Research Technical Completion Report

ANNUAL FLOW STATISTICS AND DROUGHT CHARACTERISTICS FOR GAGED AND UNGAGED STREAMS IN IDAHO

by

Dennis R. Horn
Department of Civil Engineering

WATER
for
IDAHO

Idaho Water Resources Research Institute
University of Idaho
Moscow, Idaho 83843

May, 1987

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14-08-0001-G1222-03

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Dennis R. Horn
Department of Civil Engineering

Submitted to: U.S. Geological Survey
United States Department of the Interior
Washington, D.C. 20242

Idaho Water Resources Research Institute
University of Idaho
Moscow, Idaho 83843

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ABSTRACT

This study addresses the problem of drought risk assessment for streams within the State of Idaho. As both the demand and competition for surface water supplies continue to increase, it is essential that a rational planning basis be established to quantitatively estimate the expected duration and severity of low stream flow periods, especially for extended, multiyear droughts. While hydrologists and engineers involved in the planning of surface water projects have long recognized the need to deal with this hydrologic uncertainty, most of the attempts to date have relied on the use of observed historical critical drought periods. However, since these periods vary from one location to another within the state, their true probabilities of recurrence have not been adequately defined. Moreover, for ungaged streams, or for locations with a limited period of gaged data, the problem of assessing drought probabilities has remained almost totally unresolved.

INTRODUCTION

1. Background

This study addresses the critical problem of drought risk assessment for streams within the State of Idaho. As both the demand and competition for surface water supplies continue to increase, it is essential that a rational planning basis be established to estimate quantitatively the expected duration and severity of low stream flow periods, especially for extended, multiyear droughts. While hydrologists and engineers involved in the planning of surface water projects have long recognized the need to deal with this hydrologic uncertainty, most of the attempts to date have relied on the use of observed historical critical drought periods. However, since these periods vary from one location to another within the state, their true probabilities of recurrence have not been defined adequately. Moreover, for ungaged streams, or for locations with a limited period of gaged data, the problem of assessing drought probabilities has remained almost totally unresolved.

Therefore, the development of procedures that can be applied to most gaged or ungaged locations to yield estimates of drought characteristics has a significant implication on future water resources planning and engineering in the state. Potential projects for irrigation, hydroelectric power production, municipal water supply, and other needs, could be examined in light of the probabilities of significant droughts during their economic life, leading to more reliable predictions of the risk of project failure and better project economics. Such procedures would also permit the assessment of project feasibility with less detailed and costly hydrologic investigations.

2. Nature and Scope of Research Project

In general, this study examines the duration and severity of droughts, as indicated by annual streamflow, throughout the State of Idaho. By the use of stochastic process considerations, to be described later, key annual flow statistics are used to derive the related statistics of drought probability distributions, thereby defining, for various combinations of return period and water demand, the expected drought lengths and cumulative flow deficits.

More specifically, the study efforts initially concentrated on analyzing all Idaho streamgage records that were judged to meet certain selection criteria, including those of record length, record quality, and degree of diversion or regulation. These analyses resulted in the determination of those annual flow statistics necessary to define the long-term stochastic behavior of drought sequences for the selected streams.

A compilation of these values, along with pertinent geographic, geomorphic, and meteorologic characteristics of the associated drainage basins, were then used to develop quantitative procedures for estimating the annual flow statistics for ungaged watersheds. These procedures are based on the results of regional analyses and multiple regression techniques, and are applicable over the range of drainage basin characteristics and locations included in the study sample.

Using prior research results, described later, the actual or estimated annual flow statistics are related to the probability distributions of maximum drought events, through the application of the theory of runs. This has resulted in a general methodology for assigning return periods to drought events at gaged and ungaged locations, and permits an assessment of the probabilities of observed historical droughts throughout the state.

Although there are similarities between this effort and prior studies performed in this state as well as others, there are several unique aspects to the research described in this report:

a) This is the first examination of annual drought characteristics for many of the gaged streams within the state. It therefore provides valuable information for many streams not previously studied, including the probabilities of historical drought events.

b) To ensure the best representation of regional critical periods of historical drought, short-term flow records were extended, through multivariate analysis, to include as many such periods as possible. This extension was performed prior to the determination of long-term stochastic process statistics, and provides improved estimates of these statistics.

c) While several prior studies have developed methods for estimating the mean annual flow for ungaged areas within the state, this is the first study to develop such methods for other key annual flow statistics, including the variance, skew, and serial correlation coefficient.

d) The final results of the research is the first statewide application of a general drought risk-assessment methodology to both gaged and ungaged areas.

3. Specific Research Objectives

The specific objectives that guided the performance of work for this research project include:

a) To develop, through the use of multivariate modeling, extended annual flow records at all appropriate stream gage sites throughout the state and adjacent areas.

b) To determine, at these gage locations, reliable estimates of critical annual streamflow statistics that influence long-term drought behavior. These include the mean, variance, skew, and first-order serial correlation coefficient.

c) To examine the nature and characteristics of the probability distributions of drought length and severity at each of the studied gage locations, using run-theory applied to the long-term stochastic process.

d) To estimate, at these same locations, the probabilities of observed historical drought events, as defined by the long-term stochastic process.

e) To develop quantitative procedures for estimating the critical annual streamflow statistics at ungaged locations within the state, and to estimate the corresponding drought statistics and characteristics.

f) To prepare a microcomputer program to perform the necessary calculations and to permit the wide-spread dissemination and application of the study results.

The tasks, methodologies and results related to these objectives are described in the following chapters of this report.

CHAPTER 1

SELECTION AND INITIAL ANALYSIS OF STUDY STREAMS

1. Selection Criteria and Candidate Streams

For the state of Idaho and portions of neighboring states, there are more than 400 streamflow-measuring stations for which data are readily available from HISARS (20), a hydrologic/meteorologic database storage and retrieval system. Many of these records, however, are not suitable for the types of analyses performed during this research, for a variety of reasons.

As later chapters describe, the stochastic modeling used to extend the data periods and to define the characteristics of droughts requires an accurate determination of annual flow statistics from natural streamflow records. In this case, the term "accurate" implies that the data be of good quality, with a sufficiently large sample size to adequtely define the sample statistics and to meet parameter parsimony restrictions during modeling. "Natural" implies that the flow records be reasonably free from the effects of diversion and/or storage regulation. Based on these considerations, the following set of criteria was established against which the available records could be compared:

a) Record Length From the annual flow records, the following station statistics were to be calculated and used as input to various models and equations developed from models:

$\bar{x}$ = mean annual flow

s = standard deviation of annual flows

r = lag-one serial correlation coefficient

g = skew coefficient

A consideration of the sampling distributions and confidence intervals associated with these statistics indicates that, while s and $\bar{x}$ can be estimated adequately with limited data, r and g require a considerably larger sample size to minimize the standard error of estimate.

Additionally, the stochastic models based on these statistics require that certain rules of parameter parsimony be met (23). A general expression of this requirement is that the ratio of data observations, N, to the number of model parameters, K, should be as large as possible. If

$$\delta = \frac{N}{K} \tag{1.1}$$

is defined as an index of parameter parsimony, then, ideally, it is desirable for δ to be 10 or greater.

As a "worst case" scenario, the data extension models described in the following chapter require a maximum of 7 parameters, determined from the records of 2 stations. Therefore:

$$\delta = \frac{2N}{7} \tag{1.2}$$

and, for the constraint $\delta > 10$, N must be 35 years or greater.

Since so few stations were known to have data records of this size, the restriction of $\delta > 10$ was relaxed to $\delta > 6$, yielding a required sample size of approximately 20 years. One of the justifications for this relaxation is that, in many cases, the maximum number of model parameters is 5, instead of 7, yielding a value of $\delta = 8$ for $N = 20$. Therefore, the initial criteria for record length was established at $N \geqq 20$ years.

b) Record Quality The U.S. Geological Survey generally provides comments on record quality in their publications of "Water Resources Data." These comments are subjective, and use terms such as "fair," "good," or "poor." Frequently, a record may be described as "good" during the warm weather months and "poor" during the winter, due to ice problems at the gage.

Additionally, many of the gages are not operated during the winter season, yielding partial-year records which are not usable for annual flow studies.

Therefore, the selection criteria established for record quality include:

1. Selection of only those stations with continuous flow measurements (no partial-year data).
2. Selection of only those stations where the entire series is judged to be of "fair" or better quality.

c) Flow Diversions Because the diversion of flows out of the stream for use as irrigation water (or for other uses) distorts the natural flow records, all stations where diversions were considered "significant" in relation to the total annual flow were excluded. Again, this is a subjective criterion, and decisions to exclude were based on the notations provided in the USGS publications, as well as other documents related to irrigation use.

d) Flow Regulation Since annual flow records are not significantly affected by minor storage impoundments, it is possible to use the data from streams on which reservoirs may be located, as long as the storage volume is small compared to the total annual flow. Each potential candidate flow record that met the other criteria was reviewed for the degree of regulation, and all stations with known upstream impoundments that were judged to significantly distort the natural annual flow regime were excluded.

e) Additional Criteria Because of both flow diversions and regulation, all sites on the main stem of the Snake River were eliminated. In addition, sites where the USGS reported that the gage had been relocated by a substantial distance during the period of record were also eliminated.

The application of this set of criteria to the 438 available streamflow records resulted in the elimination of all but approximately 120 stations. These candidates were then reviewed for their geographic distribution, and where additional spatial coverage was necessary, the criteria were relaxed to include a number of stations with 18 or 19 years of record. This resulted in a total of 131 sites.

2. Initial Data Analysis

Using the data summary routines in HISARS, the flow records (stored in HISARS as daily values) were accessed for the 131 stations, and aggregated for each station to produce a file of annual flow values. For any station, if the flow records were incomplete during a particular water-year, that "annual" value was treated as "missing data" that could eventually be filled in during the data augmentation analysis. Print-outs of the annual flow records were obtained for all the stations, and reviewed to see if there were any obvious data base problems, such as negative flows.

Following the initial data summarization and review, the annual flow files were used as input to a statistical software package, and preliminary values of $\bar{x}$, s, g, and r were calculated. At each site, the entire record length was used in the calculation of the first three statistics. However, since the value of r is sensitive to gaps in the time-series, preliminary calculations of r were performed by using only the longest consecutive period of record at each gage.

The review of the raw data and the preliminary values of the statistics revealed problems with the data at several of the stations. At 5 locations, anomalous values of r (extremely high) indicated that the streamflow was either highly regulated, or resulted almost solely from groundwater seepage. A further examination of these station locations and characteristics substantiated these hypotheses, and the sites were therefore eliminated.

Two of the shorter-record stations had gaps in the middle of the record period, and since these stations already violated the desired record-length constraint, they were also eliminated.

Several of the stations had data observations in the very early years of this century (generally from the period 1900-1915), and then had significant gaps before data collection resumed. Since there was no apparent way, using the records at any other station, to eventually fill in these gaps, these early observations were deleted from the data files.

Finally, a number of the stations had missing data that were known to be available from the USGS. (For some reason, these values had never been added to the original HISARS files.) Contacts with the USGS to obtain the missing information resulted in the addition of about 30 station-years of data.

The preceding review and analysis therefore yielded 124 stations with data that were judged to meet the established criteria. A listing of these stations is provided as Table A.1 in Appendix A. Although no separate gage location map is included in this report, the geographic distribution of the sites can be seen by examining Figure 5.1, included in Chapter 5.

For the final set of 124 stations, revised files were prepared of the annual flow values, with the data additions and deletions previously discussed, and used to recalculate the station statistics. These results are provided as Table B.1 in Appendix B, and are more fully discussed in the following chapter.

CHAPTER 2

DATA AUGMENTATION

1. Introduction

Since streamflow may be described as a long-term stochastic process, the knowledge about the underlying characteristics of the process comes from the samples collected in the form of historical observations. Where these observations cover a long period of time (large sample size), the statistics of the process, as well as the related parameters of the models of that process, can be estimated more accurately. If the process is purely random, then the sample size has less impact than when the process shows time-dependency, especially a time-dependency that takes the form of long-term cycles.

There has been increasing evidence of the presence of such cycles in meteorologic and hydrologic data. Recent studies (13, 22) corroborate earlier conclusions (4, 28) that there is indeed a tendency for periods of prolonged and widespread drought to cluster on a recurrent time scale of approximately 20 years, at least in the western U.S. and Canada.

Within the state of Idaho, significant regional drought events have been observed during several historical periods. At streamflow sites where observations do not encompass any of the drought periods, the estimates of statistics such as $\bar{x}$ or s may not be representative of the long-term process, with a likelihood that $\bar{x}$ will be overestimated, while s is underestimated. Conversely, if the station were operated only during a low-flow period, $\bar{x}$ and s are both likely to be underestimated.

Therefore, the use of data extension for short-term records has two important functions:

a) It creates a quasi-historical record at a site that better reflects the regional occurrences of wet- and dry-year cycles.

b) It permits the calculation of station statistics, based on this extended, quasi-historical, record, that more adequately describe the long-term flow regime and process, provided that the cycles are accurately described in the data extension.

In addition, by using stochastic models to accomplish the data extension, relationships are developed that permit the fill-in of short gaps in the historical record, providing a continuous flow record more amenable to the types of run-analyses discussed in Chapter 3.

Accordingly, the models described in the following section are "data augmentation" models, to be used to either fill in data gaps, or to extend a data period forward or backward in time.

2. Model Description

Various forms of data augmentation models have been proposed in the literature (8, 18, 30). Generally, these are all classified as stochastic, multivariate models, indicating that they involve consideration of both time- and spatial- dependence.

One of these, a model developed by Yevjevich (30), was thoroughly tested during a prior study of stochastic modeling of Idaho streamflow (16) and found to offer certain advantages over competing models. It has a structure defined by the equations:

$$Z_{w,t} = r_w Z_{w,t-1} + (1-r_w^2)^{\frac{1}{2}} R_{n,1} \qquad (2.1)$$

$$Z_{y,t} = r_y Z_{y,t-1} + AR_{N,1} + BR_{N,2} \qquad (2.2)$$

where:

$Z_{w,t}$ = standardized flow values at station w

$Z_{y,t}$ = standardized flow values at station y

r_w = lag-one serial correlation coefficient at w

r_y = lag-one serial correlation coefficient at y

$R_{N,1}$, $R_{N,2}$ = random numbers from a standardized normal distribution

and A,B = model parameters determined from the equations:

$$A = \frac{r_{wy}(1-r_w r_y)}{(1-r_w{}^2)^{\frac{1}{2}}} \qquad (2.3)$$

$$B = \left[1-r_y{}^2 - \frac{r_{wy}{}^2(1-r_w r_y)^2}{1-r_w{}^2}\right]^{\frac{1}{2}} \qquad (2.4)$$

with r_{wy} = lag-zero cross-correlation coefficient for the flows at the two stations.

This model preserves the individual station statistics ($\bar{x}$, s, and r) as well as the cross-correlation, and can be used as long as the following constraint is not violated:

$$r_{wy}{}^2 \leq \frac{(1-r_y^2)(1-r_w{}^2)}{(1-r_y r_w)^2} \qquad (2.5)$$

To be applied as a data-augmentation model, it is assumed that station w is the "key" station, with actual data observations, while station y is the "subordinate" station for which data augmentation is to be performed. In this application, $R_{N,1}$ is no longer a random variable, but is defined from the key station time series by Equation 2.1:

$$R_{N,1} = \frac{Z_{w,t} - r_w Z_{w,t-1}}{(1-r_w^{\,2})^{\frac{1}{2}}} \tag{2.6}$$

If this is substituted into Equation 2.2, the following data augmentation equation is obtained:

$$Z_{y,t} = r_y Z_{y,t-1} + C(Z_{w,t} - r_w Z_{w,t-1}) + BR_{N,2} \tag{2.7}$$

where $C = A(1-r_w^{\,2})^{\frac{1}{2}}$.

To extend the data forward in time at the subordinate station, the last observed value at that station is entered as $Z_{y,t-1}$, and the model is used to calculate $Z_{y,t}$. Application continues in a step-wise manner, using the key station data and the previously generated subordinate station values.

For "backward" extension (to extend the subordinate record to cover a time period prior to the actual data), the time subscripts are simply reversed.

The model, as structured, generates standardized flow values which are converted to actual flows by the equation

$$X_{y,t} = \bar{x}_y + s_y Z_{y,t} \tag{2.8}$$

with $\bar{x}_y$ and s_y the annual flow statistics at station y.

The assumption of data normality is inherent in this model, and therefore both of the annual flow series must be normally distributed. For non-normal series, variable transforms can be used to achieve normality, and the inverse transform eventually applied to the generated variable values. A more detailed discussion of the normality tests follows later.

3. Station Pairings

Prior to the generation of subordinate station data, appropriate pairings of key and subordinate stations must be obtained. Basically, this consists of finding the long-term key station that can best be used to extend or fill in the data at the subordinate station. With a total of 124 stations the numbers of possible pairings exceeds 15,000, and therefore criteria were necessary to make the selection process manageable. These criteria, or decision-rules, involved the following considerations:

a) Location The 124 stations were grouped into hydrologic regions according to the major river/geographic basin designation of each. Six regions were defined:

Region 1	Idaho Panhandle Basin (19 stations)
Region 2	Clearwater River Basin (21 stations)
Region 3	Salmon River Basin (12 stations)
Region 4	Southwest Idaho Basin (28 stations)
Region 5	Upper Snake River Basin (32 stations)
Region 6	Bear Lake Basin (12 stations)

Since each region included a number of long-term stations ($N>40$ years), initial pair selections were made by examining only those pairs within the designated region.

b) Unexplained Variance - The term "$BR_{N,2}$" in Equation 2.7 represents a residual error, related to the portion of the total variance in $Z_{y,t}$ that is unexplained by the model. The actual fraction of unexplained variance is B^2, and when $B^2 = 0$ the model is assumed to predict perfectly the subordinate station values. From Equation 2.4, it is seen that the value of B^2 is a function of r_w, r_y, and r_{wy}, and one desired modeling goal is to minimize B^2.

An arbitrary limit of $B^2 \leq 0.30$ was chosen as a criterion of station pair selection, indicating that model applications would explain at least 70% of the dependent variable variance.

c) Station Similarity Where several potential pairs of stations satisfied the variance constraint, the pair judged to be the most similar in terms of basin characteristics (elevation, drainage area, vegetation, geology, etc.) was selected.

d) Data Overlap The actual historic extent of each station's record influences the choice of appropriate pairings. For example, assume that two key stations have periods of records of 1930-1970 and 1930-1984, respectively, and both satisfy the previously discussed pairing considerations for a subordinate station with a 1940-1965 data period. While either one might be selected to extend the subordinate gage data to cover the 1930-1939 time period, the second key station is preferred for forward-time extension, since it permits the addition of the 1966-1984 data.

Therefore, it is possible to consider several possible pairings for a single subordinate gage, depending on the record periods involved. To evaluate this consideration, time-lines were drawn for each region, indicating the record length of each gage. A review of these graphs indicated the logical pairings that would maximize the ability to use the available long-term data, subject to all the other considerations.

e) Model Constraint The model constraint defined by Equation 2.5 cannot be violated, without introducing nonstationarity into the modeling process. Pairings that did not satisfy this constraint were eliminated.

f) Other Statistical Considerations Insofar as possible, the pairings attempted to recognize the serial correlation and skew coefficients calculated at each station. All other factors being equal, the pair of stations with similar skew and serial correlation coefficients was selected.

Based on all of the above considerations, preliminary pairings were selected and were then examined in more detail as the model application was actually begun.

4. Model Application

Before beginning the data augmentation process, the original data statistics (Table B.1) were reviewed to test for normality, since this is a critical model assumption. The hypothesis that the skew coefficient is not significantly different from zero was tested using approximate 95% confidence limits around a g = 0 value:

$$0 \pm 1.96 \left(\frac{6}{N}\right)^{\frac{1}{2}} \tag{2.9}$$

For station skew coefficients outside of these limits (indicated by "*" in Table B.1), the hypothesis of normality was rejected, and any use of these stations would therefore require variable transforms. For the other stations, the flow series were considered to be normally distributed..

Tests were also performed on the values of the serial correlation coefficients, using 95% confidence limits around a r=0 value as defined by Anderson (1):

$$\frac{-1 \pm 1.96(N-2)^{\frac{1}{2}}}{N-1} \tag{2.10}$$

None of the negative values of r tested significantly different from zero (as shown in Table B.1). Since there is no physical justification for a negative r, and since none were significantly different from zero, all of the negative values were assumed to equal zero.

Therefore, for all station pairs where both stations were assumed to have normally-distributed data, the model parameters were based on:

a) The station values of $\bar{x}$ and s from the entire sample length

b) The station values of r from the entire sample length, or r=0 (whichever was greater)

c) The value of r_{wy}, determined from a statistical analysis of the record in common at both stations.

For the station pairings where either or both of the stations had values of g significantly different from zero, the annual flow values, X, were transformed using a logarithmic transform:

$$Y = \ln X \tag{2.11}$$

In all cases where g was significantly different from zero, the values indicated positive skewness, and a logarithmic transform is generally helpful in reducing such skew.

After the variable transformation, the statistics of the logarithms were calculated ($\bar{x}_1$, s_1, r_1, g_1) and the skew coefficients again tested. All of these tests now indicated that the transformed data could be assumed to be normal.

Therefore, for the station pairs where either or both flow series were transformed, the model parameters were based on:

a) The station values of $\bar{x}$ and s, or the transformed values $\bar{x}_1$ and s_1, as appropriate.
b) The station values of r (or r_1 for the transformed data), or zero (whichever was greater)
c) The value of r_{wy}, determined by the record period in common, using the transformed data at one or both stations.

Two computer models were developed to perform the data extension: one termed "linear", the other termed "log". The linear model used the previously-given equations, while the log model included the necessary transforms of the X_y and/or the X_w data, followed by the appropriate inverse transforms to yield arithmetic values of $X_{y,t}$.

One of the problems with any log model such as this one is that the statistics of the transformed variables Y are preserved in the modeling process, but, after inverse transformation, the statistics of X may not be preserved. Fortunately, however, relatively few station pairs (twelve) required the use of the log model.

5. Results of Data Augmentation

Table 2.1 presents a summary of the data augmentation results for the 124 stations. Data were added, using the models, to 80 of the stations, increasing the total station-years of data from 4413 to 6348. This yielded an average record length of 51.2 years, compared to the original average of 35.6 years.

Table 2.1

Summary of Data Augmentation

Total Number of Stations Analyzed = 124
Total Number of Stations Augmented = 80

Total Station-Years of Historical Data = 4413
Total Station-Years of Augmented Data = 1935

Total Station-Years = 6348
Average Years/Station = 51.2

Number of Years	Number of Stations With: Historical Data	Augmented Data	Total Data
<10	0	59	0
10-19	12	13	6
20-29	41	22	18
30-39	27	20	3
40-49	18	7	18
50-59	18	3	31
60-69	7	0	38
>=70	1	0	10

For the 44 stations where no augmentation was performed, either the original record could not be paired with another station that had a longer record, or the models could not be applied due to violations of the previously discussed constraints or other considerations.

Table 2.2 presents a summary of the model performance in terms of the percent of the total dependent variable variance explained by the model relationships. The desired goal of 70% explained variance or better was exceeded in all but 6 cases, with 63 out of the 81 station pairings providing better than 80%. As previously stated, only 12 station pairings required the use of the log model.

Table 2.2

Percent of Variance Explained by Models

% Explained Variance	Number of Station Pairs Linear Model	 Log Model
< 0.70	4	2
0.70-0.75	3	0
0.75-0.80	5	4
0.80-0.85	9	2
0.85-0.90	12	4
0.90-0.95	18	0
> 0.95	18	0
Total:	69	12

Following the completion of the data augmentation modeling, the generated data at the subordinate stations were added to the original data files, with a negative sign to distinguished the generated from the observed values. The statistics of the augmented files were recalculated, with the results presented in Table B.2 of Appendix B. As with Table B.1, the results of the hypothesis tests for the serial correlation and skew coefficients are indicated by an "*" in the table. With the augmented records, 21 values of r tested significantly different from zero (compared to 17 before augmentation) and 17 values of g were significantly different from zero (compared to 15 originally).

For the analyses of drought probabilities, described in the subsequent chapters, the augmented data statistics from Table B.2 were used in defining all model parameters.

CHAPTER 3

DROUGHT DEFINITION BY NEGATIVE RUNS

1. Introduction

Hydrologists have traditionally disagreed on the proper definition of droughts, as well as the methodologies sufficient to characterize them. Dracup et al (5) have suggested that this problem arises from the conflicting concepts held by the variety of academic fields interested in drought consequences. Numerous prior studies (3, 12, 15, 29) have offered differing approaches based on streamflow, precipitation, and soil moisture, with an array of potential statistical properties that should be included in an analysis.

Since, for most engineering applications related to water resources development, a process-oriented definition is most useful, this study has concentrated on droughts as defined by streamflow, rather than input such as precipitation. Based on streamflow analysis, therefore, droughts are characterized (5) using three components: the duration of low flow, the average deficiency, and the severity (cumulative deficiency).

2. Theory of Runs

A most useful method of examining the behavior of these components is through the use of the theory of runs (19, 24) which establishes a base level ("truncation level") of streamflow, and examines all the positive and negative departures from this level. Since the negative departures are of primary interest in drought analysis, the two critical parameters for each drought event become the total duration of a negative run, and the magnitude (run-sum) of the cumulative deficit (inflows less than the selected truncation level). This approach permits a consideration of both within-year drought events as well as multiple-year (carryover) events, although the assignment of probabilities to a specific historical negative run-length or run-sum remains a problem, especially in short-term records.

To illustrate the application of run-theory to an annual streamflow record, Figure 3.1 presents the annual flow data for the South Fork of the Boise River near Featherville. For the assumed truncation level, X_o, all flows less than X_o represent deficit years, or negative runs. The duration of each negative period is defined as its run-length, L, while the total deficit within that period is the run-sum, S. With this sample size, N, consisting of 38 years of historical data, the maximum negative run-length, L_{max}, is 3 years (1959-1961) and the maximum negative run-sum, S_{max}, is 157,200 cfs-days (1977).

The truncation levels for performing the run-analysis are generally expressed as a function of quantiles, q_o:

$$q_o = P(X \leq X_o) \tag{3.1}$$

where X = annual streamflow. For normally distributed flows, the probabilities associated with each value of X_o are determined from a standardized normal distribution. In general, however, the

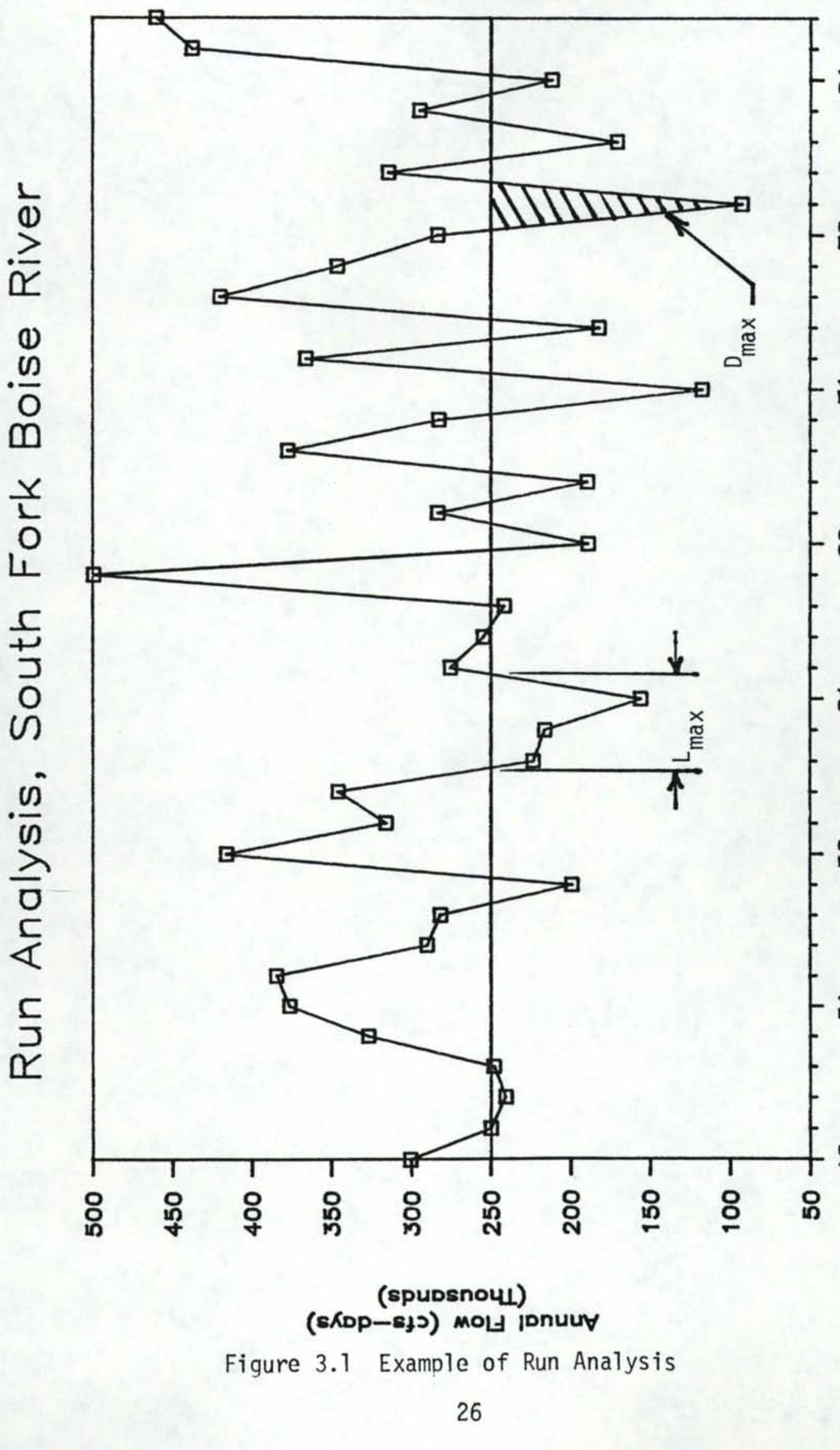


Figure 3.1 Example of Run Analysis

probabilities are derived from a Pearson Type III approximation to the gamma distribution, which permits the station skew to be considered.

Table 3.1 lists the values of k_0 associated with three selected values of q_0 and a range of skew coefficient values. For a given combination of q_0 and g, the related value of X_0 can be calculated from the equation:

$$X_0 = \bar{x} + sk_0 \tag{3.2}$$

where $\bar{x}$ and s are, respectively, the mean and standard deviation of the annual flow series. By interpolation from the tabulated values, X_0 can be determined for any value of g from 0.0 to 2.0.

Table 3.1

Values of k_0 as a Function of g and q

g	$q_0 = 0.5$	$q_0 = 0.35$	$q_0 = 0.20$
0.0	0	-0.389	-0.842
0.5	-0.083	-0.453	-0.857
1.0	-0.164	-0.506	-0.852
1.5	-0.240	-0.545	-0.825
2.0	-0.307	-0.566	-0.777

As the value of q_0 decreases, the value of X_0 also becomes smaller, and fewer flows are identified as negative run events. For $q_0 = 0.2$, 80% of the annual flows exceed the truncation level, and for $q_0 = 0.5$, 50% are in excess.

