0	561.2	696.6	163.6	103.5	267.8	677.5	831.8	309.8
1935	516.0	1952.8	1591.0	2326.2	933.8	2818.9	831.3	5632.4	872.7	721.0	153.0	66.0	1546.1
1936	42.4	305.1	175.6	285.8	1645.7	2081.0	1152.6	886.7	166.6	54.0	54.6	55.5	571.3
1937	239.1	1322.1	269.0	6179.4	3100.7	963.5	1781.4	2388.1	1219.3	542.9	160.4	51.4	1509.8
1938	361.6	107.7	1274.0	431.7	1487.4	3845.8	6579.7	1057.3	1151.8	1499.5	730.8	293.1	1563.9
1939	92.2	158.3	335.4	813.2	3547.1	5106.1	3723.9	680.2	1479.5	431.8	647.5	93.9	1409.0
1940	27.4	28.2	27.2	50.4	241.6	399.4	1415.5	1794.4	769.7	109.8	61.0	33.9	412.5
1941	43.7	128.7	212.3	284.3	187.7	112.0	923.5	328.2	1233.7	274.3	118.1	79.1	325.4
1942	630.3	2368.3	777.2	492.5	3553.8	2662.3	2674.6	928.8	2990.1	1995.3	223.4	110.0	1596.7
1943	59.9	1503.9	1402.7	1204.5	891.0	1398.0	681.0	10552.7	1280.6	550.3	145.1	53.2	1658.1
1944	30.5	109.8	35.5	89.2	354.7	1284.3	4824.7	1694.8	822.1	106.9	68.8	85.6	787.3
1945	37.4	23.6	19.5	68.5	240.1	3189.5	5594.7	2245.1	4361.5	614.0	582.4	234.5	1431.8
1946	785.4	1033.4	1072.0	2331.3	2821.6	1080.5	364.1	3901.9	1971.3	507.6	439.0	95.1	1360.5
1947	56.8	954.8	1109.0	1606.5	1224.5	573.8	2702.7	2177.4	2554.7	761.7	179.5	265.3	1175.4
1948	216.3	235.6	158.1	1110.2	973.0	4503.2	2996.5	976.6	461.8	864.5	143.2	55.4	1059.7
1949	61.1	604.9	833.3	7135.5	4545.7	1538.1	937.7	577.0	691.6	416.8	156.7	150.6	1455.1
1950	2386.2	427.4	2203.2	11517.1	5728.6	2274.8	2469.0	589.9	1713.0	1620.5	157.7	674.3	2636.0
1951	497.2	1093.3	1288.6	2425.0	5717.5	2197.1	2526.3	1238.2	657.5	1860.0	477.9	373.4	1663.9
1952	364.2	1532.7	1411.5	2358.4	2446.7	3081.1	2990.3	554.1	1334.7	416.6	88.9	69.2	1380.5
1953	28.8	37.1	56.8	93.5	200.1	2289.4	1855.0	1160.4	342.9	272.1	54.4	25.1	537.0
1954	15.8	16.4	17.0	20.6	21.6	23.4	134.7	78.3	65.9	18.8	11.6	7.7	35.9
1955	78.4	13.6	32.2	239.2	218.1	653.6	989.8	610.2	1172.4	881.0	160.9	136.7	432.3
1956	693.5	1525.5	423.8	153.2	3024.9	1329.8	865.7	900.2	1068.4	387.7	108.8	47.1	865.7
1957	24.2	29.4	325.8	552.9	1116.4	1025.8	6170.7	3049.7	5751.8	3615.6	361.9	214.9	1846.3
1958	362.1	999.3	4880.8	1778.5	603.3	1031.5	950.1	1271.5	2569.0	3844.4	2279.5	291.8	1753.7
1959	224.9	1210.9	777.0	1520.7	4748.4	2297.3	1109.3	579.1	251.7	105.9	105.1	36.5	1055.1
1960	52.1	230.9	358.6	687.4	1609.0	1278.2	1292.6	941.7	2602.6	853.8	103.6	42.7	831.3
1961	26.9	27.8	33.3	32.8	137.6	1887.5	1311.6	5810.2	826.0	398.0	490.6	210.1	942.9
1962	105.3	663.8	1149.6	3446.1	3411.4	4476.8	1025.8	1218.1	1009.6	759.7	295.0	92.4	1463.7
1963	44.5	50.1	48.8	46.7	36.4	2624.3	755.8	439.9	212.2	164.2	283.9	67.7	402.2
1964	20.2	33.2	34.5	227.6	307.4	2217.4	3203.7	769.3	183.6	95.8	36.9	26.9	595.1
1965	14.6	28.4	38.3	266.5	900.7	1002.0	2010.9	868.7	975.1	340.2	63.9	285.0	560.6
1966	195.1	81.0	95.2	476.6	549.7	416.5	1455.2	1979.2	350.6	119.5	49.2	68.2	485.8
1967	41.1	270.4	4186.8	794.1	2080.8	2544.0	978.1	2383.8	894.4	285.5	179.9	47.0	1224.2
1968	83.5	126.3	7495.1	1676.0	3778.9	878.3	1429.4	3476.4	1966.8	504.8	959.4	86.4	1871.9
1969	53.9	140.9	519.0	2867.7	4437.0	670.1	3284.4	754.6	873.3	970.5	269.8	548.4	1257.3
1970	1669.8	1343.0	574.3	1002.3	1590.8	1158.0	4787.1	1485.9	960.5	211.2	113.2	69.4	1238.4
1971	148.9	174.4	171.7	315.7	3053.7	1329.9	305.7	800.1	926.6	1071.7	217.9	78.4	708.8
1972	49.3	31.4	1433.3	767.9	477.2	373.3	3089.9	814.3	388.4	204.4	226.3	366.1	683.2
1973	537.6	2883.9	2135.8	3390.3	1210.3	5397.2	4058.7	910.3	2595.6	2987.9	923.6	164.0	2273.2
1974	172.5	605.8	3300.1	5794.4	2767.4	3842.3	3286.7	3580.0	4680.9	711.0	727.9	1688.7	2595.4

Table 1.1 Continued

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1975	242.5	729.6	1110.8	3732.6	4834.6	2978.4	2136.5	2102.6	1863.0	1498.2	463.2	362.0	1819.4
1976	247.4	260.8	1495.1	1565.4	2623.6	2611.4	576.0	256.5	214.9	229.0	71.4	37.1	845.7
1977	37.2	29.4	22.2	13.4	394.1	1432.6	993.2	1349.4	217.9	193.4	140.9	196.5	419.2
1978	540.9	325.6	2971.0	332.6	191.4	5771.3	1645.8	2773.1	677.0	956.7	1632.3	360.0	1534.0
1979	172.7	690.1	974.2	1197.4	2499.6	7556.4	5516.7	1089.4	419.7	1347.9	2761.5	245.0	2039.0
1980	80.8	167.3	570.3	384.7	764.7	2105.1	2641.2	611.8	997.4	323.9	543.2	600.5	813.1
1981	100.5	72.7	192.4	90.8	863.2	535.5	1003.1	3295.2	1435.7	1102.4	1853.6	1641.2	1016.5
1982	767.9	560.5	713.9	2689.3	7790.4	4111.3	1647.0	735.7	2235.2	1804.1	206.5	246.9	1928.0
1983	696.6	875.1	5554.8	1207.7	1365.0	1398.0	3157.4	2957.1	1852.5	606.5	120.0	45.0	1657.2
\bar{Q}	371.4	587.5	1223.3	1655.6	1915.1	2153.9	2148.3	1805.8	1313.4	733.1	443.8	332.3	1219.9
$\bar{Q}(e)$	661.3	695.1	1528.4	2150.8	1670.4	1575.2	1704.5	1878.0	1204.7	791.8	702.8	569.6	593.9

Table 1.2 Results of Low-Flow Analyses

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
1.45	69.00	1.94	4.19	6.36	8.89	Sep 1954	Sep 1954	Sep 1954	Aug 1954
2.90	34.50	9.29	9.93	11.00	15.49	Jan 1976	Jan 1976	Jan 1976	Jan 1976
4.35	23.00	11.43	12.53	14.16	15.92	Oct 1922	Sep 1922	Oct 1964	Nov 1953
5.80	17.25	12.86	13.33	14.87	16.57	Oct 1964	Jan 1953	Jan 1953	Oct 1964
7.25	13.80	13.00	13.40	17.68	20.21	Jan 1953	Oct 1964	Dec 1944	Dec 1944
8.70	11.50	16.29	16.67	18.35	20.56	Dec 1944	Dec 1944	Nov 1963	Oct 1922
10.14	9.86	16.71	17.67	18.39	21.84	Nov 1963	Nov 1930	Nov 1922	Oct 1963
11.59	8.63	16.86	17.73	19.97	25.80	Feb 1930	Jan 1939	Oct 1930	Oct 1930
13.04	7.67	17.29	18.00	21.35	26.52	Jan 1962	Nov 1963	Dec 1939	Nov 1960
14.49	6.90	17.43	18.40	23.74	26.54	Jan 1939	Sep 1936	Oct 1956	Dec 1939
15.94	6.27	17.57	19.53	23.97	26.66	Sep 1936	Jan 1962	Oct 1960	Oct 1956
17.39	5.75	18.71	21.07	26.97	28.23	Oct 1932	Oct 1932	Nov 1916	Oct 1916
18.84	5.31	20.71	22.93	27.13	30.85	Dec 1960	Oct 1960	Oct 1952	Oct 1952
20.29	4.93	20.86	23.27	28.58	35.61	Nov 1916	Oct 1956	Sep 1940	Oct 1940
21.74	4.60	22.14	23.47	28.87	36.57	Oct 1940	Nov 1940	Dec 1933	Oct 1925
23.19	4.31	23.00	24.60	28.94	37.44	Oct 1956	Nov 1916	Feb 1962	Nov 1971
24.64	4.06	24.14	25.60	30.35	38.97	Jul 1931	Nov 1952	Oct 1943	Feb 1962
26.09	3.83	24.86	28.47	30.48	40.02	Nov 1952	Oct 1943	Oct 1932	Oct 1943
27.54	3.63	25.71	28.60	31.52	41.90	Oct 1943	Nov 1933	Nov 1971	Nov 1933
28.99	3.45	26.43	29.20	31.74	42.84	Sep 1959	Sep 1959	Oct 1925	Sep 1959
30.43	3.29	27.14	29.20	32.74	46.39	Oct 1925	Nov 1971	Oct 1966	Aug 1966
31.88	3.14	27.14	29.73	33.23	48.57	Nov 1933	Oct 1925	Sep 1959	Oct 1932
33.33	3.00	28.57	29.73	40.26	48.74	Nov 1966	Nov 1966	Aug 1931	Aug 1936
34.78	2.88	28.57	33.53	40.90	51.89	Nov 1971	Jul 1931	Sep 1936	Oct 1935
36.23	2.76	31.14	34.00	41.84	56.26	Jul 1926	Sep 1937	Oct 1935	Sep 1948
37.68	2.65	31.43	35.20	42.74	57.10	Sep 1941	Sep 1941	Sep 1967	Oct 1968
39.13	2.56	33.14	36.87	45.87	60.52	Sep 1937	Sep 1955	Sep 1948	Sep 1919
40.58	2.46	34.00	37.40	46.74	61.28	Sep 1955	Jul 1934	Sep 1955	Oct 1929
42.03	2.38	35.57	38.20	48.03	65.36	Jul 1934	Jul 1926	Oct 1919	Sep 1967
43.48	2.30	36.00	40.67	48.45	68.26	Sep 1948	Oct 1935	Sep 1937	Nov 1920
44.93	2.23	37.86	40.87	49.84	75.07	Oct 1946	Oct 1948	Sep 1929	Sep 1970
46.38	2.16	38.86	41.20	50.19	75.30	Oct 1947	Oct 1967	Oct 1968	Oct 1946
47.83	2.09	39.29	42.00	56.55	79.43	Oct 1935	Oct 1947	Jul 1926	Nov 1965
49.28	2.03	39.57	42.47	56.81	79.61	Oct 1967	Oct 1946	Oct 1946	Jul 1931
50.72	1.97	40.43	42.93	57.81	79.82	Oct 1919	Oct 1919	Nov 1920	Oct 1979
52.17	1.92	40.86	43.73	57.87	83.84	Oct 1920	Oct 1920	Oct 1942	Sep 1942
53.62	1.86	41.43	44.33	58.10	86.75	Oct 1929	Oct 1929	Sep 1970	Nov 1980
55.07	1.82	45.57	48.87	58.87	91.02	Aug 1965	Nov 1968	Oct 1947	Jun 1934
56.52	1.77	46.57	49.07	60.61	95.28	Oct 1938	Aug 1965	Aug 1965	Sep 1941
57.97	1.72	47.29	51.07	62.39	98.59	Sep 1961	Oct 1942	Sep 1941	Oct 1938

Table 1.2 Continued

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
59.42	1.68	48.43	51.67	67.26	98.72	Nov 1968	Sep 1961	Oct 1924	Sep 1937
60.87	1.64	48.71	53.73	71.03	117.38	Sep 1970	Sep 1970	Sep 1961	Aug 1955
62.32	1.60	49.14	55.00	72.13	117.43	Oct 1917	Nov 1924	Nov 1980	Aug 1977
63.77	1.57	49.29	55.47	72.52	120.00	Nov 1924	Oct 1938	Nov 1979	Nov 1924
65.22	1.53	49.29	55.60	77.94	130.61	Oct 1942	Oct 1917	Jun 1934	Jul 1926
66.67	1.50	51.00	59.07	87.29	142.23	Aug 1977	Aug 1977	Jul 1977	Sep 1949
68.12	1.47	52.14	62.93	87.58	156.44	Sep 1949	Nov 1980	Oct 1917	Sep 1961
69.57	1.44	56.86	70.40	89.87	156.90	Aug 1951	Oct 1923	Oct 1938	Jan 1917
71.01	1.41	58.00	70.53	101.97	161.70	Jul 1923	Nov 1979	Sep 1928	Oct 1973
72.46	1.38	58.86	79.27	102.19	162.41	Nov 1980	Aug 1951	Sep 1945	Aug 1921
73.91	1.35	67.71	79.87	113.81	173.44	Sep 1969	Oct 1957	Nov 1958	Oct 1978
75.36	1.33	67.71	86.00	116.94	176.16	Nov 1979	Sep 1928	Sep 1969	Sep 1957
76.81	1.30	72.29	92.00	118.84	176.75	Oct 1957	Sep 1969	Oct 1951	Aug 1972
78.26	1.28	78.86	93.13	128.52	177.00	Sep 1928	Sep 1945	Aug 1949	Sep 1947
79.71	1.25	87.71	93.20	133.39	179.62	Sep 1945	Jul 1921	Oct 1957	Sep 1923
81.16	1.23	89.14	95.60	135.19	222.13	Sep 1972	Nov 1958	Oct 1978	Sep 1928
82.61	1.21	89.29	96.53	135.32	230.20	Jul 1921	Sep 1949	Jul 1921	Oct 1958
84.06	1.19	89.71	99.73	148.55	234.16	Aug 1950	Sep 1972	Sep 1973	Oct 1975
85.51	1.17	91.00	104.13	150.90	250.43	Nov 1958	Nov 1978	Aug 1972	Apr 1915
86.96	1.15	96.71	110.07	154.10	250.74	Oct 1982	Aug 1950	Aug 1950	Sep 1982
88.41	1.13	99.29	123.13	157.74	279.49	Nov 1978	Sep 1982	Sep 1982	Aug 1950
89.86	1.11	109.57	124.67	165.61	293.62	Aug 1918	Dec 1915	Jul 1923	Aug 1969
91.30	1.10	111.43	134.67	170.97	314.28	Apr 1915	Oct 1918	Apr 1915	Oct 1951
92.75	1.08	119.57	137.80	184.13	353.51	Sep 1927	Sep 1973	Aug 1918	Aug 1945
94.20	1.06	128.71	142.20	210.97	478.07	Sep 1973	Sep 1927	Sep 1927	Nov 1974
95.65	1.05	158.14	188.60	213.81	529.20	Oct 1975	Oct 1975	Oct 1974	Aug 1927
97.10	1.03	169.86	189.33	221.68	558.77	Oct 1974	Oct 1974	Nov 1975	Nov 1981
98.55	1.01	249.57	259.00	412.97	559.23	Apr 1981	Apr 1981	Dec 1981	Oct 1918
	μ	52.73	59.46	78.64	128.93				
	σ	43.02	48.25	68.81	130.57				

**Table 1.3 Results of Low-Flow Analyses
for 5- and 9-month Droughts**

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
1.43	70.00	18.08	Dec	1953	36.39	Dec	1953
2.86	35.00	25.85	Sep	1954	60.49	Sep	1954
4.29	23.33	27.62	Nov	1976	62.55	Oct	1930
5.71	17.50	28.81	Oct	1964	101.00	Sep	1976
7.14	14.00	32.50	Nov	1960	130.27	Nov	1940
8.57	11.67	24.22	Dec	1930	149.92	Oct	1963
10.00	10.00	45.08	Dec	1962	162.08	Sep	1964
11.43	8.75	45.27	Nov	1939	163.49	Oct	1944
12.86	7.78	46.78	Nov	1944	170.82	Nov	1933
14.29	7.00	55.99	Oct	1952	216.26	Nov	1939
15.71	6.36	63.51	Nov	1943	228.70	Oct	1922
17.14	5.83	67.17	Oct	1916	258.27	Oct	1952
18.57	5.38	70.15	Nov	1933	264.61	Oct	1962
20.00	5.00	73.27	Oct	1922	265.21	Aug	1925
21.43	4.67	75.30	Sep	1940	267.34	Sep	1959
22.86	4.38	76.42	Nov	1963	268.44	Aug	1916
24.29	4.12	105.93	Sep	1959	277.93	Nov	1965
25.71	3.89	106.89	Oct	1956	283.12	Jul	1932
27.14	3.68	109.45	Sep	1966	289.45	Oct	1920
28.57	3.50	112.74	Sep	1920	294.21	Oct	1943
30.00	3.33	113.86	Aug	1936	349.39	Nov	1960
31.43	3.18	135.29	Oct	1970	368.93	Nov	1980
32.86	3.04	137.62	Jun	1931	382.58	Sep	1956
34.29	2.92	143.81	Oct	1965	405.45	Sep	1970
35.71	2.80	144.23	Sep	1967	466.62	Aug	1936
37.14	2.69	146.29	Jul	1930	474.07	Oct	1935
38.57	2.59	148.33	Oct	1935	499.84	Nov	1971
40.00	2.50	155.99	Aug	1925	523.06	Jul	1931
41.43	2.41	202.80	Sep	1932	567.57	Oct	1977
42.86	2.33	210.82	Oct	1947	612.78	Jun	1955
44.29	2.26	211.09	Nov	1980	626.18	Oct	1937
45.71	2.19	244.69	Sep	1937	650.29	Nov	1917
47.14	2.12	253.51	Nov	1917	681.20	Sep	1938
48.57	2.06	257.66	Aug	1977	700.09	Sep	1941
50.00	2.00	269.28	Jun	1976	717.03	Oct	1947
51.43	1.94	289.35	Nov	1979	723.69	Feb	1915
52.86	1.89	289.52	Sep	1971	729.56	Nov	1946
54.29	1.84	317.06	Aug	1948	748.86	Oct	1979
55.71	1.79	321.84	Oct	1938	755.56	Aug	1934
57.14	1.75	325.50	Apr	1934	777.35	Aug	1948
58.57	1.71	343.84	Feb	1941	809.00	Jul	1949
60.00	1.67	344.33	Aug	1972	830.37	Dec	1942
61.43	1.63	348.86	Sep	1968	835.65	Jul	1967
62.86	1.59	370.80	Jul	1953	873.04	Sep	1966
64.29	1.56	370.99	Jun	1963	881.12	Jul	1928
65.71	1.52	373.36	Sep	1961	889.34	Sep	1969
67.14	1.49	386.41	Sep	1928	936.16	Sep	1921
68.57	1.46	388.71	Aug	1923	948.66	Sep	1923
70.00	1.43	395.73	Sep	1929	1005.12	Oct	1924
71.43	1.40	398.39	Jul	1949	1015.02	Aug	1968
72.86	1.37	406.56	Jul	1941	1017.53	Oct	1978
74.29	1.35	409.45	Sep	1924	1038.75	Jun	1919
75.71	1.32	410.52	Sep	1946	1095.08	Sep	1975
77.14	1.30	426.42	Feb	1955	1110.92	Sep	1950
78.57	1.27	505.63	Dec	1914	1141.39	Sep	1951
80.00	1.25	514.94	Aug	1921	1144.90	Dec	1945
81.43	1.23	565.46	Oct	1975	1182.75	Aug	1972
82.86	1.21	586.40	Nov	1955	1188.82	Oct	1961
84.29	1.19	618.64	May	1916	1242.33	Dec	1957

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
85.71	1.17	649.81	Sep	1945	1374.60	Aug	1981
87.14	1.15	658.99	Apr	1932	1389.59	May	1926
88.57	1.13	659.85	Oct	1942	1406.22	Jul	1982
90.00	1.11	674.75	Jul	1962	1408.43	Sep	1918
91.43	1.09	678.61	Nov	1978	1411.88	May	1983
92.86	1.08	683.09	Jul	1969	1554.24	Sep	1958
94.29	1.06	730.07	Oct	1950	1688.18	Dec	1929
95.71	1.04	746.42	Aug	1951	1746.27	Aug	1973
97.14	1.03	785.54	Sep	1982	1861.57	Nov	1974
98.57	1.01	794.56	Aug	1919	2286.40	Oct	1927

PROB ≥	Flow in cfs												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
99	7.05	3.95	5.06	12.05	15.19	24.68	80.46	72.48	52.80	15.18	9.41	8.55	13.00
95	16.99	16.92	17.99	21.99	45.25	173.91	229.10	176.94	108.66	53.98	32.99	21.92	27.00
90	22.99	22.00	26.99	51.97	99.94	317.86	328.00	249.93	160.00	75.98	42.99	30.00	41.00
85	27.99	27.91	35.99	89.95	150.95	413.86	427.56	304.92	209.29	99.97	52.99	34.93	62.01
80	31.99	32.00	50.97	124.93	219.86	508.82	503.00	376.87	253.00	123.96	63.98	39.00	88.01
75	36.99	45.67	85.92	192.84	331.82	588.81	597.71	431.87	303.77	146.95	74.97	44.86	121.02
70	42.05	65.00	135.27	253.45	410.89	695.77	701.00	501.41	355.00	172.19	86.09	50.00	162.95
60	56.06	110.00	219.52	390.53	658.84	930.76	890.00	625.47	464.00	230.22	112.08	66.00	275.95
50	79.11	179.00	404.53	580.65	932.05	1200.84	1140.00	792.60	619.00	308.28	140.10	85.00	438.93
40	127.15	285.00	632.60	860.84	1341.07	1560.99	1520.00	1050.71	837.00	426.32	183.13	123.00	660.93
30	206.15	472.00	955.71	1310.98	1861.32	2091.15	2080.00	1430.95	1170.00	598.30	255.16	177.00	999.92
25	261.21	605.46	1210.86	1661.33	2290.10	2501.59	2545.33	1771.12	1458.02	705.41	313.24	230.26	1259.90
20	350.28	790.00	1580.93	2231.72	2861.72	3181.72	3180.00	2251.72	1790.00	880.41	417.37	324.00	1619.88
15	500.48	1078.43	2081.65	3152.24	3698.41	4101.75	4117.29	3171.93	2201.14	1100.76	617.58	470.86	2149.87
10	841.70	1660.00	3262.37	4752.43	5302.12	5351.75	5310.00	4552.25	2970.00	1641.27	1030.79	737.00	3230.00
5	1592.23	2686.57	5803.02	7353.80	7370.45	7223.53	7442.46	6963.86	5103.31	3002.36	1881.58	1456.63	5440.00
1	5402.63	5429.94	10976.42	13870.30	13064.07	13272.43	12819.48	13569.89	8963.98	7041.59	4587.66	4209.97	10500.00
\bar{Q} , cfs	371.39	587.52	1223.27	1655.60	1915.30	2153.90	2148.30	1805.81	1313.42	733.08	443.84	332.30	1219.94
$10\bar{Q}$, %	19.30	25.67	24.83	25.08	29.37	29.24	29.27	24.64	27.51	24.21	19.34	19.72	25.77

Table 1.5 Protected-Flow Statistics for Month of October

with $Q_p = Q_m(90)$

Year	<i>If Available Flow ≤ 0</i>				<i>If Available Flow > 0</i>			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1915	-309.89	19	-16.31	-21.99	1336.07	12	111.34	307.01
1916	0.00	0	0.00	0.00	7197.15	31	232.17	677.01
1917	-1.99	2	-0.99	-0.99	241.16	29	8.32	17.01
1918	0.00	0	0.00	0.00	4421.17	31	142.62	1047.01
1919	0.00	0	0.00	0.00	11715.16	31	377.91	2657.01
1920	0.00	0	0.00	0.00	29233.16	31	943.01	6447.00
1921	0.00	0	0.00	0.00	1458.17	31	47.04	213.01
1922	0.00	0	0.00	0.00	18619.12	31	600.62	2817.01
1923	-147.89	19	-7.78	-12.99	208.07	12	17.34	52.01
1924	0.00	0	0.00	0.00	17676.15	31	570.20	3777.01
1925	0.00	0	0.00	0.00	2717.17	31	87.65	187.01
1926	0.00	0	0.00	0.00	274.17	31	8.84	16.01
1927	0.00	0	0.00	0.00	119952.00	31	3869.42	11777.00
1928	0.00	0	0.00	0.00	86187.06	31	2780.23	6227.00
1929	0.00	0	0.00	0.00	10438.15	31	336.71	2047.01
1930	0.00	0	0.00	0.00	1179.17	31	38.04	125.01
1931	-66.90	17	-3.94	-4.99	243.08	14	17.36	142.01
1932	0.00	0	0.00	0.00	32277.14	31	1041.20	5147.00
1933	-34.95	9	-3.88	-5.99	282.12	22	12.82	60.01
1934	0.00	0	0.00	0.00	1765.17	31	56.94	141.01
1935	0.00	0	0.00	0.00	15283.12	31	493.00	1857.01
1936	0.00	0	0.00	0.00	601.17	31	19.39	34.01
1937	0.00	0	0.00	0.00	6700.15	31	216.13	644.01
1938	0.00	0	0.00	0.00	10496.15	31	338.59	1777.01
1939	0.00	0	0.00	0.00	2144.17	31	69.17	268.01
1940	-27.94	11	-2.54	-3.99	164.11	20	8.21	17.01
1941	-11.97	5	-2.39	-2.99	655.15	26	25.20	151.01
1942	0.00	0	0.00	0.00	18825.15	31	607.26	2567.01
1943	0.00	0	0.00	0.00	1143.17	31	36.88	108.01
1944	0.00	0	0.00	0.00	233.17	31	7.52	13.01
1945	-6.98	3	-2.33	-2.99	453.16	28	16.18	63.01
1946	0.00	0	0.00	0.00	23634.12	31	762.39	2247.01
1947	0.00	0	0.00	0.00	1048.17	31	33.81	130.01
1948	0.00	0	0.00	0.00	5992.17	31	193.30	2127.01
1949	0.00	0	0.00	0.00	1182.17	31	38.13	118.01
1950	0.00	0	0.00	0.00	73260.06	31	2363.23	9877.00
1951	0.00	0	0.00	0.00	14700.14	31	474.20	1117.01
1952	0.00	0	0.00	0.00	10577.16	31	341.20	2537.01
1953	0.00	0	0.00	0.00	180.17	31	5.81	12.01
1954	-223.83	31	-7.22	-9.99	0.00	0	0.00	0.00
1955	-236.80	17	-13.93	-19.99	1955.08	14	139.65	427.01
1956	0.00	0	0.00	0.00	20787.13	31	670.55	3437.01
1957	0.00	0	0.00	0.00	38.17	31	1.23	5.01
1958	0.00	0	0.00	0.00	10511.16	31	339.07	2217.01
1959	0.00	0	0.00	0.00	6258.14	31	201.88	1237.01
1960	0.00	0	0.00	0.00	903.17	31	29.13	63.01
1961	-7.97	6	-1.33	-1.99	128.14	25	5.13	13.01
1962	0.00	0	0.00	0.00	2552.17	31	82.33	223.01
1963	0.00	0	0.00	0.00	665.17	31	21.46	113.01
1964	-102.86	25	-4.11	-6.99	15.03	6	2.51	7.01
1965	-259.83	31	-8.38	-10.99	0.00	0	0.00	0.00
1966	0.00	0	0.00	0.00	5334.15	31	172.07	503.01
1967	0.00	0	0.00	0.00	560.17	31	18.07	53.01
1968	0.00	0	0.00	0.00	1877.17	31	60.55	348.01
1969	0.00	0	0.00	0.00	958.17	31	30.91	39.01

Year	If Available Flow ≤ 0				If Available Flow > 0						
	ΣQ_n	No. Days	\bar{Q}_n	Q_{max}	ΣQ_n	No. Days	\bar{Q}_n	Q_{max}			
1970	0.00	0	0.00	0.00	51052.14	31	1646.84	4357.00			
1971	0.00	0	0.00	0.00	3903.17	31	125.91	263.01			
1972	0.00	0	0.00	0.00	816.17	31	26.33	50.01			
1973	0.00	0	0.00	0.00	15954.12	31	514.65	1237.01			
1974	0.00	0	0.00	0.00	4634.16	31	149.49	226.01			
1975	0.00	0	0.00	0.00	6806.15	31	219.55	642.01			
1976	0.00	0	0.00	0.00	6957.15	31	224.42	539.01			
1977	0.00	0	0.00	0.00	440.17	31	14.20	42.01			
1978	0.00	0	0.00	0.00	16056.13	31	517.94	963.01			
1979	0.00	0	0.00	0.00	4641.16	31	149.71	448.01			
1980	0.00	0	0.00	0.00	1792.17	31	57.81	66.01			
1981	0.00	0	0.00	0.00	2402.17	31	77.49	139.01			
1982	0.00	0	0.00	0.00	23092.12	31	744.91	1377.01			
1983	0.00	0	0.00	0.00	20882.13	31	673.62	3607.01			
μ	-7.38				384.09						
σ	7.67				760.14						
% YEAR =		18.84	% DAYS =		9.12	% YEAR =		97.10	% DAYS =		90.88

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_n	No. Days	\bar{Q}_n	Q_{max}	ΣQ_n	No. Days	\bar{Q}_n	Q_{max}
1915	-676.00	23	-29.39	-40.00	1144.00	8	143.00	289.00
1916	0.00	0	0.00	0.00	6639.00	31	214.16	659.00
1917	-319.00	31	-10.29	-19.00	0.00	0	0.00	0.00
1918	0.00	0	0.00	0.00	3863.00	31	124.61	1029.00
1919	0.00	0	0.00	0.00	11157.00	31	359.90	2039.00
1920	-6.00	14	-0.43	-2.00	28681.00	17	1687.12	6429.00
1921	-6.00	5	-1.20	-3.00	906.00	26	34.85	195.00
1922	0.00	0	0.00	0.00	18061.00	31	582.61	2799.00
1923	-553.00	26	-21.27	-31.00	55.00	5	11.00	34.00
1924	0.00	0	0.00	0.00	17118.00	31	552.19	3759.00
1925	0.00	0	0.00	0.00	2159.00	31	69.65	169.00
1926	-284.00	31	-9.16	-15.00	0.00	0	0.00	0.00
1927	0.00	0	0.00	0.00	119394.00	31	3851.42	11759.00
1928	0.00	0	0.00	0.00	85629.00	31	2762.23	6209.00
1929	0.00	0	0.00	0.00	9880.00	31	318.71	2029.00
1930	0.00	6	0.00	0.00	621.00	25	24.84	107.00
1931	-520.00	28	-18.57	-23.00	138.00	3	46.00	124.00
1932	0.00	0	0.00	0.00	31719.00	31	1023.19	5129.00
1933	-396.00	27	-14.67	-24.00	85.00	4	21.25	42.00
1934	-2.00	1	-2.00	-2.00	1209.00	30	40.30	123.00

Table L.6 Continued

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1935	0.00	0	0.00	0.00	14725.00	31	475.00	1839.00
1936	-20.00	13	-1.54	-4.00	63.00	18	3.50	16.00
1937	0.00	1	0.00	0.00	6142.00	30	204.73	626.00
1938	-37.00	4	-9.25	-13.00	9975.00	27	369.44	1759.00
1939	0.00	1	0.00	0.00	1586.00	30	52.87	250.00
1940	-422.00	31	-13.61	-22.00	0.00	0	0.00	0.00
1941	-281.00	21	-13.38	-21.00	366.00	10	36.60	133.00
1942	-14.00	2	-7.00	-10.00	18281.00	29	630.38	2549.00
1943	0.00	0	0.00	0.00	585.00	31	18.87	90.00
1944	-325.00	31	-10.48	-17.00	0.00	0	0.00	0.00
1945	-275.00	22	-12.50	-21.00	163.00	9	18.11	45.00
1946	0.00	0	0.00	0.00	23076.00	31	744.39	2229.00
1947	-22.00	9	-2.44	-7.00	512.00	22	23.27	112.00
1948	-37.00	9	-4.11	-8.00	5471.00	22	248.68	2109.00
1949	-29.00	10	-2.90	-7.00	653.00	21	31.10	100.00
1950	0.00	0	0.00	0.00	72702.00	31	2345.23	9859.00
1951	0.00	0	0.00	0.00	14142.00	31	456.19	1099.00
1952	0.00	0	0.00	0.00	10019.00	31	323.19	2519.00
1953	-378.00	31	-12.19	-15.00	0.00	0	0.00	0.00
1954	-782.00	31	-25.23	-28.00	0.00	0	0.00	0.00
1955	-568.90	19	-29.94	-38.00	1729.00	12	144.08	409.00
1956	0.00	0	0.00	0.00	20229.00	31	652.55	3419.00
1957	-520.00	31	-16.77	-18.00	0.00	0	0.00	0.00
1958	0.00	0	0.00	0.00	9953.00	31	321.06	2199.00
1959	0.00	0	0.00	0.00	5700.00	31	183.87	1219.00
1960	-66.00	11	-6.00	-14.00	411.00	20	20.55	45.00
1961	-438.00	31	-14.13	-20.00	0.00	0	0.00	0.00
1962	0.00	0	0.00	0.00	1994.00	31	64.32	205.00
1963	-138.00	19	-7.26	-11.00	245.00	12	20.42	95.00
1964	-646.00	31	-20.84	-25.00	0.00	0	0.00	0.00
1965	-818.00	31	-26.39	-29.00	0.00	0	0.00	0.00
1966	0.00	0	0.00	0.00	4776.00	31	154.06	485.00
1967	-156.00	21	-7.43	-12.00	158.00	10	15.80	35.00
1968	-11.00	9	-1.22	-3.00	1330.00	22	60.45	330.00
1969	0.00	0	0.00	0.00	400.00	31	12.90	21.00
1970	0.00	0	0.00	0.00	50494.00	31	1628.84	4339.00
1971	0.00	0	0.00	0.00	3345.00	31	107.90	245.00
1972	-15.00	6	-2.50	-7.00	273.00	25	10.92	32.00
1973	0.00	0	0.00	0.00	15396.00	31	496.65	1219.00
1974	0.00	0	0.00	0.00	4076.00	31	131.48	208.00
1975	0.00	0	0.00	0.00	6248.00	31	201.55	624.00
1976	0.00	0	0.00	0.00	6399.00	31	206.42	521.00
1977	-206.00	23	-8.96	-11.00	88.00	8	11.00	24.00
1978	0.00	0	0.00	0.00	15498.00	31	499.94	945.00
1979	0.00	0	0.00	0.00	4083.00	31	131.71	430.00
1980	0.00	0	0.00	0.00	1234.00	31	39.81	48.00
1981	0.00	0	0.00	0.00	1844.00	31	59.48	121.00
1982	0.00	0	0.00	0.00	22534.00	31	726.90	1359.00
1983	0.00	0	0.00	0.00	20324.00	31	655.61	3589.00
μ	-14.01				477.44			
σ	13.71				824.37			
% YEAR =	50.72	% DAYS =	29.92	% YEAR =	85.51	% DAYS =	70.08	

Table 1.7 Summary of Protected-Flow Statistics
 USGS NO. 03345500 Embarras River at Ste. Marie
 Drainage Area 1516.00 sq mi Period of Record (1914-1983) 69 years

