Illinois State Water Survey Division
SURFACE WATER SECTION

SWS Contract Report 461

OPTIMAL USE OF THE KASKASKIA NAVIGATION CANAL: MANAGEMENT STRATEGIES AND GUIDELINES

by
Ali Durgunoglu and Krishan P. Singh

Prepared for the
Illinois Department of Transportation
Division of Water Resources

Champaign, Illinois
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Illinois Department of Energy and Natural Resources

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INTRODUCTION

The Kaskaskia River originates near Champaign, Illinois, and flows southwesterly for approximately 300 miles to its confluence with the Mississippi River, 8 miles upstream from Chester, Illinois. With a drainage basin of approximately 5,800 square miles, it is the largest river located entirely within Illinois. The area covered by the drainage area of the Kaskaskia River includes 15 counties.

The Kaskaskia River Navigation Project was envisioned and authorized by Congress in 1962 to provide a navigable waterway from Fayetteville, Illinois, to the confluence of the Kaskaskia River with the Mississippi River. Two upstream reservoirs can contribute flow to the navigation canal. Carlyle Lake was completed in 1967, and Lake Shelbyville was completed in 1969. Minimum flow releases of 10 and 50 cubic feet per second (cfs) are mandated from these reservoirs. The major tributaries to the Kaskaskia River below Carlyle Lake, and their drainage areas, are Crooked Creek (465 sq mi), Shoal Creek (916 sq mi), Sugar Creek (176 sq mi), Elkhorn Creek (89 sq mi), Silver Creek (478 sq mi), Mud Creek (136 sq mi), Richland Creek (248 sq mi), Plum Creek (90 sq mi), Horse Creek (94 sq mi), and Ninemile Creek (44 sq mi). Currently there are two active streamflow gaging stations on the Kaskaskia River below Carlyle Lake. One is located just downstream of the Carlyle Dam. The other one, which is near Venedy (mile 57.2), replaced the New Athens (mile 30) station in 1969 after it was flooded by the navigation pool. Six of the major tributaries are gaged.

The Kaskaskia River system below Carlyle Dam consists of about 57 miles of the Kaskaskia River down to Fayetteville and 36 miles of 225-foot-wide, 9-foot-deep navigation channel. The primary benefit of the navigation project is transportation of coal mined in the area. Secondary benefits include industrial and agricultural development and recreational activities. The present annual barge traffic is less than 4 million tons of coal with approximately 5 lockages per day. Because commercial barge traffic has not reached its expected levels so far, water releases from Carlyle Lake have not been made to maintain flows in the navigation canal. Once these releases are made, recreational activities at Carlyle Lake will be affected, and the state of Illinois may have to start paying a fee to the federal government for the maintenance of Carlyle Lake.

Although the primary purpose of constructing the waterway was for navigation of commercial barges, the overwhelming use of the waterway to date has been for recreational boating, especially during May through September, which coincides with the low-flow period. The low-flow situation became worse during the past few years as a result of dry weather conditions. As an example, maximum total monthly lockages were 191 in 1983, 211 in 1984, 296 in 1985, 247 in 1986, 285 in 1987, and 281 in 1988 (up to June 30). Each lockage represents two sequential operations of the lock chamber. During the same time period, the maximum number of daily lockages increased from 18 in 1983 to 28 in 1987. If remedial measures are not taken, navigational releases will have to be made from Carlyle Lake, affecting recreational activities.

The objectives of this study, therefore, are 1) to process and analyze various types of hydrologic data (such as streamflows near Venedy Station, associated natural flow from downstream drainage areas, evaporation losses, and Mississippi stages at the confluence with the Kaskaskia River) and to develop low-flow distributions; 2) to investigate the amount and fluctuations of other seasonal consumptive water uses due to withdrawals by water supply systems and the Baldwin power plant; 3) to develop information on flow needed for lockages during May to October from historical information on daily lockages and Mississippi stages; 4) to develop a basinwide algorithm to estimate the natural flow from the 1,800-square-mile drainage area downstream of Venedy Station; and 5) to develop optimum management techniques and guidelines for the operation of the Kaskaskia Lock and Dam.

Characteristics of the Navigation Pool and the Lock and Dam

The Kaskaskia navigation pool is formed by the water impounded behind the Kaskaskia Navigation Lock and Dam located at mile 0.8 of the Kaskaskia River, north of Chester, Illinois. The head of the navigation (or the upstream end of the navigation channel) is located at mile 36, near Fayetteville, Illinois. The navigable channel is about 225 feet wide and 9 feet deep, and it passes through St. Clair, Monroe, and Randolph Counties. The general layout of the Kaskaskia navigation channel is illustrated in figure 1. The surface area covered by the backwaters, wetlands, and oxbows is about 3,663 acres at the normal pool level (U.S. Army Corps of Engineers, St. Louis, unofficial document). The normal pool level is 368.00. The nearest gaging station upstream of the head of navigation is at Venedy (mile 57.2). The total inflow into the navigation system is the sum of flows Venedy Station and the natural inflow from 1,408 sq mi of drainage area downstream.

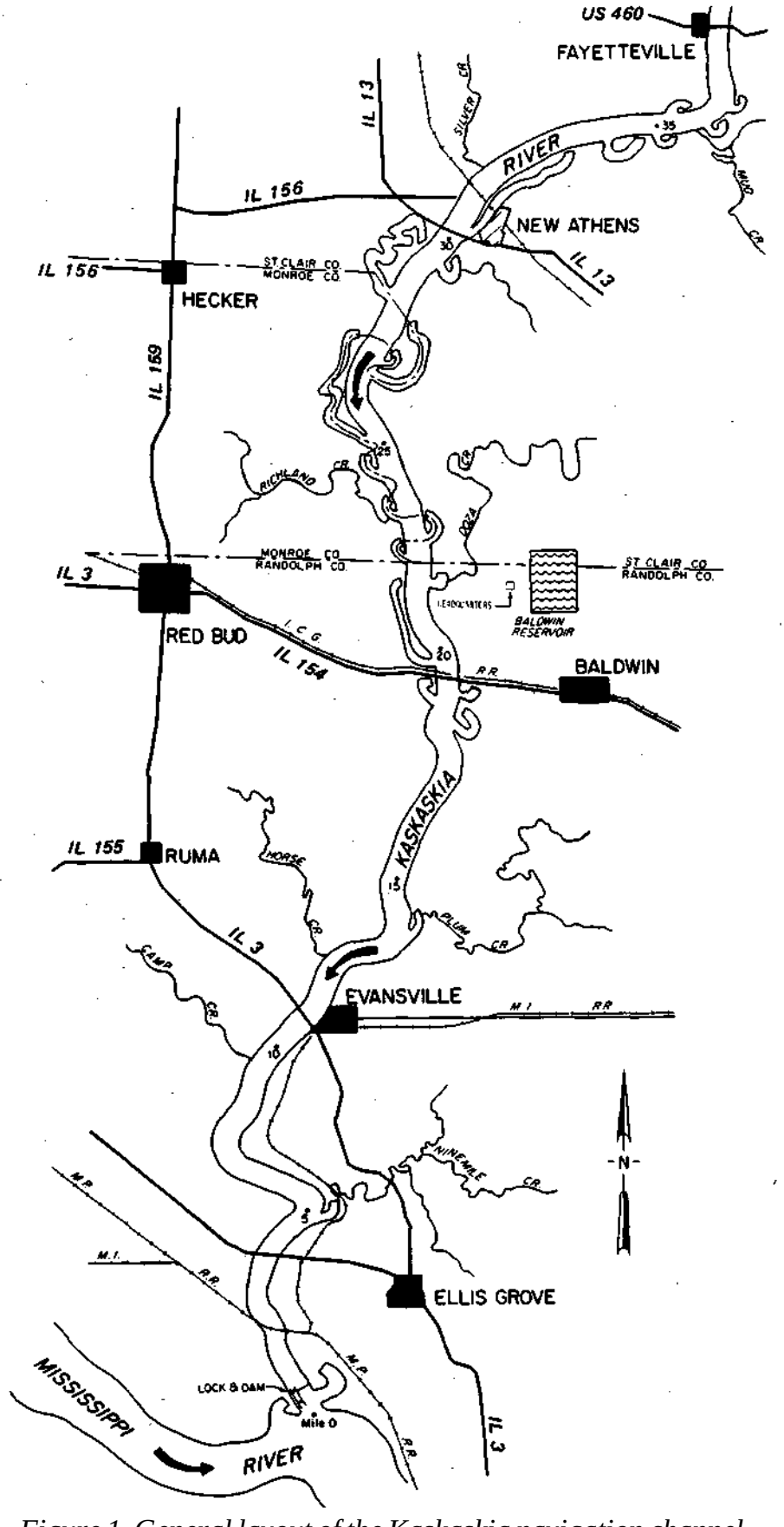


Figure 1. General layout of the Kaskaskia navigation channel

The lock and dam construction began in December 1967. The lock chamber is 600 feet long and 84 feet wide. The lock can be operated up to 29.2 feet of lift (head difference between the navigation pool and the Mississippi levels). The average time required for lockages is approximately 25 minutes. If Mississippi levels are higher than 368.00 feet, the gates are completely opened and vessels pass without locking. Currently there are no restrictions on the passage of non-commercial craft. However, as stated in Senate Document No. 44 (August 14, 1961), lockage of non-commercial crafts may be regulated to hourly lockages, if deemed necessary. The canal was opened to commercial traffic in 1973.

Acknowledgments

This study was jointly supported by the Division of Water Resources (Illinois Department of Transportation) and the Illinois State Water Survey. Siavash Mostoufi of the Division of Water Resources served in a liaison capacity during the course of the study. This report was prepared under the general direction of Richard G. Semonin (Chief) and Michael L. Terstriep (Head of the Surface Water Section), Illinois State Water Survey.

The authors also thank Hank Martin of the U.S. Army Corps of Engineers, St. Louis District, and Leo Fortman, lockmaster at the Kaskaskia Lock and Dam. Their efforts and contributions helped us locate and gather the information about stage records and lockage rates at the Kaskaskia Lock and Dam. Kishore Rajagopalan helped type and compile the data, and Roman Waupotitsch helped prepare the computer programs and the tables.

DATA USED IN THE STUDY

Three types of data were used in the study: 1) hydrological data, which consist of average daily streamflows, average daily evaporations, and daily stages at the Mississippi River; 2) direct water withdrawals from the Kaskaskia River by water supply systems and the Baldwin power plant; and 3) daily lockage and pool elevation records at the lock and dam.

Hydrologic Data

The streamflow gaging stations used in the study are listed in table 1 along with their periods of record. The locations of these tributaries and gaging stations are shown in figure 2 on a drainage map of the lower Kaskaskia basin. Flow records for all these gaging stations were used for generating the flow statistics. However, only four of these gaging stations, which are located downstream of Venedy Station, have been used directly in the model studies. These stations are Kaskaskia River near Venedy Station, Silver Creek near Freeburg, Mud Creek near Marissa, and Richland Creek near Hecker. All the streamflow data were obtained from annual U.S. Geological Survey (USGS) *Water Resources Data* reports.

Table 1. Streamflow Gaging Stations Used in the Study

Station Name	Period of Record	Drainage Area (sq mi)
Kaskaskia River near Venedy Station	10/1938 - 9/1988*	4393
Shoal Creek near Breese	9/1909 - 9/1987	735
Silver Creek near Freeburg	10/1970 - 9/1988	464
Richland Creek near Hecker	10/1969 - 9/1988	129
Crooked Creek near Hoffman	10/1974 - 9/1987	254
Mud Creek near Marissa	10/1970 - 9/1988**	72.4
Little Crooked Creek near New Minden	10/1967 - 9/1988	84.3
Silver Creek near Troy	10/1966 - 9/1987	154
Sugar Creek at Albers	10/1972 - 9/1982	124

* Data for Water Years 1939 through 1969 were simulated by using Carlyle Lake releases and flows at the Kaskaskia River at New Athens.

** Data for Water Years 1985 through 1988 were simulated by using flows at Little Crooked Creek near New Minden.

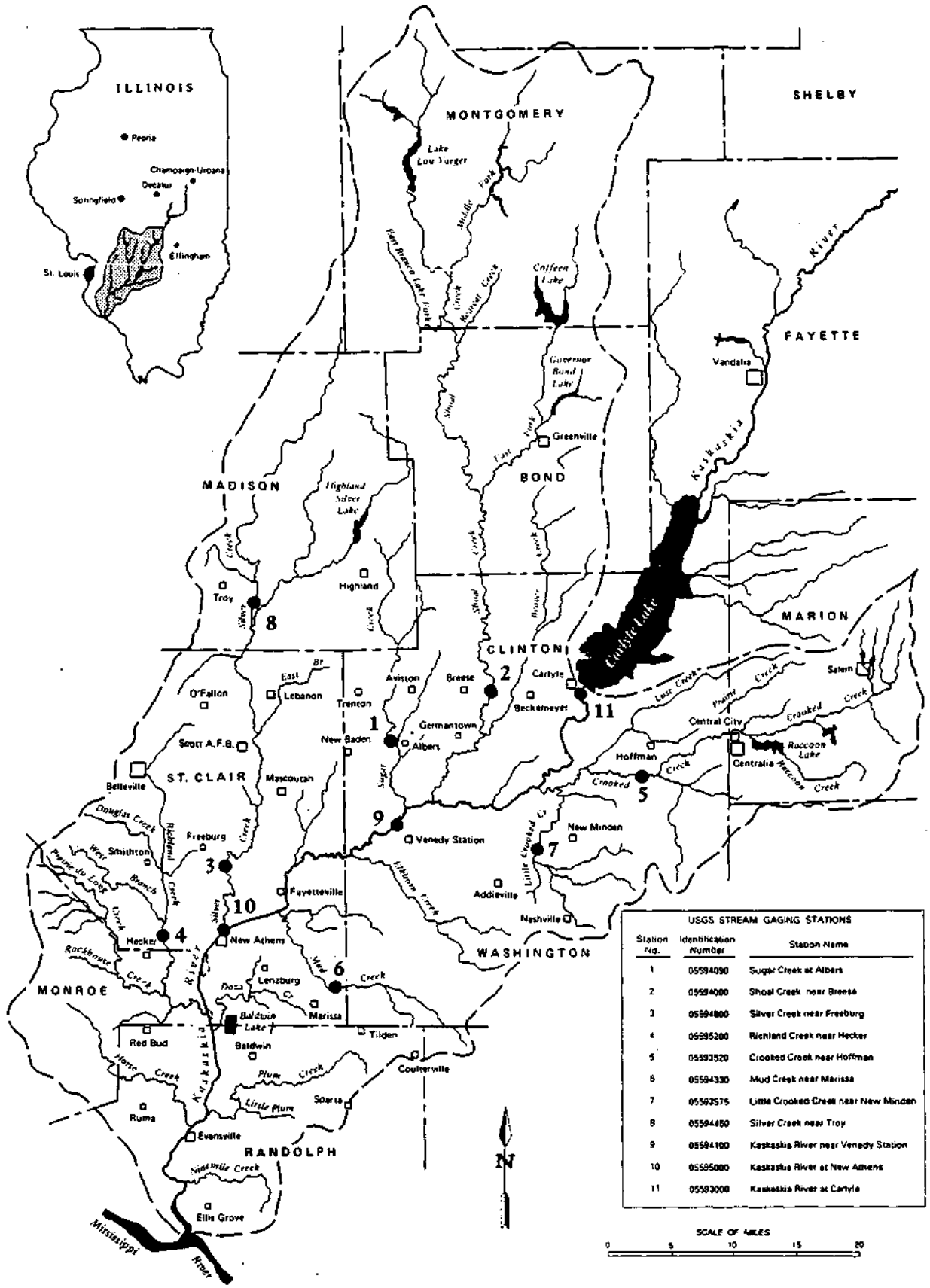


Figure 2. Lower Kaskaskia River basin: major tributaries and gaging stations

Daily evaporation data were needed to determine the evaporation losses from 3,663 acres of water surface. Daily pan evaporation records at Carlyle Lake for the period 1969 through 1988 were used to determine the daily evaporation losses from the navigation pool and the backwaters. Pan evaporation values were converted to actual lake evaporation by using average monthly pan-to-lake evaporation constants (Singh, 1977).

Daily stages for the Mississippi River downstream of the Kaskaskia Lock and Dam were obtained from the U.S. Army Corps of Engineers. The data for 1980 through 1988 were recorded at the lock and dam. Prior data were generated by using the stages at the Mississippi River at Chester, and correlating them to the data recorded at the lock and dam. The relation used for generating the Mississippi stages at the lock and dam from the Chester data is as follows:

$$WL_{L\&D} = ST_{Chester} + 341.05 + 4.66 \quad (1)$$

where

$WL_{L\&D}$ = Mississippi water level elevation at the lock and dam, msl
$ST_{Chester}$ = Mississippi stage at Chester
341.05 = datum at Chester, msl
4.66 = average difference in water elevations at the lock and dam and Chester

Water Withdrawals

Direct withdrawals from the Kaskaskia River for water supply and the Illinois Power Company's Baldwin power plant cooling lake are the two main sources of consumptive water use downstream of Venedy Station. The combined water supply withdrawal downstream of Venedy Station is approximately 5 cfs at the peak demand, with almost 100% consumption during dry periods (Singh et al., 1988, and personal correspondence with the water supply districts). The water supply districts and/or the communities considered here are Evansville, Kaskaskia Water District (New Athens), SLM (St. Clair), and Sparta. Water withdrawals and water returns located upstream of Venedy Station and upstream of any of the gaging stations were not considered because these losses are already considered in the discharges recorded at the gaging station.

The water losses at the Baldwin power plant were estimated by using the data provided by the Illinois Power Company (IPC). IPC provided daily pumpage data at the Baldwin power plant from January 1986 through April 1988 as well as the average monthly return volumes to their ash pond, which eventually flows into the Kaskaskia River (R.E. Schuler, personal communication, May 1988). Based on the available information, the average monthly withdrawal volumes from the Kaskaskia River in million gallons are as follows:

Jan:	696	Feb:	696	Mar:	684	Apr:	486	May:	828	Jun:	1044
Jul:	963	Aug:	1035	Sep:	1008	Oct:	696	Nov:	702	Dec:	693

The average water discharge to the ash pond for the period from January 1986 through July 1987 was approximately 11.6 million gallons per day (mgd), whereas IPC estimates its return flow to the ash pond during summer months as 15 mgd with all three power generating units in operation (J.C. Schmitt, IPC, personal communications, 1987). Some of the water discharged into the 600-acre ash pond is also lost due to evaporation before it reaches the Kaskaskia River, especially during the summer season. Considering all these facts, average monthly consumption (average withdrawal from the Kaskaskia River minus that returned to the river), in millions of gallons, has been assumed to be as follows from May through October:

May	:	700 mg	(35 cfs)
June	:	775 mg	(40 cfs)
July	:	900 mg	(45 cfs)
August	:	800 mg	(40 cfs)
September	:	800 mg	(40 cfs)
October	:	400 mg	(20 cfs)

These are average values derived from a relatively short period of available records. IPC was not able to provide more information regarding their water use at the Baldwin power plant. These average estimates may fluctuate because of varying power demands, air temperature, and pump failure.

Lock and Dam Data

The lock and dam data consist of daily records of lockages performed each day and the daily pool levels near the lock. Daily lockages are needed to determine the amount of water released to the Mississippi River through the operation of the lock. The U.S. Army Corps of Engineers keeps all the records regarding the passage of commercial craft through the lock. However, the Corps does not keep long-term records of lock operation for pleasure boats. The lockage information was therefore obtained from the Kaskaskia Lock and Dam pool and tailwater elevation charts. These are continuous-record charts that show the variation of the water level in the navigation pool just upstream of the lock and the Mississippi water stage just downstream of the lock. Stage charts covering a period of 1981 through 1988 (partial) were analyzed to determine the total number of times the lock chamber was filled. This was indicated on the pool-stage charts by a surge, generated every time the valves were opened to fill the lock chamber. The observed pool and Mississippi River elevations,

and the actual lockage data at the Kaskaskia Lock and Dam, have been illustrated in figure 3 for the years 1986 through 1988.

The latter part of the historical lockage data (1984-1988) was used to develop the weekly and monthly variations of lockage traffic during the months May through October, dating back to 1970. This information was then augmented with the available lockage data. Weekdays and weekends (including holidays) were handled separately because of the significant variation in the number of lockages between them. The pool and Mississippi River elevations, and the augmented lockage series for the last three years, are illustrated in figure 4.

The average daily pool levels are compiled from the Corps data, either as continuous charts or in digital form. The difference between the pool and the Mississippi River elevations downstream of the lock and dam is used in estimating the volume of water released from the navigation pool by each lockage. For most practical purposes, pool elevations can be considered to be constant at 368.00 feet for normal operations, provided that Mississippi levels are lower. If the Mississippi levels rise above 368.00 feet msl, no lock operation is needed.

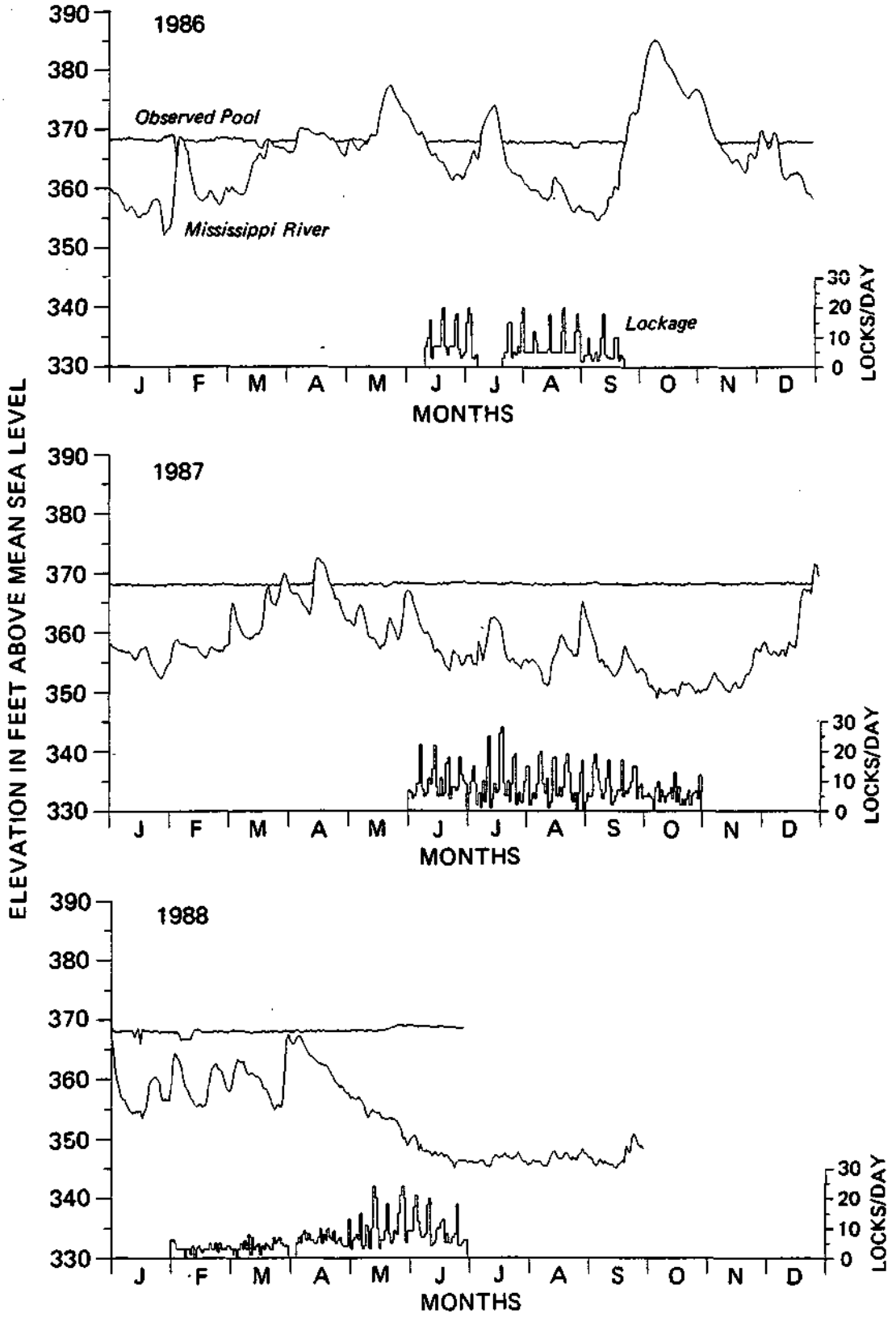


Figure 3. Observed pool and Mississippi River water elevations, with actual lockage data

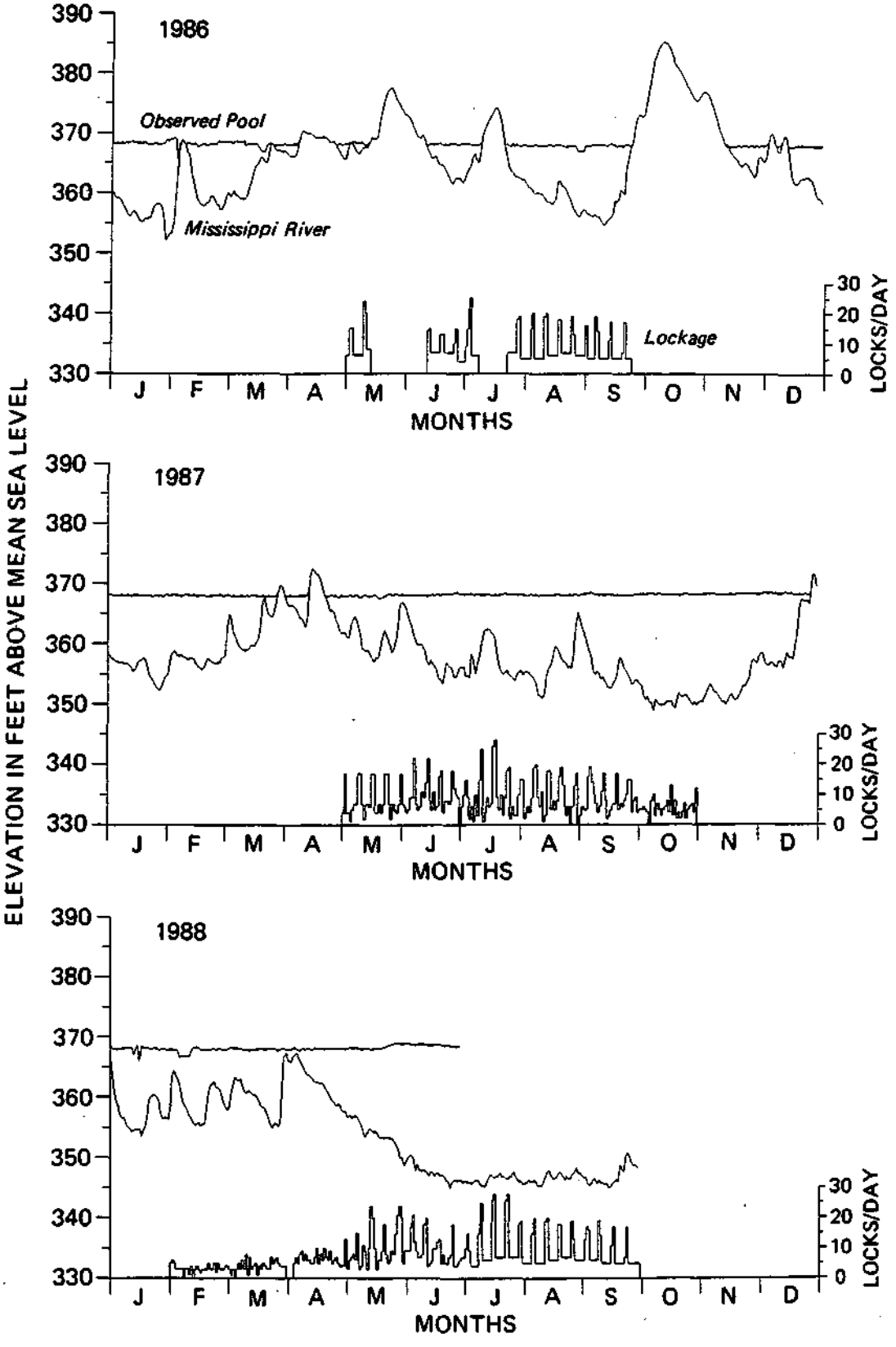
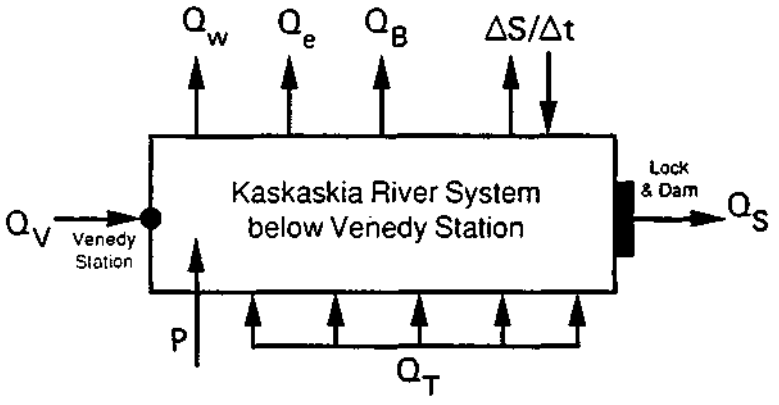


Figure 4. Observed pool and Mississippi River water elevations, with augmented lockage series

BASIN MODEL

A basin model has been developed to simulate the daily water balance for the lower Kaskaskia River system below Venedy Station by using daily streamflows at Venedy, tributary flows, evaporation from the navigation pool and the backwaters, withdrawals by water supply systems and the Baldwin power plant, and spills into the Mississippi River through the lock and dam. A schematic system configuration and the variables used in the model are shown below:



where

Q_V	= daily streamflows at Kaskaskia River at Venedy Station
Q_w	= consumptive water withdrawals by water supply systems
Q_e	= evaporation loss from the navigation pool and other water surfaces
Q_B	= consumptive water use by the Baldwin power plant
Q_T	= tributary inflow, or natural inflow from 1,408 sq mi of drainage area
Q_S	= water available for lockages and other spills
P	= precipitation on the navigation pool and backwater surfaces
$\Delta S/\Delta t$	= rate of change in pool storage due to change in pool stage

A water-balance equation has been used to estimate the daily water budget in the form of

$$Q_S = Q_V + Q_T + P - Q_w - Q_e - Q_B - \frac{\Delta S}{\Delta t} \quad (2)$$

where

$$\frac{\Delta S}{\Delta t} = \frac{h_p(t) - h_p(t-1)}{\Delta t} A_w \quad (3)$$

and $h_p(t)$ and $h_p(t\text{-}1)$ are the navigation pool stages at times t and (t-1), respectively, At is the time difference between t and (t-1), and A_w is the water-surface area of the pool.

The model was used in the daily operation mode to simulate the water budget within the Kaskaskia River system below Venedy Station. The time lag among the streamflows at Venedy Station (Qv), tributary inflows downstream of Venedy Station (Q_T), and spills at the lock and dam (Qs) was assumed to be negligible. Otherwise a flow-routing algorithm would have been needed to correlate the flows at the lock and dam to the flows at Venedy Station and the tributaries. Developing such an algorithm would be difficult because of inadequate gaging on the Kaskaskia River below Venedy Station. However, there are reasons to support the zero time-lag assumption. First, the purpose of using this model is to estimate the deficits and surpluses in the water budget over a 15-day period or longer, where time lags of one to three days would not affect the overall results. Secondly, during low-flow conditions, the river flow varies only slightly.

It is assumed in the model that under normal operating conditions any surplus water would be spilled over the dam to maintain the pool levels at a designated elevation. Surplus water would be generated if the amount of water released by lockages (Q_L) is less than Q_S. However, if $Q_L > Q_S$, then a deficit day would be observed and the pool level. would fall corresponding to the deficit amount ($Q_L - Q_S$). A deficit day has been defined in this study as any day where $Q_L > Q_S$, or $\Sigma(Q_L - Q_S)$ is positive. Duration of deficit is the number of consecutive days when $\Sigma(Q_L - Q_S)$ is positive. In other words, a deficit period starts when the pool level drops below its normal level (i.e., 368.00 feet msl), regardless of what elevation it has been operated at, and continues until the pool level returns to normal elevation. The value of Q_L has been calculated as follows:

$$Q_L = NL \times [h_p(t) - h_M(t)] \times C \qquad (4)$$

where

NL = number of lockages per day
$h_p(t)$ = pool elevation at time t
$h_M(t)$ = Mississippi River elevation at time t
C = conversion coefficient for the lock chamber for calculating Q_L

GENERATING TOTAL TRIBUTARY INFLOWS (Q_T)

Three tributary gaging stations cover approximately 50% of the total drainage area downstream of Venedy Station. These stations are Silver Creek near Freeburg, Mud Creek near Marissa, and Richland Creek near Hecker. An algorithm was needed to generate the total tributary inflows, Q_T, to the system. The total system inflow into the Kaskaskia River system below Venedy Station was estimated by using the historical streamflow records of these three tributary gaging stations and the Venedy Station flows. The total drainage area below Venedy Station was divided into four hydrologically similar regions, which are shown in figure 5. These regions are represented by the three gaging stations listed above and by one tributary gaging station located outside the region. These gaging stations do not need to be within the boundaries of the region insofar as they represent similar basin hydrologic conditions. For example, Region 1 is represented by Little Crooked Creek near New Minden, which lies outside the region. The total daily flows generated within a particular region are related to the daily flows recorded at the gaging station designated for that region.

Region 1 covers 105.7 sq mi just downstream of Venedy Station and mainly drains Elkhorn Creek. There are no gaging stations within this region; therefore streamflow records at Little Crooked Creek near New Minden were used for generating inflows from Region 1. Region 2 is 372.1 sq mi and includes the drainage basins of Mud Creek, Doza Creek, Plum Creek, and Ninemile Creek. Streamflows at Mud Creek near Marissa were used for generating inflows from Region 2. Region 3 covers 534.3 sq mi, which is mostly the Silver Creek basin. Inflows from Region 3 were generated by using streamflows at Silver Creek near Freeburg. Region 4 is 395.9 sq mi and includes the basins for Richland Creek and Horse Creek. Inflows from Region 4 were estimated by using streamflows at Richland Creek near Hecker.

The procedure used in this study for generating the inflows from these regions was based on the assumption that the flow-duration profiles of these regions and the gaging stations representing them would be similar. Flow duration is the percent of time a flow value is equaled or exceeded. Flow-duration profiles were developed for eight tributary gaging stations inside the Kaskaskia River basin below Carlyle Dam for establishing discharge versus drainage area relations for several flow-duration values. The relation of flow duration versus drainage area has been shown by other studies (Singh et al., 1986a, 1986b). The relation used in this study is of the following form:

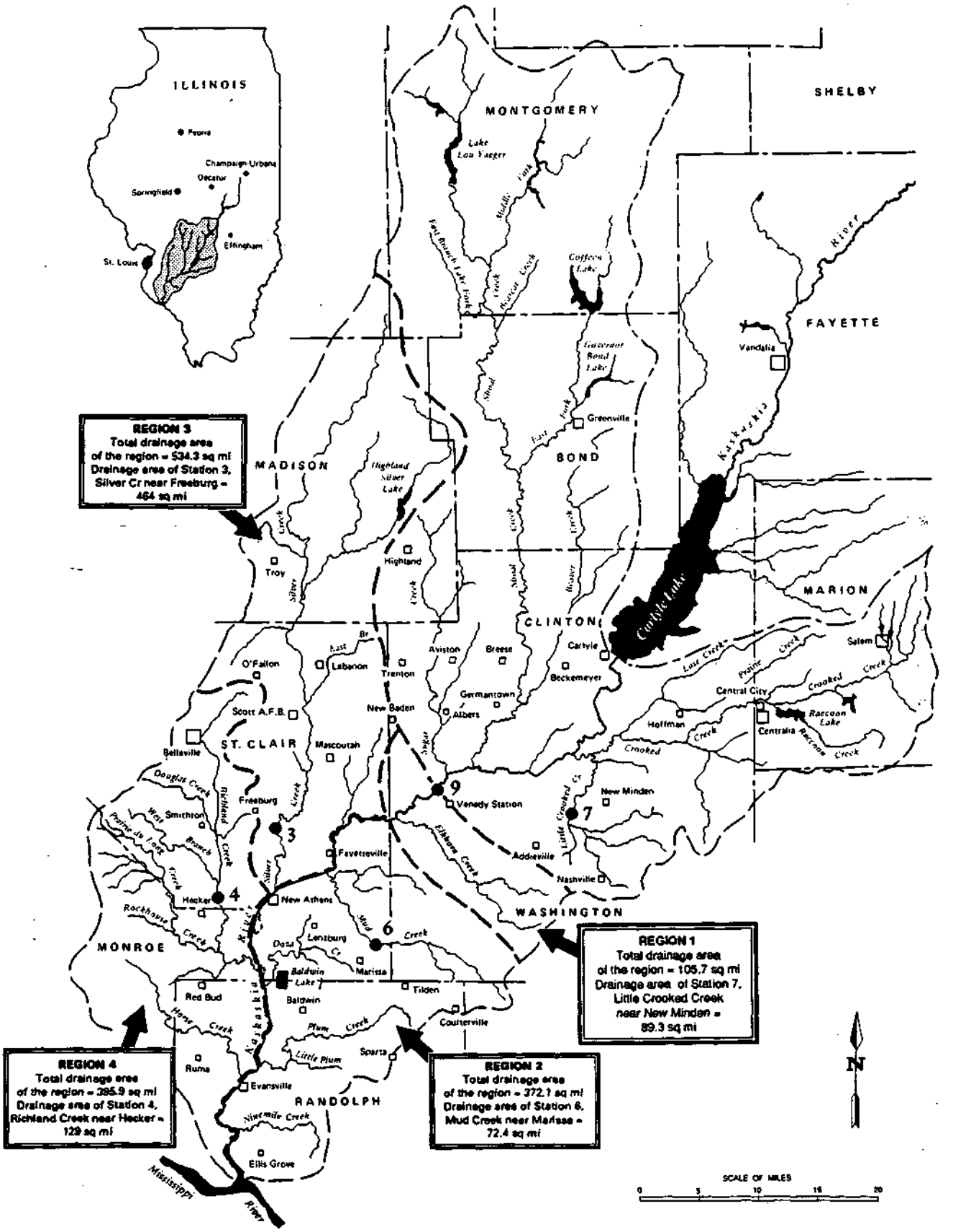


Figure 5. Division of the Kaskaskia River basin below Venedy Station into four hydrologically similar regions

$$Q_p = \alpha_p A^{b_p} \quad (5)$$

$$\log(Q_p) = a_p + b_p \log(A) \quad (6)$$

where

Q_p = discharge at flow duration p (in percent) for a particular gaging station
a_p = log (α_p)
a_p, b_p = regression coefficients for flow duration p
A = drainage area for the gaging station

Therefore a discharge value that is equaled or exceeded 90% of the time would be indicated by Q_{90} (p = 90%), and the corresponding regression coefficients would be a_{90} and b_{90}. Because some of the tributaries had net constant effluents or losses due to wastewater treatment outfalls and industrial water uses, these values were removed or added to the total raw streamflow values before the regression coefficients were determined. The flow-duration values and regression coefficients are shown in table 2 for all the tributary stations within the Kaskaskia River basin below Carlyle Dam. The regression lines of flow versus drainage area for selected flow durations are shown in figure 6.

It is assumed that the flow-duration profile of a region is similar to the flow-duration profile at the gaging station. Therefore the flow-duration coefficients a_p and b_p that were generated for the gaging station can be used for estimating the inflows from a region represented by that gaging station. The only question here is which flow-duration value should be used for a particular day for generating the daily inflow from the region. Relying on the assumption of homogeneity of the region, it is reasonable to believe that for a given day both the region and its designated gaging station would have the same flow-duration values (probability of exceedance). We can therefore say that the inflow from a region is

$$\log(Q_p^*) = a_p + b_p + \log(A^*) \quad (7)$$

where

Q_p = inflow from a region for flow duration p
a_p, b_p = regression coefficients (see table 2)
A^* = total drainage area of a region

Combining equations 6 and 7 by eliminating a_p, and transforming, we get

$$Q_p^* = Q_p \left[\frac{A^*}{A}\right]^{b_p} \quad (8)$$

or, by generalizing equation 8 to all regions:

Table 2. Flow-Duration Values and Regression Coefficients for the Tributaries of the Kaskaskia River below Carlyle Dam

Flow Duration (%)	Stations 1	2	3	4	5	6	7	8	Regression Coefficients b	a
99	0.4	1.1	2.8	5.6	2.5	0.0	0.0	0.1	1.607	-4.196
98	0.5	3.6	3.8	6.2	3	0.0	0.0	0.2	1.734	-4.259
97	0.5	5.4	4.3	6.5	3.2	0.0	0.0	0.2	1.922	-4.654
96	0.5	6.6	4.8	7	3.4	0.0	0.0	0.2	1.877	-4.449
95	0.6	7.7	5.2	7	3.7	0.0	0.1	0.3	1.966	-4.615
94	0.7	8.8	5.8	7.4	4	0.0	*01*	0.4	1.907	-4.393
93	0.8	9.6	6.2	7.7	4.3	0.0	0.1	0.4	1.895	-4.316
92	0.8	10	6.8	8	4.5	0.0	0.2	0.4	1.734	-3.871
91	1	11	7.4	8	4.8	0.0	0.2	0.5	1.731	-3.815
90	1	12	7.9	8.4	5	0.0	0.2	0.6	1.732	-3.777
85	1.4	17	10	9.6	6	0.0	0.4	0.9	1.587	-3.263
80	1.9	22	14	11	7.3	0.0	0.6	1.6	1.517	-2.939
75	2.4	30	18.5	12	8.6	0.0	0.9	2.6	1.489	-2.743
70	3	38	24	14	10	0.1	1.2	4	1.989	-3.897
65	3.9	49	31	16	12	0.3	1.7	5.8	1.798	-3.298
60	4.9	61.6	40	18	14	0.6	2.3	8	1.694	-2.931
55	5.9	79	50	21	17	1	3	11	1.636	-2.678
50	7.1	100	61	25	20	2	4	14	1.528	-2.310
45	9.7	128	78	30	25	3	5.4	19	1.479	-2.075
40	13	164	100	35	32	5	7.1	25	1.423	-1.822
35	17	220	130	42	42	8	9.3	32	1.394	-1.631
30	24	300	175	50	56	12	13	42	1.374	-1.451
25	33	407	238.5	64	78	18	19	56.5	1.346	-1.245
20	47	553	364.4	84	112	27	30	85	1.322	-1.026
15	70	773.6	589	118	200	42.4	50	146.5	1.301	-0.777
10	147.8	1340	975.2	200	419.2	69.3	125	294	1.233	-0.342
9	184.3	1580	1049.8	239.2	500	75.4	157.3	327.7	1.217	-0.237
8	212	1850	1160	291.3	631.3	821	200	391.2	1.209	-0.147
7	300	2143.7	1320	3411	800	93	241.3	445.2	1.192	-0.O29
6	396	2459.2	1500	405.5	1071.2	112.5	300	512	1.162	0.123
5	500	2780	1691	514	1450	153.2	370	606	1.102	0.350
4	678.4	3130	2000	701.3	1800	221.7	500	763	1.003	0.684
3	952.4	3557.3	2336.6	976.6	2100	380.7	645.8	986.9	0.868	1.106
2	1420	4430	3200.8	1311.6	2560.8	562.3	917.5	1250	0.808	1.374
1	2094	6595.5	4404.4	2125.8	3390	912.2	1372.5	1993	0.758	1.662
Q_m	101.1	533.9	388.6	151.6	221.2	242.2	112.2	122.1		
Area (sq mi)	124	735	464	129	254	72.4	84.3	154		
Period of Record	'72-'82	'46-'86	'70-'88	'69-'88	'74-'87	'70-'88	'67-'88	'66-'87		
C_q	-0.2	+0.7	-1.0	-6.5	-1.8	0	0	0		

Notes:

Q_m: Average flow in cfs

C_q: (-) indicates effluent; (+) indicates net municipal and industrial water loss

All flows are in cfs

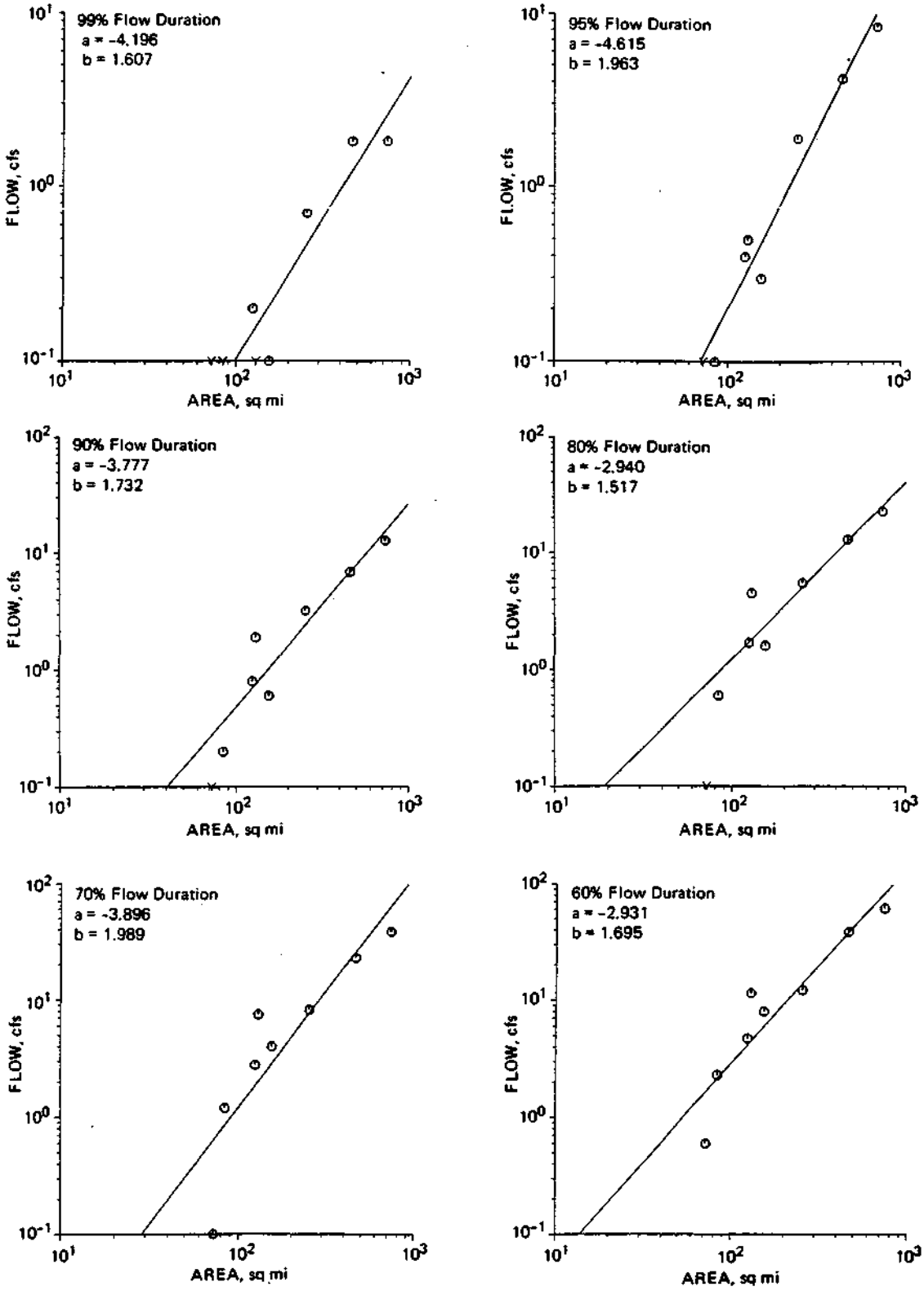


Figure 6. Relation between flow and drainage area for various flow durations

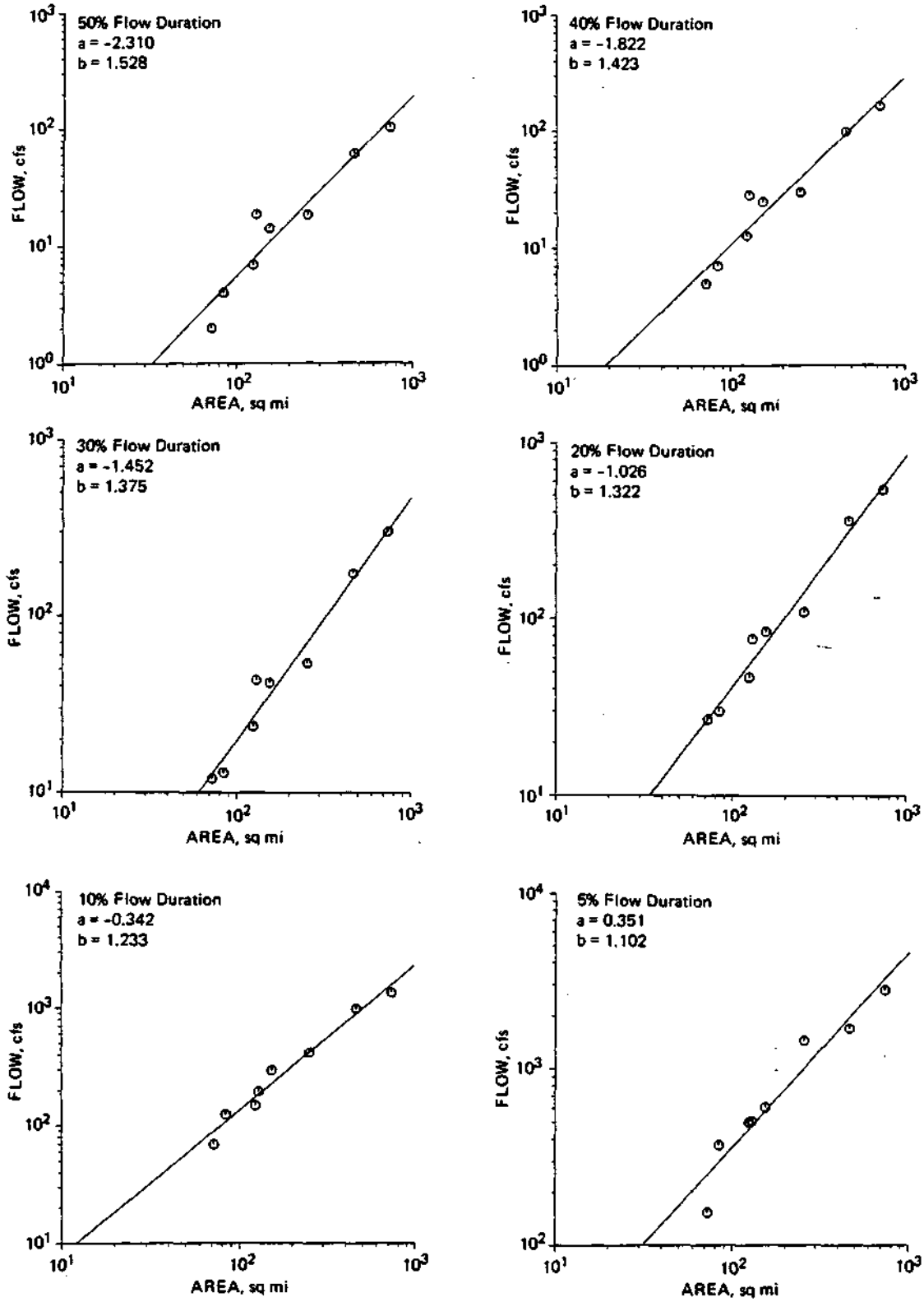


Figure 6. Concluded

$$Q^*_{i,p} = Q_{i,p} \left[\frac{A_i^*}{A_i} \right]^{b_p} \quad (9)$$

where i = 1, 2 , 3, 4 indicates the regions; and subscripts i and p indicate the flow duration p for region i. A_i^*/A_i is the ratio of the total drainage area of the region to the drainage area of its designated gaging station.

