Technical Memorandum
WRE # 369

Hydrologic Report on S65A and S65B Sub-Basins in the Lower Kissimmee River Water Management Basin

January 1999

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EXECUTIVE SUMMARY

This report summarizes hydrologic data collected from two sub-basins, S65A and S65B, located within the northern section of the lower Kissimmee River water management basin and northeast of the Lake Istokpoga water management basin. The main water conveyance system within the sub-basins described in this report is the Kissimmee River (C-38) which is a primary input into Lake Okeechobee from the north. The major water control structures are S-65A and S-65B, corresponding to Pool A and Pool B, located on the C-38 canal.

The historical hydrologic data collected within the sub-basins and reported here include rain, stage, flow, and runoff. No evaporation data exist for these two sub-basins. Data sets pertaining to the different hydrologic parameters were analyzed with respect to expected range and magnitude, prediction of missing values, and consistency with adjacent stations. This data evaluation was applied to rainfall, stage, and flow data obtained from the monitoring stations in both sub-basins. Statistical rainfall results for each station are reported on a monthly and yearly basis as mean, median, standard deviation, maximum, and minimum values. Monthly and yearly areal rainfall results are also reported for each sub-basin. Monthly and yearly statistics for stage and flow at each station within the sub-basins are presented in tabular and graphical format. Runoff estimates are presented in graphical and tabular format for the two sub-basins. The adjusted continuous historical flow data are stored in the South Florida Water Management District database, DBHYDRO, as preferred database keys.

ACKNOWLEDGEMENTS

The author would like to thank Janet Wise for her contribution of the basin and sub-basin maps shown in this document. Thanks are extended to Wossenu Abtew, Joanne Chamberlain, Emile Damisse, Linda Lindstrom, Steve Lin, Garth Redfield, and Barry Rosen for comments on the text. Special thanks are extended to Ron Mierau and Nagendra Khanal for their detailed and lucid comments throughout the document and with respect to furthering the analyses on runoff within the sub-basins discussed in this manuscript.

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INTRODUCTION

The lower Kissimmee River water management basin is one of the primary water conveyance systems feeding into the northern section of Lake Okeechobee. The upper Kissimmee River water management basin (UKR) is the primary source of water for the lower Kissimmee River water management basin. The two sub-basins, S65A and S65B, discussed in this report are located in the northern section of the lower Kissimmee River water management basin. The primary water conveyance system within these sub-basins is the Kissimmee River (C-38 canal).

A discussion summarizing the hydrologic data collected from the upper Kissimmee River water management basin has been reported by Ali (1998). Hydrologic characteristics, including the main water control structures, within the S65A and S65B sub-basins discussed in this report have been described in detail by Abtew (1992) and Van Horn (1996). The Kissimmee River was channelized in the late 1960's as the C-38 canal system with associated control structures to provide flood protection for the upstream sections of the lower Kissimmee River watershed. Currently, the District is in the process of redesigning the Kissimmee River/C-38 canal to restore some areas to their natural meandering pathways that existed as natural ecosystem wetlands prior to the redesign efforts in the late 1960's.

The lower Kissimmee River water management basin is shown in Figure 1. Figure 2 shows a detailed description of the S65A sub-basin. The S65A sub-basin is located south of Lake Kissimmee and encompasses approximately 161 square miles. The region is bounded by longitudes 81°00'00'' and 81°20'26'' and latitudes 27°36'24'' and 27°49'36''. The inflow of water into the Kissimmee River at the northern edge of this sub-basin is controlled by the S65 structure at the southern edge of Lake Kissimmee. The S65A sub-basin contributes to the first reach, Pool A, of the Kissimmee River, and outflow from the sub-basin is controlled by the water control structure S-65A (concrete gated spillway and lock structure). The S65B sub-basin is shown in Figure 3. The region is bounded by longitudes 80°54'25'' and 81°16'43'' and latitudes 27°29'48'' and 27°44'39''. The sub-basin encompasses just over 200 square miles. The primary water control structure at the outlet of this sub-basin is the concrete gated spillway and lock structure S-65B. The S65B sub-basin contributes to the second reach, Pool B, of the Kissimmee River. The purpose of the water control structures within these two sub-basins is to provide flood protection within their respective sub-basins, maintain seasonally varying operational goals for pool water levels, and pass design flood without exceeding upstream flood stages. The structures also pass sufficient discharge to maintain downstream stages and provide minimum flow through capacity for the UKR.

This report presents the hydrologic summary of S65A and S65B sub-basins. Time series of rainfall, stage, flow, and runoff estimates are presented along with the available sources of data. Annual and monthly hydrologic statistics are presented. When applicable, missing data gaps were estimated and continuous flow data were stored in preferred database keys.

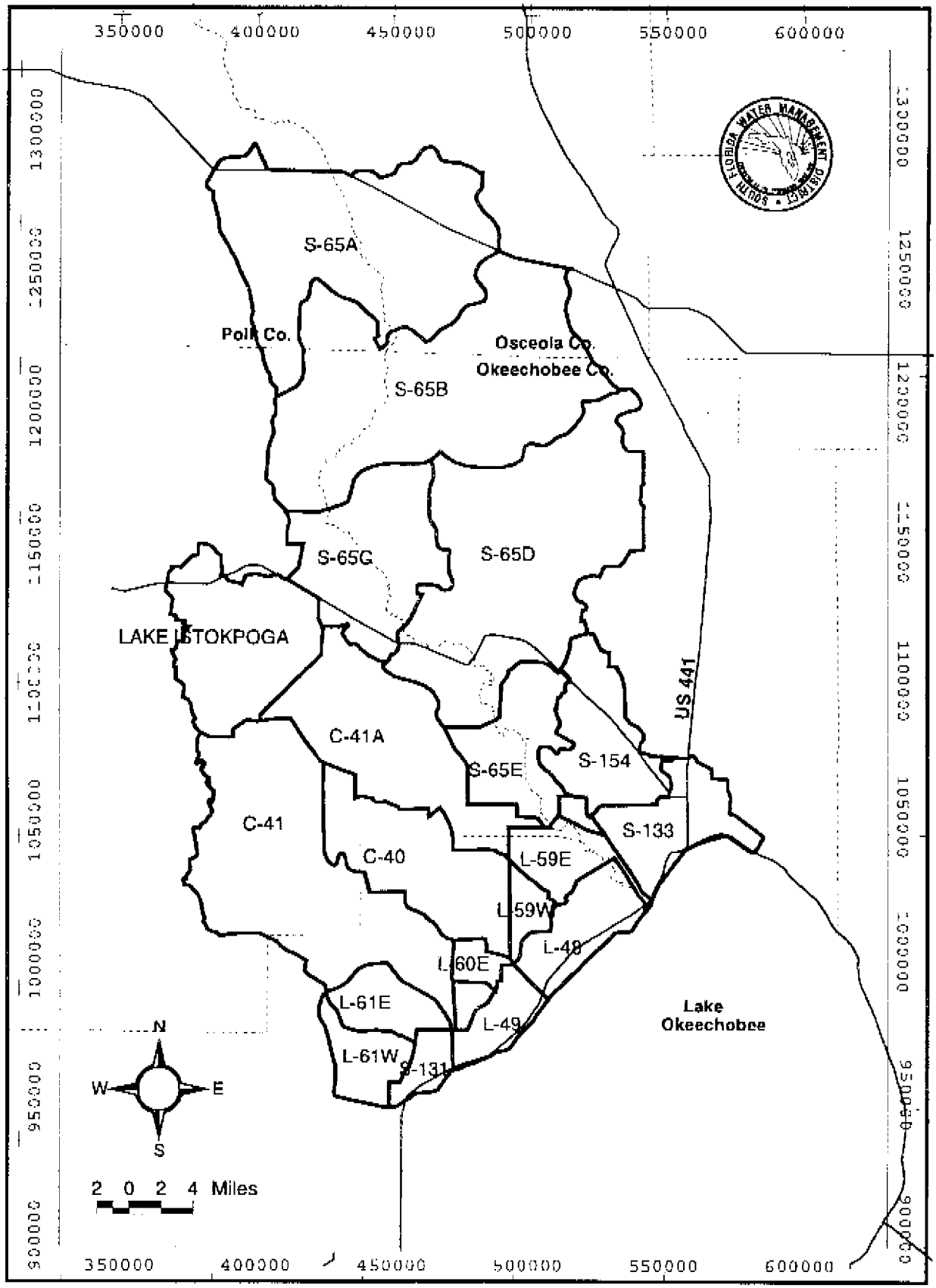

Figure 1. Lower Kissimmee River and Lake Istokpoga water management basins.

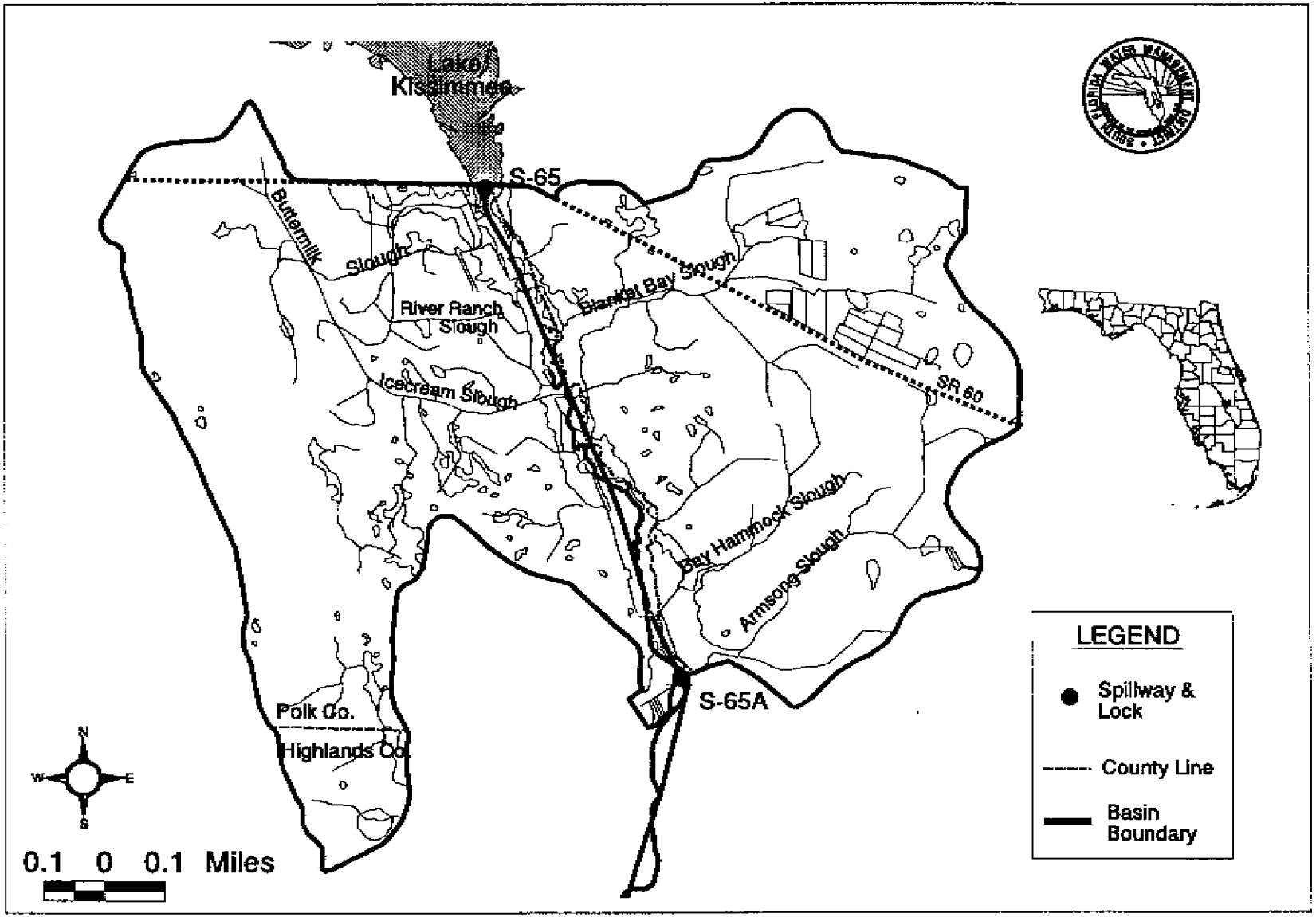

Figure 2. S65A sub-basin map.

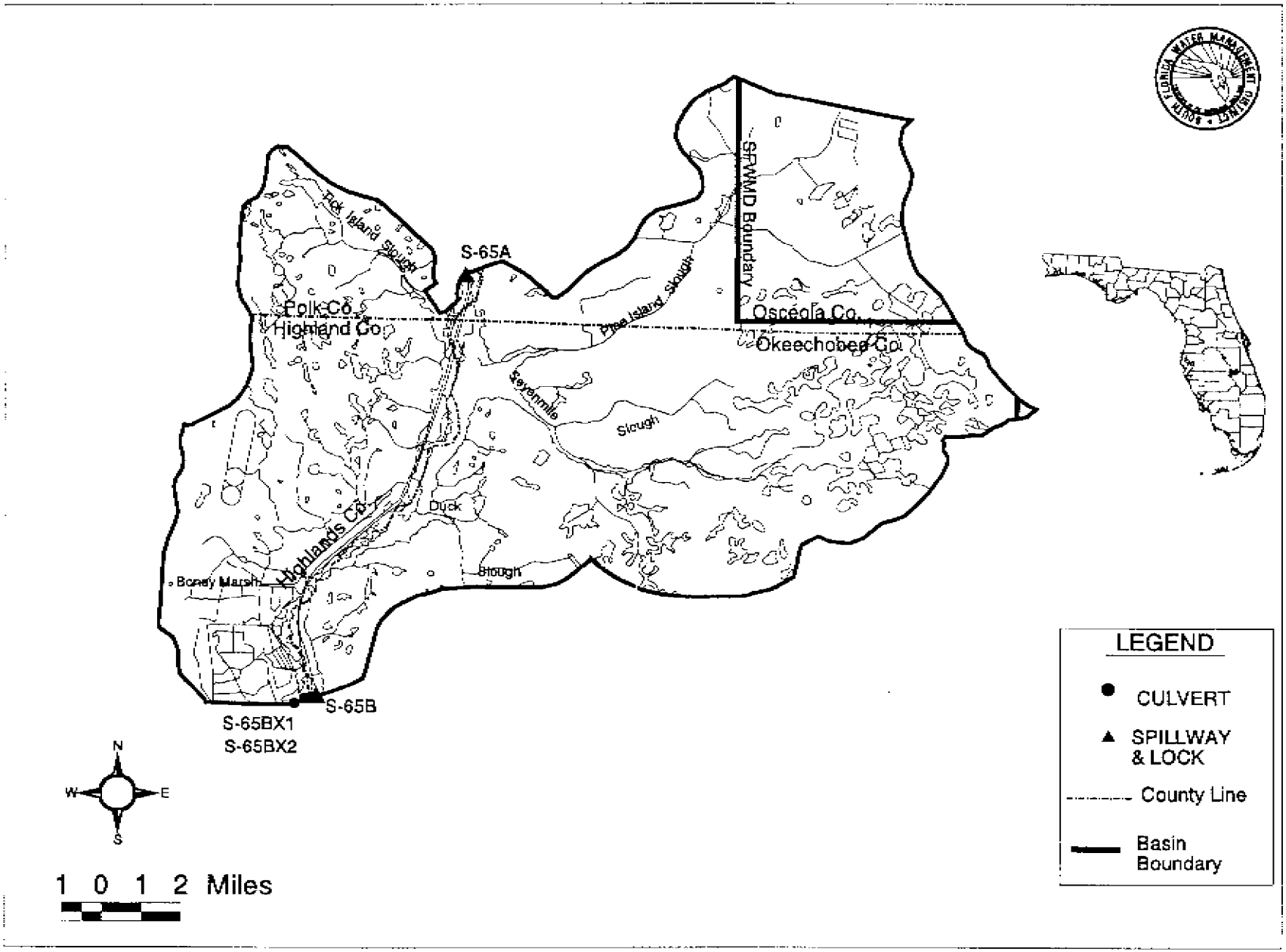

Figure 3. S65D sub-basin map.

S65A SUB-BASIN

The S65A sub-basin encompasses approximately 161 square miles. The location of this sub-basin and a detailed map of the sub-basin are shown in Figures 1 and 2. The sub-basin extends from the lower edge of Lake Kissimmee southward approximately 10.5 miles. The main water conveyance structure within this sub-basin is the Kissimmee River (C-38 canal). The small watersheds located within the sub-basin that contribute flow through their tributaries to the C-38 canal are the Buttermilk Slough, Ice Cream Slough, Blanket Bay Slough, Bay Hammock, Skeeter Slough, Armstrong Slough, and the River Ranch Slough.

The major water control structure located at the southern edge of the sub-basin is a reinforced concrete gated spillway (S-65A) with three gates and a lock structure. The purpose of the structure is to maintain seasonally varying operational goals for water levels upstream of S-65A and to pass design flood without exceeding the upstream flood stage. The S65A sub-basin contributes to the first reach, Pool A, of the Kissimmee River, and outflow from the sub-basin is controlled by the water control structure S-65A. The regulation schedule for Pool A is set at 46.3 feet for the entire year (based on data records for 1 October 1997 through 30 September 1998). The flow capacity for the S-65A structure is 11,000 cubic feet per second (cfs), which is 30% of the standard project flood (SPF). This design rate will not exceed the headwater and tailwater design stages. The maximum capacity is 14,200 cfs, or 100 percent of the Standard Project Flood (SPF). This structure is sized to provide a minimum of 3,000 cfs flow through capacity for the Upper Kissimmee River water management basin flood control, irrespective of local runoff conditions.

The data collected for this sub-basin and presented in this report include rainfall, stage, and flow. Evaporation data were not available for this sub-basin. Daily records exist for the above hydrologic parameters within the South Florida Water Management District database, DBHYDRO, and are accessed through assigned database keys. Data presented in this report were collected by the District, United States Geological Service (USGS), and the National Oceanic and Atmospheric Administration (NOAA). Preliminary review of the hydrologic data showed missing values or questionable data for single and multiple days for the period of record associated with all data sets. Data were examined with respect to consistency with adjacent stations, seasonal range, and magnitude of recorded value. Predictions for missing data were made based on time gap and consistency with adjacent station data.

Rainfall

The lower Kissimmee River water management basin average annual areal rainfall was reported as 50.1 inches for the years 1915 - 1985, while District wide average annual areal rainfall was 52.8 inches (Sculley, 1986). The wet season spans from June through October while the dry season occurs during the remaining months. Data compiled by Sculley (1986) resulted in a wet season average of 32.8 inches and a dry season average of 17.1 inches.

A description of rainfall monitoring stations in the S65A sub-basin is given in Table 1 and includes station name, database key for data access from DBHYDRO, daily calculation method, period of record, and grid coordinates. Monitoring locations for rainfall in this basin are shown in Figure 4. The data from each station were checked for missing values, accumulated data with missing values, and consistency with respect to adjacent stations. If data gaps of three days or less were encountered, missing data were

Table 1. Rainfall stations in S65A sub-basin.

Station	Dbkey	Method†	Start	End	Latitude	Longitude
ARMSSO_R	05750	Sum	Nov/1979	Sep/1989	273954	810703
GAC_R	05878	Sum	Apr/1974	May/1998	274444	811444
YEEHAW J_R	05964	Sum	May/1965	Aug/1972	274403	810128
S65A_R	05981	Sum	Jul/1965	May/1998	273935	810804
S65A_R	16572	Sum	Jan/1991	Nov/1997	273935	810804
AVON P2_R	05993	Sum	Feb/1965	Jan/1972	273751	811534
INDIAN 4_R	06200	Sum	Feb/1960	Mar/1981	274800	811900
TRIPLE_C_R	13061	Sum	Jul/1989	Jul/1991	274205	812707

†Indicates method of reporting data were daily sum.

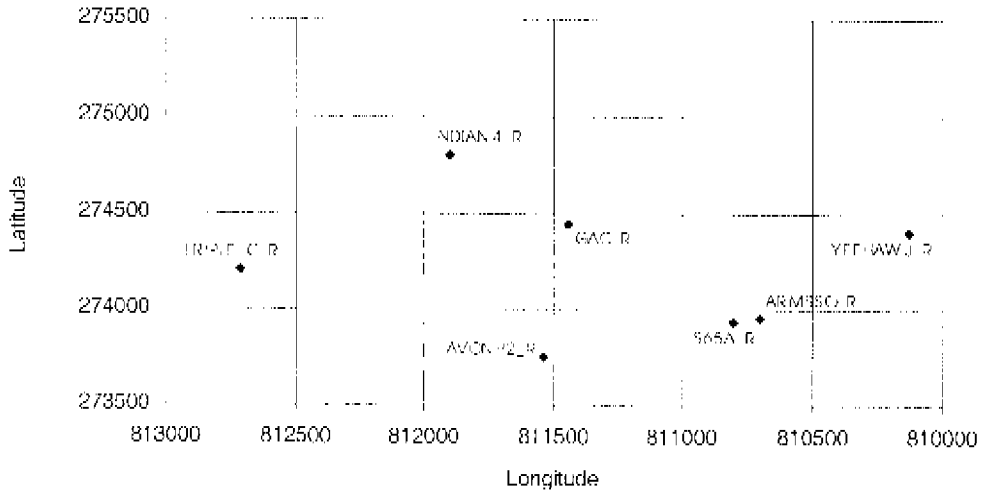

Figure 4. Location of rainfall collection stations in sub-basin S65A.

estimated using the closest station with valid rainfall. Any month with greater than three days of missing data were excluded from statistical analysis for that specific month. For data accumulated over time, estimates were made based on the ratio method given in Equation 1, using the next closest station with valid data.

$$P_A(t) = [P_A(c)/P_B(c)]*P_B(t) \quad (1)$$

where

$P_A(t)$ = estimated rainfall for station A on day t, inches,

$P_A(c)$ = cumulative rainfall for station A, inches,

$P_B(t)$ = observed rainfall for station B on day t, inches,

$P_B(c)$ = cumulative rainfall for station B, inches.

During the process of analyzing rainfall data, results were checked for consistency and magnitude with respect to time of year and adjacent stations. If erratic or erroneous data were observed in the data set, these data were adjusted, with respect to the closest station exhibiting valid data, or removed from the analysis. For example, at station ARMSSO_R a 10 inch rainfall event occurred that was inconsistent with the adjacent station S65A_R. Also, observations indicated questionable data existed over time periods prior to and after this event. That is, extremely low rainfall values were recorded, that were inconsistent with station S65A_R for the years 1985 - 1989. The questionable data were removed from the statistical analysis for this station, and subsequently for the rainfall analysis over the entire sub-basin. The result was an increase of 12 - 15 inches for average annual sub-basin rainfall during the years of 1985 – 1989.

Historical results, monthly statistics and annual sums, for each monitoring location are given in graphical and tabular format in Appendix A. Monthly statistics (mean, median, maximum, minimum, standard deviation) were compiled for each month over the period of record for each station. These data were combined for sub-basin wide estimates of average monthly and annual rainfall. For sub-basin wide average annual areal rainfall, data from each station with temporal overlap were averaged for that year. Monthly statistics for sub-basin rainfall results for the calendar years 1963 – 1997 are depicted in Table 2. Monthly and annual results for sub-basin wide rainfall are given in Appendix A. Note that the maximum monthly rainfall occurred in June and the minimum monthly rainfall occurred in April for the calendar years 1963 – 1997. Also, mean monthly rainfall was highest in June and lowest in December for the calendar years 1963 – 1997.

Table 2. Statistics for monthly rainfall (inches) over calendar years 1963 – 1997 in sub-basin S65A.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR†
Mean	2.32	2.90	3.28	2.11	4.33	7.98	7.32	7.62	5.96	3.16	2.36	1.91	51.10
Standard Deviation	1.62	1.87	2.08	1.43	2.71	3.66	2.58	3.46	2.59	2.44	2.57	1.52	8.99
Minimum	0.10	0.45	0.12	0.04	1.16	2.30	2.93	1.56	1.33	0.49	0.19	0.21	31.88
Median	2.22	2.59	2.69	1.96	3.90	7.71	7.13	7.19	5.43	2.19	1.55	1.38	51.37
Maximum	6.24	7.43	8.76	4.56	13.61	20.65	15.35	17.80	14.91	10.91	13.21	7.32	70.74

† Indicates period of record for statistic.

Sub-basin wide statistical estimates for rainfall over the calendar years 1963 - 1997 are shown in Figures 5 - 7. Results for this time period showed an annual areal maximum rainfall of 70.7 inches, minimum of 31.9 inches, and historical average of 51.1 inches (with a standard deviation of 9.0 inches). Average wet season areal rainfall was 32.1 inches, while dry season average areal rainfall was 19.1 inches over the years 1963 - 1997. These results are consistent with those reported by Sculley (1986) for the entire basin during the years 1915 - 1985 (32.8 and 17.1 inches for wet and dry season, respectively).

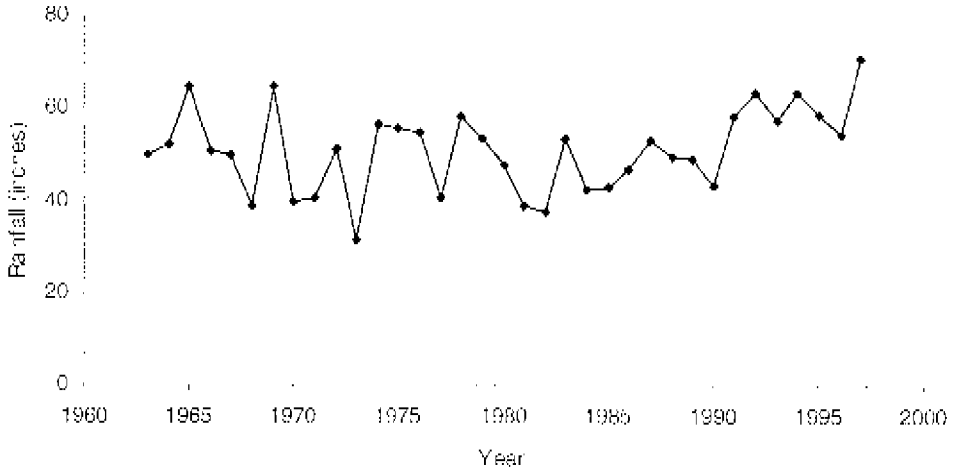

Figure 5. Average annual areal rainfall in S65A sub basin for years 1963 - 1997.

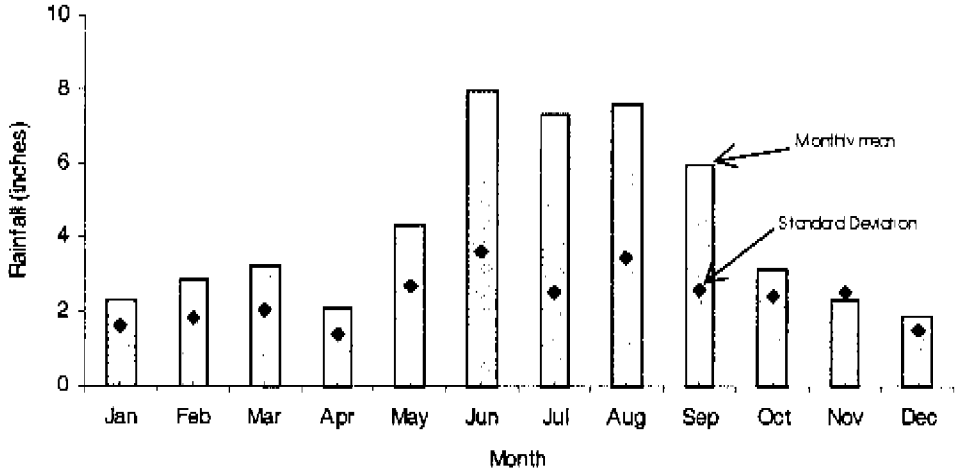

Figure 6. Mean monthly areal rainfall and standard deviation in S65A sub-basin for years 1963 – 1997.

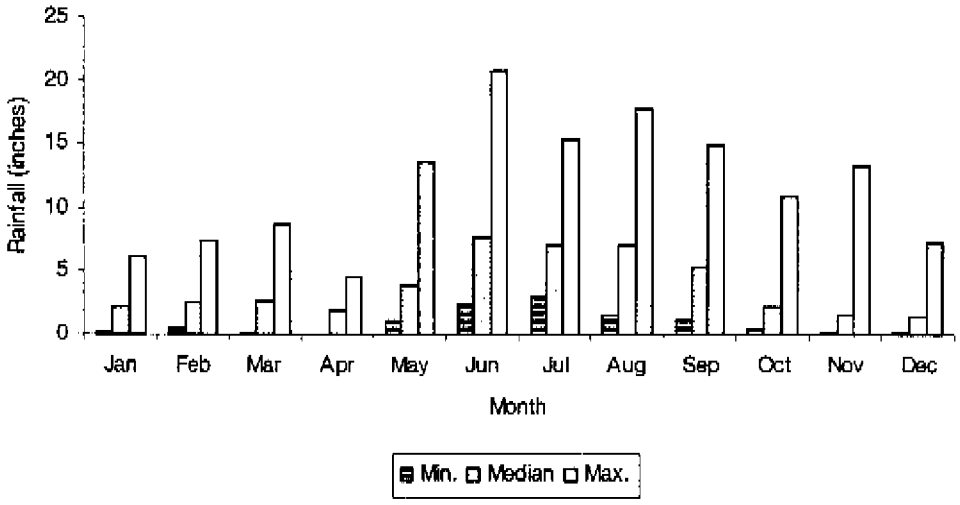

Figure 7. Minimum, median, and maximum monthly areal rainfall in S65A sub-basin for years 1963 - 1997.

Stage

The main structure controlling stage in the S65A sub-basin is the reinforced concrete gated spillway and lock structure (S-65A). The spillway is designed to maintain a headwater stage of 46.3 feet (NGVD) and tailwater stage of 42.1 feet (NGVD) corresponding to the design flood of 30% SPF for the C-38 canal. Water will bypass the spillway structure at an elevation of 54.0 feet (NGVD). Upstream of the S65A sub-basin control structure is the RATHAM station, located in Rattlesnake Hammock, between the S-65 and S-65A control structures. Characteristics of stage and flow through the S-65 control structure were reported by Ali (1998). Other structures in the S65A sub-basin included S65AX, a culvert in the old Kissimmee River oxbow to improve marsh flow, and the stations ARMSO, ARMSC, and ARMSF which controlled and monitored stage in the Armstrong slough.

A description of stage data collection stations in the S65A sub-basin are given in Table 3 and locations for these stations are shown in Figure 8. The upstream water control structure, S-65, is shown in italics. Stage statistics for the structures in the S65A sub-basin are shown in Figures 9 – 13. The data show consistency with respect to stage, that is, mean stage at RATHAM is at a higher elevation versus headwater stage at S65A. Several stations showed minimal amount of data (one year or less) and no graphical results are presented for these (ARMSO, ARMSC_C, and ARMSF_F). Summaries of daily stage over each month for ARMSO, ARMSC C, and ARMSF_F are given in tabular format in Appendix A. Daily historical results of stage for the remaining stations are given in graphical format in Appendix A.

Table 3. Stage data collection stations in S65A sub-basin.

Station	Dbkey	Method†	Start	End	Latitude	Longitude
RATHAM	13089	Mean	Jul/1990	Dec/1995	274320	811005
RATHAM	16553	Mean	Dec/1995	Jun/1998	274320	811005
S65A_H	04426	Mean	Jun/1969	Aug/1994	273935	810804
S65A_H	06799	Mean	Mar/1986	May/1998	273935	810804
S65A_T	04428	Mean	Jun/1967	Aug/1994	273935	810804
S65A_T	06800	Mean	May/1986	May/1998	273935	810804
S65AX_H	12568	Mean	Jul/1988	May/1998	273938	810754
S65AX_T	12569	Mean	Jul/1988	May/1998	273938	810754
ARMSO_H	05164	Mean	Jun/1983	Mar/1984	274038	810617
ARMSC_H	05170	Mean	May/1983	Jun/1984	274003	810725
ARMSC_T	05172	Mean	Jun/1983	Mar/1984	274003	810725
ARMSF_H	05176	Mean	Jun/1983	Mar/1984	273950	810626
ARMSF_T	05178	Mean	Jun/1983	Mar/1984	273950	810626

† Indicates method of reporting data were daily mean.

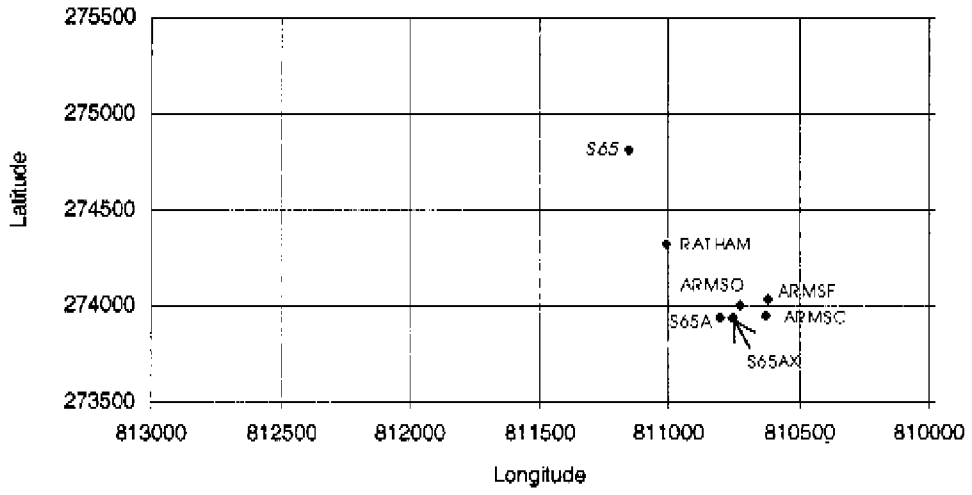

Figure 8. Stage and flow data collection locations in S65A sub-basin.

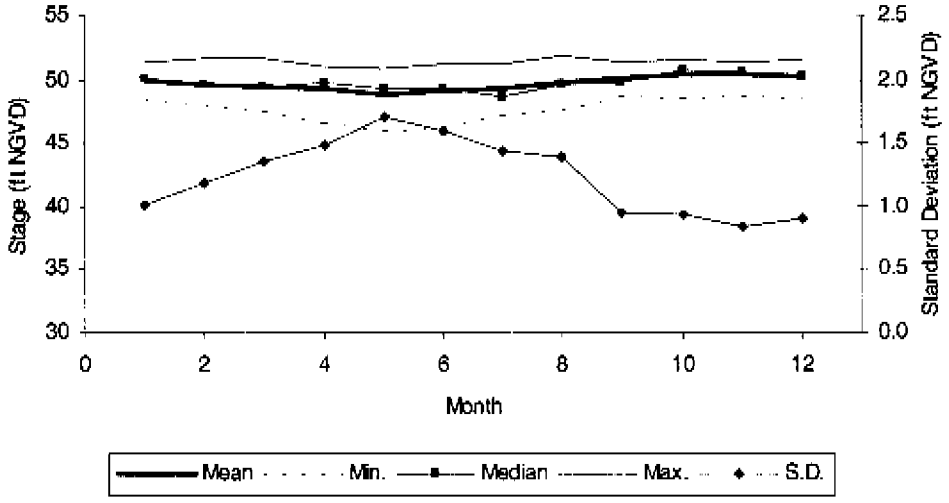

Figure 9. Statistics for daily stage over each month at station RATHAM.

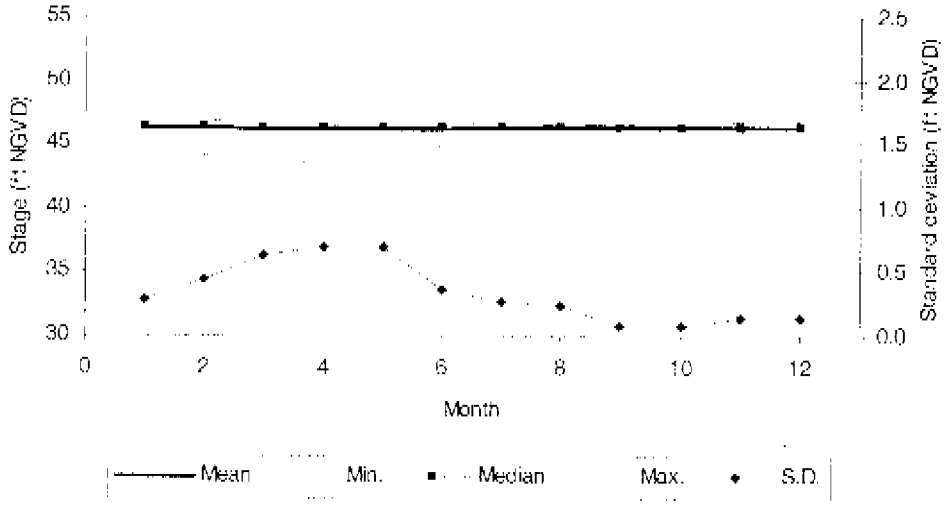

Figure 10. Statistics for daily headwater stage over each month at station S65A_H.

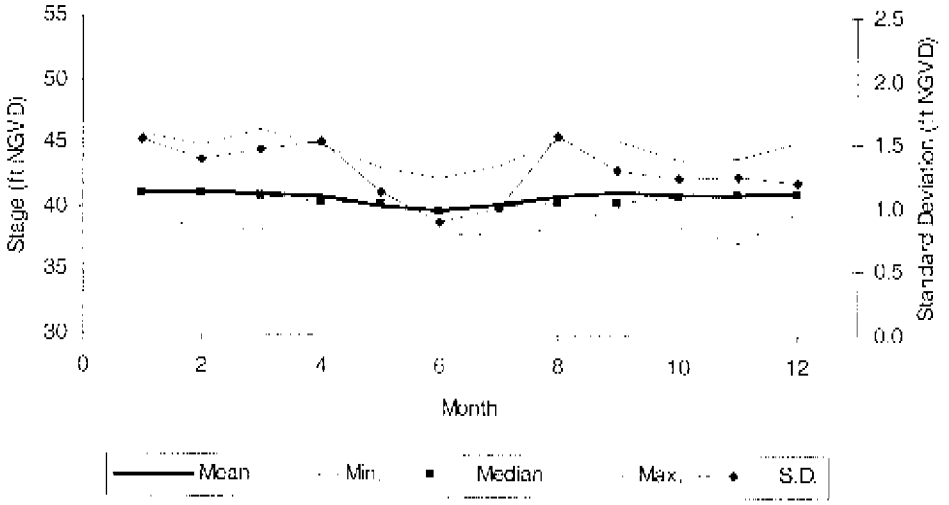

Figure 11. Statistics for daily tailwater stage over each month at station S65A_T.