T	Item	Mean Flow, Flow Duration, and Selected Protected-Flow Statistics												Year
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
	\bar{Q}	371.39	587.52	1223.27	1655.60	1915.14	2153.90	2148.30	1805.81	1313.42	733.08	443.84	332.30	1219.95
	$\bar{Q}(S)$	661.27	695.11	1528.45	2150.77	1670.45	1575.22	1704.52	1877.95	1204.66	791.84	702.77	569.65	593.87
	Q(90)	22.99	22.00	26.99	51.97	99.94	317.87	328.00	249.93	160.00	75.98	42.99	30.00	41.00
M	AVQ(-)	-7.38	-6.39	-10.24	-26.43	-53.98	-145.91	-121.02	-83.06	-52.24	-28.20	-13.21	-8.52	
	% years	18.84	18.84	17.39	18.84	18.84	28.99	27.54	24.64	23.19	26.09	23.19	24.64	
	% days	9.12	10.14	9.72	9.96	9.55	9.96	10.05	9.96	10.10	9.77	9.72	10.82	
	AVQ(+)	384.09	630.09	1326.24	1783.90	2012.58	2055.22	2037.16	1737.13	1288.82	731.31	445.45	340.02	
	% years	97.10	97.10	95.65	98.55	97.10	97.10	98.55	100.00	100.00	100.00	100.00	100.00	
	% days	90.88	89.86	90.28	90.04	90.45	90.04	89.95	90.04	89.90	90.23	90.28	89.18	
Y	AVQ(-)	-14.01	-17.28	-17.59	-18.85	-17.41	-15.55	-16.63	-9.57	-12.62	-15.42	-11.71	-12.45	
	% years	50.72	31.88	27.54	18.84	8.70	4.35	1.45	1.45	2.90	8.70	23.19	40.58	
	% days	29.92	23.62	16.64	8.56	4.67	1.87	0.39	0.65	0.63	3.51	9.35	21.64	
	AVQ(+)	477.44	720.90	1421.84	1767.43	1966.96	2153.46	2115.54	1776.50	1280.54	717.79	445.60	375.20	
	% years	85.51	88.41	94.20	98.55	100.00	98.55	100.00	100.00	100.00	100.00	100.00	100.00	
	% days	70.08	76.38	83.36	91.44	95.33	98.13	99.61	99.35	99.37	96.49	90.65	78.36	
	Q(85)	27.99	27.91	35.99	89.95	150.95	413.87	427.56	304.92	209.29	99.97	52.99	34.93	62.01
M	AVQ(-)	-8.97	-9.37	-14.28	-49.66	-76.58	-178.15	-166.33	-102.95	-76.10	-38.65	-17.14	-10.31	
	% years	26.09	23.19	24.64	26.09	30.43	39.13	33.33	31.88	34.78	31.88	34.78	33.33	
	% days	14.49	14.88	14.96	14.82	15.24	14.96	14.98	14.68	15.02	14.77	14.68	14.98	
	AVQ(+)	403.12	659.06	1398.67	1846.70	2095.32	2077.48	2053.12	1776.83	1312.80	749.56	461.05	351.57	
	% years	97.10	97.10	94.20	94.20	95.65	97.10	95.65	98.55	98.55	100.00	98.55	100.00	
	% days	85.51	85.12	85.04	85.18	84.76	85.04	85.02	85.32	84.98	85.23	85.32	85.02	
Y	AVQ(-)	-27.89	-32.95	-32.43	-32.70	-29.19	-35.86	-37.63	-27.12	-20.39	-22.70	-21.21	-23.87	
	% years	57.97	42.03	31.88	20.29	14.49	5.80	1.45	1.45	2.90	18.84	42.03	56.52	
	% days	42.96	29.42	21.65	11.31	6.93	1.92	0.39	0.79	1.40	6.97	19.17	38.21	
	AVQ(+)	563.45	758.30	1491.03	1801.06	1993.40	2133.47	2094.53	1757.99	1269.48	723.02	477.41	452.22	
	% years	82.61	81.16	89.86	95.65	97.10	98.55	100.00	100.00	100.00	100.00	97.10	92.75	
	% days	57.04	70.58	78.35	88.69	93.07	98.08	99.61	99.21	98.60	93.03	80.83	61.79	
	Q(80)	31.99	32.00	50.97	124.93	219.86	508.82	503.00	376.87	253.00	123.96	63.98	39.00	88.01
M	AVQ(-)	-10.36	-10.57	-23.87	-68.17	-119.76	-216.97	-190.37	-138.65	-94.60	-49.83	-22.81	-11.18	
	% years	33.33	27.54	27.54	33.33	34.78	49.28	49.28	50.72	49.28	44.93	42.03	37.68	
	% days	19.17	20.00	19.87	19.92	19.50	19.96	20.10	19.92	20.14	19.96	19.50	20.39	
	AVQ(+)	422.34	697.04	1468.90	1928.28	2135.07	2109.50	2106.99	1818.78	1351.79	773.48	477.37	371.27	
	% years	94.20	94.20	91.30	91.30	94.20	97.10	92.75	94.20	97.10	97.10	97.10	98.55	
	% days	80.83	80.00	80.13	80.08	80.50	80.04	79.90	80.08	79.86	80.04	80.50	79.61	
Y	AVQ(-)	-45.54	-50.34	-52.01	-47.72	-46.21	-59.52	-30.22	-35.63	-27.15	-32.60	-33.63	-40.27	
	% years	71.01	52.17	40.58	26.09	17.39	5.80	2.90	4.35	11.59	28.99	66.67	72.46	
	% days	53.76	36.38	25.15	14.82	8.77	2.01	1.16	1.36	3.04	12.48	31.51	51.59	
	AVQ(+)	665.86	813.89	1534.23	1848.63	2007.48	2109.49	2084.81	1741.90	1264.72	741.72	535.01	547.59	
	% years	72.46	78.26	88.41	94.20	97.10	98.55	100.00	100.00	100.00	100.00	95.65	84.06	
	% days	46.24	63.62	74.85	85.18	91.23	97.99	98.84	98.64	96.96	87.52	68.49	48.41	
	Q(75)	36.99	45.67	85.92	192.84	331.82	588.81	597.71	431.87	303.77	146.95	74.97	44.86	121.02
M	AVQ(-)	-12.70	-21.07	-50.30	-116.21	-192.34	-245.41	-240.35	-160.99	-122.01	-60.77	-28.19	-14.59	
	% years	39.13	34.78	40.58	39.13	43.48	62.32	56.52	56.52	55.07	50.72	57.97	47.83	
	% days	24.59	24.73	24.96	24.96	25.19	24.96	24.83	24.82	24.98	24.87	24.54	24.54	
	AVQ(+)	447.60	726.84	1532.50	1988.10	2181.52	2167.45	2142.19	1880.81	1386.37	800.29	498.02	385.67	
	% years	89.86	85.51	88.41	88.41	91.30	97.10	92.75	92.75	95.65	95.65	95.65	97.10	
	% days	75.41	75.27	75.04	75.04	74.81	75.04	75.17	75.18	75.02	75.13	75.46	75.46	
Y	AVQ(-)	-72.32	-75.18	-76.63	-64.25	-59.10	-50.44	-41.69	-47.43	-40.10	-47.47	-52.66	-65.63	
	% years	76.81	55.07	46.38	33.33	27.54	10.14	5.80	7.25	14.49	42.03	79.71	82.61	
	% days	59.61	41.50	28.52	19.92	12.78	4.11	2.22	2.24	5.70	19.73	43.57	59.71	
	AVQ(+)	726.59	850.73	1572.57	1932.20	2065.76	2122.27	2074.30	1724.55	1266.91	774.16	612.76	621.68	
	% years	71.01	75.36	84.06	91.30	97.10	98.55	100.00	100.00	100.00	97.10	94.20	76.81	
	% days	40.39	58.50	71.48	80.08	87.22	95.89	97.78	97.76	94.30	80.27	56.43	40.29	

Table 2.1 Monthly and Annual Mean Flows in cfs

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1915	136.8	13.5	21.6	300.0	2843.7	286.5	57.4	1489.3	2306.9	1718.9	5794.3	308.6	1266.8
1916	61.5	195.9	1186.7	5858.4	3729.6	530.4	195.2	154.7	776.4	75.2	172.1	18.5	1073.6
1917	10.2	14.7	124.3	1039.7	185.4	733.0	1274.2	2031.9	3194.6	93.6	89.3	24.8	734.8
1918	37.1	57.0	21.7	79.0	1663.2	365.7	4886.8	2614.6	167.2	697.5	164.9	1465.9	1006.2
1919	143.1	328.9	3562.0	665.6	782.3	1711.9	141.3	984.5	2003.3	413.6	33.4	16.6	902.8
1920	1177.9	3276.4	1457.5	212.2	1574.8	2903.0	1541.6	1915.6	259.5	188.7	295.5	248.8	1251.7
1921	21.9	17.9	273.9	661.6	620.0	2267.0	978.1	297.5	81.6	44.8	249.2	280.8	483.3
1922	125.3	1135.4	1518.5	246.5	454.3	3624.0	6266.9	351.8	100.1	121.2	12.4	5.4	1161.5
1923	8.8	5.6	186.4	281.6	695.0	3297.6	1090.7	1200.1	456.7	201.3	655.7	159.7	689.4
1924	233.4	187.6	2124.8	786.2	1586.6	956.0	893.4	994.5	1618.7	90.4	215.8	215.5	822.1
1925	28.9	85.6	1185.0	275.0	976.9	1078.3	122.2	45.1	226.1	99.4	46.7	20.6	346.6
1926	69.6	741.5	665.9	612.8	1674.6	1501.8	2626.9	91.4	47.3	55.6	68.7	959.1	748.4
1927	1633.5	1218.3	442.5	2142.1	1643.6	3452.0	3132.9	2392.1	1754.0	96.9	353.7	150.6	1533.1
1928	1303.2	300.1	3525.1	1391.3	3087.8	865.0	991.5	435.0	1755.4	324.9	407.1	33.0	1196.0
1929	290.3	406.7	1505.4	2635.1	626.4	1873.5	2737.8	5815.3	1300.6	470.1	194.8	25.2	1501.3
1930	52.5	321.0	2211.1	6529.1	1675.1	723.7	447.0	83.1	20.6	9.7	4.3	372.5	1040.4
1931	50.2	16.5	81.6	23.2	125.9	545.0	140.2	140.2	55.1	227.8	169.3	830.3	200.4
1932	163.6	1139.8	1826.1	5145.5	558.0	183.3	162.5	87.2	339.8	68.3	117.1	364.8	851.7
1933	42.8	575.8	1031.7	2959.4	714.5	3447.1	2838.6	4670.0	132.2	22.0	87.8	73.6	1393.7
1934	15.3	4.6	12.3	52.1	14.4	399.3	438.0	45.9	48.0	431.4	548.4	372.5	199.8
1935	243.4	1891.5	1092.3	1833.6	511.4	3200.4	592.5	4972.6	383.2	177.8	23.2	7.1	1255.9
1936	6.7	369.1	87.7	291.1	1185.4	1422.7	607.1	207.0	19.0	30.0	4.4	7.3	349.7
1937	44.1	604.8	58.6	4367.0	2060.9	663.2	1194.4	1697.2	454.8	106.3	59.3	16.9	938.9
1938	249.1	35.4	1026.5	196.5	974.6	3494.4	3570.2	579.1	313.3	746.5	201.4	56.7	953.0
1939	12.8	144.4	97.9	423.4	2642.4	2416.0	2588.2	134.8	846.3	85.3	552.6	20.7	814.7
1940	5.5	8.5	8.6	66.6	336.1	371.5	1589.1	1006.8	159.6	14.1	26.6	8.4	298.4
1941	29.2	75.6	133.6	177.6	72.5	36.9	702.4	102.9	707.4	45.3	38.2	62.4	180.7
1942	271.8	1524.5	337.7	238.3	2477.5	2032.1	1452.5	416.5	2237.5	1478.6	143.2	22.8	1038.2
1943	7.0	1052.3	750.3	466.6	627.7	872.5	747.2	10145.5	360.6	186.6	10.9	6.7	1282.7
1944	2.6	41.6	7.6	59.1	282.2	605.7	3768.2	435.7	138.0	12.5	105.7	102.2	458.4
1945	11.8	3.9	4.3	131.7	425.3	4575.1	4876.7	1704.6	4271.3	510.9	108.4	426.2	1418.4
1946	658.9	675.1	745.6	1613.8	2700.5	677.2	100.1	5281.6	668.7	205.9	391.6	32.2	1141.7
1947	51.5	1041.5	857.5	1293.3	1173.1	202.2	2525.0	1546.7	747.2	445.6	87.0	302.2	850.2
1948	258.0	217.3	168.5	2078.0	1224.9	2992.9	1706.5	695.0	407.4	895.0	69.7	59.3	899.2
1949	84.0	1760.2	1097.5	6925.2	2805.5	1665.5	679.7	349.7	495.2	453.0	81.0	159.6	1374.6
1950	2145.9	102.8	2189.7	9030.5	4981.0	1679.5	1717.4	473.7	1343.0	479.4	89.5	386.0	2040.2
1951	50.9	726.0	808.3	1948.5	4221.5	2047.0	1496.2	164.4	307.0	775.0	34.9	80.5	1033.4
1952	141.4	861.4	886.0	1412.9	1476.1	2918.1	2407.0	130.6	651.6	79.5	12.4	18.3	912.5
1953	1.7	11.5	28.3	42.5	82.9	1590.8	805.8	651.4	113.4	65.4	9.5	0.8	285.9
1954	0.3	1.1	1.7	18.5	22.0	4.9	56.9	63.4	29.9	16.5	31.1	106.6	29.3
1955	251.8	10.7	146.2	331.9	502.0	904.2	1113.5	238.2	561.4	510.7	29.7	127.2	392.4
1956	387.9	835.0	110.3	35.5	2466.4	827.8	399.4	646.6	634.5	427.1	236.2	67.2	580.4
1957	4.5	18.9	822.7	577.1	943.7	928.5	5406.8	2809.6	4009.7	2582.8	282.5	117.3	1537.7
1958	180.9	1230.8	4894.6	1575.6	400.6	1469.9	639.4	948.5	549.0	2363.9	1562.3	162.2	1346.6
1959	120.5	752.2	329.9	1357.0	3141.5	1248.8	713.8	605.9	569.2	121.1	322.2	62.9	762.1
1960	50.1	344.1	1113.2	894.2	1358.1	1296.5	1172.4	806.3	1223.9	1162.4	30.4	7.8	786.3
1961	5.6	16.4	37.4	29.3	271.7	2404.0	800.7	6165.9	238.6	479.8	1175.8	93.3	989.9
1962	35.4	337.4	868.2	2481.8	2626.1	3415.1	319.4	459.4	1504.4	156.5	282.0	55.3	1037.5
1963	13.8	27.8	21.6	49.3	12.6	2616.8	367.6	1351.4	100.6	308.7	85.6	2.9	419.7
1964	2.5	14.6	6.4	147.5	79.5	1607.6	970.9	117.1	256.3	51.6	4.2	2.1	272.3
1965	1.1	3.4	24.6	49.3	557.5	456.2	419.1	160.5	327.2	450.7	16.3	216.5	220.6
1966	52.4	24.9	98.7	409.8	733.2	210.0	1332.3	1515.3	70.2	27.4	18.2	95.2	379.4
1967	16.9	263.5	1637.5	368.1	1101.8	2320.6	604.3	1661.3	662.0	182.8	119.2	66.6	751.3
1968	164.1	86.7	7882.4	1141.5	2096.3	1061.8	1488.2	1477.6	409.0	96.2	480.3	38.6	1374.0
1969	17.6	93.3	549.6	2803.4	3568.3	511.5	3379.8	439.7	1065.1	1165.1	93.5	275.4	1143.3
1970	520.2	666.3	203.7	855.1	1735.8	983.8	4456.6	847.0	1549.8	60.3	20.8	52.5	982.4
1971	69.5	43.6	38.6	67.9	2629.2	562.8	90.0	249.9	757.8	350.2	29.6	11.4	392.1
1972	26.4	13.7	437.7	114.8	95.4	134.5	2466.8	208.1	71.8	12.2	129.8	27.3	309.1
1973	10.5	1788.1	1220.9	2539.9	828.1	5388.8	3445.3	545.4	1654.3	1201.4	258.9	74.0	1584.0
1974	31.9	933.9	2680.9	3646.8	1899.1	2548.1	2288.0	1465.5	3062.6	87.1	442.2	1392.6	1702.6

Table 2.1 Continued

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1975	136.3	415.9	805.7	2260.1	3718.2	2209.7	1746.9	786.4	493.1	537.8	90.0	162.4	1096.6
1976	44.7	86.3	451.5	869.5	802.2	1704.4	235.2	69.7	177.3	67.8	99.1	61.5	389.6
1977	45.9	26.0	11.5	6.9	569.8	1597.1	902.5	131.9	76.1	127.4	235.5	110.1	318.5
1978	267.0	197.7	2405.6	112.7	63.2	5425.0	728.0	2619.6	155.0	124.5	218.5	32.6	1045.3
1979	28.2	113.2	420.0	926.1	2801.1	5217.0	4200.2	427.0	248.2	1373.4	2042.7	47.1	1479.9
1980	14.5	128.1	235.0	108.7	543.3	1954.1	1808.2	168.0	245.2	280.2	191.9	304.7	496.9
1981	20.9	14.5	40.5	13.9	592.8	159.9	177.3	1218.5	425.7	593.1	896.9	826.3	414.1
1982	110.0	120.9	634.5	2011.8	6832.9	3154.3	592.7	361.8	1072.1	726.3	41.0	357.8	1298.2
1983	369.0	229.7	5571.0	631.3	1102.0	977.0	2652.3	2315.9	1290.4	327.6	64.7	14.4	1299.8
\bar{Q}	186.7	435.2	971.8	1317.8	1443.3	1703.0	1580.6	1266.9	793.6	408.9	308.1	184.0	880.6
$\bar{Q}(e)$	378.5	601.6	1408.4	1835.2	1339.9	1341.8	1458.6	1773.6	925.1	526.4	755.4	291.4	451.0

Table 2.2 Results of Low-Flow Analyses

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
1.45	69.00	0.00	0.00	0.27	0.36	Sep 1954	Sep 1954	Oct 1953	Oct 1953
2.90	34.50	0.14	0.18	0.32	1.24	Nov 1953	Oct 1953	Sep 1954	Oct 1964
4.35	23.00	0.20	0.47	0.75	2.67	Nov 1944	Nov 1944	Oct 1964	Oct 1963
5.80	17.25	0.37	0.52	1.14	3.38	Sep 1955	Oct 1952	Oct 1952	Aug 1930
7.25	13.80	0.46	0.60	1.77	3.45	Oct 1952	Oct 1964	Nov 1944	Nov 1944
8.70	11.50	0.47	1.13	2.31	4.63	Oct 1964	Sep 1955	Jul 1930	Oct 1943
10.14	9.86	0.97	1.65	2.34	5.18	Aug 1936	Jul 1930	Sep 1963	Oct 1960
11.59	8.63	1.10	1.75	2.48	5.19	Aug 1930	Sep 1940	Oct 1943	Oct 1952
13.04	7.67	1.57	2.03	2.63	5.83	Oct 1940	Oct 1963	Nov 1933	Aug 1936
14.49	6.90	1.87	2.07	2.68	6.50	Nov 1933	Sep 1936	Sep 1940	Oct 1922
15.94	6.27	1.89	2.15	2.89	6.65	Oct 1963	Oct 1943	Sep 1955	Oct 1939
17.39	5.75	2.00	2.19	4.03	6.79	Oct 1943	Nov 1933	Oct 1960	Oct 1935
18.84	5.31	2.39	2.97	4.41	7.70	Sep 1966	Nov 1960	Nov 1922	Jan 1976
20.29	4.93	2.44	3.08	4.43	7.71	Oct 1935	Sep 1966	Aug 1936	Oct 1956
21.74	4.60	2.56	3.31	4.46	8.45	Nov 1960	Oct 1935	Oct 1956	Nov 1933
23.19	4.31	3.03	3.46	5.08	11.45	Sep 1941	Sep 1922	Oct 1935	Oct 1916
24.64	4.06	3.13	3.72	5.37	11.75	Sep 1922	Oct 1956	Oct 1939	Aug 1966
26.09	3.83	3.24	4.63	6.10	14.66	Oct 1956	Oct 1939	Jan 1976	Oct 1979
27.54	3.63	3.90	4.75	6.41	14.80	Nov 1978	Nov 1978	Oct 1942	Oct 1942
28.99	3.45	4.10	4.82	8.32	14.92	Oct 1946	Oct 1972	Oct 1917	Sep 1971
30.43	3.29	4.14	4.90	9.13	15.38	Oct 1939	Jan 1976	Sep 1971	Oct 1962
31.88	3.14	4.16	5.99	9.46	15.68	Nov 1971	Oct 1942	Oct 1966	Sep 1940
33.33	3.00	4.47	6.05	9.92	15.94	Oct 1972	Nov 1971	Oct 1948	Aug 1954
34.78	2.88	4.71	6.18	9.94	16.73	Jan 1976	Oct 1938	Oct 1972	Oct 1938
36.23	2.76	5.37	6.33	9.95	17.49	Sep 1937	Oct 1917	Oct 1916	Nov 1980
37.68	2.65	5.56	6.60	10.42	18.72	Oct 1938	Sep 1937	Sep 1919	Sep 1972
39.13	2.56	5.93	7.37	11.27	19.57	Oct 1942	Oct 1946	Aug 1965	Nov 1920
40.58	2.46	6.01	7.56	11.55	19.77	Aug 1965	Oct 1916	Feb 1962	Sep 1917
42.03	2.38	6.14	7.60	11.66	19.97	Oct 1917	Oct 1920	Oct 1946	Oct 1978
43.48	2.30	6.41	7.69	12.43	20.59	May 1934	Jun 1934	Oct 1938	Sep 1919
44.93	2.23	6.71	8.00	12.47	23.79	Jul 1931	Sep 1919	Nov 1978	Nov 1965
46.38	2.16	6.94	8.59	12.77	24.63	Sep 1959	Dec 1962	Oct 1920	Oct 1968
47.83	2.09	7.00	8.82	12.93	26.24	Sep 1919	Oct 1948	Sep 1929	Aug 1970
49.28	2.03	7.00	9.15	13.17	33.18	Oct 1920	Oct 1968	Oct 1979	Aug 1925
50.72	1.97	7.11	9.32	13.87	34.42	Oct 1916	Oct 1957	Jan 1980	Sep 1937
52.17	1.92	7.14	9.62	13.97	37.23	Jan 1962	Aug 1965	Oct 1968	Sep 1929
53.62	1.86	7.14	9.63	15.51	38.51	Jul 1926	Sep 1959	Aug 1970	Jul 1941
55.07	1.82	7.61	10.30	16.39	40.29	Oct 1948	Oct 1947	Sep 1937	Sep 1946
56.52	1.77	7.84	10.33	16.55	41.08	Oct 1957	Jul 1926	Oct 1924	Sep 1948
57.97	1.72	8.14	10.53	17.06	42.45	Sep 1925	Oct 1951	Oct 1951	Oct 1959

Table 2.2 Continued

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
59.42	1.68	8.14	10.93	17.39	42.50	Oct 1951	Nov 1980	Nov 1921	Jun 1934
60.87	1.64	8.36	11.09	18.55	43.08	Oct 1968	Oct 1979	Jul 1925	Jul 1921
62.32	1.60	9.03	11.27	19.53	43.55	Oct 1932	Aug 1918	Sep 1959	Oct 1973
63.77	1.57	9.27	11.54	21.58	46.41	Nov 1980	Oct 1929	Sep 1928	Sep 1951
65.22	1.53	9.31	12.05	21.98	48.43	Oct 1947	Aug 1925	Jun 1934	Aug 1955
66.67	1.50	9.67	12.05	22.71	51.37	Sep 1970	Sep 1970	Jun 1977	Jun 1931
68.12	1.47	10.04	12.19	23.26	51.39	Oct 1973	Jul 1941	Jul 1961	Jul 1926
69.57	1.44	10.20	12.53	23.66	53.72	Oct 1979	Jul 1932	Oct 1947	Oct 1975
71.01	1.41	10.79	13.40	25.52	54.39	Sep 1945	Nov 1924	Jul 1932	Nov 1924
72.46	1.38	10.86	14.03	28.41	56.79	Oct 1929	Sep 1967	Aug 1941	Sep 1928
73.91	1.35	11.29	15.33	31.65	62.34	Aug 1918	Nov 1921	Oct 1973	Sep 1961
75.36	1.33	11.50	16.00	36.32	79.11	Sep 1967	Jul 1961	Oct 1957	Aug 1945
76.81	1.30	12.29	16.07	36.68	82.86	Sep 1928	Sep 1928	Nov 1958	Sep 1967
78.26	1.28	12.71	17.10	37.80	83.64	Nov 1924	Aug 1945	Jul 1931	Jun 1977
79.71	1.25	13.43	18.45	38.10	88.90	Nov 1921	Jun 1931	Jun 1926	Aug 1932
81.16	1.23	15.14	19.13	40.55	91.18	Oct 1961	Jun 1977	Aug 1982	Sep 1957
82.61	1.21	15.93	19.22	41.21	91.21	Aug 1977	Oct 1973	Sep 1945	Oct 1950
84.06	1.19	16.71	21.87	44.52	98.02	Oct 1958	Oct 1958	Oct 1975	Aug 1947
85.51	1.17	20.14	23.87	46.03	109.08	Nov 1950	Oct 1950	Oct 1950	Apr 1915
86.96	1.15	20.57	27.80	50.03	113.66	Oct 1923	Aug 1982	Oct 1915	Nov 1981
88.41	1.13	21.43	28.00	57.32	117.26	Oct 1949	Oct 1923	Aug 1918	Sep 1949
89.86	1.11	22.57	30.07	63.05	127.72	Oct 1975	Jul 1974	Sep 1967	Aug 1969
91.30	1.10	23.43	31.27	67.71	135.77	Aug 1982	Aug 1969	Jul 1974	Oct 1958
92.75	1.08	25.29	31.60	75.10	155.97	Jul 1974	Nov 1915	Aug 1949	Sep 1923
94.20	1.06	25.71	36.13	79.81	194.07	Aug 1969	Oct 1975	Apr 1981	Sep 1982
95.65	1.05	29.14	46.93	87.19	204.39	Nov 1915	Jul 1927	Aug 1969	Oct 1918
97.10	1.03	38.14	53.73	90.87	218.16	Jul 1927	Aug 1949	Jul 1927	Jul 1974
98.55	1.01	51.43	59.93	101.97	223.39	Jun 1981	Apr 1981	Oct 1923	Aug 1927
μ		9.47	12.35	23.05	50.49				
σ		9.34	12.33	24.16	54.71				

**Table 2.3 Results of Low-Flow Analyses
for 5- and 9-Month Droughts**

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
1.43	70.00	2.54	Oct	1953	12.73	Dec	1953
2.86	35.00	6.89	Oct	1964	45.96	Oct	1933
4.29	23.33	13.79	Oct	1943	56.47	Sep	1964
5.71	17.50	14.32	Oct	1952	62.65	Sep	1976
7.14	14.00	19.13	Nov	1960	63.74	Nov	1940
8.57	11.67	19.66	Dec	1933	73.46	Sep	1930
10.00	10.00	20.88	Aug	1936	82.98	Oct	1963
11.43	8.75	21.88	Nov	1939	103.06	Oct	1952
12.86	7.78	22.25	Oct	1963	103.83	Oct	1944
14.29	7.00	24.85	Dec	1962	106.34	Oct	1943
15.71	6.36	30.17	Nov	1976	109.64	Sep	1954
17.14	5.83	30.63	Sep	1922	119.22	Sep	1922
18.57	5.38	30.68	Sep	1940	134.68	Nov	1971
20.00	5.00	33.02	Mar	1954	141.98	Sep	1980
21.43	4.67	43.90	Nov	1917	161.62	Nov	1939
22.86	4.38	44.82	Oct	1970	171.23	Aug	1916
24.29	4.12	45.40	Aug	1966	175.74	Aug	1936
25.71	3.89	45.47	Oct	1944	195.06	Sep	1965
27.14	3.68	50.14	Aug	1972	213.70	Jun	1932
28.57	3.50	58.10	Sep	1916	226.29	Aug	1925
30.00	3.33	59.40	Dec	1930	235.75	Oct	1962
31.43	3.18	78.68	Nov	1980	266.31	Jun	1931
32.86	3.04	81.58	Oct	1965	270.14	Nov	1917
34.29	2.92	83.20	Sep	1954	281.17	Oct	1935
35.71	2.80	86.06	Sep	1971	286.06	Sep	1938
37.14	2.69	87.52	Jul	1925	287.53	Oct	1920
38.57	2.59	93.31	Sep	1937	305.37	Sep	1970
40.00	2.50	97.97	Jul	1930	309.26	Oct	1960
41.43	2.41	98.68	Oct	1935	314.96	Sep	1955
42.86	2.33	102.54	Oct	1938	346.52	Oct	1937
44.29	2.26	103.16	Sep	1978	361.76	Aug	1956
45.71	2.19	106.46	Nov	1979	369.76	Sep	1941
47.14	2.12	123.71	Sep	1967	391.10	Sep	1975
48.57	2.06	127.21	Sep	1924	394.15	Jul	1966
50.00	2.00	129.61	Jun	1976	399.26	Oct	1977
51.43	1.94	135.98	Jul	1977	433.47	Aug	1959
52.86	1.89	145.02	Sep	1968	442.13	Sep	1921
54.29	1.84	146.45	Jun	1931	461.23	Nov	1924
55.71	1.79	150.64	Sep	1956	490.86	Jul	1934
57.14	1.75	154.56	Sep	1920	493.06	Aug	1978
58.57	1.71	154.91	Jun	1932	502.95	Jul	1981
60.00	1.67	156.30	Aug	1921	513.64	Sep	1979
61.43	1.63	166.76	Oct	1975	516.54	Aug	1968
62.86	1.59	179.93	Sep	1959	518.05	Sep	1951
64.29	1.56	191.17	Jul	1941	520.97	Dec	1942
65.71	1.52	206.48	Oct	1947	583.12	Nov	1946
67.14	1.49	212.62	Sep	1929	586.94	Sep	1969
68.57	1.46	224.51	Feb	1941	612.05	Jul	1928
70.00	1.43	244.36	Jul	1926	614.19	Oct	1947
71.43	1.40	267.65	Aug	1951	651.79	Jul	1967
72.86	1.37	269.88	Aug	1946	659.31	Aug	1972
74.29	1.35	272.44	May	1934	667.25	Sep	1923
75.71	1.32	287.52	Sep	1923	674.78	Aug	1950
77.14	1.30	292.33	Sep	1928	681.25	Jul	1949
78.57	1.27	293.31	Jul	1955	739.79	Sep	1926
80.00	1.25	302.95	Aug	1948	750.25	May	1919
81.43	1.23	307.59	Jul	1949	752.60	Aug	1948
82.86	1.21	328.35	Mar	1965	766.97	Jul	1982
84.29	1.19	344.53	Sep	1982	825.15	Aug	1958

Table 2.3 Continued

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
85.71	1.17	346.21	Sep	1950	828.41	Feb	1915
87.14	1.15	351.62	Oct	1969	856.10	Dec	1945
88.57	1.13	395.03	Oct	1942	926.10	Oct	1961
90.00	1.11	404.41	Aug	1961	1041.51	May	1983
91.43	1.09	440.84	Sep	1927	1118.46	Sep	1974
92.86	1.08	475.78	Sep	1945	1202.70	Aug	1973
94.29	1.06	491.34	Jul	1962	1251.85	Sep	1927
95.71	1.04	494.61	Sep	1974	1353.21	Dec	1929
97.14	1.03	499.84	Sep	1973	1414.85	Nov	1957
98.57	1.01	509.21	Sep	1981	1558.97	Aug	1918

Table 2.4 Monthly and Annual Flow Duration Values

PROB ≥	Flows in cfs												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
99	0.31	0.49	1.11	3.03	6.95	5.86	22.87	13.12	8.36	2.22	1.11	0.19	1.10
95	1.90	2.69	4.20	9.00	15.09	62.97	59.78	39.98	18.94	7.40	4.00	1.99	5.00
90	3.50	4.80	8.50	17.99	33.98	101.96	93.00	55.99	28.00	12.00	6.30	3.20	10.00
85	5.20	7.56	13.99	31.98	50.44	141.94	117.64	69.98	38.84	15.99	9.99	5.57	16.00
80	6.80	11.00	19.99	46.97	81.94	187.91	145.00	84.97	50.00	22.99	13.99	7.50	24.00
75	8.40	13.93	28.98	68.95	124.14	228.90	178.20	102.96	63.67	29.98	16.99	9.26	34.00
70	10.02	18.00	42.12	95.19	173.37	274.40	216.00	123.15	79.00	36.05	20.03	12.00	44.99
60	15.02	31.00	79.20	153.27	275.48	396.61	308.00	169.19	113.00	51.06	29.03	19.00	79.98
50	22.03	55.00	149.21	250.26	430.62	615.92	436.00	235.29	167.00	74.08	41.04	30.00	138.98
40	34.03	94.00	240.41	360.70	671.25	1011.48	766.00	361.54	253.00	108.11	59.08	43.00	234.97
30	52.04	184.00	461.67	738.05	1281.20	1801.63	1300.00	650.04	438.00	167.15	100.11	72.00	422.95
25	68.06	273.63	700.82	1111.94	1671.00	2381.49	1795.56	1021.12	654.55	219.23	138.14	95.97	620.92
20	93.08	424.00	1051.44	1941.98	2271.76	3021.40	2440.00	1501.92	967.00	318.36	200.23	136.00	988.88
15	138.16	746.31	1821.70	3001.92	3128.14	3771.25	3556.86	2531.64	1442.57	513.77	324.39	197.57	1619.85
10	252.70	1320.00	3031.82	4371.52	4161.56	4661.37	4720.00	3701.73	2310.00	1061.00	599.64	375.00	2740.00
5	1001.37	2514.94	4983.27	6003.25	5682.97	6133.00	6065.66	5554.21	4003.73	2131.87	1282.33	955.42	4510.00
1	3339.34	4988.96	10574.51	11574.60	12556.59	11276.55	13627.39	12767.12	7934.24	5335.39	5261.86	3178.05	9600.00
\bar{Q} , cfs	186.69	435.20	971.77	1317.78	1442.25	1703.02	1580.63	1266.91	793.61	408.93	308.13	183.98	880.61
$t(\bar{Q})$ %	12.88	19.83	21.14	23.76	27.93	31.25	27.17	22.44	22.77	17.68	15.65	16.10	21.47

Table 2.5 Protected-Flow Statistics for Month of October

with $Q_p = Q_m(90)$

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1915	0.00	0	0.00	0.00	4132.54	31	133.31	1096.50
1916	0.00	0	0.00	0.00	1796.55	31	57.95	180.50
1917	0.00	0	0.00	0.00	206.35	31	6.66	12.50
1918	0.00	0	0.00	0.00	1041.55	31	33.60	644.50
1919	0.00	0	0.00	0.00	4327.54	31	139.60	1216.50
1920	0.00	0	0.00	0.00	36405.54	31	1174.37	11596.50
1921	0.00	0	0.00	0.00	571.55	31	18.44	151.50
1922	0.00	0	0.00	0.00	3775.55	31	121.79	1016.50
1923	-1.30	3	-0.43	-0.50	164.84	28	5.89	38.50
1924	0.00	0	0.00	0.00	7126.53	31	229.89	1816.50
1925	0.00	0	0.00	0.00	787.55	31	25.40	54.50
1926	0.00	0	0.00	0.00	2048.55	31	66.08	547.50
1927	0.00	0	0.00	0.00	50531.50	31	1630.05	5156.50
1928	0.00	0	0.00	0.00	40289.50	31	1299.66	2896.50
1929	0.00	0	0.00	0.00	8890.52	31	286.79	2586.50
1930	0.00	0	0.00	0.00	1517.65	31	48.96	349.50
1931	0.00	0	0.00	0.00	1447.04	31	46.68	483.50
1932	0.00	0	0.00	0.00	4962.53	31	160.08	1236.50
1933	0.00	0	0.00	0.00	1217.74	31	39.28	225.50
1934	-2.70	3	-0.90	-1.20	369.24	28	13.19	56.50
1935	0.00	0	0.00	0.00	7435.50	31	239.85	2396.50
1936	-8.79	10	-0.88	-1.30	107.03	21	5.10	15.50
1937	-0.60	1	-0.60	-0.60	1258.04	30	41.93	169.50
1938	0.00	0	0.00	0.00	7614.83	31	245.64	1096.50
1939	0.00	0	0.00	0.00	288.95	31	9.32	60.50
1940	0.00	0	0.00	0.00	61.15	31	1.97	3.90
1941	-9.69	6	-1.62	-2.60	805.44	25	32.22	284.50
1942	-1.00	1	-1.00	-1.00	8318.13	30	277.27	1236.50
1943	0.00	0	0.00	0.00	109.75	31	3.54	23.50
1944	-28.46	25	-1.14	-2.10	2.01	6	0.33	1.20
1945	-32.88	15	-2.19	-3.30	289.32	16	18.08	94.50
1946	0.00	0	0.00	0.00	20316.50	31	655.37	2406.50
1947	0.00	0	0.00	0.00	1487.15	31	47.97	361.50
1948	0.00	0	0.00	0.00	7890.04	31	254.52	2406.50
1949	0.00	0	0.00	0.00	2496.85	31	80.54	843.50
1950	0.00	0	0.00	0.00	66413.50	31	2142.37	7536.50
1951	0.00	0	0.00	0.00	1470.55	31	47.44	212.50
1952	0.00	0	0.00	0.00	4275.54	31	137.92	1176.50
1953	-60.56	26	-2.33	-3.10	4.51	5	0.90	3.00
1954	-99.05	31	-3.20	-3.40	0.00	0	0.00	0.00
1955	-8.69	6	-1.45	-2.80	7704.73	25	308.19	1856.50
1956	0.00	0	0.00	0.00	11916.51	31	384.40	1826.50
1957	-3.39	8	-0.42	-0.70	35.53	23	1.54	3.50
1958	0.00	0	0.00	0.00	5500.34	31	177.43	1656.50
1959	0.00	0	0.00	0.00	3625.55	31	116.95	908.50
1960	0.00	0	0.00	0.00	1445.55	31	46.63	266.50
1961	-2.19	7	-0.31	-0.80	67.54	24	2.81	27.50
1962	0.00	0	0.00	0.00	988.55	31	31.89	109.50
1963	0.00	0	0.00	0.00	319.35	31	10.30	29.50
1964	-30.46	28	-1.09	-1.70	0.70	3	0.23	0.40
1965	-75.35	31	-2.43	-3.10	0.00	0	0.00	0.00
1966	0.00	0	0.00	0.00	1514.55	31	48.86	220.50
1967	0.00	0	0.00	0.00	415.64	31	13.41	83.50
1968	0.00	0	0.00	0.00	4977.53	31	160.57	955.50
1969	0.00	0	0.00	0.00	436.74	31	14.09	36.50

Table 2.5 Continued								
Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1970	0.00	0	0.00	0.00	16016.52	31	516.66	2816.50
1971	0.00	0	0.00	0.00	2044.55	31	65.95	413.50
1972	0.00	0	0.00	0.00	709.55	31	22.89	43.50
1973	0.00	0	0.00	0.00	217.65	31	7.02	36.50
1974	0.00	0	0.00	0.00	880.85	31	28.41	136.50
1975	0.00	0	0.00	0.00	4117.54	31	132.82	718.50
1976	0.00	0	0.00	0.00	1276.55	31	41.18	150.50
1977	0.00	0	0.00	0.00	1315.34	31	42.43	292.50
1978	0.00	0	0.00	0.00	8167.51	31	263.47	1426.50
1979	0.00	0	0.00	0.00	766.35	31	24.72	125.50
1980	0.00	0	0.00	0.00	339.95	31	10.97	22.50
1981	0.00	0	0.00	0.00	538.55	31	17.37	35.50
1982	0.00	0	0.00	0.00	3300.55	31	106.47	196.50
1983	0.00	0	0.00	0.00	11330.52	31	365.50	2046.50
μ	-1.82				202.39			
σ	1.62				428.08			
	% YEAR =	21.74	% DAYS =	9.40	% YEAR =	97.10	% DAYS =	90.60