The total inflow from the total drainage area below Venedy is merely the sum of all inflows from these four regions:

$$Q_T = \sum_{i=1}^{4} Q^*_{i,p} \quad (10)$$

The flow-duration value p for any particular day was determined by using the historical daily flows of the designated gaging stations and the information given in table 2. Three of the gaging stations (Silver Creek near Freeburg, Little Crooked Creek near New Minden, and Richland Creek near Hecker) used for generating Q_T had continuous streamflow records from Water Years 1971 through 1988. However, Mud Creek near Marissa was discontinued after Water Year 1983. The flows at Mud Creek near Marissa after 1983 were generated by assuming that Mud Creek near Marissa and Little Crooked Creek near New Minden should have similar flow-duration profiles. Therefore, daily flows at Mud Creek near Marissa after 1983 were estimated from table 2 by 1) finding the flow duration corresponding to the historical daily flow at Little Crooked Creek near New Minden; and 2) finding the flow value corresponding to the same flow duration for Mud Creek near Marissa. Any flow-duration value that falls within two table entries has been interpolated.

Flow-duration values for Venedy Station along with the total system flows (Q_T + Qv) are listed in table 3. These values may be used for estimating approximate system flows based on flows observed at Venedy Station, assuming that the flow-duration properties of both series should be similar (as was assumed in generating the Mud Creek flows after 1983). Although this approach cannot be used for generating accurate daily flows, as can the method that uses historical daily tributary flows, it may be useful for estimating total system inflows when tributary flows are not available. The future system flows may be generated by using the regression between $Q_V + Q_T$ and Q_V (figure 7) with the addition of a random component.

Table 3. Flow Durations for a) Kaskaskia River Near Venedy Station (Water Years 1938 -1988) and b) System Inflow (Water Years 1970 -1988)

a) Venedy Station

Mean Flow = 3324.2 cfs

Flow Duration(%)	Q	Flow Duration(%)	Q	Flow Duration (%)	Q
99.0	68.0	75.0	330.0	15.0	6970.0
98.0	74.0	70.0	466.0	10.0	9310.0
97.0	80.0	65.0	679.3	9.0	9790.2
96.0	84.0	60.0	900.0	8.0	10329.2
95.0	88.0	55.0	1199.0	7.0	10935.7
94.0	93.0	50.0	1560.0	6.0	11560.1
93.0	97.0	45.0	2014.3	5.0	12397.0
92.0	102.0	40.0	2420.0	4.0	13239.6
91.0	108.0	35.0	3090.0	3.0	14420.4
90.0	115.0	30.0	3839.0	2.0	16400.0
85.0	156.0	25.0	4520.5	1.0	20104.3
80.0	222.0	20.0	5460.0		

Mean flow = 3324.2 cfs occurs at 33.44 % flow duration

b) System Inflow

Mean Flow = 4949.7 cfs

Flow Duration (%)	Q	Flow Duration (%)	Q	Flow Duration (%)	Q
99.0	93.0	75.0	641.0	15.0	10511.3
98.0	104.0	70.0	892.5	10.0	13030.5
97.0	115.0	65.0	1188.8	9.0	13809.0
96.0	127.0	60.0	1579.0	8.0	14727.0
95.0	136.0	55.0	2019.8	7.0	15756.8
94.0	147.0	50.0	2516.0	6.0	16834.5
93.0	159.0	45.0	3160.5	5.0	18287.8
92.0	175.0	40.0	3812.0	4.0	20103.0
91.0	194.0	35.0	4343.8	3.0	22095.3
90.0	210.5	30.0	5041.5	2.0	25366.0
85.0	319.0	25.0	6178.3	1.0	31756.0
80.0	473.0	20.0	7889.0		

Mean flow = 4949.7 cfs occurs at 30.66 % flow duration

Note: Q is flow in cfs

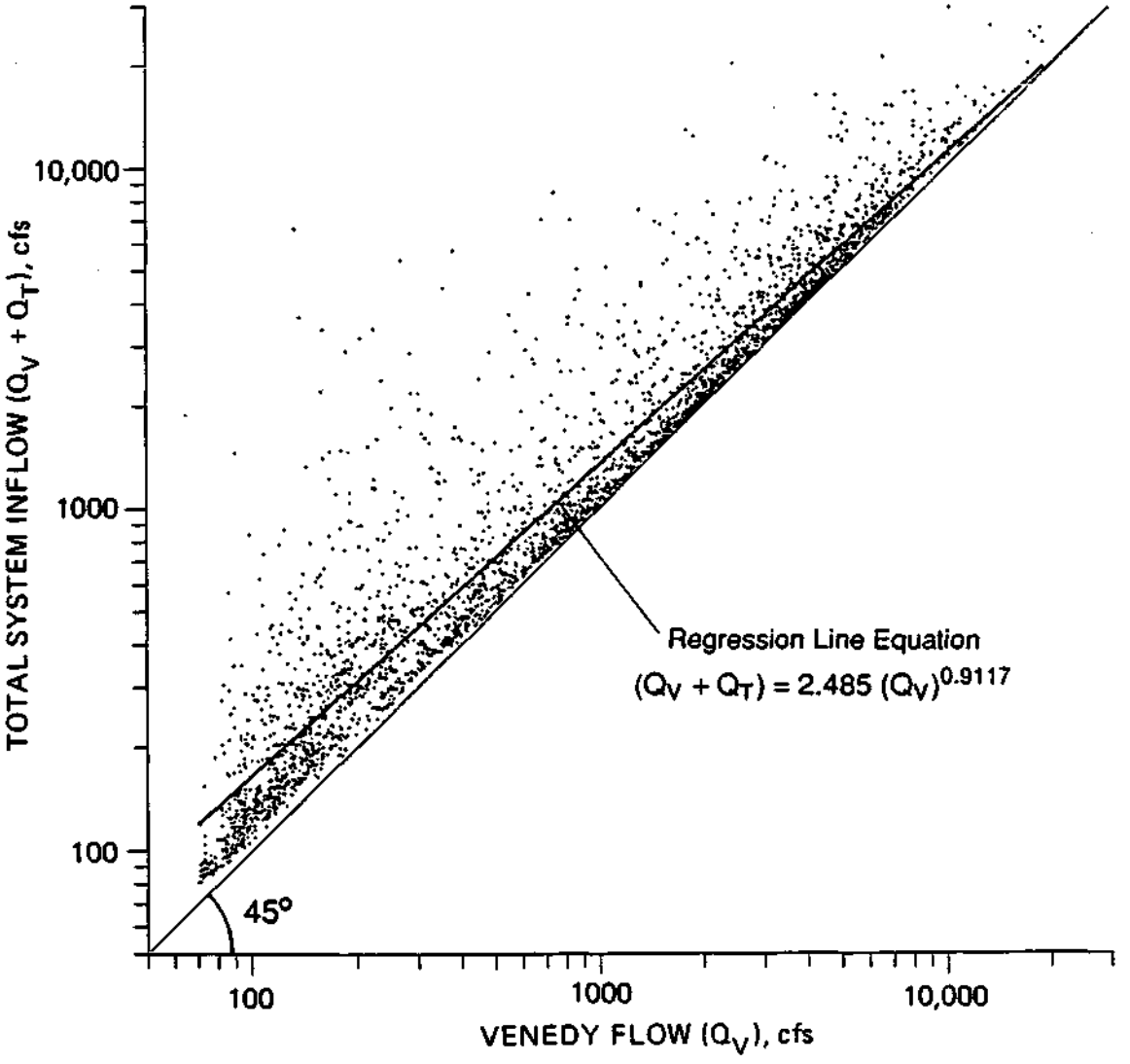


Figure 7. Relation between total system inflows ($Q_V + Q_T$) and Venedy flows (Q_V) for the period 1971-1988

LOW-FLOW STATISTICS

Low-flow statistics are needed to analyze the impacts of sustained low-flow periods on the design and operation of storage reservoirs. Low-flow values also provide information on average deficit or surplus flow available for the particular duration for which they are generated, and the percentage of years or days during which these low-flow events occur. The severity of a drought, for example, is usually indicated by its magnitude and duration. If sufficiently long records are available, an expected return period (or recurrence interval) for such an event can also be estimated.

Low-flow values were developed for the Kaskaskia River near Venedy Station as well as for the total system inflows (flow at Venedy Station plus tributary flows downstream of Venedy Station). Flows at Venedy Station prior to 1969 were generated by using the historical flows at Carlyle and New Athens (now discontinued) in conjunction with the operation policies of Carlyle Lake (Knapp, in preparation). Simulated flows at Venedy Station were needed because the available historical streamflow records were not long enough for classifying the results of model studies beyond a 20-year recurrence interval, and thus could have been biased. Low-flow distributions of the total system inflows were used to determine the years corresponding to the worst low-flow conditions, for several durations. The expected low-flow recurrences of the system inflows for the indicated years were then estimated from the low-flow distributions of the flows at Venedy Station.

The distributions of 1-, 3-, 7-, and 15-day low flows among the months of the year, and the monthly values for 2-, 5-, 10-, and 25-year recurrence intervals, are given in table 4 for Venedy Station. The same monthly low-flow distributions, and the values for 2-, 5-, and 10-year recurrence intervals, are given in table 5 for total system inflows. Distributions of low flows ranging from 7 days to 6 months (7 days, 15 days, and 1, 2, 3, 4, 5, and 6 months) have also been developed for Venedy Station and total system inflows for the period May through October. These statistics and their 2-, 5-, 10-, and 25-year recurrence intervals are given in table 6 for Venedy Station. The same statistics and their 2-, 5-, 10-, and 19-year recurrence intervals are given in table 7 for total system inflows. Low-flow distributions with durations of 1 month or longer are very useful in analyzing the effects of droughts on water resources systems, because they show the expected cumulative availability of water over an extended period of time, as well as the expected frequency of occurrence of such events.

Analysis of low flows for each month for Venedy Station and system flows clearly indicates that the lowest flows for all durations usually occur during June through November. Therefore water budget analyses of the Kaskaskia River system below Venedy

Station were conducted for the period May through October. Although May is not statistically a low-flow month, including it in the analysis provides a full initial storage. Also the heavy pleasure-craft traffic during Memorial Day weekend is not excluded from the analysis. November was not included in the analysis because recreational lockages are quite low during this month.

Table 4. Monthly Low-Flow Statistics for Kaskaskia River near Venedy Station
(Water Years 1939 -1988)

1 -DAY LOW FLOWS IN CFS

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1939	63	92	284	337	6248	7248	1872	733	508	541	341	180
1940	94	91	90	72	90	545	172	790	535	95	92	67
1941	49	61	94	156	124	100	92	136	144	137	76	92
1942	57	3583	2446	741	4395	3332	1572	1040	872	6587	352	171
1943	127	681	2787	1385	1153	729	417	1115	9606	2026	124	99
1944	77	93	80	65	108	1109	518	4421	1297	145	98	83
1945	70	68	77	64	104	2322	8872	3819	2846	1739	190	84
1946	689	696	567	1627	1550	2246	229	386	1554	596	614	219
1947	143	802	2729	2262	923	895	1946	5744	3307	595	215	129
1948	76	257	308	424	324	2098	4463	2450	600	1367	221	113
1949	89	365	1926	6174	8972	5509	1196	714	583	549	253	183
1950	167	521	2227	12396	12356	10445	4679	1032	1154	812	346	436
1951	292	256	2409	909	1072	4128	3281	867	643	2310	258	285
1952	150	420	2608	2165	1824	1514	4831	953	967	380	123	116
1953	83	81	114	122	154	363	454	417	160	94	88	75
1954	66	66	58	58	67	56	77	50	65	64	30	65
1955	84	88	87	140	128	785	618	631	751	662	83	56
1956	136	278	334	94	117	962	147	555	541	732	290	113
1957	71	56	608	244	950	1192	903	8029	6057	1265	2026	165
1958	122	312	537	1247	839	1510	1145	1032	942	1286	4592	369
1959	249	172	2348	611	2742	4842	1219	865	383	135	127	109
1960	136	127	731	730	1221	703	2594	1292	1854	1001	162	101
1961	94	109	134	122	109	918	734	3585	1850	301	299	134
1962	149	301	2383	2456	7520	7491	1270	1365	978	546	278	94
1963	101	136	162	100	90	125	625	655	409	284	187	104
1964	81	75	71	74	332	320	1087	647	375	131	95	75
1965	61	52	91	101	452	505	87	481	544	189	93	118
1966	137	209	187	436	420	1045	261	2683	479	159	123	100
1967	117	78	2797	585	1409	1359	247	407	563	205	256	144
1968	133	127	636	7588	7226	1748	779	258	4244	372	574	144
1969	344	211	226	1008	9653	2392	2815	1004	508	3863	351	265
1970	388	2560	740	350	3070	1520	424	6090	4300	1580	101	56
1971	180	112	198	1250	1100	3100	210	195	163	131	376	100
1972	83	86	98	3620	4120	730	364	2500	210	235	235	377
1973	360	705	4100	5640	9000	5500	7080	4910	4820	5070	3630	1710
1974	287	335	3180	5240	8580	10800	4000	2540	4790	4360	4270	2950
1975	1560	1210	1340	2200	4500	3610	1990	837	450	382	131	304
1976	604	608	1300	846	945	2430	473	143	93	74	86	71
1977	70	79	84	70	70	983	829	251	120	154	140	132
1978	977	1220	2680	1020	350	530	4350	1260	1610	1550	1080	154
1979	95	378	607	1000	400	11200	10900	2320	1920	165	3300	222
1980	111	506	237	350	200	1300	1590	238	309	140	102	177
1981	72	213	313	97	120	145	120	189	2140	1980	1280	1570
1982	286	916	603	1310	8560	11500	1660	144	3090	2860	430	450
1983	565	752	5400	4320	1230	1030	4840	3490	2910	3130	489	95
1984	82	525	8140	3690	4090	6830	5520	3700	3510	788	127	113
1985	162	1853	3540	5784	2050	8941	10312	422	250	360	211	95
1986	82	98	4710	2370	2660	1380	196	138	191	273	97	95
1987	381	406	1180	1140	980	551	279	149	94	722	138	86
1988	82	85	864	6870	7230	2000	879	127	84	92	120	82

Table 4. Continued

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1.96	51.00	49	52	58	58	67	56	77	50	65	64	30	56
3.92	25.50	57	56	71	64	70	100	87	127	84	74	76	56
5.88	17.00	61	61	77	65	90	125	92	136	93	92	83	65
7.84	12.75	63	66	80	70	90	145	120	138	94	94	86	67
9.80	10.20	66	68	84	72	104	320	147	143	120	95	88	71
11.76	8.50	70	75	87	74	108	363	172	144	144	131	92	75
13.73	7.29	70	78	90	94	109	505	196	149	160	131	93	75
15.69	6.38	71	79	91	97	117	530	210	189	163	135	95	82
17.65	5.67	72	81	94	100	120	545	229	195	191	137	97	83
19.61	5.10	76	85	98	101	124	551	247	238	210	140	98	84
21.57	4.64	77	86	114	122	128	703	261	251	250	145	101	86
23.53	4.25	81	88	134	122	154	729	279	258	309	154	102	92
25.49	3.92	82	91	162	140	200	730	364	386	375	159	120	94
27.45	3.64	82	92	187	156	324	785	417	407	383	165	123	95
29.41	3.40	82	93	198	244	332	895	424	417	409	189	123	95
31.37	3.19	83	98	226	337	350	918	454	422	450	205	124	95
33.33	3.00	83	109	237	350	400	962	473	481	479	235	127	99
35.29	2.83	84	112	284	350	420	983	518	555	508	273	127	100
37.25	2.68	89	127	308	424	452	1030	618	631	508	284	131	100
39.22	2.55	94	127	313	436	839	1045	625	647	535	301	138	101
41.18	2.43	94	136	334	585	923	1109	734	655	541	360	140	104
43.14	2.32	95	172	537	611	945	1192	779	714	544	372	162	109
45.10	2.22	101	209	567	730	950	1300	829	733	563	380	187	113
47.06	2.13	111	211	603	741	980	1359	879	790	583	382	190	113
49.02	2.04	117	213	607	846	1072	1380	903	837	600	541	211	113
50.98	1.96	122	256	608	909	1100	1510	1087	865	643	546	215	116
52.94	1.89	127	257	636	1000	1153	1514	1145	867	751	549	221	118
54.90	1.82	133	278	731	1008	1221	1520	1196	953	872	595	235	129
56.86	1.76	136	301	740	1020	1230	1748	1219	1004	942	596	253	132
58.82	1.70	136	312	864	1140	1409	2000	1270	1032	967	662	256	134
60.78	1.65	137	335	1180	1247	1550	2098	1572	1032	978	722	258	144
62.75	1.59	143	365	1300	1250	1824	2246	1590	1040	1154	732	278	144
64.71	1.55	149	378	1340	1310	2050	2322	1660	1115	1297	788	290	154
66.67	1.50	150	406	1926	1385	2660	2392	1872	1260	1554	812	299	165
68.63	1.46	162	420	2227	1627	2742	2430	1946	1292	1610	1001	341	171
70.59	1.42	167	506	2348	2165	3070	3100	1990	1365	1850	1265	346	177
72.55	1.38	180	521	2383	2200	4090	3332	2594	2320	1854	1286	351	180
74.51	1.34	249	525	2409	2262	4120	3610	2815	2450	1920	1367	352	183
76.47	1.31	286	608	2446	2370	4395	4128	3281	2500	2140	1550	376	219
78.43	1.27	287	681	2608	2456	4500	4842	4000	2540	2846	1580	430	222
80.39	1.24	292	696	2680	3620	6248	5500	4350	2683	2910	1739	489	265
82.35	1.21	344	705	2729	3690	7226	5509	4463	3490	3090	1980	574	285
84.31	1.19	360	752	2787	4320	7230	6830	4679	3585	3307	2026	614	304
86.27	1.16	381	802	2797	5240	7520	7248	4831	3700	3510	2310	1080	369
88.24	1.13	388	916	3180	5640	8560	7491	4840	3819	4244	2860	1280	377
90.20	1.11	565	1210	3540	5784	8580	8941	5520	4421	4300	3130	2026	436
92.16	1.09	604	1220	4100	6174	8972	10445	7080	4910	4790	3863	3300	450
94.12	1.06	689	1853	4710	6870	9000	10800	8872	5744	4820	4360	3630	1570
96.08	1.04	977	2560	5400	7588	9653	11200	10312	6090	6057	5070	4270	1710
98.04	1.02	1560	3583	8140	12396	12356	11500	10900	8029	9606	6587	4592	2950
25-yr	flow	57	56	71	64	71	101	87	128	85	75	76	57
10-yr	flow	66	69	84	72	104	325	150	143	123	99	88	71
5-yr	flow	76	85	101	106	125	584	250	241	219	141	99	84
2-yr	flow	120	235	608	878	1086	1446	997	851	622	544	213	115

Table 4. Continued

3-DAY LOW FLOWS IN CFS

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1939	70	94	288	342	6587	7667	2080	756	523	589	603	185
1940	95	91	90	85	90	557	209	815	606	105	93	69
1941	59	61	152	160	127	101	96	142	326	148	80	106
1942	98	3901	2459	754	4843	3524	2275	1062	1037	9154	379	176
1943	127	887	2794	2124	1246	737	747	1164	9890	2081	126	100
1944	79	94	81	66	110	1164	566	5161	1474	160	99	84
1945	71	68	77	68	107	4530	10146	4166	3064	1808	209	116
1946	720	707	597	1671	1623	2303	255	1121	1943	607	670	228
1947	154	2807	2733	2459	964	902	2205	5888	3709	631	239	151
1948	82	265	329	449	327	2251	4701	2553	604	1436	245	114
1949	92	753	2175	6466	10116	5626	1290	733	621	645	274	195
1950	202	533	2229	12562	12695	10686	4760	1710	1278	883	359	466
1951	302	260	2437	1302	1144	5738	3478	913	778	2391	280	353
1952	158	440	2685	2221	1875	1538	5767	976	999	402	129	119
1953	83	81	115	126	156	420	1503	467	167	126	91	75
1954	67	68	58	59	69	60	78	56	106	65	43	67
1955	110	89	87	143	160	827	635	679	804	708	89	57
1956	184	477	340	108	290	1014	168	767	561	769	330	115
1957	71	63	641	265	974	1194	1836	8527	6296	2023	2112	178
1958	123	320	917	1315	850	1638	1261	1160	1085	1463	4754	374
1959	260	174	2354	625	2815	5040	1236	900	424	143	131	111
1960	144	132	828	749	1234	747	2759	1426	2094	1980	171	101
1961	94	115	143	126	113	935	791	3619	1876	308	324	135
1962	166	359	2398	2526	7577	7838	1292	1368	1052	610	298	99
1963	160	139	196	101	91	135	645	747	448	313	207	105
1964	81	78	71	77	354	321	1132	669	388	137	96	76
1965	61	55	91	102	454	658	175	588	734	212	97	134
1966	138	213	229	447	420	1099	344	2907	489	165	136	106
1967	119	88	2896	595	1431	1379	904	729	944	378	313	149
1968	133	128	1966	7640	7243	1860	1165	270	4253	383	606	150
1969	528	221	233	1212	9703	2503	2875	1374	508	4013	386	294
1970	437	2657	748	350	3173	1613	435	6833	4553	1907	104	58
1971	187	113	201	1307	1183	3100	223	198	184	138	442	103
1972	84	86	100	3630	4123	766	391	2513	233	239	265	380
1973	360	2800	4230	5683	9400	5887	7143	5033	4967	5107	3773	1810
1974	292	339	3490	5310	8663	10867	4067	2573	4967	4373	4287	3113
1975	1643	1237	1477	3443	4970	4290	2093	997	471	460	145	358
1976	614	660	1953	877	1072	2520	481	145	94	76	89	71
1977	71	80	85	70	70	1187	875	260	125	163	170	136
1978	1140	1227	4820	1210	350	592	5633	1557	1633	1570	1373	162
1979	95	380	732	1200	400	11200	11067	2350	2003	178	3463	226
1980	111	508	239	373	200	1403	1867	245	453	150	106	253
1981	72	214	395	99	241	164	124	197	2267	2067	1370	1657
1982	500	936	641	1573	8983	11767	2053	150	3160	3000	440	563
1983	661	754	6380	4567	1297	1123	5120	3557	3247	3373	498	97
1984	83	560	8407	3863	4290	7030	5627	3847	3540	799	133	115
1985	172	2141	3814	6013	2083	9220	10596	465	257	424	229	95
1986	82	110	4920	2697	3427	1573	205	141	198	368	100	96
1987	915	459	2090	1303	1020	598	283	162	100	763	142	89
1988	82	85	1115	7000	7857	2127	953	130	89	96	122	85

Table 4. Continued

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1.96	51.00	59	55	58	59	69	60	78	56	89	65	43	57
3.92	25.50	61	61	71	66	70	101	96	130	94	76	80	58
5.88	17.00	67	63	77	68	90	135	124	141	100	96	89	67
7.84	12.75	70	68	81	70	91	164	168	142	106	105	89	69
9.80	10.20	71	68	85	77	107	321	175	145	125	126	91	71
11.76	8.50	71	78	87	85	110	420	205	150	167	137	93	75
13.73	7.29	71	80	90	99	113	557	209	162	184	138	96	76
15.69	6.38	72	81	91	101	127	592	223	197	198	143	97	84
17.65	5.67	79	85	100	102	156	598	255	198	233	148	99	85
19.61	5.10	81	86	115	108	160	658	283	245	257	150	100	89
21.57.	4.64	82	88	143	126	200	737	344	260	326	160	104	95
23.53	4.25	82	89	152	126	241	747	391	270	388	163	106	96
25.49	3.92	82	91	196	143	290	766	435	465	424	165	122	97
27.45	3.64	83	94	201	160	327	827	481	467	448	178	126	99
29.41	3.40	83	94	229	265	350	902	566	588	453	212	129	100
31.37	3.19	84	110	233	342	354	935	635	669	471	239	131	101
33.33	3.00	92	113	239	350	400	1014	645	679	489	308	133	103
35.29	2.83	94	115	288	373	420	1099	747	729	508	313	136	105
37.25	2.68	95	128	329	447	454	1123	791	733	523	368	142	106
39.22	2.55	95	132	340	449	850	1164	875	747	561	378	145	106
41.18	2.43	98	139	395	595	964	1187	904	756	604	383	170	111
4314	2.32	110	174	597	625	974	1194	953	767	606	402	171	114
4510	2.22	111	213	641	749	1020	1379	1132	815	621	424	207	115
47.06	2.13	119	214	641	754	1072	1403	1165	900	734	460	209	115
49.02	2.04	123	221	732	877	1144	1538	1236	913	778	589	229	116
50.98	1.96	127	260	748	1200	1183	1573	1261	976	804	607	239	119
52.94	1.89	133	265	828	1210	1234	1613	1290	997	944	610	245	134
54.90	1.82	138	320	917	1212	1246	1638	1292	1062	999	631	265	135
56.86	1.76	144	339	1115	1302	1297	1860	1503	1121	1037	645	274	136
58.82	1.70	154	359	1477	1303	1431	2127	1836	1160	1052	708	280	149
60.78	1.65	158	380	1953	1307	1623	2251	1867	1164	1085	763	298	150
62.75	1.59	160	440	1966	1315	1875	2303	2053	1368	1278	769	313	151
64.71	1.55	166	459	2090	1573	2083	2503	2080	1374	1474	799	324	162
66.67	1.50	172	477	2175	1671	2815	2520	2093	1426	1633	883	330	176
68.63	1.46	184	508	2229	2124	3173	3100	2205	1557	1876	1436	359	178
70.59	1.42	187	533	2354	2221	3427	3524	2275	1710	1943	1463	379	185
72.55	1.38	202	560	2398	2459	4123	4290	2759	2350	2003	1570	386	195
74.51	1.34	260	660	2437	2526	4290	4530	2875	2513	2094	1808	440	226
76.47	1.31	292	707	2459	2697	4843	5040	3478	2553	2267	1907	442	228
78.43	1.27	302	753	2685	3443	4970	5626	4067	2573	3064	1980	498	253
80.39	1.24	360	754	2733	3630	6587	5738	4701	2907	3160	2023	603	294
82.35	1.21	437	887	2794	3863	7243	5887	4760	3557	3247	2067	606	353
84.31	1.19	500	936	2896	4567	7577	7030	5120	3619	3540	2081	670	358
86.27	1.16	528	1227	3490	5310	7857	7667	5627	3847	3709	2391	1370	374
88.24	1.13	614	1237	3814	5683	8663	7838	5633	4166	4253	3000	1373	380
90.20	1.11	661	2141	4230	6013	8983	9220	5767	5033	4553	3373	2112	466
9216	1.09	720	2657	4820	6466	9400	10686	7143	5161	4967	4013	3463	563
94.12	1.06	915	2800	4920	7000	9703	10867	10146	5888	4967	4373	3773	1657
96.08	1.04	1140	2807	6380	7640	10116	11200	10596	6833	6296	5107	4287	1810
98.04	1.02	1643	3901	8407	12562	12695	11767	11067	8527	9890	9154	4754	3113
25-yr	flow	62	61	71	66	71	103	98	131	95	77	81	59
10-yr	flow	71	70	85	78	107	333	179	146	130	127	91	72
5-yr	flow	81	86	121	112	169	675	296	248	272	152	101	90
2-yr	flow	125	241	740	1042	1164	1556	1249	945	791	598	234	118

Table 4. Continued

7-DAY LOW FLOWS IN CFS

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1939	73	98	316	448	6770	9135	3198	786	601	900	752	204
1940	97	98	92	88	132	604	239	895	658	127	117	72
1941	62	62	204	202	137	103	449	381	627	166	86	147
1942	140	4272	2476	794	5433	4295	2561	1270	1804	11587	841	194
1943	130	989	2860	2970	1412	790	1061	1389	10107	2203	132	105
1944	79	96	82	70	112	1390	604	5437	1659	198	102	97
1945	74	69	79	71	112	6606	12751	4704	3956	1942	286	139
1946	887	779	1101	1912	2019	2594	283	2541	2652	803	1968	245
1947	164	4697	2830	3163	1083	915	3468	6595	4591	1149	261	174
1948	86	295	379	497	332	2771	5400	2950	716	1759	270	119
1949	96	902	2333	7567	11864	5897	1356	827	661	819	311	251
1950	802	566	2236	13482	13071	11659	4941	1887	2052	1041	407	558
1951	319	282	2495	1668	2192	7060	3866	1079	906	2819	445	583
1952	174	472	2713	2401	2094	1789	7353	1032	1077	467	139	133
1953	83	82	123	131	159	2395	1869	1119	180	199	91	76
1954	67	68	58	60	71	63	80	70	116	74	76	69
1955	141	91	98	148	340	947	704	776	855	840	100	61
1956	263	1160	346	123	689	1154	185	888	632	926	417	123
1957	72	77	755	277	1397	1247	5197	9894	8353	8201	2761	190
1958	127	331	1716	1438	907	2502	1410	1229	1503	1677	5172	400
1959	289	182	2379	709	3308	5340	1351	987	504	154	336	116
1960	158	492	1715	864	1389	759	3713	1589	2457	3589	208	105
1961	96	116	158	149	118	2385	957	4419	2063	329	380	151
1962	176	802	2428	3571	7865	8343	1401	1493	1073	800	326	108
1963	182	145	236	104	95	2253	723	869	567	398	219	111
1964	82	79	71	78	388	331	2180	799	396	152	99	78
1965	62	59	95	113	460	756	351	644	799	276	108	325
1966	227	222	336	508	425	1219	375	3594	535	175	155	112
1967	136	97	3272	655	1598	2093	1210	1187	1496	570	559	159
1968	139	129	3870	7776	7281	2426	2724	302	4402	415	737	162
1969	665	250	256	1531	9867	3170	3432	2600	534	4648	479	746
1970	579	2957	807	353	3323	1757	507	7706	5533	2763	131	63
1971	245	114	229	1330	2449	3129	259	206	215	340	472	111
1972	85	86	105	3717	4146	854	423	2537	265	247	356	401
1973	366	3556	4591	5901	9726	6503	7594	5567	6596	5157	3867	1940
1974	304	353	3863	5371	8749	10914	4874	2911	5929	4403	4334	3509
1975	1776	1299	2411	4310	5340	5863	2159	1053	801	504	219	636
1976	669	750	2229	1031	1285	2714	530	147	97	76	101	72
1977	72	81	86	70	70	1994	898	376	131	191	443	266
1978	1298	1264	4940	1361	350	689	7131	2311	1681	1741	1624	178
1979	96	383	823	1529	427	11357	11700	2453	2070	187	3534	233
1980	112	515	325	374	200	1737	2659	261	780	203	111	359
1981	74	215	437	100	269	305	130	245	2670	2199	1881	1781
1982	684	1147	904	4131	9927	11986	2587	156	3469	3294	453	958
1983	735	772	9151	5650	1690	1563	5954	4007	4429	3674	608	101
1984	86	722	9901	4099	5274	8014	5850	4151	3604	864	152	118
1985	231	2931	4031	6578	2259	9440	10919	623	1182	651	308	96
1986	85	136	6111	3563	4020	1673	248	158	280	757	104	125
1987	1055	639	2331	1880	1157	1083	301	204	118	808	159	97
1988	83	86	1675	7671	8979	2447	1117	141	90	102	132	95

Table 4. Continued

FROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1.96	51.00	62	59	58	60	70	63	80	70	90	74	76	61
3.92	25.50	62	62	71	70	71	103	130	141	97	76	86	63
5.88	17.00	67	68	79	70	95	305	185	147	116	102	91	69
7.84	12.75	72	69	82	71	112	331	239	156	118	127	99	72
9.80	10.20	72	77	86	78	112	604	248	158	131	152	100	72
11.76	8.50	73	79	92	88	118	689	259	204	180	154	101	76
13.73	7.29	74	81	95	100	132	756	283	206	215	166	102	78
15.69	6.38	74	82	98	104	137	759	301	245	265	175	104	95
17.65	5.67	79	86	105	113	159	790	351	261	280	187	108	96
19.61	5.10	82	86	123	123	200	854	375	302	396	191	111	97
21.57	4.64	83	91	158	131	269	915	423	376	504	198	117	97
23.53	4.25	83	96	204	148	332	947	449	381	534	199	131	101
25.49	3.92	85	97	229	149	340	1083	507	623	535	203	132	105
27.45	3.64	85	98	236	202	350	1154	530	644	567	247	132	105
29.41	3.40	86	98	256	277	388	1219	604	776	601	276	139	108
31.37	3.19	86	114	316	353	425	1247	704	786	627	329	152	111
33.33	3.00	96	116	325	374	427	1390	723	799	632	340	155	111
35.29	2.83	96	129	336	448	460	1563	898	827	658	398	159	112
37.25	2.68	96	136	346	497	689	1673	957	869	661	415	208	116
39.22	2.55	97	145	379	508	907	1737	1061	888	716	467	219	118
41.18	2.43	112	182	437	655	1083	1757	1117	895	780	504	219	119
43.14	2.32	127	215	755	709	1157	1789	1210	987	799	570	261	123
45.10	2.22	130	222	807	794	1285	1994	1351	1032	801	651	270	125
47.06	2.13	136	250	823	864	1389	2093	1356	1053	855	757	286	133
49.02	2.04	139	282	904	1031	1397	2253	1401	1079	906	800	308	139
50.98	1.96	140	295	1101	1330	1412	2385	1410	1119	1073	803	311	147
52.94	1.89	141	331	1675	1361	1598	2395	1869	1187	1077	808	326	151
54.90	1.82	158	353	1715	1438	1690	2426	2159	1229	1182	819	336	159
56.86	1.76	164	383	1716	1529	2019	2447	2180	1270	1496	840	356	162
58.82	1.70	174	472	2229	1531	2094	2502	2561	1389	1503	864	380	174
60.78	1.65	176	492	2236	1668	2192	2594	2587	1493	1659	900	407	178
62.75	1.59	182	515	2331	1880	2259	2714	2659	1589	1681	926	417	190
64.71	1.55	227	566	2333	1912	2449	2771	2724	1887	1804	1041	443	194
66.67	1.50	231	639	2379	2401	3308	3129	3198	2311	2052	1149	445	204
68.63	1.46	245	722	2411	2970	3323	3170	3432	2453	2063	1677	453	233
70.59	1.42	263	750	2428	3163	4020	4295	3468	2537	2070	1741	472	245
72.55	1.38	289	772	2476	3563	4146	5340	3713	2541	2457	1759	479	251
74.51	1.34	304	779	2495	3571	5274	5863	3866	2600	2652	1942	559	266
76.47	1.31	319	802	2713	3717	5340	5897	4874	2911	2670	2199	608	325
78.43	1.27	366	902	2830	4099	5433	6503	4941	2950	3469	2203	737	359
80.39	1.24	579	989	2860	4131	6770	6606	5197	3594	3604	2763	752	400
82.35	1.21	665	1147	3272	4310	7281	7060	5400	4007	3956	2819	841	401
84.31	1.19	669	1160	3863	5371	7865	8014	5850	4151	4402	3294	1624	558
86.27	1.16	684	1264	3870	5650	8749	8343	5954	4419	4429	3589	1881	583
88.24	1.13	735	1299	4031	5901	8979	9135	7131	4704	4591	3674	1968	636
90.20	1.11	802	2931	4591	6578	9726	9440	7353	5437	5533	4403	2761	746
92.16	1.09	887	2957	4940	7567	9867	10914	7594	5567	5929	4648	3534	958
94.12	1.06	1055	3556	6111	7671	9927	11357	10919	6595	6596	5157	3867	1781
96.08	1.04	1298	4272	9151	7776	11864	11659	11700	7706	8353	8201	4334	1940
98.04	1.02	1776	4697	9901	13482	13071	11986	12751	9894	10107	11587	5172	3509
25-yr	flow	63	62	71	70	72	115	133	142	98	78	87	63
10-yr	flow	72	77	87	79	112	614	249	163	137	152	100	72
5-yr	flow	83	87	131	125	215	867	386	318	419	192	112	97
2-yr	flow	140	289	1004	1183	1405	2321	1406	1099	991	801	310	143

Table 4. Continued

15-DAY LOW FLOWS IN CFS

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1939	78	99	343	598	7024	9925	3459	944	943	1087	1744	372
1940	99	100	226	92	393	870	603	1033	858	172	132	77
1941	81	73	399	490	147	125	1006	719	1587	226	90	283
1942	701	4730	2605	838	7679	6300	3467	2446	3445	12706	1476	237
1943	138	1116	3101	3837	1724	1015	1442	2603	10254	3234	153	126
1944	80	115	91	93	123	1734	1711	6853	1771	247	165	153
1945	81	73	83	81	145	8637	14854	5509	4685	2541	572	178
1946	1662	1190	1844	4829	3708	3365	397	3969	3384	1337	2447	273
1947	411	7807	3815	3865	1418	1111	5047	6763	5373	3039	292	245
1948	91	415	1400	617	554	3697	7378	3421	1240	2246	595	150
1949	101	1504	2363	10012	12879	7560	1680	1050	947	1540	677	1095
1950	2968	818	2380	20680	13757	12340	6603	2186	2759	1616	650	905
1951	396	1337	2615	3823	5818	9581	4689	1491	1131	6737	525	604
1952	190	1655	3127	3095	4684	4336	8128	1123	1878	1250	174	152
1953	84	84	404	156	181	3484	2520	1847	393	328	94	78
1954	68	68	59	60	79	66	83	100	159	82	87	77
1955	239	96	111	180	835	1456	938	801	1050	1311	160	64
1956	436	1273	970	136	866	1447	285	1039	1071	1329	808	161
1957	74	80	811	310	2372	1500	8757	11205	11582	10574	4152	258
1958	131	399	2015	2453	1108	4695	1781	1711	2029	2062	7952	589
1959	384	202	2428	885	4898	5605	1598	1167	635	189	1096	127
1960	265	675	2410	1739	2870	802	3795	2186	2795	4759	465	189
1961	105	122	1240	159	418	5808	1294	15785	2942	400	685	169
1962	186	1015	2564	6166	8939	8580	1730	1994	2812	1235	414	145
1963	251	172	1121	131	119	5188	878	968	845	945	469	135
1964	83	81	598	81	396	3115	3751	1048	446	196	104	80
1965	63	60	231	182	1129	881	956	818	1128	398	132	567
1966	414	244	365	705	4098	1617	500	4368	643	211	193	123
1967	177	327	4911	1821	3959	4439	1235	2502	1628	1778	1247	184
1968	150	138	6064	7824	7720	3736	3398	700	4717	564	854	210
1969	697	316	517	1582	10277	3945	4506	3334	1085	5540	925	1667
1970	1774	3191	1004	440	3689	1912	720	8439	5998	3577	180	97
1971	375	127	373	1421	3234	3599	470	452	452	1251	823	115
1972	88	87	1964	3737	4153	1240	1478	2827	340	399	523	514
1973	541	5913	5329	7177	10227	7816	8243	6358	7423	5271	4243	2217
1974	342	428	3953	5692	9240	11600	7097	3637	6285	4487	4363	4086
1975	2039	1763	3216	7040	7053	8343	3126	1402	1241	863	323	838
1976	728	894	2363	1532	1940	3531	710	170	106	79	164	75
1977	86	82	88	70	356	2930	1099	550	206	392	1176	774
1978	1617	1538	6655	1919	402	4422	9003	4373	1840	2086	1845	282
1979	204	412	904	1840	565	13180	14840	3496	2235	295	3613	295
1980	122	520	596	421	221	2195	4793	313	992	226	120	500
1981	81	229	584	102	507	442	136	871	3315	2657	2753	1840
1982	1040	1173	1758	4772	13246	12740	4051	170	4207	3985	747	1491
1983	1856	826	11117	8060	2369	2533	9590	5046	4604	3802	720	108
1984	94	1052	15527	4453	7529	10795	7952	4663	3681	971	209	363
1985	527	3264	4984	8205	2766	9811	11785	1031	2379	762	466	103
1986	101	281	9581	5032	4992	2533	260	186	563	1827	121	135
1987	1370	884	2772	2949	2169	1399	700	223	144	1345	197	139
1988	89	89	3078	7915	9730	3144	1598	161	90	125	145	126

Table 4. Concluded

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1.96	51.00	63	60	59	60	79	66	83	100	90	79	87	64
3.92	25.50	68	68	83	70	119	125	136	161	106	82	90	75
5.88	17.00	74	73	88	81	123	442	260	170	144	125	94	77
7.84	12.75	78	73	91	81	145	802	285	170	159	172	104	77
9.80	10.20	80	80	111	92	147	870	397	186	206	189	120	78
11.76	8.50	81	81	226	93	181	881	470	223	340	196	121	80
13.73	7.29	81	82	231	102	221	1015	500	313	393	211	132	97
15.69	6.38	81	84	343	131	356	1111	603	452	446	226	132	103
17.65	5.67	83	87	365	136	393	1240	700	550	452	226	145	108
19.61	5.10	84	89	373	156	396	1399	710	700	563	247	153	115
21.57	4.64	86	96	399	159	402	1447	720	719	635	295	160	123
23.53	4.25	88	99	404	180	418	1456	878	801	643	328	164	126
25.49	3.92	89	100	517	182	507	1500	938	818	845	392	165	126
27.45	3.64	91	115	584	310	554	1617	956	871	858	398	174	127
29.41	3.40	94	122	596	421	565	1734	1006	944	943	399	180	135
31.37	3.19	99	127	598	440	835	1912	1099	968	947	400	193	135
33.33	3.00	101	138	811	490	866	2195	1235	1031	992	564	197	139
35.29	2.83	101	172	904	598	1108	2533	1294	1033	1050	762	209	145
37.25	2.68	105	202	970	617	1129	2533	1442	1039	1071	863	292	150
39.22	2.55	122	229	1004	705	1418	2930	1478	1048	1085	945	323	152
41.18	2.43	131	244	1121	838	1724	3115	1598	1050	1128	971	414	153
43.14	2.32	138	281	1240	885	1940	3144	1598	1123	1131	1087	465	161
45.10	2.22	150	316	1400	1421	2169	3365	1680	1167	1240	1235	466	169
47.06	2.13	177	327	1758	1532	2369	3484	1711	1402	1241	1250	469	178
49.02	2.04	186	399	1844	1582	2372	3531	1730	1491	1587	1251	523	184
50.98	1.96	190	412	1964	1739	2766	3599	1781	1711	1628	1311	525	189
52.94	1.89	204	415	2015	1821	2870	3697	2520	1847	1771	1329	572	210
54.90	1.82	239	428	2363	1840	3234	3736	3126	1994	1840	1337	595	237
56.86	1.76	251	520	2363	1919	3689	3945	3398	2186	1878	1345	650	245
58.82	1.70	265	675	2380	2453	3708	4336	3459	2186	2029	1540	677	258
60.78	1.65	342	818	2410	2949	3959	4422	3467	2446	2235	1616	685	273
62.75	1.59	375	826	2428	3095	4098	4439	3751	2502	2379	1778	720	282
64.71	1.55	384	884	2564	3737	4153	4695	3795	2603	2759	1827	747	283
66.67	1.50	396	894	2605	3823	4684	5188	4051	2827	2795	2062	808	295
68.63	1.46	411	1015	2615	3837	4898	5605	4506	3334	2812	2086	823	363
70.59	1.42	414	1052	2772	3865	4992	5808	4689	3421	2942	2246	854	372
72.55	1.38	436	1116	3078	4453	5818	6300	4793	3496	3315	2541	925	500
74.51	1.34	527	1173	3101	4772	7024	7560	5047	3637	3384	2657	1096	514
76.47	1.31	541	1190	3127	4829	7053	7816	6603	3969	3445	3039	1176	567
78.43	1.27	697	1273	3216	5032	7529	8343	7097	4368	3681	3234	1247	589
80.39	1.24	701	1337	3815	5692	7679	8580	7378	4373	4207	3577	1476	604
82.35	1.21	728	1504	3953	6166	7720	8637	7952	4663	4604	3802	1744	774
84.31 -	1.19	1040	1538	4911	7040	8939	9581	8128	5046	4685	3985	1845	838
86.27	1.16	1370	1655	4984	7177	9240	9811	8243	5509	4717	4487	2447	905
88.24	1.13	1617	1763	5329	7824	9730	9925	8757	6358	5373	4759	2753	1095
90.20	1.11	1662	3191	6064	7915	10227	10795	9003	6763	5998	5271	3613	1491
92.16	1.09	1774	3264	6655	8060	10277	11600	9590	6853	6285	5540	4152	1667
94.12	1.06	1856	4730	9581	8205	12879	12340	11785	8439	7423	6737	4243	1840
96.08	1.04	2039	5913	11117	10012	13246	12740	14840	11205	10254	10574	4363	2217
98.04	1.02	2968	7807	15527	20680	13757	13180	14854	15785	11582	12706	7952	4086
25-yr	flow	69	69	83	71	119	143	143	162	109	85	90	75
10-yr	flow	80	80	125	92	151	871	406	191	222	189	121	79
5-yr	flow	84	91	379	157	397	1409	712	704	579	257	154	117
2-yr	flow	188	406	1905	1662	2573	3566	1756	1603	1608	1282	524	187