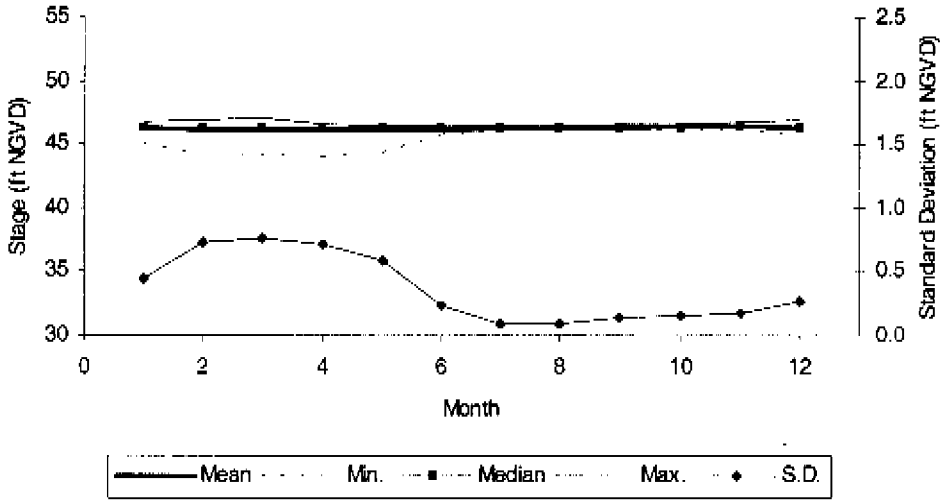

Figure 12. Statistics for daily headwater stage over each month at station S65AX_H.

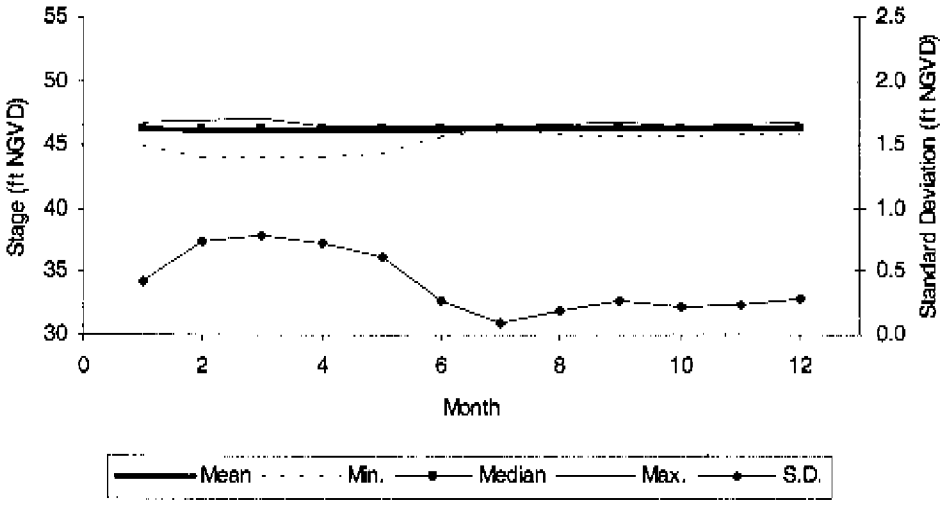

Figure 13. Statistics for daily tailwater stage over each month at station S65AX_T.

Stage data were checked for consistency with respect to upstream stations, when possible. Missing data gaps were estimated by assuming a linear arithmetic increase or decrease between the respective data entries that contained valid data. For stations with temporal overlap, the most recent valid data was assumed to be representative for that day. It should also be noted that S 65 tailwater is a valid measure for water levels in Pool A within the S65A sub-basin. Missing data for headwater at the S-65A structure can also be estimated using tailwater measurements at the S 65 structure. Figure 15 shows the results for S 65 tailwater and S-65A headwater measurements and the resultant water levels associated with Pool A.

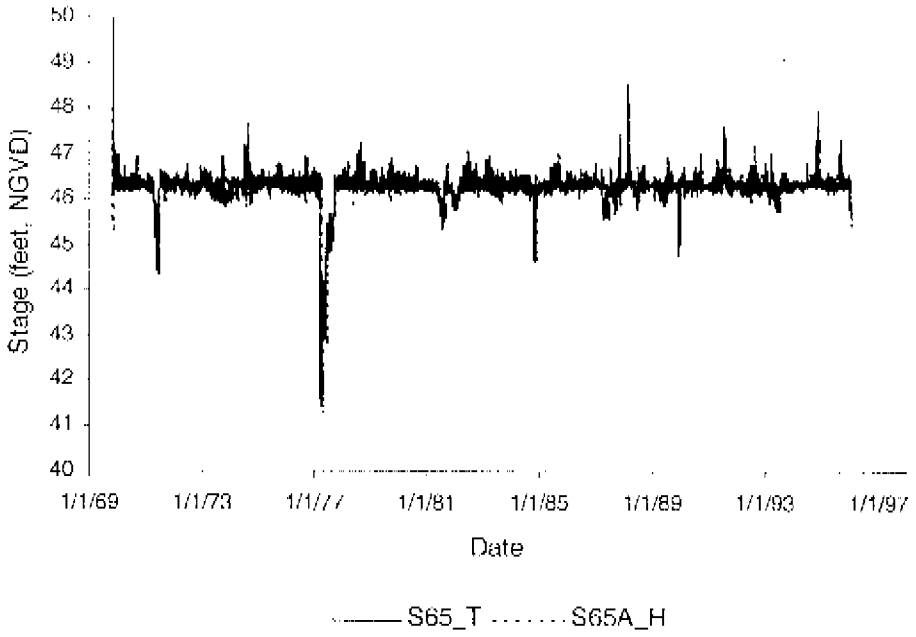

Figure 14. S65_T (tailwater) and S65A_H (headwater) daily stage results indicative of water levels in Pool A.

Recall that design headwater stage for the S-65A control structure was 46.3 feet (NGVD), while design tailwater stage was 42.1 feet (NGVD). Historical results, or time series data, showed a maximum headwater stage of 48.15 feet (NGVD) on 27 February 1988. Maximum tailwater stage for this structure was 46.93 feet (NGVD) on 23 February 1998, an El Nino year.

Flow

The design discharge rate for the S65A sub-basin control structure is 11,000 cfs (30% SPF). The 100% SPF discharge rate is 14,000 cfs. The maximum flow rate that occurred through the S-65A control structure was 13,114 cfs on 3 October 1969. A minimum flow rate of 0 cfs occurred through the control structure for twenty percent of the period of record analyzed.

The spillway structure was designed to maintain an optimum headwater elevation of 46.3 feet (NGVD) and maximum water level drop across the structure of 10 feet. The structure passes the design flood (30% SPF) without exceeding upstream flood stage and restricts downstream flood stages and channel velocities to non-damaging levels (Abtew, 1992). The lock operation was established by the U.S. Corp of Engineers in accordance with the River and Harbor Act of 1917 and is currently set as: Monday through Friday, 8:00 a.m. to 5:00 p.m., all year; for Saturday and Sunday, 1 March through 31 October, 5:30 a.m. to 7:30 p.m.; for Saturday and Sunday, 1 November through 28 February, 5:30 a.m. to 6:30 p.m.

The data base keys and period of record for data collection at flow stations for sub-basin S65A are shown in Table 4. Locations of the stations that monitored flow are shown in Figure 8. The S-65A control structure was the only station with valid flow data for the S65A sub-basin. Although stations ARMSO, ARMSC_C, and ARMSF_F indicate flow data exist for the years from 1979 to 1983, access of these stations through their assigned database key in DBHYDRO showed that the data had not been processed.

Missing gaps for flow data were estimated by assuming a linear arithmetic increase or decrease between the respective data entries that contained valid data. For temporal overlap, the most recent valid data was assumed to be representative for that day. Monthly statistics for daily flow at station S65A_S are shown in Figure 15. Data from flow station S65A_S is stored in the database under the preferred database key HG237. The period of record for this database key is 13 June 1969 through 31 May 1998. The source database keys in DBHYDRO for flow station S65A_S are 04430 and 06801. Daily historical flow for S65A_S is shown in Appendix A. Average daily flows over each year and yearly flow summations at station S65A_S are presented in the section discussing runoff. Average daily flows over each month and year, and monthly and yearly flow summations for S65A_S are presented in Appendix A.

Table 4. Flow monitoring stations in S65A sub-basin.

Station	Dbkey	Method†	Start	End	Latitude	Longitude
S65A_S	04430	Mean	Jun/1969	Dec/1991	273935	810804
S65A_S	06801	Mean	May/1986	May/1998	273935	810804
ARMSO	05168	Mean	May/1979	July/1983	274038	810617
ARMSC_C	05174	Mean	Jan/1979	Jul/1983	274003	810725
ARMSF_F	05180	Mean	Aug/1979	Jul/1983	273950	810626

†Indicates method of reporting data were daily mean.

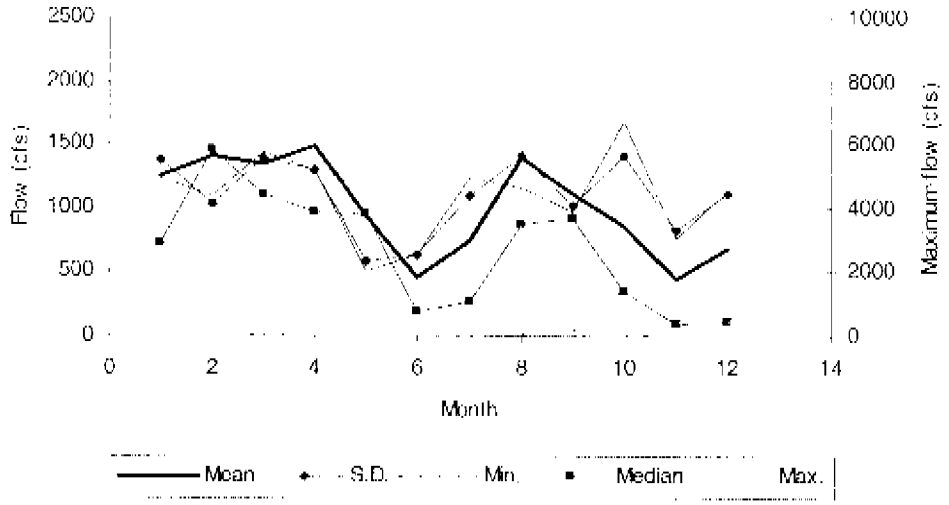

Figure 15. Statistics for daily flow over each month at station S65A_S.

S65B SUB-BASIN

The location of sub-basin S65B within the lower Kissimmee River water management basin is shown in Figure 1, with a detailed map of the sub-basin depicted in Figure 3. The sub-basin encompasses approximately 200 square miles. The main water conveyance system is the Kissimmee River (C-38) which extends 12.1 miles from the S-65A control structure to the main control structure within the S65B sub-basin (S-65B). The small watersheds contributing flow within this sub-basin are Tick Island Slough, Pine Island Slough, Sevenmile Slough, and Duck Island Slough.

The major water control structure within this sub-basin is a reinforced concrete gated spillway, S-65B, with three gates and a lock structure. The purpose of the structure is to maintain seasonally varying operational goals for water levels upstream of S-65B without exceeding upstream flood design stage and also, restrict downstream flood stages to non-damaging design flood levels. The S65B sub-basin contributes to the second reach, Pool B, of the Kissimmee River, and outflow from the sub-basin is controlled by the water control structure S-65B. The regulation schedule for Pool B was set at 42.2 feet (1 October 1997 through 20 April 1998). The schedule was subsequently decreased from 42.2 feet to 38.5 feet through 15 July 1998, and allowed to increase to 41.5 feet through 30 September 1998. The flow capacity of the S-65B structure is 14,000 cfs (30% SPF), with a maximum capacity of 16,700 cfs (100% SPF). Two auxillary structures exist at this site, S65BX1 and S65BX2. S65BX1, now disfunctional, was used for over thirty years. The purpose of the S65BX1 structure was to maintain flow in the old oxbow upstream and downstream of S65-B. It was abandoned when repairs were considered to be uneconomical in light of the imminent obsolesence by the Kissimmee River Restoration Project. The S65BX2 is located approximately six tenths of a mile west of the S-65B control structure. The purpose of this auxiliary structure is to provide drainage to tributary lands, including Boney Marsh, that were cut off by the local levee. Also, the culverts at the S65BX2 structure allow drainage to Pool C rather than the diked off portion of Pool B. The S-65B structure is sized to provide a minimum of 3,000 cfs flow through capacity for the Upper Kissimmee River water management basin flood control, irrespective of local runoff conditions.

The data collected for this sub-basin and presented here include rainfall, stage, and flow. No pan evaporation data was available for this sub-basin. Daily records exist for the above hydrologic parameters in the District database, DBHYDRO. The data were collected by the District, the USGS, and NOAA. The data reported here were checked for consistency with respect to magnitude, upstream data collection station, and missing or questionable data. Estimations of missing data were made based on time gap length and consistency with adjacent stations.

Rainfall

Average annual areal rainfall District-wide for the years 1915 - 1985 has been reported as 52.8 inches, while the lower Kissimmee River water management basin was reported as 50.1 inches for same time period (Sculley, 1986). The wet season for the southern section of Florida spans from June through October. Sculley (1986) reported wet season average annual areal rainfall as 32.8 inches and 17.1 inches for the dry season average for the entire lower Kissimmee River water management basin.

A description of rainfall monitoring locations for the S65B sub-basin are given in Table 5. The table includes station name, database key for accessing information from DBHYDRO, calculation method, period of record, and grid coordinates. Locations for the monitoring stations are shown in Figure 16. All rainfall data for each station were analyzed with respect to missing values, accumulated data with missing values, and consistency in magnitude, time of year, and adjacent stations. If data gaps of three days or less were encountered, missing data were estimated using the closest station with valid rainfall. Any month with greater than three days of missing data were excluded from statistical analysis for that specific month. Data accumulated over time were estimated using the ratio method and the next closest station with valid data (*i.e.*, equation 1). If erratic or erroneous data were observed, these data were adjusted with respect to the closest station exhibiting valid data, or removed from the analysis.

Table 5. Rainfall stations in S65B sub-basin.

Station	Dbkey	Method†	Start	End	Latitude	Longitude
PEAVF_R	05672	Sum	Apr/1979	Sep/1982	274215	810125
ELMAX R	05852	Sum	Mar/1972	May/1998	274509	810439
PEAVINE_R	05858	Sum	Jun/1972	May/1998	273257	810125
MAXCEY N_R	05871	Sum	Apr/1974	May/1998	274100	810126
TICK ISL_R	05872	Sum	Apr/1974	Mar/1998	274108	811112
BONEY.WS_R	05887	Sum	May/1975	Oct/1989	273204	811257
S65B_R	05999	Sum	May/1965	Jun/1998	273009	811145
S65B_R	16282	Sum	Feb/1995	Nov/1997	273009	811145
KREFR	FI286	Sum	May/1997	Jun/1998	273008	811144
KRBNR	FZ609	Sum	Oct/1997	Jun/1998	272739	811016

†Indicates method of reporting data were daily sum.

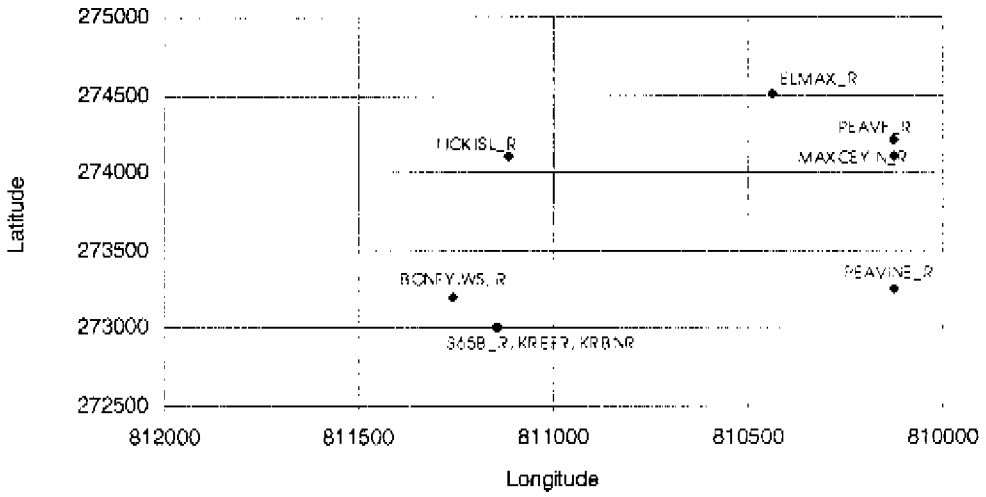

Figure 16. Location of rainfall collection stations in sub-basin S65B.

Daily historical results for all rainfall collection locations, and the entire sub-basin, are given in graphical and tabular format in Appendix B. Mean, median, standard deviation, maximum, and minimum values were compiled for each month over the period of record for each station. The data from all stations were combined to estimate a sub-basin wide average monthly and annual areal rainfall. Temporal overlap among stations were averaged for the respective year. Monthly statistics for sub-basin rainfall results for the calendar years 1966 – 1997 are depicted in Table 6. Monthly and annual results for sub-basin wide rainfall are given in Appendix B. Note that the maximum monthly rainfall occurred in June and the minimum monthly rainfall occurred in November for the calendar years 1966 – 1997. Mean monthly rainfall was highest in June and lowest in December. Statistical results, compiled over the calendar years 1966 - 1997, for the sub-basin are shown graphically in Figures 17 – 19.

Table 6. Statistics for monthly rainfall (inches) over calendar years 1966 – 1997 in sub-basin S65B.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR†
Mean	2.15	2.52	2.92	2.03	4.09	7.59	6.59	6.14	5.66	2.90	2.05	1.61	45.92
Standard Deviation	1.74	1.85	2.12	1.62	2.29	2.91	2.09	2.37	2.18	2.30	2.00	1.21	8.09
Minimum	0.14	0.32	0.07	0.08	0.92	2.98	3.22	1.42	2.61	0.65	0.04	0.12	32.83
Median	1.76	2.18	2.30	1.75	3.86	7.01	6.54	6.07	5.28	2.38	1.43	1.32	44.28
Maximum	6.52	8.97	8.42	5.26	10.53	15.80	13.21	13.76	11.26	13.20	8.06	5.50	63.41

† Indicates period of record for statistic.

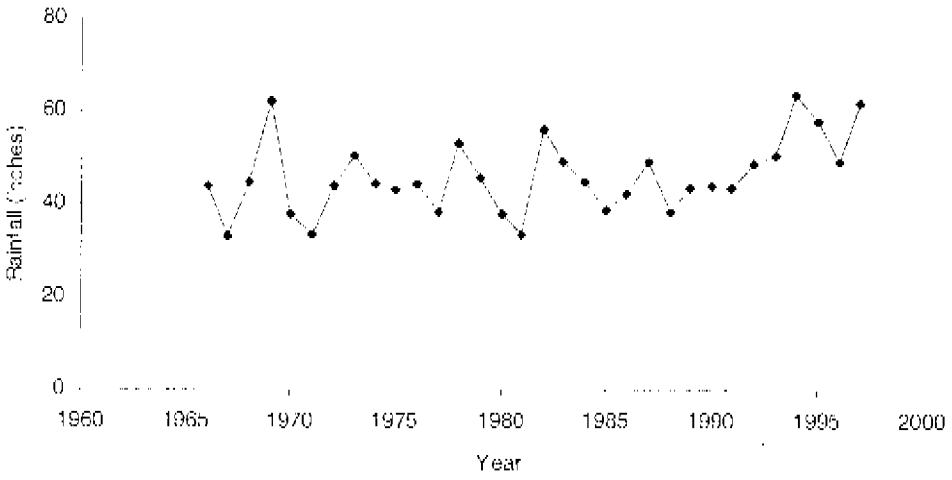

Figure 17. Average annual areal rainfall in S65B sub basin for years 1966 – 1997.

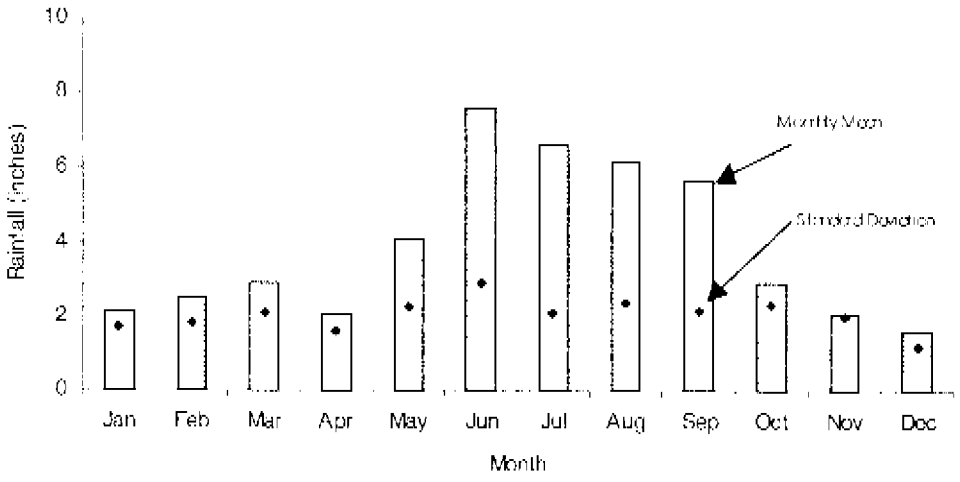

Figure 18. Mean monthly areal rainfall and standard deviation in S65B sub-basin for years 1966 – 1997.

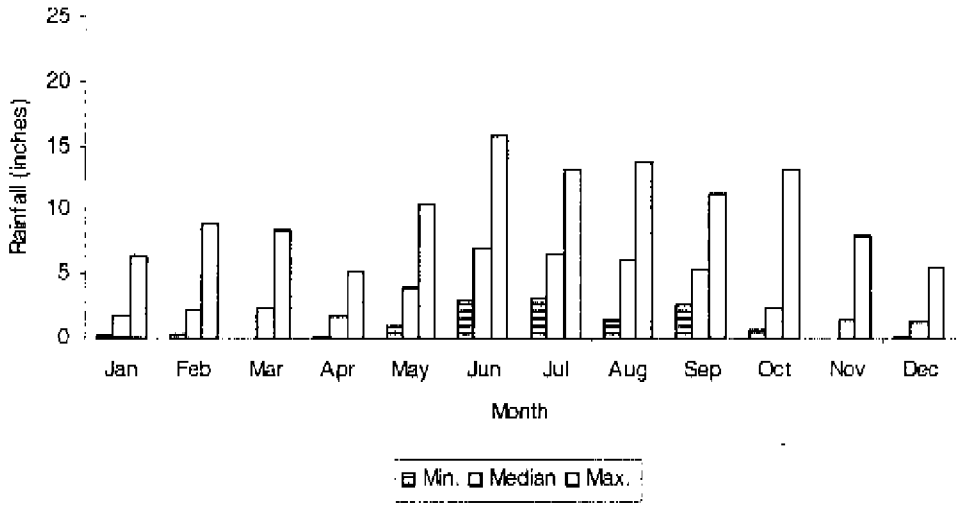

Figure 19. Minimum, median, and maximum monthly areal rainfall in S65B sub-basin for years 1966 - 1997.

Rainfall analysis for the S65B sub-basin over the calendar years 1966 - 1997 showed an annual areal maximum of 63.4 inches, minimum of 32.8 inches, and average of 45.9 inches (with a standard deviation of 8.1 inches). Average wet season rainfall for these years was 28.7 inches and dry season rainfall was 13.7 inches. These results are lower than those reported by Sculley (1986) for the lower Kissimmee River water management basin during the years 1915 - 1985 (32.8 and 17.1 inches for wet and dry season, respectively).

Stage

The S-65B reinforced concrete gated spillway and lock structure controls stage in the S65B sub-basin. The spillway is designed to maintain seasonally varying operational goals for water levels upstream of S65-B. Prior to 1984 the operational target stage was 40.0 feet (NGVD). Seasonal stage levels are now targeted for a headwater stage of 40.0 feet (NGVD) and tailwater stage of 35.7 feet (NGVD) corresponding to the 30% SPF for the C-38 canal at this structure. Water will bypass the structure at an elevation of 46.5 feet (NGVD). The spillway is operated in accordance with the "Interim Regulation Schedule - Kissimmee River Pools", dated July 1982. Optimum headwater should be between 39.0 and 42.0 feet (NGVD). During high discharge periods (greater than 3,000 cfs) the elevation should be raised to 42.0 feet (NGVD).

Additional structures between the S-65A and S-65B control structures within the sub-basin are used for different purposes. The C-38.MRSH location monitors stage through marsh C-38 Pool B, north of Pine Island Slough. C-38.PINE monitors stage at Pine Island Slough near the outfall to C-38, below the S-65A control structure. The station FTKISS monitors Kissimmee River stage at Ft. Kissimmee. Weir 1, Weir 2, and

Weir 2, and Weir 3 are Kissimmee River Demonstration structures on Pool B. The Boney sites monitored flow-through detail at Boney Marsh Slough. S65BX1 was an auxiliary culvert on C-38, now disfunctional in light of the imminent obsolescence by the Kissimmee River Restoration Project. This structure was used to maintain flow in the old oxbow upstream and downstream of S-65B. S65BX2, was constructed in order to provide drainage to tributary lands, including Boney Marsh, that were cut off by the local levee. The culverts at S65BX2 allow drainage to Pool C rather than the diked off portion of Pool B. KRFN, KREN, KRBN are Kissimmee River Restoration structures for stage measurements.

An overview of the stage monitoring locations database keys for DBHYDRO access, method of reporting stage, period of record and grid locations are given in Table 7. Figure 20 shows locations for the stations in this sub-basin, with the upstream water control structure, S-65A, shown in italics. Historical results for all stations (excluding BONEY locations, KRFN, KREN, KRBN) are given in Appendix B in graphical format. Average daily stage over each month are given in tabular format for the BONEY locations and KRFN, KREN, and KRBN, since the period of records were one year or less.

Table 7. Stage data collection stations in S65B sub-basin.

Station	Dbkey	Method†	Start	End	Latitude	Longitude
S65B_H	04432	Mean	Nov/1967	Jan/1994	273009	811145
S65B_H	06802	Mean	Mar/1986	Mar/1998	273009	811145
S65B_T	04434	Mean	Nov/1967	Jan/1994	273009	811145
S65B_T	06803	Mean	Mar/1986	Mar/1998	273009	811145
S65BX1_H	04442	Mean	Feb/1984	Jul/1992	273005	811202
S65BX1_T	04444	Mean	Feb/1984	Jul/1992	273005	811202
S65BX2_H	04448	Mean	Feb/1984	Jul/1992	272957	811219
S65BX2_T	04450	Mean	Feb/1984	Jul/1992	272957	811219
WEIR3_H	05596	Mean	Apr/1985	Dec/1995	273439	810938
WEIR3_H	06908	Mean	Oct/1986	Jun/1998	273439	810938
WEIR3_T	05598	Mean	Apr/1985	Jun/1998	273439	810938
WEIR2_H	05602	Mean	Apr/1985	Dec/1995	273352	811033
WEIR2_H	12766	Mean	Jan/1989	May/1998	273352	811033
WEIR2_T	05604	Mean	Apr/1985	May/1998	273352	811033
WEIR1_H	05608	Mean	Aug/1985	Dec/1995	273214	811209
WEIR1_H	12768	Mean	Dec/1986	May/1998	273214	811209
WEIR1_T	05610	Mean	Aug/1985	May/1998	273214	811209
FTKISS	00191	Mean	Dec/1941	Sep/1967	273530	810919
C38.PINE	06842	Mean	May/1986	May/1998	273703	810818
C38.MRSH	06893	Mean	Apr/1987	May/1998	273818	810812
BONEY.M1	12691	Mean	Nov/1988	Aug/1989	273231	811257
BONEY.M2	12692	Mean	Nov/1988	Aug/1989	273220	811257

Table 7. continued.

Station	Dbkey	Method†	Start	End	Latitude	Longitude
BONEY.M3	12693	Mean	Nov/1988	Aug/1989	273210	811257
BONEY.M4	12698	Mean	Nov/1988	Aug/1989	273158	811257
BONEY.M5	12699	Mean	Nov/1988	Aug/1989	273143	811257
AVON P3	04440	Mean	Sep/1984	May/1998	273237	811220
KRFN	G4893	Mean	Nov/1997	Jun/1998	272739	811016
KREN	FZ604	Mean	Nov/1997	Jun/1998	274501	811037
KRBN	FZ599	Mean	Oct/1997	Jun/1998	274717	811133

† Indicates method of reporting data were daily mean.

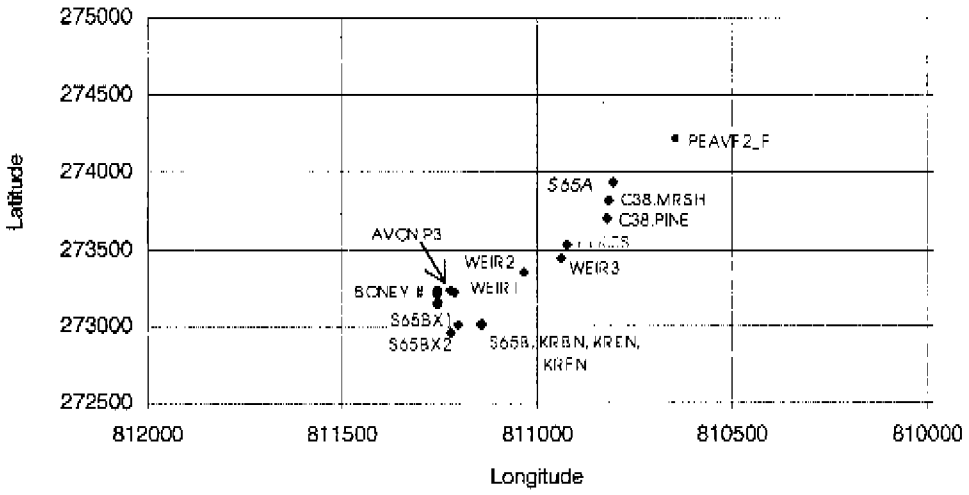

Figure 20. Stage and flow data collection locations for S65B sub-basin.

Maximum headwater and tailwater stages for several monitoring locations and dates of occurrence over the historical period of records are given in Table 8. The design headwater stage for the S-65B structure was 40.0 feet (NGVD), while tailwater was 35.7 feet (NGVD). Statistical results for all stations (excluding stations with one year or less of data and stations S65BX1 and S65BX2) are shown in Figures 21 - 33. Daily historical results for stage are given in Appendix B in graphical format for all stations except for BONEY.M#, KRBN, KREN, and KRFN which are given as daily averages over each month in tabular format.

Table 8. Maximum headwater and tailwater occurrences for several stations in sub-basin S65B.

Station	Headwater maximum (ft NGVD)	Tailwater maximum (ft NGVD)	Date of occurrence
S65B_H	43.24		01/21/87
S65B_T		35.99	10/04/69
WEIR1_H	44.80		02/22/98
WEIR1_T		43.21	01/21/87
AVON P3	46.37		03/21/98,03/22/98
WEIR2_H	45.71		02/25/88
WEIR2_T		45.17	02/22/98
WEIR3_H	46.71		02/22/98,02/23/98
WEIR3_T		45.72	02/25/88
FTKISS	50.12, 46.72		09/18/45,02/23/98
C38.PINE	47.21		03/22/98
C38.MRSH	48.03		03/22/98

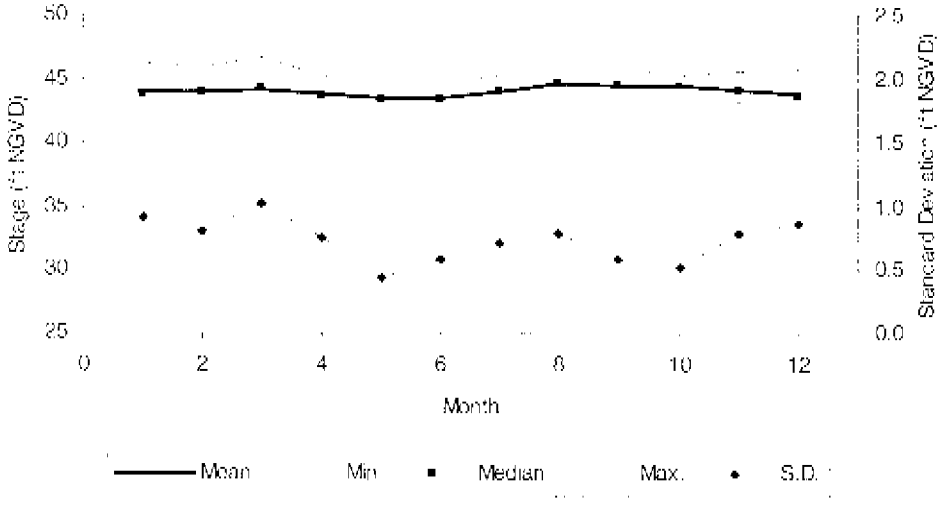

Figure 21. Statistics for daily stage over each month at station C38.MRSH.

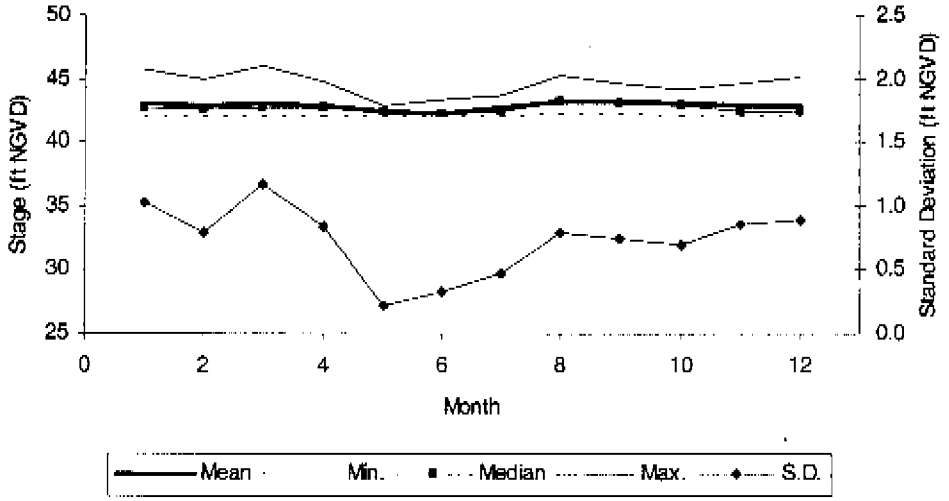

Figure 22. Statistics for daily stage over each month at station C38.PINE.

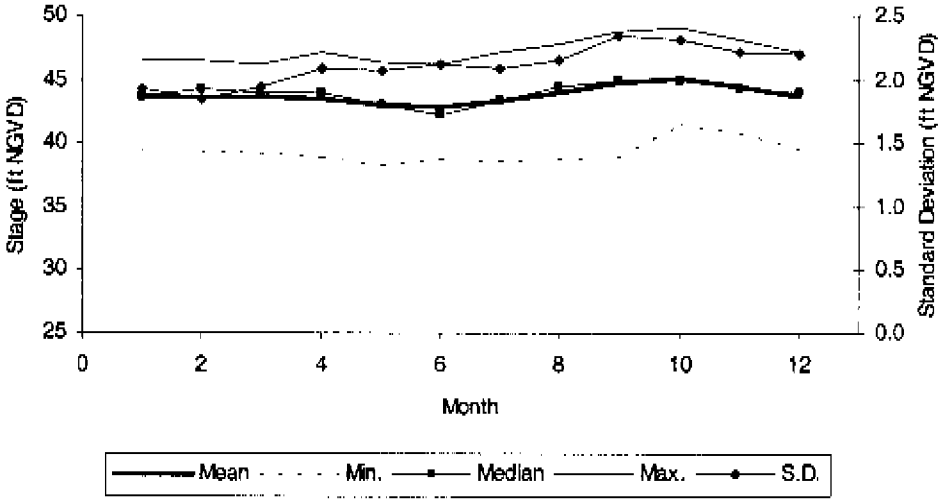

Figure 23. Statistics for daily stage over each month at station FTKISS for years 1941 - 1967.

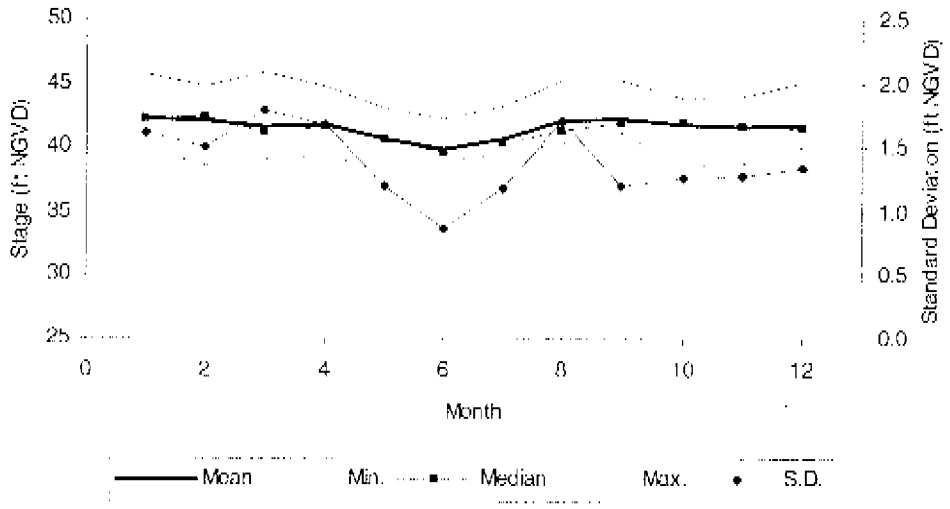

Figure 24. Statistics for daily stage over each month at station FTKISS for years 1984 - 1997.

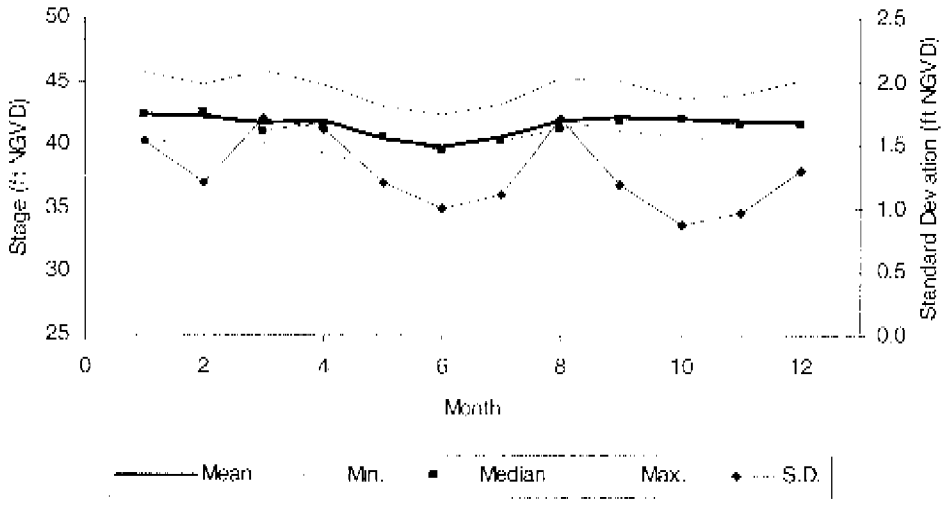

Figure 25. Statistics for daily headwater stage over each month at station WEIR3_H.