Table 2.6 Protected-Flow Statistics for Month of October								
with $Q_p = Q_y(90)$								
Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1915	-32.00	9	-3.56	-5.00	3963.00	22	180.14	1090.00
1916	0.00	0	0.00	0.00	1595.00	31	51.45	174.00
1917	-38.20	18	-2.12	-3.40	43.00	13	3.31	6.00
1918	-65.00	19	-3.42	-4.80	905.00	12	75.42	638.00
1919	0.00	0	0.00	0.00	4126.00	31	133.10	1210.00
1920	-1.00	4	-0.25	-1.00	36205.00	27	1340.93	11590.00
1921	-36.00	16	-2.25	-4.00	406.00	15	27.07	145.00
1922	0.00	0	0.00	0.00	3574.00	31	115.29	1010.00
1923	-120.00	24	-5.00	-7.00	82.00	7	11.71	32.00
1924	0.00	0	0.00	0.00	6925.00	31	223.39	1810.00
1925	0.00	0	0.00	0.00	586.00	31	18.90	48.00
1926	0.00	0	0.00	0.00	1847.00	31	59.58	541.00
1927	0.00	0	0.00	0.00	50330.00	31	1623.55	5150.00
1928	0.00	0	0.00	0.00	40088.00	31	1293.16	2890.00
1929	0.00	0	0.00	0.00	8689.00	31	280.29	2580.00
1930	-0.90	4	-0.22	-0.90	1317.00	27	48.78	343.00
1931	-18.50	8	-2.31	-3.30	1264.00	23	54.96	477.00
1932	0.00	0	0.00	0.00	4761.00	31	153.58	1230.00
1933	-6.80	7	-0.97	-1.70	1023.00	24	42.63	219.00
1934	-75.00	15	-5.00	-7.70	240.00	16	15.00	50.00

Table 2.6 Continued

Year	<i>If Available Flow ≤ 0</i>				<i>If Available Flow > 0</i>			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1935	0.00	0	0.00	0.00	7234.00	31	233.35	2390.00
1936	-124.30	26	-4.78	-7.80	21.00	5	4.20	9.00
1937	-7.10	1	-7.10	-7.10	1063.00	30	35.43	163.00
1938	-17.70	5	-3.54	-5.60	7431.00	26	285.81	1090.00
1939	-64.60	21	-3.08	-4.90	152.00	10	15.20	54.00
1940	-140.40	31	-4.53	-6.50	0.00	0	0.00	0.00
1941	-106.80	19	-5.62	-9.10	701.00	12	58.42	278.00
1942	-12.40	2	-6.20	-7.50	8128.00	29	280.28	1230.00
1943	-108.80	30	-3.63	-4.50	17.00	1	17.00	17.00
1944	-228.00	31	-7.35	-8.60	0.00	0	0.00	0.00
1945	-147.10	21	-7.00	-9.80	202.00	10	20.20	88.00
1946	0.00	0	0.00	0.00	20115.00	31	648.87	2400.00
1947	-59.40	12	-4.95	-6.50	1345.00	19	70.79	355.00
1948	-6.50	9	-0.72	-1.40	7695.00	22	349.77	2400.00
1949	-21.70	14	-1.55	-3.30	2317.00	17	136.29	837.00
1950	0.00	0	0.00	0.00	66212.00	31	2135.87	7530.00
1951	0.00	0	0.00	0.00	1269.00	31	40.94	206.00
1952	-14.00	10	-1.40	-3.50	4088.00	21	194.67	1170.00
1953	-257.60	31	-8.31	-9.60	0.00	0	0.00	0.00
1954	-300.60	31	-9.70	-9.90	0.00	0	0.00	0.00
1955	-73.50	12	-6.12	-9.30	7568.00	19	398.32	1850.00
1956	0.00	0	0.00	0.00	11715.00	31	377.90	1820.00
1957	-169.40	31	-5.46	-7.20	0.00	0	0.00	0.00
1958	-18.20	12	-1.52	-3.30	5317.00	19	279.84	1650.00
1959	0.00	0	0.00	0.00	3424.00	31	110.45	902.00
1960	0.00	0	0.00	0.00	1244.00	31	40.13	260.00
1961	-160.20	29	-5.52	-7.30	24.00	2	12.00	21.00
1962	0.00	0	0.00	0.00	787.00	31	25.39	103.00
1963	-3.20	10	-0.32	-1.00	121.00	21	5.76	23.00
1964	-231.30	31	-7.46	-8.20	0.00	0	0.00	0.00
1965	-276.90	31	-8.93	-9.60	0.00	0	0.00	0.00
1966	0.00	0	0.00	0.00	1313.00	31	42.35	214.00
1967	-25.90	11	-2.35	-4.30	240.00	20	12.00	77.00
1968	0.00	0	0.00	0.00	4776.00	31	154.06	949.00
1969	-12.80	15	-0.85	-2.10	248.00	16	15.50	30.00
1970	0.00	0	0.00	0.00	15815.00	31	510.16	2810.00
1971	0.00	0	0.00	0.00	1843.00	31	59.45	407.00
1972	0.00	0	0.00	0.00	508.00	31	16.39	37.00
1973	-92.90	21	-4.42	-6.40	109.00	10	10.90	30.00
1974	-2.70	4	-0.67	-1.00	682.00	27	25.26	130.00
1975	0.00	0	0.00	0.00	3916.00	31	126.32	712.00
1976	0.00	0	0.00	0.00	1075.00	31	34.68	144.00
1977	-8.20	9	-0.91	-1.60	1122.00	22	51.00	286.00
1978	0.00	0	0.00	0.00	7966.00	31	256.97	1420.00
1979	-30.20	15	-2.01	-4.30	595.00	16	37.19	119.00
1980	-0.60	5	-0.12	-0.60	139.00	26	5.35	16.00
1981	0.00	0	0.00	0.00	337.00	31	10.87	29.00
1982	0.00	0	0.00	0.00	3099.00	31	99.97	190.00
1983	0.00	0	0.00	0.00	11129.00	31	359.00	2040.00
μ	-4.77				256.61			
σ	4.67				455.23			
% YEAR =	57.97	% DAYS =	30.58	% YEAR =	89.86	% DAYS =	69.42	

Table 2.7 Summary of Protected-Flow Statistics
 USGS NO. 03379500 Little Wabash River below Clay City
 Drainage Area 1131.00 sq mi Period of Record (1914-1983) 69 years

T	Item	Mean Flow, Flow Duration, and Selected Protected-Flow Statistics												
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
	\bar{Q}	186.70	435.20	971.78	1317.79	1443.30	1703.02	1580.64	1266.92	793.61	408.93	308.13	183.98	880.61
	$\bar{Q}(S)$	378.48	601.58	1408.38	1835.19	1339.86	1341.79	1458.59	1773.64	925.14	526.38	755.44	291.39	451.03
	Q(90)	3.50	4.80	8.50	17.99	33.98	101.96	93.00	55.99	28.00	12.00	6.30	3.20	10.00
M	AVQ(-)	-1.82	-2.27	-3.91	-8.87	-17.33	-47.41	-34.12	-19.01	-10.07	-5.07	-2.64	-1.43	
	% years	21.74	21.74	15.94	21.74	26.09	30.43	30.43	31.88	27.54	24.64	26.09	23.19	
	% days	9.40	10.29	9.63	9.82	9.90	9.72	10.05	9.54	10.43	9.82	9.96	10.00	
	AVQ(+)	202.39	480.03	1066.36	1442.27	1564.96	1778.63	1657.63	1340.60	855.98	440.70	335.51	201.03	
	% years	97.10	100.00	97.10	97.10	98.55	97.10	100.00	100.00	100.00	100.00	100.00	98.55	
	% days	90.60	89.71	90.37	90.18	90.10	90.28	89.95	90.46	89.57	90.18	90.04	90.00	
Y	AVQ(-)	-4.77	-5.06	-4.63	-4.01	-2.04	-5.08	-1.89	-3.09	-3.34	-3.78	-4.68	-4.94	
	% years	57.97	37.68	23.19	17.39	11.59	1.45	1.45	2.90	8.70	21.74	37.68	56.52	
	% days	30.58	19.52	11.59	5.70	2.87	1.45	0.63	0.84	1.55	8.37	15.38	27.83	
	AVQ(+)	256.61	529.54	1088.52	1387.14	1474.68	1717.99	1580.58	1267.61	795.97	435.71	353.17	242.96	
	% years	89.86	97.10	97.10	98.55	100.00	98.55	100.00	100.00	100.00	100.00	98.55	95.65	
	% days	69.42	80.48	88.41	94.30	97.13	98.55	99.37	99.16	98.45	91.63	84.62	72.17	
	Q(85)	5.20	7.56	13.99	31.98	50.44	141.94	117.64	69.98	38.84	15.99	9.99	5.57	16.00
M	AVQ(-)	-2.58	-3.89	-7.41	-17.56	-25.38	-64.43	-43.82	-24.27	-16.36	-7.15	-5.01	-2.99	
	% years	30.43	27.54	30.43	27.54	33.33	46.38	42.03	43.48	42.03	36.23	36.23	28.99	
	% days	14.73	14.78	14.26	14.68	14.93	14.91	14.78	14.68	14.88	13.88	14.35	14.88	
	AVQ(+)	213.29	502.50	1118.30	1510.07	1640.55	1845.99	1724.38	1407.05	889.56	457.45	348.94	210.13	
	% years	94.20	98.55	97.10	97.10	97.10	97.10	100.00	100.00	98.55	100.00	98.55	95.65	
	% days	85.27	85.22	85.74	85.32	85.07	85.09	85.22	85.32	85.12	86.12	85.65	85.12	
Y	AVQ(-)	-8.63	-8.36	-8.00	-7.08	-5.49	-10.25	-7.89	-8.08	-5.07	-6.56	-7.69	-8.99	
	% years	71.01	47.83	36.23	21.74	15.94	4.35	1.45	2.90	15.94	39.13	62.32	68.12	
	% days	42.17	28.94	17.16	9.58	5.54	1.59	0.63	1.03	4.15	15.15	24.17	36.81	
	AVQ(+)	301.46	593.30	1155.39	1440.53	1510.24	1714.43	1574.57	1264.00	811.53	464.25	387.70	271.08	
	% years	88.41	95.65	95.65	97.10	100.00	98.55	100.00	100.00	100.00	100.00	97.10	92.75	
	% days	57.83	71.06	82.84	90.42	94.46	98.41	99.37	98.97	95.85	84.85	75.83	63.19	
	Q(80)	6.80	11.00	19.99	46.97	81.94	187.91	145.00	84.97	50.00	22.99	13.99	7.50	24.00
M	AVQ(-)	-3.33	-5.63	-10.85	-26.22	-47.06	-88.33	-56.03	-31.54	-21.99	-11.20	-7.28	-3.88	
	% years	44.93	40.58	36.23	37.68	39.13	57.97	53.62	53.62	53.62	47.83	44.93	42.03	
	% days	19.78	21.01	19.35	19.82	19.90	19.92	20.10	19.64	20.00	19.68	19.54	20.24	
	AVQ(+)	225.07	538.56	1182.83	1591.49	1710.13	1913.86	1810.81	1478.43	935.01	483.27	367.35	222.26	
	% years	92.75	97.10	94.20	95.65	97.10	97.10	100.00	100.00	98.55	100.00	98.55	95.65	
	% days	80.22	78.99	80.65	80.18	80.10	80.08	79.90	80.36	80.00	80.32	80.46	79.76	
Y	AVQ(-)	-14.12	-14.37	-12.99	-13.07	-10.71	-15.11	-11.22	-11.49	-7.98	-11.65	-11.92	-14.38	
	% years	85.51	59.42	40.58	23.19	18.84	7.25	2.90	5.80	26.09	50.72	78.26	81.16	
	% days	52.41	34.30	22.77	11.64	7.69	2.01	1.01	1.68	8.50	20.66	35.11	45.65	
	AVQ(+)	357.39	633.37	1231.01	1465.97	1537.39	1713.77	1572.70	1264.39	841.86	488.22	444.31	306.44	
	% years	86.96	89.86	92.75	97.10	98.55	98.55	100.00	100.00	100.00	100.00	95.65	91.30	
	% days	47.59	65.70	77.23	88.36	92.31	97.99	98.99	98.32	91.50	79.34	64.89	54.35	
	Q(75)	8.40	13.93	28.98	68.95	124.14	228.90	178.20	102.96	63.67	29.98	16.99	9.26	34.00
M	AVQ(-)	-4.11	-7.54	-16.80	-40.59	-75.45	-107.75	-75.00	-41.28	-29.90	-15.29	-8.68	-4.71	
	% years	47.83	46.38	43.48	43.48	52.17	72.46	63.77	63.77	65.22	60.87	62.32	49.28	
	% days	24.87	24.54	24.59	24.96	24.94	24.92	25.02	24.92	24.88	24.50	24.17	25.07	
	AVQ(+)	238.69	560.73	1255.73	1677.86	1781.05	1999.11	1895.55	1563.95	981.59	506.87	386.71	234.77	
	% years	89.86	97.10	92.75	95.65	94.20	97.10	97.10	100.00	98.55	100.00	97.10	95.65	
	% days	75.13	75.46	75.41	75.04	75.06	75.08	74.98	75.08	75.12	75.50	75.83	74.93	
Y	AVQ(-)	-21.52	-20.90	-20.04	-18.12	-17.18	-19.22	-19.20	-12.57	-13.07	-16.72	-18.33	-21.43	
	% years	88.41	69.57	43.48	30.43	26.09	8.70	2.90	17.39	36.23	68.12	88.41	88.41	
	% days	60.54	41.79	27.16	15.94	10.00	2.85	1.16	3.37	13.38	28.80	44.60	53.72	
	AVQ(+)	419.99	704.20	1294.96	1530.70	1566.72	1718.58	1565.00	1276.30	878.97	533.34	509.58	348.94	
	% years	81.16	86.96	91.30	97.10	97.10	98.55	100.00	100.00	100.00	100.00	95.65	89.86	
	% days	39.46	58.21	72.84	84.06	90.00	97.15	98.84	96.63	86.62	71.20	55.40	46.28	

Table 3.1 Monthly and Annual Mean Flows in cfs

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1940	144.1	124.9	115.0	75.2	98.8	643.4	287.9	348.8	505.4	150.6	275.8	156.1	244.3
1941	130.3	144.0	242.5	365.0	637.4	1398.6	967.9	419.3	364.7	134.9	202.3	627.5	467.5
1942	2191.9	1290.0	642.3	584.8	490.4	1376.0	642.1	437.8	796.0	227.1	697.5	557.2	830.6
1943	227.9	633.9	752.7	646.1	1706.1	1817.5	757.1	1332.8	661.7	546.2	405.4	232.3	805.2
1944	178.2	375.2	214.2	213.0	842.5	2408.3	1207.5	851.7	533.0	196.0	127.1	120.7	604.8
1945	120.0	134.6	114.2	106.7	185.7	326.9	397.3	1616.1	718.6	328.6	182.5	574.2	401.6
1946	742.6	661.7	572.0	2144.9	460.3	2355.7	468.2	315.5	457.2	178.6	108.7	78.9	717.3
1947	94.0	127.0	128.6	174.5	216.1	542.6	1659.6	828.5	1136.7	362.5	165.8	157.6	464.9
1948	136.6	232.1	480.4	127.7	874.6	2610.5	696.5	1262.6	266.3	154.0	110.1	90.0	588.1
1949	93.6	118.2	135.2	438.4	1642.1	1059.3	513.2	212.5	491.8	543.5	169.5	104.4	452.1
1950	111.9	106.2	219.6	1011.0	394.2	1711.2	2244.3	688.4	1288.0	420.2	212.1	504.2	742.3
1951	243.3	190.1	279.4	231.6	2771.1	1627.4	1626.3	1033.6	771.4	1300.9	595.8	318.8	902.6
1952	546.6	1171.3	553.0	1630.3	953.4	2480.0	1427.7	552.2	1042.2	1202.6	396.4	195.9	1013.5
1953	177.7	233.4	367.9	247.2	777.5	817.3	548.3	522.1	732.2	257.1	215.6	119.6	415.1
1954	114.9	124.1	153.0	113.0	293.2	308.0	888.7	516.9	1106.9	605.9	324.9	164.5	391.7
1955	1867.1	485.1	565.0	1121.6	1038.9	1375.2	888.2	447.7	677.7	298.9	170.8	113.7	754.1
1956	164.4	158.9	151.4	121.1	305.1	230.2	299.8	880.1	227.7	217.8	135.3	100.7	249.7
1957	75.5	95.8	102.4	184.2	433.6	426.5	734.6	877.4	394.0	292.1	263.5	137.1	333.8
1958	110.0	267.3	319.5	203.5	344.3	920.5	555.8	237.5	896.3	942.3	157.2	84.3	420.2
1959	104.1	133.7	88.1	68.8	688.4	2580.0	858.5	535.9	213.8	169.6	190.4	121.3	479.3
1960	741.5	768.5	877.5	1805.2	704.1	1305.8	2975.0	2012.3	810.9	614.5	280.7	222.6	1094.2
1961	253.5	501.2	210.0	133.2	194.3	972.2	746.1	427.2	277.7	156.5	134.2	471.1	373.2
1962	913.0	1880.0	652.8	409.7	415.0	3307.5	1497.7	1009.7	523.6	392.3	188.7	146.8	948.4
1963	152.9	160.0	130.5	106.6	117.7	763.7	279.7	403.5	495.6	203.6	116.1	96.0	253.2
1964	82.2	113.4	83.5	127.4	113.5	414.2	963.1	596.9	261.3	173.9	97.4	87.2	259.2
1965	78.8	145.8	173.5	996.8	1761.1	857.7	2355.0	578.4	241.7	201.7	339.7	1121.5	726.7
1966	830.0	556.2	1052.4	873.0	2039.3	1034.1	983.7	1407.9	662.8	257.5	142.4	102.4	821.3
1967	126.8	181.6	314.8	255.3	207.0	1204.8	1597.1	778.6	1386.6	401.7	258.5	178.4	574.4
1968	227.1	590.4	434.5	302.1	376.1	291.5	544.2	342.0	448.3	427.1	1053.5	501.0	461.3
1969	330.1	421.9	1048.6	2265.0	777.4	645.6	1741.7	751.6	1907.1	1000.2	412.4	219.2	960.3
1970	644.2	605.8	289.6	214.1	509.3	828.1	985.5	1249.5	1879.1	402.1	288.7	1797.7	804.7
1971	935.2	1092.0	776.5	342.4	2141.9	1558.3	759.0	390.1	340.9	183.9	119.3	107.0	718.9
1972	128.7	149.0	433.9	244.3	165.2	1246.3	1895.6	1252.1	1467.1	1240.5	1879.5	3577.3	1138.4
1973	2309.4	1531.3	1055.5	1627.2	964.2	2195.8	3586.3	2675.8	1427.9	689.2	320.7	528.3	1578.9
1974	1245.3	875.1	1526.7	2125.8	2145.7	2488.7	1694.0	3250.6	2404.7	685.8	350.2	246.4	1585.1
1975	261.4	298.8	297.5	566.5	632.4	1960.2	1449.1	1236.2	1203.5	592.3	498.0	257.6	771.9
1976	190.6	284.5	570.9	261.3	764.7	2370.7	1495.5	1284.4	686.3	341.8	207.2	106.4	714.2
1977	152.7	147.3	121.0	84.9	162.9	378.8	354.8	293.3	222.5	234.5	244.4	323.1	226.8
1978	544.2	642.1	601.4	384.5	261.5	961.7	1590.6	1315.5	785.8	2487.7	402.3	1263.4	940.8
1979	460.4	448.3	480.6	292.6	301.1	5395.5	3620.0	1680.7	800.0	537.2	1807.6	524.7	1371.3
1980	257.5	327.9	574.8	514.2	453.3	513.8	1296.1	553.4	1250.0	344.0	835.6	2184.1	754.9
1981	837.6	503.2	946.7	402.2	703.0	637.6	807.0	852.6	1214.3	382.2	503.2	592.8	697.6
1982	667.5	512.6	580.1	280.6	539.7	2327.6	1881.3	849.7	657.2	1546.1	671.9	268.5	902.3
1983	483.7	1382.5	3229.7	805.1	1282.1	1458.6	3073.3	1788.9	1018.5	1849.7	325.6	300.1	1417.3
\bar{Q}	464.3	475.6	515.0	573.4	747.4	1412.1	1269.1	929.5	810.3	542.6	376.9	449.6	713.1
$\bar{Q}(s)$	541.8	431.7	532.9	613.3	644.0	1003.2	850.2	640.6	499.6	500.8	383.3	654.3	348.5

Table 3.2 Results of Low-Flow Analyses

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
2.27	44.00	52.00	53.80	61.61	73.20	Sep 1964	Sep 1964	Dec 1963	Jan 1958
4.55	22.00	56.00	56.93	64.03	80.11	Dec 1963	Dec 1963	Jan 1958	Oct 1956
6.82	14.67	58.57	59.33	72.65	82.77	Jan 1958	Jan 1958	Sep 1964	Sep 1964
9.09	11.00	64.71	70.07	73.48	84.49	Oct 1956	Oct 1956	Oct 1956	Sep 1946
11.36	8.80	74.43	78.27	78.87	86.39	Sep 1946	Jan 1976	Sep 1946	Oct 1963
13.64	7.33	75.71	78.60	81.03	90.03	Jan 1976	Sep 1946	Jan 1976	Sep 1948
15.91	6.29	78.57	80.20	88.23	94.80	Sep 1959	Sep 1959	Jan 1947	Jan 1976
18.18	5.50	79.71	82.33	89.03	106.03	Sep 1948	Feb 1947	Sep 1948	Jan 1944
20.45	4.89	80.71	83.20	97.94	106.98	Sep 1971	Aug 1948	Oct 1957	Oct 1949
22.73	4.40	81.43	86.67	99.65	107.98	Feb 1947	Jan 1962	Jan 1944	Sep 1966
25.00	4.00	85.00	90.20	100.32	111.31	Jan 1962	Oct 1957	Aug 1961	Jan 1962
27.27	3.67	87.86	92.80	100.32	111.75	Sep 1966	Sep 1971	Jan 1962	Sep 1971
29.55	3.38	88.14	93.27	100.68	111.95	Oct 1957	Sep 1949	Sep 1959	Oct 1957
31.82	3.14	91.00	94.47	101.61	116.28	Oct 1949	Sep 1966	Sep 1966	Sep 1953
34.09	2.93	91.86	95.53	102.13	121.05	Sep 1961	Sep 1961	Oct 1949	Jan 1955
36.36	2.75	92.43	96.07	104.65	127.23	Jan 1944	Jan 1944	Sep 1971	Oct 1940
38.64	2.59	96.86	99.07	113.00	130.46	Jan 1953	Jan 1953	Jan 1953	Aug 1961
40.91	2.44	99.86	103.00	113.26	140.02	Jul 1940	Jan 1955	Feb 1955	Sep 1947
43.18	2.32	100.43	107.00	116.65	141.80	Jul 1965	Sep 1940	Sep 1940	Jan 1960
45.45	2.20	101.43	113.27	128.06	146.05	Feb 1955	Jul 1941	Jan 1960	Aug 1959
47.73	2.10	104.29	113.33	130.19	162.36	Aug 1970	Jan 1960	Jul 1941	Jul 1941
50.00	2.00	110.00	129.27	161.74	176.57	Jan 1960	Aug 1970	Sep 1954	Oct 1952
52.27	1.91	110.86	132.13	165.26	191.59	Jul 1941	Jul 1965	Sep 1950	Oct 1943
54.55	1.83	116.71	135.07	169.68	193.21	Jul 1977	Sep 1950	Jan 1943	Sep 1967
56.82	1.76	129.71	137.40	174.29	193.74	Sep 1950	Jul 1977	Sep 1967	Jul 1965
59.09	1.69	130.00	146.33	176.19	207.51	Feb 1943	Sep 1954	Nov 1952	Oct 1975
61.36	1.63	131.14	152.20	179.29	211.31	Aug 1945	Feb 1943	Aug 1945	Jan 1950
63.64	1.57	137.14	153.33	182.13	215.70	Sep 1954	Sep 1967	Jun 1965	Jul 1977
65.91	1.52	145.57	157.67	185.68	230.23	Sep 1967	Aug 1945	Aug 1970	Aug 1945
68.18	1.47	161.71	170.07	190.42	243.84	Jul 1942	Jul 1942	Oct 1975	Sep 1954
70.45	1.42	167.43	171.33	193.97	248.61	Oct 1952	Oct 1952	Jun 1977	Jan 1969
72.73	1.38	181.57	187.67	194.45	252.62	Oct 1969	Oct 1969	Sep 1969	Oct 1974
75.00	1.33	183.29	188.80	223.29	259.08	Oct 1975	Oct 1975	Jul 1942	Oct 1979
77.27	1.29	186.43	222.33	238.39	295.79	Sep 1978	Sep 1978	Sep 1974	Jan 1981
79.55	1.26	200.71	223.60	245.87	299.41	Jun 1968	Oct 1982	Sep 1982	Jan 1978
81.82	1.22	204.29	225.87	247.35	315.97	Oct 1982	Sep 1974	Nov 1979	Sep 1982
84.09	1.19	217.14	234.20	249.45	318.13	Jan 1974	Nov 1979	Jan 1981	Aug 1970
86.36	1.16	218.57	234.73	273.52	334.36	Sep 1951	Jun 1968	Sep 1951	May 1968
88.64	1.13	229.00	241.60	276.42	342.03	Nov 1979	Sep 1951	Jan 1978	Oct 1942
90.91	1.10	237.14	243.67	277.32	348.21	Jan 1981	Jan 1981	Sep 1973	Aug 1973
93.18	1.07	240.43	265.33	288.77	374.00	Aug 1973	Feb 1980	Jun 1968	Sep 1951
95.45	1.05	243.57	269.87	325.39	432.64	Feb 1980	Aug 1973	Jan 1980	Jan 1980
97.73	1.02	415.57	455.87	703.77	1079.67	Jun 1972	Jun 1972	May 1972	Jun 1972
	μ	135.79	146.64	170.70	211.56				
	σ	71.71	79.08	109.83	165.43				

**Table 3.3 Results of Low-Flow Analyses
for 5- and 9-Month Droughts**

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
2.22	45.00	95.78	Nov	1958	149.92	Nov	1963
4.44	22.50	98.19	Oct	1963	159.08	Nov	1944
6.67	15.00	101.92	Oct	1956	173.71	Oct	1946
8.89	11.25	107.42	Oct	1946	174.74	Oct	1956
11.11	9.00	109.41	Oct	1948	188.69	Nov	1953
13.33	7.50	111.58	Dec	1939	189.10	Nov	1976
15.56	6.43	116.51	Oct	1964	190.45	Nov	1955
17.78	5.63	119.23	Nov	1944	207.95	Oct	1971
20.00	5.00	122.37	Nov	1976	213.17	Oct	1962
22.22	4.50	124.89	Nov	1953	249.04	Aug	1940
24.44	4.09	133.50	Dec	1962	249.99	Oct	1966
26.67	3.75	137.54	Sep	1971	258.98	Oct	1957
28.89	3.46	141.86	Nov	1955	274.70	Aug	1949
31.11	3.21	142.29	Oct	1949	286.37	Aug	1964
33.33	3.00	162.08	Sep	1966	296.47	Sep	1948
35.56	2.81	171.34	Sep	1940	301.33	Sep	1958
37.78	2.65	207.44	Nov	1957	339.95	Nov	1967
40.00	2.50	210.93	Sep	1947	357.83	Oct	1960
42.22	2.37	242.58	Nov	1943	384.13	Oct	1977
44.44	2.25	244.40	Nov	1952	403.09	Sep	1947
46.67	2.14	246.18	Jul	1959	407.62	Oct	1943
48.89	2.05	258.40	Dec	1960	417.91	Dec	1952
51.11	1.96	263.48	Jul	1977	450.78	Sep	1950
53.33	1.88	285.80	Oct	1950	497.39	Aug	1959
55.56	1.80	290.77	Oct	1974	513.60	Oct	1975
57.78	1.73	293.29	Jul	1961	523.06	Dec	1969
60.00	1.67	312.90	Nov	1975	552.46	Aug	1942
62.22	1.61	331.16	Sep	1967	557.18	Jan	1980
64.44	1.55	349.72	Jul	1941	568.46	Aug	1968
66.67	1.50	371.11	May	1956	568.61	May	1941
68.89	1.45	371.13	Mar	1968	585.79	Oct	1981
71.11	1.41	394.53	Nov	1969	588.69	Nov	1974
73.33	1.36	396.51	Dec	1978	589.93	Oct	1961
75.56	1.32	425.43	Dec	1979	643.72	Aug	1945
77.78	1.29	429.16	May	1963	643.78	Sep	1965
80.00	1.25	442.97	Mar	1964	724.95	Aug	1954
82.22	1.22	452.19	Jul	1962	769.03	Oct	1978
84.44	1.18	455.03	Jun	1953	821.42	Nov	1980
86.67	1.15	468.71	Sep	1942	871.25	Oct	1951
88.89	1.13	486.63	Dec	1977	973.61	Sep	1970
91.11	1.10	496.56	Jul	1965	1099.26	Sep	1982
93.33	1.07	496.62	Jun	1955	1209.31	Oct	1973
95.56	1.05	497.91	Sep	1945	1739.04	Oct	1972
97.78	1.02	512.28	Jun	1957	900000.00	Sep	1951

Table 3.4 Monthly and Annual Flow Duration Values

PROB ≥	Flows in cfs												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
99	68.93	88.06	57.72	59.90	78.15	159.60	173.28	171.61	134.14	98.85	79.90	55.09	73.99
95	80.04	103.00	100.03	75.04	96.03	220.11	248.00	230.16	170.00	121.05	95.04	78.00	97.98
90	92.06	115.00	110.06	90.10	110.10	258.42	340.00	286.21	203.00	138.09	108.07	86.00	116.00
85	102.10	124.00	120.09	107.20	130.14	330.45	394.00	322.33	234.00	154.13	120.09	96.00	134.97
80	113.06	133.00	130.27	130.35	150.39	381.58	450.00	360.41	280.00	169.22	130.12	103.00	160.01
75	118.18	144.00	153.37	160.42	190.29	430.92	520.00	395.46	325.00	188.36	140.17	108.00	187.92
70	130.49	152.00	178.95	188.83	214.19	493.43	602.00	426.72	372.00	212.99	151.53	118.00	219.97
60	169.31	191.00	238.94	229.29	269.20	647.28	768.00	528.20	454.00	262.14	182.45	148.00	288.97
50	199.56	288.00	328.68	279.26	319.39	896.32	930.00	652.18	544.00	312.26	225.37	196.00	377.97
40	274.12	407.00	395.22	355.11	419.03	1077.88	1110.00	768.64	694.00	373.28	271.46	232.00	489.97
30	411.78	510.00	492.14	449.17	551.04	1387.26	1350.00	968.24	860.00	472.13	329.49	282.00	671.97
25	533.21	567.00	573.79	518.97	678.45	1616.62	1540.00	1088.24	992.00	538.03	373.35	333.00	800.47
20	648.65	695.00	678.76	638.59	858.26	1906.59	1740.00	1248.12	1160.00	632.88	417.48	429.00	969.96
15	784.80	903.00	798.94	798.59	1147.89	2435.32	2060.00	1448.24	1370.00	754.92	489.36	631.00	1190.65
10	1098.15	1130.00	963.04	1048.53	1617.73	3096.12	2520.00	1887.41	1610.00	970.73	691.81	998.00	1580.00
5	1698.24	1440.00	1458.54	1997.21	2936.80	4346.32	3400.00	2617.85	2210.00	1608.12	1178.57	1940.00	2442.03
1	3300.60	2446.19	3765.27	5523.33	7341.81	9534.33	6318.94	4754.13	4491.36	4579.66	2921.53	4091.85	5341.30
\bar{Q} , cfs	464.30	475.61	514.99	573.38	745.35	1412.13	1269.12	929.51	810.34	542.63	376.92	449.61	713.05
$q(\bar{Q})$ %	27.84	33.34	28.60	22.73	23.14	29.46	33.37	31.94	32.99	24.76	24.60	19.49	28.40

Table 3.5 Protected-Flow Statistics for Month of October

with $Q_p = Q_m(90)$

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1940	-18.35	6	-3.06	-7.06	1630.53	25	65.22	430.94
1941	-2.06	1	-2.06	-2.06	1187.24	30	39.57	87.94
1942	0.00	0	0.00	0.00	65094.08	31	2099.81	4897.94
1943	0.00	0	0.00	0.00	4212.18	31	135.88	251.94
1944	0.00	0	0.00	0.00	2669.18	31	86.10	118.94
1945	0.00	0	0.00	0.00	865.18	31	27.91	40.94
1946	0.00	0	0.00	0.00	20167.07	31	650.55	2367.94
1947	-147.82	14	-10.56	-16.06	208.00	17	12.24	21.94
1948	0.00	0	0.00	0.00	1382.18	31	44.59	180.94
1949	-71.71	12	-5.98	-11.06	120.88	19	6.36	19.94
1950	-3.18	3	-1.06	-1.06	618.35	28	22.08	55.94
1951	0.00	0	0.00	0.00	4689.16	31	151.26	261.94
1952	0.00	0	0.00	0.00	14090.11	31	454.52	1107.94
1953	0.00	0	0.00	0.00	2655.18	31	85.65	92.94
1954	0.00	0	0.00	0.00	709.18	31	22.88	36.94
1955	0.00	0	0.00	0.00	55025.11	31	1775.00	7537.94
1956	0.00	0	0.00	0.00	2242.18	31	72.33	206.94
1957	-513.82	31	-16.57	-43.06	0.00	0	0.00	0.00
1958	-27.76	13	-2.14	-7.06	582.94	18	32.39	83.94
1959	-110.76	13	-8.52	-17.06	483.94	18	26.89	59.94
1960	0.00	0	0.00	0.00	20134.09	31	649.49	2247.94
1961	0.00	0	0.00	0.00	5005.16	31	161.46	429.94
1962	0.00	0	0.00	0.00	25448.09	31	820.91	2597.94
1963	0.00	0	0.00	0.00	1887.18	31	60.88	70.94
1964	-372.53	26	-14.33	-34.06	67.71	5	13.54	22.94
1965	-443.64	28	-15.84	-28.06	33.82	3	11.27	19.94
1966	0.00	0	0.00	0.00	22876.08	31	737.94	1407.94
1967	0.00	0	0.00	0.00	1077.18	31	34.75	111.94
1968	0.00	0	0.00	0.00	4187.18	31	135.07	314.94
1969	0.00	0	0.00	0.00	7380.12	31	238.07	363.94
1970	0.00	0	0.00	0.00	17115.11	31	552.10	1747.94
1971	0.00	0	0.00	0.00	26138.07	31	843.16	1777.94
1972	0.00	0	0.00	0.00	1137.18	31	36.68	85.94
1973	0.00	0	0.00	0.00	68736.06	31	2217.29	4607.94
1974	0.00	0	0.00	0.00	35750.07	31	1153.23	4397.94
1975	0.00	0	0.00	0.00	5250.15	31	169.36	251.94
1976	0.00	0	0.00	0.00	3055.18	31	98.55	114.94
1977	0.00	0	0.00	0.00	1881.18	31	60.68	177.94
1978	0.00	0	0.00	0.00	14016.09	31	452.13	761.94
1979	0.00	0	0.00	0.00	11419.09	31	368.36	621.94
1980	0.00	0	0.00	0.00	5130.15	31	165.49	201.94
1981	0.00	0	0.00	0.00	23111.08	31	745.52	1317.94
1982	0.00	0	0.00	0.00	17840.09	31	575.49	1367.94
1983	0.00	0	0.00	0.00	12141.12	31	391.65	1267.94
μ	-11.64				418.61			
σ	10.31				667.59			
% YEAR =	22.73	% DAYS =	10.78	% YEAR =	97.73	% DAYS =	89.22	

Table 3.6 Protected-Flow Statistics for Month of October

with $Q_p = Q_y(90)$

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1940	-432.00	24	-18.00	-31.00	1302.00	7	186.00	407.00
1941	-91.00	8	-11.38	-26.00	534.00	23	23.22	64.00
1942	0.00	0	0.00	0.00	64352.00	31	2075.87	4874.00
1943	0.00	0	0.00	0.00	3470.00	31	111.94	229.00
1944	0.00	0	0.00	0.00	1927.00	31	62.16	95.00
1945	-3.00	7	-0.43	-3.00	126.00	24	5.25	17.00
1946	0.00	0	0.00	0.00	19425.00	31	626.61	2344.00
1947	-682.00	31	-22.00	-40.00	0.00	0	0.00	0.00
1948	-4.00	11	-0.36	-2.00	644.00	20	32.20	157.00
1949	-693.00	31	-22.35	-35.00	0.00	0	0.00	0.00
1950	-257.00	20	-12.85	-25.00	130.00	11	11.82	32.00
1951	0.00	0	0.00	0.00	3947.00	31	127.32	238.00
1952	0.00	0	0.00	0.00	13348.00	31	430.58	1084.00
1953	0.00	0	0.00	0.00	1913.00	31	61.71	69.00
1954	-97.00	22	-4.41	-16.00	64.00	9	7.11	13.00
1955	0.00	0	0.00	0.00	54283.00	31	1751.06	7514.00
1956	0.00	0	0.00	0.00	1500.00	31	48.39	183.00
1957	-1256.00	31	-40.52	-67.00	0.00	0	0.00	0.00
1958	-419.00	22	-19.05	-31.00	232.00	9	25.78	60.00
1959	-522.00	23	-22.70	-41.00	153.00	8	19.13	36.00
1960	0.00	0	0.00	0.00	19392.00	31	625.55	2224.00
1961	0.00	0	0.00	0.00	4263.00	31	137.52	406.00
1962	0.00	0	0.00	0.00	24706.00	31	796.97	2574.00
1963	0.00	0	0.00	0.00	1145.00	31	36.94	47.00
1964	-1047.00	31	-33.77	-58.00	0.00	0	0.00	0.00
1965	-1152.00	31	-37.16	-52.00	0.00	0	0.00	0.00
1966	0.00	0	0.00	0.00	22134.00	31	714.00	1384.00
1967	-178.00	12	-14.83	-20.00	513.00	19	27.00	88.00
1968	0.00	0	0.00	0.00	3445.00	31	111.13	291.00
1969	0.00	0	0.00	0.00	6638.00	31	214.13	340.00
1970	0.00	0	0.00	0.00	16373.00	31	528.16	1724.00
1971	0.00	0	0.00	0.00	25396.00	31	819.23	1754.00
1972	-53.00	9	-5.89	-20.00	448.00	22	20.36	62.00
1973	0.00	0	0.00	0.00	67994.00	31	2193.35	4584.00
1974	0.00	0	0.00	0.00	35008.00	31	1129.29	4374.00
1975	0.00	0	0.00	0.00	4508.00	31	145.42	228.00
1976	0.00	0	0.00	0.00	2313.00	31	74.61	91.00
1977	-2.00	2	-1.00	-1.00	1141.00	29	39.34	154.00
1978	0.00	0	0.00	0.00	13274.00	31	428.19	738.00
1979	0.00	0	0.00	0.00	10677.00	31	344.42	598.00
1980	0.00	0	0.00	0.00	4388.00	31	141.55	178.00
1981	0.00	0	0.00	0.00	22369.00	31	721.58	1294.00
1982	0.00	0	0.00	0.00	17098.00	31	551.55	1344.00
1983	0.00	0	0.00	0.00	11399.00	31	367.71	1244.00
μ	-21.87				459.46			
σ	21.43				687.99			
	% YEAR =	36.36	% DAYS =	23.09	% YEAR =	88.64	% DAYS =	76.91