3. Stochastic Methods for Defining Droughts

Limiting drought analyses to the historical record available at a streamflow gaging site, the traditional approach to reservoir design has often relied on the use of the "critical period" in the record (2, 26), a period in which the combination of demand and hydrologic input would have imposed the most severe constraint on a design. Such an approach examines the length and severity of the drought in terms of varying demand levels on the system, usually resulting in estimations of required storage to meet each demand.

However, even in cases where a relatively long streamflow record exists, a design based purely on the extreme event, such as the critical period, may imply an unquantifiable risk level associated with design failure. The use of historical records as the sole basis for design also introduces an element of inconsistency into the design approach, since different projects will have very different assumed risk levels. This may result in under- or over-sized projects with economics far from the desired optimum.

Two approaches have been used to minimize hydrologic uncertainty in the design of large water resources projects: deterministic modeling of the hydrologic process and stochastic modeling of the streamflow. While deterministic modeling has a number of useful applications, it also has certain drawbacks, including model complexity, significant data requirements, and costs of application.

Researchers have recognized the stochastic nature of the streamflow process, and have attempted to overcome some of the drawbacks of deterministic modeling by statistical or stochastic simulation of the process. More recently, the behavior of droughts, as part of the long-term stochastic streamflow process, has been examined in some detail, through the use of various types of stochastic streamflow generation models.

Stochastic methods applied specifically to drought analysis have resulted in conflicting conclusions regarding their ability to simulate extreme drought events. Askew et al (2) concluded that, in general, stochastic generation methods yielded synthetic critical drought periods significantly less severe than their historical counterparts. However, Millan and Yevjevich (19), using different methods, found many examples of generated flow sequences with critical periods more severe than indicated by the historical records. Dracup et al (6) also re-examined Askew's work and offered reasons why Askew's apparent conclusions may be in error.

Recently completed research (16) on two streams in Idaho corroborate the conclusions of Millan and Yevjevich, and indicate that when the long-term stochastic process is used to define the return periods of drought length and severity, these return periods may be either significantly greater or less than the return period assigned to historical events using the record length as a basis. This recent research concludes that the theoretical and experimental results obtained by Millan and Yevjevich offer an easily-applied methodology for assessing the stochastic behavior of droughts.

In summary, this methodology involves the determination of the mean, standard deviation, coefficient of skew, and the first-order serial correlation coefficient ($\bar{x}$, s, g and r, respectively) for the annual flow sequence at a gage. Using a lag-one autoregressive model of the annual flows based on these statistics, Millan and Yevjevich generated 95,000 years of standardized flow data, with a range of g and r values. They used these experimental data sets to determine the cumulative probability distributions of the maximum run-length, L_{max}, and the standardized maximum run-sum, D_{max}, for various sample lengths, N, and truncation levels, q_o. The standardized run-sum, D_{max}, is related to S_{max} by the equation:

$$S_{max} = D_{max}s \qquad (3.3)$$

From all samples of a given size, the median values of L_{max} and D_{max} (L_m and D_m, respectively) were used as the measure of drought characteristics to be associated with a given return period, T, shown to be equivalent to the sample size, N. The experimental results were consistent with those obtained theoretically, and were summarized with sets of equations that relate L_m and D_m to values of N, q_o, g and r.

Since L_m and D_m represent the median values of L_{max} and D_{max} in a large number of samples with length N, they both have a 50% exceedance probability in any single N-year period. However, by the use of probability limits placed around the median values, droughts associated with other exceedance risks can be related to the same statistics used to determine L_m and D_m.

4. Equations for Defining the Probabilities of Negative Runs

The results of Millan and Yevjevich indicate that the cumulative probability distributions of maximum negative run-length, L_{max}, and run-sum, D_{max}, can be best fitted using lognormal probability distributions. With a lognormal approximation, the mean and median of the logarithms of the data are assumed to coincide, and the antilogs of the means of these distributions provide reasonable estimates of the median values L_m and D_m.

By assuming that the parameters of the lognormal distributions satisfy a general relationship of the form

$$u = f(\ln N, \ln q_o, \ln g, \ln r), \tag{3.4}$$

Millan and Yevejvich performed a series of stepwise multiple regression analyses to define equations for the distribution parameters, for the ranges of N, q_o, g, and r used in their stochastic models. These results are summarized in the following four equations:

$$\begin{aligned}\bar{x}_L = {} & 1.275 + 0.9024 \ln q_o + 0.2703 \ln N \\ & + 0.00156 \ln(g+.0001) + 0.0237 \ln(r+.0001)\end{aligned} \tag{3.5}$$

$$\begin{aligned}s_L = {} & 0.5882 - 0.0363 \ln q_o - 0.0647 \ln N \\ & + 0.00015 \ln(g+.0001) + 0.0021 \ln(r+.0001)\end{aligned} \tag{3.6}$$

$$\begin{aligned}\bar{x}_D = {} & 1.1336 + 1.1876 \ln q_o + 0.3046 \ln N \\ & - 0.0162 \ln(g+.0001) + 0.0273 \ln(r+.0001)\end{aligned} \tag{3.7}$$

$$\begin{aligned}s_D = {} & 0.6729 - 0.0453 \ln q_o - 0.0776 \ln N \\ & - 0.0004 \ln(g+.0001) + 0.0065 \ln(r+.0001)\end{aligned} \tag{3.8}$$

where $\bar{x}_L$ is the mean of the logarithms of L_{max}; s_L is the standard deviation of the logarithms of L_{max}; $\bar{x}_D$ is the mean of the logarithms of D_{max}; and s_D is the standard deviation of the logarithms of D_{max}.

From these equations, estimates of L_m and S_m are obtained by:

$$L_m = \exp\ (\bar{x}_L) \tag{3.9}$$

$$S_m = s(\exp\ (\bar{x}_D) \tag{3.10}$$

These values therefore define a "representative drought" for a sample size N, and are the droughts that would be exceeded or not exceeded 50 percent of the time if many samples of length N were repeatedly generated using the stochastic process model. With N as an indication of return period, T, the use of these equations offers a means of relating probability of occurrence to the median, or representative, drought events.

An examination of the regression coefficients in Equations 3.5 through 3.8, as well as the partial correlation coefficients calculated by Millan and Yevjevich, reveals that the most significant independent variables are N and q_0. The lag-one serial correlation coefficient is next in importance, and has a significant effect on $\bar{x}_L$ and $\bar{x}_D$. This is due to the fact that a large serial correlation implies "persistence" in the drought events, with an increased likelihood of multiple-year droughts. Skewness has the least impact on the parameters, and, in fact, can be shown theoretically to have no influence on the values of L_{max} for an independent time series.

By assuming a lognormal distribution of L_{max} and D_{max}, exceedance limits can be placed around the means $\bar{x}_L$ and $\bar{x}_D$. For example, with many samples of size N, p percent of the values of the logarithms of L_m will exceed the limit y_L:

$$y_L = \bar{x}_L + z_p s_L \tag{3.11}$$

where $y_L = \ln X_L$ and z_p is the standardized normal deviate associated with an exceedance probability of p/100. Similarly,

$$y_D = \bar{x}_D + z_p s_L \tag{3.12}$$

Therefore, for a given exceedance limit p,

$$X_L = \exp\ (y_L) \tag{3.13}$$

$$X_S = s(\exp\ (y_D) \tag{3.14}$$

Table 3.2 provides values of z_p for various exceedance limits, based on a normal probability distribution.

Table 3.2
Exceedance Limit Versus z_p

Exceedance Limit, p	z_p
2%	2.054
10%	1.282
25%	0.674
50%	0

As an example application of the preceding equations, assume that the following station statistics are used to define a stochastic process model and to determine drought characteristics related to negative runs:

Mean annual flow = $\bar{x}$ = 100,000 cfs-days

Standard deviation = s = 30,000 cfs-days

Skew coefficient = g = 0.5

Lag-one serial correlation coefficient = r = 0.3

Further assume that the drought characteristics (run-length and run-sum) are desired for a truncation level of 0.35 and a sample size of 100. By Equation 3.2, the truncation level for $q_0 = 0.35$ and $g = 0.5$ is calculated to be $X_0 = 86{,}410$ cfs-days (65% of the flows generated in a long sequence will exceed this level).

From Equation 3.5, $\bar{x}_L = 1.5428$, and L_m is estimated by Equation 3.9 to be 4.68 years. This indicates that in many generated samples with length N = 100, the median negative run-length is 4.68. In 10% of those samples, however, longer run-lengths would have been obtained. To obtain this value of L, Equations 3.6, 3.11, and 3.13 are used:

$s_L = 0.3257$ (from Equation 3.6)

$y_L = 1.9604$ (from Equation 3.11, with $p = 10\%$)

$X_L = L = 7.10$ years (from Equation 3.13)

For the negative run-sums, $\bar{x}_D = 1.2679$ by Equation 3.7, and $S_m = 106{,}600$ cfs-days by Equation 3.10. Again, this is the median deficit, and if the deficit exceeded in 2% of the samples is desired, Equations 3.8, 3.12, and 3.14 can be used:

$s_D = 0.3556$ (from Equation 3.8)

$y_D = 1.9982$ (from Equation 3.12, with $p = 2\%$)

$X_s = 221{,}270$ cfs-days (from Equation 3.14)

It is noted that there are several potential sources of error in using Equations 3.5 through 3.14:

a) The assumption of a lognormal distribution was found to be valid for most of the cases reviewed by Millan and Yevjevich. However, for values of $r = 0.7$, they found that the lognormal function deviates at the extremes from the experimentally developed frequency distributions.

b) Although the regression equations had multiple correlation coefficients of 0.95 or greater, the fit was not perfect; and the unexplained variance represents a residual error when the observed and equation-calculated parameters are compared.

c) The antilogs of $\bar{x}_L$ and $\bar{x}_D$ are only approximations to the values of L_m and D_m (the medians) but for positively-skewed data, the approximation is reasonably correct.

d) The range of parameters for which Millan and Yevjevich developed experimental distributions included the following:

1. $0 \leq g \leq 1.0$
2. $0 \leq r \leq 0.7$
3. $25 \leq N \leq 500$
4. $0.2 \leq q_0 \leq 0.50$

The equations should not be used to extrapolate beyond these limits, since additional errors could be introduced.

Even with the foregoing limitations and potential error sources, the developed equations provide a reasonable method for relating sample size (hence, a measure of return period) and truncation level to drought length and deficit. In the following chapter, these and related equations are applied to the study streams to evaluate not only the long-term stochastic behavior of droughts, but to estimate the return periods of historical events as well.

CHAPTER 4

DROUGHT CHARACTERISTICS OF THE STUDY STREAMS

1. Introduction

By applying the equations from Chapter 3, along with the extended data statistics developed in Chapter 2, the long-term stochastic drought characteristics can be developed for each of the study streams. While this provides considerable information about the stochastic process at each site, it does not necessarily define the probabilities or return periods associated with observed historical droughts.

To accomplish this, the historical annual flow data at each station was examined using the theory of runs, with truncation levels defined from the extended data statistics. For each of the selected truncation levels (q_0 = 0.2, 0.35, and 0.50), the values of L_{max} and S_{max} were calculated and tabulated.

In the previous chapter, the concept of a "representative drought" associated with a given sample size N was introduced. As an alternative approach for describing the relationship between return period and L or D, Millan and Yevjevich (19) presented the following equations, based on their experimental results:

$$\begin{aligned} \ln N_r = {} & -2.1125 + 0.6865\, L_{max} - 2.8202 \ln q_0 \\ & -0.07962 \ln(r+.0001) - 0.00588 \ln(g+.0001) \end{aligned} \qquad (4.1)$$

$$\ln N_r = -1.2536 + 0.65044\, D_{max} - 2.8296 \ln q_o - 0.0804 \ln(r+.0001) + 0.03641 \ln(g+.0001) \qquad (4.2)$$

where N_r is defined as the "representative sample size" for the largest run-length or run-sum in a historical sample of length N.

Theoretically, N_r is the size of a sample that should have the historical drought as its mean event, if repeated samples were stochastically generated. It therefore relates N_r (or, return period) to the mean event, while the previous equations in Chapter 3 related N to the median event. Both concepts, however, are meaningful and provide alternate approaches to studying the probabilities of historical droughts.

2. Typical Results of Drought Analysis at a Gaging Station

For each study stream with a consecutive historical data period of 30 years or more, a table of drought characteristics, with estimates of the return periods of historical events, was prepared. These tables (C.1 through C.63) are presented in Appendix C. A copy of Table C.48 is included here as Table 4.1, so that a complete description of the sources of the contained information can be provided.

For this gaging station (the Salmon River near Challis, ID) the initial lines of Table 4.1 summarize the length characteristics of the data base. The total period of historical data (43 years) covers the years 1929 to 1971. These data were extended to cover the periods 1922 to 1928 and 1972 to 1984, based on station-pairings that met the augmentation criteria, adding 20 more years of data.

TABLE 4.1

SALMON RIVER NEAR CHALLIS,IDA
STATION NO. 13.2985.00 (PROJECT ID NUMBER 102)

TOTAL RECORD LENGTH = 63 YEARS (1922 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 43 YEARS (1929 TO 1971)
TOTAL YEARS, HIST. DATA = 43 TOTAL YEARS, ADDED DATA = 20
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 547702 cfs-days SERIAL CORR. = 0.043
STANDARD DEVIATION = 149701 cfs-days SKEW COEFF.= 0.366
FOR q(o)=.50, TRUNCATION LEVEL = 538600 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 482432 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 420079 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.2	5.5	7.1	9.6
25	0.35	3.1	4.1	5.2	7.1
25	0.20	1.9	2.5	3.2	4.5
50	0.50	5.1	6.5	8.0	10.6
50	0.35	3.7	4.7	5.9	7.9
50	0.20	2.2	2.9	3.7	4.9
100	0.50	6.2	7.6	9.2	11.6
100	0.35	4.5	5.5	6.7	8.6
100	0.20	2.7	3.4	4.2	5.4

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	507799	680581	886367	1239637
25	0.35	332453	450452	592445	838969
25	0.20	171040	235742	314869	454703
50	0.50	627171	810642	1021785	1370903
50	0.35	410605	536534	682958	927809
50	0.20	211248	280793	362975	502852
100	0.50	774604	965558	1177894	1516070
100	0.35	507129	639067	787300	1026056
100	0.20	260907	334453	418430	556100

HISTORICAL DROUGHTS, BASED ON 43 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	532	1103608	304
0.35	3	24	305566	26
0.20	1	29	108158	54

Based on the entire 63 year period, the statistics of the annual flows were calculated and summarized, along with the truncation levels X_o associated with three selected values of q_o.

Drought lengths, L_m, associated with the three truncation levels and three sample sizes (N=25, 50, and 100 years) were calculated using Equations 3.5 and 3.9, and appear as the "median length" column. For other exceedance levels of 25%, 10% and 2%, the lengths were calculated by Equations 3.6, 3.11, and 3.13.

Drought magnitudes (the deficit, S_m) were similarly calculated from Equations 3.7 and 3.10 and are listed in the "median deficit" column. Again, the values of S for other exceedance limits were determined, in this case using Equations 3.8, 3.12, and 3.14.

For the historical droughts, the run-analyses applied to the 43-year consecutive historical period resulted in the maximum run-lengths and maximum run-sums shown in the lower portion of the table. Using Equation 4.1, values of N_r were calculated for each of the three truncation levels, and assumed to be equivalent to the return periods for L_{max}. Therefore, at $q_o = 0.50$, and $L_{max} = 9$ years, a value of $N_r = T = 532$ years was obtained. For the maximum deficits shown, the standardized deficits D_{max} were obtained (Equation 3.3) and used in Equation 4.2. As before, the resulting values of N_r were assumed to represent the return periods, T, associated with each D_{max}.

Several cautionary comments are necessary in the use of this and the other Appendix C tables. First of all, the historical return periods are only estimates, albeit reasonable ones. The conclusions that may be properly developed from the lower portion of this table are that, at $q_o = 0.50$, the worst historical event was a severe one (certainly larger than might normally be expected in a data period of 43 years), while at $q_0 = 0.20$, the historical deficit of record is somewhat representative of the sample size of 43 years.

Second, since the historical return periods are based on the mean event from a sample of size N_r, there may be inconsistencies between these return period values and the "sample sizes" shown in the other portion of the table. In one case, sample size is related to the median event, and in the other case N_r is related to the mean. As previously stated, however, these are simply alternative approaches to the same problem; and the inconsistencies generally are small.

Third, the equations used to prepare these tables do not permit either a negative skew coefficient or a negative serial correlation coefficient. Both of these parameters were assumed to have lower limits of zero in the Millan and Yevjevich study, from which the equations were taken. In fact, there is no physical justification for negative serial correlation coefficients. Accordingly, if the extended-data values of these parameters were negative, they were set equal to zero before using the equations.

When one examines the summary of the extended data statistics in Appendix B (Table B.2), this restriction does not appear unreasonable. For 124 stations, only 26 had negative skewness, and none of these 26 values tested significantly different from zero. For the serial correlation coefficients, 37 stations had negative values, again with none testing significantly different from zero. (Of the 37 with negative values, 23 were greater than -0.10.)

Finally, although the return periods of the historical events are tabulated as calculated from the equations, the limits of N in the

Millan and Yevjevich study are from 25 to 500 years. Therefore, any values of return period less than 25 or greater than 500 represent extrapolations beyond the original data, and may not be valid. If, for example, a calculated return period of 2300 years appears in the table, this should be interpreted only as "greater than 500 years".

3. Summary of Results For All Stations

For the 63 stations presented in the Appendix C tables, it is interesting to examine the return periods assigned to the historical events, and, specifically, those for the maximum observed deficits. For the three truncation levels analyzed, Table 4.2 presents the number of stations with historical deficit return periods in various ranges. With $q_0 = 0.2$, for example, 27 stations had maximum historical deficits with a calculated return period in the range of 51 to 100 years.

Table 4.2

Summary of Historical Deficit Return Periods

Return Periods	Number of Stations in Stated Range $q_0 = 0.5$	$q_0 = 0.35$	$q_0 = 0.2$
≦ 25	15	12	0
26 - 50	22	27	8
51 - 100	5	20	27
101 - 500	12	3	28
> 500	9	1	0

Since the average historical data length for the 63 stations is 46 years, it might be anticipated that most of the "samples" would evidence drought return periods somewhat representative of the average sample length, if they are random samples from the long-term stochastic process. This is certainly true for the middle truncation level, with 47 stations having deficit return periods between 26 and 100 years, and only 4 in excess of 100 years.

However, for $q_0 = 0.50$ (equivalent to a "demand" on the supply near the mean annual flow), 21 stations had observed events with return periods exceeding 100 years (9 in excess of 500 years). Although no attempt was made to review each station's data to determine the actual historical dates of these significant events, a cursory examination of several stations showed that the periods of 1929-1931 and 1939-1942 seem to be major droughts.

For $q_0 = 0.2$ (equivalent to a much lower demand), nearly all of the stations experienced drought events with return periods in excess of 50 years. A review of a small sample of the stations indicates that the maximum deficit for this q_0 often occurred in the 1977 drought year.

If the entire extended record period had been treated as a "quasi-historical" sample for each station, then the results would likely be different. By data extension, the additional years at each site may now include drought events that are larger than those actually observed. Further study is necessary to better describe not only the return periods of these quasi-historical events, but also to characterize the historical dates of all the maximum events and any regional patterns that these dates may imply.

CHAPTER 5

ANNUAL FLOW STATISTICS AND DROUGHT CHARACTERISTICS FOR UNGAGED STREAMS

1. Introduction

Various studies (5, 25) have attempted to address the problem of defining the characteristics of drought events for ungaged areas, typically through the use of regional homogenity concepts. This approach divides a large geographic area into relatively homogeneous subregions, based on either hydrologic, climatic, or geomorphic considerations, and assumes that within each region a single drought frequency curve is applicable.

The approach used in this project differs from many of the prior drought investigations, and relies on the linkage between the statistical properties of droughts and the statistics of the annual flow series, as previously discussed. Just as this linkage can be applied to gaged areas, where the key statistics ($\bar{x}$, s, g, and r) are known, it can also be applied to ungaged areas if methods are available to estimate these same statistics.

A number of other studies (9, 10, 27) have used regression analysis to develop relationships between flow statistics and watershed characteristics, and have then applied these relationships to ungaged areas. In Idaho, prior studies for hydropower purposes (7, 14) have derived procedures for estimating the mean annual flow using a runoff-coefficient approach, with the runoff-coefficient based on gaged flows and mean annual precipitation.

In a study of flood-frequency relationships for Idaho streams (17), regression equations were developed for estimating the mean and variance of annual flood peaks at ungaged sites. This work involved the compilation of a number of pertinent drainage area and climate characteristics for each gage within the state, which were then related, through regression analysis, to the station statistics. A similar approach was selected for this annual flow study, relying on the availability of the previously tabulated basin characteristics (17) as independent variables for the regression analyses.

Although a regression approach is generally valid for relating $\bar{x}$ and s to basin characteristics, most prior studies have concluded that maps of "generalized" values of g and r offer the best estimation approach for these statistics. Such maps, similar to the one developed for annual flood flow skew coefficients in the previously-cited flood-frequency study, depict the general spatial variability of the statistic, rather than the individual station values. A mapping approach was therefore selected for this study, with the goal of developing generalized maps for estimating both g and r for ungaged streams.

The following sections of this chapter describe the approaches used and present the resulting equations and maps developed for estimating $\bar{x}$, s, g, and r.

2. Equations for $\bar{x}$ and s

With the extended-data estimates of $\bar{x}$ and s (Table B.2) as the dependent variables in a multiple regression analysis, the following general equation was assumed as the functional relationship to be defined:

$$u = aC_1^{b_1}C_2^{b_2} \ldots C_i^{b_i} \tag{5.1}$$

where u = flow statistic

a, b_i = regression coefficients

C_i = basin characteristics

This relationship is made linear by taking logarithms of both sides, and a multiple linear regression is then performed using the logarithms.

Pertinent basin characteristics available from the flood-frequency study (17) were obtained and related to the 124 study streams. For approximately 20 streams, one or more of these characteristics were missing, but subsequent contact with the USGS provided each of the characteristics listed below for all but 10 stations. Therefore, the final data set included 114 stations with the following independent variables:

a) <u>Drainage Area (DA)</u> The area, in square miles, contributing to the flow at the gaging station.

b) <u>Mean Altitude (MA)</u> The mean elevation of the basin, defined by a grid-overlay approach

c) <u>Mean Annual Precipitation (MP)</u> The average precipitation, in inches, for the basin, determined by a grid-overlay method using a 1930-1957 mean annual precipitation map.

d) <u>Length (LE)</u> The total distance, in miles, along the main channel from the gage to the basin divide.

e) Slope (SL) The average slope of the main channel, in feet per mile, in a reach from the 10th to the 85th percentile of the length upstream from the gage.

f) Forest Cover (FC) The percentage of the basin covered by forests, determined by a grid-overlay method (A minimum value of 1% is used in the regression analyses).

The values of these characteristics for the 114 stations are included as Table D.1 in Appendix D.

Using a standard statistical software package (SAS), regression analyses were performed on the data, with the data regionalized on the basis of geographic location. From the results of these initial analyses, using different combinations of the 6 original geographic areas, it was determined that a grouping of the 6 previously-defined regions into 2 larger regions yielded the best predictive results:

a) Region A: north-central Idaho (including the former Regions 1, 2 and 3), with a total of 51 stations.

b) Region B: southern Idaho (including the former Regions 4, 5, and 6), with a total of 63 stations.

Regionalization was also attempted on the basis of significant basin characteristics such as area, altitude, precipitation, and forest cover, with no improvement in the results. Combinations of geographic and basin characteristic regionalization were also used, again with no significant improvement.

A review of the numerous regression equations, with the associated correlation coefficients, standard errors of estimate, and plots of the data, provided the conclusion that the best relationships for predicting $\bar{x}$ and s consist of the following separate equations for Region A and Region B:

$$\text{Region A:}\quad \bar{x} = 0.98\ DA^{0.922}\ MP^{1.444}\ FC^{0.337} \qquad (5.2)$$

$$\text{Region A:}\quad s = 1.757\ DA^{0.902}\ MP^{1.379} \qquad (5.3)$$

$$\text{Region B:}\quad \bar{x} = 1.167\ DA^{0.947}\ MP^{1.132}\ FC^{0.518} \qquad (5.4)$$

$$\text{Region B:}\quad s = 2.038\ DA^{0.919}\ MP^{0.831}\ FC^{0.365} \qquad (5.5)$$

Figure 5.1 shows the Region A and B boundaries for selecting the appropriate equations, as well as the approximate location of the gaging stations used in the analyses.

These final equations involve, at most, only 3 of the independent variables, since the inclusion of other variables contributed very little in improving the regression results. Table 5.1 presents the multiple determination coefficient, R^2, and the standard error of estimate, S_e (as a percent) for the logarithms of the variables.

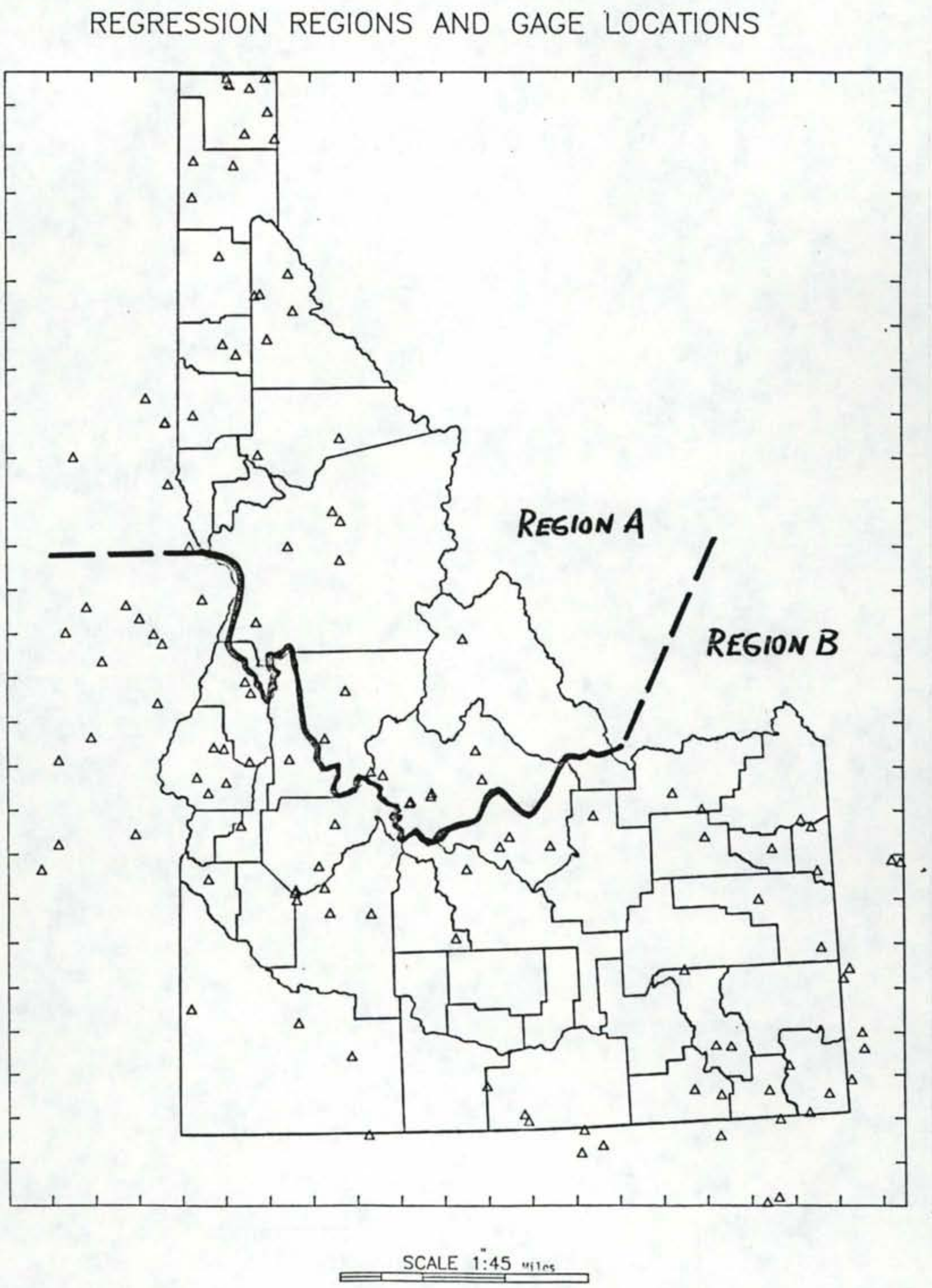


Figure 5.1 Regression Regions and Gage Locations

Table 5.1

Logarithmic Regression Results

Region	Equation for:	R^2	Standard Error of Estimate (%)	
			Average	Range
A	log $\bar{x}$	0.961	30	+35 to -26
A	log s	0.959	29	+33 to -25
B	log $\bar{x}$	0.816	69	+100 to -50
B	log s	0.829	61	+84 to -54

It can be seen that the results for Region A are much better than those for Region B, with higher values of R^2 and much lower standard errors of estimate. Further research is necessary to improve the equations for Region B, possibly by including additional independent variables related to soil types and surficial geology.

When a logarithmic regression is performed, the values of R^2 and the standard error of estimate reflect the goodness-of-fit of the logarithms of the data, and not the untransformed variable values. As an approach to defining R^2 and S_e for the arithmetic data values, the following equations can be used:

$$R = 1 - \frac{\Sigma(U_{obs} - U_{cal})^2}{\Sigma(U_{obs} - \bar{U})^2} \tag{5.6}$$

$$S_e^2 = \frac{\Sigma(U_{obs} - U_{cal})^2}{n-v} \tag{5.7}$$

where U_{obs} = station value of the statistic

U_{cal} = value calculated using the regression equation

$\bar{U}$ = mean observed value

n = sample size

v = total number of variables in the regression

Table 5.2 presents the values of R^2 and S_e for the untransformed (arithmetic) data, and indicates slightly lower multiple correlation coefficients.

Table 5.2

Regression Results, Based on Untransformed Variables

Region	Equation for:	R^2	S_e(cfs-days)
A	$\bar{x}$	0.960	± 85,573
A	s	0.942	± 25,663
B	$\bar{x}$	0.800	± 55,776
B	s	0.805	± 15,148

As a further illustration of how good (or poorly) the final equations perform in estimating values of $\bar{x}$ and s, Figures 5.2 through 5.5 present plots of observed versus calculated values of $\bar{x}$ and s for both regions, in units of cfs-days. As may be expected from the previous tables, these figures indicate much better results for Region A.

Since one problem in calculating $\bar{x}$ and s independently is that the coefficient of variation, C_v, (obtained from $s/\bar{x}$) may not be preserved, Figures 5.6 and 5.7 present plots of observed versus calculated values of C_v. These figures indicate that, in both regions, the equations perform reasonably well, without grossly distorting C_v.

The ranges of independent variables used in the regression analyses for the 2 regions are listed in Table 5.3. In applying these equations to ungaged sites, extrapolation should be avoided, and therefore the application should be limited to basins with characteristics within the stated range.