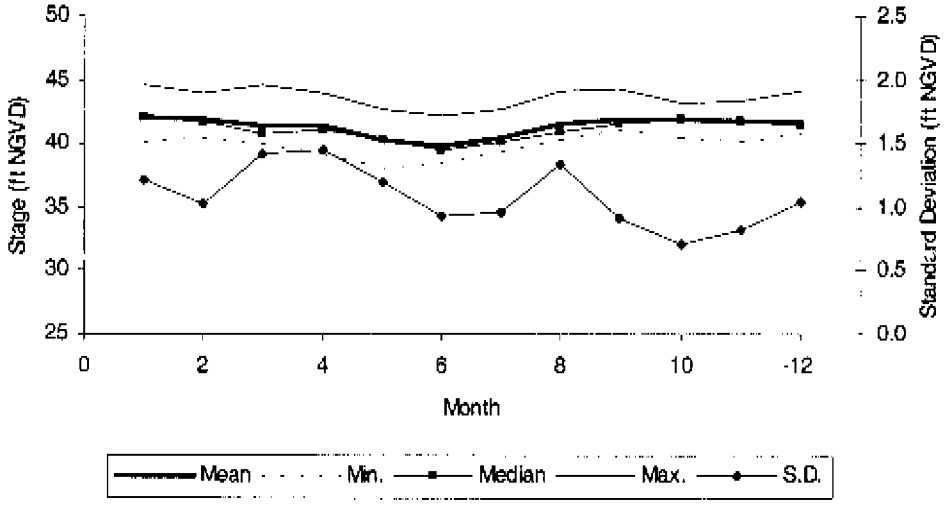

Figure 26. Statistics for daily tailwater stage over each month at station WEIR3_T.

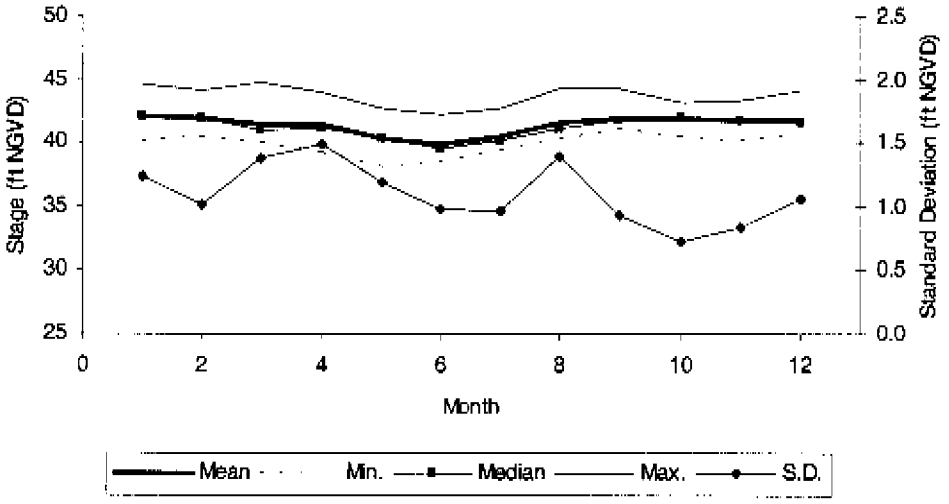

Figure 27. Statistics for daily headwater stage over each month at station WEIR2_H.

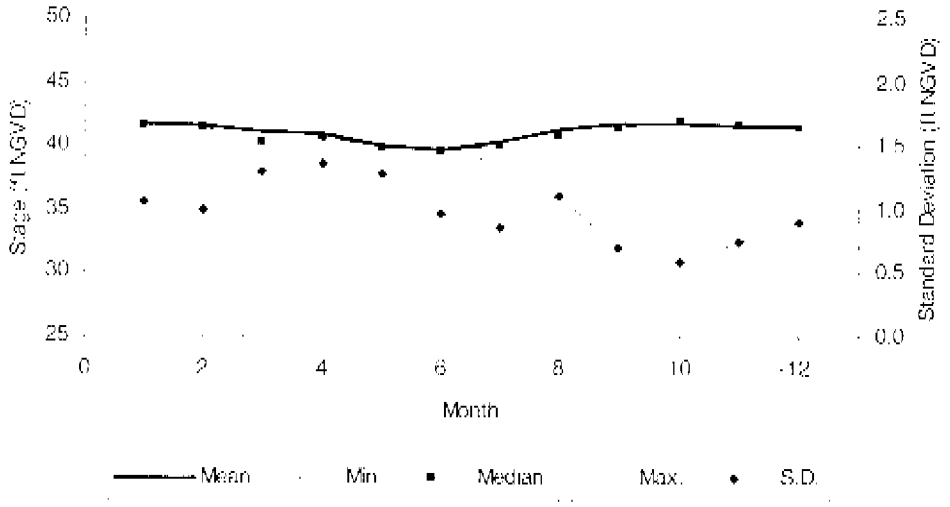

Figure 28. Statistics for daily tailwater stage over each month at station WEIR2_T.

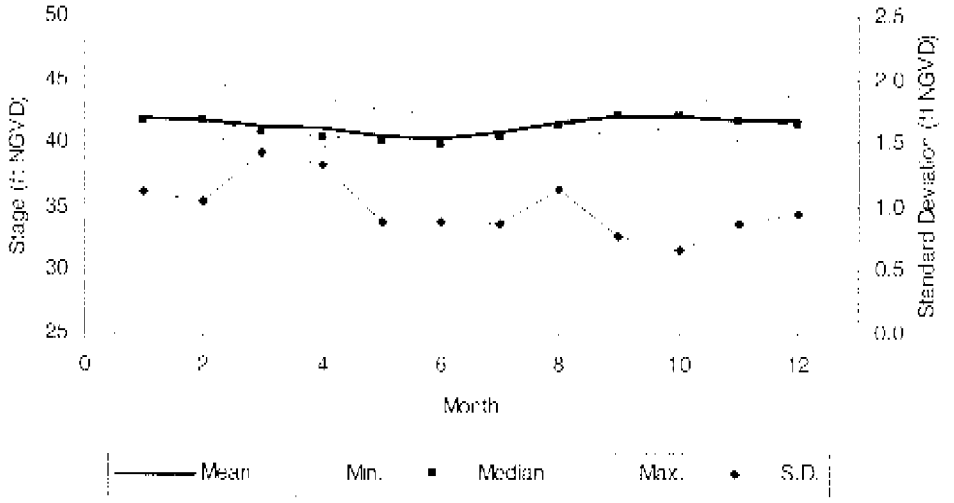

Figure 29. Statistics for daily stage over each month at station AVON P3.

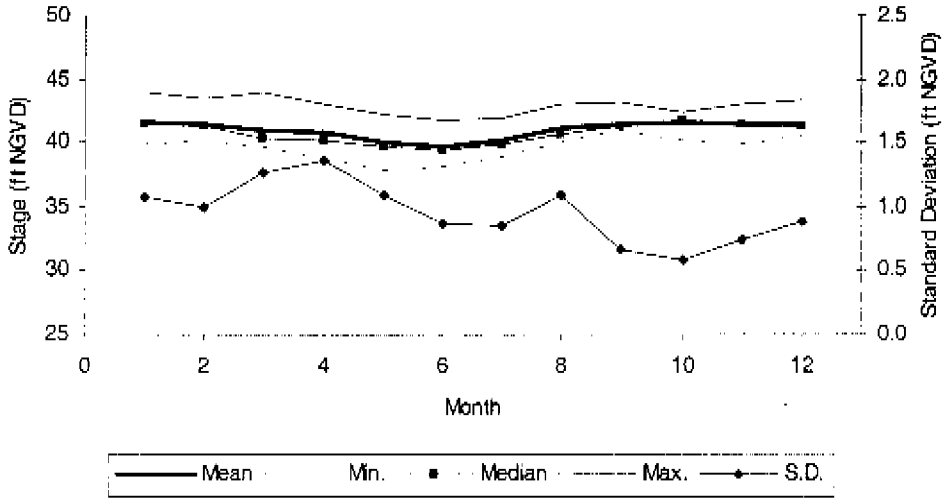

Figure 30. Statistics for daily headwater stage over each month at station WEIR1_H.

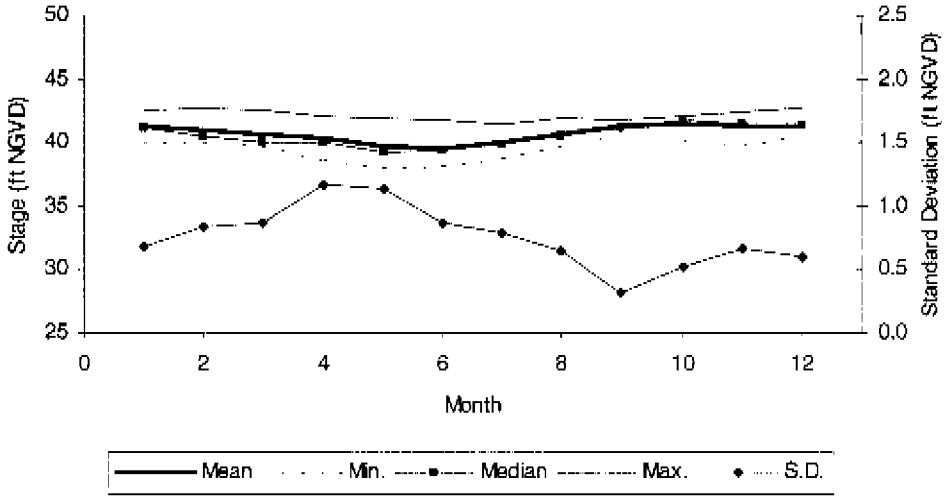

Figure 31. Statistics for daily tailwater stage over each month at station WEIR1_T.

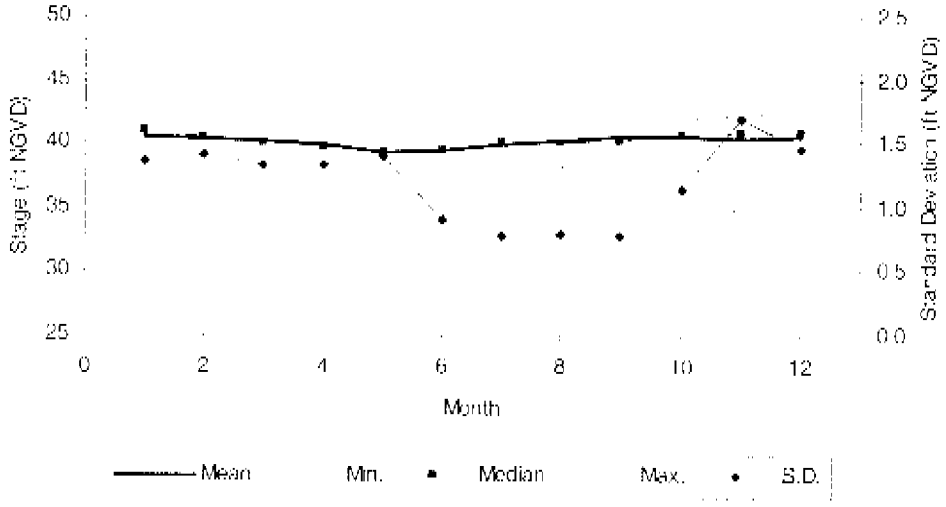

Figure 32. Statistics for daily headwater stage over each month at station S65B_H.

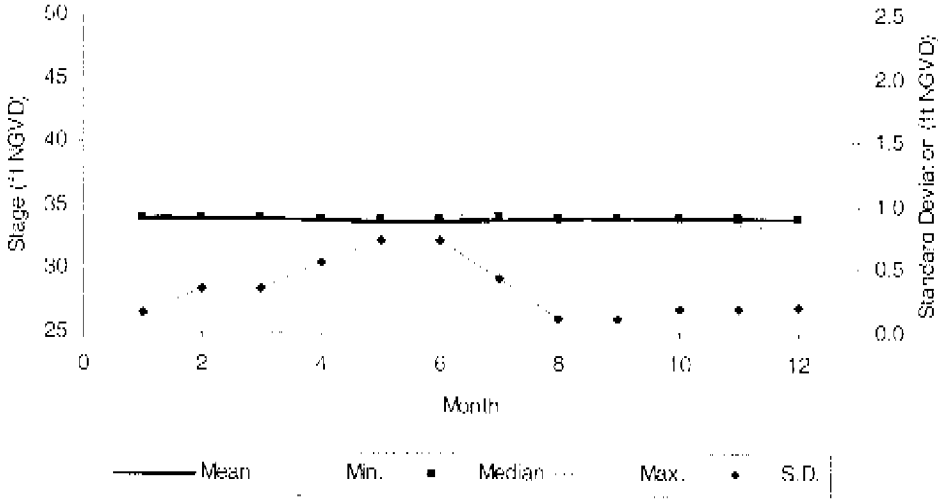

Figure 33. Statistics for daily tailwater stage over each month at station S65B_T.

Stage data were checked for consistency with upstream stations. Missing data gaps were estimated by assuming a linear arithmetic increase or decrease between the respective data entries that contained valid data. For stations with temporal overlap (stations with multiple database keys), the most recent valid data was assumed to represent stage for that day. Also, as was the case for the S65A sub-basin, S 65B tailwater is a valid measure for water levels downstream, as are the respective structures (Weir 3, Weir 2, and Weir 1), indicating that S 65B headwater measurements are valid measurements for water levels in Pool B. Figures 34 - 38 show the resultant water levels associated with Pool B. The higher stage at AVON P3 versus Weir 1_H (Figure 37) shows the addition of flow to C 38 at this point along the canal.

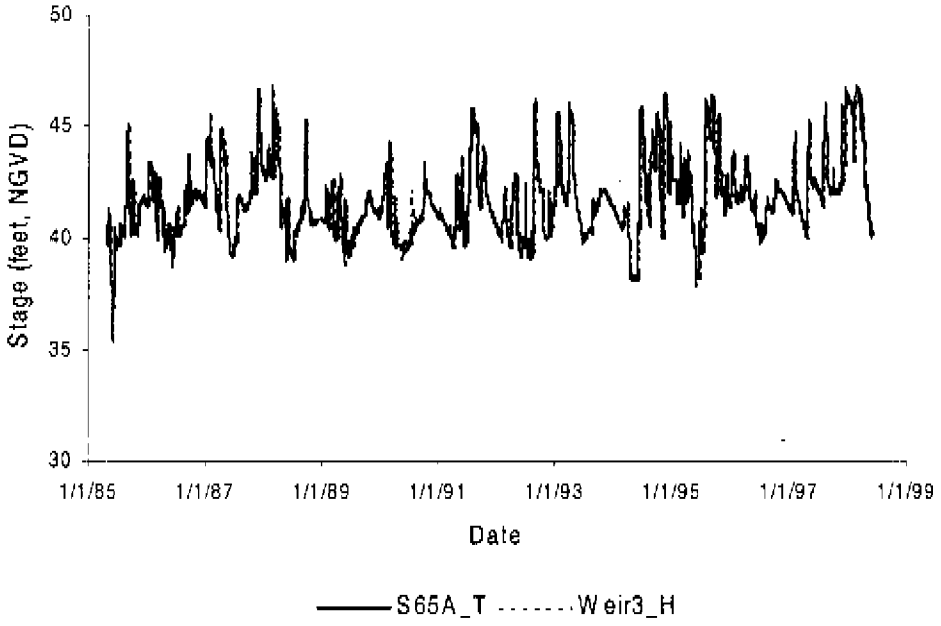

Figure 34. S65A_T (tailwater) and Weir3_H (headwater) daily stage along C-38 in S65B sub-basin.

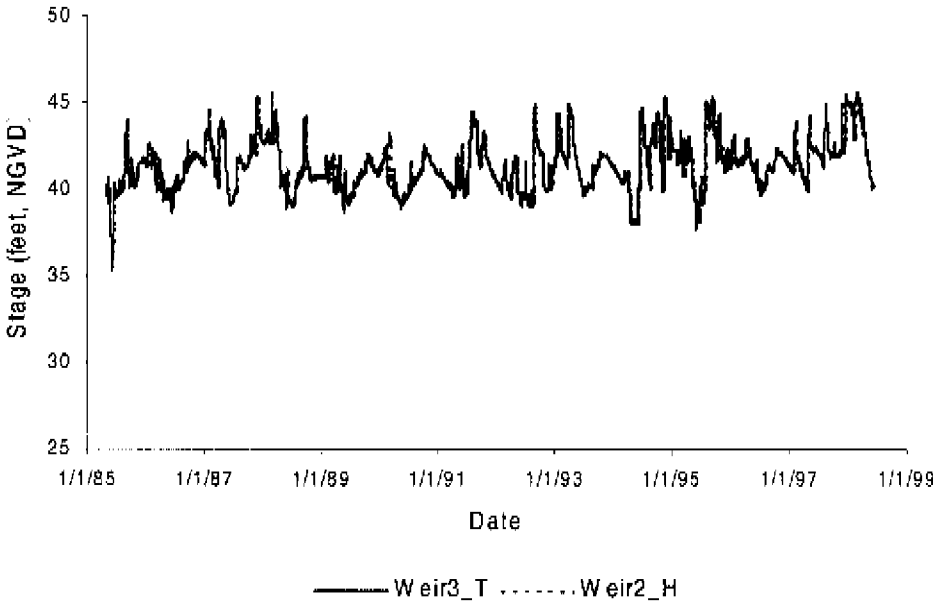

Figure 35. Weir3_T (tailwater) and Weir2_H (headwater) daily stage along C-38 in S65B sub-basin.

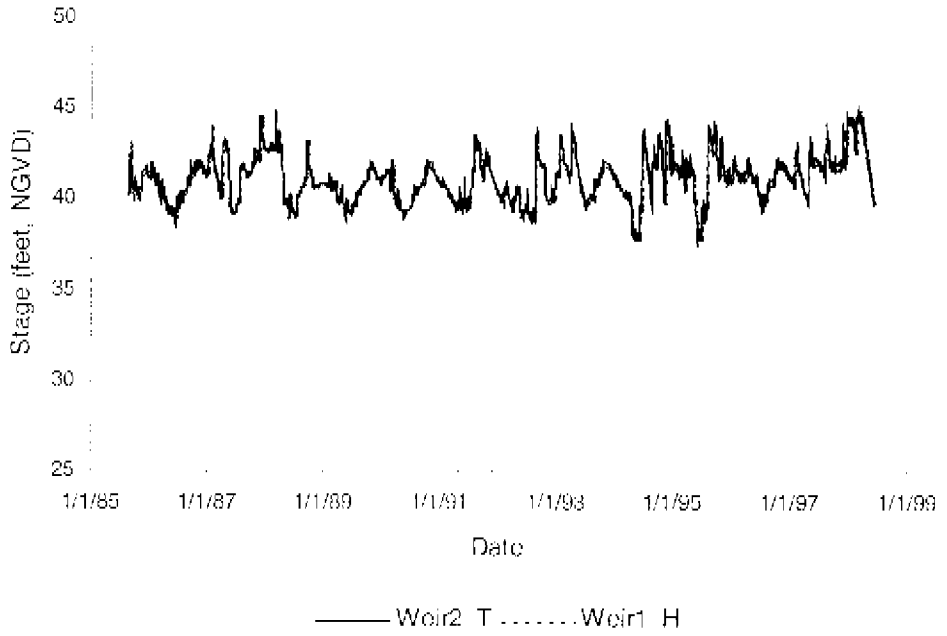

Figure 36. Weir2_T (tailwater) and Weir1_H (headwater) daily stage along C-38 in S65B sub-basin.

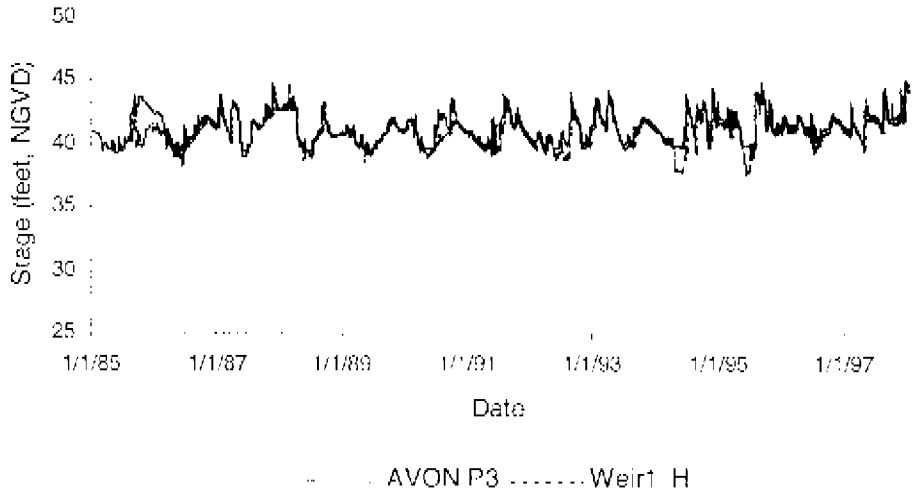

Figure 37. AVON P3 and Weir1_H (headwater) daily stage along C-38 in S65B sub basin.

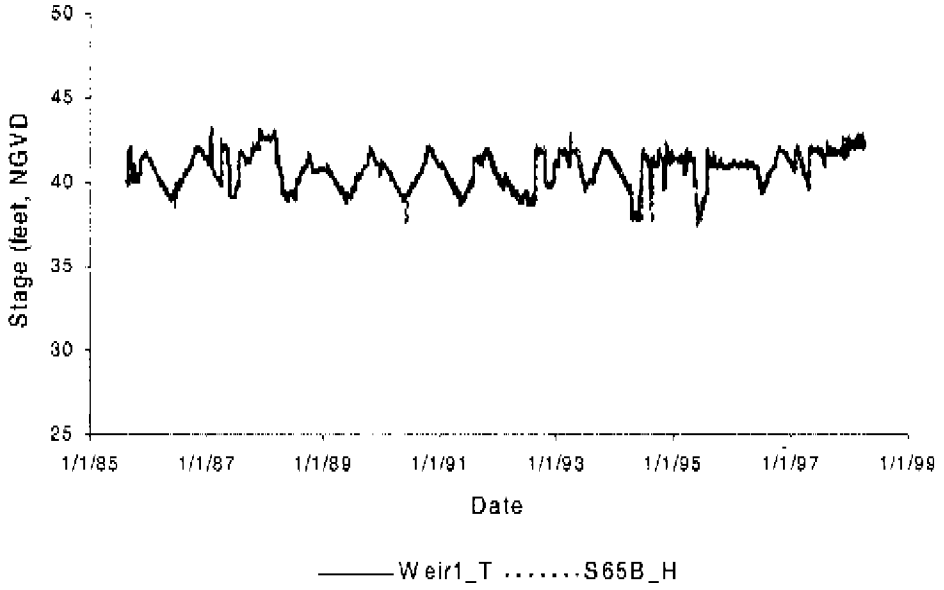

Figure 38. Weir1_T (tailwater) and S65B_H (headwater) daily stage along C-38 in S65B sub-basin.

Flow

The design discharge for the S65B sub-basin control structure is 14,000 cfs (30% SPF). The maximum discharge for this structure is rated at 16,700 cfs (100% SPF). The maximum flow rate for the period of record reported here was 16,809 cfs and occurred on 4 October 1969. A minimum flow of 0 cfs occurred through the structure for twenty percent of the period of record for this station.

The spillway structure was designed to maintain optimum upstream water control stages in C-38. The structure passes the design flood (30% SPF) without exceeding upstream flood stage and restricts downstream flood stages and channel velocities to non-damaging levels (Abtew, 1992). The lock operation was established by the U.S. Corp of Engineers in accordance with the River and Harbor Act of 1917 (8 August 1917) and is currently set as: Monday through Friday, 8:00 a.m. to 5:00 p.m., all year; for Saturday and Sunday, 1 March through 31 October, 5:30 a.m. to 7:30 p.m.; for Saturday and Sunday, 1 November through 28 February, 5:30 a.m. to 6:30 p.m.

The source database keys and period of record for data collection at flow collection stations for sub-basin S65B are shown in Table 9. Although station PEAVF2_F shows dates for flow measurements, no flow data existed for this database key. Locations of the stations that monitored flow were shown in Figure 20. Missing data gaps for flow data were estimated by assuming a linear arithmetic increase or decrease between the respective data entries that contained valid data. For stations with multiple database keys

and temporal overlap, the most recent valid data was assumed to be representative for that day. Statistics for average daily flow over each month for all flow stations, excluding SBX1_C and SBX2_C, are shown in Figures 39 - 42. Daily historical flow for all stations are shown in Appendix B. Tables with average daily flows over each year and yearly flow summations for S65B_S, Weir3_W through Weir1_W are presented in the section discussing runoff. Average daily flow over each month and year, and monthly and yearly flow summations for S65B_S, Weir3_W through Weir1_W are given in Appendix B.

Table 9. Flow monitoring stations in S65B sub-basin.

Station	Dbkey	Method†	Start	End	Latitude	Longitude
PEAVF2_F	07005	Mean	Jul/1979	Sep/1982	274216	810641
S65B_S	04436	Mean	Nov/1967	Jan/1994	273009	811145
S65B_S	06841	Mean	Mar/1986	Mar/1998	273009	811145
S65BX1_C	04446	Mean	Feb/1984	Jul/1992	273005	811202
S65BX1_C	15334	Mean	Oct/1990	Jul/1992	273005	811202
S65BX2_C	04452	Mean	Feb/1984	Jul/1992	272957	811219
S65BX2_C	15335	Mean	Oct/1990	Jul/1992	272957	811219
WEIR3_W	05600	Mean	Apr/1985	Dec/1995	273439	810938
WEIR3_W	16744	Mean	Dec/1995	Jun/1998	273439	810938
WEIR2_W	05606	Mean	Apr/1985	Dec/1995	273352	811033
WEIR2_W	16743	Mean	Dec/1995	Mar/1998	273352	811033
WEIR1_W	05612	Mean	Aug/1985	Dec/1995	273214	811209
WEIR1_W	16742	Mean	Dec/1995	May/1998	273214	811209

† Indicates method of reporting data were daily mean.

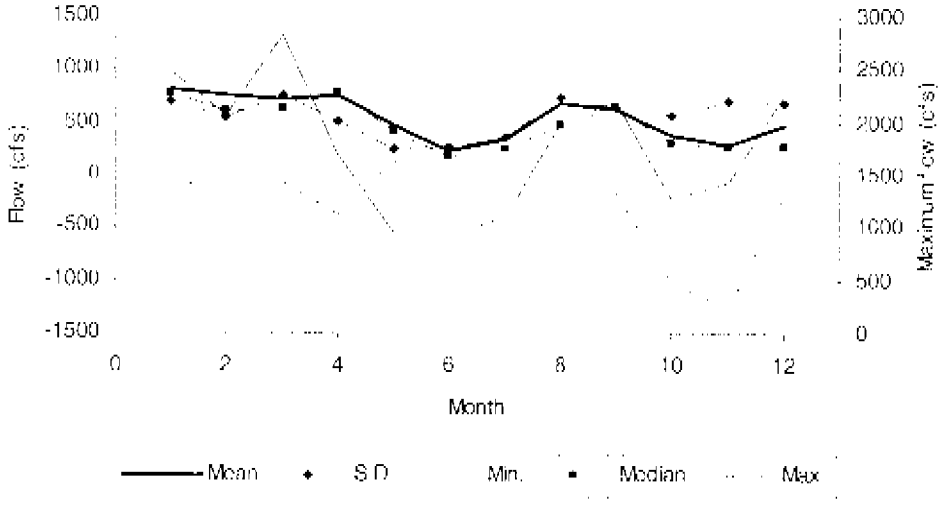

Figure 39. Statistics for daily flow over each month at station WEIR3_W.

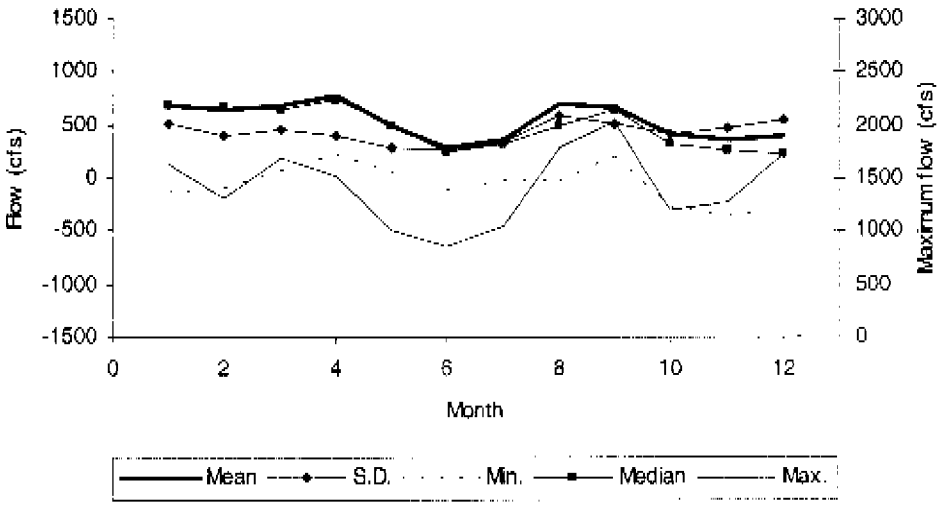

Figure 40. Statistics for daily flow over each month at station WEIR2_W.

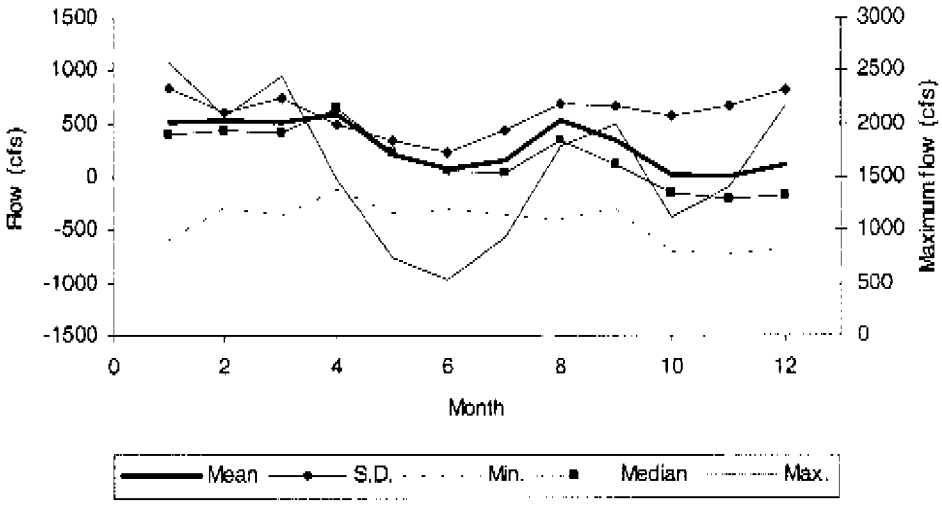

Figure 41. Statistics for daily flow over each month at station WEIR1_W.

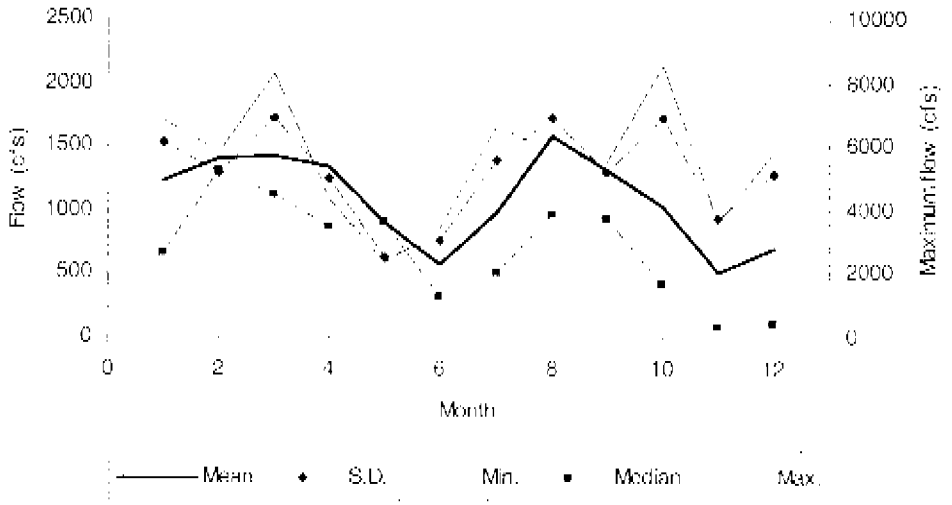

Figure 12. Statistics for daily flow over each month at station S65B_S.

Preferred database keys have been established for the flow stations and are listed in Table 10. Also shown in this table are source database keys from DBHYDRO and period of record for the data assigned to the preferred database key. Preferred database keys were assigned if flow stations had multiple database keys assigned in DBHYDRO and/or estimations were made for missing data gaps.

Table 10. Preferred database key assignments for flow stations in S65B sub-basin.

Station	Dbkey	Period of record	Preferred Database key
S65B_S	04436/06841	11/27/67-03/31/98	HG238
S65BX1_C	04446/15334	09/14/84-07/09/92	HG239
S65BX2_C	04452/15335	09/14/84 07/04/92	HG240
WEIR1_W	05600/16744	08/15/85 05/31/98	HG241
WEIR2_W	05606/16743	04/26/85-05/31/98	HG242
WEIR3_W	05612/16742	04/26/85 06/30/98	HG243

S65A AND S65B SUB-BASIN RUNOFF

Flow data have been presented with respect to the S65A and S65B sub-basins. Runoff within these sub-basins contribute to the total flow through the S-65A and S-65B structures along the C-38 canal. Historical flows through the S-65 structure at the southern edge of Lake Kissimmee were presented by Ali (1998). Daily averages over each month and year, and monthly and yearly flow summations for the S65 flow control structure for the years 1969 – 1998 are given in tabular format in Appendix C.

Runoff estimates are obtained by subtracting average daily flow measured at the upstream control structure from average daily flow measured at the downstream control structure. The data are then adjusted to obtain runoff in inches/day. Monthly and yearly statistical results for runoff within the S65A and S65B sub-basins are presented in tabular format in Appendix C. Negative flows exist for these data (monthly and yearly). The temporal results for the period of record analyzed (June 1969 – May 1998) showed that runoff within the S65A sub-basin was negative for 31% of the events recorded (S-65A flow subtracted by S-65 flow). The S65B sub-basin showed that 42% of the total runoff events were negative (S65-B flow subtracted by S65-A flow).

Temporal results for rainfall and runoff data for the S65A sub-basin are presented in Figure 43. Monthly and yearly summations for this sub-basin are presented in Figures 44 and 45. All three figures show that negative runoff can exist for the sub-basin on a daily, monthly, and yearly basis. Negative runoff implies flow losses along the canal between the S-65 and S-65A structures. These losses may be due to evaporation, seepage, diversions within oxbows that are not returned to the canal, a combination of these physical effects, or other unaccounted for losses along the canal (Pool A).

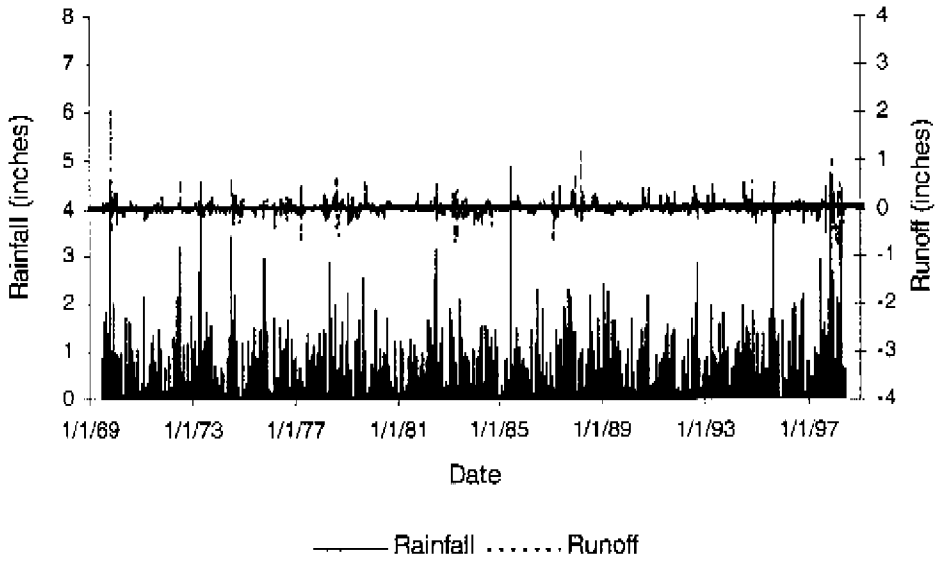

Figure 43. Temporal results for rainfall and runoff in S65A sub-basin.

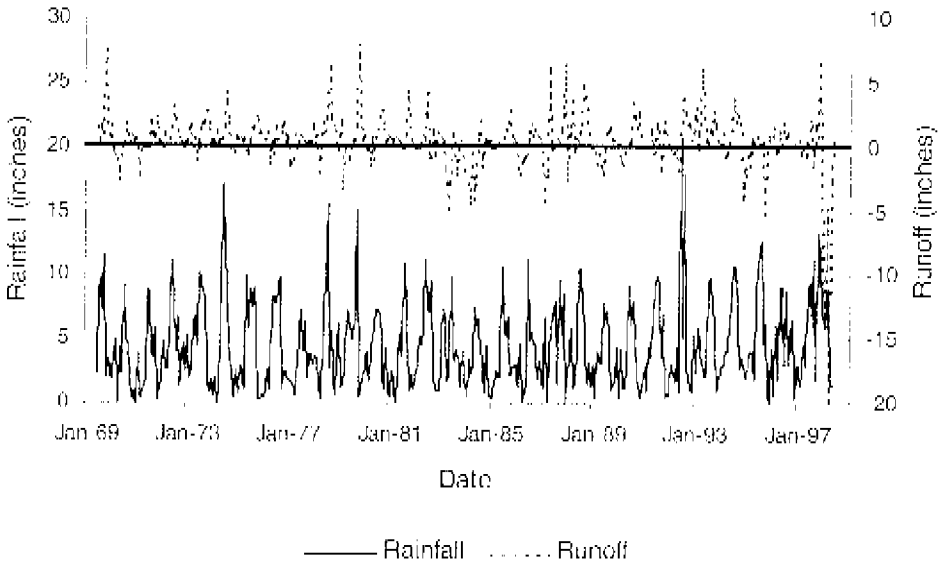

Figure 44. Monthly summations for rainfall and runoff in S65A sub-basin.

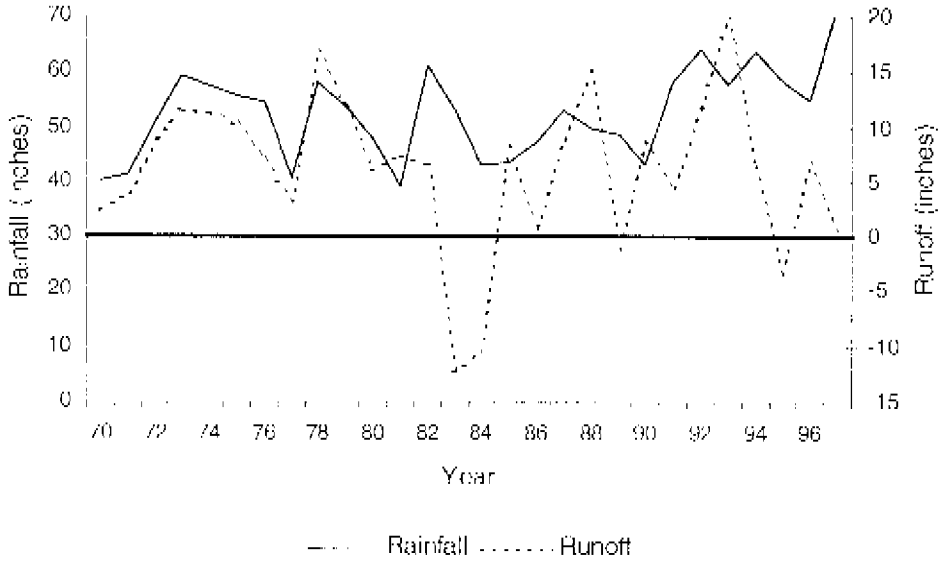

Figure 45. Yearly summations for rainfall and runoff in S65A sub-basin.