Table 5. Monthly Low-Flow Statistics for System Inflow
(Water Years 1971 - 1988)

1-DAY LOW FLOWS IN CFS

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	305	224	263	1374	1174	3385	414	322	255	186	396	113
1972	93	92	120	3700	4251	923	929	2897	287	281	312	410
1973	402	3358	4601	6102	9550	7355	9032	5916	5352	5160	3707	1797
1974	330	412	3635	5594	9251	12150	4511	2855	4965	4400	4312	3436
1975	1623	1353	1562	4193	5716	4782	2545	1214	977	593	189	474
1976	700	679	2131	993	1193	2936	594	188	121	85	110	81
1977	81	99	98	82	84	1368	1006	367	140	196	199	203
1978	1136	1357	5000	1209	485	783	4867	1933	1691	1625	1102	189
1979	127	425	918	1653	622	11688	11721	2571	2058	242	3505	259
1980	125	530	282	440	284	1552	1856	435	489	169	132	190
1981	88	243	350	128	261	215	170	299	2374	2376	1681	1935
1982	886	1310	864	1989	9549	12423	1971	351	3451	3148	540	578
1983	605	871	6765	5351	1526	1359	5834	3797	3183	3172	519	125
1984	100	763	11797	4041	4984	7873	6178	4049	3677	876	160	147
1985	246	2396	4382	6036	2290	10583	10627	545	410	496	417	126
1986	118	287	5470	2584	3572	1747	360	255	289	309	115	110
1987	1125	610	2518	1752	1326	1086	560	245	152	811	202	115
1988	98	146	1762	7700	8200	2687	1143	208	127	111	137	95

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.26	19.00	81	92	98	82	84	215	170	188	121	85	110	81
10.53	9.50	88	99	120	128	261	783	360	208	127	111	115	95
15.79	6.33	93	146	263	440	284	923	414	245	140	169	132	110
21.05	4.75	98	224	282	993	485	1086	560	255	152	186	137	113
26.32	3.80	100	243	350	1209	622	1359	594	299	255	196	160	115
31.58	3.17	118	287	864	1374	1174	1368	929	322	287	242	189	125
36.84	2.71	125	412	918	1653	1193	1552	1006	351	289	281	199	126
42.11	2.38	127	425	1562	1752	1326	1747	1143	367	410	309	202	147
47.37	2.11	246	530	1762	1989	1526	2687	1856	435	489	496	312	189
52.63	1.90	305	610	2131	2584	2290	2936	1971	545	977	593	396	190
57.89	1.73	330	679	2518	3700	3572	3385	2545	1214	1691	811	417	203
63.16	1.58	402	763	3635	4041	4251	4782	4511	1933	2058	876	519	259
68.42	1.46	605	871	4382	4193	4984	7355	4867	2571	2374	1625	540	410
73.68	1.36	700	1310	4601	5351	5716	7873	5834	2855	3183	2376	1102	474
78.95	1.27	886	1353	5000	5594	8200	10583	6178	2897	3451	3148	1681	578
84.21	1.19	1125	1357	5470	6036	9251	11688	9032	3797	3677	3172	3505	1797
89.47	1.12	1136	2396	6765	6102	9549	12150	10627	4049	4965	4400	3707	1935
94.74	1.06	1623	3358	11797	7700	9550	12423	11721	5916	5352	5160	4312	3436
10-yr	flow	88	98	119	126	252	753	350	207	126	110	115	94
5-yr	flow	98	211	279	906	453	1060	537	253	150	183	136	112
2-yr	flow	277	572	1956	2302	1928	2818	1917	493	746	547	356	189

Table 5. Continued

3-DAY LOW FLOWS IN CFS

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	385	231	269	1477	1245	3400	471	351	267	198	475	117
1972	93	93	123	3734	4272	961	974	2946	305	292	339	416
1973	406	3537	4808	6131	9974	7674	9170	5974	5847	5332	3857	1914
1974	335	423	4119	5709	9322	12319	4634	2884	5240	4420	4349	3536
1975	1706	1400	1722	5198	5972	6059	2636	1343	1252	663	203	576
1976	716	705	2632	1104	1339	2976	639	194	127	88	114	84
1977	83	100	33	52	85	1577	1041	405	151	203	218	221
1978	1247	1368	5098	1405	487	866	6127	2191	1743	1762	1404	194
1979	129	427	976	1768	623	11736	12216	2591	2078	255	3541	260
1980	126	532	297	451	285	1721	2133	447	639	180	145	331
1981	89	244	429	130	303	261	183	314	2461	2590	1834	1984
1982	1031	1344	892	3744	10208	12724	2391	367	3716	3169	578	616
1983	700	881	8994	5502	1604	1424	6017	3903	3703	3419	531	127
1984	105	843	12062	4199	5601	8493	6385	4446	3718	935	172	155
1985	314	2811	4597	6738	2369	10798	10955	623	668	628	601	130
1986	119	315	5621	2912	4031	1958	399	272	364	402	126	114
1987	1342	662	2926	1999	1432	1186	583	257	161	857	219	116
1988	105	149	2082	7963	8901	2903	1221	243	132	118	148	100

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.26	19.00	83	93	99	82	85	261	183	194	127	88	114	84
10.53	9.50	89	100	123	130	285	866	399	243	132	118	126	100
15.79	6.33	93	149	269	451	303	961	471	257	151	180	145	114
21.05	4.75	105	231	297	1104	487	1186	583	272	161	198	148	116
26.32	3.80	105	244	429	1405	623	1424	639	314	267	203	172	117
31.58	3.17	119	315	892	1477	1245	1577	974	351	305	255	203	127
36.84	2.71	126	423	976	1768	1339	1721	1041	367	364	292	218	130
42.11	2.38	129	427	1722	1999	1432	1958	1221	405	639	402	219	155
47.37	2.11	314	532	2082	2912	1604	2903	2133	447	668	628	339	194
52.63	1.90	335	662	2632	3734	2369	2976	2391	623	1252	663	475	221
57.89	1.73	385	705	2926	3744	4031	3400	2636	1343	1743	857	531	260
63.16	1.58	406	843	4119	4199	4272	6059	4634	2191	2078	935	578	331
68.42	1.46	700	881	4597	5198	5601	7674	6017	2591	2461	1762	601	416
73.68	1.36	716	1344	4808	5502	5972	8493	6127	2884	3703	2590	1404	576
78.95	1.27	1031	1368	5098	5709	8901	10798	6385	2946	3716	3169	1834	616
84.21	1.19	1247	1400	5621	6131	9322	11736	9170	3903	3718	3419	3541	1914
89.47	1.12	1342	2811	8994	6738	9974	12319	10955	4446	5240	4420	3857	1984
94.74	1.06	1706	3537	12062	7963	10208	12724	12216	5974	5847	5332	4349	3536
10-yr	flow	89	100	122	128	274	834	388	241	131	116	125	99
5-yr	flow	103	218	292	1001	458	1150	565	269	160	196	147	116
2-yr	flow	325	600	2371	3345	2007	2941	2268	540	975	646	410	208

Table 5. Continued

7-DAY LOW FLOWS IN CFS

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	421	252	292	1519	3135	3471	541	485	526	406	598	131
1972	96	94	195	3861	4303	1082	1080	3054	354	296	565	448
1973	424	5034	5959	6356	10372	8763	10078	6793	8105	5491	3918	2043
1974	355	444	4236	5908	9362	12602	5637	3291	6529	4449	4421	3845
1975	1836	1444	2696	5575	6348	7805	2792	1431	1812	769	361	852
1976	730	823	2705	1377	1607	3263	742	209	144	90	130	86
1977	91	103	103	83	88	2541	1078	609	162	264	504	398
1978	1557	1479	5282	1558	506	1583	7670	3025	1795	2178	1671	211
1979	132	433	1060	2111	676	12010	14094	2700	2169	315	3688	262
1980	130	541	410	462	287	2054	2947	460	946	244	186	414
1981	94	245	474	135	326	377	209	394	3185	2867	2745	2021
1982	1234	1452	1305	4813	11857	13076	2965	454	4130	4153	623	1038
1983	856	932	9703	6356	2037	2472	7354	4476	4833	3832	676	140
1984	112	1267	14722	4793	6707	10089	6761	4936	3880	954	207	190
1985	498	4087	4753	7273	2582	11229	11363	808	2874	996	819	135
1986	122	358	7555	3794	4718	2079	482	295	494	795	149	154
1987	1402	849	3389	2574	1749	1584	626	298	242	911	261	123
1988	115	154	2436	8280	10814	3581	1408	294	139	123	169	112

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.26	19.00	91	94	103	83	88	377	209	209	139	90	130	86
10.53	9.50	94	103	195	135	287	1082	482	294	144	123	149	112.
15.79	6.33	96	154	292	462	326	1583	541	295	162	244	169	123
21.05	4.75	112	245	410	1377	506	1584	626	298	242	264	186	131
26.32	3.80	115	252	474	1519	676	2054	742	394	354	296	207	135
31.58	3.17	122	358	1060	1558	1607	2079	1078	454	494	315	261	140
36.84	2.71	130	433	1305	2111	1749	2472	1080	460	526	406	361	154
42.11	2.38	132	444	2436	2574	2037	2541	1408	485	946	769	504	190
47.37	2.11	355	541	2696	3794	2582	3263	2792	609	1795	795	565	211
52.63	1.90	421	823	2705	3861	3135	3471	2947	808	1812	911	598	262
57.89	1.73	424	849	3389	4793	4303	3581	2965	1431	2169	954	623	398
6316	1.58	498	932	4236	4813	4718	7805	5637	2700	2874	996	676	414
68.42	1.46	730	1267	4753	5575	6348	8763	6761	3025	3185	2178	819	448
73.68	1.36	856	1444	5282	5908	6707	10089	7354	3054	3880	2867	1671	852
78.95	1.27	1234	1452	5959	6356	9362	11229	7670	3291	4130	3832	2745	1038
84.21	1.19	1402	1479	7555	6356	10372	12010	10078	4476	4833	4153	3688	2021
89.47	1.12	1557	4087	9703	7273	10814	12602	11363	4936	6529	4449	3918	2043
94.74	1.06	1836	5034	14722	8280	11857	13076	14094	6793	8105	5491	4421	3845
10-yr	flow	93	102	190	132	277	1045	468	290	144	121	148	111
5-yr	flow	110	230	391	1232	478	1584	612	298	230	260	183	130
2-yr	flow	390	690	2701	3829	2873	3372	2874	714	1804	856	582	238

Table 5. Concluded

15-DAY LOW FLOWS IN CFS

WATER YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	506	262	430	1607	4561	4170	843	1346	912	1456	896	159
1972	100	95	3563	3963	4326	1836	2851	3349	424	464	829	572
1973	609	7406	7518	8559	11788	10552	10984	7299	9744	5647	4323	2330
1974	428	525	4621	6601	9821	13657	8861	4445	7352	4545	4496	4327
1975	2132	1931	3494	10584	8267	11441	4011	1918	1822	1404	643	1115
1976	783	979	3037	1840	2289	4076	970	252	165	93	224	94
1977	119	107	110	85	1161	4772	1270	691	277	S57	2263	1015
1978	2081	1865	8591	2086	586	9234	9659	5985	2002	2394	1887	439
1979	392	512	1278	2348	943	15639	18343	3837	2494	483	3808	320
1980	153	578	909	510	329	2534	5418	599	1102	277	212	681
1981	108	278	623	136	847	510	216	1041	4641	3844	3566	2780
1982	1703	1504	2646	5386	15998	14350	4635	468	5275	4666	903	2282
1983	2304	985	12571	8576	2811	3293	12993	5838	5100	3906	790	162
1984	182	1743	19237	5571	10254	14294	10622	5391	3947	1043	353	968
1985	1229	5040	6713	8839	3768	11414	12654	1272	4079	1123	879	137
1986	214	1264	12875	5295	5989	3494	551	379	629	1903	166	316
1987	1882	1176	3857	3753	2781	2099	1656	341	327	1473	546	214
1988	141	202	4837	9051	12410	4502	2009	346	141	220	214	197

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.26	19.00	100	95	110	85	329	510	216	252	141	93	166	94
10.53	9.50	108	107	430	136	586	1836	551	341	165	220	212	137
15.79	6.33	119	202	623	510	847	2099	843	346	277	277	214	159
21.05	4.75	141	262	909	1607	943	2534	970	379	327	464	224	162
26.32	3.80	153	278	1278	1840	1161	3293	1270	468	424	483	353	197
31.58	3.17	182	512	2646	2086	2289	3494	1656	599	629	657	546	214
36.84	2.71	214	525	3037	2348	2781	4076	2009	691	912	1043	643	316
42.11	2.38	392	578	3494	3753	2811	4170	2851	1041	1102	1123	790	320
47.37	2.11	428	979	3563	3963	3768	4502	4011	1272	1822	1404	829	439
52.63	1.90	506	985	3857	5295	4326	4772	4635	1346	2002	1456	879	572
57.89	1.73	609	1176	4621	5386	4561	9234	5418	1918	2494	1473	896	681
6316	1.58	783	1264	4837	5571	5989	10552	8861	3349	3947	1903	903	968
68.42	1.46	1229	1504	6713	6601	8267	11414	9659	3837	4079	2394	1887	1015
73.68	1.36	1703	1743	7518	8559	9821	11441	10622	4445	4641	3844	2269	1115
78.95	1.27	1882	1865	8591	8576	10254	13657	10984	5391	5100	3906	3566	2282
84.21	1.19	2081	1931	12571	8839	11788	14294	12654	5838	5275	4545	3808	2330
89.47	1.12	2132	5040	12875	9051	12410	14350	12993	5985	7352	4666	4323	2780
94.74	1.06	2304	7406	19237	10584	15998	15639	18343	7299	9744	5647	4496	4327
10-yr	flow	108	106	413	133	572	1766	533	337	164	213	209	135
5-yr	flow	137	252	863	1434	928	2465	950	374	319	434	222	162
2-yr	flow	469	982	3718	4664	4062	4644	4339	1311	1917	1431	855	509

Table 6. Seasonal (May - October) Low-Flow Statistics for
Kaskaskia River Near Venedy Station over Years 1939 -1988

7-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1939	96.7	173
1940	62.4	154
1941	86.4	113
1942	130.0	176
1943	79.4	165
1944	74.3	178
1945	139.4	130
1946	164.1	161
1947	85.9	166
1948	95.6	163
1949	210.7	151
1950	318.9	178
1951	173.9	168
1952	83.0	174
1953	67.4	178
1954	65.1	26
1955	60.9	134
1956	72.1	172
1957	126.9	164
1958	288.7	156
1959	116.4	142
1960	96.3	156
1961	150.9	142
1962	105.0	148
1963	82.4	173
1964	621	178
1965	107.6	116
1966	112.1	132
1967	138.9	165
1968	161.7	136
1969	354.9	120
1970	62.6	130
1971	85.4	168
1972	240.6	60
1973	303.7	175
1974	1775.7	178
1975	219.1	114
1976	71.7	144
1977	131.1	38
1978	95.6	159
1979	111.9	161
1980	74.4	164
1981	245.4	5
1982	155.9	21
1983	86.4	158
1984	117.9	125
1985	84.9	178
1986	97.9	121
1987	83.3	170
1988	90.1	45

Table 6. Continued

PROBABILITY	T-YR	LOW FLOW VALUES
1.96	51.00	60.9
3.92	25.50	62.1
5.88	17.00	62.4
7.84	12.75	62.6
9.80	10.20	65.1
11.76	8.50	67.4
13.73	7.29	71.7
15.69	6.38	72.1
17.65	5.67	743
19.61	5.10	74.4
21.57	4.64	79.4
23.53	4.25	82.4
25.49	3.92	83.0
27.45	3.64	83.3
29.41	3.40	84.9
31.37	3.19	85.4
33.33	3.00	85.9
35.29	2.83	86.4
37.25	2.68	86.4
39.22	2.55	90.1
41.18	2.43	95.6
43.14	2.32	95.6
4510	2.22	96.3
47.06	2.13	96.7
49.02	2.04	97.9
50.98	1.96	105.0
52.94	1.89	107.6
54.90	1.82	111.9
56.86	1.76	112.1
58.82	1.70	116.4
60.78	1.65	117.9
62.75	1.59	126.9
64.71	1.55	130.0
66.67	1.50	131.1
68.63	1.46	138.9
70.59	1.42	139.4
72.55	1.38	150.9
74.51	1.34	155.9
76.47	1.31	161.7
78.43	1.27	164.1
80.39	1.24	173.9
82.35	1.21	210.7
84.31	1.19	219.1
86.27	1.16	240.6
88.24	1.13	245.4
90.20	1.11	288.7
92.16	1.09	303.7
94.12	1.06	318.9
96.08	1.04	354.9
98.04	1.02	1775.7
25-Year Flow		62.2
10-Year Flow		65.4
5-Year Flow		75.5
2-Year Flow		101.5

Table 6. Continued

15-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1939	98.6	170
1940	67.7	146
1941	901	105
1942	137.7	168
1943	80.3	162
1944	80.7	170
1945	154.9	122
1946	207.9	153
1947	91.1	160
1948	101.0	155
1949	287.3	120
1950	395.9	170
1951	190.0	160
1952	84.1	170
1953	68.5	170
1954	77.3	129
1955	64.0	131
1956	73.9	170
1957	130.5	156
1958	360.6	149
1959	127.5	139
1960	102.5	148
1961	169.2	134
1962	127.9	141
1963	83.2	170
1964	631	170
1965	126.3	112
1966	122.8	127
1967	149.7	157
1968	209.9	134
1969	514.4	114
1970	86.8	123
1971	88.1	160
1972	263.1	57
1973	341.9	170
1974	2038.7	170
1975	322.5	105
1976	721	144
1977	206.4	35
1978	122.8	151
1979	122.3	156
1980	81.1	157
1981	871.1	1
1982	170.5	15
1983	90.6	152
1984	130.7	118
1985	89.9	152
1986	106.8	113
1987	88.7	162
1988	90.5	43

Table 6. Continued

PROBABILITY	T-YR	LOW FLOW VALUES
1.96	51.00	63.1
3.92	25.50	64.0
5.88	17.00	67.7
7.84	12.75	68.5
9.80	10.20	72.1
11.76	8.50	73.9
13.73	7.29	77.3
15.69	6.38	80.3
17.65	5.S7	80.7
19.61	5.10	81.1
21.57	4.64	83.2
23.53	4.25	84.1
25.49	3.92	86.8
27.45	3.64	88.1
29.41	3.40	88.7
31.37	3.19	89.9
33.33	3.00	90.1
35.29	2.83	90.5
37.25	2.68	90.6
39.22	2.55	91.1
41.18	2.43	98.6
43.14	2.32	101.0
45.10	2.22	102.5
47.06	2.13	106.8
49.02	2.04	122.3
50.98	1.96	122.8
52.94	1.89	122.8
54.90	1.82	126.3
56.86	1.76	127.5
58.82	1.70	127.9
60.78	1.65	130.5
62.75	1.59	130.7
64.71	1.55	137.7
66.67	1.50	149.7
68.63	1.46	154.9
70.59	1.42	169.2
72.55	1.38	170.5
74.51	1.34	190.0
76.47	1.31	206.4
78.43	1.27	207.9
80.39	1.24	209.9
82.35	1.21	263.1
84.31	1.19	287.3
86.27	1.16	322.5
88.24	1.13	341.9
90.20	1.11	360.6
92.16	1.09	395.9
94.12	1.06	514.4
96.08	1.04	871.1
98.04	1.02	2038.7
25-Year Flow		64.2
10-Year Flow		72.3
5-Year Flow		81.6
2-Year Flow		122.5

Table 6. Continued

31-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1939	123.0	154
1940	84.0	130
1941	110.9	89
1942	158.2	152
1943	87.8	152
1944	94.9	154
1945	284.0	114
1946	251.0	137
1947	132.0	150
1948	1251	140
1949	504.5	105
1950	543.5	154
1951	321.7	145
1952	93.0	154
1953	72.7	154
1954	83.4	113
1955	78.4	116
1956	82.8	154
1957	164.5	146
1958	508.5	154
1959	212.4	67
1960	108.9	154
1961	227.2	118
1962	249.7	126
1963	90.6	154
1964	66.5	154
1965	161.2	96
1966	185.9	113
1967	166.9	154
1968	429.9	129
1969	1304.8	105
1970	140.5	110
1971	97.0	145
1972	332.1	37
1973	921.8	154
1974	2191.3	154
1975	534.6	94
1976	86.4	145
1977	400.6	25
1978	221.7	135
1979	169.6	143
1980	114.9	152
1981	1480.9	145
1982	429.3	1
1983	101.1	137
1984	233.0	104
1985	98.8	137
1986	144.6	112
1987	100.4	154
1988	96.0	39

Table 6. Continued

PROBABILITY	T-YR	LOW FLOW VALUES
1.96	51.00	66.5
3.92	25.50	72.7
5.88	17.00	78.4
7.84	12.75	82.8
9.80	10.20	83.4
11.76	8.50	84.0
13.73	7.29	86.4
15.69	6.38	87.8
17.65	5.67	90.6
19.61	5.10	93.0
21.57	4.64	94.9
23.53	4.25	96.0
25.49	3.92	97.0
27.45	3.64	98.8
29.41	3.40	100.4
31.37	3.19	101.1
33.33	3.00	108.9
35.29	2.83	110.9
37.25	2.68	114.9
39.22	2.55	123.0
41.18	2.43	125.1
43.14	2.32	132.0
45.10	2.22	140.5
47.06	2.13	144.6
49.02	2.04	158.2
50.98	1.96	161.2
52.94	1.89	164.5
54.90	1.82	166.9
56.86	1.76	169.6
58.82	1.70	185.9
60.78	1.65	212.4
62.75	1.59	221.7
64.71	1.55	227.2
66.67	1.50	233.0
68.63	1.46	249.7
70.59	1.42	251.0
72.55	1.38	284.0
74.51	1.34	321.7
76.47	1.31	332.1
78.43	1.27	400.6
80.39	1.24	429.3
82.35	1.21	429.9
84.31	1.19	504.5
86.27	1.16	508.5
88.24	1.13	534.6
90.20	1.11	543.5
92.16	1.09	921.8
94.12	1.06	1304.8
96.08	1.04	1480.9
98.04	1.02	2191.3 .
25-Year Flow		73.0
10-Year Flow		83.5
5-Year Flow		93.4
2-Year Flow		159.7

Table 6. Continued

61-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1939	340.9	124
1940	124.0	124
1941	321.2	64
1942	230.6	122
1943	107.5	124
1944	143.9	124
1945	611.7	90
1946	483.2	124
1947	252.5	119
1948	262.7	124
1949	883.9	99
1950	1326.3	124
1951	507.7	115
1952	196.2	124
1953	77.6	124
1954	109.8	83
1955	280.0	100
1956	144.6	124
1957	528.9	124
1958	849.8	124
1959	433.2	124
1960	189.1	124
1961	364.0	124
1962	321.4	116
1963	216.2	124
1964	77.3	124
1965	314.9	80
1966	211.4	82
1967	302.9	124
1968	660.9	124
1969	1688.1	105
1970	290.4	105
1971	119.5	124
1972	405.0	35
1973	1779.6	124
1974	3387.4	124
1975	677.6	97
1976	103.1	116
1977	817.8	27
1978	437.8	124
1979	855.2	124
1980	341.4	121
1981	1984.5	124
1982	1425.6	102
1983	266.3	113
1984	634.6	85
1985	158.1	124
1986	274.3	94
1987	125.2	124
1988	121.5	15

Table 6. Continued

PROBABILITY	T-YR	LOW FLOW VALUES
1.96	51.00	77.3
3.92	25.50	77.6
5.88	17.00	103.1
7.84	12.75	107.5
9.80	10.20	109.8
11.76	8.50	119.5
13.73	7.29	121.5
15.S9	6.38	124.0
17.65	5.67	125.2
19.61	5.10	143.9
21.57	4.64	144.6
23.53	4.25	158.1
25.49	3.92	189.1
27.45	3.64	196.2
29.41	3.40	211.4
31.37	3.19	216.2
33.33	3.00	230.6
35.29	2.83	252.5
37.25	2.68	262.7
39.22	2.55	266.3
4118	2.43	274.3
43.14	2.32	280.0
45.10	2.22	290.4
47.06	2.13	302.9
49.02	2.04	314.9
50.98	1.96	321.2
52.94	1.89	321.4
54.90	1.82	340.9
56.86	1.76	341.4
58.82	1.70	364.0
60.78	1.65	405.0
62.75	1.59	433.2
64.71	1.55	437.8
66.67	1.50	483.2
68.63	1.46	507.7
70.59	1.42	528.9
72.55	1.38	611.7
74.51	1.34	634.6
76.47	1.31	660.9
78.43	1.27	677.6
80.39	1.24	817.8
82.35	1.21	849.8
84.31	1.19	855.2
86.27	1.16	883.9
88.24	1.13	1326.3
90.20	1.11	1425.6
92.16	1.09	1688.1
94.12	1.06	1779.6
96.08	1.04	1984.5
98.04	1.02	3387.4
25-Year Flow		79.1
10-Year Flow		110.9
5-Year Flow		144.0
2-Year Flow		318.1

Table 6. Continued

91-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1939	1475.1	94
1940	190.8	94
1941	351.5	73
1942	1096.8	94
1943	251.7	94
1944	169.8	94
1945	1382.7	85
1946	4640.6	94
1947	335.7	91
1948	4741	94
1949	1110.3	68
1950	1161.8	94
1951	1096.3	94
1952	204.2	94
1953	88.8	94
1954	120.3	53
1955	445.7	94
1956	522.7	94
1957	2645.4	94
1958	3625.4	94
1959	589.0	63
1960	289.5	94
1961	972.5	94
1962	524.1	94
1963	397.8	94
1964	93.8	94
1965	694.8	52
1966	278.5	94
1967	851.5	94
1968	770.5	80
1969	2606.4	80
1970	386.0	94
1971	505.9	94
1972	475.3	35
1973	2636.9	94
1974	3767.8	94
1975	717.3	94
1976	148.7	94
1977	827.0	11
1978	939.7	94
1979	1896.9	94
1980	423.2	91
1981	2407.7	94
1982	1841.9	94
1983	968.3	83
1984	871.9	82
1985	413.0	94
1986	739.8	84
1987	304.4	94
1988	153.3	26

Table 6. Continued

PROBABILITY	T-YR	LOW FLOW VALUES
1.96	51.00	88.8
3.92	25.50	93.8
5.88	17.00	120.3
7.84	12.75	148.7
9.80	10.20	153.3
11.76	8.50	169.8
13.73	7.29	190.8
15.69	6.38	204.2
17.65	5.67	251.7
19.61	5.10	278.5
21.57	4.64	289.5
23.53	4.25	304.4
25.49	3.92	335.7
27.45	3.64	351.5
29.41	3.40	386.0
31.37	3.19	397.8
33.33	3.00	413.0
35.29	2.83	423.2
37.25	2.68	445.7
39.22	2.55	474.1
4118	2.43	475.3
4314	2.32	505.9
45.10	2.22	522.7
47.06	2.13	524.1
49.02	2.04	589.0
50.98	1.96	694.8
52.94	1.89	717.3
54.90	1.82	739.8
56.86	1.76	770.5
58.82	1.70	827.0
60.78	1.65	851.5
62.75	1.59	871.9
64.71	1.55	939.7
66.67	1.50	968.3
68.63	1.46	972.5
70.59	1.42	1096.3
72.55	1.38	1096.8
74.51	1.34	1110.3
76.47	1.31	1161.8
78.43	1.27	1382.7
80.39	1.24	1475.1
82.35	1.21	1841.9
84.31	1.19	1896.9
86.27	1.16	2407.7
88.24	1.13	2606.4
90.20	1.11	2636.9
92.16	1.09	2645.4
94.12	1.06	3625.4
96.08	1.04	3767.8
98.04	1.02	4640.6
25-Year Flow		95.3
10-Year Flow		155.3
5-Year Flow		280.9
2-Year Flow		643.0

Table 6. Continued

121-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1939	1440.6	64
1940	199.7	64
1941	577.5	50
1942	3999.7	64
1943	1555.2	64
1944	223.3	64
1945	2396.5	64
1946	3917.4	64
1947	1633.8	64
1948	1382.3	64
1949	1228.4	15
1950	1478.2	64
1951	2809.4	64
1952	476.0	64
1953	258.2	64
1954	131.6	23
1955	753.7	64
1956	845.5	64
1957	5209.3	64
1958	3871.0	64
1959	565.3	64
1960	1952.5	64
1961	1056.8	64
1962	783.7	64
1963	615.5	64
1964	148.8	64
1965	944.1	64
1966	283.3	64
1967	1408.8	64
1968	1094.5	64
1969	3806.3	22
1970	1239.8	64
1971	955.7	64
1972	566.6	34
1973	3441.9	64
1974	3954.4	64
1975	827.2	64
1976	142.2	58
1977	934.6	16
1978	1398.6	64
1979	1862.4	64
1980	525.0	64
1981	2699.7	64
1982	2427.6	64
1983	1710.0	64
1984	1239.0	53
1985	735.2	64
1986	856.3	33
1987	722.1	64
1988	149.6	33

Table 6. Continued

PROBABILITY	T-YR	LOW FLOW VALUES
1.96	51.00	131.6
3.92	25.50	142.2
5.88	17.00	148.8
7.84	12.75	149.6
9.80	10.20	199.7
11.76	8.50	223.3
13.73	7.29	258.2
15.69	6.38	283.3
17.65	5.67	476.0
19.61	5.10	525.0
21.57	4.64	565.3
23.53	4.25	566.6
25.49	3.92	577.5
27.45	3.64	615.5
29.41	3.40	722.1
31.37	3.19	735.2
33.33	3.00	753.7
35.29	2.83	783.7
37.25	2.68	827.2
39.22	2.55	845.5
41.18	2.43	856.3
43.14	2.32	934.6
45.10	2.22	944.1
47.06	2.13	955.7
49.02	2.04	1056.8
50.98	1.96	1094.5
52.94	1.89	1228.4
54.90	1.82	1239.0
56.86	1.76	1239.8
58.82	1.70	1382.3
60.78	1.65	1398.6
62.75	1.59	1408.8
64.71	1.55	1440.6
66.67	1.50	1478.2
68.63	1.46	1555.2
70.59	1.42	1633.8
72.55	1.38	1710.0
74.51	1.34	1862.4
76.47	1.31	1952.5
78.43	1.27	2396.5
80.39	1.24	2427.6
82.35	1.21	2699.7
84.31	1.19	2809.4
86.27	1.16	3441.9
88.24	1.13	3806.3
90.20	1.11	3871.0
92.16	1.09	3917.4
94.12	1.06	3954.4
96.08	1.04	3999.7
98.04	1.02	5209.3
25-Year Flow		142.6
10-Year Flow		202.5
5-Year Flow		533.7
2-Year Flow		1076.0

Table 6. Continued

151-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1939	1627.5	34
1940	354.8	34
1941	710.9	14
1942	4096.9	34
1943	3637.1	34
1944	760.0	34
1945	4137.0	34
1946	4221.8	34
1947	2507.2	34
1948	1531.4	34
1949	1263.2	8
1950	1964.2	34
1951	2687.3	25
1952	858.9	34
1953	354.9	34
1954	208.0	10
1955	861.2	34
1956	1156.8	34
1957	7289.2	34
1958	3799.4	34
1959	665.7	34
1960	2317.0	34
1961	1636.5	34
1962	1204.5	34
1963	693.7	34
1964	419.6	34
1965	1172.5	34
1966	712.0	34
1967	1552.1	34
1968	1955.8	34
1969	3514.1	15
1970	2326.8	34
1971	923.9	34
1972	664.6	34
1973	4326.1	34
1974	4481.4	34
1975	984.5	34
1976	150.2	34
1977	978.7	1
1978	1630.7	34
1979	1985.5	34
1980	629.0	32
1981	2919.2	34
1982	2645.8	3
1983	2472.9	24
1984	1765.0	34
1985	1143.3	34
1986	735.4	3
1987	641.9	34
1988	158.6	3

Table 6. Continued

PROBABILITY	T-YR	LOW FLOW VALUES
1.96	51.00	150.2
3.92	25.50	158.6
5.88	17.00	208.0
7.84	12.75	354.8
9.80	10.20	354.9
11.76	8.50	419.6
13.73	7.29	629.0
15.69	6.38	641.9
17.65	5.67	664.6
19.61	5.10	665.7
21.57	4.64	693.7
23.53	4.25	710.9
25.49	3.92	712.0
27.45	3.64	735.4
29.41	3.40	760.0
31.37	3.19	858.9
33.33	3.00	861.2
35.29	2.83	923.9
37.25	2.68	978.7
39.22	2.55	984.5
41.18	2.43	1143.3
43.14	2.32	1156.8
45.10	2.22	1172.5
47.06	2.13	1204.5
49.02	2.04	1263.2
50.98	1.96	1531.4
52.94	1.89	1552.1
54.90	1.82	1627.5
56.86	1.76	1630.7
58.82	1.70	1636.5
60.78	1.65	1765.0
62.75	1.59	1955.8
64.71	1.55	1964.2
66.67	1.50	1985.5
68.63	1.46	2317.0
70.59	1.42	2326.8
72.55	1.38	2472.9
74.51	1.34	2507.2
76.47	1.31	2645.8
78.43	1.27	2687.3
80.39	1.24	2919.2
82.35	1.21	3514.1
84.31	119	3637.1
86.27	1.16	3799.4
88.24	1.13	4096.9
90.20	1.11	4137.0
92.16	1.09	4221.8
9412	1.06	4326.1
96.08	1.04	4481.4
98.04	1.02	7289.2
25-Year Flow		161.5
10-Year Flow		362.5
5-Year Flow		671.7
2-Year Flow		1399.9

Table 6. Continued

181-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1939	1851.8	4
1940	658.6	4
1941	1015.9	1
1942	3865.5	3
1943	5934.9	4
1944	2211.4	4
1945	4691.8	4
1946	5065.0	4
1947	3513.1	4
1948	1910.4.	4
1949	1840.3	1
1950	2141.3	4
1951	2581.3	4
1952	1007.3	4
1953	669.9	4
1954	216.2	1
1955	895.4	4
1956	1241.9	4
1957	8579.7	4
1958	3825.6	4
1959	956.5	4
1960	2534.4	4
1961	4325.0	4
1962	1513.3	4
1963	1136.7	4
1964	712.6	4
1965	1279.0	4
1966	1582.4	4
1967	1950.5	4
1968	2069.4	1
1969	3733.2	1
1970	3365.3	4
1971	867.2	4
1972	1073.8	4
1973	4762.3	4
1974	4418.2	4
1975	1336.4	4
1976	166.5	4
1977	1125.1	1
1978	2261.0	4
1979	2779.8	4
1980	609.7	4
1981	2919.7	1
1982	2547.3	2
1983	3371.4	4
1984	2366.3	4
1985	1366.3	4
1986	924.2	1
1987	592.6	4

Table 6. Concluded

PROBABILITY	T-YR	LOW FLOW VALUES
2.00	50.00	166.5
4.00	25.00	216.2
6.00	16.67	592.6
8.00	12.50	609.7
10.00	10.00	658.6
12.00	8.33	669.9
14.00	7.14	712.6
16.C0	6.25	867.2
18.00	5.56	895.4
20.00	5.00	924.2
22.00	4.55	956.5
24.00	4.17	1007.3
26.00	3.85	1015.9
28.00	3.57	1073.8
30.00	3.33	1125.1
32.00	3.13	1136.7
34.00	2.94	1241.9
36.00	2.78	1279.0
38.00	2.63	1336.4
40.00	2.50	1366.3
42.00	2.38	1513.3
44.00	2.27	1582.4
46.00	2.17	1840.3
48.00	2.08	1851.8
50.00	2.00	1910.4
52.00	1.92	1950.5
54.00	1.85	2069.4
56.00	1.79	2141.3
58.00	1.72	2211.4
60.00	1.67	2261.0
62.00	1.61	2366.3
64.00	1.56	2534.4
66.00	1.52	2547.3
68.00	1.47	2581.3
70.00	1.43	2779.8
72.00	1.39	2919.7
74.00	1.35	3365.3
76.00	1.32	3371.4
78.00	1.28	3513.1
80.00	1.25	3733.2
82.00	1.22	3825.6
84.00	1.19	3865.5
86.00	1.16	4325.0
88.00	1.14	4418.2
90.00	1.11	4691.8
92.00	1.09	4762.3
94.00	1.06	5065.0
96.00	1.04	5934.9
98.00	1.02	8579.7
25-Year Flow		216.2
10-Year Flow		658.6
5-Year Flow		924.2
2-Year Flow		1910.4

Table 7. Seasonal (May - October) Low-Flow Statistics for
Total System Inflow over Years 1971 - 1988

7-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	96.4	167
1972	290.8	60
1973	354.6	173
1974	1836.0	178
1975	360.6	101
1976	85.8	141
1977	161.6	37
1978	131.6	158
1979	130.5	161
1980	93.6	163
1981	394.4	5
1982	453.7	13
1983	112.0	157
1984	174.0	119
1985	122.3	156
1986	119.9	121
1987	115.5	169
1988	112.0	147

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	85.8
10.53	9.50	93.6
15.79	6.33	96.4
21.05	4.75	112.0
26.32	3.80	112.0
31.58	3.17	115.5
36.84	2.71	119.9
42.11	2.38	122.3
47.37	2.11	130.5
52.63	1.90	131.6
57.89	1.73	161.6
6316	1.58	174.0
68.42	1.46	290.8
73.68	1.36	354.6
78.95	1.27	360.6
84.21	1.19	394.4
89.47	1.12	453.7
94.74	1.06	1836.0
19-Year Flow		85.8
10-Year Flow		93.1
5-Year Flow		109.5
2-Year Flow		131.1

Table 7. Continued

15-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	99.9	159
1972	324.9	56
1973	428.3	169
1974	2131.8	170
1975	642.5	103
1976	92.0	143
1977	277.0	35
1978	158.5	151
1979	153.2	156
1980	108.3	155
1981	1040.7	1
1982	467.5	12
1983	118.5	150
1984	195.8	117
1985	128.0	150
1986	148.2	113
1987	141.0	159
1988	137.4	58

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	92.0
10.53	9.50	99.9
15.79	6.33	108.3
21.05	4.75	118.5
26.32	3.80	128.0
31.58	3.17	137.4
36.84	2.71	141.0
42.11	2.38	148.2
47.37	2.11	153.2
52.63	1.90	158.5
57.89	1.73	195.8
6316	1.58	277.0
68.42	1.46	324.9
73.68	1.36	428.3
78.95	1.27	467.5
84.21	1.19	642.5
89.47	1.12	1040.7
94.74	1.06	2131.8
19-Year Flow		92.0
10-Year Flow		99.5
5-Year Flow		116.9
2-Year Flow		156.0

Table 7. Continued

31-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	113.5	146
1972	4221	40
1973	1072.6	154
1974	2321.2	154
1975	830.2	154
1976	114.6	57
1977	504.9	22
1978	316.6	135
1979	200.4	143
1980	155.6	151
1981	2519.2	139
1982	1235.2	1
1983	148.7	135
1984	353.8	101
1985	137.5	135
1986	239.5	110
1987	192.6	146
1988	144.4	42

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	113.5
10.53	9.50	114.6
15.79	6.33	137.5
21.05	4.75	144.4
26.32	3.80	148.7
31.58	3.17	155.6
36.84	2.71	192.6
42.11	2.38	200.4
47.37	2.11	239.5
52.63	1.90	316.6
57.89	1.73	353.8
63.16	1.58	422.1
68.42	1.46	504.9
73.68	1.36	830.2
78.95	1.27	1072.6
84.21	1.19	1235.2
89.47	1.12	2321.2
94.74	1.06	2519.2

19-Year Flow	113.5
10-Year Flow	114.5
5-Year Flow	143.3
2-Year Flow	280.0

Table 7. Continued

61-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	150.4	124
1972	513.9	35
1973	2088.2	124
1974	3802.5	124
1975	1011.3	124
1976	157.8	116
1977	1187.0	25
1978	550.2	124
1979	887.2	124
1980	479.8	120
1981	3190.4	109
1982	1843.7	101
1983	343.6	112
1984	789.5	73
1985	244.9	124
1986	589.4	93
1987	295.1	124
1988	221.6	13

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	150.4
10.53	9.50	157.8
15.79	6.33	221.6
21.05	4.75	244.9
26.32	3.80	2951
31.58	3.17	343.6
36.84	2.71	479.8
42.11	2.38	513.9
47.37	2.11	550.2
52.63	1.90	589.4
57.89	1.73	789.5
6316	1.58	887.2
68.42	1.46	1011.3
73.68	1.36	1187.0
78.95	1.27	1843.7
84.21	1.19	2088.2
89.47	1.12	3190.4
94.74	1.06	3802.5

19-Year Flow	150.4
10-Year Flow	157.4
5-Year Flow	241.2
2-Year Flow	570.8

Table 7. Continued

91 -DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	546.5	94
1972	686.9	35
1973	2916.6	94
1974	4142.2	94
1975	9871	94
1976	258.7	94
1977	1163.9	10
1978	1069.5	94
1979	2044.8	94
1980	566.6	89
1981	3474.5	94
1982	2285.1	94
1983	1127.7	82
1984	1316.6	74
1985	648.6	94
1986	1200.7	50
1987	542.0	94
1988	296.7	35

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	258.7
10.53	9.50	296.7
15.79	6.33	542.0
21.05	4.75	546.5
26.32	3.80	566.6
31.58	3.17	648.6
36.84	2.71	686.9
42.11	2.38	987.1
47.37	2.11	1069.5
52.63	1.90	1127.7
57.89	1.73	1163.9
63.16	1.58	1200.7
68.42	1.46	1316.6
73.68	1.36	2044.8
78.95	1.27	2285.1
84.21	1.19	2916.6
89.47	1.12	3474:5
94.74	1.06	4142.2
19-Year Flow		258.7
10-Year Flow		294.7
5-Year Flow		545.8
2-Year Flow		1100.1

Table 7. Continued

121-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	1025.7	64
1972	746.7	33
1973	3770.5	64
1974	4258.2	64
1975	1213.7	64
1976	275.9	56
1977	1462.3	16
1978	1549.5	64
1979	2343.3	64
1980	6941	64
1981	4036.1	56
1982	3059.4	64
1983	2015.2	52
1984	1742.7	51
1985	1005.7	64
1986	1205.8	20
1987	1208.5	64
1988	282.0	33

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	275.9
10.53	9.50	282.0
15.79	6.33	6941
21.05	4.75	746.7
26.32	3.80	1005.7
31.58	3.17	1025.7
36.84	2.71	1205.8
42.11	2.38	1208.5
47.37	2.11	1213.7
52.63	1.90	1462.3
57.89	1.73	1549.5
63.16	1.58	1742.7
68.42	1.46	2015.2
73.68	1.36	2343.3
78.95	1.27	3059.4
84.21	1.19	3770.5
89.47	1.12	4036.1
94.74	1.06	4258.2
19-Year Flow		275.9
10-Year Flow		281.7
5-Year Flow		738.4
2-Year Flow		1344.5

Table 7. Continued

151-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	1072.8	34
1972	820.3	34
1973	5034.1	34
1974	5030.1	34
1975	1409.0	34
1976	290.8	34
1977	1459.6	10
1978	1786.3	34
1979	2430.1	34
1980	797.7	32
1981	4240.7	34
1982	3614.0	9
1983	2913.2	22
1984	2298.3	22
1985	1776.6	34
1986	1107.2	2
1987	1105.7	27
1988	304.0	3

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	290.8
10.53	9.50	304.0
15.79	6.33	797.7
21.05	4.75	820.3
26.32	3.80	1072.8
31.58	3.17	1105.7
36.84	2.71	1107.2
42.11	2.38	1409.0
47.37	2.11	1459.6
52.63	1.90	1776.6
57.89	1.73	1786.3
6316	1.58	2298.3
68.42	1.46	24301
73.68	1.36	2913.2
78.95	1.27	3614.0
84.21	1.19	4240.7
89.47	1.12	5030.1
94.74	1.06	5034.1

19-Year Flow	290.8
10-Year Flow	303.3
5-Year Flow	816.7
2-Year Flow	1626.4

Table 7. Concluded

181-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	1130.8	4
1972	1257.4	4
1973	5624.5	4
1974	5059.1	4
1975	1860.5	4
1976	319.5	2
1977	1628.6	1
1978	2607.8	4
1979	3251.5	4
1980	795.6	4
1981	4217.0	1
1982	3439.8	3
1983	4137.5	4
1984	3030.1	4
1985	1947.2	4
1986	1507.7	1
1987	1022.7	4

PROBABILITY	T-YR	LOW FLOW VALUES
5.56	18.00	319.5
11.11	9.00	795.6
16.67	6.00	1022.7
22.22	4.50	1130.8
27.78	3.60	1257.4
33.33	3.00	1507.7
38.89	2.57	1628.6
44.44	2.25	1860.5
50.00	2.00	1947.2
55.56	1.80	2607.8
61.11	1.64	3030.1
66.67	1.50	3251.5
72.22	1.38	3439.8
77.78	1.29	4137.5
83.33	1.20	4217.0
88.89	1.13	5059.1
94.44	1.06	5624.5
19-Year Flow		319.5
10-Year	Flow	742.7
5-Year Flow		1094.7
2-Year Flow		1947.2

ANALYSIS OF LOCK AND DAM OPERATION

One of the main objectives of this study was to determine the severity of the water shortages experienced during the 1987 and 1988 summer seasons in the lower Kaskaskia River system due to a combination of increased pleasure-boat traffic and lockages, and dry conditions. A great deal of effort was expended in collecting and compiling the historical data, and in generating the missing and necessary information. All this information (on streamflows, evaporation, withdrawals, lockages, and pool and tailwater stages) has been used in the basin model to simulate the conditions within the lower Kaskaskia River system under different operation and management strategies. The hypothetical lockage conditions since 1971 have been generated by using the 1987 and 1988 lockage trends. The monthly and weekly lockage patterns of these last two years have also been preserved.

A number of scenarios have been analyzed by using the basin model to determine optimum or desirable management strategies for the operation of the Kaskaskia lock and dam. These scenarios do not necessarily comply with legislative constraints that may already exist. More than 25 scenarios were tested in this study, but only those with significant impact on the system will be discussed.

Basically, three control parameters were used in the analyses: 1) navigation pool level (h_p), 2) maximum number of lockages allowed per day (NL_{max}), and 3) maximum number of lockages allowed per day when pool drops below the normal level (NL_{low}). Several combinations of these parameters have been tested. However, results from some scenarios have not been presented here since they indicated insignificant variation from other scenarios.

Normal pool level was taken at 368.00 feet msl. The water-surface area at this level behind the dam has been reported as 3,663 acres by the U.S. Army Corps of Engineers (personal communications). Four other pool elevations, with 1-inch, 2-inch, 3-inch, and 6-inch additional storage, were considered. The additional storage was estimated by assuming that the water-surface area would not change as a result of the increased pool level. In that case, 1 inch of storage would equal approximately 305 acre-feet. The parameter values used are listed below:

Pool Level (h_p)	:	368.00'	368.00'+l"	368.00'+2"	368.00'+3"	368.00'+6"
NL_{max}	:	40	20	15		
NL_{low}	:	40	20	15		

with the constraint that $NL_{max} \geq NL_{low}$. The highest value for daily lockages (40) represents an unlimited lockage situation, since this exceeds the historical maximum number of daily lockages.

The results generated by using the model with different combinations of pool levels and lockage limitations are shown in tables 8 through 39. The deficit period in those tables indicates the time period between the day the pool falls below 368.00 feet and the day the pool recovers to 368.00 feet, regardless of what the initial pool level was. Deficit amounts are given in two units: inches of pool storage (1 inch equals approximately 305 acre-feet), and cfsd (average rate of deficit in cfs, times the deficit duration in days). The values shown in the tables are the maximum cumulative storage deficits that accrued during the indicated deficit periods.