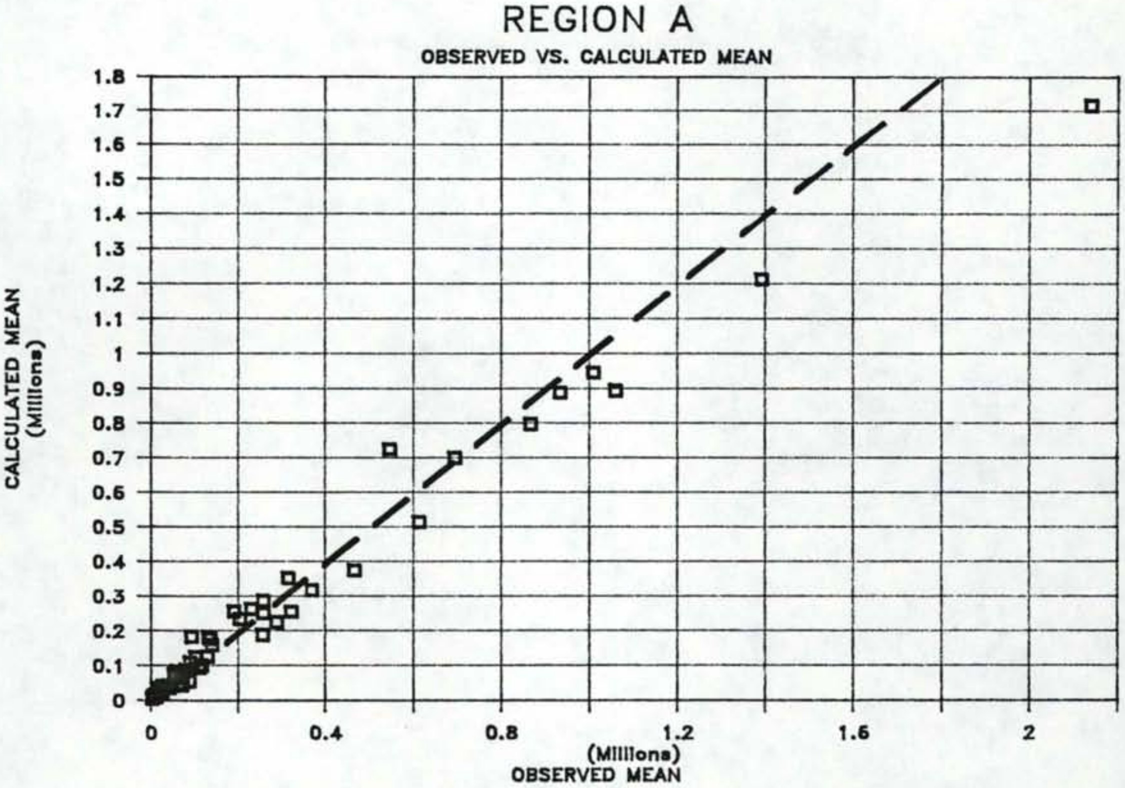


Figure 5.2 Observed Versus Calculated Mean for Region A

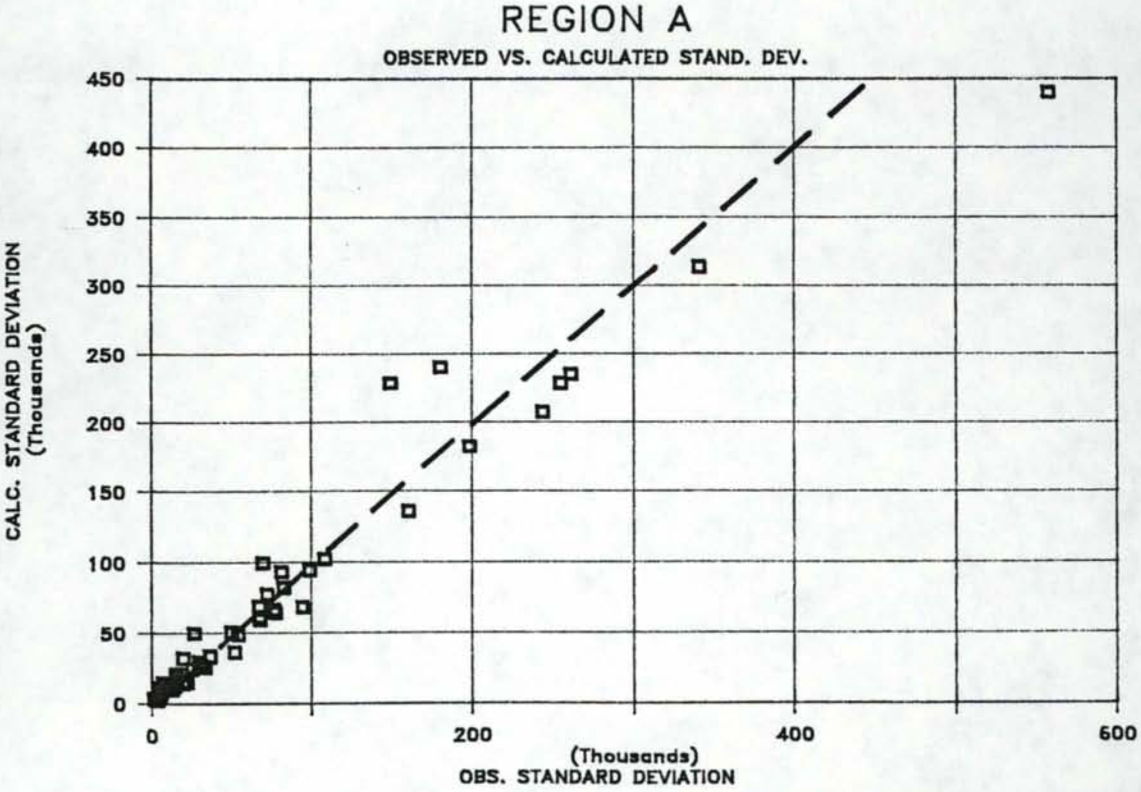


Figure 5.3 Observed Versus Calculated Standard Deviation for Region A

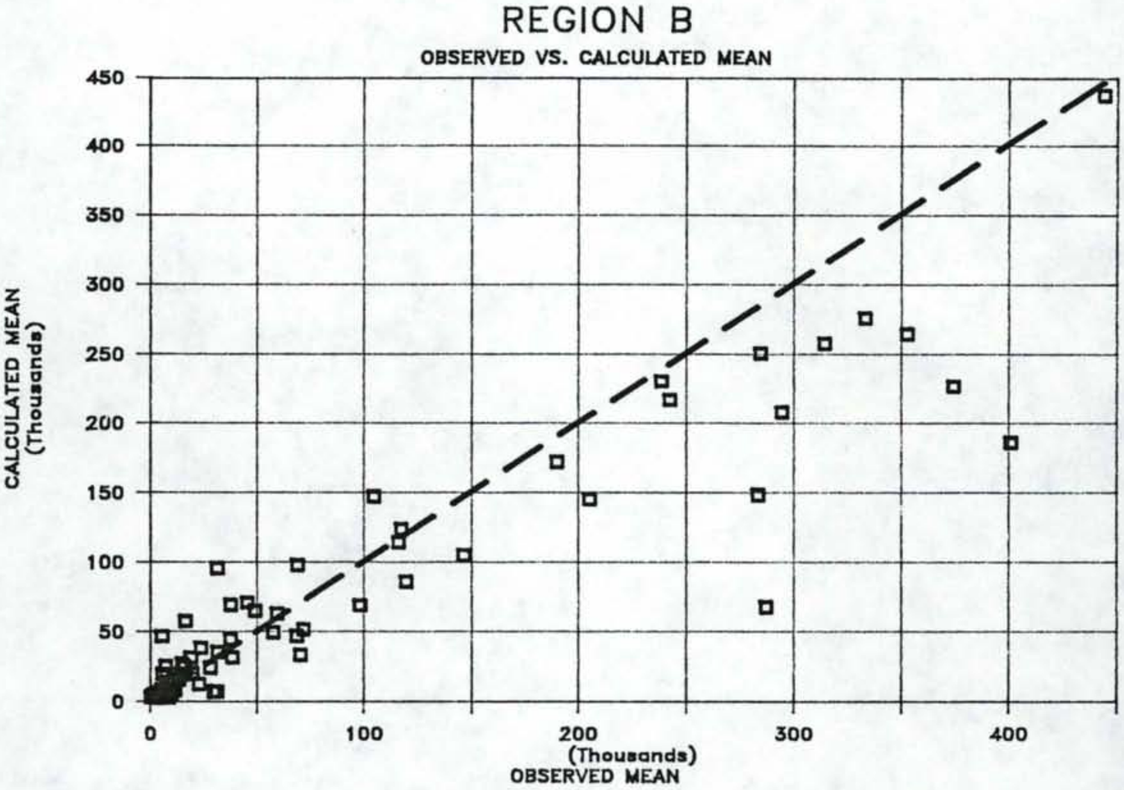


Figure 5.4 Observed Versus Calculated Mean for Region B

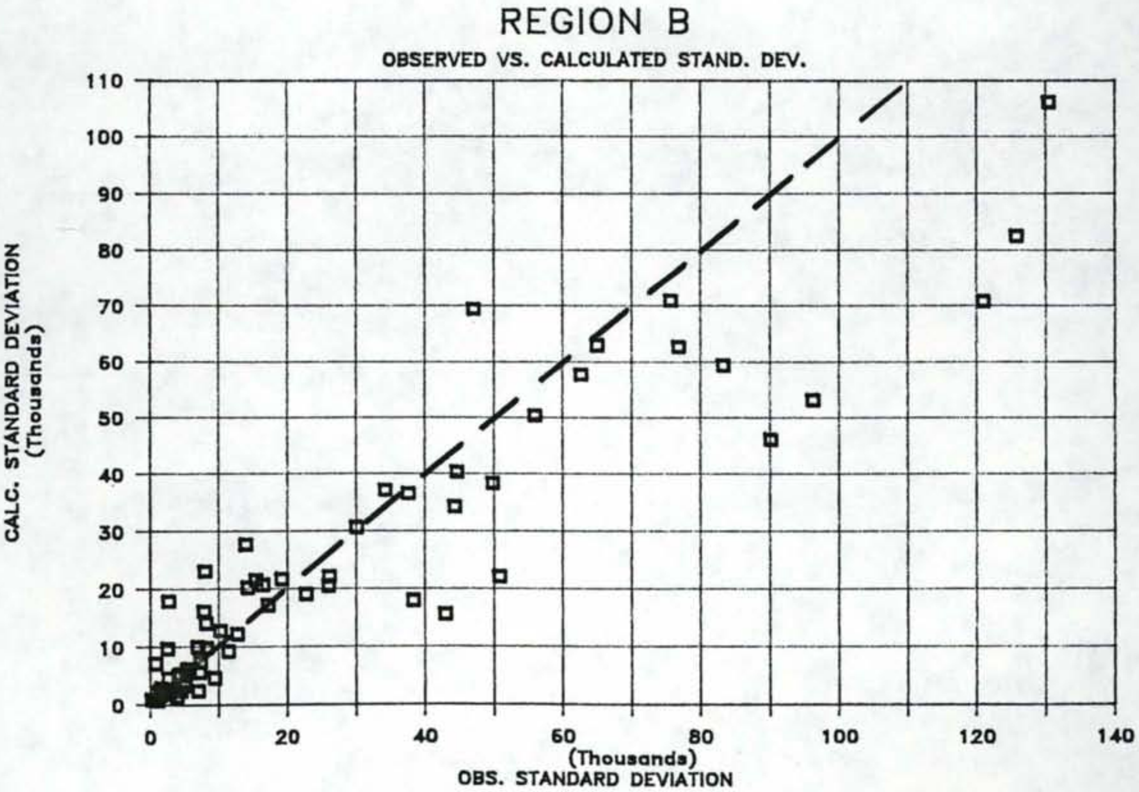


Figure 5.5 Observed Versus Calculated Standard Deviation for Region B

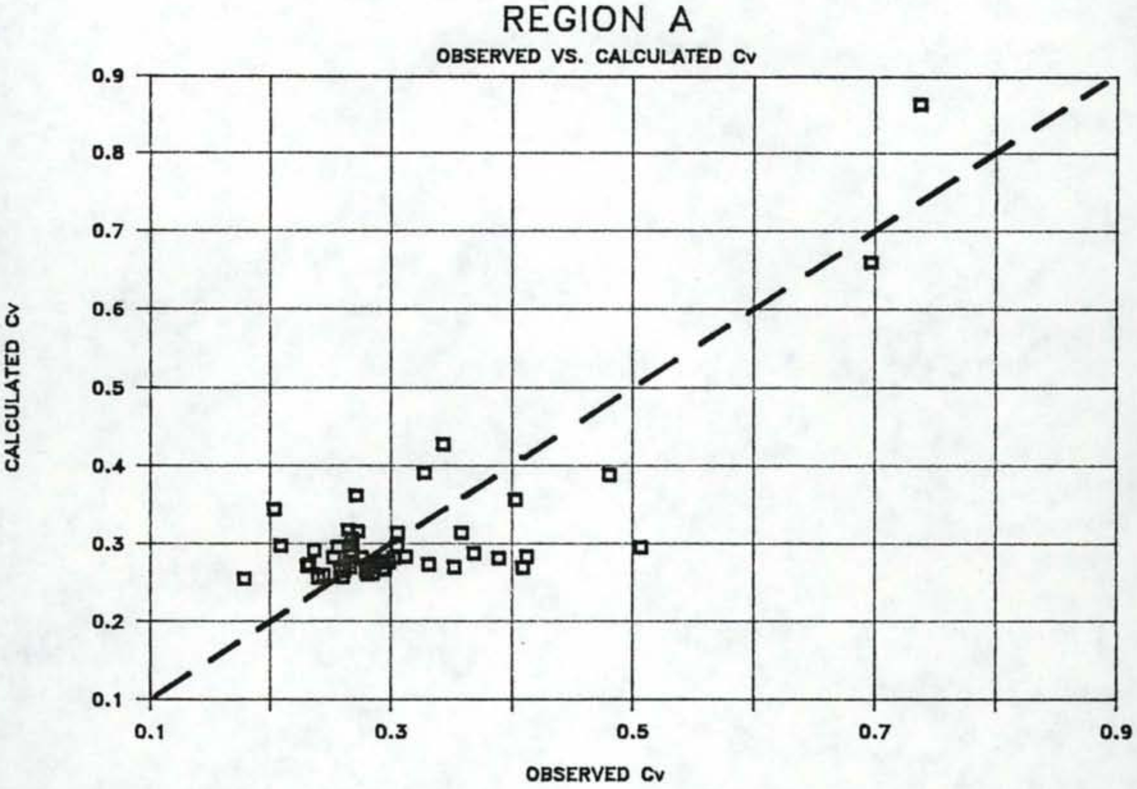


Figure 5.6 Observed Versus Calculated Coefficient of Variation for Region A

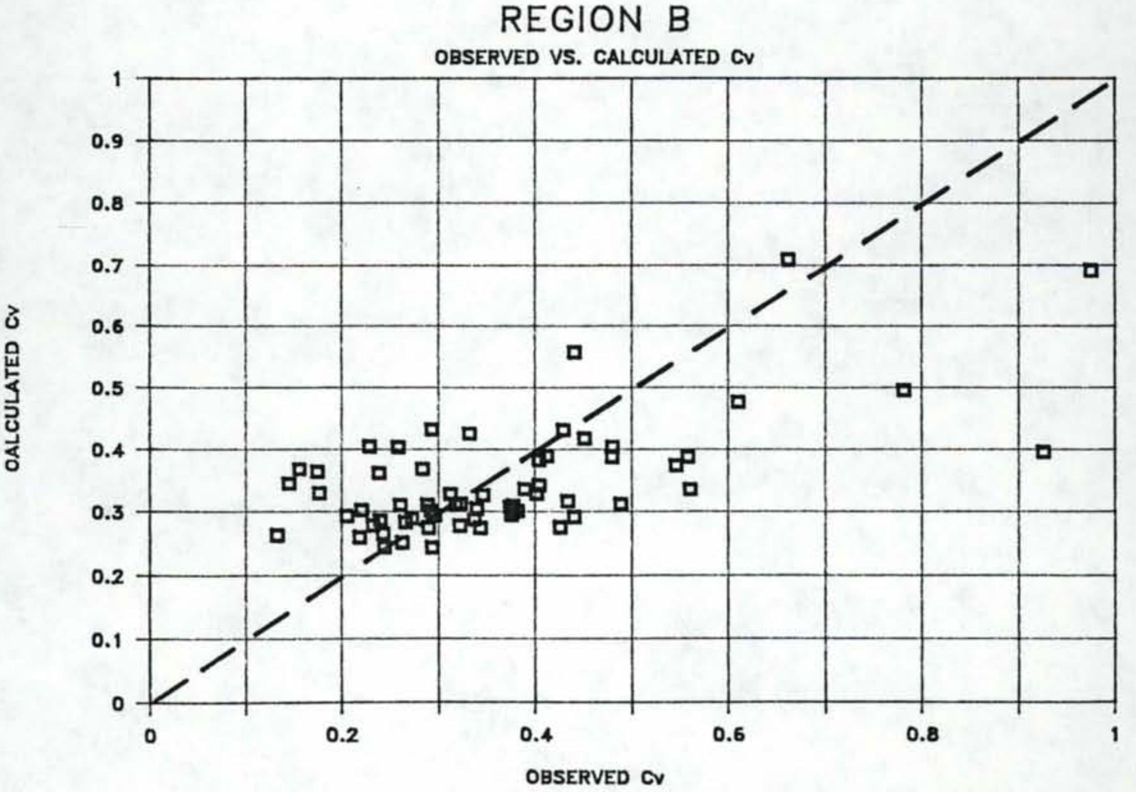


Figure 5.7 Observed Versus Calculated Coefficient of Variation for Region B

Table 5.3
Range of Independent Variables Used in the Regression

Region	Variable	Range Maximum	 Minimum
A	DA	2440 mi^2	10.3 mi^2
A	MP	58 inches	21 inches
A	FC	100%	4%
B	DA	1160 mi^2	3.96 mi^2
B	MP	45 inches	11 inches
B	FC	95%	1%

A discussion of the use of these regression equations to determine drought characteristics at ungaged locations is provided in the final section of this chapter.

3. Maps of Generalized Values of g and r

As an initial approach to evaluating the spatial variability of g and r, regression analyses were performed in a manner similar to those done for $\bar{x}$ and s. These results indicated that no significant relationships could be developed using any of the basin characteristics, and verified the selection of a mapping procedure for estimating these statistics.

While there are a number of methods that might be used to map the spatial variability, a major concern is that the maps should reflect the general spatial patterns, and not the detailed, individual station values. For statistics such as g and r, with sampling distributions that have large standard errors, true "generalized" values are necessary.

To accomplish the goal of defining and mapping these generalized values in as automated a fashion as possible, a mapping graphics software package (11) was used to perform the necessary calculations. This package has, as one major subroutine, a set of gridding algorithms that takes an input data file of x, y, z coordinates, and creates a regularly spaced grid from the irregularly spaced data. While the x, y coordinates represent the spatial position of the data, the z coordinate can be any variable (e.g. elevation) for which contour lines are eventually desired.

Although the software has several gridding options, the preferred approach for developing generalized grid values of z uses the regional variable theory called kriging (21). This option requires the specification of a search radius and the number of nearest data values to be used in estimating the z-value at each grid node. When the search radius is large (encompassing the entire grid size), and the number of nearest data values represents a significant portion of the entire data set, then the nodal values reflect general spatial trends, rather than an average of a few nearby stations.

To apply this software, the latitude and longitude of each gaging station were converted into positions measured, in miles, north and east of the southwest corner of the state. These positions defined the x, y coordinates, and the extended-data values of g and r were used, in succession, as the z coordinates. The software automatically creates a grid large enough to include all of the data points, selects the grid spacing, and then determines the nodal values using kriging. For the 124 stations shown in Figure 5.1, the resulting grid is approximately 515 miles north-south by 410 miles east-west, and has a 20 x 25 grid spacing (500 nodal points), with an average grid size of 20.5 miles on each side.

All negative values of r were set equal to zero, since none were significantly different from zero. For g, the station statistics were used directly, since there was no justification for assuming only positive values. As the gridding program was run, files were created of the calculated nodal values of each statistic, to be later used as input to several other subroutines.

Following the creation of these files, a contour subroutine was applied to develop isolines, within the grid boundaries, of each statistic. This subroutine includes a cubic spline smoothing technique that removes any angular appearance of the isolines, and options for defining the desired interval between the isolines. Once the isoline map is in the correct format, a plotting option permits the direct plotting of the final product.

Figures 5.8 and 5.9 present the final maps of the generalized skew coefficients and serial correlation coefficients, respectively. From Figure 5.8, it is observed that there are 2 major areas of large positive skewness, located in the Snake River Plain of southern Idaho, and in the Palouse region of northern Idaho and eastern Washington. The central batholith area is generally a region of zero skew, or approximately normally distributed annual streamflow.

The map of generalized serial correlation coefficients (Figure 5.9) indicates that most of northern and central Idaho has values of $r=0$, with the annual flows showing time-independence. The southeastern portion of the state, however, exhibits significant time-dependence, with r-value isolines as large as 0.5.

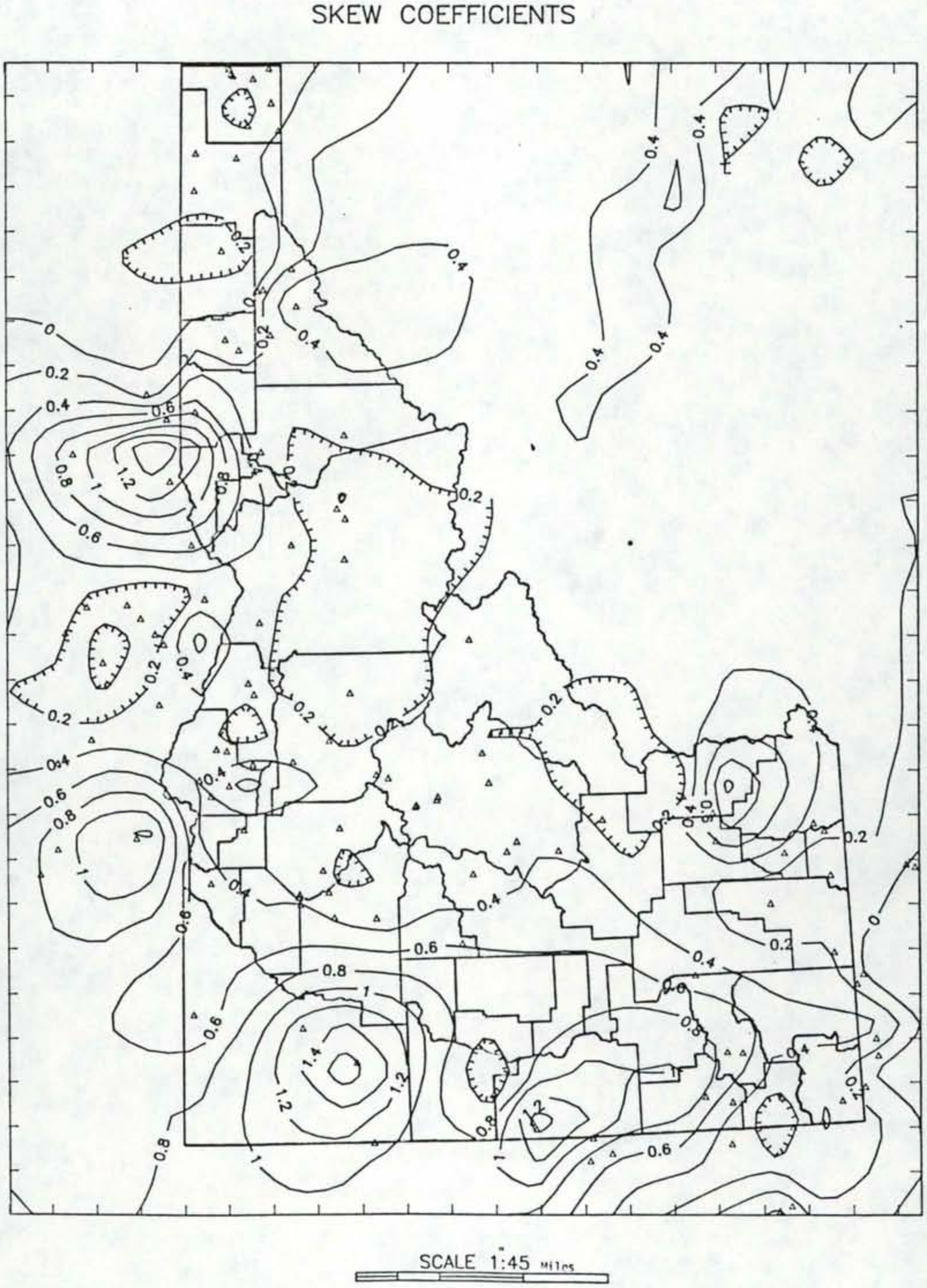


Figure 5.8 Map of Generalized Skew Coefficients for Annual Streamflow

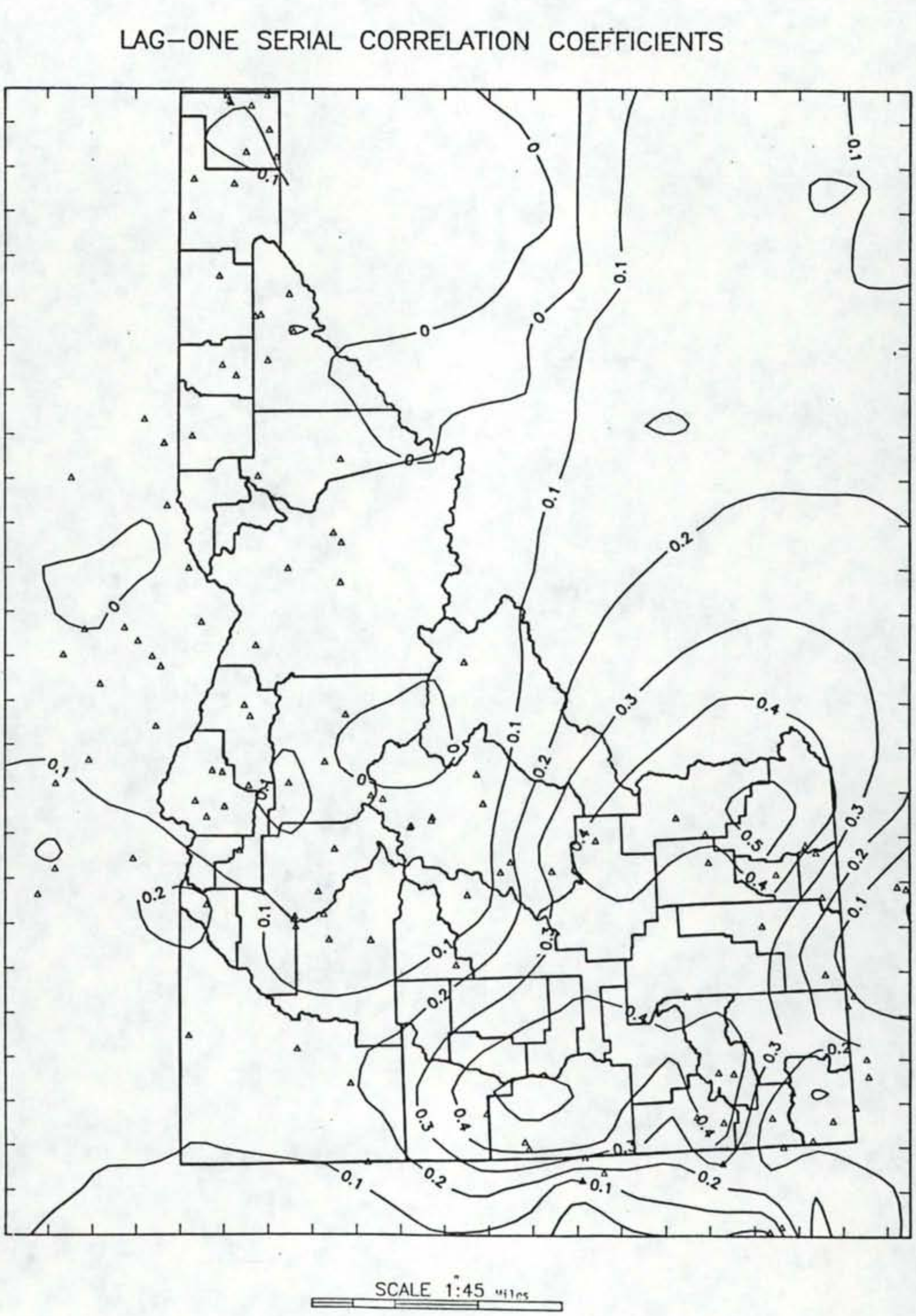


Figure 5.9 Map of Generalized Serial Correlation Coefficients for Annual Streamflow

As a further portrayal of this information, surface plots were prepared of the grid files, using another subroutine that produces a 3-dimensional surface representation of the grid values. These are presented as Figures 5.10 and 5.11 (the skew and serial correlation surfaces, respectively), and show the surfaces as viewed from the south-west corner of the grid.