An assessment of the effect of rainfall with respect to runoff is shown in Figure 46. The result shows a double mass curve, rainfall versus runoff, for the period of overlapping records for the two parameters. The resulting plot gives actual data

(observed as points), regression line, and 90% confidence intervals (CI). The equation describing runoff is:

$$RO = 0.121R + 5.99 \quad (2)$$

where

RO = runoff, inches, and

R = rainfall, inches

The data used to produce this curve were based on yearly cumulative results for rainfall and runoff (1970 – 1997). The regression line had a rsquared value of 0.95. Clearly, this curve does not produce meaningful data for runoff until the cumulative effect of rainfall is observed after one year.

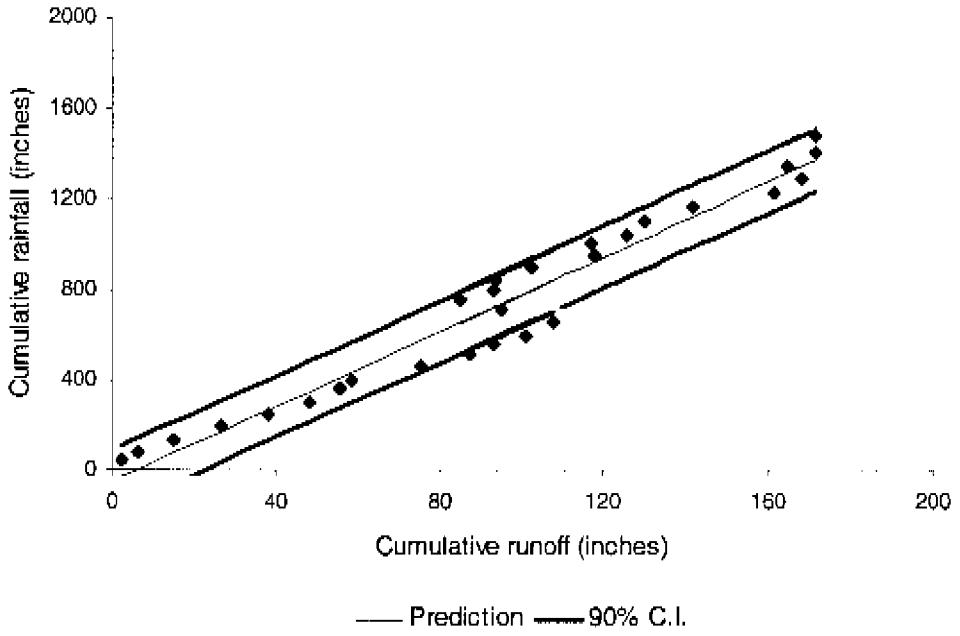

Figure 46. Double mass curve for cumulative rainfall and cumulative runoff in S65A sub-basin.

Temporal results for rainfall and runoff data for the S65B sub-basin are presented in Figure 47. Monthly and yearly summations for this sub-basin are presented in Figures 48 and 49. All three figures show that negative runoff can exist for the sub-basin on a daily, monthly, and yearly basis. Negative runoff implies flow losses along the canal between the S-65A and S-65B structures. These losses may be due to evaporation, seepage, diversions within oxbows that are not returned to the canal, a combination of these physical effects, or other unaccounted for losses along the canal (Pool B).

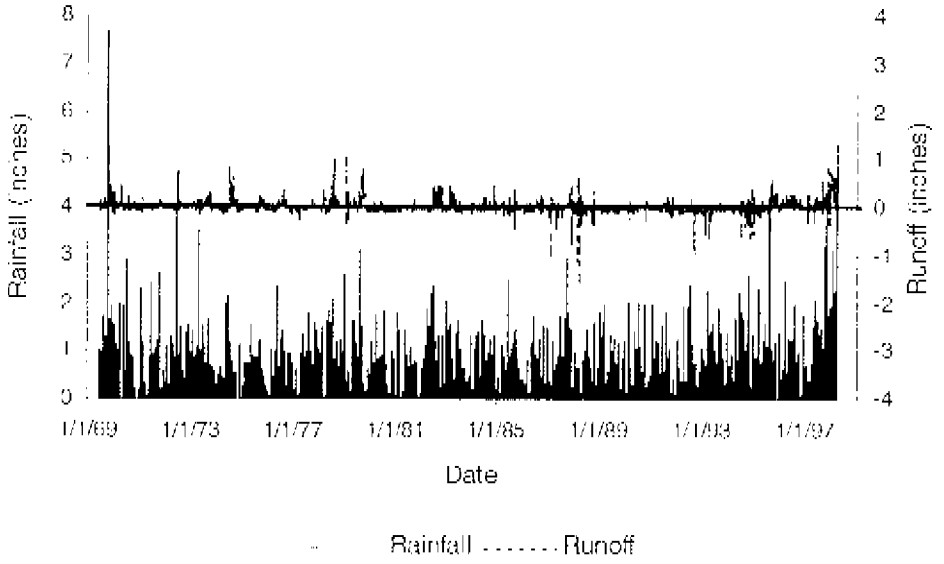

Figure 47. Temporal results for rainfall and runoff in S65B sub-basin.

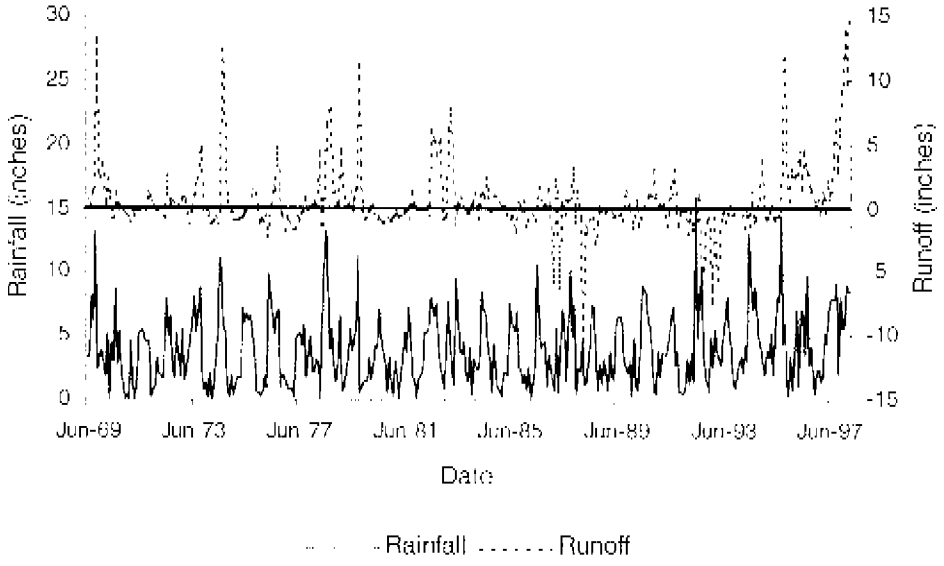

Figure 48. Monthly summations for rainfall and runoff in S65B sub basin.

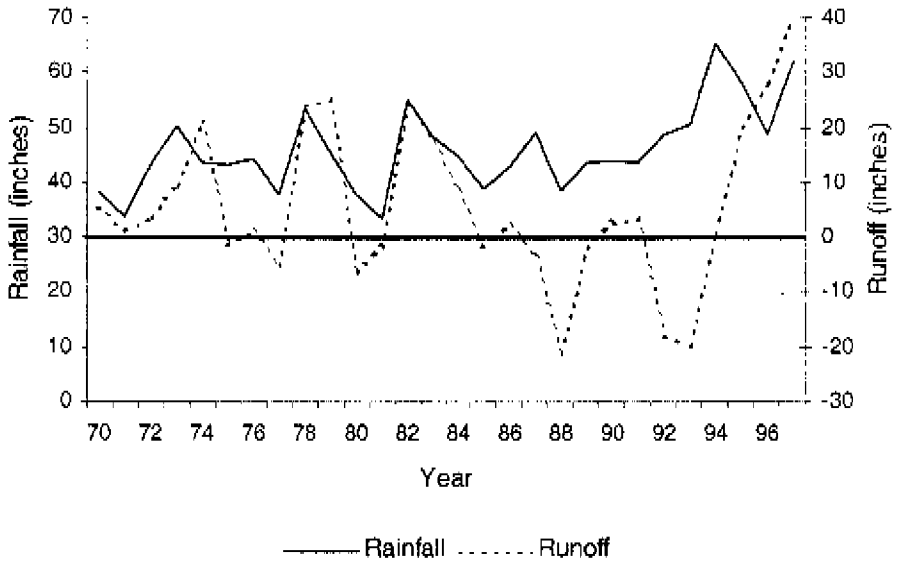

Figure 49. Yearly summations for rainfall and runoff in S65B sub-basin.

An assessment of the effect of rainfall with respect to runoff is shown in Figure 50. The result shows a double mass curve, rainfall versus runoff, for the period of overlapping records for the two parameters. The resulting plot gives actual data (observed as points), regression line, and 90% confidence intervals (CI). The equation describing runoff is:

$$RO = 0.145R - 13.66 \quad (3)$$

where

RO = runoff, inches, and

R = rainfall, inches

The data used to produce this curve were based on yearly cumulative results for rainfall and runoff (1970 – 1997). The regression line had a rsquared value of 0.58. Again, as with the effects within the S65A sub-basin, this curve does not produce meaningful data for runoff until the cumulative effect of rainfall is observed after one year. Also of note, is the higher variability, or lack of prediction ability for runoff based on rainfall measurements (low rsquared value) within the S65B sub-basin.

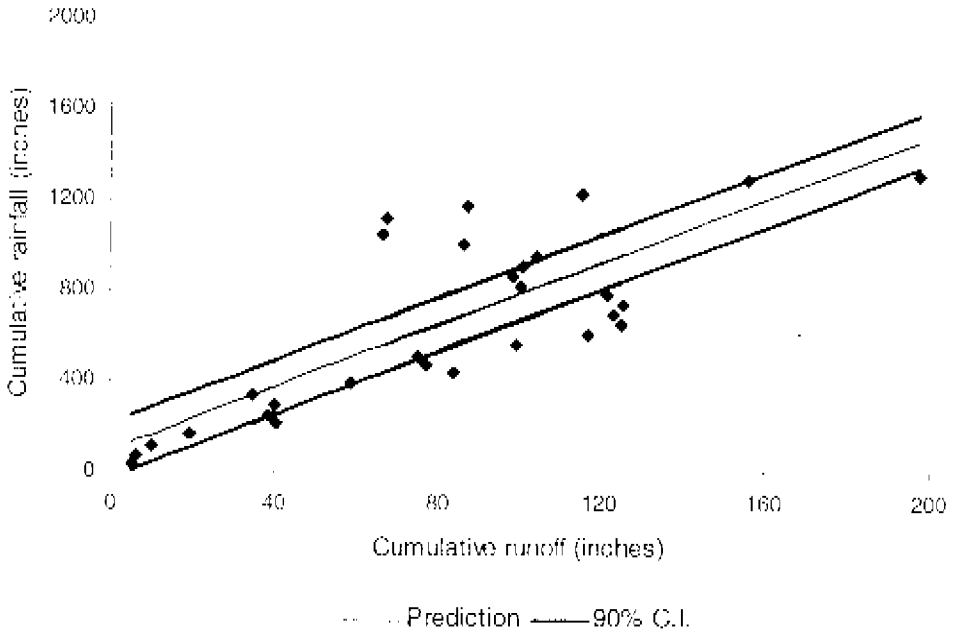

Figure 50. Double mass curve for cumulative rainfall and cumulative runoff in S65B sub-basin.

An overview of the resulting average daily flows and yearly flow summations through the control structures S-65, S 65A, and S-65B, calculated runoff flows for S65A and S65B sub-basins, and flows through Weir3, Weir2, and Weir1, for the years 1969 -- 1998 are given in Tables 11 and 12. The results, in general, show consistency with respect to upstream and downstream structures. Over the period of record analyzed, 31% of the daily runoff events within the S65A sub-basin were negative, while 42% of the daily runoff events were negative within the S65B sub-basin. Also, several years show upstream average daily flows were greater than downstream average daily flows. The same effect is seen with several yearly total flow summations. This implies flow losses along the C 38 canal between the S-65 and S 65B structures. Again, these losses may be due to evaporation, seepage, diversions within oxbows that are not returned to the canal, a combination of these physical effects, or other unaccounted for losses along the canal (Pool A and Pool B).

Table 11. Average daily flows (cfs) over period of record for S-65, RO-A, S-65A, RO-B, S-65B, Weir3, Weir2, and Weir1.

Year	S-65[⊥]	RO-A[†]	S-65A	RO-B[†]	S-65B	Weir3	Weir2	Weir1
1969[‡]	1565	322	2027	474	2145			
1970	922	31	953	63	1016			
1971	259	45	304	12	316			
1972	175	105	280	41	321			
1973	791	138	929	111	1040			
1974	1138	135	1273	250	1523			
1975	561	121	682	-19	663			
1976	882	87	969	10	979			
1977	480	38	518	-62	456			
1978	761	199	960	286	1246			
1979	924	142	1066	296	1362			
1980	651	68	719	-77	642			
1981	11	89	100	-25	75			
1982	1153	77	1230	288	1518			
1983	1693	-145	1548	204	1752			
1984	1121	-123	998	106	1104			
1985	275	97	372	-23	349	166	448	-276
1986	755	9	764	27	791	232	490	-168
1987	1288	103	1391	-44	1347	659	676	558
1988	1004	181	1185	-253	932	526	400	391
1989	520	-11	509	-25	484	306	330	159
1990	485	102	587	31	618	180	441	111

[‡]partial year data; [⊥]period of record used for this station corresponded to that for S-65A.
[†]RO-A indicates runoff for S65A sub-basin, RO-B indicates runoff for S65B sub-basin.

Table 11. continued.

Year	S-65⁻	RO-A†	S-65A	RO-B†	S-65B	Weir3	Weir2	Weir1
1991	1055	53	1108	40	1148	511	619	270
1992	835	141	976	-212	764	460	520	250
1993	938	238	1176	-233	943	494	242	161
1994	1751	77	1828	7	1835	795	691	559
1995	2016	-40	1976	234	2210	928	837	716
1996	786	79	865	333	1198	515	449	90
1997	1287	4	1291	483	1774	744	590	244
1998‡	4820	-1179	2392	1997	7033	1513	1093	1415

‡partial year data; ⁻period of record used for this station corresponded to that for S-65A.
†RO-A indicates runoff for S65A sub-basin, RO-B indicates runoff for S65B sub-basin.

Statistic‡	S-65⁻	RO-A†	S-65A	RO-B†	S-65B	Weir3	Weir2	Weir1
Average	951	60	1008	90	1084	547	538	299
Standard Deviation	1509	482	1409	543	1608	706	558	751
Minimum	0	-4639	0	-6812	0	-2239	-474	-752
Median	153	43	324	0	376	340	346	111
Maximum	11600	8835	13114	5769	16809	3658	3160	3939

‡statistic applies to daily data over the period of record; ⁻period of record used for this station corresponded to that for S-65A.
†RO-A indicates runoff for S65A sub-basin, RO-B indicates runoff for S65B sub-basin.

Table 12. Yearly flow summations (ac-ft) over period of record for S-65, RO-A, S-65A, RO-B, S-65B, Weir3, Weir2, and Weir1.

Year	S-65[⊥]	RO-A	S-65A	RO-B	S-65B	Weir3	Weir2	Weir1
1969[‡]	703411	129066	812243	189930	1552779			
1970	667176	22721	689897	45708	735605			
1971	187175	33063	220238	8591	228828			
1972	127327	75185	202511	30421	232932			
1973	572880	99877	672758	80306	753064			
1974	823819	98165	921984	180889	1102874			
1975	406493	87353	493846	-14119	479727			
1976	640561	60901	701463	9568	711031			
1977	347353	27456	374808	-44553	330255			
1978	550848	144494	695342	206774	902116			
1979	668789	102777	771566	212750	984316			
1980	472452	51946	524398	-58355	466043			
1981	7942	64662	72604	-18151	54453			
1982	834409	55980	890389	208759	1099149			
1983	1225795	-105320	1120475	147658	1268133			
1984	817630	-89652	727978	72876	800854			
1985	198917	70125	269042	-16527	252515	86427	222245	-75984
1986	546736	6663	553398	18992	572390	172033	355064	-121561
1987	932632	74457	1007088	-31736	975352	480775	489308	403851
1988	728532	130606	859137	-182536	676602	385727	290694	283886
1989	376268	-7958	368310	-17209	351101	225570	238762	114914
1990	350782	74254	425036	22142	447178	134212	319258	80040

[‡]partial year results; [⊥]period of record used for this station corresponded to that for S65-A.

Table 12. continued.

Year	S-65	RO-A	S-65A	RO-B	S-65B	Weir3	Weir2	Weir1
1991	763491	38887	802377	28626	831003	374037	448273	195696
1992	606433	100373	706806	-152081	554725	338163	377367	181472
1993	678996	172753	851749	-168911	682838	361501	175173	116257
1994	1268008	55350	1323357	5439	1328796	579307	500094	404364
1995	1459747	-29342	1430405	169329	1599734	675874	606052	518580
1996	570453	58416	628869	240650	869519	377825	326095	65126
1997	931682	2999	934681	349951	1284632	542505	427329	176373
1998‡	1443698	-353093	1090606	356429	1255512	547275	277162	423779

‡partial year results; ¹period of record used for this station corresponded to that for S-65A.

Statistic	S-65	RO-A	S-65A	RO-B	S-65B	Weir3	Weir2	Weir1
Average	634405	52757	687162	47687	734849	387294	379456	201583
Standard Deviation	339891	61925	324499	127745	381802	163169	121157	176577
Minimum	7942	-105320	72604	-182536	54453	134212	175173	-121561
Median	623497	59660	698402	20567	723319	375931	366216	178923
Maximum	1459747	172753	1430405	349951	1599734	675874	606052	518580

SUMMARY

This report summarized rainfall, stage, and flow data for the S65A and S65B sub-basins located in the northern section of the lower Kissimmee River water management basin. Time series results were presented for daily rainfall for each station in the respective sub-basin. Monthly statistics for rainfall at each station were presented in tabular format. Areal rainfall statistics were presented for each sub-basin. Daily average stage data over each month were presented in graphical format as well as daily historical graphs for the period of record at each station within the respective sub-basin. Flow data were presented as time series graphs and daily statistics over each month were presented in graphical format for each station within the respective sub-basin (excluding several stations with less than one year of data). Runoff results were estimated by subtracting flows at upstream and downstream structures. The data were presented as average daily flows over the period of record and total flow summations for each month and year. Double mass curves were presented for rainfall versus runoff within each sub-basin.

Rainfall results from the S65A sub-basin were two percent higher for the calendar years 1963 - 1997 versus previous data analyses reported by Sculley (1986) for the years 1915 – 1985 for the entire lower Kissimmee River water management basin. Wet season values were two percent lower than Sculley's results while dry season results were 10 % higher for this sub-basin. S65B sub-basin rainfall results for the calendar years 1966 – 1997 were eight percent lower than previous data reported by Sculley (1986) for the years 1915 - 1985. Wet season results for this sub-basin were 13% lower than Sculley's results while dry season results were 20% percent lower for this sub-basin.

Stage data for the S65A sub-basin control structure showed that headwater results exceeded the 30% SPF value for 50% of the data over the period of record analyzed. Tailwater results exceeded the 30% SPF value for 14% of the data over the period of record analyzed. The 100% SPF design value was not exceeded for the headwater stage at this structure, while the tailwater stage was exceeded less than one percent (50 incidents) over the period of record analyzed. Stage data for the S65B sub-basin control structure, for both headwater and tailwater results, never exceeded the 100% SPF design value. However, headwater results exceeded the 30% SPF design value for 62% of the data over the period of record analyzed, while tailwater results exceeded the 30% SPF design value three times (less than 0.1%) over the period of record analyzed.

Flow data results for the S65A sub-basin control structure showed that the 30% SPF discharge design value was exceeded one time and this incident occurred on 3 October 1969. The 100% discharge design value was never exceeded for the period analyzed. The 100% SPF and 30% SPF discharge design value for the S65B sub-basin control structure were exceeded one time on 4 October 1969 over the period considered.

Runoff calculations indicated that flow losses occurred along the C-38 canal between the S65 and S-65B control structures. These losses may be due to evaporation, seepage, diversions from oxbows that do not return to the C-38 canal, a combination of these effects, or other unaccounted for losses along the C-38 canal.

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Ali, Alaa. 1998. Lake Kissimmee Basin Hydrologic Data Summary and Preferred Database Key Development. Technical Memorandum. South Florida Water Management District, West Palm Beach, FL.

Sculley, S.P. 1986. Frequency Analysis of SFWMD Rainfall. Technical Publication 86-6. South Florida Water Management District, West Palm Beach, FL.

Van Horn, Stuart. 1996. Hydrometeorologic Monitoring Network Metadata Report. South Florida Water Management District, West Palm Beach, FL.

APPENDIX A: S65A SUB-BASIN DATA

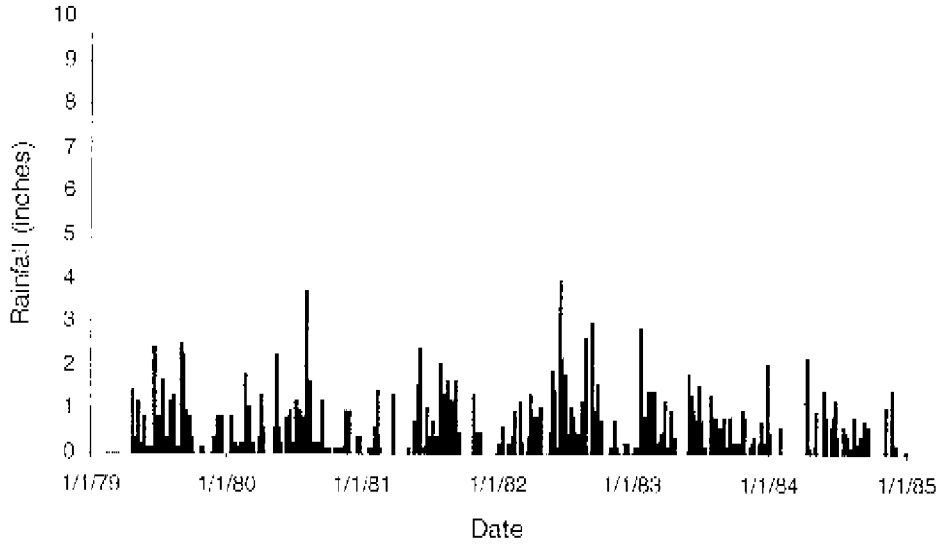

Figure A1. Daily rainfall at station ARMSSO R.

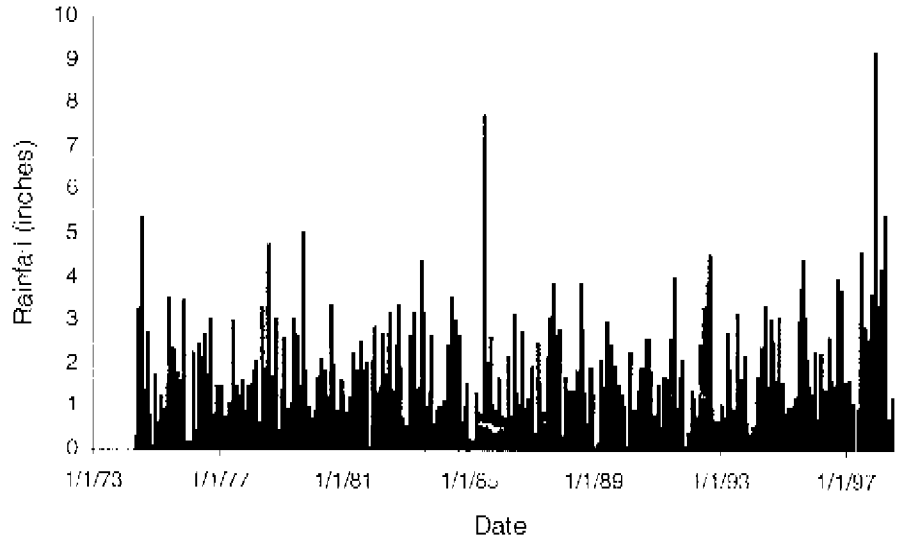

Figure A2. Daily rainfall at station GAC R.

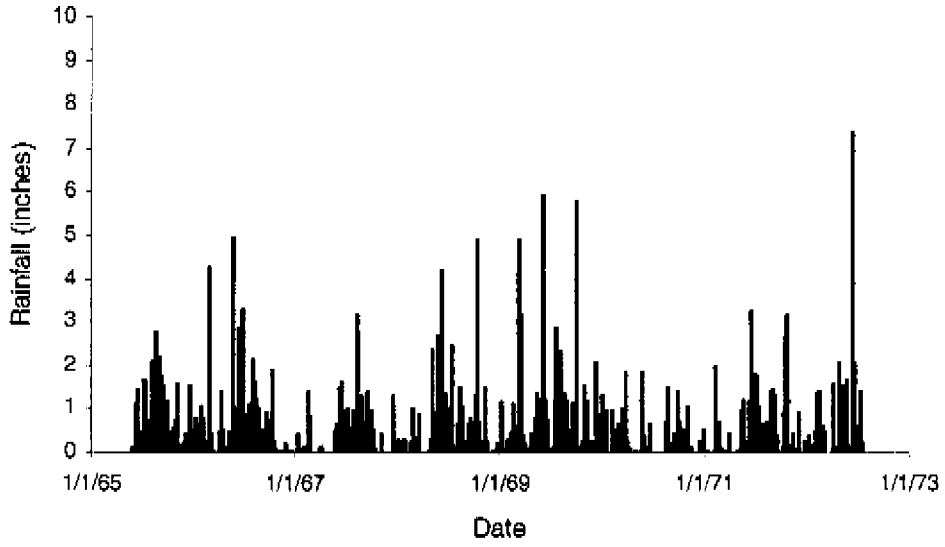

Figure A3. Daily rainfall at station YEEHAW J_R.

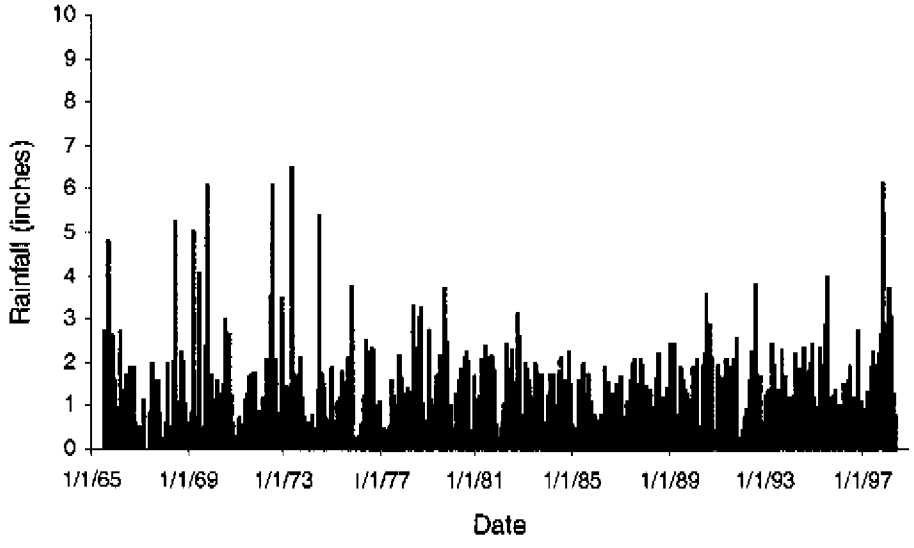

Figure A4. Daily rainfall at station S65A_R.

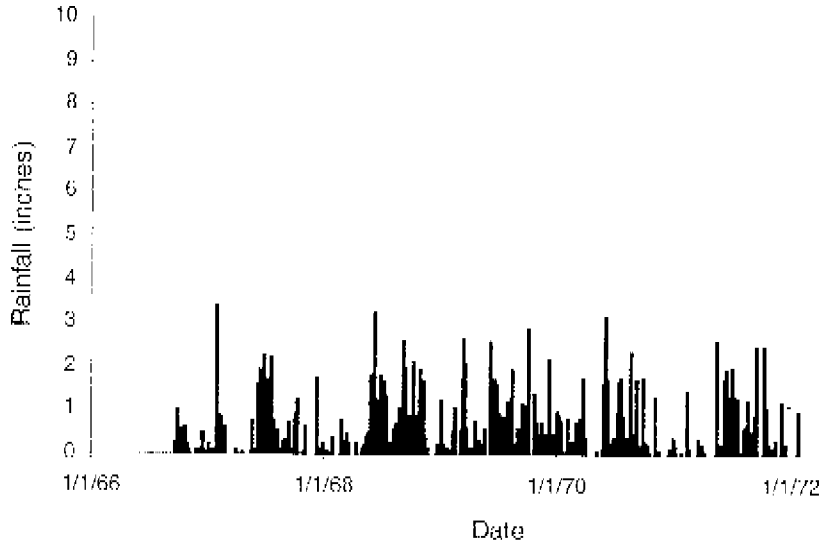

Figure A5. Daily rainfall at station AVON P2_R.

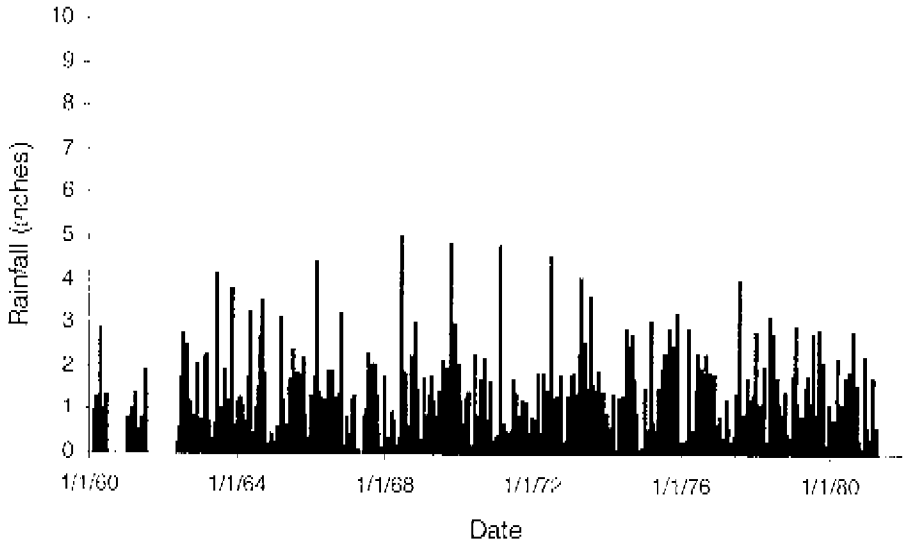

Figure A6. Daily rainfall at station INDIAN 4_R.

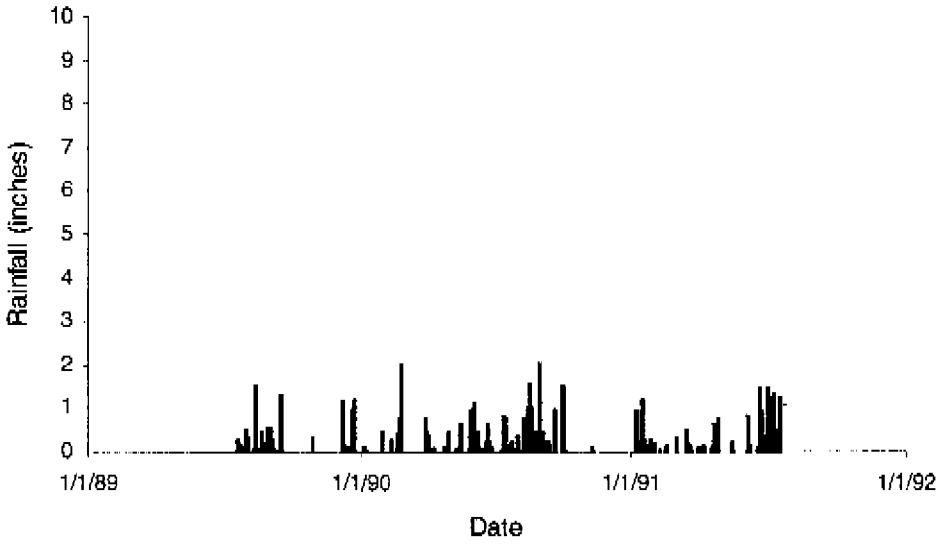

Figure A7. Daily rainfall at station TRIPLE_C_R.

Table A1. Monthly and annual rainfall (inches) in the S65A sub-basin.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1960‡			5.08	4.24	4.26			--	--	--			13.58
1961‡	1.58	1.67	2.40	--	2.00	5.35			--	--	--		13.00
1962‡				--	1.42	11.65	6.89	8.86	5.50	1.10	3.68	1.02	40.12
1963	1.79	6.33	1.38	0.32	13.61	5.31	3.57	5.48	3.72	0.85	5.12	2.61	50.12
1964	3.65	4.59	2.79	2.07	4.31	3.94	7.63	14.68	6.53	0.78	0.84	0.55	52.36
1965	1.02	4.99	3.36	3.18	4.56	10.74	9.83	11.18	6.51	5.78	1.13	2.49	64.77
1966	5.16	6.14	1.12	1.97	5.04	8.70	6.45	6.54	6.61	2.14	0.19	0.67	50.73
1967	2.32	4.67	2.34	1.96	4.52	7.52	6.75	9.18	5.31	1.91	1.89	1.51	49.88
1968	0.54	1.90	0.84	0.51	4.32	9.76	5.13	3.37	3.34	5.94	1.51	0.35	39.29
1969	1.93	1.52	7.68	1.62	2.62	8.46	7.24	9.81	7.33	10.91	2.25	3.39	64.75
1970	2.92	1.95	4.93	0.18	4.42	2.71	9.32	4.98	4.78	2.67	0.41	0.91	40.17
1971	0.10	3.76	0.84	0.40	2.55	8.98	8.42	4.70	3.60	6.01	0.47	1.17	41.00
1972	1.62	4.83	2.65	2.61	6.12	11.11	4.21	7.07	1.33	2.58	4.77	2.48	51.37
1973	2.91	0.82	2.27	3.64	2.73	2.30	5.71	4.75	3.63	1.17	0.78	1.18	31.88
1974	0.38	1.98	0.12	1.47	5.27	16.95	10.70	10.01	5.88	0.61	0.46	2.66	56.67
1975	0.84	3.03	2.12	1.24	9.87	5.93	8.98	7.62	9.10	6.09	0.34	0.64	55.80
1976	0.49	0.97	2.73	1.28	8.39	8.31	7.82	8.63	9.83	1.23	2.37	2.53	54.58
1977	1.88	1.52	0.89	0.67	3.67	4.54	7.37	4.00	6.38	2.15	3.63	3.97	40.66
1978	2.99	3.75	3.44	0.35	7.25	9.37	15.35	3.15	5.69	3.00	0.54	3.28	58.16
1979	6.24	1.27	1.58	3.41	7.30	4.96	5.37	6.29	14.91	0.49	1.12	1.67	53.60
1980	2.67	4.12	1.77	3.57	5.18	5.68	7.34	6.83	3.59	1.11	4.35	1.43	47.62
1981	0.40	2.59	1.94	0.04	2.34	5.52	3.76	10.80	7.42	1.08	2.23	1.07	39.18
1982	0.94	1.81	2.96	2.92	2.90	7.22	4.61	4.94	6.23	2.18	0.78	0.52	37.92
1983	4.23	7.43	6.20	1.71	2.21	9.87	5.18	3.28	4.31	3.49	1.24	4.16	53.31
1984	0.52	3.45	2.39	2.80	7.47	6.13	6.65	4.11	3.25	0.80	4.54	0.70	42.81
1985	0.65	0.45	2.44	2.07	1.95	10.62	5.79	5.21	6.59	2.20	2.26	2.91	43.11
1986	3.88	1.30	4.74	0.20	2.19	11.30	4.79	5.37	4.61	4.45	1.86	3.19	46.85
1987	2.22	1.33	6.75	0.16	3.90	5.42	7.79	1.56	9.61	5.38	8.48	0.25	52.84
1988	2.61	2.98	5.91	1.18	1.69	4.40	10.56	10.51	3.95	1.51	3.13	1.18	49.58
1989	3.04	0.62	4.12	3.41	3.14	7.56	7.01	7.30	5.36	1.25	2.00	4.47	49.27
1990	0.62	4.27	1.46	1.17	2.99	9.26	6.10	7.97	5.31	2.63	1.03	0.48	43.29
1991	3.07	0.92	4.34	3.64	6.44	8.40	10.42	9.32	3.57	6.99	0.45	0.74	58.29
1992	0.67	3.17	1.65	4.43	1.16	20.65	5.10	17.80	4.74	1.91	1.55	0.87	63.66
1993	5.25	2.29	5.97	4.45	2.06	2.90	8.49	9.87	8.02	6.04	0.86	1.34	57.51
1994	2.38	2.93	2.94	4.06	4.05	9.38	10.73	10.49	7.26	2.73	3.63	2.83	63.39
1995	2.08	3.18	3.99	4.03	2.06	7.41	10.12	13.13	4.89	6.30	1.56	0.21	58.84
1996	4.21	0.67	6.05	1.87	9.03	9.05	2.93	8.70	2.99	6.48	0.46	1.95	54.38
1997	2.98	1.34	1.82	4.56	2.65	7.71	9.41	6.87	11.07	1.81	13.21	7.32	70.74
1998‡	6.00	6.85	8.76	1.55	1.30	--	--	--		--	--		24.46

‡ indicates partial year

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR
Mean	2.32	2.90	3.28	2.11	4.33	7.98	7.32	7.62	5.96	3.16	2.36	1.91	51.10
Standard Deviation	1.62	1.87	2.08	1.43	2.71	3.66	2.58	5.46	2.59	2.44	2.57	1.52	8.99
Minimum	0.10	0.45	0.12	0.04	1.16	2.30	2.93	1.56	1.33	0.49	0.19	0.21	31.88
Median	2.22	2.59	2.69	1.96	3.90	7.7.	7.13	7.19	5.43	2.19	1.55	1.38	51.37
Maximum	6.24	7.43	8.76	4.56	13.61	20.65	15.35	17.80	14.91	10.91	13.21	7.32	70.74

† indicates period of record for station and excludes partial year results

Table A2. Monthly and annual rainfall (inches) at station ARMMSO_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1979‡	--	--	--	2.52	3.24	3.60	4.92	5.52	10.92	0.12	0.72	2.76	34.32
1980	1.80	2.88	1.80	2.04	4.44	4.32	8.52	4.20	2.76	0.72	3.24	1.08	37.80
1981	0.24	2.28	1.32	0.00	2.76	4.44	4.56	11.28	5.88	2.28	1.44	0.00	36.48
1982	1.44	2.76	4.56	3.36	4.80	12.48	4.80	10.20	7.32	1.56	1.08	0.60	54.96
1983	3.48	7.20	3.48	1.68	1.92	9.00	3.24	3.00	4.08	2.40	0.72	4.08	44.28
1984‡	0.60	--	--	2.52	5.28	5.58	3.00	1.62	2.04	0.00	3.75	0.21	24.60

‡indicates partial year

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR[1]
Mean	1.51	3.78	2.79	2.02	3.74	6.57	4.84	5.97	5.50	1.18	1.83	1.46	43.38
Standard Deviation	1.27	2.29	1.50	1.14	1.30	3.47	1.98	3.93	3.30	1.06	1.33	1.62	8.44
Minimum	0.24	2.28	1.32	0.00	1.92	3.60	3.00	1.62	2.04	0.00	0.72	0.00	36.48
Median	1.44	2.82	2.64	2.28	3.84	5.01	4.68	4.86	4.98	1.14	1.26	0.84	41.04
Maximum	3.48	7.20	4.56	3.36	5.28	12.48	8.52	11.28	10.92	2.40	3.75	4.08	54.96

[1] indicates period of record for station and excludes partial year results.