Table 3.7 Summary of Protected-Flow Statistics
 USGS NO. 05440000 Kishwaukee River near Perryville
 Drainage Area 1099.00 sq mi Period of Record (1939-1983) 44 years

T	Item	Mean Flow, Flow Duration, and Selected Protected-Flow Statistics												
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
	\bar{Q}	464.30	475.61	514.99	573.38	747.42	1412.13	1269.12	929.51	810.34	542.63	376.92	449.61	713.05
	$\bar{Q}(S)$	541.80	431.75	532.91	613.34	643.99	1003.20	850.23	640.59	499.61	500.84	383.26	654.29	348.54
	Q(90)	92.06	115.00	110.06	90.10	110.10	258.42	340.00	286.21	203.00	138.09	108.07	86.00	116.00
M	AVQ(-)	-11.64	-12.64	-15.92	-14.45	-15.81	-47.60	-89.16	-58.22	-36.85	-18.67	-14.78	-9.79	
	% years	22.73	25.00	29.55	22.73	25.00	34.09	22.73	31.82	29.55	29.55	34.09	27.27	
	% days	10.78	10.08	11.22	10.41	10.78	10.04	10.08	10.04	10.00	9.97	10.26	10.30	
	AVQ(+)	418.61	402.43	458.10	541.12	713.92	1287.84	1043.21	721.63	678.92	451.41	301.29	406.50	
	% years	97.73	97.73	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
	% days	89.22	89.92	88.78	89.59	89.22	89.96	89.92	89.96	90.00	90.03	89.74	89.70	
Y	AVQ(-)	-21.87	-13.24	-18.69	-30.43	-20.94	-6.00	0.00	0.00	-7.43	-11.37	-18.18	-23.23	
	% years	36.36	27.27	29.55	27.27	25.00	2.27	0.00	0.00	4.55	15.91	40.91	47.73	
	% days	23.09	10.38	13.34	16.79	11.26	0.15	0.00	0.00	0.53	3.59	13.49	29.17	
	AVQ(+)	459.46	402.79	463.30	555.80	711.89	1298.05	1153.12	813.51	698.08	442.95	304.44	480.55	
	% years	88.64	97.73	100.00	95.45	100.00	100.00	100.00	100.00	100.00	100.00	100.00	95.45	
	% days	76.91	89.62	86.66	83.21	88.74	99.85	100.00	100.00	99.47	96.41	86.51	70.83	
	Q(85)	102.10	124.00	120.09	107.20	130.15	330.45	394.00	322.34	234.00	154.13	120.09	96.00	134.97
M	AVQ(-)	-16.25	-15.38	-18.52	-24.68	-25.52	-92.45	-104.55	-69.30	-49.71	-25.39	-19.64	-14.93	
	% years	29.55	34.09	29.55	25.00	29.55	45.45	38.64	43.18	34.09	31.82	40.91	36.36	
	% days	15.54	15.38	16.57	14.96	16.50	15.10	15.00	15.03	15.15	15.03	15.40	15.23	
	AVQ(+)	431.85	418.31	477.00	552.50	741.74	1290.56	1048.00	726.83	688.14	461.70	307.14	419.81	
	% years	97.73	97.73	100.00	95.45	97.73	100.00	100.00	97.73	100.00	100.00	100.00	97.73	
	% days	84.46	84.62	83.43	85.04	83.50	84.90	85.00	84.97	84.85	84.97	84.60	84.77	
Y	AVQ(-)	-33.55	-20.63	-28.08	-41.70	-30.07	-16.37	-1.77	0.00	-16.40	-17.48	-26.44	-35.85	
	% years	38.64	36.36	29.55	29.55	29.55	6.82	2.27	0.00	9.09	27.27	52.27	52.27	
	% days	30.65	21.06	20.82	20.75	16.65	0.37	0.38	0.00	1.06	8.94	21.99	36.52	
	AVQ(+)	489.68	437.03	487.33	564.10	738.35	1281.93	1138.47	794.54	682.79	449.42	317.63	516.24	
	% years	84.09	95.45	95.45	90.91	97.73	100.00	100.00	100.00	100.00	100.00	100.00	90.91	
	% days	69.35	78.94	79.18	79.25	83.35	99.63	99.62	100.00	98.94	91.06	78.01	63.48	
	Q(80)	113.06	133.00	130.27	130.35	150.39	381.58	450.00	360.41	280.00	169.22	130.12	103.00	160.01
M	AVQ(-)	-22.18	-18.80	-24.05	-37.52	-38.17	-113.82	-126.67	-85.61	-78.05	-32.11	-23.43	-17.24	
	% years	31.82	36.36	29.55	29.55	38.64	59.09	40.91	45.45	38.64	40.91	50.00	40.91	
	% days	20.01	20.91	20.31	20.53	20.51	19.94	20.00	19.94	20.00	19.94	20.45	20.30	
	AVQ(+)	444.69	438.15	488.88	567.16	758.37	1315.60	1055.56	732.18	682.44	474.41	316.29	439.30	
	% years	93.18	95.45	97.73	90.91	95.45	100.00	100.00	97.73	100.00	100.00	100.00	95.45	
	% days	79.99	79.09	79.69	79.47	79.49	80.06	80.00	80.06	80.00	80.06	79.55	79.70	
Y	AVQ(-)	-49.45	-33.77	-43.46	-55.65	-43.98	-16.07	-17.92	-9.38	-18.56	-28.44	-38.16	-54.00	
	% years	43.18	43.18	40.91	36.36	40.91	9.09	2.27	6.82	20.45	34.09	56.82	56.82	
	% days	38.27	32.95	27.05	25.88	22.45	1.17	0.83	0.59	4.09	16.64	33.65	42.80	
	AVQ(+)	523.60	487.33	502.74	577.14	767.48	1267.18	1118.58	774.10	678.87	464.69	346.28	546.74	
	% years	79.55	84.09	86.36	81.82	93.18	100.00	100.00	100.00	100.00	100.00	100.00	79.55	
	% days	61.73	67.05	72.95	74.12	77.55	98.83	99.17	99.41	95.91	83.36	66.35	57.20	
	Q(75)	118.18	144.00	153.38	160.42	190.29	430.92	520.00	395.46	325.00	188.36	140.17	108.00	187.92
M	AVQ(-)	-22.25	-25.61	-40.25	-56.06	-65.72	-135.17	-163.58	-100.10	-102.25	-42.62	-27.92	-18.42	
	% years	36.36	38.64	36.36	36.36	50.00	63.64	47.73	54.55	52.27	43.18	54.55	43.18	
	% days	25.00	25.23	25.00	25.88	25.91	25.00	25.00	25.00	25.08	25.07	25.22	25.08	
	AVQ(+)	468.91	452.13	495.57	576.73	772.10	1353.35	1053.35	745.44	682.00	487.08	326.02	462.11	
	% years	88.64	90.91	86.36	81.82	93.18	97.73	100.00	97.73	100.00	100.00	100.00	95.45	
	% days	75.00	74.77	75.00	74.12	74.09	75.00	75.00	75.00	74.92	74.93	74.78	74.92	
Y	AVQ(-)	-65.97	-53.70	-63.22	-75.55	-67.00	-24.95	-36.86	-20.76	-30.35	-43.45	-57.20	-74.77	
	% years	56.82	47.73	43.18	40.91	47.73	13.64	4.55	9.09	27.27	40.91	63.64	65.91	
	% days	46.19	39.62	31.45	29.11	24.54	2.64	1.14	1.76	7.73	24.34	40.76	47.80	
	AVQ(+)	570.23	511.71	506.14	574.73	760.47	1258.08	1094.05	755.24	677.09	482.80	358.42	569.83	
	% years	68.18	70.45	84.09	81.82	93.18	100.00	100.00	100.00	100.00	100.00	100.00	93.18	
	% days	53.81	60.38	68.55	70.89	75.46	97.36	98.86	98.24	92.27	75.66	59.24	52.20	

Table 4.1 Monthly and Annual Mean Flows in cfs

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1940	0.0	0.7	0.1	0.1	0.6	2.1	26.7	142.5	59.0	6.7	6.3	1.0	20.6
1941	0.0	0.5	1.2	3.0	95.4	50.5	151.5	117.2	313.0	87.9	11.8	18.9	70.2
1942	1148.3	932.3	259.8	138.0	1417.5	706.8	680.7	257.7	376.5	128.9	1041.9	461.6	622.9
1943	100.3	764.8	959.0	716.2	1102.8	673.2	852.0	2764.7	247.4	67.7	20.1	0.4	688.1
1944	0.1	0.5	0.3	0.6	13.4	826.5	2085.6	479.2	149.5	9.2	1.9	3.3	296.2
1945	8.8	1.4	1.7	1.7	135.9	360.9	791.6	1259.4	273.5	25.8	43.8	140.5	254.2
1946	278.6	146.3	277.7	972.0	194.1	605.8	93.8	332.4	1117.3	165.0	1.2	0.0	350.1
1947	0.8	20.9	69.8	255.5	151.5	425.0	1473.9	843.8	850.2	47.9	0.6	1.5	244.1
1948	5.0	24.0	262.2	89.7	436.1	1013.4	272.3	741.4	93.8	47.8	21.6	0.6	251.3
1949	0.3	1.2	26.4	501.1	803.9	347.5	357.3	148.9	262.4	355.7	133.3	1.8	241.4
1950	3.2	1.1	671.3	1399.1	704.8	1002.8	2315.5	254.4	278.4	381.7	7.4	44.4	586.9
1951	53.1	22.6	47.0	373.5	1119.8	515.7	876.1	417.2	160.2	794.7	63.7	122.3	375.4
1952	165.5	641.0	212.8	874.1	283.8	803.3	881.8	346.7	753.4	81.0	25.1	5.5	422.0
1953	1.1	3.5	25.7	112.5	193.3	764.1	191.1	234.5	84.3	277.6	5.7	0.2	158.5
1954	0.3	0.5	3.7	12.0	71.7	756.9	856.3	140.0	295.1	40.1	63.6	2.6	186.7
1955	91.3	24.4	64.7	396.0	358.7	378.7	541.5	144.9	153.1	15.0	2.4	1.8	179.6
1956	3.3	2.5	0.6	0.9	80.9	34.4	32.1	46.7	128.8	159.3	7.1	3.4	41.4
1957	0.0	0.2	1.3	12.5	33.3	88.8	1459.0	556.7	1297.4	792.8	33.0	2.1	355.4
1958	29.7	179.0	297.0	160.5	270.5	242.1	99.3	52.9	1290.1	1551.0	98.5	5.4	356.6
1959	3.4	9.5	4.3	12.5	747.3	569.1	656.4	473.0	76.4	46.2	6.4	22.5	214.9
1960	241.9	340.7	464.1	577.5	724.8	678.4	726.1	242.6	1018.3	78.7	91.6	4.9	429.9
1961	3.1	5.1	6.3	3.1	8.3	41.1	167.2	164.6	56.7	9.8	4.3	720.5	98.4
1962	272.3	320.7	152.9	369.2	733.2	1699.7	338.0	482.9	160.6	147.8	5.5	7.7	390.1
1963	10.2	6.7	1.8	0.9	1.4	432.7	99.6	204.3	47.6	79.3	4.2	2.9	75.3
1964	3.1	6.0	3.1	4.6	4.2	16.5	192.9	48.4	89.6	119.8	2.3	3.7	41.0
1965	3.0	4.6	6.8	248.6	149.2	539.4	1400.0	743.7	176.2	51.4	18.0	294.3	302.4
1966	124.8	40.3	445.3	293.3	139.9	698.3	554.6	1198.2	158.9	25.5	9.8	2.1	310.3
1967	4.2	25.8	282.0	50.4	433.1	649.5	1138.8	601.3	159.8	65.0	14.0	4.6	284.0
1968	89.6	541.5	768.2	358.2	778.4	180.1	285.3	164.0	1512.9	230.6	47.2	5.7	409.6
1969	5.3	8.9	32.6	482.4	183.0	200.3	388.8	209.8	197.6	667.7	95.4	5.6	207.3
1970	53.7	117.2	76.5	71.0	187.3	307.6	959.8	1886.6	557.7	89.6	40.1	580.1	410.9
1971	454.7	276.8	167.8	58.0	654.0	693.6	104.6	50.6	48.9	107.5	5.8	8.7	216.9
1972	5.0	5.4	59.4	236.5	95.0	486.9	1011.4	556.8	839.8	571.8	1406.0	345.0	469.4
1973	438.2	959.4	1015.8	674.3	435.3	1261.5	1539.0	440.8	1298.0	300.7	22.2	9.5	699.0
1974	62.9	49.7	360.7	1128.7	730.4	642.2	749.3	1356.1	1518.7	125.5	13.0	7.5	560.5
1975	2.8	31.1	103.7	555.8	618.4	369.2	1103.4	470.5	1134.9	76.0	10.7	34.2	371.7
1976	11.4	16.3	168.4	40.6	803.7	1132.6	484.9	731.9	219.5	50.5	15.2	6.6	305.4
1977	3.5	2.3	2.7	1.1	31.5	176.9	126.8	314.5	33.5	34.6	68.8	1188.5	164.6
1978	730.0	293.5	543.4	120.1	37.5	701.1	1062.4	684.3	455.8	360.8	39.0	369.1	452.1
1979	33.6	62.4	125.6	78.5	130.6	3378.4	1616.0	449.9	132.1	176.9	646.5	25.7	576.2
1980	8.7	29.1	141.5	91.0	91.7	706.5	559.2	293.9	1776.3	36.4	9.6	359.5	339.6
1981	161.8	83.6	504.8	78.4	375.8	184.6	925.7	1236.5	1094.8	223.1	307.8	257.1	452.0
1982	348.0	241.8	257.1	553.9	1215.4	1925.6	1141.6	524.2	230.1	331.2	32.9	7.0	563.8
1983	6.4	208.4	2398.4	214.6	363.6	560.0	1746.1	1109.3	134.4	58.8	34.8	15.5	573.0
\bar{Q}	113.0	146.7	256.3	280.0	389.6	632.5	752.6	543.6	484.4	206.8	103.2	116.0	334.5
$\bar{Q}(n)$	222.4	250.7	420.2	336.9	375.0	590.8	577.0	534.4	500.4	288.3	271.9	239.5	177.0

Table 4.2 Results of Low-Flow Analyses

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
2.27	44.00	0.00	0.00	0.00	0.01	Nov 1956	Nov 1956	Nov 1956	Oct 1956
4.55	22.00	0.00	0.00	0.00	0.03	Nov 1940	Nov 1940	Oct 1946	Oct 1940
6.82	14.67	0.00	0.00	0.00	0.13	Sep 1959	Oct 1943	Oct 1940	Sep 1946
9.09	11.00	0.00	0.00	0.04	0.21	Oct 1943	Oct 1947	Oct 1943	Oct 1943
11.36	8.80	0.00	0.00	0.17	0.22	Sep 1955	Oct 1946	Sep 1953	Sep 1953
13.64	7.33	0.00	0.05	0.20	0.45	Oct 1947	Sep 1955	Aug 1947	Oct 1948
15.91	6.29	0.00	0.09	0.31	0.65	Oct 1946	Sep 1953	Oct 1948	Jan 1955
18.18	5.50	0.04	0.09	0.50	0.75	Sep 1953	Sep 1959	Dec 1955	Jan 1962
20.45	4.89	0.14	0.21	0.61	0.80	Aug 1961	Aug 1961	Feb 1962	Sep 1947
22.73	4.40	0.17	0.30	0.71	1.27	Sep 1954	Oct 1948	Oct 1957	Oct 1952
25.00	4.00	0.19	0.31	0.71	1.32	Oct 1952	Sep 1954	Aug 1961	Nov 1944
27.27	3.67	0.21	0.31	0.84	1.49	Aug 1944	Aug 1944	Jan 1963	Nov 1949
29.55	3.38	0.24	0.35	0.93	1.61	Sep 1949	Oct 1957	Oct 1944	Jan 1976
31.82	3.14	0.30	0.37	1.03	2.20	Oct 1948	Sep 1949	Oct 1952	Sep 1957
34.09	2.93	0.30	0.41	1.06	2.47	Oct 1957	Oct 1952	Jan 1976	Sep 1966
36.36	2.75	0.31	0.42	1.09	2.77	Oct 1975	Dec 1963	Nov 1949	Sep 1963
38.64	2.59	0.31	0.43	1.25	2.84	Sep 1964	Jan 1962	Aug 1964	Sep 1964
40.91	2.44	0.37	0.47	1.26	2.87	Jan 1962	Oct 1975	Sep 1945	Jan 1960
43.18	2.32	0.40	0.47	1.31	4.21	Dec 1963	Sep 1945	Sep 1954	Oct 1958
45.45	2.20	0.43	0.71	1.70	4.95	Sep 1945	Sep 1964	Sep 1966	Oct 1974
47.73	2.10	0.54	0.89	2.05	4.99	Oct 1974	Sep 1966	Sep 1950	Aug 1959
50.00	2.00	0.81	1.03	2.10	5.02	Sep 1966	Jan 1976	Jan 1960	Nov 1971
52.27	1.91	1.00	1.17	2.23	5.12	Jan 1976	Feb 1960	Sep 1959	Sep 1968
54.55	1.83	1.06	1.49	2.45	5.90	Sep 1950	Sep 1950	Oct 1974	Sep 1967
56.82	1.76	1.07	1.96	3.23	5.94	Sep 1960	Sep 1967	Oct 1958	Aug 1961
59.09	1.69	1.63	2.21	3.58	6.67	Sep 1967	Oct 1974	Sep 1967	Oct 1982
61.36	1.63	1.69	2.69	4.74	8.49	Sep 1941	Aug 1941	Oct 1971	Oct 1979
63.64	1.57	1.97	2.85	4.83	10.45	Jan 1958	Sep 1968	Sep 1968	Oct 1975
65.91	1.52	2.76	2.97	5.35	14.05	Sep 1968	Oct 1958	Sep 1969	Sep 1973
68.18	1.47	3.37	4.23	6.41	15.18	Oct 1982	Oct 1971	Oct 1982	Aug 1941
70.45	1.42	3.79	4.58	6.63	15.89	Oct 1971	Sep 1982	Oct 1975	Sep 1969
72.73	1.38	4.17	4.59	6.88	22.04	Sep 1969	Sep 1969	Nov 1979	Aug 1980
75.00	1.33	5.07	6.27	7.37	23.75	Jul 1965	Aug 1980	Aug 1980	Nov 1954
77.27	1.29	5.14	6.53	7.90	24.22	Sep 1973	Sep 1973	Sep 1973	Aug 1945
79.55	1.26	5.29	6.59	10.30	24.46	Aug 1980	Oct 1979	Aug 1965	Sep 1950
81.82	1.22	5.81	7.29	11.33	28.18	Sep 1978	Sep 1978	Aug 1941	Aug 1965
84.09	1.19	5.93	7.80	12.33	30.98	Oct 1979	Aug 1965	Sep 1978	Jul 1977
86.36	1.16	5.97	10.19	14.42	45.88	Sep 1970	Sep 1951	Aug 1970	Aug 1970
88.64	1.13	9.16	10.53	21.26	47.46	Sep 1951	Aug 1970	Jun 1977	Aug 1951
90.91	1.10	12.71	17.87	36.22	47.79	Jul 1977	Jul 1977	Sep 1951	Oct 1978
93.18	1.07	15.00	33.27	84.00	172.43	Jul 1942	Sep 1981	Jul 1942	Jul 1942
95.45	1.05	27.86	33.47	122.77	242.31	Sep 1981	Aug 1942	Nov 1981	Aug 1981
97.73	1.02	57.86	83.67	323.58	392.34	Jul 1972	Jul 1972	Sep 1972	Oct 1972
	μ	4.26	6.03	16.64	28.62				
	σ	9.84	14.26	52.93	72.20				

**Table 4.3 Results of Low-Flow Analyses
for 5- and 9-Month Droughts**

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
2.22	45.00	0.29	Dec	1939	13.74	Nov	1963
4.44	22.50	0.36	Nov	1943	15.74	Nov	1955
6.67	15.00	1.15	Nov	1940	18.30	Nov	1940
8.89	11.25	1.82	Nov	1955	25.75	Feb	1940
11.11	9.00	2.05	Oct	1953	26.89	Nov	1960
13.33	7.50	2.37	Oct	1956	32.23	Nov	1976
15.56	6.43	3.23	Nov	1976	33.96	Nov	1956
17.78	5.63	3.36	Nov	1944	34.81	Oct	1944
20.00	5.00	3.83	Oct	1963	38.04	Oct	1962
22.22	4.50	4.05	Oct	1964	38.94	Oct	1943
24.44	4.09	4.19	Dec	1962	43.96	Aug	1971
26.67	3.75	4.48	Nov	1960	50.64	Oct	1953
28.89	3.46	6.99	Nov	1958	52.31	Aug	1964
31.11	3.21	10.01	Oct	1948	110.18	Oct	1966
33.33	3.00	12.17	Oct	1952	121.07	Nov	1946
35.56	2.81	13.49	Sep	1966	124.19	Sep	1954
37.78	2.65	15.80	Sep	1947	132.85	Nov	1968
40.00	2.50	16.85	Oct	1971	133.44	Oct	1952
42.22	2.37	18.54	Oct	1946	133.92	Aug	1948
44.44	2.25	19.91	Oct	1968	145.88	Dec	1957
46.67	2.14	29.69	Sep	1975	149.20	Oct	1979
48.89	2.05	31.57	Oct	1974	162.48	Sep	1950
51.11	1.96	34.88	Oct	1950	163.53	Oct	1969
53.33	1.88	44.42	Sep	1954	175.92	Oct	1965
55.56	1.80	47.39	May	1940	179.03	Jul	1949
57.78	1.73	53.31	Mar	1964	183.91	Oct	1978
60.00	1.67	59.18	Nov	1979	190.79	Oct	1947
62.22	1.61	64.55	Apr	1956	199.34	Nov	1980
64.44	1.55	64.78	Nov	1969	202.94	Nov	1974
66.67	1.50	66.59	Aug	1967	207.64	Aug	1961
68.89	1.45	78.67	Aug	1959	218.07	Sep	1975
71.11	1.41	80.51	Jun	1961	234.02	Dec	1958
73.33	1.36	86.14	Dec	1978	249.84	Sep	1959
75.56	1.32	88.98	Sep	1973	261.38	Oct	1945
77.78	1.29	99.02	Sep	1949	289.11	Sep	1967
80.00	1.25	105.75	Sep	1965	319.84	Oct	1970
82.22	1.22	108.13	Oct	1957	336.36	Sep	1941
84.44	1.18	109.78	Jul	1941	338.85	Oct	1977
86.67	1.15	115.65	Jun	1977	367.41	Nov	1973
88.89	1.13	117.15	Sep	1982	368.68	Oct	1951
91.11	1.10	127.02	Sep	1945	421.34	Oct	1982
93.33	1.07	130.15	Sep	1980	499.84	Oct	1981
95.56	1.05	160.89	Jul	1962	502.13	Jul	1942
97.78	1.02	165.05	Mar	1958	616.54	May	1972

Table 4.4 Monthly and Annual Flow Duration Values

PROB ≥	Flows in cfs												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
99	0.00	0.00	0.10	0.10	0.11	0.62	2.17	14.85	2.84	0.78	0.00	0.00	0.00
95	0.00	0.30	0.40	0.50	0.90	13.08	20.00	38.07	14.00	4.01	0.20	0.00	0.40
90	0.00	0.80	0.90	1.00	1.52	41.17	61.00	61.09	28.00	6.21	0.80	0.20	1.20
85	0.30	1.20	1.51	1.51	5.58	70.18	87.00	76.19	38.00	8.43	1.31	0.50	2.60
80	0.51	1.70	2.22	2.26	17.17	90.35	115.00	97.26	51.00	12.04	2.11	0.80	4.70
75	1.21	2.80	3.52	7.19	35.09	120.56	143.00	119.26	68.00	15.06	3.02	1.20	7.49
70	1.97	4.00	5.13	20.46	42.74	158.44	176.00	137.26	83.00	18.84	4.15	1.60	13.99
60	3.28	7.30	18.76	49.49	69.61	226.80	285.00	188.10	114.00	30.79	6.56	2.90	38.99
50	5.27	17.00	55.46	89.41	115.44	318.65	402.00	249.10	153.00	47.75	9.16	4.80	79.99
40	14.89	37.00	108.38	137.44	212.06	418.82	544.00	324.12	215.00	73.69	13.94	6.80	139.98
30	50.68	70.00	167.48	199.45	308.30	583.54	716.00	453.85	328.00	115.63	21.93	12.00	237.98
25	77.60	126.00	199.53	259.12	386.06	708.16	850.00	536.78	424.00	151.47	29.88	17.00	313.29
20	125.44	194.00	249.41	343.01	541.49	877.01	1040.00	672.40	544.00	205.36	45.81	32.00	415.97
15	190.43	284.00	335.24	470.87	708.79	1098.05	1300.00	849.44	743.00	305.12	68.80	110.00	566.44
10	300.35	430.00	480.15	724.51	998.60	1428.06	1690.00	1188.01	1070.00	462.08	120.69	281.00	828.00
5	549.27	700.00	932.67	1457.84	1518.74	2427.06	2650.00	1907.88	2010.00	778.07	295.49	683.00	1431.71
1	1506.33	1775.92	2892.97	2819.00	3740.74	4926.53	6037.17	5131.33	5078.37	2410.81	2393.89	2004.99	3881.10
\bar{Q} , cfs	112.97	146.68	256.25	280.05	388.78	632.51	752.64	543.64	484.38	206.84	103.18	116.03	334.53
$u(\bar{Q})$ %	21.30	23.48	19.60	23.75	24.91	28.04	28.63	24.75	22.48	19.93	11.69	14.82	23.97

Table 4.5 Protected-Flow Statistics for Month of October

with $Q_p = Q_m(90)$

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1940	-0.05	31	0.00	0.00	0.00	0	0.00	0.00
1941	-0.05	31	0.00	0.00	0.00	0	0.00	0.00
1942	0.00	0	0.00	0.00	35595.79	31	1148.25	5890.00
1943	0.00	0	0.00	0.00	3109.94	31	100.32	250.00
1944	-0.04	20	0.00	0.00	1.98	11	0.18	0.30
1945	0.00	0	0.00	0.00	271.84	31	8.77	87.00
1946	0.00	0	0.00	0.00	8637.88	31	278.64	1900.00
1947	-0.03	17	0.00	0.00	23.88	14	1.71	4.10
1948	-0.03	18	0.00	0.00	155.68	13	11.98	61.00
1949	0.00	0	0.00	0.00	9.65	31	0.31	0.50
1950	0.00	0	0.00	0.00	98.05	31	3.16	14.00
1951	0.00	0	0.00	0.00	1647.34	31	53.14	336.00
1952	0.00	0	0.00	0.00	5130.92	31	165.51	910.00
1953	0.00	0	0.00	0.00	33.85	31	1.09	3.30
1954	-0.01	3	0.00	0.00	8.45	28	0.30	0.70
1955	0.00	0	0.00	0.00	2829.04	31	91.26	520.00
1956	0.00	0	0.00	0.00	102.15	31	3.30	22.00
1957	-0.05	31	0.00	0.00	0.00	0	0.00	0.00
1958	0.00	0	0.00	0.00	919.84	31	29.67	282.00
1959	0.00	0	0.00	0.00	104.25	31	3.36	6.00
1960	0.00	0	0.00	0.00	7499.90	31	241.93	942.00
1961	0.00	0	0.00	0.00	96.55	31	3.11	5.00
1962	0.00	0	0.00	0.00	8440.89	31	272.29	950.00
1963	0.00	0	0.00	0.00	316.54	31	10.21	81.00
1964	0.00	0	0.00	0.00	95.75	31	3.09	4.70
1965	0.00	0	0.00	0.00	92.55	31	2.99	7.80
1966	0.00	0	0.00	0.00	3867.94	31	124.77	364.00
1967	0.00	0	0.00	0.00	130.85	31	4.22	19.00
1968	0.00	0	0.00	0.00	2777.94	31	89.61	760.00
1969	0.00	0	0.00	0.00	162.85	31	5.25	7.60
1970	0.00	0	0.00	0.00	1663.94	31	53.68	197.00
1971	0.00	0	0.00	0.00	14095.91	31	454.71	1820.00
1972	0.00	0	0.00	0.00	154.35	31	4.98	8.00
1973	0.00	0	0.00	0.00	13582.90	31	438.16	1500.00
1974	0.00	0	0.00	0.00	1950.94	31	62.93	436.00
1975	0.00	0	0.00	0.00	85.55	31	2.76	15.00
1976	0.00	0	0.00	0.00	352.23	31	11.36	40.00
1977	0.00	0	0.00	0.00	109.15	31	3.52	12.00
1978	0.00	0	0.00	0.00	22630.88	31	730.03	3390.00
1979	0.00	0	0.00	0.00	1042.94	31	33.64	78.00
1980	0.00	0	0.00	0.00	269.34	31	8.69	15.00
1981	0.00	0	0.00	0.00	5015.93	31	161.80	756.00
1982	0.00	0	0.00	0.00	10786.89	31	347.96	1870.00
1983	0.00	0	0.00	0.00	198.65	31	6.41	14.00
μ	0.00				127.04			
σ	0.00				259.28			
% YEAR =		15.91	% DAYS =	11.07	% YEAR =	93.18	% DAYS =	88.93

Table 4.6 Protected-Flow Statistics for Month of October

with $Q_p = Q_y(90)$

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1940	-37.20	31	-1.20	-1.20	0.00	0	0.00	0.00
1941	-37.20	31	-1.20	-1.20	0.00	0	0.00	0.00
1942	0.00	0	0.00	0.00	35558.62	31	1147.05	5888.80
1943	0.00	0	0.00	0.00	3072.79	31	99.12	248.80
1944	-35.20	31	-1.14	-1.20	0.00	0	0.00	0.00
1945	-6.40	15	-0.43	-0.60	241.10	16	15.07	85.80
1946	0.00	0	0.00	0.00	8600.71	31	277.44	1898.80
1947	-21.20	21	-1.01	-1.20	7.90	10	0.79	2.90
1948	-27.70	27	-1.03	-1.20	146.20	4	36.55	59.80
1949	-27.50	31	-0.89	-1.00	0.00	0	0.00	0.00
1950	-3.60	7	-0.51	-1.00	64.50	24	2.69	12.80
1951	0.00	0	0.00	0.00	1610.20	31	51.94	334.80
1952	0.00	0	0.00	0.00	5093.76	31	164.31	908.80
1953	-11.70	18	-0.65	-1.10	8.40	13	0.65	2.10
1954	-28.70	31	-0.93	-1.20	0.00	0	0.00	0.00
1955	-1.30	2	-0.65	-0.80	2793.20	29	96.32	518.80
1956	-5.60	11	-0.51	-1.10	70.60	20	3.53	20.80
1957	-37.20	31	-1.20	-1.20	0.00	0	0.00	0.00
1958	-14.90	21	-0.71	-0.90	897.60	10	89.76	280.80
1959	0.00	0	0.00	0.00	67.10	31	2.16	4.80
1960	0.00	0	0.00	0.00	7462.74	31	240.73	940.80
1961	0.00	0	0.00	0.00	59.40	31	1.92	3.80
1962	0.00	0	0.00	0.00	8403.72	31	271.09	948.80
1963	0.00	1	0.00	0.00	279.40	30	9.31	79.80
1964	-0.30	1	-0.30	-0.30	58.90	30	1.96	3.50
1965	0.00	0	0.00	0.00	55.40	31	1.79	6.60
1966	0.00	0	0.00	0.00	3830.79	31	123.57	362.80
1967	0.00	2	0.00	0.00	93.70	29	3.23	17.80
1968	0.00	0	0.00	0.00	2740.80	31	88.41	758.80
1969	0.00	0	0.00	0.00	125.70	31	4.05	6.40
1970	0.00	0	0.00	0.00	1626.80	31	52.48	195.80
1971	0.00	0	0.00	0.00	14058.74	31	453.51	1818.80
1972	0.00	0	0.00	0.00	117.20	31	3.78	6.80
1973	0.00	0	0.00	0.00	13545.74	31	436.96	1498.80
1974	0.00	0	0.00	0.00	1913.80	31	61.74	434.80
1975	-7.70	19	-0.41	-0.70	56.10	12	4.67	13.80
1976	-10.91	14	-0.78	-0.89	326.00	17	19.18	38.80
1977	0.00	0	0.00	0.00	72.00	31	2.32	10.80
1978	0.00	0	0.00	0.00	22593.71	31	728.83	3388.80
1979	0.00	0	0.00	0.00	1005.79	31	32.44	76.80
1980	0.00	0	0.00	0.00	232.10	31	7.49	13.80
1981	0.00	0	0.00	0.00	4978.78	31	160.61	754.80
1982	0.00	0	0.00	0.00	10749.71	31	346.76	1868.80
1983	0.00	0	0.00	0.00	161.50	31	5.21	12.80
μ	-0.91				149.93			
σ	0.82				269.49			
% YEAR =	43.18	% DAYS =	25.29	% YEAR =	86.36	% DAYS =	74.71	

Table 4.7 Summary of Protected-Flow Statistics
 USGS NO. 05542000 Mazon River near Coal City
 Drainage Area 455.00 sq mi Period of Record (1939-1983) 44 years

T	Item	Mean Flow, Flow Duration, and Selected Protected-Flow Statistics												Year
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
	\bar{Q}	112.98	146.68	256.26	280.05	389.57	632.51	752.64	543.64	484.38	206.85	103.19	116.04	334.54
	$\bar{Q}(S)$	222.45	250.71	420.17	336.87	375.03	590.78	577.03	534.41	500.43	288.27	271.89	239.49	177.00
	Q(98)	0.00	0.80	0.90	1.00	1.52	41.17	61.00	61.09	28.00	6.21	0.80	0.20	1.20
M	AVQ(-)	0.00	-0.47	-0.47	-0.48	-0.66	-25.30	-35.58	-24.32	-13.28	-2.37	-0.52	-0.12	
	% years	15.91	18.18	20.45	18.18	15.91	22.73	25.00	29.55	36.36	45.45	27.27	29.55	
	% days	11.07	10.23	11.07	11.29	10.06	10.04	10.08	10.04	10.23	10.19	10.56	10.53	
	AVQ(+)	127.04	162.56	287.20	314.62	430.64	660.19	773.12	539.14	509.88	223.67	114.53	129.49	
	% years	93.18	97.73	95.45	97.73	97.73	97.73	100.00	100.00	100.00	100.00	100.00	97.73	
	% days	88.93	89.77	88.93	88.71	89.94	89.96	89.92	89.96	89.77	89.81	89.44	89.47	
Y	AVQ(-)	-0.91	-0.61	-0.66	-0.58	-0.45	-0.51	0.00	0.00	0.00	-0.94	-0.71	-0.74	
	% years	43.18	20.45	22.73	22.73	15.91	6.82	2.27	0.00	0.00	2.27	34.09	52.27	
	% days	25.29	15.68	13.34	13.56	8.37	1.76	0.15	0.00	0.00	1.17	14.59	26.36	
	AVQ(+)	149.93	172.65	294.43	322.69	423.02	642.62	752.58	542.44	483.18	208.10	119.53	156.22	
	% years	86.36	93.18	95.45	95.45	100.00	100.00	100.00	100.00	100.00	100.00	100.00	90.91	
	% days	74.71	84.32	86.66	86.44	91.63	98.24	99.85	100.00	100.00	98.83	85.41	73.64	
	Q(85)	0.30	1.20	1.51	1.51	5.58	70.18	87.00	76.19	38.00	8.43	1.31	0.50	2.60
M	AVQ(-)	-0.22	-0.61	-0.82	-0.79	-4.11	-41.32	-45.64	-28.24	-17.13	-3.53	-0.79	-0.30	
	% years	27.27	20.45	27.27	22.73	27.27	31.82	31.82	38.64	45.45	52.27	34.09	34.09	
	% days	16.94	15.68	15.98	15.54	15.12	15.10	15.08	15.25	15.23	15.03	15.03	16.89	
	AVQ(+)	135.70	172.65	303.37	329.95	452.22	669.71	791.91	556.64	529.64	234.13	120.04	139.09	
	% years	90.91	93.18	95.45	93.18	97.73	95.45	100.00	97.73	100.00	100.00	100.00	97.73	
	% days	83.06	84.32	84.02	84.46	84.88	84.90	84.92	84.75	84.77	84.97	84.97	83.11	
Y	AVQ(-)	-1.90	-1.62	-1.60	-1.58	-1.53	-1.59	-0.85	0.00	-0.61	-1.50	-1.64	-1.73	
	% years	54.55	34.09	31.82	27.27	20.45	6.82	4.55	0.00	4.55	9.09	45.45	61.36	
	% days	33.87	23.26	21.11	20.53	13.11	2.35	1.36	0.00	0.61	2.42	22.14	37.88	
	AVQ(+)	167.89	188.24	321.98	349.52	444.70	645.08	760.42	541.04	484.72	209.35	129.66	183.67	
	% years	86.36	84.09	86.36	90.91	97.73	100.00	100.00	100.00	100.00	100.00	100.00	90.91	
	% days	66.13	76.74	78.89	79.47	86.89	97.65	98.64	100.00	99.39	97.58	77.86	62.12	
	Q(80)	0.51	1.70	2.22	2.26	17.17	90.35	115.00	97.26	51.00	12.04	2.11	0.80	4.70
M	AVQ(-)	-0.37	-0.91	-1.30	-1.27	-13.54	-48.74	-58.67	-40.18	-24.29	-5.55	-1.29	-0.55	
	% years	34.09	29.55	29.55	27.27	31.82	43.18	38.64	45.45	54.55	65.91	38.64	38.64	
	% days	20.01	20.00	20.01	20.09	20.11	20.01	20.30	19.94	20.00	20.97	20.09	19.24	
	AVQ(+)	140.71	181.46	317.94	347.94	468.58	690.01	815.03	567.57	547.79	247.97	126.81	142.83	
	% years	88.64	86.36	86.36	90.91	93.18	95.45	100.00	97.73	100.00	100.00	100.00	93.18	
	% days	79.99	80.00	79.99	79.91	79.89	79.99	79.70	80.06	80.00	79.03	79.91	80.76	
Y	AVQ(-)	-3.22	-2.95	-3.07	-3.40	-3.47	-3.10	-2.12	0.00	-1.93	-2.14	-2.93	-3.16	
	% years	65.91	50.00	40.91	27.27	20.45	9.09	4.55	0.00	6.82	34.09	61.36	75.00	
	% days	47.14	32.65	28.08	23.31	14.16	2.93	2.27	0.00	1.52	5.94	32.18	49.85	
	AVQ(+)	207.71	212.24	350.97	360.09	448.01	646.87	765.38	538.94	487.09	215.04	146.62	225.14	
	% years	79.55	77.27	84.09	86.36	97.73	100.00	100.00	100.00	100.00	100.00	95.45	88.64	
	% days	52.86	67.35	71.92	76.69	85.84	97.07	97.73	100.00	98.48	94.06	67.82	50.15	
	Q(75)	1.21	2.80	3.52	7.19	35.09	120.56	143.00	119.26	68.00	15.06	3.02	1.20	7.49
M	AVQ(-)	-0.92	-1.76	-2.22	-5.56	-26.77	-66.48	-72.88	-52.00	-34.70	-7.31	-1.85	-0.81	
	% years	43.18	34.09	34.09	29.55	43.18	54.55	47.73	52.27	61.36	68.18	52.27	47.73	
	% days	25.29	24.24	24.93	25.07	25.10	24.93	25.00	24.93	25.00	25.15	24.93	24.02	
	AVQ(+)	149.92	190.49	337.39	366.02	481.20	704.01	837.15	582.54	566.74	258.68	134.04	151.39	
	% years	86.36	81.82	86.36	84.09	93.18	93.18	100.00	97.73	100.00	100.00	97.73	90.91	
	% days	74.71	75.76	75.07	74.93	74.90	75.07	75.00	75.07	75.00	74.85	75.07	75.98	
Y	AVQ(-)	-5.39	-4.97	-5.16	-5.86	-5.58	-5.44	-4.12	0.00	-3.13	-2.92	-4.65	-5.02	
	% years	68.18	54.55	43.18	29.55	27.27	9.09	4.55	0.00	11.36	52.27	77.27	84.09	
	% days	54.91	40.08	33.80	25.07	16.65	3.23	2.88	0.00	2.80	13.56	42.82	62.65	
	AVQ(+)	240.53	235.60	378.40	365.73	458.59	646.03	767.36	536.15	490.73	231.09	170.82	299.05	
	% years	75.00	75.00	79.55	84.09	97.73	100.00	100.00	100.00	100.00	100.00	95.45	81.82	
	% days	45.09	59.92	66.20	74.93	83.35	96.77	97.12	100.00	97.20	86.44	57.18	37.35	