4. Application of Results to Ungaged Areas

For an ungaged site where estimates of the drought characteristics are desired, the equations and tables presented in Chapter 3 can be used as previously described, with the values of $\bar{x}$, s, g, and r defined by the equations and maps from this chapter. There are several final cautions on the use of the ungaged area methods, however:

a) For Region B, the regression equations for $\bar{x}$ and s do not yield reliable estimates of these parameters. The plots of observed versus calculated values clearly show this, and indicate that other methods of estimation, such as transposition of flow data statistics from nearby gages with very similar basin characteristics, may provide better results. As an example, the mean annual flows from several neighboring stations might be plotted versus drainage area, and a line fitted to this plot. By interpolation, using the drainage area of the ungaged site, a value of $\bar{x}$ can be estimated and compared to the regression equation value. Subjective judgement is then required to select the

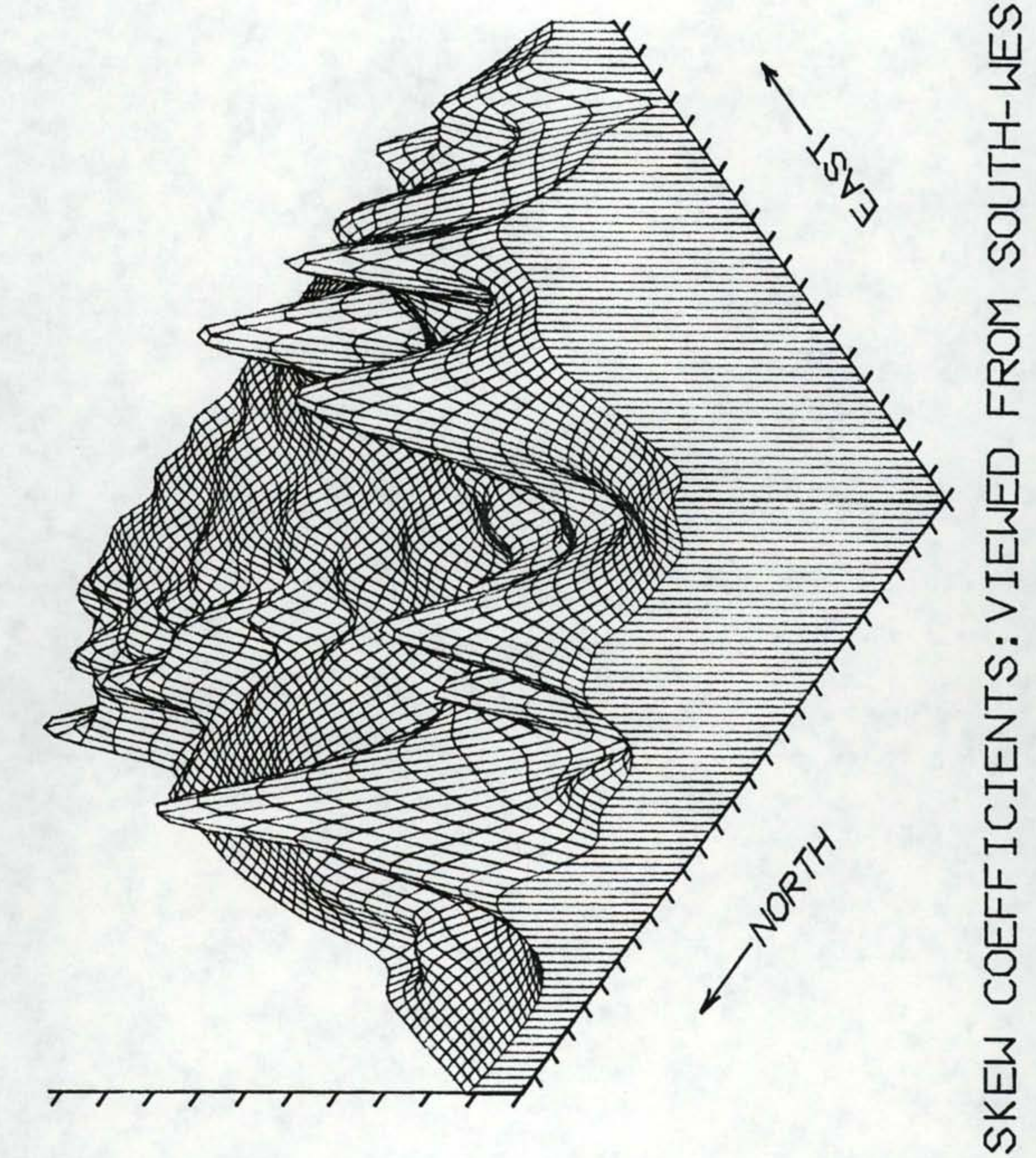


Figure 5.10 Skew Coefficient Surface

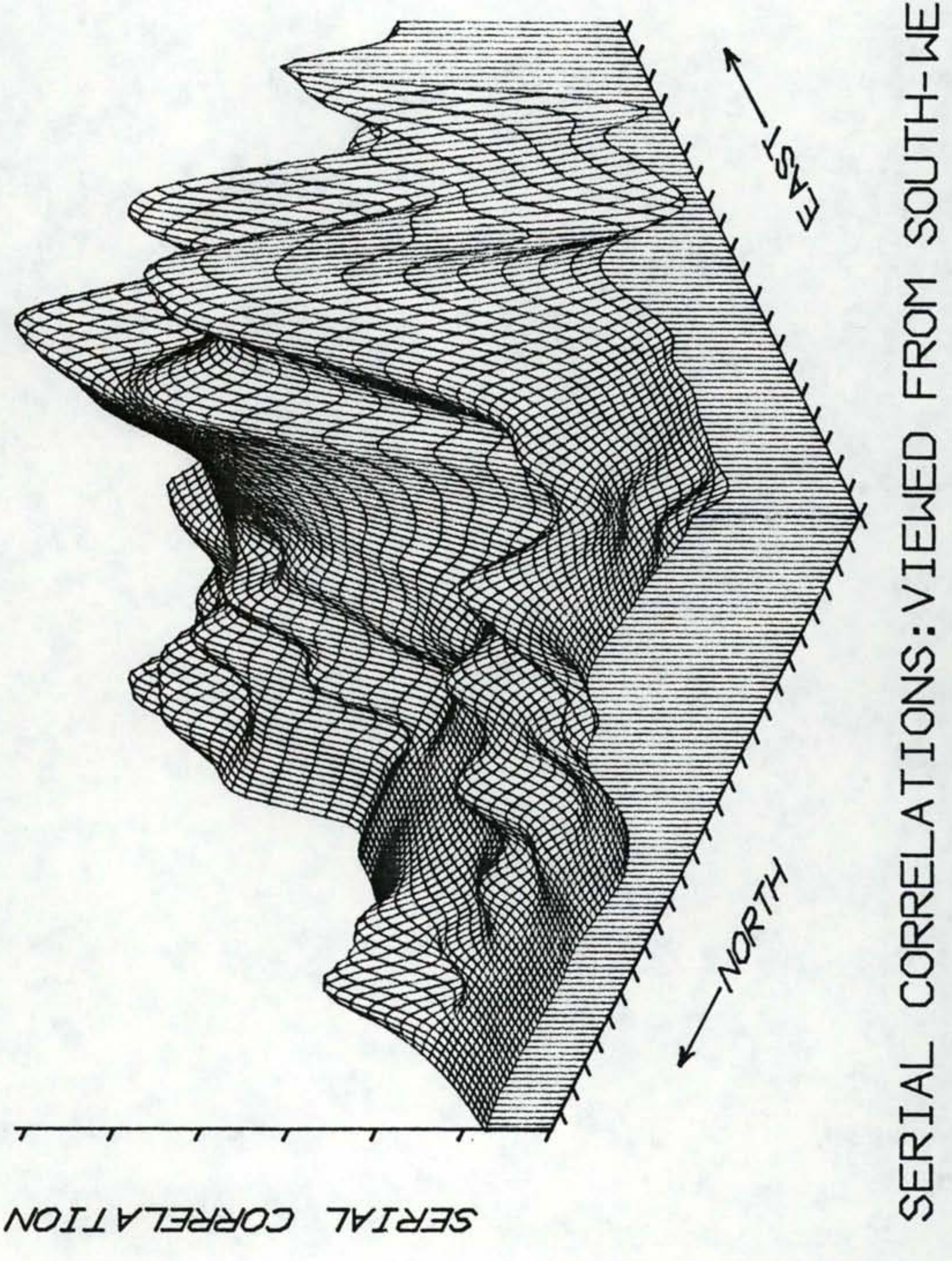


Figure 5.11 Serial Correlation Coefficient Surface

appropriate value. (A similar procedure could be used for estimating s.)

b) While the regression results for Region A are much better than those for Region B, judgement should still be exercised in using the calculated values of $\bar{x}$ and s. Again, transposition of neighbor-station statistics might provide a further check on the reasonableness of the results obtained from the regression equations.

c) The maps of generalized skew and serial correlation coefficients should only be used for streamflow sites within or near the Idaho state boundaries. Although the grids are rectangular, the state is not, and no data values were located in the north-east portion of the grid. Therefore, the isolines covering the western portion of Montana are clearly suspect.

d) As previously stated, the regression equations should not be used for sites with characteristics outside of the ranges shown in Table 5.3, with special care exercised for sites within the upper portions of the ranges.

CHAPTER 6

SPATIAL VARIABILITY OF IDAHO DROUGHT POTENTIAL

1. Introduction

The previous chapters have presented the methodology for assessing drought probabilities at individual sites, based on the annual flow statistics and the theory of runs. While the application of these procedures yields a valuable insight into the temporal variability of the stochastic process at a single location, it does not directly portray the spatial variability of drought potential throughout the state.

Since it has already been shown that the statistics affecting drought length and severity differ from one section of the state to another, it is obvious that the stochastic process and, hence, the potential for droughts of some stated magnitude must also vary. This chapter links the variability of the statistical elements defining the drought process, and presents, for a selected drought event, conclusions regarding the spatial variability in its potential length and severity.

2. Methodology

The equations from Chapter 3 that define the statistics of the probability distributions of L_{max} and D_{max} (Equations 3.5 through 3.8) all involve 4 independent variables: N, q_o, g, and r. Since N may be considered a representation of the median event's return period, and q_o expresses a measure of the demand on the resource, a particular selection of these two variables specifies a single drought frequency-demand combination that is spatially independent. The remaining variables, which are spatially dependent, describe how the annual streamflow process affects L_{max} and D_{max} for this selected drought event.

For example, if N = 100 is used as a measure of 100-year return period drought, in combination with a $q_o = 0.5$ truncation level to represent a large demand on the flow system, then the spatial variability in g and r will illustrate how the magnitude and length of this event may vary throughout the state. By using the grids that were developed in Chapter 5 for generalized values of g and r, the nodal values of each variable can be inserted into the appropriate equations, to calculate, with the specified N and q_o, the nodal values of L_m and D_m.

To perform this operation, the software package originally used to prepare the g and r grids was again applied. The gridding program permits the mathematical combination of two existing grid files to create a new grid file, using matrix operations on the grid elements. With N = 100 and $q_o = 0.5$, Equations 3.5 and 3.7 can be written as:

$$\bar{x}_L = 1.8943 + 0.00156 \ln(g+.0001) + 0.0237 \ln(r+.001) \quad (6.1)$$

$$\bar{x}_D = 1.7132 - 0.0162 \ln(g+.0001) + 0.0273 \ln(r+.0001) \quad (6.2)$$

Since these equations do not permit negative values of g or r, the original grid files were modified to define all negative nodal values equal to zero (there were very few of these for g and none for r), and to add 0.0001 to each value. In matrix-format, the revised files for the g-grid can be designated as M_g and the r-grid as M_r. Then:

$$M_{\bar{x}L} = 1.8943 + 0.00156 \ln M_g + 0.0237 \ln M_r \qquad (6.3)$$

$$M_{\bar{x}D} = 1.7132 - 0.0162 \ln M_g + 0.0273 \ln M_r \qquad (6.4)$$

where $M_{\bar{x}L}$ and $M_{\bar{x}D}$ are the matrices of the means of the logarithms of L_{max} and D_{max}. With $L_m = \exp(\bar{x}_L)$ and $D_m = \exp(\bar{x}_D)$, matrices of L_m and D_m can be obtained by:

$$M_L = \exp(M_{\bar{x}L}) \qquad (6.5)$$

$$M_D = \exp(M_{\bar{x}D}) \qquad (6.6)$$

These matrices, or grids, were then used to develop isolines and maps of the length and severity of the 100-year, $q_0 = 0.5$ drought event.

3. Results of the Spatial Variability Analysis

Figure 6.1 presents the map of the median drought lengths for the selected N, q_0 event. The isolines vary in magnitude from 5.6 years to 6.4 years, with the higher values generally in the southwestern portion of the grid. This relatively minor spatial variability is to be expected, since, theoretically, the probability distribution of L_{max} is independent of the underlying process statistics for a

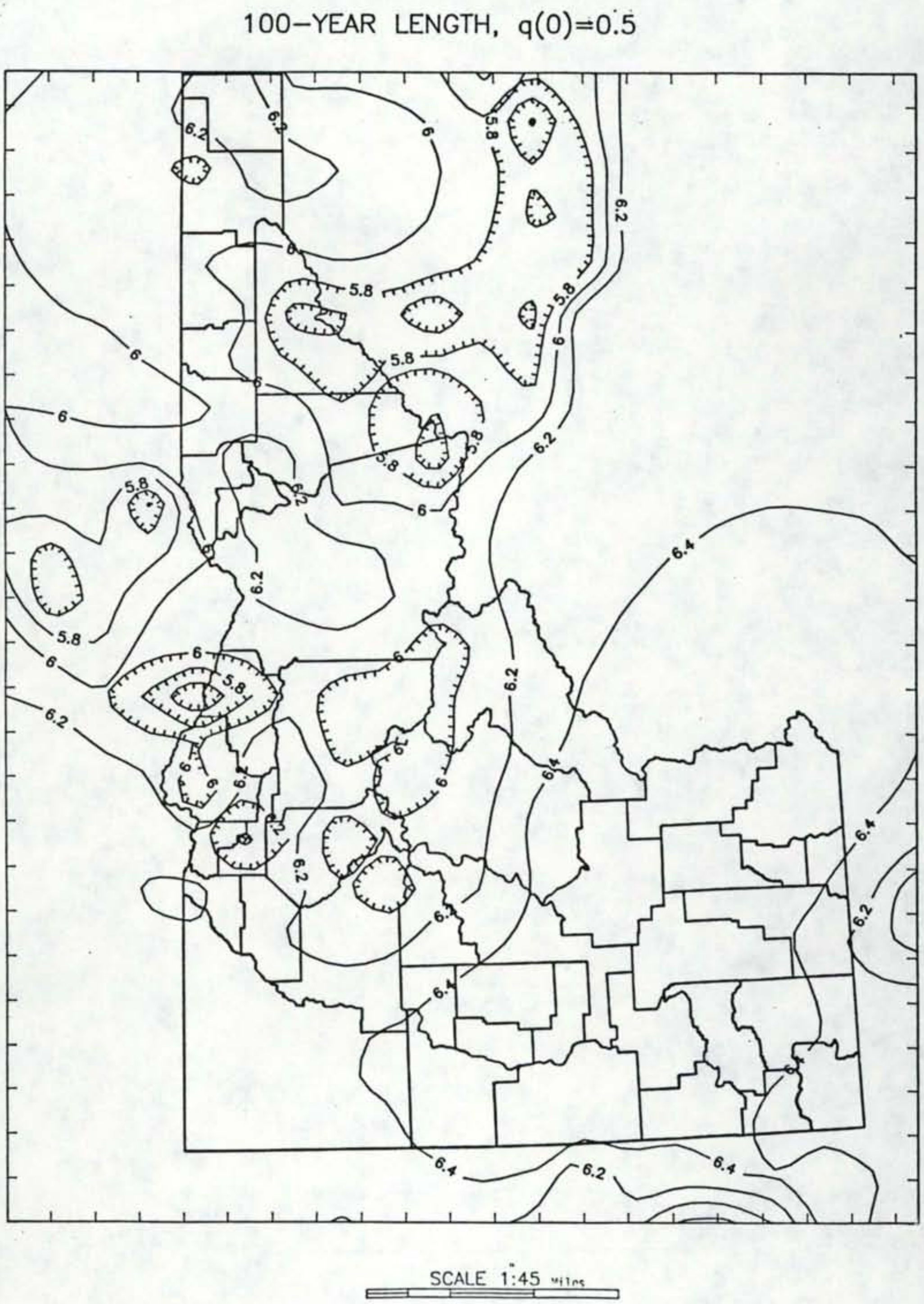


Figure 6.1 Map of L_m for Selected Drought Event

time-independent flow series. Although the value of r affects the process, its impact is small, as seen by the regression coefficient in Equation 6.3.

The spatial variability of D_m, presented in Figure 6.2, is more pronounced, with isoline values that range from 4.4 to 5.8. The higher values, indicating a more severe deficit, are generally located in the northwestern and southeastern portions of the grid. The overall pattern of the map of D_m closely resembles the spatial pattern of L_m, from Figure 6.1.

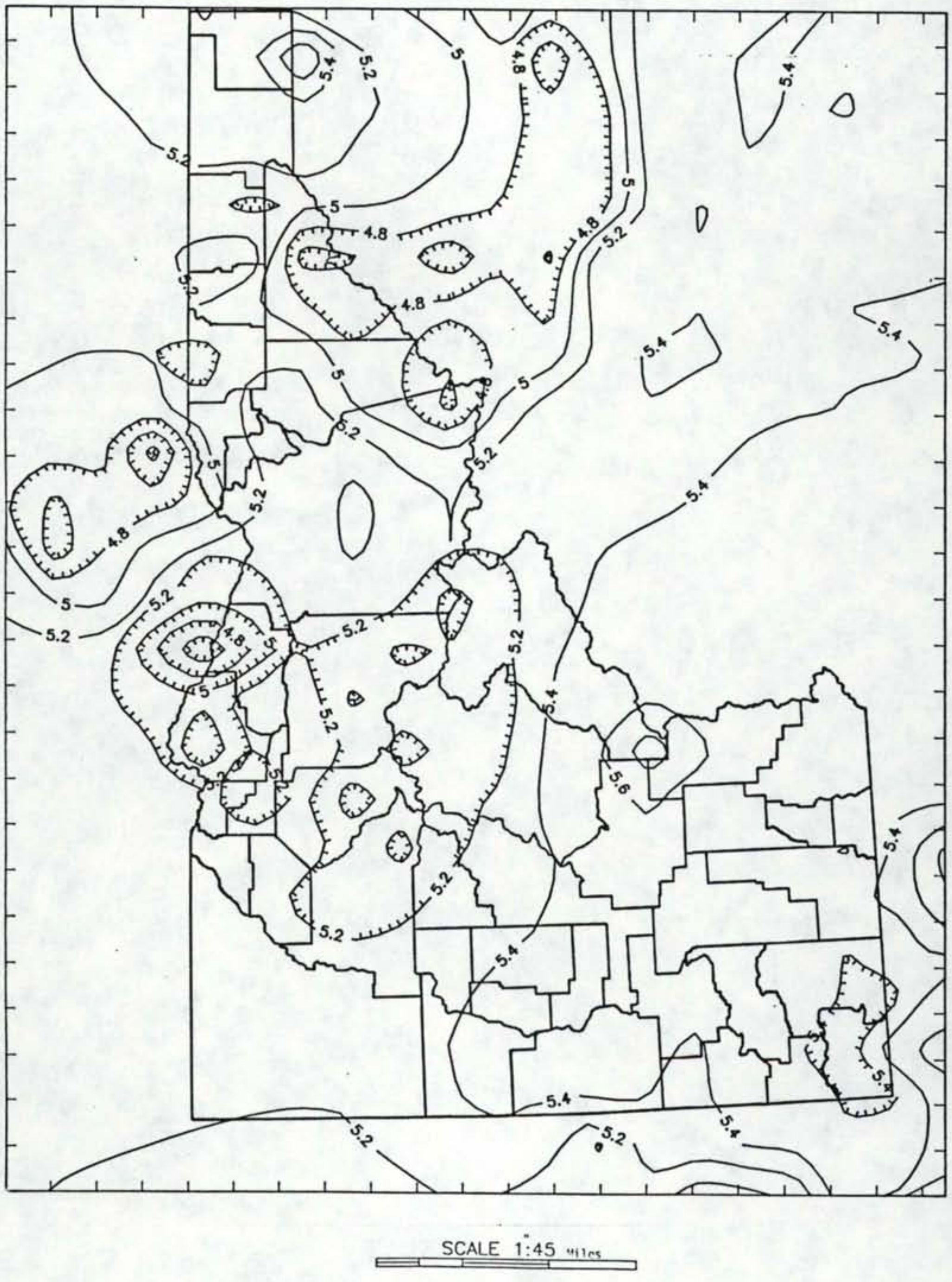
It would be a mistake, however, to conclude that the spatial variability in drought severity is relatively minor. The actual magnitude of a negative run-sum, S_m, is proportional to both the magnitude of D_m and s, the standard deviation of the annual flow series. Unless the spatial variability of s is considered, the true variability in potential drought severity cannot be assessed.

As a measure of this variability, the dimensionless coefficient of variation, C_v, can be used. With $C_v = s/\bar{x}$, Equation 3.10 can be written as:

$$S_m = \bar{x} \exp(\bar{x}_D) C_v \qquad (6.7)$$

If S_m is defined as the drought severity per unit of mean annual streamflow, then

$$S_m' = \frac{Sm}{x} = C_v \exp(\bar{x}_D) \qquad (6.8)$$



100–YEAR STANDARDIZED DEFICIT, q(0)=0.5

Figure 6.2 Map of D_M for Selected Drought Event and represents a dimensionless measure of the potential drought severity for a given N, q_0 drought event. This quantity is therefore defined as the "drought potential index", DPI, and it will vary spatially according to the variability of $\bar{x}_D$ and C_v.

Using the kriging method discussed in Chapter 5, values of C_v calculated from the extended-data statistics were gridded to develop a matrix of generalized coefficients. This matrix, M_c, was then used in the equation:

$$M_{DPI} = M_D \cdot M_c \tag{6.9}$$

to prepare a grid of DPI values that could be contoured and mapped. The results of this process are presented in Figure 6.3, a map of the isolines of DPI for the 100-year, $q_0 = 0.5$ drought event.

This figure dramatically portrays the spatial variability of drought severity within the state of Idaho. The isolines of DPI range in value from 1.0 to 4.8, with three major clusters of high values: the upper portions of the Snake River Plain, the southwestern corner of the state, and the Palouse region. The central batholith region shows little variability, with DPI values of approximately 1.6, and the Bear River Basin clearly stands out as a region of low DPI compared to the adjacent Snake River Plain. As a further graphic display of this variability, Figure 6.4 presents a 3-dimensional representation of the DPI surface, as viewed from the northeast corner of the map grid.

Since $S_m = \bar{x}(DPI)$, two streams with identical mean annual flows will have cumulative streamflow deficits, during a drought event, in

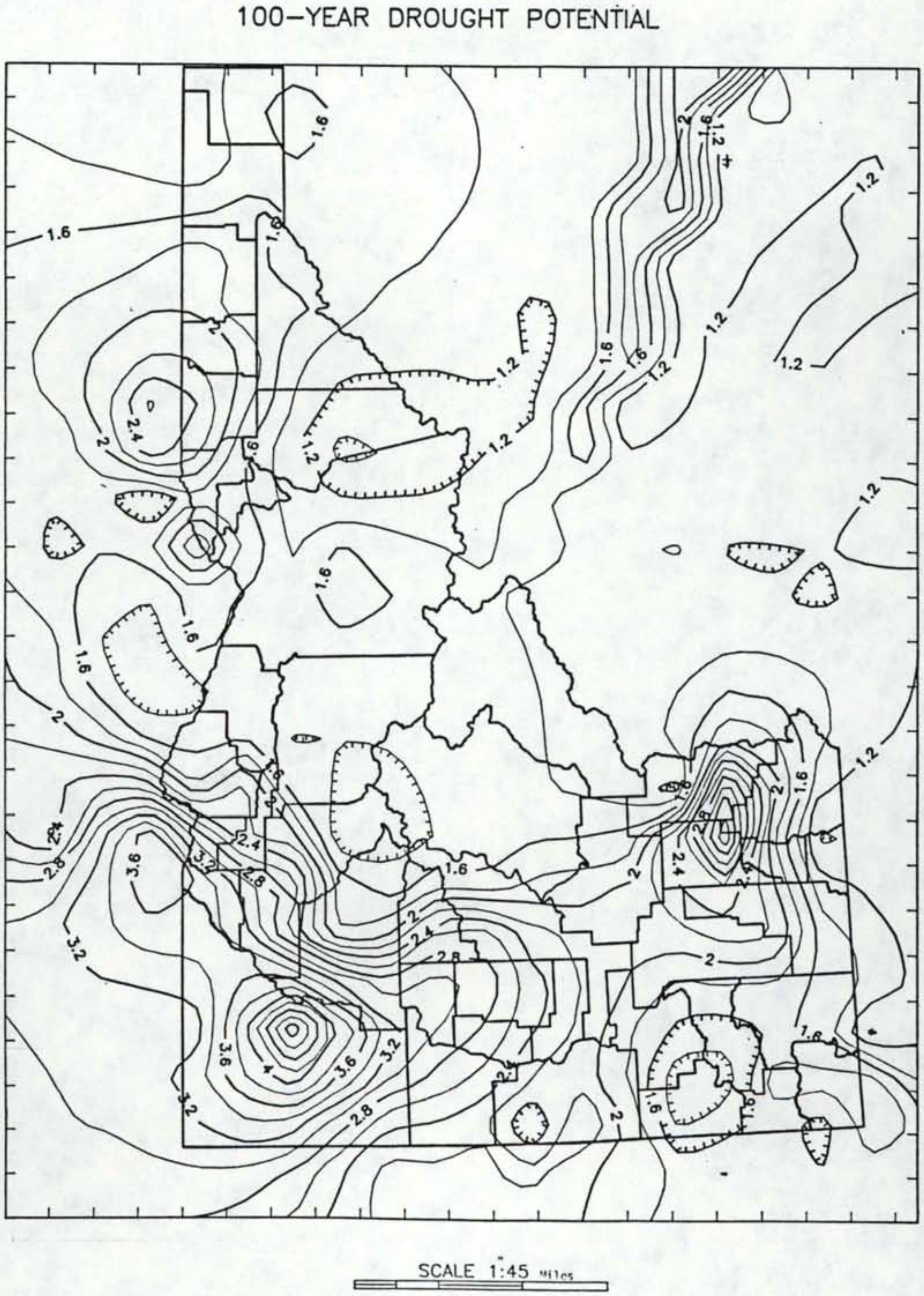


Figure 6.3 Map of Drought Potential Index Values

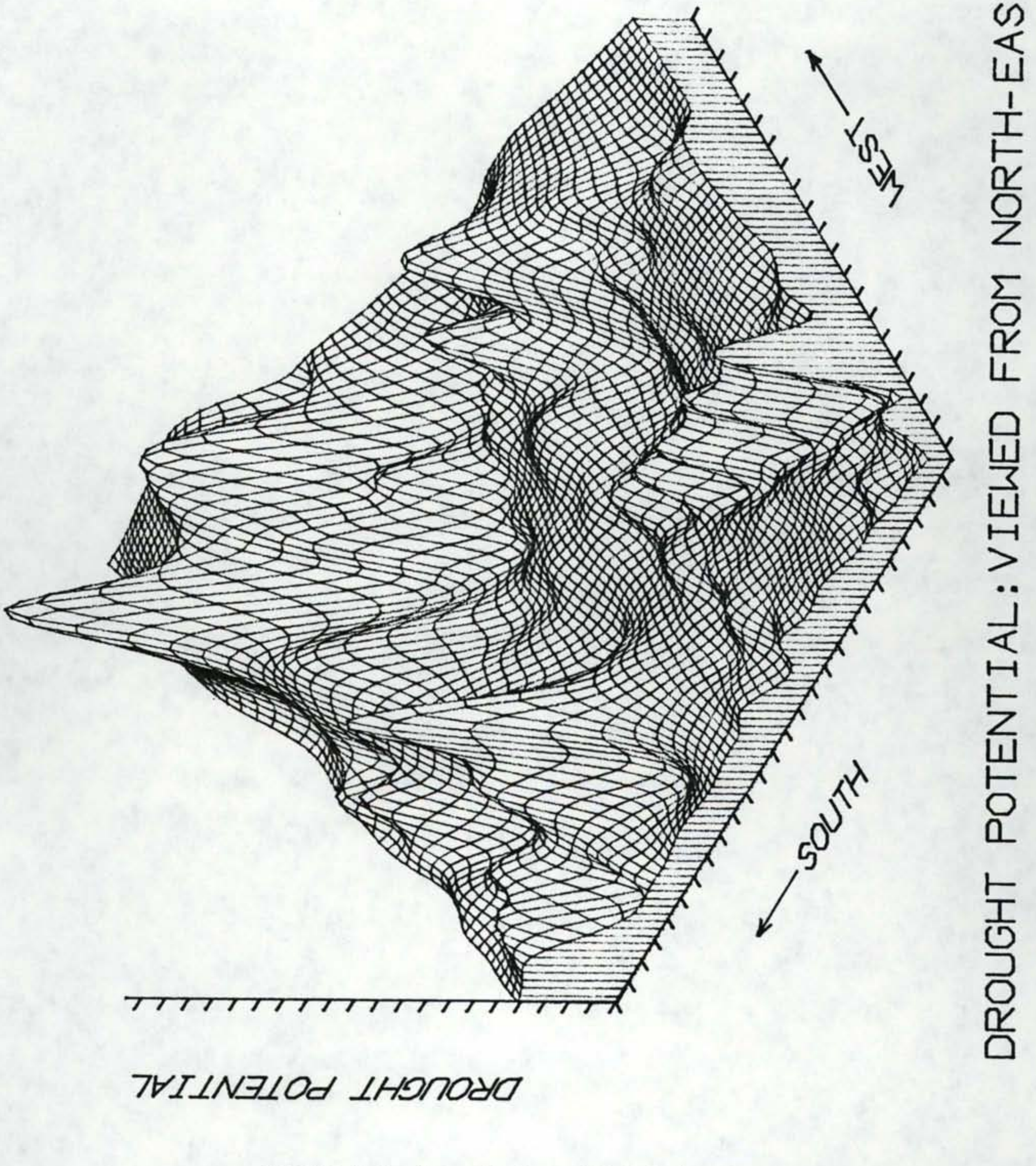


Figure 6.4 Drought Potential Index Surface

direct proportion to their DPI values. Although this analysis was performed only for the $N = 100$, $q_0 = 0.5$ combination, the same general spatial pattern will exist for other combinations due to the structure of the equations used to generate the DPI values.

In conclusion, these findings may have significant implications for future water resources planning in the state. Drought severity is not a spatially-random phenomenon, and there is a much greater potential for persistent, severe streamflow deficits in those areas with larger values of DPI. This risk must be considered in the planning, design, and operation of water resources projects in the state.

CHAPTER 7

COMPUTER PROGRAM TO APPLY THE RESEARCH RESULTS

During the course of this project, extensive use was made of the microcomputer for data analysis, modeling, and definition of drought characteristics. As one of the project objectives, a summary computer program has been developed to permit further application of the procedures described in this report. This program, coupled with the data base prepared during the project, will permit a user to perform the following operations:

a) Access the annual flow records for the 124 stations, and print out the dates and flow values for each record year. This will permit run-analyses to be performed at any station of interest, so that the actual dates associated with critical drought periods can be determined.

b) Access the station files of the statistics and basin characteristics, so that these files can be used in further investigations of functional relationships among the variables.

c) Obtain print-outs of the drought characteristics (similar to the tables in Appendix C) for any station of interest.

d) Apply the regression equations from Chapter 5 to an ungaged area, and use the resulting values of the statistics to obtain a drought characteristic table for the ungaged site.

The program is interactive, and can be run as a BASIC-language program on any IBM/PC-compatible microcomputer.

Documentation, including instructions, a program listing, and pertinent figures from this report, has been prepared to accompany the program data diskettes. These items are available at a nominal charge, from the Idaho Water Resources Research Institute at the University of Idaho.