Table A3. Monthly and annual rainfall (inches) at station GAC_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1974‡	--	--	--	--	5.26	21.76	--	--	8.84	0.26	0.28	3.19	39.59
1975	0.97	2.51	2.43	0.90	13.88	4.87	8.34	5.15	10.23	6.70	0.17	0.40	56.55
1976	0.45	1.48	3.28	0.72	8.79	6.53	6.85	8.97	10.23	1.15	2.47	1.64	52.56
1977	2.26	1.45	0.96	1.31	4.80	3.18	8.57	4.29	5.85	1.66	3.79	3.05	41.17
1978	3.65	4.18	3.50	0.67	7.25	10.91	18.58	1.63	6.62	4.20	0.49	3.03	64.71
1979	5.75	1.52	1.32	2.78	9.36	6.52	5.03	6.83	18.95	0.37	1.75	1.06	61.24
1980	3.68	5.15	0.87	5.35	6.00	4.96	8.61	6.28	3.65	1.96	4.31	1.70	52.52
1981	0.50	2.16	3.06	0.11	4.25	4.27	4.21	8.97	7.50	0.05	4.30	3.05	42.43
1982‡	3.21	2.76	6.85	5.04	9.21	--	--	6.92	9.37	3.44	0.93	1.15	48.88
1983	5.74	6.24	9.99	0.87	1.88	12.35	7.43	4.13	4.62	6.37	1.59	3.73	64.94
1984	0.39	3.60	2.17	3.70	9.39	7.07	8.75	6.99	3.79	0.67	4.81	0.69	52.02
1985	0.36	0.55	2.58	2.04	1.74	12.80	4.26	7.91	6.89	1.76	3.21	3.15	47.25
1986	2.74	1.69	6.69	0.24	1.64	10.94	3.54	5.45	5.02	3.91	0.90	4.20	46.96
1987	1.30	1.64	8.25	0.25	3.11	5.54	8.40	2.18	11.93	5.72	8.92	0.10	57.34
1988	2.36	3.26	7.32	2.05	1.12	4.01	11.82	14.95	3.18	1.18	3.83	1.42	56.50
1989‡	--	--	3.97	4.15	4.21	6.08	4.64	9.26	7.82	0.77	2.34	--	43.24
1990‡	--	4.71	2.10	0.67	1.67	10.92	8.18	8.98	5.68	3.18	2.07	0.80	48.96
1991	2.61	1.14	5.65	3.81	8.00	8.98	12.29	4.73	3.96	7.93	0.33	0.87	60.30
1992	0.42	3.70	1.40	5.09	1.53	23.82	3.57	19.11	2.83	1.65	1.55	0.67	65.34
1993	4.57	2.34	5.79	4.93	2.46	3.51	11.56	7.39	6.36	6.69	0.49	0.92	57.01
1994	1.86	2.49	2.68	6.14	4.49	10.74	10.18	12.70	8.84	1.03	3.97	2.94	68.06
1995	2.49	3.38	2.96	4.28	2.54	8.69	13.20	M	6.38	6.91	1.45	0.17	52.45
1996	5.88	0.82	6.41	2.49	8.23	9.84	3.29	11.86	3.48	6.71	0.39	2.30	61.70
1997‡	3.49	1.26	--	--	--	9.50	11.05	8.11	11.62	2.32	13.18	8.95	69.48
1998‡	6.48	4.45	8.95	1.66	1.68	--	--	--	--	--	--	--	23.22

‡ indicates partial year

Table A3. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR*
Mean	2.78	2.72	4.31	2.58	5.10	9.03	8.29	7.85	7.24	3.19	2.81	2.14	55.84
Standard Deviation	1.96	1.51	2.72	1.94	3.44	5.24	3.84	4.07	3.67	2.57	3.00	1.93	7.76
Minimum	0.36	0.55	0.87	0.11	1.12	3.18	3.29	1.63	2.83	0.05	0.17	0.10	41.17
Median	2.55	2.49	3.28	2.05	4.37	8.69	8.37	7.19	6.50	2.14	1.91	1.64	56.55
Maximum	6.48	6.24	9.99	6.14	13.88	23.82	18.58	19.11	18.95	7.93	13.18	8.95	68.06

* indicates period of record for station and excludes partial year results

Table A4. Monthly and annual rainfall (inches) at station YEEHAW J R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1965‡		--	--	-			9.00	12.24	7.47	5.18	1.26	2.68	37.83
1966‡	5.29	5.35	0.95	2.41	8.17	11.67	8.33	6.91	--	2.86	0.27	0.13	52.34
1967	0.70	4.39	0.25	0.00	0.94	6.92	6.14	8.31	3.02	0.80	0.40	1.73	33.50
1968	0.55	2.05	1.21	0.81	7.95	13.85	6.04	4.77	5.04	10.60	2.39	0.29	55.55
1969‡	2.21	1.55	9.95	1.03	4.09	10.25	6.64	11.12	4.93		2.27	3.54	57.58
1970‡	3.30	2.14	4.59	0.35	2.35		--	--	--	-	0.26	1.03	14.02
1971‡	0.06		0.47	0.06	2.95	10.90	9.51	4.09	3.83	9.72	0.56	1.28	43.43
1972†	1.14	5.12	2.10	3.03	5.71	10.90	3.24		-	--	--	--	31.24

† indicates partial year

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR*
Mean	1.89	3.42	2.79	1.10	4.59	10.75	6.99	7.91	4.86	5.83	1.06	1.53	47.13
Standard Deviation	1.86	1.70	3.48	1.18	2.79	2.25	2.16	3.31	1.68	4.26	0.93	1.24	11.91
Minimum	0.06	1.55	0.25	0.00	0.94	6.92	3.24	4.09	3.02	0.80	0.26	0.13	33.50
Median	1.14	3.22	1.21	0.81	4.09	10.90	6.64	7.61	4.93	5.18	0.56	1.28	52.34
Maximum	5.29	5.35	9.95	3.03	8.17	13.85	9.51	12.24	7.47	10.60	2.39	3.54	55.55

* indicates period of record for station and excludes partial year results.

Table A5. Monthly and annual rainfall (inches) at station S65A_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1965‡	--	--	-		--	--	10.67	10.32	4.34	4.91	0.71	2.46	33.41
1966	4.38	4.95	0.92	1.66	3.24	5.06	5.25	7.89	6.82	1.60	0.18	0.50	42.45
1967	0.03	2.25	0.00	0.00	0.00	6.16	9.10	7.06	5.23	0.83	0.00	0.30	30.96
1968‡	1.10	3.70	1.10	0.60	4.58		7.74	4.10	8.21	5.70	1.26	0.60	38.69
1969†	1.32	1.50	5.33	1.40	2.06	10.10		--	--	13.23	1.93	2.76	39.63
1970	3.05	2.37	5.17	0.10	5.05	1.93	11.39	4.92	3.93	3.11	0.81	0.85	42.68
1971	0.08	2.62	0.74	0.46	2.08	6.86	7.40	4.98	3.45	4.66	0.35	1.26	34.94
1972	1.96	4.71	2.78	2.45	8.62	11.20	6.78	6.58	2.02	2.41	5.23	1.79	56.03
1973	4.76	2.06	1.47	4.27	7.94	4.82	8.82	9.90	7.09	1.93	0.27	1.27	54.60
1974	0.16	1.82	0.00	1.34	4.84	17.09	8.76	9.12	4.61	1.26	0.71	2.43	52.14
1975	0.61	2.03	2.57	2.12	8.00	4.52	6.60	7.12	5.73	5.18	0.50	0.85	45.86
1976	0.54	0.65	1.26	1.79	9.93	8.74	7.04	6.76	9.46	0.81	1.25	3.00	51.03
1977	1.29	1.28	0.77	0.31	2.57	7.67	4.36	2.72	6.48	2.48	2.72	2.59	35.24
1978†	2.34	--	2.88	0.08	8.92	9.59	14.01	6.26	8.09	2.22	0.66	3.24	58.29
1979	6.24	1.40	1.41	1.62	7.46	3.25	3.89	8.17	13.46	1.22	0.93	1.35	50.40
1980‡	2.32	--	2.61	2.94	4.10	6.72	4.84	9.29	4.41	1.13	4.36	1.57	44.29

Table A5. continued.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1981	0.41	2.76	2.51	0.00	0.00	7.84	2.50	12.16	8.88	0.92	0.95	0.15	39.08
1982	1.39	2.68	4.33	5.39	3.90	9.18	8.74	4.61	11.38	4.98	1.25	0.96	58.79
1983	3.46	8.84	5.13	2.57	2.83	8.26	4.88	2.70	4.24	1.71	1.41	4.68	50.71
1984	0.57	3.30	2.61	2.19	7.75	5.74	8.21	3.73	3.91	1.73	5.05	1.19	45.98
1985	0.93	0.34	2.30	2.10	2.15	8.44	7.32	2.50	6.28	2.63	1.30	2.67	38.96
1986	3.02	0.90	2.78	0.16	2.73	11.66	6.04	5.28	4.20	4.98	2.81	2.17	46.73
1987	3.14	1.01	5.25	0.07	4.69	5.30	7.18	0.94	7.29	5.04	8.03	0.39	48.33
1988	2.85	2.70	4.50	0.30	2.25	4.78	9.29	6.06	4.72	1.84	2.43	0.94	42.66
1989	3.04	0.62	4.26	2.66	2.06	9.04	9.38	8.29	5.64	2.59	3.61	4.96	56.15
1990	0.47	4.55	0.86	1.74	4.68	13.36	6.79	7.08	5.64	4.66	0.86	0.65	51.34
1991	3.04	1.11	6.19	4.85	11.01	8.46	8.55	13.91	3.18	6.05	0.57	0.60	67.52
1992	0.91	2.64	1.89	3.77	0.78	17.48	6.62	16.48	6.64	2.16	1.54	1.06	61.97
1993	5.92	2.24	6.15	3.97	1.65	2.28	5.42	12.35	9.67	5.39	1.22	1.75	58.01
1994	2.90	3.36	3.20	1.98	3.61	8.02	11.27	8.27	5.68	4.43	3.29	2.71	58.72
1995	1.67	2.98	5.02	3.77	1.58	6.13	7.03	13.13	3.40	5.48	1.67	0.24	52.10
1996	2.54	0.51	5.69	1.25	9.82	8.26	2.57	5.54	2.50	6.24	0.53	1.60	47.05
1997	2.46	1.42	1.82	4.56	2.65	5.92	7.77	5.63	10.51	1.30	13.25	5.68	62.97
1998‡	5.53	9.25	8.57	1.43	0.92	--	--	--	--	--	--	--	25.70

‡ indicates partial year

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR⊥
Mean	2.25	2.66	3.09	1.94	4.38	7.87	7.37	7.31	6.16	3.48	2.17	1.79	49.41
Standard Deviation	1.72	2.09	2.09	1.56	3.10	3.63	2.53	3.58	2.70	2.50	2.66	1.38	9.03
Minimum	0.03	0.34	0.00	0.00	0.00	1.93	2.50	0.94	2.02	0.81	0.00	0.15	30.96
Median	2.32	2.25	2.61	1.74	3.61	7.84	7.25	6.91	5.66	2.59	1.25	1.35	50.56
Maximum	6.24	9.25	8.57	5.39	11.01	17.48	14.01	16.48	13.46	13.23	13.25	5.68	67.52

⊥ indicates period of record for station and excludes partial year results.

Table A6. Monthly and annual rainfall (inches) at station AVON P2_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1965‡	--	--	--	--	--	--	--	--	--	--	--	--	0.00
1966‡	--	--	--	--	--	--	--	--	--	2.39	0.20	0.80	3.39
1967‡	3.81	--	0.10	0.06	0.90	10.55	10.31	--	3.53	1.95	0.65	2.26	34.12
1968	0.51	1.84	1.03	0.64	4.74	15.44	6.73	4.60	7.31	7.45	2.38	0.49	53.16
1969‡	1.78	1.66	8.71	1.41	1.88	--	7.14	6.03	6.80	9.67	1.37	3.25	49.70
1970	2.77	1.99	4.75	0.00	5.70	3.11	8.90	4.55	7.12	1.82	0.18	0.66	41.55
1971‡	--	2.65	0.59	0.05	3.05	9.20	8.59	4.55	5.31	4.84	0.49	--	39.32

‡ indicates partial year

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR⊥
Mean	2.22	2.04	3.04	0.43	3.25	9.58	8.33	4.93	6.01	4.69	0.88	1.49	47.36
Standard Deviation	1.41	0.43	3.67	0.61	1.98	5.08	1.44	0.73	1.60	3.27	0.85	1.21	8.21
Minimum	0.51	1.66	0.10	0.00	0.90	3.11	6.73	4.55	3.53	1.82	0.18	0.49	41.55
Median	2.28	1.92	1.03	0.06	3.05	9.88	8.59	4.58	6.80	3.62	0.57	0.80	47.36
Maximum	3.81	2.65	8.71	1.41	5.70	15.44	10.31	6.03	7.31	9.67	2.38	3.25	53.16

⊥ indicates period of record for station and excludes partial year results.

Table A7. Monthly and annual rainfall (inches) at station INDIAN 4_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1960‡	.	--	5.08	4.24	4.26	.	--	--	--			--	13.58
1961‡	1.58	1.67	2.40	--	2.00	5.35	--	--	--	--			13.00
1962†		.	--	--	1.42	11.65	6.89	8.86	5.60	1.10	3.68	1.02	40.12
1963	1.79	6.33	1.38	0.32	13.61	5.34	3.57	5.48	3.72	0.85	5.12	2.61	50.12
1964	3.65	4.59	2.79	2.07	4.31	3.94	7.63	14.68	6.53	0.78	0.84	0.55	52.36
1965	1.02	4.99	3.36	3.18	4.86	10.74	9.81	10.99	7.72	7.24	1.42	2.54	67.37
1966	5.80	8.13	1.49	1.83	3.72	9.38	5.77	4.82	6.39	1.71	0.12	1.25	50.41
1967	0.72	3.81	0.07	0.00	0.15	5.76	12.14	13.28	5.38	1.29	0.16	2.72	45.48
1968	0.46	1.87	1.18	0.34	4.00	14.72	6.47	2.77	8.63	5.30	2.22	0.57	48.53
1969	2.39	1.36	6.71	2.64	2.46	5.02	7.95	12.27	10.25	9.84	3.44	4.00	68.33
1970	2.54	1.30	5.22	0.26	4.56	3.10	7.66	5.46	3.30	3.07	0.39	1.11	37.97
1971	0.17	6.02	1.55	1.03	2.10	8.97	8.19	5.19	1.79	4.83	0.49	0.96	41.29
1972	1.76	4.65	3.08	2.36	4.03	11.22	3.12	7.56	0.64	2.74	4.31	3.16	48.63
1973	5.82	1.63	4.64	7.28	5.46	4.59	11.42	9.60	7.25	2.34	1.56	2.36	63.75
1974	1.00	2.13	0.24	1.59	5.70	12.00	12.64	10.90	4.20	0.30	0.38	2.36	53.44
1975	0.94	4.56	1.37	0.70	7.72	8.38	11.99	10.58	11.33	6.40	0.34	0.68	64.99
1976	0.68	0.78	3.64	1.34	6.46	9.66	9.56	10.16	9.80	1.72	3.38	2.96	60.14
1977	2.08	1.82	0.93	0.39	3.64	2.78	9.19	5.00	6.82	2.30	4.36	6.26	45.56
1978	2.98	3.32	4.94	0.30	5.58	7.62	13.46	1.55	3.35	2.58	0.48	3.38	47.73
1979	6.72	0.88	2.00	2.70	9.14	6.47	7.63	4.64	16.31	0.25	1.09	1.52	59.35
1980	2.88	4.32	1.82	3.96	6.18	6.70	7.38	7.54	3.55	0.61	5.47	1.35	51.76
1981†	0.46	3.16	0.87	--	--	.		.	--	--	--		4.49

‡ indicates partial year

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR†
Mean	2.27	3.37	2.56	1.92	4.81	7.67	8.55	7.96	6.39	2.91	2.07	2.18	53.18
Standard Deviation	1.91	2.05	1.78	1.83	2.91	3.30	2.89	3.67	3.79	2.64	1.85	1.44	8.91
Minimum	0.17	0.78	0.07	0.00	0.15	2.78	3.12	1.55	0.64	0.25	0.12	0.55	37.97
Median	1.78	3.24	2.00	1.59	4.31	7.16	7.95	7.56	6.39	2.30	1.42	2.34	51.09
Maximum	6.72	8.13	6.71	7.28	13.61	14.72	13.45	14.68	16.31	9.84	5.47	6.26	68.33

† indicates period of record for station and excludes partial year results.

Table A8. Monthly and annual rainfall (inches) at station TRIPLE_C_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1989†			--	--			--	4.35	2.61	0.4	0.05	3.98	11.39
1990	0.77	3.54	1.41	1.1	2.63	3.5	3.33	7.84	4.62	0.06	0.16	0	28.96
1991‡	3.55	0.51	1.18	2.26	0.3	7.77	--			--	--	--	15.57

† indicates partial year

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR†
Mean	2.16	2.03	1.30	1.68	1.47	5.64	3.33	6.10	3.62	0.23	0.11	1.99	28.96
Standard Deviation	1.97	2.14	0.16	0.82	1.65	3.02		2.47	1.42	0.24	0.08	2.81	--
Minimum	0.77	0.51	1.18	1.10	0.30	3.50	3.33	4.35	2.61	0.06	0.05	0.00	28.96
Median	2.16	2.03	1.30	1.68	1.47	5.64	3.33	6.10	3.62	0.23	0.11	1.99	28.96
Maximum	3.55	3.54	1.41	2.26	2.63	7.77	3.33	7.84	4.62	0.40	0.16	3.98	28.96

† indicates period of record for station and excludes partial year results.

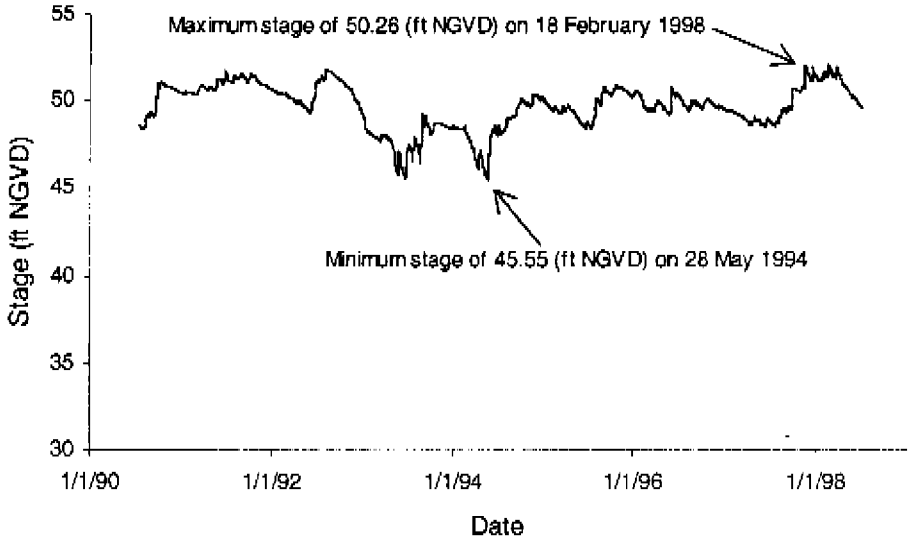

Figure A8. Daily stage at station RATHAM.

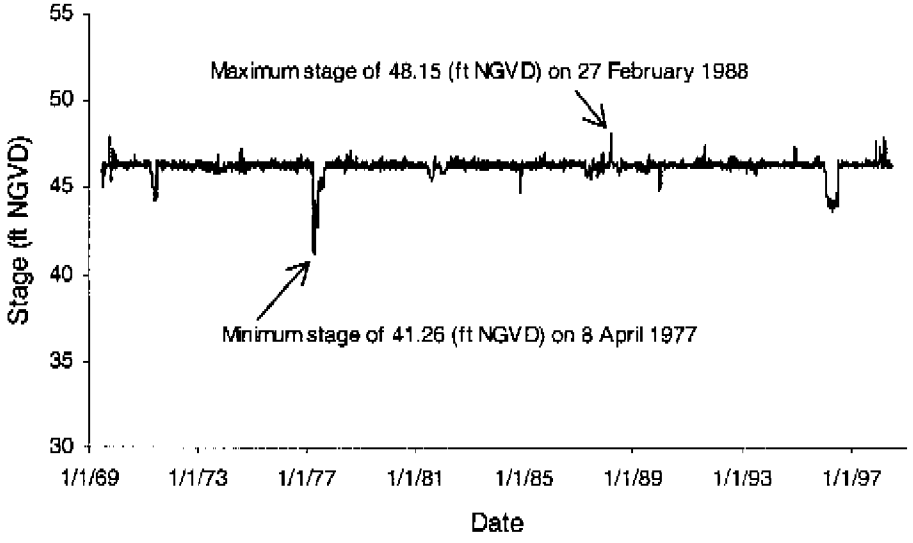

Figure A9. Daily headwater stage at station S65A_H.

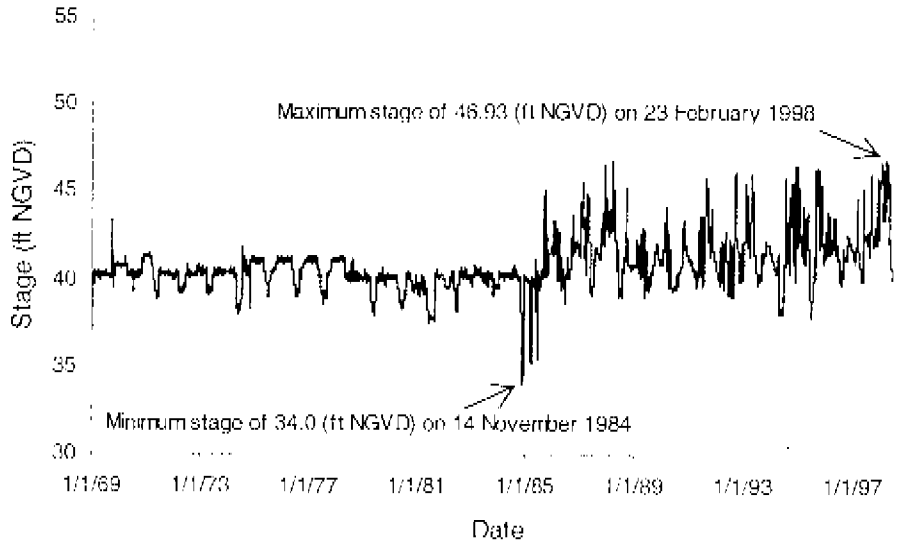

Figure A10. Daily tailwater stage at station S65A_T.

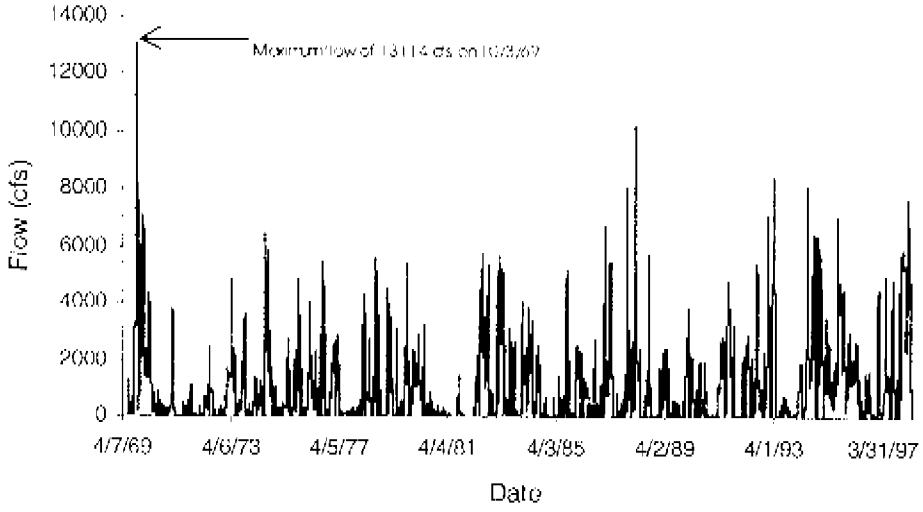

Figure A11. Daily flow at station S65A_S.

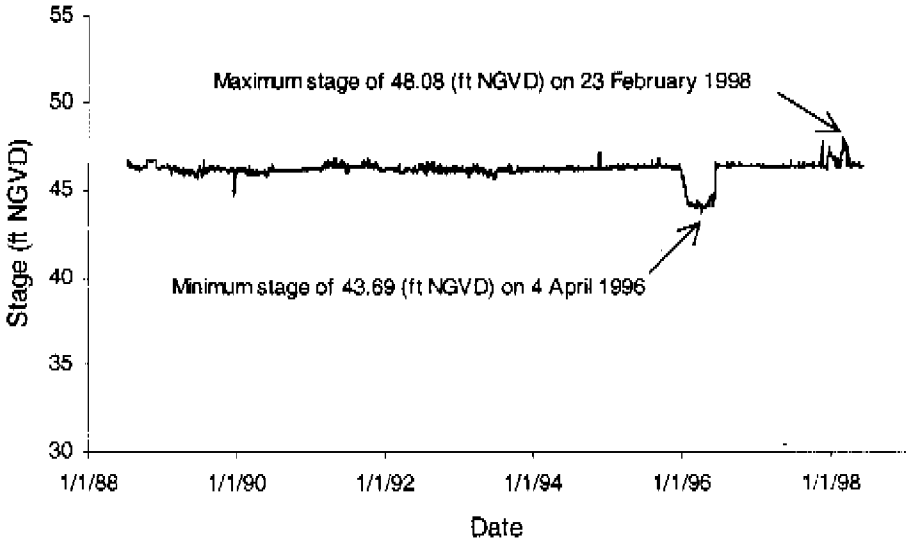

Figure A12. Daily headwater stage at station S65AX_H.

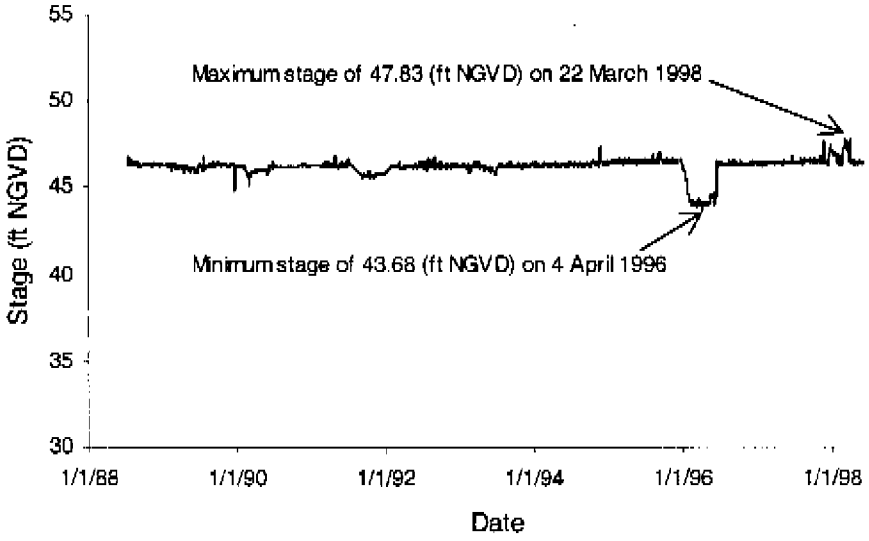

Figure A13. Daily tailwater stage at station S65AX_T.

Table A9. Statistics for daily stage (ft NGVD) over each month at ARMSC_T, ARMSC_H, ARMSO_H, ARMSF_T, ARMSF_H (1983 - 1984).

Month	ARMSC_T	ARMSC_H	ARMSO_H	ARMSF_T	ARMSF_H
Jan	46.28	47.50	50.99	51.69	52.16
Feb	46.26	47.37	50.85	51.33	52.06
Mar	46.26	47.47	51.19	51.77	52.16
Apr		47.36		--	
May		47.45		--	
Jun	46.50	47.59	51.76	52.41	52.63
Jul	46.35	47.63	50.96	51.92	52.38
Aug	46.30	47.52	51.16	52.05	52.31
Sep	46.31	47.85	51.15	52.47	52.60
Oct	46.20	47.41	50.67	51.67	52.15
Nov	46.19	47.23	50.57	51.64	51.92
Dec	46.29	47.35	50.73	51.20	51.93

Note: no data reported for tailwater stage at station ARMSO_T

Table A10. Mean daily flows (cfs) over each month and year at S-65A control structure.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg ‡
1969†	--	--	--	--	--	801	94	277	1170	6701	1614	2979	2027
1970	3069	1923	2408	2355	355	304	281	185	47	122	185	265	953
1971	732	1871	303	0	0	0	274	109	127	319	22	11	304
1972	0	145	16	432	740	722	893	192	42	25	68	68	280
1973	201	1350	1463	2499	1398	103	242	1057	2073	718	51	69	929
1974	98	837	419	390	706	548	4945	4386	2170	457	148	76	1273
1975	119	136	244	977	1214	413	196	1244	1529	993	894	207	682
1976	162	1449	1635	961	1026	268	300	2544	1608	348	108	1187	969
1977	1870	1489	1787	401	92	138	74	21	57	33	52	246	518
1978	1195	1653	1438	770	995	483	871	2916	729	180	27	278	960
1979	2440	2555	787	6	961	57	71	237	2097	2164	197	1298	1066
1980	1681	1661	1772	929	1313	156	201	389	199	132	154	96	719
1981	78	90	104	91	60	0	0	140	625	13	12	0	100
1982	0	0	43	351	1217	2531	2927	2812	2205	1982	401	189	1230
1983	569	3335	4404	3471	1322	170	1115	1828	925	46	23	1488	1548
1984	1551	1877	1085	2517	2055	196	688	1631	185	39	175	60	998
1985	0	0	112	136	913	189	192	1086	1294	421	60	27	372
1986	1830	1973	1100	939	946	180	264	669	1028	131	96	107	764
1987	3252	2061	1139	4078	817	0	125	39	209	422	3035	1638	1391
1988	921	1973	4210	2494	1400	29	256	674	2266	18	5	8	1185
1989	589	1017	1065	1596	1153	29	144	190	228	84	9	45	509
1990	1539	2143	628	919	409	85	479	313	229	389	23	3	587
1991	19	13	181	1202	1981	631	2153	4001	1348	1593	22	9	1108
1992	2	1388	255	2121	1615	545	509	2174	1501	533	381	708	976
1993	4643	1157	1872	5203	190	45	189	154	398	203	89	6	1176
1994	29	188	1444	587	233	2509	2366	2292	3369	3101	3024	2704	1828
19 5	1600	1791	1600	1660	928	553	1492	4607	3833	2882	1139	1584	1976
1996	2488	1317	1428	2308	547	392	99	874	414	524	4	19	865
1997	717	1131	89	950	2024	1006	277	3223	357	119	1054	4474	1291
1998†	4931	4338	5773	2732	471	--	--	--	--	--	--	--	2392

† indicates partial year; ‡ indicates average for daily data over the year.

Table A10. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR*
Mean	1253	1409	1538	1485	936	451	749	1388	1512	851	451	684	1008
Standard Deviation	1384	1821	1389	1297	880	632	1097	1412	1020	1415	819	1101	1409
Minimum	0	0	16	0	0	0	0	21	42	13	4	0	0
Median	732	1449	1100	951	946	196	274	874	925	348	96	107	324
Maximum	4931	4338	5773	5203	2655	2531	4945	4607	3533	6701	3035	4474	13124

* indicates statistical results were applied to period of record results.

Table A11. Monthly and yearly flow summations (ac-ft) at S-65A control structure.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums
1969†	--	--	--	--	--	28600	5756	17018	69637	412025	96053	183154	812243
1970	188738	106772	148044	140152	21820	18093	17282	11348	2819	7527	10981	16320	689897
1971	44986	103929	18613	0	0	0	16876	6694	7559	19587	1303	690	220238
1972	0	8353	994	25694	45496	42937	54921	11830	2525	1519	4062	4181	202511
1973	12381	74970	89960	148673	85953	6149	14900	65017	123324	44147	3059	4225	672758
1974	6010	46511	25772	23235	43397	32589	304063	269695	129142	28090	8829	4653	921984
1975	7295	7575	14983	58146	74677	24583	12078	76506	91011	61080	53197	12714	493846
1976	9975	83331	100512	57196	63101	15969	18417	156431	95708	21420	6421	72983	701463
1977	114980	82700	109906	23838	5685	8184	4562	1309	3372	2055	3090	15128	374808
1978	73479	91806	88399	45807	61153	28747	53556	179295	43357	11040	1611	17092	695342
1979	150060	141896	48372	379	59112	3384	4391	14599	124786	133061	11724	79802	771566
1980	103358	95537	108981	55278	80730	9257	12335	23899	11834	8122	9166	5899	524398
1981	4788	4989	6421	5405	3697	0	0	8610	37212	789	692	0	72604
1982	0	0	2636	20884	74832	150577	179949	172920	131222	121880	23869	11619	890389
1983	34969	185209	270776	206526	81270	10090	68562	112381	55046	2825	1355	91467	1120475
1984	95365	107942	66715	149796	126389	11689	42280	100310	10999	2404	10403	3687	727978
1985	0	0	6867	8097	56119	11244	11820	66761	76996	25914	3588	1636	269042
1986	112506	109574	67635	55895	58176	10687	16229	41132	61197	8065	5724	6577	553398
1987	199945	114456	70022	242687	50222	0	7696	2394	12413	25942	180578	100734	1007088
1988	56637	113512	258890	148417	86088	1710	15721	41417	134856	1077	303	508	859137
1989	36191	56464	65461	94968	70920	1724	8829	11707	13569	5185	555	2736	368309
1990	94641	119006	38638	54701	25151	5079	29456	19239	13631	23939	1348	209	425037
1991	1160	712	11140	71553	121819	37562	132366	246006	80215	97957	1317	568	802376
1992	103	79820	15677	126228	99285	32411	31323	133692	89296	32745	22701	43527	706806
1993	285513	64261	115078	309596	11706	2678	11614	9493	23676	12486	5300	348	851748
1994	1781	10421	88806	34915	14310	149323	145504	140954	200446	190694	179960	166243	1323357
1995	98354	99484	98386	98777	57055	32903	91721	283270	228079	177217	67774	97384	1430405
1996	152957	75754	87783	137345	33611	23335	6107	53769	24610	32206	250	1141	628868
1997	44058	62789	5484	56514	124471	59845	17010	198168	21234	7322	62700	275084	934680
1998†	303198	240917	354958	162555	28977	--	--	--	--	--	--	--	1090605

†partial year results.

Table A11. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Stats*
Mean	77015	78920	82233	88385	57421	26184	46016	85375	66199	52356	26825	42089	684619
Standard	85087	59856	65402	77183	35696	37423	67465	80859	60689	87035	48727	67701	324269
Minimum	0	0	991	0	0	0	0	1309	2525	789	250	0	72692
Median	44986	82700	67635	53196	54176	11689	16876	53769	55046	21420	5724	6577	698402
Maximum	303198	240917	354958	306556	126389	150577	304363	283270	228079	412025	180578	275084	1439035

*exclude- partial year results

APPENDIX B: S65B SUB-BASIN DATA

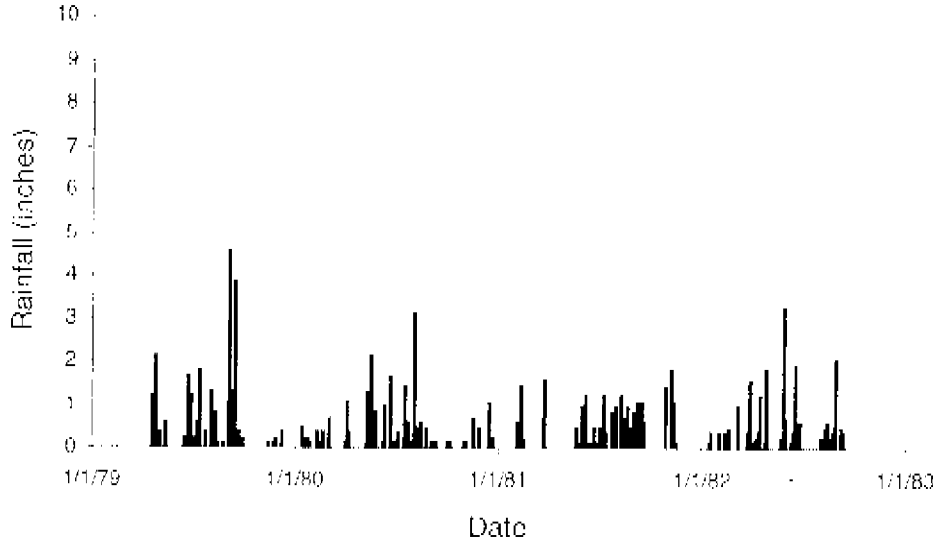

Figure B1. Daily rainfall at station PEAVE_R.