Table 5.1 Monthly and Annual Mean Flows in cfs

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1943	39.6	880.9	769.5	856.6	791.1	676.7	526.9	2967.9	391.4	101.5	1186.3	21.4	770.7
1944	10.4	17.3	11.2	10.5	90.7	819.7	2714.5	586.5	325.7	60.6	6.4	4.9	385.7
1945	20.1	17.2	6.7	3.5	124.1	303.4	733.5	1374.5	364.5	82.3	15.7	33.8	257.4
1946	78.8	71.1	111.5	983.2	460.5	715.4	190.6	744.4	990.1	466.2	19.7	2.7	403.4
1947	9.9	188.8	108.6	395.0	327.4	401.7	831.6	1083.3	741.7	116.2	7.8	3.3	350.5
1948	11.3	24.5	395.6	206.7	344.7	1090.8	673.3	575.8	286.8	325.1	49.5	2.4	333.1
1949	1.6	6.4	13.7	405.0	817.5	459.6	303.1	235.2	206.4	255.2	169.6	6.3	236.4
1950	16.7	10.0	638.3	1922.4	1452.1	741.0	1547.2	463.5	440.4	230.7	21.7	54.8	622.7
1951	34.8	21.7	60.1	274.7	1400.9	607.2	953.5	492.6	571.6	2350.5	303.6	176.7	599.3
1952	110.5	553.8	160.4	623.8	293.6	743.9	1294.8	587.6	1145.3	116.3	34.3	9.4	470.7
1953	2.8	7.5	18.6	70.2	164.6	794.6	472.6	175.4	128.9	712.2	29.4	1.8	216.0
1954	0.4	1.5	4.6	10.8	55.7	317.6	913.0	333.3	331.9	22.5	20.7	2.0	167.2
1955	66.0	14.9	36.4	546.7	368.3	408.2	510.2	329.5	260.6	108.6	16.9	5.5	221.7
1956	15.7	13.5	9.3	7.0	131.4	106.5	186.2	305.4	398.3	232.7	34.1	5.8	120.1
1957	1.0	4.1	5.9	13.9	51.3	67.7	2801.1	1008.5	484.3	734.4	55.2	9.0	435.3
1958	45.9	233.3	466.2	261.0	155.7	218.1	209.7	141.4	1716.2	1174.0	258.5	22.6	409.1
1959	12.7	40.6	21.6	37.9	982.1	695.2	777.2	482.2	102.7	26.5	10.5	10.8	261.2
1960	79.0	127.5	313.8	433.0	740.2	664.3	755.3	247.7	839.9	141.7	47.8	12.2	364.1
1961	7.6	8.7	4.8	5.5	24.1	156.1	305.5	315.6	347.4	48.7	20.9	615.9	154.3
1962	215.4	454.0	195.8	436.4	804.7	1693.4	422.8	913.8	616.3	495.7	79.1	34.2	529.5
1963	44.6	33.5	14.8	10.2	6.7	678.3	191.8	153.2	40.1	51.3	5.3	3.9	104.0
1964	3.5	6.8	4.9	13.3	8.4	23.7	252.5	71.1	148.9	54.5	5.1	8.2	49.7
1965	2.0	4.9	5.3	519.7	181.8	625.9	1740.7	1221.3	157.8	98.5	13.0	223.6	399.9
1966	144.0	53.9	556.4	354.6	123.2	518.3	483.8	994.5	223.4	42.7	13.1	8.6	295.5
1967	7.4	13.9	244.0	41.9	413.7	685.0	694.7	618.9	187.8	62.0	15.7	9.5	248.4
1968	71.7	484.6	1270.5	414.3	1269.2	302.3	542.7	514.9	1220.2	298.5	43.4	16.8	533.1
1969	8.3	10.6	43.6	430.6	239.0	293.3	834.3	326.0	179.1	172.4	22.3	4.8	213.0
1970	43.2	129.7	94.6	91.5	126.7	184.9	1405.2	2595.9	669.8	170.9	216.3	813.4	546.3
1971	556.1	312.8	154.8	85.8	387.3	762.3	145.4	219.5	56.2	99.8	9.1	8.2	233.0
1972	5.6	5.3	421.6	518.3	145.2	635.3	1207.9	696.9	688.2	338.7	254.3	353.3	439.5
1973	770.0	1167.1	1026.4	1015.2	504.7	1451.4	1877.4	571.7	1985.9	312.5	124.9	19.7	901.5
1974	122.5	58.4	329.5	1506.5	919.0	803.0	550.0	1304.1	1887.3	240.5	35.6	38.0	647.5
1975	15.3	132.1	280.0	1044.0	904.1	491.2	937.1	354.2	689.6	101.9	48.9	118.6	422.0
1976	48.8	35.0	294.0	89.5	1350.0	1388.3	576.4	575.6	405.6	288.9	23.8	9.3	420.5
1977	8.5	6.9	5.5	3.0	25.5	138.9	108.8	401.0	50.7	36.1	513.3	653.1	163.3
1978	1069.5	392.8	735.5	148.3	51.5	832.3	736.0	479.1	365.6	483.3	71.9	113.9	460.6
1979	18.7	27.0	59.6	30.7	46.7	3122.6	1774.5	585.9	128.6	367.8	543.8	52.0	568.1
1980	17.4	23.4	50.7	40.6	71.6	891.7	672.5	401.2	2232.0	254.6	28.2	24.5	390.3
1981	8.6	13.1	47.8	23.8	235.1	120.2	1156.6	1645.2	998.4	583.5	964.3	183.3	499.5
1982	220.4	156.9	94.6	266.1	797.8	1289.5	1611.8	892.4	405.6	511.5	50.5	18.4	523.8
1983	17.9	281.2	2773.2	299.3	518.2	649.5	1808.2	1140.4	247.8	159.1	24.4	21.4	663.7
\bar{Q}	97.2	147.5	289.3	352.5	436.7	672.4	888.6	710.4	577.0	305.6	132.1	91.2	391.0
$\bar{Q}(e)$	214.3	250.5	497.7	433.2	425.7	549.4	660.4	604.0	549.1	404.7	251.6	187.5	188.7

Table 5.2 Results of Low-Flow Analyses

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
2.44	41.00	0.07	0.15	0.26	0.75	Oct 1953	Oct 1953	Oct 1953	Oct 1953
4.88	20.50	0.16	0.19	0.53	1.92	Sep 1954	Oct 1947	Sep 1954	Oct 1948
7.32	13.67	0.19	0.21	1.04	2.33	Oct 1947	Sep 1954	Oct 1956	Sep 1947
9.76	10.25	0.34	0.56	1.07	2.42	Oct 1952	Oct 1956	Oct 1947	Oct 1956
12.20	8.20	0.39	0.95	1.57	2.70	Oct 1948	Oct 1948	Oct 1948	Oct 1964
14.63	6.83	0.51	1.13	1.89	3.49	Oct 1956	Oct 1946	Oct 1946	Oct 1963
17.07	5.86	0.64	1.35	1.97	3.77	Sep 1959	Oct 1952	Oct 1964	Jan 1976
19.51	5.13	0.91	1.51	2.57	3.81	Sep 1955	Sep 1955	Jan 1963	Oct 1952
21.95	4.56	1.03	1.60	2.81	4.07	Oct 1946	Sep 1959	Oct 1952	Jan 1960
24.39	4.10	1.71	1.85	2.87	4.34	Feb 1960	Feb 1960	Jan 1976	Jan 1944
26.83	3.73	1.89	1.92	3.44	4.54	Oct 1964	Oct 1964	Jan 1944	Sep 1946
29.27	3.42	2.26	2.43	3.78	5.47	Sep 1944	Dec 1963	Sep 1955	Nov 1971
31.71	3.15	2.30	2.84	3.91	7.05	Dec 1963	Jan 1976	Dec 1960	Jan 1955
34.15	2.93	2.74	2.87	4.38	7.47	Jan 1976	Jan 1944	Sep 1969	Sep 1969
36.59	2.73	3.71	4.07	5.11	7.68	Sep 1949	Oct 1969	Nov 1971	Oct 1968
39.02	2.56	3.79	4.85	5.37	7.97	Oct 1969	Nov 1971	Sep 1959	Sep 1966
41.46	2.41	4.64	4.87	5.77	8.44	Sep 1950	Sep 1949	Sep 1945	Feb 1962
43.90	2.28	4.71	5.40	5.84	9.28	Nov 1971	Sep 1945	Feb 1962	Aug 1959
46.34	2.16	4.71	5.53	6.26	9.77	Sep 1945	Feb 1962	Sep 1949	Sep 1957
48.78	2.05	4.74	5.78	6.32	9.97	Jan 1943	Sep 1950	Nov 1968	Sep 1954
51.22	1.95	5.00	5.95	7.30	9.99	Jan 1962	Jan 1943	Oct 1966	Dec 1943
53.66	1.86	5.77	5.99	7.47	10.51	Nov 1968	Nov 1968	Oct 1957	Sep 1967
56.10	1.78	5.91	6.61	8.29	10.71	Oct 1966	Sep 1966	Oct 1980	Oct 1980
58.54	1.71	6.40	7.10	8.39	10.74	Sep 1967	Oct 1957	Jan 1943	Sep 1949
60.98	1.64	6.51	7.45	8.79	14.82	Oct 1980	Oct 1980	Sep 1950	Oct 1958
63.41	1.58	6.94	7.61	8.81	15.64	Oct 1957	Sep 1967	Sep 1967	Aug 1945
65.85	1.52	7.96	8.75	11.38	17.62	Sep 1978	Aug 1961	Aug 1965	Oct 1979
68.29	1.46	8.64	9.15	11.77	17.83	Aug 1961	Sep 1978	Oct 1958	Aug 1965
70.73	1.41	9.59	10.25	12.70	18.16	Sep 1965	Aug 1965	Oct 1974	Oct 1982
73.17	1.37	10.19	10.39	15.40	22.38	Sep 1974	Oct 1974	Aug 1961	Oct 1978
75.61	1.32	10.29	11.27	15.55	26.29	Oct 1958	Oct 1958	Oct 1982	Sep 1974
78.05	1.28	11.64	14.40	15.84	28.28	Aug 1975	Oct 1979	Feb 1978	Nov 1950
80.49	1.24	14.00	14.87	16.19	29.41	Oct 1979	Oct 1982	Oct 1979	Aug 1961
82.93	1.21	14.71	16.87	19.15	37.44	Oct 1982	Sep 1973	Aug 1975	Jul 1977
85.37	1.17	16.00	17.40	19.90	42.00	Jul 1977	Aug 1975	Sep 1973	Oct 1975
87.80	1.14	16.57	19.00	22.26	44.87	Sep 1973	Jul 1977	Jul 1977	Sep 1973
90.24	1.11	36.29	42.13	65.03	83.97	Sep 1970	Sep 1951	Sep 1951	Oct 1951
92.68	1.08	36.29	43.60	73.97	109.43	Sep 1972	Sep 1972	Jan 1981	Jan 1970
95.12	1.05	38.57	47.27	77.65	124.92	Oct 1951	Sep 1970	Jan 1970	Dec 1981
97.56	1.02	50.00	51.73	86.97	223.36	Apr 1981	Apr 1981	Aug 1972	Aug 1972
μ		8.97	10.20	14.49	25.14				
σ		11.65	13.19	21.65	42.33				

**Table 5.3 Results of Low-Flow Analyses
for 5- and 9-Month Droughts**

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
2.38	42.00	3.79	Nov	1953	13.41	Nov	1963
4.76	21.00	4.85	Oct	1963	36.63	Dec	1976
7.14	14.00	5.07	Oct	1964	45.36	Nov	1960
9.52	10.50	6.13	Nov	1956	46.01	Nov	1955
11.90	8.40	6.61	Nov	1976	46.26	Nov	1956
14.29	7.00	7.74	Nov	1960	60.77	Nov	1944
16.67	6.00	10.18	Nov	1955	61.35	Aug	1964
19.05	5.25	10.49	Nov	1944	83.95	Nov	1980
21.43	4.67	14.14	Nov	1943	95.99	Oct	1969
23.81	4.20	14.53	Oct	1952	105.01	Oct	1953
26.19	3.82	14.71	Oct	1948	107.82	Aug	1971
28.57	3.50	17.13	Sep	1966	112.05	Oct	1966
30.95	3.23	21.95	Dec	1962	121.43	Dec	1962
33.33	3.00	23.55	Nov	1980	135.21	Oct	1978
35.71	2.80	24.53	Oct	1968	135.36	Nov	1952
38.10	2.63	25.22	Sep	1954	143.91	Oct	1979
40.48	2.47	25.58	Sep	1971	152.69	Sep	1954
42.86	2.33	27.06	Nov	1958	153.77	Nov	1968
45.24	2.21	32.60	Sep	1947	176.20	Sep	1959
47.62	2.10	36.53	Dec	1978	178.03	Sep	1950
50.00	2.00	36.76	Nov	1979	183.77	Dec	1957
52.38	1.91	38.63	Oct	1950	184.69	Jul	1949
54.76	1.83	45.89	Aug	1959	185.13	Sep	1948
57.14	1.75	56.35	Sep	1945	191.62	Oct	1965
59.52	1.68	58.89	Oct	1969	197.79	Sep	1975
61.90	1.62	65.94	Oct	1946	204.50	Oct	1943
64.29	1.56	69.33	Aug	1967	205.74	Oct	1947
66.67	1.50	70.62	Sep	1975	213.32	Nov	1946
69.05	1.45	73.77	Mar	1964	244.60	Oct	1945
71.43	1.40	91.58	Sep	1949	279.89	Aug	1961
73.81	1.35	92.28	Sep	1974	314.40	Jul	1967
76.19	1.31	106.56	Sep	1965	316.45	Dec	1958
78.57	1.27	127.59	Sep	1973	353.38	Nov	1974
80.95	1.24	144.95	Apr	1977	374.08	Oct	1970
83.33	1.20	161.91	Oct	1957	405.58	Oct	1977
85.71	1.17	175.85	Sep	1982	466.19	Nov	1973
88.10	1.14	184.22	Nov	1981	473.42	Dec	1951
90.48	1.11	197.17	Mar	1958	473.86	Oct	1981
92.86	1.08	207.62	Jun	1961	537.52	May	1972
95.24	1.05	222.90	May	1963	540.84	May	1983
97.62	1.02	225.53	Apr	1956	564.25	Jul	1982

Table 5.4 Monthly and Annual Flow Duration Values

PROB ≥	Flows in cfs												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
99	0.20	1.31	2.49	2.20	2.07	12.79	21.21	37.78	13.13	6.55	1.89	0.21	0.90
95	0.50	3.48	3.99	2.99	5.49	49.67	55.65	76.66	33.79	15.92	3.78	1.09	3.70
90	1.70	5.00	5.40	4.70	9.59	72.04	116.00	114.05	55.00	23.01	5.90	2.00	6.20
85	2.88	6.17	6.48	7.15	15.97	100.40	156.02	147.29	73.55	29.85	7.56	2.88	9.50
80	4.60	7.40	8.91	13.02	29.90	134.10	194.00	178.08	99.00	38.02	9.00	4.00	13.00
75	5.95	9.23	10.93	19.76	52.80	164.91	222.83	204.08	122.06	45.73	9.97	4.58	18.99
70	7.09	11.00	13.97	31.86	64.37	199.62	272.00	233.67	142.00	55.89	11.98	5.70	28.07
60	9.99	16.00	24.95	60.86	95.52	299.53	380.00	299.69	192.00	81.88	16.98	8.00	60.11
50	14.98	26.00	51.89	104.83	145.89	399.61	542.00	401.60	243.00	113.87	22.98	10.00	115.14
40	20.98	42.00	109.82	199.70	248.88	525.60	701.00	510.66	320.00	155.87	32.97	15.00	196.16
30	40.95	70.00	160.88	299.76	375.98	714.55	900.00	649.67	477.00	219.85	51.96	23.00	316.19
25	57.12	113.70	202.15	359.48	471.22	845.79	1058.20	768.50	615.47	276.25	64.61	33.55	410.21
20	88.90	180.00	262.81	457.69	613.36	1009.48	1260.00	895.60	750.00	339.80	81.95	47.00	537.25
15	135.16	260.93	415.03	620.35	811.65	1207.48	1550.48	1118.52	989.79	443.23	125.72	73.83	724.29
10	236.84	422.00	651.63	919.53	1132.34	1559.45	1980.00	1519.37	1350.00	689.61	206.87	149.00	1010.43
5	482.63	771.38	1280.82	1495.62	1814.50	2123.56	2952.50	2458.41	2096.20	1165.09	524.47	466.34	1661.03
1	1344.92	1694.37	3633.42	3260.06	3898.90	4785.18	6150.50	5668.30	5658.28	2869.72	2159.32	1483.80	4121.02
\bar{Q} , cfs	97.18	147.48	289.27	352.46	436.80	672.41	888.56	710.41	577.05	305.63	132.06	91.16	391.02
$u(\bar{Q})$ %	19.10	22.45	19.13	25.59	26.81	32.23	30.57	27.44	26.39	22.69	14.61	13.85	26.02

Table 5.5 Protected-Flow Statistics for Month of October

with $Q_p = Q_m(90)$

Year	<i>If Available Flow ≤ 0</i>				<i>If Available Flow > 0</i>			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1943	0.00	0	0.00	0.00	1174.24	31	37.88	67.30
1944	0.00	0	0.00	0.00	270.24	31	8.72	15.30
1945	0.00	0	0.00	0.00	570.74	31	18.41	113.30
1946	0.00	0	0.00	0.00	2391.24	31	77.14	391.30
1947	-8.63	16	-0.54	-0.70	264.17	15	17.61	25.30
1948	-34.34	24	-1.43	-1.60	331.09	7	47.30	113.30
1949	-13.83	16	-0.86	-1.40	9.77	15	0.65	2.30
1950	0.00	0	0.00	0.00	465.24	31	15.01	41.30
1951	0.00	0	0.00	0.00	1026.24	31	33.10	149.30
1952	0.00	0	0.00	0.00	3372.24	31	108.78	343.30
1953	-10.92	9	-1.21	-1.50	45.56	22	2.07	4.60
1954	-41.56	31	-1.34	-1.70	0.00	0	0.00	0.00
1955	-5.81	5	-1.16	-1.50	1999.95	26	76.92	298.30
1956	0.00	0	0.00	0.00	435.24	31	14.04	77.30
1957	-23.35	26	-0.90	-1.20	2.89	5	0.58	1.30
1958	0.00	0	0.00	0.00	1371.04	31	44.23	348.30
1959	0.00	0	0.00	0.00	340.24	31	10.98	15.30
1960	0.00	0	0.00	0.00	2396.24	31	77.30	323.30
1961	0.00	0	0.00	0.00	183.24	31	5.91	28.30
1962	0.00	0	0.00	0.00	6625.21	31	213.72	728.30
1963	0.00	0	0.00	0.00	1330.24	31	42.91	228.30
1964	0.00	0	0.00	0.00	56.84	31	1.83	2.60
1965	0.00	2	0.00	0.00	8.75	29	0.30	0.80
1966	0.00	0	0.00	0.00	4411.23	31	142.30	388.30
1967	0.00	0	0.00	0.00	176.34	31	5.69	8.30
1968	0.00	0	0.00	0.00	2170.14	31	70.00	498.30
1969	0.00	0	0.00	0.00	205.44	31	6.63	10.30
1970	0.00	0	0.00	0.00	1285.44	31	41.47	296.30
1971	0.00	0	0.00	0.00	17185.21	31	554.36	1918.30
1972	0.00	0	0.00	0.00	121.24	31	3.91	6.40
1973	0.00	0	0.00	0.00	23818.21	31	768.33	2158.30
1974	0.00	0	0.00	0.00	3746.24	31	120.85	735.30
1975	0.00	0	0.00	0.00	422.54	31	13.63	29.30
1976	0.00	0	0.00	0.00	1461.24	31	47.14	74.30
1977	0.00	0	0.00	0.00	210.44	31	6.79	18.30
1978	0.00	0	0.00	0.00	33101.20	31	1067.78	4568.30
1979	0.00	0	0.00	0.00	527.24	31	17.01	28.30
1980	0.00	0	0.00	0.00	486.24	31	15.69	27.30
1981	0.00	0	0.00	0.00	214.34	31	6.91	13.30
1982	0.00	0	0.00	0.00	6778.21	31	218.65	929.30
1983	0.00	0	0.00	0.00	502.24	31	16.20	25.30
μ	-1.07				106.39			
σ	1.09				238.34			
% YEAR =	19.51	% DAYS =	10.15	% YEAR =	97.56	% DAYS =	89.85	

Table 5.6 Protected-Flow Statistics for Month of October

with $Q_p = Q_y(90)$

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1943	0.00	0	0.00	0.00	1034.85	31	33.38	62.80
1944	-0.20	1	-0.20	-0.20	131.05	30	4.37	10.80
1945	-28.58	13	-2.20	-3.20	459.93	18	25.55	108.80
1946	0.00	0	0.00	0.00	2251.85	31	72.64	386.80
1947	-81.57	17	-4.80	-5.20	197.72	14	14.12	20.80
1948	-148.66	26	-5.72	-6.10	306.01	5	61.20	108.80
1949	-143.45	31	-4.63	-5.90	0.00	0	0.00	0.00
1950	-0.20	1	-0.20	-0.20	326.05	30	10.87	36.80
1951	0.00	0	0.00	0.00	886.85	31	28.61	144.80
1952	0.00	0	0.00	0.00	3232.85	31	104.29	338.80
1953	-104.85	30	-3.49	-6.00	0.10	1	0.10	0.10
1954	-180.95	31	-5.84	-6.20	0.00	0	0.00	0.00
1955	-32.69	7	-4.67	-6.00	1887.44	24	78.64	293.80
1956	-3.19	6	-0.53	-1.00	299.04	25	11.96	72.80
1957	-159.85	31	-5.16	-5.70	0.00	0	0.00	0.00
1958	0.00	0	0.00	0.00	1231.65	31	39.73	343.80
1959	0.00	0	0.00	0.00	200.85	31	6.48	10.80
1960	0.00	0	0.00	0.00	2256.85	31	72.80	318.80
1961	-12.58	11	-1.14	-2.30	56.43	20	2.82	23.80
1962	0.00	0	0.00	0.00	6485.83	31	209.22	723.80
1963	0.00	0	0.00	0.00	1190.85	31	38.41	223.80
1964	-82.55	31	-2.66	-3.40	0.00	0	0.00	0.00
1965	-130.65	31	-4.21	-4.50	0.00	0	0.00	0.00
1966	0.00	0	0.00	0.00	4271.84	31	137.80	383.80
1967	-7.19	8	-0.90	-1.60	44.14	23	1.92	3.80
1968	0.00	0	0.00	0.00	2030.75	31	65.51	493.80
1969	-0.50	2	-0.25	-0.40	66.55	29	2.29	5.80
1970	-22.48	10	-2.25	-2.70	1168.53	21	55.64	291.80
1971	0.00	0	0.00	0.00	17045.83	31	549.87	1913.80
1972	-22.05	27	-0.82	-1.50	3.91	4	0.98	1.90
1973	0.00	0	0.00	0.00	23678.82	31	763.83	2153.80
1974	0.00	0	0.00	0.00	3606.85	31	116.35	730.80
1975	0.00	0	0.00	0.00	283.15	31	9.13	24.80
1976	0.00	0	0.00	0.00	1321.85	31	42.64	69.80
1977	-10.38	10	-1.04	-1.50	81.44	21	3.88	13.80
1978	0.00	0	0.00	0.00	32961.82	31	1063.28	4563.80
1979	0.00	0	0.00	0.00	387.85	31	12.51	23.80
1980	0.00	0	0.00	0.00	346.85	31	11.19	22.80
1981	-2.20	2	-1.10	-1.20	77.15	29	2.66	8.80
1982	0.00	0	0.00	0.00	6638.83	31	214.16	924.80
1983	0.00	0	0.00	0.00	362.85	31	11.70	20.80
μ	-3.60				123.61			
σ	3.34				249.88			
% YEAR =	48.78	% DAYS =	25.65	% YEAR =	87.80	% DAYS =	74.35	

Table 5.7 Summary of Protected-Flow Statistics
 USGS NO. 05554500 Vermilion River at Pontiac
 Drainage Area 579.00 sq mi Period of Record (1942-1983) 41 years

T	Item	Mean Flow, Flow Duration, and Selected Protected-Flow Statistics												Year
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
	\bar{Q}	97.18	147.49	289.27	352.46	436.74	672.41	888.56	710.41	577.05	305.63	132.06	91.17	391.02
	$\bar{Q}(S)$	214.35	250.49	497.69	433.16	425.68	549.36	660.38	604.04	549.10	404.66	251.60	187.54	188.70
	Q(90)	1.70	5.00	5.40	4.70	9.59	72.04	116.00	114.05	55.00	23.01	5.90	2.00	6.20
M	AVQ(-)	-1.07	-1.70	-1.47	-1.49	-4.21	-28.19	-55.37	-37.77	-21.68	-8.21	-2.16	-0.82	
	% years	19.51	19.51	19.51	19.51	21.95	24.39	21.95	29.27	29.27	34.15	41.46	21.95	
	% days	10.15	10.33	9.99	10.07	9.93	9.99	10.00	10.07	10.16	10.07	10.07	10.81	
	AVQ(+)	106.39	159.09	315.55	386.87	474.79	670.15	864.55	667.37	583.56	315.18	140.53	100.08	
	% years	97.56	97.56	100.00	97.56	100.00	97.56	100.00	100.00	100.00	100.00	100.00	100.00	
	% days	89.85	89.67	90.01	89.93	90.07	90.01	90.00	89.93	89.84	89.93	89.93	89.19	
Y	AVQ(-)	-3.60	-2.18	-1.69	-2.46	-1.89	0.00	0.00	0.00	0.00	-2.16	-2.12	-3.12	
	% years	48.78	26.83	24.39	21.95	17.07	0.00	0.00	0.00	0.00	7.32	41.46	51.22	
	% days	25.65	14.88	14.08	13.30	6.73	0.00	0.00	0.00	0.00	0.94	11.80	31.87	
	AVQ(+)	123.61	166.37	329.75	399.74	461.84	666.21	882.36	704.21	570.85	302.30	142.99	126.17	
	% years	87.80	97.56	100.00	95.12	100.00	100.00	100.00	100.00	100.00	100.00	100.00	90.24	
	% days	74.35	85.12	85.92	86.70	93.27	100.00	100.00	100.00	100.00	99.06	88.20	68.13	
	Q(85)	2.88	6.17	6.48	7.15	15.97	100.40	156.02	147.29	73.55	29.85	7.56	2.88	9.50
M	AVQ(-)	-1.83	-2.16	-1.91	-3.06	-8.08	-42.95	-70.70	-52.89	-30.87	-11.31	-2.87	-1.38	
	% years	21.95	26.83	26.83	21.95	26.83	31.71	31.71	41.46	39.02	51.22	51.22	26.83	
	% days	14.24	14.88	14.56	15.03	14.94	14.56	14.63	15.03	14.72	14.87	15.03	14.31	
	AVQ(+)	110.27	166.39	331.29	406.93	496.17	676.78	870.23	672.06	595.71	325.92	147.03	103.26	
	% years	95.12	97.56	100.00	95.12	97.56	97.56	100.00	100.00	100.00	100.00	100.00	100.00	
	% days	85.76	85.12	85.44	84.97	85.06	85.44	85.37	84.97	85.28	85.13	84.97	85.69	
Y	AVQ(-)	-5.33	-4.02	-3.89	-5.04	-4.12	-1.50	0.00	0.00	0.00	-4.69	-3.78	-4.95	
	% years	56.10	36.59	34.15	21.95	21.95	4.88	0.00	0.00	0.00	7.32	60.98	70.73	
	% days	37.37	25.20	21.56	16.44	9.93	0.31	0.00	0.00	0.00	1.18	20.77	46.59	
	AVQ(+)	143.19	185.84	357.73	411.45	474.88	665.01	879.06	700.92	567.55	299.72	155.69	157.21	
	% years	82.93	92.68	92.68	95.12	100.00	100.00	100.00	100.00	100.00	100.00	100.00	87.80	
	% days	62.63	74.80	78.44	83.56	90.07	99.69	100.00	100.00	100.00	98.82	79.23	53.41	
	Q(80)	4.60	7.40	8.91	13.02	29.90	134.10	194.00	178.08	99.00	38.02	9.00	4.00	13.00
M	AVQ(-)	-2.79	-2.71	-3.57	-7.08	-18.29	-60.36	-84.00	-66.06	-44.55	-15.37	-3.34	-1.83	
	% years	31.71	34.15	31.71	29.27	31.71	53.66	48.78	51.22	48.78	56.10	60.98	41.46	
	% days	20.06	19.84	19.98	20.61	19.95	19.98	20.16	20.06	20.24	20.38	20.46	21.63	
	AVQ(+)	116.51	175.43	351.28	429.42	512.86	687.84	891.18	682.52	610.70	340.02	155.57	111.72	
	% years	87.80	97.56	92.68	92.68	95.12	97.56	100.00	100.00	100.00	100.00	100.00	100.00	
	% days	79.94	80.16	80.02	79.39	80.05	80.02	79.84	79.94	79.76	79.62	79.54	78.37	
Y	AVQ(-)	-7.73	-6.38	-6.35	-7.70	-6.65	-3.33	0.00	0.00	-2.00	-4.41	-5.51	-7.59	
	% years	68.29	48.78	43.90	24.39	24.39	7.32	0.00	0.00	4.88	19.51	65.85	75.61	
	% days	44.69	32.03	27.07	18.88	12.09	0.71	0.00	0.00	0.89	3.23	31.94	54.07	
	AVQ(+)	158.45	200.89	381.16	420.28	483.01	664.14	875.56	697.42	569.16	302.53	177.54	179.11	
	% years	78.05	85.37	85.37	92.68	100.00	100.00	100.00	100.00	100.00	100.00	100.00	97.56	
	% days	55.31	67.97	72.93	81.12	87.91	99.29	100.00	100.00	99.11	96.77	68.06	45.93	
	Q(75)	5.95	9.23	10.93	19.76	52.80	164.91	222.83	204.08	122.06	45.73	9.97	4.58	18.99
M	AVQ(-)	-3.46	-3.82	-4.82	-12.41	-35.11	-75.95	-93.97	-76.04	-56.54	-19.52	-3.92	-2.17	
	% years	43.90	36.59	36.59	31.71	48.78	58.54	51.22	63.41	58.54	60.98	60.98	41.46	
	% days	24.94	24.80	24.39	24.08	24.87	25.02	24.96	25.02	25.12	25.02	22.66	24.23	
	AVQ(+)	122.69	185.11	369.69	442.14	522.75	702.19	918.42	700.66	626.61	353.14	159.02	114.97	
	% years	87.80	92.68	87.80	87.80	95.12	97.56	100.00	97.56	95.12	100.00	100.00	97.56	
	% days	75.06	75.20	75.61	75.92	75.13	74.98	75.04	74.98	74.88	74.98	77.34	75.77	
Y	AVQ(-)	-11.61	-10.15	-10.31	-11.72	-10.63	-6.42	-3.28	0.00	-5.45	-6.38	-9.45	-11.87	
	% years	73.17	58.54	53.66	31.71	26.83	7.32	2.44	0.00	4.88	29.27	75.61	85.37	
	% days	56.57	43.58	35.64	23.92	15.71	1.65	0.57	0.00	2.11	7.40	43.04	65.28	
	AVQ(+)	195.17	235.58	425.67	441.99	497.71	664.51	874.57	691.42	570.23	310.04	205.65	230.23	
	% years	70.73	78.05	80.49	87.80	97.56	100.00	100.00	100.00	100.00	100.00	100.00	92.68	
	% days	43.43	56.42	64.36	76.08	84.29	98.35	99.43	100.00	97.89	92.60	56.96	34.72	

Table 6.1 Monthly and Annual Mean Flows in cfs

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1945	44.1	11.1	9.1	6.0	94.4	197.7	993.4	1403.6	1150.5	462.3	174.4	158.8	392.5
1946	228.9	113.7	364.0	1535.2	586.1	984.3	336.2	942.5	2218.1	340.8	37.4	4.4	641.1
1947	22.3	331.1	184.3	514.7	403.5	449.2	1747.4	1553.0	1123.3	179.4	33.1	31.2	546.0
1948	56.5	65.4	414.4	250.6	682.6	1363.6	898.8	572.4	260.0	728.1	73.4	13.9	448.5
1949	9.3	13.8	23.6	581.6	1401.7	486.9	508.2	341.9	444.6	304.2	103.4	11.2	345.1
1950	25.8	17.1	680.2	2378.9	1628.2	963.5	1937.5	642.0	988.6	950.0	78.3	97.6	860.5
1951	22.9	23.3	32.1	361.9	2089.4	699.6	1718.1	719.7	1184.5	2686.9	182.9	71.1	806.3
1952	81.5	639.4	204.2	832.4	426.1	1206.2	1923.7	889.7	1451.4	240.3	109.4	21.8	666.5
1953	9.3	19.6	36.5	104.6	164.9	823.5	927.9	316.0	336.0	981.2	54.6	9.7	316.5
1954	2.8	8.8	18.5	40.0	80.1	413.4	1433.3	769.5	764.1	80.5	204.4	24.1	319.3
1955	155.9	76.2	107.5	860.8	765.7	641.2	948.7	677.8	638.3	91.6	45.1	10.7	415.4
1956	24.7	20.8	15.5	14.3	150.0	68.1	158.4	366.1	134.5	111.3	70.8	4.5	94.8
1957	0.6	2.5	6.3	38.8	59.6	88.4	2230.5	1552.5	489.9	343.0	47.7	11.2	405.7
1958	55.8	84.8	305.8	341.1	305.5	262.2	315.4	114.2	1271.3	418.0	768.6	49.8	357.4
1959	18.1	63.2	35.2	40.6	1570.0	887.2	858.9	719.8	253.8	34.3	13.7	8.8	366.4
1960	43.9	31.1	79.8	254.6	525.7	974.9	1316.8	485.9	1282.2	384.2	132.7	22.5	458.6
1961	10.6	24.4	18.5	16.8	61.8	380.5	428.8	457.9	175.2	103.9	157.4	1709.4	294.2
1962	428.6	679.7	359.0	525.5	1028.0	2224.7	604.9	990.6	450.7	487.5	61.9	38.7	655.9
1963	29.6	21.0	13.5	7.4	14.9	586.8	260.5	130.8	21.6	51.2	12.4	5.9	97.2
1964	0.6	2.5	2.4	26.3	19.5	84.7	832.8	249.0	238.2	96.4	11.5	8.8	130.1
1965	3.5	7.8	11.7	911.8	314.6	821.2	2685.9	869.8	248.8	139.8	67.1	714.7	564.6
1966	282.5	111.5	731.4	573.1	403.3	580.0	705.3	884.8	363.7	66.6	23.0	10.2	395.6
1967	12.2	29.4	311.9	101.9	454.8	633.7	919.4	868.2	321.7	176.9	59.0	15.2	324.3
1968	152.2	618.3	1398.5	647.7	1367.4	326.6	465.3	1062.4	1362.6	452.5	144.9	29.8	665.7
1969	14.5	34.9	157.1	948.5	458.1	414.6	881.7	316.7	204.5	432.8	45.2	18.7	326.7
1970	272.3	265.1	157.1	112.3	252.2	302.2	1832.1	2259.4	1115.1	267.0	202.7	1587.3	717.3
1971	914.5	644.5	329.2	174.2	456.2	795.6	197.6	243.7	100.0	577.7	33.5	28.7	375.4
1972	13.5	15.0	493.4	429.0	233.8	669.0	1623.3	835.5	363.0	151.2	135.8	385.0	445.1
1973	488.1	1104.8	980.4	1244.1	581.8	2532.3	3135.7	774.9	2219.9	556.6	110.6	40.2	1146.9
1974	117.1	61.5	392.5	1683.9	1154.2	1384.5	1064.9	1347.5	3322.1	385.3	48.8	14.5	910.6
1975	14.1	42.0	60.2	808.9	999.8	633.6	1095.9	676.1	1045.8	212.5	129.4	298.3	496.0
1976	188.4	142.7	620.9	207.6	1247.5	1673.1	875.1	1062.6	645.2	225.0	41.5	13.8	576.7
1977	13.2	12.4	14.9	7.6	63.8	157.1	99.7	388.7	42.0	19.0	1167.3	1600.3	299.2
1978	1425.7	649.4	891.7	226.6	136.8	1142.6	1255.1	1260.3	269.7	137.8	22.4	10.9	623.8
1979	9.1	13.2	24.7	25.8	171.3	3157.4	1852.9	681.4	196.3	318.6	163.3	33.0	557.4
1980	15.8	19.5	42.1	34.0	67.2	443.9	769.5	385.8	2749.4	115.6	38.8	80.0	393.1
1981	64.1	48.6	135.2	66.4	354.0	245.5	1314.0	2876.6	1498.9	1006.1	2733.8	342.3	827.9
1982	244.2	159.2	124.5	169.5	816.1	2775.1	1983.5	856.3	568.5	510.5	265.6	62.1	710.6
1983	54.2	393.8	4061.5	532.6	541.4	830.7	2706.3	1418.4	618.7	246.5	27.1	25.6	958.3
\bar{Q}	142.8	169.8	355.1	452.2	567.5	854.0	1175.5	824.7	823.9	386.5	200.8	195.5	511.1
$\bar{Q}(e)$	275.6	263.0	688.1	535.9	522.3	736.3	753.0	498.4	768.5	456.7	466.8	442.5	238.1