A summary of these deficit durations is given in table 40 for different combinations of pool elevations, and for NL_{max} and NL_{low}. TDD denotes the total number of deficit days in the 18-year period (1971-1988), and TDD* refers to the total number of deficit days when pool was lower then 1 inch below 368 feet, or 367.92 feet.

It is obvious from the analysis of the results given in table 40 that the highest rate of decrease in the number of deficit days, TDD, occurs with an increase in pool elevation. These values may be slightly deceptive since they include all the days that the total inflows were less than total losses. For practical purposes, we can assume an arbitrary threshold value of 1 inch of total deficit and can ignore the days when the total deficit was less than the threshold deficit. Such an assumption is not critical, because the level of errors introduced in the model due to generating lockage and streamflow information is probably more significant. Therefore using such a small threshold value for deficits would not affect the interpretation of the results significantly. The second column TDD* under each pool elevation in table 40 indicates the total number of days when the cumulative deficit was greater than 1 inch. In this case the situation becomes more tolerable, although not completely remedied.

We would, of course, want to compare all these scenarios with the conditions where there are only commercial lockages. The analysis of informal daily logs of commercial barge traffic that were kept by the lock and dam operators indicated that the average number of tows that locked during low-flow periods in the last seven years was less than eight per day. Therefore, four commercial lockages per day was used as an average uniform value for the simulation period, assuming that two sequential tows would make one complete lock. There were thus 78 total deficit days for the simulation period with h_p = 368.00 feet and NL_{max} = 4, and only 24 days when the total deficit was more than 1 inch (all of them occurring in 1976). If, however, there had not been any lockages, then TDD would have equaled 12, and the deficit would never have been more than 1 inch (TDD = 0). What this tells us is that at normal pool level and under the least stressful operating

conditions (NL_{max} = 4 and zero), we would expect to have some deficit days, although, the situation would not be very serious. Therefore it may be fair to conclude that if the navigation pool had been operated only with commercial traffic, the system would have met the demands, with the exception of some years (such as 1976 and 1988) when some marginal deficits might have occurred. Bigger deficits might have occurred during such years if the number of lockages had been increased.

Table 8. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.000 ft.msl; NL_{max} =40; NL_{low} = 40

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1972	Jul	9	-	1972	Jul	10	1	0.05	6.99
1975	Aug	23	-	1975	Aug	25	2	0.10	15.50
1976	Jun	12	-	1976	Jun	23	11	1.33	204.31
1976	Jun	27	-	1976	Jun	29	2	0:17	25.64
1976	Jul	1	-	1976	Jul	3	2	0.01	2.20
1976	Jul	4	-	1976	Jul	8	4	0.76	117.57
1976	Jul	9	-	1976	Jul	30	21	12.29	1891.54
1976	Aug	7	-	1976	Aug	13	6	1.04	160.40
1976	Aug	21	-	1976	Sep	10	20	6.30	969.92
1976	Sep	12	-	1976	Oct	7	25	7.17	1103.78
1976	Oct	13	-	1976	Oct	24	11	1.97	303.51
1977	Jun	5	-	1977	Jun	13	8	1.75	268.90
1977	Jul	17	-	1977	Jul	18	1	0.04	5.69
1977	Aug	6	-	1977	Aug	9	3	1.14	174.78
1979	Oct	7	-	1979	Oct	8	1	0.04	6.65
1979	Oct	13	-	1979	Oct	15	2	0.32	48.70
1980	Jul	19	-	1980	Jul	22	3	1.43	220.71
1980	Aug	2	-	1980	Aug	5	3	1.61	248.22
1980	Aug	9	-	1980	Aug	15	6	1.69	260.78
1980	Aug	31	-	1980	Sep	2	2	0.48	74.00
1980	Oct	11	-	1980	Oct	17	6	0.88	135.94
1980	Oct	19	-	1980	Oct	20	1	0.02	3.44
1980	Oct	26	-	1980	Oct	27	1	0.13	20.46
1983	Sep	11	-	1983	Sep	12	1	0.18	28.24
1983	Sep	18	-	1983	Sep	20	2	0.41	63.35
1983	Sep	24	-	1983	Sep	26	2	0.47	71.58
1984	Sep	1	-	1984	Sep	3	2	0.66	101.45
1984	Sep	8	-	1984	Sep	9	1	0.73	112.33
1985	Sep	14	-	1985	Sep	18	4	0.45	68.82
1985	Sep	22	-	1985	Sep	25	3	0.38	58.67
1985	Sep	28	-	1985	Oct	1	3	0.28	43.57
1986	Aug	25	-	1986	Aug	26	1	0.38	59.01
1986	Aug	31	-	1986	Sep	4	4	0.57	87.36
1987	Jun	14	-	1987	Jun	16	2	0.24	36.47
1987	Jun	27	-	1987	Jun	29	2	0.29	45.03
1987	Sep	13	-	1987	Sep	14	1	0.19	29.48
1987	Sep	24	-	1987	Sep	29	5	1.14	174.95
1987	Oct	9	-	1987	Oct	10	1	0.25	39.00
1987	Oct	18	-	1987	Oct	19	1	0.34	52.75
1988	May	29	-	1988	Jun	2	4	0.66	102.18
1988	Jun	4	-	1988	Jul	20	46	10.11	1556.42
1988	Jul	24	-	1988	Jul	25	1	0.24	36.63
1988	Jul	31	-	1988	Aug	1	1	0.07	11.10
1988	Aug	6	-	1988	Aug	16	10	1.81	278.93
1988	Aug	20	-	1988	Aug	24	4	1.75	269.07
1988	Aug	27	-	1988	Aug	30	3	0.38	58.90
1988	Sep	4	-	1988	Sep	5	1	0.03	4.40
1988	Sep	10	-	1988	Sep	13	3	1.55	237.90
1988	Sep	17	-	1988	Sep	18	1	0.17	26.83
1988	Sep	25	-	1989	Oct	1	6	1.20	184.81

Total Deficit Days (TDD) =	257
TDD when Cumulative Deficit > 1" (TDD*) =	131

Table 9. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.000 ft.msl; NL_{max} =40; NL_{low} = 20

Deficit Period						Total Days	Cumulative Deficit inches	cfsd
1972	Jul	9	-	1972	Jul	10	1	0.05	6.99
1975	Aug	23	-	1975	Aug	25	2	0.10	15.50
1976	Jun	12		1976	Jun	23	11	1.17	180.36
1976	Jun	27		1976	Jun	29	2	0.17	25.64
1976	Jul	1		1976	Jul	3	2	0.01	2.20
1976	Jul	4		1976	Jul	8	4	0.76	117.57
1976	Jul	9		1976	Jul	29	20	11.07	1704.31
1976	Aug	7		1976	Aug	13	6	1.04	160.40
1976	Aug	21		1976	Sep	10	20	6.30	969.92
1976	Sep	12		1976	Oct	7	25	7.17	1103.78
1976	Oct	13		1976	Oct	24	11	1.97	303.51
1977	Jun	5	-	1977	Jun	13	8	1.57	241.28
1977	Jul	17	-	1977	Jul	18	1	0.04	5.69
1977	Aug	6	-	1977	Aug	9	3	1.14	174.78
1979	Oct	7	-	1979	Oct	8	1	0.04	6.65
1979	Oct	13	-	1979	Oct	15	2	0.32	48.70
1980	Jul	19	-	1980	Jul	22	3	0.86	133.01
1980	Aug	2	-	1980	Aug	5	3	1.61	248.22
1980	Aug	9	-	1980	Aug	15	6	1.69	260.78
1980	Aug	31	-	1980	Sep	2	2	0.48	74.00
1980	Oct	11	-	1980	Oct	17	6	0.88	135.94
1980	Oct	19	-	1980	Oct	20	1	0.02	3.44
1980	Oct	26	-	1980	Oct	27	1	0.13	20.46
1983	Sep	11	-	1983	Sep	12	1	0.18	28.24
1983	Sep	18	-	1983	Sep	20	2	0.41	63.35
1983	Sep	24	-	1983	Sep	26	2	0.47	71.58
1984	Sep	1	-	1984	Sep	3	2	0.66	101.45
1984	Sep	8	-	1984	Sep	9	1	0.73	112.33
1985	Sep	14	-	1985	Sep	18	4	0.45	68.82
1985	Sep	22	-	1985	Sep	25	3	0.38	58.67
1985	Sep	28	-	1985	Oct	1	3	0.28	43.57
1986	Aug	25	-	1986	Aug	26	1	0.38	59.01
1986	Aug	31	-	1986	Sep	4	4	0.57	87.36
1987	Jun	14	-	1987	Jun	16	2	0.24	36.47
1987	Jun	27	-	1987	Jun	29	2	0.29	45.03
1987	Sep	13	-	1987	Sep	14	1	0.19	29.48
1987	Sep	24	-	1987	Sep	29	5	1.14	174.95
1987	Oct	9	-	1987	Oct	10	1	0.25	39.00
1987	Oct	18	-	1987	Oct	19	1	0.34	52.75
1988	May	29	-	1988	Jun	2	4	0.66	102.18
1988	Jun	4	-	1988	Jul	19	45	9.62	1480.44
1988	Jul	24	-	1988	Jul	25	1	0.24	36.63
1988	Jul	31	-	1988	Aug	1	1	0.07	11.10
1988	Aug	6	-	1988	Aug	16	10	1.81	278.93
1988	Aug	20	-	1988	Aug	24	4	1.75	269.07
1988	Aug	27	-	1988	Aug	30	3	0.38	58.90
1988	Sep	4	-	1988	Sep	5	1	0.03	4.40
1988	Sep	10	-	1988	Sep	13	3	1.55	237.90
1988	Sep	17	-	1988	Sep	18	1	0.17	26.83
1988	Sep	25	-	1989	Oct	1	6	1.20	184.81
Total Deficit Days (TDD) =							255		
TDD when Cumulative Deficit > 1" (TDD*) =							126		

Table 10. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.000 ft.msl; NL_{max}=40; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1972	Jul	9	-	1972	Jul	10	1	0.05	6.99
1975	Aug	23	-	1975	Aug	25	2	0.10	15.50
1976	Jun	12	-	1976	Jun	23	11	0.91	140.45
1976	Jun	27	-	1976	Jun	29	2	0.17	25.64
1976	Jul	1	-	1976	Jul	3	2	0.01	2.20
.1976	Jul	4	-	1976	Jul	8	4	0.76	117.57
1976	Jul	9	-	1976	Jul	28	19	9.69	1491.04
1976	Aug	7	-	1976	Aug	13	6	0.70	107.09
1976	Aug	21	-	1976	Sep	10	20	5.75	884.93
1976	Sep	12		1976	Oct	7	25	7.00	1077.85
1976	Oct	13	-	1976	Oct	24	11	1.97	303.51
1977	Jun	5	-	1977	Jun	13	8	1.20	184.87
1977	Jul	17	-	1977	Jul	18	1	0.04	5.69
1977	Aug	6	-	1977	Aug	9	3	0.75	114.70
1979	Oct	7	-	1979	Oct	8	1	0.04	6.65
1979	Oct	13	-	1979	Oct	15	2	0.32	48.70
1980	Jul	19	-	1980	Jul	22	3	0.51	78.23
1980	Aug	2	-	1980	Aug	5	3	1.25	191.91
1980	Aug	9	-	1980	Aug	14	5	1.37	210.34
1980	Aug	31	-	1980	Sep	2	2	0.42	64.87
1980	Oct	11	-	1980	Oct	17	6	0.88	135.94
1980	Oct	19	-	1980	Oct	20	1	0.02	3.44
1980	Oct	26	-	1980	Oct	27	1	0.13	20.46
1983	Sep	11	-	1983	Sep	12	1	0.18	28.24
1983	Sep	18	-	1983	Sep	20	2	0.41	63.35
1983	Sep	24	-	1983	Sep	26	2	0.47	71.58
1984	Sep	1	-	1984	Sep	3	2	0.55	84.60
1984	Sep	8	-	1984	Sep	9	1	0.73	112.33
1985	Sep	14	-	1985	Sep	17	3	0.34	52.47
1985	Sep	22	-	1985	Sep	25	3	0.38	58.67
1985	Sep	28	-	1985	Oct	1	3	0.28	43.57
1986	Aug	25	-	1986	Aug	26	1	0.38	59.01
1986	Aug	31	-	1986	Sep	4	4	0.53	80.93
1987	Jun	14	-	1987	Jun	16	2	0.24	36.47
1987	Jun	27	-	1987	Jun	29	2	0.29	45.03
1987	Sep	13	-	1987	Sep	14	1	0.19	29.48
1987	Sep	24	-	1987	Sep	29	5	1.14	174.95
1987	Oct	9	-	1987	Oct	10	1	0.25	39.00
1987	Oct	18	-	1987	Oct	19	1	0.34	52.75
1988	May	29	-	1988	May	31	2	0.32	49.54
1988	Jun	4	-	1988	Jul	15	41	8.00	1231.38
1988	Jul	16	-	1988	Jul	18	2	0.99	152.74
1988	Jul	24	-	1988	Jul	25	1	0.24	36.63
1988	Jul	31	-	1988	Aug	1	1	0.07	11.10
1988	Aug	6	-	1988	Aug	15	9	1.19	182.67
1988	Aug	20	-	1988	Aug	24	4	1.52	233.28
1988	Aug	27	-	1988	Aug	30	3	0.38	58.90
1988	Sep	4	-	1988	Sep	5	1	0.03	4.40
1988	Sep	10	-	1988	Sep	13	3	1.55	237.90
1988	Sep	17	-	1988	Sep	18	1	0.17	26.83
1988	Sep	25	-	1989	Oct	1	6	1.20	184.81

Total Deficit Days (TDD) = 247

TDD when Cumulative Deficit > 1" (TDD*) = 104

Table 11. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.000 ft.msl; NL_{max}=20; NL_{low} = 20

Deficit Period						Total Days	Cumulative Deficit inches	cfsd
1975	Aug	23	-	1975	Aug	25	2	0.10	15.50
1976	Jun	12	-	1976	Jun	23	11	1.17	180.36
1976	Jun	27	-	1976	Jun	29	2	0.17	25.64
1976	Jul	1	-	1976	Jul	3	2	0.01	2.20
1976	Jul	4	-	1976	Jul	8	4	0.76	117.57
1976	Jul	9	-	1976	Jul	29	20	11.07	1704.31
1976	Aug	7	-	1976	Aug	13	6	1.04	160.40
1976	Aug	21	-	1976	Sep	10	20	6.30	969.92
1976	Sep	12	-	1976	Oct	7	25	7.17	1103.78
1976	Oct	13	-	1976	Oct	24	11	1.97	303.51
1977	Jun	5	-	1977	Jun	13	8	1.44	221.67
1977	Aug	6	-	1977	Aug	9	3	1.14	174.78
1979	Oct	7	-	1979	Oct	8	1	0.04	6.65
1979	Oct	13	-	1979	Oct	15	2	0.32	48.70
1980	Jul	20	-	1980	Jul	22	2	0.66	101.79
1980	Aug	2	-	1980	Aug	5	3	1.61	248.22
1980	Aug	9	-	1980	Aug	15	6	1.69	260.78
1980	Aug	31	-	1980	Sep	2	2	0.48	74.00
1980	Oct	11	-	1980	Oct	17	6	0.88	135.94
1980	Oct	19	-	1980	Oct	20	1	0.02	3.44
1980	Oct	26	-	1980	Oct	27	1	0.13	20.46
1983	Sep	11	-	1983	Sep	12	1	0.18	28.24
1983	Sep	18	-	1983	Sep	20	2	0.41	63.35
1983	Sep	24	-	1983	Sep	26	2	0.47	71.58
1984	Sep	1	-	1984	Sep	3	2	0.66	101.45
1984	Sep	8	-	1984	Sep	9	1	0.73	112.33
1985	Sep	14	-	1985	Sep	18	4	0.45	68.82
1985	Sep	22	-	1985	Sep	25	3	0.38	58.67
1985	Sep	28	-	1985	Oct	1	3	0.28	43.57
1986	Aug	25	-	1986	Aug	26	1	0.38	59.01
1986	Aug	31	-	1986	Sep	4	4	0.57	87.36
1987	Jun	14	-	1987	Jun	15	1	0.17	25.64
1987	Jun	27	-	1987	Jun	29	2	0.29	45.03
1987	Sep	13	-	1987	Sep	14	1	0.19	29.48
1987	Sep	24	-	1987	Sep	29	5	1.14	174.95
1987	Oct	9	-	1987	Oct	10	1	0.25	39.00
1987	Oct	18	-	1987	Oct	19	1	0.34	52.75
1988	May	30	-	1988	Jun	1	2	0.46	71.52
1988	Jun	4	-	1988	Jul	19	45	9.62	1480.44
1988	Jul	31	-	1988	Aug	1	1	0.07	11.10
1988	Aug	6	-	1988	Aug	16	10	1.81	278.93
1988	Aug	20	-	1988	Aug	24	4	1.75	269.07
1988	Aug	27	-	1988	Aug	30	3	0.38	58.90
1988	Sep	4	-	1988	Sep	5	1	0.03	4.40
1988	Sep	10	-	1988	Sep	13	3	1.55	237.90
1988	Sep	17	-	1988	Sep	18	1	0.17	26.83
1988	Sep	25	-	1989	Oct	1	6	1.20	184.81

Total Deficit Days (TDD) = 248

TDD when Cumulative Deficit>1" (TDD*) = 126

Table 12. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.000 ft.msl; NL_{max} =20; NL_{low}= 15

Deficit Period						Total Days	Cumulative Deficit inches	cfsd
1975	Aug	23	-	1975	Aug	25	2	0.10	15.50
1976	Jun	12	-	1976	Jun	23	11	0.91	140.45
1976	Jun	27	-	1976	Jun	29	2	0.17	25.64
1976	Jul	1	-	1976	Jul	3	2	0.01	2.20
1976	Jul	4	-	1976	Jul	8	4	0.76	117.57
1976	Jul	9	-	1976	Jul	28	19	9.69	1491.04
1976	Aug	7	-	1976	Aug	13	6	0.70	107.09
1976	Aug	21	-	1976	Sep	10	20	5.75	884.93
1976	Sep	12	-	1976	Oct	7	25	7.00	1077.85
1976	Oct	13	-	1976	Oct	24	11	1.97	303.51
1977	Jun	5	-	1977	Jun	13	8	1.07	165.25
1977	Aug	6	-	1977	Aug	9	3	0.75	114.70
1979	Oct	7	-	1979	Oct	8	1	0.04	6.65
1979	Oct	13	-	1979	Oct	15	2	0.32	48.70
1980	Jul	20	-	1980	Jul	22	2	0.66	101.79
1980	Aug	2	-	1980	Aug	5	3	1.25	191.91
1980	Aug	9	-	1980	Aug	14	5	1.37	210.34
1980	Aug	31	-	1980	Sep	2	2	0.42	64.87
1980	Oct	11	-	1980	Oct	17	6	0.88	135.94
1980	Oct	19	-	1980	Oct	20	1	0.02	3.44
1980	Oct	26	-	1980	Oct	27	1	0.13	20.46
1983	Sep	11	-	1983	Sep	12	1	0.18	28.24
1983	Sep	18	-	1983	Sep	20	2	0.41	63.35
1983	Sep	24	-	1983	Sep	26	2	0.47	71.58
1984	Sep	1	-	1984	Sep	3	2	0.55	84.60
1984	Sep	8	-	1984	Sep	9	1	0.73	112.33
1985	Sep	14	-	1985	Sep	17	3	0.34	52.47
1985	Sep	22	-	1985	Sep	25	3	0.38	58.67
1985	Sep	28	-	1985	Oct	1	3	0.28	43.57
1986	Aug	25	-	1986	Aug	26	1	0.38	59.01
1986	Aug	31	-	1986	Sep	4	4	0.53	80.93
1987	Jun	14	-	1987	Jun	15	1	0.17	25.64
1987	Jun	27	-	1987	Jun	29	2	0.29	45.03
1987	Sep	13	-	1987	Sep	14	1	0.19	29.48
1987	Sep	24	-	1987	Sep	29	5	1.14	174.95
1987	Oct	9	-	1987	Oct	10	1	0.25	39.00
1987	Oct	18	-	1987	Oct	19	1	0.34	52.75
1988	May	30	-	1988	Jun	1	2	0.46	71.52
1988	Jun	4	-	1988	Jul	15	41	8.00	1231.38
1988	Jul	16	-	1988	Jul	18	2	0.52	79.53
1988	Jul	31	-	1988	Aug	1	1	0.07	11.10
1988	Aug	6	-	1988	Aug	15	9	1.19	182.67
1988	Aug	20	-	1988	Aug	24	4	1.52	233.28
1988	Aug	27	-	1988	Aug	30	3	0.38	58.90
1988	Sep	4	-	1988	Sep	5	1	0.03	4.40
1988	Sep	10	-	1988	Sep	13	3	1.55	237.90
1988	Sep	17	-	1988	Sep	18	1	0.17	26.83
1988	Sep	25	-	1989	Oct	1	6	1.20	184.81

Total Deficit Days (TDD) = 242

TDD when Cumulative Deficit > 1" (TDD*) = 104

Table 13. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.000 ft.msl; NL_{max}=15; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jun	12	-	1976	Jun	23	11	0.86	132.56
1976	Jun	27	-	1976	Jun	29	2	0.17	25.64
1976	Jul	1	-	1976	Jul	3	2	0.01	2.20
1976	Jul	4	-	1976	Jul	8	4	0.76	117.57
1976	Jul	9	-	1976	Jul	28	19	9.69	1491.04
1976	Aug	8	-	1976	Aug	13	5	0.43	65.77
1976	Aug	21	-	1976	Sep	10	20	5.45	838.77
1976	Sep	12	-	1976	Sep	13	1	0.03	4.34
1976	Sep	14	-	1976	Oct	7	23	6.99	1075.26
1976	Oct	13	-	1976	Oct	24	11	1.97	303.51
1977	Jun	5	-	1977	Jun	6	1	0.06	9.81
1977	Jun	7	-	1977	Jun	9	2	0.09	13.24
1977	Jun	10	-	1977	Jun	13	3	1.07	164.46
1977	Aug	6	-	1977	Aug	9	3	0.43	65.72
1979	Oct	7	-	1979	Oct	8	1	0.04	6.65
1979	Oct	13	-	1979	Oct	15	2	0.32	48.70
1980	Jul	20	-	1980	Jul	22	2	0.31	47.01
1980	Aug	2	-	1980	Aug	5	3	1.25	191.91
1980	Aug	9	-	1980	Aug	13	4	1.10	169.25
1980	Aug	31	-	1980	Sep	2	2	0.30	46.72
1980	Oct	11	-	1980	Oct	17	6	0.88	135.94
1980	Oct	19	-	1980	Oct	20	1	0.02	3.44
1980	Oct	26	-	1980	Oct	27	1	0.13	20.46
1983	Sep	11	-	1983	Sep	12	1	0.07	10.71
1983	Sep	18	-	1983	Sep	19	1	0.29	44.86
1983	Sep	24	-	1983	Sep	26	2	0.47	71.58
1984	Sep	1	-	1984	Sep	3	2	0.55	84.60
1984	Sep	8	-	1984	Sep	9	1	0.47	73.10
1985	Sep	14	-	1985	Sep	17	3	0.34	52.47
1985	Sep	22	-	1985	Sep	24	2	0.29	44.58
1985	Sep	28	-	1985	Oct	1	3	0.28	43.57
1986	Aug	25	-	1986	Aug	26	1	0.23	35.85
1986	Aug	31	-	1986	Sep	4	4	0.53	80.93
1987	Jun	27	-	1987	Jun	29	2	0.16	24.24
1987	Sep	13	-	1987	Sep	14	1	0.09	13.64
1987	Sep	24	-	1987	Sep	29	5	1.14	174.95
1987	Oct	9	-	1987	Oct	10	1	0.25	39.00
1987	Oct	18	-	1987	Oct	19	1	0.34	52.75
1988	May	30	-	1988	May	31	1	0.12	18.88
1988	Jun	4	-	1988	Jun	10	6	1.21	186.67
1988	Jun	11	-	1988	Jul	15	34	7.87	1211.60
1988	Jul	17	-	1988	Jul	18	1	0.36	55.46
1988	Aug	6	-	1988	Aug	15	9	1.19	182.67
1988	Aug	20	-	1988	Aug	24	4	1.28	197.60
1988	Aug	27	-	1988	Aug	29	2	0.07	10.43
1988	Sep	10	-	1988	Sep	13	3	1.22	187.23
1988	Sep	17	-	1988	Sep	18	1	0.17	26.83
1988	Sep	25	-	1989	Oct	1	6	1.07	164.91

Total Deficit Days (TDD) = 226

TDD when Cumulative Deficit > 1" (TDD*) = 100

Table 14. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.000 ft.msl; NL_{max} = 4; NL_{low} = 4

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	5	-	1976	Jul	8	3	0.18	28.07
1976	Jul	9	-	1976	Jul	27	18	3.86	593.37
1976	Aug	11	-	1976	Aug	13	2	0.08	12.68
1976	Aug	23	-	1976	Aug	28	5	0.13	20.74
1976	Sep	3	-	1976	Sep	9	6	1.20	184.75
1976	Sep	15	-	1976	Oct	6	21	2.03	313.09
1976	Oct	15	-	1976	Oct	20	5	0.16	25.14
1980	Aug	11	-	1980	Aug	12	1	0.09	13.75
1986	Aug	31	-	1986	Sep	1	1	0.08	12.12
1988	Jun	26	-	1988	Jun	30	4	0.18	28.18
1988	Jul	4	-	1988	Jul	12	8	0.96	147.50
1988	Sep	27	-	1989	Oct	1	4	0.24	36.80
Total Deficit Days (TDD) =							78		
TDD when Cumulative Deficit > 1" (TDD*) =							24		

Table 15. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.000 ft.msl; NL_{max} = 0; NL_{low} = 0

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	12	-	1976	Jul	13	1	0.04	6.03
1976	Jul	15	-	1976	Jul	16	1	0.06	8.51
1976	Jul	17	-	1976	Jul	27	10	0.44	68.14
Total Deficit Days (TDD) =							12		
TDD when Cumulative Deficit > 1" (TDD*) =							0		

Table 16. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.083 ft.msl; NL_{max} =40; NL_{low} = 40

Deficit Period							Total Days	Cumulative Deficit inches	Deficit cfsd
1976	Jun	13	-	1976	Jun	16	3	0.34	52.98
1976	Jul	11	-	1976	Jul	29	18	11.35	1747.54
1976	Aug	12	-	1976	Aug	13	1	0.06	9.47
1976	Aug	22	-	1976	Sep	10	19	5.36	824.68
1976	Sep	18	-	1976	Oct	7	19	6.23	958.65
1976	Oct	17	-	1976	Oct	24	7	0.99	152.06
1977	Jun	12	-	1977	Jun	13	1	0.78	119.82
1977	Aug	7	-	1977	Aug	8	1	0.15	22.77
1980	Jul	20	-	1980	Jul	22	2	0.45	69.44
1980	Aug	3	-	1980	Aug	5	2	0.63	96.27
1980	Aug	10	-	1980	Aug	13	3	0.71	109.06
1987	Sep	27	-	1987	Sep	28	1	0.15	23.33
1988	Jun	5	-	1988	Jun	10	5	0.77	117.91
1988	Jun	12	-	1988	Jul	19	37	9.22	1419.68
1988	Aug	7	-	1988	Aug	12	5	0.61	93.90
1988	Aug	13	-	1988	Aug	15	2	0.84	129.80
1988	Aug	21	-	1988	Aug	24	3	0.76	117.18
1988	Sep	10	-	1988	Sep	12	2	0.56	85.61
1988	Sep	29	-	1989	Oct	1	2	0.21	32.86

Total Deficit Days (TDD) = 133
TDD when Cumulative Deficit > 1" (TDD*) = 76

Table 17. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.083 ft.msl; NL_{max} =40; NL_{low} = 20

Deficit Period							Total Days	Cumulative Deficit inches	Deficit cfsd
1976	Jun	13	-	1976	Jun	16	3	0.34	52.98
1976	Jul	11	-	1976	Jul	29	18	10.41	1601.90
1976	Aug	12	-	1976	Aug	13	1	0.06	9.47
1976	Aug	22	-	1976	Sep	10	19	5.36	824.68
1976	Sep	18	-	1976	Oct	7	19	6.23	958.65
1976	Oct	17	-	1976	Oct	24	7	0.99	152.06
1977	Jun	12	-	1977	Jun	13	1	0.78	119.82
1977	Aug	7	-	1977	Aug	8	1	0.15	22.77
1980	Jul	20	-	1980	Jul	22	2	0.45	69.44
1980	Aug	3	-	1980	Aug	5	2	0.63	96.27
1980	Aug	10	-	1980	Aug	13	3	0.71	109.06
1987	Sep	27	-	1987	Sep	28	1	0.15	23.33
1988	Jun	5	-	1988	Jun	10	5	0.77	117.91
1988	Jun	12	-	1988	Jul	18	36	8.80	1353.69
1988	Aug	7	-	1988	Aug	12	5	0.61	93.90
1988	Aug	13	-	1988	Aug	15	2	0.84	129.80
1988	Aug	21	-	1988	Aug	24	3	0.76	117.18
1988	Sep	10	-	1988	Sep	12	2	0.56	85.61
1988	Sep	29	-	1989	Oct	1	2	0.21	32.86

Total Deficit Days (TDD) = 132
TDD when Cumulative Deficit > 1" (TDD*) = 74

Table 18. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.083 ft.msl; NL_{max} =40; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jun	13	-	1976	Jun	16	3	0.34	52.98
1976	Jul	11	-	1976	Jul	28	17	9.29	1430.11
1976	Aug	12	-	1976	Aug	13	1	0.06	9.47
1976	Aug	22	-	1976	Sep	10	19	4.80	739.40
1976	Sep	18	-	1976	Oct	6	18	6.06	932.61
1976	Oct	17	-	1976	Oct	24	7	0.99	152.06
1977	Jun	12	-	1977	Jun	13	1	0.78	119.82
1977	Aug	7	-	1977	Aug	8	1	0.15	22.77
1980	Jul	20	-	1980	Jul	22	2	0.45	69.44
1980	Aug	3	-	1980	Aug	5	2	0.63	96.27
1980	Aug	10	-	1980	Aug	13	3	0.71	109.06
1987	Sep	27	-	1987	Sep	28	1	0.15	23.33
1988	Jun	5	-	1988	Jun	10	5	0.77	117.91
1988	Jun	12	-	1988	Jul	15	33	8.12	1249.02
1988	Jul	16	-	1988	Jul	18	2	0.75	115.37
1988	Aug	7	-	1988	Aug	12	5	0.61	93.90
1988	Aug	13	-	1988	Aug	15	2	0.67	102.52
1988	Aug	21	-	1988	Aug	24	3	0.76	117.18
1988	Sep	10	-	1988	Sep	12	2	0.56	85.61
1988	Sep	29	-	1989	Oct	1	2	0.21	32.86

Total Deficit Days (TDD) = 129
TDD when Cumulative Deficit > 1" (TDD*) = 70

Table 19. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.083 ft.msl; NL_{max} =20; NL_{low} = 20

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jun	14	-	1976	Jun	16	2	0.19	28.86
1976	Jul	11	-	1976	Jul	29	18	10.13	1559.40
1976	Aug	12	-	1976	Aug	13	1	0.06	9.47
1976	Aug	22	-	1976	Sep	10	19	5.36	824.68
1976	Sep	18	-	1976	Oct	7	19	6.23	958.65
1976	Oct	17	-	1976	Oct	24	7	0.99	152.06
1977	Jun	12	-	1977	Jun	13	1	0.47	72.37
1977	Aug	7	-	1977	Aug	8	1	0.15	22.77
1980	Aug	3	-	1980	Aug	5	2	0.63	96.27
1980	Aug	10	-	1980	Aug	13	3	0.71	109.06
1987	Sep	27	-	1987	Sep	28	1	0.15	23.33
1988	Jun	5	-	1988	Jun	9	4	0.70	107.59
1988	Jun	12	-	1988	Jul	18	36	8.73	1343.37
1988	Aug	7	-	1988	Aug	12	5	0.61	93.90
1988	Aug	13	-	1988	Aug	15	2	0.84	129.80
1988	Aug	21	-	1988	Aug	24	3	0.76	117.18
1988	Sep	10	-	1988	Sep	12	2	0.56	85.61
1988	Sep	29	-	1989	Oct	1	2	0.21	32.86

Total Deficit Days (TDD) = 128
TDD when Cumulative Deficit > 1" (TDD*) = 72

Table 20. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.083 ft.msl; NL_{max} =20; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jun	14	-	1976	Jun	16	2	0.19	28.86
1976	Jul	11	-	1976	Jul	28	17	9.02	1387.62
1976	Aug	12	-	1976	Aug	13	1	0.06	9.47
1976	Aug	22	-	1976	Sep	10	19	4.80	739.40
1976	Sep	18	-	1976	Oct	6	18	6.06	932.61
1976	Oct	17	-	1976	Oct	24	7	0.99	152.06
1977	Jun	12	-	1977	Jun	13	1	0.47	72.37
1977	Aug	7	-	1977	Aug	8	1	0.15	22.77
1980	Aug	3	-	1980	Aug	5	2	0.63	96.27
1980	Aug	10	-	1980	Aug	13	3	0.71	109.06
1987	Sep	27	-	1987	Sep	28	1	0.15	23.33
1988	Jun	5	-	1988	Jun	9	4	0.70	107.59
1988	Jun	12	-	1988	Jul	15	33	8.05	1238.71
1988	Jul	17	-	1988	Jul	18	1	0.61	93.90
1988	Aug	7	-	1988	Aug	12	5	0.61	93.90
1988	Aug	13	-	1988	Aug	15	2	0.67	102.52
1988	Aug	21	-	1988	Aug	24	3	0.76	117.18
1988	Sep	10	-	1988	Sep	12	2	0.56	85.61
1988	Sep	29	-	1989	Oct	1	2	0.21	32.86

Total Deficit Days (TDD) = 124
TDD when Cumulative Deficit > 1" (TDD*) = 68

Table 21. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.083 ft.msl; NL_{max}=15; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jul	11	-	1976	Jul	28	17	8.74	1345.12
1976	Aug	22	-	1976	Sep	10	19	4.50	693.07
1976	Sep	18	-	1976	Oct	6	18	6.04	928.95
1976	Oct	17	-	1976	Oct	24	7	0.99	152.06
1977	Jun	12	-	1977	Jun	13	1	0.08	12.40
1980	Aug	3	-	1980	Aug	5	2	0.26	39.73
1980	Aug	11	-	1980	Aug	12	1	0.11	17.08
1987	Sep	27	-	1987	Sep	28	1	0.15	23.33
1988	Jun	7	-	1988	Jun	9	2	0.23	35.56
1988	Jun	17	-	1988	Jul	14	27	6.97	1072.72
1988	Aug	7	-	1988	Aug	9	2	0.20	30.21
1988	Aug	21	-	1988	Aug	23	2	0.30	45.48
1988	Sep	11	-	1988	Sep	12	1	0.23	34.66
1988	Sep	30	-	1989	Oct	1	1	0.08	12.85

Total Deficit Days (TDD) = 101
TDD when Cumulative Deficit > 1" (TDD*) = 61

Table 22. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.167 ft.msl; NL_{max} =40; NL_{low} = 40

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jul	11	-	1976	Jul	29	18	10.42	1603.65
1976	Aug	26	-	1976	Aug	30	4	0.22	33.20
1976	Sep	3	-	1976	Sep	10	7	4.42	679.55
1976	Sep	19	-	1976	Oct	6	17	5.29	813.52
1976	Oct	19	-	1976	Oct	20	1	0.00	0.68
1988	Jun	17	-	1988	Jul	15	28	8.34	1283.07
1988	Jul	16	-	1988	Jul	18	2	2.05	315.23

Total Deficit Days (TDD) = 77
TDD when Cumulative Deficit > 1" (TDD*) = 59

Table 23. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.167 ft.msl; NL_{max} =40; NL_{low} = 20

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jul	11	-	1976	Jul	28	17	9.47	1457.33
1976	Aug	26	-	1976	Aug	30	4	0.22	33.25
1976	Sep	3	-	1976	Sep	10	7	4.42	679.60
1976	Sep	19.	-	1976	Oct	6	17	5.29	813.58
1976	Oct	19	-	1976	Oct	20	1	0.00	0.73
1988	Jun	17	-	1988	Jul	15	28	7.91	1216.95
1988	Jul	16	-	1988	Jul	18	2	0.97	149.02

Total Deficit Days (TDD) = 76
TDD when Cumulative Deficit > 1" (TDD*) = 56

Table 24. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.167 ft.msl; NL_{max} =40; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jul	11	-	1976	Jul	27	16	8.35	1284.76
1976	Aug	26	-	1976	Aug	29	3	0.22	33.37
1976	Sep	4	-	1976	Sep	10	6	3.94	606.39
1976	Sep	19	-	1976	Oct	6	17	5.29	813.69
1976	Oct	19	-	1976	Oct	20	1	0.01	0.85
1988	Jun	17	-	1988	Jul	15	28	7.23	1112.01
1988	Jul	17	-	1988	Jul	18	1	0.94	144.17

Total Deficit Days (TDD) = 72
TDD when Cumulative Deficit > 1" (TDD*) = 55

Table 25. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.167 ft.msl; NL_{max} =20; NL_{low} = 20

Deficit Period							Total Days	Cumulative Deficit inches	Cumulative Deficit cfsd
1976	Jul	12	-	1976	Jul	13	1	0.37	56.81
1976	Jul	14	-	1976	Jul	28	14	9.19	1414.56
1976	Aug	26	-	1976	Aug	30	4	0.22	33.25
1976	Sep	3	-	1976	Sep	10	7	4.42	679.60
1976	Sep	19	-	1976	Oct	6	17	5.29	813.58
1976	Oct	19	-	1976	Oct	20	1	0.00	0.73
1988	Jun	17	-	1988	Jul	15	28	7.84	1206.58
1988	Jul	17	-	1988	Jul	18	1	0.42	64.87

Total Deficit Days (TDD) = 73
TDD when Cumulative Deficit > 1" (TDD*) = 55

Table 26. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.167 ft.msl; NL_{max} =20; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	Cumulative Deficit cfsd
1976	Jul	12	-	1976	Jul	13	1	0.37	56.81
1976	Jul	14	-	1976	Jul	27	13	8.07	1241.86
1976	Aug	26	-	1976	Aug	29	3	0.22	33.25
1976	Sep	4	-	1976	Sep	10	6	3.94	606.28
1976	Sep	19	-	1976	Oct	6	17	5.29	813.58
1976	Oct	19	-	1976	Oct	20	1	0.00	0.73
1988	Jun	17	-	1988	Jul	15	28	7.16	1101.53

Total Deficit Days (TDD) = 69
TDD when Cumulative Deficit > 1" (TDD*) = 54

Table 27. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.167 ft.msl; NL_{max} =15; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	Cumulative Deficit cfsd
1976	Jul	12	-	1976	Jul	13	1	0.09	14.09
1976	Jul	15	-	1976	Jul	27	12	7.79	1199.14
1976	Sep	4	-	1976	Sep	10	6	3.56	547.44
1976	Sep	19	-	1976	Oct	6	17	5.09	782.80
1976	Oct	19	-	1976	Oct	20	1	0.00	0.73
1988	Jun	19	-	1988	Jul	14	25	6.07	934.75

Total Deficit Days (TDD) = 62
TDD when Cumulative Deficit > 1" (TDD*) = 47

Table 28. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.250 ft.msl; NL_{max} =40; NL_{low} = 40

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jul	15	-	1976	Jul	28	13	9.48	1459.59
1976	Sep	4	-	1976	Sep	10	6	3.47	534.64
1976	Sep	21	-	1976	Oct	6	15	4.34	668.50
1988	Jun	19	-	1988	Jul	15	26	7.45	1146.67
1988	Jul	17	-	1988	Jul	18	1	1.19	182.55

Total Deficit Days (TDD) = 61
TDD when Cumulative Deficit > 1" (TDD*) = 48

Table 29. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.250 ft.msl; NL_{max} =40; NL_{low} = 20

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jul	15	-	1976	Jul	27	12	8.53	1312.60
1976	Sep	4	-	1976	Sep	10	6	3.47	534.64
1976	Sep	21	-	1976	Oct	6	15	4.34	668.50
1988	Jun	19	-	1988	Jul	14	25	7.02	1080.22
1988	Jul	17	-	1988	Jul	18	1	0.75	116.10

Total Deficit Days (TDD) = 59
TDD when Cumulative Deficit > 1" (TDD*) = 47

Table 30. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.250 ft.msl; NL_{max} =40; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jul	15	-	1976	Jul	27	12	7.40	1139.17
1976	Sep	4	-	1976	Sep	10	6	3.15	485.05
1976	Sep	21	-	1976	Oct	6	15	4.34	668.50
1988	Jun	19	-	1988	Jul	14	25	6.33	974.77
1988	Jul	17	-	1988	Jul	18	1	0.07	10.65

Total Deficit Days (TDD) = 59
TDD when Cumulative Deficit > 1" (TDD*) = 46

Table 31. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.250 ft.msl; NL_{max} =20; NL_{low} = 20

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	17	-	1976	Jul	27	10	8.25	1269.59
1976	Sep	4	-	1976	Sep	10	6	3.47	534.64
1976	Sep	21	-	1976	Oct	6	15	4.34	668.50
1988	Jun	19	-	1988	Jul	14	25	6.95	1069.85

Total Deficit Days (TDD) = 56
TDD when Cumulative Deficit > 1" (TDD*) = 46

Table 32. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.250 ft.msl; NL_{max} =20; NL_{low} = 15

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	17	-	1976	Jul	27	10	7.46	1148.53
1976	Sep	4	-	1976	Sep	10	6	3.15	485.05
1976	Sep	21	-	1976	Oct	6	15	4.34	668.50
1988	Jun	19	-	1988	Jul	14	25	6.27	964.40

Total Deficit Days (TDD) = 56
TDD when Cumulative Deficit > 1" (TDD*) = 45

Table 33. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.250 ft.msl; NL_{max} =15; NL_{low} = 15

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	17	-	1976	Jul	27	10	6.84	1053.22
1976	Sep	5	-	1976	Sep	9	4	2.61	401.86
1976	Sep	22	-	1976	Oct	6	14	4.14	636.49
1988	Jun	24		1988	Jul	13	19	5.18	796.78

Total Deficit Days (TDD) = 47
TDD when Cumulative Deficit > 1" (TDD*) = 37

Table 34. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.500 ft.msl; NL_{max} =40; NL_{low} = 40

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	18	-	1976	Jul	27	9	6.68	1027.92
1976	Sep	7	-	1976	Sep	9	2	0.64	99.25
1976	Sep	26	-	1976	Sep	27	1	0.11	16.51
1976	Oct	2	-	1976	Oct	6	4	1.52	233.34
1988	Jun	26	-	1988	Jun	30	4	0.21	32.75
1988	Jul	3	-	1988	Jul	13	10	4.79	736.92
Total Deficit Days (TDD) =							30		
TDD when Cumulative Deficit > 1" (TDD*) =							20		

Table 35. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.500 ft.msl; NL_{max} =40; NL_{low} = 20

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	18	-	1976	Jul	27	9	6.68	1027.92
1976	Sep	7	-	1976	Sep	9	2	0.64	99.25
1976	Sep	26	-	1976	Sep	27	1	0.11	16.51
1976	Oct	2	-	1976	Oct	6	4	1.52	233.34
1988	Jun	26	-	1988	Jun	30	4	0.21	32.75
1988	Jul	3	-	1988	Jul	13	10	4.35	669.80
Total Deficit Days (TDD) =							30		
TDD when Cumulative Deficit > 1" (TDD*) =							20		

Table 36. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.500 ft.msl; NL_{max} =40; NL_{low} = 15

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	18	-	1976	Jul	27	9	6.23	958.42
1976	Sep	7	-	1976	Sep	9	2	0.64	99.25
1976	Sep	26	-	1976	Sep	27	1	0.11	16.51
1976	Oct	2	-	1976	Oct	6	4	1.52	233.34
1988	Jun	26	-	1988	Jun	30	4	0.21	32.75
1988	Jul	3	-	1988	Jul	13	10	3.92	602.62
Total Deficit Days (TDD) =							30		
TDD when Cumulative Deficit > 1" (TDD*) =							20		

Table 37. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.500 ft.msl; NL_{max}=20; NL_{low} = 20

Deficit Period							Total Days	Cumulative Deficit inches	Cumulative Deficit cfsd
1976	Jul	19	-	1976	Jul	27	8	5.43	835.16
1976	Sep	7	-	1976	Sep	9	2	0.64	99.25
1976	Sep	26	-	1976	Sep	27	1	0.11	16.51
1976	Oct	2	-	1976	Oct	6	4	1.52	233.34
1988	Jun	27	-	1988	Jun	30	3	0.14	22.21
1988	Jul	3	-	1988	Jul	13	10	4.28	659.26
Total Deficit Days (TDD) =							28		
TDD when Cumulative Deficit > 1" (TDD*) =							17		

Table 38. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.500 ft.msl; NL_{max}=20; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	Cumulative Deficit cfsd
1976	Jul	19	-	1976	Jul	27	8	4.97	765.67
1976	Sep	7	-	1976	Sep	9	2	0.64	99.25
1976	Sep	26	-	1976	Sep	27	1	0.11	16.51
1976	Oct	2	-	1976	Oct	6	4	1.52	233.34
1988	Jun	27	-	1988	Jun	30	3	0.14	22.21
1988	Jul	3	-	1988	Jul	13	10	3.85	592.08
Total Deficit Days (TDD) =							28		
TDD when Cumulative Deficit > 1" (TDD*) =							17		

Table 39. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.500 ft.msl; NL_{max}=15; NL_{low} = 15

Deficit Period							Total Days	Cumulative Deficit inches	Cumulative Deficit cfsd
1976	Jul	21	-	1976	Jul	27	6	4.00	615.52
1976	Oct	2	-	1976	Oct	6	4	1.29	197.83
1988	Jul	7	-	1988	Jul	13	6	2.49	382.86
Total Deficit Days (TDD) =							16		
TDD when Cumulative Deficit > 1" (TDD*) =							9		

Table 40. Summary of Deficit Durations (1971 -1988)

Lockages		Pool Elevations									
		368.00		368.00 + 1″		368.00 + 2″		368.00 + 3″		368.00 + 6″	
NL_{max}	NL_{low}	TDD	TDD*	TDD	TDD*	TDD	TDD*	TDD	TDD*	TDD	TDD*
40	40	257	131	133	76	77	59	61	48	30	20
	20	255	126	132	74	76	56	59	47	30	20
	15	247	104	129	70	72	55	59	46	30	20
20	20	248	126	128	72	73	55	56	46	28	17
	15	242	104	124	68	69	54	56	45	28	17
15	15	226	100	101	61	62	47	47	37	16	9

NL_{max} = maximum number of locks allowed per day
NL_{low} = maximum number of locks allowed per day when the pool is below the normal level
TDD = total number of deficit days
TDD* = total number of deficit days when pool was below 367.92 feet

DISCUSSION OF RESULTS

Several operating conditions of the lock and dam were simulated in this study that would be most likely in extreme situations. Through the use of the most recent lockage rates (last three to five years), and Baldwin power plant and water supply consumption rates, which have been increasing steadily, some scenarios were created that would represent the conditions if the current practices had been implemented in the past. The results from these scenarios give us statistical information about the response of the system (simulated by the model) based on the historical streamflow, evaporation, and stage data. What we need to discuss here is the significance of having a particular result based on 18 years of data for the lower Kaskaskia River system and 51 years of streamflow information at Venedy Station (partially generated). We also need to discuss the practicality and feasibility of some of the measures that can be adopted to partially or totally eliminate any deficit condition.

In discussing the significance of some of the results, we should refer back to tables 8 through 39 and remember that most of the deficits with longer durations and higher magnitudes occurred in 1976 and 1988. Therefore it may be worthwhile to investigate the monthly and seasonal low-flow statistics for the total system inflows and the streamflows at Venedy Station to determine the significance of these years in the low-flow analyses.