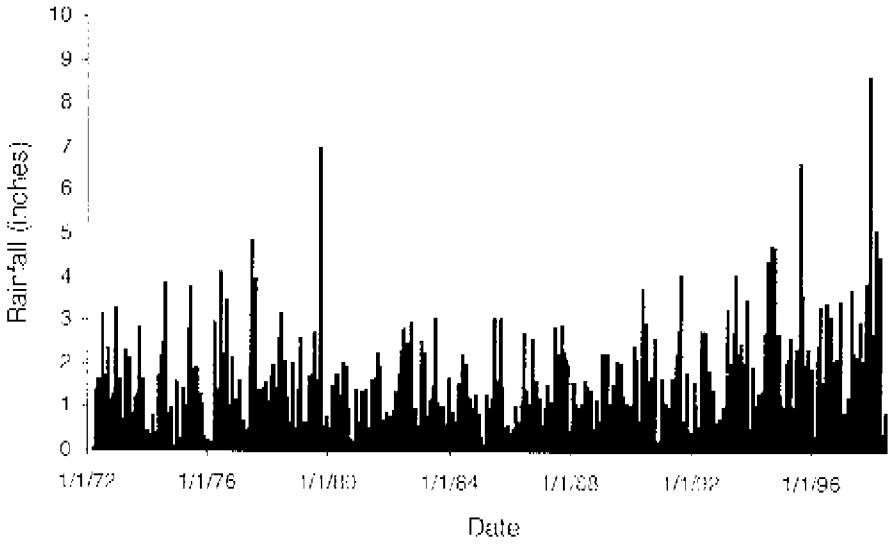

Figure B2. Daily rainfall at station ELMAX_R.

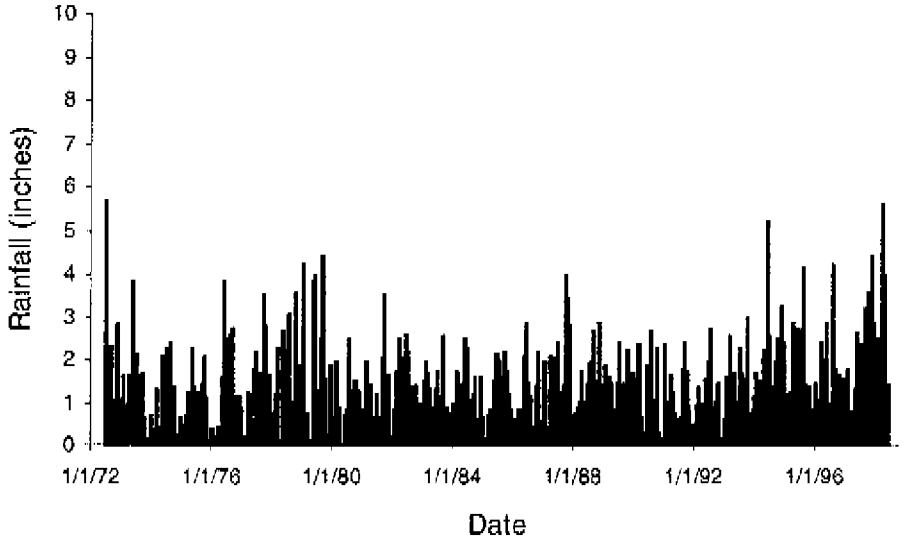

Figure B3. Daily rainfall at station PEAVINE_R.

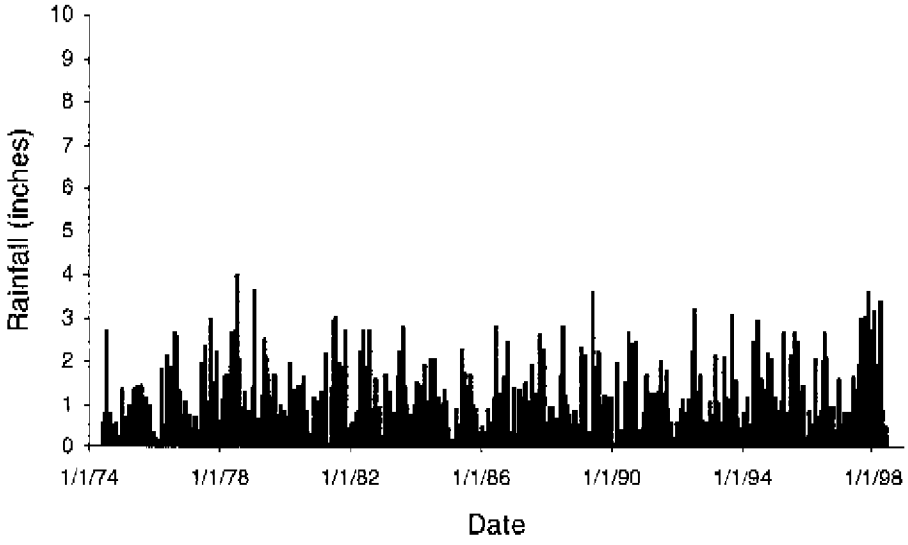

Figure B4. Daily rainfall at station MAXCEY N_R.

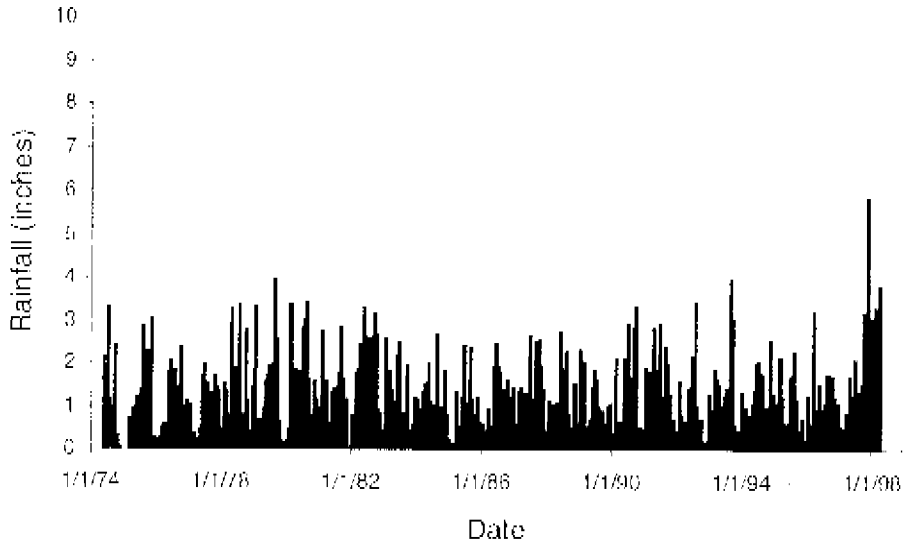

Figure B5. Daily rainfall at station TICK ISL_R.

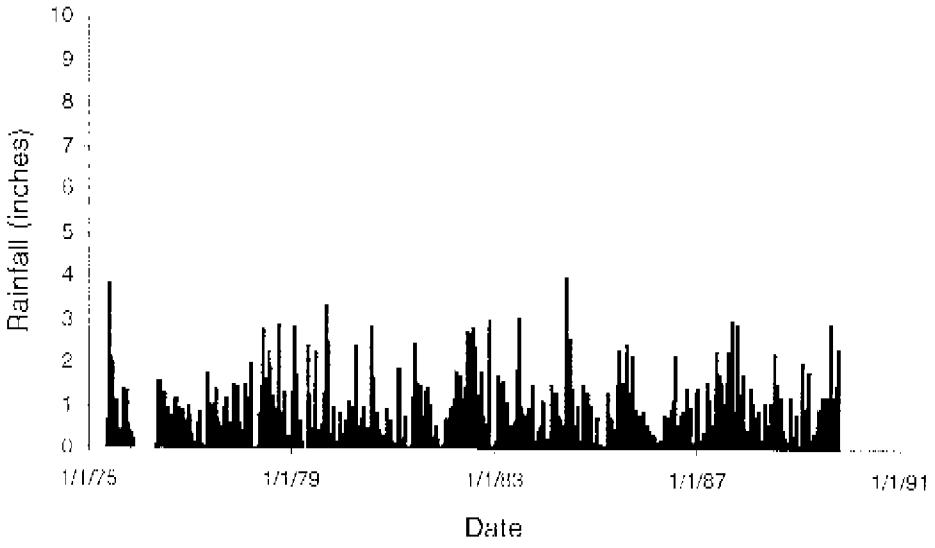

Figure B6. Daily rainfall at station BONEY.WS_R.

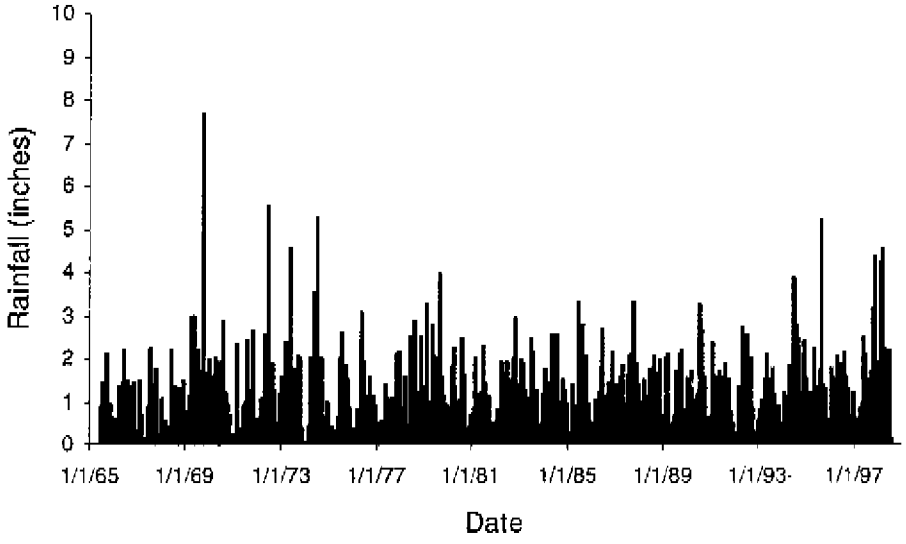

Figure B7. Daily rainfall at station S65B_R.

Table B1. Monthly and annual rainfall (inches) in sub-basin S6518.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1965[1]				--	--	7.23		6.15	4.79	3.38	0.40	1.65	23.61
1966	3.53	2.33	0.63	1.75	7.73	8.05	6.03	4.98	4.42	3.61	0.10	0.56	43.75
1967	0.89	3.47	0.51	0.14	0.92	8.03	5.73	3.68	5.73	1.66	0.10	1.97	32.83
1968	0.84	1.21	0.97	0.44	5.70	13.49	7.14	5.00	5.21	1.80	2.35	0.45	44.60
1969	1.76	1.57	6.69	3.36	3.54	8.61	3.22	8.19	6.21	13.20	2.39	3.27	62.01
1970	3.89	1.91	5.25	0.08	4.63	2.98	8.62	2.85	5.28	2.04	3.04	0.47	38.04
1971	0.14	4.24	1.03	0.15	1.56	5.26	5.43	4.78	4.60	4.76	0.38	0.72	33.55
1972	1.14	3.31	2.66	1.76	3.86	8.24	5.09	6.62	2.63	1.71	5.14	1.95	44.10
1973	5.53	1.54	2.30	3.64	4.78	6.33	8.20	5.26	8.76	1.75	0.84	1.48	50.39
1974	0.20	2.18	0.07	0.99	4.80	11.86	10.59	5.58	5.11	0.77	0.26	1.84	44.24
1975	0.42	1.75	1.69	1.72	7.13	6.06	6.56	6.16	6.64	3.55	0.73	0.61	43.02
1976	0.30	0.60	1.87	1.02	10.53	6.44	5.22	6.49	7.00	0.88	2.05	1.91	44.32
1977	1.34	0.96	0.93	0.26	4.87	5.02	5.36	4.28	6.27	1.69	4.99	2.14	38.04
1978	2.15	3.14	2.77	0.12	5.42	10.59	13.21	3.42	5.64	2.38	1.39	2.75	53.02
1979	6.52	0.83	0.91	2.92	5.61	3.97	4.59	5.77	11.26	0.66	1.02	1.42	45.51
1980	1.62	3.26	1.38	2.72	4.24	4.17	7.08	4.24	3.06	0.69	3.37	1.32	37.74
1981	0.25	2.75	1.81	0.11	4.09	5.30	3.73	7.43	5.51	3.80	1.60	0.12	36.29
1982	1.58	2.26	5.30	5.20	5.66	8.03	7.43	7.02	7.83	2.84	2.01	0.90	55.96
1983	3.04	6.88	5.02	2.58	1.79	9.36	1.31	1.11	4.98	2.17	1.43	3.62	49.28
1984	0.41	3.11	2.42	2.77	8.42	7.01	6.75	4.43	3.32	0.68	4.31	1.02	44.70
1985	0.72	0.32	1.98	2.16	1.88	7.47	6.14	5.38	6.91	2.43	2.32	1.18	38.88
1986	1.99	0.78	2.45	0.18	2.25	10.66	6.76	4.19	4.28	4.56	0.74	3.49	42.33
1987	1.36	0.73	3.57	0.61	3.43	6.99	6.01	1.42	10.26	4.87	7.27	0.54	49.05
1988	2.47	2.15	4.50	1.13	1.47	4.52	7.37	7.11	2.72	0.82	2.81	1.22	38.28
1989	3.14	0.73	3.74	1.72	1.58	3.84	6.53	6.62	5.95	2.66	1.99	2.94	43.42
1990	0.26	4.90	0.98	0.74	3.61	8.98	8.34	6.07	5.61	3.44	0.66	0.46	44.07
1991	3.70	1.74	3.69	3.43	4.16	5.22	6.62	7.47	2.68	3.83	0.61	0.53	43.69
1992	0.74	3.17	1.22	3.53	1.48	15.80	4.31	10.51	3.86	1.88	1.33	0.67	48.50
1993	4.89	2.51	5.56	3.73	2.71	4.91	6.26	8.09	5.25	4.12	1.48	1.02	50.52
1994	2.82	3.24	2.05	4.24	2.95	12.96	9.49	7.06	8.76	3.06	3.90	2.89	63.41
1995	1.95	3.61	3.26	5.17	1.97	8.00	7.65	13.76	4.74	5.89	1.27	0.42	57.89
1996	3.31	0.81	6.87	1.19	7.15	6.82	3.40	10.16	2.61	4.04	0.42	2.25	49.02
1997	2.35	1.36	1.79	5.26	4.42	6.34	7.81	7.92	9.02	2.05	8.06	5.50	61.89
1998[1]	5.75	8.97	8.42	2.33	1.85	-	--	--				--	27.31

[1] indicates partial year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR[1]
Mean	2.15	2.52	2.92	2.03	4.09	7.59	6.59	6.14	5.66	2.90	2.05	1.61	45.92
Standard Deviation	1.74	1.85	2.12	1.62	2.29	3.91	2.09	2.37	2.18	2.30	2.00	1.21	8.09
Minimum	0.14	0.32	0.07	0.08	0.92	2.98	3.22	1.42	2.61	0.65	0.04	0.12	32.83
Median	1.76	2.18	2.30	1.75	3.86	7.01	6.54	6.07	5.28	2.38	1.43	1.32	44.28
Maximum	6.52	8.97	8.42	5.26	10.53	15.80	13.21	13.76	11.26	13.20	8.06	5.50	63.41

[1] indicates period of record for station and excludes partial year results.

Table B2. Monthly and annual rainfall (inches) at station PEAVF_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1979‡	--	--	--	--	0.72	4.32	5.64	3.48	12.48	0.00	0.48	0.72	27.84
1980	1.08	0.96	0.84	1.44	4.80	2.88	6.36	2.40	0.48	0.36	2.52	1.56	25.68
1981	0.00	2.28	1.68	0.00	1.68	2.52	3.96	5.88	5.64	1.68	3.12	0.00	28.44
1982‡	--	0.84	3.24	3.96	5.40	5.04	--	6.13	--	--	--	--	24.61

‡ indicates partial year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR‡
Mean	0.54	1.36	1.92	1.80	3.15	3.69	5.32	4.47	6.20	0.68	2.04	0.76	27.06
Standard Deviation	0.76	0.80	1.22	2.00	2.30	1.19	1.23	1.83	6.02	0.88	1.38	0.78	1.95
Minimum	0.00	0.84	0.84	0.00	0.72	2.52	3.96	2.40	0.48	0.00	0.48	0.00	25.68
Median	0.54	0.96	1.68	1.44	3.24	3.60	5.64	4.68	5.64	0.36	2.52	0.72	27.06
Maximum	1.08	2.28	3.24	3.96	5.40	5.04	6.36	6.13	12.48	1.68	3.12	1.56	28.44

‡ indicates period of record for station and excludes partial year results.

Table B3. Monthly and annual rainfall (inches) at station ELMAX_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1972‡	--	--	--	2.34	5.49	7.78	3.64	5.98	2.64	1.61	6.37	2.43	38.28
1973	5.48	1.61	1.57	6.10	3.93	4.85	7.58	5.51	11.12	2.61	1.66	0.97	52.99
1974‡	0.06	1.64	0.02	1.12	4.07	12.18	14.38	--	3.97	0.80	0.15	2.38	40.77
1975	0.33	2.28	2.01	3.79	11.83	5.96	10.47	6.31	4.81	4.54	0.81	0.44	53.58
1976‡	0.20	0.30	4.02	1.34	14.57	6.71	6.15	--	7.09	0.78	2.25	2.49	45.90
1977‡	2.10	0.96	0.69	0.51	9.82	3.21	8.82	2.50	--	--	4.67	2.82	36.10
1978‡	3.66	3.97	3.65	0.14	6.52	11.11	12.34	--	2.80	3.01	0.53	2.89	50.62
1979	5.32	0.78	0.85	2.29	4.41	3.25	6.20	6.83	18.20	0.66	0.62	1.21	50.62
1980	1.58	3.10	1.73	2.43	4.21	6.55	7.53	3.71	1.79	0.53	4.33	1.04	38.53
1981	0.30	2.37	1.56	0.21	3.83	4.20	4.30	9.83	5.98	0.83	1.51	0.15	35.07
1982	2.31	1.89	4.74	4.94	5.41	10.88	6.70	6.13	7.94	1.98	1.73	0.99	55.65
1983	3.26	5.71	5.56	1.69	1.84	9.48	2.10	4.86	3.81	2.79	1.22	4.17	46.49
1984‡	0.60	2.79	--	--	7.06	9.23	7.14	2.46	3.77	0.56	4.16	1.21	38.99
1985	0.63	0.38	1.57	2.48	1.49	10.14	10.55	5.77	7.23	1.94	1.83	0.56	44.57
1986	1.71	0.82	3.09	0.19	1.70	11.83	6.32	5.02	6.09	3.20	1.09	3.49	44.55
1987	1.55	1.08	5.43	0.10	2.53	6.60	5.10	2.38	13.10	4.12	9.16	0.48	51.63
1988	2.80	2.65	5.20	1.33	1.49	3.94	5.61	7.06	4.73	0.58	1.98	0.90	38.27
1989	4.44	0.34	3.64	1.83	2.29	6.66	11.97	7.17	5.49	1.32	2.09	3.13	50.37
1990	0.13	6.15	1.10	0.98	5.06	8.14	7.99	7.76	6.24	2.32	0.56	0.28	46.71
1991	3.64	1.74	1.80	3.90	4.94	5.01	11.98	10.53	2.60	4.53	0.56	0.98	52.21
1992	0.72	3.93	1.39	4.10	1.07	19.58	3.88	8.22	4.92	1.89	1.51	0.75	51.96
1993	4.35	2.93	7.17	3.96	4.39	7.42	7.25	9.07	5.05	4.87	4.13	0.90	61.49
1994‡	3.72	3.04	3.02	2.98	3.05	13.31	15.57	11.22	12.36	--	3.76	2.92	74.95
1995‡	2.73	5.56	4.32	4.54	2.05	12.46	9.16	--	--	8.54	2.45	0.42	52.23
1996	4.67	0.36	8.69	0.93	7.40	10.90	2.84	11.68	4.86	5.19	0.18	3.84	61.54
1997‡	1.75	1.96	2.30	8.20	--	--	11.45	8.48	10.48	2.36	14.22	9.17	70.37
1998‡	7.44	9.23	8.29	0.99	2.66	--	--	--	--	--	--	--	28.61

‡ indicates partial year.

Table B3. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR*
Mean	2.52	2.60	3.34	2.44	4.74	8.46	7.96	6.75	6.54	2.57	2.83	1.96	49.19
Standard Deviation	1.98	2.14	2.37	2.03	3.28	3.83	3.54	2.72	3.94	1.95	3.13	1.91	7.48
Minimum	0.06	0.30	0.02	0.10	1.07	3.21	2.16	2.38	1.79	0.63	0.13	0.15	35.07
Median	2.21	2.12	3.02	2.06	4.14	7.78	7.39	6.57	5.27	2.15	1.78	1.13	50.62
Maximum	7.61	9.23	8.69	8.20	14.57	19.38	15.57	11.68	18.20	8.54	14.22	9.17	61.54

* indicates period of record for station and excludes partial year results

Table B4. Monthly and annual rainfall (inches) at station PEAVINE_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1972‡	--					--	6.51	9.20	1.81	2.42	5.69	1.89	27.52
1973	5.67	1.74	1.53	2.30	4.86	6.92	8.42	5.22	5.61	1.57	0.25	1.98	45.05
1974	0.36	2.02	0.03	0.86	5.73	10.56	7.28	6.09	5.30	0.47	0.31	1.21	40.22
1975	0.31	1.77	1.71	0.47	6.42	5.39	4.05	3.09	7.76	3.60	0.38	0.47	35.42
1976	0.30	0.57	0.71	0.69	11.38	5.66	6.71	9.46	6.91	0.84	2.31	1.95	47.49
1977	0.99	0.71	1.47	0.22	5.97	5.68	4.56	4.50	8.61	0.95	4.26	2.59	40.51
1978†	1.38	2.52	2.93	0.15	5.78	11.30	12.05		8.72	1.73	2.20	2.84	51.60
1979	5.99	0.75	0.81	3.24	12.63	1.56	4.87	9.73	8.94	0.11	1.10	2.83	52.86
1980‡	2.14	3.64	1.54			3.76	8.28	3.09	6.09	1.43	3.35	1.57	34.89
1981	0.25	3.43	2.30	0.14	2.34	2.76	1.90	6.37	6.36	3.07	1.25	0.24	30.31
1982	1.38	3.40	6.83	5.44	7.78	7.63	5.34	7.26	7.00	1.96	1.48	1.21	56.38
1983	4.17	8.55	5.26	2.38	0.40	11.80	2.89	3.00	5.21	3.95	1.18	3.79	51.58
1984	0.37	3.94	2.55	2.76	9.79	6.21	5.69	4.14	3.98	0.91	3.66	1.03	45.03
1985	0.82	0.29	2.21	2.51	3.06	4.99	7.45	4.65	9.81	2.45	2.72	1.54	42.50
1986‡	2.07	0.60	2.33	0.24	3.04	10.82	5.91	-	--	3.81	1.03	3.92	35.77
1987	1.57	0.76	5.50	0.98	5.06	8.94	6.84	2.38	14.01	5.89	6.75	0.56	59.24
1988	2.49	1.72	5.65	1.04	2.46	4.06	8.54	9.60	3.13	2.13	5.13	2.21	48.16
1989	2.02	1.07	5.59	2.09	1.22	5.80	4.02	5.75	6.01	5.71	2.43	3.49	45.20
1990	0.22	5.06	0.91	0.84	2.09	5.54	8.29	3.16	3.54	5.25	0.25	0.27	35.42
1991	4.56	2.23	4.84	2.32	0.16	2.87	1.81	8.77	2.87	3.55	0.77	0.07	34.82
1992‡	1.22	--		3.50	2.24	11.93			3.63	3.04	0.71	0.76	27.03
1993	6.66	3.74	5.96	4.28	2.31	7.23	7.20	5.72	5.39	6.08	1.12	1.74	57.43
1994	3.30	4.29	2.90	6.06	3.97	15.45	8.64	5.99	12.06	4.96	5.24	2.97	76.83
1995	2.24	3.82	3.08	8.13	3.42	7.77	11.79	12.22	5.29	7.03	0.88	0.46	66.13
1996	2.95	1.41	7.74	1.65	11.86	5.14	1.47	14.30	1.35	3.87	0.59	2.01	54.34
1997	4.15	1.10	1.47	3.21	5.51	6.85	7.78	11.61	9.29	2.83	8.73	6.67	69.33
1998‡	5.01	8.89	12.99	5.21	1.14						--	--	33.57

‡ indicates partial year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR
Mean	2.40	2.72	3.54	2.43	4.84	7.06	6.33	6.75	6.35	3.11	2.45	1.97	49.40
Standard Deviation	1.96	2.26	2.89	2.10	3.54	3.36	2.76	3.30	3.08	1.94	2.27	1.51	11.79
Minimum	0.22	0.29	0.03	0.14	0.16	1.56	1.47	2.35	1.35	0.41	0.25	0.07	30.31
Median	2.05	2.02	2.55	2.30	3.97	6.21	6.71	5.99	6.01	2.89	1.37	1.82	47.83
Maximum	6.66	8.89	12.99	8.13	12.63	15.45	12.05	14.30	14.04	7.03	8.73	6.67	76.83

* indicates period of record for station and excludes partial year results

Table B5. Monthly and annual rainfall (inches) at station MAXCEY N_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1974‡	--	--	--	--	2.15	9.25	9.45	4.39	2.60	0.95	0.35	2.14	31.28
1975	0.45	2.06	1.89	1.56	6.59	5.25	4.62	5.46	5.18	2.35	0.94	0.68	37.03
1976	0.22	0.43	2.26	0.96	11.11	3.92	7.02	7.24	6.98	1.51	1.92	1.51	45.08
1977	1.34	0.91	0.95	0.06	3.59	6.38	6.43	4.85	6.93	2.16	6.10	1.79	41.49
1978	1.78	3.34	3.04	0.21	5.14	12.76	9.83	1.29	3.29	1.51	0.84	2.61	45.64
1979‡	7.74	0.71	0.73	2.40	6.40	4.96	--	--	5.53	1.07	0.98	1.55	32.07
1980	2.19	3.50	1.30	2.21	4.57	3.00	5.65	4.62	1.80	0.52	3.04	1.70	34.10
1981‡	0.24	2.26	2.62	0.06	2.00	6.95	5.18	--	8.02	3.06	2.31	0.20	32.90
1982‡	1.54	2.02	5.29	5.50	5.76	6.78	6.51	--	--	0.03	1.13	0.55	35.11
1983	3.30	7.14	3.45	2.02	1.34	9.98	4.71	4.98	5.33	1.63	1.47	4.36	49.71
1984	0.34	3.32	2.07	2.64	5.04	5.63	7.84	3.65	4.57	0.04	3.66	1.31	40.12
1985	0.72	0.33	1.25	1.88	2.07	6.02	6.13	6.23	4.81	2.91	1.68	0.74	34.77
1986	2.04	0.74	2.81	0.11	1.70	13.52	8.71	5.27	5.12	4.23	0.80	2.74	47.79
1987	1.16	0.45	5.02	0.09	2.93	5.32	6.01	0.95	9.81	4.40	7.05	0.37	43.56
1988	2.66	1.57	3.99	0.92	0.90	4.64	8.91	5.12	1.67	0.59	1.95	0.70	33.62
1989	3.65	0.60	3.21	1.18	1.46	6.91	0.68	7.58	3.80	2.83	1.98	2.09	35.97
1990	0.09	4.91	0.50	0.37	3.09	9.16	6.63	6.72	2.75	4.06	0.66	0.51	39.45
1991	3.62	1.84	3.25	3.52	1.74	5.16	5.16	4.45	2.69	1.66	0.29	0.83	34.21
1992	0.66	2.92	1.00	2.73	0.58	17.20	5.59	10.70	5.38	1.19	1.82	0.62	50.39
1993	4.34	1.96	4.18	2.50	3.01	2.94	4.87	8.26	5.30	4.11	1.30	0.76	43.53
1994	1.93	3.39	1.28	3.13	0.77	11.03	6.28	5.59	8.45	3.02	2.72	2.40	49.99
1995	1.58	3.00	2.16	4.60	0.92	7.29	3.82	12.53	4.95	6.08	1.48	0.34	48.75
1996	2.27	0.58	6.03	0.97	4.89	8.00	5.17	9.44	2.10	2.50	0.54	1.96	44.45
1997	1.61	2.09	1.83	3.85	3.55	5.47	7.21	8.79	6.45	0.81	6.63	2.87	51.16
1998‡	6.71	6.24	6.56	1.36	1.03	--	--	--	--	--	--	--	21.90

‡ indicates partial year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR†
Mean	2.17	2.35	2.78	1.87	3.29	7.40	6.19	6.10	4.94	2.22	2.15	1.47	42.54
Standard Deviation	1.95	1.82	1.70	1.51	2.46	3.48	2.01	2.81	2.18	1.56	1.91	1.03	6.08
Minimum	0.09	0.33	0.50	0.06	0.58	2.94	0.68	0.95	1.67	0.03	0.29	0.20	33.62
Median	1.70	2.04	2.44	1.72	2.93	6.58	6.13	5.46	5.12	1.91	1.58	1.41	43.55
Maximum	7.74	7.14	6.56	5.50	11.11	17.20	9.83	12.53	9.81	6.08	7.05	4.36	51.16

† indicates period of record for station and excludes partial year results.

Table B6. Mean and annual rainfall (inches) at station TICK ISL_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1974‡	--	--	--	--	7.23	15.45	--	--	8.56	0.46	--	--	31.70
1975‡	--	--	1.96	2.39	6.82	3.70	8.84	7.88	8.32	6.23	0.86	0.78	47.78
1976	0.47	0.73	1.21	1.11	8.19	6.92	5.40	7.15	9.13	0.68	2.15	1.50	44.64
1977	1.62	0.78	0.55	0.57	3.07	6.99	4.44	6.16	6.88	3.62	3.00	1.61	39.29
1978	2.74	3.88	1.72	0.16	8.10	11.71	14.86	2.73	8.22	3.01	0.45	3.00	60.58
1979	6.56	0.62	0.99	2.76	5.82	6.34	3.02	7.73	13.58	2.43	0.04	0.30	50.19
1980	0.88	4.75	1.53	3.35	5.97	8.05	9.83	9.89	6.39	0.74	5.28	1.47	58.13
1981‡	0.50	--	2.02	0.11	3.61	5.70	4.69	13.77	5.46	1.03	1.73	0.10	38.72
1982	1.62	3.02	6.59	4.56	7.70	9.88	9.25	2.26	11.46	5.65	2.35	1.05	65.39
1983	4.19	8.53	5.21	2.36	1.46	8.15	4.65	2.19	5.36	2.15	1.58	4.81	50.63
1984	0.43	2.65	2.24	2.28	10.12	5.71	5.58	7.62	3.34	1.37	4.95	1.01	47.30
1985	0.58	0.35	1.93	1.98	0.78	9.86	3.34	2.80	6.56	1.56	2.36	2.38	34.48
1986‡	2.34	0.98	3.49	0.18	2.55	14.06	7.04	5.82	4.50	3.78	--	3.60	48.34
1987	1.45	0.59	5.80	0.02	3.10	9.75	3.61	0.71	10.02	4.39	7.24	0.73	47.41
1988	1.99	2.72	4.88	1.13	0.89	5.14	6.24	7.50	1.95	0.67	2.57	0.89	36.57
1989	4.60	0.43	3.22	1.72	1.30	6.25	7.32	4.44	4.90	1.19	2.12	2.82	40.31
1990	0.35	3.98	1.17	0.39	4.18	11.11	9.42	3.80	9.41	3.24	1.12	0.53	48.70

Table B6. continued.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1991	2.91	1.07	5.13	4.27	8.68	7.72	7.08	9.07	2.57	6.31	0.88	0.52	56.21
1992[†]	0.73	3.06	1.52	3.24	2.31	15.12	6.42	11.98	2.16	1.40	--		47.97
1993	4.90	1.41	5.83	3.37	1.82	3.65	6.47	13.85	7.31	2.53	3.68	0.88	55.75
1994	2.91	2.95	1.14	2.78	2.74	13.16	7.22	6.79	4.19	1.09	3.57	2.55	52.51
1995[‡]	1.68	3.62	4.38	4.37	0.83	5.68	6.75		--	1.79	0.89	0.43	30.42
1996[‡]	3.29	0.39	5.88	--	4.84	2.56	2.79	M	1.14	5.98	0.13	1.73	28.83
1997	1.90	0.30	2.02	5.26	3.25	7.68	6.93	4.85	10.48	1.55	11.71	7.72	63.75
1998[†]	5.85	9.18	7.02		--			--		-	--		22.05

[†] indicates partial year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR[†]
Mean	2.37	2.55	3.23	2.70	4.30	8.35	6.60	6.62	6.61	2.66	2.65	1.83	49.93
Standard Deviation	1.83	2.47	2.07	1.61	2.85	3.61	2.72	3.71	3.29	1.87	2.77	1.78	9.12
Minimum	0.35	0.35	0.58	0.02	0.78	2.56	2.79	0.71	1.14	0.46	0.04	0.10	31.18
Median	1.90	2.03	2.13	2.32	3.13	7.70	6.47	6.29	6.56	2.07	2.12	1.26	50.19
Maximum	6.56	9.18	7.02	5.26	10.12	15.45	14.86	13.98	13.58	6.31	11.71	7.72	65.39

[†] indicates period of record for station and excludes partial year results.

Table B7. Mean and annual rainfall (inches) at station BONEY.WS_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1975[†]			--	--	5.97	7.13	-		7.00	3.80		--	21.90
1976[‡]			-	--		-	3.64	4.09	5.46	0.80	1.63	2.47	17.49
1977	0.92	0.96	1.16	0.06	3.87	4.29	3.44	4.38	4.80	1.04	5.05	2.34	31.31
1978	2.25	2.91	3.06	0.00	4.61	8.96	14.63	4.52	6.73	2.60	1.55	2.48	54.33
1979	6.57	1.00	1.39	3.44	3.78	4.04	0.75	3.18	8.91	0.08	1.86	1.24	35.74
1980	1.51	3.32	1.74	3.22	2.69	7.38	5.93	4.36	2.65	0.64	3.08	0.98	32.50
1981	0.73	2.89	1.14	0.17	4.88	8.05	3.55	3.83	3.51	1.50	0.57	0.06	30.03
1982	1.46	2.68	5.27	5.65	4.07	9.07	9.91	10.20	6.42	2.84	3.75	0.07	61.39
1983	2.20	7.61	4.85	1.63	0.86	11.12	3.71	3.39	3.81	1.45	1.30	3.51	45.37
1984	0.35	3.55	2.48	2.66	8.90	7.93	5.88	3.72	2.34	0.52	5.08	0.49	43.90
1985	1.07	0.34	2.26	2.21	2.16	6.23	5.47	6.03	7.05	1.86	2.89	1.09	38.66
1986	2.06	0.91	0.51	0.22	2.20	3.33	7.51	3.22	1.95	4.77	0.37	3.75	30.80
1987	1.23	0.88	5.97	0.58	4.47	6.62	7.24	0.93	7.77	4.87	7.61	0.69	48.86
1988	2.80	2.52	3.12	1.30	1.96	4.94	8.20	4.94	2.41	0.29	2.25	0.96	34.69
1989[‡]	2.15	1.03	3.34	1.31	1.60	4.88	7.43	7.23	7.02		-	--	36.02

[†] indicates partial year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR[†]
Mean	1.91	2.36	2.79	1.73	3.68	6.28	6.19	5.47	5.19	1.79	2.85	1.55	40.63
Standard Deviation	1.60	1.93	1.71	1.68	2.09	2.56	3.15	2.30	2.27	1.52	2.07	1.24	10.20
Minimum	0.23	0.34	0.51	0.00	0.86	2.38	0.75	0.93	1.95	0.08	0.37	0.06	30.03
Median	1.51	2.52	2.48	1.34	3.58	6.43	5.91	5.91	5.46	1.48	2.25	1.09	37.20
Maximum	6.57	7.61	5.97	5.65	8.90	11.12	14.63	10.20	8.91	4.87	7.61	3.75	61.39

[†] indicates period of record for station and excludes partial year results.

Table B8. Monthly and annual rainfall (inches) at station S65B_R.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1965‡	--	--	--	--	--	7.24	--	6.15	4.79	3.38	0.40	1.65	23.61
1966	3.53	2.33	0.63	1.75	7.73	8.05	6.03	4.98	4.42	3.64	0.10	0.56	43.75
1967	0.89	3.47	0.51	0.14	0.92	8.03	5.73	3.68	5.73	1.66	0.10	1.97	32.83
1968	0.84	1.21	0.97	0.44	5.70	13.49	7.14	5.00	5.21	1.80	2.35	0.45	44.60
1969	1.76	1.57	6.69	3.36	3.54	8.61	3.22	8.19	6.21	13.20	2.39	3.27	62.01
1970	3.89	1.91	5.25	0.08	4.63	2.98	8.62	2.85	5.28	2.04	0.04	0.47	38.04
1971	0.14	4.74	1.03	0.15	1.56	5.26	5.43	4.78	4.60	4.76	0.38	0.72	33.55
1972	1.14	3.31	2.66	1.18	2.22	8.70	5.11	4.69	3.43	1.10	3.36	1.52	38.42
1973‡	5.48	1.28	3.80	2.51	5.54	7.21	8.70	5.04	9.53	1.06	0.61	--	50.76
1974‡	0.19	2.89	0.17	--	--	--	11.23	6.25	--	1.16	0.24	1.63	23.76
1975	0.57	0.89	0.89	0.41	5.17	8.96	4.80	8.07	6.76	2.79	0.65	0.66	40.62
1976	0.33	0.96	1.14	0.98	7.40	9.00	2.99	4.53	6.45	0.68	2.03	1.56	38.05
1977‡	1.08	1.41	0.73	0.15	2.91	3.58	4.09	--	4.13	0.68	6.86	1.71	27.33
1978	1.08	2.23	2.22	0.04	2.33	7.71	15.54	5.35	4.08	2.39	2.77	2.66	48.40
1979	6.92	1.14	0.89	3.41	6.01	3.29	7.03	3.65	11.19	0.00	2.06	2.07	47.66
1980	1.93	3.51	1.69	3.65	3.17	2.59	5.98	5.11	2.21	0.61	2.00	0.94	33.39
1981	0.26	3.26	1.44	0.10	3.26	6.91	2.51	5.21	2.19	1.43	0.70	0.11	27.38
1982	1.20	2.00	5.41	6.32	3.40	6.93	6.28	10.15	6.34	4.59	1.64	1.55	55.81
1983	2.61	8.33	5.50	2.78	0.95	6.94	4.75	3.46	3.52	1.35	1.26	3.80	45.25
1984	0.34	2.61	2.78	3.49	9.61	7.38	8.37	4.96	2.19	0.50	4.35	1.07	47.65
1985	0.47	0.23	2.67	1.91	1.69	7.57	3.90	6.80	5.99	3.85	2.41	0.78	38.27
1986	1.74	0.63	2.48	0.13	2.31	10.39	5.04	1.63	3.73	5.55	0.40	3.47	37.50
1987	1.18	0.60	5.71	1.91	2.51	4.68	7.26	1.19	6.81	5.52	5.83	0.41	43.61
1988	2.06	1.71	4.14	1.06	1.10	5.39	6.70	8.46	2.45	0.68	2.97	1.65	38.37
1989	1.99	0.91	3.44	2.14	1.58	4.53	7.75	7.55	8.47	2.24	1.32	3.15	45.07
1990‡	0.52	4.38	1.24	1.11	--	10.93	9.37	8.90	6.24	2.35	0.71	0.72	46.47
1991‡	3.79	1.83	3.43	3.15	5.28	5.35	7.09	4.52	--	3.09	0.57	0.24	38.34
1992‡	0.39	2.76	0.96	4.09	1.16	15.18	1.37	11.14	3.19	--	1.28	0.56	42.08
1993	4.18	2.51	4.64	4.53	2.02	3.33	5.53	3.43	3.17	2.97	0.27	0.83	37.41
1994	2.19	2.54	1.93	6.25	4.21	11.84	9.26	5.69	6.76	2.25	4.19	2.59	59.70
1995	1.52	3.07	2.28	4.20	2.63	6.80	6.75	16.53	3.96	4.32	0.63	0.53	54.92
1996	3.36	1.19	6.02	1.21	6.74	7.48	4.73	5.23	3.58	2.66	0.67	1.72	44.59
1997	2.34	1.27	1.35	5.77	5.36	5.01	4.71	4.63	9.52	2.27	7.47	5.04	54.74
1998‡	4.37	8.96	9.32	3.24	2.44	0.89	--	--	--	--	--	--	29.22

‡ indicates partial year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR⊥
Mean	1.95	2.47	2.85	2.24	3.71	7.04	6.34	5.87	5.23	2.76	1.91	1.56	43.52
Standard Deviation	1.67	1.93	2.19	1.89	2.24	3.12	2.74	2.97	2.28	2.48	1.95	1.19	8.66
Minimum	0.14	0.23	0.17	0.04	0.92	0.89	1.37	1.19	2.19	0.00	0.04	0.11	27.38
Median	1.52	2.00	2.28	1.91	3.17	7.21	6.01	5.08	4.79	2.26	1.28	1.54	43.68
Maximum	6.92	8.96	9.32	6.32	9.61	15.18	15.54	16.53	11.19	13.20	7.47	5.04	62.01

⊥ indicates period of record for station and excludes partial year results.