NOTATION

The following symbols are used in this report:

A = data augmentation model parameter
a = regression equation coefficient
B = data augmentation model parameter
b_i = regression equation coefficient
C = data augmentation model parameter
C_i = general basin characteristics
C_v = coefficient of variation
D = standardized negative run-sum
D_m = median standardized negative run-sum in many samples of size N
D_{max} = maximum negative standardized run-sum in a sample size N
DA = Drainage area
DPI = drought potential index
FC = percent forest cover
g = skew coefficient of the annual flows
g_1 = skew coefficient of the annual flow logarithms
K = number of stochastic model parameters
k_o = frequency factor for Pearson Type-III distribution
L = negative run-length
L_m = median negative run-length in many samples of size N
L_{max} = maximum negative run-length in a sample size N
LE = main channel length
M_c = grid matrix of values of C_v
M_D = grid matrix of values of D
M_{DPI} = grid matrix of values of DPI

M_L = grid matrix of values of L

M_r = grid matrix of values of r

$M_{\bar{x}}$ = grid matrix of values of $\bar{x}$

$M_{\bar{x}D}$ = grid matrix of values of $\bar{x}_D$

$M_{\bar{x}L}$ = grid matrix of values of $\bar{x}_L$

MA = mean elevation

MP = mean annual precipitation

N = sample size (record length) of annual flows

N_r = representative sample size for L_{max} or D_{max}

n = sample size for regression analysis

P = probability

p = percent of values exceeding a stated value of L_{max} or D_{max}

q_o = truncation quantile

R = multiple correlation coefficient for regression equation

R_N = random standardized normal deviate

r = lag-one serial correlation coefficient for annual flows

r_1 = serial correlation coefficient of the annual flow logarithms

r_w = serial correlation coefficient at key station

r_y = serial correlation coefficient at subordinate station

r_{wy} = lag-zero cross correlation between key and subordinate station

S = negative run-sum

S_e = standard error of estimate for regression equation

S_m = median negative run-sum in many samples of size N

S'_m = median negative run-sum per unit of mean annual streamflow

S_{max} = maximum negative run-sum in a sample size N

SL = main channel slope

s = standard deviation of the annual flows

s_D = standard deviation of the logarithms of D_{max}

s_L = standard deviation of the logarithms of L_{max}

s_1 = standard deviation of the logarithms of the annual flow

T = return period of droughts

t = time subscript (year)

$\bar{U}$ = mean observed value of a station statistic

U_{cal} = calculated value of a station statistic, by regression

U_{obs} = observed value of a station statistic

u = general parameter (statistic)

v = number of variables in regression equation

w = key station designation

x = annual flow

X_o = truncation level

X_L = negative run-length exceeded in p % of the samples

X_s = negative run-sum exceeded in p % of the samples

$\bar{x}$ = mean annual flow

$\bar{x}_D$ = mean of the logarithms of D_{max}

$\bar{x}_L$ = mean of the logarithms of L_{max}

$\bar{x}_1$ = mean of the logarithms of the annual flows

Y = natural logarithm of X

y = subordinate station designation

y_D = exceedance limit for logarithms of D_{max}

y_L = exceedance limit for logarithms of L_{max}

Z_w = standardized flow values at key station

Z_y = standardized flow values at subordinate station

z_p = standardized normal deviate, for exceedance limit p

δ = index of parameter parsimony

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APPENDIX A

TABLE A-1: LIST OF GAGES USED DURING STUDY

STATION NO. UI.1000.00
CRUMARINE CREEK NEAR MOSCOW,IDAHO

STATION NO. 10.0410.00
THOMAS FORK NEAR WYO-IDA,BORDER

STATION NO. 10.0475.00
MONTPELIER CREEK AT IRRIGATORS WEIR NEAR MONTPELIER,IDA

STATION NO. 10.0586.00
BLOOMINGTON CREEK AT BLOOMINGTON,IDA

STATION NO. 10.0728.00
EIGHTMILE CREEK NEAR SODA SPRINGS,IDA

STATION NO. 10.0845.00
COTTONWOOD CREEK NEAR CLEVELAND,IDA

STATION NO. 10.0930.00
CUB RIVER NEAR PRESTON,IDA

STATION NO. 10.1047.00
LITTLE BEAR R BL DAVENPORT C NR AVON,UT

STATION NO. 10.1060.00
LITTLE BEAR RIVER NEAR PARADISE,UTAH

STATION NO. 10.1135.00
BLACKSMITH FORK AB U.P.&L. CO,UT

STATION NO. 10.1190.00
LITTLE MALAD RIVER ABOVE ELKHORN RESERVOIR NEAR MALAD,IDA

STATION NO. 10.1225.00
DEVIL CREEK ABOVE CAMPBELL CREEK NEAR MALAD,IDA

STATION NO. 10.1255.00
MALAD R AT WOODRUFF,IDAHO

STATION NO. 12.3055.00
BOULDER CREEK NEAR LEONIA,IDAHO

STATION NO. 12.3065.00
MOYIE RIVER AT EASTPORT,IDA

STATION NO. 12.3075.00
MOYIE RIVER AT EILEEN,IDA

STATION NO. 12.3110.00
DEEP CREEK AT MORAVIA,IDAHO

TABLE A-1: LIST OF GAGES USED DURING STUDY

STATION NO. 12.3168.00
MISSION CREEK NEAR COPELAND, IDA

STATION NO. 12.3205.00
LONG CANYON CREEK NEAR PORTHILL, IDAHO

STATION NO. 12.3210.00
SMITH CREEK NEAR PORTHILL, IDAHO

STATION NO. 12.3215.00
BOUNDARY CREEK NEAR PORTHILL, IDA

STATION NO. 12.3923.00
PACK RIVER NEAR COLBURN, IDA

STATION NO. 12.3940.00
PRIEST RIVER NEAR COOLIN, IDA

STATION NO. 12.3950.00
PRIEST RIVER NEAR PRIEST RIVER, IDA

STATION NO. 12.4110.00
COEUR D'ALENE RIVER ABOVE SHOSHONE CRK NEAR PRICHARD, IDA

STATION NO. 12.4130.00
COEUR D'ALENE RIVER AT ENAVILLE, IDA

STATION NO. 12.4131.40
PLACER CREEK AT WALLACE, IDA

STATION NO. 12.4135.00
COEUR D'ALENE RIVER NEAR CATALDO, IDAHO

STATION NO. 12.4145.00
ST. JOE RIVER AT CALDER, IDA

STATION NO. 12.4149.00
ST. MARIES RIVER NEAR SANTA, IDA

STATION NO. 12.4150.00
ST. MARIES RIVER AT LOTUS, IDAHO

STATION NO. 12.4160.00
HAYDEN CREEK BELOW NORTH FORK NEAR HAYDEN LAKE, IDA

STATION NO. 13.0115.00
PACIFIC CREEK AT MORAN, WYO

STATION NO. 13.0119.00
BUFFALO FORK ABOVE LAVA CREEK NEAR MORAN, WYO

TABLE A-1: LIST OF GAGES USED DURING STUDY

STATION NO. 13.0230.00
GREYS R AB RESERVOIR NR ALPINE,WYO.

STATION NO. 13.0245.00
COTTONWOOD CREEK NEAR SMOOT,WYO.

STATION NO. 13.0250.00
SWIFT CREEK NEAR AFTON,WYO.

STATION NO. 13.0275.00
SALT RIVER ABOVE RESERVOIR NEAR ETNA,WYO

STATION NO. 13.0320.00
BEAR CREEK ABOVE RESERVOIR NEAR IRWIN,IDA

STATION NO. 13.0440.00
HENRYS FORK AT WARM RIVER,IDAHO

STATION NO. 13.0475.00
FALLS RIVER NEAR SQUIRREL,IDA

STATION NO. 13.0522.00
TETON RIVER ABOVE SOUTH LEIGH CREEK NEAR DRIGGS,IDA

STATION NO. 13.0550.00
TETON RIVER NEAR ST. ANTHONY,IDA

STATION NO. 13.0580.00
WILLOW CREEK NEAR RIRIE,IDA

STATION NO. 13.0685.00
BLACKFOOT RIVER NEAR BLACKFOOT,IDA

STATION NO. 13.0730.00
PORTNEUF RIVER AT TOPAZ,IDA

STATION NO. 13.0750.00
MARSH CREEK NEAR MCCAMMON,IDA

STATION NO. 13.0777.00
GEORGE CREEK NEAR YOST,UTAH

STATION NO. 13.0780.00
RAFT RIVER AT PETERSON RANCH NEAR BRIDGE,IDA

STATION NO. 13.0790.00
CLEAR CREEK NEAR NAF,IDA

STATION NO. 13.0825.00
GOOSE CREEK ABOVE TRAPPER CREEK NEAR OAKLEY,IDA

TABLE A-1: LIST OF GAGES USED DURING STUDY

STATION NO. 13.0830.00
TRAPPER CREEK NEAR OAKLEY, IDA

STATION NO. 13.0920.00
ROCK CREEK NEAR ROCK CREEK, IDA

STATION NO. 13.1120.00
CAMAS CREEK AT CAMAS, IDA

STATION NO. 13.1135.00
BEAVER CREEK AT DUBOIS, IDA

STATION NO. 13.1160.00
MEDICINE LODGE C AT ELLIS RANCH NR ARGORA, ID

STATION NO. 13.1187.00
LITTLE LOST RIVER BELOW WET CREEK NEAR HOWE, IDA

STATION NO. 13.1200.00
NORTH FORK BIG LOST RIVER AT WILD HORSE NEAR CHILLY, IDA

STATION NO. 13.1205.00
BIG LOST RIVER AT HOWELL RANCH NEAR CHILLY, IDA

STATION NO. 13.1270.00
BIG LOST RIVER BELOW MACKAY RESERVOIR NEAR MACKAY, IDA

STATION NO. 13.1355.00
BIG WOOD RIVER NEAR KETCHUM, IDAHO

STATION NO. 13.1415.00
CAMAS CREEK NEAR BLAINE, IDA

STATION NO. 13.1625.00
EAST FORK JARBIDGE R NR THREE C, IDAHO

STATION NO. 13.1675.00
EAST FORK BRUNEAU R NR HOT SPRING, IDAHO

STATION NO. 13.1695.00
BIG JACKS CREEK NEAR BRUNEAU, IDA

STATION NO. 13.1780.00
JORDAN C AB LONE TREE C NR JORDAN VALLEY, OREG

STATION NO. 13.1850.00
BOISE RIVER NEAR TWIN SPRINGS, IDA

STATION NO. 13.1860.00
SOUTH FORK BOISE RIVER NEAR FEATHERVILLE, IDA

TABLE A-1: LIST OF GAGES USED DURING STUDY

STATION NO. 13.1910.00
SOUTH FORK BOISE RIVER NEAR LENOX,IDA

STATION NO. 13.1965.00
BANNOCK CREEK NEAR IDAHO CITY,IDA

STATION NO. 13.2000.00
MORES CREEK ABOVE ROBIE CREEK NEAR ARROWROCK DAM,IDA

STATION NO. 13.2005.00
ROBIE CREEK NEAR ARROWROCK DAM,IDA

STATION NO. 13.2010.00
MORES CREEK NEAR ARROWROCK,IDA

STATION NO. 13.2125.00
BOISE RIVER AT NOTUS,IDA

STATION NO. 13.2140.00
MALHEUR RIVER NEAR DREWSEY,OREG.

STATION NO. 13.2165.00
N F MALHEUR R A BEULAH RES NR BEULAH,OREG.

STATION NO. 13.2265.00
BULLY C AT WARMSPRINGS NR VALE,OREG.

STATION NO. 13.2350.00
SOUTH FORK PAYETTE RIVER AT LOWMAN,IDAHO

STATION NO. 13.2450.00
NORTH FORK PAYETTE RIVER AT CASCADE,IDA

STATION NO. 13.2506.00
BIG WILLOW CREEK NEAR EMMETT,IDA

STATION NO. 13.2513.00
WEST BRANCH WEISER RIVER NEAR TAMARACK,IDA

STATION NO. 13.2515.00
WEISER RIVER AT TAMARACK,IDA

STATION NO. 13.2585.00
WEISER RIVER NEAR CAMBRIDGE,IDA

STATION NO. 13.2600.00
PINE CREEK NEAR CAMBRIDGE,IDA

STATION NO. 13.2610.00
LITTLE WEISER R NR INDIAN VALLEY,IDAHO

TABLE A-1: LIST OF GAGES USED DURING STUDY

STATION NO. 13.2635.00
WEISER R AB CRANE C NR WEISER, IDAHO

STATION NO. 13.2645.00
CRANE CREEK NEAR MIDVALE, IDA

STATION NO. 13.2670.00
MANN CREEK NEAR WEISER, IDA

STATION NO. 13.2730.00
BURNT RIVER NEAR HEREFORD, OREG.

STATION NO. 13.2755.00
POWDER RIVER NEAR BAKER, OREG.

STATION NO. 13.2882.00
EAGLE CR AB SKULL CR NR NEW BRIDGE, OREG.

STATION NO. 13.2920.00
IMNAHA RIVER AT IMNAHA, OREG.

STATION NO. 13.2950.00
VALLEY CREEK AT STANLEY, IDA

STATION NO. 13.2955.00
SALMON RIVER BELOW VALLEY CREEK AT STANLEY, IDA

STATION NO. 13.2960.00
YANKEE FORK SALMON RIVER NEAR CLAYTON, IDA

STATION NO. 13.2965.00
SALMON RIVER BELOW YANKEE FORK NEAR CLAYTON, IDA

STATION NO. 13.2985.00
SALMON RIVER NEAR CHALLIS, IDA

STATION NO. 13.2990.00
CHALLIS CREEK NEAR CHALLIS, IDA

STATION NO. 13.3065.00
PANTHER CREEK NEAR SHOUP, IDA

STATION NO. 13.3085.00
MIDDLE FORK SALMON RIVER NEAR CAPEHORN, IDA

STATION NO. 13.3090.00
BEAR VALLEY CREEK NEAR CAPEHORN, IDA

STATION NO. 13.3105.00
SOUTH FORK SALMON RIVER NEAR KNOX, IDA

TABLE A-1: LIST OF GAGES USED DURING STUDY

STATION NO. 13.3130.00
JOHNSON CREEK AT YELLOW PINE,IDA

STATION NO. 13.3165.00
LITTLE SALMON RIVER AT RIGGINS,IDA

STATION NO. 13.3190.00
GRANDE RONDE RIVER AT LA GRANDE,OREG.

STATION NO. 13.3200.00
CATHERINE CREEK NEAR UNION,OREG.

STATION NO. 13.3235.00
GRANDE RONDE RIVER NR ELGIN,OREG.

STATION NO. 13.3250.00
EAST FORK WALLOWA RIVER NR JOSEPH,OREG.

STATION NO. 13.3295.00
HURRICANE CREEK NEAR JOSEPH,OREG.

STATION NO. 13.3300.00
LOSTINE RIVER NEAR LOSTINE,OREG.

STATION NO. 13.3305.00
BEAR CREEK NEAR WALLOWA,OREG.

STATION NO. 13.3347.00
ASOTIN CREEK BELOW KEARNEY GULCH NEAR ASOTIN,WASH

STATION NO. 13.3365.00
SELWAY RIVER NEAR LOWELL,IDA

STATION NO. 13.3370.00
LOCHSA RIVER NEAR LOWELL,IDA

STATION NO. 13.3375.00
SOUTH FORK CLEARWATER RIVER NEAR ELK CITY,IDA

STATION NO. 13.3380.00
SOUTH FORK CLEARWATER R NR GRANGEVILLE,IDAHO

STATION NO. 13.3405.00
N FK CLEARWATER R AT BUNGALOW R S,IDAHO

STATION NO. 13.3410.00
NORTH FORK CLEARWATER AT AHSAHKA,IDA

STATION NO. 13.3445.00
TUCANNON RIVER NEAR STARBUCK,WASH.

TABLE A-1: LIST OF GAGES USED DURING STUDY

STATION NO. 13.3450.00
PALOUSE RIVER NEAR POTLATCH,IDA

STATION NO. 13.3480.00
SOUTH FORK PALOUSE RIVER AT PULLMAN,WASH.

STATION NO. 13.3485.00
MISSOURI FLAT CREEK AT PULLMAN,WASHINGTON

STATION NO. 13.3492.10
PALOUSE RIVER BELOW SOUTH FORK AT COLFAX,WASH

STATION NO. 14.0185.00
WALLA WALLA RIVER NEAR TOUCHET,WASH

APPENDIX B

TABLE B-1: ORIGINAL DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. COR. COEFF.
UI.1000.00	619	306	0.75	-.11
10.0410.00	19719	8946	0.18	0.05
10.0475.00	8278	2906	0.31	0.23
10.0586.00	10581	2935	0.62	0.06
10.0728.00	5995	2192	0.06	-.08
10.0845.00	11364	4569	0.14	0.05
10.0930.00	30435	7077	-.21	-.03
10.1047.00	20087	5800	-.50	0.04
10.1060.00	34413	12248	-.13	-.01
10.1135.00	46195	19765	0.52	0.51*
10.1190.00	6119	992	0.81	0.21
10.1225.00	3391	912	0.19	0.63*
10.1255.00	24023	7987	0.45	0.31
12.3055.00	43657	13615	0.14	0.37*
12.3065.00	258031	78132	-.21	0.01
12.3075.00	323342	100129	-.30	0.01
12.3110.00	53429	16227	-.22	0.23
12.3168.00	13312	3947	-.13	-.20
12.3205.00	23299	6476	-.33	0.25
12.3210.00	69818	16859	-.43	0.28
12.3215.00	72714	18933	0.05	0.03
12.3923.00	118036	31359	0.40	-.14
12.3940.00	480429	106555	0.08	-.11

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B-1: ORIGINAL DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. COR. COEFF.
12.3950.00	615588	155985	-.11	0.10
12.4110.00	265089	68969	0.08	-.28
12.4130.00	706312	196737	-.27	-.06
12.4131.40	13683	5332	0.71	-.30
12.4135.00	932433	255739	-.25	0.18
12.4145.00	866901	241976	0.09	-.06
12.4149.00	133157	53810	0.77	-.29
12.4150.00	189378	67054	0.32	0.15
12.4160.00	9799	3942	-.21	-.31
13.0115.00	97981	22415	0.45	0.01
13.0119.00	206430	45838	-.29	-.21
13.0230.00	239766	60104	-.06	-.00
13.0245.00	16238	3462	-.35	0.28
12.0250.00	31730	4615	0.52	0.20
13.0275.00	292243	81933	0.51	0.30
13.0440.00	364542	56169	0.31	0.61*
13.0475.00	286791	50016	0.25	0.34*
13.0522.00	152240	32782	0.05	0.28
13.0550.00	302087	61691	0.41	0.47*
13.0685.00	59979	20733	0.60	0.35
13.0730.00	72626	16807	0.53	0.58*
13.0750.00	32694	9264	1.35*	0.58*
13.0777.00	2946	1219	0.71	-.25

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B-1: ORIGINAL DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. COR. COEFF.
13.0780.00	6101	2863	0.99	0.17
13.0790.00	3862	1563	0.59	0.19
13.0825.00	17256	8114	1.56*	0.35*
13.0830.00	5587	1604	1.36*	0.50*
13.0920.00	12597	5116	0.47	0.52*
13.1120.00	12610	7283	0.39	0.28*
13.1135.00	7982	7150	1.55*	0.47*
13.1160.00	15298	2681	0.01	0.46*
13.1187.00	25795	6955	0.04	0.47*
13.1200.00	39413	10974	0.29	0.02
13.1205.00	122501	37188	0.22	0.15
13.1270.00	112285	34506	0.55	0.36*
13.1355.00	61076	17966	0.32	-.14
13.1415.00	70543	43082	0.70	0.15
13.1625.00	22200	9246	1.02	0.10
13.1675.00	12000	7138	1.39*	0.19
13.1695.00	1517	1633	1.48*	0.19
13.1850.00	444409	130602	0.20	-.01
13.1780.00	71063	36264	0.48	-.01
13.1860.00	296959	94037	0.17	0.01
13.1910.00	354306	120464	0.56	-.20
13.1965.00	808	389	0.60	0.15
13.2000.00	112608	49385	0.21	0.10

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B-1: ORIGINAL DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. COR. COEFF.
13.2005.00	3010	1658	0.77	0.09
13.2010.00	110394	44217	0.73	-.07
13.2125.00	484860	342691	0.97	0.22
13.2140.00	65988	35589	0.83*	0.08
13.2165.00	47525	17243	0.91*	-.13
13.2265.00	16867	14773	1.93*	0.27
13.2350.00	327104	81750	0.12	-.19
13.2450.00	401304	96331	0.56	0.23
13.2506.00	9199	4058	0.25	-.15
13.2513.00	1895	745	0.45	-.13
13.2515.00	16216	4522	0.11	-.31
13.2585.00	245684	78361	0.15	-.01
13.2600.00	14114	4366	0.58	-.01
13.2610.00	38432	10862	0.17	0.08
13.2635.00	325351	128454	0.32	-.12
13.2645.00	26947	14241	1.20*	0.03
13.2670.00	14757	5324	0.53	-.15
13.2730.00	30725	13683	0.88	-.08
13.2755.00	39914	14438	0.21	0.06
13.2882.00	115289	26027	-.65	-.15
13.2920.00	185720	51897	-0.02	0.09
13.2950.00	73199	18320	0.45	0.06
13.2955.00	242679	59111	0.40	0.25

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B-1: ORIGINAL DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. COR. COEFF.
13.2960.00	71951	22830	0.66	-.12
13.2965.00	366879	94954	0.28	0.11
13.2985.00	543636	141816	0.73	0.16
13.2990.00	16024	4129	0.67	0.24
13.3065.00	94204	27068	0.31	-.04
13.3085.00	88134	21880	0.56	0.08
13.3090.00	105847	27613	0.39	0.16
13.3105.00	52979	13674	0.05	0.15
13.3130.00	129682	36176	0.14	-.08
13.3165.00	306342	81852	0.14	-.20
13.3190.00	137882	52277	0.38	-.04
13.3200.00	42994	11262	-.07	0.01
13.3235.00	238407	90172	-.28	-.11
13.3250.00	4383	1452	0.78*	0.01
13.3295.00	26923	5513	-.27	0.06
13.3300.00	70795	15087	-.25	-.12
13.3305.00	41036	9381	-.14	-.04
13.3347.00	28314	8549	1.48*	-.22
13.3365.00	1391398	330250	-.16	0.01
13.3370.00	1058720	251086	-.07	0.02
13.3375.00	99959	25299	0.06	-.04
13.3380.00	319540	86750	0.51	0.35*
13.3405.00	1038193	156549	0.19	-.07

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B-1: ORIGINAL DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. COR. COEFF.
13.3410.00	2084790	554258	0.20	0.26
13.3445.00	62711	22386	0.88*	-.17
13.3450.00	102830	52159	0.67	-.33
13.3480.00	14235	8585	1.59*	-.12
13.3485.00	3093	1936	1.09*	-.13
13.3492.00	142816	64268	0.11	-.05
14.0185.00	208443	65477	0.10	-.19

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B.2: EXTENDED DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. CORR. COEFF.
UI.1000.00	619	306	0.75	-.11
10.0410.00	19331	8394	0.28	-.01
10.0475.00	8157	2825	0.36	0.23
10.0586.00	10325	2932	0.42	0.17
10.0728.00	5902	2229	0.37	0.02
10.0845.00	11364	4569	0.14	0.05
10.0930.00	29886	7141	-.09	0.04
10.1047.00	20087	5800	-.50	0.04
10.1060.00	34413	12248	-.13	-.01
10.1135.00	45706	15542	0.55	0.51*
10.1190.00	6102	956	0.90*	0.21
10.1225.00	3391	912	0.19	0.63*
10.1255.00	24023	7987	0.45	0.31
12.3055.00	43896	13118	0.23	0.15
12.3065.00	259128	76577	-.17	0.03
12.3075.00	322724	94917	-.29	-.06
12.3110.00	53960	15713	-.16	0.14
12.3168.00	13024	3978	-.28	0.09
12.3205.00	23612	6291	-.37	0.26*
12.3210.00	69795	16122	-.33	0.19
12.3215.00	72082	18896	0.10	0.01
12.3923.00	116471	31070	-.12	0.06
12.3940.00	466877	108775	-.00	-.03

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B.2: EXTENDED DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. CORR. COEFF.
12.3950.00	614535	160952	-.10	0.06
12.4110.00	258953	72643	0.16	-.07
12.4130.00	695661	198704	-.07	-.03
12.4131.40	13683	5332	0.71	-.30
12.4135.00	933863	261557	-.06	0.01
12.4145.00	867045	243886	0.08	-.06
12.4149.00	132460	54242	0.15	0.01
12.4150.00	191585	67627	0.39	0.07
12.4160.00	10035	4144	-.42	-.04
13.0115.00	98468	22910	0.32	-.09
13.0119.00	205441	49909	-.19	-.14
13.0230.00	238792	62772	-.14	0.05
13.0245.00	16238	3462	-.35	0.28
13.0250.00	31730	4615	0.52	0.20
13.0275.00	284659	75764	0.31	0.26*
13.0320.00	28575	7451	0.25	0.07
13.0440.00	353107	47179	0.16	0.61*
13.0475.00	287255	50959	0.23	0.34*
13.0522.00	146752	30191	0.03	0.23*
13.0550.00	294742	65164	0.38	0.45*
13.0580.00	57894	26138	-.02	0.37
13.0685.00	57691	18385	0.44	0.35*
13.0730.00	72023	16507	0.55	0.58*

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B.2: EXTENDED DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. CORR. COEFF.
13.0750.00	32066	8304	1.01*	0.54*
13.0777.00	3005	1214	0.61	-.03
13.0780.00	5891	2828	1.11*	0.47*
13.0790.00	3862	1563	0.59	0.19
13.0825.00	16934	8135	1.73*	0.35*
13.0830.00	5545	1627	1.47*	0.50*
13.0920.00	12057	5181	0.20	0.54*
13.1120.00	12810	7370	0.35	0.31*
13.1135.00	7677	7110	1.75*	0.47*
13.1160.00	15298	2681	0.01	0.46*
13.1187.00	25795	6955	0.04	0.47*
13.1200.00	37935	10344	0.36	0.03
13.1205.00	117486	34333	0.27	0.22
13.1270.00	112285	34506	0.55	0.36*
13.1355.00	59671	17297	0.08	0.04
13.1415.00	70543	43082	0.70	0.15
13.1625.00	23182	9546	0.99	0.10
13.1675.00	11072	7331	1.87*	0.19
13.1695.00	1821	1776	1.34*	0.19
13.1780.00	68753	38405	0.39	0.11
13.1850.00	444409	130602	0.20	-.01
13.1860.00	283518	90167	0.25	-.05
13.1910.00	374658	121037	0.36	0.01

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B.2: EXTENDED DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. CORR. COEFF.
13.1965.00	763	373	0.17	0.08
13.2000.00	104966	44747	0.39	0.08
13.2005.00	2926	1641	0.41	0.04
13.2010.00	116338	44438	0.31	-.11
13.2125.00	484333	318453	0.38	0.25*
13.2140.00	69033	37695	0.77*	0.15
13.2165.00	49451	19272	0.93*	0.07
13.2265.00	16412	12830	1.53*	0.20
13.2350.00	314645	76941	0.22	-.06
13.2450.00	401304	96331	0.56	0.23
13.2506.00	9199	4059	0.25	-.15
13.2513.00	1942	655	0.20	-.08
13.2515.00	16677	5378	0.29	0.01
13.2585.00	242593	83334	0.08	-.12
13.2600.00	13845	4330	0.26	0.03
13.2610.00	38805	11514	0.09	0.13
13.2635.00	333573	125898	-.14	-.14
13.2645.00	26971	14624	1.18*	0.03
13.2670.00	14811	5541	0.48	-.15
13.2730.00	31878	14053	0.32	0.14
13.2755.00	38137	14326	0.33	0.06
13.2882.00	119886	26224	0.01	-.04
13.2920.00	190213	56130	0.17	0.06

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B.2: EXTENDED DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. CORR. COEFF.
13.2950.00	73717	19797	0.41	0.01
13.2955.00	256916	68151	0.43	0.11
13.2960.00	81522	25480	0.26	0.02
13.2965.00	370104	99152	0.39	0.03
13.2985.00	547702	149701	0.37	0.04
13.2990.00	15573	4765	0.19	-.10
13.3065.00	94204	27068	0.31	-.04
13.3085.00	88563	22420	0.34	0.00
13.3090.00	110626	33493	0.39	-.06
13.3105.00	55635	15370	0.16	-.05
13.3130.00	129994	36711	0.03	-.13
13.3165.00	289104	77638	0.21	0.04
13.3190.00	136536	50416	0.31	-.01
13.3200.00	43085	11060	-.21	0.01
13.3235.00	230829	82806	0.15	-.03
13.3250.00	4715	1903	1.40*	0.00
13.3295.00	27150	5532	-.21	0.05
13.3300.00	70931	14845	-.36	-.05
13.3305.00	41679	9888	-.02	-.06
13.3347.00	28206	7663	1.46*	-.10
13.3365.00	1392840	341272	0.04	0.02
13.3370.00	1059930	255022	-.08	0.02
13.3375.00	90242	29937	0.05	0.14

* SIGNIFICANTLY DIFFERENT FROM ZERO AT THE 95% LEVEL

TABLE B.2: EXTENDED DATA STATISTICS

STATION NO. (USGS)	MEAN (cfs-days)	STD. DEV. (cfs-days)	SKEW COEFF.	SER. CORR. COEFF.
13.3380.00	315283	81479	0.30	0.07
13.3405.00	1009905	180629	0.26	-.02
13.3410.00	2140453	557911	0.21	0.11
13.3445.00	60969	19996	1.04*	0.02
13.3450.00	102830	52159	0.67	-.33
13.3480.00	15718	10958	2.16*	0.08
13.3485.00	3632	2681	1.50*	0.02
13.3492.10	140543	67655	-.16	-.38
14.0185.00	203621	70009	0.05	-.12

APPENDIX C

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                    TABLE C- 1

THOMAS FORK NEAR WYO-IDA,BORDER
STATION NO.  10.0410.00 (PROJECT ID NUMBER 2)

TOTAL RECORD LENGTH = 39 YEARS ( 1943 TO 1981 )
LONGEST CONSECUTIVE HIST. PERIOD = 32 YEARS ( 1950 TO 1981 )
TOTAL YEARS, HIST. DATA = 32    TOTAL YEARS, ADDED DATA = 7
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

  MEAN ANN. FLOW  =    19331 cfs-days   SERIAL CORR. =-0.014
  STANDARD DEVIATION =    8394 cfs-days   SKEW COEFF.= 0.278
  FOR q(o)=.50, TRUNCATION LEVEL = 18943  cfs-days
  FOR q(o)=.35, TRUNCATION LEVEL = 15766  cfs-days
  FOR q(o)=.20, TRUNCATION LEVEL = 12197  cfs-days

DROUGHT LENGTHS:

   SAMPLE   TRUNC   MEDIAN  LENGTH EXCEEDED IN P%
    SIZE    LEVEL   LENGTH       OF SAMPLES
   (YEARS)  q(o)    (YEARS)    25%       10%      2%
   ----------------------------------------------------
     25     0.50     3.7       4.8       6.0      8.1
     25     0.35     2.7       3.5       4.4      6.0
     25     0.20     1.6       2.1       2.7      3.8
     50     0.50     4.4       5.6       6.8      8.9
     50     0.35     3.2       4.1       5.0      6.6
     50     0.20     1.9       2.5       3.1      4.2
    100     0.50     5.3       6.5       7.8      9.8
    100     0.35     3.9       4.8       5.7      7.3
    100     0.20     2.3       2.9       3.6      4.6

DROUGHT MAGNITUDES:

   SAMPLE   TRUNC   MEDIAN         DEFICIT EXCEEDED IN P%
    SIZE    LEVEL   DEFICIT             OF SAMPLES
   (YEARS)  q(o)    cfs-days       25%        10%        2%
   ------------------------------------------------------------
     25     0.50     24231       31626      40215      54560
     25     0.35     15864       20932      26880      36925
     25     0.20      8162       10955      14286      20013
     50     0.50     29927       37670      46359      60337
     50     0.35     19593       24932      30986      40836
     50     0.20     10080       13048      16468      22132
    100     0.50     36963       44869      53442      66727
    100     0.35     24199       29697      35720      45160
    100     0.20     12450       15542      18984      24476