Monthly Low-Flow Analyses

The recurrence intervals for several flow durations at Venedy Station for the months June through October are given in table 41. The same statistics for the total system inflows are given in table 42.

The statistics for the total system inflows may be expected to be biased because the period of information is short. However, most of the low flows during May through October

Table 41. Recurrence Intervals in Years for Monthly Low Flows at Venedy Station
(Data Period [Total 50 Years]: 1939-1968 Simulated; 1969-1988 Observed)

Low-Flow	May		June		July		Aug		Sep		Oct	
Duration	1976	1988	1976	1988	1976	1988	1976	1988	1976	1988	1976	1988
1-Day	10.2	25.5	17	25.5	25.5	17	12.8	3.9	10.2	6.4	8.5	
3-Day	10.2	25.5	25.5	51	25.5	17	17	3.9	10.2	5.7	10.2	
7-Day	25.5	17	51	25.5	25.5	17	8.5	3.9	12.8	6.4	12.8	
15-Day	17	25.5	25.5	51	51	17	4.3	5.7	25.5	4.3	4.6	

Table 42. Recurrence Intervals in Years for Monthly Low Flows for Total System Inflow (Data Period [18 Years]: 1971-1988)

Low-Flow	May		June		July		Aug		Sep		Oct	
Duration	1976	1988	1976	1988	1976	1988	1976	1988	1976	1988	1976	1988
1-Day	19	9.50	19	9.5	19	9.5	19	4.75	19	9.5	19	
3-Day	19	9.50	19	9.5	19	9.5	19	4.75	19	9.5	19	
7-Day	19	9.50	9.5	19	19	9.5	19	6.33	19	9.5	19	
15-Day	19	6.33	9.5	19	19	9.5	6.33	4.75	19	3.8	6.33	

are ranked as the lowest or the second-lowest (corresponding to 19- and 9.50-year recurrence intervals, respectively). This is an indication that 1976 and 1988 were the two driest years in the lower Kaskaskia River basin during the last 18 years.

If we examine the flow statistics for Venedy Station in table 41, we see that the 7- and 15-day low-flow recurrence intervals for May, June, and July correspond to more than 17 years. Streamflow at Venedy Station contributes a major portion of the total system inflow. Therefore, based on the longer information at Venedy Station and the consistency of high recurrence intervals for monthly flows at Venedy Station and total system inflows, we can conclude that the 1976 and 1988 low-flow conditions in the lower Kaskaskia basin represent the conditions that would be expected to occur every 17 years or more. This conclusion is based on the analyses of the monthly flows at Venedy and the total system flows. However, we also need to analyze the effects of low-flow conditions that prevail for longer durations. Longer low-flow durations were analyzed for a continuous period of six months, and the results are discussed in the following section.

Seasonal Low-Flow Analyses

Daily flow statistics for Venedy Station and the total system inflows were generated for longer low-flow durations. Only the period from May to October was considered in the analyses because the remaining months are not critical low-flow months and do not have high lockage traffic. For both series, recurrence intervals of the flows were calculated that corresponded to low-flow durations varying from 7 to 181 days. Using longer durations minimizes the effects of the regulated flow at Venedy Station due to Carlyle Dam and gives the expected water shortages during an extended drought. Results of low-flow analyses for flows at Venedy Station between May and October were given in table 6. Variations in recurrence intervals corresponding to 1976 and 1988 low flows for several low-flow

durations at Venedy Station are illustrated in figure 8. It can be seen from this figure that in 1976 most of the durations indicate a recurrence interval of 10 years or more. For example, for a 151-day duration, 1976 and 1988 rank as the two. driest years. Data were not available in 1988 beyond the end of September; therefore recurrence intervals for 181 days could not be obtained.

Results of low-flow analyses for total system inflows indicate the same trends, as shown in table 7 and figure 9. The recurrence intervals for total system inflows are lower than the recurrence intervals for Venedy Station because of the shorter flow series. However, the 7-, 15-, 31-, and 181-day low flows in 1976 were the lowest for the 18 years of information. Also, the 91-, 121-, and 151-day low flows in 1988 were the lowest for the period, with 1976 conditions being the second-driest.

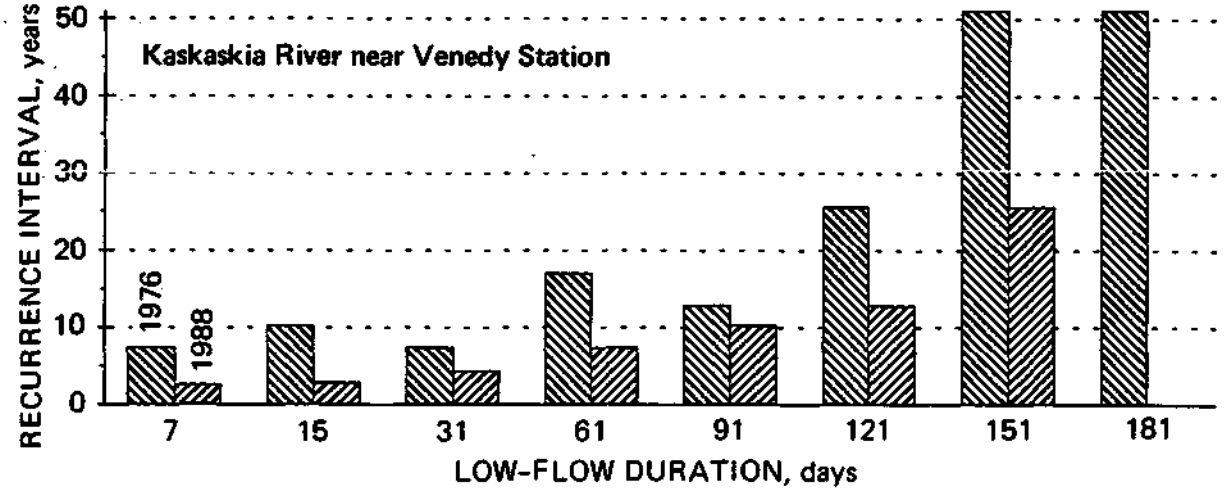


Figure 8. Variations in recurrence intervals with low-flow durations for the Kaskaskia River near Venedy Station

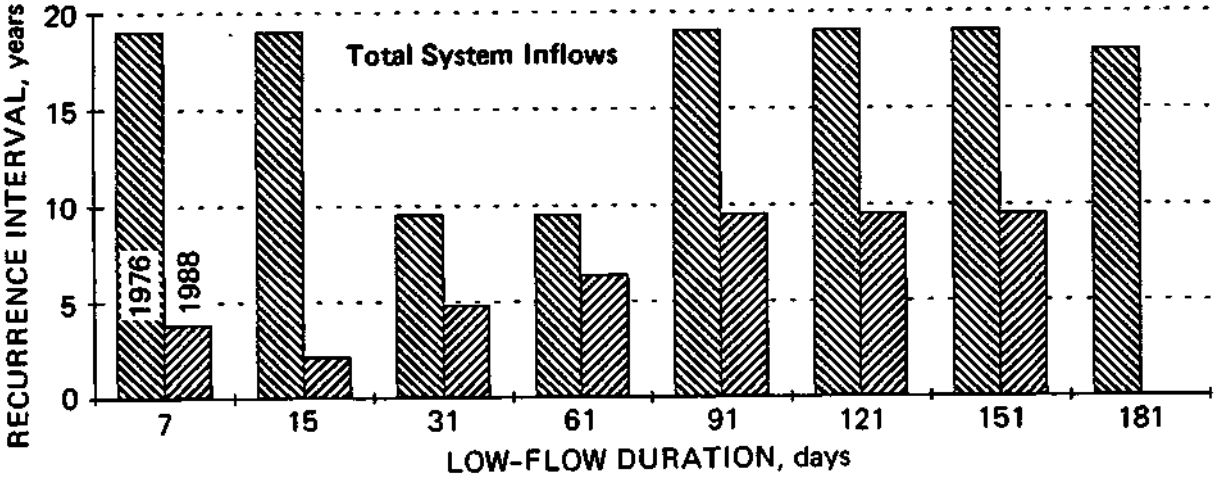


Figure 9. Variations in recurrence intervals with low-flow durations for the total system inflows

RECOMMENDATIONS

On the basis of the earlier findings, it can be concluded that the long-term low-flow conditions experienced in the Kaskaskia River system below Venedy Station during 1976 and 1988 correspond to a 10-year or higher recurrence interval. This is important because most of the severe deficit conditions indicated by the model studies were concentrated in those two years. Therefore our recommendations are directed towards partially or totally eliminating deficit conditions that would occur every 10 or more years. The 10-year period selected in our study represents the shortest recurrence interval indicated by our model studies; however, longer periods have also been indicated for larger flow durations. An exact recurrence interval can be selected if a particular design low-flow duration is adopted. The model findings and the detailed deficit distributions were presented earlier in a series of tables for various operating conditions. A decision maker can therefore choose an alternative with a desired level of risk and an expected deficit.

All the statistics presented in this report can be improved as more recent tributary flow data become available in the lower Kaskaskia basin. The guidelines that are recommended here for the better operation and management of the Kaskaskia Lock and Dam should be compared to the following base conditions:

	h_p	NL_{max}	TDD	TDD*
Condition 1:	368.00	actual	257	131
Condition 2:	368.00	4	78	24
Condition 3:	368.00	0	12	0

Condition 1 represents the situation if the current pool level (368.00 feet), lockage, and operation practices had prevailed for the entire period of record (1971-1988). Under Condition 1, major deficit events would have occurred in 1976, 1977, 1980, and 1988 (see table 8). Condition 2 represents operation with the current pool elevation and commercial traffic only. Under Condition 2 there are only 78 deficit days, and all but two occur in 1976 or 1988 (see table 14). Condition 3 represents operation with no lockages. Under Condition 3 there are 12 deficit days (all in 1976); however, cumulative deficits are always less than 1 inch (see table 15).

Alternative 1

It is obvious from these three conditions that reducing the number of lockages alone may not solve the deficit problem. Even with very restricted lockages there may still be some deficits, although these are restricted to low-frequency drought events. Therefore, the lock and dam should be operated at a pool level of 368.50 feet, one-half foot higher than the present operation level, and should be allowed to draw down to 368-00 feet during low-flow periods. Using this 0.50 foot of extra pool storage in combination with scheduled lockages can eliminate most of the deficit conditions. This alternative is supported by the results presented in table 43.

Table 43. Summary of Total Deficit Days for Various Lockage Rates at h_p = 368.50 feet

NL_{max}	TDD	TDD*
16	19	11
12	10	3
8	3	1
4	0	0

A detailed breakdown of these deficit days with respect to years is given in tables 44 through 47. This alternative is the most practical solution. It involves very little cost and does not disturb too many parties. With this alternative, shortages can be eliminated for a given lockage schedule and risk. The risk here is that there might be a certain number of deficit days if a drought with a 10-year recurrence interval (or more) occurs. For example, if the pool had been operated at 369.00 feet (1 foot higher than the normal level), then we would expect practically no deficits with up to NL_{max} = 21, up to a 51-year recurrence interval. For any selected pool level and lockage rate, the number of expected deficit days and their magnitude can either be interpolated from the tables, or determined by model runs.

Assuming NL_{max} =16, the distributions of deficit days as shown in table 44 are 6, 1, 4, and 8 days for four deficit events in 18 years of record. The maximum deficit in these events varies between 0.09 inches and 4.32 inches. If a drawdown of 3 to 4 inches can be tolerated for a period of less than a week once every ten years, then there should be no problems with the barge and recreational craft traffic.

The U.S. Corps of Engineers has recently been permitted to operate the pool at 368.80 feet during low flows. Results of simulation studies with the new maximum allowable pool level and three different lockage rates are shown in tables 48 through 50. These results

Table 44. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.500 ft.msl; NL_{max}=16; NL_{low} = 16

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	21	-	1976	Jul	27	6	4.32	665.46
1976	Sep	8	-	1976	Sep	9	1	0.09	13.92
1976	Oct	2	-	1976	Oct	6	4	1.37	211.07
1988	Jul	5	-	1988	Jul	13	8	2.95	454.50

Total Deficit Days (TDD) = 19
TDD when Cumulative Deficit > 1" (TDD*) = 11

Table 45. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.500 ft.msl; NL_{max}=12; NL_{low} = 12

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	22	-	1976	Jul	27	5	2.85	438.66
1976	Oct	3	-	1976	Oct	6	3	0.53	81.84
1988	Jul	10	-	1988	Jul	12	2	0.97	148.96

Total Deficit Days (TDD) = 10
TDD when Cumulative Deficit > 1" (TDD*) = 3

Table 46. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.500 ft.msl; NL_{max} = 8; NL_{low}= 8

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	24	-	1976	Jul	27	3	1.32	202.84

Total Deficit Days (TDD) = 3
TDD when Cumulative Deficit > 1" (TDD*) = 1

Table 47. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.500 ft.msl; NL_{max} = 4; NL_{low} = 4

Deficit Period	Total Days	Cumulative inches	Deficit cfsd

Total Deficit Days (TDD) = 0
TDD when Cumulative Deficit > 1" (TDD*) = 0

Table 48. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.800 ft.msl; NL_{max} =40; NL_{low} = 40

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	23	-	1976	Jul	27	4	3.31	509.73
1988	Jul	10	-	1988	Jul	12	2	1.59	245.34

Total Deficit Days (TDD) = 6
TDD when Cumulative Deficit > 1" (TDD*) = 5

Table 49. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.800 ft.msl; NL_{max} =20; NL_{low} = 20

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	24	-	1976	Jul	27	3	2.04	313.59
1988	Jul	10	-	1988	Jul	12	2	1.08	166.66

Total Deficit Days (TDD) = 5
TDD when Cumulative Deficit > 1" (TDD*) = 3

Table 50. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.800 ft.msl; NL_{max} =15; NL_{low} = 15

Deficit Period							Total Days	Cumulative inches	Deficit cfsd
1976	Jul	25	-	1976	Jul	27	2	.59	90.12

Total Deficit Days (TDD) = 2
TDD when Cumulative Deficit > 1" (TDD*) = 0

indicate that if the lock and dam is operated at 368.80 feet with a restricted lockage schedule, we should not expect any major deficits up to a recurrence interval of 50 years.

There are almost no economical constraints in the implementation of this alternative. Since the pool is expected to be raised during low-flow periods, there should be no flooding risks. Probably the only costs involved would be the modification of the shoreline and ramp facilities.

Alternative 2

Another alternative would be to ask Illinois Power Company (IPC) to stop pumping water from Kaskaskia River into Baldwin Lake when low-flow periods coincide with the days of heavy lockage demand. This application can be useful only if applied in conjunction with strictly scheduled lockages. Otherwise, with an average of two pumps running, IPC could withdraw up to approximately 55 cfs, with some return to the Kaskaskia River through their ash pond. Assuming 10 cfs return from the ash pond, an average of 45 cfs can be conserved (in July) if IPC does not pump for two days per week (only weekends during peak traffic). Over a weekend, up to 90 cfsd can be saved, which is approximately equal to 0.60 inches of storage. It should be remembered that in the following five days of the week there should be surplus water so that IPC can replenish the water that would be lost from the lake over the two-day period. As demonstrated, this plan can be useful if the deficits are not expected to be more than seven days long or to accumulate to more than 0.60 inches. This may not be possible for a 25-year or higher recurrence interval event, but with proper lockage scheduling and some risk taking it may alleviate some of the deficit conditions, provided that there is enough flow between the peak traffic periods.

This also is an economical solution, but it involves the cooperation of a second party. This procedure was used in the summer of 1988 for some weekends when high amounts of pleasure-boat traffic coincided with the low flows in the lower Kaskaskia. Implementation of this alternative would require adding at least one pump of the same capacity to the existing three pumps at the Baldwin power plant, because it is expected that under this condition all three pumps might need to operate simultaneously during the low-demand periods, thus leaving no stand-by pumps.

In conjunction with the proposed pumping schedule, Baldwin Lake can be raised by about one foot by using stop logs (U.S. Army Corps of Engineers, 1979). This could reduce the risk of depleting the Baldwin Lake storage to a dangerous level while water is not being pumped from the Kaskaskia River. On the other hand, higher water levels in the lake also increase the risk of breach of the dikes and may necessitate more frequent inspections of

the dam and the dikes because the Baldwin Lake dam has been classified in the "high hazard potential" category by the National Dam Safety Program inspection (U.S. Army Corps of Engineers, 1979).

Alternative 3

There are other alternatives that may not require the cooperation of IPC, such as pumping Mississippi River water into the navigation pool. Although this method is more expensive than the previous methods, it is safer and more flexible in meeting water demands in the system. During the period of analysis, the maximum pumpage would have been needed in July 1976, when 21 deficit days occurred and the maximum cumulative deficit was 12.29" or 1891.54 cfsd (see table 8). This corresponds to the highest average daily deficit for the entire period of analysis. Several options can be used to meet the deficit, such as using large pumps that operate only during the deficit period, or using smaller pumps that operate longer than the deficit period, allowing fluctuations in the pool storage.

Suppose that we do not want to start pumping before the deficit conditions begin (i.e., pool level falling below 368.00 feet). This implies that we do not have any forecast information about the flows and we do not allow the pool to rise above its normal level. In that case, under July 1976 conditions (table 8), we would have to pump an average of 90 cfs for 21 days (1891.54 divided by 21). This is approximately equal to 58 mgd pumping (or about 40,400 gpm total pump capacity). However, if we consider a less severe case, we can find two events with similar magnitudes. The first one occurred in August 1980 (the cumulative deficit was 1.61" or 248.22 cfsd), and the other occurred in September 1988 (the cumulative deficit was 1.55" or 237.90 cfsd). Both had deficit durations of three days. Assuming an average daily deficit of 81 cfs, we would need 52.3 mgd pumping (36,300 gpm total pump capacity).

Both of these options, however, are constrained by the normal pool level and by the fact that the pumps are operated only during the deficit period. This obviously requires large pumping capacities and long periods of no pumping. A cheaper option would be to use smaller pumps to divert about 30 cfs (about 13,500 gpm) intermittently to keep the pool at higher than the normal level. The results from the model studies indicate that if Mississippi River water is pumped into the navigation pool at a rate of 30 cfs or less to maintain the pool at 368.25 feet (3" higher than normal), then TDD = 19 and TDD* = 9 with unlimited lockage, or TDD = 12 and TDD* = 5 with NL_{max} = 15 (see tables 51 and 52).

Table 51. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.250 ft.msl; NL_{max} =40; NL_{low} = 40 and 30 cfs Pumpage from Mississipi River

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jul	17	-	1976	Jul	27	10	6.09	937.18
1976	Sep	6	-	1976	Sep	9	3	0.37	56.25
1976	Sep	26	-	1976	Sep	27	1	0.60	93.11
1976	Oct	3	-	1976	Oct	6	3	0.33	50.27
1988	Jul	10	-	1988	Jul	12	2	0.80	123.77
Total Deficit Days (TDD) =							19		
TDD when Cumulative Deficit > 1" (TDD*) =							9		

Table 52. Deficit Periods and Cumulative Deficits for Kaskaskia River System below Venedy Station with h_p = 368.250 ft.msl; NL_{max} =15; NL_{low} = 15 and 30 cfs Pumpage from Mississipi River

Deficit Period							Total Days	Cumulative Deficit inches	cfsd
1976	Jul	19	-	1976	Jul	27	8	3.45	530.75
1976	Sep	26	-	1976	Sep	27	1	0.43	66.90
1976	Oct	3	-	1976	Oct	6	3	0.16	24.07
Total Deficit Days (TDD) =							12		
TDD when Cumulative Deficit > 1" (TDD*) =							5		

Alternative 4

If it is objectionable to implement scheduled lockages of pleasure craft, then a bypass structure can be constructed to lift the smaller craft from one side of the lock to the other side. This can be achieved by a smaller bypass lock chamber that can accommodate small boats with less water loss per lockage, or by the installation of rail tracks for transporting the crafts. However, these methods are almost unprecedented and may be unacceptable to the public. These applications also would require initial investment costs and some maintenance costs.

CONCLUSIONS

The behavior of the Kaskaskia River system below Venedy Station was analyzed in terms of various hypothetical operation conditions. The results presented in this study should be interpreted as the conditions "expected" to occur due to the specified drought conditions, rather than as absolute results. The order in which the alternatives are listed in the report does not necessarily imply any preference or economic feasibility. The number of possible combinations of the suggested alternatives are quite large so as to present results for each case. Cumulative deficits and the corresponding durations are also given in the tables so that the additional storage needed for any special case can be estimated.

The low-flow statistics for the entire Lower Kaskaskia River system are included in the appendices at the end of this report. Several assumptions were made regarding the water consumption by the water supply systems and the Baldwin power plant, by using average monthly values. The operation guidelines suggested earlier can be modified depending on the level of risk accepted. For example, if the model studies indicate deficits only in 1976 for a particular operation, then it is reasonably safe to assume that this operation is safe up to a minimum recurrence interval of 25 years. If that particular operation also yields deficits in 1988, then a minimum 10-year recurrence interval can be assumed. Based on the available data, any operation that would eliminate all deficits for the period of analysis can be considered safe up to a 51-year recurrence interval. No extrapolations beyond the duration of the record were performed.

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Appendix A

Monthly and Seasonal Low-Flow Statistics for Sugar Creek at Albers, Illinois (Water Years 1973 -1982)

Monthly Low-Flow Statistics for Sugar Creek at Albers
(Water Years 1973 -1982)

1-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1973	1	16	15	4	18	17	26	7	12	1	1	1
1974	1	2	6	12	26	41	18	8	6	2	2	3
1975	2	3	5	17	17	31	15	9	3	2	1	1
1976	0	2	3	3	4	7	4	2	1	0	1	0
1977	0	1	1	0	0	6	3	1	0	1	1	2
1978	2	5	8	5	5	7	12	9	2	1	1	0
1979	1	1	4	5	10	21	17	5	1	1	1	1
1980	1	1	2	2	2	9	9	4	2	1	1	1
1981	1	0	1	0	1	4	4	3	3	3	3	3
1982	2	6	4	6	15	13	8	2	10	5	2	2

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
9.09	11.00	0	0	1	0	0	4	3	1	0	0	1	0
18.18	5.50	0	1	1	0	1	6	4	2	1	1	1	0
27.27	3.67	1	1	2	2	2	7	4	2	1	1	1	1
36.36	2.75	1	1	3	3	4	7	8	3	2	1	1	1
45.45	2.20	1	2	4	4	5	9	9	4	2	1	1	1
54.55	1.83	1	2	4	5	10	13	12	5	3	1	1	1
63.64	1.57	1	3	5	5	15	17	15	7	3	2	1	2
72.73	1.38	2	5	8	6	17	21	17	8	6	2	2	2
81.82	1.22	2	6	8	12	18	31	18	9	10	3	2	3
90.91	1.10	2	16	15	17	26	41	26	9	12	5	3	3
10-yr	flow	0	0	1	0	0	4	3	1	0	0	1	0
5-yr	flow	0	1	1	1	1	6	4	2	1	1	1	0
2-yr	flow	1	2	4	5	8	11	11	4	2	1	1	1

3-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1973	1	19	16	5	19	18	30	8	15	1	1	1
1974	1	2	9	14	27	48	19	8	7	2	2	3
1975	2	4	7	18	21	32	15	10	3	2	1	1
1976	1	2	3	4	5	7	4	2	2	0	1	0
1977	0	1	1	0	0	7	3	1	0	1	1	2
1978	2	5	9	5	5	7	13	11	2	1	1	0
1979	1	1	4	5	10	22	18	5	1	1	1	1
1980	1	1	2	2	2	9	9	4	2	1	1	1
1981	1	0	1	0	2	4	4	3	3	3	4	3
1982	2	7	5	6	16	14	9	3	12	5	2	2

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
9.09	11.00	0	0	1	0	0	4	3	1	0	0	1	0
18.18	5.50	1	1	1	0	2	7	4	2	1	1	1	0
27.27	3.67	1	1	2	2	2	7	4	3	2	1	1	1
36.36	2.75	1	1	3	4	5	7	9	3	2	1	1	1
45.45	2.20	1	2	4	5	5	9	9	4	2	1	1	1
54.55	1.83	1	2	5	5	10	14	13	5	3	1	1	1
63.64	1.57	1	4	7	5	16	18	15	8	3	2	1	2
72.73	1.38	2	5	9	6	19	22	18	8	7	2	2	2
81.82	1.22	2	7	9	14	21	32	19	10	12	3	2	3
90.91	1.10	2	19	16	18	27	48	30	11	15	5	4	3
10-yr	flow	0	0	1	0	1	4	3	1	1	0	1	0
5-yr	flow	1	1	1	1	2	7	4	2	1	1	1	0
2-yr	flow	1	2	4	5	8	12	11	4	2	1	1	1

7-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1973	1	28	40	6	21	56	111	10	29	2	1	1
1974	1	2	9	18	28	63	23	10	16	2	2	5
1975	2	5	8	22	24	50	18	17	3	2	1	1
1976	1	2	4	5	9	14	5	3	2	0	1	1
1977	1	1	1	0	0	8	4	1	1	2	1	3
1978	3	6	11	5	5	36	20	23	3	1	1	0
1979	1	1	5	5	10	28	27	5	1	1	3	1
1980	1	1	2	2	2	13	11	6	2	1	1	1
1981	1	0	1	0	2	4	5	5	4	6	5	3
1982	3	8	5	6	19	25	11	3	32	6	3	2

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
9.09	11.00	1	0	1	0	0	4	4	1	1	0	1	0
18.18	5.50	1	1	1	0	2	8	5	3	1	1	1	1
27.27	3.67	1	1	2	2	2	13	5	3	2	1	1	1
36.36	2.75	1	1	4	5	5	14	11	5	2	1	1	1
45.45	2.20	1	2	5	5	9	25	11	5	3	2	1	1
54.55	1.83	1	2	5	5	10	28	18	6	3	2	1	1
63.64	1.57	1	5	8	6	19	36	20	10	4	2	2	2
72.73	1.38	2	6	9	6	21	50	23	10	16	2	3	3
81.82	1.22	3	8	11	18	24	56	27	17	29	6	3	3
90.91	1.10	3	28	40	22	28	63	111	23	32	6	5	5
10-yr	flow	1	0	1	0	1	4	4	2	1	0	1	0
5-yr	flow	1	1	1	1	2	9	5	3	1	1	1	1
2-yr	flow	1	2	5	5	9	26	15	6	3	2	1	1

15-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1973	1	64	141	60	116	111	226	15	367	3	1	4
1974	1	2	11	21	33	96	104	23	173	2	4	13
1975	3	5	11	33	43	162	24	23	5	9	4	4
1976	1	2	16	10	11	21	7	4	3	1	2	1
1977	1	1	1	0	63	70	4	2	1	5	113	4
1978	8	9	30	6	5	720	22	27	5	2	1	1
1979	2	1	6	10	12	64	226	7	2	1	5	1
1980	1	2	2	3	2	22	27	7	3	2	7	17
1981	1	1	1	0	9	4	6	10	16	59	28	3
1982	5	9	6	11	104	66	32	3	61	16	5	28

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
9.09	11.00	1	1	1	0	2	4	4	2	1	1	1	1
18.18	5.50	1	1	1	0	5	21	6	3	2	1	1	1
27.27	3.67	1	1	2	3	9	22	7	4	3	2	2	1
36.36	2.75	1	2	6	6	11	64	22	7	3	2	4	3
45.45	2.20	1	2	6	10	12	66	24	7	5	2	4	4
54.55	1.83	1	2	11	10	33	70	27	10	5	3	5	4
63.64	1.57	2	5	11	11	43	96	32	15	16	5	5	4
72.73	1.38	3	9	16	21	63	111	104	23	61	9	7	13
81.82	1.22	5	9	30	33	104	162	226	23	173	16	28	17
90.91	1.10	8	64	141	60	116	720	226	27	367	59	113	28
10-yr	flow	1	1	1	0	3	7	5	2	1	1	1	1
5-yr	flow	1	1	1	1	6	22	6	4	2	1	1	1
2-yr	flow	1	2	9	10	23	68	26	9	5	2	4	4

Seasonal (May-October) Low-Flow Statistics for
Sugar Creek at Albers over Years 1973 -1982

7-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1973	0.5	114
1974	1.7	77
1975	0.8	167
1976	0.2	78
1977	0.5	37
1978	0.3	147
1979	0.5	134
1980	0.6	157
1981	2.6	144
1982	2.4	147

PROBABILITY	T-YR	LOW FLOW VALUES
9.09	11.00	0.2
18.18	5.50	0.3
27.27	3.67	0.5
36.36	2.75	0.5
45.45	2.20	0.5
54.55	1.83	0.6
63.64	1.57	0.8
72.73	1.38	1.7
81.82	1.22	2.4
90.91	1.10	2.6
10.-Year Flow		0.2
5.-Year Flow		0.3
2.-Year Flow		0.6

15-DAY DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1973	0.9	107
1974	2.0	75
1975	1.4	162
1976	0.6	71
1977	1.1	38
1978	0.7	144
1979	0.5	134
1980	0.7	155
1981	2.7	143
1982	3.3	12

PROBABILITY	T-YR	LOW FLOW VALUES
9.09	11.00	0.5
18.18	5.50	0.6
27.27	3.67	0.7
36.36	2.75	0.7
45.45	2.20	0.9
54.55	1.83	1.1
63.64	1.57	1.4
72.73	1.38	2.0
81.82	1.22	2.7
90.91	1.10	3.3
10.-Year Flow		0.5
5.-Year Flow		0.6
2.-Year Flow		1.0

31-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1973	1.9	154
1974	2.7	64
1975	1.7	148
1976	0.8	121
1977	2.0	23
1978	1.9	127
1979	0.5	133
1980	1.4	146
1981	3.8	128
1982	16.3	88

PROBABILITY	T-YR	LOW FLOW VALUES
9.09	11.00	0.5
18.18	5.50	0.8
27.27	3.67	1.4
36.36	2.75	1.7
45.45	2.20	1.9
54.55	1.83	1.9
63.64	1.57	2.0
72.73	1.38	2.7
81.82	1.22	3.8
90.91	1.10	16.3
10.-Year Flow		0.6
5.-Year Flow		1.0
2.-Year Flow		1.9

61-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1973	6.5	71
1974	7.9	60.
1975	10.0	74
1976	1.8	98
1977	9.4	11
1978	2.1	105
1979	1.2	124
1980	13.1	42
1981	15.9	109
1982	26.2	76

PROBABILITY	T-YR	LOW FLOW VALUES
9.09	11.00	1.2
18.18	5.50	1.8
27.27	3.67	2.1
36.36	2.75	6.5
45.45	2.20	7.9
54.55	1.83	9.4
63.64	1.57	10.0
72.73	1.38	13.1
81.82	1.22	15.9
90.91	1.10	26.2
10.-Year Flow		1.3
5.-Year Flow		1.9
2.-Year Flow		8.7

91-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1973	11.4	94
1974	20.3	61
1975	11.8	88
1976	2.7	94
1977	8.2	10
1978	4.7	75
1979	14.2	94
1980	14.1	12
1981	32.0	94
1982	47.1	63

PROBABILITY	T-YR	LOW FLOW VALUES
9.09	11.00	2.7
18.18	5.50	4.7
27.27	3.67	8.2
36.36	2.75	11.4
45.45	2.20	11.8
54.55	1.83	14.1
63.64	1.57	14.2
72.73	1.38	20.3
81.82	1.22	32.0
90.91	1.10	47.1
10.-Year Flow		3.1
5.-Year Flow		5.7
2.-Year Flow		13.1

121-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1973	16.0	64
1974	18.4	63
1975	19.9	64
1976	9.3	57
1977	42.5	1
1978	4.7	45
1979	74.0	64
1980	14.6	4
1981	52.8	55
1982	68.4	33

PROBABILITY	T-YR	LOW FLOW VALUES
9.09	11.00	4.7
18.18	5.50	9.3
27.27	3.67	14.6
36.36	2.75	16.0
45.45	2.20	18.4
54.55	1.83	19.9
63.64	1.57	42.5
72.73	1.38	52.8
81.82	1.22	68.4
90.91	1.10	74.0
10.-Year Flow		5.5
5.-Year Flow		10.7
2.-Year Flow		19.2

151-DAY LOW FLOW IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1973	89.11	34
1974	45.7	34
1975	21.0	34
1976	8.4	34
1977	35.4	9
1978	5.6	34
1979	61.1	34
1980	17.0	34
1981	62.4	34
1982	75.1	3

PROBABILITY	T-YR	LOW FLOW VALUES
9.09	11.00	5.6
18.18	5.50	8.4
27.27	3.67	17.0
36.36	2.75	21.0
45.45	2.20	35.4
54.55	1.83	45.7
63.64	1.57	61.1
72.73	1.38	62.4
81.82	1.22	75.1
90.91	1.10	89.1
10.-Year Flow		6.1
5.-Year Flow		10.8
2.-Year Flow		41.0

181-DAY LOW FLOW IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1973	95.0	4
1974	73.2	4
1975	26.8	4
1976	12.6	3
1977	36.9	1
1978	17.8	4
1979	53.3	4
1980	16.4	1
1981	65.9	1

PROBABILITY	T-YR	LOW FLOW VALUES
10.00	10.00	12.6
20.00	5.00	16.4
30.00	3.33	17.8
40.00	2.50	26.8
50.00	2.00	36.9
60.00	1.67	53.3
70.00	1.43	65.9
80.00	1.25	73.2
90.00	1.11	95.0
10.-Year Flow		12.6
5.-Year Flow		16.4
2.-Year Flow		36.9

Appendix B

Monthly and Seasonal Low-Flow Statistics for Shoal Creek near Breese, Illinois (Water Years 1947 -1986)

Monthly Low-Flow Statistics for Shoal Creek near Breese
(Water Years 1947 -1986)

1-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1947	17	300	201	212	80	60	286	216	75	30	11	7
1948	6	23	21	15	15	131	89	69	28	71	20	11
1949	12	60	72	664	538	231	142	59	35	23	19	8
1950	8	35	33	387	282	282	184	68	112	35	17	16
1951	15	17	39	29	11	312	232	49	38	60	26	20
1952	13	21	51	152	184	178	235	62	21	15	7	3
1953	1	7	10	14	10	50	110	75	30	14	4	1
1954	1	14	12	6	5	9	10	6	5	0	0	0
1955	0	0	0	0	0	28	63	21	18	24	4	0
1956	7	17	7	12	17	76	35	31	11	20	18	7
1957	0	0	7	9	38	78	220	162	121	80	40	10
1958	8	40	100	65	63	219	128	59	53	28	50	16
1959	14	14	48	40	252	173	92	112	30	8	10	4
1960	21	20	61	151	190	120	173	162	170	60	28	12
1961	4	21	16	8	8	66	130	200	27	24	44	19
1962	6	70	80	140	560	336	141	125	65	36	17	9
1963	20	30	9	15	15	25	42	35	40	20	10	6
1964	9	13	7	9	36	36	126	41	12	8	4	3
1965	0	1	6	8	11	32	34	18	13	12	4	11
1966	5	4	6	15	15	66	51	107	17	78	75	6
1967	22	22	107	60	70	80	206	97	107	51	35	20
1968	23	51	400	150	90	90	93	55	63	25	13	8
1969	8	11	40	60	195	200	296	81	51	106	26	26
1970	64	90	80	40	136	128	152	89	211	41	19	16
1971	20	24	28	40	30	133	68	56	44	28	10	3
1972	5	5	18	80	40	88	126	52	22	18	16	19
1973	8	148	159	150	166	155	599	128	138	48	51	36
1974	44	49	243	300	276	443	298	182	231	32	25	60
1975	41	59	87	342	389	314	211	146	68	32	18	25
1976	14	26	55	50	76	99	80	32	24	7	12	2
1977	2	8	10	4	6	129	45	42	18	21	20	15
1978	23	43	55	25	30	40	297	139	45	21	10	7
1979	6	9	25	39	38	309	406	71	35	18	31	9
1980	3	5	12	19	13	52	106	61	26	12	4	13
1981	7	10	15	12	15	30	26	60	73	37	48	37
1982	30	40	31	70	600	378	168	48	129	78	33	53
1983	55	85	396	90	140	119	309	171	77	19	13	10
1984	5	22	95	70	427	641	368	261	38	16	34	32
1985	26	149	271	80	64	202	247	76	70	42	56	18
1986	14	25	183	75	137	125	64	36	23	26	1	7

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2.44	41.00	0	0	0	0	0	9	10	6	5	0	0	0
4.88	20.50	0	0	6	4	5	25	26	18	11	7	1	0
7.32	13.67	0	1	6	6	6	28	34	21	12	8	4	1
9.76	10.25	1	4	7	8	8	30	35	31	13	8	4	2
12.20	8.20	1	5	7	8	10	32	42	32	17	12	4	3
14.63	6.83	2	5	7	9	11	36	45	35	18	12	4	3
17.07	5.86	3	7	9	9	11	40	51	36	18	14	4	3
19.51	5.13	4	8	10	12	13	50	63	41	21	15	7	4
21.95	4.56	5	9	10	12	15	52	64	42	22	16	10	6
24.39	4.10	5	10	12	14	15	60	68	48	23	18	10	6
26.83	3.73	5	11	12	15	15	66	80	49	24	18	10	7
29.27	3.42	6	13	15	15	15	66	89	52	26	19	10	7
31.71	3.15	6	14	16	15	17	76	92	55	27	20	11	7
34.15	2.93	6	14	18	19	30	78	93	56	28	20	12	7
36.59	2.73	7	17	21	25	30	80	106	59	30	21	13	8
39.02	2.56	7	17	25	29	36	88	110	59	30	21	13	8
41.46	2.41	8	20	28	39	38	90	126	60	35	23	16	9
43.90	2.28	8	21	31	40	38	99	126	61	35	24	17	9
46.34	2.16	8	21	33	40	40	119	128	62	38	24	17	10
48.78	2.05	8	22	39	40	63	120	130	68	38	25	18	10
51.22	1.95	9	22	40	50	64	125	141	69	40	26	18	11
53.66	1.86	12	23	48	60	70	128	142	71	44	28	19	11
56.10	1.78	13	24	51	60	76	129	152	75	45	28	19	12
58.54	1.71	14	25	55	65	80	131	168	76	51	30	20	13
60.98	1.64	14	26	55	70	90	133	173	81	53	32	20	15
63.41	1.58	14	30	61	70	136	155	184	89	63	32	25	16
65.85	1.52	15	35	72	75	137	173	206	97	65	35	26	16
68.29	1.46	17	40	80	80	140	178	211	107	68	36	26	16
70.73	1.41	20	40	80	80	166	200	220	112	70	37	28	18
73.17	1.37	20	43	87	90	184	202	232	125	73	41	31	19
75.61	1.32	21	49	95	140	190	219	235	128	75	42	33	19
78.05	1.28	22	51	100	150	195	231	247	139	77	48	34	20
80.49	1.24	23	59	107	150	252	282	286	146	107	51	35	20
82.93	1.21	23	60	159	151	276	309	296	162	112	60	40	25
85.37	1.17	26	70	183	152	282	312	297	162	121	60	44	26
87.80	1.14	30	85	201	212	389	314	298	171	129	71	48	32
90.24	1.11	41	90	243	300	427	336	309	182	138	78	50	36
92.68	1.08	44	148	271	342	538	378	368	200	170	78	51	37
95.12	1.05	55	149	396	387	560	443	406	216	211	80	56	53
97.56	1.02	64	300	400	664	600	641	599	261	231	106	75	60
25-yr	flow	0	0	5	3	4	22	22	15	10	5	1	0
10-yr	flow	1	4	7	8	8	30	36	31	13	8	4	2
5-yr	flow	4	8	10	12	13	50	63	41	21	15	8	5
2-yr	flow	9	22	40	45	64	123	136	69	39	26	18	11

3-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1947	18	325	208	217	90	68	327	217	89	31	12	8
1948	6	23	21	15	15	148	100	81	31	86	21	12
1949	13	86	75	1153	599	237	142	62	35	25	20	11
1950	8	36	33	547	292	320	189	68	119	39	19	17
1951	15	17	39	38	12	321	249	51	41	66	34	20
1952	13	22	53	161	193	187	271	68	22	17	8	4
1953	1	8	11	15	10	161	119	83	30	17	4	1
1954	1	15	12	7	5	9	10	6	7	0	0	0
1955	1	0	0	0	1	30	79	22	18	38	4	0
1956	7	19	7	13	20	78	41	33	12	28	18	8
1957	0	0	7	9	46	80	342	196	145	84	57	11
1958	8	44	103	66	64	241	135	63	73	30	51	17
1959	16	15	49	41	256	184	96	113	31	8	10	4
1960	22	32	64	158	197	123	177	162	186	63	29	12
1961	4	22	18	8	8	71	137	250	29	25	47	20
1962	7	73	83	143	585	395	152	143	80	38	19	11
1963	26	30	9	15	15	30	49	36	45	21	10	7
1964	9	13	7	9	39	39	140	49	14	8	4	3
1965	0	1	6	8	11	34	34	19	15	12	4	12
1966	5	4	6	15	15	69	52	113	20	80	75	6
1967	25	23	150	60	70	101	261	114	117	55	45	20
1968	24	52	519	150	90	94	104	58	70	30	14	9
1969	9	15	42	60	205	210	331	91	54	145	28	28
1970	67	93	82	41	145	132	160	99	268	45	20	16
1971	21	24	28	45	32	141	71	57	52	31	10	4
1972	5	5	20	80	40	89	128	54	22	20	17	20
1973	8	176	160	153	175	157	683	129	199	49	52	37
1974	45	50	264	307	296	470	311	198	310	33	27	63
1975	42	62	101	375	399	343	226	163	71	36	19	28
1976	15	26	58	55	81	102	85	33	24	7	14	2
1977	2	8	10	4	7	141	49	43	21	23	22	15
1978	38	45	58	25	30	40	347	170	46	23	11	8
1979	6	9	25	40	38	332	458	76	38	18	33	10
1980	4	7	13	21	15	66	110	65	29	14	5	21
1981	7	10	16	12	15	31	28	68	100	48	54	38
1982	30	42	32	82	617	470	191	49	155	90	35	58
1983	57	96	469	93	150	125	344	204	84	19	13	10
1984	5	24	102	72	475	683	428	281	43	17	35	35
1985	27	166	274	85	64	210	279	77	71	43	75	19
1986	15	25	272	81	238	130	65	38	23	62	2	8

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2.44	41.00	0	0	0	0	1	9	10	6	7	0	0	0
4.88	20.50	0	0	6	4	5	30	28	19	12	7	2	0
7.32	13.67	1	1	6	7	7	30	34	22	14	8	4	1
9.76	10.25	1	4	7	8	8	31	41	33	15	8	4	2
12.20	8.20	1	5	7	8	10	34	49	33	18	12	4	3
14.63	6.83	2	7	7	9	11	39	49	36	20	14	4	4
17.07	5.86	4	8	9	9	12	40	52	38	21	17	5	4
19.51	5.13	4	8	10	12	15	66	65	43	22	17	8	4
21.95	4.56	5	9	11	13	15	68	71	49	22	17	10	6
24.39	4.10	5	10	12	15	15	69	79	49	23	18	10	7
26.83	3.73	5	13	13	15	15	71	85	51	24	19	10	8
29.27	3.42	6	15	16	15	15	78	96	54	29	20	11	8
31.71	3.15	6	15	18	15	20	80	100	57	29	21	12	8
34.15	2.93	7	15	20	21	30	89	104	58	30	23	13	8
36.59	2.73	7	17	21	25	32	94	110	62	31	23	14	9
39.02	2.56	7	19	25	38	38	101	119	63	31	25	14	10
41.46	2.41	8	22	28	40	39	102	128	65	35	25	17	10
43.90	2.28	8	22	32	41	40	123	135	68	38	28	18	11
46.34	2.16	8	23	33	41	46	125	137	68	41	30	19	11
48.78	2.05	9	23	39	45	64	130	140	68	43	30	19	11
51.22	1.95	9	24	42	55	64	132	142	76	45	31	19	12
53.66	1.86	13	24	49	60	70	141	152	77	46	31	20	12
56.10	1.78	13	25	53	60	81	141	160	81	52	33	20	12
58.54	1.71	15	26	58	66	90	148	177	83	54	36	21	15
60.98	1.64	15	30	58	72	90	157	189	91	70	38	22	16
63.41	1.58	15	32	64	80	145	161	191	99	71	38	27	17
65.85	1.52	16	36	75	81	150	184	226	113	71	39	28	17
68.29	1.46	18	42	82	82	175	187	249	113	73	43	29	19
70.73	1.41	21	44	83	85	193	210	261	114	80	45	33	20
73.17	1.37	22	45	101	93	197	210	271	129	84	48	34	20
75.61	1.32	24	50	102	143	205	237	279	143	89	49	35	20
78.05	1.28	25	52	103	150	238	241	311	162	100	55	35	20
80.49	1.24	26	62	150	153	256	320	327	163	117	62	45	21
82.93	1.21	27	73	160	158	292	321	331	170	119	63	47	28
85.37	1.17	30	86	208	161	296	332	342	196	145	66	51	28
87.80	1.14	38	93	264	217	399	343	344	198	155	80	52	35
90.24	1.11	42	96	272	307	475	395	347	204	186	84	54	37
92.68	1.08	45	166	274	375	585	470	428	217	199	86	57	38
95.12	1.05	57	176	469	547	599	470	458	250	268	90	75	58
97.56	1.02	67	325	519	1153	617	683	683	281	310	145	75	63
25-yr	flow	0	0	5	3	4	25	24	16	11	6	2	0
10-yr	flow	1	5	7	8	8	31	42	33	15	9	4	2
5-yr	flow	4	9	10	12	15	66	67	45	22	17	8	5
2-yr	flow	9	24	40	50	64	131	141	72	44	31	19	11

7-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1947	19	461	218	239	99	95	754	243	136	34	16	8
1948	7	24	23	16	16	273	113	107	35	126	27	12
1949	14	105	88	2013	648	263	168	73	41	38	21	14
1950	50	37	34	939	342	383	207	70	213	47	21	20
1951	20	18	41	73	465	429	323	62	46	91	41	24
1952	14	24	58	202	205	302	482	83	24	20	9	9
1953	2	8	12	15	10	192	140	126	33	22	4	1
1954	3	16	13	7	6	9	11	6	11	0	6	0
1955	7	0	0	0	17	37	98	36	24	59	5	0
1956	14	26	7	13	41	82	70	39	13	53	27	8
1957	0	1	45	10	64	82	512	260	210	114	77	12
1958	8	51	111	73	68	318	154	68	108	42	57	21
1959	16	15	53	44	312	226	106	117	33	9	25	5
1960	23	65	90	202	202	125	198	257	249	74	32	13
1961	5	25	29	8	9	352	153	291	36	26	56	22
1962	10	82	85	363	652	488	169	217	145	43	20	13
1963	31	31	10	15	20	863	61	45	53	27	14	9
1964	9	14	7	10	47	46	358	80	18	9	4	4
1965	0	1	7	9	12	38	107	24	19	15	5	15
1966	6	5	9	15	15	76	55	120	50	82	76	10
1967	31	27	180	64	76	445	313	138	145	65	62	21
1968	31	53	1831	150	99	95	124	66	75	32	18	9
1969	10	27	46	64	263	239	826	133	59	182	32	43
1970	74	97	87	45	178	144	183	114	432	52	25	16
1971	24	24	28	48	434	166	85	62	83	37	10	7
1972	6	6	21	96	41	95	174	59	22	25	28	23
1973	9	323	416	197	194	604	923	134	268	56	59	39
1974	47	57	298	334	341	523	465	206	883	35	36	84
1975	45	101	107	452	419	427	252	225	82	40	23	40
1976	15	27	66	68	151	275	91	35	26	8	15	2
1977	5	9	11	4	9	171	56	51	39	28	27	18
1978	40	46	80	26	30	40	464	308	64	26	13	9
1979	6	10	28	40	38	435	634	83	39	19	37	10
1980	5	10	15	23	15	76	180	75	32	24	7	27
1981	8	12	17	12	16	33	30	70	249	85	75	45
1982	38	46	36	136	724	579	221	52	213	174	36	75
1983	97	124	534	106	170	374	502	329	120	21	13	11
1984	6	72	136	84	739	909	455	315	49	18	39	41
1985	29	337	297	95	67	247	393	86	247	49	94	19
1986	15	27	457	88	350	140	70	42	24	73	6	9

