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Peak streamflow estimation for Kentucky streams using historical streamflow records.

John Edwin Spalding Jr., 1982-
University of Louisville

PEAK STREAMFLOW ESTIMATION FOR KENTUCKY STREAMS USING HISTORIAL STREAMFLOW RECORDS

By

John Edwin Spalding, Jr.
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Submitted by: ___________________________________
John Edwin Spalding, Jr.

A Thesis Approved on

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(Date)

by the Following Reading and Examination Committee:

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Dr. Mark French, Thesis Director

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Dr. A.C. Parola, Committee Member

____
Dr. G.W. DePuy, Committee Member

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ABSTRACT

This work develops a method of estimating peak daily streamflow, Q_{peak}, for Kentucky streams using daily average streamflow, Q_{ave}, data from the United States Geological Survey's (USGS) National Water Information System (NWIS) website. The purpose of doing this is to develop a systematic approach to increase the number of Q_{peak} values available for frequency analysis. Specifically, the enhanced record of Q_{peak} values will allow estimation of flood flow magnitudes with recurrence intervals of less than one year. Stream gages with drainage areas less than 1,000 square miles are examined to analyze stream corridors that are most commonly considered for stream restoration projects. The developed method is applied to three stream gages for a period of one year each to demonstrate how it may be applied increase the number of Q_{peak} values available for frequency analysis.

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I. INTRODUCTION

The channel forming discharge is an important criterion to stream restoration. This level of discharge is defined as the "theoretical discharge that if maintained indefinitely would produce the same channel geometry as the natural long-term hydrograph" (Copeland et al 2000), which has been shown in previous studies to correspond to flood events with a 1- to 2-year recurrence interval (Wolman and Leopold 1957). However, more recent studies have shown that the channel forming discharge may occur at flood events with a 1-year or less recurrence interval (Crowder and Knapp 2005).

The United States Army Corps of Engineers and the Interagency Advisory Committee on Water Data both currently recommend the log-Pearson Type III distribution for flood frequency analysis (Connelly 2006). As shown by Connelly (2006), the log-Pearson Type III distribution can be used to estimate the flood flow magnitudes associated with the 1.01-, 1.1-, 1.5-, and 2-year recurrence interval for Kentucky streams. The United States Geological Survey's (USGS) National Water Information System (NWIS) provides the historic peak annual streamflow data for Kentucky used by Connelly (2006).

Unfortunately, the only peak streamflow values for Kentucky streams available on the USGS NWIS are the peak annual streamflow values. This creates a problem when one considers the possibility that flood events with a 1-year or less recurrence interval are responsible for producing channel geometry.

The objective of this thesis is to develop a method of estimating instantaneous peak-daily streamflow, Q_{peak}, for Kentucky streams using daily-average streamflow, Q_{ave}, data from the United States Geological Survey's (USGS) National Water Information System (NWIS) website. The purpose of doing this is to develop a systematic approach to increase the number of available Q_{peak} values available for frequency analysis. Specifically, the enhanced record of Q_{peak} values will allow estimation of flood flow magnitudes with recurrence intervals of less than 1 year. The approach is similar to partial duration series and will be incorporated into a log-Pearson Type III frequency analysis to estimate flood flow magnitude.

The next chapter presents an overview explanation of the relation between the frequency of a particular flow event, the historical record of events, and the analytical methods implemented to develop a quantitative framework for analysis, including annual maximum series (AMS) and partial duration series (PDS). Chapter III discuses previous research and provides information about the data archive used for the study. Chapter IV details the methods of analysis used, including data partitioning, regression models, and selection of the best model. Provided in Chapter V are the regression models developed from the data and the selection of the best model. Finally, Chapter VI discusses the best model and the limitations of this study, and also provides examples on the application of the best model.

II. HYDROLOGIC FREQUENCY MODELING

This chapter addresses the topic of hydrologic frequency analysis and specifically the topic of annual maximum series and partial duration series. The general field of hydrologic frequency analysis attempts to estimate the frequency or probability of occurrence within any given year, p, of a particular hydrologic event such as the 100-year flood. It is also common for the reciprocal of the frequency, known as the return period, T, in years, to be used to define the likelihood of the hydrologic event of interest. Early applications of hydrologic frequency analysis and modeling principally focused on flood flow estimation. With the importance of understanding natural variability and expected impact of hydrologic events on communities, industry, and agriculture, nearly all facets of hydrology are now studied in the context of frequency analysis, including runoff volumes, low flows, rainfall events, water quality parameters, groundwater levels and flows, and numerous hydrology-related environmental variables (Haan 2002). This study focuses on peak-flood streamflows for return periods relevant to stream restoration design. The specific return period of interest is unknown or undefined, since the flow magnitude of interest is the level often associated with bank-full flow conditions and is stream specific. An underlying objective of this work is to provide a means of estimating the flood-peak streamflow magnitude for a particular return period. These flow magnitudes are extreme in terms of being more frequent and may be represented by the extreme end of the probability distribution or frequency histogram.

This chapter provides an overview explanation of the relation between the frequency of a particular flow event (or so-called flood event), the historical record of events, and the analytical methods implemented to develop a quantitative framework for analysis. For extreme events to be better described, assume that an extreme event can be said to have occurred if a random variable X is greater than or equal to the value x_T. The time between occurrences of $X \geq x_T$ can be called the recurrence interval, τ. As the number of occurrences becomes large, the expected value of τ, $E[\tau]$, can be determined. The expected value $E[\tau]$ is the average τ for $X \geq x_T$ and is referred to as the return period, T, and leads to the definition $T = E[\tau]$.

Frequency modeling is the process of using historical records of a process, in this case daily-averaged streamflow, to estimate T for a range of flow magnitudes. As a first constraint in the frequency modeling procedure, data must be homogeneous and independent, or assumed to approximate these characteristics. The homogeneous requirement implies all data come from the same population. Traditionally, this means a data series is generated from a constant process at a single location, such as streamflow measured at a single location on a certain stream. In hydrologic studies, due to the relatively limited record length of streamflow data, data from several neighboring and related locations are frequently grouped in order to create a larger population - the result is termed a regional frequency model. Despite this broadened definition of homogeneity, the approach is considered acceptable when data groupings are established using objective criteria to create the "homogenous" region (Haan 2002).

The requirement of independence means that a single event does not enter the data set multiple times and that each data value or event does not depend on any other. In hydrologic frequency analysis, an example of the independence constraint being violated is a single rain storm producing more than one peak runoff value for a particular stream or watershed. In this case, only the largest flow value recorded would be used. For hydrologic frequency modeling on annual data, independence is generally assured by the use of the "water year," or annual maximum series. In the United States the water year begins on October 1 and ends on September 30, with the year being designated by the calendar year in which it ends. For example, the water year ending September 30, 2005 is called the "2005" water year. The water year falls where it does so that the data record begins "at a point in the normal climatic cycle when the precipitation first begins to exceed the average evapotranspirational losses (Schulz 1973)." Further:

> At this point in the annual cycle, the precipitation begins to recharge the watershed soils which are subsequently depleted again during the following dry season. Thus by beginning the water year when the natural recharge cycle first begins, it is most likely that the precipitation, evapotranspirational and runoff events for a year come nearest to coinciding.

Two commonly used approaches the flood flow frequency modeling are the annual maximum series (AMS) and the partial duration series (PDS). These two approaches are explained below.

A. Annual Maximum Series

The most commonly used approach to hydrologic frequency analysis and modeling, the annual maximum series (AMS) (Terry 2004), uses the single largest annual flow value. Numerous methods of frequency modeling have been developed for the AMS, including the log-Pearson Type III distribution, which is currently recommended by the Interagency Advisory Committee on Water Data (Bulletin 17B 1982) and the

United States Army Corps of Engineers (Engineering and Design – Hydrologic Frequency Analysis 1993).

Despite its popularity, use of the AMS has limitations and challenges in application and interpretation. Relative to the field of stream restoration, a significant limitation of the AMS is that it is constrained to estimation of events with a return period or recurrence interval greater than one year. This is simply due to the constraint that a single flow value per year is included in the data set, and implies flow magnitudes more frequent than annual cannot be determined. In terms of data available for use in this study, the annual maximum series is the peak annual streamflow archive as available from the U.S. Geological Survey, National Water Information System (USGS NWIS 2004).

B. Partial Duration Series

An alternative to use of methods exclusively dealing with the AMS are approaches known as partial duration series (PDS). The PDS techniques attempt to both recognize the occurrence of multiple floods of relative significance, and incorporate these flow values into a systematic procedure for estimating flow magnitude for more frequent floods (T less than the annual recurrence interval). The procedure is relatively straightforward and employs a threshold value to which recorded values of a random variable are compared. Those values with magnitude greater than the threshold are selected, given that they are also independent under the criteria defined earlier. The advantage of the PDS approach is demonstrated below.

The records of peak streamflow data available from the USGS NWIS (2004) provide only those values comprising the AMS. The resulting record is the true annual maximums; however it is often the case that streamflow values with high magnitude, but less than the particular water year's annual maximum are not part of this record. Despite that these floods are large and may be only slightly less than the annual maximum, they must be omitted from the AMS since only the largest peak streamflow value occurring within a given water year forms the AMS archive. An example of this phenomenon is demonstrated in Figure 1, a plot of the daily streamflow record at the site, Bayou Creek near Heath, Kentucky, over a period of two years:

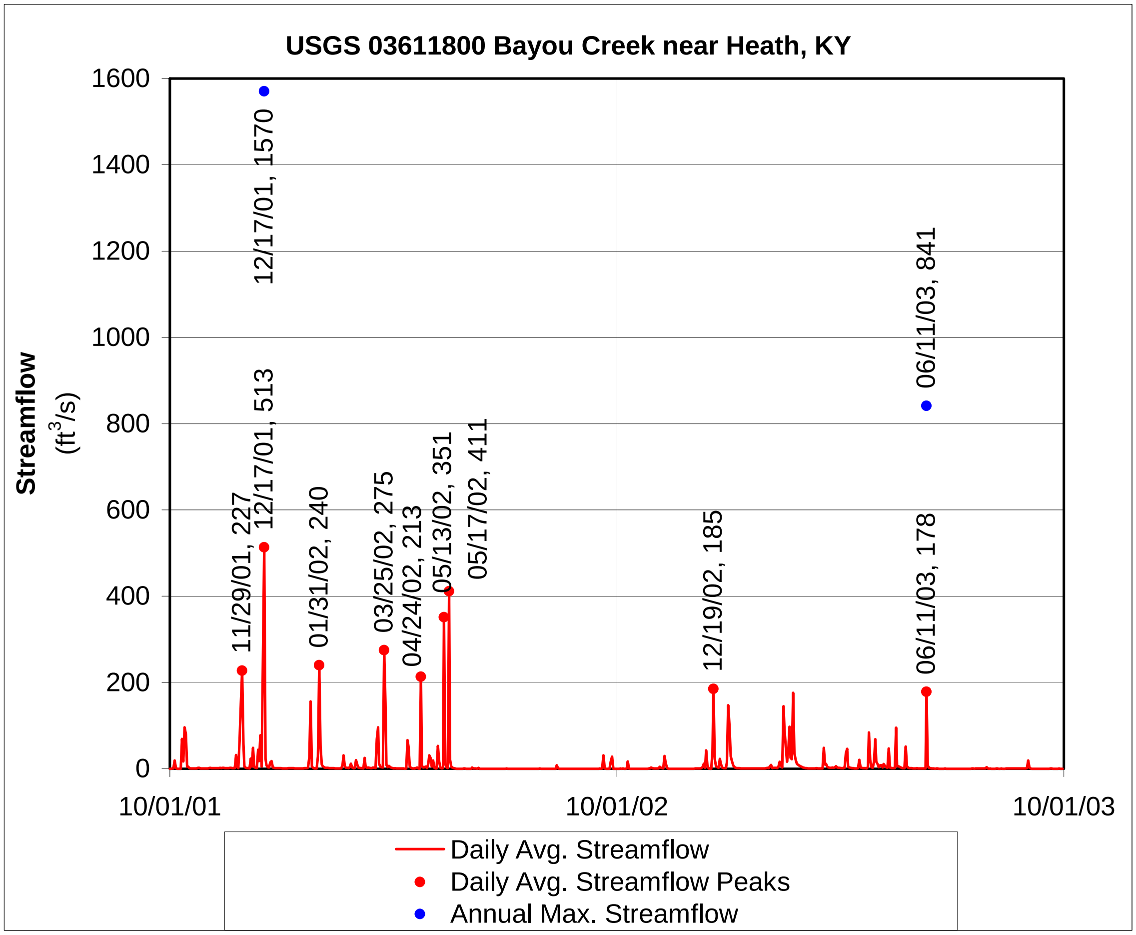


FIGURE 1 - Daily Streamflow Record for Bayou Creak near Heath, KY for Water Years 2002 and 2003

Figure 1 shows the daily mean streamflow at the gaging station from October 1, 2001 through September 30, 2003, or water years 2002 and 2003. The annual maximum instantaneous streamflow values during the 2002 and 2003 water years were 1570 cfs on December 17, 2001 and 841 cfs on June 11, 2003, which correspond to mean daily streamflow values of 513 cfs and 185 cfs, respectively. It is clear from Figure 1 there were several other days with mean flows equal to or exceeding the lower "peak flow" magnitude for 2003. Inspection of the flow record shows that for these two years, there were seven mean daily streamflow values between 513 cfs and 178 cfs, six of which occurred in the 2002 water year. This is summarized in the table below:

TABLE I

ANNUAL MAXIMUM AND DAILY-AVERAGE STREAMFLOW FOR BAYOU CREEK NEAR HEATH, KENTUCKY FOR WATER YEARS 2002 AND 2003

2002 Water Year

Date -	AMS Streamflow (cfs)	Daily Avg. Discharge (cfs)
11/29/01	-	227
12/17/01	1570	513
01/31/02	-	240
03/25/02	-	275
04/24/02	-	213
05/13/02	-	351
05/17/02	-	411

2003 Water Year

Date -	AMS Streamflow (cfs)	Daily Avg. Discharge (cfs)
12/19/02	-	185
06/11/03	841	178

This data record indicates a likelihood that additional high streamflow events occurred in the 2002 water year with magnitude greater than the annual peak streamflow value from the 2003 water year. This conclusion presents the challenge, opportunity, and motivation to expand the peak flow record available for flood frequency analysis. Use of additional peak streamflow data would readily allow the PDS approach to be applied, and provide a means for systematically and objectively estimating flood flows with return periods less than one year. The challenges remaining include deriving an estimation of the peak flow from the daily average flow, extracting to the number of "partial duration" flow records corresponding to the desired minimum recurrence interval, and evaluating the procedure. This process is the focus of this work. A set of equations relating instantaneous peak to daily-average streamflow and drainage area are developed, the equations applied to derive peak flow estimates from daily mean flow, and finally, the derived peak flow data are used to develop flood flow magnitudes for return periods less than one year. The following chapters provide a description of the processes developed to conduct this research and present a quantitative assessment of the procedure applied to streamflow records.

III. COLLECTION OF DATA

This chapter provides information about the data archive used for the study, including a review of data archive components such as drainage area and hydrologic region for each USGS stream gaging station in Kentucky, as well as a summary of peak-annual streamflow and corresponding daily-average streamflow values for each gage.

A. Review of Recent Research

In a related research work, Connelly (2006) fitted the log-Pearson Type III distribution to the annual peak flow data for 216 gages in Kentucky. These gages were selected using the constraints that “each gage record consists of at least 10 years of [AMS] record and watershed drainage areas are less than 1000 square miles.” A minimum of 10 years of AMS record was required because this “is assumed to be the minimum representative sample size for frequency analysis.” Only those gages whose watershed drainage areas are less than 1000 square miles are considered because this “focuses on work on watersheds that typically host stream channels in need of restoration” (Connelly 2006).

For continuity between this research and that by Connelly (2006), the same 216 gages are considered. Due to the need to compare peak flow to corresponding daily-average flow, any gage record lacking daily-average streamflow data corresponding to peak-annual streamflow values are neglected. The resulting data archive is composed of 4,223 data pairs of peak flow and corresponding daily-average flow records from 129 gages in Kentucky, which have drainage areas ranging from 0.50 to 960 mi^2 (1.29 to 2,490 km^2).

B. USGS Water Data

The USGS NWIS (2005) provides an archive record of historic peak annual streamflow data for Kentucky as used by Connelly (2006). Data compilation and analysis were performed using the Microsoft® spreadsheet program Excel. Data for each gage are accessed via the NWIS website and inserted into a Microsoft Excel file. Additionally, the daily-average streamflow data were retrieved from the same source (USGS NWIS 2005). Using the peak-annual streamflow data, the daily-average streamflow values corresponding to the date of each peak annual streamflow are extracted. An example of the resulting data set is shown below in Table II for USGS stream gage number 3312500 Barren River near Pageville, Kentucky. The first column of Table II is the date of the peak flow record, and the following two columns contain the instantaneous peak streamflow and the corresponding average-daily streamflow in cfs:

TABLE II

STREAMFLOW DATA FOR BARREN RIVER NEAR PAGEVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/31/40	20100	12000
07/05/41	7220	6460
04/10/42	10400	9540
12/29/42	15300	12300
02/18/44	14000	9600
01/01/45	26900	20200
01/08/46	48900	30400
05/22/47	13800	12200
02/14/48	35000	26100
06/16/49	27700	22700
01/06/50	22500	20300
02/02/51	13000	10000
03/23/52	70000	46700
05/18/53	7850	7220
04/17/54	14200	11700
03/22/55	38600	30200
01/30/56	32700	19700
01/30/57	42800	29400
11/19/57	17700	12400
02/15/59	9340	8330
06/29/60	11200	9410
06/15/61	11300	9070
02/27/62	50000	40000
03/12/63	11000	9000

Similar tables for the remaining gages may be found in the appendix.

As discussed in the previous chapter and repeated here for emphasis, it should be noted that in order to account for independence, the “water year” is employed when the USGS reports annual statistics. In the United States the water year begins on October 1 and ends on September 30, with the year being designated by the calendar year in which it ends.

Once the data archive has been completed, study and analysis of the data may begin. The methods of data partitioning, regression models development, and selection of the best regression model are discussed in the next chapter.

IV. ANALYSIS METHODS

This chapter addresses the methods employed for data partitioning, regression model development, and selection of the optimal regression model for a particular stream gage location or group of gage locations.

A. Data Partitioning

This section addresses the methods employed in partitioning the gages for developing regional models or regionalized frequency analysis. Gages are partitioned by three methods, those being all gages analyzed simultaneously, gages grouped by drainage area size or scale, and gages grouped by hydrologic region. These partitioning methods are described below.

1. All Gages Analyzed Simultaneously

This method employs each of the 4,223 data pairs of flood-peak streamflow and corresponding daily average streamflow measurements, which came from the 129 gages with available data. Regression models produced are derived from historical data measured at Kentucky streams with drainage areas between 0.50 and 960 mi^2 (1.29 and 2,490 km^2), as this was the range in drainage area for gages with daily-average streamflow data available corresponding to peak annual streamflow values whose watershed drainage areas are less than 1000 square miles (2,590 km^2).

2. Gages Grouped by Drainage Area Size

The drainage area for gaged streams in Kentucky varies from 0.13 mi^2 (0.337 km^2) for Clarks River Tributary near Reidland and Ball's Branch Tributary near Danville, to well over 100,000 mi^2 (259,000 km^2) for the Ohio River at gage stations in western Kentucky. The range of stream drainage area size considered in this study is limited to areas of less than 1,000 mi^2 (2,590 km^2), in order to evaluate improvement possible that grouping streams by drainage area may have on regression models' predicting ability (Connelly 2006). This notion comes from the fundamental geomorphic concept which implies that streams with similar characteristics such as equivalent drainage area will behave similarly during flood events.

The data from the 129 gages being analyzed in this thesis will be partitioned into three drainage area ranges: 0.1 to 10 mi^2 (0.259 to 25.9 km^2); 10 to 100 mi^2 (25.9 to 259 km^2); and 100 to 1000 mi^2 (259 to 2,590 km^2). A summary of the data employed in the regression modeling is indicated in Table III:

TABLE III

NUMBER OF GAGES AND PEAK-DAILY/DAILY-AVERAGE STREAMFLOW MEASUREMENTS PER AREAL PARTITION

Drainage Area Range	0.1 to 10 mi^2	10 to 100 mi^2	100 to 1000 mi^2	Σ =
No. of Gages	15	48	66	129
No. of Data Pairs	199	1365	2659	4223
% of Data Pairs	4.71%	32.32%	62.96%	100.00%
Avg. # Data Per Gage	13.27	28.44	40.29	32.74

Table II shows that the number of gages in each area range increases with area size, as does the average number of data per gage. Also shown is the percentage of the total number of data pairs that is contained in each area range.

3. <u>Gages Grouped by Hydrologic Region</u>

The surface runoff contributing to streamflow for a particular event is affected by a number of geomorphic factors – quantitative properties of the surface landform that includes soil type, vegetative cover, land use, and geology (Chow et al 1988). These factors pose a challenge to hydrologists as they are generally difficult to quantify and may vary with time and season, in turn making it difficult to accurately use geomorphology alone as a predictor of streamflow runoff volume for a particular flood or rainfall-runoff event. In an attempt to address this issue, seven physiographic hydrologic regions as defined for Kentucky in USGS Report 87-4209 (Choquette 1988) were used as a systematic guide to group data. These regions are defined by determining areas where "streamflow gaging stations indicate a similarity of flood response which differs from the flood response in adjacent regions" (Choquette 1988) by using the method of residuals to identify similarities in flood response. This method examines flood flow magnitudes for specified return period events and compares these magnitudes to a regression equation developed for the area. Regions whose flood flow magnitudes were over or under estimated were defined as independent hydrologic regions. The resulting regions are shown in Figure 2 below:

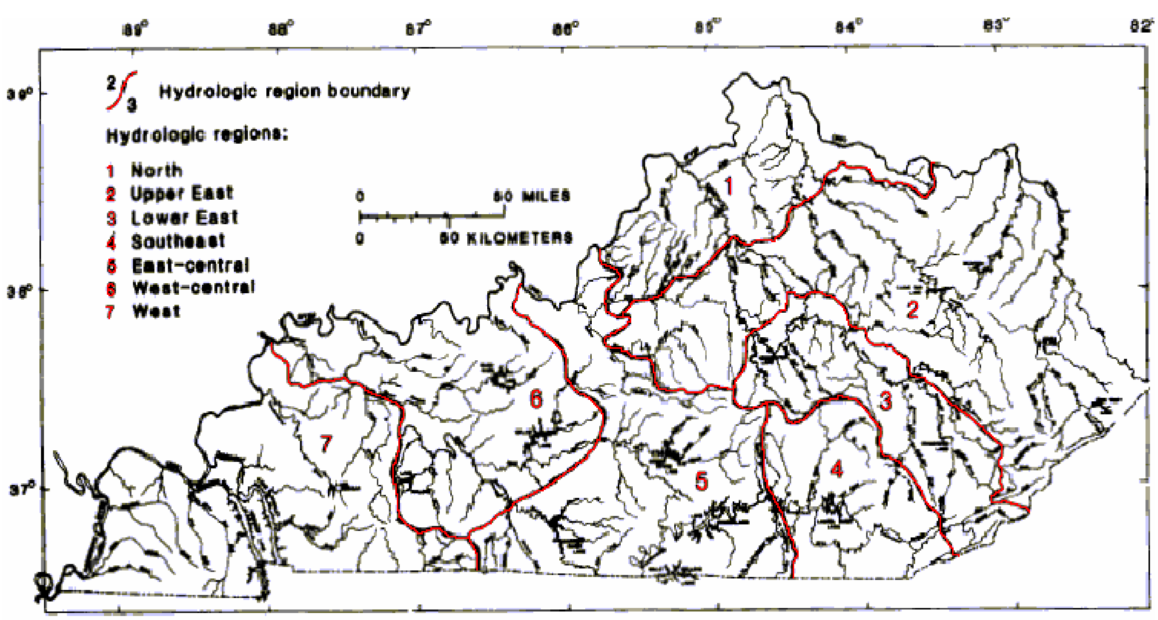


FIGURE 2 – Hydrologic Regions of Kentucky as defined by Choquette (1988)

A summary of the data employed in the regression modeling is indicated in Table IV:

TABLE IV

NUMBER OF GAGES AND FLOOD-PEAK/DAILY-AVERAGE STREAMFLOW MEASUREMENTS PER HYDROLOGIC REGION

Hydrologic Region	1	2	3	4	5	6	7	Σ =
No. of Gages	16	44	15	8	20	16	10	129
No. of Data Pairs	438	1497	533	367	623	423	342	4223
% of Data Pairs	10.4%	35.4%	12.6%	8.7%	14.8%	10.0%	8.1%	100.0%
Avg. # Data Per Gage	27.38	34.02	35.53	45.88	31.15	26.44	34.20	32.74

B. Regression Methods

The statistical procedure used to determine or identify a relationship between two or more variables is known as a regression. For this thesis, four regression models are fitted to data in order to develop models to estimate or predict peak streamflow using either daily-average streamflow or daily-average streamflow and drainage area as independent variables. The regression models used are simple linear regression, multiple linear regression, quadratic regression, and power regression. The process of fitting each of these regressions to a data set is discussed in the following section.

1. Simple Linear Regression

The simple linear regression is perhaps the most commonly used model in hydrology and is used when a linear relationship between two variables can be assumed to exist (Haan 2002) or is expected to provide an adequate representation of the relation. The general form for a simple linear regression is:

$$Y = \beta_0 + \beta_1 X \qquad (1)$$

where β_0 = regression coefficient representing the intercept

β_1 = regression coefficient representing the slope

Y = dependent variable

X = independent variable

The coefficients β_0 and β_1 are defined as:

$$\beta_1 = \frac{\sum X_i Y_i - \sum X_i Y_i / n}{\sum X_i^{\,2} - \left(\sum X_i\right)^2 / n} \tag{2}$$

$$\beta_0 = \overline{Y} - \beta_1 \overline{X} \tag{3}$$

where X = observed independent value
$\overline{X}$ = mean of X values
Y = observed dependent value
$\overline{Y}$ = mean of Y values
n = number of X and Y observations

The resulting equation has the lowest sum of the squared errors possible for the data set.

For analysis in this thesis, the independent variable is daily-average streamflow, Q_{ave}, in cfs and the dependent variable is peak-daily streamflow, Q_{peak}, in cfs. The resulting form of the simple linear regression is thus:

$$Q_{peak} = \beta_0 + \beta_1 Q_{avg} \tag{4}$$

2. Multiple Linear Regression

It is often desirable to express a dependent variable as a linear function of several other variables. A linear regression model containing multiple independent variables is called a multiple linear regression and follows the general form of:

$$Y = \beta_0 + \beta_1 X_1 + \Lambda + \beta_p X_p \tag{5}$$

where $\beta_0, \beta_1, \Lambda, \beta_p$ = regression coefficients
Y = dependent variable
X_1, Λ, X_p = independent variables

There are *n* observations available on Y and *n* corresponding observations on each of the *p* independent variables, with the constraint placed on *n* that it must be larger than *p* so that the *p+1* unknown parameters (β values) can be estimated. Further, it is desirable in practice that *n* be at least 3 to 4 times larger that *p* (Haan 2002).

In matrix notation, the general form becomes:

$$[Y]_{n\times 1} = [X]_{n\times(p+1)} \cdot [\beta]_{(p+1)\times 1} \tag{6}$$

where $[Y]_{n\times 1}$ = $n \times 1$ vector of *n* observations
$[X]_{n\times(p+1)}$ = $n \times (p+1)$ matrix composed of *n* observations on each of *p* independent variables and a column of "1"s in the first column for the intercept
$[\beta]_{(p+1)\times 1}$ = $(p+1)\times 1$ vector of *p* unknown coefficients

The $[\beta]_{(p+1)\times 1}$ coefficient matrix can be solved by the following:

$$[\beta]_{(p+1)\times 1} = \left([X^T]_{(p+1)\times n} \cdot [X]_{n\times(p+1)}\right)^{-1} \cdot \left([X^T]_{(p+1)\times n} \cdot [Y]_{n\times 1}\right) \tag{7}$$

The resulting equation has the lowest sum of the squared errors possible for the data set.

For analysis in this thesis, the independent variables are daily-average streamflow, Q_{ave}, in cfs and drainage area, A, in mi^2. The dependent variable is peak-daily streamflow, Q_{peak}, in cfs. The resulting form of the multiple linear regression is thus:

$$Q_{peak} = \beta_0 + \beta_1 Q_{avg} + \beta_2 A \tag{8}$$

3. <u>Quadratic Regression</u>

Natural processes in hydrology are often modeled by non-linear regression, with one common regression model being the quadratic regression. The quadratic is a second order model and takes the general form of:

$$Y = \beta_0 + \beta_1 X + \beta_2 X^2 \tag{9}$$

where $\beta_0, \beta_1, \beta_2$ = regression coefficients
Y = dependent variable
X = independent variable

This model can be analyzed using the multiple linear regression techniques discussed above. In order to determine the regression coefficients, the following transformation can be made:

$$Y = \beta_0 + \beta_1 X + \beta_2 X' \tag{10}$$

where
$\beta_0, \beta_1, \beta_2 = \beta_0, \beta_1, \beta_2$
$Y = Y$
$X = X$
$X' = X^2$

Therefore, the resulting regression coefficients are determined using the same procedure as shown in Equation (7).

For analysis in this thesis, the independent variable is daily-average streamflow, Q_{ave}, in cfs and the dependent variable is peak-daily streamflow, Q_{peak}, in cfs. The resulting form of the simple linear regression is thus:

$$Q_{peak} = \beta_0 + \beta_1 Q_{avg} + \beta_2 \left(Q_{avg}\right)^2 \tag{11}$$

4. <u>Power Regression</u>

Another common non-linear regression model is the power regression, which takes the general form of:

$$Y = \alpha X^{\beta} \tag{12}$$

where
$\alpha, \beta =$ regression coefficients
$Y =$ dependent variable
$X =$ independent variable

In order to determine the regression coefficients, this model can be linearized using a logarithmic transformation:

$$\ln(Y) = \ln(\alpha) + \beta \ln(X) \tag{13}$$

or:

$$Y' = \alpha' + \beta' X' \tag{14}$$

where

$$Y' = \ln(Y)$$
$$\alpha' = \ln(\alpha)$$
$$\beta' = \beta$$
$$X' = \ln(X)$$

Using the transformed form of the variables and regression coefficients, the same technique used to solve for the regression coefficients in Equation (7) for the multiple linear regression can be used to solve for α' and β'. The relationships used above in Equation (14) can then be used to obtain α and β.

For analysis in this thesis, the independent variable is daily-average streamflow, Q_{ave}, in cfs and the dependent variable is peak-daily streamflow, Q_{peak}, in cfs. The resulting form of the power regression is thus:

$$Q_{peak} = \alpha(Q_{avg})^{\beta} \tag{15}$$

C. <u>Regression Model Evaluation</u>

An essential question to address when evaluating a regression analysis is how well does the regression model describe the relationship between the variables? A common approach is to determine how much of the variability in the dependent variable is described by the regression. This is determined using the coefficient of determination, R^2, which is "an indicator from 0 to 1 that reveals how closely the estimated values for the trendline correspond to your actual data" (Microsoft Office Assistant 2005). This coefficient is defined as the ratio of the sum of squares due to the regression to the total sum of squares corrected for the mean. The mathematical definition is shown in Equation (16) below:

$$R^2 = \frac{\sum \left(\hat{Y} - \overline{Y}\right)^2}{\sum \left(Y - \overline{Y}\right)^2} \tag{16}$$

where R^2 = sum of squares due to regression/sum of squares corrected for mean
Y = observed dependent value
$\overline{Y}$ = mean of Y values
$\hat{Y}$ = predicted dependent value

This value is "loosely interpreted as the proportion of the variability in the data 'explained'" (Montgomery 1997) by the model, indicating that larger values are more desirable.

When more than one regression model is developed for a given set of dependent variables, a second question must be answered. This question is which model best represents the data being described? The technique commonly used - though not necessarily recommended - in selecting a regression model is to perform as many regressions on a data set as practical using different combinations of independent variables and regression models. The "best" model is then selected using the R^2 values, with the criterion for the "best" fit being the regression that yields the largest value of R^2. The use of this criterion exclusively has a fatal flaw, which is described by Haan (1977) and repeated here:

> As more variables are added to a regression equation, the R^2 value can never decrease. Thus from the standpoint of the R^2 criterion, one should use all of the variables he can lay his hands on. This, however, makes a clumsy equation and one in which it is extremely difficult to place a meaningful interpretation on the coefficients.

To address this issue and reduce the constraint imposed, another, and perhaps better, measure known as the standard error, S_e, may be used (Haan 1977). The standard error is directly related to confidence intervals on a regression line, which estimate the range over which an observed value from the population is expected to fall. Smaller confidence intervals indicate greater confidence that a given regression accurately represents the data being modeled, indicating that a smaller value of S_e implies a better fit. The standard error can be calculated according to Haan (1977) as:

$$S_e = \frac{\sum\left(Y - \hat{Y}\right)^2}{n - p - 1} \qquad (17)$$

where $\hat{Y}$ = predicted dependent value
Y = observed dependent value
n = number of Y observations
p = number of independent variables

Both the coefficient of determination and the standard error are considered when selecting regressions in this thesis. For comparing the simple linear, quadratic, and logarithmic regressions, the R^2 values may be used with reasonable reliability to determine which regression model is "best." However, when comparing those regression models with a single independent variable to a multiple linear regression model, the S_e is considered.

Consideration is also given to the residual plot. The residual, as defined by Haan (2002), is:

$$e = \hat{Y} - Y \qquad (18)$$

where e = residual of Y
$\hat{Y}$ = predicted value of Y
Y = observed value of Y

Thus, a negative value of *e* indicates that the value of *Y* has been underestimated by the regression model and a positive value of *e* indicates that the value of *Y* has been overestimated by the regression model. It is desirable that a plot of the residuals versus the observed *Y* values "contain no obvious patterns" (Montgomery 1997). If any obvious patterns are seen to exist, this is an indication that a source of variance has been neglected by the regression model. Further discussion regarding residual plots can be found in Chapter VI.

V. RESULTS

The results are presented in three sections; each section focuses on results from one of the three data partitioning methods, those methods being: (1) all gages analyzed simultaneously; (2) gages grouped by drainage area size; and (3) gages grouped by hydrologic region. In all cases, data from all 129 flow gages was used. Within each partition, the regression equation, coefficient of determination, and standard error for each method is shown. The sections are further subdivided for each data partition within each regression method to allow comparison of the results and evaluation of regression models. Finally, the overall better performing regression models are discussed.

The independent variables in the regression models are average-daily streamflow, Q_{ave}, in cfs, and in the case of the multiple regression approach, the drainage area, A, in mi^2. The dependent variable in all cases is peak-daily streamflow, Q_{peak} (cfs).

A. All Gages Analyzed Simultaneously

The resulting regression equations, coefficient of determination, and standard error for each regression method is shown in Table V for the case when all 129 gages are analyzed simultaneously. The first column gives the regression method name, second column shows the regression equation, and the third and forth columns provide the performance criteria values of determination coefficient, R^2, and standard error, S_e:

TABLE V

SUMMARY OF REGRESSION EQUATIONS FOR ALL GAGES ANALYZED SIMULTANEOUSLY

Regression Method	Equation	Coefficient of Determination, R^2	Standard Error, S_e
Simple Linear	$Q_{peak} = 1307.11 + 1.1875Q_{ave}$	0.9185	2943.8
Multiple Linear	$Q_{peak} = 1792.27 + 1.2772Q_{ave} - 4.0870A$	0.9239	2844.9
Quadratic	$Q_{peak} = 1164.54 + 1.2266Q_{ave} - 1.0661Q_{ave}^2$	0.9188	2938.7
Power	$Q_{peak} = 16.400Q_{ave}^{0.72136}$	0.8701	4228.6

As indicated in Table V by the larger coefficient of determination, $R^2 = 0.9239$, and lowest standard error, $S_e = 2{,}844.9$, the multiple linear regression model is indicated as the most desirable in predicting peak-daily streamflow for all gages analyzed simultaneously. Figure 3 is the residual plot for the multiple linear regression model:

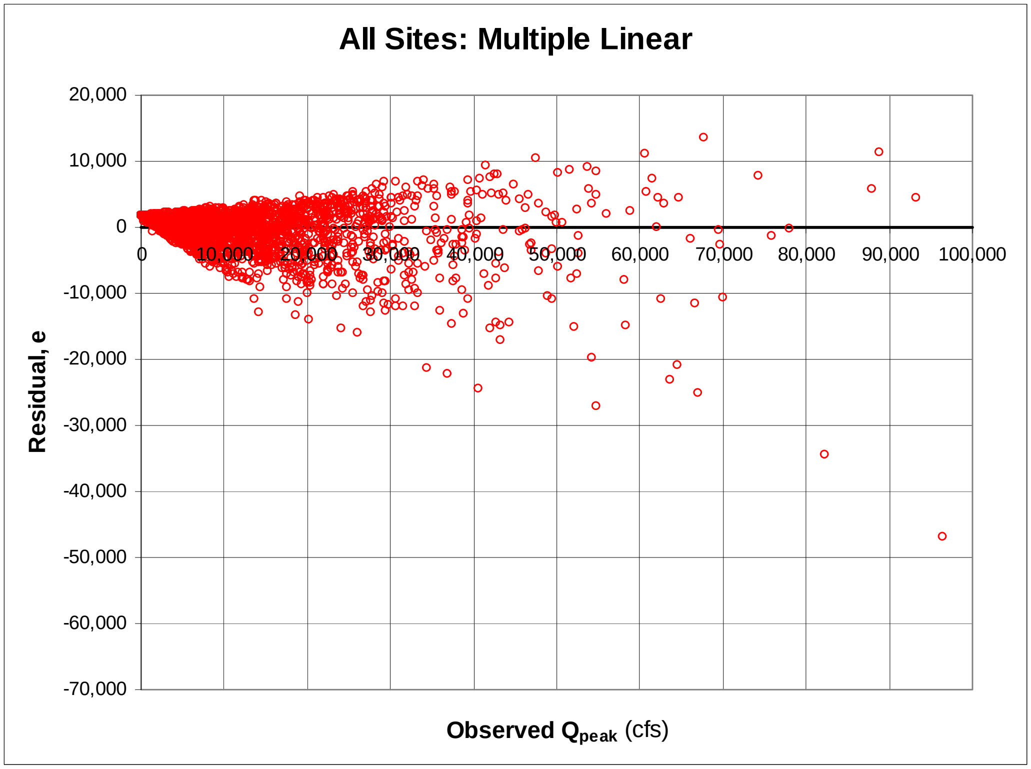


FIGURE 3 – Residual Plot for Multiple Linear Regression Model Developed for All Gages Analyzed Simultaneously

The residual plot shows the difference between the observed peak streamflow and the peak streamflow estimated using the regression equation. When the estimated value is less than the observed flow, the residual, e, is negative; when the estimate is greater than the observed flow, the residual is positive. It is clear that the residual increases with observed flow magnitude and the variance of the residual also increases with flow magnitude. Residual plots were developed for each regression model, and comparison of residual plots failed to indicate that another form of the regression model was more desirable.

The residual plot indicates a tendency for the multiple linear regression model to overestimate peak-daily streamflow at lower streamflow rates, particularly when the peak streamflow is below 2,000 cfs. This can be attributed to some extent to reliance on the empirical relationship allowing the regression equation intercept to be non-zero, rather than forcing the theoretical constraint of zero intercept. The result is an intercept of 1,792.27 cfs instead of 0 cfs, as the theoretical relationship would dictate. The residual plot also indicates a negative skew in predicting peak-daily streamflow, indicating that the model underestimates larger streamflow rates. This becomes particularly evident when peak-daily streamflow is greater than 30,000 cfs. At streamflows greater than this, a number of predicted peak-daily streamflows are seen to be underestimates by magnitudes greater than 20,000 cfs, while the most any peak-daily streamflow is overestimated is less that 13,500 cfs.

The next section, in which gages are grouped by area size, attempts to address some of these limitations by developing models that are more site specific to a particular watershed by separating gages into partitions of similar drainage areas and is expected to produce lower residuals.

B. Gages Grouped by Drainage Area Size

The resulting equations, coefficient of determination, and standard error for each regression method is shown in Table VI for the case when all data are analyzed by areal groupings:

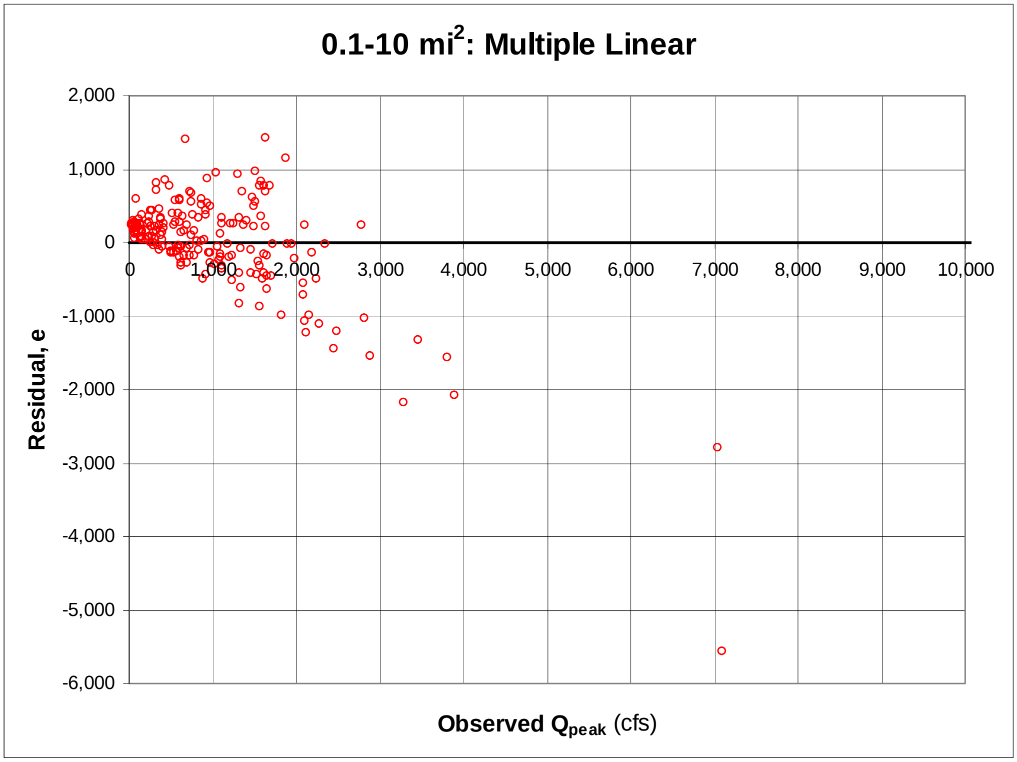
TABLE VI

SUMMARY OF REGRESSION EQUATIONS FOR GAGES GROUPED BY DRAINAGE AREA

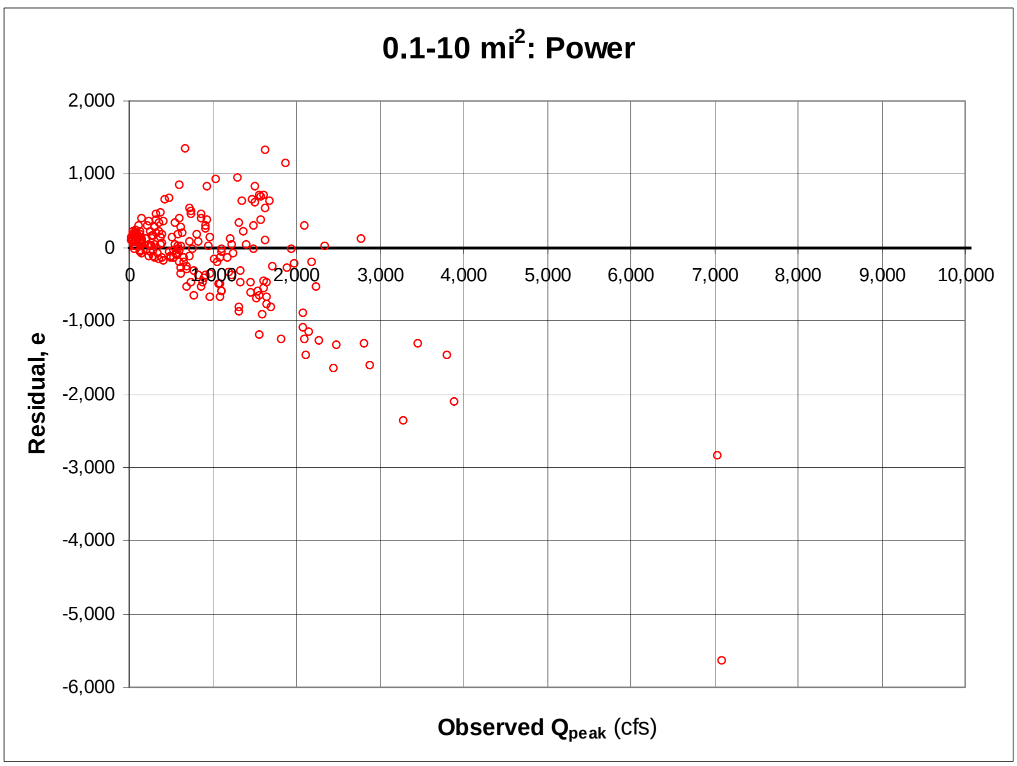
Areal Grouping	Regression Method	Equation	Coefficient of Determination, R^2	Standard Error, S_e
0.1-10 mi^2	Simple Linear	$Q_{peak} = 286.23 + 4.0542Q_{ave}$	0.4673	713.4
	Multiple Linear	$Q_{peak} = -37.26 + 3.4319Q_{ave} + 93.2504A$	0.4980	700.1
	Quadratic	$Q_{peak} = 316.61 + 3.7011Q_{ave} + (5.504x10^{-4})Q_{ave}^2$	0.4680	718.9
	Power	$Q_{peak} = 10.665Q_{ave}^{0.85956}$	0.6281	729.5
10-100 mi^2	Simple Linear	$Q_{peak} = 1067.60 + 1.5739Q_{ave}$	0.5566	1690.8
	Multiple Linear	$Q_{peak} = 1694.48 + 1.7736Q_{ave} - 20.2184A$	0.5802	1645.8
	Quadratic	$Q_{peak} = 852.14 + 1.8455Q_{ave} - (5.287x10^{-5})Q_{ave}^2$	0.5602	1683.9
	Power	$Q_{peak} = 29.352Q_{ave}^{0.64447}$	0.5808	1759.9
100-1,000 mi^2	Simple Linear	$Q_{peak} = 1059.58 + 1.1980Q_{ave}$	0.9070	3467.3
	Multiple Linear	$Q_{peak} = 2216.03 + 1.2698Q_{ave} - 4.6689A$	0.9137	3340
	Quadratic	$Q_{peak} = 618.13 + 1.2754Q_{ave} - (1.822x10^{-6})Q_{ave}^2$	0.9078	3452
	Power	$Q_{peak} = 2.462Q_{ave}^{0.93026}$	0.9051	3485.3

1. 0.1 to 10 mi^2 Areal Grouping

Figure 4 shows the residual plots for the multiple linear and power models of the 0.1 to 10 mi^2 areal grouping:



(a) Multiple Linear Model



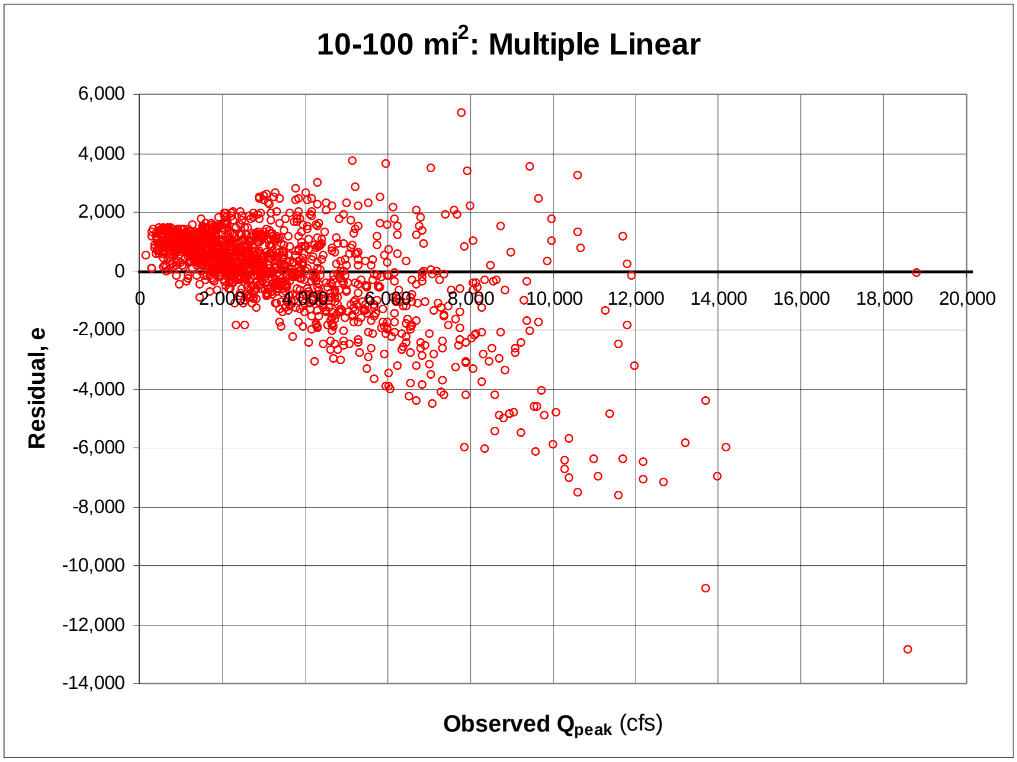
(b) Power Model

FIGURE 4 – Residual Plots for Regression Models Developed for 0.1 to 10 mi^2 Areal Grouping

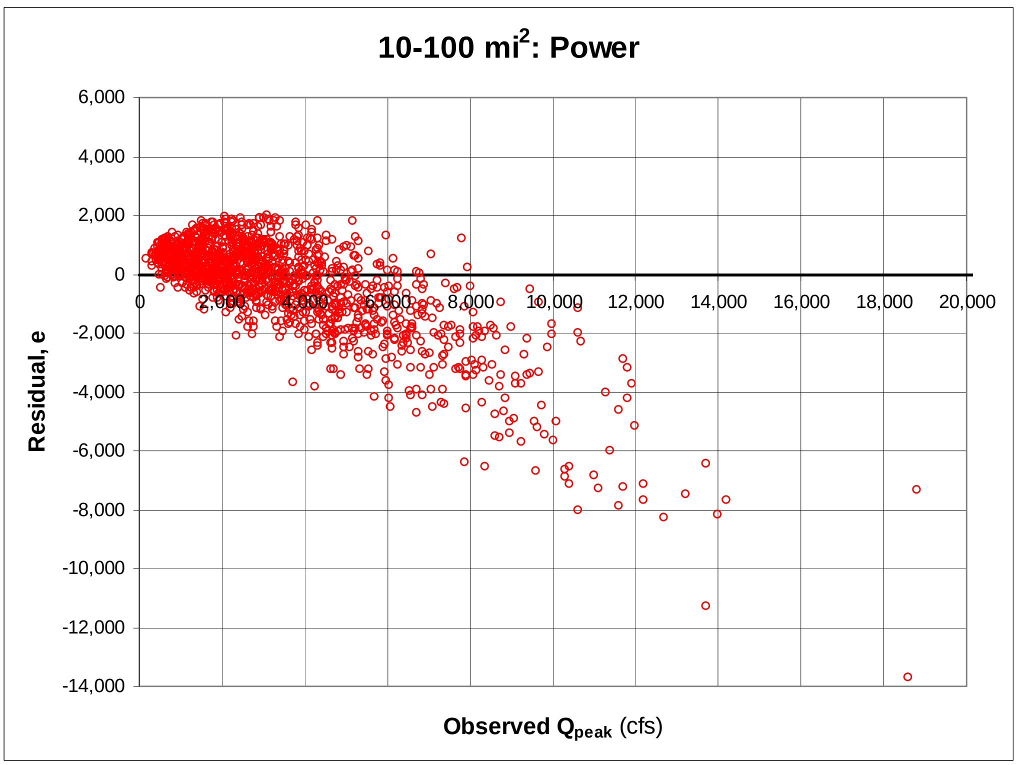
For the 0.1 to 10 mi^2 areal grouping, the power regression model has the highest coefficient of determination, $R^2 = 0.6281$, but also has the largest standard error, $S_e = 729.5$. Of the remaining three models, the multiple linear regression model has the highest coefficient of determination, $R^2 = 0.4980$, and standard error, $S_e = 700.1$. Upon reviewing the residual plots, it can be seen that each model has difficulty in accurately predicting peak-daily streamflow at values greater than 2,000 to 3,000 cfs. At these larger streamflows, the predicted streamflow can be seen to be significantly lower than the observed streamflow. However, at lower streamflows, the multiple linear model is seen to have a strong bias towards overestimating peak-daily streamflow at lower streamflow rates. The power model appears to have less bias present at lower streamflow rates and as a result, the power regression model is said to be the best model for the 0.1 to 10 mi^2 areal grouping.