HISTORICAL DROUGHTS, BASED ON  32  CONSECUTIVE YEARS:

   TRUNC      MAX RUN     RETURN     MAX         RETURN
   LEVEL      LENGTH      PERIOD     DEFICIT     PERIOD
   ----------------------------------------------------
   0.50          4          26        30704        41
   0.35          3          36        20699        52
   0.20          3         176         9992       111
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TABLE C- 2

MONTPELIER CREEK AT IRRIGATORS WEIR NEAR MONTPELIER, IDA
STATION NO. 10.0475.00 (PROJECT ID NUMBER 3)

TOTAL RECORD LENGTH = 42 YEARS (1940 TO 1981)
LONGEST CONSECUTIVE HIST. PERIOD = 37 YEARS (1943 TO 1979)
TOTAL YEARS, HIST. DATA = 37   TOTAL YEARS, ADDED DATA = 5
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 8157 cfs-days   SERIAL CORR. = 0.229
STANDARD DEVIATION = 2825 cfs-days   SKEW COEFF.= 0.361
FOR q(o)=.50, TRUNCATION LEVEL = 7988 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 6927 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 5750 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.4	5.8	7.4	10.1
25	0.35	3.2	4.2	5.4	7.5
25	0.20	1.9	2.6	3.4	4.7
50	0.50	5.3	6.8	8.4	11.1
50	0.35	3.9	4.9	6.2	8.2
50	0.20	2.3	3.0	3.8	5.2
100	0.50	6.4	7.9	9.6	12.2
100	0.35	4.6	5.8	7.0	9.1
100	0.20	2.8	3.5	4.4	5.7

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	10029	13539	17750	25032
25	0.35	6566	8961	11864	16941
25	0.20	3378	4690	6305	9182
50	0.50	12386	16127	20461	27683
50	0.35	8109	10674	13676	18735
50	0.20	4172	5586	7269	10154
100	0.50	15298	19209	23588	30614
100	0.35	10015	12714	15766	20719
100	0.20	5153	6654	8379	11229

HISTORICAL DROUGHTS, BASED ON 37 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	15	11913	34
0.35	3	21	8542	43
0.20	3	100	5009	93

TABLE C- 3

COTTONWOOD CREEK NEAR CLEVELAND,IDA
STATION NO. 10.0845.00 (PROJECT ID NUMBER 7)

TOTAL RECORD LENGTH = 42 YEARS (1940 TO 1981)
LONGEST CONSECUTIVE HIST. PERIOD = 42 YEARS (1940 TO 1981)
TOTAL YEARS, HIST. DATA = 42 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 11364 cfs-days SERIAL CORR. = 0.049
STANDARD DEVIATION = 4569 cfs-days SKEW COEFF.= 0.137
FOR q(o)=.50, TRUNCATION LEVEL = 11261 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 9507 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 7500 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.2	5.6	7.1	9.6
25	0.35	3.1	4.1	5.2	7.2
25	0.20	1.9	2.5	3.2	4.5
50	0.50	5.1	6.5	8.1	10.6
50	0.35	3.7	4.7	5.9	7.9
50	0.20	2.2	2.9	3.7	5.0
100	0.50	6.2	7.6	9.2	11.6
100	0.35	4.5	5.6	6.8	8.7
100	0.20	2.7	3.4	4.2	5.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	15807	21203	27636	38689
25	0.35	10349	14034	18472	26184
25	0.20	5324	7345	9817	14191
50	0.50	19523	25256	31858	42786
50	0.35	12781	16716	21294	28957
50	0.20	6576	8748	11317	15694
100	0.50	24112	30082	36726	47316
100	0.35	15786	19910	24547	32023
100	0.20	8122	10420	13046	17356

HISTORICAL DROUGHTS, BASED ON 42 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	5	34	20566	45
0.35	3	24	11778	35
0.20	3	114	5758	73

TABLE C- 4

BLACKSMITH FORK AB U.P.&L. CO,UT
STATION NO. 10.1135.00 (PROJECT ID NUMBER 11)

TOTAL RECORD LENGTH = 63 YEARS (1919 TO 1981)
LONGEST CONSECUTIVE HIST. PERIOD = 63 YEARS (1919 TO 1981)
TOTAL YEARS, HIST. DATA = 63 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 45706 cfs-days SERIAL CORR. = 0.506
STANDARD DEVIATION = 15542 cfs-days SKEW COEFF.= 0.554
FOR q(o)=.50, TRUNCATION LEVEL = 44281 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 38574 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 32402 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.5	5.9	7.5	10.3
25	0.35	3.3	4.3	5.6	7.7
25	0.20	2.0	2.6	3.4	4.8
50	0.50	5.4	6.9	8.6	11.3
50	0.35	3.9	5.0	6.3	8.4
50	0.20	2.4	3.1	3.9	5.3
100	0.50	6.5	8.1	9.8	12.5
100	0.35	4.7	5.9	7.2	9.3
100	0.20	2.9	3.6	4.5	5.8

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	56003	75862	99755	141226
25	0.35	36665	50211	66676	95580
25	0.20	18863	26277	35437	51802
50	0.50	69168	90360	114995	156181
50	0.35	45284	59806	76863	105701
50	0.20	23298	31299	40850	57288
100	0.50	85428	107628	132564	172719
100	0.35	55929	71235	88606	116894
100	0.20	28774	37280	47092	63354

HISTORICAL DROUGHTS, BASED ON 63 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	7	111	103590	160
0.35	4	39	57504	64
0.20	4	187	32819	111

TABLE C- 5

BOULDER CREEK NEAR LEONIA, IDAHO
STATION NO. 12.3055.00 (PROJECT ID NUMBER 15)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 43 YEARS (1929 TO 1971)
TOTAL YEARS, HIST. DATA = 47   TOTAL YEARS, ADDED DATA = 17
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 43896 cfs-days   SERIAL CORR. = 0.145
STANDARD DEVIATION = 13118 cfs-days   SKEW COEFF. = 0.228
FOR q(o)=.50, TRUNCATION LEVEL = 43400 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 38410 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 32767 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.4	5.7	7.3	9.9
25	0.35	3.2	4.2	5.4	7.4
25	0.20	1.9	2.6	3.3	4.6
50	0.50	5.3	6.7	8.3	10.9
50	0.35	3.8	4.9	6.1	8.1
50	0.20	2.3	3.0	3.8	5.1
100	0.50	6.3	7.8	9.4	12.0
100	0.35	4.6	5.7	7.0	8.9
100	0.20	2.8	3.5	4.3	5.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	46348	62457	81742	115034
25	0.35	30344	41338	54636	77854
25	0.20	15611	21634	29038	42195
50	0.50	57243	74393	94230	127216
50	0.35	37477	49238	62983	86098
50	0.20	19281	25768	33474	46663
100	0.50	70700	88609	108627	140687
100	0.35	46287	58647	72606	95215
100	0.20	23814	30693	38588	51604

HISTORICAL DROUGHTS, BASED ON 43 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	3	8	57021	38
0.35	3	22	42052	50
0.20	3	104	25122	104

TABLE C- 6

MOYIE RIVER AT EASTPORT, IDA
STATION NO. 12.3065.00 (PROJECT ID NUMBER 16)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 55 YEARS (1930 TO 1984)
TOTAL YEARS, HIST. DATA = 55 TOTAL YEARS, ADDED DATA = 9
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 259128 cfs-days SERIAL CORR. = 0.035
STANDARD DEVIATION = 76577 cfs-days SKEW COEFF.=-0.167
FOR q(o)=.50, TRUNCATION LEVEL = 259128 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 229347 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 194680 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.2	5.4	6.9	9.4
25	0.35	3.0	4.0	5.1	7.0
25	0.20	1.8	2.4	3.2	4.4
50	0.50	5.0	6.4	7.9	10.3
50	0.35	3.6	4.7	5.8	7.7
50	0.20	2.2	2.8	3.6	4.8
100	0.50	6.1	7.4	9.0	11.4
100	0.35	4.4	5.4	6.6	8.5
100	0.20	2.6	3.3	4.1	5.3

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	294899	395737	515979	722665
25	0.35	193069	261924	344878	489090
25	0.20	99330	137077	183294	265076
50	0.50	364223	471363	594810	799189
50	0.35	238455	311978	397569	540880
50	0.20	122680	163272	211298	293145
100	0.50	449843	561442	685684	883816
100	0.35	294510	371598	458309	598155
100	0.20	151519	194474	243580	324187

HISTORICAL DROUGHTS, BASED ON 55 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	18	366305	44
0.35	3	25	188303	26
0.20	3	122	113191	68

TABLE C- 7

MOYIE RIVER AT EILEEN, IDA
STATION NO. 12.3075.00 (PROJECT ID NUMBER 17)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 53 YEARS (1926 TO 1978)
TOTAL YEARS, HIST. DATA = 53 TOTAL YEARS, ADDED DATA = 11
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 322724 cfs-days SERIAL CORR. =-0.060
STANDARD DEVIATION = 94917 cfs-days SKEW COEFF.=-0.293
FOR q(o)=.50, TRUNCATION LEVEL = 322724 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 285810 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 242842 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.6	4.7	5.9	8.0
25	0.35	2.6	3.4	4.4	5.9
25	0.20	1.6	2.1	2.7	3.7
50	0.50	4.4	5.5	6.8	8.8
50	0.35	3.2	4.0	5.0	6.5
50	0.20	1.9	2.5	3.1	4.1
100	0.50	5.3	6.4	7.7	9.6
100	0.35	3.8	4.7	5.7	7.2
100	0.20	2.3	2.9	3.5	4.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	311551	407500	519167	706087
25	0.35	203971	269709	347010	477870
25	0.20	104939	141151	184427	258995
50	0.50	384790	485374	598485	780855
50	0.35	251920	321251	400026	528472
50	0.20	129607	168125	212603	286420
100	0.50	475245	578130	689922	863541
100	0.35	311140	382643	461141	584433
100	0.20	160075	200254	245085	316750

HISTORICAL DROUGHTS, BASED ON 53 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	3	14	408730	49
0.35	3	38	297990	62
0.20	3	184	169083	126

TABLE C- 8

DEEP CREEK AT MORAVIA, IDAHO
STATION NO. 12.3110.00 (PROJECT ID NUMBER 18)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 43 YEARS (1929 TO 1971)
TOTAL YEARS, HIST. DATA = 43   TOTAL YEARS, ADDED DATA = 21
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 53960 cfs-days   SERIAL CORR. = 0.137
STANDARD DEVIATION = 15713 cfs-days   SKEW COEFF.=-0.162
FOR q(o)=.50, TRUNCATION LEVEL = 53960 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 47849 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 40736 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.6	7.2	9.8
25	0.35	3.1	4.1	5.3	7.3
25	0.20	1.9	2.5	3.3	4.6
50	0.50	5.2	6.6	8.2	10.7
50	0.35	3.8	4.8	6.0	8.0
50	0.20	2.3	2.9	3.7	5.0
100	0.50	6.3	7.7	9.3	11.8
100	0.35	4.5	5.6	6.9	8.8
100	0.20	2.7	3.4	4.2	5.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	62812	84797	111161	156762
25	0.35	41123	56124	74300	106094
25	0.20	21157	29372	39488	57501
50	0.50	77578	101002	128144	173361
50	0.35	50790	66849	85651	117329
50	0.20	26130	34985	45521	63589
100	0.50	95815	120303	147722	191719
100	0.35	62729	79624	98737	129753
100	0.20	32273	41671	52476	70323

HISTORICAL DROUGHTS, BASED ON 43 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	16	84592	58
0.35	3	23	66260	74
0.20	3	109	44921	150

TABLE C- 9

SMITH CREEK NEAR PORTHILL, IDAHO
STATION NO. 12.3210.00 (PROJECT ID NUMBER 21)

TOTAL RECORD LENGTH = 55 YEARS (1930 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 30 YEARS (1931 TO 1960)
TOTAL YEARS, HIST. DATA = 30 TOTAL YEARS, ADDED DATA = 25
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 69795 cfs-days SERIAL CORR. = 0.192
STANDARD DEVIATION = 16122 cfs-days SKEW COEFF.=-0.326
FOR q(o)=.50, TRUNCATION LEVEL = 69795 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 63525 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 56227 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.7	7.2	9.9
25	0.35	3.1	4.1	5.3	7.3
25	0.20	1.9	2.5	3.3	4.6
50	0.50	5.2	6.6	8.2	10.8
50	0.35	3.8	4.9	6.1	8.1
50	0.20	2.3	3.0	3.8	5.1
100	0.50	6.3	7.8	9.4	11.9
100	0.35	4.6	5.7	6.9	8.9
100	0.20	2.8	3.5	4.3	5.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	65045	87942	115438	163069
25	0.35	42585	58205	77158	110363
25	0.20	21909	30461	41008	59814
50	0.50	80336	104747	133074	180336
50	0.35	52595	69328	88946	122049
50	0.20	27059	36283	47273	66148
100	0.50	99221	124765	153405	199432
100	0.35	64959	82577	102536	134973
100	0.20	33420	43216	54495	73152

HISTORICAL DROUGHTS, BASED ON 30 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	3	8	54827	16
0.35	3	22	36808	21
0.20	3	106	23838	59

TABLE C- 10

BOUNDARY CREEK NEAR PORTHILL, IDA
STATION NO. 12.3215.00 (PROJECT ID NUMBER 22)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 54 YEARS (1931 TO 1984)
TOTAL YEARS, HIST. DATA = 54 TOTAL YEARS, ADDED DATA = 10
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 72082 cfs-days SERIAL CORR. = 0.005
STANDARD DEVIATION = 18896 cfs-days SKEW COEFF.= 0.100
FOR q(o)=.50, TRUNCATION LEVEL = 71769 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 64491 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 56123 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.0	5.2	6.7	9.0
25	0.35	2.9	3.8	4.9	6.7
25	0.20	1.8	2.3	3.0	4.2
50	0.50	4.9	6.1	7.6	9.9
50	0.35	3.5	4.5	5.6	7.4
50	0.20	2.1	2.7	3.5	4.7
100	0.50	5.9	7.2	8.6	10.9
100	0.35	4.2	5.3	6.4	8.1
100	0.20	2.6	3.2	3.9	5.1

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	61832	82144	106135	146947
25	0.35	40481	54368	70941	99452
25	0.20	20827	28453	37703	53901
50	0.50	76367	97842	122351	162508
50	0.35	49997	64758	81779	109983
50	0.20	25722	33891	43463	59608
100	0.50	94319	116540	141043	179716
100	0.35	61750	77133	94273	121629
100	0.20	31769	40367	50104	65920

HISTORICAL DROUGHTS, BASED ON 54 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	20	66164	28
0.35	3	28	46048	38
0.20	3	136	29312	104

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                    TABLE C- 11

PRIEST RIVER NEAR COOLIN,IDA
STATION NO.  12.3940.00         (PROJECT ID NUMBER 24)

TOTAL RECORD LENGTH = 55 YEARS ( 1930 TO 1984 )
LONGEST CONSECUTIVE HIST. PERIOD = 36 YEARS ( 1949 TO 1984 )
TOTAL YEARS, HIST. DATA = 36    TOTAL YEARS, ADDED DATA = 19
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

  MEAN ANN. FLOW  =  466877 cfs-days   SERIAL CORR. =-0.028
  STANDARD DEVIATION = 108775 cfs-days   SKEW COEFF.=-0.002
  FOR q(o)=.50, TRUNCATION LEVEL = 466877  cfs-days
  FOR q(o)=.35, TRUNCATION LEVEL = 424574  cfs-days
  FOR q(o)=.20, TRUNCATION LEVEL = 375332  cfs-days

DROUGHT LENGTHS:

   SAMPLE   TRUNC   MEDIAN  LENGTH EXCEEDED IN P%
    SIZE    LEVEL   LENGTH      OF SAMPLES
   (YEARS)  q(o)    (YEARS)    25%      10%      2%
  ------------------------------------------------
      25     0.50     3.6      4.7      5.9      8.0
      25     0.35     2.6      3.4      4.4      5.9
      25     0.20     1.6      2.1      2.7      3.7
      50     0.50     4.4      5.5      6.8      8.8
      50     0.35     3.2      4.0      5.0      6.5
      50     0.20     1.9      2.5      3.1      4.1
     100     0.50     5.3      6.4      7.7      9.6
     100     0.35     3.8      4.7      5.7      7.2
     100     0.20     2.3      2.9      3.5      4.5

DROUGHT MAGNITUDES:

   SAMPLE   TRUNC    MEDIAN         DEFICIT EXCEEDED IN P%
    SIZE    LEVEL    DEFICIT              OF SAMPLES
   (YEARS)  q(o)     cfs-days      25%        10%        2%
  ---------------------------------------------------------
      25     0.50     357039     466996     594967     809178
      25     0.35     233751     309087     397674     547640
      25     0.20     120260     161759     211354     296809
      50     0.50     440970     556240     685866     894863
      50     0.35     288701     368155     458431     605631
      50     0.20     148531     192672     243644     328239
     100     0.50     544632     662539     790653     989621
     100     0.35     356568     438510     528470     669762
     100     0.20     183447     229492     280868     362996

HISTORICAL DROUGHTS, BASED ON  36  CONSECUTIVE YEARS:

   TRUNC      MAX RUN     RETURN     MAX         RETURN
   LEVEL      LENGTH      PERIOD     DEFICIT     PERIOD
  -----------------------------------------------------
   0.50          5          55       517764       65
   0.35          2          19       229784       32
   0.20          1          47       180542      116
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TABLE C- 12

PRIEST RIVER NEAR PRIEST RIVER, IDA
STATION NO. 12.3950.00 (PROJECT ID NUMBER 25)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 55 YEARS (1930 TO 1984)
TOTAL YEARS, HIST. DATA = 55 TOTAL YEARS, ADDED DATA = 9
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 614535 cfs-days SERIAL CORR. = 0.059
STANDARD DEVIATION = 160952 cfs-days SKEW COEFF.=-0.102
FOR q(o)=.50, TRUNCATION LEVEL = 614535 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 551941 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 479078 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.2	5.5	7.0	9.5
25	0.35	3.1	4.0	5.2	7.1
25	0.20	1.8	2.5	3.2	4.5
50	0.50	5.1	6.4	8.0	10.5
50	0.35	3.7	4.7	5.9	7.8
50	0.20	2.2	2.9	3.6	4.9
100	0.50	6.1	7.5	9.1	11.5
100	0.35	4.4	5.5	6.7	8.6
100	0.20	2.7	3.4	4.2	5.4

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	628731	845652	1104876	1551520
25	0.35	411626	559706	738495	1050047
25	0.20	211773	292919	392491	569103
50	0.50	776531	1007258	1273678	1715812
50	0.35	508390	666667	851322	1161238
50	0.20	261556	348897	452456	629366
100	0.50	959075	1199748	1468270	1897502
100	0.35	627901	794069	981387	1284203
100	0.20	323042	415572	521582	696010

HISTORICAL DROUGHTS, BASED ON 55 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	18	691053	31
0.35	3	24	460146	33
0.20	2	59	314421	89

TABLE C- 13

COEUR D'ALENE RIVER ABOVE SHOSHONE CRK NEAR PRICHARD,IDA
STATION NO. 12.4110.00 (PROJECT ID NUMBER 26)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 34 YEARS (1951 TO 1984)
TOTAL YEARS, HIST. DATA = 34 TOTAL YEARS, ADDED DATA = 30
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 258953 cfs-days SERIAL CORR. =-0.072
STANDARD DEVIATION = 72643 cfs-days SKEW COEFF.= 0.156
FOR q(o)=.50, TRUNCATION LEVEL = 257069 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 229243 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 197479 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.8	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.6	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	211673	276313	351402	476836
25	0.35	138581	182881	234876	322716
25	0.20	71297	95710	124831	174905
50	0.50	261432	329117	405089	527329
50	0.35	171158	217830	270761	356889
50	0.20	88057	114001	143902	193426
100	0.50	322889	392012	466979	583168
100	0.35	211393	259458	312127	394680
100	0.20	108757	135786	165888	213908

HISTORICAL DROUGHTS, BASED ON 34 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	2	7	175683	18
0.35	2	18	147857	39
0.20	2	89	116093	142

TABLE C- 14

COEUR D'ALENE RIVER AT ENAVILLE, IDA
STATION NO. 12.4130.00 (PROJECT ID NUMBER 27)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 45 YEARS (1940 TO 1984)
TOTAL YEARS, HIST. DATA = 45 TOTAL YEARS, ADDED DATA = 19
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 695661 cfs-days SERIAL CORR. =-0.026
STANDARD DEVIATION = 198704 cfs-days SKEW COEFF.=-0.071
FOR q(o)=.50, TRUNCATION LEVEL = 695661 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 618385 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 528432 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.6	4.7	5.9	8.0
25	0.35	2.6	3.4	4.4	5.9
25	0.20	1.6	2.1	2.7	3.7
50	0.50	4.4	5.5	6.8	8.8
50	0.35	3.2	4.0	5.0	6.5
50	0.20	1.9	2.5	3.1	4.1
100	0.50	5.3	6.4	7.7	9.6
100	0.35	3.8	4.7	5.7	7.2
100	0.20	2.3	2.9	3.5	4.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	652216	853079	1086848	1478154
25	0.35	427002	564621	726446	1000395
25	0.20	219684	295492	386088	542192
50	0.50	805537	1016104	1252897	1634678
50	0.35	527380	672522	837432	1106328
50	0.20	271326	351961	445074	599605
100	0.50	994899	1210284	1444314	1807776
100	0.35	651355	801042	965375	1223478
100	0.20	335109	419222	513072	663099

HISTORICAL DROUGHTS, BASED ON 45 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	3	14	703686	30
0.35	3	38	471858	38
0.20	2	93	309675	109

TABLE C- 15

COEUR D'ALENE RIVER NEAR CATALDO, IDAHO
STATION NO. 12.4135.00 (PROJECT ID NUMBER 29)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 52 YEARS (1921 TO 1972)
TOTAL YEARS, HIST. DATA = 52 TOTAL YEARS, ADDED DATA = 12
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 933863 cfs-days SERIAL CORR. = 0.009
STANDARD DEVIATION = 261557 cfs-days SKEW COEFF.=-0.061
FOR q(o)=.50, TRUNCATION LEVEL = 933863 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 832143 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 713736 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.0	5.3	6.7	9.1
25	0.35	2.9	3.8	4.9	6.7
25	0.20	1.8	2.4	3.1	4.2
50	0.50	4.9	6.2	7.6	10.0
50	0.35	3.5	4.5	5.6	7.4
50	0.20	2.1	2.8	3.5	4.7
100	0.50	5.9	7.2	8.7	11.0
100	0.35	4.3	5.3	6.4	8.2
100	0.20	2.6	3.2	4.0	5.1

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	972298	1297388	1682960	2341849
25	0.35	636558	858693	1124885	1584931
25	0.20	327496	449393	597848	858998
50	0.50	1200861	1545322	1940082	2589831
50	0.35	786197	1022791	1296745	1752762
50	0.20	404482	535273	689187	949959
100	0.50	1483156	1840637	2236487	2864071
100	0.35	971013	1218249	1494861	1938365
100	0.20	499566	637565	794480	1050551

HISTORICAL DROUGHTS, BASED ON 52 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	20	1264753	50
0.35	4	55	959594	64
0.20	3	135	604373	130

TABLE C- 16

ST. JOE RIVER AT CALDER, IDA
STATION NO. 12.4145.00 (PROJECT ID NUMBER 30)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 64 YEARS (1921 TO 1984)
TOTAL YEARS, HIST. DATA = 64 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 867045 cfs-days SERIAL CORR. =-0.063
STANDARD DEVIATION = 243886 cfs-days SKEW COEFF.= 0.084
FOR q(o)=.50, TRUNCATION LEVEL = 863644 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 769563 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 661180 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.7	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.6	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	717827	937192	1192058	1617875
25	0.35	469957	620293	796768	1094955
25	0.20	241783	324627	423462	593442
50	0.50	886571	1116292	1374180	1789193
50	0.35	580433	738832	918497	1210902
50	0.20	298621	386665	488158	656282
100	0.50	1094982	1329618	1584127	1978654
100	0.35	716879	880025	1058825	1339126
100	0.20	368819	460557	562739	725777

HISTORICAL DROUGHTS, BASED ON 64 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	27	1065249	63
0.35	4	73	783006	81
0.20	3	177	457857	167

TABLE C- 17

ST. MARIES RIVER AT LOTUS, IDAHO
STATION NO. 12.4150.00 (PROJECT ID NUMBER 32)

TOTAL RECORD LENGTH = 64 YEARS (1921 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 46 YEARS (1921 TO 1966)
TOTAL YEARS, HIST. DATA = 46 TOTAL YEARS, ADDED DATA = 18
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 191585 cfs-days SERIAL CORR. = 0.072
STANDARD DEVIATION = 67627 cfs-days SKEW COEFF.= 0.388
FOR q(o)=.50, TRUNCATION LEVEL = 187230 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 161911 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 133889 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.6	7.2	9.7
25	0.35	3.1	4.1	5.3	7.2
25	0.20	1.9	2.5	3.3	4.6
50	0.50	5.2	6.6	8.1	10.7
50	0.35	3.7	4.8	6.0	8.0
50	0.20	2.3	2.9	3.7	5.0
100	0.50	6.2	7.7	9.3	11.8
100	0.35	4.5	5.6	6.8	8.8
100	0.20	2.7	3.4	4.2	5.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	232357	312102	407276	571032
25	0.35	152123	206568	272222	386466
25	0.20	78264	108107	144679	209456
50	0.50	286979	371745	469499	631499
50	0.35	187883	246044	313812	427390
50	0.20	96662	128766	166783	231636
100	0.50	354441	442787	541229	698369
100	0.35	232050	293064	361756	472647
100	0.20	119385	153374	192264	256164

HISTORICAL DROUGHTS, BASED ON 46 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	17	308157	47
0.35	4	45	232201	62
0.20	3	110	148134	135

TABLE C- 18

HENRYS FORK AT WARM RIVER, IDAHO
STATION NO. 13.0440.00 (PROJECT ID NUMBER 41)

TOTAL RECORD LENGTH = 34 YEARS (1919 TO 1952)
LONGEST CONSECUTIVE HIST. PERIOD = 34 YEARS (1919 TO 1952)
TOTAL YEARS, HIST. DATA = 34   TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 353107 cfs-days   SERIAL CORR. = 0.611
STANDARD DEVIATION = 47179 cfs-days   SKEW COEFF.= 0.158
FOR q(o)=.50, TRUNCATION LEVEL = 351866 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 333798 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 313178 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.5	5.9	7.6	10.3
25	0.35	3.3	4.3	5.6	7.7
25	0.20	2.0	2.6	3.5	4.8
50	0.50	5.4	6.9	8.6	11.4
50	0.35	3.9	5.1	6.3	8.5
50	0.20	2.4	3.1	3.9	5.3
100	0.50	6.6	8.1	9.8	12.5
100	0.35	4.7	5.9	7.2	9.3
100	0.20	2.9	3.6	4.5	5.8

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	174376	236487	311295	441299
25	0.35	114163	156522	208068	298665
25	0.20	58734	81915	110583	161870
50	0.50	215367	281680	358854	488029
50	0.35	141000	186434	239857	330291
50	0.20	72541	97569	127478	179011
100	0.50	265995	335510	413680	539707
100	0.35	174145	222062	276502	365266
100	0.20	89594	116215	146954	197966

HISTORICAL DROUGHTS, BASED ON 34 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	13	6746	592775	6993
0.35	8	596	282511	266
0.20	4	185	102824	109

TABLE C- 19

FALLS RIVER NEAR SQUIRREL,IDA
STATION NO. 13.0475.00 (PROJECT ID NUMBER 42)

TOTAL RECORD LENGTH = 66 YEARS (1919 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 66 YEARS (1919 TO 1984)
TOTAL YEARS, HIST. DATA = 66 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 287255 cfs-days SERIAL CORR. = 0.337
STANDARD DEVIATION = 50959 cfs-days SKEW COEFF.= 0.234
FOR q(o)=.50, TRUNCATION LEVEL = 285276 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 265904 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 244012 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.4	5.8	7.4	10.2
25	0.35	3.2	4.3	5.5	7.6
25	0.20	1.9	2.6	3.4	4.8
50	0.50	5.4	6.8	8.5	11.2
50	0.35	3.9	5.0	6.2	8.3
50	0.20	2.3	3.1	3.9	5.2
100	0.50	6.5	8.0	9.7	12.3
100	0.35	4.7	5.8	7.1	9.1
100	0.20	2.8	3.6	4.4	5.8

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	184146	249060	327044	462186
25	0.35	120559	164844	218595	312801
25	0.20	62025	86270	116178	169531
50	0.50	227434	296656	377009	511127
50	0.35	148900	196346	251992	345924
50	0.20	76606	102757	133927	187483
100	0.50	280898	353348	434609	565252
100	0.35	183902	233868	290491	382554
100	0.20	94614	122394	154389	207336

HISTORICAL DROUGHTS, BASED ON 66 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	6	58	198810	27
0.35	4	40	144508	36
0.20	2	49	100725	102

TABLE C- 20

PORTNEUF RIVER AT TOPAZ,IDA
STATION NO. 13.0730.00 (PROJECT ID NUMBER 47)

TOTAL RECORD LENGTH = 64 YEARS (1920 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 64 YEARS (1920 TO 1983)
TOTAL YEARS, HIST. DATA = 64 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 72023 cfs-days SERIAL CORR. = 0.584
STANDARD DEVIATION = 16507 cfs-days SKEW COEFF.= 0.547
FOR q(o)=.50, TRUNCATION LEVEL = 70528 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 64461 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 57893 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.5	5.9	7.6	10.3
25	0.35	3.3	4.3	5.6	7.7
25	0.20	2.0	2.6	3.5	4.8
50	0.50	5.4	6.9	8.6	11.4
50	0.35	3.9	5.1	6.3	8.5
50	0.20	2.4	3.1	3.9	5.3
100	0.50	6.6	8.1	9.8	12.5
100	0.35	4.8	5.9	7.2	9.3
100	0.20	2.9	3.6	4.5	5.9

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	59725	80956	106514	150905
25	0.35	39102	53582	71194	102131
25	0.20	20117	28042	37838	55353
50	0.50	73765	96427	122787	166885
50	0.35	48294	63821	82071	112945
50	0.20	24846	33401	43618	61214
100	0.50	91106	114854	141547	184557
100	0.35	59646	76018	94609	124905
100	0.20	30687	39784	50282	67696

HISTORICAL DROUGHTS, BASED ON 64 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	11	1703	121986	254
0.35	6	150	60864	63
0.20	3	93	23796	71

TABLE C- 21

MARSH CREEK NEAR MCCAMMON,IDA
STATION NO. 13.0750.00 (PROJECT ID NUMBER 48)