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2.44	41.00	0	0	0	0	6	9	11	6	11	0	4	0
4.88	20.50	0	1	7	4	9	33	30	24	13	8	4	0
7.32	13.67	2	1	7	7	9	37	55	35	18	9	5	1
9.76	10.25	3	5	7	8	10	38	56	36	19	9	5	2
12.20	8.20	5	6	9	9	12	40	61	39	22	15	6	4
14.63	6.83	5	8	10	10	15	46	70	42	24	18	6	5
17.07	5.86	5	9	11	10	15	76	70	45	24	19	7	7
19.51	5.13	6	10	12	12	16	76	85	51	24	20	9	8
21.95	4.56	6	10	13	13	16	82	91	52	26	21	10	8
24.39	4.10	6	12	15	15	17	82	98	59	32	22	13	9
26.83	3.73	6	14	17	15	20	95	106	62	33	24	13	9
29.27	3.42	7	15	21	15	30	95	107	62	33	25	14	9
31.71	3.15	7	16	23	16	38	95	113	66	35	26	15	9
34.15	2.93	8	18	28	23	41	125	124	68	36	26	16	9
36.59	2.73	8	24	28	26	41	140	140	70	39	27	18	10
39.02	2.56	9	24	29	40	47	144	153	70	39	28	20	10
41.46	2.41	9	24	34	44	64	166	154	73	41	32	21	11
43.90	2.28	10	25	36	45	67	171	168	75	46	34	21	12
46.34	2.16	10	26	41	48	68	192	169	80	49	35	23	12
48.78	2.05	14	27	45	64	76	226	174	83	50	37	25	13
51.22	1.95	14	27	46	64	99	239	180	83	53	38	25	13
53.66	1.86	14	27	53	68	99	247	183	86	59	40	27	14
56.10	1.78	15	27	58	73	151	263	198	107	64	42	27	15
58.54	1.71	15	31	66	73	170	273	207	114	75	43	27	16
60.98	1.64	16	37	80	84	178	275	221	117	82	47	28	18
63.41	1.58	19	46	85	88	194	302	252	120	83	49	32	19
65.85	1.52	20	46	87	95	202	318	313	126	108	52	32	20
68.29	1.46	23	51	88	96	205	352	323	133	120	53	36	21
70.73	1.41	24	53	90	106	263	374	358	134	136	56	36	21
73.17	1.37	29	57	107	136	312	383	393	138	145	59	37	22
75.61	1.32	31	65	111	150	341	427	455	206	145	65	39	23
78.05	1.28	31	72	136	197	342	429	464	217	210	73	41	24
80.49	1.24	31	82	180	202	350	435	465	225	213	74	56	27
82.93	1.21	38	97	218	202	419	445	482	243	213	82	57	39
85.37	1.17	40	101	297	239	434	488	502	257	247	85	59	40
87.80	1.14	45	105	298	334	465	523	512	260	249	91	62	41
90.24	1.11	47	124	416	363	648	579	634	291	249	114	75	43
92.68	1.08	50	323	457	452	652	604	754	308	268	126	76	45
95.12	1.05	74	337	534	939	724	863	826	315	432	174	77	75
97.56	1.02	97	461	1831	2013	739	909	923	329	883	182	94	84
25-yr	flow	0	1	5	4	8	28	26	20	13	6	4	0
10-yr	flow	3	5	8	8	11	38	57	36	20	10	6	3
5-yr	flow	6	10	12	13	16	77	87	51	25	20	10	8
2-yr	flow	14	27	46	64	88	233	177	83	52	37	25	13

15-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1947	34	862	566	504	143	198	1288	373	463	41	20	16
1948	8	30	25	19	28	386	191	480	50	213	67	14
1949	17	163	103	2372	1158	317	264	128	65	67	79	50
1950	503	42	176	2396	1452	1083	272	81	837	51	28	25
1951	20	61	44	339	1634	1483	1162	93	66	390	45	28
1952	14	260	88	315	277	1211	1363	86	34	72	13	18
1953	2	9	18	17	29	438	262	278	43	25	4	1
1954	4	17	14	9	7	10	15	7	45	0	11	0
1955	82	0	0	2	150	116	301	45	51	284	7	1
1956	16	116	9	14	176	90	134	105	21	68	56	11
1957	0	2	57	11	86	90	832	477	1018	598	89	13
1958	8	98	126	102	85	680	227	155	349	52	106	26
1959	21	19	57	71	2162	392	136	203	41	11	95	6
1960	44	190	163	721	243	131	353	290	320	197	35	14
1961	6	26	32	21	167	1118	232	387	69	29	100	24
1962	11	96	196	624	831	1033	190	316	173	98	24	18
1963	43	37	18	19	29	1040	80	249	69	70	16	15
1964	12	15	8	11	52	251	475	95	22	9	5	4
1965	1	2	8	13	37	47	133	32	34	59	5	69
1966	8	10	19	20	641	109	128	191	99	90	81	34
1967	88	134	290	73	119	585	335	404	351	311	185	21
1968	54	58	2801	168	115	110	169	159	163	34	35	11
1969	12	29	53	104	418	370	1245	144	71	301	36	51
1970	644	105	97	59	216	251	290	253	711	61	29	21
1971	31	26	31	50	860	424	111	170	307	73	17	9
1972	7	10	950	145	55	175	578	87	31	42	48	27
1973	12	492	830	456	353	2010	1159	165	622	101	214	84
1974	63	75	377	433	464	723	566	296	1719	39	45	216
1975	67	144	159	798	591	931	311	343	155	93	36	152
1976	18	31	182	82	194	307	108	50	29	10	53	4
1977	10	10	12	5	199	524	66	59	45	44	172	118
1978	82	51	851	28	30	505	574	1065	156	32	14	15
1979	9	13	32	45	39	1044	2457	91	42	19	53	11
1980	5	16	44	28	17	105	429	88	46	54	9	68
1981	10	17	22	13	20	38	37	304	301	281	192	102
1982	41	47	44	341	2092	856	633	56	427	447	43	308
1983	134	147	1089	135	264	605	2296	516	177	23	14	11
1984	8	103	631	178	1727	1468	921	685	54	21	49	164
1985	53	497	676	134	106	563	844	137	513	53	120	21
1986	17	34	862	100	435	215	74	45	35	200	13	10

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
2.44	41.00	0	0	0	2	7	10	15	7	21	0	4	0
4.88	20.50	1	2	8	5	17	38	37	32	22	9	5	1
7.32	13.67	2	2	8	9	20	47	66	45	29	10	5	1
9.76	10.25	4	9	9	11	28	90	74	45	31	11	7	4
12.20	8.20	5	10	12	11	29	90	80	50	34	19	9	4
14.63	6.83	6	10	14	13	29	105	108	56	34	21	11	6
17.07	5.86	7	10	18	13	30	109	111	59	35	23	13	9
19.51	5.13	8	13	18	14	37	110	128	81	41	25	13	10
21.95	4.56	8	15	19	17	39	116	133	86	42	29	14	11
24.39	4.10	8	16	22	19	52	131	134	87	43	32	14	11
26.83	3.73	8	17	25	19	55	175	136	88	45	34	16	11
29.27	3.42	9	17	31	20	85	198	169	91	45	39	17	11
31.71	3.15	10	19	32	21	86	215	190	93	46	41	20	13
34.15	2.93	10	26	32	28	106	251	191	95	50	42	24	14
36.59	2.73	11	26	44	28	115	251	227	105	51	44	28	14
39.02	2.56	12	29	44	45	119	307	232	128	54	51	29	15
41.46	2.41	12	30	44	50	143	317	262	137	65	52	35	15
43.90	2.28	12	31	53	59	150	370	264	144	66	53	35	16
46.34	2.16	14	34	57	71	167	386	272	155	69	54	36	18
48.78	2.05	16	37	57	73	176	392	290	159	69	59	36	18
51.22	1.95	17	42	88	82	194	424	301	165	71	61	43	21
53.66	1.86	17	47	97	100	199	438	311	170	99	67	45	21
56.10	1.78	18	51	103	102	216	505	335	191	155	68	45	21
58.54	1.71	20	58	126	104	243	524	353	203	156	70	48	24
60.98	1.64	21	61	159	134	264	563	429	249	163	72	49	25
63.41	1.58	31	75	163	135	277	585	475	253	173	73	53	26
65.85	1.52	34	96	176	145	353	605	566	278	177	90	53	27
68.29	1.46	41	98	182	168	418	680	574	290	301	93	56	28
70.73	1.41	43	103	196	178	435	723	578	296	307	98	67	34
73.17	1.37	44	105	290	315	464	856	633	304	320	101	79	50
75.61	1.32	53	116	377	339	591	931	832	316	349	197	81	51
78.05	1.28	54	134	566	341	641	1033	844	343	351	200	89	68
80.49	1.24	63	144	631	433	831	1040	921	373	427	213	95	69
82.93	1.21	67	147	676	456	860	1044	1159	387	463	281	100	84
85.37	1.17	82	163	830	504	1158	1083	1162	404	513	284	106	102
87.80	1.14	82	190	851	624	1452	1118	1245	477	622	301	120	118
90.24	1.11	88	260	862	721	1634	1211	1288	480	711	311	172	152
92.68	1.08	134	492	950	798	1727	1468	1363	516	837	390	185	164
95.12	1.05	503	497	1089	2372	2092	1483	2296	685	1018	447	192	216
97.56	1.02	644	862	2801	2396	2162	2010	2457	1065	1719	598	214	308
25-yr	flow	1	1	6	4	15	32	32	27	22	7	5	1
10-yr	flow	4	9	9	11	28	90	75	46	31	12	7	4
5-yr	flow	8	14	18	15	37	111	129	82	41	26	13	10
2-yr	flow	16	39	73	78	185	408	296	162	70	60	40	19

Seasonal (May-October) Low-Flow Statistics for
Shoal Creek near Breese over Years 1947-1986

7-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1947	6.9	168
1948	12.4	146
1949	9.7	151
1950	16.7	150
1951	13.6	158
1952	1.9	160
1953	0.7	150
1954	0.0	88
1955	0.1	139
1956	0.0	171
1957	7.6	160
1958	16.4	178
1959	4.8	143
1960	5.4	163
1961	9.5	171
1962	12.6	147
1963	8.8	144
1964	0.4	170
1965	4.6	112
1966	9.6	135
1967	20.6	133
1968	9.2	132
1969	28.1	121
1970	16.4	125
1971	5.8	149
1972	9.3	168
1973	38.6	142
1974	34.1	87
1975	14.9	169
1976	2.4	143
1977	18.1	129
1978	6.1	156
1979	4.6	157
1980	6.6	95
1981	38.3	164
1982	36.0	112
1983	5.7	157
1984	17.6	85
1985	15.0	160
1986	6.0	111

PROBABILITY	T-YR	LOW FLOW VALUES
2.44	41.00	0.0
4.88	20.50	0.0
7.32	13.67	0.1
9.76	10.25	0.4
12.20	8.20	0.7
14.63	6.83	1.9
17.07	5.86	2.4
3 9.51	5.13	4.6
21.95	4.56	4.6
24.39	4.10	4.8
26.83	3.73	5.4
29.27	3.42	5.7
31.71	3.15	5.8
34.15	2.93	6.0
36.59	2.73	6.1
39.02	2.56	6.6
41.46	2.41	6.9
43.90	2.28	7.6
46.34	2.16	8.8
48.78	2.05	9.2
51.22	1.95	9.3
53.66	1.86	9.5
56.10	1.78	9.6
58.54	1.71	9.7
60.98	1.64	12.4
63.41	1.58	12.6
65.85	1.52	13.6
68.29	1.46	14.9
70.73	1.41	15.0
73.17	1.37	16.4
75.61	1.32	16.4
78.05	1.28	16.7
80.49	1.24	17.6
82.93	1.21	18.1
85.37	1.17	20.6
87.80	1.14	28.1
90.24	1.11	34.1
92.68	1.08	36.0
95.12	1.05	38.3
97.56	1.02	38.6
25.-Year Flow		0.0
10.-Year Flow		0.4
5.-Year Flow		4.6
2.-Year Flow		9.2

15-DAY LOW FLOWS IN CFS

YEAR .	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1947	8.0	164
1948	13.5	142
1949	17.3	119
1950	20.2	143
1951	14.1	156
1952	2.0	153
1953	0.9	143
1954	0.0	127
1955	0.7	131
1956	0.1	169
1957	8.4	155
1958	20.9	170
1959	6.0	135
1960	6.2	164
1961	11.2	162
1962	16.6	140
1963	10.5	148
1964	1.0	167
1965	4.8	104
1966	34.2	128
1967	21.1	132
1968	11.1	125
1969	35.9	99
1970	18.3	121
1971	7.3	149
1972	11.6	162
1973	53.0	117
1974	37.6	80
1975	18.4	161
1976	3.1	143
1977	43.4	121
1978	7.4	150
1979	5.5	154
1980	9.3	93
1981	41.2	155
1982	43.1	109
1983	7.3	150
1984	20.5	78
1985	16.5	156
1986	9.9	128

PROBABILITY	T-YR	LOW FLOW VALUES
2.44	41.00	0.0
4.88	20.50	0.1
7.32	13.67	0.7
9.76	10.25	0.9
12.20	8.20	1.0
14.63	6.83	2.0
17.07	5.86	3.1
19.51	5.13	4.8
21.95	4.56	5.5
24.39	4.10	6.0
26.83	3.73	6.2
29.27	3.42	7.3
31.71	3.15	7.3
34.15	2.93	7.4
36.59	2.73	8.0
39.02	2.56	8.4
41.46	2.41	9.3
43.90	2.28	9.9
46.34	2.16	10.5
48.78	2.05	11.1
51.22	1.95	11.2
53.66	1.86	11.6
56.10	1.78	13.5
58.54	1.71	14.1
60.98	1.64	16.5
63.41	1.58	16.6
65.85	1.52	17.3
68.29	1.46	18.3
70.73	1.41	18.4
73.17	1.37	20.2
75.61	1.32	20.5
78.05	1.28	20.9
80.49	1.24	21.1
82.93	1.21	34.2
85.37	1.17	35.9
87.80	1.14	37.6
90.24	1.11	41.2
92.68	1.08	43.1
95.12	1.05	43.4
97.56	1.02	53.0
25.-Year Flow		0.1
10.-Year Flow		1.0
5.-Year Flow		4.9
2.-Year Flow		11.1

31-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1947	11.2	150
1948	15.8	138
1949	50.7	104
1950	37.5	92
1951	17.9	145
1952	3.4	150
1953	2.0	128
1954	2.0	66
1955	2.5	115
1956	1.2	154
1957	13.0	140
1958	47.5	154
1959	9.6	120
1960	8.5	153
1961	23.8	154
1962	46.9	103
1963	12.9	141
1964	3.0	154
1965	9.7	91
1966	82.5	112
1967	23.5	126
1968	12.7	154
1969	58.6	97
1970	24.6	107
1971	8.2	141
1972	22.8	154
1973	89.7	118
1974	58.1	64
1975	23.5	149
1976	6.7	128
1977	52.9	24
1978	11.0	153
1979	8.6	139
1980	15.8	149
1981	50.5	145
1982	73.9	94
1983	9.8	134
1984	27.3	62
1985	18.1	145
1986	11.4	112

PROBABILITY	T-YR	LOW FLOW VALUES
2.44	41.00	1.2
4.88	20.50	2.0
7.32	13.67	2.0
9.76	10.25	2.5
12.20	8.20	3.0
14.63	6.83	3.4
17.07	5.86	6.7
19.51	5.13	8.2
21.95	4.56	8.5
24.39	4.10	8.6
26.83	3.73	9.6
29.27	3.42	9.7
31.71	3.15	9.8
34.15	2.93	11.0
36.59	2.73	11.2
39.02	2.56	11.4
41.46	2.41	12.7
43.90	2.28	12.9
46.34	2.16	13.0
48.78	2.05	15.8
51.22	1.95	15.8
53.66	1.86	17.9
56.10	1.78	18.1
58.54	1.71	22.8
60.98	1.64	23.5
63.41	1.58	23.5
65.85	1.52	23.8
68.29	1.46	24.6
70.73	1.41	27.3
73.17	1.37	37.5
75.61	1.32	46.9
78.05	1.28	47.5
80.49	1.24	50.5
82.93	1.21	50.7
85.37	1.17	52.9
87.80	1.14	58.1
90.24	1.11	58.6
92.68	1.08	73.9
95.12	1.05	82.5
97.56	1.02	89.7
25.-Year Flow		1.8
10.-Year Flow		2.6
5.-Year Flow		8.2
2.-Year Flow		15.8

61-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1947	20.0	119
1948	33.9	122
1949	71.1	99
1950	50.6	71
1951	33.1	116
1952	13.1	124
1953	3.3	108
1954	12.0	81
1955	37.5	85
1956	7.9	124
1957	25.6	117
1958	90.4	124
1959	42.5	38
1960	24.8	123
1961	45.2	124
1962	62.4	94
1963	18.3	121
1964	4.5	124
1965	40.3	81
1966	94.5	47
1967	49.5	118
1968	16.1	124
1969	110.0	80
1970	37.6	86
1971	10.4	114
1972	42.5	124
1973	160.3	123
1974	73.7	60
1975	83.9	61
1976	15.6	117
1977	131.7	75
1978	14.4	124
1979	13.6	124
1980	44.6	119
1981	120.3	124
1982	243.5	99
1983	13.9	105
1984	45.8	40
1985	27.0	124
1986	37.2	92

PROBABILITY	T-YR	LOW FLOW VALUES
2.44	41.00	3.3
4.88	20.50	4.5
7.32	13.67	7.9
9.76	10.25	10.4
12.20	8.20	12.0
14.63	6.83	13.1
17.07	5.86	13.6
19.51	5.13	13.9
21.95	4.56	14.4
24.39	4.10	15.6
26.83	3.73	16.1
29.27	3.42	18.3
31.71	3.15	20.0
34.15	2.93	24.8
36.59	2.73	25.6
39.02	2.56	27.0
41.46	2.41	33.1
43.90	2.28	33.9
46.34	2.16	37.2
48.78	2.05	37.5
51.22	1.95	37.6
53.66	1.86	40.3
56.10	1.78	42.5
58.54	1.71	42.5
60.98	1.64	44.6
63.41	1.58	45.2
65.85	1.52	45.8
68.29	1.46	49.5
70.73	1.41-	50.6
73.17	1.37	62.4
75.61	1.32	71.1
78.05	1.28	73.7
80.49	1.24	83.9
82.93	1.21	90.4
85.37	1.17	94.5
87.80	1.14	110.0
90.24	1.11	120.3
92.68	1.08	131.7
95.12	1.05	160.3
97.56	1.02	243.5
25.-Year Flow		4.2
10.-Year Flow		10.6
5.-Year Flow		14.0
2.-Year Flow		37.5

91-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1947	21.2	89
1948	65.0	94
1949	106.9	68
1950	57.1	67
1951	55.1	94
1952	14.3	94
1953	5.4	93
1954	10.6	52
1955	49.9	93
1956	65.9	94
1957	148.5	87
1958	485.8	94
1959	68.6	61
1960	29.7	94
1961	187.1	94
1962	74.7	85
1963	21.0	94
1964	10.3	94
1965	62.7	50
1966	105.9	52
1967	180.4	94
1968	74.8	94
1969	263.7	76
1970	47.8	94
1971	15.1	94
1972	54.4	89
1973	218.9	94
1974	165.5	61
1975	90.5	89
1976	31.5	86
1977	139.2	66
1978	18.0	94
1979	90.3	94
1980	64.5	89
1981	209.3	94
1982	323.4	94
1983	15.9	82
1984	48.8	42
1985	84.4	94
1986	216.4	62

PROBABILITY	T-YR	LOW FLOW VALUES
2.44	41.00	5.4
4.88	20.50	10.3
7.32	13.67	10.6
9.76	10.25	14.3
12.20	8.20	15.1
14.63	6.83	15.9
17.07	5.86	18.0
19.51	5.13	21.0
21.95	4.56	21.2
24.39	4.10	29.7
26.83	3.73	31.5
29.27	3.42	47.8
31.71	3.15	48.8
34.15	2.93	49.9
36.59	2.73	54.4
39.02	2.56	55.1
41.46	2.41	57.1
43.90	2.28	62.7
46.34	2.16	64.5
48.78	2.05	65.0
51.22	1.95	65.9
53.66	1.86	68.6
56.10	1.78	74.7
58.54	1.71	74.8
60.98	1.64	84.4
63.41	1.58	90.3
65.85	1.52	90.5
68.29	1.46	105.9
70.73	1.41	106.9
73.17	1.37	139.2
75.61	1.32	148.5
78.05	1.28	165.5
80.49	1.24	180.4
82.93	1.21	187.1
85.37	1.17	209.3
87.80	1.14	216.4
90.24	1.11	218.9
92.68	1.08	263.7
95.12	1.05	323.4
97.56	1.02	485.8
25.-Year Flow		9.2
10.-Year Flow		14.4
5.-Year Flow		21.0
2.-Year Flow		65.5

121-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1947	77.9	64
1948	237.7	64
1949	149.1	38
1950	69.3	64
1951	272.6	64
1952	41.3	64
1953	12.7	64
1954	26.4	22
1955	120.1	25
1956	73.8	64
1957	318.7	64
1958	588.2	64
1959	73.0	37
1960	111.1	64
1961	209.1	64
1962	128.8	62
1963	44.5	64
1964	11.5	64
1965	66.2	20
1966	126.7	34
1967	364.0	64
1968	72.9	64
1969	446.5	19
1970	62.5	64
1971	32.9	64
1972	57.6	59
1973	323.9	64
1974	151.4	64
1975	98.3	64
1976	28.5	57
1977	156.6	64
1978	39.8	64
1979	142.0	64
1980	91.2	64
1981	376.2	64
1982	488.2	64
1983	48.9	64
1984	95.5	46
1985	104.2	64
1986	204.7	32

PROBABILITY	T-YR	LOW FLOW VALUES
2.44	41.00	11.5
4.88	20.50	12.7
7.32	13.67	26.4
9.76	10.25	28.5
12.20	8.20	32.9
14.63	6.83	39.8
17.07	5.86	41.3
19.51	5.13	44.5
21.95	4.56	48.9
24.39	4.10	57.6
26.83	3.73	62.5
29.27	3.42	66.2
31.71	3.15	69.3
34.15	2.93	72.9
36.59	2.73	73.0
39.02	2.56	73.8
41.46	2.41	77.9
43.90	2.28	91.2
46.34	2.16	95.5
48.78	2.05	98.3
51.22	1.95	104.2
53.66	1.86	111.1
56.10	1.78	120.1
58.54	1.71	126.7
60.98	1.64	128.8
63.41	1.58	142.0
65.85	1.52	149.1
68.29	1.46	151.4
70.73	1.41	156.6
73.17	1.37	204.7
75.61	1.32	209.1
78.05	1.28	237.7
80.49	1.24	272.6
82.93	1.21	318.7
85.37	1.17	323.9
87.80	1.14	364.0
90.24	1.11	376.2
92.68	1.08	446.5
95.12	1.05	488.2
97.56	1.02	588.2
25.-Year Flow		12.5
10.-Year Flow		29.1
5.-Year Flow		45.5
2.-Year Flow		101.3

151-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1947	214.2	34
1948	241.2	34
1949	172.1	9
1950	267.9	34
1951	436.1	25
1952	66.7	34
1953	102.2	34
1954	41.2	14
1955	112.4	9
1956	109.1	34
1957	1206.8	34
1958	545.3	34
1959	134.8	34
1960	247.8	34
1961	183.9	34
1962	213.6	34
1963	60.5	34
1964	105.5	34
1965	78.3	34
1966	123.9	34
1967	370.1	34
1968	126.2	34
1969	447.6	13
1970	302.7	34
1971	98.5	34
1972	59.1	34
1973	568.1	34
1974	574.0	34
1975	127.3	34
1976	34.7	27
1977	164.1	10
1978	77.3	34
1979	129.1	34
1980	100.3	34
1981	370.7	34
1982	590.1	9
1983	211.1	34
1984	122.7	34
1985	224.6	34
1986	174.5	2

PROBABILITY	T-YR	LOW FLOW VALUES
2.44	41.00	34.7
4.88	20.50	41.2
7.32	13.67	59.1
9.76	10.25	60.5
12.20	8.20	66.7
14.63	6.83	77.3
17.07	5.86	78.3
19.51	5.13	98.5
21.95	4.56	100.3
24.39	4.10	102.2
26.83	3.73	105.5
29.27	3.42	109.1
31.71	3.15	112.4
34.15	2.93	122.7
36.59	2.73	123.9
39.02	2.56	126.2
41.46	2.41	127.3
43.90	2.28	129.1
46.34	2.16	134.8
48.78	2.05	164.1
51.22	1.95	172.1
53.66	1.86	174.5
56.10	1.78	183.9
58.54	1.71	211.1
60.98	1.64	213.6
63.41	1.58	214.2
65.85	1.52	224.6
68.29	1.46	241.2
70.73	1.41	247.8
73.17	1.37	267.9
75.61	1.32	302.7
78.05	1.28	370.1
80.49	1.24	370.7
82.93	1.21	436.1
85.37	1.17	447.6
87.80	1.14	545.3
90.24	1.11	568.1
92.68	1.08	574.0
95.12	1.05	590.1
97.56	1.02	1206.8
25.-Year Flow		39.8
10.-Year Flow		61.3
5.-Year Flow		98.9
2.-Year Flow		168.2

181-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1947	302.2	4
1948	313.5	4
1949	237.1	1
1950	254.3	4
1951	387.1	4
1952	75.9	4
1953	170.3	4
1954	53.6	1
1955	103.1	4
1956	128.3	4
1957	1285.0	4
1958	520.5	4
1959	224.0	4
1960	292.3	4
1961	504.9	4
1962	281.2	4
1963	243.0	4
1964	105.7	4
1965	77.2	4
1966	276.2	4
1967	409.0	4
1968	417.3	4
1969	667.3	4
1970	345.6	4
1971	121.9	4
1972	74.1	4
1973	526.0	4
1974	601.4	4
1975	211.7	4
1976	42.7	4
1977	181.0	1
1978	297.7	4
1979	145.3	4
1980	122.9	4
1981	432.6	4
1982	572.0	4
1983	460.2	4
1984	238.3	4
1985	228.4	4

PROBABILITY	T-YR	LOW FLOW VALUES
2.50	40.00	42.7
5.00	20.00	53.6
7.50	13.33	74.1
10.00	10.00	75.9
12.50	8.00	77.2
15.00	6.67	103.1
17.50	5.71	105.7
20.00	5.00	121.9
22.50	4.44	122.9
25.00	4.00	128.3
27.50	3.64	145.3
30.00	3.33	170.3
32.50	3.08	181.0
35.00	2.86	211.7
37.50	2.67	224.0
40.00	2.50	228.4
42.50	2.35	237.1
45.00	2.22	238.3
47.50	2.11	243.0
50.00	2.00	254.3
52.50	1.90	276.2
55.00	1.82	281.2
57.50	1.74	292.3
60.00	1.67	297.7
62.50	1.60	302.2
65.00	1.54	313.5
67.50	1.48	345.6
70.00	1.43	387.1
72.50	1.38	409.0
75.00	1.33	417.3
77.50	1.29	432.6
80.00	1.25	460.2
82.50	1.21	504.9
85.00	1.18	520.5
87.50	1.14	526.0
90.00	1.11	572.0
92.50	1.08	601.4
95.00	1.05	667.3
97.50	1.03	1285.0
25.-Year Flow		50.9
10.-Year Flow		75.9
5.-Year Flow		121.9
2.-Year Flow		254.3

Appendix C

Monthly and Seasonal Low-Flow Statistics for Silver Creek near Freeburg, Illinois (Water Years 1971 - 1988)

Monthly Low-Flow Statistics for Silver Creek near Freeburg
(Water Years 1971 -1988)

1-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	10	15	13	15	13	72	51	35	25	9	3	4
1972	1	1	3	26	25	45	123	32	13	5	17	8
1973	7	143	120	100	132	121	497	78	129	19	5	5
1974	5	9	61	90	105	307	138	68	72	11	10	34
1975	16	18	42	151	193	181	114	103	33	17	11	13
1976	7	9	26	24	30	25	39	10	7	2	7	3
1977	3	4	4	2	3	70	27	6	5	6	5	12
1978	19	26	84	35	35	50	114	79	19	17	7	4
1979	4	9	29	45	45	139	164	43	13	10	17	4
1980	3	7	9	8	9	26	63	32	10	6	5	5
1981	4	4	6	6	5	18	15	10	14	11	15	13
1982	24	38	23	35	150	145	75	18	71	23	9	10
1983	8	25	126	50	84	74	161	87	56	6	6	0
1984	3	18	50	45	140	281	181	88	25	5	4	4
1985	23	162	155	50	40	113	101	27	24	16	15	4
1986	5	29	80	45	120	90	38	27	11	7	5	5
1987	35	44	56	56	95	85	67	18	9	13	11	6
1988	5	10	22	30	50	38	16	13	10	8	8	8

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.26	19.00	1	1	3	2	3	18	15	6	5	2	3	0
10.53	9.50	3	4	4	6	5	25	16	10	7	5	4	3
15.79	6.33	3	4	6	8	9	26	27	10	9	5	5	4
21.05	4.75	3	7	9	15	13	38	38	13	10	6	5	4
26.32	3.80	4	9	13	24	25	45	39	18	10	6	5	4
31.58	3.17	4	9	22	26	30	50	51	18	11	6	5	4
36.84	2.71	5	9	23	30	35	70	63	27	13	7	6	4
42.11	2.38	5	10	26	35	40	72	67	27	13	8	7	5
47.37	2.11	5	15	29	35	45	74	75	32	14	9	7	5
52.63	1.90	7	18	42	45	50	85	101	32	19	10	8	5
57.89	1.73	7	18	50	45	84	90	114	35	24	11	9	6
63.16	1.58	8	25	56	45	95	113	114	43	25	11	10	8
68.42	1.46	10	26	61	50	105	121	123	68	25	13	11	8
73.68	1.36	16	29	80	50	120	139	138	78	33	16	11	10
78.95	1.27	19	38	84	56	132	145	161	79	56	17	15	12
84.21	1.19	23	44	120	90	140	181	164	87	71	17	15	13
89.47	1.12	24	143	126	100	150	281	181	88	72	19	17	13
94.74	1.06	35	162	155	151	193	307	497	103	129	23	17	34
10-yr	flow	3	4	4	5	5	25	16	9	7	4	4	2
5-yr	flow	3	6	8	14	12	36	36	12	9	6	5	4
2-yr	flow	6	17	36	40	48	80	89	32	17	10	7	5

3-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	10	16	13	16	13	78	56	41	29	10	4	5
1972	1	1	4	28	27	46	131	34	13	5	21	8
1973	7	178	128	103	145	125	666	84	143	19	6	6
1974	5	9	62	93	108	324	143	79	121	14	11	38
1975	17	20	47	160	199	209	118	117	34	20	13	14
1976	7	9	29	25	35	27	39	11	8	2	7	3
1977	3	4	4	2	4	81	28	6	6	7	5	13
1978	21	28	88	35	35	50	120	84	21	20	7	5
1979	4	9	31	45	45	148	204	44	14	11	20	4
1980	3	7	9	9	9	31	64	34	10	7	5	5
1981	4	4	6	6	5	18	16	11	15	14	21	14
1982	27	40	24	35	157	155	78	18	89	29	9	10
1983	8	27	131	55	89	75	177	101	61	8	6	0
1984	3	20	53	47	170	309	213	96	28	6	5	5
1985	24	208	164	53	40	116	114	31	38	16	16	4
1986	6	31	90	48	143	93	40	30	12	8	5	6
1987	37	46	57	58	97	87	73	18	10	13	15	6
1988	5	10	23	31	54	38	17	13	10	9	8	8

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.26	19.00	1	1	4	2	4	18	16	6	6	2	4	0
10.53	9.50	3	4	4	6	5	27	17	11	8	5	5	3
15.79	6.33	3	4	6	9	9	31	28	11	10	6	5	4
21.05	4.75	3	7	9	16	13	38	39	13	10	7	5	4
26.32	3.80	4	9	13	25	27	46	40	18	10	7	5	5
31.58	3.17	4	9	23	28	35	50	56	18	12	8	6	5
36.84	2.71	5	9	24	31	35	75	64	30	13	8	6	5
42.11	2.38	5	10	29	35	40	78	73	31	14	9	7	5
47.37	2.11	6	16	31	35	45	81	78	34	15	10	7	6
52.63	1.90	7	20	47	45	54	87	114	34	21	11	8	6
57.89	1.73	7	20	53	47	89	93	118	41	28	13	9	6
63.16	1.58	8	27	57	48	97	116	120	44	29	14	11	8
68.42	1.46	10	28	62	53	108	125	131	79	34	14	13	8
73.68	1.36	17	31	88	55	143	148	143	84	38	16	15	10
78.95	1.27	21	40	90	58	145	155	177	84	61	19	16	13
84.21	1.19	24	46	128	93	157	209	204	96	89	20	20	14
89.47	1.12	27	178	131	103	170	309	213	101	121	20	21	14
94.74	1.06	37	208	164	160	199	324	666	117	143	29	21	38
10-yr	flow	3	4	4	5	5	26	17	10	8	5	5	3
5-yr	flow	3	6	9	15	13	37	37	13	10	7	5	4
2-yr	flow	6	18	39	40	50	84	97	34	18	10	8	6

7-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	12	18	14	20	127	89	64	46	45	18	5	7
1972	1	1	6	34	28	51	182	54	15	6	31	9
1973	8	249	297	124	169	451	861	92	306	20	8	16
1974	6	10	73	100	125	339	196	87	350	14	15	45
1975	21	37	53	191	207	253	126	149	37	32	17	20
1976	7	11	41	28	44	91	42	14	9	3	10	3
1977	3	5	5	2	5	102	30	7	7	9	6	24
1978	36	36	111	35	37	55	149	150	26	21	7	6
1979	5	9	35	45	46	206	493	49	15	12	25	4
1980	4	7	10	11	10	40	76	36	11	7	8	8
1981	4	4	6	6	5	19	22	12	20	58	42	17
1982	37	42	29	38	210	212	85	19	151	44	11	15
1983	26	30	150	61	102	101	227	168	81	10	7	1
1984	5	109	58	58	304	553	248	104	28	9	5	10
1985	31	504	181	56	43	131	151	41	202	19	19	5
1986	6	37	136	57	230	102	49	32	14	12	5	6
1987	43	47	59	59	102	98	83	20	12	15	17	8
1988	5	12	57	37	63	44	19	14	11	9	8	8

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.26	19.00	1	1	5	2	5	19	19	7	7	3	5	1
10.53	9.50	3	4	6	6	5	40	22	12	9	6	5	3
15.79	6.33	4	5	6	11	10	44	30	14	11	7	5	4
21.05	4.75	4	7	10	20	28	51	42	14	11	9	6	5
26.32	3.80	5	9	14	28	37	55	49	19	12	9	7	6
31.58	3.17	5	10	29	34	43	89	64	20	14	9	7	6
36.84	2.71	5	11	35	35	44	91	76	32	15	10	8	7
42.11	2.38	6	12	41	37	46	98	83	36	15	12	8	8
47.37	2.11	6	18	53	38	63	101	85	41	20	12	8	8
52.63	1.90	7	30	57	45	102	102	126	46	26	14	10	8
57.89	1.73	8	36	58	56	102	102	149	49	28	15	11	9
63.16	1.58	12	37	59	57	125	131	151	54	37	18	15	10
68.42	1.46	21	37	73	58	127	206	182	87	45	19	17	15
73.68	1.36	26	42	111	59	169	212	196	92	81	20	17	16
78.95	1.27	31	47	136	61	207	253	227	104	151	21	19	17
84.21	1.19	36	109	150	100	210	339	248	149	202	32	25	20
89.47	1.12	37	249	181	124	230	451	493	150	306	44	31	24
94.74	1.06	43	504	297	191	304	553	861	168	350	58	42	45
10-yr	flow	3	4	6	6	5	39	22	12	9	6	5	3
5-yr	flow	4	7	9	19	25	50	40	14	11	8	6	4
2-yr	flow	6	24	55	41	83	101	106	44	23	13	9	8

15-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	27	19	16	25	369	166	93	116	184	54	9	15
1972	2	2	353	38	29	77	413	61	18	8	59	11
1973	10	502	555	326	363	901	895	157	587	24	16	21
1974	8	12	113	174	190	501	301	133	493	16	50	99
1975	36	69	63	439	294	814	169	218	51	50	21	35
1976	7	13	103	31	64	120	53	22	13	4	31	3
1977	10	5	6	3	145	370	34	11	13	27	180	70
1978	166	58	750	38	38	683	168	483	47	36	11	12
1979	12	13	41	50	49	713	1368	61	21	14	45	4
1980	4	9	12	15	12	52	250	41	16	13	26	37
1981	4	5	7	6	8	20	23	37	100	196	126	77
1982	57	50	39	79	592	353	153	26	305	131	16	121
1983	35	38	481	71	139	152	1544	281	201	14	8	2
1984	10	169	295	154	761	1154	817	134	34	11	10	161
1985	133	799	432	72	111	282	430	63	609	24	40	5
1986	10	111	297	69	278	168	55	36	25	39	8	11
1987	149	49	71	82	112	157	197	25	15	25	43	12
1988	8	13	174	64	116	59	27	18	11	23	11	12

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.26	19.00	2	2	6	3	8	20	23	11	11	4	8	2
10.53	9.50	4	5	7	6	12	52	27	18	13	8	8	3
15.79	6.33	4	5	12	15	29	59	34	22	13	11	9	4
21.05	4.75	7	9	16	25	38	77	53	25	15	13	10	5
26.32	3.80	8	12	39	31	49	120	55	26	16	14	11	11
31.58	3.17	8	13	41	38	64	152	93	36	18	14	11	11
36.84	2.71	10	13	63	38	111	157	153	37	21	16	16	12
42.11	2.38	10	13	71	50	112	166	168	41	25	23	16	12
47.37	2.11	10	19	103	64	116	168	169	61	34	24	21	12
52.63	1.90	10	38	113	69	139	282	197	61	47	24	26	15
57.89	1.73	12	49	174	71	145	353	250	63	51	25	31	21
63.16	1.58	27	50	295	72	190	370	301	116	100	27	40	35
68.42	1.46	35	58	297	79	278	501	413	133	184	36	43	37
73.68	1.36	36	69	353	82	294	683	430	134	201	39	45	70
78.95	1.27	57	111	432	154	363	713	817	157	305	50	50	77
84.21	1.19	133	169	481	174	369	814	895	218	493	54	59	99
89.47	1.12	149	502	555	326	592	901	1368	281	587	131	126	121
94.74	1.06	166	799	750	439	761	1154	1544	483	609	196	180	161
10-yr	flow	3	4	4	5	5	25	16	9	7	4	4	2
5-yr	flow	3	6	8	14	12	36	36	12	9	6	5	4
2-yr	flow	6	17	36	40	48	80	89	32	17	10	7	5

Seasonal (May-October) Low-Flow Statistics for
Silver Creek near Freeburg over Years 1971-1988

7-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	1.3	169
1972	6.1	81
1973	5.6	175
1974	13.2	88
1975	6.8	172
1976	2.7	74
1977	6.5	94
1978	4.5	152
1979	3.6	162
1980	4.0	158
1981	12.3	4
1982	10.8	153
1983	0.8	138
1984	4.9	92
1985	4.5	138
1986	5.4	113
1987	5.2	156
1988	8.0	129

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	0.8
10.53	9.50	1.3
15.79	6.33	2.7
21.05	4.75	3.6
26.32	3.80	4.0
31.58	3.17	4.5
36.84	2.71	4.5
42.11	2.38	4.9
47.37	2.11	5.2
52.63	1.90	5.4
57.89	1.73	5.6
63.16	1.58	6.1
68.42	1.46	6.5
73.68	1.36	6.8
78.95	1.27	8.0
84.21	1.19	10.8
89.47	1.12	12.3
94.74	1.06	13.2
19.-Year Flow		0.8
10.-Year Flow		1.3
5.-Year Flow		3.4
2.-Year Flow		5.3

15-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	1.7	169
1972	8.3	73
1973	8.2	169
1974	14.7	81
1975	7.4	169
1976	3.1	135
1977	11.0	17
1978	5.2	150
1979	3.7	154
1980	4.1	155
1981	36.9	1
1982	15.6	105
1983	1.9	138
1984	7.1	86
1985	5.3	132
1986	7.2	113
1987	7.7	154
1988	10.7	111

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	1.7
10.53	9.50	1.9
15.79	6.33	3.1
21.05	4.75	3.7
26.32	3.80	4.1
31.58	3.17	5.2
36.84	2.71	5.3
42.11	2.38	7.1
47.37	2.11	7.2
52.63	1.90	7.4
57.89	1.73	7.7
63.16	1.58	8.2
68.42	1.46	8.3
73.68	1.36	10.7
78.95	1.27	11.0
84.21	1.19	14.7
89.47	1.12	15.6
94.74	1.06	36.9
19.-Year Flow		1.7
10.-Year Flow		1.9
5.-Year Flow		3.6
2.-Year Flow		7.3

31-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	2.5	154
1972	10.9	58
1973	15.4	154
1974	20.8	65
1975	8.2	154
1976	4.0	127
1977	14.5	23
1978	14.8	108
1979	4.0	139
1980	5.0	150
1981	83.1	139
1982	23.2	93
1983	3.3	132
1984	10.3	79
1985	6.4	133
1986	8.7	105
1987	12.6	154
1988	12.1	110

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	2.5
10.53	9.50	3.3
15.79	6.33	4.0
21.05	4.75	4.0
26.32	3.80	5.0
31.58	3.17	6.4
36.84	2.71	8.2
42.11	2.38	8.7
47.37	2.11	10.3
52.63	1.90	10.9
57.89	1.73	12.1
63.16	1.58	12.6
68.42	1.46	14.5
73.68	1.36	14.8
78.95	1.27	15.4
84.21	1.19	20.8
89.47	1.12	23.2
94.74	1.06	83.1
19.-Year Flow		2.5
10.-Year Flow		3.3
5.-Year Flow		4.0
2.-Year Flow		10.6

61-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	13.5	124
1972	17.2	122
1973	38.0	71
1974	52.4	61
1975	43.8	124
1976	10.2	116
1977	55.1	12
1978	24.2	105
1979	6.6	124
1980	25.8	120
1981	128.4	110
1982	70.1	80
1983	5.8	104
1984	24.6	71
1985	15.3	122
1986	15.4	80
1987	24.8	124
1988	16.9	94

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	5.8
10.53	9.50	6.6
15.79	6.33	10.2
21.05	4.75	13.5
26.32	3.80	15.3
31.58	3.17	15.4
36.84	2.71	16.9
42.11	2.38	17.2
47.37	2.11	24.2
52.63	1.90	24.6
57.89	1.73	24.8
63.16	1.58	25.8
68.42	1.46	38.0
73.68	1.36	43.8
78.95	1.27	52.4
84.21	1.19	55.1
89.47	1.12	70.1
94.74	1.06	128.4
19.-Year Flow		5.8
10.-Year Flow		6.6
5.-Year Flow		12.9
2.-Year Flow		24.4

91-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	12.5	94
1972	43.0	5
1973	36.4	94
1974	125.0	61
1975	48.8	94
1976	26.0	68
1977	50.1	10
1978	38.9	94
1979	81.4	94
1980	31.8	90
1981	167.7	94
1982	124.4	92
1983	10.4	75
1984	37.0	42
1985	37.8	91
1986	81.1	50
1987	46.7	86
1988	27.4	64

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	10.4
10.53	9.50	12.5
15.79	6.33	26.0
21.05	4.75	27.4
26.32	3.80	31.8
31.58	3.17	36.4
36.84	2.71	37.0
42.11	2.38	37.8
47.37	2.11	38.9
52.63	1.90	43.0
57.89	1.73	46.7
63.16	1.58	48.8
68.42	1.46	50.1
73.68	1.36	81.1
78.95	1.27	81.4
84.21	1.19	124.4
89.47	1.12	125.0
94.74	1.06	167.7

19.-Year Flow	10.4
10.-Year Flow	12.4
5.-Year Flow	27.2
2.-Year Flow	41.0

121-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	24.0	64
1972	44.1	58
1973	47.2	64
1974	111.3	64
1975	90.0	64
1976	23.6	38
1977	107.4	1
1978	42.3	64
1979	142.0	64
1980	34.5	64
1981	259.8	46
1982	213.8	64
1983	48.5	53
1984	68.9	12
1985	41.7	64
1986	102.9	20
1987	91.9	64
1988	851.4	21

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	23.6
10.53	9.50	24.0
15.79	6.33	34.5
21.05	4.75	41.7
26.32	3.80	42.3
31.58	3.17	44.1
36.84	2.71	47.2
42.11	2.38	48.5
47.37	2.11	68.9
52.63	1.90	90.0
57.89	1.73	91.9
63.16	1.58	102.9
68.42	1.46	107.4
73.68	1.36	111.3
78.95	1.27	142.0
84.21	1.19	213.8
89.47	1.12	259.8
94.74	1.06	851.4
19.-Year Flow		23.6
10.-Year Flow		24.0
5.-Year Flow		40.5
2.-Year Flow		80.0

151-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	65.5	34
1972	41.0	31
1973	178.1	34
1974	240.9	34
1975	127.9	34
1976	28.6	34
1977	102.3	10
1978	47.7	34
1979	129.8	34
1980	40.3	34
1981	252.2	24
1982	261.6	34
1983	180.4	22
1984	107.6	14
1985	180.5	30
1986	91.8	1
1987	85.6	26
1988	687.1	4

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	28.6
10.53	9.50	40.3
15.79	6.33	41.0
21.05	4.75	47.7
26.32	3.80	65.5
31.58	3.17	85.6
36.84	2.71	91.8
42.11	2.38	102.3
47.37	2.11	107.6
52.63	1.90	127.9
57.89	1.73	129.8
63.16	1.58	178.1
68.42	1.46	180.4
73.68	1.36	180.5
78.95	1.27	240.9
84.21	1.19	252.2
89.47	1.12	261.6
94.74	1.06	687.1
19.-Year Flow		28.6
10.-Year Flow		39.6
5.-Year Flow		46.6
2.-Year Flow		118.3

181-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	81.4	4
1972	49.6	4
1973	226.4	4
1974	243.3	4
1975	171.7	4
1976	32.6	1
1977	125.7	1
1978	135.2	4
1979	128.2	4
1980	46.3	4
1981	250.8	1
1982	268.4	4
1983	304.8	4
1984	157.4	4
1985	167.9	4
1986	161.0	1
1987	81.7	4

PROBABILITY	T-YR	LOW FLOW VALUES
5.56	18.00	32.6
11.11	9.00	46.3
16.67	6.00	49.6
22.22	4.50	81.4
27.78	3.60	81.7
33.33	3.00	125.7
38.89	2.57	128.2
44.44	2.25	135.2
50.00	2.00	157.4
55.56	1.80	161.0
61.11	1.64	167.9
66.67	1.50	171.7
72.22	1.38	226.4
77.78	1.29	243.3
83.33	1.20	250.8
88.89	1.13	268.4
94.44	1.06	304.8
19.-Year Flow		32.6
10.-Year Flow		44.8
5.-Year Flow		70.8
2.-Year Flow		157.4

Appendix D

Monthly and Seasonal Low-Flow Statistics for Richland Creek near Hecker, Illinois (Water Years 1970 - 1988)

Monthly Low-Flow Statistics for Richland Creek near Hecker
(Water Years 1970 - 1988)

1-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	10	13	14	8	24	24	20	17	16	8	7	7
1971	9	10	9	10	10	23	19	15	11	7	6	4
1972	4	4	7	10	9	15	26	13	10	7	7	8
1973	5	32	30	41	49	45	60	35	25	10	7	8
1974	11	11	25	35	41	76	40	25	18	8	7	5
1975	7	8	12	21	35	54	34	31	13	10	8	9
1976	8	8	10	9	14	14	12	9	7	5	6	5
1977	4	7	6	7	7	16	14	8	7	8	7	11
1978	12	16	20	15	15	25	31	20	8	7	6	6
1979	8	10	17	25	20	44	71	21	7	10	10	5
1980	5	6	7	10	13	14	27	16	10	8	6	6
1981	7	9	9	7	8	9	9	14	18	16	10	9
1982	22	23	25	25	35	57	36	25	27	8	7	10
1983	9	16	43	40	30	29	59	34	20	11	9	7
1984	5	28	23	18	35	70	62	34	12	9	6	9
1985	10	42	48	24	23	50	42	19	18	13	9	8
1986	9	18	34	23	54	32	17	13	8	8	7	6
1987	18	22	24	23	24	24	29	15	10	13	12	6
1988	6	10	67	87	168	130	48	16	9	3	5	3