2. 10 to 100 mi^2 Areal Grouping

Figure 5 shows the residual plots for the multiple linear and power models of the 10 to 100 mi^2 areal grouping:



(a) Multiple Linear Model



(b) Power Model

FIGURE 5 – Residual Plots for Multiple Linear and Power Regression Models Developed for 10 to 100 mi^2 Areal Grouping

For the 10 to 100 mi^2 areal grouping, the power regression model has the highest coefficient of determination, R^2 = 0.5808, but also has the largest standard error, S_e = 1,759.9. Of the remaining three models, the multiple linear regression model has the highest coefficient of determination, R^2 = 0.5802, and standard error, S_e = 1,645.8. Upon reviewing the residual plots, it can be seen that each model has some bias. Both tend to overestimate smaller streamflows and underestimate larger streamflow values. However, the multiple linear regression model overall appears to have less bias and, as a result, is identified as the best model for the 10 to 100 mi^2 areal grouping.

3. <u>100 to 1,000 mi^2 Areal Grouping</u>

Figure 6 shows the residual plots for the multiple linear model of the 100 to 1,000 mi^2 areal grouping:

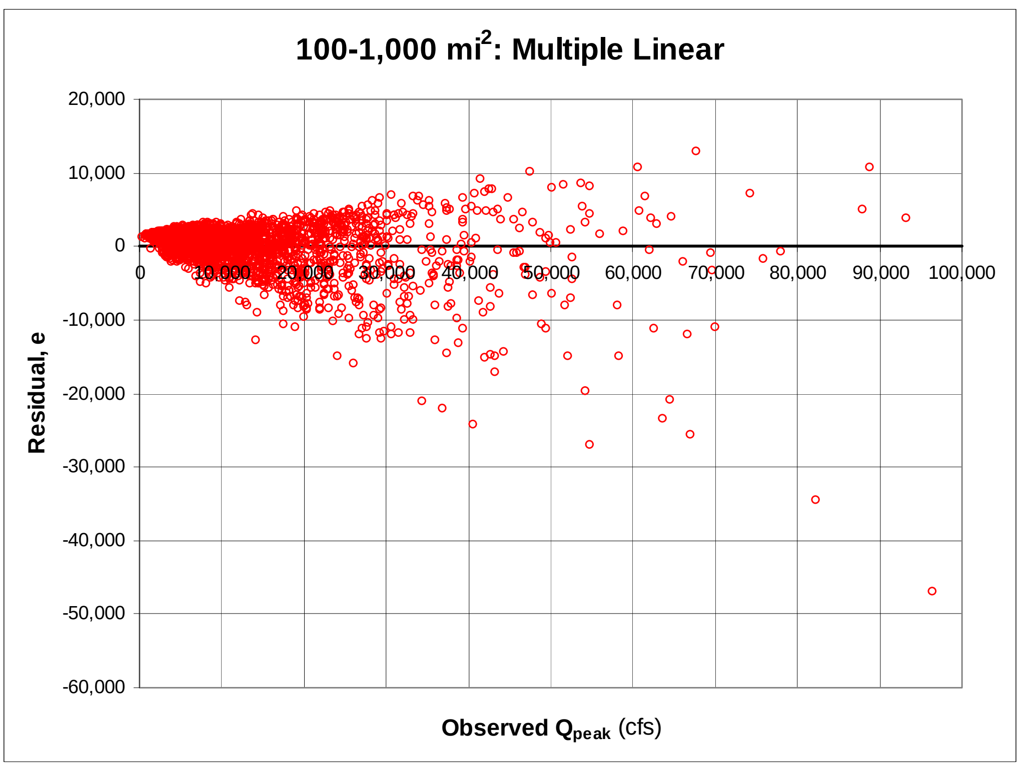


FIGURE 6 – Residual Plot for Multiple Linear Regression Model Developed for 100 to 1,000 mi^2 Areal Grouping

As indicated by the larger coefficient of determination, R^2 = 0.9137, and the lower standard error, S_e = 3,340.0, the multiple linear regression model is the most desirable to use in predicting the peak-daily streamflow for all gages analyzed simultaneously. A comparison of the residual plots fails to indicate another model as more desirable.

C. Gages Grouped by Hydrologic Region

The resulting equations, coefficient of determination, and standard error for each regression method is shown in Table VII for the case when data are partitioned by hydrologic region:

TABLE VII

SUMMARY OF REGRESSION EQUATIONS FOR GAGES GROUPED BY HYDROLOGIC REGION

Hydrologic Region	Regression Method	Equation	Coefficient of Determination, R^2	Standard Error, S_e
1	Simple Linear	$Q_{peak} = 1920.72 + 1.4075Q_{ave}$	0.9191	2513.2
	Multiple Linear	$Q_{peak} = 1830.96 + 1.3467Q_{ave} + 3.0734A$	0.9200	2503.2
	Quadratic	$Q_{peak} = 1629.60 + 1.5743Q_{ave} - (7.147x10^{-6})Q_{ave}^2$	0.9220	2467.5
	Power	$Q_{peak} = 34.457Q_{ave}^{0.66274}$	0.8451	3122.3
2	Simple Linear	$Q_{peak} = 1364.95 + 1.1382Q_{ave}$	0.8694	2491.7
	Multiple Linear	$Q_{peak} = 1759.04 + 1.2448Q_{ave} - 4.1441A$	0.8779	2410.2
	Quadratic	$Q_{peak} = 1076.41 + 1.2467Q_{ave} - (5.188x10^{-6})Q_{ave}^2$	0.8708	2478.7
	Power	$Q_{peak} = 9.781Q_{ave}^{0.77572}$	0.8903	2627.9
3	Simple Linear	$Q_{peak} = 2098.03 + 1.2164Q_{ave}$	0.8875	3829.3
	Multiple Linear	$Q_{peak} = 3743.99 + 1.3607Q_{ave} - 8.9434A$	0.9051	3519.4
	Quadratic	$Q_{peak} = 1350.95 + 1.3806Q_{ave} - (4.810x10^{-6})Q_{ave}^2$	0.8903	3780.6
	Power	$Q_{peak} = 15.040Q_{ave}^{0.74288}$	0.8400	4450.3
4	Simple Linear	$Q_{peak} = 1317.87 + 1.0939Q_{ave}$	0.9730	1974.6
	Multiple Linear	$Q_{peak} = 1335.16 + 1.0985Q_{ave} - 0.1814A$	0.9730	1987.0
	Quadratic	$Q_{peak} = 1129.63 + 1.1361Q_{ave} - (1.185x10^{-6})Q_{ave}^2$	0.9732	1978.7
	Power	$Q_{peak} = 3.936Q_{ave}^{0.87715}$	0.9636	2023.4
5	Simple Linear	$Q_{peak} = 1362.76 + 1.2153Q_{ave}$	0.9431	3913.7
	Multiple Linear	$Q_{peak} = 1693.43 + 1.2511Q_{ave} - 1.9502A$	0.944	3884.7
	Quadratic	$Q_{peak} = 768.60 + 1.3611Q_{ave} - (2.888x10^{-6})Q_{ave}^2$	0.9454	3832.6
	Power	$Q_{peak} = 16.893Q_{ave}^{0.72662}$	0.9114	6408.0
6	Simple Linear	$Q_{peak} = 1306.2 + 0.9772Q_{ave}$	0.9312	1448.0
	Multiple Linear	$Q_{peak} = 1559.54 + 1.0906Q_{ave} - 2.5088A$	0.9439	1037.9
	Quadratic	$Q_{peak} = 1558.11 + 0.8526Q_{ave} + (8.594x10^{-6})Q_{ave}^2$	0.9335	1128.6
	Power	$Q_{peak} = 29.707Q_{ave}^{0.63238}$	0.8228	1594.7
7	Simple Linear	$Q_{peak} = 344.36 + 1.2581Q_{ave}$	0.9088	1472.8
	Multiple Linear	$Q_{peak} = 929.00 + 1.3441Q_{ave} - 6.2514A$	0.9201	1380.1
	Quadratic	$Q_{peak} = 718.96 + 1.0798Q_{ave} + (1.123x10^{-5})Q_{ave}^2$	0.9138	1431.9
	Power	$Q_{peak} = 31.340Q_{ave}^{0.61932}$	0.8604	2624.8

1. Region 1

Figure 7 shows the residual plots for Region 1 quadratic regression model:

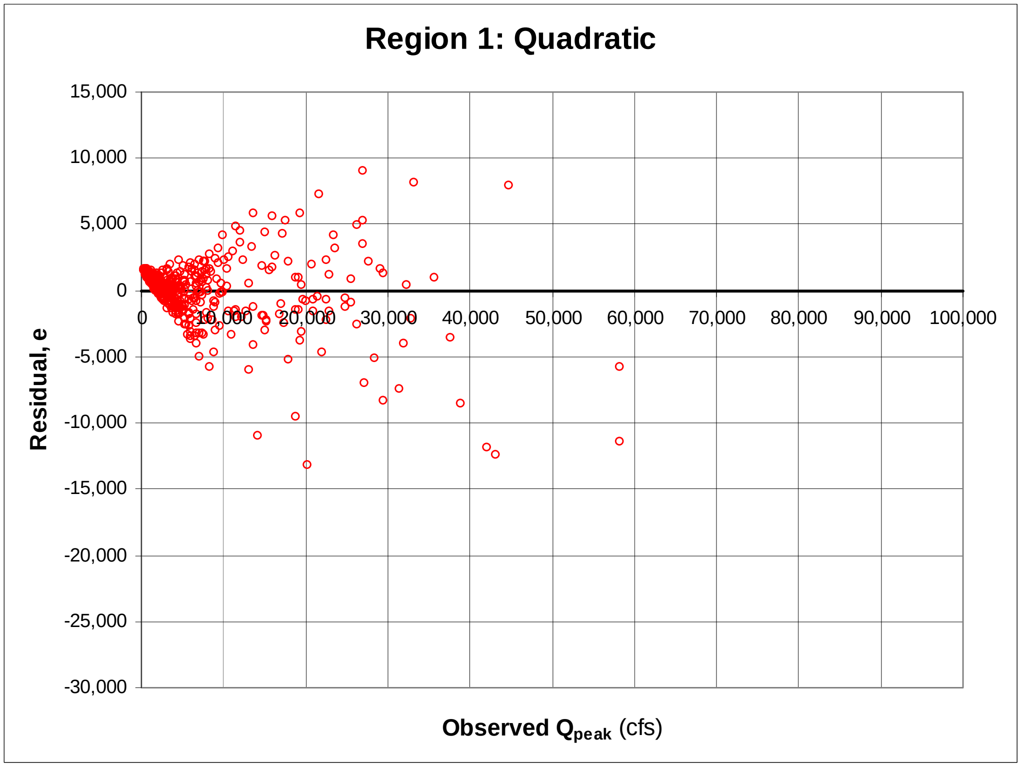
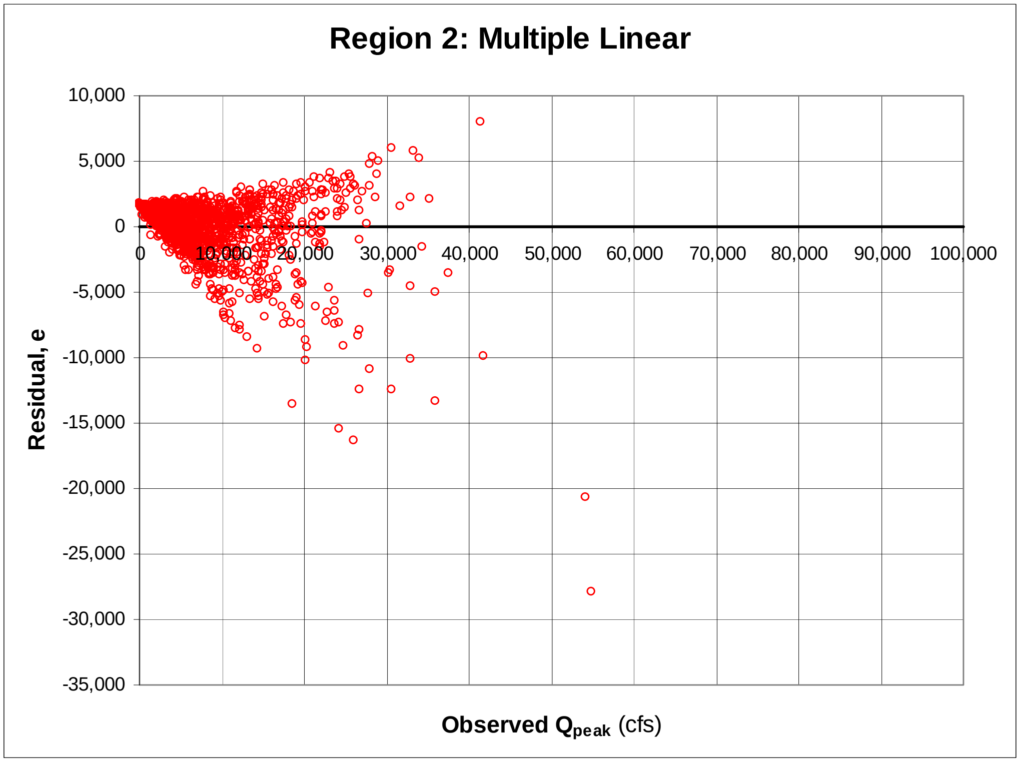


FIGURE 7 – Residual Plot for Quadratic Regression Model Developed for Region 1

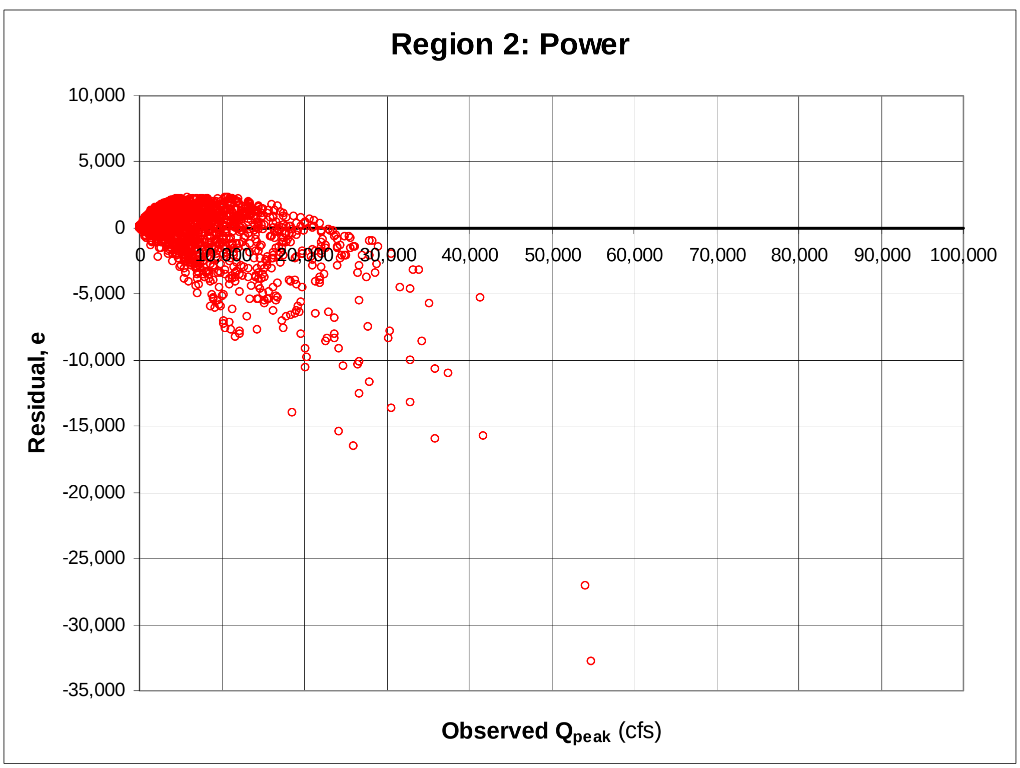
As indicated by the larger coefficient of determination, R^2 = 0.9220, and the lower standard error, S_e = 2,467.5, the quadratic regression model is the better method for predicting peak-daily streamflow for Region 1. A comparison of the residual plots fails to indicate that another model might be more desirable. Also from the residual plots, it should be noted that all of the models have a tendency to overestimate peak-daily streamflow values at lower streamflow levels.

2. Region 2

Figure 8 shows the residual plots for the Region 2 multiple linear and power regression models:



(a) Multiple Linear Model



(b) Power Model

FIGURE 8 – Residual Plots for Mulitple Linear and Power Regression Models Developed for Region 2

The power regression model has the largest coefficient of determination, $R^2 = 0.8903$, but also the largest standard error, $S_e = 2,627.9$. Of the remaining models, the multiple linear regression has the highest coefficient of determination, $R^2 = 0.8779$, and the lowest standard error, $S_e = 2,410.2$. A comparison of the residual plots indicates the multiple linear model has a tendency to overestimate peak-daily streamflow at lower streamflow levels. This tendency, though, is present in all models except for the power model, which shows a very strong bias towards underestimating large peak-daily streamflow levels. As a result of the large bias that the power model has at larger streamflow levels, the multiple linear regression model is the preferred model for Region 2.

3. <u>Region 3</u>

Figure 9 shows the residual plots for the Region 3 multiple linear regression model:

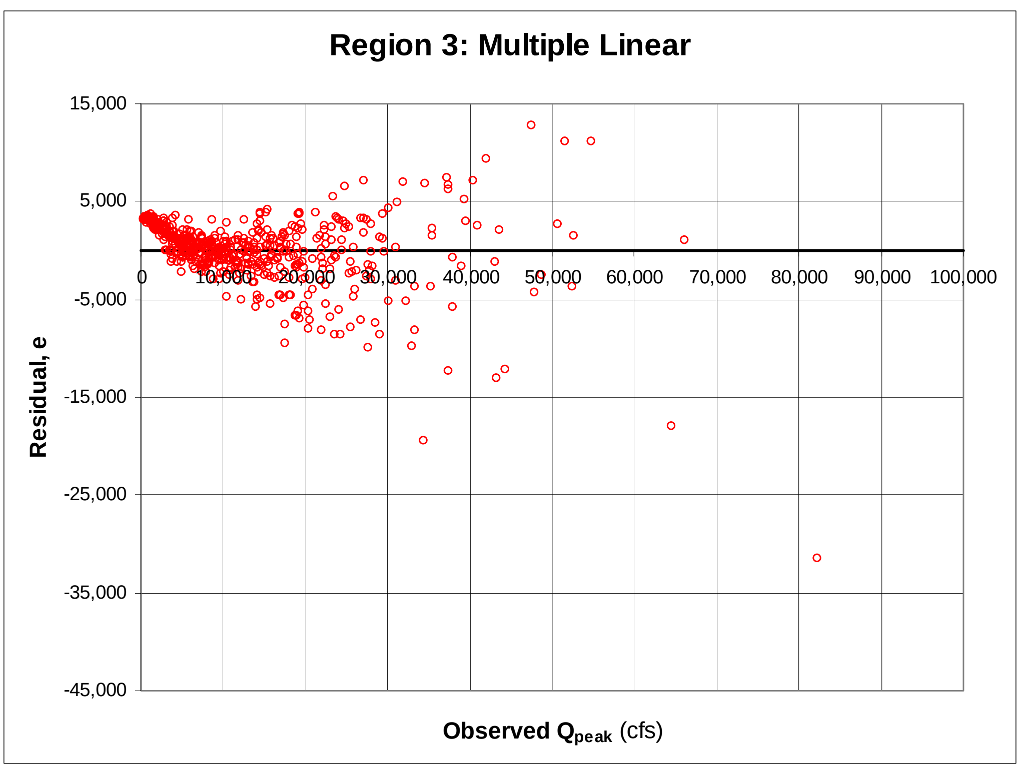
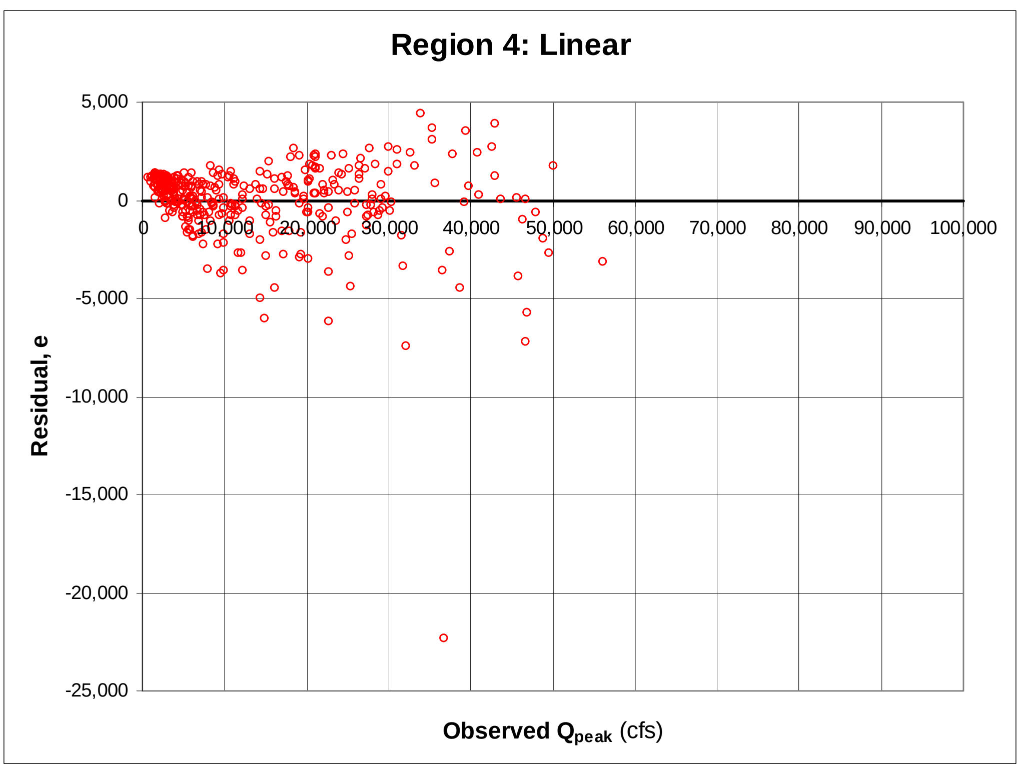


FIGURE 9 – Residual Plot for Multiple Linear Regression Model Developed for Region 3

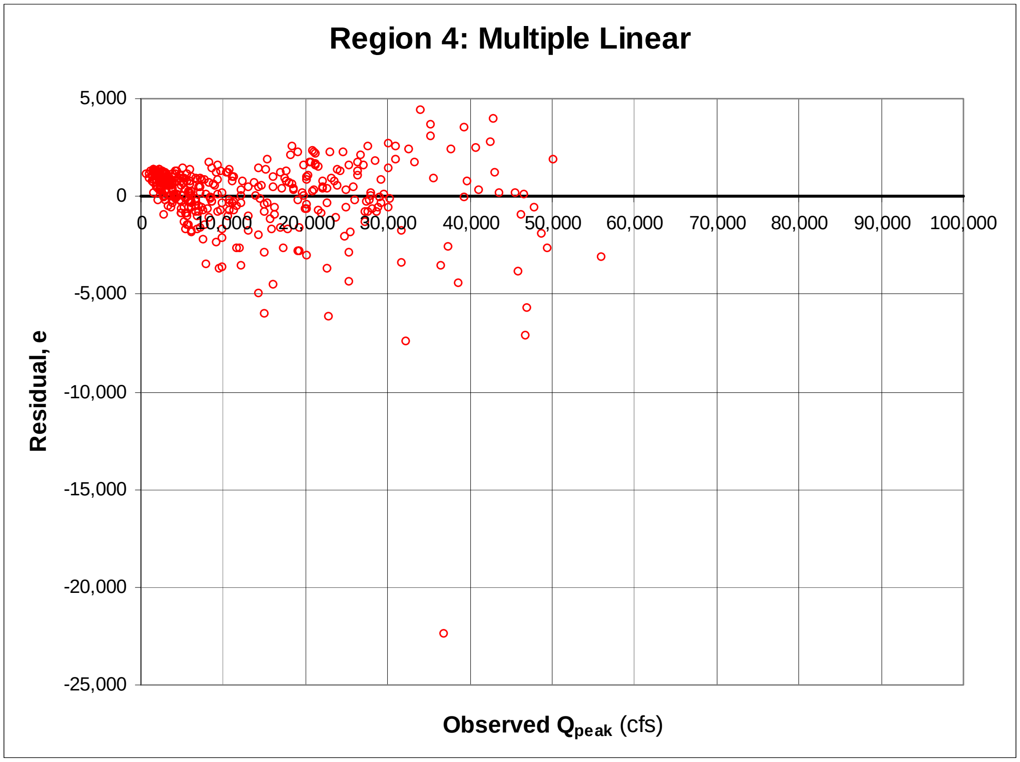
As indicated by the larger coefficient of determination, $R^2 = 0.9051$, and the lower standard error, $S_e = 3{,}519.4$, the multiple linear regression model is the most desirable to use in predicting the peak-daily streamflow for Region 3. A comparison of the residual plots indicates the multiple linear model has a tendency to overestimate peak-daily streamflow at lower streamflow levels. This tendency is present in all forms of regression models. A comparison of the residual plots fails to indicate that another model might be more desirable. Also from the residual plots, it should be noted that all of the models have a tendency to peak-daily streamflow values at lower streamflow levels.

4. Region 4

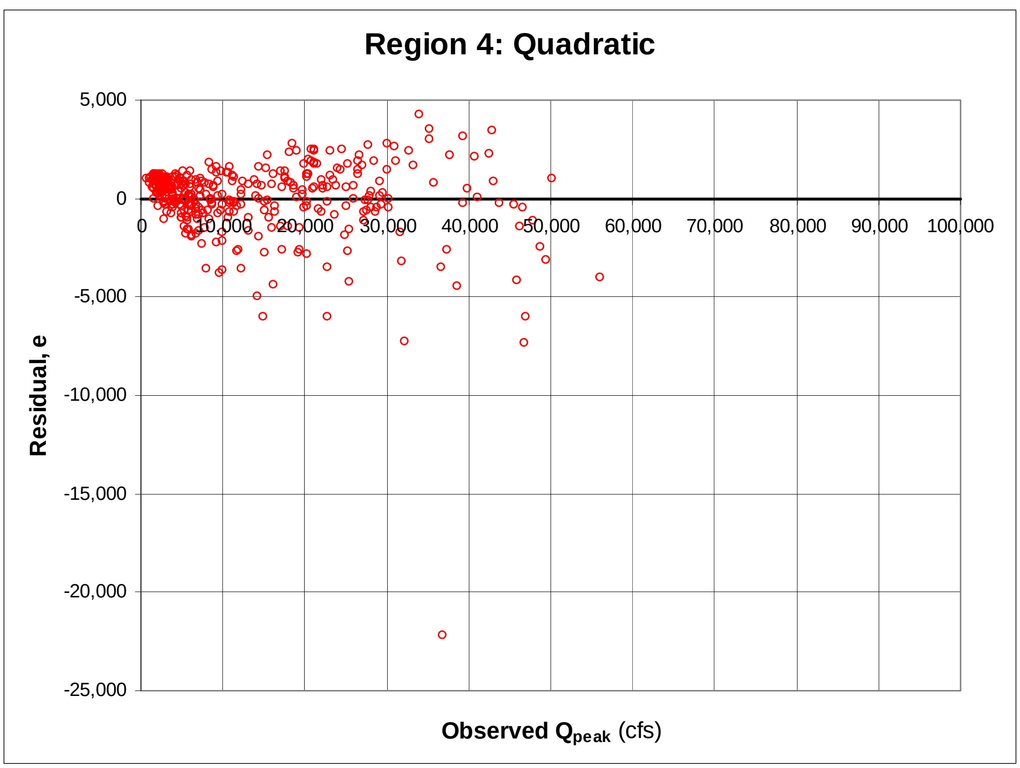
Figure 10 shows the residual plots for the Region 4 linear, multiple linear, and quadratic regression models:



(a) Linear Model



(b) Multiple Linear Model



(c) Quadratic Model

FIGURE 10 – Residual Plots for Linear, Multiple Linear, and Quadratic Regression Models Developed for Region 4

A comparison of the values for the coefficient of determination and the standard error indicate that the simple linear, multiple linear, and quadratic regression models each are nearly equally attractive. By examining the residual plots, it can be seen that each of these models has a tendency to overestimate peak-daily streamflow at lower streamflow levels. This tendency, though, is slightly less in the quadratic and, as a result, the quadratic regression model is the preferred model for Region 4.

5. Region 5

Figure 11 shows the residual plots for the Region 5 quadratic regression model:

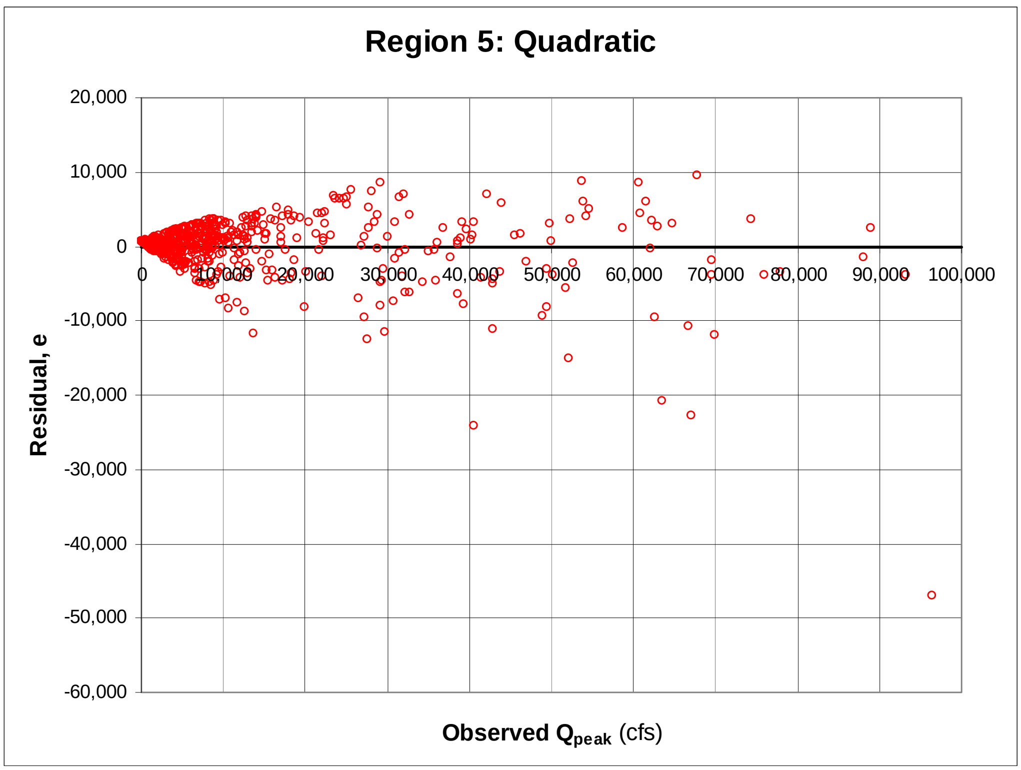


FIGURE 11 – Residual Plot for Quadratic Regression Model Developed for Region 5

As indicated by the larger coefficient of determination, R^2 = 0.9454, and the lower standard error, S_e = 3,832.6, the quadratic regression model is the most desirable to use in predicting the peak-daily streamflow for Region 5. A comparison of the residual plots fails to indicate that another model might be more desirable. Also from the residual plots, it should be noted that the quadratic model has less of a tendency to overestimate smaller peak-daily streamflow rates than all other models except for the power model, which has a strong bias towards underestimating peak-daily streamflow rates across most of its range of values.

6. Region 6

Figure 12 shows the residual plots for the Region 6 multiple linear regression model:

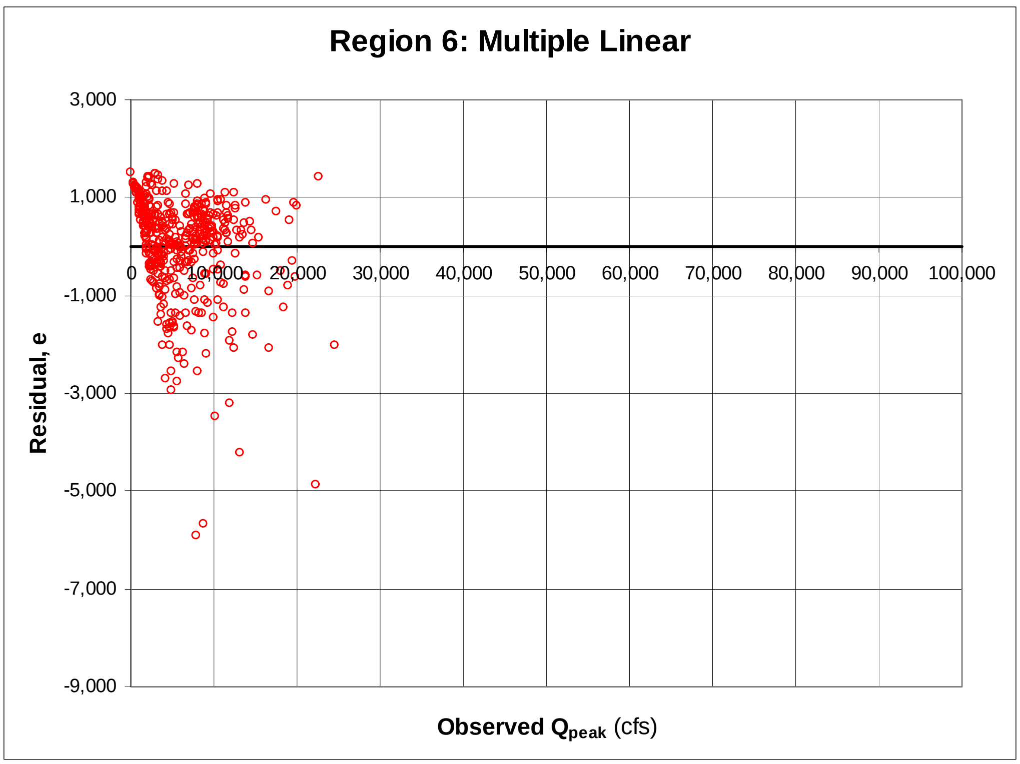


FIGURE 12 – Residual Plot for Multiple Linear Regression Model Developed for Region 6

As indicated by the larger coefficient of determination, R^2 = 0.9439, and the lower standard error, S_e = 1,037.9, the multiple linear regression model is the most desirable to use in predicting the peak-daily streamflow for Region 6. A comparison of the residual plots fails to indicate that another model might be more desirable. Also from the residual plots, it can be seen that the models have a tendency to overestimate lower peak-daily streamflow rates. For the multiple linear model, the lowest peak-daily streamflow rate to be underestimated had a value of approximately 1,900 cfs.

7. Region 7

Figure 13 shows the residual plots for the Region 7 multiple linear regression model:

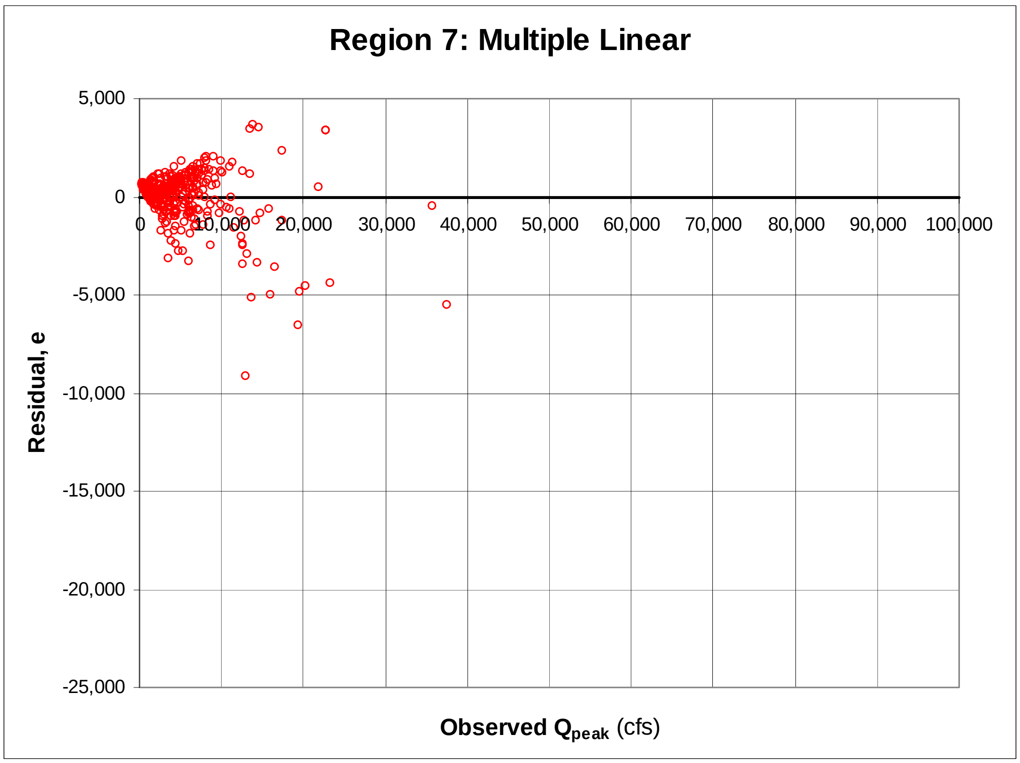


FIGURE 13 – Residual Plot for Multiple Linear Regression Model Developed for Region 7

As indicated by the larger coefficient of determination, R^2 = 0.9201, and the lower standard error, S_e = 1,380.1, the multiple linear regression model is the most desirable to use in predicting the peak-daily streamflow for Region 7. A comparison of the residual plots fails to indicate that the simple linear regression model might be more desirable due to the tendency to overestimate peak-daily streamflow rates at lower streamflow levels being less for the simple linear model than the multiple linear model. However, the lower standard error of the multiple linear model indicates that it produces less error overall, and is therefore the preferred model.

D. Regression Model Evaluation Summary

The regression models evaluated as best performing for each data partitioning approach are summarized in Table VIII:

TABLE VIII

SUMMARY OF THE OPTIMAL REGRESSION EQUATIONS
FOR EACH GAGE PARTITION

Regression Method	Equation	Coefficient of Determination, R^2	Standard Error, S_e
Multiple Linear	$Q_{peak} = 1792.27 + 1.2772Q_{ave} - 4.0870A$	0.9239	2844.9

(a) All Sites

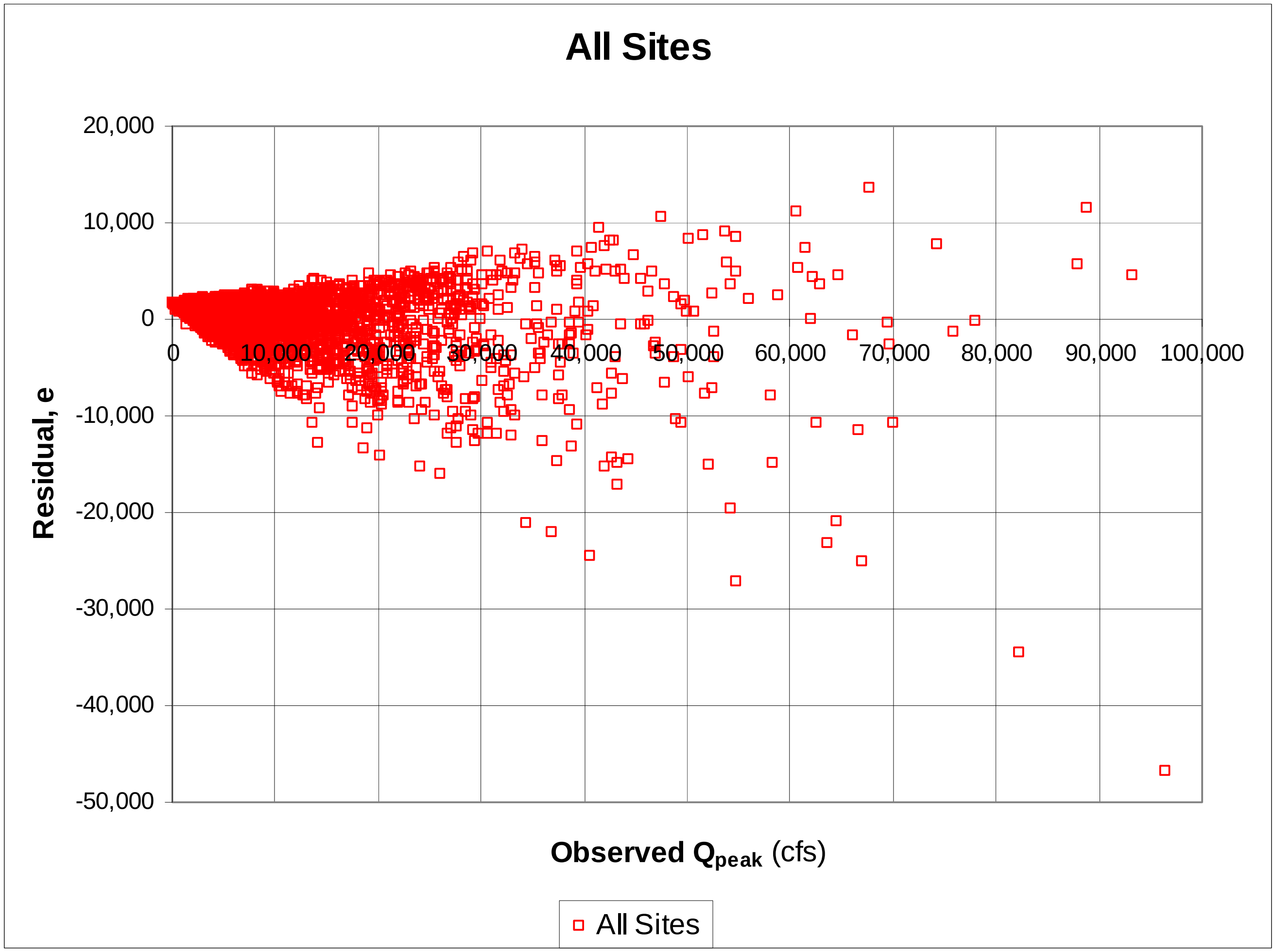
Areal Grouping	Regression Method	Equation	Coefficient of Determination, R^2	Standard Error, S_e
0.1-10 mi^2	Power	$Q_{peak} = 10.665Q_{ave}^{0.85956}$	0.6281	729.5
10-100 mi^2	Multiple Linear	$Q_{peak} = 1694.48 + 1.7736Q_{ave} - 20.2184A$	0.5802	1645.8
100-1,000 mi^2	Multiple Linear	$Q_{peak} = 2216.03 + 1.2698Q_{ave} - 4.6689A$	0.9137	3340.0

(b) Grouped by Area

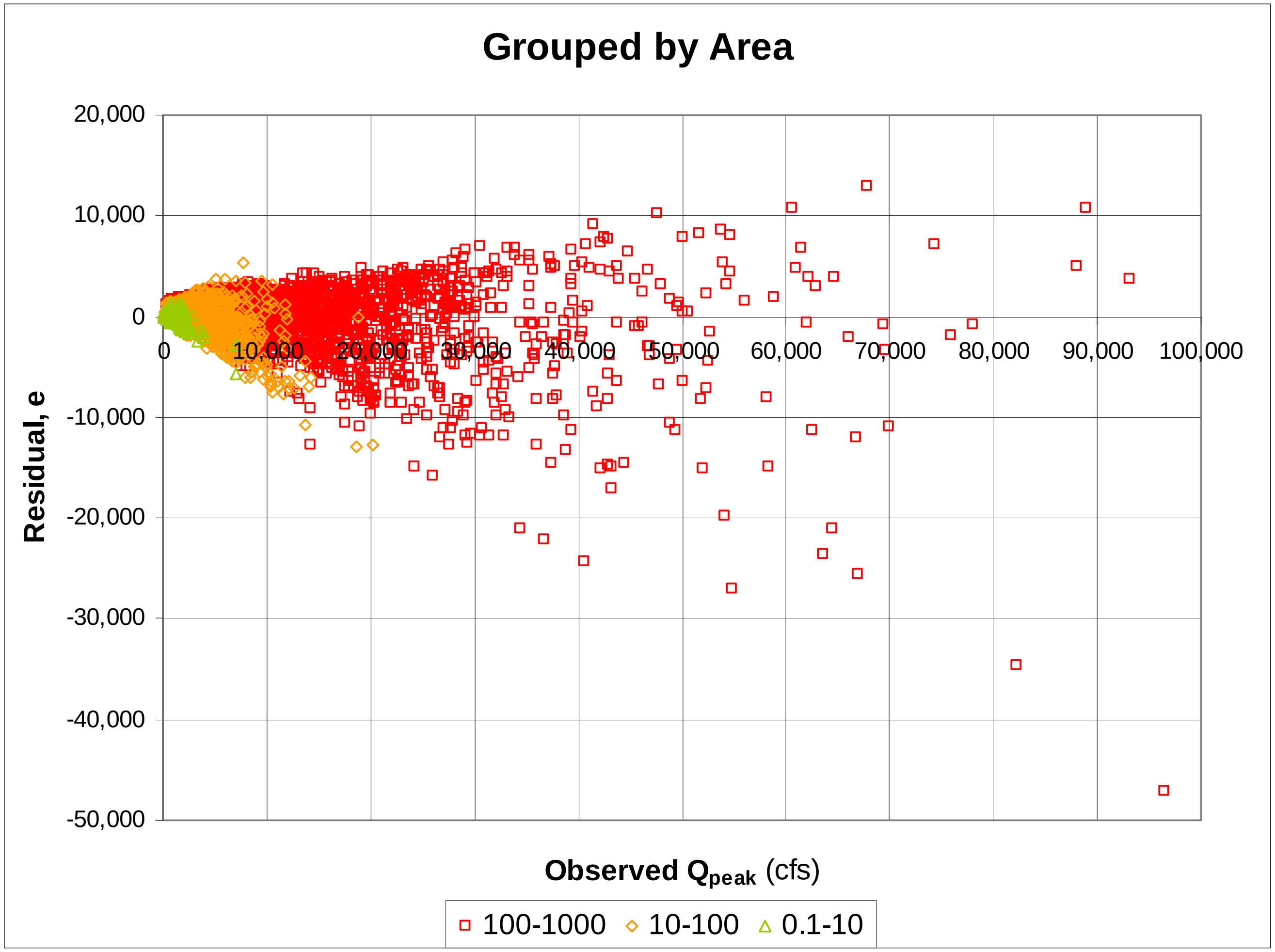
Hydrologic Region	Regression Method	Equation	Coefficient of Determination, R^2	Standard Error, S_e
1	Quadratic	$Q_{peak} = 1629.60 + 1.5743Q_{ave} - (7.147\text{x}10^{-6})Q_{ave}^2$	0.9220	2467.5
2	Multiple Linear	$Q_{peak} = 1759.04 + 1.2448Q_{ave} - 4.1441A$	0.8779	2410.2
3	Multiple Linear	$Q_{peak} = 3743.99 + 1.3607Q_{ave} - 8.9434A$	0.9051	3519.4
4	Quadratic	$Q_{peak} = 1129.63 + 1.1361Q_{ave} - (1.185\text{x}10^{-6})Q_{ave}^2$	0.9732	1978.7
5	Quadratic	$Q_{peak} = 768.60 + 1.3611Q_{ave} - (2.888\text{x}10^{-6})Q_{ave}^2$	0.9454	3832.6
6	Multiple Linear	$Q_{peak} = 1559.54 + 1.0906Q_{ave} - 2.5088A$	0.9439	1037.9
7	Multiple Linear	$Q_{peak} = 929.00 + 1.3441Q_{ave} - 6.2514A$	0.9201	1380.1

(c) Grouped by Hydrologic Region

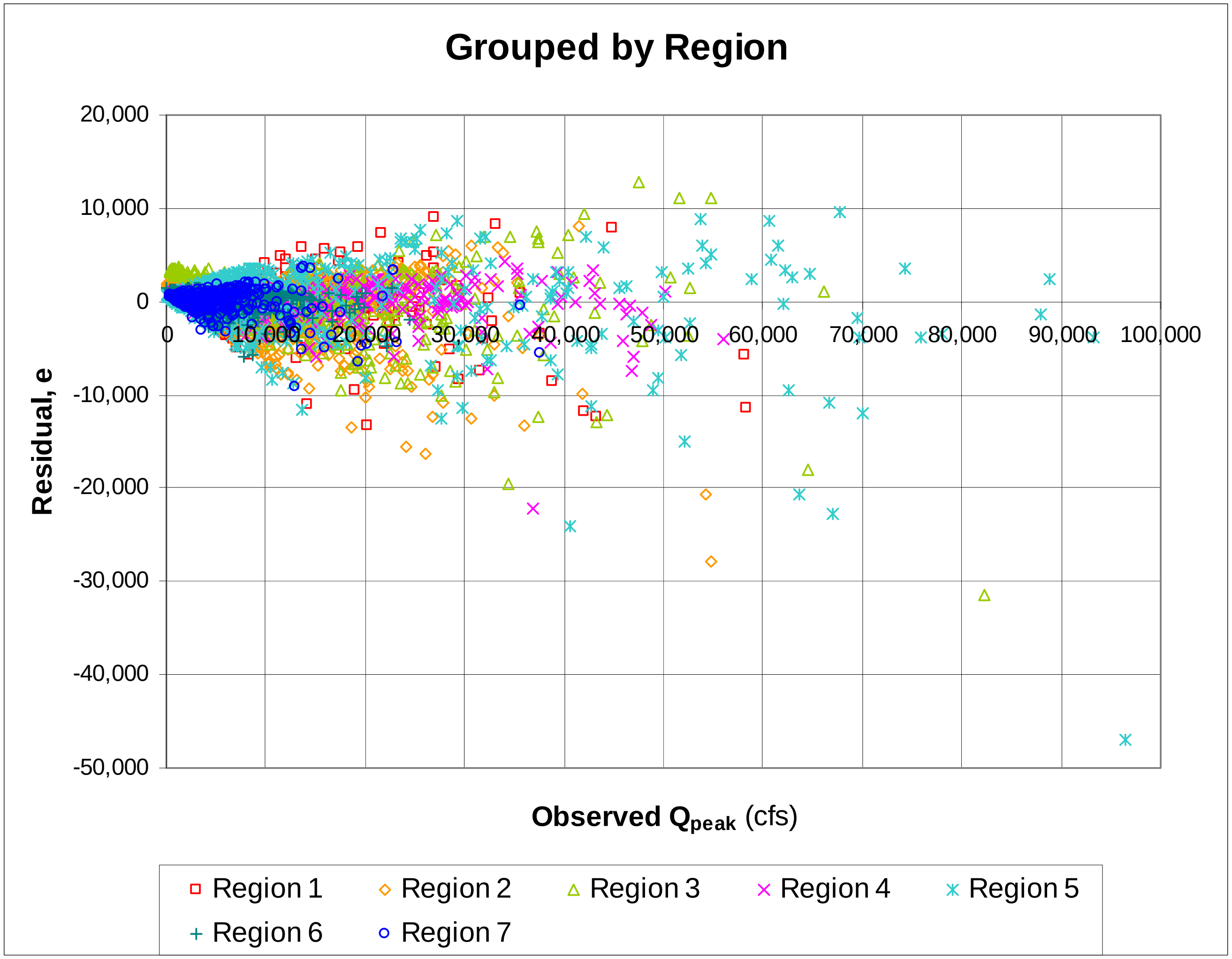
Using these regression models, the following residual plots are created:


All Sites
20,000
10,000
0
-10,000
-20,000
-30,000
-40,000
-50,000
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
Residual, e
Observed Qpeak (cfs)
All Sites

(a) All Sites



(b) Grouped by Area



(c) Grouped by Region

FIGURE 14 – Combined Residual Plots

Reviewing the information contained in Table VIII, the coefficients of determination indicate that a large portion of the variance is explained by the models selected for all gage data analyzed simultaneously and gage data grouped by region. The only partition within the gage data grouped by area with as much variance explained is the partition for the largest drainage areas, 100 to 1,000 mi^2. This data partition also had nearly twice as many points as either of the other groups (see Table III from Chapter IV also with data partition characteristics listed, and Appendix II), which has a role influencing the coefficient of determination. Regardless, the relatively low coefficients of determination for the 0.1 to 10 mi^2 and 10 to 100 mi^2 partitions indicates this data grouping is a relatively less desirable means for portioning the data for analysis.