Table B9. Monthly rainfall (inches) at stations KREFR and KRBNR.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
KREFI997‡	--	--	--	--	--	6.7	8.8	9.17	7.77	2.46	7.49	6.25	48.64
KREFI998‡	5.88	8.14	6.31	0.74	2.77	2.77	--	--	--	--	--	--	26.61
KRBNI997‡	--	--	--	--	--	--	--	--	--	--	0.14	0.81	0.95
KREFI998‡	4.96	12.13	--	2.42	0.75	0.87	--	--	--	--	--	--	21.13

‡ indicates partial year.

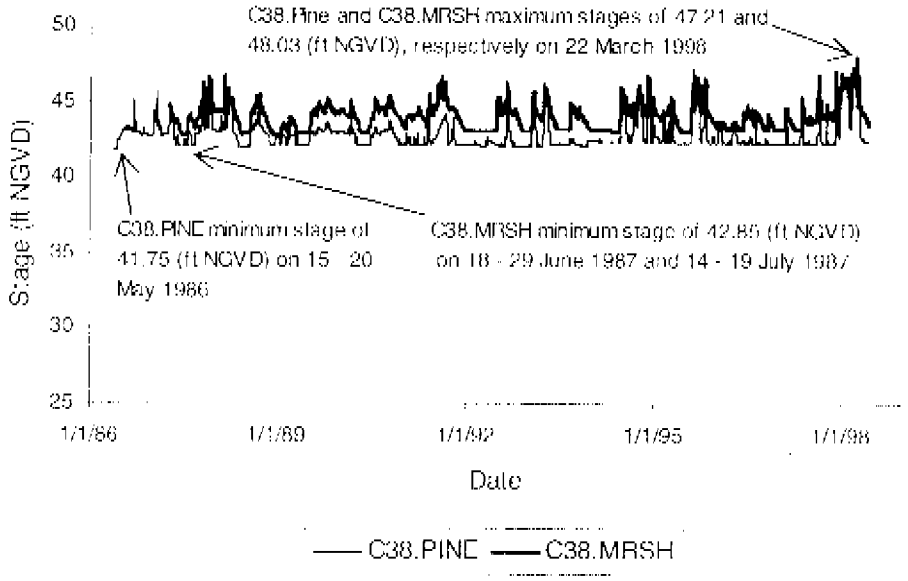

Figure B10. Daily stage at stations C38.MRSH and C38.PINE.

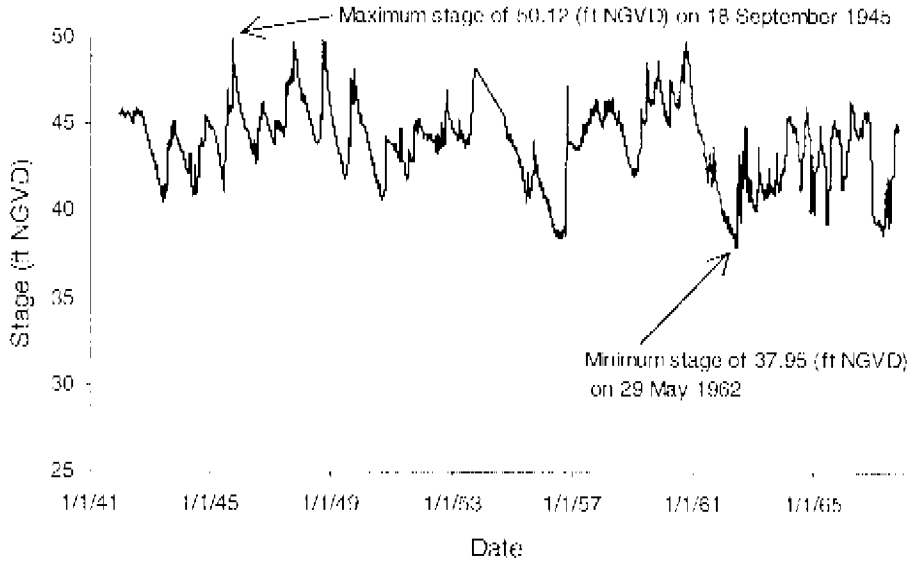

Figure B11. Daily stage at station FTKISS for years 1941 - 1967.

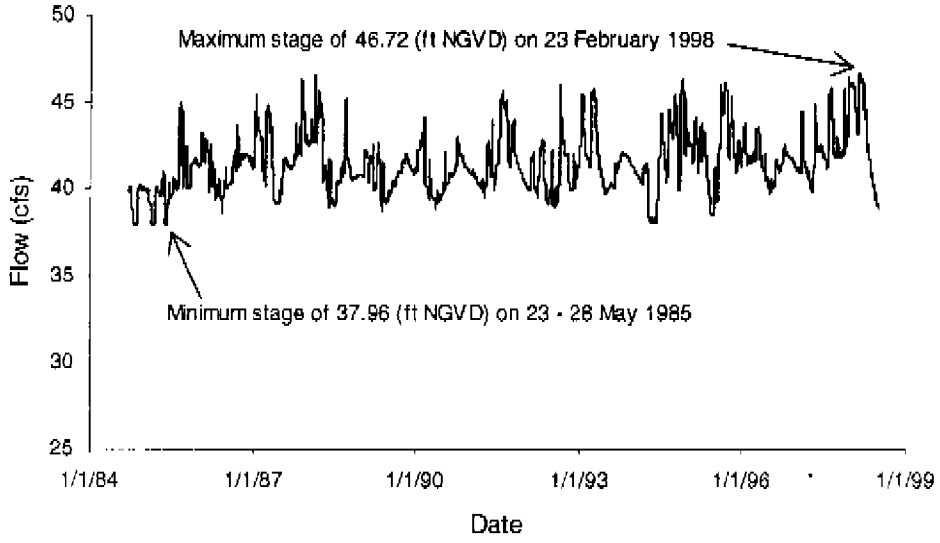

Figure B12. Daily stage at station FTKISS for years 1984 –1997.

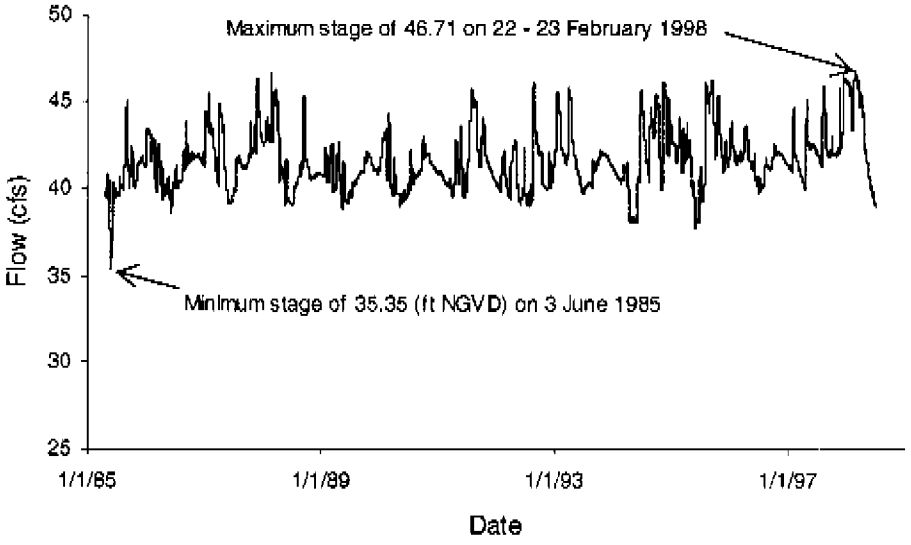

Figure B13. Daily headwater stage at station WEIR3_H.

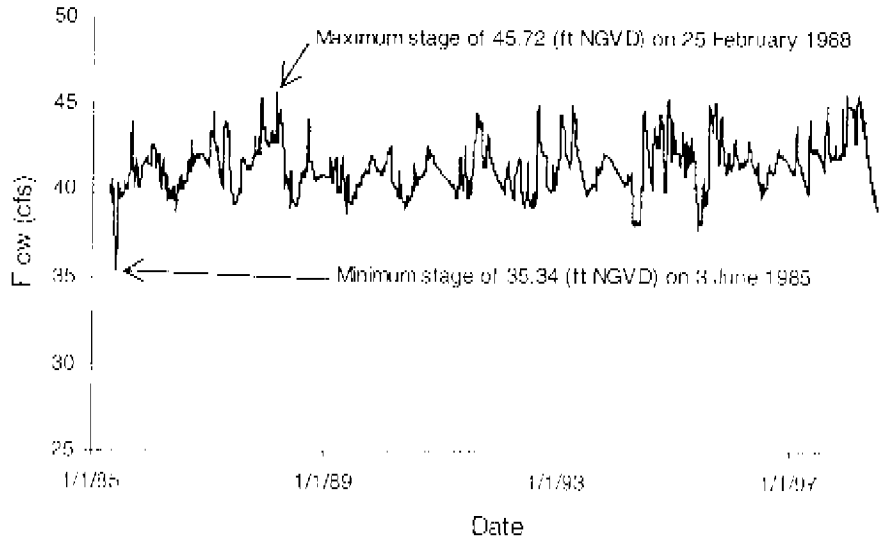

Figure B14. Daily tailwater stage at station WEIR3_T.

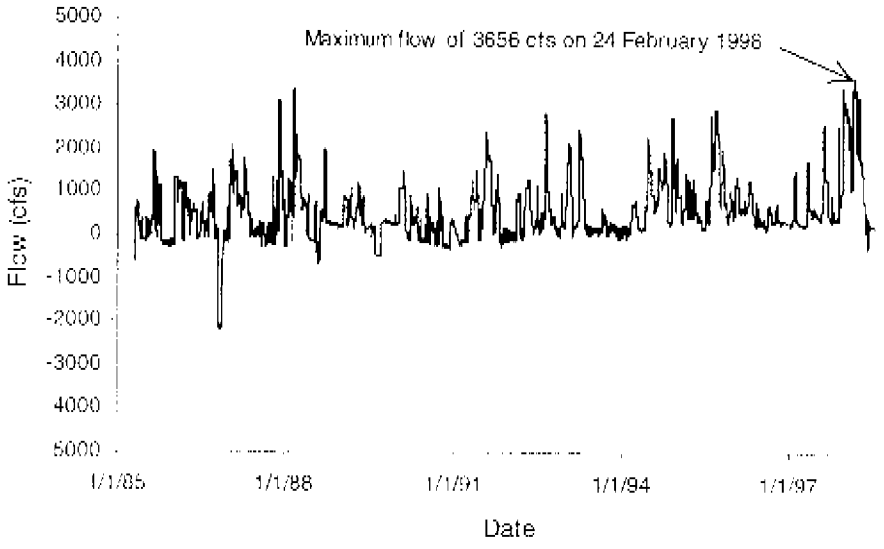

Figure B15. Daily flow at station WEIR3_W.

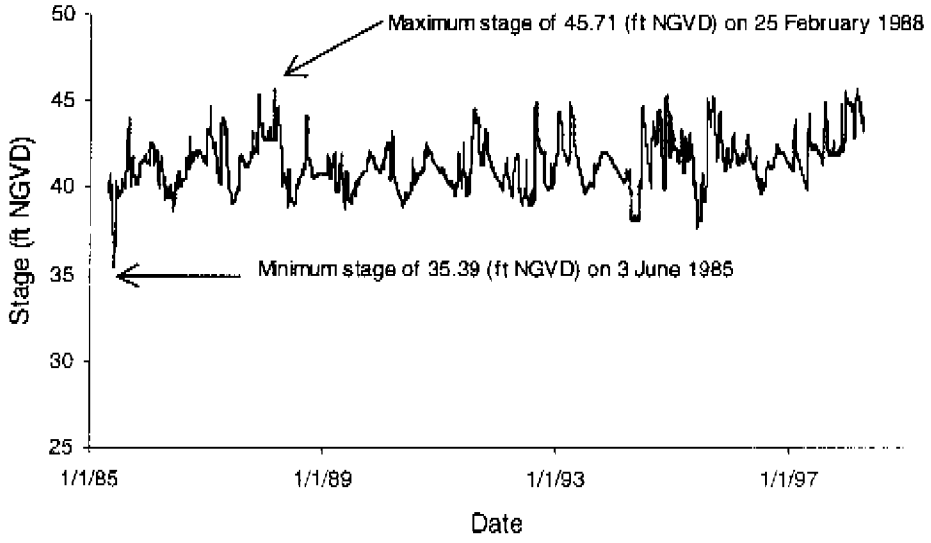

Figure B16. Daily headwater stage at station WEIR2_H.

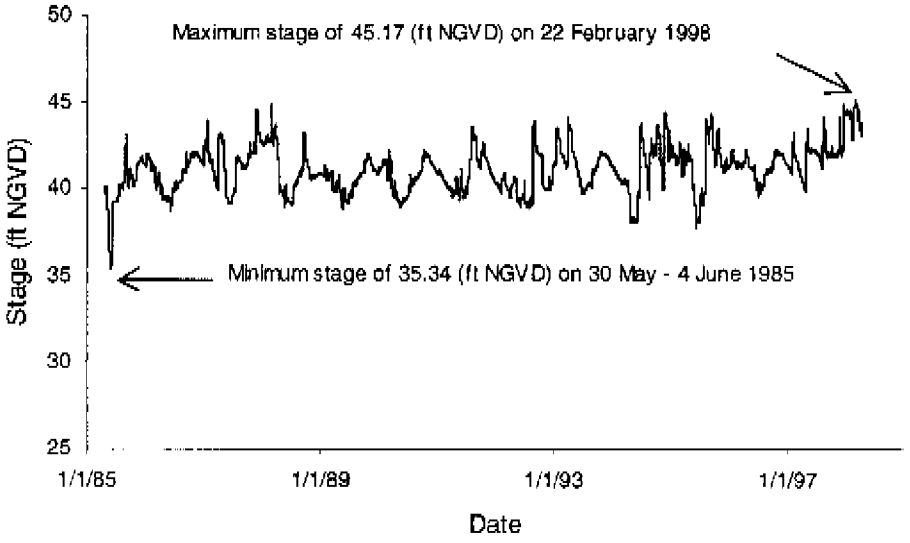

Figure B17. Daily tailwater stage at station WEIR2_T.

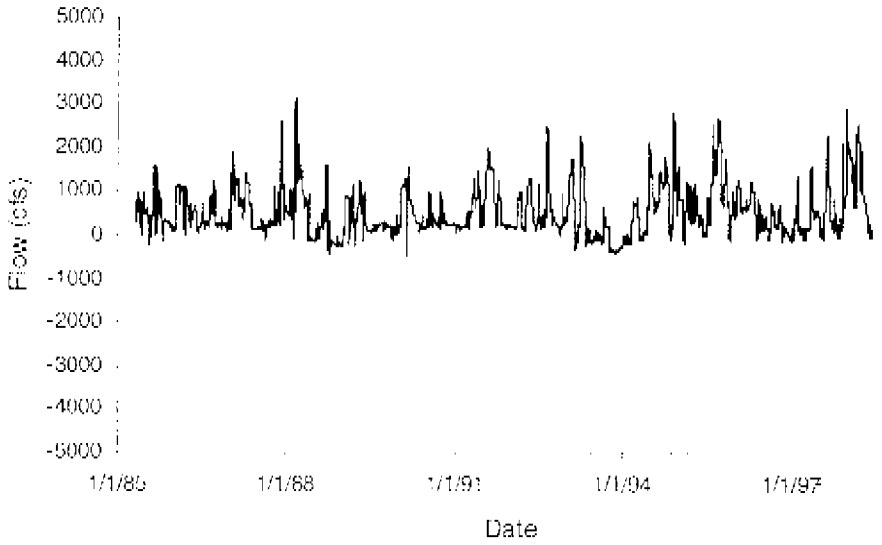

Figure B18. Daily flow at station WEIR2_W.

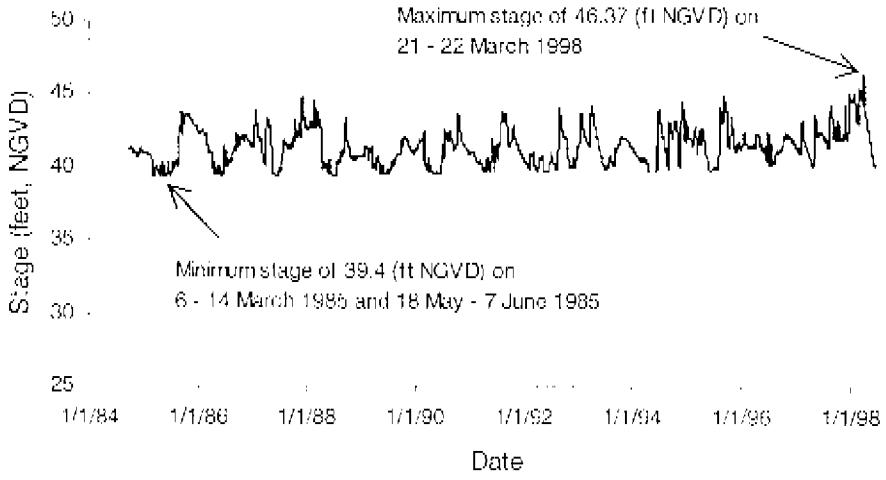

Figure B19. Daily stage at station AVON P3.

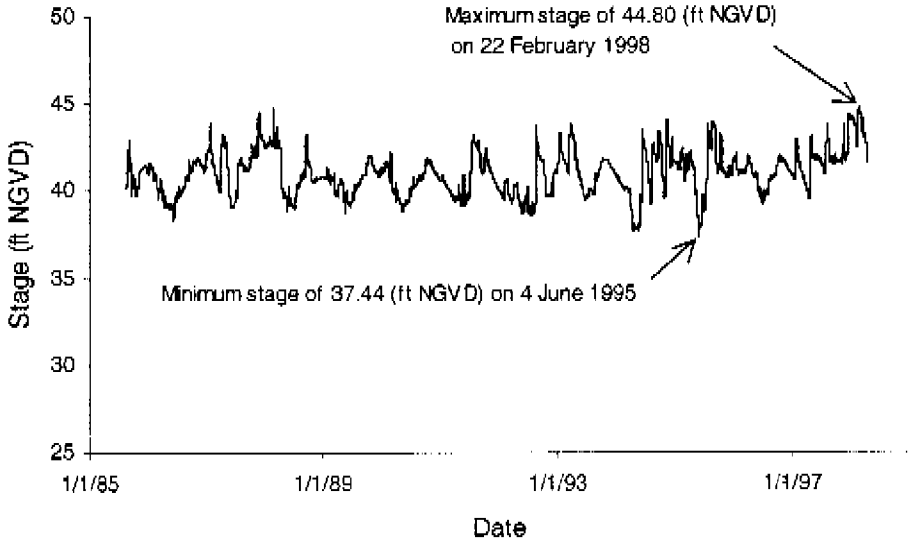

Figure B20. Daily headwater stage at station WEIR1_H.

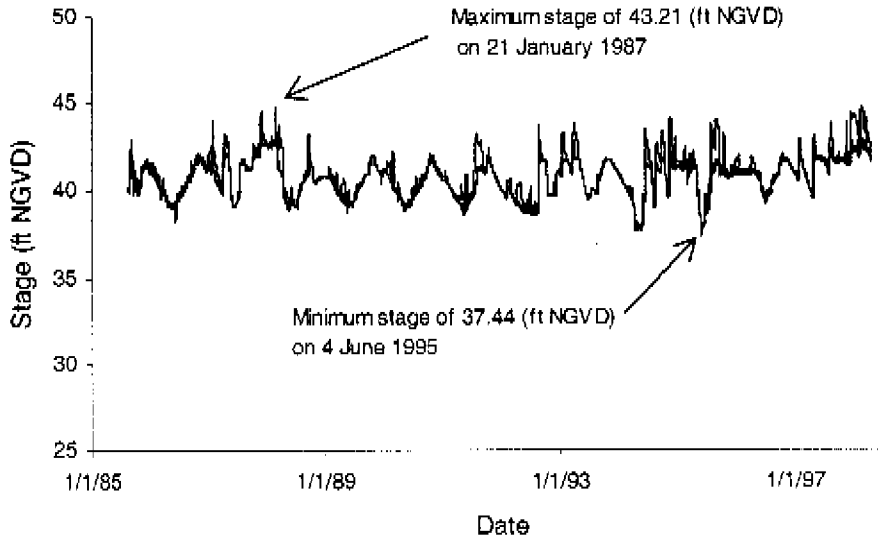

Figure B21. Daily tailwater stage at station WEIR1_T.

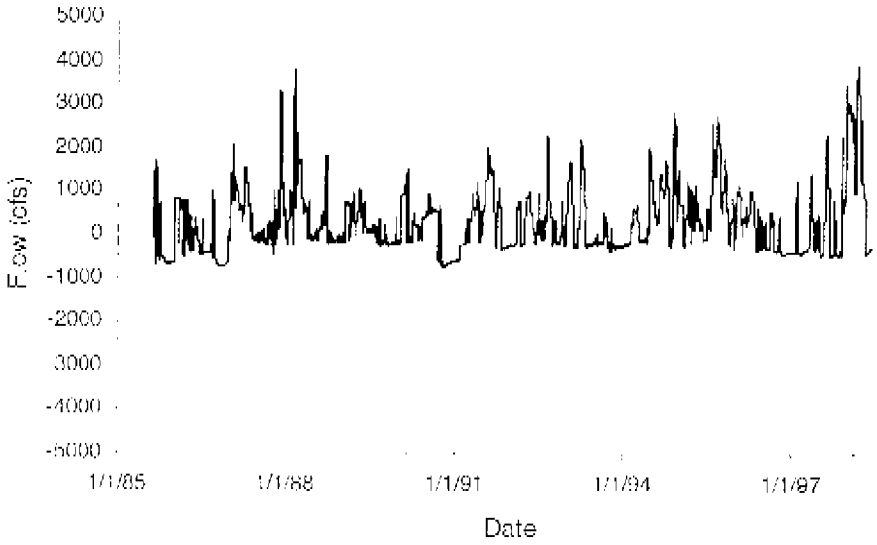

Figure B22. Daily flow at station WEIR1_W.

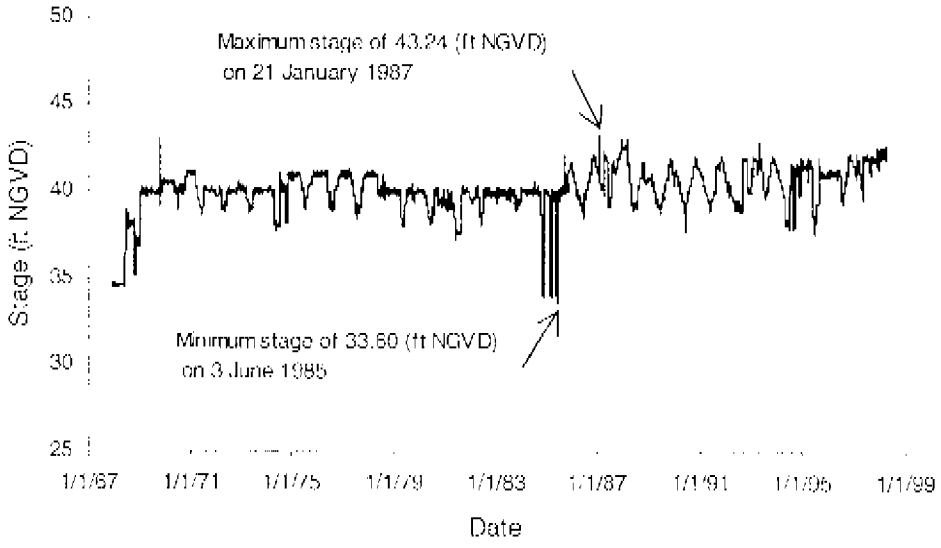

Figure B23. Daily headwater stage at station S65B_H.

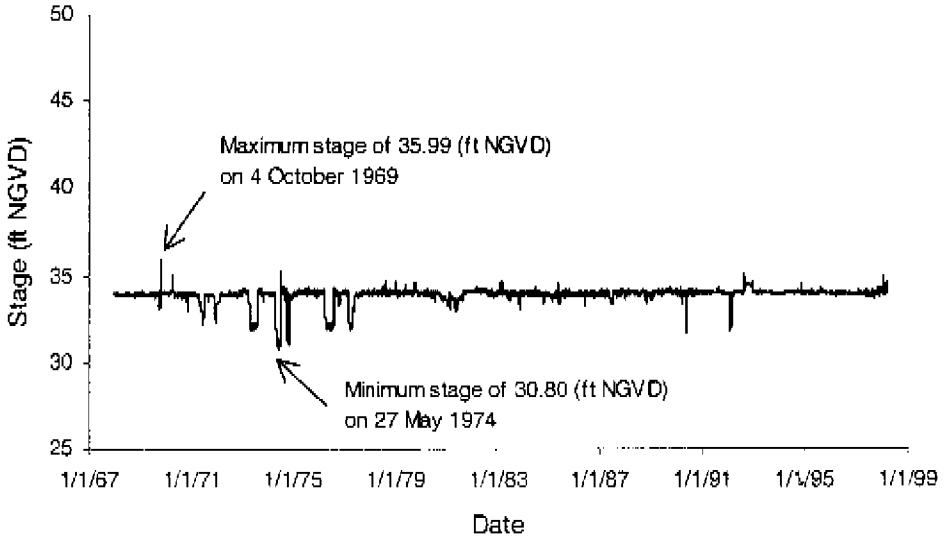

Figure B24. Daily tailwater stage at station S65B_T.

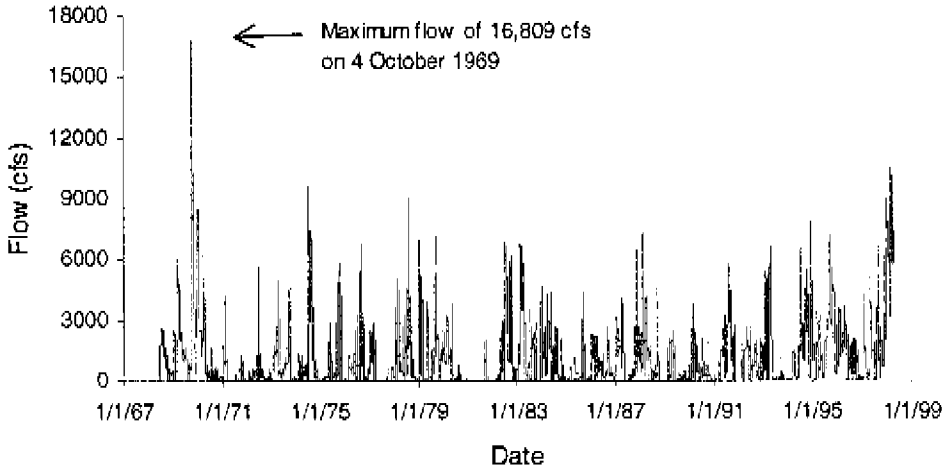

Figure B25. Daily flow at station S65B_S.

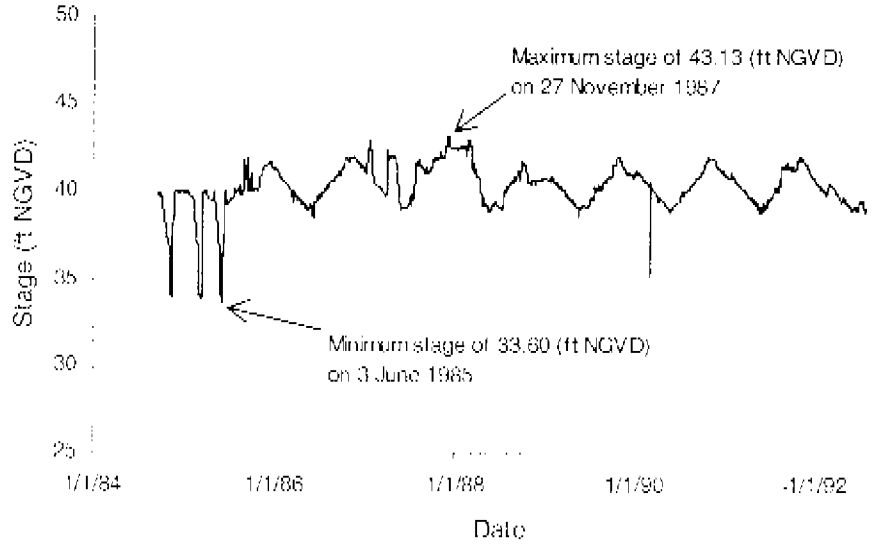

Figure B26. Daily headwater stage at station S65BX1_H.

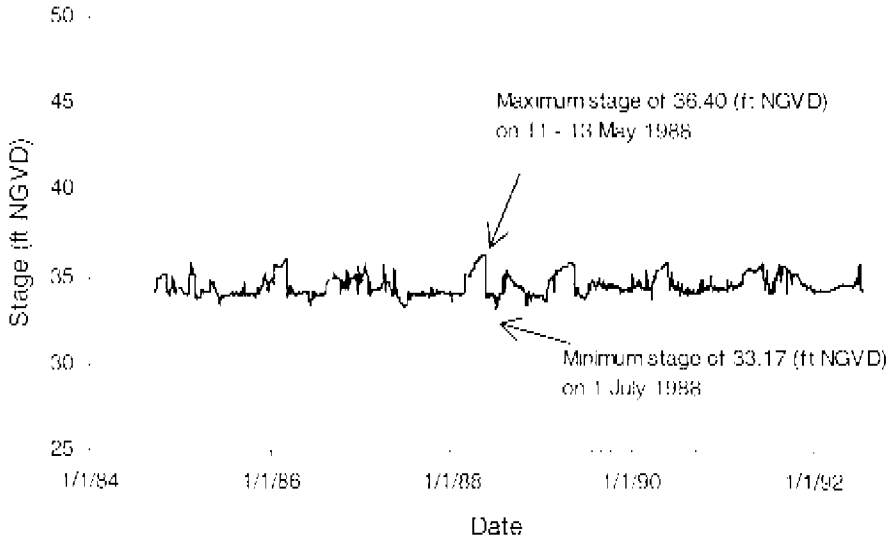

Figure B27. Daily headwater stage at station S65BX1_T.

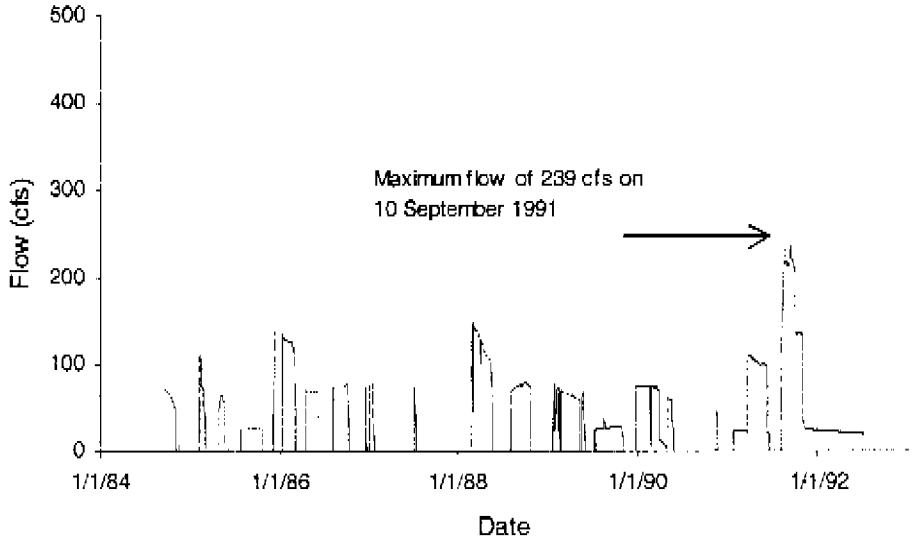

Figure B28. Daily flow at station S65BX1_C.

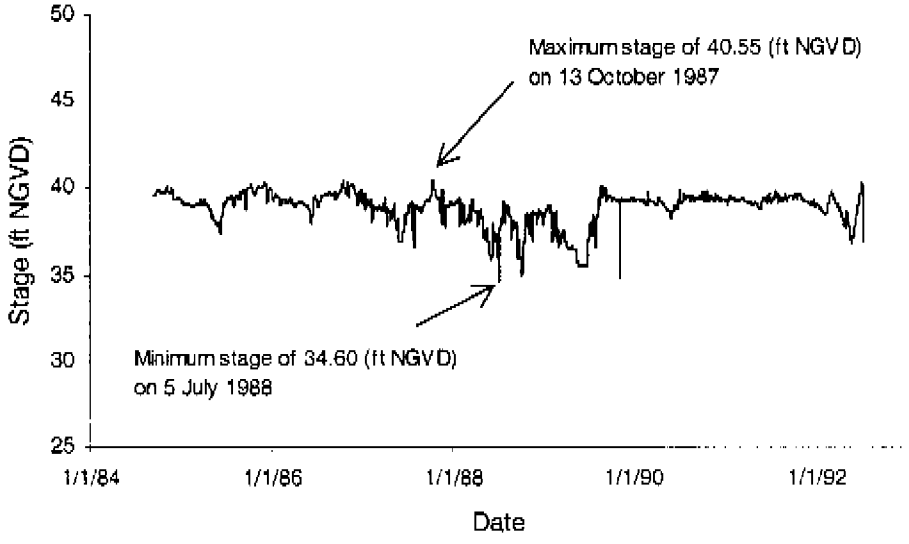

Figure B29. Daily headwater stage at station S65BX2_H.

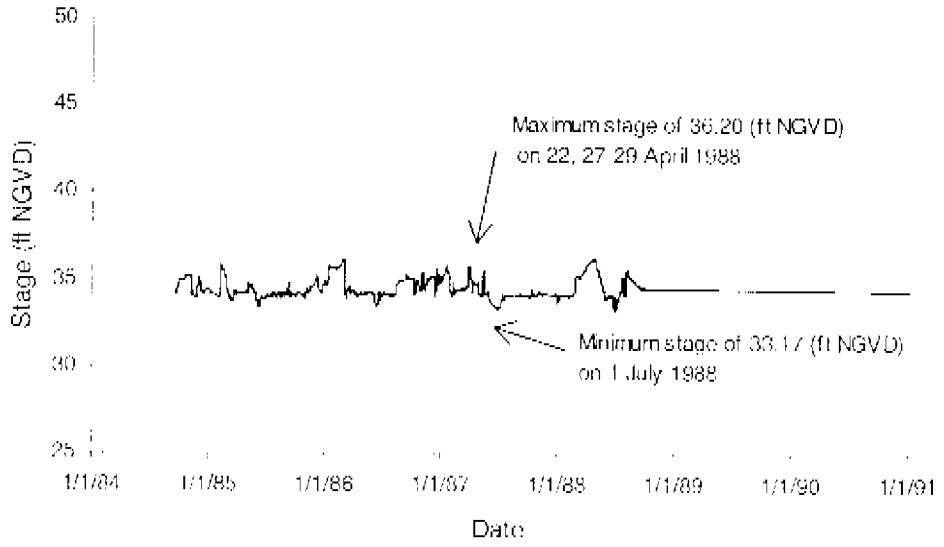

Figure B30. Daily tailwater stage at station S65BX2_T.

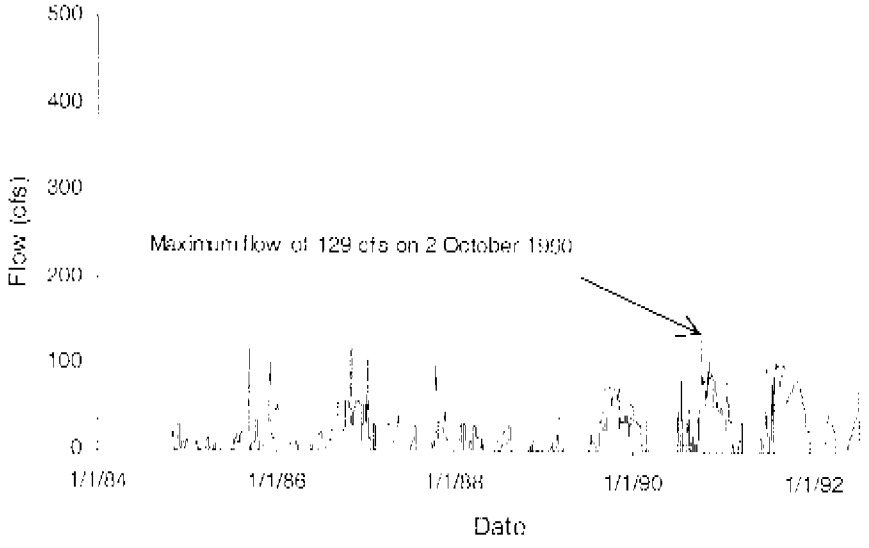

Figure B31. Daily flow data at station S65BX2_C.

Table B10. Average daily stage (ft NGVD) over each month at BONEY.M#, KRBN, KREN, and KRFN stations.