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.00	20.00	4	4	6	7	7	9	9	8	7	3	5	3
10.00	10.00	4	6	7	7	8	14	12	9	7	5	6	4
15.00	6.67	5	7	7	8	9	14	14	13	7	7	6	5
20.00	5.00	5	8	9	9	10	15	17	13	8	7	6	5
25.00	4.00	5	8	9	10	13	16	19	14	8	7	6	5
30.00	3.33	6	9	10	10	14	23	20	15	9	8	6	6
35.00	2.86	7	10	12	10	15	24	26	15	10	8	7	6
40.00	2.50	7	10	14	15	20	24	27	16	10	8	7	6
45.00	2.22	8	10	17	18	23	25	29	16	10	8	7	6
50.00	2.00	8	11	20	21	24	29	31	17	11	8	7	7
55.00	1.82	9	13	23	23	24	32	34	19	12	8	7	7
60.00	1.67	9	16	24	23	30	44	36	20	13	9	7	8
65.00	1.54	9	16	25	24	35	45	40	21	16	10	7	8
70.00	1.43	10	18	25	25	35	50	42	25	18	10	8	8
75.00	1.33	10	22	30	25	35	54	48	25	18	10	9	9
80.00	1.25	11	23	34	35	41	57	59	31	18	11	9	9
85.00	1.18	12	28	43	40	49	70	60	34	20	13	10	9
90.00	1.11	18	32	48	41	54	76	62	34	25	13	10	10
95.00	1.05	22	42	67	87	168	130	71	35	27	16	12	11
10-yr	flow	4	6	7	7	8	14	12	9	7	5	6	4
5-yr	flow	5	8	9	9	10	15	17	13	8	7	6	5
2-yr	flow	8	11	20	21	24	29	31	17	11	8	7	7

3-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	11	14	15	8	26	25	21	17	17	8	7	7
1971	9	11	9	10	10	25	21	16	11	7	6	5
1972	5	5	8	11	9	15	27	13	10	8	7	8
1973	6	37	33	45	49	45	63	35	32	15	8	9
1974	11	11	27	37	42	88	45	28	20	8	7	5
1975	8	8	13	22	42	65	38	34	15	11	9	9
1976	8	8	11	10	14	15	13	10	8	6	6	5
1977	5	8	6	7	7	17	14	9	8	8	7	12
1978	12	17	20	15	15	27	32	25	9	8	6	8
1979	9	10	18	25	20	46	77	21	8	11	10	6
1980	5	7	7	11	13	15	27	17	10	8	7	7
1981	7	9	9	7	8	9	9	14	20	22	11	10
1982	26	24	26	25	37	61	37	25	28	8	8	10
1983	9	16	44	40	30	30	63	38	21	11	9	7
1984	6	28	24	19	40	77	71	36	13	10	7	11
1985	11	49	52	25	24	52	44	20	25	14	10	9
1986	9	18	35	25	59	34	19	13	8	9	8	7
1987	19	24	25	24	25	24	30	16	10	15	13	6
1988	6	10	85	90	194	139	49	19	9	4	6	3

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.00	20.00	5	5	6	7	7	9	9	9	8	4	6	3
10.00	10.00	5	7	7	7	8	15	13	10	8	6	6	5
15.00	6.67	5	8	8	8	9	15	14	13	8	7	6	5
20.00	5.00	6	8	9	10	10	15	19	13	8	8	6	5
25.00	4.00	6	8	9	10	13	17	21	14	9	8	7	6
30.00	3.33	6	9	11	11	14	24	21	16	9	8	7	6
35.00	2.86	7	10	13	11	15	25	27	16	10	8	7	7
40.00	2.50	8	10	15	15	20	25	27	17	10	8	7	7
45.00	2.22	8	11	18	19	24	27	30	17	10	8	7	7
50.00	2.00	9	11	20	22	25	30	32	19	11	8	7	7
55.00	1.82	9	14	24	24	26	34	37	20	13	9	8	8
60.00	1.67	9	16	25	25	30	45	38	21	15	10	8	8
65.00	1.54	9	17	26	25	37	46	44	25	17	11	8	9
70.00	1.43	11	18	27	25	40	52	45	25	20	11	9	9
75.00	1.33	11	24	33	25	42	61	49	28	20	11	9	9
80.00	1.25	11	24	35	37	42	65	63	34	21	14	10	10
85.00	1.18	12	28	44	40	49	77	63	35	25	15	10	10
90.00	1.11	19	37	52	45	59	88	71	36	28	15	11	11
95.00	1.05	26	49	85	90	194	139	77	38	32	22	13	12
10-yr	flow	5	7	7	7	8	15	13	10	8	6	6	5
5-yr	flow	6	8	9	10	10	15	19	13	8	8	6	5
2-yr	flow	9	11	20	22	25	30	32	19	11	8	7	7

7-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	13	14	17	9	32	28	22	19	26	8	8	9
1971	10	13	10	11	27	28	22	17	12	7	6	5
1972	6	5	18	13	11	16	36	14	11	10	9	9
1973	6	51	67	56	51	179	129	37	39	33	8	14
1974	11	12	30	44	44	103	57	35	27	9	10	5
1975	8	12	14	34	54	77	45	37	15	13	10	10
1976	8	10	13	14	16	20	14	10	9	6	7	6
1977	5	8	7	7	7	21	15	11	8	9	8	14
1978	13	27	29	15	16	126	37	27	12	9	7	8
1979	9	10	19	29	21	53	86	23	9	11	11	6
1980	6	7	7	11	13	19	30	19	10	8	7	8
1981	8	9	10	7	9	9	10	17	30	43	13	16
1982	29	27	27	26	41	71	40	28	37	9	12	13
1983	12	16	47	42	33	35	72	44	26	12	10	9
1984	8	30	27	21	58	127	91	41	14	10	7	15
1985	18	64	56	28	26	57	56	23	57	14	11	9
1986	9	20	45	25	65	37	20	14	8	9	8	7
1987	20	24	26	25	26	25	33	16	12	16	15	6
1988	8	11	143	96	255	157	53	24	10	5	7	4

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.00	20.00	5	5	7	7	7	9	10	10	8	5	6	4
10.00	10.00	6	7	7	7	9	16	14	11	8	6	7	5
15.00	6.67	6	8	10	9	11	19	15	14	9	7	7	5
20.00	5.00	6	9	10	11	13	20	20	14	9	8	7	6
25.00	4.00	8	10	13	11	16	21	22	16	10	8	7	6
30.00	3.33	8	10	14	13	16	25	22	17	10	9	7	6
35.00	2.86	8	11	17	14	21	28	30	17	11	9	8	7
40.00	2.50	8	12	18	15	26	28	33	19	12	9	8	8
45.00	2.22	8	12	19	21	26	35	36	19	12	9	8	8
50.00	2.00	9	13	26	25	27	37	37	23	12	9	8	9
55.00	1.82	9	14	27	25	32	53	40	23	14	10	9	9
60.00	1.67	10	16	27	26	33	57	45	24	18	10	10	9
65.00	1.54	11	20	29	28	41	71	53	27	26	11	10	9
70.00	1.43	12	24	30	29	44	77	56	28	26	12	10	10
75.00	1.33	13	27	45	34	51	103	57	35	27	13	11	13
80.00	1.25	13	27	47	42	54	126	72	37	30	14	11	14
85.00	1.18	18	30	56	44	58	127	86	37	37	16	12	14
90.00	1.11	20	51	67	56	65	157	91	41	39	33	13	15
95.00	1.05	29	64	143	96	255	179	129	44	57	43	15	16
10-yr	flow	6	7	7	7	9	16	14	11	8	6	7	5
5-yr	flow	6	9	10	11	13	20	20	14	9	8	7	6
2-yr	flow	9	13	26	25	27	37	37	23	12	9	8	9

15-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	23	15	18	17	38	38	27	27	29	11	39	10
1971	17	15	11	14	44	33	29	56	17	11	7	7
1972	6	6	29	14	13	32	75	17	12	11	19	10
1973	7	67	106	87	88	213	211	48	162	48	15	19
1974	15	17	47	60	52	139	122	64	53	11	16	7
1975	9	13	15	40	57	185	50	50	21	41	16	13
1976	9	10	35	15	19	21	15	12	9	7	8	6
1977	6	8	8	7	73	64	19	13	13	23	88	18
1978	20	41	54	15	18	525	44	33	14	11	8	8
1979	10	20	21	31	25	100	415	24	11	16	14	6
1980	6	10	8	12	17	22	49	24	11	10	8	19
1981	8	9	10	8	22	10	12	20	85	199	35	160
1982	75	33	30	33	135	120	51	29	66	12	14	63
1983	22	19	64	54	39	48	263	69	34	13	11	10
1984	17	42	53	52	134	326	147	46	16	14	12	117
1985	62	97	134	32	95	70	67	32	105	16	21	10
1986	12	190	57	29	89	55	25	21	10	9	9	12
1987	56	27	29	56	30	34	52	17	13	18	15	12
1988	11	18	286	167	561	210	74	31	11	14	12	10

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
5.00	20.00	6	6	8	7	13	10	12	12	9	7	7	6
10.00	10.00	6	8	8	8	17	21	15	13	10	9	8	6
15.00	6.67	6	9	10	12	18	22	19	17	11	10	8	7
20.00	5.00	7	10	11	14	19	32	25	17	11	11	8	7
25.00	4.00	8	10	15	14	22	33	27	20	11	11	9	8
30.00	3.33	9	13	18	15	25	34	29	21	12	11	11	10
35.00	2.86	9	15	21	15	30	38	44	24	13	11	12	10
40.00	2.50	10	15	29	17	38	48	49	24	13	11	12	10
45.00	2.22	11	17	29	29	39	55	50	27	14	12	14	10
50.00	2.00	12	18	30	31	44	64	51	29	16	13	14	10
55.00	1.82	15	19	35	32	52	70	52	31	17	14	15	12
60.00	1.67	17	20	47	33	57	100	67	32	21	14	15	12
65.00	1.54	17	27	53	40	73	120	74	33	29	16	16	13
70.00	1.43	20	33	54	52	88	139	75	46	34	16	16	18
75.00	1.33	22	41	57	54	89	185	122	48	53	18	19	19
80.00	1.25	23	42	64	56	95	210	147	50	66	23	21	19
85.00	1.18	56	67	106	60	134	213	211	56	85	41	35	63
90.00	1.11	62	97	134	87	135	326	263	64	105	48	39	117
95.00	1.05	75	190	286	167	561	525	415	69	162	199	88	160
10-yr	flow	6	8	8	8	17	21	15	13	10	9	8	6
5-yr	flow	7	10	11	14	19	32	25	17	11	11	8	7
2-yr	flow	12	18	30	31	44	64	51	29	16	13	14	10

Seasonal (May-October) Low-Flow Statistics for
Richland Creek near Hecker over Years 1970 - 1988

7-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1970	7.6	116
1971	5.1	150
1972	6.3	167
1973	8.3	115
1974	5.1	143
1975	8.2	169
1976	4.8	165
1977	7.6	93
1978	6.7	110
1979	5.8	161
1980	6.8	116
1981	12.7	110
1982	7.8	91
1983	7.6	123
1984	7.3	103
1985	9.3	142
1986	7.3	121
1987	5.8	145
1988	3.9	148

PROBABILITY	T-YR	LOW FLOW VALUES
5.00	20.00	3.9
10.00	10.00	4.8
15.00	6.67	5.1
20.00	5.00	5.1
25.00	4.00	5.8
30.00	3.33	5.8
35.00	2.86	6.3
40.00	2.50	6.7
45.00	2.22	6.8
50.00	2.00	7.3
55.00	1.82	7.3
60.00	1.67	7.6
65.00	1.54	7.6
70.00	1.43	7.6
75.00	1.33	7.8
80.00	1.25	8.2
85.00	1.18	8.3
90.00	1.11	9.3
95.00	1.05	12.7
20.-Year Flow		3.9
10.-Year Flow		4.8
5.-Year Flow		5.1
2.-Year Flow		7.3

15-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1970	10.1	115
1971	5.6	145
1972	6.9	160
1973	11.1	112
1974	7.0	136
1975	8.6	163
1976	5.9	162
1977	8.3	29
1978	7.7	106
1979	5.9	153
1980	7.4	110
1981	19.8	1
1982	8.9	83
1983	8.7	150
1984	11.7	99
1985	9.4	145
1986	8.9	83
1987	11.4	159
1988	9.5	123

PROBABILITY	T-YR	LOW FLOW VALUES
5.00	20.00	5.6
10.00	10.00	5.9
15.00	6.67	5.9
20.00	5.00	6.9
25.00	4.00	7.0
30.00	3.33	7.4
35.00	2.86	7.7
40.00	2.50	8.3
45.00	2.22	8.6
50.00	2.00	8.7
55.00	1.82	8.9
60.00	1.67	8.9
65.00	1.54	9.4
70.00	1.43	9.5
75.00	1.33	10.1
80.00	1.25	11.1
85.00	1.18	11.4
90.00	1.11	11.7
95.00	1.05	19.8
20.-Year Flow		5.6
10.-Year Flow		5.9
5.-Year Flow		6.9
2.-Year Flow		8.7

31-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1970	10.8	66
1971	6.2	144
1972	9.7	153
1973	17.9	149
1974	11.6	154
1975	9.2	147
1976	6.3	119
1977	11.4	13
1978	11.0	125
1979	6.1	137
1980	8.5	148
1981	49.1	93
1982	28.1	147
1983	10.2	104
1984	13.8	100
1985	9.8	132
1986	9.8	103
1987	15.1	19
1988	11.2	124

PROBABILITY	T-YR	LOW FLOW VALUES
5.00	20.00	6.1
10.00	10.00	6.2
15.00	6.67	6.3
20.00	5.00	8.5
25.00	4.00	9.2
30.00	3.33	9.7
35.00	2.86	9.8
40.00	2.50	9.8
45.00	2.22	10.2
50.00	2.00	10.8
55.00	1.82	11.0
60.00	1.67	11.2
65.00	1.54	11.4
70.00	1.43	11.6
75.00	1.33	13.8
80.00	1.25	15.1
85.00	1.18	17.9
90.00	1.11	28.1
95.00	1.05	49.1
20.-Year Flow		6.1
10.-Year Flow		6.2
5.-Year Flow		8.5
2.-Year Flow		10.8

61-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1970	26.1	63
1971	7.1	119
1972	11.4	123
1973	46.4	66
1974	20.4	59
1975	12.3	124
1976	8.8	113
1977	26.8	117
1978	11.5	105
1979	7.0	124
1980	22.5	3
1981	104.6	89
1982	34.2	75
1983	10.8	104
1984	15.5	70
1985	12.8	121
1986	17.3	74
1987	24.9	1
1988	15.3	94

PROBABILITY	T-YR	LOW FLOW VALUES
5.00	20.00	7.0
10.00	10.00	7.1
15.00	6.67	8.8
20.00	5.00	10.8
25.00	4.00	11.4
30.00	3.33	11.5
35.00	2.86	12.3
40.00	2.50	12.8
45.00	2.22	15.3
50.00	2.00	15.5
55.00	1.82	17.3
60.00	1.67	20.4
65.00	1.54	22.5
70.00	1.43	24.9
75.00	1.33	26.1
80.00	1.25	26.8
85.00	1.18	34.2
90.00	1.11	46.4
95.00	1.05	104.6
20.-Year Flow		7.0
10.-Year Flow		7.1
5.-Year Flow		10.8
2.-Year Flow		15.5

91-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1970	30.3	55
1971	7.3	94
1972	20.4	22
1973	59.8	93
1974	22.5	60
1975	33.1	94
1976	15.4	94
1977	36.9	10
1978	13.6	94
1979	10.9	94
1980	21.3	34
1981	171.8	59
1982	47.7	76
1983	28.0	74
1984	29.2	41
1985	18.6	89
1986	20.2	43
1987	29.2	87
1988	25.7	64

PROBABILITY	T-YR	LOW FLOW VALUES
5.00	20.00	7.3
10.00	10.00	10.9
15.00	6.67	13.6
20.00	5.00	15.4
25.00	4.00	18.6
30.00	3.33	20.2
35.00	2.86	20.4
40.00	2.50	21.3
45.00	2.22	22.5
50.00	2.00	25.7
55.00	1.82	28.0
60.00	1.67	29.2
65.00	1.54	29.2
70.00	1.43	30.3
75.00	1.33	33.1
80.00	1.25	36.9
85.00	1.18	47.7
90.00	1.11	59.8
95.00	1.05	171.8
20.-Year Flow		7.3
10.-Year Flow		10.9
5.-Year Flow		15.4
2.-Year Flow		25.7

121-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1970	27.9	60
1971	8.7	64
1972	21.5	63
1973	60.0	63
1974	21.3	64
1975	55.1	64
1976	20.1	38
1977	50.6	63
1978	15.0	45
1979	76.7	64
1980	23.4	4
1981	164.4	1
1982	57.3	63
1983	28.6	46
1984	37.9	11
1985	21.5	64
1986	34.4	20
1987	58.3	19
1988	848.8	34
PROBABILITY	T-YR	LOW FLOW
5.00	20.00	8.7
10.00	10.00	15.0
15.00	6.67	20.1
20.00	5.00	21.3
25.00	4.00	21.5
30.00	3.33	21.5
35.00	2.86	23.4
40.00	2.50	27.9
45.00	2.22	28.6
50.00	2.00	34.4
55.00	1.82	37.9
60.00	1.67	50.6
65.00	1.54	55.1
70.00	1.43	57.3
75.00	1.33	58.3
80.00	1.25	60.0
85.00	1.18	76.7
90.00	1.11	164.4
95.00	1.05	848.8
20.-Year Flow		8.7
10.-Year Flow		15.0
5.-Year Flow		21.3
2.-Year Flow		34.4

151-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1970	35.9	29
1971	13.0	34
1972	20.1	33
1973	82.8	33
1974	33.0	34
1975	53.4	34
1976	20.5	33
1977	47.2	10
1978	15.5	34
1979	71.0	34
1980	25.8	34
1981	193.9	1
1982	67.5	34
1983	35.7	22
1984	71.0	13
1985	46.8	31
1986	58.0	2
1987	52.1	27
1988	686.9	4

PROBABILITY	T-YR	LOW FLOW VALUES
5.00	20.00	13.0
10.00	10.00	15.5
15.00	6.67	20.1
20.00	5.00	20.5
25.00	4.00	25.8
30.00	3.33	33.0
35.00	2.86	35.7
40.00	2.50	35.9
45.00	2.22	46.8
50.00	2.00	47.2
55.00	1.82	52.1
60.00	1.67	53.4
65.00	1.54	58.0
70.00	1.43	67.5
75.00	1.33	71.0
80.00	1.25	71.0
85.00	1.18	82.8
90.00	1.11	193.9
95.00	1.05	686.9

20.-Year Flow	13.0
10.-Year Flow	15.5
5.-Year Flow	20.5
2.-Year Flow	47.2

181-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1970	45.4	4
1971	28.8	4
1972	21.5	4
1973	99.3	3
1974	50.1	4
1975	61.3	4
1976	21.7	2
1977	52.7	1
1978	24.4	4
1979	65.8	4
1980	26.5	4
1981	200.3	1
1982	80.7	3
1983	72.5	4
1984	84.3	4
1985	45.3	4
1986	94.4	1
1987	49.7	4

PROBABILITY	T-YR	LOW FLOW VALUES
5.26	19.00	21.5
10.53	9.50	21.7
15.79	6.33	24.4
21.05	4.75	26.5
26.32	3.80	28.8
31.58	3.17	45.3
36.84	2.71	45.4
42.11	2.38	49.7
47.37	2.11	50.1
52.63	1.90	52.7
57.89	1.73	61.3
63.16	1.58	65.8
68.42	1.46	72.5
73.68	1.36	80.7
78.95	1.27	84.3
84.21	1.19	94.4
89.47	1.12	99.3
94.74	1.06	200.3
20.-Year Flow		21.5
10.-Year Flow		21.7
5.-Year Flow		26.2
2.-Year Flow		51.5

Appendix E

Monthly and Seasonal Low-Flow Statistics for Crooked Creek near Hoffman, Illinois (Water Years 1974 -1987)

Monthly Low-Flow Statistics for Crooked Creek near Hoffman
(Water Years 1975 - 1987)

1-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1975	2	5	14	20	40	50	28	18	12	7	4	3
1976	3	5	11	10	10	24	11	5	5	3	3	2
1977	4	4	5	3	3	29	12	7	6	9	8	7
1978	4	8	15	10	9	20	43	35	14	10	8	5
1979	3	4	36	10	20	44	46	21	5	3	12	3
1980	3	5	6	7	7	20	24	11	5	4	5	8
1981	5	4	5	5	5	5	5	8	9	8	8	6
1982	6	12	10	17	70	52	36	9	20	12	8	9
1983	5	4	15	20	25	21	50	17	12	8	5	3
1984	3	21	20	15	70	91	65	22	9	4	3	3
1985	5	61	60	20	17	25	17	8	8	3	8	2
1986	2	4	25	8	43	20	11	4	2	2	2	2
1987	4	6	13	19	28	24	8	3	2	5	3	3

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
7.14	14.00	2	4	5	3	3	5	5	3	2	2	2	2
14.29	7.00	2	4	5	5	5	20	8	4	2	3	3	2
21.43	4.67	3	4	6	7	7	20	11	5	5	3	3	2
28.57	3.50	3	4	10	8	9	20	11	7	5	3	3	3
35.71	2.80	3	4	11	10	10	21	12	8	5	4	4	3
42.86	2.33	3	5	13	10	17	24	17	8	6	4	5	3
50.00	2.00	4	5	14	10	20	24	24	9	8	5	5	3
57.14	1.75	4	5	15	15	25	25	28	11	9	7	8	3
64.29	1.56	4	6	15	17	28	29	36	17	9	8	8	5
71.43	1.40	5	8	20	19	40	44	43	18	12	8	8	6
78.57	1.27	5	12	25	20	43	50	46	21	12	9	8	7
85.71	1.17	5	21	36	20	70	52	50	22	14	10	8	8
92.86	1.08	6	61	60	20	70	91	65	35	20	12	12	9
10-yr	flow	2	4	5	4	4	13	7	3	2	3	2	2
5-yr	flow	3	4	6	7	7	20	11	5	5	3	3	2
2-yr	flow	4	5	14	10	20	24	24	9	8	5	5	3

3-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1975	3	6	15	21	47	55	29	19	13	8	4	4
1976	3	6	11	12	11	25	12	5	6	3	3	2
1977	4	4	5	3	3	33	12	8	6	10	8	7
1978	4	10	17	10	9	23	45	39	14	10	8	5
1979	3	4	37	12	20	48	49	21	5	4	13	4
1980	3	5	6	7	7	25	24	12	5	5	5	8
1981	6	4	5	5	5	5	6	9	10	8	9	7
1982	7	13	10	17	75	56	38	9	22	13	9	9
1983	5	4	16	20	25	22	55	20	13	9	6	3
1984	3	22	21	16	82	99	83	24	10	4	3	3
1985	5	78	69	20	17	25	18	9	8	3	13	2
1986	2	4	25	11	46	21	12	4	2	3	2	2
1987	5	7	14	20	31	25	9	3	4	5	3	3

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
7.14	14.00	2	4	5	3	3	5	6	3	2	3	2	2
14.29	7.00	3	4	5	5	5	21	9	4	4	3	3	2
21.43	4.67	3	4	6	7	7	22	12	5	5	3	3	2
28.57	3.50	3	4	10	10	9	23	12	8	5	4	3	3
35.71	2.80	3	4	11	11	11	25	12	9	6	4	4	3
42.86	2.33	3	5	14	12	17	25	18	9	6	5	5	3
50.00	2.00	4	6	15	12	20	25	24	9	8	5	6	4
57.14	1.75	4	6	16	16	25	25	29	12	10	8	8	4
64.29	1.56	5	7	17	17	31	33	38	19	10	8	8	5
71.43	1.40	5	10	21	20	46	48	45	20	13	9	9	7
78.57	1.27	5	13	25	20	47	55	49	21	13	10	9	7
85.71	1.17	6	22	37	20	75	56	55	24	14	10	13	8
92.86	1.08	7	78	69	21	82	99	83	39	22	13	13	9
10-yr	flow	2	4	5	4	4	14	8	4	3	3	3	2
5-yr	flow	3	4	6	7	7	22	11	5	5	3	3	2
2-yr	flow	4	6	15	12	20	25	24	9	8	5	6	4

7-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1975	3	14	18	24	54	83	32	21	13	12	5	4
1976	4	6	13	14	14	39	13	6	7	4	3	2
1977	4	4	6	3	4	48	13	8	6	11	8	8
1978	4	11	26	11	10	41	59	133	16	10	8	8
1979	4	5	39	14	23	61	73	24	5	4	21	4
1980	3	6	6	9	7	65	28	14	5	5	5	10
1981	8	4	5	5	6	6	7	10	12	9	10	7
1982	11	15	11	17	88	74	48	10	26	22	9	12
1983	6	6	23	22	28	49	76	30	21	9	6	3
1984	4	57	26	20	133	133	127	31	10	4	4	3
1985	6	224	93	21	18	29	21	10	22	4	33	3
1986	2	8	29	16	60	24	15	5	2	4	2	3
1987	8	8	16	21	33	33	13	3	4	5	4	3

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
7.14	14.00	2	4	5	3	4	6	7	3	2	4	2	2
14.29	7.00	3	4	6	5	6	24	13	5	4	4	3	3
21.43	4.67	3	5	6	9	7	29	13	6	5	4	4	3
28.57	3.50	4	6	11	11	10	33	13	8	5	4	4	3
35.71	2.80	4	6	13	14	14	39	15	10	6	4	5	3
42.86	2.33	4	6	16	14	18	41	21	10	7	5	5	3
50.00	2.00	4	8	18	16	23	48	28	10	10	5	6	4
57.14	1.75	4	8	23	17	28	49	32	14	12	9	8	4
64.29	1.56	6	11	26	20	33	61	48	21	13	9	8	7
71.43	1.40	6	14	26	21	54	65	59	24	16	10	9	8
78.57	1.27	8	15	29	21	60	74	73	30	21	11	10	8
85.71	1.17	8	57	39	22	88	83	76	31	22	12	21	10
92.86	1.08	11	224	93	24	133	133	127	133	26	22	33	12
10-yr	flow	3	4	6	4	5	16	10	5	3	4	3	2
5-yr	flow	3	5	6	8	7	28	13	6	5	4	4	3
2-yr	flow	4	8	18	16	23	48	28	10	10	5	6	4

15-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1975	4	18	28	36	72	614	41	30	23	41	6	10
1976	5	7	22	30	20	118	14	8	8	4	6	3
1977	5	4	8	3	39	303	17	10	9	15	41	8
1978	6	13	133	11	11	1201	119	372	24	12	9	12
1979	6	5	56	45	32	279	620	29	7	8	52	4
1980	3	10	7	12	7	170	108	16	6	6	8	16
1981	8	5	6	5	56	7	8	40	33	16	15	11
1982	19	21	15	27	421	358	66	14	105	75	11	65
1983	6	11	45	27	31	203	245	120	134	11	7	4
1984	13	103	62	70	496	693	311	44	13	4	6	30
1985	25	301	485	24	146	106	75	12	53	8	33	3
1986	5	52	39	18	112	274	25	8	5	9	3	10
1987	13	11	34	60	41	48	181	4	6	8	6	4

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
7.14	14.00	3	4	6	3	7	7	8	4	5	4	3	3
14.29	7.00	4	5	7	5	11	48	14	8	6	4	6	3
21.43	4.67	5	5	8	11	20	106	17	8	6	6	6	4
28.57	3.50	5	7	15	12	31	118	25	10	7	8	6	4
35.71	2.80	5	10	22	18	32	170	41	12	8	8	6	4
42.86	2.33	6	11	28	24	39	203	66	14	9	8	7	8
50.00	2.00	6	11	34	27	41	274	75	16	13	9	8	10
57.14	1.75	6	13	39	27	56	279	108	29	23	11	9	10
64.29	1.56	8	18	45	30	72	303	119	30	24	12	11	11
71.43	1.40	13	21	56	36	112	358	181	40	33	15	15	12
78.57	1.27	13	52	62	45	146	614	245	44	53	16	33	16
85.71	1.17	19	103	133	60	421	693	311	120	105	41	41	30
92.86	1.08	25	301	485	70	496	1201	620	372	134	75	52	65
10-yr	flow	4	5	6	4	9	30	12	6	6	4	4	3
5-yr	flow	5	5	7	10	19	98	16	8	6	6	6	3
2-yr	flow	6	11	34	27	41	274	75	16	13	9	8	10

Seasonal (May-October) Low-Flow Statistics for
Crooked Creek near Hoffman over Years 1975 - 1987

7-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING FROM FROM MAY 1
1975	4.5	156
1976	2.3	144
1977	4.4	171
1978	3.6	176
1979	2.8	154
1980	5.2	43
1981	6.6	149
1982	5.8	168
1983	3.2	151
1984	3.2	124
1985	2.3	158
1986	2.0	55
1987	3.0	27

PROBABILITY	T-YR	LOW FLOW VALUES
7.14	14.00	2.0
14.29	7.00	2.3
21.43	4.67	2.3
28.57	3.50	2.8
35.71	2.80	3.0
42.86	2.33	3.2
50.00	2.00	3.2
57.14	1.75	3.6
64.29	1.56	4.4
71.43	1.40	4.5
78.57	1.27	5.2
85.71	1.17	5.8
92.86	1.08	6.6

14.-Year Flow	2.0
10.-Year Flow	2.1
5.-Year Flow	2.3
2.-Year Flow	3.2

15-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING FROM FROM MAY 1
1975	4.6	148
1976	3.0	137
1977	6.5	168
1978	6.4	170
1979	3.1	152
1980	6.4	39
1981	8.3	144
1982	6.4	169
1983	3.5	143
1984	3.5	117
1985	2.5	151
1986	2.4	114
1987	3.6	19

PROBABILITY	T-YR	LOW FLOW VALUES
7.14	14.00	2.4
14.29	7.00	2.5
21.43	4.67	3.0
28.57	3.50	3.1
35.71	2.80	3.5
42.86	2.33	3.5
50.00	2.00	3.6
57.14	1.75	4.6
64.29	1.56	6.4
71.43	1.40	6.4
78.57	1.27	6.4
85.71	1.17	6.5
92.86	1.08	8.3

14.-Year Flow	2.4
10.-Year Flow	2.4
5.-Year Flow	2.9
2.-Year Flow	3.6

31-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING FROM FROM MAY 1
1975	6.1	148
1976	5.9	58
1977	8.7	22
1978	9.6	90
1979	3.7	136
1980	8.3	74
1981	12.5	128
1982	11.7	93
1983	3.9	133
1984	5.9	68
1985	2.7	135
1986	3.4	104
1987	5.2	17

PROBABILITY	T-YR	LOW FLOW VALUES
7.14	14.00	2.7
14.29	7.00	3.4
21.43	4.67	3.7
28.57	3.50	3.9
35.71	2.80	5.2
42.86	2.33	5.9
50.00	2.00	5.9
57.14	1.75	6.1
64.29	1.56	8.3
71.43	1.40	8.7
78.57	1.27	9.6
85.71	1.17	11.7
92.86	1.08	12.5
14.-Year Flow		2.7
10.-Year Flow		3.1
5.-Year Flow		3.7
2.-Year Flow		5.9

61-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING FROM FROM MAY 1
1975	9.7	124
1976	8.2	114
1977	16.5	124
1978	11.5	105
1979	6.3	124
1980	9.1	69
1981	33.5	58
1982'	43.6	99
1983	7.1	104
1984	7.5	71
1985	4.4	123
1986	9.6	80
1987	12.1	79

PROBABILITY	T-YR	LOW FLOW VALUES
7.14	14.00	4.4
14.29	7.00	6.3
21.43	4.67	7.1
28.57	3.50	7.5
35.71	2.80	8.2
42.86	2.33	9.1
50.00	2.00	9.6
57.14	1.75	9.7
64.29	1.56	11.5
71.43	1.40	12.1
78.57	1.27	16.5
85.71	1.17	33.5
92.86	1.08	43.6

14.-Year Flow	4.4
10.-Year Flow	5.5
5.-Year Flow	6.9
2.-Year Flow	9.6

91-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING FROM FROM MAY 1
1975	9.4	94
1976	10.3	1
1977	27.4	11
1978	11.8	75
1979	30.5	94
1980	10.8	73
1981	47.7	68
1982	42.2	94
1983	8.2	74
1984	10.5	41
1985	39.7	94
1986	22.3	44
1987	64.5	10

PROBABILITY	T-YR	LOW FLOW VALUES
7.14	14.00	8.2
14.29	7.00	9.4
21.43	4.67	10.3
28.57	3.50	10.5
35.71	2.80	10.8
42.86	2.33	11.8
50.00	2.00	22.3
57.14	1.75.	27.4
64.29	1.56	30.5
71.43	1.40	39.7
78.57	1.27	42.2
85.71	1.17	47.7
92.86	1.08	64.5
14.-Year Flow		8.2
10.-Year Flow		8.9
5.-Year Flow		10.2
2.-Year Flow		22.3

121-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING FROM FROM MAY 1
1975	21.2	64
1976	14.9	56
1977	35.8	27
1978	13.3	64
1979	84.1	64
1980	12.5	64
1981	46.5	48
1982	68.5	64
1983	44.7	52
1984	16.8	25
1985	37.6	64
1986	24.2	10
1987	52.2	19

PROBABILITY	T-YR	LOW FLOW VALUES
7.14	14.00	12.5
14.29	7.00	13.3
21.43	4.67	14.9
28.57	3.50	16.8
35.71	2.80	21.2
42.86	2.33	24.2
50.00	2.00	35.8
57.14	1.75	37.6
64.29	1.56	44.7
71.43	1.40	46.5
78.57	1.27	52.2
85.71	1.17	68.5
92.86	1.08	84.1

14.-Year Flow	12.5
10.-Year Flow	12.9
5.-Year Flow	14.7
2.-Year Flow	35.8

151-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING FROM FROM MAY 1
1975	23.0	34
1976	14.7	26
1977	31.8	11
1976	24.2	34
1979	69.5	34
1980	12.4	34
1981	78.0	34
1982	108.0	34
1983	104.5	22
1984	35.0	16
1985	54.1	33
1986	22.7	3
1987	46.7	2

PROBABILITY	T-YR	LOW FLOW VALUES
7.14	14.00	12.4
14.29	7.00	14.7
21.43	4.67	22.7
28.57	3.50	23.0
35.71	2.80	24.2
42.86	2.33	31.8
50.00	2.00	35.0
57.14	1.75	46.7
64.29	1.56	54.1
71.43	1.40	69.5
78.57	1.27	78.0
85.71	1.17	104.5
92.86	1.08	108.0

14.-Year Flow	12.4
10.-Year Flow	13.7
5.-Year Flow	21.6
2.-Year Flow	35.0

181-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING FROM FROM MAY 1
1975	35.5	4
1976	14.0	1
1977	45.1	4
1978	111.0	4
1979	89.7	4
1980	14.7	4
1981	100.2	1
1982	114.4	4
1983	205.8	4
1984	111.7	4
1985	49.4	4
1986	33.4	1

PROBABILITY	T-YR	LOW FLOW VALUES
7.69	13.00	14.0
15.38	6.50	14.7
23.08	4.33	33.4
30.77	3.25	35.5
38.46	2.60	45.1
46.15	2.17	49.4
53.85	1.86	89.7
61.54	1.63	100.2
69.23	1.44	111.0
76.92	1.30	111.7
84.62	1.18	114.4
92.31	1.08	205.8
14.-Year Flow		14.0
10.-Year Flow		14.3
5.-Year Flow		27.7
2.-Year Flow		71.1

Appendix F

Monthly and Seasonal Low-Flow Statistics for Mud Creek near Marissa, Illinois (Water Years 1971 - 1982)

Monthly Low-Flow Statistics for Mud Creek near Marissa
(Water Years 1971 - 1982)

1-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	0	0	0	0	0	5	2	0	0	0	0	0
1972	0	0	0	0	0	5	15	0	0	0	0	0
1973	0	11	8	3	12	15	18	5	4	0	0	0
1974	0	0	3	5	8	24	12	2	1	0	0	0
1975	0	0	4	4	7	13	6	2	0	0	0	0
1976	0	0	4	2	2	5	2	0	0	0	0	0
1977	0	0	0	0	0	4	2	0	0	0	1	1
1978	1	3	4	2	2	5	11	7	1	0	0	0
1979	0	0	2	2	3	8	12	2	0	0	0	0
1980	0	0	0	1	1	4	4	1	0	0	0	0
1981	0	0	0	0	0	0	0	1	1	3	3	1
1982	1	4	3	2	20	10	4	2	2	0	0	0

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
7.69	13.00	0	0	0	0	0	0	0	0	0	0	0	0
15.38	6.50	0	0	0	0	0	4	2	0	0	0	0	0
23.08	4.33	0	0	0	0	0	4	2	0	0	0	0	0
30.77	3.25	0	0	0	0	0	5	2	0	0	0	0	0
38.46	2.60	0	0	0	1	1	5	4	1	0	0	0	0
46.15	2.17	0	0	2	2	2	5	4	1	0	0	0	0
53.85	1.86	0	0	3	2	2	5	6	2	0	0	0	0
61.54	1.63	0	0	3	2	3	8	11	2	1	0	0	0
69.23	1.44	0	0	4	2	7	10	12	2	1	0	0	0
76.92	1.30	0	3	4	3	8	13	12	2	1	0	0	0
84.62	1.18	1	4	4	4	12	15	15	5	2	0	1	1
92.31	1.08	1	11	8	5	20	24	18	7	4	3	3	1
10-yr	flow	0	0	0	0	0	2	1	0	0	0	0	0
5-yr	flow	0	0	0	0	0	4	2	0	0	0	0	0
2-yr	flow	0	0	2	2	2	5	5	2	0	0	0	0

3-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	0	0	0	1	0	5	2	0	0	0	0	0
1972	0	0	0	0	2	5	16	1	0	0	0	0
1973	0	14	9	3	14	15	21	6	5	0	0	0
1974	0	0	3	5	8	30	15	2	1	0	0	0
1975	0	0	5	5	8	15	6	2	0	0	0	0
1976	0	0	5	2	2	5	2	0	0	0	0	0
1977	0	0	0	0	0	5	2	0	0	0	1	1
1978	1	3	4	2	2	5	11	8	1	0	0	0
1979	0	0	3	3	3	9	13	3	0	0	0	0
1980	0	0	0	1	1	4	4	1	0	0	0	0
1981	0	0	0	0	0	0	0	1	1	4	3	1
1982	1	5	3	2	20	12	6	2	3	1	0	0

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
7.69	13.00	0	0	0	0	0	0	0	0	0	0	0	0
15.38	6.50	0	0	0	0	0	4	2	0	0	0	0	0
23.08	4.33	0	0	0	0	0	5	2	0	0	0	0	0
30.77	3.25	0	0	0	1	1	5	2	1	0	0	0	0
38.46	2.60	0	0	0	1	2	5	4	1	0	0	0	0
46.15	2.17	0	0	3	2	2	5	6	1	0	0	0	0
53.85	1.86	0	0	3	2	2	5	6	2	0	0	0	0
61.54	1.63	0	0	3	2	3	9	11	2	1	0	0	0
69.23	1.44	0	0	4	3	8	12	13	2	1	0	0	0
76.92	1.30	0	3	5	3	8	15	15	3	1	0	0	0
84.62	1.18	1	5	5	5	14	15	16	6	3	1	1	1
92.31	1.08	1	14	9	5	20	30	21	8	5	4	3	1
10-yr	flow	0	0	0	0	0	2	1	0	0	0	0	0
5-yr	flow	0	0	0	0	0	5	2	0	0	0	0	0
2-yr	flow	0	0	3	2	2	5	6	2	0	0	0	0

7-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	0	1	0	1	12	5	5	2	0	0	0	0
1972	0	0	1	1	4	7	21	1	0	0	0	0
1973	0	26	35	4	20	72	40	7	7	1	0	0
1974	0	0	3	7	9	49	27	4	2	0	0	0
1975	0	2	5	8	11	24	8	3	0	0	0	0
1976	1	0	6	2	3	6	3	0	0	0	0	0
1977	0	0	0	0	0	9	2	0	0	1	1	1
1978	1	4	6	2	2	79	12	10	1	1	0	0
1979	0	0	5	3	4	12	18	4	0	0	0	0
1980	0	0	1	1	1	5	4	2	0	0	0	0
1981	0	0	0	0	0	1	0	1	5	12	3	1
1982	1	7	4	2	22	17	8	3	12	1	0	0

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
7.69	13.00	0	0	0	0	0	1	0	0	0	0	0	0
15.38	6.50	0	0	0	0	0	5	2	0	0	0	0	0
23.08	4.33	0	0	0	1	1	5	3	1	0	0	0	0
30.77	3.25	0	0	1	1	2	6	4	1	0	0	0	0
38.46	2.60	0	0	1	1	3	7	5	2	0	0	0	0
46.15	2.17	0	0	3	2	4	9	8	2	0	0	0	0
53.85	1.86	0	0	4	2	4	12	8	3	0	0	0	0
61.54	1.63	0	1	5	2	9	17	12	3	1	1	0	0
69.23	1.44	0	2	5	3	11	24	18	4	2	1	0	0
76.92	1.30	1	4	6	4	12	49	21	4	5	1	0	0
84.62	1.18	1	7	6	7	20	72	27	7	7	1	1	1
92.31	1.08	1	26	35	8	22	79	40	10	12	12	3	1
10-yr	flow	0	0	0	0	0	2	1	0	0	0	0	0
5-yr	flow	0	0	0	0	0	5	3	1	0	0	0	0
2-yr	flow	0	0	4	2	4	11	8	2	0	0	0	0

15-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1971	1	2	0	2	32	10	11	23	2	0	0	0
1972	0	0	14	1	7	24	78	2	0	0	0	0
1973	0	37	65	41	53	78	113	10	83	8	0	0
1974	0	0	17	11	11	104	139	34	36	0	0	1
1975	1	2	6	10	20	136	10	3	2	5	1	13
1976	1	1	56	5	6	10	6	0	0	0	0	0
1977	0	0	0	0	42	83	2	0	0	3	18	2
1978	1	5	26	2	2	161	15	13	1	1	0	1
1979	1	1	13	7	13	38	122	15	1	0	0	0
1980	1	0	1	1	1	6	10	2	0	0	2	0
1981	0	0	0	0	9	1	1	2	30	36	5	41
1982	3	10	6	9	81	50	16	10	42	6	1	3

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
7.69	13.00	0	0	0	0	1	1	1	0	0	0	0	0
15.38	6.50	0	0	0	0	2	6	2	0	0	0	0	0
23.08	4.33	0	0	0	1	6	10	6	2	0	0	0	0
30.77	3.25	0	0	1	1	7	10	10	2	0	0	0	0
38.46	2.60	0	0	6	2	9	24	10	2	1	0	0	0
46.15	2.17	1	1	6	2	11	38	11	3	1	0	0	0
53.85	1.86	1	1	13	5	13	50	15	10	2	1	0	1
61.54	1.63	1	2	14	7	20	78	16	10	2	3	1	1
69.23	1.44	1	2	17	9	32	83	78	13	30	5	1	2
76.92	1.30	1	5	26	10	42	104	113	15	36	6	2	3
84.62	1.18	1	10	56	11	53	136	122	23	42	8	5	13
92.31	1.08	3	37	65	41	81	161	139	34	83	36	18	41
10-yr	flow	0	0	0	0	1	3	1	0	0	0	0	0
5-yr	flow	0	0	0	1	4	8	5	2	0	0	0	0
2-yr	flow	1	1	10	4	12	45	13	7	2	1	0	1

Seasonal (May-October) Low-Flow Statistics for
Mud Creek near Marissa over Years 1971-1982

7-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	0.0	57
1972	0.0	54
1973	0.0	111
1974	0.0	111
1975	0.0	101
1976	0.0	67
1977	0.0	37
1978	0.0	146
1979	0.0	79
1980	0.0	162
1981	0.9	143
1982	0.3	147

PROBABILITY	T-YR	LOW FLOW VALUES
7.69	13.00	0.0
15.38	6.50	0.0
23.08	4.33	0.0
30.77	3.25	0.0
38.46	2.60	0.0
46.15	2.17	0.0
53.85	1.86	0.0
61.54	1.63	0.0
69.23	1.44	0.0
76.92	1.30	0.0
84.62	1.18	0.3
92.31	1.08	0.9
13.-Year Flow		0.0
10.-Year Flow		0.0
5.-Year Flow		0.0
2.-Year Flow		0.0

15-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	0.0	144
1972	0.0	128
1973	0.0	111
1974	0.0	90
1975	1.2	170
1976	0.0	67
1977	0.2	29
1978	0.1	' 145
1979	0.0	72
1980	0.0	120
1981	2.1	1
1982	0.8	88

PROBABILITY	T-YR	LOW FLOW VALUES
7.69	13.00	0.0
15.38	6.50	0.0
23.08	4.33	0.0
30.77	3.25	0.0
38.46	2.60	0.0
46.15	2.17	0.0
53.85	1.86	0.0
61.54	1.63	0.1
69.23	1.44	0.2
76.92	1.30	0.8
84.62	1.18	1.2
92.31	1.08	2.1
13.-Year Flow		0.0
10.-Year Flow		0.0
5.-Year Flow		0.0
2.-Year Flow		0.0

31-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	0.0	144
1972	0.0	54
1973	0.1	135
1974	0.1	69
1975	2.4	26
1976	0.1	57
1977	2.1	24
1978	0.9	43
1979	0.1	57
1980	0.1	112
1981	13.4	88
1982	1.2	88

PROBABILITY	T-YR	LOW FLOW VALUES
7.69	13.00	0.0
15.38	6.50	0.0
23.08	4.33	0.1
30.77	3.25	0.1
38.46	2.60	0.1
46.15	2.17	0.1
53.85	1.86	0.1
61.54	1.63	0.9
69.23	1.44	1.2
76.92	1.30	2.1
84.62	1.18	2.4
92.31	1.08	13.4
13.-Year Flow		0.0
10.-Year Flow		0.0
5.-Year Flow		0.0
2.-Year Flow		0.1

61-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	0.1	124
1972	0.4	35
1973	1.7	105
1974	0.6	62
1975	8.9	6
1976	1.3	98
1977	11.2	124
1978	1.9	105
1979	0.7	96
1980	1.3	119
1981	27.0	89
1982	11.1	76

PROBABILITY	T-YR	LOW FLOW VALUES
7.69	13.00	0.1
15.38	6.50	0.4
23.08	4.33	0.6
30.77	3.25	0.7
38.46	2.60	1.3
46.15	2.17	1.3
53.85	1.86	1.7
61.54	1.63	1.9
69.23	1.44	8.9
76.92	1.30	11.1
84.62	1.18	11.2
92.31	1.08	27.0
13.-Year Flow		0.1
10.-Year Flow		0.2
5.-Year Flow		0.5
2.-Year Flow		1.5

91-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	1.2	86
1972	2.9	5
197-3	2.3	93
1974	20.7	61
1975	7.5	17
1976	1.7	94
1977	22.3	8
1978	2.7	94
1979	1.1	94
1980	4.0	16
1981	36.8	94
1982	28.7	63

PROBABILITY	T-YR	LOW FLOW VALUES
7.69	13.00	1.1
15.38	6.50	1.2
23.08	4.33	1.7
30.77	3.25	2.3
38.46	2.60	2.7
46.15	2.17	2.9
53.85	1.86	4.0
61.54	1.63	7.5
69.23	1.44	20.7
76.92	1.30	22.3
84.62	1.18	28.7
92.31	1.08	36.8
13.-Year Flow		1.1
10.-Year Flow		1.2
5.-Year Flow		1.5
2.-Year Flow		3.5