TOTAL RECORD LENGTH = 65 YEARS (1920 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 30 YEARS (1955 TO 1984)
TOTAL YEARS, HIST. DATA = 30 TOTAL YEARS, ADDED DATA = 35
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 32066 cfs-days SERIAL CORR. = 0.536
STANDARD DEVIATION = 8304 cfs-days SKEW COEFF.= 1.009
FOR q(o)=.50, TRUNCATION LEVEL = 30693 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 27857 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 24999 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.5	5.9	7.6	10.3
25	0.35	3.3	4.3	5.6	7.7
25	0.20	2.0	2.6	3.4	4.8
50	0.50	5.4	6.9	8.6	11.4
50	0.35	3.9	5.1	6.3	8.4
50	0.20	2.4	3.1	3.9	5.3
100	0.50	6.6	8.1	9.8	12.5
100	0.35	4.7	5.9	7.2	9.3
100	0.20	2.9	3.6	4.5	5.8

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	29679	40207	52875	74865
25	0.35	19431	26612	35341	50667
25	0.20	9997	13927	18783	27461
50	0.50	36656	47891	60953	82792
50	0.35	23998	31697	40741	56033
50	0.20	12347	16589	21653	30368
100	0.50	45273	57043	70265	91559
100	0.35	29640	37755	46965	61966
100	0.20	15249	19759	24961	33584

HISTORICAL DROUGHTS, BASED ON 30 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	3	7	22268	12
0.35	3	19	13760	17
0.20	2	47	6354	47

TABLE C- 22

GOOSE CREEK ABOVE TRAPPER CREEK NEAR OAKLEY,IDA
STATION NO. 13.0825.00 (PROJECT ID NUMBER 52)

TOTAL RECORD LENGTH = 64 YEARS (1920 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 64 YEARS (1920 TO 1983)
TOTAL YEARS, HIST. DATA = 64 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 16934 cfs-days SERIAL CORR. = 0.347
STANDARD DEVIATION = 8135 cfs-days SKEW COEFF.= 1.730
FOR q(o)=.50, TRUNCATION LEVEL = 14731 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 12420 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 10402 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.5	5.9	7.5	10.2
25	0.35	3.2	4.3	5.5	7.6
25	0.20	2.0	2.6	3.4	4.8
50	0.50	5.4	6.8	8.5	11.2
50	0.35	3.9	5.0	6.3	8.4
50	0.20	2.4	3.1	3.9	5.3
100	0.50	6.5	8.0	9.7	12.3
100	0.35	4.7	5.9	7.1	9.2
100	0.20	2.8	3.6	4.4	5.8

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	28483	38508	50547	71400
25	0.35	18648	25487	33785	48323
25	0.20	9594	13339	17956	26190
50	0.50	35179	45867	58269	78961
50	0.35	23032	30358	38947	53439
50	0.20	11849	15888	20699	28963
100	0.50	43449	54633	67172	87322
100	0.35	28446	36159	44897	59098
100	0.20	14635	18924	23862	32030

HISTORICAL DROUGHTS, BASED ON 64 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	5	29	24897	17
0.35	3	20	12136	16
0.20	3	96	6982	53

TABLE C- 23

TRAPPER CREEK NEAR OAKLEY,IDA
STATION NO. 13.0830.00 (PROJECT ID NUMBER 53)

TOTAL RECORD LENGTH = 65 YEARS (1920 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 65 YEARS (1920 TO 1984)
TOTAL YEARS, HIST. DATA = 65 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 5545 cfs-days SERIAL CORR. = 0.500
STANDARD DEVIATION = 1627 cfs-days SKEW COEFF.= 1.466
FOR q(o)=.50, TRUNCATION LEVEL = 5163 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 4663 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 4199 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.5	5.9	7.5	10.3
25	0.35	3.3	4.3	5.6	7.7
25	0.20	2.0	2.6	3.4	4.8
50	0.50	5.4	6.9	8.6	11.3
50	0.35	3.9	5.1	6.3	8.4
50	0.20	2.4	3.1	3.9	5.3
100	0.50	6.5	8.1	9.8	12.5
100	0.35	4.7	5.9	7.2	9.3
100	0.20	2.9	3.6	4.5	5.8

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	5771	7815	10273	14539
25	0.35	3778	5172	6866	9840
25	0.20	1944	2707	3649	5333
50	0.50	7127	9308	11843	16078
50	0.35	4666	6161	7916	10881
50	0.20	2401	3224	4207	5898
100	0.50	8803	11087	13652	17781
100	0.35	5763	7338	9125	12034
100	0.20	2965	3840	4850	6522

HISTORICAL DROUGHTS, BASED ON 65 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	7	110	8412	63
0.35	4	38	3020	20
0.20	3	94	1643	56

TABLE C- 24

ROCK CREEK NEAR ROCK CREEK, IDA
STATION NO. 13.0920.00 (PROJECT ID NUMBER 55)

TOTAL RECORD LENGTH = 65 YEARS (1920 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 30 YEARS (1945 TO 1974)
TOTAL YEARS, HIST. DATA = 30 TOTAL YEARS, ADDED DATA = 35
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 12057 cfs-days SERIAL CORR. = 0.538
STANDARD DEVIATION = 5181 cfs-days SKEW COEFF. = 0.202
FOR q(o)=.50, TRUNCATION LEVEL = 11883 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 9907 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 7665 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.5	5.9	7.5	10.3
25	0.35	3.3	4.3	5.6	7.7
25	0.20	2.0	2.6	3.4	4.8
50	0.50	5.4	6.9	8.6	11.3
50	0.35	3.9	5.0	6.3	8.4
50	0.20	2.4	3.1	3.9	5.3
100	0.50	6.5	8.1	9.8	12.5
100	0.35	4.7	5.9	7.2	9.3
100	0.20	2.9	3.6	4.5	5.8

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	19009	25764	33895	48017
25	0.35	12445	17052	22656	32497
25	0.20	6403	8924	12041	17613
50	0.50	23478	30688	39074	53101
50	0.35	15371	20311	26117	35938
50	0.20	7908	10630	13880	19478
100	0.50	28997	36552	45044	58724
100	0.35	18984	24193	30107	39744
100	0.20	9767	12661	16001	21540

HISTORICAL DROUGHTS, BASED ON 30 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	5	28	20121	25
0.35	3	19	10709	21
0.20	3	94	3983	44

TABLE C- 25

CAMAS CREEK AT CAMAS, IDA
STATION NO. 13.1120.00 (PROJECT ID NUMBER 57)

TOTAL RECORD LENGTH = 56 YEARS (1927 TO 1982)
LONGEST CONSECUTIVE HIST. PERIOD = 44 YEARS (1927 TO 1970)
TOTAL YEARS, HIST. DATA = 55 TOTAL YEARS, ADDED DATA = 1
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 12810 cfs-days SERIAL CORR. = 0.308
STANDARD DEVIATION = 7370 cfs-days SKEW COEFF.= 0.351
FOR q(o)=.50, TRUNCATION LEVEL = 12381 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 9611 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 6530 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.4	5.8	7.4	10.1
25	0.35	3.2	4.3	5.5	7.5
25	0.20	1.9	2.6	3.4	4.8
50	0.50	5.4	6.8	8.5	11.2
50	0.35	3.9	5.0	6.2	8.3
50	0.20	2.3	3.0	3.9	5.2
100	0.50	6.5	8.0	9.6	12.3
100	0.35	4.7	5.8	7.1	9.1
100	0.20	2.8	3.6	4.4	5.7

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	26392	35678	46829	66142
25	0.35	17279	23614	31300	44764
25	0.20	8890	12358	16635	24261
50	0.50	32597	42497	53983	73145
50	0.35	21341	28127	36082	49504
50	0.20	10979	14720	19177	26830
100	0.50	40259	50618	62231	80891
100	0.35	26358	33502	41595	54746
100	0.20	13560	17533	22107	29671

HISTORICAL DROUGHTS, BASED ON 44 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	11	1796	85996	4248
0.35	11	4912	55533	792
0.20	5	387	16239	120

TABLE C- 26

BEAVER CREEK AT DUBOIS,IDA
STATION NO. 13.1135.00 (PROJECT ID NUMBER 58)

TOTAL RECORD LENGTH = 43 YEARS (1931 TO 1973)
LONGEST CONSECUTIVE HIST. PERIOD = 43 YEARS (1931 TO 1973)
TOTAL YEARS, HIST. DATA = 43 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 7677 cfs-days SERIAL CORR. = 0.471
STANDARD DEVIATION = 7110 cfs-days SKEW COEFF.= 1.746
FOR q(o)=.50, TRUNCATION LEVEL = 5736 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 3727 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 1979 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.5	5.9	7.5	10.3
25	0.35	3.3	4.3	5.6	7.7
25	0.20	2.0	2.6	3.4	4.8
50	0.50	5.4	6.9	8.6	11.3
50	0.35	3.9	5.0	6.3	8.4
50	0.20	2.4	3.1	3.9	5.3
100	0.50	6.5	8.1	9.8	12.5
100	0.35	4.7	5.9	7.2	9.3
100	0.20	2.9	3.6	4.5	5.8

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	25099	33978	44654	63173
25	0.35	16432	22489	29847	42755
25	0.20	8454	11769	15863	23172
50	0.50	30999	40471	51476	69863
50	0.35	20295	26786	34407	47282
50	0.20	10441	14018	18286	25626
100	0.50	38286	48205	59341	77261
100	0.35	25065	31905	39663	52289
100	0.20	12896	16697	21080	28339

HISTORICAL DROUGHTS, BASED ON 43 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	7	110	35539	57
0.35	7	302	21474	43
0.20	7	1463	9236	68

TABLE C- 27

NORTH FORK BIG LOST RIVER AT WILD HORSE NEAR CHILLY,IDA
STATION NO. 13.1200.00 (PROJECT ID NUMBER 61)

TOTAL RECORD LENGTH = 65 YEARS (1920 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 40 YEARS (1945 TO 1984)
TOTAL YEARS, HIST. DATA = 40 TOTAL YEARS, ADDED DATA = 25
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 37935 cfs-days SERIAL CORR. = 0.029
STANDARD DEVIATION = 10344 cfs-days SKEW COEFF.= 0.363
FOR q(o)=.50, TRUNCATION LEVEL = 37311 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 33429 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 29118 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.2	5.5	7.0	9.5
25	0.35	3.0	4.0	5.1	7.1
25	0.20	1.8	2.5	3.2	4.4
50	0.50	5.1	6.4	8.0	10.4
50	0.35	3.7	4.7	5.9	7.8
50	0.20	2.2	2.9	3.6	4.9
100	0.50	6.1	7.5	9.1	11.5
100	0.35	4.4	5.5	6.7	8.6
100	0.20	2.7	3.4	4.1	5.4

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	34720	46454	60407	84317
25	0.35	22731	30746	40376	57065
25	0.20	11695	16091	21459	30928
50	0.50	42882	55332	69636	93246
50	0.35	28075	36622	46544	63107
50	0.20	14444	19166	24737	34203
100	0.50	52962	65906	80275	103120
100	0.35	34674	43621	53655	69790
100	0.20	17839	22829	28517	37825

HISTORICAL DROUGHTS, BASED ON 40 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	18	45249	45
0.35	3	24	31598	52
0.20	3	118	18664	112

TABLE C- 28

BIG LOST RIVER AT HOWELL RANCH NEAR CHILLY,IDA
STATION NO. 13.1205.00 (PROJECT ID NUMBER 62)

TOTAL RECORD LENGTH = 65 YEARS (1920 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 36 YEARS (1949 TO 1984)
TOTAL YEARS, HIST. DATA = 36 TOTAL YEARS, ADDED DATA = 29
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 117486 cfs-days SERIAL CORR. = 0.217
STANDARD DEVIATION = 34333 cfs-days SKEW COEFF.= 0.265
FOR q(o)=.50, TRUNCATION LEVEL = 115975 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 102964 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 88320 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.4	5.8	7.4	10.0
25	0.35	3.2	4.2	5.4	7.5
25	0.20	1.9	2.6	3.4	4.7
50	0.50	5.3	6.7	8.4	11.0
50	0.35	3.8	4.9	6.2	8.2
50	0.20	2.3	3.0	3.8	5.2
100	0.50	6.4	7.9	9.5	12.1
100	0.35	4.6	5.8	7.0	9.0
100	0.20	2.8	3.5	4.4	5.7

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	122338	165140	216465	305229
25	0.35	80094	109300	144684	206575
25	0.20	41207	57202	76896	111959
50	0.50	151096	196699	249536	337550
50	0.35	98922	130188	166789	228449
50	0.20	50893	68133	88644	123814
100	0.50	186615	234289	287660	373293
100	0.35	122176	155067	192271	252640
100	0.20	62857	81154	102187	136925

HISTORICAL DROUGHTS, BASED ON 36 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	15	157586	43
0.35	3	21	109240	48
0.20	3	101	65311	101

TABLE C- 29

BIG LOST RIVER BELOW MACKAY RESERVOIR NEAR MACKAY, IDA
STATION NO. 13.1270.00 (PROJECT ID NUMBER 63)

TOTAL RECORD LENGTH = 64 YEARS (1920 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 64 YEARS (1920 TO 1983)
TOTAL YEARS, HIST. DATA = 64 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 112285 cfs-days SERIAL CORR. = 0.355
STANDARD DEVIATION = 34506 cfs-days SKEW COEFF.= 0.546
FOR q(o)=.50, TRUNCATION LEVEL = 109166 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 96480 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 82747 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.5	5.8	7.5	10.2
25	0.35	3.2	4.3	5.5	7.6
25	0.20	1.9	2.6	3.4	4.8
50	0.50	5.4	6.8	8.5	11.2
50	0.35	3.9	5.0	6.3	8.3
50	0.20	2.4	3.1	3.9	5.3
100	0.50	6.5	8.0	9.7	12.3
100	0.35	4.7	5.9	7.1	9.2
100	0.20	2.8	3.6	4.4	5.8

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	123173	166595	218760	309160
25	0.35	80641	110263	146218	209235
25	0.20	41488	57706	77711	113401
50	0.50	152128	198432	252182	341897
50	0.35	99598	131335	168558	231391
50	0.20	51241	68734	89584	125409
100	0.50	187890	236353	290710	378101
100	0.35	123011	156433	194310	255893
100	0.20	63286	81869	103271	138689

HISTORICAL DROUGHTS, BASED ON 64 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	12	3519	401970	4213
0.35	9	1227	227531	431
0.20	3	97	42808	65

TABLE C- 30

CAMAS CREEK NEAR BLAINE,IDA
STATION NO. 13.1415.00 (PROJECT ID NUMBER 65)

TOTAL RECORD LENGTH = 40 YEARS (1945 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 40 YEARS (1945 TO 1984)
TOTAL YEARS, HIST. DATA = 40 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 70543 cfs-days SERIAL CORR. = 0.153
STANDARD DEVIATION = 43082 cfs-days SKEW COEFF.= 0.696
FOR q(o)=.50, TRUNCATION LEVEL = 65598 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 50122 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 33726 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.4	5.7	7.3	10.0
25	0.35	3.2	4.2	5.4	7.4
25	0.20	1.9	2.6	3.3	4.7
50	0.50	5.3	6.7	8.3	11.0
50	0.35	3.8	4.9	6.1	8.2
50	0.20	2.3	3.0	3.8	5.1
100	0.50	6.4	7.8	9.5	12.0
100	0.35	4.6	5.7	7.0	9.0
100	0.20	2.8	3.5	4.3	5.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	149709	201729	264001	371499
25	0.35	98014	133517	176457	251425
25	0.20	50426	69875	93782	136267
50	0.50	184902	240280	304334	410837
50	0.35	121054	159032	203416	278049
50	0.20	62280	83229	108110	150696
100	0.50	228368	286198	350831	454341
100	0.35	149511	189424	234494	307492
100	0.20	76920	99134	124628	166654

HISTORICAL DROUGHTS, BASED ON 40 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	3	8	106811	12
0.35	3	21	60384	16
0.20	1	26	28908	48

TABLE C- 31

BOISE RIVER NEAR TWIN SPRINGS, IDA
STATION NO. 13.1850.00 (PROJECT ID NUMBER 71)

TOTAL RECORD LENGTH = 73 YEARS (1912 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 73 YEARS (1912 TO 1984)
TOTAL YEARS, HIST. DATA = 73 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 444409 cfs-days SERIAL CORR. =-0.006
STANDARD DEVIATION = 130602 cfs-days SKEW COEFF.= 0.197
FOR q(o)=.50, TRUNCATION LEVEL = 440133 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 390305 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 333727 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.8	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.6	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	379128	494874	629322	853898
25	0.35	248213	327539	420637	577907
25	0.20	127700	171416	223558	313213
50	0.50	468252	589445	725470	944319
50	0.35	306562	390132	484902	639102
50	0.20	157720	204174	257713	346379
100	0.50	578326	702090	836307	1044314
100	0.35	378627	464687	558985	706777
100	0.20	194796	243192	297086	383058

HISTORICAL DROUGHTS, BASED ON 73 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	819	1029927	641
0.35	4	72	335804	55
0.20	3	177	172219	120

TABLE C- 32

SOUTH FORK BOISE RIVER NEAR FEATHERVILLE,IDA
STATION NO. 13.1860.00 (PROJECT ID NUMBER 72)

TOTAL RECORD LENGTH = 73 YEARS (1912 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 39 YEARS (1946 TO 1984)
TOTAL YEARS, HIST. DATA = 39   TOTAL YEARS, ADDED DATA = 34
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 283518 cfs-days   SERIAL CORR. =-0.054
STANDARD DEVIATION = 90167 cfs-days   SKEW COEFF.= 0.251
FOR q(o)=.50, TRUNCATION LEVEL = 279761 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 245542 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 206959 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.8	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.6	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	260730	340308	432738	587119
25	0.35	170698	225237	289241	397354
25	0.20	87821	117877	153724	215357
50	0.50	322021	405342	498851	649289
50	0.35	210826	268281	333431	439430
50	0.20	108465	140403	177210	238162
100	0.50	397721	482803	575066	718044
100	0.35	260386	319550	384372	485962
100	0.20	133963	167235	204284	263381

HISTORICAL DROUGHTS, BASED ON 39 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	6	104	310521	36
0.35	3	36	152729	32
0.20	1	45	114147	117

TABLE C- 33

MORES CREEK ABOVE ROBIE CREEK NEAR ARROWROCK DAM, IDA
STATION NO. 13.2000.00 (PROJECT ID NUMBER 75)

TOTAL RECORD LENGTH = 73 YEARS (1912 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 34 YEARS (1951 TO 1984)
TOTAL YEARS, HIST. DATA = 34 TOTAL YEARS, ADDED DATA = 39
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 104966 cfs-days SERIAL CORR. = 0.081
STANDARD DEVIATION = 44747 cfs-days SKEW COEFF.= 0.393
FOR q(o)=.50, TRUNCATION LEVEL = 102046 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 85302 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 66783 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.6	7.2	9.8
25	0.35	3.1	4.1	5.3	7.3
25	0.20	1.9	2.5	3.3	4.6
50	0.50	5.2	6.6	8.2	10.7
50	0.35	3.8	4.8	6.0	8.0
50	0.20	2.3	2.9	3.7	5.0
100	0.50	6.3	7.7	9.3	11.8
100	0.35	4.5	5.6	6.9	8.8
100	0.20	2.7	3.4	4.2	5.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	154232	207275	270613	379653
25	0.35	100975	137187	180877	256944
25	0.20	51949	71796	96131	139258
50	0.50	190488	246885	311957	419855
50	0.35	124711	163404	208511	284152
50	0.20	64161	85517	110818	154004
100	0.50	235267	294066	359618	464314
100	0.35	154028	194631	240367	314241
100	0.20	79244	101859	127749	170312

HISTORICAL DROUGHTS, BASED ON 34 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	6	64	161816	25
0.35	4	45	88539	24
0.20	3	109	42603	60

TABLE C- 34

MORES CREEK NEAR ARROWROCK, IDA
STATION NO. 13.2010.00 (PROJECT ID NUMBER 77)

TOTAL RECORD LENGTH = 73 YEARS (1912 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 38 YEARS (1917 TO 1954)
TOTAL YEARS, HIST. DATA = 38 TOTAL YEARS, ADDED DATA = 35
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 116338 cfs-days SERIAL CORR. =-0.113
STANDARD DEVIATION = 44438 cfs-days SKEW COEFF.= 0.306
FOR q(o)=.50, TRUNCATION LEVEL = 114080 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 97307 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 78534 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.8	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.6	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	128084	167168	212562	288377
25	0.35	83856	110642	142076	195169
25	0.20	43142	57904	75510	105778
50	0.50	158194	199115	245037	318913
50	0.35	103569	131787	163782	215836
50	0.20	53284	68970	87046	116978
100	0.50	195382	237166	282474	352683
100	0.35	127915	156971	188805	238691
100	0.20	65810	82150	100345	129366

HISTORICAL DROUGHTS, BASED ON 38 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	26	168413	45
0.35	4	72	118094	60
0.20	3	176	61776	127

TABLE C- 35

MALHEUR RIVER NEAR DREWSEY,OREG.
STATION NO. 13.2140.00 (PROJECT ID NUMBER 79)

TOTAL RECORD LENGTH = 57 YEARS (1927 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 57 YEARS (1927 TO 1983)
TOTAL YEARS, HIST. DATA = 57 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 69033 cfs-days SERIAL CORR. = 0.151
STANDARD DEVIATION = 37695 cfs-days SKEW COEFF.= 0.767
FOR q(o)=.50, TRUNCATION LEVEL = 64275 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 50883 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 36846 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.4	5.7	7.3	10.0
25	0.35	3.2	4.2	5.4	7.4
25	0.20	1.9	2.6	3.3	4.7
50	0.50	5.3	6.7	8.3	11.0
50	0.35	3.8	4.9	6.1	8.2
50	0.20	2.3	3.0	3.8	5.1
100	0.50	6.4	7.8	9.5	12.0
100	0.35	4.6	5.7	7.0	9.0
100	0.20	2.8	3.5	4.3	5.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	130730	176139	230492	324310
25	0.35	85588	116580	154060	219489
25	0.20	44034	61012	81879	118958
50	0.50	161462	209800	265706	358652
50	0.35	105708	138859	177597	242731
50	0.20	54385	72671	94388	131555
100	0.50	199418	249893	306301	396630
100	0.35	130558	165395	204731	268434
100	0.20	67169	86559	108809	145485

HISTORICAL DROUGHTS, BASED ON 57 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	479	284093	315
0.35	5	84	92976	32
0.20	3	103	40733	63

TABLE C- 36

N F MALHEUR R A BEULAH RES NR BEULAH,OREG.
STATION NO. 13.2165.00 (PROJECT ID NUMBER 80)

TOTAL RECORD LENGTH = 47 YEARS (1937 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 47 YEARS (1937 TO 1983)
TOTAL YEARS, HIST. DATA = 47 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 49451 cfs-days SERIAL CORR. = 0.074
STANDARD DEVIATION = 19272 cfs-days SKEW COEFF.= 0.930
FOR q(o)=.50, TRUNCATION LEVEL = 46510 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 39839 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 33025 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.6	7.2	9.8
25	0.35	3.1	4.1	5.3	7.3
25	0.20	1.9	2.5	3.3	4.6
50	0.50	5.2	6.6	8.2	10.7
50	0.35	3.8	4.8	6.0	8.0
50	0.20	2.3	2.9	3.7	5.0
100	0.50	6.2	7.7	9.3	11.8
100	0.35	4.5	5.6	6.9	8.8
100	0.20	2.7	3.4	4.2	5.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	65345	87762	114515	160542
25	0.35	42781	58087	76542	108653
25	0.20	22010	30399	40680	58887
50	0.50	80705	104534	132011	177542
50	0.35	52837	69187	88236	120158
50	0.20	27184	36209	46895	65123
100	0.50	99677	124511	152180	196342
100	0.35	65258	82409	101716	132882
100	0.20	33574	43128	54060	72019

HISTORICAL DROUGHTS, BASED ON 47 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	6	65	65683	23
0.35	2	11	18013	13
0.20	1	28	11199	49

TABLE C- 37

SOUTH FORK PAYETTE RIVER AT LOWMAN, IDAHO
STATION NO. 13.2350.00 (PROJECT ID NUMBER 82)

TOTAL RECORD LENGTH = 73 YEARS (1912 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 43 YEARS (1942 TO 1984)
TOTAL YEARS, HIST. DATA = 43 TOTAL YEARS, ADDED DATA = 30
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 314645 cfs-days SERIAL CORR. =-0.062
STANDARD DEVIATION = 76941 cfs-days SKEW COEFF.= 0.224
FOR q(o)=.50, TRUNCATION LEVEL = 311780 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 282503 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 249377 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.8	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.6	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	222889	290926	369954	501954
25	0.35	145924	192553	247276	339716
25	0.20	75075	100772	131421	184118
50	0.50	275285	346523	426476	555107
50	0.35	180228	229351	285055	375688
50	0.20	92723	120030	151499	203615
100	0.50	339998	412744	491632	613888
100	0.35	222595	273180	328606	415471
100	0.20	114520	142968	174645	225176

HISTORICAL DROUGHTS, BASED ON 43 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	26	208444	22
0.35	4	72	153990	38
0.20	1	45	120864	142

TABLE C- 38

WEISER RIVER AT TAMARACK, IDA
STATION NO. 13.2515.00 (PROJECT ID NUMBER 87)

TOTAL RECORD LENGTH = 48 YEARS (1937 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 35 YEARS (1937 TO 1971)
TOTAL YEARS, HIST. DATA = 36   TOTAL YEARS, ADDED DATA = 12
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 16677 cfs-days   SERIAL CORR. = 0.014
STANDARD DEVIATION = 5378 cfs-days   SKEW COEFF.= 0.294
FOR q(o)=.50, TRUNCATION LEVEL = 16415 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 14382 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 12104 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES		
			25%	10%	2%
25	0.50	4.1	5.4	6.8	9.3
25	0.35	3.0	3.9	5.0	6.9
25	0.20	1.8	2.4	3.1	4.4
50	0.50	5.0	6.3	7.8	10.2
50	0.35	3.6	4.6	5.7	7.6
50	0.20	2.2	2.8	3.6	4.8
100	0.50	6.0	7.4	8.9	11.2
100	0.35	4.3	5.4	6.5	8.4
100	0.20	2.6	3.3	4.1	5.3

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES		
			25%	10%	2%
25	0.50	17749	23672	30692	42684
25	0.35	11620	15667	20515	28888
25	0.20	5978	8199	10903	15657
50	0.50	21922	28195	35382	47203
50	0.35	14352	18661	23649	31947
50	0.20	7384	9766	12569	17314
100	0.50	27075	33583	40787	52202
100	0.35	17726	22228	27262	35330
100	0.20	9119	11633	14489	19148

HISTORICAL DROUGHTS, BASED ON 35 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	5	37	12187	12
0.35	2	13	8072	20
0.20	1	32	5794	74

TABLE C- 39

WEISER RIVER NEAR CAMBRIDGE,IDA
STATION NO. 13.2585.00 (PROJECT ID NUMBER 88)

TOTAL RECORD LENGTH = 48 YEARS (1937 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 45 YEARS (1940 TO 1984)
TOTAL YEARS, HIST. DATA = 45 TOTAL YEARS, ADDED DATA = 3
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 242593 cfs-days SERIAL CORR. =-0.121
STANDARD DEVIATION = 83334 cfs-days SKEW COEFF.= 0.078
FOR q(o)=.50, TRUNCATION LEVEL = 241507 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 209344 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 172264 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.7	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.5	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	245546	320590	407780	553455
25	0.35	160758	212187	272559	374571
25	0.20	82707	111047	144858	203009
50	0.50	303268	381856	470080	612061
50	0.35	198548	252736	314200	414235
50	0.20	102149	132268	166989	224506
100	0.50	374559	454829	541899	676874
100	0.35	245222	301035	362204	458099
100	0.20	126162	157545	192502	248280

HISTORICAL DROUGHTS, BASED ON 45 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	5	53	222540	21
0.35	4	73	180216	41
0.20	1	45	143136	150

TABLE C- 40

LITTLE WEISER R NR INDIAN VALLEY,IDAHO
STATION NO. 13.2610.00 (PROJECT ID NUMBER 90)

TOTAL RECORD LENGTH = 46 YEARS (1939 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 33 YEARS (1939 TO 1971)
TOTAL YEARS, HIST. DATA = 33 TOTAL YEARS, ADDED DATA = 13
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 38805 cfs-days SERIAL CORR. = 0.130
STANDARD DEVIATION = 11514 cfs-days SKEW COEFF.= 0.085
FOR q(o)=.50, TRUNCATION LEVEL = 38642 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 34201 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 29086 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.7	7.2	9.9
25	0.35	3.1	4.2	5.3	7.3
25	0.20	1.9	2.5	3.3	4.6
50	0.50	5.2	6.6	8.3	10.9
50	0.35	3.8	4.9	6.1	8.1
50	0.20	2.3	3.0	3.8	5.1
100	0.50	6.3	7.8	9.4	11.9
100	0.35	4.6	5.7	6.9	8.9
100	0.20	2.8	3.5	4.3	5.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	41207	55517	72644	102205
25	0.35	26978	36745	48555	69171
25	0.20	13880	19230	25806	37489
50	0.50	50894	66126	83743	113028
50	0.35	33320	43767	55973	76496
50	0.20	17143	22905	29748	41459
100	0.50	62858	78763	96537	124996
100	0.35	41153	52130	64525	84596
100	0.20	21172	27282	34293	45849

HISTORICAL DROUGHTS, BASED ON 33 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	5	32	40126	21
0.35	4	43	24125	23
0.20	1	27	8196	46

TABLE C- 41

WEISER R AB CRANE C NR WEISER, IDAHO
STATION NO. 13.2635.00 (PROJECT ID NUMBER 91)

TOTAL RECORD LENGTH = 62 YEARS (1922 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 31 YEARS (1922 TO 1952)
TOTAL YEARS, HIST. DATA = 31   TOTAL YEARS, ADDED DATA = 31
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 333573 cfs-days   SERIAL CORR. =-0.137
STANDARD DEVIATION = 125898 cfs-days   SKEW COEFF.=-0.135
FOR q(o)=.50, TRUNCATION LEVEL = 333573 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 284612 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 227618 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.6	4.7	5.9	8.0
25	0.35	2.6	3.4	4.4	5.9
25	0.20	1.6	2.1	2.7	3.7
50	0.50	4.4	5.5	6.8	8.8
50	0.35	3.2	4.0	5.0	6.5
50	0.20	1.9	2.5	3.1	4.1
100	0.50	5.3	6.4	7.7	9.6
100	0.35	3.8	4.7	5.7	7.2
100	0.20	2.3	2.9	3.5	4.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	413242	540508	688624	936554
25	0.35	270547	357742	460274	633847
25	0.20	139191	187223	244624	343531
50	0.50	510386	643800	793831	1035727
50	0.35	334146	426108	530594	700966
50	0.20	171911	223001	281997	379908
100	0.50	630365	766832	915113	1145401
100	0.35	412696	507538	611659	775192
100	0.20	212324	265618	325081	420137

HISTORICAL DROUGHTS, BASED ON 31 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	5	55	532469	46
0.35	3	38	385584	59
0.20	3	184	214602	120

TABLE C- 42

CRANE CREEK NEAR MIDVALE, IDA
STATION NO. 13.2645.00 (PROJECT ID NUMBER 92)