Table 6.2 Results of Low-Flow Analyses

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
2.56	39.00	0.20	0.24	0.43	0.93	Oct 1956	Oct 1956	Oct 1956	Oct 1963
5.13	19.50	0.31	0.37	0.54	1.24	Oct 1963	Oct 1963	Oct 1963	Oct 1956
7.69	13.00	0.64	0.88	2.18	4.65	Sep 1959	Sep 1959	Oct 1953	Oct 1953
10.26	9.75	1.29	1.97	3.33	5.10	Sep 1953	Oct 1953	Oct 1964	Oct 1964
12.82	7.80	1.86	2.07	3.63	8.62	Oct 1964	Oct 1964	Sep 1959	Jan 1962
15.38	6.50	2.57	3.75	4.38	9.19	Sep 1955	Sep 1946	Sep 1946	Sep 1946
17.95	5.57	3.51	4.27	6.19	9.31	Oct 1957	Oct 1957	Sep 1957	Aug 1959
20.51	4.88	3.53	5.02	6.73	9.61	Sep 1946	Sep 1955	Jan 1962	Oct 1978
23.08	4.33	4.51	5.11	7.16	10.65	Sep 1966	Jan 1962	Jan 1976	Oct 1952
25.64	3.90	5.03	5.91	8.22	10.77	Jan 1962	Sep 1966	Sep 1955	Jan 1976
28.21	3.55	5.73	7.00	8.32	11.02	Oct 1978	Feb 1976	Oct 1978	Oct 1948
30.77	3.25	5.81	7.52	8.82	11.02	Oct 1969	Oct 1978	Sep 1966	Sep 1966
33.33	3.00	6.09	7.95	9.05	11.38	Jul 1977	Oct 1969	Oct 1948	Sep 1957
35.90	2.79	6.20	8.04	9.18	13.90	Sep 1967	Oct 1960	Oct 1952	Oct 1971
38.46	2.60	6.61	8.17	9.55	14.17	Sep 1949	Sep 1949	Sep 1969	Oct 1974
41.03	2.44	7.00	8.20	10.57	14.20	Feb 1976	Oct 1948	Oct 1960	Jan 1955
43.59	2.29	7.31	8.29	10.60	15.59	Oct 1952	Oct 1952	Sep 1949	Jan 1960
46.15	2.17	7.53	8.37	11.08	15.61	Oct 1960	Sep 1967	Sep 1974	Oct 1979
48.72	2.05	7.60	8.68	12.36	17.31	Oct 1948	Jul 1977	Oct 1968	Oct 1968
51.28	1.95	8.10	8.87	12.62	18.30	Sep 1974	Oct 1947	Nov 1971	Sep 1949
53.85	1.86	8.21	9.02	12.99	21.55	Sep 1945	Sep 1974	Sep 1967	Sep 1969
56.41	1.77	8.30	9.26	13.84	22.59	Oct 1947	Sep 1945	Oct 1947	Oct 1958
58.97	1.70	9.71	11.07	13.94	22.90	Nov 1971	Nov 1971	Nov 1979	Nov 1950
61.54	1.63	9.73	11.47	15.68	23.26	Nov 1968	Nov 1968	Jul 1977	Sep 1967
64.10	1.56	11.00	12.33	15.97	25.36	Sep 1954	Sep 1954	Oct 1958	Jul 1977
66.67	1.50	12.86	13.33	17.09	27.17	Nov 1979	Nov 1979	Sep 1945	Sep 1947
69.23	1.44	13.71	15.40	19.58	39.05	Jan 1958	Nov 1958	Oct 1950	Aug 1980
71.79	1.39	15.86	16.80	20.19	49.77	Sep 1950	Sep 1950	Sep 1954	Sep 1973
74.36	1.34	16.86	21.60	38.55	58.05	Aug 1961	Oct 1980	Aug 1980	Oct 1982
76.92	1.30	17.86	23.20	39.74	67.46	Oct 1980	Aug 1961	Sep 1973	Oct 1951
79.49	1.26	24.00	32.20	46.45	75.64	Aug 1975	Sep 1973	Oct 1982	Nov 1954
82.05	1.22	29.00	33.00	51.16	88.44	Sep 1951	Aug 1975	Sep 1951	Aug 1965
84.62	1.18	29.71	41.33	57.74	110.98	Sep 1973	Sep 1951	Aug 1965	Aug 1945
87.18	1.15	36.86	41.33	58.94	127.25	Jul 1965	Sep 1982	Jul 1961	Aug 1972
89.74	1.11	40.00	51.27	85.26	129.64	Oct 1982	Aug 1965	Aug 1972	Jun 1961
92.31	1.08	54.57	67.87	87.26	136.38	Jul 1972	Sep 1970	Jul 1975	Dec 1981
94.87	1.05	60.14	68.40	102.87	147.97	Sep 1970	Sep 1972	Dec 1981	Aug 1975
97.44	1.03	70.00	70.33	139.23	192.82	Dec 1981	Dec 1981	Aug 1970	Aug 1970
μ		14.73	17.37	25.83	41.55				
σ		17.01	19.46	31.88	49.04				

**Table 6.3 Results of Low-Flow Analyses
for 5- and 9-Month Droughts**

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
2.50	40.00	4.72	Oct	1963	15.78	Oct	1963
5.00	20.00	8.63	Oct	1964	42.51	Nov	1956
7.50	13.33	10.54	Nov	1956	47.02	Dec	1976
10.00	10.00	12.32	Nov	1976	48.96	Nov	1955
12.50	8.00	15.96	Nov	1953	76.02	Oct	1978
15.00	6.67	16.00	Oct	1978	98.79	Oct	1979
17.50	5.71	17.18	Nov	1955	114.89	Dec	1962
20.00	5.00	17.26	Dec	1962	116.86	Nov	1960
22.50	4.44	18.56	Nov	1960	127.49	Nov	1980
25.00	4.00	26.35	Sep	1959	138.39	Oct	1959
27.50	3.64	26.79	Oct	1948	152.59	Oct	1966
30.00	3.33	28.26	Sep	1966	162.14	Aug	1964
32.50	3.08	28.83	Nov	1979	169.95	Nov	1952
35.00	2.86	32.93	Dec	1944	170.17	Oct	1953
37.50	2.67	35.90	Oct	1974	189.19	Aug	1971
40.00	2.50	38.33	Nov	1952	192.13	Dec	1957
42.50	2.35	41.38	Nov	1958	195.52	Oct	1969
45.00	2.22	50.84	Oct	1950	249.23	Jul	1949
47.50	2.11	69.37	Sep	1980	252.88	Sep	1948
50.00	2.00	73.10	Sep	1947	254.18	Nov	1946
52.50	1.90	76.19	Oct	1968	294.93	Nov	1968
55.00	1.82	92.31	Sep	1949	308.76	Sep	1958
57.50	1.74	101.02	Oct	1957	315.15	Oct	1947
60.00	1.67	108.20	Sep	1954	324.00	Nov	1954
62.50	1.60	115.90	Oct	1946	334.08	Nov	1974
65.00	1.54	116.80	Oct	1971	355.18	Sep	1950
67.50	1.48	141.25	May	1977	363.55	Oct	1965
70.00	1.43	144.34	Oct	1973	391.22	Sep	1975
72.50	1.38	144.97	Aug	1967	418.24	Jul	1967
75.00	1.33	151.64	Oct	1969	434.43	Feb	1945
77.50	1.29	167.68	May	1956	497.95	Dec	1945
80.00	1.25	194.19	Sep	1975	499.95	Aug	1961
82.50	1.21	207.89	Nov	1981	536.13	May	1972
85.00	1.18	207.96	Oct	1945	596.73	Nov	1970
87.50	1.14	210.17	May	1963	611.17	Nov	1973
90.00	1.11	235.80	Oct	1951	618.60	Dec	1951
92.50	1.08	242.43	Mar	1964	684.23	Oct	1977
95.00	1.05	257.18	Sep	1982	771.82	May	1983
97.50	1.03	263.12	Sep	1965	788.19	Oct	1981

Table 6.4 Monthly and Annual Flow Duration Values

PROB ≥	Flows in cfs												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
99	0.30	0.88	0.81	3.70	6.00	41.03	23.48	57.10	16.80	7.83	5.01	0.88	1.60
95	1.02	3.97	6.82	6.01	13.01	57.33	105.13	110.46	47.67	24.09	9.24	3.27	7.20
90	3.80	8.80	9.99	8.00	20.02	101.93	179.00	172.90	77.00	35.98	13.99	5.00	12.00
85	6.74	10.94	12.09	15.13	31.07	141.00	238.47	227.96	113.07	51.28	17.09	7.34	16.01
80	8.49	12.00	15.99	20.98	56.12	185.85	320.00	270.86	147.00	63.96	20.99	9.10	22.01
75	9.75	14.88	19.15	35.83	88.12	221.45	394.80	330.00	179.61	78.62	24.11	9.96	33.02
70	11.02	16.00	23.10	58.35	115.65	260.61	455.00	383.49	220.00	95.19	27.05	12.00	49.93
60	14.02	22.00	41.14	118.31	168.71	366.59	626.00	467.47	298.00	128.26	36.06	15.00	98.92
50	19.05	36.00	70.19	180.29	249.63	486.59	799.00	561.52	379.00	180.28	49.08	20.00	179.89
40	31.14	57.00	115.38	250.33	349.64	630.79	972.00	686.52	490.00	248.32	68.10	28.00	290.87
30	72.18	110.00	230.38	350.38	539.48	869.81	1220.00	844.51	667.00	344.24	98.09	43.00	449.87
25	108.64	153.85	307.14	427.14	639.55	1033.89	1377.79	948.14	817.38	393.18	115.36	56.70	560.84
20	185.24	244.00	375.40	533.64	765.54	1220.81	1560.00	1110.81	990.00	474.31	145.15	73.00	699.84
15	257.39	374.42	497.28	726.69	999.36	1464.56	1822.75	1354.56	1280.75	566.93	190.98	127.62	919.81
10	405.49	547.00	701.15	1041.57	1429.22	1781.51	2320.00	1670.97	1700.00	724.62	305.66	308.00	1249.81
5	702.79	851.54	1394.84	1992.92	2169.33	2693.21	3755.21	2255.65	2869.79	1097.23	707.01	1051.70	1959.80
1	1518.47	1463.93	3995.12	4395.50	5000.00	6612.65	7987.12	4915.01	7529.87	3485.52	3365.01	4019.02	5017.64
\bar{Q} , cfs	142.85	169.82	355.11	452.25	567.14	853.98	1175.47	824.72	823.92	386.48	200.85	195.50	511.11
$u(\bar{Q})$ %	22.77	24.11	21.49	23.82	28.62	30.66	31.80	31.25	24.81	25.68	14.57	13.12	27.24

Table 6.5 Protected-Flow Statistics for Month of October

with $Q_p = Q_m(90)$

Year	<i>If Available Flow ≤ 0</i>				<i>If Available Flow > 0</i>			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1945	0.00	0	0.00	0.00	1248.54	31	40.28	446.20
1946	0.00	0	0.00	0.00	6979.30	31	225.14	1116.20
1947	-2.19	3	-0.73	-1.00	577.13	28	20.61	139.20
1948	0.00	0	0.00	0.00	1632.44	31	52.66	520.20
1949	0.00	0	0.00	0.00	169.54	31	5.47	8.20
1950	0.00	0	0.00	0.00	681.54	31	21.99	59.20
1951	0.00	0	0.00	0.00	591.34	31	19.08	34.20
1952	0.00	0	0.00	0.00	2409.34	31	77.72	238.20
1953	0.00	0	0.00	0.00	169.24	31	5.46	10.20
1954	-39.88	25	-1.60	-3.30	8.83	6	1.47	4.20
1955	0.00	0	0.00	0.00	4716.33	31	152.14	554.20
1956	0.00	0	0.00	0.00	647.94	31	20.90	140.20
1957	-99.46	31	-3.21	-3.60	0.00	0	0.00	0.00
1958	-8.87	7	-1.27	-2.50	1619.91	24	67.50	689.20
1959	0.00	0	0.00	0.00	444.34	31	14.33	20.20
1960	0.00	0	0.00	0.00	1244.34	31	40.14	243.20
1961	0.00	0	0.00	0.00	211.94	31	6.84	18.20
1962	0.00	0	0.00	0.00	13170.30	31	424.85	996.20
1963	0.00	0	0.00	0.00	801.34	31	25.85	97.20
1964	-99.06	31	-3.20	-3.60	0.00	0	0.00	0.00
1965	-34.59	23	-1.50	-2.20	24.74	8	3.09	7.20
1966	0.00	0	0.00	0.00	8641.31	31	278.75	618.20
1967	0.00	0	0.00	0.00	260.74	31	8.41	39.20
1968	0.00	0	0.00	0.00	4599.34	31	148.37	1246.20
1969	0.00	0	0.00	0.00	332.34	31	10.72	20.20
1970	0.00	0	0.00	0.00	8322.32	31	268.46	1056.20
1971	0.00	0	0.00	0.00	28231.30	31	910.69	1786.20
1972	0.00	0	0.00	0.00	302.14	31	9.75	18.20
1973	0.00	0	0.00	0.00	15014.30	31	484.33	1196.20
1974	0.00	0	0.00	0.00	3512.34	31	113.30	596.20
1975	0.00	0	0.00	0.00	320.74	31	10.35	29.20
1976	0.00	0	0.00	0.00	5722.33	31	184.59	483.20
1977	0.00	0	0.00	0.00	291.34	31	9.40	18.20
1978	0.00	0	0.00	0.00	44080.30	31	1421.94	3446.20
1979	0.00	0	0.00	0.00	163.44	31	5.27	9.20
1980	0.00	0	0.00	0.00	373.34	31	12.04	19.20
1981	0.00	0	0.00	0.00	1868.34	31	60.27	277.20
1982	0.00	0	0.00	0.00	7451.32	31	240.37	597.20
1983	0.00	0	0.00	0.00	1562.34	31	50.40	76.20
μ	-2.37				154.64			
σ	2.30				318.07			
% YEAR =	15.38	% DAYS =	9.93	% YEAR =	94.87	% DAYS =	90.07	

Table 6.6 Protected-Flow Statistics for Month of October

with $Q_p = Q_y(90)$

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1945	-62.84	17	-3.70	-5.00	1056.97	14	75.50	438.00
1946	0.00	0	0.00	0.00	6724.89	31	216.93	1108.00
1947	-103.44	16	-6.46	-9.20	423.96	15	28.26	131.00
1948	-46.94	18	-2.61	-5.20	1424.97	13	109.61	512.00
1949	-84.87	31	-2.74	-6.20	0.00	0	0.00	0.00
1950	-13.81	5	-2.76	-6.30	440.94	26	16.96	51.00
1951	0.00	0	0.00	0.00	336.93	31	10.87	26.00
1952	0.00	0	0.00	0.00	2154.93	31	69.51	230.00
1953	-92.16	27	-3.41	-7.00	6.99	4	1.75	2.00
1954	-285.47	31	-9.21	-11.50	0.00	0	0.00	0.00
1955	-2.00	2	-1.00	-1.00	4463.92	29	153.93	546.00
1956	-55.44	20	-2.77	-5.90	448.97	11	40.82	132.00
1957	-353.87	31	-11.42	-11.80	0.00	0	0.00	0.00
1958	-138.34	20	-6.92	-10.70	1494.97	11	135.91	681.00
1959	0.00	0	0.00	0.00	189.93	31	6.13	12.00
1960	0.00	1	0.00	0.00	989.93	30	33.00	235.00
1961	-67.46	25	-2.70	-4.90	24.99	6	4.16	10.00
1962	0.00	0	0.00	0.00	12915.89	31	416.64	988.00
1963	0.00	0	0.00	0.00	546.93	31	17.64	89.00
1964	-353.47	31	-11.40	-11.80	0.00	0	0.00	0.00
1965	-264.27	31	-8.52	-10.40	0.00	0	0.00	0.00
1966	0.00	0	0.00	0.00	8386.89	31	270.54	610.00
1967	-84.65	21	-4.03	-6.90	90.98	10	9.10	31.00
1968	-3.02	7	-0.43	-2.00	4347.94	24	181.16	1238.00
1969	-4.03	13	-0.31	-1.00	81.96	18	4.55	12.00
1970	-55.02	9	-6.11	-7.60	8122.92	22	369.22	1048.00
1971	0.00	0	0.00	0.00	27976.88	31	902.48	1778.00
1972	-12.24	18	-0.68	-5.20	59.97	13	4.61	10.00
1973	0.00	0	0.00	0.00	14759.89	31	476.13	1188.00
1974	0.00	0	0.00	0.00	3257.93	31	105.09	588.00
1975	-36.64	20	-1.83	-4.50	102.98	11	9.36	21.00
1976	0.00	0	0.00	0.00	5467.91	31	176.38	475.00
1977	-24.04	17	-1.41	-3.00	60.97	14	4.35	10.00
1978	0.00	0	0.00	0.00	43825.88	31	1413.74	3438.00
1979	-93.96	28	-3.36	-7.40	2.99	3	1.00	1.00
1980	0.00	1	0.00	0.00	118.93	30	3.96	11.00
1981	0.00	0	0.00	0.00	1613.93	31	52.06	269.00
1982	0.00	0	0.00	0.00	7196.90	31	232.16	589.00
1983	0.00	0	0.00	0.00	1307.93	31	42.19	68.00
μ	-5.09				208.62			
σ	5.28				333.55			
% YEAR =	61.54	% DAYS =	36.39	% YEAR =	87.18	% DAYS =	63.61	

Table 6.7 Summary of Protected-Flow Statistics
 USGS NO. 05567500 Mackinaw River near Congerville
 Drainage Area 767.00 sq mi Period of Record (1944-1983) 39 years

T	Item	Mean Flow, Flow Duration, and Selected Protected-Flow Statistics												
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
	\bar{Q}	142.85	169.82	355.11	452.25	567.49	853.98	1175.47	824.72	823.92	386.48	200.85	195.50	511.11
	$\bar{Q}(S)$	275.62	263.00	688.09	535.86	522.35	736.32	753.01	498.42	768.48	456.74	466.80	442.50	238.06
	Q(90)	3.80	8.80	9.99	8.00	20.02	101.93	179.00	172.90	77.00	35.98	13.99	5.00	12.00
M	AVQ(-)	-2.37	-4.47	-4.12	-2.29	-7.60	-41.44	-78.19	-61.78	-32.45	-13.43	-4.97	-2.02	
	% years	15.38	23.08	20.51	15.38	20.51	23.08	23.08	23.08	23.08	28.21	33.33	23.08	
	% days	9.93	10.00	9.18	9.93	10.26	9.93	10.00	9.84	10.00	9.93	9.76	10.09	
	AVQ(+)	154.64	179.41	380.42	493.46	610.56	839.49	1115.88	729.73	833.51	390.60	207.60	212.10	
	% years	94.87	97.44	97.44	97.44	100.00	100.00	100.00	100.00	100.00	97.44	100.00	100.00	
	% days	90.07	90.00	90.82	90.07	89.74	90.07	90.00	90.16	90.00	90.07	90.24	89.91	
Y	AVQ(-)	-5.09	-4.34	-4.13	-5.19	-4.05	-1.50	0.00	0.00	-4.34	-4.14	-3.61	-4.73	
	% years	61.54	33.33	23.08	23.08	12.82	2.56	0.00	0.00	2.56	5.13	30.77	53.85	
	% days	36.39	20.00	15.22	13.07	4.91	0.17	0.00	0.00	0.68	1.99	8.44	32.74	
	AVQ(+)	208.62	198.36	405.44	507.21	583.98	843.37	1163.47	812.72	817.53	382.15	206.58	275.11	
	% years	87.18	94.87	92.31	94.87	100.00	100.00	100.00	100.00	100.00	100.00	100.00	97.44	
	% days	63.61	80.00	84.78	86.93	95.09	99.83	100.00	100.00	99.32	98.01	91.56	67.26	
	Q(85)	6.74	10.95	12.09	15.13	31.07	141.00	238.48	227.96	113.08	51.28	17.09	7.34	16.01
M	AVQ(-)	-4.00	-5.39	-4.22	-7.02	-14.60	-55.58	-101.01	-87.46	-51.53	-21.52	-5.74	-3.33	
	% years	33.33	28.21	23.08	23.08	30.77	33.33	28.21	35.90	35.90	48.72	48.72	33.33	
	% days	14.89	12.99	15.22	15.88	15.07	15.55	15.04	14.97	15.04	15.14	15.38	14.96	
	AVQ(+)	160.62	183.41	405.36	520.97	633.84	854.49	1120.79	717.23	845.83	398.82	218.21	221.84	
	% years	94.87	97.44	92.31	92.31	100.00	100.00	100.00	97.44	97.44	94.87	100.00	100.00	
	% days	85.11	87.01	84.78	84.12	84.93	84.45	84.96	85.03	84.96	84.86	84.62	85.04	
Y	AVQ(-)	-7.60	-6.01	-6.51	-7.54	-5.62	-5.51	0.00	0.00	-6.25	-6.60	-5.16	-6.86	
	% years	69.23	48.72	30.77	23.08	17.95	2.56	0.00	0.00	2.56	5.13	43.59	69.23	
	% days	45.24	30.09	20.10	16.63	7.72	0.17	0.00	0.00	0.94	2.56	14.14	44.44	
	AVQ(+)	237.93	222.60	426.05	524.74	597.71	839.37	1159.47	808.72	815.64	380.40	216.14	328.59	
	% years	82.05	89.74	92.31	92.31	100.00	100.00	100.00	100.00	100.00	100.00	100.00	94.87	
	% days	54.76	69.91	79.90	83.37	92.28	99.83	100.00	100.00	99.06	97.44	85.86	55.56	
	Q(80)	8.49	12.00	15.99	20.98	56.12	185.85	320.00	270.86	147.00	63.96	20.99	9.10	22.01
M	AVQ(-)	-4.55	-4.34	-6.92	-11.24	-33.70	-83.07	-146.21	-104.12	-67.60	-28.14	-7.95	-4.00	
	% years	46.15	33.33	28.21	30.77	33.33	48.72	43.59	43.59	43.59	56.41	51.28	43.59	
	% days	19.77	20.00	18.86	19.02	19.98	19.85	20.00	19.85	20.09	19.35	19.77	20.09	
	AVQ(+)	168.58	198.36	419.55	535.23	647.05	854.18	1105.90	716.83	864.04	406.68	226.13	234.26	
	% years	92.31	94.87	92.31	89.74	94.87	100.00	97.44	97.44	94.87	100.00	100.00	100.00	
	% days	80.23	80.00	81.14	80.98	80.02	80.15	80.00	80.15	79.91	80.65	80.23	79.91	
Y	AVQ(-)	-11.71	-9.41	-9.38	-11.39	-8.21	-11.51	-3.51	0.00	-8.09	-8.76	-7.77	-11.04	
	% years	71.79	56.41	41.03	30.77	23.08	2.56	2.56	0.00	5.13	10.26	61.54	74.36	
	% days	54.92	41.54	29.28	20.60	12.08	0.17	0.68	0.00	1.79	4.22	23.08	54.36	
	AVQ(+)	282.33	259.52	474.90	544.78	621.15	833.36	1161.43	802.71	816.71	380.91	234.81	393.27	
	% years	74.36	82.05	89.74	89.74	100.00	100.00	100.00	100.00	100.00	100.00	100.00	79.49	
	% days	45.08	58.46	70.72	79.40	87.92	99.83	99.32	100.00	98.21	95.78	76.92	45.64	
	Q(75)	9.75	14.88	19.15	35.83	88.12	221.45	394.80	330.00	179.61	78.62	24.11	9.96	33.02
M	AVQ(-)	-4.63	-6.07	-7.99	-21.99	-56.56	-95.45	-185.09	-137.02	-84.51	-35.00	-8.87	-4.32	
	% years	48.72	38.46	38.46	35.90	46.15	53.85	56.41	48.72	46.15	61.54	64.10	43.59	
	% days	25.56	24.79	24.90	24.90	24.97	25.64	24.70	24.90	24.79	24.98	25.89	22.91	
	AVQ(+)	180.39	208.01	449.99	561.74	657.32	883.56	1097.48	704.15	884.49	422.03	241.58	241.95	
	% years	92.31	92.31	89.74	87.18	94.87	97.44	94.87	97.44	94.87	97.44	100.00	100.00	
	% days	74.44	75.21	75.10	75.10	75.03	74.36	75.30	75.10	75.21	75.02	74.11	77.09	
Y	AVQ(-)	-21.33	-18.25	-17.92	-19.97	-15.65	-22.52	-8.77	0.00	-12.16	-11.81	-13.73	-19.61	
	% years	76.92	56.41	46.15	35.90	30.77	2.56	2.56	0.00	7.69	28.21	76.92	82.05	
	% days	60.22	48.97	35.73	23.99	15.99	0.17	1.71	0.00	3.50	8.93	37.55	63.85	
	AVQ(+)	308.33	285.61	511.13	557.82	638.72	822.35	1162.47	791.70	820.06	389.29	276.99	484.05	
	% years	64.10	74.36	82.05	87.18	100.00	100.00	100.00	100.00	100.00	100.00	100.00	94.87	
	% days	39.78	51.03	64.27	76.01	84.01	99.83	98.29	100.00	96.50	91.07	62.45	36.15	

Table 7.1 Monthly and Annual Mean Flows in cfs

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1915	74.4	24.9	26.8	373.4	2170.2	256.9	123.2	616.1	663.9	1283.2	1754.9	2513.8	812.3
1916	312.9	281.2	477.7	5499.8	2055.3	1104.2	1197.2	1597.6	1797.5	325.1	189.7	195.4	1252.6
1917	165.0	251.0	261.0	804.5	205.9	1811.1	941.7	909.7	3897.5	689.3	262.3	791.9	915.7
1918	984.4	423.9	152.2	43.5	1805.2	792.7	959.0	1231.5	1239.9	1451.7	614.1	483.7	841.4
1919	311.4	529.8	841.5	1364.5	854.8	2429.7	956.0	2288.7	2058.0	511.6	374.8	114.3	1056.1
1920	184.6	352.7	328.5	115.0	586.2	2184.2	2975.3	2411.6	691.1	259.6	70.7	32.8	849.0
1921	42.6	60.6	57.2	134.1	66.0	699.5	1024.5	621.9	417.3	169.8	345.5	638.7	356.9
1922	288.6	346.6	721.5	665.6	1118.6	1427.8	2435.2	1151.1	432.7	839.2	89.7	363.6	820.1
1923	61.2	145.2	65.4	160.5	240.9	1732.1	343.4	321.9	250.9	215.3	96.3	145.3	316.5
1924	237.0	154.7	289.4	1014.9	1500.0	1052.4	718.5	311.9	2774.9	1980.2	4767.3	777.1	1299.2
1925	335.2	272.0	250.2	141.3	2177.2	554.6	395.1	314.5	599.2	299.5	216.6	144.4	462.3
1926	263.3	438.0	399.6	801.6	1356.6	794.2	1891.7	553.1	2671.7	527.1	1094.0	8440.3	1585.4
1927	3320.3	3675.5	1790.0	780.5	2935.7	2978.7	3851.3	6062.6	3763.0	615.2	432.0	1019.0	2594.0
1928	5218.4	1649.5	2077.1	2907.7	1595.0	752.7	1627.5	618.7	1027.6	1899.4	460.8	282.7	1682.7
1929	268.7	1546.7	1237.7	3260.5	2809.1	3836.5	4520.0	1429.7	1781.0	4858.1	832.7	204.9	2212.8
1930	266.2	484.9	430.7	437.9	2839.5	1250.1	1047.1	566.5	341.7	139.1	124.6	190.6	660.5
1931	195.2	108.5	238.5	86.1	122.9	305.2	394.6	509.1	832.6	184.1	217.5	519.5	309.3
1932	180.6	1102.4	686.2	1417.5	1180.8	934.1	689.8	776.2	586.4	739.3	356.2	138.8	731.0
1933	138.1	116.0	1275.1	1096.1	1076.1	914.4	2394.0	5379.4	856.7	313.2	199.2	164.3	1163.9
1934	78.9	65.3	101.6	104.5	56.5	251.9	119.8	29.1	88.0	574.2	148.3	686.4	192.6
1935	111.6	721.9	1172.0	1155.6	2015.4	2407.4	1532.3	4331.9	2723.2	2195.0	424.0	244.8	1585.8
1936	116.2	1099.4	363.7	430.5	2250.7	1901.6	501.7	482.7	117.6	30.1	95.4	1027.1	693.1
1937	569.4	300.6	296.8	1924.3	1858.1	777.7	1209.9	1220.6	441.5	480.4	228.8	55.3	774.5
1938	77.7	65.2	260.9	2998.5	1381.1	947.3	2563.7	1174.7	1070.5	1055.7	477.7	183.3	1019.0
1939	56.5	82.1	63.7	159.3	1018.1	1645.2	1991.2	990.8	813.8	471.6	311.2	31.2	632.0
1940	129.3	64.9	49.2	17.7	121.6	1334.7	231.1	157.7	97.3	41.0	224.1	34.6	210.2
1941	58.3	44.0	106.3	202.4	601.1	395.4	796.5	1103.9	1592.8	521.6	126.0	506.7	501.3
1942	4530.1	1648.9	708.6	719.7	3520.0	2520.6	1539.7	1137.5	1275.6	1987.5	303.9	226.8	1666.9
1943	82.9	691.4	1401.5	1228.1	2602.0	702.9	1114.7	4332.6	2073.1	795.4	382.7	101.1	1284.9
1944	88.9	130.8	66.4	92.0	452.4	2419.2	4055.2	2631.3	735.1	186.7	80.4	98.6	918.6
1945	155.7	191.9	64.5	63.7	839.6	1288.9	1839.9	4554.8	3207.0	697.8	169.2	361.0	1118.7
1946	312.8	217.8	402.0	3666.1	516.6	1510.5	658.9	1056.5	3287.6	379.5	195.4	68.0	1026.4
1947	89.1	519.3	339.4	572.5	576.5	786.2	3504.7	1950.3	3627.3	1597.9	152.0	216.0	1156.9
1948	53.6	159.7	395.1	292.9	1466.8	4842.3	630.3	423.8	420.1	1318.7	311.5	224.2	880.7
1949	85.1	108.6	322.3	1554.4	4386.8	784.1	1048.9	331.2	520.6	347.4	104.3	66.3	779.6
1950	68.2	37.1	268.2	1582.0	1093.9	1606.5	3829.5	1459.8	3239.0	2410.1	327.7	437.7	1359.8
1951	126.6	110.0	106.3	743.7	3887.1	1114.8	2537.3	1730.6	866.1	4217.3	919.2	596.0	1396.8
1952	563.8	983.0	508.5	1961.6	1527.9	2754.5	2403.3	1663.2	2689.0	734.8	964.6	201.0	1410.6
1953	87.8	248.8	369.4	290.9	771.8	1021.6	1311.3	1243.2	804.4	760.4	88.9	30.4	584.1
1954	74.9	53.8	78.1	74.8	277.2	1358.8	2430.3	842.3	2489.4	197.0	564.0	85.7	708.0
1955	939.9	493.9	519.9	2284.5	3269.3	1623.2	2182.7	1672.9	1990.8	435.3	229.4	111.1	1298.0
1956	166.3	103.4	57.8	56.2	689.2	187.7	89.7	316.8	266.7	1156.2	729.9	130.1	329.2
1957	26.5	63.8	66.5	458.0	451.1	448.7	1773.3	1254.8	1309.1	341.8	97.1	59.1	526.8
1958	133.6	148.4	328.7	264.2	825.2	689.0	482.4	276.0	3362.0	1544.0	715.0	227.8	745.7
1959	139.2	157.6	78.3	63.3	3805.6	1003.6	921.4	955.5	343.0	420.5	192.3	214.9	668.8
1960	1328.9	522.5	782.4	1545.2	905.5	2015.3	4920.7	2607.4	3182.0	1071.3	1020.1	216.0	1674.8
1961	142.7	330.4	144.8	155.2	339.1	744.2	551.3	478.3	176.4	885.2	375.2	3698.0	665.4
1962	1142.7	2207.3	910.3	947.4	2367.9	4429.4	1480.7	1623.7	823.5	449.1	142.6	54.0	1376.1
1963	214.8	120.8	72.7	54.4	97.3	1794.8	448.2	623.0	142.1	217.1	66.8	42.7	327.9
1964	29.0	69.0	27.6	286.2	150.6	607.2	1812.3	531.7	1889.8	289.9	108.8	64.2	485.6
1965	36.9	54.0	48.3	3234.8	1335.9	2083.6	4065.7	1065.2	577.4	320.2	861.0	3183.4	1399.9
1966	714.4	396.2	856.1	1379.7	1406.0	891.6	1260.6	3092.6	966.7	419.4	186.6	108.7	972.8
1967	78.5	95.2	219.9	158.8	692.5	591.1	2045.8	2053.5	1069.0	2102.2	786.7	190.2	841.4
1968	472.2	1782.3	1078.7	1259.0	1391.0	770.6	736.1	438.5	1138.3	543.5	116.4	177.2	820.8
1969	72.6	195.0	617.6	3946.8	2272.9	704.7	800.3	783.5	1166.8	2320.0	591.9	168.2	1133.4
1970	1051.5	381.8	243.7	227.7	452.9	565.5	2838.0	5065.5	4350.0	621.2	758.7	5539.0	1837.0
1971	2041.9	1584.7	997.7	665.8	2340.4	1215.7	523.6	425.2	283.5	307.4	61.7	40.6	864.9
1972	96.2	58.7	329.3	291.6	428.6	567.2	1194.0	1082.2	1193.5	938.6	730.7	596.7	625.2
1973	480.2	1086.3	1232.5	1747.9	1396.4	4009.4	5934.3	4115.5	3510.7	1305.1	578.9	356.3	2146.0
1974	2159.6	883.1	2285.4	4825.2	2389.6	3319.0	3003.7	3182.3	7908.0	1384.3	370.0	134.2	2652.3

Table 7.1 Continued

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1975	142.3	328.8	502.6	718.0	1568.5	1857.8	2639.3	1416.6	1400.6	853.7	435.9	420.8	1017.4
1976	233.5	226.2	732.8	366.5	1340.6	3137.7	3614.4	2398.7	927.9	731.6	547.5	121.1	1197.2
1977	136.3	122.8	71.2	52.7	495.5	972.5	566.0	1389.3	285.5	272.1	1216.6	2142.7	643.3
1978	2455.2	3211.0	1344.7	488.1	324.1	1864.9	2473.7	4286.7	988.7	1133.3	219.1	140.1	1586.4
1979	126.1	236.4	283.5	145.2	286.8	5601.3	4885.7	1935.3	840.6	606.7	398.8	100.7	1293.0
1980	70.5	111.3	206.8	78.2	600.1	815.7	1054.6	443.8	3851.8	338.0	603.5	1380.3	786.9
1981	339.4	273.5	886.5	320.3	577.1	566.1	2767.9	2650.0	3027.1	3192.6	2628.2	540.2	1486.3
1982	512.0	477.6	416.8	425.8	2785.7	4109.2	3488.3	1275.9	942.5	5355.3	941.3	548.3	1769.4
1983	275.1	1925.7	5744.5	1926.5	1423.2	1817.2	6752.0	1599.9	797.8	335.9	81.7	110.5	1772.7
\bar{Q}	523.5	525.5	581.7	995.8	1367.0	1553.4	1878.6	1587.8	1559.0	988.3	505.7	629.9	1054.6
$\bar{Q}(n)$	971.3	709.1	804.2	1198.6	1047.5	1175.3	1471.3	1382.6	1402.9	1056.8	673.5	1323.9	539.9