Another way to review the coefficient of determination considers a weighted average, with weight assigned according to the number of data pairs or points used for the data partition. Under this approach, the weighted coefficient of determination and standard error are shown in Table IX:

TABLE IX

WEIGHTED COEFFICIENTS OF DETERMINATION AND STANDARD ERRORS

Partitioning Method	Weighted R^2	Weighted S_e
All Gages	0.9239	2844.9
By Area	0.7925	2669.3
By Region	0.9142	2507.6

The coefficient of determination values in Table IX confirm that grouping gage data by area results in the least degree of the variance being explained by the regression model.

The coefficients of determination for the remaining two groupings are similar in both Tables V and VII. However, the standard error is largest when all gages are analyzed simultaneously. By analyzing the gages by hydrologic region, the weighted average of the standard errors is minimized, which indicates that using the regression models developed for each of seven hydrologic regions produces a better result for predicting peak-daily streamflow.

VI. CONCLUSIONS

In the conclusion to his research on flood frequency curves for Kentucky, Connelly (2006) states that "a component of stream restoration design requires defining the channel forming discharge; however, existing guidance is often unclear as to the appropriate flood recurrence interval." He continues to state that:

> Many of the current investigations examining the flow magnitudes responsible for the dynamic shaping of streams (i.e. channel forming discharge) are finding these flow magnitudes to have recurrence intervals near one year or less.

The objective of this thesis is to identify the relationship between peak-daily streamflow, Q_{peak}, daily-average streamflow data, Q_{ave}, and drainage area data, A, for Kentucky streams. Historical streamflow data from the United States Geological Survey's (USGS) national system for streamflow data (NWIS) website served as the data source for the work. The purpose of the research is to develop a method for estimating peak-daily streamflow, Q_{peak}, and provide a systematic approach to increase the number of available Q_{peak} values. The results are useful in frequency analysis, where the enhanced record of Q_{peak} values that will allow estimation of flood flow magnitudes with recurrence intervals of less than one year. The current practice in flood flow record keeping provides only a single peak flow streamflow per annual flow period. The results show that it is possible to develop such an approach by way of developing a system of equations to estimate peak-daily streamflow for Kentucky streams with coefficients of determination, R^2, equal or greater than 0.8779.

A. <u>Recommended Peak-Daily Streamflow Equations</u>

The recommended method of estimating peak-daily streamflow involves using daily-average streamflow or daily-average streamflow and drainage area in one of seven equations, each of which corresponds to one of the seven physiographic hydrologic regions have been defined for Kentucky in USGS Report 87-4209 (Choquette 1988). These regions are shown on the Kentucky map in Figure 2, which is repeated below for convenience:

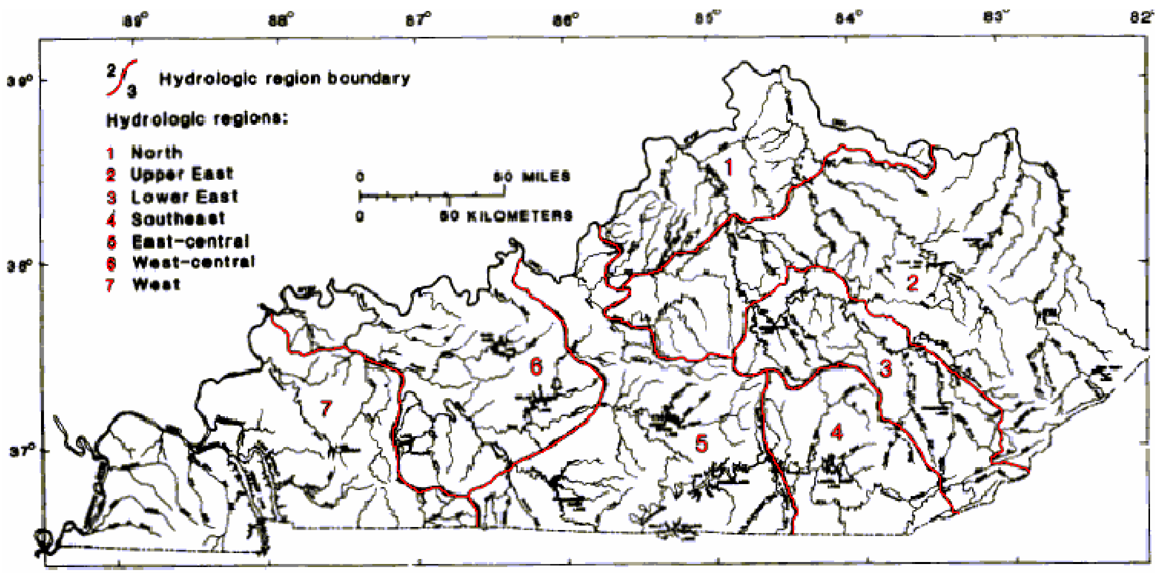


FIGURE 2 – Hydrologic Regions of Kentucky as Defined by Choquette (1988)

The recommended equations are shown in Table VII (c), which is also repeated for convenience:

Table VII

SUMMARY OF THE OPTIMAL REGRESSION EQUATIONS FOR EACH GAGE PARTITION

Hydrologic Region	Regression Method	Equation	Coefficient of Determination, R^2	Standard Error, S_e
1	Quadratic	$Q_{peak} = 1629.60 + 1.5743Q_{ave} - (7.147x10^{-6})Q_{ave}^2$	$R^2 = 0.9220$	$S_e = 2467.5$
2	Multiple Linear	$Q_{peak} = 1759.04 + 1.2448Q_{ave} - 4.1441A$	$R^2 = 0.8779$	$S_e = 2410.2$
3	Multiple Linear	$Q_{peak} = 3743.99 + 1.3607Q_{ave} - 8.9434A$	$R^2 = 0.9051$	$S_e = 3519.4$
4	Quadratic	$Q_{peak} = 1129.63 + 1.1361Q_{ave} - (1.185x10^{-6})Q_{ave}^2$	$R^2 = 0.9732$	$S_e = 1978.7$
5	Quadratic	$Q_{peak} = 768.60 + 1.3611Q_{ave} - (2.888x10^{-6})Q_{ave}^2$	$R^2 = 0.9454$	$S_e = 3832.6$
6	Multiple Linear	$Q_{peak} = 1559.54 + 1.0906Q_{ave} - 2.5088A$	$R^2 = 0.9439$	$S_e = 1037.9$
7	Multiple Linear	$Q_{peak} = 929.00 + 1.3441Q_{ave} - 6.2514A$	$R^2 = 0.9201$	$S_e = 1380.14$

(c) Grouped by Hydrologic Region

The units in the above equations are cfs for peak-daily and daily-average streamflow, Q_{peak} and Q_{ave}, respectively, and mi^2 for drainage area, A.

B. Limitations of Peak-Daily Streamflow Regressions

Despite the relatively large portion of variance described by the recommended regression relation in Table VII (c), further review of the results indicates the equations have certain limitations. Most notably, the residual plot shown in Figure 14 (c) in Chapter V shows these equations have strong tendency to overestimate peak-daily streamflow for lower streamflow rates. This can be attributed to the reliance on empirical relationships, which result in non-zero intercepts as theory would dictate. In other words, while a stream with daily-average streamflow rate of 0 cfs would have a peak-daily streamflow rate of 0 cfs, the equations presented here will not produce an estimate of 0 cfs for peak-daily streamflow when the daily-average streamflow inputted is 0 cfs. This can be explained because the equations use the given data set to estimate the β coefficients that produce the lowest sum of the squared errors for the data set. However, interest is not in “low-flow” records but in application to the higher flow events corresponding to “flood” flow.

Also seen in the residual plots is a characteristic known as nonconstant or non-stationary variance, which is where “the variance of the observations increases as the magnitude of the observation increases.” This characteristic indicates a methodology limitation and is an indication that the assumption of homogeneity of variances used in estimating the β coefficients is violated, and that a variance-stabilization transformation should be applied (Montgomery 1997). This can be done if the theoretical distribution of the observations is known. According to the distribution that the observations follow (i.e. Poisson distribution, normal distribution, log-normal distribution, etc.), a transformation can be applied to equalize the variance, and then the analysis run on the transformed data.

The recommended equations fail to take into account the effects of regulation or diversion, which are known to influence a number of the streamflow gage sites. A t-test testing for difference in means of two normal distributions (Haan 2002) performed on the Annual Mean Series (AMS) series from Little Sandy River at Grayson, Kentucky can be seen in Appendix V. This gage site was chosen because it has the largest number of available data points of the gages affected by regulation or diversion of flow. The test performed uses the 90% confidence level to test the null hypothesis that the mean annual maximum streamflow rates prior to and after regulation or diversion are equal. The results of the t-test show that the null hypothesis is rejected, indicating that there is a statistically significant difference between the mean annual maximum streamflow rates prior to and after regulation or diversion. Since the reason for diversion or flow regulation is typically directed at flood control, this result is expected and not an unusual result.

Also in Appendix V is an F-test testing for equality of variance for two normal distributions (Haan 2002) performed on the same data set using the 90% confidence level to test the null hypothesis that the variances are equal prior to and after regulation or diversion are equal. The results of the F-test show that the null hypothesis is rejected, indicating that there is a statistically significant difference between the variances prior to and after regulation or diversion. Again, since flow regulation is directed at reducing peak streamflows and reducing flood magnitudes, this is the expected result. These tests show that regulation or diversion can have significant effects on streamflow, and the relationship this has on peak-daily streamflow should be further investigated in future studies.

C. Applications

The recommended method of estimating peak-daily streamflow involves using daily-average streamflow or daily-average streamflow and drainage area (available from the USGS NWIS) in one of the seven equations in Table VII (c). Which equation is appropriate to be applied is dependant upon the hydrologic region in which the stream gage is located in, which can be determined from Table XIII located in Appendix I for stream gages used in this research or from Figure 2 located Chapter IV for other Kentucky streams.

Within this section, the methods discussed in this research will be applied to three stream gages of different drainage areas and located within separate hydrologic regions. Streamflow data for one water year is examined for each and an arbitrary threshold value is employed as the minimum predicted peak streamflow that will be considered. This data is summarized in Table X below:

TABLE X

STATISTICS FOR STREAM GAGES ANALYZED USING HYDROLOGIC REGION REGRESSION MODEL EQUATIONS

USGS Gage Number -	USGS Gage Station Name -	Drainage Area (mi^2)	Hydrologic Region -	Water Year -	Threshold (cfs)
3312500	Barren River near Pageville, KY	531	5	1942	3000
3300000	Beech Fork near Springfield, KY	85.9	2	1972	1500
3611800	Bayou Creek near Heath, KY	6.55	7	2002	230

Streamflow data for each of these three gages are accessed via the USGS NWIS website and inserted into a Microsoft Excel file. The data retrieved are the average-daily streamflow and the corresponding dates for the water year indicated, as well as the streamflow and date of the AMS flow occurring within the water year.

The data accessed above are then employed using the equations in Table VII (c) to estimate the peak-daily streamflow for the water year. Using the threshold value selected, those predicted values less than the threshold immediately be neglected. The predicted data must now be examined on a plot of the streamflow data to ensure that each of the streamflow values remaining is independent; that is, each storm event causing a peak in the streamflow should only be included once.

In the following figures and tables are the data for the three stream gages indicated in Table X.

1. <u>Barren River near Pageville, Kentucky</u>

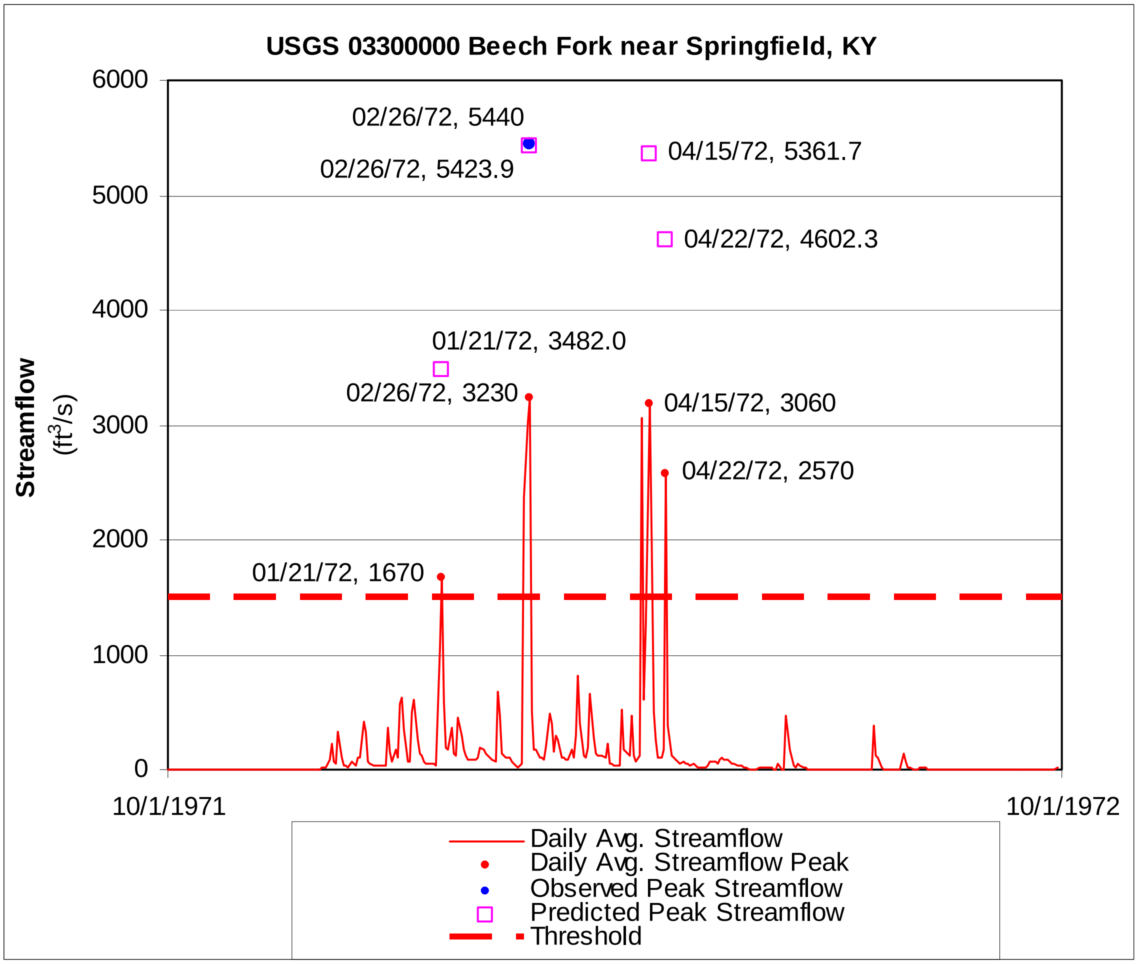


FIGURE 15 - Daily Streamflow Record for Barren River near Pageville, Kentucky for Water Year 1942

TABLE XI

PEAK STREAMFLOW DATA FOR BARREN RIVER NEAR PAGEVILLE, KY FOR WATER YEAR 1942

Date -	Daily-Ave Discharge (cfs)	Obs. Peak Discharge (cfs)	Pred. Peak Discharge (cfs)
04/10/42	9540.00	10400	13490.5
01/02/42	5160.00	-	7714.9
02/17/42	4750.00	-	7168.6
03/14/42	3300.00	-	5228.7
07/09/42	3540.00	-	5550.7

2. Beech Fork near Springfield, Kentucky

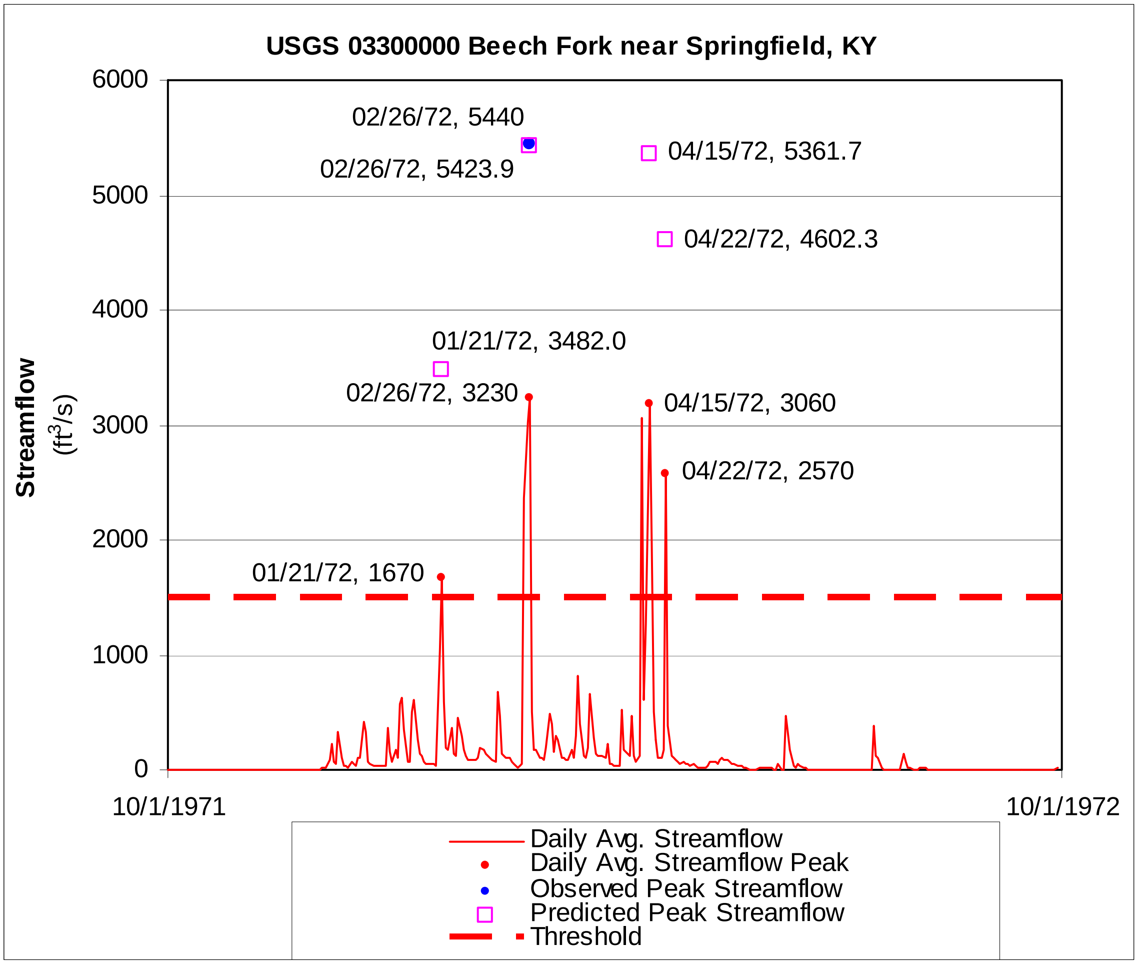


FIGURE 16 - Daily Streamflow Record for Beech Fork near Springfield, Kentucky for Water Year 1972

TABLE XII

PEAK STREAMFLOW DATA FOR BEECH FORK NEAR SPRINGFIELD, KY FOR WATER YEAR 1972

Date -	Daily-Ave Discharge (cfs)	Obs. Peak Discharge (cfs)	Pred. Peak Discharge (cfs)
02/26/72	3230.00	5440	5423.9
01/21/72	1670.00	-	3482.0
04/15/72	3180.00	-	5361.7
04/22/72	2570.00	-	4602.3

3. Bayou Creek near Heath, Kentucky

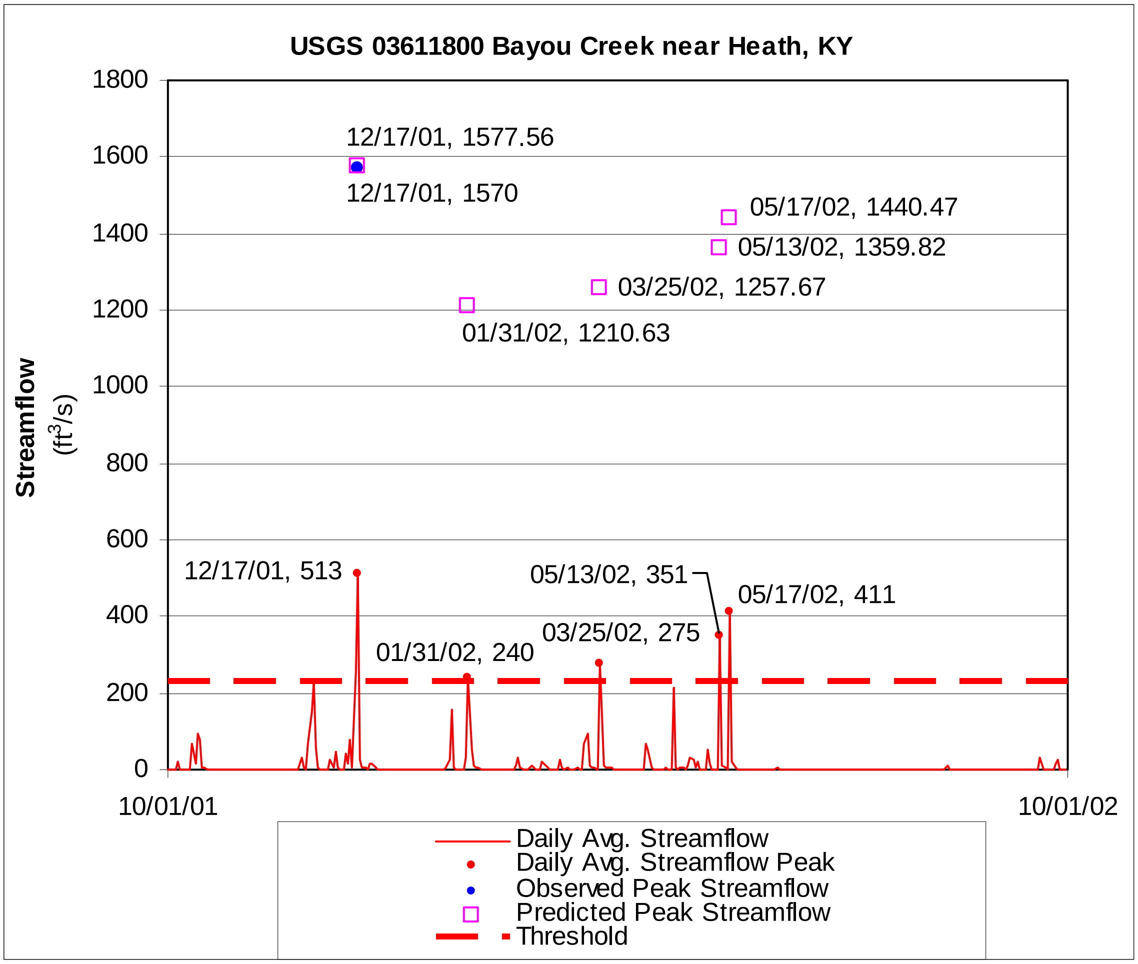


FIGURE 17 - Daily Streamflow Record for Bayou Creek near Heath, Kentucky for Water Year 2002

TABLE XIII

PEAK STREAMFLOW DATA FOR BAYOU CREEK NEAR HEATH, KY FOR WATER YEAR 2002

Date -	Daily-Ave Discharge (cfs)	Obs. Peak Discharge (cfs)	Pred. Peak Discharge (cfs)
12/17/01	513	1570	1577.56
01/31/02	240	-	1210.63
03/25/02	275	-	1257.67
05/13/02	351	-	1359.82
05/17/02	411	-	1440.47

APPENDIX I

LIST OF STREAM GAGES

TABLE XIV

LIST OF STREAM GAGES USED IN FITTING REGRESSION MODELS

USGS Gage Identification Number	USGS Gage Station Name	Drainage Area (mi^2)	County	Hydrologic Region [1]	No. Data Points
3403500	CUMBERLAND RIVER AT BARBOURVILLE, KY	960	Knox	4	63
3410500	SOUTH FORK CUMBERLAND RIVER NEAR STEARNS, KY	954	McCreary	5	62
3313000	BARREN RIVER NEAR FINNEY, KY	942	Allen	5	40
3249500	LICKING RIVER AT FARMERS, KY	827	Bath	2	53
3402900	CUMBERLAND R AT PINE ST BR AT PINEVILLE, KY	770	Bell	4	14
3319000	ROUGH RIVER NEAR DUNDEE, KY	757	Ohio	6	52
3306500	GREEN RIVER AT GREENSBURG, KY	736	Green	5	36
3281500	SOUTH FORK KENTUCKY RIVER AT BOONEVILLE, KY	722	Owsley	3	66
3311000	NOLIN RIVER AT KYROCK, KY	703	Edmonson	6	37
3306000	GREEN RIVER NEAR CAMPBELLSVILLE, KY	682	Taylor	5	32
3301000	BEECH FORK AT BARDSTOWN, KY	669	Nelson	2	39
3252500	SOUTH FORK LICKING RIVER AT CYNTHIANA, KY	621	Harrison	2	56
3406500	ROCKCASTLE RIVER AT BILLOWS, KY	604	Laurel	4	68
3310500	NOLIN RIVER AT WAX, KY	600	Grayson	6	25
3209300	RUSSELL FORK AT ELKHORN CITY, KY	554	Pike	2	31
3281000	MIDDLE FORK KENTUCKY RIVER AT TALLEGA, KY	537	Lee	3	64
3312500	BARREN RIVER NEAR PAGEVILLE, KY	531	Barren	5	24
3318500	ROUGH RIVER AT FALLS OF ROUGH, KY	504	Grayson	6	46
3314000	DRAKES CREEK NEAR ALVATON, KY	478	Warren	5	31
3289500	ELKHORN CREEK NEAR FRANKFORT, KY	473	Franklin	2	63
3277500	NORTH FORK KENTUCKY RIVER AT HAZARD, KY	466	Perry	3	53
3318000	ROUGH RIVER NEAR FALLS OF ROUGH, KY	454	Grayson	6	12
3291500	EAGLE CREEK AT GLENCOE, KY	437	Gallatin	1	60
3300400	BEECH FORK AT MAUD, KY	436	Nelson	2	32
3280900	MIDDLE FORK KENTUCKY RIVER AT BUCKHORN, KY	420	Perry	3	19
3216500	LITTLE SANDY RIVER AT GRAYSON, KY	400	Carter	2	66
3285500	DIX RIVER NEAR BURGIN, KY	395	Mercer	3	7
3208000	LEVISA FORK BELOW FISHTRAP DAM, KY	392	Pike	2	51
3401000	CUMBERLAND RIVER NEAR HARLAN, KY	374	Harlan	3	65
3283500	RED RIVER AT CLAY CITY, KY	362	Powell	2	69
3310300	NOLIN RIVER AT WHITE MILLS, KY	357	Hardin	6	44
3403910	CLEAR FORK AT SAXTON, KY	331	Whitley	4	31
3285000	DIX RIVER NEAR DANVILLE, KY	318	Garrard	3	62
3307100	RUSSELL CREEK NEAR GRESHAM, KY	265	Green	5	11
3295890	BRASHEARS CREEK AT TAYLORSVILLE, KY	259	Spencer	1	21
3216400	LITTLE SANDY RIVER AT LEON, KY	255	Carter	2	18
3383000	TRADEWATER RIVER AT OLNEY, KY	255	Caldwell	7	58
3438000	LITTLE RIVER NEAR CADIZ, KY	244	Trigg	7	64
3217000	TYGARTS CREEK NEAR GREENUP, KY	242	Greenup	2	63
3252000	STONER CREEK AT PARIS, KY	239	Bourbon	5	38
3299000	ROLLING FORK NEAR LEBANON, KY	239	Marion	2	54
3251200	NORTH FORK LICKING RIVER NEAR MT OLIVET, KY	226	Bracken	2	11
3317000	ROUGH RIVER NEAR MADRID, KY	225	Breckinridge	6	22
3215500	BLAINE CREEK AT YATESVILLE, KY	217	Lawrence	2	41
3211500	JOHNS CREEK NEAR VAN LEAR, KY	206	Floyd	2	52
3280600	MIDDLE FORK KENTUCKY RIVER NEAR HYDEN, KY	202	Leslie	3	35
3216350	LITTLE SANDY RIVER BELOW GRAYSON DAM NEAR LEON, KY	196	Carter	2	25
3295500	SALT RIVER NEAR VAN BUREN, KY	196	Anderson	2	44
3320500	POND RIVER NEAR APEX, KY	194	Muhlenberg	7	63
3307000	RUSSELL CREEK NEAR COLUMBIA, KY	188	Adair	5	64

Notes:

[1] Hydrologic Regions of Kentucky as Defined by Choquette (1988)

USGS Gage Identification Number	USGS Gage Station Name	Drainage Area (mi^2)	County	Hydrologic Region [1]	No. Data Points
3278500	TROUBLESOME CREEK AT NOBLE, KY	177	Breathitt	2	31
3295400	SALT RIVER AT GLENSBORO, KY	172	Anderson	2	14
3281100	GOOSE CREEK AT MANCHESTER, KY	163	Clay	4	39
3281040	RED BIRD RIVER NEAR BIG CREEK, KY	155	Clay	3	28
3252300	HINKSTON CREEK NEAR CARLISLE, KY	154	Bourbon	2	11
3288100	NORTH ELKHORN CREEK AT GEORGETOWN, KY	147	Scott	2	11
3248500	LICKING RIVER NEAR SALYERSVILLE, KY	140	Magoffin	4	57
3404820	LAUREL RIVER AT MUNICIPAL DAM NEAR CORBIN, KY	140	Laurel	2	24
3298000	FLOYDS FORK AT FISHERVILLE, KY	138	Jefferson	1	59
3610200	CLARKS RIVER AT ALMO, KY	134	Calloway	7	21
3318800	CANEY CREEK NEAR HORSE BRANCH, KY	124	Ohio	6	36
3251000	NORTH FORK LICKING RIVER NEAR LEWISBURG, KY	119	Mason	2	45
3288000	NORTH ELKHORN CREEK NEAR GEORGETOWN, KY	119	Scott	2	43
3313700	WEST FORK DRAKES CREEK NEAR FRANKLIN, KY	110	Simpson	5	36
3289300	SOUTH ELKHORN CREEK NEAR MIDWAY, KY	105	Scott	2	20
3212000	PAINT CREEK AT STAFFORDSVILLE, KY	103	Johnson	2	26
3300000	BEECH FORK NR SPRINGFIELD, KY	85.9	Washington	2	20
3310400	BACON CREEK NEAR PRICEVILLE, KY	85.4	Hart	6	35
3250100	NORTH FORK TRIPLETT CREEK NEAR MOREHEAD, KY	84.7	Rowan	2	27
3400500	POOR FORK AT CUMBERLAND, KY	82.3	Harlan	2	54
3297900	FLOYDS FORK NEAR PEWEE VALLEY, KY	79.9	Oldham	1	13
3282040	STURGEON CREEK AT CRESSMONT, KY	77.3	Lee	3	12
7024000	BAYOU DE CHIEN NEAR CLINTON, KY	68.7	Hickman	7	59
3277300	NORTH FORK KENTUCKY RIVER AT WHITESBURG, KY	66.4	Letcher	2	6
3282500	RED RIVER NEAR HAZEL GREEN, KY	65.8	Wolfe	2	50
3302000	POND CREEK NEAR LOUISVILLE, KY	64.0	Jefferson	5	59
3280700	CUTSHIN CREEK AT WOOTON, KY	61.3	Leslie	3	47
3277450	CARR FORK NEAR SASSAFRAS, KY	60.6	Knott	2	31
3402000	YELLOW CREEK NEAR MIDDLESBORO, KY	60.6	Bell	4	64
3216800	TYGARTS CREEK AT OLIVE HILL, KY	59.6	Carter	2	38
3321350	SOUTH FORK PANTHER CREEK NEAR WHITESVILLE, KY	58.2	Ohio	6	15
3210000	JOHNS CREEK NEAR META, KY	56.3	Pike	2	62
3400800	MARTINS FORK NEAR SMITH, KY	55.8	Harlan	3	33
3404900	LYNN CAMP CREEK AT CORBIN, KY	53.8	Whitley	4	31
3312765	BEAVER CREEK AT HWY 31 E NEAR GLASGOW, KY	49.6	Barren	5	9
3250000	TRIPLETT CREEK AT MOREHEAD, KY	47.5	Rowan	2	44
3297845	FLOYDS FORK NEAR CRESTWOOD, KY	46.7	Shelby	1	12
3413200	BEAVER CREEK NEAR MONTICELLO, KY	43.4	Wayne	5	28
3291000	EAGLE CREEK AT SADIEVILLE, KY	42.9	Scott	1	34
3317500	NORTH FORK ROUGH RIVER NEAR WESTVIEW, KY	42.0	Breckinridge	6	19
3295000	SALT RIVER NEAR HARRODSBURG, KY	41.4	Mercer	2	21
3277400	LEATHERWOOD CREEK AT DAISY, KY	40.9	Perry	3	17
3310000	NORTH FORK NOLIN RIVER AT HODGENVILLE, KY	36.4	Larue	5	32
3305500	GREEN RIVER NEAR MOUNT SALEM, KY	36.3	Lincoln	5	8
3297500	PLUM CREEK AT WATERFORD, KY	31.8	Spencer	1	21
3312000	BEAR BRANCH NEAR LEITCHFIELD, KY	30.8	Grayson	6	22
3284300	SILVER CREEK NEAR KINGSTON, KY	28.6	Madison	3	16
3292460	HARRODS CREEK NEAR LA GRANGE, KY	24.1	Oldham	1	27
3283000	STILLWATER CREEK AT STILLWATER, KY	24.0	Wolfe	2	19
3289000	SOUTH ELKHORN CREEK AT FORT SPRING, KY	24.0	Fayette	2	49

Notes:

[1] Hydrologic Regions of Kentucky as Defined by Choquette (1988)

USGS Gage Identification Number	USGS Gage Station Name	Drainage Area (mi^2)	County	Hydrologic Region [1]	No. Data Points
3237900	CABIN CREEK NEAR TOLLESBORO, KY	22.4	Lewis	1	20
3305000	GREEN RIVER NEAR MCKINNEY, KY	22.4	Lincoln	5	22
3318200	ROCK LICK CREEK NEAR GLEN DEAN, KY	20.1	Breckinridge	6	15
3296500	PLUM CREEK NEAR WILSONVILLE, KY	19.1	Bullitt	1	7
3293000	M FK BEARGRASS CR AT OLD CANNONS LN AT LOUISVILLE, KY	18.9	Jefferson	1	59
3307500	SOUTH FORK LITTLE BARREN RIVER AT EDMONTON, KY	18.3	Metcalfe	5	31
3292500	SOUTH FORK BEARGRASS CREEK AT LOUISVILLE, KY	17.2	Jefferson	1	49
3611850	BAYOU CREEK NEAR GRAHAMVILLE, KY	14.9	McCracken	7	8
3611260	MASSAC CREEK NEAR PADUCAH, KY	14.6	McCracken	7	33
3322360	BEAVERDAM CREEK NEAR CORYDON, KY	14.3	Henderson	6	20
3254400	NORTH FORK GRASSY CREEK NEAR PINER, KY	13.6	Kenton	1	16
3216540	EAST FORK LITTLE SANDY RIVER NEAR FALLSBURG, KY	12.2	Lawrence	2	19
3284550	WEST HICKMAN CREEK AT JONESTOWN, KY	11.0	Fayette	3	10
3311600	BEAVERDAM CREEK AT RHODA, KY	10.9	Edmonson	6	22
3298550	LONG LICK AT CLERMONT, KY	7.91	Bullitt	1	13
3313500	WEST BAYS FORK AT SCOTTSVILLE, KY	7.47	Allen	5	22
3611800	BAYOU CREEK NEAR HEATH, KY	6.55	McCracken	7	8
3207965	GRAPEVINE CREEK NEAR PHYLLIS, KY	6.20	Pike	2	22
3611900	LITTLE BAYOU CREEK NEAR GRAHAMVILLE, KY	5.78	McCracken	7	8
3290000	FLAT CREEK NEAR FRANKFORT, KY	5.63	Franklin	1	20
3309500	MCDOUGAL CREEK NEAR HODGENVILLE, KY	5.34	Larue	5	18
3297000	LITTLE PLUM CREEK NEAR WATERFORD, KY	5.15	Spencer	1	7
3288500	CAVE CREEK NEAR FORT SPRING, KY	2.53	Fayette	2	20
3250150	INDIAN CREEK NEAR OWINGSVILLE, KY	2.43	Bath	2	1
3278000	BEAR BRANCH NEAR NOBLE, KY	2.21	Breathitt	2	19
3304500	MCGILLS CREEK NEAR MCKINNEY, KY	2.14	Lincoln	5	20
3384000	ROSE CREEK AT NEBO, KY	2.10	Hopkins	7	19
3216564	MILE BRANCH AT COALTON, KY	1.61	Boyd	2	1
3306640	WHITE OAK CREEK TRIBUTARY NEAR MONTPELIER, KY	0.50	Adair	6	1

Notes:

[1] Hydrologic Regions of Kentucky as Defined by Choquette (1988)

APPENDIX II

NUMBER OF POINTS PER DATA PARTITION

TABLE XV

NUMBER OF POINTS PER DATA PARTITION

Number of Points
4223

(a) All Gages Analyzed Simultaneously

Areal Grouping	Number of Points
0.1-10 mi^2	199
10-100 mi^2	1365
100-1,00 mi^2	2659

(b) Gages Grouped by Drainage Area Size

Hydrologic Region	Number of Points
1	438
2	1497
3	533
4	367
5	623
6	423
7	342

(c) Gages Grouped by Hydrologic Region

APPENDIX III

REGRESSION MODEL EQUATIONS

Simple Linear Regression: $$Q_{peak} = \beta_0 + \beta_1 Q_{ave} \quad (4)$$

Multiple Linear Regression: $$Q_{peak} = \beta_0 + \beta_1 Q_{ave} + \beta_2 A \quad (8)$$

Quadratic Regression: $$Q_{peak} = \alpha \left(Q_{ave}\right)^{\beta} \quad (11)$$

Power Regression: $$Q_{peak} = \beta_0 + \beta_1 Q_{ave} + \beta_2 \left(Q_{ave}\right)^2 \quad (15)$$

TABLE XVI

REGRESSION MODEL EQUATIONS

Regression Method	**Regression Coefficients**				
	α	**β**	**β_0**	**β_1**	**β_2**
Simple Linear	-	-	1,307.11499800	1.1875084886	-
Multiple Linear	-	-	1,792.27319386	1.2772395234	-4.0869715074
Quadratic	-	-	1,164.53847717	1.2266477611	-1.06605538E-06
Power	16.3998872023	0.7213605179	-	-	-

(a) All Gages Analyzed Simultaneously

Areal Grouping	Regression Method	Regression Coefficients				
		α	β	β_0	β_1	β_2
0.1-10 mi^2	Simple Linear	-	-	286.23288075	4.0541663980	-
	Multiple Linear	-	-	-37.25559375	3.4318882282	93.2504421991
	Quadratic	-	-	316.61159070	3.7010727237	5.50351560E-04
	Power	10.6647291964	0.8595600501	-	-	-
10-100 mi^2	Simple Linear	-	-	1,067.60226609	1.5738779682	-
	Multiple Linear	-	-	1,694.48275401	1.7736472394	-20.2183912476
	Quadratic	-	-	852.14136644	1.8454646149	-5.28674915E-05
	Power	29.3516664281	0.6444680390	-	-	-
100-1,000 mi^2	Simple Linear	-	-	1,059.58133118	1.1980327415	-
	Multiple Linear	-	-	2,216.03102670	1.2697941689	-4.6689024147
	Quadratic	-	-	618.13069020	1.2753987931	-1.82207990E-06
	Power	2.4622371479	0.9302613146	-	-	-

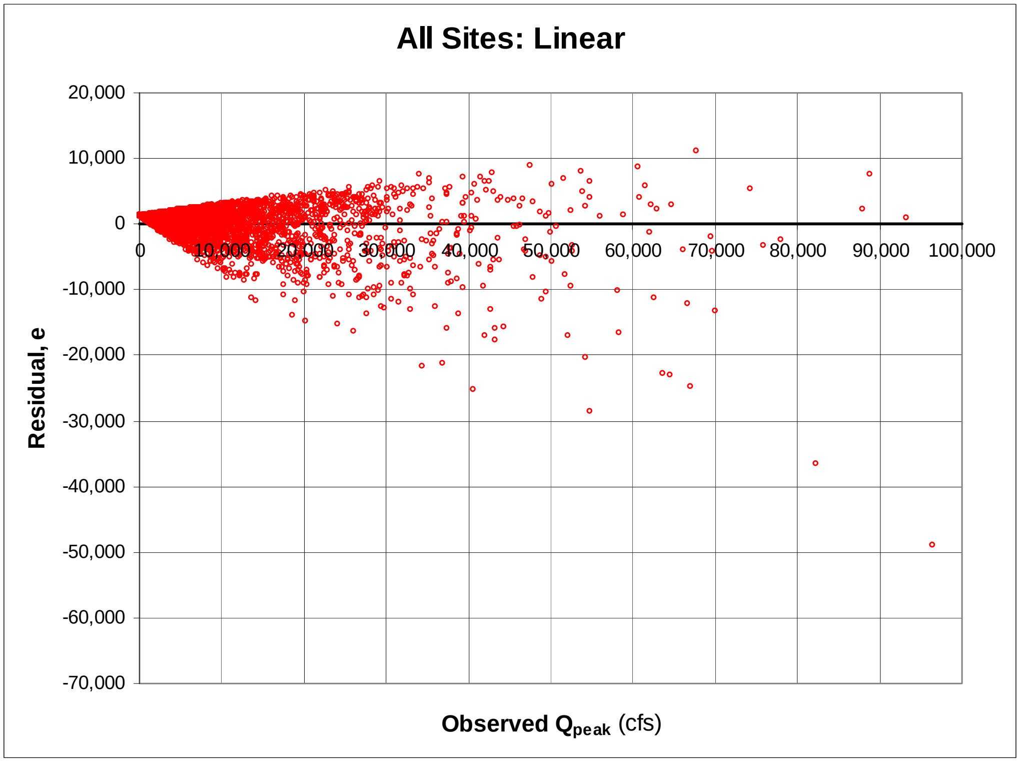
(b) Gages Grouped by Drainage Area Size

Hydrologic Region	Regression Method	Regression Coefficients				
		α	β	β_0	β_1	β_2
1	Simple Linear	-	-	1,920.72274610	1.4075276784	-
	Multiple Linear	-	-	1,830.96397046	1.3466530529	3.0733788858
	Quadratic	-	-	1,629.60390507	1.5743138916	-7.14680660E-06
	Power	34.4571914448	0.6627419875	-	-	-
2	Simple Linear	-	-	1,364.94801861	1.1381821440	-
	Multiple Linear	-	-	1,759.03851534	1.2448446309	-4.1440910464
	Quadratic	-	-	1,076.40628464	1.2466582076	-5.08780819E-06
	Power	9.7812117343	0.7757243563	-	-	-
3	Simple Linear	-	-	2,098.03135383	1.2164068092	-
	Multiple Linear	-	-	3,743.99310081	1.3607315239	-8.9434153168
	Quadratic	-	-	1,350.95042902	1.3806485398	-4.80978985E-06
	Power	15.0402491716	0.7428745422	-	-	-
4	Simple Linear	-	-	1,317.87488040	1.0939063961	-
	Multiple Linear	-	-	1,335.15686391	1.0985350562	-0.1814479705
	Quadratic	-	-	1,129.62907140	1.1360779170	-1.18510852E-06
	Power	3.9358162917	0.8771463920	-	-	-
5	Simple Linear	-	-	1,362.76302871	1.2152998111	-
	Multiple Linear	-	-	1,693.43375905	1.2511052521	-1.9501527967
	Quadratic	-	-	768.60076039	1.3610886371	-2.88811658E-06
	Power	16.8932790526	0.7266217163	-	-	-
6	Simple Linear	-	-	1,306.22800001	0.9771522030	-
	Multiple Linear	-	-	1,559.54360256	1.0906016786	-2.5087674983
	Quadratic	-	-	1,558.10925663	0.8525957169	8.59436879E-06
	Power	29.7074390908	0.6323789670	-	-	-
7	Simple Linear	-	-	344.36478577	1.2580688004	-
	Multiple Linear	-	-	929.00118921	1.3440725324	-6.2513636402
	Quadratic	-	-	718.96404003	1.0798408884	1.12311278E-05
	Power	31.3401183137	0.6193188623	-	-	-