121-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	1.5	57
1972	3.3	32
1973	6.0	64
1974	16.5	63
1975	9.8	14
1976	5.0	38
1977	24.1	63
1978	3.0	45
1979	15.8	47
1980	4.9	59
1981	47.3	54
1982	38.6	33

PROBABILITY	T-YR	LOW FLOW VALUES
7.69	13.00	1.5
15.38	6.50	3.0
23.08	4.33	3.3
30.77	3.25	4.9
38.46	2.60	5.0
46.15	2.17	6.0
53.85	1.86	9.8
61.54	1.63	15.8
69.23	1.44	16.5
76.92	1.30	24.1
84.62	1.18	38.6
92.31	1.08	47.3
13.-Year Flow		1.5
10.-Year Flow		2.2
5.-Year Flow		3.2
2.-Year Flow		8.0

151-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	2.6	34
1972	2.8	34
1973	32.3	33
1974	25.5	34
1975	12.3	34
1976	4.4	34
1977	29.6	9
1978	3.3	34
1979	13.0	34
1980	4.5	29
1981	50.9	28
1982	50.4	3

PROBABILITY	T-YR	LOW FLOW VALUES
7.69	13.00	2.6
15.38	6.50	2.8
23.08	4.33	3.3
30.77	3.25	4.4
38.46	2.60	4.5
46.15	2.17	12.3
53.85	1.86	13.0
61.54	1.63	25.5
69.23	1.44	29.6
76.92	1.30	32.3
. 84.62	1.18	50.4
92.31	1.08	50.9
13.-Year Flow		2.6
10.-Year Flow		2.7
5.-Year Flow		3.2
2.-Year Flow		12.7

181-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1971	7.1	4
1972	3.8	4
1973	39.7	3
1974	30.8	4
1975	12.7	4
1976	4.3	3
1977	25.8	1
1978	9.8	4
1979	16.2	4
1980	4.3	4
1981	60.8	1

PROBABILITY	T-YR	LOW FLOW VALUES
8.33	12.00	3.8
16.67	6.00	4.3
25.00	4.00	4.3
33.33	3.00	7.1
41.67	2.40	9.8
50.00	2.00	12.7
58.33	1.71	16.2
66.67	1.50	25.8
75.00	1.33	30.8
83.33	1.20	39.7
9167	1.09	60.8
13.-Year Flow		3.8
10.-Year Flow		3.9
5.-Year Flow		4.3
2.-Year Flow		12.7

Appendix G

Monthly and Seasonal Low-Flow Statistics for Little Crooked Creek near New Minden, Illinois (Water Years 1968 - 1988)

Monthly Low-Flow Statistics for Little Crooked Creek near New Minden
(Water Years 1968 - 1988)

1-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1968	0	0	6	3	2	2	4	1	0	0	0	0
1969	0	0	1	1	8	6	7	1	0	4	0	0
1970	0	2	2	2	8	7	7	2	3	0	0	0
1971	0	0	1	1	1	6	3	1	0	1	0	0
1972	0	0	0	1	1	4	4	2	1	1	0	0
1973	1	10	7	5	15	17	15	4	3	1	1	0
1974	0	2	4	7	9	20	13	6	3	1	1	2
1975	0	1	2	6	8	17	7	2	1	0	0	1
1976	2	0	1	2	2	3	1	1	0	0	0	0
1977	0	0	0	0	0	2	4	1	0	1	0	0
1978	0	1	2	1	1	4	6	5	0	0	0	0
1979	0	0	5	3	5	9	9	2	1	0	0	0
1980	0	0	0	0	1	1	3	1	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0
1982	2	4	0	2	7	10	6	3	7	3	1	0
1983	0	1	2	2	5	5	8	4	1	0	0	0
1984	0	2	3	3	7	22	12	3	1	0	0	0
1985	0	8	9	5	4	6	2	0	0	2	0	0
1986	0	3	8	2	11	6	4	1	0	0	0	0
1987	1	1	4	4	6	9	3	0	0	0	0	0
1988	0	1	2	4	17	9	3	0	0	0	0	0

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
4.55	22.00	0	0	0	0	0	0	0	0	0	0	0	0
9.09	11.00	0	0	0	0	0	1	1	0	0	0	0	0
13.64	7.33	0	0	0	0	1	2	2	0	0	0	0	0
18.18	5.50	0	0	0	1	1	2	3	0	0	0	0	0
22.73	4.40	0	0	0	1	1	3	3	1	0	0	0	0
27.27	3.67	0	0	1	1	1	4	3	1	0	0	0	0
31.82	3.14	0	0	1	1	2	4	3	1	0	0	0	0
36.36	2.75	0	0	1	2	2	5	4	1	0	0	0	0
40.91	2.44	0	0	2	2	4	6	4	1	0	0	0	0
45.45	2.20	0	1	2	2	5	6	4	1	0	0	0	0
50.00	2.00	0	1	2	2	5	6	4	1	0	0	0	0
54.55	1.83	0	1	2	2	6	6	6	2	0	0	0	0
59.09	1.69	0	1	2	3	7	7	6	2	1	0	0	0
63.64	1.57	0	1	3	3	7	9	7	2	1	1	0	0
68.18	1.47	0	2	4	3	8	9	7	2	1	1	0	0
72.73	1.38	0	2	4	4	8	9	7	3	1	1	0	0
77.27	1.29	0	2	5	4	8	10	8	3	1	1	0	0
81.82	1.22	1	3	6	5	9	17	9	4	3	1	0	0
86.36	1.16	1	4	7	5	11	17	12	4	3	2	1	0
90.91	1.10	2	8	8	6	15	20	13	5	3	3	1	1
95.45	1.05	2	10	9	7	17	22	15	6	7	4	1	2
10-yr	flow	0	0	0	0	0	1	1	0	0	0	0	0
5-yr	flow	0	0	0	1	1	2	3	1	0	0	0	0
2-yr	flow	0	1	2	2	5	6	4	1	0	0	0	0

3-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1968	0	0	8	3	2	2	5	1	0	0	0	0
1969	0	1	1	1	8	6	7	1	0	5	0	0
1970	1	2	2	2	11	10	7	3	4	0	0	0
1971	0	0	1	1	7	6	3	2	0	1	0	0
1972	0	0	0	1	1	5	5	2	1	1	0	0
1973	1	13	7	5	17	18	19	5	5	1	1	0
1974	0	2	5	7	9	25	15	6	4	1	1	2
1975	0	1	3	6	8	18	7	2	1	0	0	1
1976	2	0	2	2	2	3	1	1	0	0	0	0
1977	0	0	0	0	0	3	4	1	0	1	0	0
1978	0	1	2	1	1	5	6	7	1	1	0	0
1979	0	1	5	3	5	10	10	2	1	0	0	0
1980	0	0	0	0	1	1	3	1	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0
1982	3	4	0	2	7	12	7	3	7	4	1	0
1983	0	1	2	3	5	5	9	5	1	0	0	0
1984	0	2	3	3	8	23	16	4	1	0	0	0
1985	0	9	10	5	4	7	2	1	2	2	1	0
1986	0	3	8	2	12	6	5	1	0	0	0	0
1987	1	1	4	5	6	9	3	0	0	0	0	0
1988	0	1	2	4	18	10	4	0	0	0	0	0

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
4.55	22.00	0	0	0	0	0	0	0	0	0	0	0	0
9.09	11.00	0	0	0	0	0	1	1	0	0	0	0	0
13.64	7.33	0	0	0	0	1	2	2	0	0	0	0	0
18.18	5.50	0	0	0	1	1	3	3	1	0	0	0	0
22.73	4.40	0	0	0	1	1	3	3	1	0	0	0	0
27.27	3.67	0	0	1	1	2	5	3	1	0	0	0	0
31.82	3.14	0	0	1	1	2	5	4	1	0	0	0	0
36.36	2.75	0	1	2	2	4	5	4	1	0	0	0	0
40.91	2.44	0	1	2	2	5	6	5	1	0	0	0	0
45.45	2.20	0	1	2	2	5	6	5	1	0	0	0	0
50.00	2.00	0	1	2	2	6	6	5	2	1	0	0	0
54.55	1.83	0	1	2	3	7	7	6	2	1	0	0	0
59.09	1.69	0	1	3	3	7	9	7	2	1	1	0	0
63.64	1.57	0	1	3	3	8	10	7	2	1	1	0	0
68.18	1.47	0	2	4	3	8	10	7	3	1	1	0	0
72.73	1.38	0	2	5	4	8	10	7	3	1	1	0	0
77.27	1.29	1	2	5	5	9	12	9	4	2	1	0	0
81.82	1.22	1	3	7	5	11	18	10	5	4	1	1	0
86.36	1.16	1	4	8	5	12	18	15	5	4	2	1	0
90.91	1.10	2	9	8	6	17	23	16	6	5	4	1	1
95.45	1.05	3	13	10	7	18	25	19	7	7	5	1	2
10-yr	flow	0	0	0	0	0	2	2	0	0	0	0	0
5-yr	flow	0	0	0	1	1	3	3	1	0	0	0	0
2-yr	flow	0	1	2	2	6	6	5	2	1	0	0	0

7-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1968	0	0	22	3	2	2	9	2	1	0	0	0
1969	0	1	1	1	8	7	14	2	1	30	0	1
1970	1	2	2	2	21	12	8	3	8	0	0	0
1971	0	0	1	2	12	9	4	3	1	1	0	0
1972	0	0	2	1	1	6	8	3	1	2	1	0
1973	1	25	30	6	20	69	27	6	6	2	1	1
1974	0	2	5	8	10	41	37	9	8	2	1	2
1975	0	1	4	7	9	29	8	2	1	1	0	1
1976	2	0	2	3	4	4	1	1	1	0	0	0
1977	1	1	0	0	0	5	5	1	0	2	0	0
1978	0	1	3	1	1	22	9	12	1	1	0	0
1979	0	1	11	3	5	13	13	2	2	1	0	0
1980	0	0	0	0	1	11	4	2	1	0	0	1
1981	0	0	0	0	1	0	1	0	0	4	0	1
1982	3	5	1	2	8	13	9	3	9	6	1	0
1983	1	2	3	3	7	11	14	7	2	0	0	0
1984	0	10	3	3	16	29	24	4	1	0	0	0
1985	0	33	13	5	4	8	3	1	8	3	14	0
1986	0	4	9	3	13	7	5	1	0	0	0	0
1987	2	2	5	5	6	9	4	0	1	1	0	1
1988	0	2	13	4	27	12	4	1	0	0	0	0

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
4.55	22.00	0	0	0	0	0	0	1	0	0	0	0	0
9.09	11.00	0	0	0	0	1	2	1	0	0	0	0	0
13.64	7.33	0	0	0	0	1	4	3	1	0	0	0	0
18.18	5.50	0	0	1	1	1	5	4	1	0	0	0	0
22.73	4.40	0	0	1	1	1	6	4	1	1	0	0	0
27.27	3.67	0	0	1	1	2	7	4	1	1	0	0	0
31.82	3.14	0	1	2	2	4	7	4	1	1	0	0	0
36.36	2.75	0	1	2	2	4	8	5	2	1	0	0	0
40.91	2.44	0	1	2	2	5	9	5	2	1	1	0	0
45.45	2.20	0	1	3	3	6	9	8	2	1	1	0	0
50.00	2.00	0	1	3	3	7	11	8	2	1	1	0	0
54.55	1.83	0	2	3	3	8	11	8	2	1	1	0	0
59.09	1.69	0	2	4	3	8	12	9	3	1	1	0	0
63.64	1.57	0	2	5	3	9	12	9	3	1	2	0	0
68.18	1.47	1	2	5	3	10	13	9	3	2	2	0	1
72.73	1.38	1	2	9	4	12	13	13	3	2	2	0	1
77.27	1.29	1	4	11	5	13	22	14	4	6	2	1	1
81.82	1.22	1	5	13	5	16	29	14	6	8	3	1	1
86.36	1.16	2	10	13	6	20	29	24	7	8	4	1	1
90.91	1.10	2	25	22	7	21	41	27	9	8	6	1	1
95.45	1.05	3	33	30	8	27	69	37	12	9	30	14	2
10-yr	flow	0	0	0	0	1	3	2	0	0	0	0	0
5-yr	flow	0	0	1	1	1	5	4	1	0	0	0	0
2-yr	flow	0	1	3	3	7	11	8	2	1	1	0	0

15-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1968	0	0	141	3	2	12	80	6	1	0	0	0
1969	0	4	1	4	8	36	142	5	31	231	0	9
1970	8	2	3	5	62	66	13	4	34	1	5	1
1971	1	1	1	2	57	12	6	16	2	2	1	0
1972	0	0	34	2	2	10	123	3	2	4	5	0
1973	1	34	61	60	105	114	114	11	96	2	1	2
1974	0	3	15	11	12	58	160	18	46	2	2	3
1975	1	2	6	7	15	108	10	3	3	2	0	2
1976	2	0	14	4	5	9	2	1	1	0	0	0
1977	2	1	0	0	12	77	6	1	1	5	23	1
1978	1	20	20	1	1	209	10	31	1	1	1	1
1979	1	1	17	9	7	40	122	2	2	2	2	0
1980	0	1	0	1	1	41	13	3	1	0	0	2
1981	0	0	0	0	2	0	1	1	4	22	0	2
1982	26	9	2	4	65	42	20	4	28	20	1	11
1983	2	2	6	5	9	66	84	17	3	0	0	0
1984	1	26	7	29	33	173	44	6	2	0	0	6
1985	37	59	137	6	80	21	8	1	37	7	16	0
1986	1	31	11	4	38	76	9	5	1	1	0	4
1987	3	2	8	27	9	15	9	0	7	2	2	2
1988	0	2	124	6	63	35	6	1	0	2	0	1

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
4.55	22.00	0	0	0	0	1	0	1	0	0	0	0	0
9.09	11.00	0	0	0	0	1	9	2	1	1	0	0	0
13.64	7.33	0	0	0	1	2	10	6	1	1	0	0	0
18.18	5.50	0	0	1	1	2	12	6	1	1	0	0	0
22.73	4.40	0	1	1	2	2	12	6	1	1	0	0	0
27.27	3.67	0	1	2	2	5	15	8	1	1	1	0	0
31.82	3.14	0	1	3	3	7	21	9	2	1	1	0	0
36.36	2.75	1	1	6	4	8	35	9	3	2	1	0	1
40.91	2.44	1	2	6	4	9	36	10	3	2	2	0	1
45.45	2.20	1	2	7	4	9	40	10	3	2	2	0	1
50.00	2.00	1	2	8	4	12	41	13	4	2	2	1	1
54.55	1.83	1	2	11	5	12	42	13	4	3	2	1	2
59.09	1.69	1	2	14	5	15	58	20	5	3	2	1	2
63.64	1.57	1	3	15	6	33	66	44	5	4	2	1	2
68.18	1.47	2	4	17	6	38	66	80	6	7	2	2	2
72.73	1.38	2	9	20	7	57	76	84	6	28	4	2	2
77.27	1.29	2	20	34	9	62	77	114	11	31	5	2	3
81.82	1.22	3	26	61	11	63	108	122	16	34	7	5	4
86.36	1.16	8	31	124	27	65	114	123	17	37	20	5	6
90.91	1.10	26	34	137	29	80	173	142	18	46	22	16	9
95.45	1.05	37	59	141	60	105	209	160	31	96	231	23	11
10-yr	flow	0	0	0	0	1	9	3	1	1	0	0	0
5-yr	flow	0	0	1	1	2	12	6	1	1	0	0	0
2-yr	flow	1	2	8	4	12	41	13	4	2	2	1	1

Seasonal (May-October) Low-Flow Statistics for
L. Crooked Creek near New Minden, IL over Years 1968 - 1988

7-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1968	0.0	69
1969	0.2	120
1970	0.1	129
1971	0.0	160
1972	0.0	127
1973	0.1	174
1974	0.5	161
1975	0.2	100
1976	0.0	81
1977	0.2	37
1978	0.1	158
1979	0.2	165
1980	0.0	159
1981	0.0	97
1982	0.3	150
1983	0.0	101
1984	0.0	106
1985	0.0	130
1986	0.0	116
1987	0.1	111
1988	0.0	109

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	0.0
9.09	11.00	0.0
13.64	7.33	0.0
18.18	5.50	0.0
22.73	4.40	0.0
27.27	3.67	0.0
31.82	3.14	0.0
36.36	2.75	0.0
40.91	2.44	0.0
45.45	2.20	0.0
50.00	2.00	0.0
54.55	1.83	0.1
59.09	1.69	0.1
63.64	1.57	0.1
68.18	1.47	0.1
72.73	1.38	0.2
77.27	1.29	0.2
81.82	1.22	0.2
86.36	1.16	0.2
90.91	1.10	0.3
95.45	1.05	0.5
22.-Year Flow		0.0
10.-Year Flow		0.0
5.-Year Flow		0.0
2.-Year Flow		0.0

15-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1968	0.0	126
1969	0.3	112
1970	0.6	67
. 1971	0.0	160
1972	0.0	127
1973	0.4	169
1974	1.3	154
1975	0.4	94
1976	0.0	75
1977	0.4	29
1978	0.1	151
1979	0.3	163
1980	0.0	155
1981	0.1	94
1982	0.6	145
1983	0.0	101
1984	0.0	103
1985	0.0	129
1986	0.1	116
1987	0.3	17
1988	0.1	107

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	0.0
9.09	11.00	0.0
13.64	7.33	0.0
18.18	5.50	0.0
22.73	4.40	0.0
27.27	3.67	0.0
31.82	3.14	0.0
36.36	2.75	0.0
40.91	2.44	0.1
45.45	2.20	0.1
50.00	2.00	0.1
54.55	1.83	0.1
59.09	1.69	0.3
63.64	1.57	0.3
68.18	1.47	0.3
72.73	1.38	0.4
77.27	1.29	0.4
81.82	1.22	0.4
86.36	1.16	0.6
90.91	1.10	0.6
95.45	1.05	1.3

22.-Year Flow	0.0
10.-Year Flow	0.0
5.-Year Flow	0.0
2.-Year Flow	0.1

31-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1968	0.1	111
1969	0.5	97
1970	0.8	151
1971	0.3	144
1972	0.3	117
1973	1.9	135
1974	1.8	154
1975	0.5	87
1976	0.3	61
1977	0.7	13
1978	1.3	44
1979	0.4	154
1980	0.4	77
1981	2.1	88
1982	5.9	106
1983	0.1	85
1984	0.0	101
1985	0.2	123
1986	0.5	103
1987	0.8	146
1988	0.1	98

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	0.0
9.09	11.00	0.1
13.64	7.33	0.1
18.18	5.50	0.1
22.73	4.40	0.2
27.27	3.67	0.3
31.82	3.14	0.3
36.36	2.75	0.3
40.91	2.44	0.4
45.45	2.20	0.4
50.00	2.00	0.5
54.55	1.83	0.5
59.09	1.69	0.5
63.64	1.57	0.7
68.18	1.47	0.8
72.73	1.38	0.8
77.27	1.29	1.3
81.82	1.22	1.8
86.36	1.16	1.9
90.91	1.10	2.1
95.45	1.05	5.9
22.-Year Flow		0.0
10.-Year Flow		0.1
5.-Year Flow		0.1
2.-Year Flow		0.5

61-DAY LOW FLOWS IN CFS

YEAR		AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1968		0.2	118
1969		6.3	99
1970		3.1	124
1971		0.4	114
1972		1.4	118
1973		3.1	71
1974		10.3	107
1975		2.2	61
1976		1.4	31
1977	-	2.8	10
1978		2.5	33
1979		0.4	119
1980		1.3	64
1981		27.8	57
1982		12.5	101
1983		0.6	100
1984		0.1	72
1985		1.7	121
1986		3.7	74
1987		6.8	122
1988		0.9	1

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	0.1
9.09	11.00	0.2
13.64	7.33	0.4
18.18	5.50	0.4
22.73	4.40	0.6
27.27	3.67	0.9
31.82	3.14	1.3
36.36	2.75	1.4
40.91	2.44	1.4
45.45	2.20	1.7
50.00	2.00	2.2
54.55	1.83	2.5
59.09	1.69	2.8
63.64	1.57	3.1
68.18	1.47	3.1
72.73	1.38	3.7
77.27	1.29	6.3
81.82	1.22	6.8
86.36	1.16	10.3
90.91	1.10	12.5
95.45	1.05	27.8

22.-Year Flow	0.1
10.-Year Flow	0.3
5.-Year Flow	0.5
2.-Year Flow	2.2

91-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1968	1.3	94
1969	52.9	74
1970	4.2	87
1971	0.8	84
1972	4.3	5
1373	7.4	75
1974	11.6	77
1975	3.5	27
1976	1.4	1
1977	6.0	11
1978	3.2	46
1979	2.6	94
1980	1.5	79
1981	33.1	68
1982	14.6	93
1983	0.5	71
1984	0.7	42
1985	17.1	94
1986	9.3	64
1987	8.8	87
1988	2.9	64

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	0.5
9.09	11.00	0.7
13.64	7.33	0.8
18.18	5.50	1.3
22.73	4.40	1.4
27.27	3.67	1.5
31.82	3.14	2.6
36.36	2.75	2.9
40.91	2.44	3.2
45.45	2.20	3.5
50.00	2.00	4.2
54.55	1.83	4.3
59.09	1.69	6.0
63.64	1.57	7.4
68.18	1.47	8.8
72.73	1.38	9.3
77.27	1.29	11.6
81.82	1.22	14.6
86.36	1.16	17.1
90.91	1.10	33.1
95.45	1.05	52.9

22.-Year Flow	0.5
10.-Year Flow	0.7
5.-Year Flow	1.3
2.-Year Flow	4.2

121-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1968	2.3	64
1969	132.4	64
1970	3.6	64
1971	3.4	54
1972	4.8	58
1973	8.1	63
1974	10.6	62
1975	3.8	45
1976	2.8	11
1977	10.7	33
1978	3.3	45
1979	32.9	64
1980	1.5	58
1981	31.6	38
1982	19.9	64
1983	5.2	52
1984	2.1	13
1985	20.1	64
1986	11.7	13
1987	39.6	64
1988	827.7	15

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	1.5
9.09	11.00	2.1
13.64	7.33	2.3
18.18	5.50	2.8
22.73	4.40	3.3
27.27	3.67	3.4
31.82	3.14	3.6
36.36	2.75	3.8
40.91	2.44	4.8
45.45	2.20	5.2
50.00	2.00	8.1
54.55	1.83	10.6
59.09	1.69	10.7
63.64	1.57	11.7
68.18	1.47	19.9
72.73	1.38	20.1
77.27	1.29	31.6
81.82	1.22	32.9
86.36	1.16	39.6
90.91	1.10	132.4
95.45	1.05	827.7

22.-Year Flow	1.5
10.-Year Flow	2.1
5.-Year Flow	3.0
2.-Year Flow	8.1

151-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1968	2.1	34
1969	120.6	13
1970	28.4	34
1971	3.3	34
1972	4.5	33
1973	39.8	33
1974	21.2	34
1975	4.3	21
1976	3.8	8
1977	8.9	10
1978	5.3	34
1979	28.6	34
1980	1.7	34
1981	46.7	34
1982	34.9	34
1983	6.9	22
1984	8.6	14
1985	42.2	15
1986	11.4	3
1987	38.5	18
1988	664.3	4

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	1.7
9.09	11.00	2.1
13.64	7.33	3.3
18.18	5.50	3.8
22.73	4.40	4.3
27.27	3.67	4.5
31.82	3.14	5.3
36.36	2.75	6.9
40.91	2.44	8.6
45.45	2.20	8.9
50.00	2.00	11.4
54.55	1.83	21.2
59.09	1.69	28.4
63.64	1.57	28.6
68.18	1.47	34.9
72.73	1.38	38.5
77.27	1.29	39.8
81.82	1.22	42.2
86.36	1.16	46.7
90.91	1.10	120.6
95.45	1.05	664.3

22.-Year Flow	1.7
10.-Year Flow	2.4
5.-Year Flow	4.0
2.-Year Flow	11.4

181-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1968	4.7	4
1969	125.3	4
1970	26.3	4
1971	9.0	4
1972	4.7	3
1973	49.7	3
1974	21.9	4
1975	7.9	4
1976	4.1	1
1977	13.7	4
1978	12.4	4
1979	30.4	4
1980	2.1	4
1981	55.6	1
1982	45.2	4
1983	33.3	4
1984	37.4	4
1985	36.0	4
1986	17.4	4
1987	33.0	4

PROBABILITY	T-YR	LOW FLOW VALUES
4.76	21.00	2.1
9.52	10.50	4.1
14.29	7.00	4.7
19.05	5.25	4.7
23.81	4.20	7.9
28.57	3.50	9.0
33.33	3.00	12.4
38.10	2.63	13.7
42.86	2.33	17.4
47.62	2.10	21.9
52.38	1.91	26.3
57.14	1.75	30.4
61.90	1.62	33.0
66.67	1.50	33.3
71.43	1.40	36.0
76.19	1.31	37.4
80.95	1.24	45.2
85.71	1.17	49.7
90.48	1.11	55.6
95.24	1.05	125.3
22.-Year Flow		2.1
10.-Year Flow		4.2
5.-Year Flow		5.5
2.-Year Flow		24.2

Appendix H

Monthly and Seasonal Low-Flow Statistics for Silver Creek near Troy, Illinois (Water Years 1967 - 1987)

Monthly Low-Flow Statistics for Silver Creek near Troy
(Water Years 1967 - 1987)

1-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1967	0	0	10	5	5	26	15	13	3	2	0	0
1968	0	2	11	13	13	15	15	7	4	1	1	0
1969	0	0	8	10	34	27	33	5	2	7	0	0
1970	2	7	10	3	17	17	20	8	6	1	0	0
1971	0	0	4	2	2	12	10	11	5	2	0	0
1972	0	0	1	4	4	6	24	5	1	0	1	0
1973	1	18	15	30	30	29	71	30	21	1	0	0
1974	0	0	13	25	26	95	19	8	11	1	0	1
1975	1	3	11	39	40	34	33	18	5	1	0	0
1976	1	2	4	4	6	9	9	1	1	0	0	0
1977	0	0	0	0	0	12	8	1	0	2	1	4
1978	3	7	15	8	8	13	27	23	3	1	0	0
1979	0	0	2	7	7	33	21	8	1	0	0	0
1980	0	0	0	1	1	6	11	4	1	0	0	0
1981	0	0	0	0	0	1	0	2	1	1	1	0
1982	1	5	2	17	50	50	19	5	25	5	2	1
1983	5	13	36	15	22	21	40	20	14	1	1	0
1984	0	5	18	16	40	78	43	23	2	0	0	0
1985	1	29	36	10	8	30	21	6	5	3	3	0
1986	0	3	17	8	21	23	5	3	2	2	1	1
1987	14	10	17	8	29	27	18	2	0	0	4	2

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
4.55	22.00	0	0	0	0	0	1	0	1	0	0	0	0
9.09	11.00	0	0	0	0	0	6	5	1	0	0	0	0
13.64	7.33	0	0	0	1	1	6	8	2	1	0	0	0
18.18	5.50	0	0	1	2	2	9	9	2	1	0	0	0
22.73	4.40	0	0	2	3	4	12	10	3	1	0	0	0
27.27	3.67	0	0	2	4	5	12	11	4	1	0	0	0
31.82	3.14	0	0	4	4	6	13	15	5	1	1	0	0
36.36	2.75	0	0	4	5	7	15	15	5	2	1	0	0
40.91	2.44	0	0	8	7	8	17	18	5	2	1	0	0
45.45	2.20	0	2	10	8	8	21	19	6	2	1	0	0
50.00	2.00	0	2	10	8	13	23	19	7	3	1	0	0
54.55	1.83	0	3	11	8	17	26	20	8	3	1	0	0
59.09	1.69	1	3	11	10	21	27	21	8	4	1	1	0
63.64	1.57	1	5	13	10	22	27	21	8	5	1	1	0
68.18	1.47	1	5	15	13	26	29	24	11	5	2	1	0
72.73	1.38	1	7	15	15	29	30	27	13	5	2	1	0
77.27	1.29	1	7	17	16	30	33	33	18	6	2	1	1
81.82	1.22	2	10	17	17	34	34	33	20	11	2	1	1
86.36	1.16	3	13	18	25	40	50	40	23	14	3	2	1
90.91	1.10	5	18	36	30	40	78	43	23	21	5	3	2
95.45	1.05	14	29	36	39	50	95	71	30	25	7	4	4
10-yr	flow	0	0	0	0	0	6	6	1	0	0	0	0
5-yr	flow	0	0	1	3	3	10	9	3	1	0	0	0
2-yr	flow	0	2	10	8	13	23	19	7	3	1	0	0

3-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1967	0	0	10	5	5	36	17	14	3	2	0	0
1968	0	3	40	13	13	17	16	7	4	1	1	0
1969	0	1	8	10	36	29	39	6	2	9	1	1
1970	2	7	10	3	18	21	21	9	7	2	0	0
1971	0	0	4	2	2	13	10	11	6	2	0	0
1972	0	0	1	5	4	7	30	6	1	0	1	0
1973	1	23	16	30	33	31	83	32	23	1	0	0
1974	0	0	14	26	27	106	20	9	14	1	0	1
1975	1	3	15	47	41	39	33	22	6	1	0	0
1976	1	2	4	5	7	9	9	1	1	0	0	0
1977	0	0	0	0	0	14	9	1	0	2	1	5
1978	3	8	15	8	8	13	35	27	4	1	0	0
1979	0	0	2	7	7	37	24	9	1	0	1	0
1980	0	0	0	1	1	7	12	5	2	0	0	0
1981	0	0	0	0	0	1	0	3	2	2	2	1
1982	1	5	3	18	55	53	21	5	32	6	2	1
1983	6	14	38	16	23	22	45	24	15	1	1	0
1984	0	17	19	17	52	81	55	24	3	0	0	0
1985	1	39	40	10	8	31	24	6	6	3	4	0
1986	0	3	19	9	32	24	7	3	2	2	1	1
1987	15	11	17	9	30	27	19	3	0	0	4	2

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
4.55	22.00	0	0	0	0	0	1	0	1	0	0	0	0
9.09	11.00	0	0	0	0	0	7	7	1	0	0	0	0
13.64	7.33	0	0	0	1	1	7	9	3	1	0	0	0
18.18	5.50	0	0	1	2	2	9	9	3	1	0	0	0
22.73	4.40	0	0	2	3	4	13	10	3	1	0	0	0
27.27	3.67	0	0	3	5	5	13	12	5	2	0	0	0
31.82	3.14	0	0	4	5	7	14	16	5	2	1	0	0
36.36	2.75	0	0	4	5	7	17	17	6	2	1	0	0
40.91	2.44	0	1	8	7	8	21	19	6	2	1	0	0
45.45	2.20	0	2	10	8	8	22	20	6	3	1	0	0
50.00	2.00	0	3	10	9	13	24	21	7	3	1	1	0
54.55	1.83	0	3	14	9	18	27	21	9	4	1	1	0
59.09	1.69	1	3	15	10	23	29	24	9	4	2	1	0
63.64	1.57	1	5	15	10	27	31	24	9	6	2	1	0
68.18	1.47	1	7	16	13	30	31	30	11	6	2	1	1
72.73	1.38	1	8	17	16	32	36	33	14	6	2	1	1
77.27	1.29	1	11	19	17	33	37	35	22	7	2	1	1
81.82	1.22	2	14	19	18	36	39	39	24	14	2	2	1
86.36	1.16	3	17	38	26	41	53	45	24	15	3	2	1
90.91	1.10	6	23	40	30	52	81	55	27	23	6	4	2
95.45	1.05	15	39	40	47	55	106	83	32	32	9	4	5
10-yr	flow	0	0	0	0	0	7	8	1	0	0	0	0
5-yr	flow	0	0	2	3	3	11	10	3	1	0	0	0
2-yr	flow	0	3	10	9	13	24	21	7	3	1	1	0

7-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1967	0	0	11	6	9	67	20	17	4	3	1	0
1968	0	4	138	13	13	17	20	8	6	1	1	0
1969	0	1	9	10	41	33	45	9	3	13	1	1
1970	5	7	11	5	20	23	22	12	15	2	1	1
1971	0	1	4	3	30	15	14	13	9	3	0	1
1972	0	0	1	6	5	10	47	8	1	1	3	1
1973	1	28	110	33	37	137	184	34	38	1	0	0
1974	1	1	16	30	32	125	29	13	54	2	0	4
1975	1	7	16	53	46	51	36	45	6	1	1	1
1976	1	3	6	6	16	42	10	1	2	0	0	0
1977	0	0	0	0	0	26	10	1	0	3	2	7
1978	5	9	19	8	8	13	42	74	6	2	0	0
1979	0	0	3	7	7	58	53	10	2	1	1	0
1980	0	0	0	1	1	9	14	5	2	1	1	0
1981	0	1	0	0	0	1	1	4	3	7	4	1
1982	1	7	4	19	66	64	25	5	79	12	2	3
1983	12	16	44	18	27	35	62	33	22	2	1	0
1984	0	32	20	20	99	119	61	25	6	0	0	1
1985	4	120	45	11	9	34	46	7	34	3	6	1
1986	0	4	28	11	47	25	8	4	2	2	1	1
1987	17	11	18	11	33	29	22	3	1	4	4	2

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
4.55	22.00	0	0	0	0	0	1	1	1	0	0	0	0
9.09	11.00	0	0	0	0	0	9	8	1	1	0	0	0
13.64	7.33	0	0	0	1	1	10	10	3	1	1	0	0
18.18	5.50	0	0	1	3	5	13	10	4	2	1	0	0
22.73	4.40	0	0	3	5	7	15	14	4	2	1	0	0
27.27	3.67	0	1	4	6	8	17	14	5	2	1	0	0
31.82	3.14	0	1	4	6	9	23	20	5	2	1	1	0
36.36	2.75	0	1	6	6	9	25	20	7	3	1	1	0
40.91	2.44	0	1	9	7	13	26	22	8	3	2	1	1
45.45	2.20	0	3	11	8	16	29	22	8	4	2	1	1
50.00	2.00	0	4	11	10	20	33	25	9	6	2	1	1
54.55	1.83	1	4	16	11	27	34	29	10	6	2	1	1
59.09	1.69	1	7	16	11	30	35	36	12	6	2	1	1
63.64	1.57	1	7	18	11	32	42	42	13	6	3	1	1
68.18	1.47	1	7	19	13	33	51	45	13	9	3	1	1
72.73	1.38	1	9	20	18	37	58	46	17	15	3	2	1
77.27	1.29	4	11	28	19	41	64	47	25	22	3	2	1
81.82	1.22	5	16	44	20	46	67	53	33	34	4	3	2
86.36	1.16	5	28	45	30	47	119	61	34	38	7	4	3
90.91	1.10	12	32	110	33	66	125	62	45	54	12	4	4
95.45	1.05	17	120	138	53	99	137	184	74	79	13	6	7
10-yr	flow	0	0	0	0	0	9	9	2	1	1	0	0
5-yr	flow	0	0	2	4	6	14	12	4	2	1	0	0
2-yr	flow	0	4	11	10	20	33	25	9	6	2	1	1

15-DAY LOW FLOWS IN CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1967	4	9	18	8	18	140	23	52	7	13	5	0
1968	0	5	406	16	15	22	34	11	23	2	3	0
1969	0	3	10	19	62	90	270	15	6	27	1	2
1970	34	8	16	7	26	35	33	21	72	4	2	3
1971	1	1	4	4	108	28	21	25	149	13	0	4
1972	0	0	177	10	8	24	204	10	5	1	7	1
1973	2	67	211	73	89	221	251	44	77	2	4	2
1974	1	3	26	38	60	176	43	32	150	3	1	8
1975	7	12	26	108	80	197	47	50	11	11	3	9
1976	1	3	19	9	19	46	12	6	2	0	9	0
1977	1	0	0	0	89	163	11	1	0	4	48	23
1978	50	14	117	8	9	373	48	150	15	5	0	0
1979	0	1	4	8	8	154	339	13	3	1	2	0
1980	0	1	0	1	1	11	58	8	3	2	11	1
1981	0	1	0	0	0	1	2	15	27	72	30	1
1982	1	8	5	38	171	152	64	7	144	41	3	12
1983	14	21	92	22	42	49	319	80	112	2	1	0
1984	0	57	32	61	225	395	168	36	8	1	1	66
1985	31	245	124	15	24	71	91	11	65	5	26	1
1986	0	49	42	15	66	31	10	6	3	5	1	1
1987	24	13	21	14	34	41	147	5	1	5	5	3

PROB	T-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
4.55	22.00	0	0	0	0	0	1	2	1	0	0	0	0
9.09	11.00	0	0	0	0	1	11	10	5	1	1	0	0
13.64	7.33	0	1	0	1	8	22	11	6	2	1	1	0
18.18	5.50	0	1	4	4	8	24	12	6	3	1	1	0
22.73	4.40	0	1	4	7	9	28	21	7	3	2	1	0
27.27	3.67	0	1	5	8	15	31	23	8	3	2	1	0
31.82	3.14	0	3	10	8	18	35	33	10	5	2	1	1
36.36	2.75	0	3	16	8	19	41	34	11	6	2	2	1
40.91	2.44	1	3	18	9	24	46	43	11	7	3	2	1
45.45	2.20	1	5	19	10	26	49	47	13	8	4	3	1
50.00	2.00	1	8	21	14	34	71	48	15	11	4	3	1
54.55	1.83	1	8	26	15	42	90	58	15	15	5	3	2
59.09	1.69	1	9	26	15	60	140	64	21	23	5	4	2
63.64	1.57	2	12	32	16	62	152	91	25	27	5	5	3
68.18	1.47	4	13	42	19	66	154	147	32	65	5	5	3
72.73	1.38	7	14	92	22	80	163	168	36	72	11	7	4
77.27	1.29	14	21	117	38	89	176	204	44	77	13	9	8
81.82	1.22	24	49	124	38	89	197	251	50	112	13	11	9
86.36	1.16	31	57	177	61	108	221	270	52	144	27	26	12
90.91	1.10	34	67	211	73	171	373	319	80	149	41	30	23
95.45	1.05	50	245	406	108	225	395	339	150	150	72	48	66
10-yr	flow	0	1	0	0	3	14	10	5	1	1	1	0
5-yr	flow	0	1	4	5	8	26	16	6	3	1	1	0
2-yr	flow	1	8	21	14	34	71	48	15	11	4	3	1

Seasonal (May-October) Low-Flow Statistics for
Silver Creek near Troy over Years 1967-1987

7-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
13G7	0.0	158
1968	0.0	152
1969	0.6	118
1970	0.1	174
1971	0.1	167
1972	0.6	80
1973	0.4	141
1974	0.5	112
1975	0.6	111
1976	0.2	134
1977	0.1	46
1978	0.1	149
1979	0.2	144
1980	0.3	149
1981	0.6	145
1982	2.3	112
1983	0.2	151
1984	0.4	120
1985	0.3	175
1986	0.7	117
1987	0.7	55

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	0.0
9.09	11.00	0.0
13.64	7.33	0.1
18.18	5.50	0.1
22.73	4.40	0.1
27.27	3.67	0.1
31.82	3.14	0.2
36.36	2.75	0.2
40.91	2.44	0.2
45.45	2.20	0.3
50.00	2.00	0.3
54.55	1.83	0.4
59.09	1.69	0.4
63.64	1.57	0.5
68.18	1.47	0.6
72.73	1.38	0.6
77.27	1.29	0.6
81.82	1.22	0.6
86.36	1.16	0.7
90.91	1.10	0.7
95.45	1.05	2.3
22.-Year Flow		0.0
10.-Year Flow		0.0
5.-Year Flow		0.1
2.-Year Flow		0.3

15-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1967	0.0	154
1968	0.0	152
1969	0.7	112
1970	0.6	170
1971	0.1	160
1972	0.7	72
1973	1.5	169
1974	1.3	105
1975	0.9	148
1976	0.2	128
1977	0.2	38
1978	0.1	169
1979	0.2	138
1980	0.4	149
1981	0.7	143
1982	3.2	104
1983	0.2	147
1984	0.5	84
1985	0.4	169
1986	0.8	117
1987	1.1	51

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	0.0
9.09	11.00	0.0
13.64	7.33	0.1
18.18	5.50	0.1
22.73	4.40	0.2
27.27	3.67	0.2
31.82	3.14	0.2
36.36	2.75	0.2
40.91	2.44	0.4
45.45	2.20	0.4
50.00	2.00	0.5
54.55	1.83	0.6
59.09	1.69	0.7
63.64	1.57	0.7
68.18	1.47	0.7
72.73	1.38	0.8
77.27	1.29	0.9
81.82	1.22	1.1
86.36	1.16	1.3
90.91	1.10	1.5
95.45	1.05	3.2
22.-Year Flow		0.0
10.-Year Flow		0.1
5.-Year Flow		0.2
2.-Year Flow		0.5

31-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1967	1.4	153
1968	0.4	150
1969	1.2	100
1970	1.1	154
1971	0.2	154
1972	2.1	154
1973	6.2	154
1974	3.1	89
1975	1.2	147
1976	0.4	127
1977	1.9	22
1978	0.6	106
1979	0.3	137
1980	0.6	146
1981	1.3	139
1982	4.6	88
1983	0.4	134
1984	0.7	79
1985	0.6	153
1986	1.0	110
1987	1.5	35

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	0.2
9.09	11.00	0.3
13.64	7.33	0.4
18.18	5.50	0.4
22.73	4.40	0.4
27.27	3.67	0.6
31.82	3.14	0.6
36.36	2.75	0.6
40.91	2.44	0.7
45.45	2.20	1.0
50.00	2.00	1.1
54.55	1.83	1.2
59.09	1.69	1.2
63.64	1.57	1.3
68.18	1.47	1.4
72.73	1.38	1.5
77.27	1.29	1.9
81.82	1.22	2.1
86.36	1.16	3.1
90.91	1.10	4.6
95.45	1.05	6.2
22.-Year Flow		0.2
10.-Year Flow		0.3
5.-Year Flow		0.4
2.-Year Flow		1.1

61-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1967	2.7	123
1968	1.0	124
1969	7.7	79
1970	3.8	85
1971	11.0	114
1972	4.1	121
1973	12.0	124
1974	4.1	59
1975	7.4	124
1976	2.8	115
1977	7.8	1
1978	2.3	104
1979	0.4	124
1980	3.7	117
1981	10.0	124
1982	16.7	80
1983	0.6	112
1984	3.3	49
1985	0.8	123
1986	1.4	89
1987	4.3	7

PROBABILITY	T-YR	V LOW FLOW VALUES
4.55	22.00	0.4
9.09	11.00	0.6
13.64	7.33	0.8
18.18	5.50	1.0
22.73	4.40	1.4
27.27	3.67	2.3
31.82	3.14	2.7
36.36	2.75	2.8
40.91	2.44	3.3
45.45	2.20	3.7
50.00	2.00	3.8
54.55	1.83	4.1
59.09	1.69	4.1
63.64	1.57	4.3
68.18	1.47	7.4
72.73	1.38	7.7
77.27	1.29	7.8
81.82	1.22	10.0
86.36	1.16	11.0
90.91	1.10	12.0
95.45	1.05	16.7
22.-Year Flow		0.4
10.-Year Flow		0.7
5.-Year Flow		1.2
2.-Year Flow		3.8

91-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1967	5.4	94
1968	7.4	94
1969	27.7	75
1970	4.1	94
1971	7.6	94
1972	9.9	56
1973	10.6	94
1974	21.7	60
1975	13.8	87
1976	8.3	94
1977	7.5	9
1978	2.3	94
1979	8.7	94
1980	9.7	88
1981	19.2	94
1982	38.5	88
1983	0.9	82
1984	6.7	40
1985	12.5	94
1986	27.0	64
1987	9.3	22

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	0.9
9.09	11.00	2.3
13.64	7.33	4.1
18.18	5.50	5.4
22.73	4.40	6.7
27.27	3.67	7.4
31.82	3.14	7.5
36.36	2.75	7.6
40.91	2.44	8.3
45.45	2.20	8.7
50.00	2.00	9.3
54.55	1.83	9.7
59.09	1.69	9.9
63.64	1.57	10.6
68.18	1.47	12.5
72.73	1.38	13.8
77.27	1.29	19.2
81.82	1.22	21.7
86.36	1.16	27.0
90.91	1.10	27.7
95.45	1.05	38.5
22.-Year Flow		0.9
10.-Year Flow		2.8
5.-Year Flow		6.0
2.-Year Flow		9.3

121-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1967	16.7	64
1968	8.4	64
1969	158.3	19
1970	5.0	64
1971	12.3	64
1972	8.8	59
1973	16.2	64
1974	21.7	64
1975	30.6	64
1976	7.3	38
1977	25.8	1
1978	5.0	64
1979	21.2	64
1980	10.3	64
1981	70.7	55
1982	93.7	64
1983	8.4	64
1984	17.2	11
1985	12.7	64
1986	32.3	32
1987	8.3	19

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	5.0
9.09	11.00	5.0
13.64	7.33	7.3
18.18	5.50	8.3
22.73	4.40	8.4
27.27	3.67	8.4
31.82	3.14	8.8
36.36	2.75	10.3
40.91	2.44	12.3
45.45	2.20	12.7
50.00	2.00	16.2
54.55	1.83	16.7
59.09	1.69	17.2
63.64	1.57	21.2
68.18	1.47	21.7
72.73	1.38	25.8
77.27	1.29	30.6
81.82	1.22	32.3
86.36	1.16	70.7
90.91	1.10	93.7
95.45	1.05	158.3
22.-Year Flow		5.0
10.-Year Flow		5.6
5.-Year Flow		8.3
2.-Year Flow		16.2

151-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1967	15.8	34
1968	12.3	34
1969	134.7	13
1970	28.5	34
1971	41.3	34
1972	9.9	34
1973	43.7	34
1974	48.8	34
1975	60.6	34
1976	8.7	34
1977	27.8	4
1978	9.1	34
1979	19.2	34
1980	13.4	34
1981	67.8	25
1982	109.8	34
1983	86.8	34
1984	26.4	13
1985	64.7	34
1986	27.2	2
1987	8.6	3

PROBABILITY	T-YR	LOW FLOW VALUES
4.55	22.00	8.6
9.09	11.00	8.7
13.64	7.33	9.1
18.18	5.50	9.9
22.73	4.40	12.3
27.27	3.67	13.4
31.82	3.14	15.8
36.36	2.75	19.2
40.91	2.44	26.4
45.45	2.20	27.2
50.00	2.00	27.8
54.55	1.83	28.5
59.09	1.69	41.3
63.64	1.57	43.7
68.18	1.47	48.8
72.73	1.38	60.6
77.27	1.29	64.7
81.82	1.22	67.8
86.36	1.16	86.8
90.91	1.10	109.8
95.45	1.05	134.7
22.-Year Flow		8.6
10.-Year Flow		8.8
5.-Year Flow		11.0
2.-Year Flow		27.8

181-DAY LOW FLOWS IN CFS

YEAR	AVERAGE LOW FLOW	STARTING DAY FROM MAY 1
1967	29.7	4
1968	56.2	4
1969	132.6	4
1970	37.7	4
1971	43.0	4
1972	11.7	4
1973	56.6	4
1974	83.1	4
1975	64.1	4
1976	10.3	2
1977	40.9	1
1978	67.7	4
1979	20.2	4
1980	16.9	4
1981	67.1	1
1982	106.7	4
1983	97.1	4
1984	39.2	4
1985	57.2	4
1986	50.2	1

PROBABILITY	T-YR	LOW FLOW VALUES
4.76	21.00	10.3
9.52	10.50	11.7
14.29	7.00	16.9
19.05	5.25	20.2
23.81	4.20	29.7
28.57	3.50	37.7
33.33	3.00	39.2
38.10	2.63	40.9
42.86	2.33	43.0
47.62	2.10	50.2
52.38	1.91	56.2
57.14	1.75	56.6
61.90	1.62	57.2
66.67	1.50	64.1
71.43	1.40	67.1
76.19	1.31	67.7
80.95	1.24	83.1
85.71	1.17	97.1
90.48	1.11	106.7
95.24	1.05	132.6
22.-Year Flow		10.3
10.-Year Flow		12.4
5.-Year Flow		22.5
2.-Year Flow		53.4