Table 7.2 Results of Low-Flow Analyses

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
1.45	69.00	10.71	12.33	17.68	27.21	Oct 1940	Sep 1940	Jan 1939	Jan 1939
2.90	34.50	13.57	15.27	19.32	30.61	Aug 1936	Aug 1936	Aug 1936	Oct 1963
4.35	23.00	14.86	16.47	22.06	31.64	Oct 1963	Dec 1963	Oct 1963	Jul 1936
5.80	17.25	15.14	17.00	26.16	34.61	Jan 1939	Jan 1939	Oct 1956	Sep 1920
7.25	13.80	18.00	20.33	26.42	38.21	May 1934	May 1934	May 1934	Sep 1940
8.70	11.50	19.57	21.73	26.52	40.02	Sep 1937	Oct 1957	Oct 1940	Nov 1949
10.14	9.86	20.29	23.00	27.68	41.41	Oct 1957	Sep 1953	Oct 1937	May 1934
11.59	8.63	20.43	23.40	28.29	42.07	Sep 1953	Oct 1956	Oct 1964	Oct 1956
13.04	7.67	21.71	25.53	29.81	42.28	Oct 1949	Sep 1949	Sep 1953	Nov 1964
14.49	6.90	22.43	25.93	32.74	50.00	Sep 1959	Sep 1959	Sep 1920	Sep 1971
15.94	6.27	23.00	25.93	34.58	51.48	Oct 1956	Oct 1964	Sep 1971	Nov 1953
17.39	5.75	23.71	26.00	36.55	51.87	Sep 1971	Oct 1937	Nov 1949	Sep 1957
18.84	5.31	24.57	28.07	43.55	53.33	Sep 1922	Sep 1971	Jan 1917	Jan 1955
20.29	4.93	24.86	28.73	46.26	57.20	Oct 1964	Sep 1920	Sep 1957	Jan 1976
21.74	4.60	27.14	30.00	47.55	57.80	Sep 1932	Jan 1917	Jan 1955	Jan 1962
23.19	4.31	27.71	31.20	48.61	58.97	Sep 1920	Oct 1938	Oct 1938	Nov 1937
24.64	4.06	28.43	35.67	48.71	60.70	Sep 1947	Sep 1922	Oct 1947	Jan 1944
26.09	3.83	29.86	36.27	49.10	64.70	Oct 1938	Sep 1947	Sep 1930	Dec 1943
27.54	3.63	30.00	37.13	49.16	66.38	Jan 1917	Oct 1946	Oct 1922	Jan 1958
28.99	3.45	33.57	37.60	50.16	68.74	Sep 1944	Oct 1932	Jan 1976	Oct 1938
30.43	3.29	33.71	39.47	50.52	70.30	Oct 1946	Sep 1930	Oct 1946	Nov 1933
31.88	3.14	34.43	40.73	52.84	70.87	Sep 1933	Sep 1944	Jan 1962	Oct 1979
33.33	3.00	34.71	41.53	55.10	77.72	Sep 1930	Sep 1962	Jan 1943	Sep 1946
34.78	2.88	34.71	42.33	57.42	79.25	Sep 1962	Jan 1955	Dec 1944	Oct 1922
36.23	2.76	35.57	46.73	57.52	84.10	Aug 1923	Feb 1976	Feb 1933	Oct 1966
37.68	2.65	38.00	48.40	59.58	86.54	Sep 1941	Oct 1966	Oct 1979	Aug 1930
39.13	2.56	39.43	49.53	61.97	89.85	Dec 1955	Sep 1933	Jan 1958	Oct 1968
40.58	2.46	39.43	49.80	63.29	89.92	Oct 1966	Dec 1943	Sep 1968	Nov 1948
42.03	2.38	41.86	52.07	65.32	90.23	Dec 1958	Dec 1958	Sep 1959	Aug 1923
43.48	2.30	43.29	54.00	76.16	94.00	Oct 1916	Oct 1916	Oct 1948	Oct 1952
44.93	2.23	45.14	54.73	77.77	96.39	Feb 1976	Sep 1925	Oct 1916	Jan 1917
46.38	2.16	45.57	56.13	78.35	102.90	Jan 1943	Sep 1968	Oct 1966	Oct 1947
47.83	2.09	47.57	56.67	80.03	108.13	Sep 1925	Sep 1923	Sep 1954	Dec 1950
49.28	2.03	49.71	57.20	81.16	115.07	Sep 1968	Oct 1979	Jul 1923	Apr 1915
50.72	1.97	50.86	57.27	82.90	117.93	Sep 1979	Sep 1919	Oct 1942	Oct 1932
52.17	1.92	51.29	58.67	85.39	127.92	Sep 1919	Aug 1941	Sep 1919	Jan 1960
53.62	1.86	53.00	59.33	86.26	131.11	Sep 1954	Sep 1954	May 1915	Sep 1916
55.07	1.82	53.14	61.40	87.48	132.87	Sep 1978	Oct 1948	Oct 1952	Oct 1978
56.52	1.77	55.57	67.00	99.29	136.30	Oct 1948	Sep 1978	Oct 1932	Aug 1959
57.97	1.72	57.00	68.00	106.29	138.33	Jul 1931	Feb 1960	Dec 1950	Oct 1974

Table 7.2 Continued

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
59.42	1.68	64.00	75.67	110.19	141.07	May 1915	Oct 1952	Oct 1978	Oct 1942
60.87	1.64	65.71	76.40	113.29	142.13	Jan 1960	May 1915	Jan 1960	Sep 1919
62.32	1.60	69.00	77.33	116.19	169.08	Oct 1952	Oct 1942	Oct 1935	Aug 1945
63.77	1.57	72.43	77.93	116.45	177.16	Jul 1921	Aug 1931	Dec 1924	Sep 1935
65.22	1.53	74.57	86.93	116.48	179.05	Sep 1935	Sep 1945	Jul 1941	Aug 1925
66.67	1.50	76.14	87.67	118.23	187.92	Sep 1961	Sep 1961	Sep 1945	Jul 1931
68.12	1.47	77.00	90.73	118.39	195.67	Oct 1942	Dec 1950	Aug 1941	Jan 1924
69.57	1.44	81.86	94.00	120.00	198.13	Sep 1945	Jan 1924	Sep 1974	Dec 1969
71.01	1.41	84.71	96.20	127.94	219.08	Oct 1969	Sep 1935	Sep 1925	Oct 1975
72.46	1.38	87.14	100.93	131.10	223.82	Dec 1924	Oct 1969	Sep 1969	Sep 1929
73.91	1.35	87.29	105.27	167.94	243.15	Dec 1950	Sep 1974	Aug 1961	Aug 1941
75.36	1.33	92.43	115.60	168.42	256.66	Sep 1974	Sep 1928	Oct 1918	Aug 1921
76.81	1.30	100.57	117.47	168.61	262.20	Aug 1965	Aug 1980	Jul 1921	Sep 1967
78.26	1.28	107.57	131.00	169.97	262.79	Jul 1977	Jul 1921	Oct 1928	Sep 1928
79.71	1.25	109.71	140.47	170.87	264.84	Aug 1980	Jul 1965	Jul 1980	Jul 1977
81.16	1.23	111.00	143.67	173.29	275.77	Sep 1928	Oct 1918	Sep 1967	Jul 1954
82.61	1.21	125.71	156.80	190.68	291.51	Oct 1967	Jul 1977	Sep 1929	Nov 1980
84.06	1.19	136.43	158.47	198.58	329.51	Oct 1918	Sep 1967	Nov 1975	May 1961
85.51	1.17	139.86	176.27	223.61	331.90	Sep 1927	Sep 1929	Jul 1977	Oct 1918
86.96	1.15	163.43	178.40	259.13	373.29	Sep 1929	Aug 1927	Jul 1965	Jul 1965
88.41	1.13	182.43	185.73	274.52	379.44	Nov 1975	Nov 1975	Oct 1982	Oct 1982
89.86	1.11	205.57	242.00	337.32	403.44	Jun 1926	Sep 1972	Sep 1973	Dec 1981
91.30	1.10	206.86	248.13	352.16	457.07	Aug 1973	Oct 1982	Jan 1981	Aug 1927
92.75	1.08	222.29	268.67	374.19	469.44	Oct 1982	Aug 1973	Aug 1972	Aug 1973
94.20	1.06	225.71	293.80	389.19	473.34	Sep 1951	Sep 1951	May 1926	Sep 1972
95.65	1.05	225.86	304.67	395.06	511.59	Sep 1972	Jun 1926	Aug 1927	Oct 1951
97.10	1.03	268.57	310.67	440.81	638.25	Dec 1981	Dec 1981	Sep 1951	Aug 1970
98.55	1.01	337.57	463.60	562.03	803.25	Aug 1970	Jul 1970	Aug 1970	Jul 1926
	μ	75.51	90.93	123.24	174.55				
	σ	69.01	87.33	114.96	157.65				

**Table 7.3 Results of Low-Flow Analyses
for 5- and 9-Month Droughts**

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
1.43	70.00	46.86	Oct	1963	99.45	Feb	1934
2.86	35.00	52.76	Oct	1920	107.21	Sep	1940
4.29	23.33	58.37	Nov	1939	114.41	Oct	1963
5.71	17.50	62.24	Oct	1964	157.17	Oct	1920
7.14	14.00	62.26	Nov	1953	167.80	Nov	1930
8.57	11.67	80.32	Sep	1940	187.72	Dec	1955
10.00	10.00	81.31	Dec	1933	210.26	Sep	1971
11.43	8.75	95.75	Nov	1943	223.30	Oct	1939
12.86	7.78	98.80	Nov	1955	225.30	Oct	1962
14.29	7.00	100.58	Nov	1976	228.21	Aug	1923
15.71	6.36	103.18	Nov	1962	249.07	Oct	1953
17.14	5.83	108.72	Oct	1949	266.46	Oct	1922
18.57	5.38	108.88	Nov	1938	268.36	Oct	1944
20.00	5.00	112.70	Sep	1971	283.22	Nov	1966
21.43	4.67	113.25	Nov	1979	310.14	Aug	1949
22.86	4.38	114.79	Nov	1944	320.62	Nov	1957
24.29	4.12	132.03	Nov	1966	331.86	Nov	1979
25.71	3.89	133.07	Nov	1958	340.10	Feb	1961
27.14	3.68	134.60	Dec	1922	341.11	Aug	1925
28.57	3.50	137.51	Oct	1937	342.63	Dec	1976
30.00	3.33	148.83	Nov	1956	357.02	Sep	1956
31.43	3.18	150.19	Dec	1930	380.09	Aug	1936
32.86	3.04	153.22	Oct	1957	391.65	Nov	1946
34.29	2.92	169.68	Sep	1923	395.24	Oct	1978
35.71	2.80	186.02	Nov	1978	427.07	Aug	1948
37.14	2.69	191.82	Jun	1934	448.18	Aug	1968
38.57	2.59	195.16	Oct	1947	448.83	Aug	1937
40.00	2.50	197.65	Nov	1960	462.90	Oct	1938
41.43	2.41	210.23	Oct	1948	464.66	Oct	1943
42.86	2.33	212.41	Oct	1916	466.12	Oct	1916
44.29	2.26	219.02	Nov	1919	468.37	Sep	1921
45.71	2.19	220.76	Sep	1968	481.08	Feb	1915
47.14	2.12	221.56	Oct	1950	497.15	Jul	1932
48.57	2.06	239.45	Nov	1952	513.95	Oct	1919
50.00	2.00	242.11	Oct	1946	514.01	Aug	1931
51.43	1.94	245.43	Jun	1936	521.06	Nov	1952
52.86	1.89	272.34	Sep	1925	537.13	Aug	1964
54.29	1.84	272.43	Jul	1930	586.94	Nov	1980
55.71	1.79	292.45	Oct	1945	631.11	Aug	1959
57.14	1.75	295.34	Oct	1974	660.59	Nov	1917
58.57	1.71	297.62	Sep	1932	666.82	Nov	1969
60.00	1.67	309.86	Apr	1956	667.62	Oct	1975
61.43	1.63	355.14	Nov	1924	729.09	Sep	1958
62.86	1.59	357.83	Sep	1921	778.28	Nov	1974
64.29	1.56	364.86	Nov	1929	801.09	Jun	1972
65.71	1.52	374.09	Jan	1970	836.36	Jan	1930
67.14	1.49	386.80	Aug	1931	851.39	Aug	1918
68.57	1.46	388.40	Apr	1940	868.22	Dec	1945
70.00	1.43	395.72	Nov	1975	884.49	Oct	1947
71.43	1.40	420.26	Feb	1941	926.04	Sep	1942
72.86	1.37	425.09	Jul	1959	935.03	Sep	1954
74.29	1.35	449.55	Oct	1935	942.71	Jul	1928
75.71	1.32	455.95	Sep	1954	995.55	Sep	1950
77.14	1.30	457.69	Apr	1961	999.14	Nov	1934
78.57	1.27	474.21	Nov	1981	1002.80	Nov	1935
80.00	1.25	479.10	Dec	1980	1039.09	Sep	1965
81.43	1.23	479.17	Nov	1917	1092.36	Nov	1967
82.86	1.21	507.21	Mar	1958	1130.38	Jan	1941
84.29	1.19	509.17	Mar	1921	1250.54	Nov	1924

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
85.71	1.17	533.93	Dec	1914	1304.22	Oct	1977
87.14	1.15	541.18	Oct	1942	1349.14	Oct	1951
88.57	1.13	556.08	Oct	1918	1376.98	May	1933
90.00	1.11	561.93	Feb	1972	1540.90	Sep	1981
91.43	1.09	575.25	Jul	1922	1582.49	May	1983
92.86	1.08	584.88	Jul	1983	1671.08	Jan	1916
94.29	1.06	588.66	May	1915	1740.63	Dec	1970
95.71	1.04	606.31	May	1949	1884.66	Nov	1961
97.14	1.03	620.90	Apr	1963	1942.44	May	1960
98.57	1.01	677.41	Mar	1964	1995.49	Jul	1982

PROB ≥	Flows in cfs												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
99	18.03	25.96	20.09	18.12	40.16	84.47	59.54	31.57	42.75	21.19	24.09	18.97	23.00
95	25.00	36.93	38.99	44.98	65.11	186.94	187.23	156.93	111.58	62.98	42.99	26.95	42.00
90	32.99	50.00	49.99	54.99	89.97	299.89	322.00	265.90	166.00	109.96	53.99	33.00	60.00
85	42.99	60.84	55.99	69.98	120.74	377.89	410.71	329.91	210.36	140.96	65.98	39.90	81.01
80	52.98	73.00	69.97	84.97	173.89	433.90	486.00	395.88	273.00	179.93	79.97	48.00	108.01
75	61.98	88.62	82.97	109.94	241.59	487.87	555.33	461.85	331.58	210.93	96.96	56.79	140.02
70	74.09	99.00	100.20	142.39	310.84	555.38	640.00	538.57	406.00	250.25	116.13	66.00	184.95
60	100.10	135.00	161.28	260.34	543.53	671.47	846.00	713.64	560.00	325.28	157.13	92.00	297.95
50	135.14	192.00	260.29	380.47	715.47	840.51	1100.00	940.63	762.00	425.30	204.18	132.00	440.94
40	194.19	271.00	385.29	582.44	900.82	1060.65	1430.00	1210.71	1010.00	555.35	279.21	185.00	621.94
30	298.22	410.00	540.24	818.51	1300.60	1410.73	1950.00	1590.76	1310.00	740.47	391.22	289.00	899.93
25	375.29	509.60	625.33	1000.54	1495.50	1670.72	2227.31	1860.84	1588.49	909.40	470.23	376.26	1099.92
20	501.43	700.00	765.25	1230.58	1811.17	1980.97	2530.00	2220.88	1940.00	1080.62	568.34	470.00	1369.91
15	730.74	984.14	900.48	1540.80	2382.09	2501.40	3044.14	2691.11	2435.43	1410.91	750.52	635.86	1769.90
10	1260.91	1270.00	1240.75	2111.84	3452.08	3502.25	4020.00	3481.49	3500.00	2061.83	1120.54	1040.00	2430.00
5	2232.83	1918.13	2042.21	4084.43	5480.63	5912.29	6854.21	5073.21	6368.97	4023.59	1701.91	2844.58	4180.00
1	7077.91	4920.88	5822.77	11665.44	9822.61	9832.13	12520.53	10574.92	12823.38	10171.97	4965.12	10226.74	9700.00
\bar{Q} , cfs	523.54	525.46	581.71	995.85	1364.48	1553.43	1878.58	1587.83	1559.05	988.28	505.66	629.86	1054.58
$t(\bar{Q})$ %	19.52	24.58	27.56	25.13	28.36	27.26	31.37	30.08	25.53	22.70	23.19	15.18	26.13

Table 7.5 Protected-Flow Statistics for Month of October

with Q_p $Q_m(90)$

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1915	-50.92	11	-4.63	-8.99	1333.15	20	66.66	297.01
1916	0.00	0	0.00	0.00	8676.15	31	279.88	1587.01
1917	0.00	0	0.00	0.00	4093.23	31	132.04	522.01
1918	0.00	0	0.00	0.00	29492.18	31	951.36	2627.01
1919	0.00	0	0.00	0.00	8631.21	31	278.43	1527.01
1920	0.00	0	0.00	0.00	4700.21	31	151.62	385.01
1921	-41.92	10	-4.19	-6.99	341.16	21	16.25	31.01
1922	0.00	0	0.00	0.00	7924.18	31	255.62	1197.01
1923	-13.98	3	-4.66	-8.99	889.21	28	31.76	429.01
1924	0.00	0	0.00	0.00	6325.19	31	204.04	1067.01
1925	0.00	0	0.00	0.00	9368.16	31	302.20	557.01
1926	0.00	0	0.00	0.00	7139.15	31	230.30	1447.01
1927	0.00	0	0.00	0.00	101907.00	31	3287.32	10767.00
1928	0.00	0	0.00	0.00	160747.00	31	5185.39	15967.00
1929	0.00	0	0.00	0.00	7308.19	31	235.75	727.01
1930	0.00	0	0.00	0.00	7229.19	31	233.20	732.01
1931	0.00	0	0.00	0.00	5028.17	31	162.20	1187.01
1932	0.00	0	0.00	0.00	4576.21	31	147.62	827.01
1933	-6.99	1	-6.99	-6.99	3264.22	30	108.81	551.01
1934	0.00	0	0.00	0.00	1423.23	31	45.91	125.01
1935	0.00	0	0.00	0.00	2438.23	31	78.65	222.01
1936	0.00	0	0.00	0.00	2579.23	31	83.20	170.01
1937	0.00	0	0.00	0.00	16629.15	31	536.42	3417.01
1938	-141.88	16	-8.87	-10.99	1529.11	15	101.94	607.01
1939	-30.92	11	-2.81	-3.99	758.15	20	37.91	357.01
1940	-176.82	24	-7.37	-10.99	3161.05	7	451.58	1377.01
1941	-275.84	21	-13.14	-22.99	1061.07	10	106.11	382.01
1942	0.00	0	0.00	0.00	139411.00	31	4497.13	10067.00
1943	0.00	0	0.00	0.00	1547.23	31	49.91	63.01
1944	0.00	0	0.00	0.00	1734.23	31	55.94	283.01
1945	0.00	0	0.00	0.00	3804.23	31	122.72	703.01
1946	0.00	0	0.00	0.00	8673.13	31	279.78	1547.01
1947	0.00	0	0.00	0.00	1739.23	31	56.10	468.01
1948	-1.99	1	-1.99	-1.99	642.22	30	21.41	86.01
1949	0.00	0	0.00	0.00	1616.23	31	52.14	224.01
1950	-57.94	8	-7.24	-13.99	1150.17	23	50.01	377.01
1951	0.00	0	0.00	0.00	2903.23	31	93.65	152.01
1952	0.00	0	0.00	0.00	16454.15	31	530.78	1107.01
1953	0.00	0	0.00	0.00	1700.23	31	54.85	117.01
1954	-29.92	11	-2.72	-5.99	1330.15	20	66.51	581.01
1955	0.00	0	0.00	0.00	28115.16	31	906.94	5107.00
1956	0.00	0	0.00	0.00	4133.23	31	133.33	585.01
1957	-212.80	26	-8.18	-9.99	12.04	5	2.41	3.01
1958	-168.89	15	-11.26	-12.99	3288.12	16	205.51	907.01
1959	0.00	0	0.00	0.00	3292.23	31	106.20	237.01
1960	0.00	0	0.00	0.00	40173.14	31	1295.91	7067.00
1961	0.00	0	0.00	0.00	3402.23	31	109.75	697.01
1962	0.00	0	0.00	0.00	34402.12	31	1109.75	2967.01
1963	0.00	0	0.00	0.00	5637.20	31	181.85	987.01
1964	-315.82	24	-13.16	-18.99	192.05	7	27.44	62.01
1965	-137.83	23	-5.99	-10.99	259.06	8	32.38	95.01
1966	0.00	0	0.00	0.00	21122.13	31	681.36	1267.01
1967	-8.98	3	-2.99	-4.99	1421.21	28	50.76	192.01
1968	0.00	0	0.00	0.00	13614.18	31	439.17	1587.01
1969	0.00	0	0.00	0.00	1229.23	31	39.65	87.01

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1970	0.00	0	0.00	0.00	31573.16	31	1018.49	4837.00
1971	0.00	0	0.00	0.00	62277.12	31	2008.94	5117.00
1972	0.00	0	0.00	0.00	1959.23	31	63.20	313.01
1973	0.00	0	0.00	0.00	13862.15	31	447.17	1277.01
1974	0.00	0	0.00	0.00	65925.12	31	2126.62	6397.00
1975	0.00	0	0.00	0.00	3388.23	31	109.30	278.01
1976	0.00	0	0.00	0.00	6214.18	31	200.46	386.01
1977	0.00	0	0.00	0.00	3203.23	31	103.33	464.01
1978	0.00	0	0.00	0.00	75087.06	31	2422.16	4877.00
1979	0.00	0	0.00	0.00	2887.23	31	93.14	228.01
1980	0.00	0	0.00	0.00	1161.23	31	37.46	67.01
1981	0.00	0	0.00	0.00	9499.16	31	306.42	407.01
1982	0.00	0	0.00	0.00	14850.15	31	479.04	777.01
1983	0.00	0	0.00	0.00	7505.18	31	242.10	421.01
μ	-8.05				544.25			
σ	7.72				1091.49			
	% YEAR =	23.19	% DAYS =	9.72	% YEAR =	100.00	% DAYS =	90.28

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1915	-441.00	17	-25.94	-36.00	886.00	14	63.29	270.00
1916	0.00	0	0.00	0.00	7839.00	31	252.87	1560.00
1917	-139.00	9	-15.44	-23.00	3395.00	22	154.32	495.00
1918	0.00	0	0.00	0.00	28655.00	31	924.35	2600.00
1919	0.00	0	0.00	0.00	7794.00	31	251.42	1500.00
1920	0.00	0	0.00	0.00	3863.00	31	124.61	358.00
1921	-550.00	28	-19.64	-34.00	12.00	3	4.00	4.00
1922	0.00	0	0.00	0.00	7087.00	31	228.61	1170.00
1923	-533.00	26	-20.50	-36.00	571.00	5	114.20	402.00
1924	-2.00	1	-2.00	-2.00	5490.00	30	183.00	1040.00
1925	0.00	0	0.00	0.00	8531.00	31	275.19	530.00
1926	0.00	0	0.00	0.00	6302.00	31	203.29	1420.00
1927	0.00	0	0.00	0.00	101070.00	31	3260.32	10740.00
1928	0.00	0	0.00	0.00	159910.00	31	5158.39	15940.00
1929	0.00	0	0.00	0.00	6471.00	31	208.74	700.00
1930	0.00	0	0.00	0.00	6392.00	31	206.19	705.00
1931	-12.00	2	-6.00	-10.00	4203.00	29	144.93	1160.00
1932	-28.00	4	-7.00	-20.00	3767.00	27	139.52	800.00
1933	-182.00	13	-14.00	-34.00	2602.00	18	144.56	524.00
1934	-65.00	10	-6.50	-12.00	651.00	21	31.00	98.00

Table 7.6 Continued

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1935	-11.00	3	-3.67	-6.00	1612.00	28	57.57	195.00
1936	0.00	0	0.00	0.00	1742.00	31	56.19	143.00
1937	0.00	0	0.00	0.00	15792.00	31	509.42	3390.00
1938	-684.00	23	-29.74	-38.00	1234.00	8	154.25	580.00
1939	-651.00	27	-24.11	-31.00	541.00	4	135.25	330.00
1940	-873.00	26	-33.58	-38.00	3020.00	5	604.00	1350.00
1941	-954.00	27	-35.33	-50.00	962.00	4	225.50	355.00
1942	0.00	0	0.00	0.00	138574.00	31	4470.13	10040.00
1943	0.00	0	0.00	0.00	710.00	31	22.90	36.00
1944	-119.00	12	-9.92	-18.00	1016.00	19	53.47	256.00
1945	-169.00	17	-9.94	-15.00	3136.00	14	224.00	676.00
1946	0.00	0	0.00	0.00	7836.00	31	252.77	1520.00
1947	-352.00	16	-22.00	-27.00	1254.00	15	83.60	441.00
1948	-410.00	24	-17.08	-29.00	213.00	7	30.43	59.00
1949	-32.00	9	-3.56	-7.00	811.00	22	36.86	197.00
1950	-517.00	21	-24.62	-41.00	772.00	10	77.20	350.00
1951	0.00	0	0.00	0.00	2066.00	31	66.65	125.00
1952	0.00	0	0.00	0.00	15617.00	31	503.77	1080.00
1953	-8.00	2	-4.00	-5.00	871.00	29	30.03	90.00
1954	-659.00	27	-24.41	-33.00	1122.00	4	280.50	554.00
1955	0.00	0	0.00	0.00	27278.00	31	879.94	5080.00
1956	-83.00	11	-7.55	-16.00	3379.00	20	168.95	558.00
1957	-1038.00	31	-33.48	-37.00	0.00	0	0.00	0.00
1958	-604.00	21	-28.76	-40.00	2886.00	10	288.60	880.00
1959	0.00	0	0.00	0.00	2455.00	31	79.19	210.00
1960	0.00	0	0.00	0.00	39336.00	31	1268.90	7040.00
1961	0.00	0	0.00	0.00	2565.00	31	82.74	670.00
1962	0.00	0	0.00	0.00	33565.00	31	1082.74	2940.00
1963	-18.00	4	-4.50	-15.00	4818.00	27	178.44	960.00
1964	-1029.00	28	-36.75	-46.00	68.00	3	22.67	35.00
1965	-832.00	27	-30.81	-38.00	116.00	4	29.00	68.00
1966	0.00	0	0.00	0.00	20285.00	31	654.35	1240.00
1967	-212.00	16	-13.25	-32.00	787.00	15	52.47	165.00
1968	0.00	0	0.00	0.00	12777.00	31	412.16	1560.00
1969	-12.00	8	-1.50	-8.00	404.00	23	17.57	60.00
1970	0.00	0	0.00	0.00	30736.00	31	991.48	4810.00
1971	0.00	0	0.00	0.00	61440.00	31	1981.94	5090.00
1972	-136.00	16	-8.50	-18.00	1258.00	15	83.87	286.00
1973	0.00	0	0.00	0.00	13025.00	31	420.16	1250.00
1974	0.00	0	0.00	0.00	65088.00	31	2099.61	6370.00
1975	0.00	0	0.00	0.00	2551.00	31	82.29	251.00
1976	0.00	0	0.00	0.00	5377.00	31	173.45	359.00
1977	0.00	0	0.00	0.00	2366.00	31	76.32	437.00
1978	0.00	0	0.00	0.00	74250.00	31	2395.16	4850.00
1979	0.00	0	0.00	0.00	2050.00	31	66.13	201.00
1980	-62.00	10	-6.20	-11.00	386.00	21	18.38	40.00
1981	0.00	0	0.00	0.00	8662.00	31	279.42	380.00
1982	0.00	0	0.00	0.00	14013.00	31	452.03	750.00
1983	0.00	0	0.00	0.00	6668.00	31	215.10	394.00
μ	-22.13				617.94			
σ	20.24				1090.87			
	% YEAR =	46.38	% DAYS =	24.12	% YEAR =	98.55	% DAYS =	75.88

Table 7.7 Summary of Protected-Flow Statistics
 USGS NO. 05570000 Spoon River at Seville
 Drainage Area 1636.00 sq mi Period of Record (1914-1983) 69 years

T	Item	Mean Flow, Flow Duration, and Selected Protected-Flow Statistics												Year
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
	\bar{Q}	523.54	525.46	581.71	995.85	1367.04	1553.43	1878.58	1587.83	1559.05	988.28	505.66	629.86	1054.59
	$\bar{Q}(S)$	971.33	709.10	804.18	1198.63	1047.50	1175.33	1471.30	1382.58	1402.87	1056.78	673.52	1323.93	539.87
	Q(90)	32.99	50.00	49.99	54.99	89.97	299.89	322.00	265.90	166.00	109.96	53.99	33.00	60.00
M	AVQ(-)	-8.05	-13.20	-14.97	-15.06	-28.10	-120.68	-135.94	-118.55	-60.10	-47.67	-13.93	-6.78	
	% years	23.19	23.19	23.19	21.74	24.64	27.54	24.64	27.54	27.54	33.33	34.78	30.43	
	% days	9.72	10.19	9.35	9.54	9.85	9.82	10.00	9.91	10.05	9.86	9.54	10.29	
	AVQ(+)	544.25	530.92	588.11	1041.64	1416.85	1403.14	1744.64	1480.41	1555.38	979.67	500.76	666.10	
	% years	100.00	97.10	98.55	98.55	98.55	100.00	98.55	98.55	100.00	98.55	100.00	100.00	
	% days	90.28	89.81	90.65	90.46	90.15	90.18	90.00	90.09	89.95	90.14	90.46	89.71	
Y	AVQ(-)	-22.13	-17.37	-16.14	-16.22	-14.60	-14.83	-8.19	-25.73	-23.76	-24.14	-15.67	-21.14	
	% years	46.38	28.99	30.43	23.19	10.14	2.90	2.90	4.35	5.80	14.49	37.68	55.07	
	% days	24.12	14.83	17.30	12.16	4.26	0.28	1.01	2.10	1.64	4.63	12.76	27.44	
	AVQ(+)	617.94	549.53	634.21	1067.59	1363.15	1497.68	1837.30	1561.22	1524.48	974.50	513.16	793.36	
	% years	98.55	97.10	98.55	95.65	100.00	100.00	100.00	98.55	98.55	100.00	100.00	100.00	
	% days	75.88	85.17	82.70	87.84	95.74	99.72	98.99	97.90	98.36	95.37	87.24	72.56	
	Q(85)	42.99	60.84	55.99	69.98	120.74	377.89	410.71	329.91	210.36	140.96	65.98	39.90	81.01
M	AVQ(-)	-13.70	-18.21	-14.92	-22.76	-43.69	-145.39	-163.40	-133.66	-77.59	-57.30	-18.91	-11.07	
	% years	30.43	28.99	27.54	27.54	33.33	46.38	31.88	34.78	36.23	42.03	44.93	36.23	
	% days	14.96	14.83	14.59	14.49	15.24	14.87	14.98	14.77	15.02	14.91	14.96	13.91	
	AVQ(+)	567.50	548.69	618.04	1086.65	1475.20	1406.22	1755.19	1499.14	1600.87	1005.88	520.35	687.10	
	% years	98.55	97.10	98.55	95.65	97.10	100.00	95.65	97.10	98.55	97.10	100.00	100.00	
	% days	85.04	85.17	85.41	85.51	84.76	85.13	85.02	85.23	84.98	85.09	85.04	86.09	
Y	AVQ(-)	-34.25	-27.95	-28.99	-27.01	-22.06	-14.59	-18.91	-37.66	-29.18	-33.88	-26.76	-34.57	
	% years	57.97	40.58	40.58	33.33	21.74	5.80	4.35	4.35	10.14	20.29	49.28	60.87	
	% days	33.01	23.29	24.59	19.17	8.77	0.79	2.08	2.81	3.14	6.87	20.57	36.14	
	AVQ(+)	677.42	587.83	673.44	1138.18	1409.03	1484.34	1836.11	1551.40	1526.90	976.73	541.56	878.96	
	% years	97.10	94.20	94.20	94.20	98.55	100.00	100.00	98.55	98.55	100.00	100.00	100.00	
	% days	66.99	76.71	75.41	80.83	91.23	99.21	97.92	97.19	96.86	93.13	79.43	63.86	
	Q(80)	52.98	73.00	69.97	84.97	173.89	433.90	486.00	395.88	273.00	179.93	79.97	48.00	108.01
M	AVQ(-)	-19.23	-23.99	-23.84	-30.10	-81.53	-156.95	-188.27	-157.21	-113.31	-78.33	-26.72	-14.09	
	% years	40.58	39.13	33.33	34.78	36.23	57.97	42.03	43.48	43.48	50.72	49.28	49.28	
	% days	19.78	20.00	19.40	19.78	19.95	19.96	20.00	19.92	20.00	19.50	19.82	20.87	
	AVQ(+)	591.29	571.57	640.66	1142.83	1507.80	1437.92	1787.79	1527.48	1635.89	1023.07	537.54	739.04	
	% years	98.55	97.10	95.65	94.20	97.10	98.55	95.65	97.10	97.10	100.00	100.00	100.00	
	% days	80.22	80.00	80.60	80.22	80.05	80.04	80.00	80.08	80.00	80.50	80.18	79.13	
Y	AVQ(-)	-50.14	-42.02	-46.25	-45.32	-38.39	-27.71	-40.99	-53.46	-42.34	-47.09	-42.72	-53.22	
	% years	68.12	52.17	46.38	39.13	30.43	10.14	4.35	7.25	13.04	31.88	62.32	72.46	
	% days	43.06	33.43	32.12	24.59	12.78	1.87	2.46	3.60	4.54	9.58	28.19	44.01	
	AVQ(+)	767.64	648.18	719.71	1192.14	1446.12	1473.50	1816.33	1537.08	1522.08	978.57	570.53	973.88	
	% years	92.75	91.30	88.41	89.86	98.55	100.00	100.00	98.55	100.00	98.55	100.00	91.30	
	% days	56.94	66.57	67.88	75.41	87.22	98.13	97.54	96.40	95.46	90.42	71.81	55.99	
	Q(75)	61.98	88.62	82.97	109.94	241.59	487.87	555.33	461.85	331.58	210.93	96.96	56.79	140.02
M	AVQ(-)	-23.54	-33.47	-30.56	-47.08	-127.41	-174.26	-213.28	-186.74	-142.70	-89.00	-36.45	-19.84	
	% years	46.38	40.58	40.58	39.13	43.48	63.77	50.72	44.93	50.72	59.42	60.87	50.72	
	% days	24.73	24.93	24.92	24.68	25.04	24.96	24.88	24.73	25.02	24.92	24.96	25.02	
	AVQ(+)	620.95	593.00	674.41	1191.69	1540.51	1478.06	1832.14	1557.31	1684.77	1064.88	556.81	770.97	
	% years	98.55	92.75	94.20	89.86	97.10	97.10	92.75	97.10	97.10	100.00	100.00	97.10	
	% days	75.27	75.07	75.08	75.32	74.96	75.04	75.12	75.27	74.98	75.08	75.04	74.98	
Y	AVQ(-)	-71.72	-63.67	-68.34	-66.98	-54.41	-37.52	-48.51	-69.64	-53.27	-56.37	-61.02	-75.29	
	% years	75.36	60.87	52.17	46.38	34.78	13.04	5.80	8.70	17.39	42.03	73.91	79.71	
	% days	51.29	40.97	38.24	29.97	18.06	3.60	4.06	4.63	7.15	14.91	36.70	51.50	
	AVQ(+)	862.79	697.09	757.52	1250.70	1506.34	1467.60	1814.15	1521.46	1532.40	1006.82	613.01	1089.87	
	% years	88.41	89.86	79.71	88.41	97.10	100.00	100.00	98.55	98.55	100.00	97.10	98.55	88.41
	% days	48.71	59.03	61.76	70.03	81.94	96.40	95.94	95.37	92.85	85.09	63.30	48.50	

Table 8.1 Monthly and Annual Mean Flows in cfs

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1922	307.0	300.6	563.7	716.8	956.0	2047.9	3319.3	462.6	132.7	645.7	86.1	297.3	816.4
1923	39.8	269.1	52.2	72.4	83.3	1345.6	258.2	533.2	164.0	314.3	314.2	401.4	323.1
1924	148.5	84.9	342.5	601.9	1229.8	982.9	619.7	315.3	2101.5	3038.2	1301.0	312.5	923.1
1925	111.6	254.2	159.7	344.5	1702.1	649.0	920.3	338.0	757.2	387.8	818.8	212.2	545.4
1926	350.6	546.3	364.1	854.8	1460.6	995.3	2009.2	401.9	2402.4	577.5	776.3	2976.9	1131.2
1927	2270.0	2115.5	785.0	175.5	2009.6	2050.0	2400.0	2340.0	2160.0	393.6	228.5	82.0	1409.6
1928	1243.1	712.1	540.0	832.0	1140.0	384.1	959.9	445.5	895.8	380.7	267.2	552.1	692.7
1929	357.4	1929.7	1005.9	1595.8	1283.9	4080.6	2946.3	1902.9	3030.7	2595.2	210.6	120.5	1756.1
1930	159.3	358.7	176.3	214.6	2196.1	626.3	664.1	170.5	95.0	59.1	25.3	117.3	391.5
1931	122.4	69.7	263.1	20.5	36.1	402.1	226.1	541.8	1408.7	183.5	31.9	506.5	317.4
1932	75.4	854.2	505.8	1129.2	670.4	574.8	218.2	222.0	516.0	380.8	1591.1	103.5	571.2
1933	131.9	101.1	1160.7	1277.2	655.5	707.5	1014.5	3692.9	324.5	298.5	135.9	82.9	804.4
1934	29.1	24.0	44.7	35.2	24.4	150.4	115.9	21.3	87.4	32.6	16.7	271.7	70.9
1935	67.3	476.5	812.3	876.0	1330.7	1550.1	981.2	5044.3	2862.1	702.1	231.1	228.5	1264.4
1936	56.0	853.7	239.7	347.6	2196.7	1491.1	258.5	390.4	42.5	16.1	11.4	533.3	528.6
1937	385.0	208.7	128.6	1459.1	1191.0	498.3	495.0	813.2	216.2	433.1	198.8	145.1	511.5
1938	23.0	34.7	174.4	1484.4	1103.7	1445.1	3216.0	2137.0	755.7	601.1	170.5	195.8	942.7
1939	85.0	127.1	80.9	56.8	504.5	2033.1	2434.3	584.4	440.3	230.7	820.1	37.8	619.0
1940	67.5	34.6	25.6	13.5	67.7	695.2	303.0	152.5	72.9	25.1	154.5	11.8	136.0
1941	32.4	13.2	54.9	180.0	136.5	61.4	701.7	120.2	574.6	94.6	89.2	351.8	199.1
1942	2188.0	969.5	681.6	321.8	3661.9	1579.8	1602.7	808.4	490.4	1178.0	101.7	105.3	1123.8
1943	50.2	750.3	1425.6	876.6	1345.1	360.2	688.9	4925.7	1585.1	537.6	353.5	61.5	1081.2
1944	55.7	139.2	34.2	56.0	231.7	2193.9	5677.8	2152.3	272.2	106.9	364.9	269.7	960.0
1945	739.8	530.0	133.2	118.1	1380.6	3598.8	2645.6	3371.2	2829.5	769.2	97.1	566.9	1395.8
1946	571.7	187.8	237.6	3337.8	395.2	1154.2	590.7	1061.8	1716.2	262.6	344.7	119.5	837.2
1947	295.3	1279.5	757.8	685.6	362.4	793.4	3333.2	1280.3	4917.6	1506.1	105.5	163.5	1285.2
1948	24.6	75.0	237.8	159.9	750.7	3486.4	777.7	609.9	125.6	3073.6	499.5	172.3	839.2
1949	85.8	77.5	80.9	719.5	3167.5	823.0	914.1	260.7	494.5	252.5	121.6	107.9	573.1
1950	113.0	31.4	546.1	1287.5	882.8	754.5	1846.3	623.2	1507.9	998.0	299.1	224.1	756.9
1951	53.8	37.3	28.2	367.3	2865.1	1431.2	2234.4	554.9	788.9	1199.4	350.4	86.1	816.9
1952	87.8	249.5	91.9	473.2	395.9	1878.3	2066.6	1503.0	1003.2	547.9	388.6	156.9	737.3
1953	29.8	114.2	126.8	101.3	229.7	497.1	1022.1	747.5	642.8	67.4	23.6	15.1	300.4
1954	36.9	12.7	17.2	13.2	94.5	438.9	1168.6	238.0	657.5	62.3	102.3	27.8	237.9
1955	396.2	101.1	90.3	1136.1	2213.7	656.9	1837.0	1673.7	581.6	341.7	342.5	83.2	777.6
1956	614.7	53.0	28.2	23.2	151.4	68.6	117.5	118.4	247.5	190.3	582.2	35.3	186.8
1957	7.1	11.8	18.8	272.3	205.0	256.0	1402.1	1123.5	1377.9	383.9	78.2	37.5	430.0
1958	130.5	50.7	157.0	97.6	497.1	198.1	245.9	152.9	923.5	1360.0	1011.5	263.0	424.0
1959	93.7	172.2	54.7	53.7	3539.9	693.2	551.2	514.4	468.9	89.3	1092.5	139.0	601.1
1960	1335.7	167.7	220.1	603.0	527.5	1173.6	3440.7	1803.5	3576.6	2061.8	847.3	98.0	1320.2
1961	63.5	161.0	45.4	45.9	507.0	869.3	1196.6	999.9	161.4	3568.7	1298.9	5725.6	1219.7
1962	906.9	2352.7	589.7	1130.2	2088.2	3067.1	783.6	854.3	1401.3	233.4	58.9	28.8	1116.5
1963	190.5	64.2	36.2	29.9	88.6	1354.6	307.7	303.2	89.8	303.4	73.2	18.0	240.8
1964	11.2	19.9	12.0	54.4	36.6	411.3	3057.2	371.9	498.8	121.2	150.9	32.6	394.6
1965	19.8	35.8	46.6	3015.2	747.3	1904.0	3171.5	438.3	571.5	694.5	113.4	1340.7	1007.4
1966	221.8	122.4	456.2	586.8	690.9	993.6	1279.5	1590.4	1213.2	96.3	89.8	77.0	617.0
1967	30.7	19.0	131.7	85.4	324.8	291.5	1454.5	1509.5	1256.1	951.5	687.0	174.1	576.7
1968	314.5	974.3	696.0	693.8	1132.6	295.6	275.6	206.4	764.8	306.1	162.7	100.1	489.7
1969	165.0	406.1	651.6	2817.0	1634.6	1481.6	1575.8	558.1	580.5	3300.7	497.1	114.2	1149.8
1970	2333.8	286.7	154.7	182.1	235.2	500.1	2918.6	2802.9	1309.6	127.6	1241.7	5605.1	1473.5
1971	1628.7	992.5	815.1	594.4	1414.3	859.5	234.3	225.8	257.9	374.1	76.1	187.7	634.4
1972	152.6	36.7	488.5	328.5	575.8	781.3	1497.2	708.6	380.8	149.8	105.6	226.9	451.1
1973	141.2	506.8	502.1	1600.7	1479.7	3988.3	4728.3	2566.2	1726.9	589.3	486.9	244.4	1544.5
1974	2886.6	676.3	2478.1	3061.3	1292.1	1676.5	2015.0	2590.0	4337.2	648.3	296.6	95.4	1842.9
1975	55.6	335.4	751.1	734.6	1637.0	2097.4	2038.9	1469.1	1196.1	202.0	75.2	135.9	887.6
1976	89.8	145.8	353.8	113.3	845.0	1763.1	2084.0	1167.9	205.2	72.6	73.1	18.0	575.8