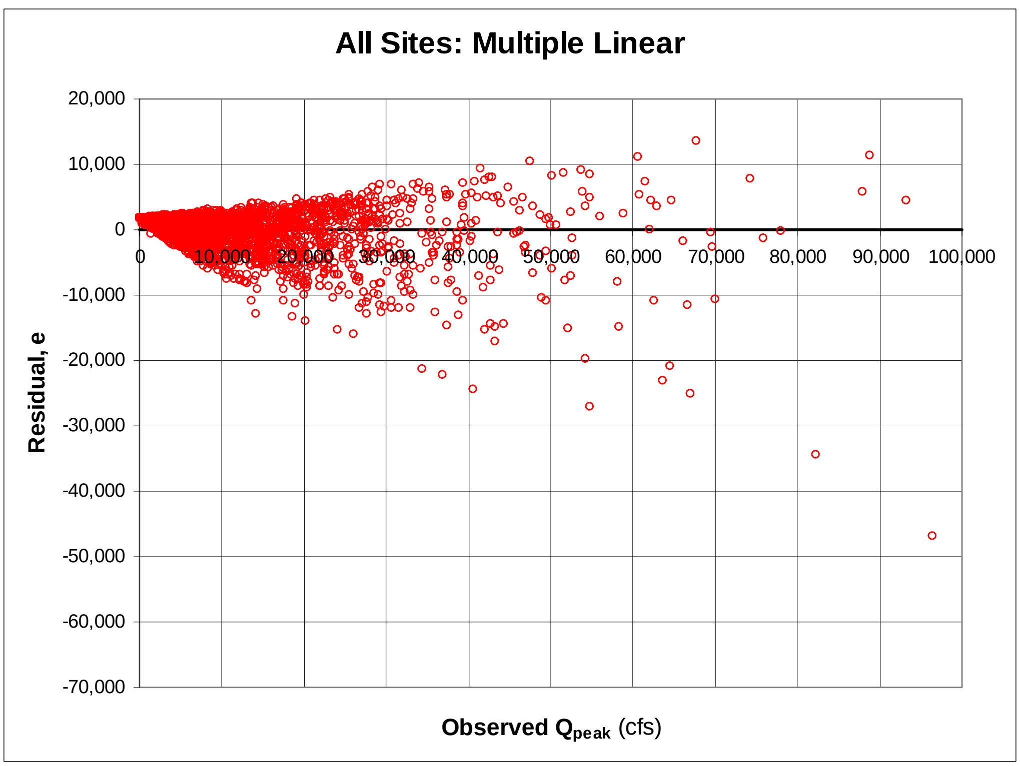
(c) Gages Grouped by Hydrologic Region

APPENDIX IV

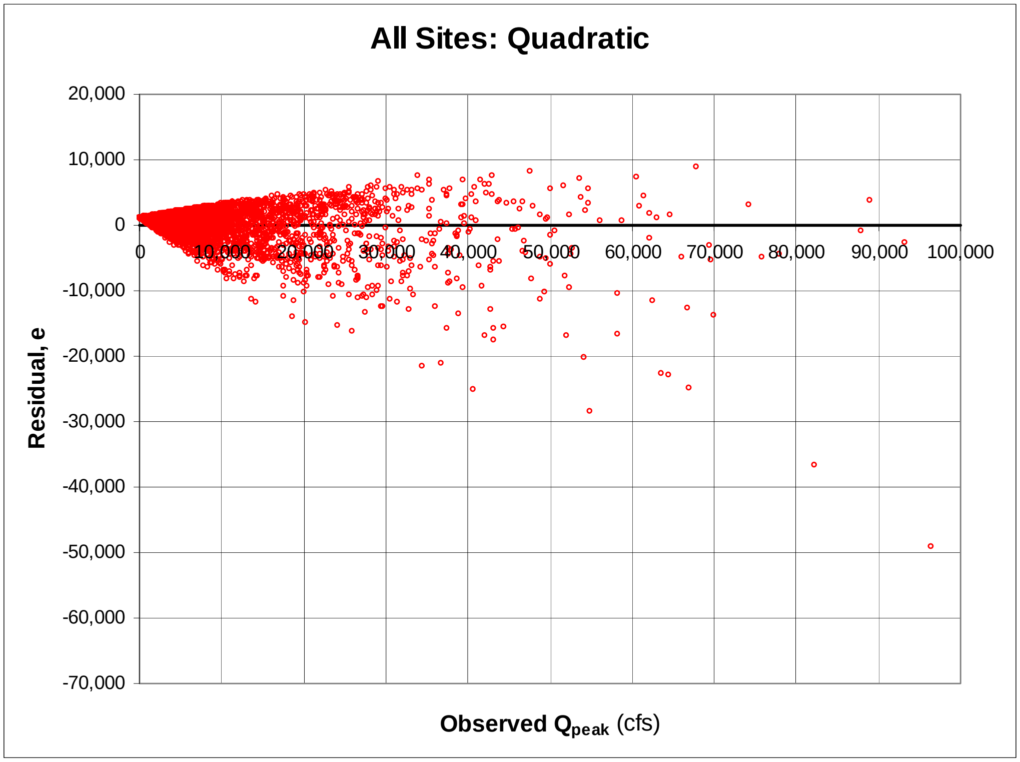
RESIDUAL PLOTS



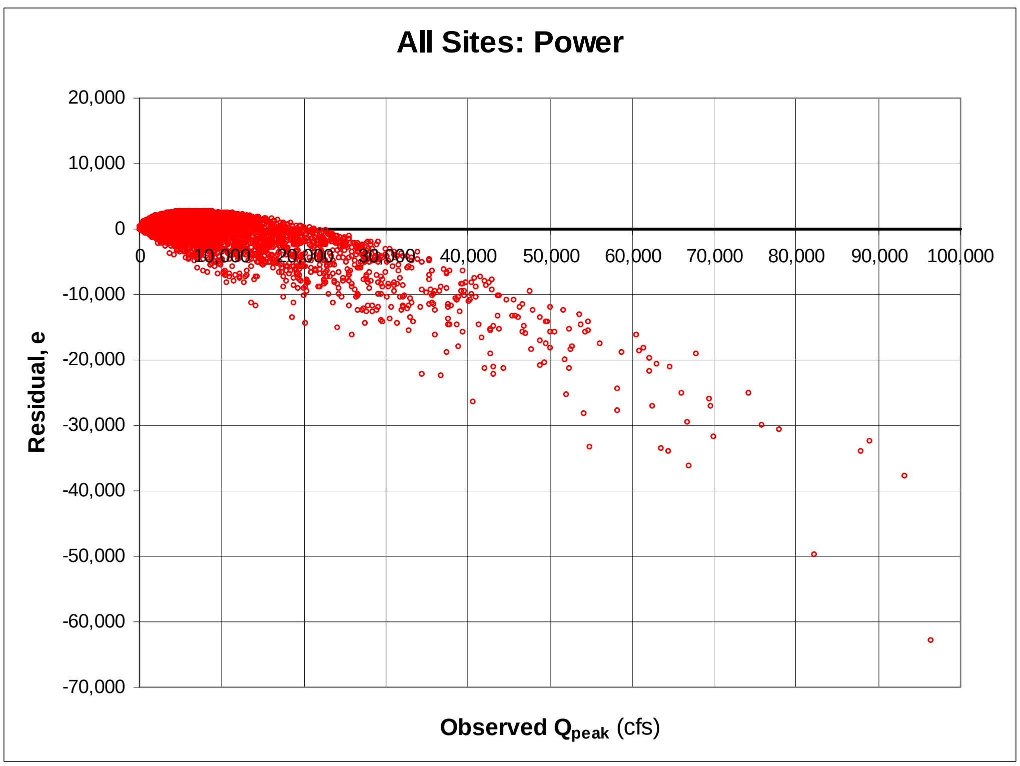
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model

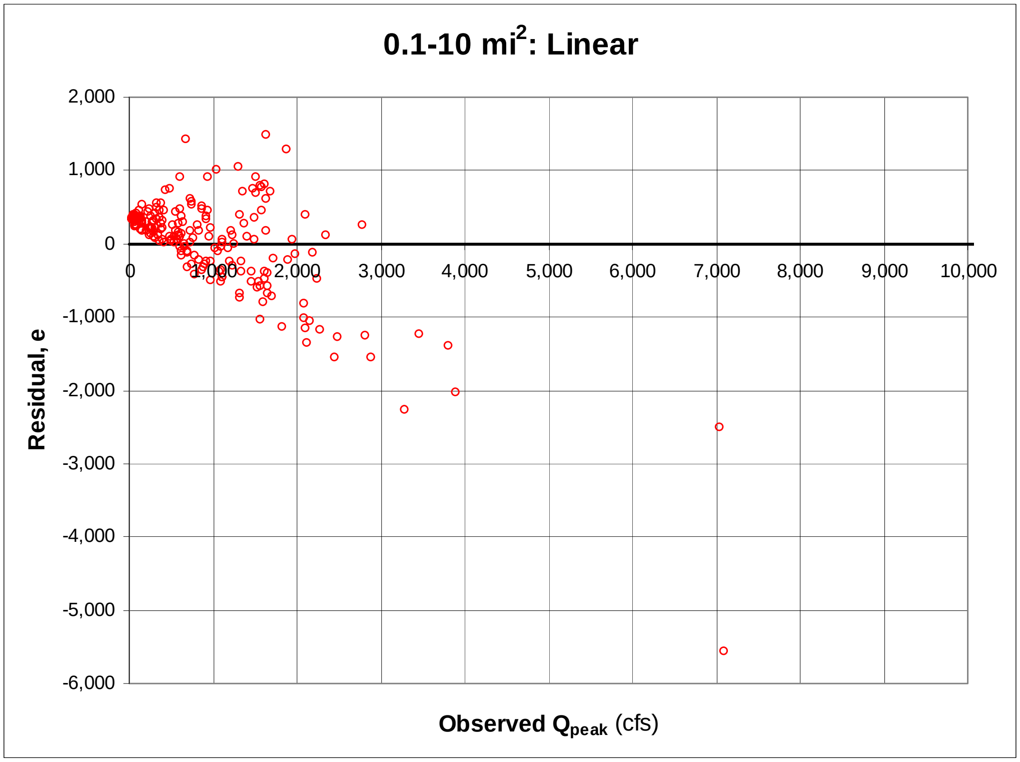


(c) Quadratic Regression Model

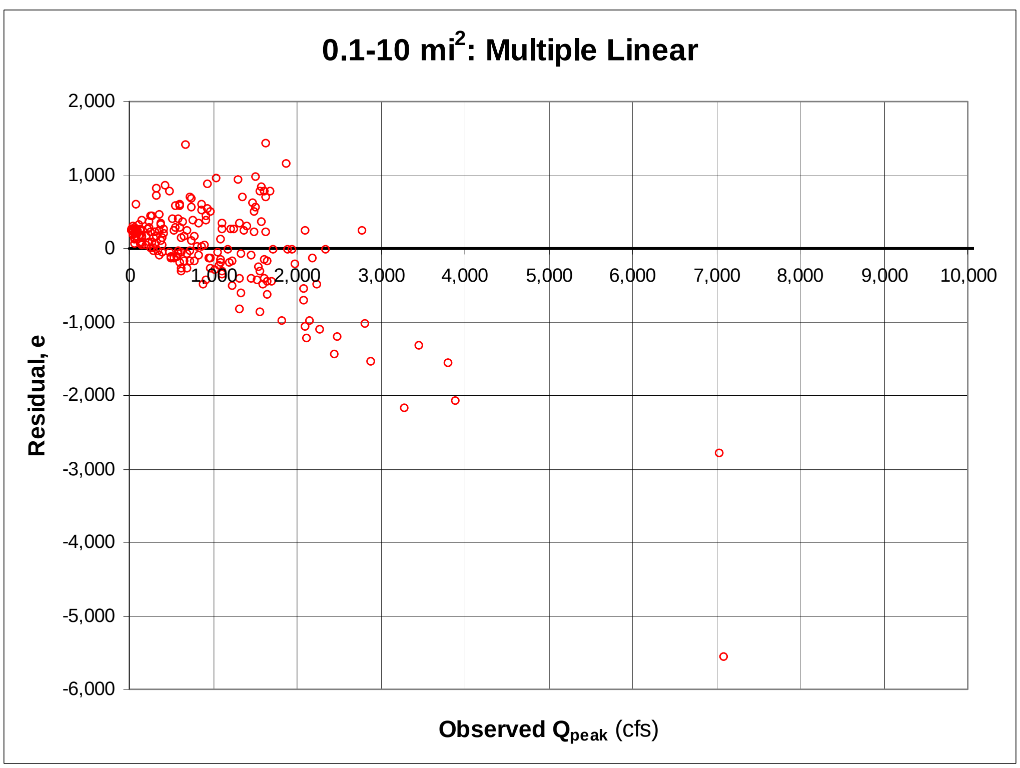


(d) Power Regression Model

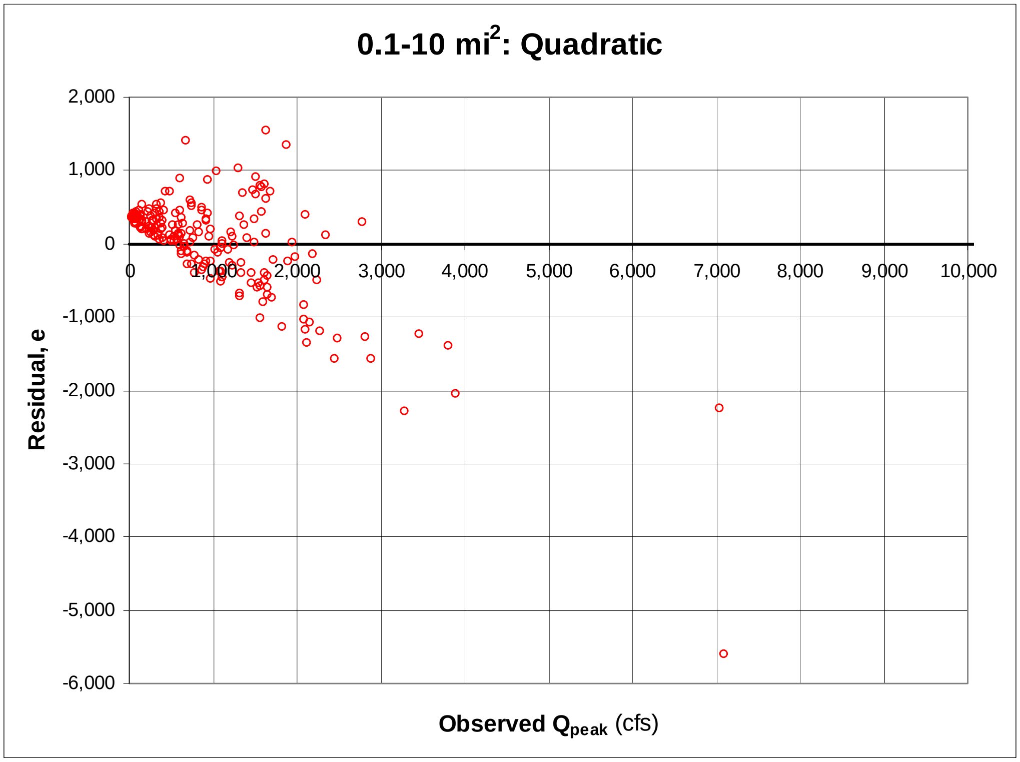
FIGURE 18 – Residual Plots for Regression Models Developed for All Gages Analyzed Simultaneously



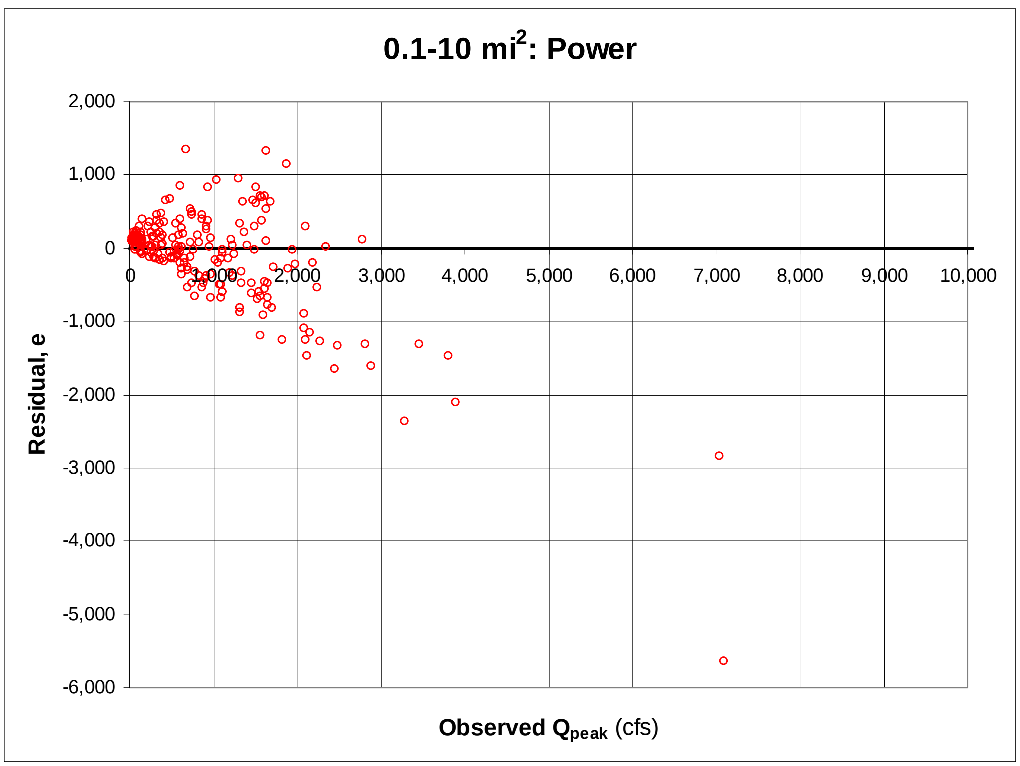
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model

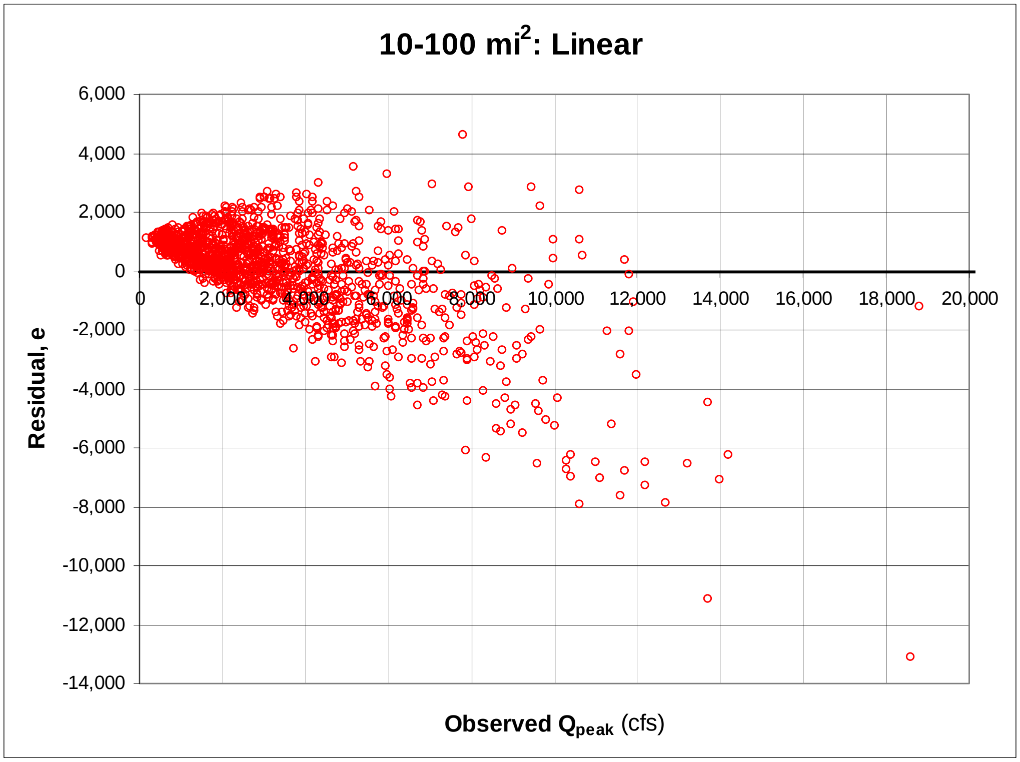


(c) Quadratic Regression Model

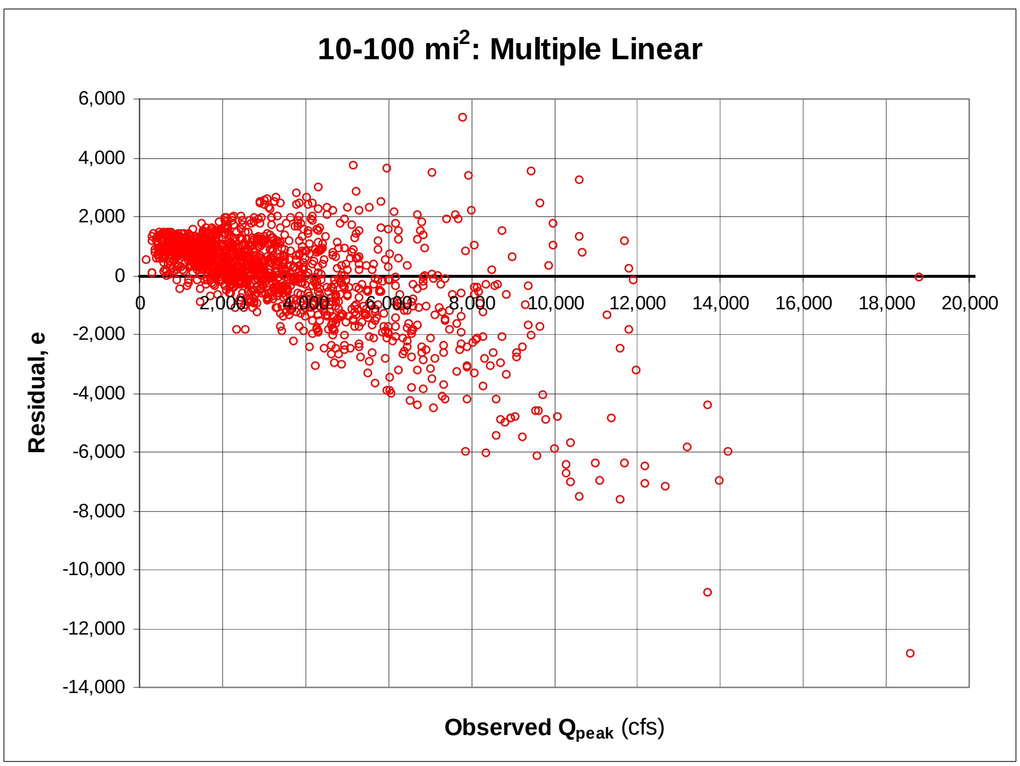


(d) Power Regression Model

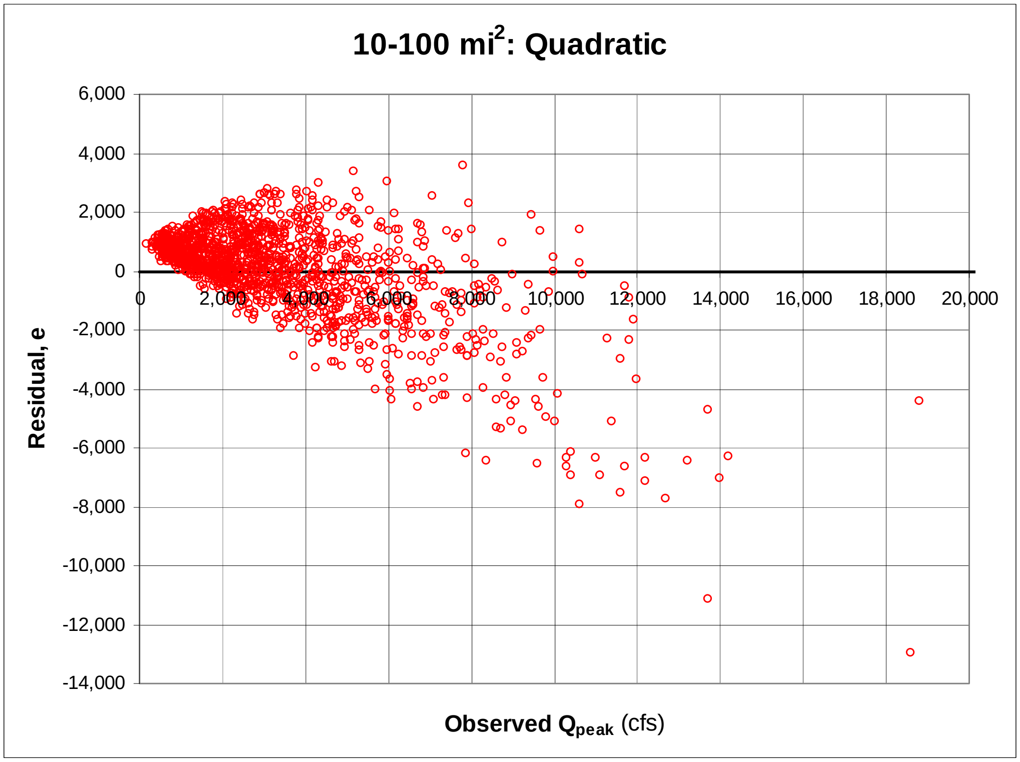
FIGURE 19 – Residual Plots for Regression Models Developed for 0.1 to 10 mi^2 Areal Grouping



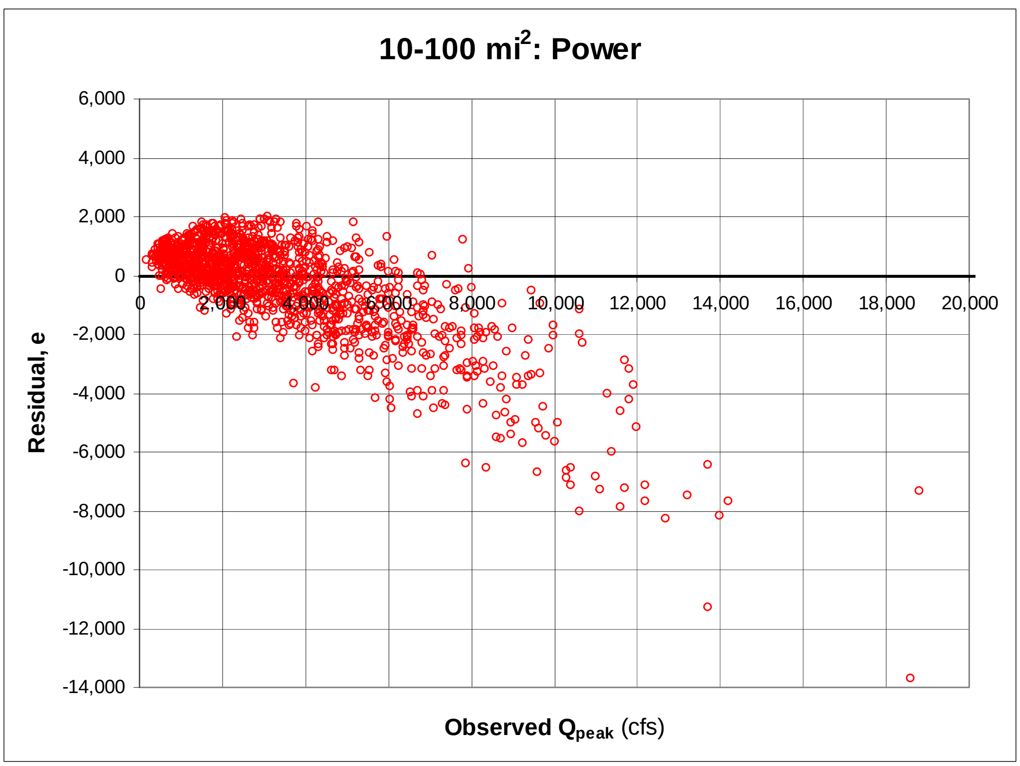
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model

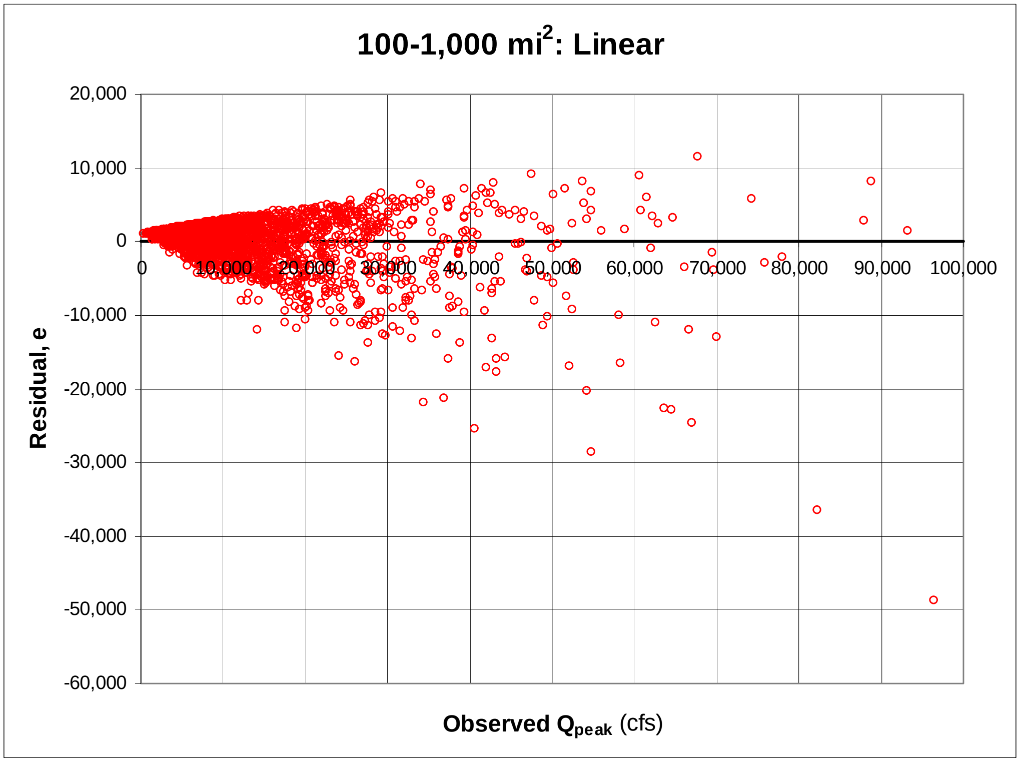


(c) Quadratic Regression Model

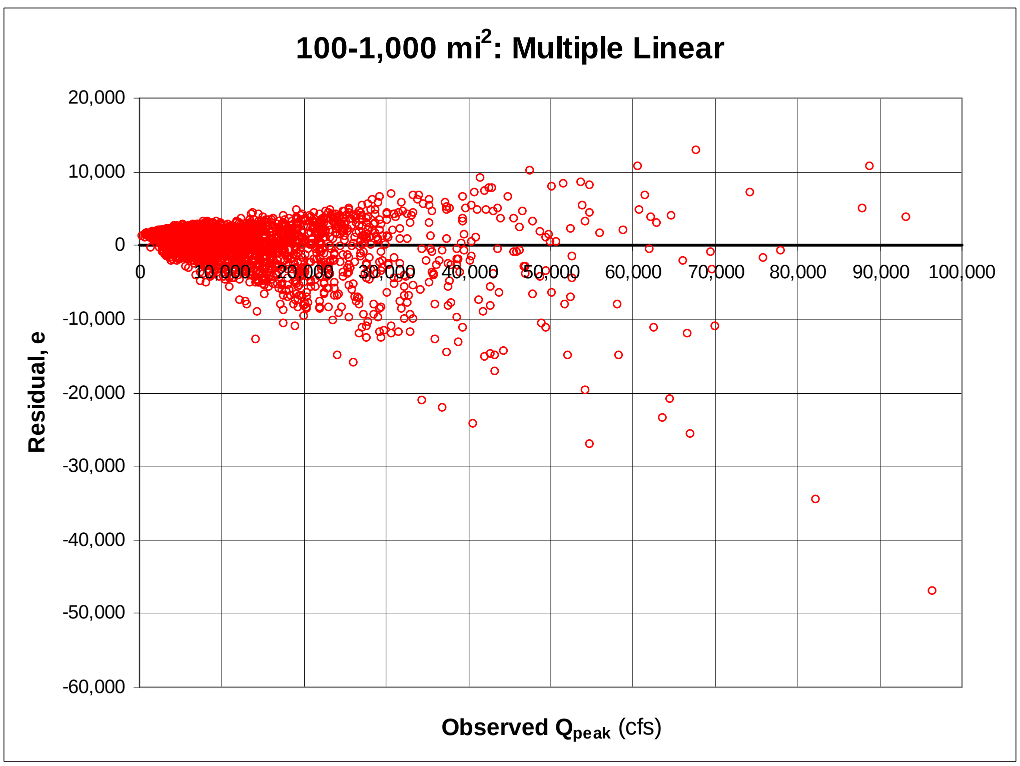


(d) Power Regression Model

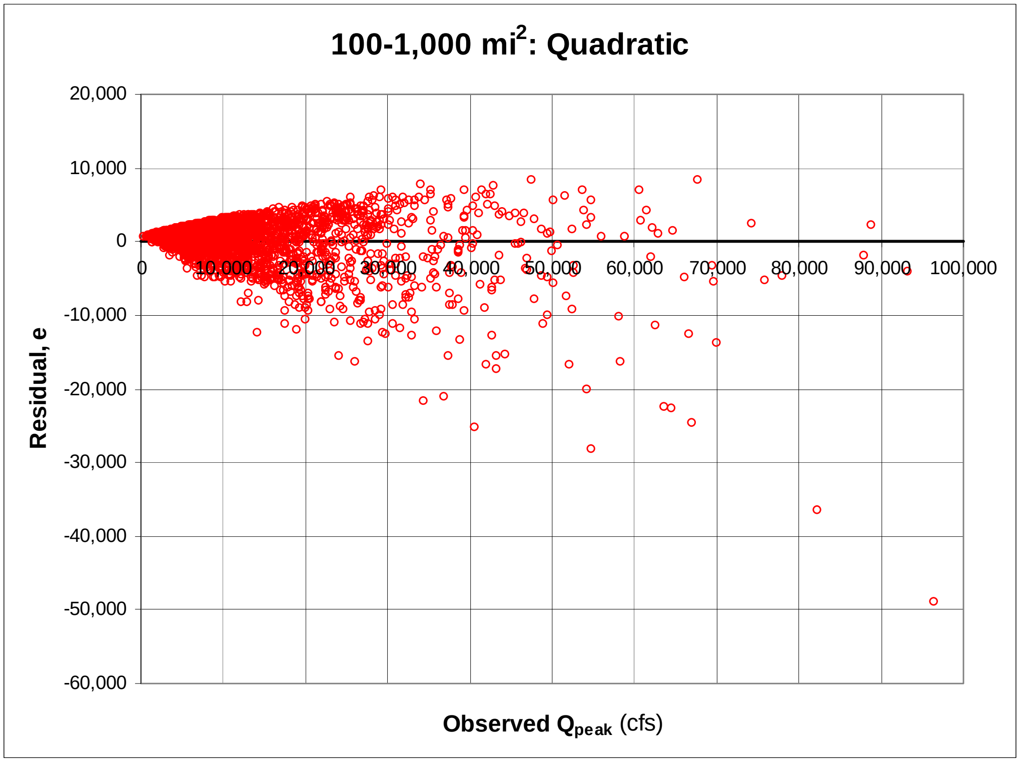
FIGURE 20 – Residual Plots for Regression Models Developed for 10 to 100 mi^2 Areal Grouping



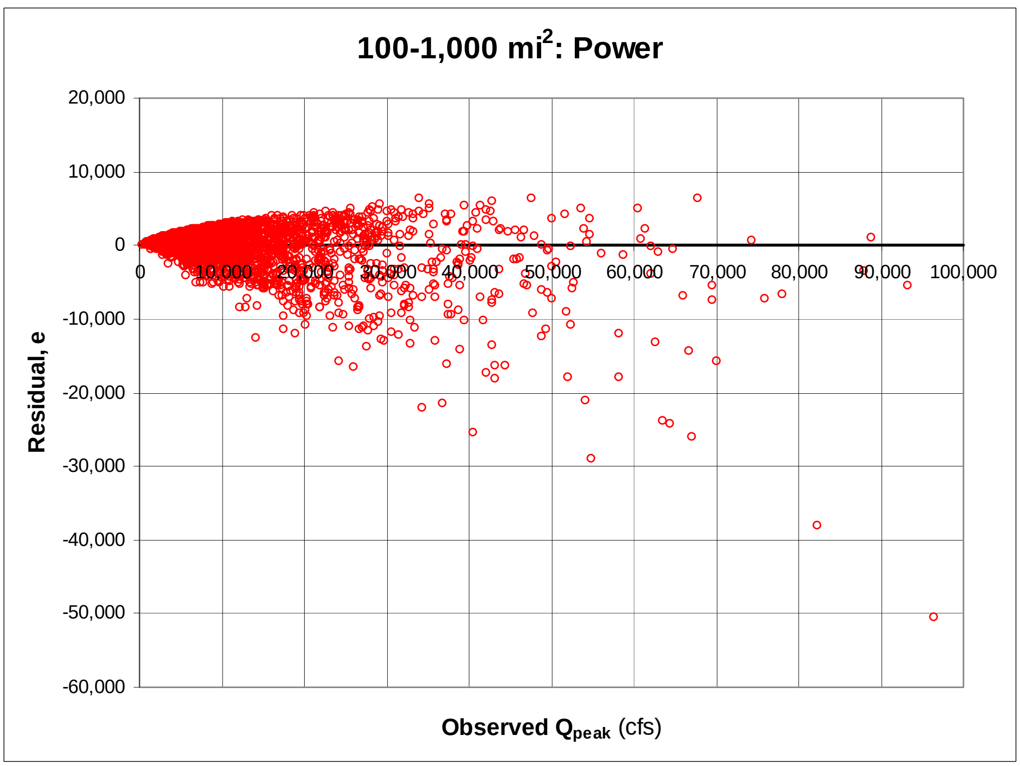
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model

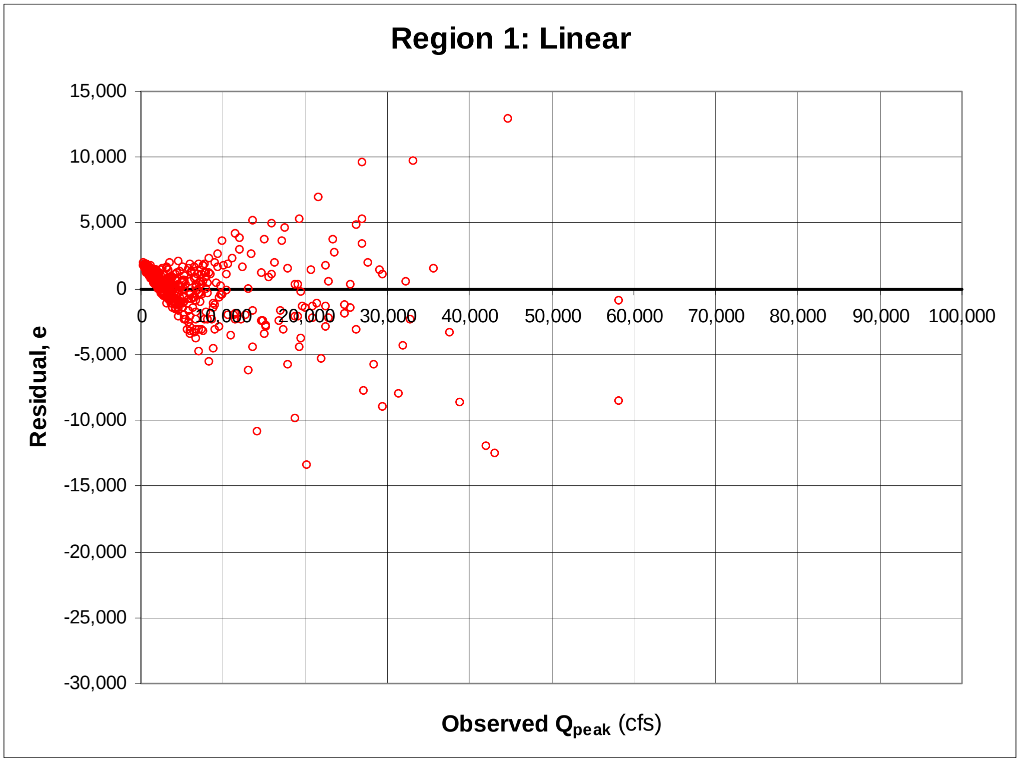


(c) Quadratic Regression Model

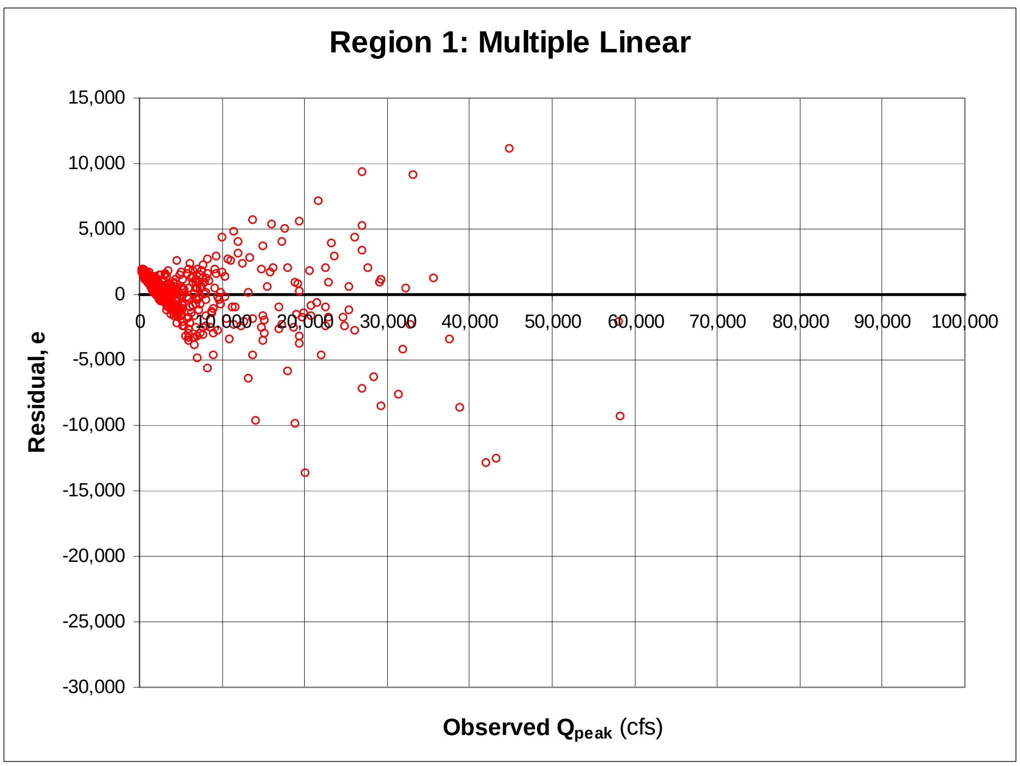


(d) Power Regression Model

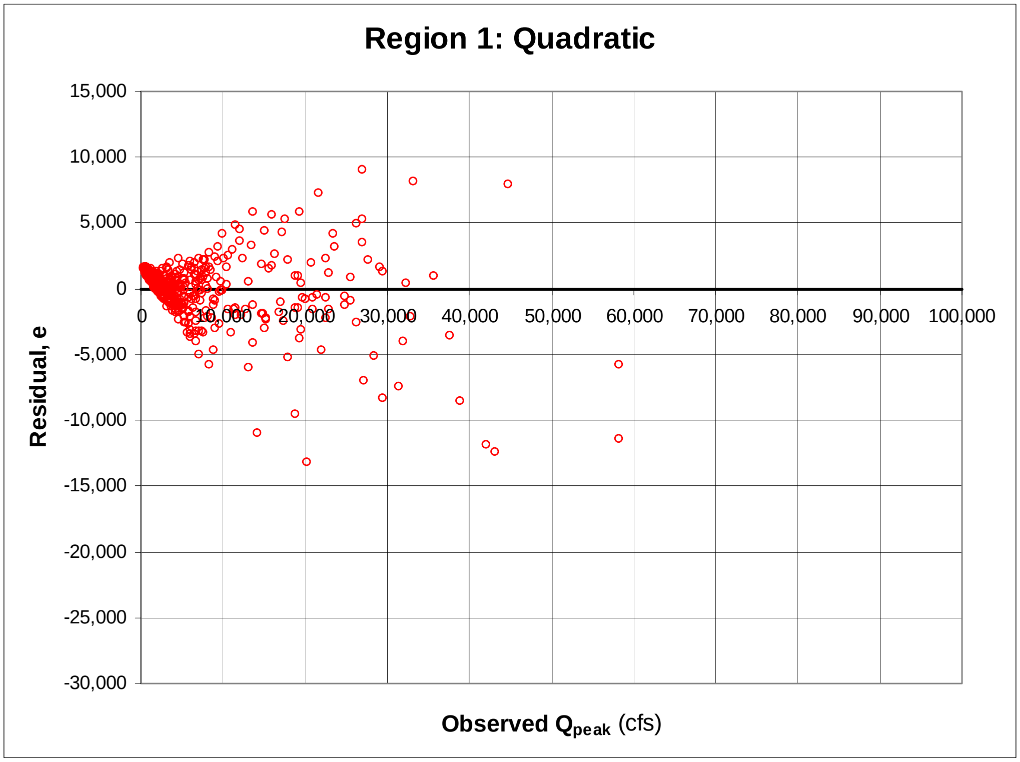
FIGURE 21 – Residual Plots for Regression Models Developed for 100 to 1,000 mi^2 Areal Grouping



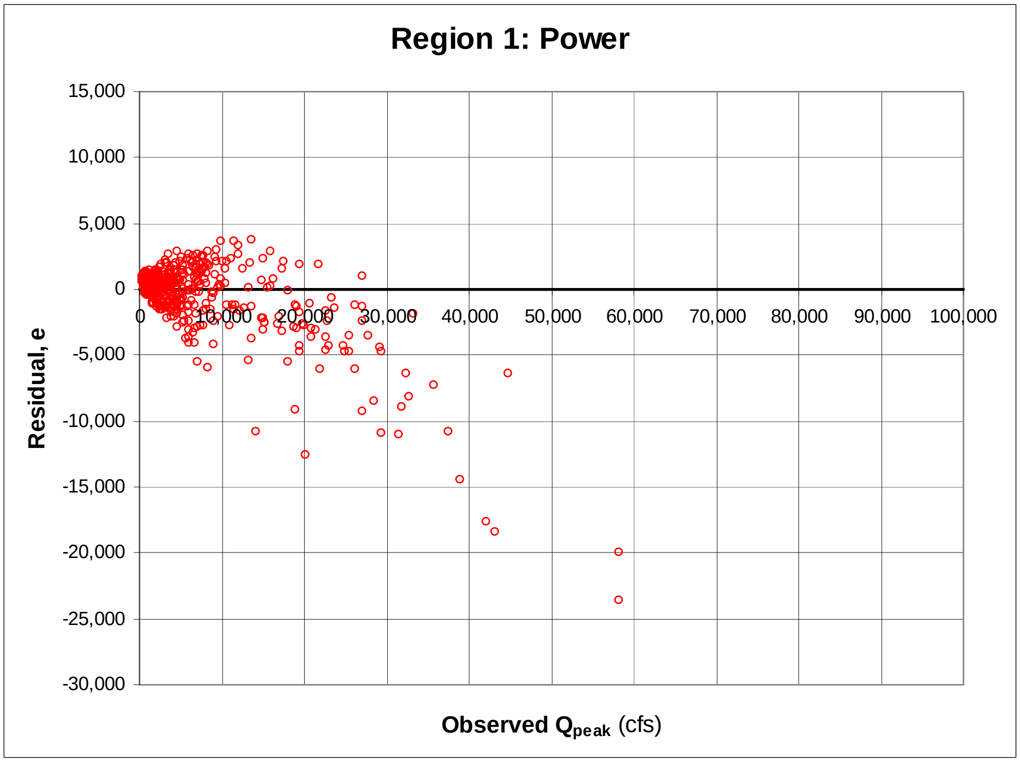
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model