	1988 – 1989					1997 – 1998		
	Boney.M1	Boney.M2	Boney.M3	Boney.M4	Boney.M5	KRBN	KREN	KRFN
Jan	40.80	40.50	40.41	40.31	40.33	35.90	47.12	47.05
Feb	40.91	40.54	40.31	40.29	40.16	35.93	47.23	47.12
Mar	40.25	40.10	39.74	39.84	39.63	35.96	47.56	47.48
Apr	39.63	39.83	39.10	39.10	39.02	35.84	46.61	46.45
May	38.19	39.26	38.06	37.91	38.42	35.79	46.48	46.29
Jun	37.62	38.74	37.93	37.92	37.80	35.80	46.49	46.30
Jul	40.47	40.47	40.34	38.94	40.04	--	--	--
Aug	--	40.44	40.59	40.22	40.24	--	--	--
Sep	--	40.23	40.54	40.29	40.22	--	--	--
Oct	--	--	--	--	--	--	--	--
Nov	41.15	41.00	40.91	40.89	40.87	35.83	--	--
Dec	40.90	40.70	40.56	40.55	40.56	35.85	47.15	47.07

Table B11. Mean daily flows (cfs) over each month and year at Weir3_W.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg.[2]
1985[1]				-382	440	13	14	560	662	140	-193	-217	166
1986	942	1112	883	514	458	127	274	457	655	-1018	-1275	-15	232
1987	1443	1326	930	1277	267	81	106	-9	27	266	1433	1067	659
1988	438	829	1621	1113	658	-107	-33	72	1807	286	265	209	526
1989	418	599	555	760	612	203	153	-227	-175	321	279	266	306
1990	781	720	-69	478	311	-110	139	46	-61	260	-255	12	180
1991	134	-163	-26	482	953	318	1033	1923	690	775	58	-12	512
1992	-45	602	120	920	705	287	308	1085	750	295	209	306	460
1993	1522	589	697	1061	212	132	147	187	293	284	171	102	494
1994	148	141	627	359	142	907	1202	904	1355	1276	1386	1354	795
1995	782	566	762	805	385	249	591	1984	2203	1279	568	602	928
1996	1090	588	626	1086	355	348	250	479	549	409	318	269	575
1997	397	590	286	445	811	522	405	1532	456	391	835	2226	744
1998[1]	2483	2863	2827	1243	247	219							1513

[1] indicates partial years [2] indicates average for daily data over the year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR[1]
Mean	818	758	776	766	471	219	345	692	631	376	253	466	547
Standard Deviation	702	543	768	515	242	265	368	742	658	507	708	678	709
Minimum	-45	-163	-69	-382	142	-110	-33	-227	-175	-1018	-1275	-217	-2259
Median	781	602	627	782	412	176	250	479	655	298	265	266	540
Maximum	2483	2863	2827	1691	953	907	1202	1984	2203	1279	1433	2255	3659

[1] indicates statistics apply to daily period of record results.

Table B12. Monthly and yearly flow summations (ac-ft) at Weir3_W.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums
1985†				-3787	27047	791	875	34450	39389	8610	-11533	-13352	86427
1986	57930	61683	35818	30558	30635	6934	16870	28122	38964	-62609	-75893	-919	172033
1987	88728	73621	44892	75959	16428	2424	6531	-571	1578	16353	85281	65610	480774
1988	26957	47664	99667	66221	39032	-6373	-2002	4424	59945	17604	15798	12851	385728
1989	25703	33290	34128	45195	37619	7906	9438	-13947	-10426	19761	16603	16354	225570
1990	48035	40010	-4266	24876	19109	-6570	8518	2816	-3641	15974	-15334	736	134212
1991	8243	-9078	-1577	28732	58578	18923	63489	118255	41074	47629	-3457	-724	374036
1992	-2792	34618	7360	54731	43376	17051	18962	66724	44606	18345	12424	18805	338163
1993	93591	32698	42882	100603	13005	7850	9027	11503	17437	12556	10152	6244	361500
1994	9111	7812	38562	21347	8707	53981	67757	55581	80626	78467	82463	70938	579306
1995	48065	48071	46861	47880	23647	14807	36338	122014	131062	78661	33821	40690	675874
1996	66999	33821	39084	64613	23041	20704	15376	29433	20245	25139	18899	16512	377825
1997	24392	32743	15388	26485	49847	31088	24905	94185	27142	24014	49704	138652	542505
1998†	152684	114570	173846	73980	15213	13021							547276

†indicates partial year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums‡
Mean	49819	42425	44050	46957	28949	13038	21237	42538	37538	23116	16841	28646	387294
Standard Deviation	43092	30099	47219	27645	14872	15761	22118	45607	37940	34865	42111	41661	163169
Minimum	-2792	-9078	-4266	-3787	8707	-6570	-2002	-13947	-10426	-62609	-75893	-13352	134212
Median	48035	34618	38562	46538	25347	10463	15376	29433	38964	18345	15798	16354	375930
Maximum	152684	114570	173846	100603	58578	53981	67757	122014	131062	78661	85281	138652	675874

‡excludes partial year results.

Table B13. Mean daily flows (cfs) over each month and year at Weir2_W.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg.[2]
1985[1]				502	530	519	337	585	715	358	317	297	448
1986	884	1013	588	492	501	237	339	492	648	244	265	222	490
1987	1218	1189	688	1292	475	142	191	131	263	459	1230	880	676
1988	620	675	1406	1055	600	-91	9	272	748	-109	-178	-184	480
1989	277	525	525	822	618	135	150	206	216	240	141	141	350
1990	757	876	902	387	241	183	371	308	277	496	265	254	441
1991	204	194	248	685	998	468	1035	1645	727	734	254	225	619
1992	195	680	267	976	753	319	350	1016	741	316	266	280	520
1993	1321	330	484	1522	73	-113	-37	-15	240	-258	-351	-294	242
1994	137	-93	638	253	51	856	1042	894	1287	1144	1271	1055	692
1995	682	673	697	743	363	274	598	1783	2032	1189	451	647	837
1996	1064	607	656	1076	289	331	294	474	308	312	158	-45	449
1997	300	478	81	361	774	466	150	1389	548	254	722	1737	590
1998[1]	1625	1539	1692										1093

[1] indicates partial year. [2] indicates average for daily data over the year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR[1]
Mean	693	651	682	774	485	277	366	706	657	416	369	401	538
Standard Deviation	519	391	446	392	278	262	349	592	517	419	472	557	558
Minimum	-137	-93	81	253	51	-113	-37	-15	216	-258	-351	-294	-474
Median	682	673	638	743	501	237	331	492	648	316	265	223	546
Maximum	1625	1539	1692	1522	995	856	1042	1783	2032	1189	1271	1737	2160

[1] indicates statistics apply to daily period of record results.

Table B14. Monthly and yearly flow summations (ac-ft) at Weir2_W.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums
1985†				4979	35065	30889	20376	35974	42412	21534	18887	12130	222246
1986	54350	56235	36156	29281	30832	14123	20824	30254	38579	15023	15740	13667	355064
1987	74874	66060	42333	76879	29221	8436	11716	8065	15626	28244	73770	54084	489307
1988	38112	38836	86429	62781	36864	-5432	540	16726	44489	-6721	-10595	-11336	290694
1989	17013	29140	32165	48932	37978	6869	9238	12694	12858	14776	8406	8693	238761
1990	46555	48655	55529	22777	14841	10913	22814	18912	16460	30487	15669	15645	319258
1991	12567	10752	15241	36011	61355	27863	63618	101158	43271	47619	15125	13693	448273
1992	11729	39124	16437	58062	46288	18994	21549	62465	44104	19435	15813	23368	377368
1993	81230	18330	29765	90586	4506	-6727	-1061	-915	14292	-15857	-20915	-18062	175173
1994	-8428	-5185	39242	13875	3137	50930	64081	55001	76594	70356	75622	64868	500093
1995	41935	37382	42856	44194	22318	10348	36753	109643	120895	73104	26861	39763	606052
1996	65409	34924	40341	64034	17770	19716	12519	29165	17829	19159	8020	-2790	326095
1997	18429	26569	4951	21484	47576	27717	9236	85411	20580	15591	42961	106824	427328
1998†	99889	73232	104040										277161

†indicates partial year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums[1]
Mean	42590	36466	41960	44144	29827	16511	22477	43427	39076	25596	21951	24657	379455
Standard Deviation	31896	21717	27447	25650	17090	15591	20889	36382	30744	25762	28103	34244	121157
Minimum	-8428	-5185	4951	4979	3137	-6727	-1061	-915	12858	-15857	-20915	-18062	175173
Median	41935	37382	39242	44194	30832	14123	20376	30254	38579	19435	15740	13693	366216
Maximum	99889	73232	104040	90586	61355	50930	64081	109643	120895	73104	75622	106824	606052

[1]excludes partial year results.

Table B15. Mean daily flows (cfs) over each month and year at Weir1_W.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg.[‡]
1985[†]								340	152	259	-649	-682	-276
1986	397	612	119	-108	36	-296	-355	-400	-72	-696	714	-479	-168
1987	1181	1022	569	[illegible]	375	79	-59	-114	106	142	1487	903	558
1988	364	779	1521	1081	497	-54	-70	221	841	-113	-129	-137	391
1989	150	427	447	676	518	93	124	77	-64	-148	-212	-163	159
1990	531	824	201	287	86	362	554	562	-224	-512	-676	-622	113
1991	-588	-288	-105	747	742	245	854	1620	429	467	-292	-257	270
1992	-250	410	-97	708	546	101	202	865	534	15	-35	10	258
1993	1234	269	336	1473	-181	-205	-137	-137	62	-247	-263	-251	161
1994	-222	-173	507	131	-197	529	934	619	1156	1098	1178	987	559
1995	556	562	571	641	228	27	434	1790	2002	1126	302	346	716
1996	865	353	416	909	-133	3	-211	179	-242	-246	-426	-397	90
1997	-206	21	-367	37	271	138	-350	1325	-313	-303	432	2167	244
1998[†]	2582	2079	2448	334	-339								1415

[†] indicates partial year; [‡] indicates average for daily data over the year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR
Mean	510	531	504	593	203	72	160	535	335	25	-6	119	299
Standard Deviation	855	602	741	490	335	231	444	690	665	560	673	809	751
Minimum	-588	-288	-367	-108	-339	-296	-355	-400	-313	-696	-714	-682	-753
Median	397	427	416	641	228	60	33	340	106	-148	-212	-163	111
Maximum	2582	2979	2448	1473	742	529	934	1790	2002	1126	1407	2167	2979

[*] indicates statistics apply to daily period of record results

Table B16. Monthly and yearly flow summations (ac-ft) at Weir1_W.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums
1985†								11453	9015	-15932	-38613	-41907	-75984
1986	24412	33962	7341	-6433	2228	-17635	-21836	-24586	-4277	-42800	-42499	-29438	-121561
1987	72599	56769	34455	77992	23055	-4679	-3598	-6979	6286	8704	83746	55501	403850
1988	22355	44800	93517	59540	30583	-3195	-4312	13611	50037	-6935	-7703	-8411	283887
1989	9232	23735	27513	40246	31848	5529	7596	4743	-3788	-9087	-12614	-10039	114914
1990	32636	45779	12379	17080	5270	21550	34086	34581	-13336	-31498	-40250	-38236	80040
1991	-36138	-16014	-6477	20629	45633	14605	52529	99626	25524	28702	-17348	-15576	195696
1992	-14136	23602	-5994	42153	33594	6037	12418	53218	31158	910	-2100	612	181473
1993	75867	14925	20667	87634	-11122	-12221	-8453	-8419	3670	-15194	-15668	-15428	116257
1994	-13628	-9583	31165	8961	-6559	31463	57412	38039	68813	67490	70078	60713	404364
1995	34202	31193	35081	38171	13999	1584	26701	110091	119118	69244	17951	21246	518580
1996	54421	20331	25600	54063	-8165	115	-12978	10998	-14410	-15123	-25335	-24389	65127
1997	-12682	1192	-22543	-2174	22809	8194	-21500	81469	-18600	-18748	25730	133224	176373
1998†	158785	115453	150516	19888	-20864								423778

†indicates partial year.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums[1]
Mean	31379	29703	31017	35211	12485	4279	9839	32142	19939	1518	-356	6759	201583
Standard Deviation	51372	33439	45566	29162	20582	13741	27288	42731	39560	34448	40037	49753	176577
Minimum	-36138	-16014	-22543	-6433	-20864	-17635	-21836	-24586	-18600	-42800	-42499	-41907	-121561
Median	24412	23735	25600	38171	13999	3556	1999	13611	6286	-9087	-12614	-10039	178923
Maximum	158785	115453	150516	87634	45633	31463	57412	110091	119118	69244	83746	133224	518580

[1]excludes partial year results.

Table B17. Mean daily flows (cfs) over each month and year at S-65B control structure.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg [2]
1967 [1]	--	--		--	--	--	--	--	--	--	32	34	33
1968	35	33	33	34	33	1227	2093	1732	946	268	243	443	596
1969	1349	341	3109	2467	1353	1049	125	467	1486	8558	1981	3328	2145
1970	3551	1989	2221	2480	261	207	464	167	56	86	94	161	1016
1971	585	1842	252	0	0	0	320	86	288	466	73	20	326
1972	0	144	40	350	637	1089	909	269	100	28	82	182	321
1973	329	1442	1407	2358	1450	117	514	1597	2768	718	57	45	1048
1974	15	648	271	280	852	578	6666	5816	3623	536	120	29	1523
1975	25	14	153	865	1148	408	204	1253	1742	1157	588	74	663
1976	41	1285	1556	652	940	497	503	3209	1815	285	4	985	939
1977	1801	1314	1589	180	0	8	15	0	180	32	77	226	456
1978	1337	1862	2050	575	832	864	1791	4084	927	368	69	347	1346
1979	3081	2829	834	44	1147	35	275	468	371	2640	160	1180	1262
1980	1644	1657	1795	860	1331	47	50	226	94	0	0	5	642
1981	0	16	0	0	0	0	0	42	811	13	35	0	75
1982	0	0	39	377	1140	3419	3693	3540	2797	2742	271	79	1518
1983	502	4315	5485	4038	1158	199	1235	1852	895	0	0	1528	1752
1984	1628	2061	979	2658	2229	531	1021	1780	151	49	317	102	1104
1985	2	29	148	83	919	94	108	825	1354	445	45	208	349
1986	1637	1841	1122	864	875	312	496	729	1069	196	312	168	791
1987	2451	2419	1266	3185	875	2	73	131	322	865	2684	1832	1347
1988	985	1844	2498	2285	1136	49	159	297	1971	55	0	0	932
1989	535	3004	181	1517	1084	17	84	126	108	274	61	41	484
1990	1328	2054	719	715	906	108	597	451	241	817	154	24	618
1991	54	53	258	1018	1949	872	2311	4429	1309	1409	0	0	1148
1992	-	1087	250	1888	1450	506	659	1106	1220	394	285	393	764
1993	3630	1048	1360	4393	129	34	52	94	423	139	39	23	943
1994	49	94	1240	571	145	2524	2548	2138	3282	3224	3579	2741	1855
1995	1474	1690	2569	1694	806	468	1558	5321	5521	3518	337	1615	2210
1996	2925	1668	1867	2957	748	1041	501	1269	600	727	50	165	1193
1997	658	1317	201	906	2317	1130	470	4198	790	990	2581	5850	1774
1998 [1]	6854	5853	8278	--	--	--	--	--	--	-			7033

[1] indicates 'partial' year; [2] indicates average for daily data over the year.

Table B17. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR*
Mean	1239	1412	1419	1343	894	567	977	1580	1317	1033	505	703	1084
Standard Deviation	1530	1297	1726	1249	630	757	1398	1721	1292	1728	931	1278	1608
Minimum	0	0	0	0	0	0	0	0	56	0	0	0	0
Median	658	1317	1122	864	897	322	499	966	936	419	82	108	376
Maximum	6854	5853	8278	4393	2317	3419	6666	5816	5521	8558	3579	5850	16809

*indicates statistics apply to daily period of record results.

Table B18. Monthly and yearly flow summations (ac-ft) at S-65B control structure.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums
1967											256	2118	2374
1968	2051	1882	2045	1997	2035	73027	128997	106585	56278	16503	14445	27220	432960
1969	82958	18925	19158	246579	81934	62433	7660	28741	83646	526246	117864	204655	1382779
1970	218324	110487	167921	147565	16019	12545	28547	10255	3358	5308	5586	9888	735608
1971	35965	102287	14253	0	0	0	19656	5296	17155	28668	4320	1228	228829
1972	0	8257	2479	20811	39176	64771	57145	16550	5935	1720	4885	11203	232932
1973	20244	80130	86496	139150	82925	6988	31595	8591	164684	44127	3106	2729	753864
1974	950	36003	16640	16649	32730	34386	409808	357617	156097	32976	7147	1771	1102874
1975	1549	754	9582	51482	70577	24258	12546	73037	203642	71120	52858	4522	479727
1976	2549	73925	95670	38857	57777	29600	36893	197340	108017	17524	214	58708	718031
1977	110743	72953	97687	18715	0	0	912	0	10665	1985	4552	20031	378255
1978	76083	103424	126055	34382	21166	51422	110108	349230	55167	22633	4080	21366	902116
1979	189446	157139	51291	2646	70611	1984	16901	28749	220841	162359	9527	72921	984376
1980	101105	95592	110364	51280	81837	2805	3072	13883	5035	0	0	3101	466043
1981	0	875	0	0	0	0	0	2561	48267	801	1956	0	54463
1982	0	0	3396	22423	30105	203428	227097	217693	166433	168576	16136	4864	1069151
1983	30845	239072	337257	240295	31186	11861	75928	113881	55243	0	0	93984	1268133
1984	108109	118562	60195	158192	136455	19718	62810	107033	8989	2993	16839	6319	880854
1985	135	1603	9118	4931	56500	5617	6635	50754	80580	27356	2650	6647	252615
1986	108673	102226	69084	51383	50629	28575	30480	44811	63631	12070	18572	10838	572398
1987	150708	131323	77814	139506	53824	99	4507	8037	39139	53092	171603	112651	975552
1988	60574	106068	153673	136349	69853	2898	9779	18273	217280	2176	0	2	676902
1989	32916	55750	62169	90283	66665	1002	5181	7728	6417	16850	3616	2525	351101
1990	81647	114091	44234	42532	15792	6222	36687	27733	14313	50358	9732	1498	447178
1991	2314	1811	24606	68545	119555	51883	143076	272548	77916	86617	0	28	851003
1992	52	62504	24168	112324	89135	30203	46503	68000	72536	24207	16971	24185	554725
1993	223185	58218	82597	261429	7958	2049	3174	5788	25163	8519	2531	1458	682838
1994	3021	5217	76246	33954	8890	138288	186673	131486	195270	198235	212994	168524	1358796
1995	90646	93859	96150	100776	49760	27838	83482	327176	328553	216295	81928	102671	1599734
1996	179826	95968	111122	175946	45976	61955	30835	78053	38709	44672	2987	6472	869519
1997	40485	73150	12375	54026	142465	65872	28874	258121	47801	60887	141664	359733	1286632
1998*	421444	325080	508988										1255512

*Indicates partial year.

Table B18. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums*
Mean	76178	79064	87250	79889	54990	33714	60089	97140	78386	63492	30009	43254	752051
Standard Deviation	94059	72144	106138	74303	38715	45046	85959	105852	76882	106236	55439	78592	402025
Minimum	0	0	0	0	0	0	0	0	3358	0	0	0	54453
Median	40485	73925	69004	51432	55162	19147	30658	59377	55722	25782	4885	6647	723318
Maximum	421444	325080	508988	261429	142465	203428	409908	357617	328553	526246	212994	359735	1599734

*excludes partial year results.

APPENDIX C: S65A AND S65B SUB-BASIN RUNOFFS

Table C1. Mean daily flows (cfs) over each month and year at S-65 control structure.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg.‡
1969†	--	--	--	--	--	589	30	38	1021	5652	1335	2871	1565
1970	2837	2037	2549	2717	352	272	21	56	0	22	109	175	922
1971	759	2214	278	1	1	1	0	1	1	1	2	2	259
1972	1	2	3	346	530	277	762	104	1	24	40	2	175
1973	2	1085	1465	2406	1543	32	1	799	1673	527	6	17	791
1974	85	653	357	304	633	308	4352	4121	2183	507	47	2	1138
1975	41	76	167	1001	1284	320	2	1032	1206	727	747	120	561
1976	91	1289	1808	909	1095	43	214	2526	1388	96	37	1082	882
1977	2070	1636	1654	394	43	0	7	12	0	0	1	1	480
1978	1156	1517	1701	515	821	1	9	2605	509	2	2	300	761
1979	2172	3055	797	1	1092	1	1	2	943	1854	109	1179	924
1980	1725	1668	1974	821	1452	38	18	1	1	67	50	6	651
1981	19	1	19	49	36	1	0	2	1	1	1	1	11
1982	1	1	1	245	1126	1936	3040	2919	2009	2068	259	108	1153
1983	513	3604	4804	4151	1454	13	1076	2122	957	0	0	1756	1693
1984	1948	2511	1152	3093	2364	41	401	1840	106	0	113	0	1121
1985	0	0	72	115	893	86	0	803	891	411	1	0	275
1986	2058	2294	1251	1063	1009	16	0	542	832	27	0	83	755
1987	3292	2705	1377	3213	840	0	63	0	0	0	2123	1987	1288
1988	930	1720	3715	2528	1342	25	0	0	1839	0	3	0	1004
1989	633	1222	1134	1854	1440	14	0	0	0	0	0	0	520
1990	1695	2334	678	883	369	0	0	0	0	0	0	0	485
1991	0	0	0	1264	2034	360	1982	4253	1297	1321	0	0	1055
1992	0	1476	258	2376	1732	0	0	1800	1241	313	372	519	835
1993	4222	1169	1472	4320	112	0	0	0	0	0	0	0	938
1994	0	12	1532	638	167	1965	2086	1942	3098	2955	3598	2930	1751
1995	1699	2005	1531	1631	802	450	1446	4537	4554	2924	1020	1581	2016
1996	2273	1371	1459	2136	509	136	0	714	370	184	0	0	786
1997	637	1220	103	1051	2091	731	41	3440	118	0	106	5797	1287
1998†	6868	5076	8652	3078	395	--	--	--	--	--	--	--	4820

† indicates partial year; ‡ indicates average for daily data over the year.

Table C1. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR*
Mean	1301	1516	1447	1486	950	264	536	1249	905	689	348	708	951
Standard Deviation	1577	1214	1782	1272	653	507	1072	1488	1085	1289	793	1315	1509
Minimum	0	0	0	1	1	0	0	0	0	0	0	0	0
Median	759	1476	1251	1051	893	38	9	714	832	27	37	17	153
Maximum	6868	5076	8652	4520	2364	1965	4352	4537	4554	5652	3598	5797	11600

* Indicates statistics apply to daily period of record results

Table C2. Monthly and yearly flow summations (ac-ft) at S-65 control structure.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums
1969†						35027	1851	2348	60753	347509	79413	176510	703411
1970	174469	113119	156736	161695	21628	16164	1299	3414	0	1383	6489	10780	667176
1971	46644	122957	17077	34	39	37	26	32	37	66	120	106	187174
1972	86	89	158	20573	32579	16493	46858	6384	88	1471	2404	141	127326
1973	97	60234	98051	143155	94865	1932	76	49118	99522	32429	376	1026	572881
1974	5243	36270	21936	18115	38908	18356	267574	253372	129915	31180	2825	125	823820
1975	2524	4246	10257	59565	78951	19023	125	63482	71788	44710	44441	7381	406492
1976	5583	74145	111193	54082	67324	2554	13149	155297	82615	5879	2224	66517	640562
1977	127301	90885	101720	23469	2631	0	450	766	10	28	41	51	347352
1978	71080	84229	104610	30615	50502	64	571	160206	30283	108	141	18440	550848
1979	133540	169692	49004	80	67144	50	61	304	56120	114002	6511	72481	668788
1980	106097	95958	121351	48874	89278	2232	1116	50	47	4098	2986	364	472451
1981	1176	75	1198	2908	2218	33	26	110	42	59	52	45	7942
1982	57	66	68	14601	69254	115192	186905	179487	119563	127184	15398	6635	834410
1983	31526	200161	295403	246985	89410	764	66187	130457	56924	0	0	107978	1225795
1984	119760	144419	70813	184029	145375	2420	24639	113117	6315	0	6744	0	817630
1985	0	0	4407	6815	54903	5106	0	49359	53009	25252	48	17	198918
1986	126531	127420	76910	63239	62032	968	0	33349	49504	1680	0	5102	546735
1987	202416	150230	84670	191209	51675	0	3900	0	0	0	126349	122182	932631
1988	57202	98937	228400	150429	82529	1480	0	0	109404	0	151	0	728532
1989	38900	67891	69730	110328	88563	855	0	0	0	0	0	0	376268
1990	104199	129644	41699	52539	22701	0	0	0	0	0	0	0	350782
1991	0	0	0	75189	125060	21420	121886	261524	77196	81216	0	0	763491
1992	0	84902	15864	141384	106484	0	0	110650	73873	19270	22122	31885	606433
1993	259620	64924	90495	257042	6914	0	0	0	0	0	0	0	678996
1994	0	684	94181	37948	10251	116947	128255	119387	184366	181691	214121	180177	1268008
1995	104471	111342	94159	97059	49330	26783	88910	278979	270986	179804	60685	97239	1459747
1996	139738	78844	89714	127083	31274	8063	0	43927	22023	29787	0	0	570452
1997	39140	67735	6363	62546	128594	43474	2521	211493	7047	0	6311	356457	931682
1998†	422307	281915	532014	183162	24300								1443698

† indicates partial year.

Table C2. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums
Mean	79998	84863	88972	58440	58439	15705	32979	76773	53842	42373	20688	43505	634404
Standard Deviation	96945	67590	109581	75677	40138	30140	65896	91517	64539	79233	47165	80860	339898
Minimum	0	0	0	34	39	0	0	0	0	0	0	0	7042
Median	46644	84229	[illegible]	61546	54903	2232	[illegible]	13927	49569	1680	2224	[illegible]	[illegible]
Maximum	422307	281915	532814	257042	145375	116947	367574	278979	370986	347509	214121	556457	1459747

excludes partial year results.

Table C3. Mean daily runoff (cfs) over each month and year within S65A sub-basin.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg.‡
1969†						387	63	239	149	1049	280	108	322
1970	232	-114	-141	-362	3	32	260	129	47	100	75	90	31
1971	-27	-343	25	-1	-1	-1	274	108	126	317	20	9	46
1972	-1	144	14	86	210	444	131	89	41	1	28	66	104
1973	200	265	-2	93	-145	71	241	259	400	191	45	52	138
1974	12	184	62	86	73	239	593	265	-13	-50	101	74	136
1975	78	60	77	-24	-69	93	194	212	323	266	147	87	121
1976	71	160	-174	52	-69	225	86	19	220	253	71	105	84
1977	-200	-147	133	6	50	137	67	9	56	33	51	245	38
1978	39	136	-264	255	173	482	862	310	220	178	25	-22	200
1979	269	-500	-10	5	-131	56	70	236	1154	310	87	119	142
1980	-45	-7	-201	108	-139	118	182	388	198	65	104	90	72
1981	59	88	85	42	24	-1	0	138	625	12	11	-1	89
1982	-1	-1	42	106	91	595	-113	-107	196	-86	142	81	77
1983	56	-269	-400	-680	-132	157	39	-294	-32	46	23	-268	-145
1984	-397	-634	-67	-575	-309	156	287	-208	79	39	61	60	-123
1985	0	0	40	22	20	103	192	283	403	11	59	26	97
1986	-228	-321	-151	-123	-63	163	264	127	197	104	96	24	9
1987	-40	-644	-238	865	-24	0	62	39	209	422	911	-349	103
1988	16	-9	253	496	-34	58	4	256	674	428	18	3	180
1989	-44	-206	-69	-258	-287	15	144	190	228	84	9	45	11
1990	-155	-192	-50	36	40	85	479	313	229	389	23	3	103
1991	19	13	181	-61	-53	271	170	-252	51	272	22	9	54
1992	2	-88	-3	-255	-117	545	509	375	259	219	10	189	138
1993	421	-12	400	883	78	45	189	154	398	203	89	6	239
1994	29	175	-87	-51	66	544	281	351	270	146	-574	-227	76
1995	-99	-214	69	29	126	103	46	70	-721	-42	119	2	-41
1996	215	-54	-31	172	38	257	99	160	43	39	4	19	80
1997	80	-89	-14	-101	-67	275	236	-217	238	119	948	-1323	4
1998†	-1937	-738	-2880	-346	76								-1179

† indicates partial year; ‡ indicates average for daily data over the year.

Table C3. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR*
Mean	-48	-116	-113	17	-20	195	204	125	216	177	104	-23	60
Standard Deviation	396	261	555	334	120	180	201	190	301	220	264	278	482
Minimum	-1937	-738	-2880	-680	-309	-1	-113	-294	-721	-86	-574	-1323	-4639
Median	12	-54	-10	22	1	137	182	154	209	119	59	26	43
Maximum	421	265	400	883	216	595	862	388	1154	1049	948	245	8835

* indicates statistics apply to daily period of record results

Table C4. Monthly and yearly runoff summations (ac-ft) for S65A sub-basin.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sum
1969†						13802	3900	14670	8884	64519	16642	6648	129066
1970	14270	-6349	-8697	-21541	189	1927	15980	7934	2816	6143	4490	5542	22705
1971	-1653	-19027	1537	-34	-39	-37	16849	6658	7522	19522	1185	584	33067
1972	-86	8266	836	5126	12918	26445	8058	5443	2436	47	1658	4041	75189
1973	12283	14740	-97	5520	-8908	4216	14822	15902	23809	11715	2681	3194	99877
1974	767	10238	3832	5119	4482	14230	36485	16323	-772	-3090	6007	4530	98152
1975	4777	3321	4726	-1419	-4273	5563	11951	13021	19231	16372	8759	5336	87364
1976	4394	9185	-10682	3113	-4224	13411	5263	1139	13090	15544	4199	6468	60900
1977	-12320	-8190	8189	366	3049	8181	4109	545	3361	2028	3049	15077	27444
1978	2400	7576	-16213	15199	10661	28683	52983	19088	13072	10929	1470	-1349	144500
1979	16518	-27294	-629	299	-8029	3333	4328	14497	68662	19058	5206	7325	102775
1980	-2741	-421	-12369	6405	-8547	7023	11216	23849	11789	4026	6182	5533	51944
1981	3610	4914	5222	2498	1480	-33	-26	8497	37172	729	640	-45	64659
1982	-57	-66	2567	6283	5582	35386	-6958	-6567	11655	-5306	8477	4981	55976
1983	3442	-14950	-24625	-40458	-8142	9328	2374	-18075	-1878	2824	1354	-16509	-105315
1984	-24392	-36478	-4098	-34234	-18989	9269	17643	-12808	4684	2405	3658	3693	-89648
1985	0	0	2461	1283	1218	6140	11825	17400	23986	657	3537	1618	70125
1986	-14027	-17844	-9272	-7344	-3854	9723	16228	7783	11693	6385	5724	1476	6670
1987	-2471	-35774	-14648	51478	-1453	0	3796	2394	12413	25942	54229	-21448	74458
1988	984	-565	14575	30490	-2011	3558	230	15721	41417	25452	1077	153	131082
1989	-2709	-11427	-4268	-15360	-17643	869	8829	11707	13569	5185	555	2736	-7959
1990	-9558	-10637	-3061	2162	2450	5079	29456	19239	13631	23944	1348	209	74260
1991	1155	713	11139	-3636	-3740	16142	10480	-15518	3020	16741	1317	568	38880
1992	103	-5082	-187	-15156	-7199	32411	31323	23042	15422	13476	579	11642	100373
1993	25893	-663	24582	52554	4792	2678	11614	9493	23676	12486	5300	348	172753
1994	1781	9736	-5374	-3033	4060	32376	17249	21567	16080	9004	-34161	-13934	55349
1995	-6117	-11858	4228	1718	7726	6120	2810	4291	-42906	-2587	7088	145	-29342
1996	13220	-3090	-1931	10262	2337	15272	6107	9843	2587	2419	250	1141	58417
1997	4918	-4945	-879	-6032	-4123	16371	14489	-13324	14187	7322	56388	-81373	2998
1998†	-119109	-40998	-177057	-20607	4677								-353093

† indicates partial year.

Table C4. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums[a]
Mean	-2922	-6464	-7248	1070	1209	11292	12531	7716	12907	10824	6769	-1437	52773
Standard Deviation	24357	14605	34081	19921	7383	10486	12338	11663	18000	13513	15716	17095	67947
Minimum	-119100	-48998	-177057	-40458	-8980	37	6958	18075	-42906	-5306	-54151	-87335	-105315
Median	767	-3098	-629	1387	39	8181	1216	9493	12413	7322	3537	1618	59659
Maximum	25893	14740	24582	52554	12018	35386	52983	23849	98062	64519	56385	15073	112753

[a] excludes partial year results.

Table C5. Mean daily runoff (cfs) over each month and year within S65B sub-basin.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg.‡
1969†						133	31	191	235	1858	366	350	474
1970	481	67	323	125	-94	-97	183	-18	9	-36	-91	-105	63
1971	-147	-30	-71	0	0	0	45	-23	161	148	51	9	12
1972	0	-2	24	-82	-103	367	36	77	57	3	14	114	42
1973	128	92	-56	-160	32	14	272	340	695	0	1	-24	111
1974	-82	-189	-148	-111	-173	30	1721	1430	453	79	-28	-47	250
1975	-94	-123	-91	-112	-67	-6	8	9	212	163	-6	-133	-20
1976	-121	-164	-79	-309	-87	229	203	665	207	-63	-104	-232	13
1977	-69	-175	-199	-220	-92	-137	-59	-21	123	-1	25	80	-62
1978	42	209	612	-192	-163	381	920	1089	199	189	42	70	286
1979	641	274	47	38	185	-24	203	230	1614	477	-37	-112	294
1980	-37	6	22	-69	18	-108	-151	-163	-105	-132	-154	-91	-80
1981	-78	-74	-104	-91	-60	0	0	-98	186	0	21	0	-25
1982	0	0	-4	26	-77	888	767	728	592	759	-130	-110	288
1983	-67	981	1081	567	-164	30	120	24	-30	-46	-23	41	204
1984	77	185	-106	141	164	135	334	119	-34	10	142	43	100
1985	2	29	37	-53	6	-95	-84	-260	60	24	-16	81	-23
1986	-192	-132	22	-76	-123	133	232	60	41	65	216	61	26
1987	-801	358	127	-894	59	2	-52	92	113	442	-151	194	-44
1988	64	-129	-1713	-206	-264	20	-97	-376	-295	18	-5	-8	-251
1989	-53	-13	-54	-79	-69	-12	-59	-65	-120	190	51	-3	-24
1990	-211	-89	91	-204	-103	19	118	138	11	428	131	21	31
1991	35	20	56	-185	-32	241	158	428	-39	-184	-22	-9	40
1992	-1	-301	-25	-234	-165	-39	149	-1068	-281	-139	-96	-315	-209
1993	-1014	-109	-512	-809	-61	-11	-137	-60	25	-65	-50	18	-233
1994	20	-94	-204	-16	-88	-186	182	-154	-87	123	555	37	7
1995	-125	-101	-31	34	-119	-85	-134	714	1688	636	238	91	234
1996	437	351	380	649	201	649	402	395	186	203	46	87	331
1997	-58	186	112	-42	293	101	193	975	433	871	1327	1377	483
1998†	1923	1515	2505										1997

† indicates partial year; ‡ indicates average for daily data over the year.

Table C5. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	POR*
Mean	24	88	70	-92	-41	89	190	186	216	207	80	51	90
Standard Deviation	478	367	636	301	127	254	383	488	456	415	285	284	543
Minimum	-3014	-301	-1713	-894	-264	-186	-451	-1068	-295	-384	-154	-515	-6812
Median	-37	-2	-4	-80	-73	14	120	77	113	65	1	18	0
Maximum	1925	1515	2505	649	293	888	1721	1430	1688	1858	1327	1377	5769

* indicates statistics apply to daily period of record results.

Table C6. Monthly and yearly runoff summations (ac-ft) for S65B sub-basin.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums
1969†						4764	1909	11720	14012	114219	21808	21500	189931
1970	29585	3717	19882	7415	-5799	-5746	11268	-1093	542	-2218	-5394	-6435	45724
1971	-9026	-1643	-4361	0	0	0	2781	-1395	9597	9080	3015	538	8587
1972	0	-98	1485	-4888	-6321	21833	2229	4723	3410	202	823	7020	30417
1973	7864	5126	-3457	-9525	1965	839	16697	20891	41353	-17	50	1481	80305
1974	-5059	-10506	-9129	-6584	-10660	1800	105849	87922	26954	4885	-1686	-2884	180982
1975	-5752	-6813	-5601	-6664	-4102	-328	470	535	12624	10039	-342	-8194	-14128
1976	-7428	-9406	-4841	-18382	-5323	13634	12481	40904	12313	-3899	-6208	-14277	9569
1977	-4238	-9743	-12222	-13120	-5680	-8181	-3647	-1310	7315	-71	1462	4894	-44541
1978	2603	11618	37658	-11432	-9996	22675	56554	60936	11812	11595	2470	4276	206768
1979	39388	15241	2916	2267	11396	-1399	12512	14148	96059	29299	-2191	-6884	212753
1980	-2252	355	1383	-4099	1107	-6450	-9259	-10017	-6230	-8124	-9168	-5597	-58352
1981	-4786	-4114	-6420	-5406	-3698	0	0	-6046	11047	13	1264	0	-18147
1982	0	0	-239	1540	-4731	52850	47150	44773	35213	46697	-7739	-6752	208762
1983	-4123	54461	66459	33768	-10083	1770	7367	1499	-1803	-2824	-1354	2516	147653
1984	4742	10621	-6520	8397	10069	8029	20528	7324	-2010	588	8477	2627	72872
1985	125	1603	2249	-3167	379	-5628	-5190	-16006	3585	1447	-935	5011	-16527
1986	-11831	-7351	1366	-4513	-7549	7885	14253	3679	2434	4005	12847	3761	18985
1987	-49236	19867	7823	-53182	3602	99	-3189	5643	6726	27150	-8975	11937	-31736
1988	3937	-7444	-105320	-12268	-16255	1188	-5943	-23145	-17576	1099	-303	-506	-182536
1989	-3275	-714	-3293	-4685	-4255	-722	-3648	-3979	-7153	11665	3061	-211	-17208
1990	-12994	-4915	5596	-12168	-6359	1143	7230	8495	682	26313	7824	1289	22136
1991	2160	1100	3465	-11009	-1963	14326	9709	26348	-2300	-11337	-1317	-539	28641
1992	-52	-17316	-1507	-13898	-10150	-2310	9182	-65691	-16720	-8539	-5730	-19342	-152071
1993	-62327	-6042	-31482	-48168	-3755	-639	-8437	-3706	1486	-3966	-2974	1084	-168926
1994	1233	-5214	-12559	-959	-5424	-11040	11164	-9466	-5179	7537	33038	2282	5413
1995	-7713	-5627	-1937	1999	-7294	-5066	-8237	43907	100472	39078	14154	5590	169327
1996	26872	20211	23337	38598	12360	38619	24731	24288	11091	12460	2742	5331	240639
1997	-3571	10342	6898	-2491	17994	6030	11870	59952	25768	53562	78950	84658	349963
1998†	118245	84158	154026										356429

†partial year results.

Table C6. continued.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Sums
Mean	1456	4878	-325	-2451	-2519	5172	11668	11442	12949	12756	4747	2145	41657
Standard Deviation	29361	20426	39091	17894	7779	13907	23545	30021	27146	25504	16932	17442	137743
Minimum	-63527	-17316	-105321	-53152	16255	11040	-9259	-65691	-17576	-11337	-9768	-19312	192536
Median	2253	-98	-239	-4756	-4493	839	7367	4723	6726	4005	50	3084	20561
Maximum	118245	84158	54026	38598	17994	52850	105849	87922	100472	114219	78950	84658	349963

excludes partial year results.