Table 8.1 Continued

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1977	32.7	34.1	18.2	16.6	145.5	366.6	131.4	820.4	51.9	24.9	716.8	951.7	276.8
1978	1893.1	2889.4	1056.7	244.2	121.2	2744.7	3575.4	2948.4	420.9	646.7	62.2	48.3	1394.2
1979	34.2	72.2	95.6	55.5	296.7	3439.4	3114.0	622.5	235.5	190.4	82.6	23.3	689.8
1980	19.5	28.8	41.3	25.4	133.0	344.0	523.0	241.9	2878.5	121.2	383.6	875.3	463.1
1981	87.7	59.4	564.7	110.5	485.1	280.9	2173.4	3339.9	2321.9	5525.6	970.7	329.6	1362.7
1982	287.8	388.3	277.7	638.2	3404.0	3705.5	3283.7	723.1	920.5	1901.5	567.1	605.6	1376.4
1983	175.9	747.8	5060.2	643.7	1117.1	776.5	5258.3	1585.6	416.7	83.4	34.9	21.7	1325.4
\bar{Q}	398.6	415.1	447.9	641.9	1021.1	1271.0	1659.7	1174.1	1071.7	751.8	369.2	439.6	802.4
$\bar{Q}(e)$	663.2	597.4	733.3	784.0	931.1	1051.1	1330.4	1157.7	1084.7	1054.1	382.6	1052.3	432.2

Table 8.2 Results of Low-Flow Analyses

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
1.61	62.00	5.76	6.29	6.73	9.33	Oct 1956	Oct 1956	Oct 1956	Oct 1956
3.23	31.00	6.69	6.79	8.53	11.99	Sep 1940	Sep 1940	Sep 1940	Aug 1936
4.84	20.67	8.67	9.13	10.35	12.42	Aug 1941	Dec 1963	Dec 1963	Oct 1963
6.45	15.50	8.89	10.12	11.13	13.23	Sep 1936	Sep 1930	Nov 1953	Nov 1940
8.06	12.40	9.00	10.89	11.30	13.66	Dec 1963	Aug 1936	Aug 1936	Nov 1953
9.68	10.33	9.40	11.03	13.39	15.87	Sep 1930	Aug 1934	Jan 1939	Jan 1939
11.29	8.86	9.93	11.07	13.81	16.95	Aug 1934	Oct 1953	Oct 1979	Jan 1976
12.90	7.75	10.00	12.33	15.68	17.92	Jan 1953	Oct 1979	Oct 1964	Oct 1979
14.52	6.89	10.79	12.73	16.39	22.50	Sep 1976	Jan 1939	Jan 1976	Aug 1930
16.13	6.20	11.29	13.20	16.72	23.03	Oct 1979	Oct 1957	Aug 1934	Oct 1964
17.74	5.64	12.14	13.51	18.23	24.13	Jan 1939	Aug 1941	Nov 1966	Jan 1955
19.35	5.17	12.43	13.77	20.03	24.74	Oct 1957	Sep 1976	Jan 1930	Aug 1934
20.97	4.77	12.57	15.07	20.90	24.89	Sep 1954	Sep 1954	Jan 1955	Nov 1966
22.58	4.43	14.29	15.07	22.81	25.66	Oct 1964	Oct 1964	Oct 1937	Nov 1933
24.19	4.13	15.29	16.00	22.87	28.67	Nov 1966	Nov 1966	Jan 1943	Nov 1937
25.81	3.88	16.57	17.93	23.84	30.49	Jul 1977	Oct 1937	Nov 1933	Jan 1962
27.42	3.65	16.86	18.20	24.45	31.13	Sep 1922	Jul 1977	Jul 1977	Sep 1957
29.03	3.44	17.29	18.80	24.58	31.85	Oct 1947	Oct 1922	Oct 1947	Dec 1943
30.65	3.26	17.29	19.20	26.58	32.36	Dec 1950	Jan 1955	Oct 1978	Dec 1950
32.26	3.10	17.71	19.53	27.29	36.43	Oct 1937	Oct 1947	Sep 1968	Jul 1977
33.87	2.95	17.86	19.53	27.52	39.95	Jan 1955	Dec 1950	Aug 1931	Oct 1952
35.48	2.82	18.29	20.00	27.71	40.02	Sep 1978	Jan 1962	Jan 1962	Oct 1978
37.10	2.70	19.29	21.27	27.87	40.79	Feb 1933	Sep 1978	Dec 1950	Jan 1960
38.71	2.58	19.29	21.53	28.26	49.13	Aug 1944	Dec 1943	Oct 1957	Oct 1947
40.32	2.48	19.29	21.87	29.68	50.48	Oct 1949	Sep 1968	Oct 1938	Nov 1971
41.94	2.38	20.00	22.00	29.71	52.31	Dec 1943	Nov 1933	Oct 1952	Jan 1958
43.55	2.30	20.00	22.53	30.06	55.03	Feb 1962	Oct 1938	Sep 1954	Jan 1938
45.16	2.21	20.29	23.67	30.19	58.70	Sep 1925	Feb 1960	Nov 1949	Dec 1922
46.77	2.14	21.00	24.80	35.03	63.36	Aug 1931	Aug 1931	Nov 1971	Nov 1948
48.39	2.07	21.43	24.93	35.16	63.97	Sep 1968	Aug 1944	Oct 1922	Nov 1949
50.00	2.00	22.29	28.00	36.47	64.26	Oct 1938	Dec 1949	Jul 1941	Aug 1954
51.61	1.94	23.00	28.13	37.65	67.44	Sep 1923	Oct 1952	Jan 1960	Nov 1980
53.23	1.88	23.14	28.60	46.77	70.10	Jan 1960	Nov 1971	Dec 1958	Sep 1968
54.84	1.82	25.57	32.53	48.03	73.97	Oct 1971	Oct 1946	Oct 1942	Oct 1974
56.45	1.77	25.71	33.73	49.45	75.49	Oct 1952	Jul 1959	Oct 1946	Oct 1942
58.06	1.72	29.86	34.13	53.32	77.72	Jul 1959	Jul 1923	Sep 1959	Oct 1975
59.68	1.68	30.29	37.33	55.19	80.21	Oct 1946	Sep 1925	Oct 1951	Aug 1941
61.29	1.63	31.00	39.60	55.42	85.03	Oct 1951	Dec 1958	Oct 1974	Oct 1951
62.90	1.59	31.71	42.27	55.61	88.61	Dec 1958	Nov 1924	Oct 1935	Nov 1932
64.52	1.55	32.00	43.73	55.97	97.18	Sep 1927	Sep 1927	Jan 1924	Nov 1923

Table 8.2 Continued

PROB	T-YR	Low Flows in cfs				Month and Year of Occurrence			
		7-DAY	15-DAY	31-DAY	61-DAY	7-DAY	15-DAY	31-DAY	61-DAY
66.13	1.51	36.43	43.93	57.42	101.92	Oct 1975	Oct 1935	Nov 1980	Sep 1946
67.74	1.48	36.71	44.07	62.16	105.85	Aug 1965	Sep 1951	Nov 1975	Aug 1945
69.35	1.44	37.29	45.27	62.42	107.56	Nov 1924	Oct 1942	Nov 1948	Jul 1931
70.97	1.41	37.57	47.33	68.68	110.75	Dec 1932	Sep 1945	Aug 1945	Aug 1972
72.58	1.38	38.00	48.27	73.16	113.00	Oct 1935	Dec 1948	Dec 1932	Dec 1924
74.19	1.35	38.71	48.87	75.71	113.93	Oct 1974	Aug 1972	Aug 1944	Jan 1944
75.81	1.32	42.57	49.67	78.10	118.75	Oct 1948	Oct 1974	Sep 1927	Sep 1929
77.42	1.29	43.29	54.87	83.81	121.25	Aug 1972	Aug 1975	Aug 1972	Jul 1959
79.03	1.27	44.43	54.87	84.94	122.66	Sep 1967	Nov 1980	Nov 1923	Nov 1965
80.65	1.24	44.57	55.47	94.35	130.74	Oct 1942	Dec 1932	Jan 1969	Dec 1969
82.26	1.22	45.86	56.07	101.71	133.93	Sep 1945	Sep 1967	Sep 1929	Oct 1935
83.87	1.19	50.00	56.67	107.68	156.44	Aug 1980	Aug 1965	Aug 1965	Aug 1927
85.48	1.17	60.43	71.80	118.84	171.62	Oct 1969	Oct 1929	Jul 1970	Sep 1967
87.10	1.15	63.57	75.07	120.61	263.49	Sep 1929	Sep 1928	Aug 1928	Dec 1981
88.71	1.13	65.00	79.33	134.35	280.11	Sep 1928	Jan 1969	Sep 1925	Sep 1925
90.32	1.11	66.14	82.53	140.81	302.75	Jul 1970	Jun 1961	Jun 1961	Aug 1928
91.94	1.09	69.57	100.33	143.10	337.20	Jun 1961	Jul 1970	Sep 1967	Oct 1982
93.55	1.07	97.14	100.73	174.48	361.57	Sep 1973	Jan 1926	Oct 1982	Sep 1973
95.16	1.05	100.43	116.33	175.55	456.77	Jan 1926	Aug 1973	Jan 1926	Jan 1961
96.77	1.03	118.29	166.07	177.10	467.15	Sep 1981	Apr 1981	Sep 1973	Jul 1970
98.39	1.02	136.86	169.20	193.32	475.28	Aug 1982	Oct 1982	Sep 1981	Jan 1926
	μ	32.57	39.47	57.03	103.18				
	σ	27.11	34.39	47.91	114.85				

**Table 8.3 Results of Low-Flow Analyses
for 5- and 9-Month Droughts**

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
1.59	63.00	18.92	Nov	1953	58.63	Jan	1934
3.17	31.50	22.96	Nov	1963	68.28	Oct	1976
4.76	21.00	23.78	Nov	1976	68.57	Oct	1963
6.35	15.75	27.47	Nov	1979	74.35	Nov	1940
7.94	12.60	31.46	Dec	1933	79.84	Nov	1953
9.52	10.50	35.73	Nov	1939	86.44	Oct	1979
11.11	9.00	47.35	Sep	1940	89.81	Oct	1930
12.70	7.88	54.76	Jun	1934	110.79	Mar	1956
14.29	7.00	57.02	Oct	1964	127.20	Nov	1966
15.87	6.30	61.00	Nov	1978	155.20	Jan	1940
17.46	5.73	62.43	Sep	1966	165.75	Dec	1957
19.05	5.25	64.80	Jan	1956	186.50	Oct	1922
20.63	4.85	68.93	Nov	1956	192.30	Oct	1978
22.22	4.50	69.24	Nov	1943	219.33	Aug	1936
23.81	4.20	69.81	Nov	1962	225.80	Aug	1971
25.40	3.94	78.75	Sep	1930	231.55	Nov	1962
26.98	3.71	82.64	Nov	1960	243.48	Nov	1952
28.57	3.50	90.70	Oct	1957	281.45	Aug	1937
30.16	3.32	103.36	Dec	1922	284.58	Aug	1923
31.75	3.15	105.69	Nov	1952	286.33	Oct	1938
33.33	3.00	109.08	Nov	1938	297.90	Jul	1968
34.92	2.86	115.16	Oct	1937	309.93	Dec	1956
36.51	2.74	121.21	Oct	1947	312.29	Sep	1954
38.10	2.63	125.22	Sep	1949	315.68	Aug	1949
39.68	2.52	127.37	Nov	1958	329.63	Nov	1980
41.27	2.42	128.42	Oct	1950	339.30	Oct	1943
42.86	2.33	129.59	Sep	1975	350.58	Oct	1975
44.44	2.25	137.85	Sep	1954	413.57	Oct	1951
46.03	2.17	143.72	Jun	1936	425.87	Dec	1960
47.62	2.10	165.29	Sep	1971	426.57	Jul	1932
49.21	2.03	173.05	Oct	1951	434.98	Oct	1944
50.79	1.97	183.12	Oct	1948	441.21	Oct	1934
52.38	1.91	189.56	Feb	1931	453.81	Sep	1958
53.97	1.85	200.73	Aug	1972	459.78	Sep	1950
55.56	1.80	205.04	Oct	1929	468.62	Aug	1972
57.14	1.75	215.34	Jun	1963	469.99	Jul	1931
58.73	1.70	226.84	Feb	1941	476.85	Sep	1964
60.32	1.66	227.89	Sep	1968	504.95	Sep	1965
61.90	1.62	236.50	Nov	1924	508.65	Aug	1959
63.49	1.57	238.23	Mar	1958	514.42	Sep	1925
65.08	1.54	246.05	Jul	1941	520.68	Jan	1930
66.67	1.50	251.06	Jun	1956	544.46	Nov	1946
68.25	1.47	252.67	Sep	1923	598.06	Jun	1928
69.84	1.43	258.21	Apr	1940	598.98	Sep	1941
71.43	1.40	261.32	Dec	1980	604.88	Sep	1948
73.02	1.37	271.61	Jan	1970	633.70	Dec	1942
74.60	1.34	278.88	May	1977	639.44	Dec	1924
76.19	1.31	286.11	Sep	1974	642.25	Dec	1947
77.78	1.29	321.76	Oct	1935	705.11	Nov	1935
79.37	1.26	324.85	Jul	1922	738.88	Nov	1974
80.95	1.24	330.27	Sep	1931	764.27	Oct	1967
82.54	1.21	332.13	Oct	1945	793.13	Dec	1945
84.13	1.19	350.67	Aug	1944	802.34	Dec	1969
85.71	1.17	382.33	May	1932	871.61	Jul	1977
87.30	1.15	384.14	Nov	1981	927.14	Jun	1955

PROB	T-YR	5-Month Drought			9-Month Drought		
		Flow, cfs	Month	Year	Flow, cfs	Month	Year
88.89	1.13	385.06	Aug	1942	947.90	Sep	1927
90.48	1.11	392.66	Aug	1955	1029.66	Apr	1933
92.06	1.09	415.50	Dec	1965	1103.99	May	1983
93.65	1.07	428.26	Jul	1983	1386.75	Sep	1926
95.24	1.05	457.43	Feb	1967	1403.21	Jul	1982
96.83	1.03	458.39	Oct	1925	1463.63	Feb	1962
98.41	1.02	460.26	Sep	1946	1475.27	Nov	1970

PROB ≥	Flows in cfs												
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
99	7.11	9.97	11.02	11.01	15.94	30.12	21.43	22.18	26.90	12.03	10.02	8.68	11.00
95	12.01	15.00	18.00	16.00	23.95	72.05	128.00	84.04	45.00	22.01	17.01	13.00	19.00
90	17.01	20.00	22.01	20.02	39.02	122.08	175.00	121.06	64.00	35.03	26.01	19.00	28.00
85	20.01	26.00	27.02	30.05	59.68	161.22	216.00	150.11	90.00	48.05	33.02	22.00	38.01
80	24.02	31.00	33.03	45.06	78.08	231.19	260.00	185.15	116.00	63.07	40.04	26.00	50.99
75	30.03	35.00	40.05	59.11	115.05	277.30	298.00	222.24	144.00	79.09	49.04	30.00	67.02
70	35.91	42.00	49.86	79.70	149.72	334.17	362.00	269.31	176.00	95.76	56.89	37.00	88.09
60	48.92	60.00	79.81	119.75	249.66	434.37	515.00	371.36	244.00	133.76	76.87	53.00	144.11
50	67.90	92.00	130.73	209.53	401.57	570.29	703.00	493.36	355.00	189.71	102.86	72.00	226.15
40	106.84	150.00	189.75	335.47	599.55	754.23	992.00	639.39	524.00	267.67	137.85	98.00	360.18
30	166.81	268.00	301.65	499.49	899.49	1039.11	1480.00	947.04	867.00	415.54	211.77	152.00	559.21
25	219.72	355.00	373.62	592.52	1149.00	1298.65	1900.00	1228.53	1140.00	528.41	289.59	200.00	714.83
20	361.41	481.00	469.60	789.18	1499.20	1708.29	2460.00	1618.37	1670.00	736.13	393.57	276.00	960.36
15	582.31	652.00	639.47	999.34	2020.47	2238.34	3600.00	2337.75	2160.00	1078.93	599.36	415.00	1369.73
10	1059.01	990.00	889.48	1598.75	2699.22	3367.65	4690.00	3218.17	3050.00	1848.40	939.29	722.00	2160.78
5	2268.74	1950.00	1799.05	2958.58	4197.51	5427.85	6620.00	4828.32	4640.00	3538.24	1809.09	1840.00	3939.61
1	5291.34	4463.51	6297.11	6509.83	8479.96	8969.86	11526.37	8669.00	8158.91	8864.74	4372.66	6927.35	7997.98
\bar{Q} , cfs	398.64	415.07	447.92	641.92	1018.12	1270.96	1659.71	1174.15	1071.69	751.81	369.21	439.57	802.40
$t(\bar{Q})$ %	19.16	22.62	21.13	23.74	27.62	25.53	27.86	25.97	26.25	19.77	21.17	14.60	23.22

Table 8.5 Protected-Flow Statistics for Month of October

with $Q_p = Q_m(90)$

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1922	0.00	0	0.00	0.00	8988.78	31	289.96	1192.99
1923	-17.04	7	-2.43	-7.01	722.85	24	30.12	227.99
1924	0.00	0	0.00	0.00	4077.80	31	131.54	712.99
1925	0.00	0	0.00	0.00	2933.80	31	94.64	192.99
1926	0.00	0	0.00	0.00	10341.76	31	333.60	1342.99
1927	0.00	0	0.00	0.00	69842.69	31	2252.99	2252.99
1928	0.00	0	0.00	0.00	38008.76	31	1226.09	3282.99
1929	0.00	0	0.00	0.00	10551.77	31	340.38	1502.99
1930	0.00	0	0.00	0.00	4409.80	31	142.25	602.99
1931	0.00	0	0.00	0.00	3267.80	31	105.41	1462.99
1932	0.00	0	0.00	0.00	1809.80	31	58.38	430.99
1933	0.00	0	0.00	0.00	3562.80	31	114.93	942.99
1934	0.00	0	0.00	0.00	375.81	31	12.12	52.99
1935	-21.07	12	-1.76	-3.01	1579.88	19	83.15	454.99
1936	0.00	0	0.00	0.00	1207.80	31	38.96	102.99
1937	0.00	0	0.00	0.00	11406.77	31	367.96	2922.99
1938	-5.04	7	-0.72	-1.01	191.85	24	7.99	36.99
1939	0.00	0	0.00	0.00	2107.80	31	67.99	835.99
1940	-6.07	12	-0.51	-1.01	1570.88	19	82.68	669.99
1941	-143.64	23	-6.25	-10.01	619.95	8	77.49	304.99
1942	0.00	0	0.00	0.00	67301.69	31	2171.02	5112.99
1943	0.00	0	0.00	0.00	1029.80	31	33.22	56.99
1944	0.00	0	0.00	0.00	1199.81	31	38.70	343.99
1945	0.00	0	0.00	0.00	22407.76	31	722.83	3472.99
1946	0.00	0	0.00	0.00	17194.76	31	554.67	4142.99
1947	0.00	0	0.00	0.00	8627.79	31	278.32	4012.99
1948	-2.02	3	-0.67	-1.01	238.83	28	8.53	27.99
1949	0.00	0	0.00	0.00	2133.80	31	68.83	440.99
1950	-1.01	1	-1.01	-1.01	2977.81	30	99.26	891.99
1951	0.00	0	0.00	0.00	1141.80	31	36.83	78.99
1952	0.00	0	0.00	0.00	2194.80	31	70.80	356.99
1953	0.00	0	0.00	0.00	396.81	31	12.80	17.99
1954	-110.14	22	-5.01	-7.01	726.94	9	80.77	223.99
1955	0.00	0	0.00	0.00	11755.77	31	379.22	1712.99
1956	0.00	0	0.00	0.00	18529.76	31	597.73	6392.99
1957	-308.29	31	-9.94	-11.71	0.00	0	0.00	0.00
1958	-60.11	18	-3.34	-5.01	3579.92	13	275.38	1252.99
1959	0.00	0	0.00	0.00	2376.80	31	76.67	325.99
1960	0.00	0	0.00	0.00	40880.77	31	1318.73	4612.99
1961	0.00	0	0.00	0.00	1442.80	31	46.54	715.99
1962	0.00	0	0.00	0.00	27585.76	31	889.86	4972.99
1963	0.00	0	0.00	0.00	5377.79	31	173.48	1152.99
1964	-179.39	31	-5.79	-7.51	0.00	0	0.00	0.00
1965	-33.12	20	-1.66	-3.01	118.93	11	10.81	48.99
1966	0.00	0	0.00	0.00	6348.78	31	204.80	464.99
1967	-11.07	12	-0.92	-3.01	435.88	19	22.94	115.99
1968	0.00	0	0.00	0.00	9220.79	31	297.44	1972.99
1969	0.00	0	0.00	0.00	4588.78	31	148.03	1892.99
1970	0.00	0	0.00	0.00	71820.25	31	2316.78	7742.99
1971	0.00	0	0.00	0.00	49961.76	31	1611.67	8132.99

Table 8.5 Continued								
Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1972	0.00	0	0.00	0.00	4202.79	31	135.57	653.99
1973	0.00	0	0.00	0.00	3849.80	31	124.19	461.99
1974	0.00	0	0.00	0.00	88956.81	31	2869.57	6972.99
1975	0.00	0	0.00	0.00	1197.80	31	38.64	109.99
1976	0.00	0	0.00	0.00	2256.80	31	72.80	372.99
1977	0.00	0	0.00	0.00	485.80	31	15.67	75.99
1978	0.00	0	0.00	0.00	58159.76	31	1876.12	5602.99
1979	-0.01	2	-0.01	-0.01	531.82	29	18.34	50.99
1980	-76.11	18	-4.23	-6.01	151.92	13	11.69	37.99
1981	0.00	0	0.00	0.00	2191.80	31	70.70	136.99
1982	0.00	0	0.00	0.00	8393.78	31	270.77	1052.99
1983	0.00	0	0.00	0.00	4926.79	31	158.93	240.99
μ	-4.45				431.29			
σ	4.13				780.46			
	% YEAR =	24.19	% DAYS =	11.39	% YEAR =	96.77	% DAYS =	88.61

Table 8.6 Protected-Flow Statistics for Month of October								
with $Q_p = Q_y(90)$								
Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1922	0.00	0	0.00	0.00	8648.12	31	278.97	1182.00
1923	-174.92	21	-8.33	-18.00	540.04	10	54.00	217.00
1924	-5.00	1	-5.00	-5.00	3742.12	30	124.74	702.00
1925	0.00	0	0.00	0.00	2593.12	31	83.65	182.00
1926	0.00	0	0.00	0.00	10001.12	31	322.62	1332.00
1927	0.00	0	0.00	0.00	69502.06	31	2242.00	2242.00
1928	0.00	0	0.00	0.00	37668.12	31	1215.10	3272.00
1929	0.00	0	0.00	0.00	10211.12	31	329.39	1492.00
1930	0.00	0	0.00	0.00	4069.12	31	131.26	592.00
1931	-104.93	17	-6.17	-10.00	3032.06	14	216.58	1452.00
1932	0.00	0	0.00	0.00	1469.12	31	47.39	420.00
1933	0.00	0	0.00	0.00	3222.12	31	103.94	932.00
1934	-101.92	21	-4.85	-8.00	137.04	10	13.70	42.00
1935	-194.92	19	-10.26	-14.00	1413.05	12	117.75	444.00
1936	0.00	0	0.00	0.00	867.12	31	27.97	92.00
1937	0.00	0	0.00	0.00	11066.12	31	356.97	2912.00
1938	-208.90	25	-8.36	-12.00	55.02	6	9.17	26.00
1939	-94.92	20	-4.75	-8.00	1862.04	11	169.28	825.00
1940	-248.90	24	-10.37	-12.00	1473.03	7	210.43	659.00
1941	-414.39	26	-15.94	-21.00	550.02	5	110.00	294.00

Table 8.6 Continued

Year	If Available Flow ≤ 0				If Available Flow > 0			
	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}	ΣQ_a	No. Days	\bar{Q}_a	Q_{max}
1942	0.00	0	0.00	0.00	66961.06	31	2160.03	5102.00
1943	0.00	0	0.00	0.00	689.12	31	22.23	46.00
1944	-69.93	18	-3.88	-6.00	929.05	13	71.47	333.00
1945	0.00	0	0.00	0.00	22067.12	31	711.84	3462.00
1946	0.00	0	0.00	0.00	16854.12	31	543.68	4132.00
1947	0.00	0	0.00	0.00	8287.12	31	267.33	4002.00
1948	-150.91	22	-6.86	-12.00	47.04	9	5.23	17.00
1949	0.00	0	0.00	0.00	1793.12	31	57.84	430.00
1950	-65.96	9	-7.33	-12.00	2702.09	22	122.82	881.00
1951	0.00	0	0.00	0.00	801.12	31	25.84	68.00
1952	-8.98	4	-2.25	-4.00	1863.11	27	69.00	346.00
1953	-18.97	7	-2.71	-3.00	75.10	24	3.13	7.00
1954	-366.90	24	-15.29	-18.00	643.03	7	91.86	213.00
1955	0.00	0	0.00	0.00	11415.12	31	368.23	1702.00
1956	0.00	0	0.00	0.00	18189.12	31	586.75	6382.00
1957	-648.97	31	-20.93	-22.70	0.00	0	0.00	0.00
1958	-276.92	21	-13.19	-16.00	3456.04	10	345.60	1242.00
1959	0.00	0	0.00	0.00	2036.12	31	65.68	315.00
1960	0.00	0	0.00	0.00	40540.12	31	1307.75	4602.00
1961	0.00	0	0.00	0.00	1102.12	31	35.55	705.00
1962	0.00	0	0.00	0.00	27245.12	31	878.87	4962.00
1963	-2.99	2	-1.50	-2.00	5040.11	29	173.80	1142.00
1964	-520.07	31	-16.78	-18.50	0.00	0	0.00	0.00
1965	-312.89	28	-11.17	-14.00	58.01	3	19.34	38.00
1966	0.00	0	0.00	0.00	6008.12	31	193.81	454.00
1967	-228.90	24	-9.54	-14.00	313.03	7	44.72	105.00
1968	0.00	0	0.00	0.00	8880.12	31	286.46	1962.00
1969	-22.97	7	-3.28	-5.00	4271.09	24	177.96	1882.00
1970	0.00	0	0.00	0.00	71480.06	31	2305.81	7732.00
1971	0.00	0	0.00	0.00	49621.12	31	1600.68	8122.00
1972	-16.99	3	-5.66	-8.00	3879.11	28	138.54	643.00
1973	0.00	0	0.00	0.00	3509.12	31	113.20	451.00
1974	0.00	0	0.00	0.00	88617.00	31	2858.61	6962.00
1975	0.00	0	0.00	0.00	857.12	31	27.65	99.00
1976	0.00	0	0.00	0.00	1916.12	31	61.81	362.00
1977	-84.93	18	-4.72	-8.00	230.05	13	17.70	65.00
1978	0.00	0	0.00	0.00	57819.12	31	1865.13	5592.00
1979	-82.96	10	-8.30	-11.00	274.08	21	13.05	40.00
1980	-322.90	25	-12.92	-17.00	58.02	6	9.67	27.00
1981	0.00	0	0.00	0.00	1851.12	31	59.71	126.00
1982	0.00	0	0.00	0.00	8053.12	31	259.78	1042.00
1983	0.00	0	0.00	0.00	4586.12	31	147.94	230.00
μ	-10.38				489.85			
σ	9.97				777.08			
% YEAR =	41.94	% DAYS =	23.83	% YEAR =	96.77	% DAYS =	76.17	

Table 8.7 Summary of Protected-Flow Statistics
 USGS NO. 05585000 La Moine River at Ripley
 Drainage Area 1293.00 sq mi Period of Record (1921-1983) 62 years

T	Item	Mean Flow, Flow Duration, and Selected Protected-Flow Statistics												
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
	\bar{Q}	398.65	415.07	447.92	641.92	1021.11	1270.96	1659.71	1174.15	1071.69	751.81	369.21	439.57	802.41
	$\bar{Q}(S)$	663.16	597.40	733.30	784.02	931.12	1051.09	1330.43	1157.72	1084.67	1054.10	382.55	1052.32	432.20
	Q(90)	17.01	20.00	22.01	20.02	39.02	122.08	175.00	121.06	64.00	35.03	26.01	19.00	28.00
M	AVQ(-)	-4.45	-5.23	-4.80	-4.18	-14.06	-48.22	-67.52	-43.70	-20.55	-12.00	-8.98	-5.42	
	% years	24.19	20.97	24.19	17.74	20.97	25.81	27.42	27.42	27.42	29.03	29.03	30.65	
	% days	11.39	10.27	10.46	10.25	10.16	9.99	10.16	9.99	10.11	10.67	10.51	11.02	
	AVQ(+)	431.29	440.88	476.21	693.40	1091.48	1281.73	1660.28	1174.82	1123.30	803.80	384.56	473.34	
	% years	96.77	98.39	98.39	95.16	98.39	98.39	100.00	98.39	100.00	98.39	98.39	100.00	
	% days	88.61	89.73	89.54	89.75	89.84	90.01	89.84	90.01	89.89	89.33	89.49	88.98	
Y	AVQ(-)	-10.38	-10.17	-8.44	-10.28	-7.85	-6.18	-7.72	-8.34	-9.10	-9.02	-10.36	-9.42	
	% years	41.94	29.03	30.65	24.19	16.13	3.23	1.61	3.23	4.84	20.97	32.26	45.16	
	% days	23.83	15.70	15.04	13.48	6.29	0.57	1.34	1.35	1.02	7.23	11.19	22.58	
	AVQ(+)	489.85	461.05	495.73	711.14	1057.02	1250.15	1654.05	1161.99	1054.56	780.95	385.50	534.36	
	% years	96.77	96.77	95.16	95.16	100.00	100.00	100.00	100.00	100.00	100.00	98.39	98.39	
	% days	76.17	84.30	84.96	86.52	93.71	99.43	98.66	98.65	98.98	92.77	88.81	77.42	
	Q(85)	20.01	26.00	27.02	30.05	59.68	161.22	216.00	150.11	90.00	48.05	33.02	22.00	38.01
M	AVQ(-)	-5.86	-8.33	-7.46	-11.15	-27.85	-64.83	-80.02	-52.75	-35.35	-19.50	-11.94	-6.15	
	% years	32.26	29.03	30.65	25.81	29.03	35.48	37.10	35.48	37.10	37.10	45.16	40.32	
	% days	15.19	15.43	15.04	15.04	14.22	14.98	15.00	15.09	15.16	14.98	15.19	15.86	
	AVQ(+)	447.51	461.58	496.71	722.14	1121.95	1316.76	1712.61	1215.38	1163.44	831.24	398.55	497.44	
	% years	96.77	96.77	95.16	93.55	96.77	98.39	100.00	98.39	98.39	98.39	98.39	98.39	
	% days	84.81	84.57	84.96	84.96	85.78	85.02	85.00	84.91	84.84	85.02	84.81	84.14	
Y	AVQ(-)	-16.27	-13.88	-13.70	-16.76	-13.62	-9.47	-13.88	-14.98	-9.55	-13.68	-14.04	-15.70	
	% years	53.23	43.55	38.71	27.42	20.97	6.45	3.23	3.23	12.90	30.65	51.61	59.68	
	% days	32.36	27.58	23.83	17.69	9.77	2.03	2.04	1.93	3.55	11.76	18.89	30.91	
	AVQ(+)	540.97	525.95	542.44	737.31	1087.66	1258.68	1655.82	1158.74	1072.06	810.74	411.59	588.27	
	% years	95.16	90.32	93.55	93.55	98.39	100.00	100.00	98.39	100.00	98.39	98.39	95.16	
	% days	67.64	72.42	76.17	82.31	90.23	97.97	97.96	98.07	96.45	88.24	81.11	69.09	
	Q(80)	24.03	31.00	33.03	45.06	78.08	231.19	260.00	185.15	116.00	63.07	40.04	26.00	50.99
M	AVQ(-)	-7.55	-10.56	-10.78	-20.45	-35.72	-109.50	-98.73	-69.73	-49.53	-27.67	-15.18	-7.81	
	% years	38.71	35.48	37.10	32.26	37.10	51.61	45.16	41.94	45.16	43.55	51.61	45.16	
	% days	20.92	20.32	20.24	21.07	19.99	19.98	20.00	20.29	20.00	20.03	20.03	21.61	
	AVQ(+)	475.70	484.73	522.91	761.67	1183.80	1326.71	1774.32	1258.52	1206.99	868.20	415.43	529.75	
	% years	96.77	95.16	93.55	90.32	95.16	96.77	100.00	98.39	98.39	98.39	98.39	98.39	
	% days	79.08	79.68	79.76	78.93	80.01	80.02	80.00	79.71	80.00	79.97	79.97	78.39	
Y	AVQ(-)	-24.54	-22.49	-22.02	-24.43	-21.95	-15.88	-23.30	-22.72	-14.78	-21.53	-21.42	-24.33	
	% years	64.52	56.45	48.39	33.87	27.42	11.29	6.45	8.06	17.74	38.71	62.90	70.97	
	% days	40.89	35.32	30.85	23.00	12.74	3.23	2.42	2.50	6.56	15.66	26.01	38.33	
	AVQ(+)	605.18	575.20	583.87	774.71	1111.48	1261.16	1649.19	1152.51	1093.38	834.95	437.65	645.25	
	% years	93.55	87.10	88.71	88.71	96.77	100.00	100.00	98.39	100.00	98.39	96.77	93.55	
	% days	59.11	64.68	69.15	77.00	87.26	96.77	97.58	97.50	93.44	84.34	73.99	61.67	
	Q(75)	30.03	35.00	40.05	59.11	115.05	277.30	298.00	222.24	144.00	79.09	49.04	30.00	67.02
M	AVQ(-)	-11.33	-12.06	-15.02	-30.33	-60.96	-128.50	-112.50	-90.09	-64.88	-36.20	-20.02	-10.21	
	% years	43.55	43.55	40.32	33.87	46.77	56.45	54.84	50.00	54.84	56.45	62.90	51.61	
	% days	26.27	25.22	25.03	24.97	25.07	24.97	25.27	24.97	25.00	25.13	25.34	25.59	
	AVQ(+)	504.02	512.29	549.03	786.91	1225.64	1367.20	1860.19	1298.76	1258.54	910.67	435.62	553.94	
	% years	96.77	91.94	91.94	87.10	95.16	96.77	100.00	98.39	96.77	96.77	98.39	96.77	
	% days	73.73	74.78	74.97	75.03	74.93	75.03	74.73	75.03	75.00	74.87	74.66	74.41	
Y	AVQ(-)	-34.83	-33.33	-32.98	-34.85	-30.36	-25.73	-33.65	-30.79	-22.22	-30.20	-29.93	-34.25	
	% years	75.81	64.52	54.84	40.32	30.65	12.90	8.06	9.68	27.42	43.55	70.97	80.65	
	% days	49.90	42.80	37.25	27.84	16.90	4.27	2.90	3.33	10.75	21.02	35.22	47.42	
	AVQ(+)	696.55	633.37	626.62	810.09	1150.77	1258.74	1641.32	1146.32	1128.39	875.07	482.79	739.41	
	% years	88.71	85.48	85.48	87.10	95.16	100.00	100.00	98.39	98.39	98.39	96.77	91.94	
	% days	50.10	57.20	62.75	72.16	83.10	95.73	97.10	96.67	89.25	78.98	64.78	52.58	