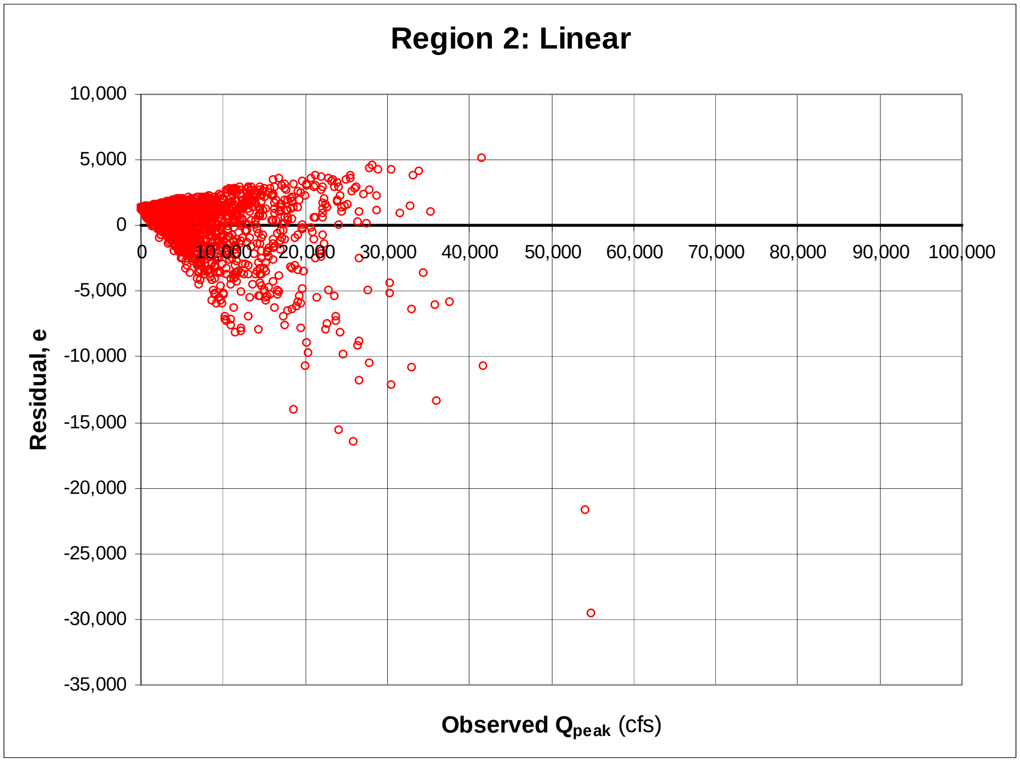


(c) Quadratic Regression Model

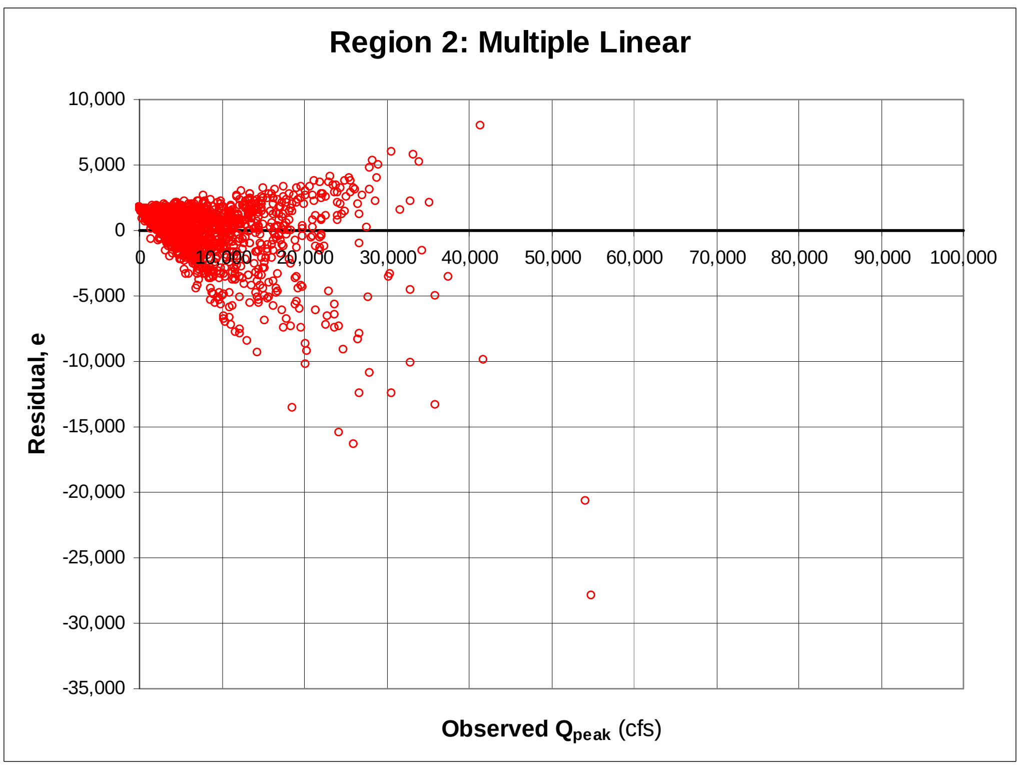


(d) Power Regression Model

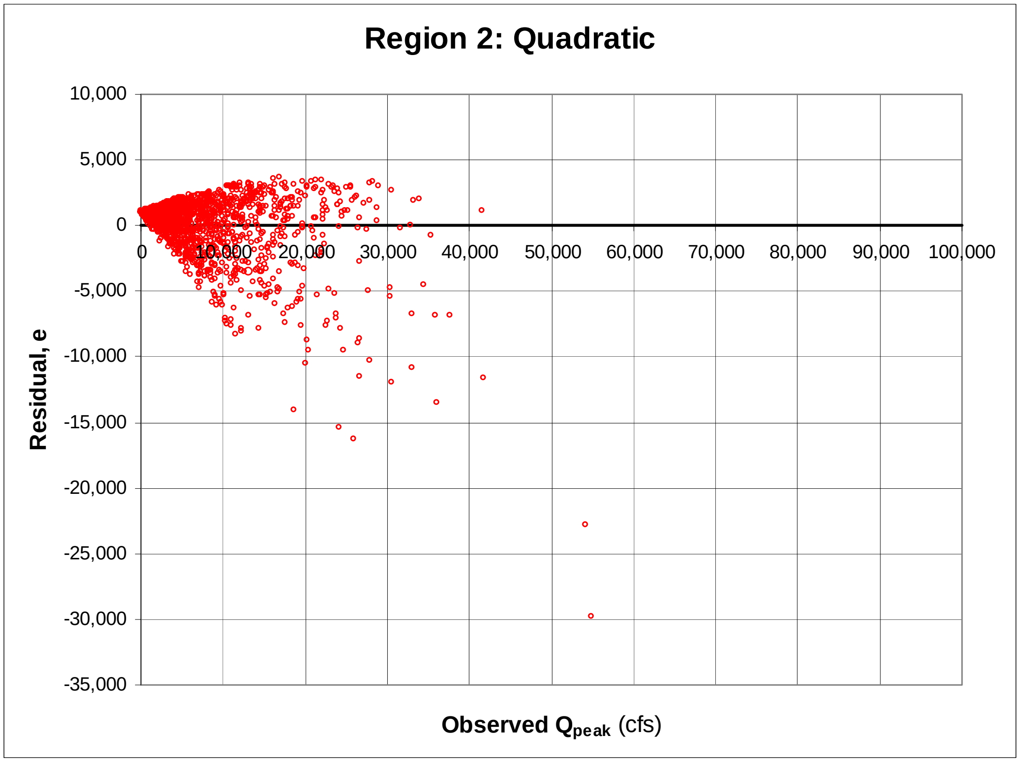
FIGURE 22 – Residual Plots for Regression Models Developed for Hydrologic Region 1



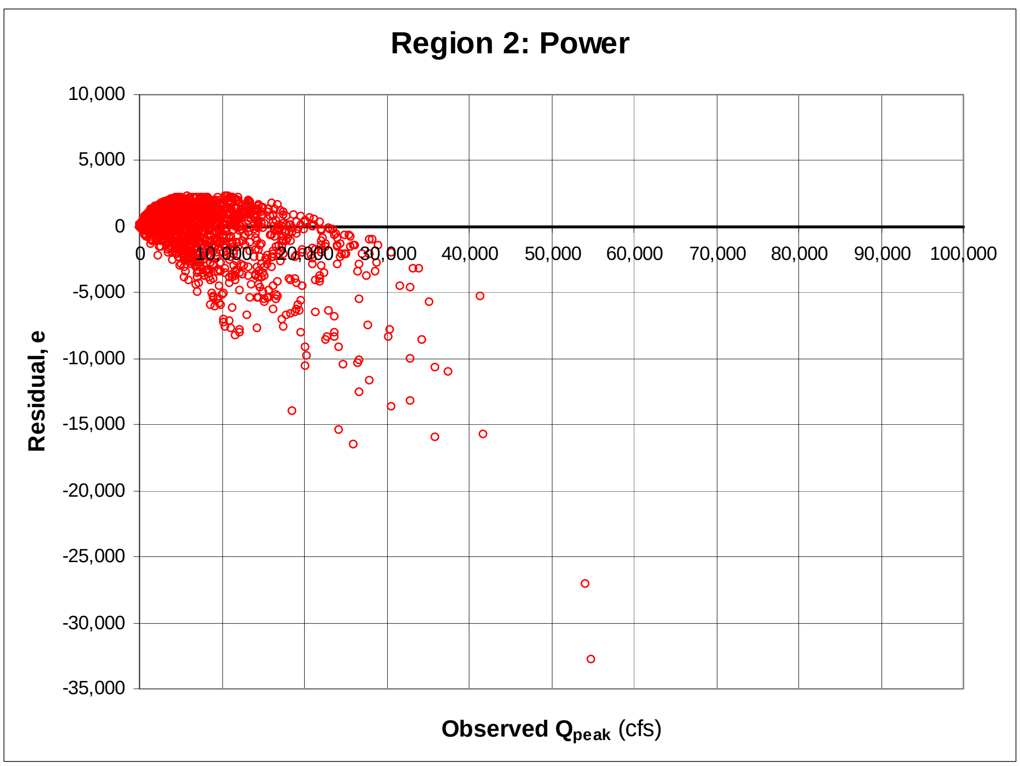
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model

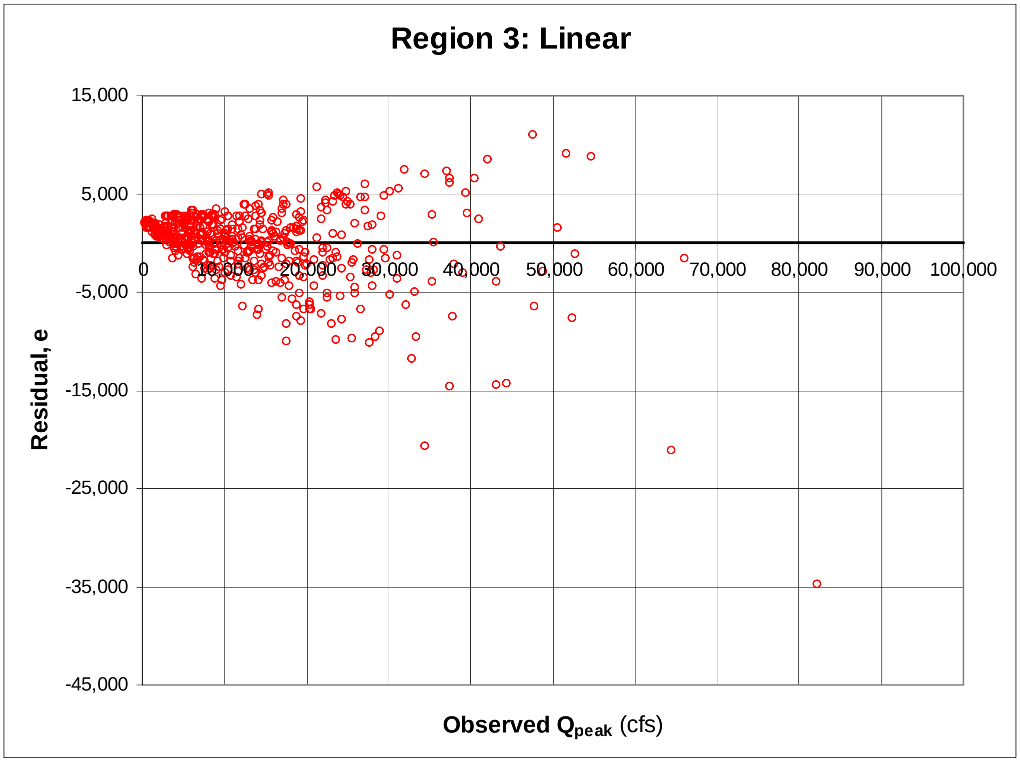


(c) Quadratic Regression Model

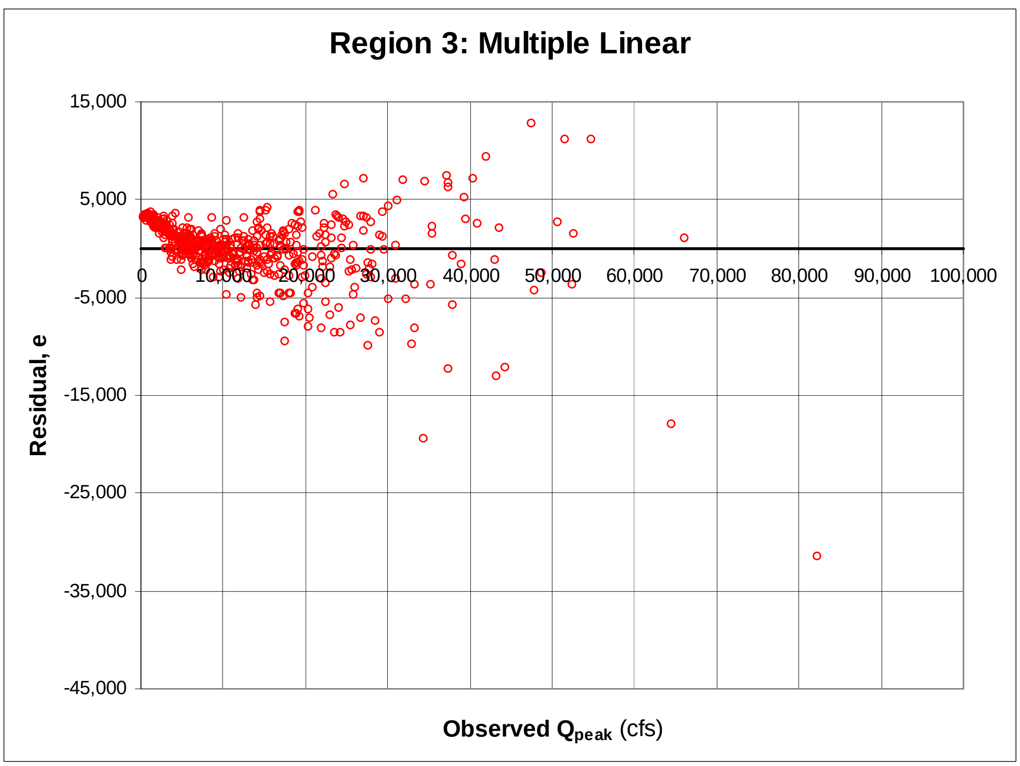


(d) Power Regression Model

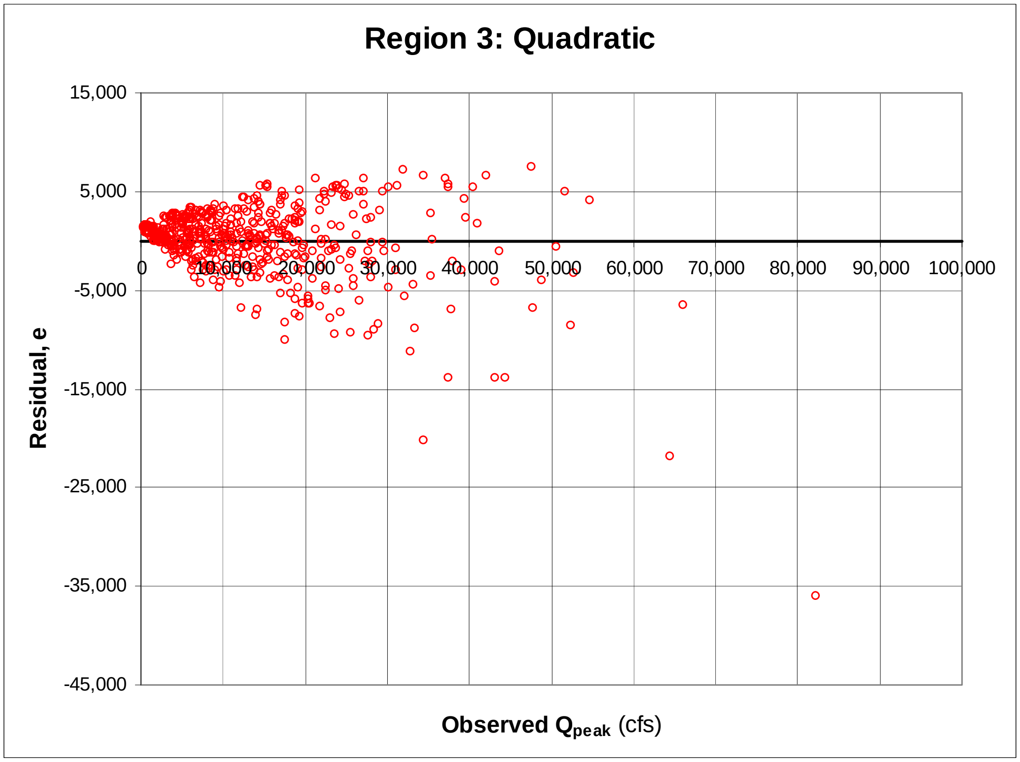
FIGURE 23 – Residual Plots for Regression Models Developed for Hydrologic Region 2



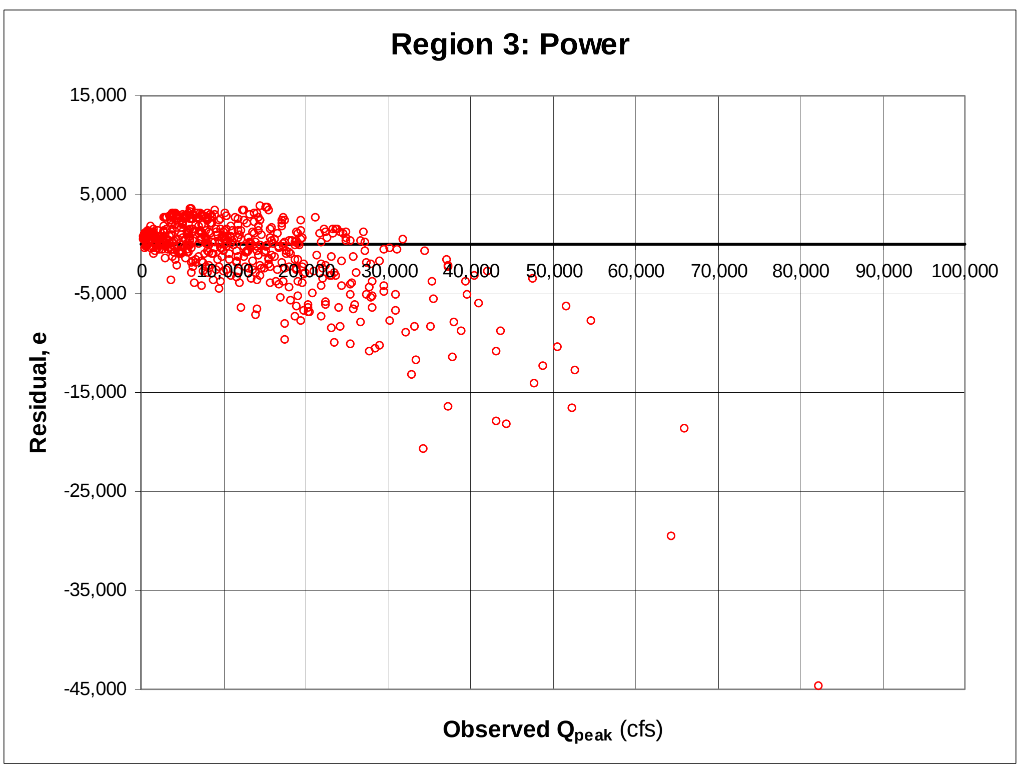
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model

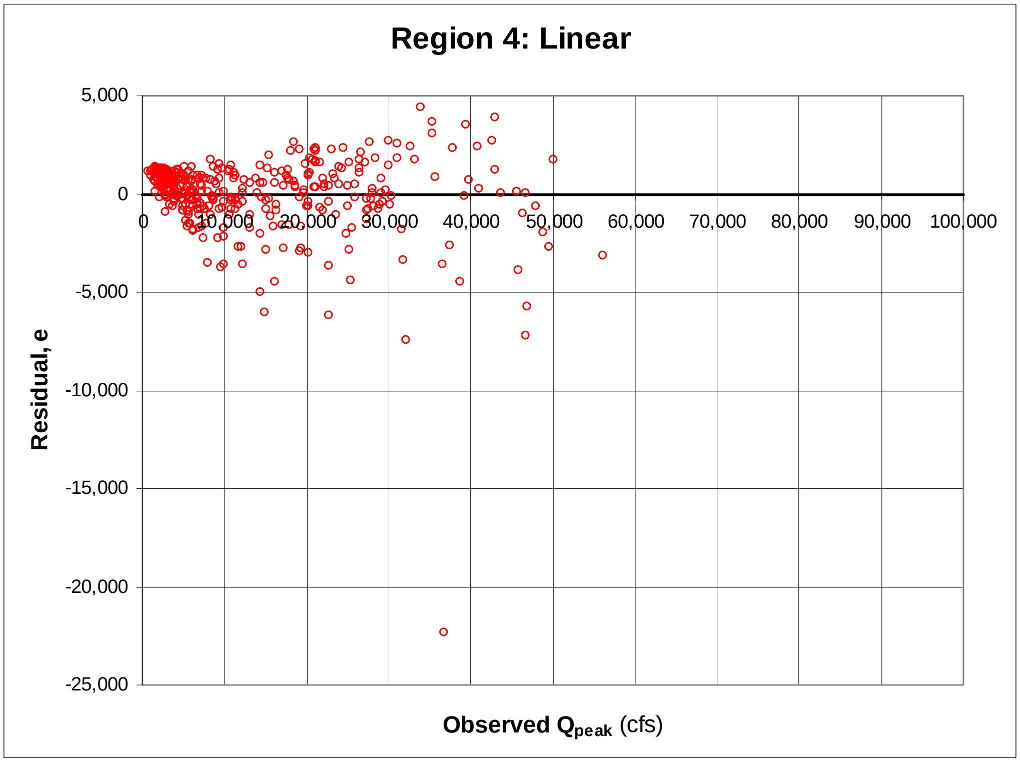


(c) Quadratic Regression Model

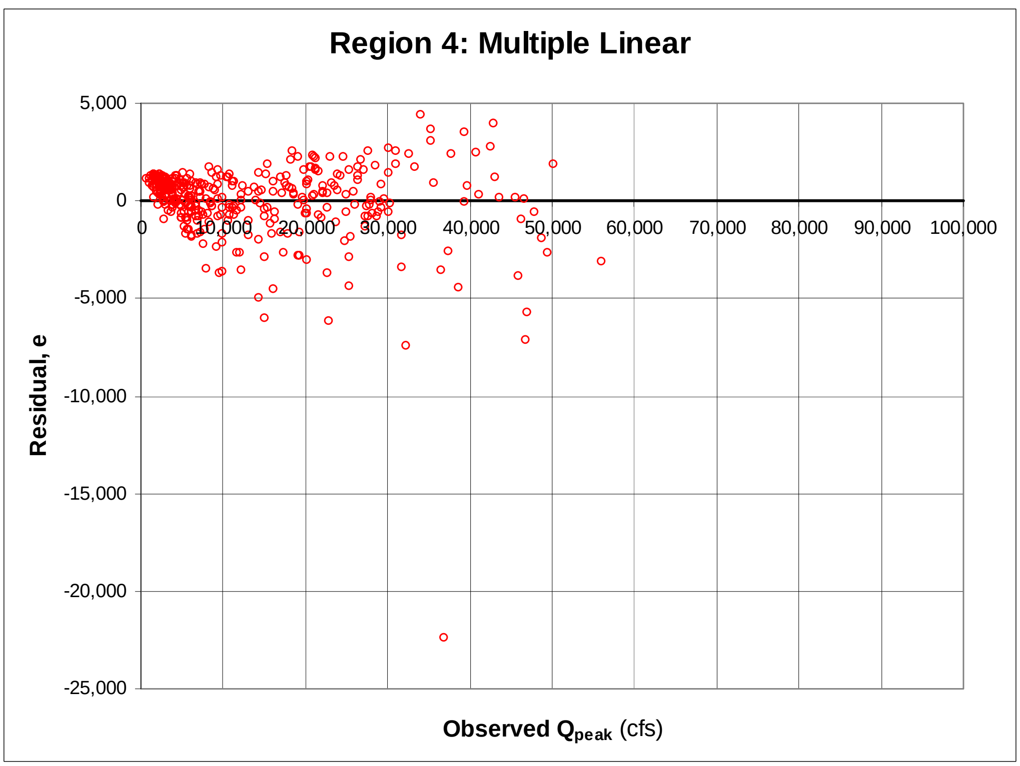


(d) Power Regression Model

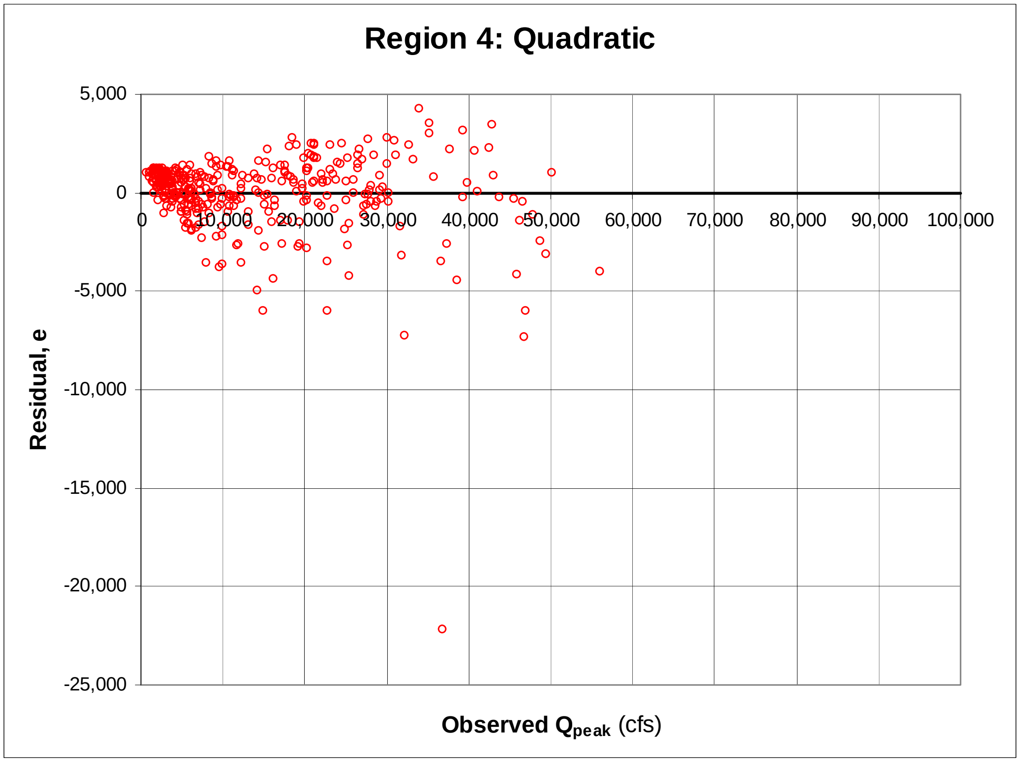
FIGURE 24 – Residual Plots for Regression Models Developed for Hydrologic Region 3



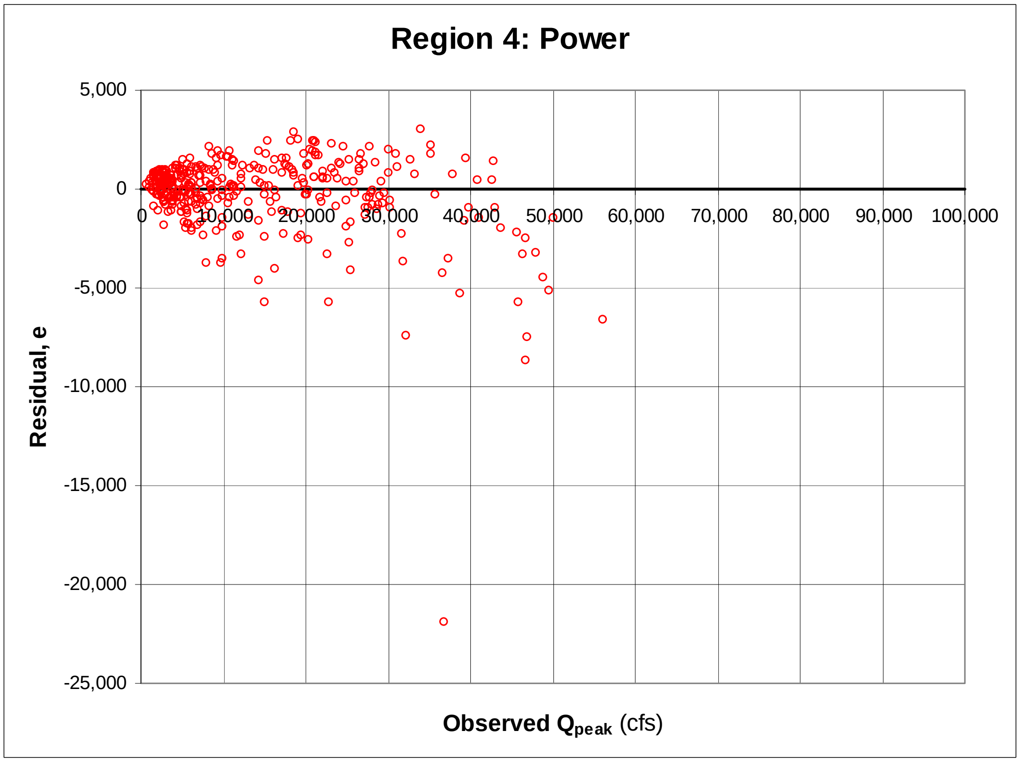
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model

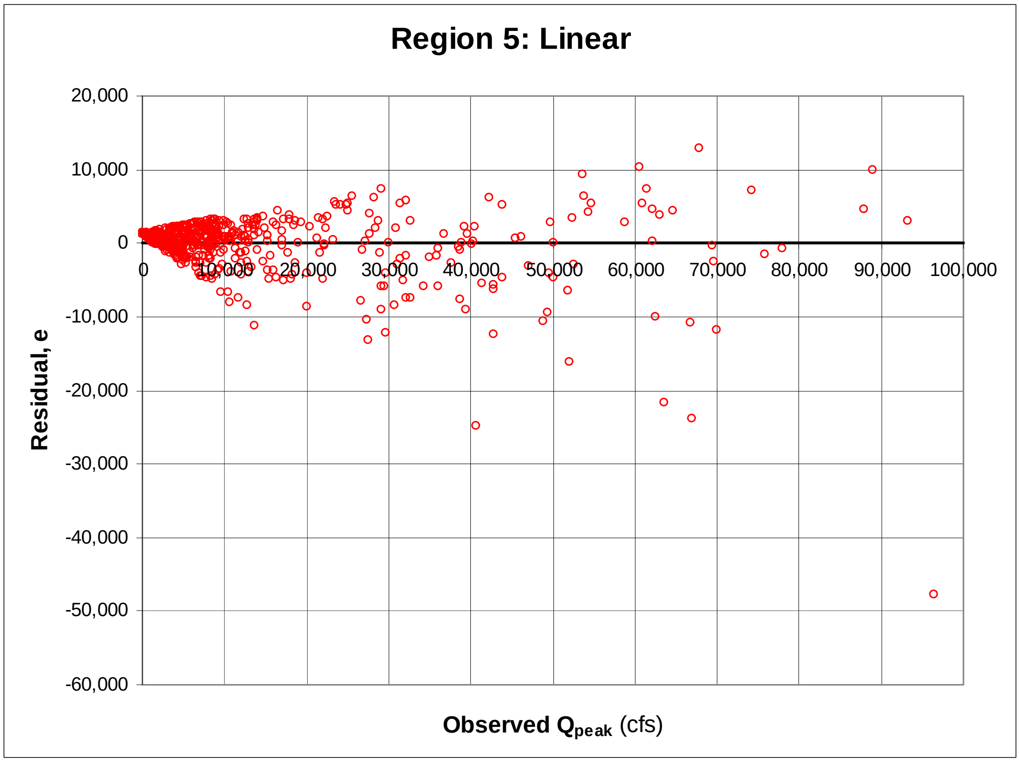


(c) Quadratic Regression Model

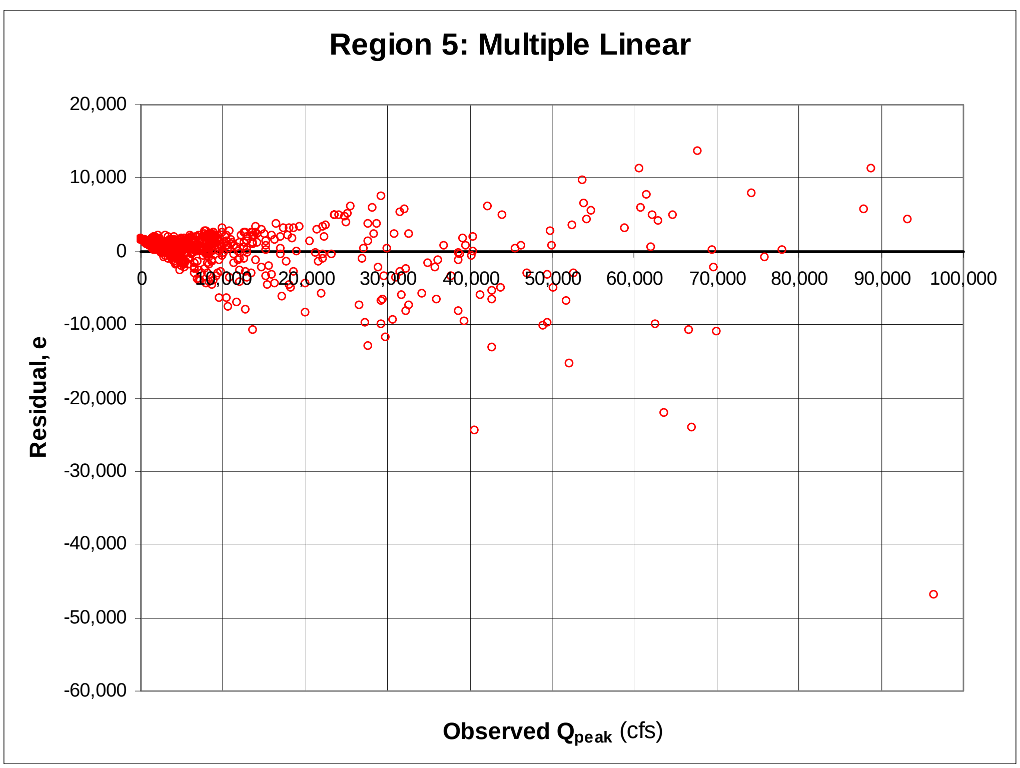


(d) Power Regression Model

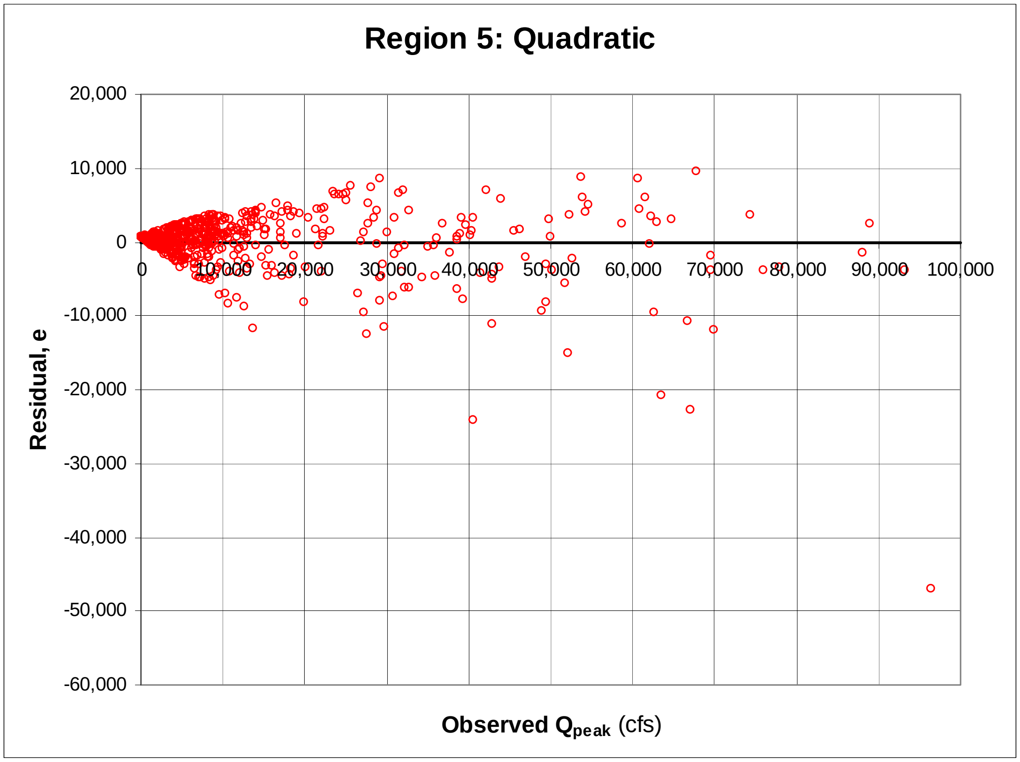
FIGURE 25 – Residual Plots for Regression Models Developed for Hydrologic Region 4



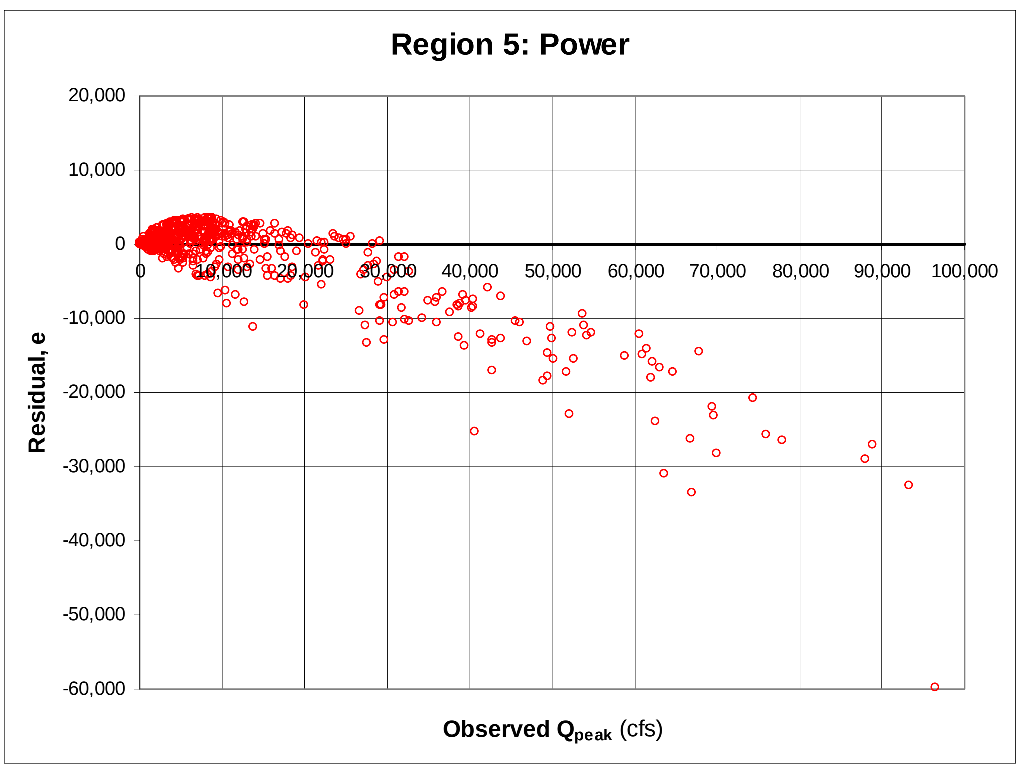
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model

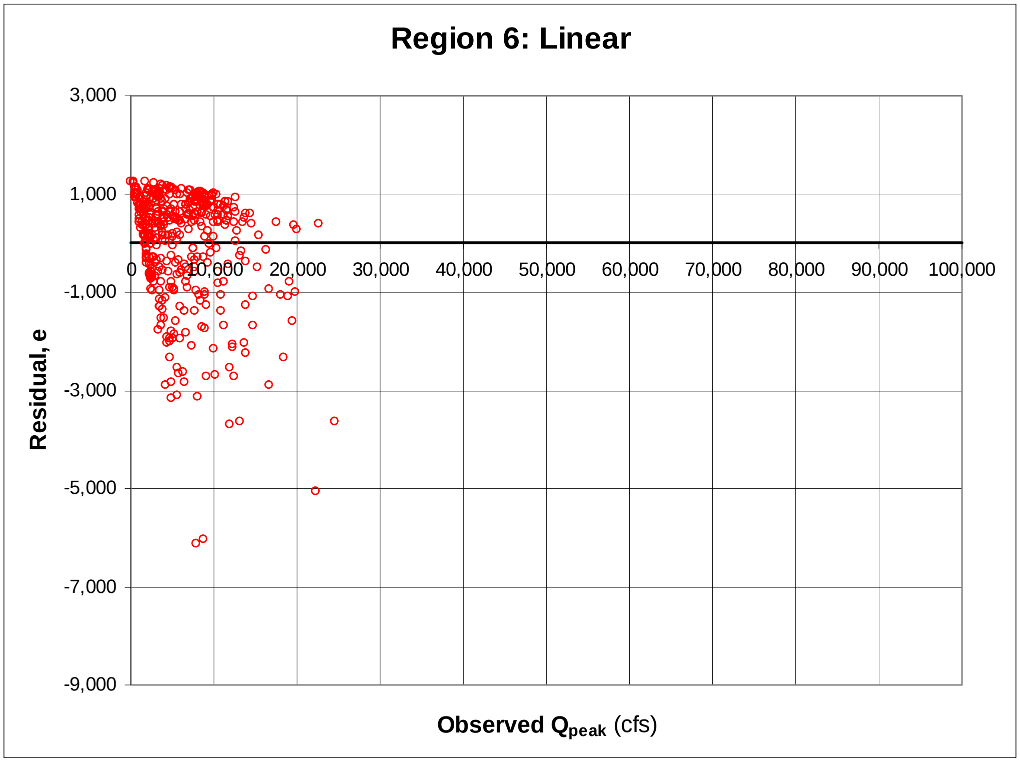


(c) Quadratic Regression Model

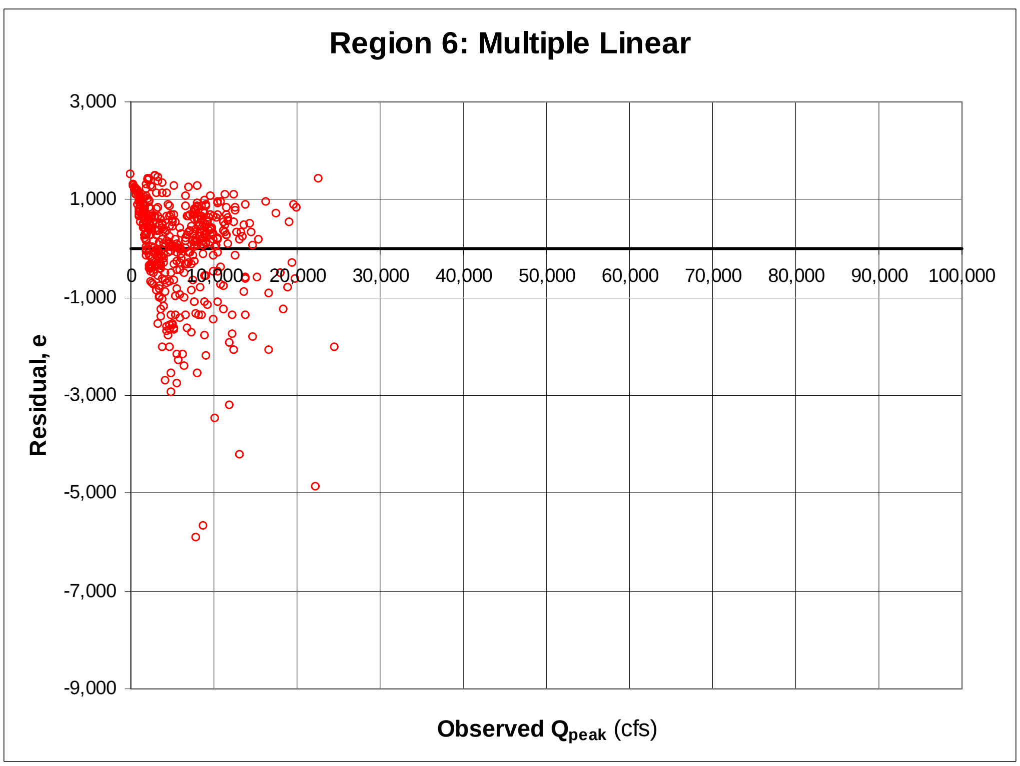


(d) Power Regression Model

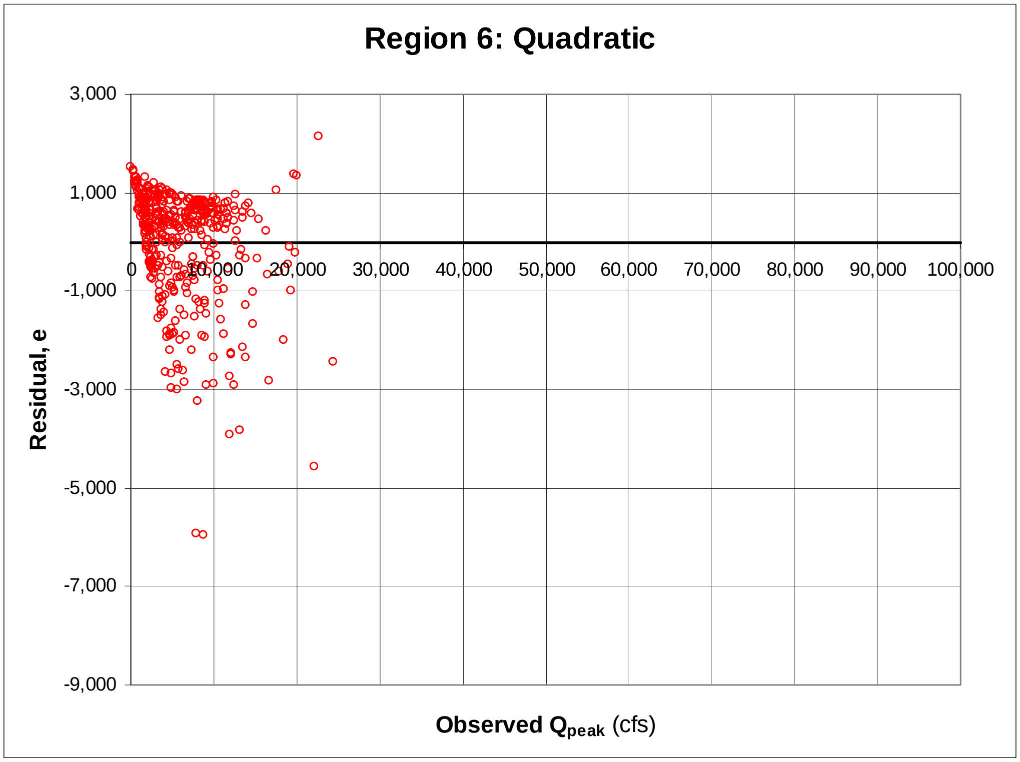
FIGURE 26 – Residual Plots for Regression Models Developed for Hydrologic Region 5



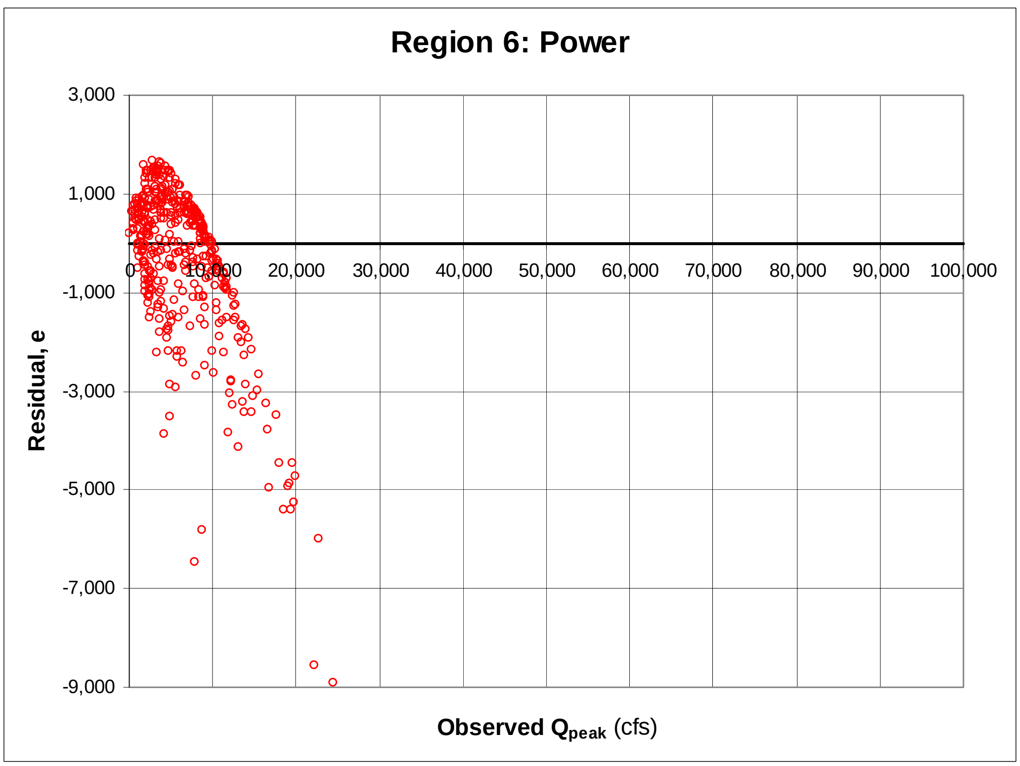
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model

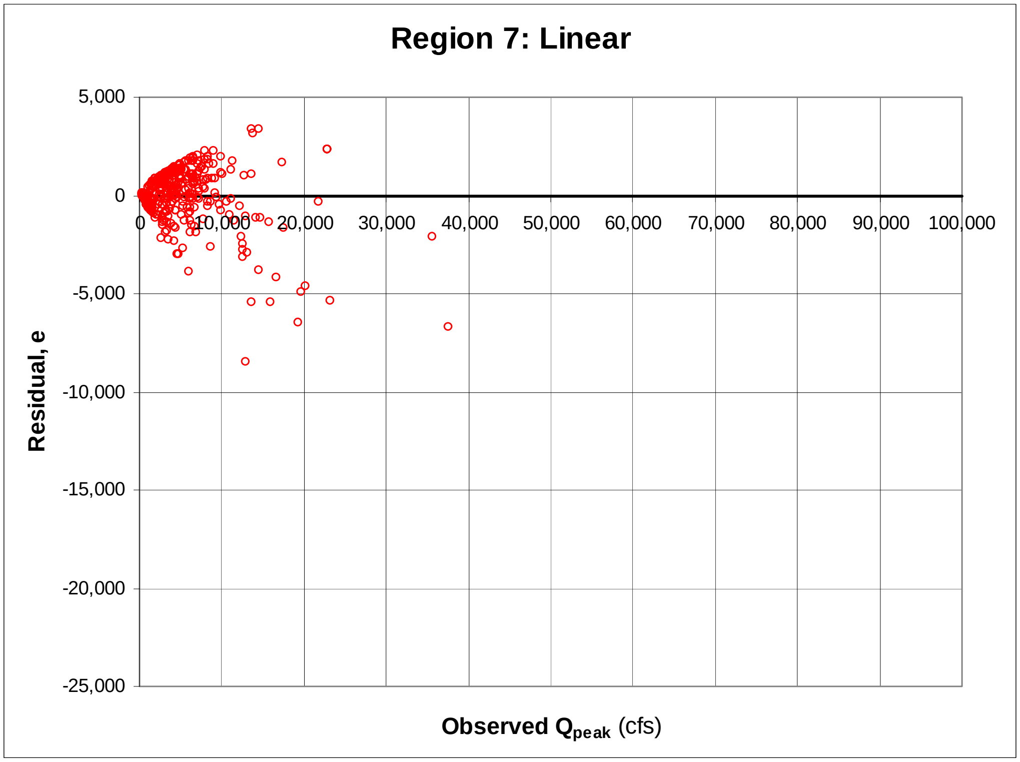


(c) Quadratic Regression Model

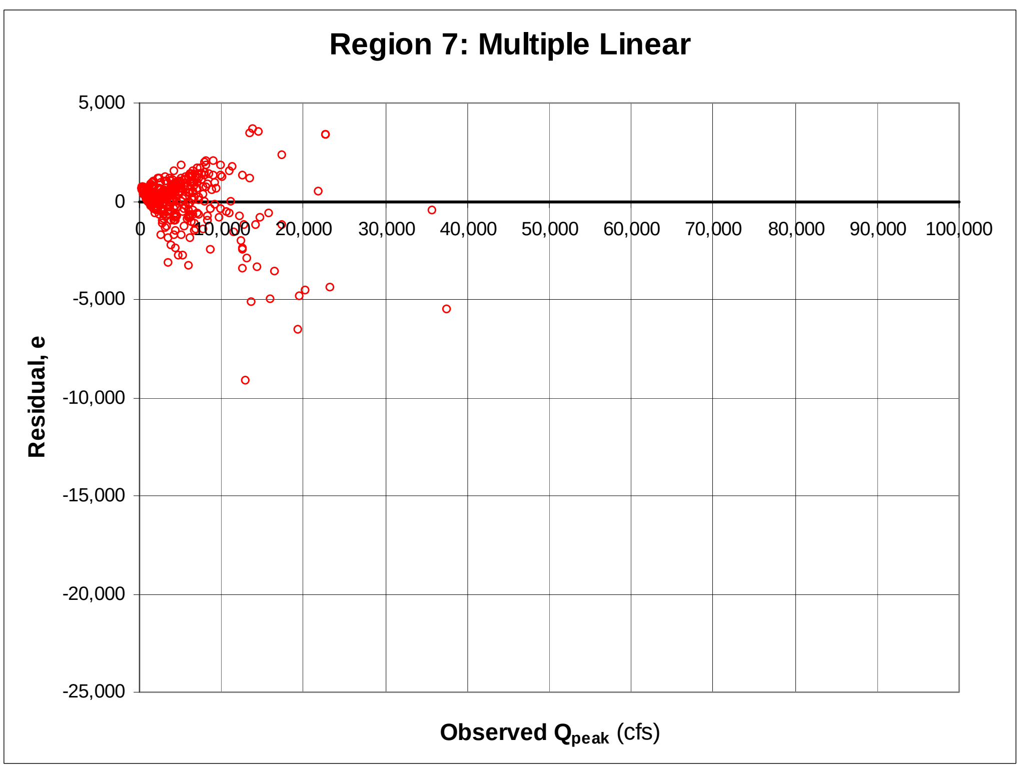


(d) Power Regression Model

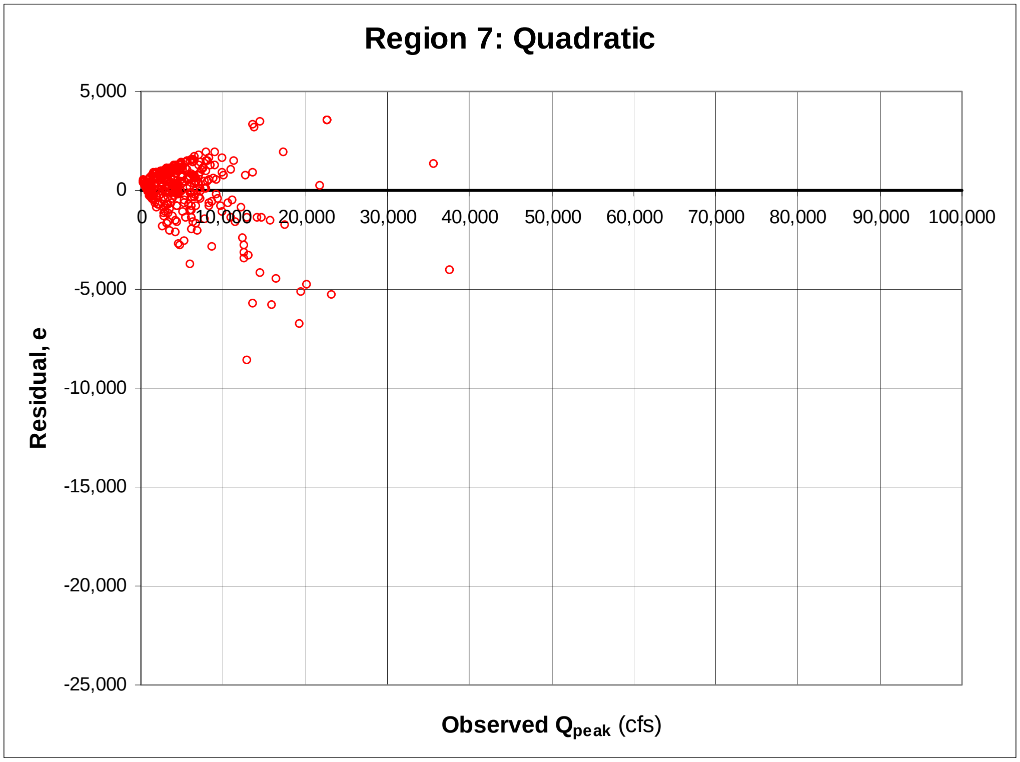
FIGURE 27 – Residual Plots for Regression Models Developed for Hydrologic Region 6



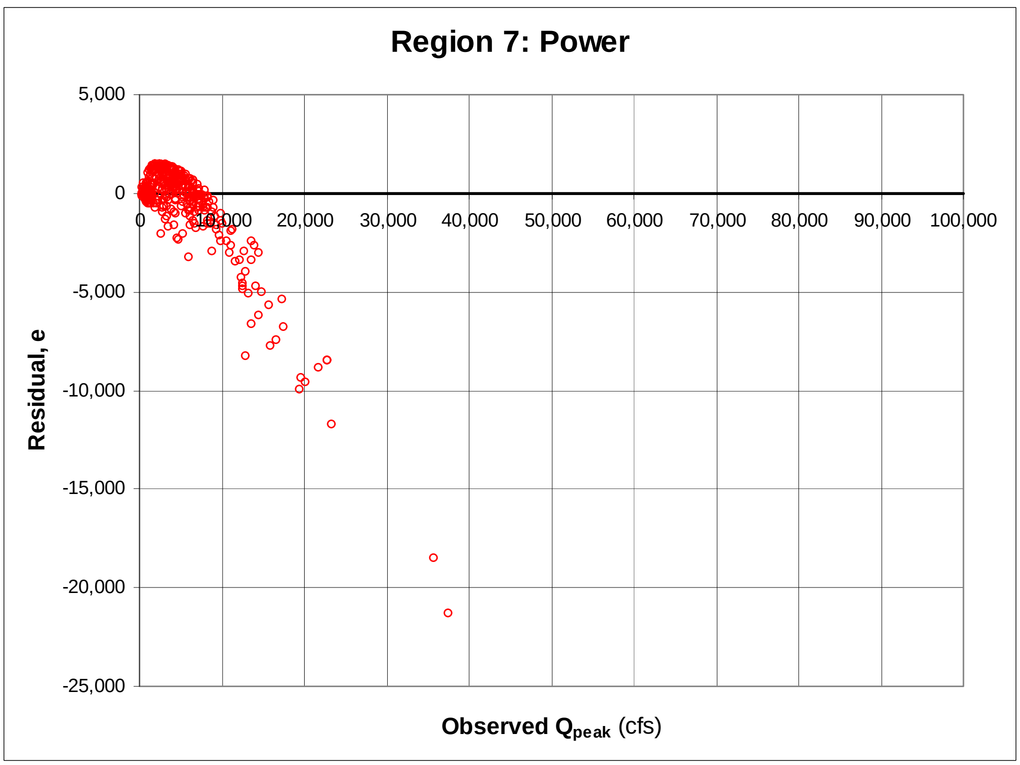
(a) Simple Linear Regression Model



(b) Multiple Linear Regression Model



(c) Quadratic Regression Model



(d) Power Regression Model

FIGURE 28 – Residual Plots for Regression Models Developed for Hydrologic Region 7

APPENDIX V

TEST FOR DIFFERENCES IN STREAMFLOW PRIOR TO AND AFTER REGULATION OR DIVERSION FOR LITTLE SANDY RIVER AT GRAYSON, KENTUCKY

TABLE XVII

STREAMFLOW DATA AND STATISTICS FOR LITTLE SANDY RIVER AT GRAYSON, KENTUCKY

Little Sandy River at Grayson, KY: #03216500							
Period 1 (1939-1967):			**Period 2 (1968-2004):**			**Period 1 (1939-1967):**	
						n =	29
Peak Date	**Annual Peak Q**		**Peak Date**	**Annual Peak Q**		mean =	10,714.83
						std dev =	4,888.14
-	(cfs)		-	(cfs)		variance =	23,893,897
02/04/39	19,800		03/13/68	7,160			
03/31/40	8,200		01/30/69	1,340		**Period 2 (1968-2004):**	
07/20/41	5,940		04/02/70	5,860		n =	37
04/10/42	7,940		05/14/71	5,650		mean =	6,885.95
12/30/42	15,400		04/22/72	8,830		std dev =	3182.24
04/12/44	8,040		12/09/72	7,920		variance =	10,126,641
01/02/45	9,530		01/11/74	8,340			
06/03/46	10,000		03/29/75	7,330		**Combined (1939-2004)**	
09/06/47	4,440		10/18/75	5,950		n =	65
04/13/48	14,600		04/05/77	3,850		mean =	8,519
02/16/49	6,510		01/26/78	7,780		std dev =	4,423.59
09/22/50	24,500		12/09/78	13,900		variance =	19,568,149
02/02/51	9,780		12/13/79	4,620			
03/23/52	19,200		06/14/81	3,640			
03/04/53	8,210		05/30/82	4,570			
09/20/54	2,560		05/02/83	5,740			
03/06/55	13,500		04/23/84	5,880			
02/18/56	12,900		12/22/84	3,950			
12/15/56	11,100		02/18/86	4,150			
05/08/58	9,840		11/09/86	4,730			
01/22/59	5,860		03/05/88	4,270			
07/04/60	9,000		02/16/89	11,100			
06/16/61	10,200		05/29/90	6,160			
02/28/62	17,600		12/31/90	8,300			
03/12/63	9,380		12/03/91	5,060			
04/20/64	7,480		02/22/93	6,910			
03/27/65	7,780		03/10/94	9,240			
02/14/66	9,640		05/18/95	5,590			
03/07/67	11,800		05/16/96	6,110			
	310,730		03/02/97	16,300			
			01/08/98	4,760			
			01/10/99	3,550			
			02/19/00	7,310			
			05/19/01	4,780			
			03/20/02	14,200			
			05/06/03	9,850			
			09/18/04	10,100			
				254,780			

A. Test for Equality of Means

- Hypothesis
  - H_o: $\mu_1 - \mu_2 = 0$
  - H_a: $\mu_1 - \mu_2 \neq 0$

- Confidence Level: 90%
  - $\alpha = 0.10$

- Sample Statistics
  - Period 1:

n =	29
mean =	10,714.83
std dev =	4,888.14

  - Period 2:

n =	37
mean =	6,885.95
std dev =	3,182.24

- Test Statistic

$$t' = \frac{\bar{x}_1 - \bar{x}_2 - \delta}{\sqrt{s_1^2/n_1 + s_2^2/n_2}}$$

$$t' = \frac{10{,}714.83 - 6{,}885.95 - 0}{\sqrt{4{,}888.14^2/29 + 3{,}182.24^2/37}}$$

$$t' = 3.6546$$

- Reject H_0 if…

$$|t'| > \frac{\left(s_1^2/n_1\right) \times t_{1-\alpha/2, n_1-1} + \left(s_2^2/n_2\right) \times t_{1-\alpha/2, n_2-1}}{s_1^2/n_1 + s_2^2/n_2}$$

$$|3.6546| > \frac{\left(4{,}888.14^2/29\right) \times 1.7011 + \left(3{,}182.24^2/37\right) \times 1.6883}{4{,}888.14^2/29 + 3{,}182.24^2/37}$$

$$|3.6546| > 1.6979 \quad \therefore \text{ Reject } H_0$$

B. Test for Equality of Variance

- Hypothesis
  - H_o: $\sigma_1 = \sigma_2$
  - H_a: $\mu_1 \neq \mu_2$

- Confidence Level: 90%
  - $\alpha = 0.10$

- Sample Statistics
  - Period 1:

n =	29
mean =	10,714.83
std dev =	4,888.14

  - Period 2:

n =	37
mean =	6,885.95
std dev =	3,182.24

- Test Statistic

$$F_c = s_1^{\,2} / s_2^{\,2}$$

$$F_c = 4{,}888.14^2 / 3{,}182.24^2$$

$$F_c = 2.3595$$

- Reject H_0 if…

$$F_c > F_{1-\alpha, n_1-1, n_2-1}$$

$2.3595 > 1.5723 \therefore$ Reject H_0

APPENDIX VI

STREAMFLOW DATA

TABLE XVIII

STREAMFLOW DATA FOR CUMBERLAND RIVER AT BARBOURVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/04/23	28200	24000
01/04/24	21100	20200
12/09/24	27400	23600
05/16/26	21100	18400
05/31/27	47900	42000
06/30/28	18200	17400
03/24/29	46300	40200
11/18/29	18500	18100
04/23/31	23100	22000
01/06/49	24000	22000
02/02/50	34000	33900
02/02/51	45900	37200
03/23/52	32700	30900
05/20/53	21200	20200
01/16/54	20200	16700
03/23/55	29100	25400
02/19/56	28500	26500
01/30/57	43000	39200
05/08/58	25300	23400
01/22/59	30300	26400
11/28/59	17900	13700
02/26/61	20500	19200
03/01/62	29600	26000
03/13/63	45600	40600
03/15/64	15100	12300
03/27/65	28100	24700
02/14/66	20300	18300
03/08/67	36600	29000
03/13/68	19700	17000
02/03/69	10800	10000
12/31/69	48800	41600
05/14/71	26000	22400
04/13/72	20200	18100
03/17/73	37800	35500
11/28/73	49500	41600
03/14/75	46900	36400
03/30/76	25500	20500
04/05/77	56100	47200
11/07/77	21700	18000
12/10/78	23500	21000 [1]
03/21/80	27300	22600 [1]
04/21/81	14300	12400 [1]
01/04/82	26500	24000 [1]
05/17/83	16200	14600 [1]
05/08/84	42900	41600 [1]
02/02/85	13200	11400 [1]
02/18/86	23200	20900 [1]
11/10/86	16400	13000 [1]
01/20/88	17100	13000 [1]
06/16/89	31000	29500 [1]
02/11/90	16100	14000 [1]
02/20/91	27700	26500 [1]
12/04/91	31800	24800 [1]
03/24/93	23700	19500 [1]
03/08/96	21600	20000 [1]
12/02/96	30100	28800 [1]
04/20/98	35300	34400 [1]
01/24/99	15400	14700 [1]
04/04/00	25000	22000 [1]
02/17/01	21000	18300 [1]
03/19/02	39400	38000 [1]
02/17/03	35300	33900 [1]
02/07/04	24600	23400 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XIX

STREAMFLOW DATA FOR SOUTH FORK CUMBERLAND RIVER NEAR STEARNS, KENTUCKY

Peak Date -	Annual Peak Streamflow (cfs)	Mean Daily Streamflow (cfs)
12/29/42	53900	48400
02/18/44	52600	39700
01/01/45	28900	21500
01/08/46	67800	65300
01/03/47	31800	20800
02/13/48	69600	54000
01/05/49	62600	42200
01/31/50	49800	42100
02/01/51	64700	55800
12/15/51	45500	36800
02/21/53	29200	18000
01/21/54	36100	28000
03/22/55	54300	47000
02/18/56	42200	38700
01/29/57	61500	55500
11/19/57	40500	34000
01/22/59	39600	32400
12/19/59	40400	32400
03/08/61	39400	23900
02/27/62	43900	39200
03/12/63	62100	50200
02/16/64	23200	18300
03/26/65	42800	23900
02/14/66	29400	18300
03/07/67	52400	44800
03/13/68	32200	19300
02/02/69	22200	17100
12/31/69	88000	75000
02/05/71	31500	23100
01/03/72	29200	15500
05/28/73	93200	78100
01/11/74	60900	53500
03/13/75	88900	80200
03/30/76	38900	30900
04/05/77	75900	60100
01/26/78	39200	32900
02/26/79	36000	23700
03/21/80	58800	49600
04/05/81	17200	8910
09/03/82	67000	34400
04/06/83	32200	23900
05/07/84	62200	53800
11/19/84	22000	13000
02/18/86	32700	28200
11/09/86	31000	22000
01/20/88	40200	31800
03/06/89	46200	37600
10/01/89	35800	26900
12/23/90	74300	65900
12/03/91	63000	53800
03/24/93	50100	36200
02/11/94	66700	44800
03/08/95	30700	17200
03/07/96	21300	17000
12/01/96	69500	55800
04/19/98	41400	28500
01/24/99	38700	24500
04/04/00	37700	27600
02/17/01	36800	30200
03/18/02	53700	50800
02/16/03	54700	48300
09/17/04	63600	33300

TABLE XX

STREAMFLOW DATA FOR SOUTH FORK BARREN RIVER NEAR FINNEY, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/10/42	16400	14400
12/30/42	23500	22800
03/01/44	20500	17500
01/02/45	49400	31800
01/08/46	43800	31100
05/22/47	17900	16200
02/14/48	51800	36100
06/16/49	42800	29000
01/06/50	38700	30000
06/16/61	14100	13300
02/28/62	78000	62500
03/14/63	8460	8370
03/08/64	7410	6930 [1]
12/08/64	5440	5270 [1]
01/11/66	4590	4500 [1]
03/23/67	6080	5210 [1]
12/02/67	3420	3190 [1]
02/15/69	3690	3670 [1]
05/08/70	4140	3980 [1]
03/06/71	4300	4290 [1]
02/18/72	6060	4100 [1]
05/10/73	4860	4020 [1]
02/04/74	4980	4960 [1]
04/06/75	6360	6350 [1]
02/04/76	5080	4880 [1]
03/02/77	8160	4200 [1]
12/14/77	4590	4400 [1]
02/07/80	5220	5120 [1]
05/25/83	4380	4350 [1]
12/11/83	5000	4330 [1]
11/18/84	4030	3350 [1]
02/27/86	3560	3510 [1]
12/12/86	4540	4510 [1]
01/28/88	3990	3930 [1]
04/12/89	5130	5110 [1]
02/09/90	4890	4020 [1]
03/22/91	5340	4550 [1]
01/08/92	4170	4130 [1]
02/24/93	3290	3270 [1]
04/11/94	7470	3680 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XXI

STREAMFLOW DATA FOR LICKING RIVER AT FARMERS, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/15/38	13500	13200
02/04/39	22200	18800
03/31/40	11200	11000
07/20/41	6060	4590
04/10/42	10200	9430
12/31/42	17200	16600
04/13/44	10600	10500
01/02/45	13700	12800
06/03/46	10800	10700
01/21/47	7140	6960
04/09/48	17000	14700
02/17/49	10500	10400
02/01/50	21300	20200
02/02/51	11400	11300
03/24/52	19700	19100
03/05/53	11000	10800
05/09/54	4220	3860
03/06/55	14500	14100
02/19/56	13200	12900
12/16/56	12000	11700
04/30/58	13200	13000
01/21/59	8610	6930
02/11/60	7550	7310
05/09/61	11000	9470
02/28/62	24000	21500
03/13/63	11600	11400
03/11/64	12200	11600
03/27/65	11300	11200
02/15/66	9370	8940
03/08/67	16900	16800
04/06/68	11400	11200
04/20/69	4220	4180
04/30/70	12100	12000
02/06/71	11300	11000
04/23/72	6950	6760
12/13/72	5840	5810
01/15/74	8100	7820 [1]
03/18/75	4040	4020 [1]
02/25/76	3380	3290 [1]
04/10/77	3600	3530 [1]
02/04/78	4710	4690 [1]
02/03/79	5110	5060 [1]
12/19/79	4140	3600 [1]
06/04/81	3390	3340 [1]
03/26/82	3810	3660 [1]
05/25/83	4440	4230 [1]
11/15/86	4080	4070 [1]
03/11/89	4630	4620 [1]
02/27/90	4450	4440 [1]
01/18/91	4980	4970 [1]
12/07/91	3830	3810 [1]
03/12/93	3920	3900 [1]
04/07/94	4860	4410 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XXII

STREAMFLOW DATA FOR CUMBERLAND RIVER AT PINE STREET BRIDGE AT PINEVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/10/90	15100	10000 [1]
12/03/91	33300	30800 [1]
03/24/93	28900	24700 [1]
02/12/94	38700	30100 [1]
05/15/95	20300	14600 [1]
03/07/96	17200	14900 [1]
12/01/96	31100	28900 [1]
04/19/98	30200	25900 [1]
01/24/99	11200	10000 [1]
04/04/00	22100	19700 [1]
02/17/01	18400	16200 [1]
03/18/02	46700	41500 [1]
02/16/03	39300	34600 [1]
03/06/04	24900	19700 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XXII

STRAMFLOW DATA FOR ROUGH RIVER NEAR DUNDEE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/21/40	9790	9650
07/04/41	3640	3320
04/11/42	11400	11200
03/21/43	9840	9610
04/14/44	4740	4680
03/01/45	11600	11200
02/15/46	11300	11000
02/16/48	8900	8720
02/17/49	15500	14700
01/14/50	20000	19400
01/16/51	14300	13900
03/24/52	17600	17100
03/06/53	9790	9680
04/18/54	3860	3810
03/23/55	8480	8400
02/04/56	11600	11200
05/24/57	14600	14000
11/19/57	8000	7700
01/23/59	9100	8760
01/17/60	5090	5000 [1]
05/09/61	9960	9000 [1]
02/28/62	9560	9410 [1]
03/06/63	6960	6620 [1]
03/10/64	16600	14700 [1]
12/12/64	5290	4860 [1]
02/11/66	6080	5690 [1]
05/16/67	6990	6440 [1]
04/05/68	5880	5700 [1]
01/31/69	8450	8270 [1]
04/03/70	7490	7050 [1]
02/23/71	9070	8710 [1]
02/26/72	10500	9850 [1]
12/10/72	9920	9560 [1]
01/12/74	10000	9340 [1]
01/12/75	9290	7760 [1]

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/19/76	13800	12400 [1]
03/05/77	7810	7600 [1]
12/06/77	8830	8550 [1]
09/22/79	22200	16200 [1]
11/26/79	8940	8830 [1]
05/20/81	8700	8350 [1]
05/01/83	19000	17000 [1]
05/08/84	19800	17900 [1]
12/22/84	9660	9420 [1]
04/15/87	7510	7340 [1]
01/20/88	10200	9700 [1]
02/15/89	19600	19100 [1]
02/16/90	15300	13800 [1]
12/19/90	13500	12900 [1]
03/31/92	7680	7420 [1]
02/16/03	10600	10200 [1]
05/28/04	7860	7710 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XXIV

STREAMFLOW DATA FOR GREEN RIVER AT GREENSBURG, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/01/40	18400	16000
04/05/41	6920	5870
04/10/42	13600	11600
12/31/42	25100	24000
04/13/44	13600	12700
01/02/45	24800	23500
01/09/46	12800	12100
01/04/47	13700	12500
04/14/48	32100	30000
02/16/49	31500	29300
01/07/50	28200	27100
02/02/51	14000	13000
03/24/52	47000	35000
05/20/53	16500	16000
04/18/54	11700	9620
03/23/55	23600	22600
02/19/56	24200	23100
01/30/57	21500	19300
11/20/57	25600	25200
01/22/59	12500	11800
06/25/60	13000	11800
03/01/61	10300	9660
02/28/62	60600	57200
03/13/63	18000	16800
03/10/64	25000	23000
03/27/65	14700	14000
02/14/66	12900	11200
03/08/67	9350	9030
04/06/68	8360	8340
01/22/69	2880	2870 [1]
01/09/70	8990	8260 [1]
05/13/71	7560	5950 [1]
01/27/72	8700	5680 [1]
12/08/72	8730	8170 [1]
01/24/74	8680	8610 [1]
03/12/75	8560	8350 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XXV

STREAMFLOW DATA FOR SOUTH FORK KENTUCKY RIVER AT BOONEVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
11/17/27	15800	13100
04/20/40	13800	11900
07/05/41	16600	13600
08/09/42	12400	11700
03/20/43	23900	22000
04/12/44	22300	20200
03/06/45	19300	15200
01/08/46	42100	39800
06/29/47	50700	41200
02/14/48	40500	37000
03/19/49	16800	12400
02/02/50	21300	20500
02/02/51	41000	34000
03/23/52	31900	30600
05/07/53	12600	11800
01/16/54	8230	6900
02/28/55	26700	24000
02/18/56	39600	33300
01/30/57	66100	51300
05/07/58	23800	22000
01/22/59	18900	16100
06/24/60	24600	22300
03/09/61	13000	11000
02/28/62	54700	50400
03/12/63	48800	36000
03/09/64	13800	12700
03/26/65	21900	18200
02/14/66	13200	12000
03/07/67	35400	29700
03/13/68	23300	20900
01/21/69	8950	8000
04/29/70	37400	34400
05/08/71	24200	22100
04/13/72	31200	28500
12/12/72	25400	22400
01/11/74	37200	34800
03/14/75	47600	46400
03/30/76	17200	15600
04/05/77	39400	34800
01/26/78	29100	24400
12/09/78	37400	34100
03/22/80	11900	9770
06/07/81	27200	24400
01/04/82	17100	14800
05/16/83	24900	21900
05/08/84	51600	48100
11/19/84	12300	9620
02/18/86	15500	14900
11/09/86	15900	13400
01/20/88	11000	8810
03/07/89	26200	19700
10/18/89	30200	27400
12/24/90	22600	19600
12/03/91	25900	21200
03/05/93	14300	11500
03/28/94	27200	23300
05/19/95	17500	15900
05/29/96	17100	15200
03/04/97	22400	20000
04/18/98	25000	22300
01/10/99	18800	14600
04/05/00	11800	8360
02/17/01	17300	16000
03/19/02	21800	19100
02/17/03	34500	32400
02/07/04	29500	26400

TABLE XXVI

STREAMFLOW DATA FOR NOLIN RIVER AT KYROCK, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)	
04/26/31	3390	3120	
01/30/32	22700	22300	
03/03/40	10500	8800	
07/19/41	4540	2710	
04/10/42	7360	6640	
03/20/43	8800	8710	
04/12/44	6820	4940	
03/01/45	10600	10100	
02/15/46	8850	8500	
01/03/47	8940	6740	
02/14/48	14700	12000	
02/17/49	11700	11500	
12/13/49	13600	13100	
05/09/61	12600	11600	
02/28/62	12600	12500	
03/23/63	9120	8820	1
03/27/64	9620	9360	1
12/01/64	13100	8340	1
02/25/66	5640	5430	1
05/24/67	6980	6900	1
06/07/68	5520	5400	1
02/06/69	4790	4700	1
05/08/70	8220	8140	1
03/14/72	9990	9620	1
07/25/73	6200	6140	1
12/06/73	10100	6260	1
04/08/75	8420	8340	1
03/04/76	6790	6650	1
03/17/77	5680	4980	1
12/28/77	7860	7760	1
12/27/78	11200	9320	1
10/19/79	7160	7080	1
05/27/81	4380	4350	1
09/09/82	7180	6680	1
05/29/83	10300	10200	1
05/22/84	8480	8330	1
01/22/85	10000	9950	1

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XXVII

STREAMFLOW DATA FOR GREEN RIVER NEAR CAMPBELLSVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)	
03/29/31	8450	7770	
01/30/32	29200	29000	
03/10/64	27700	24900	
03/27/65	15900	14200	
02/14/66	18300	10400	
03/08/67	8820	8740	
04/06/68	8810	8740	
01/23/69	3280	2300	1
01/09/70	10100	7550	1
11/06/70	6960	6840	1
03/11/72	7220	7110	1
01/23/74	8470	8350	1
05/25/75	6740	5030	1
02/25/76	5360	4290	1
03/19/77	4970	4900	1
01/02/78	5860	5820	1
02/05/79	8190	7600	1
12/04/79	5320	5290	1
05/28/81	6000	5940	1
02/08/82	7260	6820	1
05/25/83	6180	6130	1
05/16/84	7870	7820	1
01/09/85	5980	5920	1
12/10/85	4330	4270	1
12/15/86	5370	5040	1
01/26/88	4300	4230	1
04/11/89	6730	6680	1
02/19/90	4640	4570	1
01/23/91	7040	6970	1
12/07/91	4490	4400	1
02/24/93	4200	4170	1
04/21/94	6270	6210	1

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XXVIII

STREAMFLOW DATA FOR BEECH FORK AT BARDSTOWN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/25/41	6130	5740
04/10/42	14600	14000
12/30/42	22700	19900
04/12/44	11200	10700
02/27/45	24100	22500
02/14/46	21100	19900
01/03/47	14600	12700
02/14/48	25600	24400
02/15/49	24600	21600
12/13/49	27100	24700
01/15/51	20700	20100
03/23/52	25500	24500
03/04/53	20200	19200
04/17/54	8280	7800
02/07/55	18300	16700
02/03/56	18700	18000
04/05/57	22200	19400
11/19/57	27600	23200
01/22/59	26700	23200
06/24/60	12900	11500
05/09/61	26200	24400
02/28/62	27900	27100
03/06/63	17600	15900
03/05/64	33900	32200
12/12/64	12900	11800
02/14/66	12400	10800
05/15/67	22200	20900
04/05/68	16100	16000
04/19/69	10300	9170
04/29/70	32900	29000
12/23/70	23700	22200
04/15/72	31700	27500
12/09/72	22000	21400
01/11/74	27900	25700
04/17/98	16000	14800
01/10/99	17700	15300
03/20/02	24900	22000
02/16/03	23500	22500
05/31/04	17600	17000

TABLE XXIX

STREAMFLOW DATA FOR SOUTH FORK LICKING RIVER AT CYNTHIANA, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/15/38	18400	16800
03/05/39	17600	14800
03/03/40	16900	14500
07/19/41	9300	6420
04/10/42	11600	10600
03/20/43	27700	18800
04/12/44	9450	8400
03/07/45	19900	13200
06/17/46	18400	15400
01/03/47	9000	7150
04/13/48	35300	30700
02/15/49	18300	16000
01/06/50	25700	23600
01/04/51	21300	20800
03/23/52	23900	22600
03/04/53	20000	18300
01/22/54	3120	1910
03/22/55	13300	12600
03/08/56	17000	14900
04/05/57	16400	14000
05/05/58	12600	11300
01/21/59	18000	15100
01/15/60	13700	12500
05/08/61	24000	21600
02/28/62	25000	23800
03/17/63	14600	12400
03/05/64	29000	28000
03/26/65	9910	7460
02/14/66	12500	10200
03/15/67	19200	15000
04/05/68	13700	12400
01/30/69	8330	7730
04/02/70	17900	14800
12/22/70	17400	13700
04/23/72	22100	20600
12/09/72	20200	19300
01/11/74	23000	22100
03/29/75	21100	17800
02/18/76	19800	16200
03/05/77	9100	7160
03/14/78	22200	19100
12/10/78	26100	24200
12/13/79	14400	10900
01/23/82	11800	10700
05/02/83	17800	16800
04/23/84	17900	15480
12/22/84	14000	13180
03/14/86	8180	6483
03/01/87	10700	9679
02/03/88	12300	10900
02/16/89	28300	27700
05/29/90	12300	10900
12/19/90	20800	16900
12/03/91	16500	13600
02/22/93	16600	15100
03/10/94	14900	14200

TABLE XXX

STREAMFLOW DATA FOR ROCKCASTLE RIVER AT BILLOWS, KENTUCKY

Date	AMS Streamflow	Daily Avg. Streamflow
-	(cfs)	(cfs)
01/03/37	19400	14000
03/04/38	13100	9180
02/03/39	32200	21400
03/31/40	16300	13200
07/19/41	16000	11900
07/14/42	9250	5180
12/30/42	25900	22900
04/12/44	17700	15700
03/06/45	27600	23300
01/08/46	26500	24600
06/29/47	46800	35000
02/14/48	35700	32200
02/15/49	18600	16100
01/31/50	22700	16200
02/01/51	20300	17000
03/23/52	39800	35800
01/09/53	12300	10100
01/21/54	8020	6260
03/22/55	22200	19500
02/18/56	27800	24000
01/30/57	25000	21100
11/19/57	19100	16100
01/22/59	11200	9740
06/24/60	28000	24400
05/08/61	8140	5680
02/28/62	43700	38800
03/12/63	23900	21100
03/09/64	20400	18400
03/26/65	19800	16900
02/14/66	11100	8690
03/07/67	26700	25100
03/13/68	22700	19900
01/21/69	7310	6340
04/29/70	30100	27600
05/07/71	18600	16200
04/13/72	29300	25200
12/10/72	20900	20000
01/11/74	40800	38300
03/13/75	42600	40200
03/30/76	18000	15900
04/05/77	20800	19400
01/26/78	22700	19200
12/09/78	50100	46200
12/14/79	15100	11900
06/07/81	27100	25000
02/09/82	16200	9520
05/16/83	24300	22200
05/08/84	41100	36600
11/19/84	15500	12700
02/18/86	14400	13300
11/09/86	22000	18100
01/20/88	13800	12100
02/21/89	25400	18000
10/18/89	37400	30600
12/23/90	28700	24300
12/03/91	20000	16500
03/05/93	11300	8880
03/10/94	21200	19700
05/19/95	26500	24200
05/28/96	15700	12100
03/04/97	27300	23000
01/08/98	21200	19600
01/09/99	25300	19300
04/04/00	9840	7180
02/17/01	36800	12000
05/03/02	17600	15700
02/17/03	29200	26200
02/06/04	31700	26100

TABLE XXXI

STREAMFLOW DATA FOR NOLIN RIVER AT WAX, KENTUCKY

Date	AMS Streamflow	Daily Avg. Streamflow
-	(cfs)	(cfs)
08/05/38	7350	5900
03/06/39	9270	8940
03/04/40	7190	6880
07/20/41	3350	2500
04/10/42	6670	6270
03/20/43	8240	8040
04/12/44	5910	5350
02/28/45	10600	10300
02/15/46	9000	8850
04/17/47	7540	6260
02/16/48	11400	10700
02/16/49	11800	11300
12/13/49	12700	12300
01/16/51	11700	11200
03/24/52	13900	13500
03/05/53	9060	8700
01/21/54	3440	3220
03/22/55	8740	8420
02/04/56	8010	7850
04/06/57	12500	11900
11/19/57	18000	16000
01/22/59	7360	7100
02/11/60	4970	4450
05/10/61	11200	10700
02/28/62	12800	12000

TABLE XXXI

STREAMFLOW DATA FOR RUSSELL FORK AT ELKHORN CITY, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/31/61	26700	11900
02/28/62	18900	12700
03/12/63	41800	26100
09/30/64	11000	4500 [1]
03/26/65	14300	8810 [1]
05/01/66	7120	5370 [1]
03/07/67	30600	15000 [1]
05/28/68	14300	4380 [1]
01/21/69	6050	4800 [1]
04/28/70	18400	9330 [1]
05/07/71	13000	9120 [1]
04/12/72	15300	7160 [5]
03/16/73	21500	12800 [1]
01/11/74	23700	14900 [1]
03/30/75	23800	13600 [1]
01/01/76	8250	6250 [1]
04/04/77	54200	27400 [1]
01/26/78	27900	14100 [1]
12/09/78	14500	7630 [1]
11/26/79	8390	4720 [1]
04/20/81	6450	4020 [1]
09/15/82	8630	3770 [1]
04/25/83	5430	4780 [1]
05/07/84	36000	18630 [1]
02/01/85	8830	5015 [1]
07/11/87	13100	4199 [1]
12/26/87	3640	1730 [1]
05/06/89	12800	7450 [1]
10/19/89	14100	7940 [1]
03/23/91	10300	6000 [1]
12/02/91	9980	7510 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XXXII

STREAMFLOW DATA FOR MIDDLE FORK KENTUCKY RIVER AT TALLEGA, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/06/41	8750	7520
08/09/42	7390	6490
12/31/42	14200	13200
02/19/44	14600	10400
02/18/45	9610	7980
01/09/46	25700	18000
06/29/47	17600	13700
03/19/49	11500	10000
02/02/50	15200	14800
02/02/51	35300	24000
03/23/52	14300	12800
05/08/53	8440	7490
01/17/54	5480	4800
03/01/55	14600	14300
02/19/56	19400	17900
01/30/57	52700	40600
05/08/58	15400	15100
01/23/59	8990	8460
03/18/60	6100	5980
03/09/61	6830	6290 [1]
02/27/62	11900	10300 [1]
03/12/63	7320	5030 [1]
03/09/64	4510	3260 [1]
03/26/65	5800	5400 [1]
05/07/66	3210	3110 [1]
05/16/67	5000	3630 [1]
03/22/68	5080	4680 [1]
01/21/69	3770	3600 [1]
04/29/70	6460	5380 [1]
05/07/71	6590	5830 [1]
02/25/72	6960	5980 [1]
04/27/73	5300	4470 [1]
06/02/74	5980	5660 [1]
03/29/75	8560	7620 [1]
03/30/76	5100	4010 [1]

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
08/14/77	5080	4090 [1]
01/26/78	8040	5000 [1]
01/08/79	4660	4300 [1]
12/13/79	3900	3020 [1]
06/07/81	8620	7530 [1]
02/09/82	5170	4010 [1]
05/16/83	7410	6580 [1]
05/06/84	6390	4320 [1]
11/19/84	3770	3220 [1]
02/18/86	4540	3920 [1]
11/09/86	5150	4460 [1]
04/10/88	2950	2910 [1]
03/06/89	7540	6600 [1]
10/17/89	8140	6720 [1]
12/31/90	8050	6880 [1]
12/03/91	7270	6630 [1]
03/04/93	4970	4120 [1]
02/23/94	7380	6640 [1]
05/19/95	8190	7450 [1]
05/29/96	5280	4700 [1]
03/03/97	6750	5160 [1]
04/19/98	7700	6790 [1]
01/09/99	5950	4990 [1]
04/06/00	3550	3410 [1]
02/17/01	5580	4920 [1]
03/20/02	5970	5050 [1]
02/17/03	10400	9100 [1]
05/31/04	10200	9250 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XXXIII

STREAMFLOW DATA FOR BARREN RIVER NEAR PAGEVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/31/40	20100	12000
07/05/41	7220	6460
04/10/42	10400	9540
12/29/42	15300	12300
02/18/44	14000	9600
01/01/45	26900	20200
01/08/46	48900	30400
05/22/47	13800	12200
02/14/48	35000	26100
06/16/49	27700	22700
01/06/50	22500	20300
02/02/51	13000	10000
03/23/52	70000	46700
05/18/53	7850	7220
04/17/54	14200	11700
03/22/55	38600	30200
01/30/56	32700	19700
01/30/57	42800	29400
11/19/57	17700	12400
02/15/59	9340	8330
06/29/60	11200	9410
06/15/61	11300	9070
02/27/62	50000	40000
03/12/63	11000	9000

TABLE XXXIV

STREAMFLOW DATA FOR ROUGH RIVER AT FALLS OF ROUGH, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/20/40	8080	7820
01/25/41	1800	1780
04/10/42	9670	9450
03/20/43	9170	8800
04/24/44	4390	4250
02/27/45	9710	9140
02/14/46	10400	9200
04/17/47	7800	7500
02/15/48	8620	8130
02/15/49	13100	11800
01/13/50	13400	12200
01/15/51	11600	11000

TABLE XXXV

STREAMFLOW DATA FOR DRAKES CREEK NEAR ALVATON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/04/41	5730	3770
04/10/42	15600	10300
03/19/43	18600	12000
02/29/44	17100	12700
01/01/45	28400	23900
01/09/46	8950	8280
05/22/47	13000	9560
02/14/48	30900	26000
12/16/48	19000	14600
01/06/50	22100	19700
01/04/51	12600	9860
03/23/52	30000	23600
03/04/53	7930	7270
01/21/54	7810	5930
03/22/55	27200	21400
01/30/56	21700	15600
01/30/57	34300	22200
11/19/57	22400	18900
01/22/59	13600	11000
06/29/60	12800	7300
03/07/61	9970	7750
02/27/62	49500	36300
03/06/63	11800	8850
03/10/64	17000	13300
02/12/65	15200	11600
02/14/66	8240	5860
03/07/67	17300	15700
04/05/68	22200	16800
06/23/69	96400	38900
12/30/69	18600	16700
08/04/71	7220	6100

TABLE XXXVI

STREAMFLOW DATA FOR ELKHORN CREEK NEAR FRANKFORT, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/18/15	17500	13200
01/22/17	14800	13400
02/09/18	8730	8190
03/03/40	14000	13000
07/19/41	3450	2640
08/24/42	7780	6190
03/19/43	19200	12700
04/12/44	3820	3560
03/07/45	14900	11200
02/14/46	8840	8240
04/16/47	8840	6400
04/14/48	22400	17200
02/15/49	13400	12000
01/06/50	16400	15800
01/15/51	13500	13000
03/23/52	14400	13600
03/04/53	14600	13600
04/17/54	2960	2490
02/06/55	10200	7890
02/03/56	10000	8500
04/05/57	10000	7500
05/05/58	15000	12600
01/22/59	13500	11000
06/24/60	13000	12100
05/09/61	16300	14200
02/28/62	15600	14700
03/06/63	9170	8000
03/05/64	23200	22100
12/12/64	7020	5000
02/14/66	8740	6240
03/07/67	11200	9340
04/05/68	12000	9490
04/19/69	8190	6400
04/02/70	12300	9540
12/22/70	10300	8040
04/23/72	11400	8640
12/09/72	13000	12400
01/11/74	14800	13800
04/25/75	14600	12200
02/18/76	12700	9560
03/05/77	4670	3920
03/14/78	13200	11500
12/09/78	17900	16200
12/14/79	7930	5950
02/20/81	4420	3700
01/23/82	7470	6300
05/02/83	15800	15100
02/16/89	28700	25000
06/03/90	10600	8720
12/19/90	14900	14200
12/03/91	9790	8150
02/22/93	10800	9820
01/28/94	11200	10200
05/19/95	13300	12700
05/06/96	13100	12000
03/04/97	35900	25000
07/21/98	18500	16600
01/09/99	7030	6230
02/19/00	16200	15100
12/17/00	10100	8650
03/21/02	16000	13200
02/17/03	8030	7660
06/01/04	18600	16300

TABLE XXXVII

STREAMFLOW DATA FOR NORTH FORK KENTUCKY RIVER AT HAZARD, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)	
04/20/40	7150	6050	
07/05/41	3750	2200	
07/08/42	21900	10400	
12/30/42	17300	12900	
02/18/44	17400	9490	
02/17/45	15800	7870	
01/08/46	27400	18500	
08/05/47	26700	14700	
02/13/48	18900	15200	
03/18/49	16300	12600	
02/02/50	15800	12200	
02/01/51	28100	20800	
03/23/52	13800	10700	
05/19/53	24300	11800	
01/16/54	9440	6580	
03/06/55	20000	12900	
02/18/56	24400	19000	
01/29/57	47800	32300	
05/07/58	19700	16300	
01/22/59	18000	11500	
11/28/59	13000	8310	
02/25/61	7760	5080	
02/27/62	22100	15600	
03/12/63	43700	33900	
03/09/64	14600	7460	
03/26/65	23200	18100	
02/13/66	10400	4510	
03/07/67	35500	27500	
03/12/68	14300	9140	
01/20/69	6070	4260	
12/31/69	27100	25500	
05/07/71	28000	22800	
02/25/72	23000	15800	
03/17/73	27700	19600	
06/22/74	31000	20800	
03/13/75	23400	21500	
03/30/76	13400	9310	1
04/05/77	39000	27800	1
05/24/78	20400	9440	1
12/09/78	19200	9790	1
03/21/80	9180	6840	1
04/20/81	12000	8820	1
01/04/82	10100	7050	1
05/16/83	10700	7360	1
05/07/84	38000	27700	1
02/01/85	7160	5400	1
11/29/85	13600	7890	1
04/09/87	14100	9330	1
12/26/87	4980	2350	1
06/16/89	24100	13600	1
10/17/89	30200	18700	1
02/20/91	18000	13000	1
12/03/91	22000	15900	1

TABLE XXXVIII

STREAMFLOW DATA FOR ROUGH RIVER NEAR FALLS OF ROUGH, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/20/40	8080	7820
01/25/41	1800	1780
04/10/42	9670	9450
03/20/43	9170	8800
04/24/44	4390	4250
02/27/45	9710	9140
02/14/46	10400	9200
04/17/47	7800	7500
02/15/48	8620	8130
02/15/49	13100	11800
01/13/50	13400	12200
01/15/51	11600	11000

TABLE XXXIX

STREAMFLOW DATA FOR EAGLE CREEK AT GLENCOE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/17/15	27000	21600
05/28/17	27000	24600
02/09/18	17600	14400
06/29/28	14800	10000
05/15/29	22600	12600
02/26/30	13700	12000
04/04/31	14200	1000
03/11/39	27100	12400
03/03/40	32800	20300
06/10/41	11600	5510
04/09/42	18000	12500
03/19/43	43200	20400
04/23/44	11300	5260
03/06/45	38900	20100
03/27/46	17000	9540
04/16/47	15900	10700
02/14/48	32400	22000
12/15/48	21700	19000
01/06/50	27000	20200
01/15/51	17300	13500
03/23/52	21500	13100
03/04/53	16000	13500
01/21/54	6140	3950
02/27/55	20700	14300
02/25/56	29400	13100
07/05/57	37600	23000
05/05/58	22000	10500
01/21/59	22900	15300
06/23/60	29400	20300
05/08/61	33200	29100
02/27/62	23000	13400
03/05/63	22600	15900
03/10/64	58200	39300
09/02/65	19500	9770
01/02/66	23400	17900
05/07/67	12500	8670
05/24/68	22600	13700
01/30/69	10000	8290
04/02/70	35700	25100
02/22/71	25500	15700
04/16/72	10700	7580
04/24/73	15000	7550
11/28/73	20900	12500
02/24/75	31900	18200
02/18/76	23700	17400
08/12/77	15200	7440
02/15/89	25500	17000
05/17/90	27700	19700
06/18/92	19400	9240
02/22/93	20900	11900
01/28/94	19400	16200
05/25/95	31500	15300
05/11/96	26200	15000
03/02/97	58300	34000
04/16/98	19100	10700
01/09/99	11500	9770
01/04/00	18900	12300
06/06/01	19500	12300
04/28/02	19200	12500
01/04/04	17400	8810

TABLE XL

STREAMFLOW DATA FOR BEECH FORK AT MAUD, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/09/72	17000	15100
01/11/74	24400	22200
02/24/75	24100	20000
02/18/76	25200	22300
03/13/77	11300	9110
01/08/78	12400	10000
12/09/78	33300	31400
12/13/79	11500	7000
05/19/81	12500	8930
01/23/82	9040	8000
05/02/83	13900	9120
05/08/84	22300	20200
12/22/84	18900	14600
03/13/86	14000	11400
03/01/87	14100	11200
12/26/87	17000	14700
02/15/89	30600	29400
01/21/90	11800	8200
12/19/90	19300	17400
06/19/92	22200	19800
02/22/93	17600	14400
03/10/94	16200	15000
05/19/95	17000	13400
01/24/96	11500	9490
03/02/97	41500	39800
02/12/98	12300	10500
01/09/99	14400	12100
02/19/00	14000	12600
12/17/00	15300	13300
03/20/02	22200	17600
02/16/03	21400	18100
05/31/04	14500	12500

TABLE XLI

STREAMFLOW DATA FOR MIDDLE FORK KENTUCKY RIVER AT BUCKHORN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/29/57	82300	37400
05/07/58	14300	11900
01/22/59	9660	7330
06/25/60	6170	5240
05/02/61	6440	5750 [1]
12/18/61	6340	4470 [1]
03/19/63	6200	6030 [1]
03/21/64	3870	3770 [1]
01/15/65	4390	4160 [1]
05/06/66	3850	3660 [1]
03/14/67	3840	3800 [1]
03/27/68	3860	3510 [1]
01/21/69	2900	2890 [1]
02/20/70	3990	3870 [1]
05/19/71	4440	4030 [1]
04/20/72	5850	3830 [1]
03/26/73	3860	3840 [1]
01/18/74	4280	4170 [1]
03/28/75	5630	4850 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XLII

STREAMFLOW DATA FOR LITTLE SANDY RIVER AT GRAYSON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/04/39	19800	15900
03/31/40	8200	7600
07/20/41	5940	4490
04/10/42	7940	7520
12/30/42	15400	10600
04/12/44	8040	6970
01/02/45	9530	8220
06/03/46	10000	9330
09/06/47	4440	3870
04/13/48	14600	10400
02/16/49	6510	5970
09/22/50	24500	21200
02/02/51	9780	8100
03/23/52	19200	17900
03/04/53	8210	7540
09/20/54	2560	1410
03/06/55	13500	13000
02/18/56	12900	11600
12/15/56	11100	10300
05/08/58	9840	9430
01/22/59	5860	5610
07/04/60	9000	8540
06/16/61	10200	9580
02/28/62	17600	16700
03/12/63	9380	8410
04/20/64	7480	7280
03/27/65	7780	6940
02/14/66	9640	9370
03/07/67	11800	11500
03/13/68	7160	5230 [1]
01/30/69	1340	479 [1]
04/02/70	5860	4330 [1]
05/14/71	5650	3990 [1]
04/22/72	8830	7900 [1]
12/09/72	7920	7120 [1]
01/11/74	8340	8080 [1]
03/29/75	7330	5750 [1]
10/18/75	5950	4140 [1]
04/05/77	3850	3300 [1]
01/26/78	7780	7070 [1]
12/09/78	13900	12900 [1]
12/13/79	4620	2730 [1]
06/14/81	3640	2790 [1]
05/30/82	4570	3270 [1]
05/02/83	5740	3480 [1]
04/23/84	5880	4278 [1]
12/22/84	3950	3621 [1]
02/18/86	4150	3682 [1]
11/09/86	4730	3886 [1]
03/05/88	4270	3040 [1]
02/16/89	11100	10000 [1]
05/29/90	6160	4920 [1]
12/31/90	8300	7200 [1]
12/03/91	5060	3510 [1]
02/22/93	6910	5530 [1]
03/10/94	9240	8620 [1]
05/18/95	5590	4820 [1]
05/16/96	6110	5000 [1]
03/02/97	16300	14600 [1]
01/08/98	4760	3820 [1]
01/10/99	3550	3000 [1]
02/19/00	7310	6200 [1]
05/19/01	4780	3560 [1]
03/20/02	14200	10000 [1]
05/06/03	9850	8330 [1]
09/18/04	10100	8460 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XLIII

STREAMFLOW DATA FOR DIX RIVER NEAR BURGIN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/17/15	19400	16800
01/22/17	27500	22300
01/28/18	14500	12700
01/01/19	23600	16800
01/09/20	24900	23000
03/31/21	8000	4940
03/02/22	15800	12300

TABLE XLIV

STREAMFLOW DATA FOR LEVISA FORK BELOW FISHTRAP DAM, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/04/38	10200	7140
02/04/39	17900	8800
08/14/40	11000	4900
03/12/41	4360	2900
06/20/42	7640	6350
12/30/42	11700	9570
02/18/44	12900	9790
02/18/45	13200	7700
01/08/46	23000	14600
01/16/47	8580	5980
02/13/48	13200	10400
12/04/48	8560	6350
02/02/50	17200	13100
12/04/50	8960	7340
04/28/52	11300	7620
05/19/53	17100	12200
01/16/54	4240	3200
02/27/55	19500	10700
04/16/56	16100	13300
01/29/57	33000	18300
05/07/58	16700	12900
04/13/59	9140	5280
11/28/59	7270	4600
02/26/61	11500	6180
02/28/62	11500	7540
03/12/63	30400	21600
03/09/64	7950	5540
03/26/65	16300	11700
05/01/66	10000	8000
02/17/70	4890	4600 [1]
01/06/71	6830	3920 [1]
02/28/72	6600	6370 [1]
12/14/72	5410	4840 [1]
01/18/74	8540	7730 [1]
03/18/75	7420	7040 [1]
01/04/76	3330	2740 [1]
04/09/77	8390	8160 [1]
01/31/78	5560	5310 [1]
01/30/79	5630	3920 [1]
04/28/80	4710	3970 [1]
06/08/81	4750	4280 [1]
05/24/82	4750	3280 [1]
04/25/83	3770	2910 [1]
05/11/84	6180	6020 [1]
02/02/85	5660	4102 [1]
02/20/86	4170	3926 [1]
04/12/87	5620	4980 [1]
12/27/87	1890	1800 [1]
05/06/89	7330	5040 [1]
10/21/89	7880	7550 [1]
03/23/91	4350	2440 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XLV

STREAMFLOW DATA FOR CUMBERLAND RIVER NEAR HARLAN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/20/40	10500	8060
07/05/41	8140	4800
03/17/42	11000	7840
04/19/43	15600	10000
02/18/44	27700	12700
02/17/45	10800	6120
01/08/46	37900	23300
06/28/47	20400	10100
02/14/48	25500	17600
01/06/49	14200	6790
01/31/50	18100	14400
02/01/51	23800	16700
12/15/51	19700	13300
02/21/53	16300	10900
01/16/54	9810	8370
03/22/55	19200	13500
04/16/56	22000	13600
01/29/57	31000	22700
12/08/57	17100	11000
01/22/59	25900	15300
11/28/59	13900	9920
02/25/61	15700	9290
02/28/62	17700	12600
03/12/63	43100	30500
03/05/64	8530	6780
03/26/65	18700	13000
02/13/66	18000	9510
03/07/67	33300	21500
12/22/67	10500	6770
02/02/69	5050	4130
12/31/69	43200	21900
05/07/71	18900	12300
04/12/72	16900	8790
03/16/73	26000	15900
11/28/73	28200	19200
03/13/75	19500	16000
03/30/76	17600	11000
04/04/77	64500	33900
11/07/77	20600	9660
12/09/78	15100	10100 [1]
03/21/80	13200	9350 [1]
04/20/81	5640	3640 [1]
01/04/82	11200	7550 [1]
05/16/83	8350	5940 [1]
05/07/84	32200	19600 [1]
11/19/84	5920	4140 [1]
02/18/86	10300	7740 [1]
11/09/86	8340	4830 [1]
01/20/88	8520	5910 [1]
05/06/89	9560	5950 [1]
02/10/90	10300	6900 [1]
03/23/91	22500	12200 [1]
12/02/91	29000	14700 [1]
03/23/93	18900	8640 [1]
02/11/94	27900	18700 [1]
05/14/95	13100	8340 [1]
03/07/96	11100	8490 [1]
12/01/96	22100	14500 [1]
04/19/98	21400	16300 [1]
01/09/99	6010	3740 [1]
04/04/00	12200	8700 [1]
02/17/01	11000	7170 [1]
03/18/02	29600	21300 [1]
02/16/03	23200	16000 [1]
03/06/04	15500	9380 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE XLVI

STREAMFLOW DATA FOR RED RIVER AT CLAY CITY, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/29/31	5760	3760
01/30/32	15100	14500
07/15/38	21100	16400
07/06/39	19800	16000
03/31/40	9360	6880
01/25/41	2540	2370
08/25/42	6840	6110
12/31/42	13300	11400
04/13/44	7440	5740
01/02/45	11700	10100
06/03/46	5060	4440
08/02/47	4210	3730
02/15/48	13400	9750
02/16/49	8400	8000
02/01/50	15100	13900
01/16/51	5800	5330
03/23/52	19200	16900
01/09/53	7180	5520
05/08/54	2180	2060
03/01/55	12800	11600
02/19/56	10400	9170
12/15/56	12000	10300
04/29/58	11500	9340
01/22/59	3320	3050
02/12/60	4590	3530
05/09/61	5790	4930
02/28/62	22600	20000
03/13/63	8480	7420
03/10/64	7100	6530
03/27/65	8100	7210
02/14/66	4800	4100
03/07/67	12600	11400
04/05/68	11300	8980
04/20/69	2250	1990
04/29/70	14400	12600
02/06/71	7230	6460
04/16/72	10900	9550
12/10/72	8500	7620
01/11/74	11700	9790
03/30/75	11400	10200
03/22/76	5980	5300
04/06/77	5200	4480
01/27/78	13500	12200
12/09/78	28800	26100
12/14/79	6030	5020
07/08/81	7500	5670
03/17/82	5500	4930
05/17/83	7330	6890
05/08/84	13400	12400
12/22/84	6860	6020
11/29/85	5610	4750
11/10/86	8760	8000
12/27/87	7020	6240
02/16/89	17300	15400
01/01/90	8040	6740
12/24/90	12100	10500
12/04/91	10700	8630
02/22/93	8930	7470
03/10/94	11800	11300
05/20/95	10200	9010
05/06/96	5660	4590
03/02/97	14900	12900
01/08/98	7230	5700
01/10/99	9400	8150
02/19/00	4500	3940
07/30/01	10100	9360
03/21/02	13600	11900
2/17/03	19600	18200
6/1/04	22000	16200

TABLE XLVII

STREAMFLOW DATA FOR NOLIN RIVER AT WHITE MILLS, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/11/60	3860	2780
05/09/61	7770	6260
02/28/62	8060	7960
03/06/63	4820	4590
03/05/64	16700	12800
03/26/65	3890	3130
02/14/66	4530	3450
08/02/67	7660	6970
04/05/68	7560	6940
01/31/69	4000	3400
04/29/70	19400	16900
12/23/70	7740	7200
04/16/72	11700	10200
12/09/72	9660	8350
01/11/74	10500	8580
02/24/75	12200	8980
02/19/76	13900	11600
03/13/77	4390	2760
12/06/77	8570	8050
12/09/78	18500	15200
12/14/79	4750	4160
05/19/81	4710	3940
01/23/82	4410	3750
04/30/83	9310	8440
05/08/84	16400	15300
12/22/84	7930	7360
02/07/86	2940	2690
03/01/87	6780	6200
12/26/87	5680	3830
02/16/89	19200	17500
02/16/90	6560	4940
12/19/90	10600	9980
12/03/91	5670	4520
02/22/93	6600	6220
03/11/94	8710	7280
05/19/95	9050	8520
01/24/96	6050	5310
03/02/97	24500	20000
01/08/99	3090	2550
02/19/00	5420	4850
02/17/01	3290	3020
03/21/02	8600	7810
02/16/03	8090	7580
05/28/04	8480	7760

TABLE XLVIII

STREAMFLOW DATA FOR CLEAR FORK AT SAXTON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
06/24/69	3760	2740
12/31/69	19900	18400
05/13/71	10900	8580
04/13/72	10800	8360
05/28/73	22200	19400
11/28/73	17700	16100
03/14/75	19100	18300
03/30/76	10600	9590
04/05/77	22800	14000
01/27/78	10700	7610
02/26/79	9250	8340
03/21/80	12300	10300
08/08/81	6160	4140
01/04/82	11300	10000
02/02/83	6180	4490
05/08/84	19400	15000
02/01/85	5440	3700
02/18/86	9780	8910
11/09/86	7170	4920
01/20/88	8820	7410
06/16/89	17100	15500
10/01/89	7510	6400
06/10/96	9370	6640
12/01/96	15300	14000
04/20/98	14500	11900
01/24/99	8650	6450
04/04/00	10500	9470
02/17/01	6660	4790
03/19/02	13100	9800
02/16/03	14000	11600
09/18/04	12400	10800

TABLE XLIX

STREAMFLOW DATA FOR DIX RIVER NEAR DANVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/30/42	17400	13300
04/12/44	10400	6980
03/06/45	20900	11800
01/07/46	7890	4550
06/28/47	9910	6730
04/13/48	14600	12800
02/15/49	14200	9430
02/01/50	15900	12100
01/04/51	9220	6630
03/23/52	16900	12300
05/19/53	7420	5790
04/17/54	5610	3740
03/22/55	14600	10300
02/17/56	15500	9860
04/04/57	15900	10600
11/19/57	14700	11500
01/21/59	7240	4400
06/23/60	9580	6260
05/07/61	11700	7170
02/27/62	19200	15100
03/05/63	10100	7370
03/10/64	15400	11100
03/26/65	11800	9100
02/13/66	8000	5790
03/06/67	16100	12000
04/05/68	19700	11600
04/19/69	3720	3020
04/28/70	33400	17900
12/22/70	10400	9090
04/12/72	19900	12700
12/09/72	13700	10700
01/11/74	22500	16300
03/13/75	19000	12200
10/18/75	15000	8560
03/13/77	8960	5530
01/26/78	13100	9580
12/09/78	44400	23000
12/13/79	13300	9030
06/07/81	13000	8190
09/14/82	11900	6800
05/16/83	12600	10900
05/07/84	29500	21900
12/21/84	8740	5330
03/13/86	7950	5120
11/26/86	14200	9760
01/20/88	11400	7370
02/15/89	18400	14700
02/10/90	13300	9320
12/31/90	21000	14100
12/03/91	19900	13800
02/22/93	7800	3720
03/10/94	28100	17800
05/19/95	25400	16300
07/20/96	52400	35100
03/02/97	19100	16100
01/08/98	15300	10900
01/09/99	18800	14900
02/19/00	11000	7640
02/17/01	7250	5160
03/20/02	17700	12800
02/16/03	18200	13100
09/17/04	13900	7130

TABLE L

STREAMFLOW DATA FOR RUSSELL CREEK NEAR GRESHAM, KENTUCKY

Peak Date -	Annual Peak Streamflow (cfs)	Mean Daily Streamflow (cfs)
03/30/65	10400	7900
02/13/66	5170	4320
08/01/67	13500	11900
04/05/68	12500	9940
04/19/69	3490	3140
12/31/69	10700	8200
05/13/71	7280	5080
02/25/72	9860	9400
12/09/72	7930	7580
01/11/74	14000	12900
03/13/75	52100	28400

TABLE LI

STREAMFLOW DATA FOR BRASHEARS CREEK AT TAYLORSVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/23/82	12000	9900
05/02/83	20000	11800
05/08/84	12000	9280
06/10/85	5790	2210
03/13/86	9390	7200
03/01/87	7480	4710
02/14/89	13500	10100
02/16/90	26200	20700
12/18/90	16300	11600
06/18/92	9520	4940
06/05/93	10500	6860
02/23/94	4530	3320
01/24/96	11200	8240
03/02/97	44800	39600
04/17/98	8340	5390
01/23/99	8340	6200
02/19/00	29200	20400
12/17/00	7320	4170
01/24/02	13200	7960
12/20/02	7810	5470
05/31/04	15100	12000

TABLE LII

STREAMFLOW DATA FOR LITTLE SANDY RIVER AT LEON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/12/63	6180	5920
03/05/64	4840	4460
03/26/65	4960	4260
05/01/66	6670	6020
03/07/67	7730	7360
04/05/68	3390	3180 [1]
01/29/69	698	552 [1]
04/02/70	2670	1960 [1]
05/15/71	2760	2110 [1]
04/22/72	5420	4000 [1]
04/27/73	3240	2270 [1]
01/11/74	4670	3590 [1]
03/12/75	4280	2490 [1]
10/18/75	3770	2100 [1]
04/08/77	1470	1420 [1]
01/26/78	3370	2810 [1]
12/09/78	7650	6580 [1]
12/13/79	2540	1530 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE LIII

STREAMFLOW DATA FOR TRADEWATER RIVER AT OLNEY, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/11/42	5180	4960
03/20/43	2960	2790
05/08/44	1950	1950
02/08/46	4100	4100
01/05/47	3140	3140
03/30/48	2440	2380
02/16/49	7120	7030
01/06/50	4260	4220
01/16/51	6260	6190
03/24/52	5520	5410
05/20/53	4020	3970
05/11/54	1670	1610
03/23/55	3510	3460
02/03/56	4060	3910
05/25/57	6020	5890
11/19/57	7960	7860
01/22/59	3200	3050
07/01/60	4400	4180
05/10/61	3840	3770
02/28/62	6530	6300
03/09/63	2480	2430
03/10/64	13600	13200
03/31/65	5050	4990
01/06/66	3680	3560
03/10/67	3090	3050
03/26/68	2490	2470
06/24/69	4980	4960
01/02/70	2450	2390
02/24/71	2980	2890
02/27/72	3240	3210
12/11/72	4320	4300
01/13/74	3210	3100
03/30/75	4950	4860
02/19/76	6550	6500
04/04/77	1580	1570
05/16/78	2750	2190
12/09/78	6480	6360
11/27/79	4740	4720
06/08/81	2660	2540
01/26/82	2580	2560
05/03/83	5580	5210
03/02/87	1930	1910
12/28/87	4190	4050
02/16/89	14600	14000
02/16/90	8040	7560
12/22/90	6420	6190
03/20/92	1940	1920
04/11/93	2040	1990
01/29/94	3160	3110
05/19/95	3810	3560
04/21/96	1970	1940
03/03/97	8990	8680
06/13/98	3240	3210
01/04/00	2900	2670
02/18/01	2350	2200
12/01/01	5660	5620
02/23/03	2600	2510
06/01/04	1970	1940

TABLE LIV

STREAMFLOW DATA FOR LITTLE RIVER NEAR CADIZ, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/19/40	3880	2920
07/11/41	2870	2440
04/10/42	7300	6900
03/19/43	5700	4470
02/29/44	4250	3290
03/17/45	5140	3000
01/09/46	6530	4780
01/03/47	3850	3650
03/27/48	5020	4780
02/15/49	11400	10200
09/03/50	6180	4520
01/15/51	14200	10100
03/23/52	8810	7430
05/17/53	8330	5910
04/17/54	3020	1990
03/21/55	6580	4960
01/30/56	7980	6360
07/30/57	13000	3320
11/19/57	13600	11400
01/22/59	5970	4530
06/29/60	4460	2630
03/06/61	6020	4780
02/27/62	9940	9180
07/18/63	3510	698
03/10/64	12600	7230
03/30/65	6050	5270
01/02/66	4600	3300
05/15/67	6780	4640
04/04/68	8280	6020
04/19/69	4840	4560
12/30/69	5140	4240
02/22/71	7120	6230
01/28/72	4940	4420
12/09/72	7130	6640
01/11/74	9100	8200
03/12/75	19400	10000
03/30/76	6600	5700
03/13/77	3530	1690
01/10/78	4300	3120
12/09/78	19600	11400
11/26/79	11600	7910
06/07/81	4530	3250
01/23/82	7270	5330
05/19/83	10600	7900
05/07/84	20200	12100
12/21/84	4490	3160
11/02/85	3780	3060
03/01/87	3580	2680
01/20/88	6530	5330
02/15/89	9300	7200
02/16/90	9800	7110
12/18/90	8510	7770
12/03/91	4420	3560
05/04/93	2530	1780
03/28/94	5750	4910
05/19/95	6820	5630
07/31/96	3880	1660
03/02/97	37600	24300
06/10/98	12900	9140
01/23/99	7630	6930
05/25/00	6560	5640
02/17/01	2820	2380
11/30/01	12200	8960
12/20/02	7030	5210
04/24/04	4000	2670

TABLE LV

STREAMFLOW DATA FOR TYGARTS CREEK NEAR GREENUP, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/20/41	2560	1440
04/10/42	6340	5610
03/20/43	8780	7260
04/12/44	3340	3100
02/27/45	6870	5850
03/27/46	6270	5370
01/21/47	2730	2500
04/13/48	16100	11400
12/16/48	5650	5200
09/22/50	14200	11000
01/15/51	7020	6280
03/23/52	12400	9740
03/04/53	7080	5980
09/21/54	1540	1100
03/06/55	6870	5540
02/18/56	7470	6010
12/15/56	6640	5700
05/08/58	7380	6000
01/21/59	4920	4360
07/04/60	7900	6360
05/08/61	8100	7240
02/28/62	19700	11800
03/12/63	6900	5040
03/05/64	7650	6750
03/26/65	5160	4300
02/14/66	6440	5480
03/07/67	14700	10900
03/13/68	7890	6820
01/29/69	5800	4210
04/02/70	10200	6420
02/06/71	6070	4350
04/22/72	19100	10400
12/09/72	10600	7720
01/11/74	15600	11000
04/25/75	9100	6660
10/18/75	9130	6930
03/05/77	3590	2630
01/27/78	10600	8000
12/09/78	30300	20900
12/14/79	5520	4590
04/18/81	3850	3090
06/10/82	3750	2780
05/02/83	8870	7280
04/23/84	9040	7440
12/22/84	5010	4640
07/02/86	3940	3300
07/07/87	4940	3390
02/03/88	4530	3890
02/16/89	17400	14200
05/29/90	6080	4710
12/31/90	10600	9020
12/03/91	5020	3260
02/22/93	6750	6130
03/10/94	6660	5750
08/06/95	6630	5440
05/16/96	8980	7610
03/02/97	34400	25800
02/12/98	5200	4470
02/19/00	18400	12100
05/19/01	6920	5650
03/20/02	15200	9670
05/07/03	8500	5990
09/18/04	12200	10700

TABLE LVI

STREAMFLOW DATA FOR STONER CREEK AT PARIS, KENTUCKY

Peak Date -	Annual Peak Streamflow (cfs)	Mean Daily Streamflow (cfs)
01/21/54	1240	1000
03/22/55	6990	5390
03/08/56	10000	9060
04/04/57	9640	5730
08/03/58	7230	4940
01/22/59	7940	5310
01/15/60	5750	4410
05/08/61	8760	7241
02/28/62	12200	10400
03/05/63	6580	5360
03/05/64	17000	14200
03/26/65	5030	4380
02/13/66	6000	4090
03/07/67	9310	7740
04/05/68	6800	4500
01/29/69	3580	3000
04/02/70	8830	7040
12/22/70	8980	7250
04/22/72	15200	12200
12/09/72	10100	7830
01/11/74	10900	9860
03/29/75	12000	9510
10/18/75	11000	9080
03/13/77	4140	3560
03/14/78	9110	7260
12/09/78	19400	17200
12/13/79	7040	5610
07/06/81	5150	3960
01/23/82	5640	4770
05/02/83	11900	7510
04/22/84	9630	6620
12/22/84	7290	6130
11/27/85	4500	2890
03/01/87	5640	4530
02/03/88	6160	4260
02/16/89	15000	12900
05/29/90	6530	4320
12/19/90	12600	8290

TABLE LVII

STREAMFLOW DATA FOR ROLLING FORK NEAR LEBANON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
06/19/39	26000	7110
03/30/40	8530	4130
04/05/41	6140	3720
04/09/42	9680	4200
03/19/43	16200	11800
04/11/44	12200	5080
01/01/45	26500	14000
02/13/46	9680	6130
07/07/47	15800	7990
04/13/48	22000	16000
02/14/49	24700	11900
01/05/50	14800	9570
01/04/51	14800	8520
03/22/52	19000	10100
03/03/53	8450	6330
04/17/54	6390	2950
03/16/55	12400	7120
02/18/56	15100	9190
04/04/57	14200	8180
11/18/57	20200	8680
01/22/59	9020	4020
01/15/60	7100	3570
05/07/61	11500	7240
02/27/62	17000	12700
03/05/63	10700	7470
03/10/64	16800	10200
03/26/65	10600	6380
02/13/66	6920	4600
03/06/67	16100	10600
04/04/68	17600	7580
04/19/69	4630	2600
04/28/70	54800	21000
05/13/71	9120	5760
04/12/72	23800	13300
12/09/72	12300	6430
01/10/74	26700	14500
03/12/75	24300	13000
10/17/75	12600	6590
03/13/77	13400	5710
12/05/77	16900	9170
12/08/78	37600	26700
12/13/79	14600	8340
04/20/81	14500	8610
09/01/82	19600	9120
05/13/83	22600	11700
05/07/84	33000	22200
11/19/84	11400	5480
03/13/86	9520	6090
12/09/86	16200	9250
01/20/88	15500	7630
02/14/89	26500	22300
02/10/90	14500	6750
12/31/90	26700	20000
06/19/92	24200	6390

TABLE LVIII

STREAMFLOW DATA FOR NORTH FORK LICKING RIVER NEAR MT OLIVET, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/03/91	5990	5220
02/22/93	4470	4090
01/28/94	6500	5910
05/19/95	5570	5010
05/16/96	6170	5800
03/02/97	13500	12400
06/12/98	5910	5530
01/10/99	3870	3520
12/18/00	4970	4400
01/25/02	7160	6430
02/23/03	5100	4950
03/07/04	4360	3830

TABLE LIX

STREAMFLOW DATA FOR ROUGH RIVER NEAR MADRID, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
08/05/38	5900	4080
03/05/39	10800	8630
03/03/40	10900	8390
01/24/41	1650	1050
04/09/42	7770	5210
03/19/43	5300	4570
04/11/44	3920	2110
02/27/45	11900	7050
02/14/46	8640	5750
04/16/47	8420	6060
02/14/48	12000	8330
02/15/49	9500	8360
12/13/49	12400	8560
01/15/51	12200	9020
03/22/52	13800	10500
03/04/53	8140	6690
09/21/54	1920	1100
02/22/55	6640	6160
02/03/56	7570	6290
04/04/57	8930	6770
11/19/57	14800	12700
01/22/59	7070	6170

TABLE LX

STREAMFLOW DATA FOR BLAINE CREEK AT YATESVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/18/15	7060	6290
01/22/17	7610	5960
01/28/18	5960	4420
08/05/38	8220	6120
02/04/39	15500	10600
04/20/40	4120	3140
07/19/41	2620	1500
08/24/42	7860	7320
12/30/42	7240	5960
04/12/44	5540	4820
03/01/45	4820	3680
06/03/46	8400	6760
01/16/47	2460	2350
04/14/48	8900	7320
02/15/49	4120	3720
02/01/50	11200	9810
02/02/51	10200	6980
03/23/52	11200	9250
01/09/53	4530	4070
05/08/54	1710	1460
03/06/55	8800	7000
02/19/56	7260	6000
12/15/56	9720	8430
05/08/58	6540	5300
04/11/59	3230	3000
02/26/60	4680	3170
07/31/61	5690	4470
02/28/62	21000	16800
03/12/63	5050	4380
04/19/64	4300	3510
03/26/65	5630	4400
02/14/66	6380	5050
03/07/67	10900	7600
03/12/68	5910	4010
04/19/69	2870	2220
04/02/70	4420	4210
05/13/71	5590	3930
04/23/72	5130	3330
12/09/72	4420	3830
01/11/74	6610	5660
03/30/75	8180	5980

TABLE LXI

STREAMFLOW DATA FOR JOHNS CREEK NEAR VAN LEAR, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/20/40	2510	2020
03/12/41	848	797
08/06/42	3350	3100
04/20/43	5120	4560
04/13/44	4480	3620
03/06/45	5350	4010
01/09/46	8350	6990
01/21/47	2670	2300
02/14/48	7010	5870
03/19/49	2080	1870
02/03/50	5170	4880 [1]
02/07/51	3180	3060 [1]
03/26/52	3120	3080 [1]
05/22/53	1730	1600 [1]
03/04/54	1120	981 [1]
03/22/55	4100	3870 [1]
04/17/56	4490	3780 [1]
02/14/57	3150	3090 [1]
05/11/58	2510	2440 [1]
01/23/59	2380	2010 [1]
02/07/60	2170	1930 [1]
08/03/61	2760	2720 [1]
03/04/62	3610	3060 [1]
03/18/63	3400	3180 [1]
03/15/64	3150	2840 [1]
03/26/65	3340	2790 [1]
05/04/66	2430	1880 [1]
03/18/67	3150	2910 [1]
03/13/68	2930	2770 [1]
01/21/69	2090	1930 [1]
02/18/70	3030	2890 [1]
02/05/71	2600	2470 [1]
2/30/1972	3090	3030 [1]
03/16/73	3140	2750 [1]
01/15/74	3110	3030 [1]
03/12/75	3170	1840 [1]
11/13/75	2850	2790 [1]
04/09/77	3000	2940 [1]
01/30/78	3070	2730 [1]
01/24/79	3270	3190 [1]
12/13/79	2080	1220 [1]
06/10/81	2500	2390 [1]
03/16/82	2850	2620 [1]
05/12/84	3110	3070 [1]
02/02/85	2630	2470 [1]
11/301985	3130	3100 [1]
04/11/87	3140	2860 [1]
12/27/87	1190	1140 [1]
03/07/89	3010	2570 [1]
10/18/89	3170	2720 [1]
03/24/91	2720	2520 [1]
12/05/91	2780	2340 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE LXII

STREAMFLOW DATA FOR MIDDLE FORK KENTUCKY RIVER NEAR HYDEN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
05/06/58	10400	6400
01/21/59	17600	5900
06/25/60	17600	4540
02/25/61	5750	2850
02/28/62	11700	6280
03/12/63	37400	17000
03/05/64	5890	2460
03/26/65	14700	8210
02/13/66	7670	2980
03/07/67	23600	9550
03/12/68	9960	5840
01/20/69	2920	2250
04/28/70	23100	10500
05/07/71	14600	8460
04/12/72	17000	7710
12/10/72	16400	8550
11/28/73	18300	8620
03/13/75	14200	9870
03/30/76	10000	5210
04/04/77	22500	12500
11/07/77	18800	7500
12/09/78	9820	5770
03/21/80	7400	5100
04/20/81	6420	3730
01/04/82	7910	4910
05/04/83	4660	2520
05/07/84	32900	15600
01/30/85	7460	2940
02/18/86	7360	4920
11/09/86	8890	4600
01/20/88	5010	3140
06/16/89	34400	9560
10/17/89	19800	9020
03/23/91	11700	6100
12/02/91	19400	7660

TABLE LXIII

STREAMFLOW DATA FOR LITTLE SANDY RIVER BELOW GRAYSON DAM NEAR LEON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/14/68	4830	1650
04/30/69	300	209
04/28/70	2470	1440
07/21/71	2400	2340
04/22/72	4850	2650
05/24/73	2780	2080
01/16/74	2880	2840
03/17/75	2770	2600
10/19/75	1790	1680
04/08/77	1510	1430
05/13/78	2210	1530
12/19/78	3280	2750
03/07/80	2010	1950
05/21/81	2060	2020
03/16/82	1960	1820
05/18/83	2660	2600
04/25/84	2480	2375
12/26/84	1900	1760
12/03/85	2770	2546
11/13/86	2340	2203
12/28/87	2660	2100
02/15/89	4380	2570
01/03/90	2450	2230
12/27/90	3170	2220
12/04/91	2820	1450

TABLE LXIV

STREAMFLOW DATA FOR SALT RIVER NEAR VAN BUREN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/05/39	13200	7080
03/30/40	10900	6020
01/24/41	2770	2250
08/23/42	11500	7500
12/30/42	9690	7050
04/11/44	5330	3760
02/26/45	9690	6030
02/13/46	9130	7390
04/16/47	8720	3930
02/13/48	14700	7640
02/15/49	10000	9060
12/12/49	10100	6620
01/04/51	7940	5230
03/23/52	11600	5550
03/03/53	9690	6510
04/16/54	3240	2080
02/06/55	6250	5670
02/15/56	8370	6030
04/04/57	11400	7670
11/18/57	14400	6660
01/21/59	10200	6390
06/23/60	9930	4920
05/07/61	13600	6800
02/27/62	8430	6670
03/05/63	6310	4920
03/04/64	16700	9090
12/04/64	5250	3470
02/13/66	4660	3540
05/15/67	6730	4420
04/04/68	6500	4140
04/18/69	6210	2570
06/04/70	9820	3330
12/22/70	8790	6760
04/22/72	8340	5420
12/08/72	10700	6130
01/11/74	9540	7720
03/29/75	12200	8500
02/18/76	11200	8000
08/08/77	6970	1300
12/05/77	8470	5120
12/09/78	12300	9840
03/21/80	5650	3480
05/27/81	5750	1160
01/23/82	4610	3560

TABLE LXV

STREAMFLOW DATA FOR POND RIVER NEAR APEX, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/11/41	1630	1300
04/10/42	9240	7760
03/20/43	5720	4900
03/01/44	2700	2520
02/27/45	4140	3240
02/14/46	6600	5800
01/04/47	3780	3240
03/27/48	6160	4700
02/15/49	14800	10600
12/13/49	8250	7710
01/15/51	17500	12300
03/23/52	7790	6510
05/18/53	7930	7070
04/17/54	3040	2600
03/22/55	6830	5850
01/30/56	8730	6420
05/23/57	11100	9590
11/19/57	21800	16800
01/22/59	7330	6520
06/28/60	13200	7870
06/15/61	4660	3440
02/28/62	9920	8550
03/06/63	4020	3540
03/10/64	17400	14900
03/29/65	12400	7900
01/02/66	5130	4500
05/15/67	7280	5680
04/05/68	5170	4500
06/24/69	12700	10600
12/31/69	2990	2860
02/23/71	6240	5520
02/25/72	3970	3890
12/10/72	8320	7030
01/11/74	7590	6890
03/29/75	8150	6820
03/30/76	6360	5610
03/05/77	2560	2350
05/13/78	7210	5720
12/09/78	22800	19700
11/25/79	12600	7760
06/07/81	3710	3010
01/23/82	4320	3410
04/30/83	10100	8610
05/07/84	35700	26400
12/21/84	11200	8490
11/02/85	5460	3970
12/10/86	5900	3930
01/20/88	13900	13300
02/03/90	4790	4030
12/19/90	8270	7860
03/31/92	1400	1280
05/04/93	5030	4400
03/28/94	4460	4190
05/19/95	5750	5310
01/24/96	2980	2770
03/02/97	22800	19700
06/10/98	4770	4510
01/23/99	7860	5000
02/19/00	2880	2600
02/16/01	2430	2100
11/30/01	7750	6200
12/20/02	4600	3600
05/15/04	2420	1850

TABLE LXVI

STREAMFLOW DATA FOR RUSSELL CREEK NEAR COLUMBIA, KENTUCKY

Peak Date -	Annual Peak Streamflow (cfs)	Mean Daily Streamflow (cfs)
03/30/40	8280	4940
07/19/41	5190	3680
02/17/42	4500	2880
12/30/42	7980	6810
02/29/44	5820	4780
01/01/45	9490	7520
01/07/46	3580	2430
01/02/47	6060	4500
02/14/48	9010	7080
06/16/49	20000	8210
01/31/50	9010	7850
12/07/50	8310	4040
03/22/52	27600	10700
05/19/53	4060	3450
04/16/54	5100	2960
03/22/55	15500	7600
01/30/56	8030	7110
01/29/57	7790	6640
11/18/57	8090	4980
02/15/59	4340	3400
06/23/60	3300	1810
06/09/61	5990	4360
02/27/62	29700	13200
03/12/63	7700	5880
03/05/64	8260	5820
03/29/65	9030	6220
02/13/66	4270	3360
08/01/67	14700	8910
04/04/68	8590	7180
06/23/69	2430	1600
12/30/69	8350	7420
05/13/71	6070	4410
02/25/72	8420	5530
12/09/72	6230	5460
01/11/74	15300	8410
03/12/75	26600	14300
10/18/75	9790	4540
03/13/77	7950	4970
12/05/77	9830	7600
12/09/78	28800	25000
12/13/79	8630	6650
06/07/81	13000	6370
09/01/82	40600	11800
05/16/83	8840	7000
05/07/84	29600	19800
11/19/84	8750	6050
11/27/85	6190	3740
11/09/86	11300	7600
01/20/88	8630	4830
02/03/90	12000	6450
12/31/90	13400	7200
12/03/91	8690	5830
02/21/93	3580	1800
03/10/94	16400	8470
05/14/95	18100	9720
03/07/96	4490	3560
03/01/97	12100	5230
06/01/98	8140	5310
01/09/99	9430	6930
03/20/00	8760	6400
06/04/01	4050	2330
05/18/02	12100	7780
02/16/03	12600	9520
02/06/04	10700	7830

TABLE LXVII

STREAMFLOW DATA FOR TROUBLESOME CREEK AT NOBLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/01/51	15600	10400
03/22/52	9410	4920
01/08/53	3270	1870
01/16/54	1750	1240
02/27/55	9300	6510
03/14/56	10400	6370
01/29/57	13500	9230
05/07/58	6060	4780
01/22/59	6920	3740
07/01/60	5550	2380
04/01/61	3820	2580
02/27/62	18300	12100
03/12/63	22800	12200
03/09/64	5600	2740
03/26/65	7960	5780
04/13/66	6190	3310
03/07/67	15100	7740
03/12/68	9440	5940
01/20/69	3410	2000
12/31/69	11200	8000
05/07/71	12100	8170
04/12/72	15200	9050
12/09/72	8560	5840
06/22/74	21400	15400
05/23/75	16300	7640
03/21/76	8870	5130
04/05/77	16700	8790
01/26/78	9440	6170
12/09/78	16200	12100
12/13/79	3030	1580
06/07/81	20400	8190

TABLE LXVIII

STREAMFLOW DATA FOR SALT RIVER AT GLENSBORO, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/16/90	5810	2910
12/18/90	11600	9220
12/03/91	11200	6460
02/21/93	11600	5830
03/10/94	8050	6490
05/18/95	10700	7920
03/02/97	22000	16400
07/20/98	20100	7070
06/28/99	12300	2700
02/19/00	10400	4690
12/16/00	8970	3900
03/20/02	9480	7180
05/09/03	8580	3100
05/31/04	15200	7310

TABLE LXIX

STREAMFLOW DATA FOR GOOSE CREEK AT MANCHESTER, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/26/65	7780	6620
04/13/66	5260	3080
03/07/67	11400	8510
03/12/68	7180	4620
01/20/69	2640	1900
04/28/70	14400	10100
05/07/71	9960	7540
04/12/72	12000	7300
05/28/73	10800	7960
01/11/74	9330	8710
03/13/75	14800	12800
11/13/75	5170	3500
04/05/77	15000	7000
01/26/78	8300	7000
12/09/78	9950	8000
03/21/80	5110	4300
06/06/81	8340	8000
01/04/82	6730	5770
05/04/83	7200	3880
05/07/84	19200	13700
11/19/84	6060	4890
02/18/86	5670	5010
11/09/86	6050	4990
01/20/88	4490	3560
10/17/89	12200	6650
05/20/91	10000	4620
12/03/91	8980	7450
03/24/93	5850	3620
03/28/94	8690	8000
05/14/95	6930	4160
06/09/96	5670	2610
03/03/97	8340	5430
04/17/98	17300	12100
01/09/99	7280	5560
04/04/00	3870	2940
02/17/01	5830	4250
03/18/02	9430	7450
02/16/03	12300	9680
02/06/04	9380	8110

TABLE LXX

STREAMFLOW DATA FOR RED BIRD RIVER NEAR BIG CREEK, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/15/73	13500	6250
11/28/73	13100	6770
03/13/75	15300	10500
03/29/76	10100	4100
04/04/77	19100	11200
01/26/78	13600	7130
12/09/78	12800	8010
03/21/80	7040	4750
06/06/81	8920	2620
01/04/82	8660	5270
02/11/83	6800	2440
05/07/84	24400	16200
11/19/84	7010	3960
11/28/85	9490	4050
11/09/86	8680	6900
01/20/88	5990	3330
06/16/89	25500	11200
10/17/89	28500	13800
12/23/90	12500	8280
12/02/91	16700	9920
03/23/93	10900	4440
02/11/94	12600	7370
05/14/95	10100	5750
03/06/96	5430	3080
12/01/96	12800	6640
04/17/98	20400	9850
01/09/99	10800	5640
04/04/00	7440	4580

TABLE LXXI

STREAMFLOW DATA FOR HINKSTON CREEK NEAR CARLISLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/03/91	4080	2830
03/10/94	4290	4110
05/19/95	4630	4420
05/16/96	4450	4090
03/02/97	7800	7520
01/08/98	3440	3230
01/09/99	3350	3090
08/12/01	2900	2450
03/20/02	5310	4740
02/17/03	4340	4260
06/01/04	4820	4420

TABLE LXXII

STREAMFLOW DATA FOR NORTH ELKHORN CREEK AT GEORGETOWN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/22/93	6150	4250
03/10/94	4680	4400
05/18/95	6880	6030
05/06/96	5190	4790
03/03/97	19300	11000
07/20/98	9270	5290
01/09/99	2760	2370
02/19/00	7180	4740
03/20/02	6420	5820
02/16/03	4530	3610
06/01/04	7990	4830

TABLE LXXIII

STREAMFLOW DATA FOR LICKING RIVER NEAR SALYERSVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/03/39	14300	7300
04/20/40	2700	2340
07/05/41	1090	841
06/23/42	3140	2670
03/20/43	5300	4440
04/12/44	3830	3350
03/06/45	4190	3770
01/08/46	5600	4570
08/05/47	2950	1320
02/14/48	7340	5900
02/14/49	2870	1350
01/31/50	4640	3380
02/01/51	8720	6470
03/23/52	8550	6470
01/08/53	2160	1960
05/08/54	711	508
02/28/55	6280	4730
02/18/56	5220	3580
01/30/57	5880	4360
05/08/58	3050	2590
01/22/59	2020	1840
03/17/60	1530	1460
01/16/61	2300	2110
02/27/62	11300	8810
03/12/63	6230	5370
03/09/64	2880	2460
03/26/65	4810	3990
02/14/66	3700	2650
03/07/67	6050	5560
03/12/68	3770	2240
04/19/69	1830	1650
04/29/70	6280	4720
05/07/71	4910	3940
04/15/72	5980	4380
12/10/72	4360	3910
11/28/73	6890	5830
03/13/75	5180	4790
03/21/76	4020	2530
04/05/77	4860	4180
01/26/78	4310	3740
12/09/78	11700	9010
12/13/79	2550	1510
07/06/81	5350	2440
02/10/82	3060	2320
05/17/83	3000	2630
05/07/84	8470	6470
02/23/85	1650	1540
02/18/86	2600	2360
11/09/86	3150	2550
12/26/87	1370	1010
06/17/89	3900	2700
11/17/89	3760	3000
12/31/90	3240	2580
12/03/91	5340	4310
05/19/95	3160	2720
06/09/96	4100	2580
03/03/97	3340	2510

TABLE LXXIV

STREAMFLOW DATA FOR LAUREL RIVER AT MUNICIPAL DAM NEAR CORBIN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/11/74	7880	6000
03/13/75	12400	11400
11/12/75	4800	3220
04/05/77	7740	6850
10/02/77	7160	6600
12/09/78	7980	7230
03/21/80	2540	2290
05/20/81	5420	4410
01/04/82	4690	3990
05/16/83	3450	3240
05/07/84	18300	16000
11/19/84	2590	2310
02/18/86	3620	3390
11/09/86	4250	3680
01/20/88	2570	2290
03/06/89	7290	6690
10/17/89	8740	5690
12/23/90	5400	5220
12/03/91	6320	5440
02/22/93	2720	2240
03/28/94	5970	5500
05/14/95	3380	2670
03/03/97	5600	4380
02/14/00	1480	1210

TABLE LXXXV

STREAMFLOW DATA FOR FLOYDS FORK AT FISHERVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/26/45	12300	5670
02/06/46	7560	5260
01/15/47	6940	4300
04/12/48	14800	7390
02/15/49	6540	4190
05/10/50	13700	7130
01/14/51	10100	7030
03/22/52	7650	5300
03/03/53	6830	4090
09/20/54	9590	3400
03/21/55	5810	3820
02/02/56	8470	5380
04/04/57	9400	6440
11/18/57	7950	4230
01/21/59	7920	4850
06/23/60	15200	7390
05/08/61	19800	11700
01/22/62	7640	4410
03/17/63	11000	3900
03/09/64	24800	15400
12/26/64	9080	4230
01/02/66	9840	5720
07/02/67	7720	1780
04/04/68	9250	5510
01/30/69	6010	4180
04/02/70	28500	14800
02/22/71	9140	6520
04/12/72	5280	3080
07/22/73	10600	4760
05/31/74	7320	3600
02/23/75	15100	6870
02/18/76	8080	5240
05/05/77	7440	1660
10/01/77	12800	6270
09/14/79	24900	15000
12/24/79	6290	3930
06/10/81	9030	2800
01/23/82	9720	5200
05/01/83	16900	8890
04/22/84	6620	4530
12/21/84	8880	3860
07/15/86	6770	2150
02/28/87	6040	2600
04/04/89	15600	10300
02/15/90	18900	5030
12/30/90	11500	5130
03/19/92	7490	4180
06/05/93	6820	2800
01/28/94	7020	3900
05/18/95	7080	5000
01/24/96	6830	3720
03/02/97	42100	20000
04/16/98	4870	3000
01/23/99	5180	3450
02/18/00	18000	7310
12/16/00	6510	3810
01/24/02	10500	5960
12/19/02	8070	3050
05/28/04	7750	4990

TABLE LXXXVI

STREAMFLOW DATA FOR CLARKS RIVER AT ALMO, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/26/82	16000	8120
05/08/84	14500	8210
02/12/85	5580	3120
02/03/86	7170	5960
12/09/86	6040	3800
12/26/87	7400	6690
02/14/89	15800	11200
02/16/90	13700	6270
12/18/90	16600	9600
12/03/91	6190	3980
04/10/93	6710	3810
03/27/94	6710	5620
08/06/95	6260	3180
06/02/96	4490	2700
03/02/97	23300	14000
06/05/98	11000	7650
01/23/99	12600	7520
05/25/00	10000	7060
02/15/01	5350	3520
12/20/02	8770	4590
02/06/04	5300	1800

TABLE LXXXVII

STREAMFLOW DATA FOR CANEY CREEK NEAR HORSE BRANCH, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/04/57	9020	6120
11/19/57	10000	6700
01/22/59	5870	4300
06/30/60	3800	2710
05/07/61	6510	3900
02/27/62	5250	4830
03/06/63	4950	3450
03/05/64	9100	6680
03/30/65	3150	2480
02/11/66	3900	2860
03/07/67	5070	4050
04/05/68	3390	2730
01/30/69	4410	3930
04/02/70	4980	2950
01/14/71	6600	4600
02/25/72	6740	5040
12/09/72	7640	5960
01/11/74	6020	3500
02/24/75	5120	4040
02/18/76	4600	3890
03/05/77	3180	2810
12/02/77	2560	2350
09/21/79	9150	5230
11/25/79	3630	2060
05/19/81	5380	2540
09/13/82	5310	2190
04/30/83	11300	8500
05/07/84	13600	10500
12/21/84	6180	4420
05/15/86	4680	2530
11/26/86	5230	3060
01/20/88	7320	4000
02/14/89	9000	8000
02/16/90	7720	5950
12/18/90	7070	6490
03/30/92	3120	1950

TABLE LXXXVIII

STREAMFLOW DATA FOR NORTH FORK LICKING RIVER NEAR LEWISBURG, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/30/47	4020	2100
04/13/48	11300	7640
12/15/48	4260	3360
09/20/50	10400	4990
01/04/51	6390	3390
03/22/52	5910	3650
03/04/53	5750	3430
03/13/54	1780	881
02/27/55	5140	3630
02/02/56	5400	3440
04/04/57	6310	3470
11/18/57	5430	1700
01/21/59	5010	3620
07/03/60	8220	2910
05/07/61	6460	3000
02/28/62	6960	3970
03/05/63	4850	3310
03/04/64	9850	4260
09/01/65	4010	3300
04/30/66	4970	2790
03/15/67	6640	4290
05/24/68	5960	3080
01/29/69	3180	2210
04/02/70	6290	4330
09/02/71	5430	1870
04/22/72	7320	4870
12/08/72	6330	2800
08/09/74	6010	2460
09/24/75	6370	3660
10/17/75	7250	2630
08/14/77	4830	2660
12/05/77	6400	3510
09/22/79	9520	4989
12/13/79	4080	2860
02/02/81	2890	1880
06/10/82	5360	2650
05/03/83	5250	4500
04/22/84	3490	2340
12/21/84	4680	2300
11/12/85	2590	1510
11/26/86	6470	4140
02/02/88	6600	3630
02/15/89	7580	5300
01/20/90	3870	1870
12/30/90	6610	2250

TABLE LXXXIX

STREAMFLOW DATA FOR NORTH ELKHORN CREEK NEAR GEORGETOWN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/04/51	5560	4360
03/23/52	6480	3980
03/04/53	4430	3290
04/17/54	896	719
03/05/55	3390	2550
03/08/56	3550	2980
04/05/57	4130	2400
05/05/58	3750	2500
01/21/59	3990	2989
06/24/60	3920	2490
05/08/61	4940	3920
02/28/62	4990	4450
03/17/63	3370	2160
03/05/64	8500	6650
03/26/65	2470	1780
02/13/66	2920	2500
03/06/67	3980	2810
04/05/68	3550	2460
04/18/69	2900	1100
04/02/70	4460	3720
12/22/70	3990	3430
04/22/72	5520	4400
12/09/72	5060	3970
01/11/74	5780	4790
04/25/75	6050	4320
02/18/76	4560	4350
03/04/77	2040	1560
03/14/78	5600	4630
12/09/78	8730	7860
12/12/79	3330	2960
02/19/81	2170	1090
01/23/82	2660	2310
05/02/83	5690	4160
02/16/89	7690	6210
06/03/90	4160	2420
07/09/91	6290	3100
12/03/91	4980	4270
02/22/93	4990	3350
03/10/94	4400	4120
05/18/95	6740	6040
05/06/96	5340	4600
03/02/97	15700	8400
07/20/98	7480	4170

TABLE XC

STREAMFLOW DATA FOR WEST FORK DRAKES CREEK NEAR FRANKLIN, KENTUCKY

Peak Date -	Annual Peak Streamflow (cfs)	Mean Daily Streamflow (cfs)
06/23/69	9930	6210
12/30/69	6780	5100
01/14/71	3370	1370
05/08/72	7150	2480
12/09/72	7370	4700
05/22/74	7910	4970
03/12/75	27300	12800
03/21/76	7710	4440
03/04/77	5760	4300
12/05/77	4590	3120
12/08/78	16000	8960
12/13/79	6710	4160
06/11/81	10800	4510
09/13/82	7770	3090
05/19/83	10500	8230
05/07/84	8170	5390
11/19/84	3350	2100
02/17/86	3230	1570
02/28/87	5920	2160
01/19/88	3600	1580
02/14/89	8000	6200
02/16/90	3490	2130
12/18/90	11300	6500
12/03/91	6190	3340
05/04/93	1890	1180
03/09/94	4500	3060
03/08/95	3660	2600
05/07/96	5800	2620
03/02/97	6420	3830
06/09/98	6880	3170
01/23/99	6470	4180
02/14/00	3510	1580
02/17/01	2460	1470
01/24/02	3510	2040
09/22/03	5010	2630
04/22/04	2460	1900

TABLE XCI

STREAMFLOW DATA FOR SOUTH ELKHORN CREEK NEAR MIDWAY, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
05/02/83	5760	3390
05/08/84	2790	1690
12/22/84	2630	2120
11/27/85	1350	999
03/01/87	2120	1500
12/26/87	2920	2130
01/29/90	1710	1030
12/18/90	5320	3020
06/19/92	5280	3750
06/05/93	1690	864
03/10/94	3150	2650
05/18/95	5550	3660
05/06/96	5530	4090
03/02/97	12300	10700
07/20/98	7510	3940
01/09/99	1890	1480
02/19/00	3290	2390
12/17/00	2600	1780
11/11/02	2170	1720
05/31/04	8120	6460

TABLE XCII

STREAMFLOW DATA FOR PAINT CREEK AT STAFFORDSVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
09/20/50	11700	5930
02/01/51	8520	4740
03/22/52	11700	5320
01/08/53	3450	1740
05/08/54	920	716
03/22/55	3590	1780
02/18/56	7360	4320
12/14/56	7990	4640
05/07/58	6210	3980
04/11/59	1970	1380
02/11/60	1440	882
07/30/61	17400	7970
02/27/62	14700	9970
03/12/63	5030	2770
03/09/64	3100	1530
03/26/65	6320	3680
02/13/66	5530	2550
05/14/67	10200	3220
03/12/68	7060	3460
04/18/69	1480	593
04/28/70	5480	2730
02/05/71	5050	3540
02/26/72	7360	4160
12/09/72	3290	1930
11/27/73	8270	3030
03/12/75	7810	3360

TABLE XCIII

STREAMFLOW DATA FOR BEECH FORK NEAR SPRINGFIELD, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/03/53	4180	1850
04/16/54	2560	921
02/27/55	4630	2400
07/24/56	6480	2420
04/04/57	7280	3950
11/18/57	8280	4000
01/21/59	5310	4280
11/27/59	4830	1240
05/07/61	8840	2180
02/28/62	7080	4030
03/05/63	5760	3930
03/04/64	10000	2340
03/26/65	4680	2160
01/02/66	3360	2160
03/06/67	5240	2760
04/04/68	5880	2250
04/18/69	3470	1770
04/28/70	10600	6740
12/22/70	9680	6860
02/24/72	5440	2370

TABLE XCIV

STREAMFLOW DATA FOR BACON CREEK NEAR PRICEVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/15/60	630	459
03/05/61	1510	972
02/28/62	2240	1730
03/05/63	734	440
03/10/64	2400	1710
03/26/65	918	640
01/02/66	654	363
03/12/67	1710	577
04/05/68	1920	993
04/19/69	323	243
04/02/70	2360	1530
12/22/70	822	610
04/16/72	2610	1750
12/09/72	1500	1060
01/11/74	2900	2030
02/24/75	3350	1500
02/18/76	2080	1600
03/13/77	1520	867
12/05/77	2080	974
12/08/78	6600	3560
12/13/79	1090	711
04/20/81	590	420
08/25/82	3540	1300
04/29/83	4200	1810
05/07/84	6800	4700
12/22/84	1290	778
05/15/86	299	236
03/01/87	1850	1090
12/26/87	1230	870
02/14/89	5120	3860
02/04/90	1200	600
12/31/90	2670	1560
12/03/91	1720	1140
02/22/93	912	429
03/10/94	2230	1670

TABLE XCV

STREAMFLOW DATA FOR NORTH FORK TRIPLETT CREEK NEAR MOREHEAD, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/12/68	5190	3660
05/09/69	4770	1840
04/02/70	6180	3440
07/18/71	6180	2500
04/22/72	8220	4110
12/08/72	6590	3220
01/10/74	6860	3680
03/12/75	7760	3280
10/17/75	6570	2630
04/28/77	2570	425
01/26/78	6760	3200
12/08/78	9380	5100
12/13/79	5000	2720
06/04/81	5630	1690
05/30/82	4680	1640
05/01/83	8550	3330
04/22/84	5760	3150
12/22/84	4310	1670
05/14/86	2650	1190
11/26/86	6470	2290
12/26/87	4340	2000
02/15/89	10600	7800
10/17/89	6620	2700
12/30/90	10100	3000
12/03/91	6810	2480
02/21/93	7680	3400
01/07/94	6910	3320

TABLE XCVI

STREAMFLOW DATA FOR POOR FORK AT CUMBERLAND, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/20/40	2540	1870
03/11/41	1180	900
07/08/42	6860	2220
04/19/43	4220	2620
02/17/44	4890	1960
02/17/45	2820	1710
01/07/46	7500	3540
01/20/47	2620	1730
02/14/48	5310	3330
03/18/49	3640	2050
01/30/50	4390	2480
12/07/50	4220	2250
12/15/51	2530	1730
05/19/53	3200	2260
01/16/54	2650	1960
03/16/55	3510	2260
04/15/56	5140	2230
01/29/57	11800	6750
05/07/58	4190	3460
01/21/59	4640	1260
11/28/59	3200	2110
02/25/61	3120	1790
02/28/62	3450	2450
03/12/63	8740	5750
03/05/64	1360	1050
03/26/65	4020	2720
02/13/66	5850	2950
03/07/67	7770	3560
03/12/68	2490	1480
01/20/69	908	651
12/30/69	8560	4590
05/07/71	4370	2920
02/25/72	3240	1800
03/16/73	4790	2800
01/11/74	5220	3710
03/30/75	3500	2310
03/30/76	2640	1560
04/04/77	10700	6460
01/26/78	2620	2280
12/09/78	2290	1390
03/21/80	1240	990
02/10/81	984	276
09/14/82	2820	1210
05/16/83	2670	1850
05/07/84	6890	4380
11/19/84	1670	1100
02/18/86	2380	1770
04/08/87	2280	1020
01/20/88	1440	1030
08/30/89	2700	991
02/10/90	3230	2170
03/23/91	4880	2910
12/02/91	7220	4050
04/04/00	2890	2260

TABLE XCVII

STREAMFLOW DATA FOR FLOYDS FORK NEAR PEWEE VALLEY, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/19/92	4730	2120
02/21/93	4460	1760
01/28/94	4280	2230
01/28/95	4640	2150
05/11/96	6010	3240
03/02/97	18800	10500
04/16/98	4590	2030
02/01/99	2420	1360
02/18/00	13700	5190
12/16/00	5530	2780
01/24/02	6730	3480
12/20/02	6400	2110
05/28/04	8090	4130

TABLE XCVIII

STREAMFLOW DATA FOR STURGEON CREEK AT CRESSMONT, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/21/93	3110	1230
02/23/94	5810	2890
05/19/95	7660	2390
05/29/96	8080	2590
03/03/97	8200	4230
04/17/98	9120	3500
01/09/99	8340	3020
06/22/00	2330	609
02/17/01	3170	2200
03/20/02	3970	1090
08/04/03	9720	3120
09/17/04	11800	5530

TABLE XCIX

STREAMFLOW DATA FOR BAYOU DE CHIEN NEAR CLINTON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/13/40	3000	1350
01/24/41	1010	543
04/09/42	2730	2080
05/11/43	2400	1340
02/28/44	2860	894
06/09/45	3840	2990
05/25/46	2680	1890
01/03/47	2680	1740
03/27/48	1800	1480
02/14/49	4360	3200
08/31/50	4760	1110
01/15/51	6880	3690
03/22/52	3650	2070
03/04/53	2990	2120
03/24/54	1160	1030
03/21/55	1800	1720
02/18/56	3630	2540
05/23/57	4330	3960
11/18/57	6470	3660
01/21/59	1570	1380
05/21/60	1410	1060
02/22/61	3220	2110
02/27/62	4690	3710
03/05/63	2450	1900
03/10/64	6140	4500
03/30/65	3860	2410
01/02/66	9460	7150
05/15/67	3400	2090
04/05/68	2320	1210
01/30/69	4150	3250
12/30/69	2460	2330
08/23/71	2720	2340
07/17/72	2250	2130
12/09/72	3350	2840
11/25/73	4060	2900
03/12/75	6270	4200
02/18/76	5160	4840
03/04/77	3160	2870
03/14/78	3200	2730
10/08/84	3110	1530
02/04/86	1700	1410
12/10/86	2890	1620
01/20/88	2890	1650
02/14/89	4170	3550
02/16/90	4530	3690
12/18/90	4960	3700
11/20/91	1090	905
04/10/93	2420	1900
12/05/93	1790	1000
08/06/95	1500	1370
06/10/96	1610	1370
03/02/97	5240	4370
06/06/98	3970	2950
01/23/99	3780	3320
05/27/00	4200	3230
02/16/01	1600	1530
12/17/01	5300	3660
05/17/03	6240	3660
06/17/04	1240	829

TABLE C

STREAMFLOW DATA FOR NORTH FORK KENTUCKY RIVER AT WHITESBURG, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/09/99	1040	476
07/13/00	3400	980
02/17/01	2120	900
03/18/02	2880	1780
02/16/03	3360	1960
01/02/04	2600	1120

TABLE CI

STREAMFLOW DATA FOR RED RIVER NEAR HAZEL GREEN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/28/55	3020	2840
04/15/56	3000	2160
12/14/56	2830	2080
04/28/58	2370	1940
04/11/59	1350	1180
02/11/60	909	668
05/08/61	1300	920
02/27/62	9080	2200
03/12/63	2780	2450
03/09/64	1820	1430
03/26/65	2500	2260
02/14/66	1530	1010
03/07/67	3200	2570
03/12/68	2910	1980
04/19/69	664	633
04/28/70	4130	2720
08/05/71	2080	1720
04/22/72	2940	2550
12/08/72	1800	626
01/11/74	4060	2920
03/13/75	3030	2160
03/21/76	1560	1120
04/05/77	2130	1820
01/26/78	3140	2870
12/09/78	7930	6170
12/13/79	1500	1040
07/06/81	3400	1620
03/16/82	2260	1180
05/16/83	1590	1300
05/07/84	4330	3080
12/21/84	1190	868
11/28/85	2070	1900
11/09/86	1980	1790
12/26/87	1280	1120
02/21/89	2660	2330
12/31/89	1570	1270
03/23/91	1190	1020
12/03/91	1790	1530
02/21/93	1500	747
03/10/94	2230	1680
05/19/95	2210	1790
05/05/96	1150	228
03/03/97	1920	1710
04/19/98	1380	1070
01/09/99	1830	1670
08/08/00	1210	313
07/29/01	2100	1550
03/20/02	2140	1820
02/16/03	4850	3510
05/31/04	4550	3510

TABLE CII

STREAMFLOW DATA FOR POND CREEK NEAR LOUISVILLE, KENTUCKY

Peak Date -	Annual Peak Streamflow (cfs)	Mean Daily Streamflow (cfs)
03/06/45	2000	1590
02/06/46	1740	1650
04/16/47	1460	1310
04/13/48	2060	2040
02/15/49	1530	1480
05/10/50	1600	1330
01/14/51	1690	1410
03/22/52	1420	1280
03/03/53	1330	936
09/20/54	607	498
03/21/55	1380	1230
02/02/56	1660	1530
04/04/57	2290	1640
11/18/57	2590	1550
01/21/59	3260	2210
06/23/60	2490	1870
05/08/61	3080	2980
02/27/62	2520	1800
03/17/63	3360	1640
03/09/64	8020	5530
03/29/65	4310	2240
01/02/66	4380	2730
05/14/67	3220	1120
04/04/68	4320	2840
01/30/69	2620	1700
04/02/70	5970	5190
02/22/71	3410	2610
04/12/72	2770	1760
07/22/73	3420	3080
03/06/74	3560	1840
03/29/75	3770	2820
02/18/76	3210	2190
03/04/77	2050	1270
12/05/77	2910	1590
09/22/79	4040	3530
12/24/79	2480	1560
04/04/81	1910	477
01/23/82	2940	1300
04/30/83	5180	3180
05/07/84	2940	1480
12/21/84	3930	2110
02/06/86	1660	610
02/28/87	3380	1470
01/19/88	4140	1380
04/04/89	5130	3090
05/17/90	4770	3090
12/31/90	2770	810
02/21/93	2220	1230
01/28/94	2220	1000
05/18/95	3850	3060
05/26/96	5010	2690
03/02/97	7800	7200
04/16/98	2780	1540
06/28/99	3960	1330
02/18/00	4920	2340
12/16/00	3000	1620
01/24/02	3810	2210
12/19/02	3430	1480
05/28/04	3270	1920

TABLE CIII

STREAMFLOW DATA FOR CUTSHIN CREEK AT WOOTON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
05/07/58	2880	1900
01/21/59	4840	1680
06/24/60	2680	802
04/01/61	1970	1040
02/27/62	4830	2400
03/12/63	14200	4370
03/08/64	2410	927
10/04/64	4930	1770
02/13/66	3140	1210
03/07/67	9560	2520
03/12/68	3620	2070
01/20/69	960	752
04/28/70	8300	3240
05/07/71	6170	3000
04/12/72	6720	2560
03/16/73	5220	3020
11/28/73	7120	3000
03/12/75	5200	2080
03/29/76	3490	1270
04/04/77	8380	4300
11/07/77	12200	2960
12/09/78	4040	2010
03/21/80	2180	1510
06/07/81	3160	1480
01/04/82	2770	1510
05/03/83	3660	1310
05/07/84	11600	4890
11/19/84	2260	1110
11/28/85	3130	1490
11/09/86	4080	1690
12/25/87	1760	589
06/15/89	14000	3700
10/17/89	12000	4690
03/23/91	3540	1540
12/02/91	6370	1830
03/23/93	2910	1110
02/11/94	5860	2920
05/18/95	6550	1040
03/07/96	2040	1160
11/30/96	6270	1450
04/19/98	8650	4430
01/24/99	2380	926
04/03/00	4480	876
02/16/01	3540	1700
03/18/02	6040	3060
02/16/03	9300	4410
05/27/04	8040	2990

TABLE CIV

STREAMFLOW DATA FOR CARR FORK NEAR SASSAFRAS, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/08/64	3250	1110
03/26/65	3510	2210
02/12/66	2360	32
03/07/67	5220	2100
03/12/68	2600	1540
01/20/69	2350	1320
12/30/69	3230	2260
05/06/71	3600	1180
04/12/72	5420	2180
03/17/73	4270	2000
11/27/73	2180	1720
03/14/75	2120	2020
11/12/75	1400	418 [1]
04/07/77	1560	1370 [1]
10/02/77	1710	777 [1]
01/24/79	1840	1100 [1]
09/17/80	1470	46 [1]
04/21/81	1190	978 [1]
09/17/82	1470	311 [1]
05/04/83	732	409 [1]
05/14/84	717	340 [1]
02/01/85	447	389 [1]
02/21/86	717	576 [1]
04/11/87	621	617 [1]
12/26/87	175	128 [1]
06/17/89	960	862 [1]
10/20/89	636	582 [1]
12/19/90	582	299 [1]
12/05/91	661	528 [1]
03/27/93	618	432 [1]
03/29/94	940	460 [1]

Notes:
[1] Discharge affected by regulation or diversion.

TABLE CV

STREAMFLOW DATA FOR YELLOW CREEK NEAR MIDDLESBORO, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/04/41	2200	614
03/17/42	2790	2000
12/30/42	2880	2430
02/17/44	3660	1590
01/01/45	1790	1360
01/07/46	6160	2700
01/20/47	3080	2260
02/14/48	3820	2820
01/05/49	3480	1940
01/30/50	3970	2220
02/01/51	5570	4170
03/22/52	4900	2480
02/21/53	2030	1280
01/16/54	2390	1590
03/22/55	4950	3050
02/18/56	3000	2090
01/28/57	3980	2070
12/08/57	2960	1970
01/21/59	5550	2330
06/23/60	2980	1720
02/23/61	2870	2100
02/28/62	3020	2180
03/12/63	5830	3930
03/05/64	2400	1430
07/24/65	9660	4200
02/13/66	2550	1630
07/25/67	7920	2830
12/22/67	2570	1610
06/23/69	2890	1410
12/30/69	9980	5940
05/13/71	5040	3870
04/12/72	4380	2700
05/28/73	6280	2910
11/28/73	9980	6340
03/13/75	5640	3000
03/30/76	2200	1150
04/04/77	11700	7000
01/26/78	5670	3140
12/04/78	4340	2630
03/21/80	6010	4000
08/08/81	4110	2470
01/03/82	5800	2710
05/21/83	2250	1540
05/07/84	7690	5140
11/19/84	2310	1180
02/18/86	3880	2590
11/09/86	3870	2110
01/20/88	4820	2970
06/16/89	4940	2520
03/17/90	3510	2470
03/23/91	7890	4650
12/02/91	6840	3480
03/23/93	7540	3620
02/11/94	7420	5000
05/14/95	2650	1370
01/19/96	2420	1650
12/01/96	6720	4670
04/19/98	7050	5660
01/23/99	2830	1310
04/04/00	5000	2770
02/16/01	3290	1320
03/18/02	6270	3960
02/16/03	6710	4200
02/06/04	5490	3020

TABLE CVI

STREAMFLOW DATA FOR TYGARTS CREEK AT OLIVE HILL, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/08/57	2790	1010
05/05/58	2930	1400
01/21/59	2840	1100
07/03/60	6190	2020
05/07/61	5900	2310
02/27/62	7310	3140
03/12/63	8970	2030
03/05/64	6010	1990
03/26/65	5700	2050
02/13/66	4040	2460
05/07/67	8460	2750
03/12/68	6330	2700
01/28/69	3460	611
04/02/70	4080	2070
07/18/71	5480	2510
04/22/72	9470	3920
12/08/72	6920	2200
01/10/74	5700	2280
03/12/75	7900	2430
10/17/75	6480	2360
03/13/77	2080	680
01/25/78	7500	2900
12/08/78	8500	4620
12/13/79	2830	1520
06/04/81	2170	910
05/30/82	1410	620
05/01/83	7900	2410
03/20/84	5970	885
12/22/84	2610	1010
07/02/86	2720	741
11/09/86	3980	1500
12/26/87	3310	1670
02/15/89	7780	3750
10/16/89	4130	681
12/30/90	7360	2530
12/03/91	6000	2020
02/21/93	4350	1910
05/07/94	3390	1330

TABLE CVII

STREAMFLOW DATA FOR SOUTH FORK PANTHER CREEK NEAR WHITESVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/18/69	1880	1630
04/02/70	2490	2160
02/22/71	2060	1900
02/24/72	2120	1920
12/09/72	1770	1280
01/11/74	1870	1540
03/29/75	3040	2850
02/18/76	3300	3060
04/23/77	2900	2720
11/21/77	3000	2030
12/04/78	3860	3270
11/26/79	3280	2970
05/19/81	2290	2120
01/23/82	2930	2760
04/30/83	3800	3410

TABLE CVIII

STREAMFLOW DATA FOR JOHNS CREEK NEAR META, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
06/20/42	2160	1050
04/19/43	2740	1490
02/29/44	2420	1400
03/05/45	4350	1610
01/07/46	4270	2040
01/20/47	1580	847
02/13/48	4350	2590
03/18/49	1420	807
02/02/50	2240	1470
02/01/51	3170	2230
03/22/52	2330	1060
02/21/53	900	657
01/16/54	780	508
02/27/55	4480	2500
03/14/56	3480	2030
01/29/57	4680	2770
05/07/58	3240	2160
06/02/59	1370	692
11/28/59	1420	776
07/30/61	2980	1160
02/27/62	4420	2700
03/12/63	7380	3000
03/08/64	1870	731
03/26/65	1880	1330
09/27/66	2680	1020
03/07/67	4370	1770
06/12/68	2580	994
07/10/69	856	248
12/31/69	2980	1290
05/06/71	3430	1030
02/26/72	3410	2240
03/17/73	2470	1430
01/10/74	4690	2700
03/13/75	1520	1520
11/12/75	2030	963
04/04/77	5050	2310
01/26/78	4020	2280
12/09/78	4280	2970
03/05/80	857	427
06/07/81	6010	2080
03/15/82	2740	1390
05/16/83	1040	703
05/07/84	5950	3342
02/01/85	1030	760
11/28/85	2220	1115
04/08/87	2950	1370
09/24/88	596	448
06/16/89	2060	1070
10/17/89	3850	1930
03/23/91	2780	1430
12/02/91	2230	757
03/23/93	2010	720
05/19/95	2580	1510
05/16/96	3320	1690
03/03/97	3870	1790
04/17/98	2630	1430
01/09/99	877	491
07/05/00	2190	687
08/04/01	2210	894
05/03/02	4680	1410
02/16/03	3340	2210
05/31/04	2760	1580

TABLE CIX

STREAMFLOW DATA FOR MARTINS FORK NEAR SMITH, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
05/07/71	2750	1800
01/05/72	2120	900
03/17/73	6040	3480
11/28/73	5760	3420
03/13/75	4310	3380
03/30/76	3930	2360
04/04/77	9000	5100
01/26/78	1620	1270
01/21/79	857	560
03/22/80	693	687
06/07/81	820	818
02/18/82	759	623
12/01/82	568	499
05/08/84	1040	854
02/08/85	406	241
11/20/85	668	137
11/10/86	567	363
12/28/87	456	309
06/17/89	1050	826
10/03/89	579	551
02/20/91	1270	967
12/03/91	1350	972
03/25/93	478	468
02/12/94	1290	1280
05/18/95	597	560
12/02/96	601	461
04/19/98	1520	1110
03/05/99	400	350
04/05/00	464	462
08/13/01	486	279
03/18/02	1940	941
02/17/03	1550	954
03/08/04	597	399

TABLE CX

STREAMFLOW DATA FOR LYNN CAMP CREEK AT CORBIN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/11/74	2760	2220
03/13/75	4500	2940
02/14/76	1530	959
04/04/77	3110	1750
01/26/78	2100	1740
12/09/78	2490	2030
03/21/80	1540	1330
05/19/81	1630	400
01/04/82	1910	1590
05/03/83	2010	1010
05/07/84	6190	4150
11/19/84	2080	1730
02/18/86	1710	1340
11/09/86	1530	1350
01/20/88	1220	1040
03/06/89	2240	2030
02/10/90	1640	1410
07/02/91	2850	550
12/03/91	1930	1590
02/21/93	1540	801
02/11/94	2140	1740
05/14/95	2000	1360
05/08/96	2480	1410
03/03/97	2470	1920
04/17/98	6820	4530
01/09/99	2140	1790
05/25/00	1100	642
02/16/01	1430	766
03/18/02	3660	2810
02/16/03	3200	2570
09/17/04	3940	2620

TABLE CXI

STREAMFLOW DATA FOR BEAVER CREEK AT HWY 31 E NEAR GLASGOW, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
06/18/92	6620	2740
03/02/93	764	222
04/11/94	5010	2060
05/19/95	4260	2490
03/06/96	1620	958
03/01/97	3460	1670
05/24/00	1170	709
12/16/00	2250	646
05/18/02	2860	1930

TABLE CXII

STREAMFLOW DATA FOR TRIPLETT CREEK AT MOREHEAD, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/19/41	7090	1030
04/09/42	7330	2240
03/19/43	3520	1630
04/11/44	3650	961
12/31/44	4700	1170
05/15/46	3610	855
08/05/47	4970	964
04/08/48	9250	1700
01/05/49	4350	1160
09/21/50	11400	3260
01/04/51	5080	1050
03/22/52	8110	2910
03/03/53	4620	1490
05/01/54	2190	472
07/09/55	11000	2190
02/17/56	7330	1610
12/14/56	7020	2320
05/05/58	3210	1080
01/21/59	3130	893
07/03/60	18600	2820
05/07/61	6370	1980
02/27/62	7730	2500
03/11/63	10300	1770
04/18/64	10300	1590
03/26/65	7030	1750
02/13/66	3850	1740
03/07/67	11900	6200
03/12/68	8720	2820
05/09/69	1960	600
04/02/70	5630	1810
07/18/71	8620	1380
04/22/72	11600	1830
12/09/72	2600	1380
11/27/73	10400	1490
03/12/75	12200	2460
10/17/75	9820	2340
04/28/77	2520	367
01/26/78	7130	2000
12/08/78	11300	5190
12/13/79	3130	1280
02/15/89	9100	3220
12/31/89	2700	1120
12/30/90	9640	2420
12/03/91	11100	1900

TABLE CXIII

STREAMFLOW DATA FOR FLOYDS FORK NEAR CRESTWOOD, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/24/79	7230	3030
06/10/81	2820	1390
01/22/82	3340	1120
05/01/83	4280	2410
05/07/84	3540	1320
12/21/84	3500	1660
03/13/86	3330	1230
02/28/87	3110	910
01/19/88	4300	1800
04/04/89	5370	2430
02/15/90	4430	1530
12/30/90	3810	1590

TABLE CXIV

STREAMFLOW DATA FOR BEAVER CREEK NEAR MONTICELLO, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/18/69	890	412
12/30/69	2260	1920
12/22/70	2450	500
04/12/72	3020	1260
05/28/73	2300	1800
04/04/74	4380	1900
03/13/75	6850	4180
06/02/76	5390	1680
04/04/77	8160	3900
01/26/78	2950	1310
12/09/78	9240	3380
04/08/80	3060	1520
06/06/81	4570	1800
09/01/82	3030	1280
12/15/82	1730	425
10/17/89	2970	1890
12/23/90	2710	1620
06/18/92	1760	527
02/21/93	1310	515
04/11/94	2820	1500
02/15/95	1540	980
11/07/95	1690	855
03/03/97	2570	1810
04/17/98	3140	1580
01/23/99	1740	971
02/14/00	371	233
03/18/02	3180	1830
09/17/04	3880	2090

TABLE CXV

STREAMFLOW DATA FOR EAGLE CREEK AT SADIEVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/09/42	3200	2050
03/19/43	9870	5290
03/06/44	2730	773
03/06/45	6860	3370
03/26/46	4710	2020
04/16/47	6460	2700
02/13/48	7110	3460
12/15/48	3320	1990
06/19/50	8100	4680
01/14/51	3550	2510
03/22/52	4420	2630
03/03/53	5310	2750
06/13/54	3080	770
07/18/55	3370	1090
02/02/56	3120	1900
04/04/57	5280	2820
05/04/58	4570	1060
01/20/59	3760	1800
07/01/60	5090	2730
05/07/61	6620	2820
02/26/62	3640	1540
03/05/63	3140	1410
03/04/64	8860	4140
09/01/65	3730	1530
02/13/66	3490	1480
05/07/67	4200	1700
04/04/68	2640	1590
04/18/69	3600	1270
04/02/70	4340	2140
02/22/71	3750	1580
02/24/72	3220	1340
12/08/72	4890	2130
06/23/74	4010	1610
04/24/75	6230	2460

TABLE CXVI

STREAMFLOW DATA FOR NORTH FORK ROUGH RIVER NEAR WESTVIEW, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/21/55	1470	918
02/15/56	2280	1150
05/22/57	2210	1230
11/18/57	2520	1220
01/21/59	3170	1540
01/14/60	1210	600
05/07/61	2270	1500
02/27/62	1110	722
10/02/62	1280	620
03/09/64	3890	2700
12/11/64	1510	800
02/10/66	1090	583
04/30/67	3010	1330
05/26/68	2020	900
01/30/69	1250	700
04/02/70	2750	1180
02/22/71	2000	750
02/22/72	1970	1040
12/08/72	2300	1220

TABLE CXVII

STREAMFLOW DATA FOR SALT RIVER NEAR HARRODSBURG, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
05/19/53	2960	1230
04/16/54	1540	901
02/28/55	3040	1500
07/24/56	5520	736
04/04/57	5520	2300
11/18/57	5750	2200
01/21/59	5520	1820
06/23/60	2600	1670
05/07/61	4970	2070
02/28/62	4350	1380
03/05/63	2650	1320
03/10/64	4060	1450
03/26/65	2510	1080
05/18/66	1650	470
12/09/66	3500	1620
05/27/68	2970	1500
04/19/69	890	772
04/28/70	7620	4980
12/22/70	3300	2000
04/15/72	4060	3150
06/27/73	2440	728

TABLE CXVIII

STREAMFLOW DATA FOR LEATHERWOOD CREEK AT DAISY, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/26/65	3150	1620
02/13/66	1960	495
03/07/67	7370	1280
12/22/67	1830	933
01/19/69	555	459
04/28/70	4740	1790
05/07/71	4740	1820
04/12/72	3970	1890
12/10/72	3510	1510
04/04/74	4110	1370
12/02/91	4170	975
03/23/93	2440	883
02/11/94	2850	1250
05/19/95	3450	1150
05/21/96	1820	336
03/03/97	5490	1850
04/19/98	3830	2720

TABLE CXIX

STREAMFLOW DATA FOR NORTH FORK NOLIN RIVER AT HODGENVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/09/42	2280	771
03/11/43	2250	798
04/11/44	2190	577
02/26/45	4390	1320
02/13/46	3550	1060
07/06/47	2470	768
02/13/48	6560	2040
11/05/48	5170	1530
01/30/50	4720	442
11/20/50	2720	676
03/10/52	5290	1070
03/03/53	6580	1600
09/21/54	548	87
03/16/55	6840	1130
02/02/56	3810	1130
04/04/57	6510	2200
07/11/58	8300	2000
07/23/59	7310	1270
09/17/60	1640	470
05/07/61	4970	1110
02/28/62	2220	837
07/07/63	2100	576
03/04/64	8860	2560
03/26/65	2300	640
07/04/66	4280	820
08/01/67	7900	1540
04/04/68	5500	1900
04/18/69	1400	500
04/28/70	9380	3790
01/14/71	4980	1360
04/12/72	8600	1930
12/08/72	4700	2010

TABLE CXX

STREAMFLOW DATA FOR GREEN RIVER NEAR MOUNT SALEM, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/20/54	1400	411
03/21/55	5300	1470
01/30/56	4340	1450
04/08/57	3280	1080
11/18/57	11700	2440
01/21/59	1630	524
06/23/60	4800	1510
06/15/61	5260	1760

TABLE CXXI

STREAMFLOW DATA FOR PLUM CREEK AT WATERFORD, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
09/20/54	6040	844
04/24/55	2850	655
02/17/56	4300	826
04/04/57	7760	2470
08/01/58	6060	617
01/21/59	6820	1770
06/23/60	13200	3560
05/07/61	8170	2800
02/23/62	5560	889
03/16/63	7060	1410
03/04/64	8740	3160
09/01/65	6580	961
02/13/66	3070	1010
05/14/67	3880	602
04/04/68	5050	1460
01/28/69	2550	707
04/14/70	8960	1720
07/18/71	6720	697
02/24/72	5240	1600
07/22/73	5950	1690
11/27/73	7380	3500

TABLE CXXII

STREAMFLOW DATA FOR BEAR BRANCH NEAR LEITCHFIELD, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
09/03/50	4740	1140
11/19/50	4740	1460
03/22/52	5700	1890
03/03/53	3590	1160
01/20/54	2470	600
09/30/55	4950	828
03/07/56	5040	1840
04/04/57	3830	1210
11/18/57	8070	3710
01/21/59	2510	1370
06/29/60	4120	1320
05/08/61	4460	1250
03/27/62	4260	60
03/05/63	3690	870
03/09/64	6250	2380
02/24/65	3400	332
05/13/66	4900	434
05/01/67	7880	452
04/04/68	3720	1660
01/30/69	3480	1710
04/28/70	5720	1800
12/22/70	6470	2370

TABLE CXXIII

STREAMFLOW DATA FOR SILVER CREEK NEAR KINGSTON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/04/68	6410	2290
12/28/68	633	216
04/28/70	5320	2460
05/06/71	2460	1200
04/12/72	6180	2030
07/26/73	2210	600
01/10/74	5670	2380
03/12/75	5690	2500
10/17/75	2890	1240
04/04/77	1020	357
12/05/77	3890	1410
12/08/78	5820	4060
12/13/79	2060	1000
06/06/81	2920	2000
02/09/82	2000	700
05/16/83	1640	839

TABLE CXXIV

STREAMFLOW DATA FOR HARRODS CREEK NEAR LA GRANGE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/04/68	3570	1000
01/30/69	2110	994
04/02/70	4530	1110
02/22/71	3950	1390
04/16/72	2880	855
06/20/73	5320	992
05/31/74	3800	760
04/24/75	4810	1530
06/25/76	3180	1050
06/28/77	2500	728
10/01/77	3720	1370
09/14/79	5310	1880
12/24/79	2150	840
04/04/81	2260	426
01/22/82	2980	925
05/01/83	4680	1700
04/22/84	3840	1410
12/21/84	2860	1070
02/06/86	2420	194
02/28/87	3130	731
01/19/88	3900	997
04/04/89	6100	1480
05/17/90	4050	1140
12/18/90	3660	1850
06/18/92	4140	1030
02/21/93	5690	450
04/29/94	4320	682

TABLE CXXV

STREAMFLOW DATA FOR STILLWATER CREEK AT STILLWATER, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/28/55	2600	1060
02/18/56	2960	895
12/14/56	3890	1130
11/18/57	3520	1060
04/10/59	921	524
07/01/60	1980	629
05/07/61	1350	675
02/27/62	7390	2600
05/28/63	4000	934
03/08/64	1540	561
03/26/65	2790	864
02/13/66	1170	714
05/14/67	5440	1610
03/12/68	3710	1290
04/18/69	452	180
04/28/70	2880	1620
07/06/71	5570	1280
04/15/72	3250	1100
12/09/72	1460	531

TABLE CXXVI

STREAMFLOW DATA FOR SOUTH ELKHORN CREEK AT FORT SPRING, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
01/04/51	1130	672
03/22/52	1280	788
03/04/53	766	496
04/16/54	309	139
05/13/55	867	234
03/08/56	580	410
04/04/57	850	524
07/25/58	740	370
01/21/59	548	422
06/23/60	1890	1180
05/08/61	720	466
02/28/62	1450	753
03/05/63	588	471
03/10/64	1860	926
03/26/65	690	502
02/13/66	480	358
05/07/67	1820	638
04/04/68	548	258
04/18/69	410	191
04/24/70	970	482
12/22/70	1200	780
04/22/72	1670	720
12/08/72	994	538
08/11/74	1090	402
04/24/75	1460	407
02/18/76	982	606
03/12/77	554	145
03/14/78	822	573
12/08/78	1990	1040
12/13/79	720	548
07/13/81	508	76
08/31/82	563	197
05/01/83	2100	800
04/22/84	1010	676
12/22/84	952	373
11/27/85	911	362
02/28/87	821	347
12/26/87	1300	668
02/15/89	2280	1310
08/29/90	807	299
12/18/90	1620	1130
06/19/92	2190	559
07/20/98	2040	712
01/09/99	827	290
02/18/00	1300	447
12/16/00	1070	336
03/20/02	1690	1020
05/09/03	2180	838
05/31/04	1960	744

TABLE CXXVII

STREAMFLOW DATA FOR CABIN CREEK NEAR TOLLESBORO, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/22/72	8370	600
12/08/72	4870	1300
08/08/74	6090	471
09/24/75	5940	1050
02/17/76	4650	401
08/14/77	5330	742
12/05/77	4670	1140
06/21/79	4690	1050
12/13/79	1920	685
02/01/81	1510	503
06/10/82	3480	464
04/08/83	3580	726
10/22/83	2270	337
08/25/85	3250	728
07/02/86	4670	884
11/26/86	5190	1240
02/02/88	4440	1340
02/15/89	4520	1610
12/31/89	3760	860
03/26/91	4690	785

TABLE CXXVIII

STREAMFLOW DATA FOR GREEN RIVER NEAR MCKINNEY, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/22/52	10400	1950
05/18/53	1300	449
04/16/54	708	308
03/21/55	3900	765
01/30/56	3710	946
04/08/57	2630	686
11/18/57	9600	1250
01/21/59	890	326
06/23/60	2660	788
06/15/61	3900	1130
02/27/62	4840	1650
03/11/63	2060	741
03/04/64	4000	750
03/25/65	3320	540
02/13/66	770	442
03/06/67	4750	2340
04/04/68	10600	1030
04/02/69	1420	244
04/28/70	12700	2400
05/06/71	2290	563
04/12/72	13700	949
04/23/73	4330	645

TABLE CXXIX

STREAMFLOW DATA FOR ROCK LICK CREEK NEAR GLEN DEAN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
05/22/57	4730	1510
11/18/57	2210	1030
01/21/59	8720	1410
01/14/60	1750	418
05/08/61	3550	980
02/23/62	1900	380
03/05/63	1940	1370
03/09/64	6010	2810
12/10/64	2210	622
02/10/66	1720	755
05/14/67	5650	1260
04/04/68	2700	771
04/18/69	1780	639
04/02/70	3650	685
02/22/71	3490	896

TABLE CXXX

STREAMFLOW DATA FOR PLUM CREEK NEAR WILSONVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/26/55	2670	265
03/07/56	2860	632
04/04/57	3940	1500
08/01/58	4180	483
01/21/59	3200	937
06/23/60	5180	1300
05/07/61	3290	1300

TABLE CXXXI

STREAMFLOW DATA FOR MUDDY FORK BEARGRASS CREEK AT OLD CANNONS LANE AT LOUISVILLE, KENTUCKY

Date -	**AMS Streamflow** (cfs)	**Daily Avg. Streamflow** (cfs)
03/06/45	1810	800
02/06/46	791	422
06/02/47	839	261
04/12/48	1750	754
02/15/49	898	436
08/29/50	2120	169
01/14/51	1220	717
01/04/52	1290	487
03/03/53	768	316
09/20/54	1570	441
07/09/55	1240	135
02/15/56	1060	464
02/09/57	1490	280
11/18/57	884	513
01/21/59	1320	600
06/23/60	3300	1150
05/07/61	2400	997
01/22/62	976	413
03/16/63	918	365
03/09/64	3920	2000
09/01/65	1150	376
08/09/66	874	97
05/02/67	712	315
04/04/68	1450	680
01/30/69	707	420
04/02/70	5200	1490
07/18/71	2150	541
03/02/72	1170	421
07/21/73	2080	453
08/18/74	1250	157
04/24/75	2270	763
12/31/75	1560	488
05/05/77	2000	574
08/18/78	1960	554
09/14/79	2210	824
11/25/79	900	286
06/10/81	1270	297
04/03/82	1480	399
05/01/83	2220	831
07/04/84	903	268
12/21/84	1040	501
07/15/86	711	159
08/03/87	1580	50
01/19/88	1290	437
04/04/89	1730	639
02/15/90	1350	622
03/22/91	1410	530
07/27/92	1500	512
07/14/93	1820	320
01/28/94	516	247
05/17/95	1220	486
05/10/96	1390	334
03/02/97	5900	1610
03/09/98	948	211
01/08/99	680	199
02/18/00	2320	1120
09/27/02	1680	774
12/19/02	1400	546
07/10/04	1680	314

TABLE CXXXII

STREAMFLOW DATA FOR SOUTH FORK LITTLE BARREN RIVER AT EDMONTON, KENTUCKY

Peak Date -	**Annual Peak Streamflow** (cfs)	**Mean Daily Streamflow** (cfs)
04/09/42	1750	625
03/19/43	1380	528
09/02/44	1690	450
12/31/44	2120	792
03/07/46	1280	495
05/21/47	2140	516
02/13/48	1810	1040
06/15/49	2970	566
01/31/50	2340	871
11/20/50	1740	475
03/22/52	2700	1390
03/04/53	1150	285
04/16/54	1280	668
03/21/55	2000	825
01/30/56	1690	524
01/22/57	1790	614
11/18/57	1780	715
05/30/59	1160	345
06/28/60	1110	376
03/06/61	970	312
02/27/62	2260	898
03/11/63	1340	634
03/08/64	1220	490
07/10/65	2430	738
04/13/66	1310	448
07/11/67	1670	460
04/04/68	1880	863
06/23/69	1980	717
04/02/70	1750	545
05/13/71	1490	539
01/27/72	1810	463

TABLE CXXXIII

STREAMFLOW DATA FOR SOUTH FORK BEARGRASS CREEK AT LOUISVILLE, KENTUCKY

Date	AMS Streamflow	Daily Avg. Streamflow
-	(cfs)	(cfs)
03/03/40	1360	490
03/06/45	1890	769
02/13/46	528	233
04/16/47	346	240
04/12/48	1080	569
01/27/49	486	249
05/10/50	1860	930
01/14/51	776	500
01/04/52	890	337
03/03/53	424	202
03/21/55	497	336
02/15/56	853	416
04/04/57	554	338
11/18/57	600	355
01/21/59	1180	560
06/23/60	2220	1060
05/07/61	1870	992
02/23/62	996	208
04/02/70	4610	1260
07/18/71	2930	840
03/02/72	1260	308
07/22/73	3790	1760
08/19/74	2040	414
03/29/75	2560	868
12/31/75	1380	382
08/24/77	1420	252
10/01/77	2390	955
04/12/79	2370	699
07/27/80	828	132
04/04/81	866	167
09/01/82	1060	253
05/01/83	1910	735
07/19/88	679	145
04/04/89	2000	691
05/28/90	1800	687
03/22/91	1510	440
08/08/92	2150	721
07/14/93	1630	268
11/17/93	683	161
05/17/95	1320	471
05/28/96	2230	328
03/02/97	5290	1960
06/10/98	2100	376
06/28/99	1400	381
01/03/00	2580	755
12/16/00	1280	524
09/27/02	1910	869
12/19/02	1520	560
05/25/04	1140	132

TABLE CXXXIV

STREAMFLOW DATA FOR BAYOU CREEK NEAR GRAHAMVILLE, KENTUCKY

Date	AMS Streamflow	Daily Avg. Streamflow
-	(cfs)	(cfs)
03/01/97	1750	923
06/09/98	1550	502
01/22/99	1370	713
01/03/00	1500	763
07/26/01	1380	443
12/17/01	1580	844
12/19/02	1340	568
05/31/04	1340	187

TABLE CXXXV

STREAMFLOW DATA FOR MASSAC CREEK NEAR PADUCAH, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/02/72	2080	557
04/19/73	3250	781
12/26/73	1670	486
06/05/75	3320	907
02/17/76	2730	130
03/03/77	742	250
04/18/78	1370	439
04/01/79	3000	1060
05/30/80	1960	352
07/28/81	1150	330
09/01/82	1120	266
07/03/83	4530	969
05/07/84	2240	735
09/05/85	5990	1380
03/12/86	1440	381
02/28/87	849	354
02/02/88	2760	1070
02/13/89	4200	1780
02/15/90	3370	1710
12/17/90	1060	146
07/26/92	1240	266
04/09/93	930	498
11/17/93	1840	432
05/01/95	1130	316
05/15/96	1440	447
03/01/97	4310	1310
06/09/98	2840	750
01/22/99	1090	617
01/03/00	4430	1910
06/06/01	638	102
05/17/02	3340	1300
05/17/03	2150	654
06/16/04	1340	352

TABLE CXXXVI

STREAMFLOW DATA FOR BEAVERDAM CREEK NEAR CORYDON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
04/23/73	1910	508
09/28/74	1260	250
03/28/75	2500	736
07/03/76	2450	425
03/28/77	2240	335
03/13/78	2220	261
02/23/79	2520	594
11/25/79	1690	409
05/30/81	2640	374
04/03/82	1940	246
09/24/84	2610	603
06/11/85	2760	667
11/13/85	2440	493
02/28/87	968	234
07/02/89	2380	420
01/20/90	2420	428
07/02/91	2500	259
03/18/92	1920	342
06/09/93	2910	952
11/17/93	1890	273

TABLE CXXXVII

STREAMFLOW DATA FOR NORTH FORK GRASSY CREEK NEAR PINER, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
05/24/68	4650	872
05/18/69	2790	302
04/30/70	20200	3450
02/22/71	2950	595
03/02/72	1370	263
06/27/73	2790	228
11/27/73	3340	454
04/24/75	3610	640
09/27/76	1810	228
05/05/77	1320	130
12/05/77	2270	423
09/14/79	6730	1170
12/24/79	1010	227
04/04/81	1420	175
05/30/82	2630	183
05/03/83	2340	556

TABLE CXXXVIII

STREAMFLOW DATA FOR EAST FORK LITTLE SANDY RIVER NEAR FALLSBURG, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
12/08/72	943	500
01/10/74	1060	324
03/12/75	1230	448
02/18/76	744	281
04/04/77	655	168
01/26/78	899	414
07/04/79	1510	376
12/13/79	640	300
02/02/81	582	268
05/26/82	846	162
05/01/83	582	213
04/22/84	773	368
12/21/84	741	327
02/17/86	314	105
11/09/86	1120	434
12/26/87	1240	552
02/15/89	1600	742
05/28/90	1890	534
12/30/90	1640	431

TABLE CXXXIX

STREAMFLOW DATA FOR WEST HICKMAN CREEK AT JONESTOWN, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
08/11/75	3730	2.7
02/18/76	786	200
08/04/77	539	3.6
08/25/78	1530	124
09/21/79	3060	525
07/04/80	661	75
09/03/81	692	93
08/30/82	1170	171
05/01/83	1680	372
03/28/84	818	162

TABLE CXL

STREAMFLOW DATA FOR BEAVERDAM CREEK AT RHODA, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
05/10/73	965	75
01/10/74	2140	973
03/12/75	4460	1130
03/29/76	2550	969
03/12/77	1640	487
12/05/77	1510	574
09/14/79	2220	481
12/13/79	759	374
04/20/81	1340	418
01/23/82	540	241
05/15/83	1670	852
05/07/84	4850	1780
08/25/85	1110	299
03/19/86	549	184
02/28/87	1360	501
01/19/88	1530	421
07/03/89	2670	850
02/03/90	1000	389
12/30/90	1690	524
06/18/92	1880	455
02/21/93	499	179
02/22/94	1120	240

TABLE CXLI

STREAMFLOW DATA FOR LONG LICK AT CLERMONT, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
05/29/92	695	68
06/04/93	750	43
05/07/94	2080	193
05/09/95	1460	193
06/08/96	966	221
03/01/97	2790	680
05/21/98	1890	340
01/23/99	1260	240
01/03/00	2080	240
03/04/01	323	128
05/06/02	2820	317
09/02/03	1110	217
06/17/04	871	53

TABLE CXLII

STREAMFLOW DATA FOR WEST BAYS FORK AT SCOTTSVILLE, KENTUCKY

Peak Date -	Annual Peak Streamflow (cfs)	Mean Daily Streamflow (cfs)
01/14/51	1490	308
03/22/52	1640	700
06/16/53	1600	128
09/20/54	780	81
03/21/55	1590	513
02/17/56	1500	388
01/29/57	1510	528
11/18/57	1720	305
02/10/59	1700	171
06/28/60	1620	233
06/14/61	1650	235
02/26/62	1690	523
03/11/63	765	138
04/07/64	1560	172
12/24/64	1540	181
04/12/66	910	85
07/22/67	1330	77
04/04/68	1640	485
06/23/69	7050	1050
12/30/69	1400	300
08/03/71	1100	70
05/08/72	1120	209

TABLE CXLIII

STREAMFLOW DATA FOR BAYOU CREEK NEAR HEATH, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/01/97	1870	710
06/09/98	1640	375
04/03/99	1340	199
01/03/00	1620	529
07/26/01	1090	185
12/17/01	1570	513
06/11/03	841	178
05/30/04	1100	109

TABLE CXLIV

STREAMFLOW DATA FOR GRAPEVINE CREEK NEAR PHYLLIS, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
06/01/74	1650	191
07/24/75	694	23
12/31/75	264	45
04/04/77	673	448
01/25/78	917	237
12/09/78	730	259
09/02/80	775	15
06/06/81	1220	274
09/14/82	970	45
05/05/89	1350	438
10/17/89	943	272
03/23/91	555	173
05/14/95	327	145
07/19/96	243	16
03/03/97	753	256
06/10/98	878	273
01/09/99	89	42
07/05/00	600	100
08/13/01	1530	160
05/02/02	659	80
02/16/03	442	220
06/12/04	2190	440

TABLE CXLV

STREAMFLOW DATA FOR LITTLE BAYOU CREEK NEAR GRAHAMVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/01/97	1300	506
06/09/98	868	259
04/03/99	595	143
01/03/00	947	385
07/26/01	612	197
12/17/01	1050	436
05/17/03	524	122
05/30/04	423	37

TABLE CXLVI

STREAMFLOW DATA FOR FLAT CREEK NEAR FRANKFORT, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/22/52	3460	480
03/03/53	1940	419
04/16/54	542	86
07/08/55	7100	307
06/20/56	2120	118
06/28/57	2460	152
05/04/58	2490	231
01/21/59	2150	197
06/23/60	2240	365
05/07/61	2340	533
02/23/62	1460	161
03/16/63	2280	200
03/25/64	3280	178
09/01/65	3900	390
05/18/66	1080	103
03/14/67	1820	100
05/24/68	1570	62
05/18/69	1120	93
04/02/70	2100	161
12/22/70	1610	206

TABLE CXLVII

STREAMFLOW DATA FOR MCDOUGAL CREEK NEAR HODGENVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
06/18/54	320	25
03/16/55	974	110
01/30/56	650	161
04/04/57	1370	336
11/18/57	2100	545
07/23/59	1180	206
01/14/60	284	74
05/08/61	835	80
02/27/62	486	232
10/02/62	376	70
03/04/64	1480	477
03/25/65	558	109
07/04/66	2890	260
08/01/67	1990	383
04/04/68	750	245
04/18/69	369	106
04/28/70	1510	470
02/22/71	1580	430

TABLE CXLVIII

STREAMFLOW DATA FOR LITTLE PLUM CREEK NEAR WATERFORD, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/24/55	1120	92
02/17/56	1060	164
04/04/57	1320	353
07/21/58	1200	164
01/21/59	930	249
06/23/60	3810	527
04/23/61	1650	169

TABLE CXLIX

STREAMFLOW DATA FOR CAVE CREEK NEAR FORT SPRING, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/03/53	105	35
09/20/54	76	6.1
05/13/55	400	41
03/07/56	65	20
04/04/57	94	43
07/24/58	207	51
01/21/59	63	40
06/23/60	165	101
05/08/61	112	46
02/27/62	130	73
03/05/63	48	40
03/09/64	132	56
03/26/65	40	27
04/28/66	43	21
05/07/67	135	52
05/27/68	49	30
04/18/69	38	20
04/23/70	94	15
06/21/71	275	48
04/22/72	264	85

TABLE CL

STREAMFLOW DATA FOR INDIAN CREEK NEAR OWINGSVILLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/03/80	1330	91

TABLE CLI

STREAMFLOW DATA FOR BEAR BRANCH NEAR NOBLE, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/16/55	290	77
02/18/56	328	94
01/29/57	375	160
05/07/58	230	94
01/21/59	152	36
07/01/60	142	44
07/30/61	250	46
02/27/62	415	144
03/11/63	382	92
03/08/64	103	36
03/29/65	160	41
02/12/66	138	13
03/06/67	397	104
08/10/68	155	8.2
04/18/69	49	19
04/28/70	305	106
08/04/71	292	38
04/12/72	568	81
04/27/73	83	52

TABLE CLII

STREAMFLOW DATA FOR MCGILLS CREEK NEAR MCKINNEY, KENTUCKY

Peak Date -	Annual Peak Streamflow (cfs)	Mean Daily Streamflow (cfs)
03/22/52	950	189
05/17/53	257	28
01/20/54	88	26
03/16/55	535	67
01/30/56	398	80
04/08/57	481	73
11/18/57	1030	168
06/05/59	146	12
06/23/60	499	64
06/15/61	666	94
02/27/62	620	173
07/29/63	209	25
03/04/64	607	70
03/25/65	310	58
02/13/66	57	34
03/06/67	249	107
04/04/68	598	113
04/02/69	73	11
04/28/70	1340	166
05/06/71	163	45

TABLE CLIII

STREAMFLOW DATA FOR ROSE CREEK AT NEBO, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
03/21/52	624	43
03/03/53	722	110
04/06/54	358	28
04/23/55	500	60
02/15/56	884	68
06/01/57	689	72
11/18/57	1230	260
08/06/59	732	154
07/01/60	622	56
05/08/61	588	102
02/27/62	358	128
03/04/63	300	27
03/09/64	614	306
03/29/65	622	117
01/02/66	571	84
05/01/67	350	42
04/04/68	920	95
06/23/69	1240	163
04/01/70	818	196

TABLE CLIV

STREAMFLOW DATA FOR MILE BRANCH AT COALTON, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
02/01/81	155	33

TABLE CLV

STREAMFLOW DATA FOR WHITE OAK CREEK TRIBUTARY NEAR MONTPELIER, KENTUCKY

Date -	AMS Streamflow (cfs)	Daily Avg. Streamflow (cfs)
07/03/76	77	36

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VITRA

The author was born in Louisville, Kentucky on October 22, 1982, where he has resided since. He graduated from Louisville Male High School in 2001 and entered University of Louisville's J.B. Speed School of Engineering in August 2001. The author completed the requirements for the Bachelor of Science in Civil Engineering in May 2005 and the requirements for the Masters of Engineering in Civil Engineering in August 2006. He currently is a project engineer at Fuller, Mossbarger, Scott and May Engineers, Inc. in Louisville, Kentucky.