TOTAL RECORD LENGTH = 45 YEARS (1925 TO 1969)
LONGEST CONSECUTIVE HIST. PERIOD = 45 YEARS (1925 TO 1969)
TOTAL YEARS, HIST. DATA = 45 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 26971 cfs-days SERIAL CORR. = 0.029
STANDARD DEVIATION = 14624 cfs-days SKEW COEFF.= 1.184
FOR q(o)=.50, TRUNCATION LEVEL = 24163 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 19358 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 14659 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.2	5.5	7.0	9.5
25	0.35	3.0	4.0	5.2	7.1
25	0.20	1.8	2.5	3.2	4.5
50	0.50	5.1	6.4	8.0	10.5
50	0.35	3.7	4.7	5.9	7.8
50	0.20	2.2	2.9	3.6	4.9
100	0.50	6.1	7.5	9.1	11.5
100	0.35	4.4	5.5	6.7	8.6
100	0.20	2.7	3.4	4.1	5.4

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	48129	64369	83672	116737
25	0.35	31510	42603	55926	79006
25	0.20	16211	22296	29723	42820
50	0.50	59443	76670	96456	129098
50	0.35	38917	50745	64471	87372
50	0.20	20022	26557	34264	47354
100	0.50	73417	91322	111192	142769
100	0.35	48066	60443	74320	96624
100	0.20	24729	31632	39499	52368

HISTORICAL DROUGHTS, BASED ON 45 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	18	34211	12
0.35	3	24	19395	18
0.20	3	118	6018	47

TABLE C- 43

POWDER RIVER NEAR BAKER,OREG.
STATION NO. 13.2755.00 (PROJECT ID NUMBER 95)

TOTAL RECORD LENGTH = 40 YEARS (1929 TO 1968)
LONGEST CONSECUTIVE HIST. PERIOD = 40 YEARS (1929 TO 1968)
TOTAL YEARS, HIST. DATA = 40 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 38137 cfs-days SERIAL CORR. = 0.062
STANDARD DEVIATION = 14326 cfs-days SKEW COEFF.= 0.333
FOR q(o)=.50, TRUNCATION LEVEL = 37344 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 31952 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 25938 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.6	7.1	9.7
25	0.35	3.1	4.1	5.3	7.2
25	0.20	1.9	2.5	3.3	4.5
50	0.50	5.2	6.5	8.1	10.7
50	0.35	3.7	4.8	6.0	7.9
50	0.20	2.3	2.9	3.7	5.0
100	0.50	6.2	7.7	9.2	11.7
100	0.35	4.5	5.6	6.8	8.7
100	0.20	2.7	3.4	4.2	5.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	49153	65984	86061	120584
25	0.35	32180	43672	57523	81610
25	0.20	16556	22856	30572	44231
50	0.50	60708	78594	99209	133353
50	0.35	39745	52018	66311	90251
50	0.20	20448	27224	35243	48914
100	0.50	74979	93613	114366	147474
100	0.35	49088	61959	76442	99808
100	0.20	25255	32426	40627	54094

HISTORICAL DROUGHTS, BASED ON 40 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	6	66	57328	33
0.35	4	46	35757	34
0.20	2	56	17810	73

TABLE C- 44

IMNAHA RIVER AT IMNAHA,OREG.
STATION NO. 13.2920.00 (PROJECT ID NUMBER 97)

TOTAL RECORD LENGTH = 55 YEARS (1929 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 55 YEARS (1929 TO 1983)
TOTAL YEARS, HIST. DATA = 55 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 190213 cfs-days SERIAL CORR. = 0.057
STANDARD DEVIATION = 56130 cfs-days SKEW COEFF.= 0.170
FOR q(o)=.50, TRUNCATION LEVEL = 188626 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 167155 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 142689 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.6	7.1	9.7
25	0.35	3.1	4.1	5.2	7.2
25	0.20	1.9	2.5	3.2	4.5
50	0.50	5.1	6.5	8.1	10.6
50	0.35	3.7	4.8	6.0	7.9
50	0.20	2.2	2.9	3.7	5.0
100	0.50	6.2	7.6	9.2	11.7
100	0.35	4.5	5.6	6.8	8.7
100	0.20	2.7	3.4	4.2	5.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	194234	260693	339953	476218
25	0.35	127164	172543	227223	322298
25	0.20	65423	90300	120763	174678
50	0.50	239894	310512	391891	526645
50	0.35	157057	205516	261938	356426
50	0.20	80803	107556	139214	193175
100	0.50	296287	369852	451764	582413
100	0.35	193977	244791	301957	394169
100	0.20	99797	128110	160483	213631

HISTORICAL DROUGHTS, BASED ON 55 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	523	508141	864
0.35	4	46	191874	61
0.20	4	224	94012	95

TABLE C- 45

VALLEY CREEK AT STANLEY, IDA
STATION NO. 13.2950.00 (PROJECT ID NUMBER 98)

TOTAL RECORD LENGTH = 63 YEARS (1922 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 50 YEARS (1922 TO 1971)
TOTAL YEARS, HIST. DATA = 50 TOTAL YEARS, ADDED DATA = 13
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 73717 cfs-days SERIAL CORR. = 0.008
STANDARD DEVIATION = 19797 cfs-days SKEW COEFF.= 0.410
FOR q(o)=.50, TRUNCATION LEVEL = 72370 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 64974 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 56814 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.1	5.3	6.7	9.2
25	0.35	2.9	3.9	5.0	6.8
25	0.20	1.8	2.4	3.1	4.3
50	0.50	4.9	6.2	7.7	10.1
50	0.35	3.6	4.5	5.7	7.5
50	0.20	2.1	2.8	3.5	4.7
100	0.50	5.9	7.3	8.7	11.1
100	0.35	4.3	5.3	6.4	8.2
100	0.20	2.6	3.3	4.0	5.2

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	63949	85061	110026	152548
25	0.35	41867	56299	73541	103242
25	0.20	21540	29464	39085	55955
50	0.50	78982	101317	126836	168701
50	0.35	51709	67058	84777	114175
50	0.20	26603	35094	45057	61880
100	0.50	97549	120679	146214	186565
100	0.35	63865	79873	97729	126265
100	0.20	32857	41801	51940	68433

HISTORICAL DROUGHTS, BASED ON 50 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	7	154	112964	119
0.35	3	27	43010	33
0.20	3	131	18530	71

TABLE C- 46

SALMON RIVER BELOW VALLEY CREEK AT STANLEY, IDA
STATION NO. 13.2955.00 (PROJECT ID NUMBER 99)

TOTAL RECORD LENGTH = 63 YEARS (1922 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 35 YEARS (1926 TO 1960)
TOTAL YEARS, HIST. DATA = 35 TOTAL YEARS, ADDED DATA = 28
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 256916 cfs-days SERIAL CORR. = 0.106
STANDARD DEVIATION = 68151 cfs-days SKEW COEFF.= 0.428
FOR q(o)=.50, TRUNCATION LEVEL = 252077 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 226664 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 198691 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.7	7.2	9.8
25	0.35	3.1	4.1	5.3	7.3
25	0.20	1.9	2.5	3.3	4.6
50	0.50	5.2	6.6	8.2	10.8
50	0.35	3.8	4.8	6.1	8.1
50	0.20	2.3	3.0	3.8	5.1
100	0.50	6.3	7.8	9.4	11.9
100	0.35	4.6	5.7	6.9	8.9
100	0.20	2.8	3.5	4.3	5.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	236291	317920	415499	583685
25	0.35	154699	210420	277718	395030
25	0.20	79589	110122	147600	214098
50	0.50	291838	378676	478979	645492
50	0.35	191064	250631	320148	436860
50	0.20	98299	131167	170150	236769
100	0.50	360442	451042	552157	713844
100	0.35	235979	298528	369060	483120
100	0.20	121406	156233	196146	261840

HISTORICAL DROUGHTS, BASED ON 35 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	495	570555	546
0.35	3	22	179053	36
0.20	3	107	95136	78

TABLE C- 47

SALMON RIVER BELOW YANKEE FORK NEAR CLAYTON, IDA
STATION NO. 13.2965.00 (PROJECT ID NUMBER 101)

TOTAL RECORD LENGTH = 63 YEARS (1922 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 51 YEARS (1922 TO 1972)
TOTAL YEARS, HIST. DATA = 59 TOTAL YEARS, ADDED DATA = 4
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 370104 cfs-days SERIAL CORR. = 0.032
STANDARD DEVIATION = 99152 cfs-days SKEW COEFF.= 0.388
FOR q(o)=.50, TRUNCATION LEVEL = 363721 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 326599 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 285512 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.2	5.5	7.0	9.5
25	0.35	3.0	4.0	5.2	7.1
25	0.20	1.8	2.5	3.2	4.5
50	0.50	5.1	6.4	8.0	10.5
50	0.35	3.7	4.7	5.9	7.8
50	0.20	2.2	2.9	3.6	4.9
100	0.50	6.1	7.5	9.1	11.5
100	0.35	4.4	5.5	6.7	8.6
100	0.20	2.7	3.4	4.1	5.4

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	333174	445923	580032	809927
25	0.35	218127	295140	387691	548147
25	0.20	112222	154460	206048	297084
50	0.50	411496	531140	668649	895691
50	0.35	269404	351542	446923	606191
50	0.20	138603	183978	237528	328542
100	0.50	508229	632642	770805	990537
100	0.35	332734	418722	515203	670382
100	0.20	171185	219136	273817	363332

HISTORICAL DROUGHTS, BASED ON 51 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	545	746702	347
0.35	3	24	235584	33
0.20	3	117	112322	72

TABLE C- 48

SALMON RIVER NEAR CHALLIS, IDA
STATION NO. 13.2985.00 (PROJECT ID NUMBER 102)

TOTAL RECORD LENGTH = 63 YEARS (1922 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 43 YEARS (1929 TO 1971)
TOTAL YEARS, HIST. DATA = 43 TOTAL YEARS, ADDED DATA = 20
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 547702 cfs-days SERIAL CORR. = 0.043
STANDARD DEVIATION = 149701 cfs-days SKEW COEFF. = 0.366
FOR q(o)=.50, TRUNCATION LEVEL = 538600 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 482432 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 420079 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.2	5.5	7.1	9.6
25	0.35	3.1	4.1	5.2	7.1
25	0.20	1.9	2.5	3.2	4.5
50	0.50	5.1	6.5	8.0	10.6
50	0.35	3.7	4.7	5.9	7.9
50	0.20	2.2	2.9	3.7	4.9
100	0.50	6.2	7.6	9.2	11.6
100	0.35	4.5	5.5	6.7	8.6
100	0.20	2.7	3.4	4.2	5.4

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	507799	680581	886367	1239637
25	0.35	332453	450452	592445	838969
25	0.20	171040	235742	314869	454703
50	0.50	627171	810642	1021785	1370903
50	0.35	410605	536534	682958	927809
50	0.20	211248	280793	362975	502852
100	0.50	774604	965558	1177894	1516070
100	0.35	507129	639067	787300	1026056
100	0.20	260907	334453	418430	556100

HISTORICAL DROUGHTS, BASED ON 43 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	532	1103608	304
0.35	3	24	305566	26
0.20	1	29	108158	54

TABLE C- 49

PANTHER CREEK NEAR SHOUP, IDA
STATION NO. 13.3065.00 (PROJECT ID NUMBER 105)

TOTAL RECORD LENGTH = 33 YEARS (1945 TO 1977)
LONGEST CONSECUTIVE HIST. PERIOD = 33 YEARS (1945 TO 1977)
TOTAL YEARS, HIST. DATA = 33 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 94204 cfs-days SERIAL CORR. =-0.042
STANDARD DEVIATION = 27068 cfs-days SKEW COEFF.= 0.310
FOR q(o)=.50, TRUNCATION LEVEL = 92814 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 82600 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 71174 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.8	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.6	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	78007	101810	129455	175627
25	0.35	51071	67384	86527	118862
25	0.20	26275	35265	45987	64421
50	0.50	96344	121266	149233	194225
50	0.35	63076	80261	99747	131449
50	0.20	32451	42004	53013	71242
100	0.50	118993	144440	172033	214792
100	0.35	77904	95599	114986	145368
100	0.20	40080	50031	61112	78786

HISTORICAL DROUGHTS, BASED ON 33 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	6	104	92455	36
0.35	3	36	41968	29
0.20	2	89	23342	90

TABLE C- 50

MIDDLE FORK SALMON RIVER NEAR CAPEHORN,IDA
STATION NO. 13.3085.00 (PROJECT ID NUMBER 106)

TOTAL RECORD LENGTH = 63 YEARS (1922 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 43 YEARS (1929 TO 1971)
TOTAL YEARS, HIST. DATA = 43 TOTAL YEARS, ADDED DATA = 20
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 88563 cfs-days SERIAL CORR. = 0.005
STANDARD DEVIATION = 22420 cfs-days SKEW COEFF.= 0.340
FOR q(o)=.50, TRUNCATION LEVEL = 87297 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 78863 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 69467 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.0	5.2	6.7	9.0
25	0.35	2.9	3.8	4.9	6.7
25	0.20	1.8	2.3	3.0	4.2
50	0.50	4.9	6.1	7.6	9.9
50	0.35	3.5	4.5	5.6	7.4
50	0.20	2.1	2.7	3.5	4.7
100	0.50	5.9	7.2	8.6	10.9
100	0.35	4.2	5.3	6.4	8.1
100	0.20	2.6	3.2	3.9	5.1

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	71752	95255	122998	170156
25	0.35	46975	63046	82211	115159
25	0.20	24168	32995	43693	62414
50	0.50	88619	113459	141789	188174
50	0.35	58018	75094	94771	127353
50	0.20	29849	39300	50369	69023
100	0.50	109451	135141	163452	208100
100	0.35	71657	89445	109251	140839
100	0.20	36866	46811	58064	76332

HISTORICAL DROUGHTS, BASED ON 43 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	632	167968	390
0.35	3	28	61043	48
0.20	3	136	32854	104

TABLE C- 51

BEAR VALLEY CREEK NEAR CAPEHORN, IDA
STATION NO. 13.3090.00 (PROJECT ID NUMBER 107)

TOTAL RECORD LENGTH = 56 YEARS (1929 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 32 YEARS (1929 TO 1960)
TOTAL YEARS, HIST. DATA = 32 TOTAL YEARS, ADDED DATA = 24
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 110626 cfs-days SERIAL CORR. =-0.061
STANDARD DEVIATION = 33493 cfs-days SKEW COEFF.= 0.392
FOR q(o)=.50, TRUNCATION LEVEL = 108448 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 95913 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 82048 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.8	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.6	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	96153	125485	159550	216440
25	0.35	62951	83054	106643	146484
25	0.20	32387	43466	56678	79391
50	0.50	118756	149465	183926	239360
50	0.35	77749	98925	122936	161995
50	0.20	40000	51772	65337	87798
100	0.50	146673	178028	212026	264706
100	0.35	96026	117830	141718	179149
100	0.20	49403	61666	75319	97095

HISTORICAL DROUGHTS, BASED ON 32 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	816	229780	337
0.35	3	36	81788	52
0.20	3	176	40191	113

TABLE C- 52

SOUTH FORK SALMON RIVER NEAR KNOX, IDA
STATION NO. 13.3105.00 (PROJECT ID NUMBER 108)

TOTAL RECORD LENGTH = 56 YEARS (1929 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 32 YEARS (1929 TO 1960)
TOTAL YEARS, HIST. DATA = 32 TOTAL YEARS, ADDED DATA = 24
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 55635 cfs-days SERIAL CORR. =-0.048
STANDARD DEVIATION = 15370 cfs-days SKEW COEFF.= 0.165
FOR q(o)=.50, TRUNCATION LEVEL = 55214 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 49331 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 42624 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES		
			25%	10%	2%
25	0.50	3.7	4.8	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.6	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES		
			25%	10%	2%
25	0.50	44747	58410	74283	100796
25	0.35	29295	38660	49650	68217
25	0.20	15072	20232	26388	36972
50	0.50	55265	69573	85631	111470
50	0.35	36182	46048	57236	75441
50	0.20	18615	24099	30419	40887
100	0.50	68257	82868	98714	123273
100	0.35	44687	54847	65980	83430
100	0.20	22991	28704	35067	45217

HISTORICAL DROUGHTS, BASED ON 32 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	820	130546	945
0.35	3	36	31816	40
0.20	3	177	11694	83

TABLE C- 53

JOHNSON CREEK AT YELLOW PINE, IDA
STATION NO. 13.3130.00 (PROJECT ID NUMBER 109)

TOTAL RECORD LENGTH = 63 YEARS (1922 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 56 YEARS (1929 TO 1984)
TOTAL YEARS, HIST. DATA = 56 TOTAL YEARS, ADDED DATA = 7
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 129994 cfs-days SERIAL CORR. =-0.132
STANDARD DEVIATION = 36711 cfs-days SKEW COEFF.= 0.035
FOR q(o)=.50, TRUNCATION LEVEL = 129781 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 115552 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 99060 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.7	6.0	8.1
25	0.35	2.6	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.5	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.7	5.7	7.3
100	0.20	2.3	2.9	3.5	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	109595	143120	182080	247188
25	0.35	71751	94726	121702	167294
25	0.20	36914	49574	64681	90669
50	0.50	135358	170471	209898	273363
50	0.35	88618	112828	140295	185009
50	0.20	45592	59048	74563	100271
100	0.50	167177	203048	241966	302310
100	0.35	109450	134390	161730	204599
100	0.20	56310	70333	85955	110888

HISTORICAL DROUGHTS, BASED ON 56 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	5	53	142669	45
0.35	3	37	99982	57
0.20	2	90	54232	124

TABLE C- 54

GRANDE RONDE RIVER AT LA GRANDE, OREG.
STATION NO. 13.3190.00 (PROJECT ID NUMBER 111)

TOTAL RECORD LENGTH = 58 YEARS (1926 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 58 YEARS (1926 TO 1983)
TOTAL YEARS, HIST. DATA = 58 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 136536 cfs-days SERIAL CORR. =-0.014
STANDARD DEVIATION = 50416 cfs-days SKEW COEFF.= 0.311
FOR q(o)=.50, TRUNCATION LEVEL = 133933 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 114913 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 93639 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.7	4.8	6.0	8.1
25	0.35	2.7	3.5	4.4	6.0
25	0.20	1.6	2.1	2.7	3.8
50	0.50	4.4	5.6	6.8	8.9
50	0.35	3.2	4.1	5.0	6.6
50	0.20	1.9	2.5	3.1	4.2
100	0.50	5.3	6.5	7.8	9.8
100	0.35	3.9	4.8	5.7	7.3
100	0.20	2.3	2.9	3.6	4.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	145280	189610	241097	327087
25	0.35	95114	125496	161148	221368
25	0.20	48934	65678	85646	119977
50	0.50	179431	225845	277931	361723
50	0.35	117473	149478	185768	244809
50	0.20	60437	78229	98731	132681
100	0.50	221612	269004	320393	400026
100	0.35	145088	178044	214150	270732
100	0.20	74645	93178	113815	146731

HISTORICAL DROUGHTS, BASED ON 58 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	8	411	308966	208
0.35	8	1125	156803	80
0.20	2	89	42171	89

TABLE C- 55

CATHERINE CREEK NEAR UNION,OREG.
STATION NO. 13.3200.00 (PROJECT ID NUMBER 112)

TOTAL RECORD LENGTH = 58 YEARS (1926 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 58 YEARS (1926 TO 1983)
TOTAL YEARS, HIST. DATA = 58 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 43085 cfs-days SERIAL CORR. = 0.010
STANDARD DEVIATION = 11060 cfs-days SKEW COEFF.=-0.211
FOR q(o)=.50, TRUNCATION LEVEL = 43085 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 38784 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 33777 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.0	5.3	6.7	9.1
25	0.35	2.9	3.9	4.9	6.8
25	0.20	1.8	2.4	3.1	4.2
50	0.50	4.9	6.2	7.6	10.0
50	0.35	3.5	4.5	5.6	7.4
50	0.20	2.1	2.8	3.5	4.7
100	0.50	5.9	7.2	8.7	11.0
100	0.35	4.3	5.3	6.4	8.2
100	0.20	2.6	3.2	4.0	5.1

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	41148	54912	71240	99146
25	0.35	26939	36344	47617	67100
25	0.20	13860	19021	25307	36367
50	0.50	50820	65406	82124	109644
50	0.35	33272	43290	54892	74206
50	0.20	17118	22656	29173	40218
100	0.50	62767	77906	94671	121255
100	0.35	41093	51563	63278	82064
100	0.20	21142	26985	33631	44477

HISTORICAL DROUGHTS, BASED ON 58 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	20	41177	24
0.35	4	55	24190	25
0.20	2	68	15993	74

TABLE C- 56

HURRICANE CREEK NEAR JOSEPH,OREG.
STATION NO. 13.3295.00 (PROJECT ID NUMBER 115)

TOTAL RECORD LENGTH = 59 YEARS (1925 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 54 YEARS (1925 TO 1978)
TOTAL YEARS, HIST. DATA = 54 TOTAL YEARS, ADDED DATA = 5
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 27150 cfs-days SERIAL CORR. = 0.050
STANDARD DEVIATION = 5532 cfs-days SKEW COEFF.=-0.207
FOR q(o)=.50, TRUNCATION LEVEL = 27150 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 24999 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 22494 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.2	5.5	7.0	9.5
25	0.35	3.0	4.0	5.1	7.1
25	0.20	1.8	2.5	3.2	4.4
50	0.50	5.1	6.4	8.0	10.4
50	0.35	3.7	4.7	5.9	7.8
50	0.20	2.2	2.9	3.6	4.9
100	0.50	6.1	7.5	9.1	11.5
100	0.35	4.4	5.5	6.7	8.5
100	0.20	2.7	3.4	4.1	5.4

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	21509	28909	37746	52960
25	0.35	14082	19134	25229	35842
25	0.20	7245	10014	13409	19426
50	0.50	26566	34434	43513	58568
50	0.35	17392	22790	29084	39638
50	0.20	8948	11927	15457	21483
100	0.50	32811	41014	50160	64769
100	0.35	21481	27146	33527	43835
100	0.20	11052	14207	17819	23758

HISTORICAL DROUGHTS, BASED ON 54 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	9	550	50829	747
0.35	4	49	17626	41
0.20	3	119	9168	74

TABLE C- 57

LOSTINE RIVER NEAR LOSTINE,OREG.
STATION NO. 13.3300.00 (PROJECT ID NUMBER 116)

TOTAL RECORD LENGTH = 58 YEARS (1926 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 58 YEARS (1926 TO 1983)
TOTAL YEARS, HIST. DATA = 58 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 70931 cfs-days SERIAL CORR. =-0.053
STANDARD DEVIATION = 14845 cfs-days SKEW COEFF.=-0.357
FOR q(o)=.50, TRUNCATION LEVEL = 70931 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 65158 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 58438 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.6	4.7	5.9	8.0
25	0.35	2.6	3.4	4.4	5.9
25	0.20	1.6	2.1	2.7	3.7
50	0.50	4.4	5.5	6.8	8.8
50	0.35	3.2	4.0	5.0	6.5
50	0.20	1.9	2.5	3.1	4.1
100	0.50	5.3	6.4	7.7	9.6
100	0.35	3.8	4.7	5.7	7.2
100	0.20	2.3	2.9	3.5	4.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	48726	63732	81196	110430
25	0.35	31900	42182	54271	74737
25	0.20	16412	22076	28844	40506
50	0.50	60180	75911	93601	122123
50	0.35	39399	50243	62563	82651
50	0.20	20270	26294	33250	44795
100	0.50	74327	90418	107901	135055
100	0.35	48661	59844	72121	91403
100	0.20	25035	31319	38330	49539

HISTORICAL DROUGHTS, BASED ON 58 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	4	28	63072	47
0.35	4	75	45753	60
0.20	3	184	25593	121

TABLE C- 58

BEAR CREEK NEAR WALLOWA,OREG.
STATION NO. 13.3305.00 (PROJECT ID NUMBER 117)

TOTAL RECORD LENGTH = 59 YEARS (1925 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 59 YEARS (1925 TO 1983)
TOTAL YEARS, HIST. DATA = 59 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 41679 cfs-days SERIAL CORR. =-0.058
STANDARD DEVIATION = 9888 cfs-days SKEW COEFF.=-0.020
FOR q(o)=.50, TRUNCATION LEVEL = 41679 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 37834 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 33358 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	3.6	4.7	5.9	8.0
25	0.35	2.6	3.4	4.4	5.9
25	0.20	1.6	2.1	2.7	3.7
50	0.50	4.4	5.5	6.8	8.8
50	0.35	3.2	4.0	5.0	6.5
50	0.20	1.9	2.5	3.1	4.1
100	0.50	5.3	6.4	7.7	9.6
100	0.35	3.8	4.7	5.7	7.2
100	0.20	2.3	2.9	3.5	4.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	32454	42449	54082	73553
25	0.35	21248	28096	36148	49780
25	0.20	10932	14704	19212	26980
50	0.50	40084	50562	62344	81342
50	0.35	26243	33465	41671	55051
50	0.20	13501	17514	22147	29837
100	0.50	49506	60224	71869	89955
100	0.35	32412	39860	48037	60881
100	0.20	16675	20861	25531	32996

HISTORICAL DROUGHTS, BASED ON 59 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	5	55	37887	36
0.35	3	38	24944	42
0.20	3	184	16502	117

TABLE C- 59

SELWAY RIVER NEAR LOWELL,IDA
STATION NO. 13.3365.00 (PROJECT ID NUMBER 119)

TOTAL RECORD LENGTH = 59 YEARS (1925 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 54 YEARS (1930 TO 1983)
TOTAL YEARS, HIST. DATA = 54 TOTAL YEARS, ADDED DATA = 5
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 1392840 cfs-days SERIAL CORR. = 0.017
STANDARD DEVIATION = 341272 cfs-days SKEW COEFF.= 0.038
FOR q(o)=.50, TRUNCATION LEVEL = 1390696 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 1258458 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 1105241 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.1	5.4	6.9	9.3
25	0.35	3.0	3.9	5.1	6.9
25	0.20	1.8	2.4	3.1	4.4
50	0.50	5.0	6.3	7.8	10.2
50	0.35	3.6	4.6	5.8	7.6
50	0.20	2.2	2.8	3.6	4.8
100	0.50	6.0	7.4	8.9	11.3
100	0.35	4.4	5.4	6.6	8.4
100	0.20	2.6	3.3	4.1	5.3

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	1171356	1564608	2031476	2830140
25	0.35	766880	1035556	1357832	1915399
25	0.20	394544	541954	721653	1038105
50	0.50	1446713	1863608	2341844	3129826
50	0.35	947155	1233453	1565281	2118223
50	0.20	487292	645522	831907	1148031
100	0.50	1786801	2219749	2699630	3461248
100	0.35	1169808	1469169	1804425	2342525
100	0.20	601842	768883	959006	1269597

HISTORICAL DROUGHTS, BASED ON 54 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	8	292	2395863	240
0.35	6	202	1233651	72
0.20	2	63	372504	68

TABLE C- 60

LOCHSA RIVER NEAR LOWELL, IDA
STATION NO. 13.3370.00 (PROJECT ID NUMBER 120)

TOTAL RECORD LENGTH = 55 YEARS (1930 TO 1984)
LONGEST CONSECUTIVE HIST. PERIOD = 55 YEARS (1930 TO 1984)
TOTAL YEARS, HIST. DATA = 55 TOTAL YEARS, ADDED DATA = 0
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 1059930 cfs-days SERIAL CORR. = 0.015
STANDARD DEVIATION = 255022 cfs-days SKEW COEFF.=-0.085
FOR q(o)=.50, TRUNCATION LEVEL = 1059930 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 960752 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 845303 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.1	5.3	6.8	9.2
25	0.35	3.0	3.9	5.0	6.8
25	0.20	1.8	2.4	3.1	4.3
50	0.50	4.9	6.2	7.7	10.1
50	0.35	3.6	4.6	5.7	7.5
50	0.20	2.2	2.8	3.5	4.7
100	0.50	5.9	7.3	8.8	11.1
100	0.35	4.3	5.3	6.5	8.3
100	0.20	2.6	3.3	4.0	5.2

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	959981	1283536	1668020	2326423
25	0.35	628494	849525	1114899	1574491
25	0.20	323347	444595	592540	853340
50	0.50	1185649	1528823	1922859	2572771
50	0.35	776238	1011871	1285233	1741216
50	0.20	399358	529558	683069	943701
100	0.50	1464367	1820985	2216634	2845205
100	0.35	958713	1205243	1481591	1925596
100	0.20	493238	630758	787428	1043631

HISTORICAL DROUGHTS, BASED ON 55 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	8	304	2107797	450
0.35	8	832	1314373	163
0.20	3	130	366238	71

TABLE C- 61

SOUTH FORK CLEARWATER RIVER NEAR ELK CITY, IDA
STATION NO. 13.3375.00 (PROJECT ID NUMBER 121)

TOTAL RECORD LENGTH = 59 YEARS (1925 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 30 YEARS (1945 TO 1974)
TOTAL YEARS, HIST. DATA = 30 TOTAL YEARS, ADDED DATA = 29
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 90242 cfs-days SERIAL CORR. = 0.140
STANDARD DEVIATION = 29937 cfs-days SKEW COEFF. = 0.053
FOR q(o)=.50, TRUNCATION LEVEL = 89979 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 78396 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 65000 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.7	7.3	9.9
25	0.35	3.1	4.2	5.3	7.4
25	0.20	1.9	2.5	3.3	4.6
50	0.50	5.2	6.7	8.3	10.9
50	0.35	3.8	4.9	6.1	8.1
50	0.20	2.3	3.0	3.8	5.1
100	0.50	6.3	7.8	9.4	12.0
100	0.35	4.6	5.7	6.9	8.9
100	0.20	2.8	3.5	4.3	5.6

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	108182	145814	190874	268684
25	0.35	70826	96509	127580	181842
25	0.20	36438	50507	67805	98554
50	0.50	133613	173679	220036	297135
50	0.35	87475	114952	147071	201097
50	0.20	45004	60159	78165	108990
100	0.50	165022	206869	253653	328599
100	0.35	108039	136919	169541	222392
100	0.20	55584	71656	90107	120531

HISTORICAL DROUGHTS, BASED ON 30 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	2	4	41336	5
0.35	2	11	29753	11
0.20	1	27	16357	41

TABLE C- 62

SOUTH FORK CLEARWATER R NR GRANGEVILLE,IDAHO
STATION NO. 13.3380.00 (PROJECT ID NUMBER 122)

TOTAL RECORD LENGTH = 60 YEARS (1924 TO 1983)
LONGEST CONSECUTIVE HIST. PERIOD = 40 YEARS (1924 TO 1963)
TOTAL YEARS, HIST. DATA = 40 TOTAL YEARS, ADDED DATA = 20
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

MEAN ANN. FLOW = 315283 cfs-days SERIAL CORR. = 0.065
STANDARD DEVIATION = 81479 cfs-days SKEW COEFF.= 0.303
FOR q(o)=.50, TRUNCATION LEVEL = 311182 cfs-days
FOR q(o)=.35, TRUNCATION LEVEL = 280419 cfs-days
FOR q(o)=.20, TRUNCATION LEVEL = 245974 cfs-days

DROUGHT LENGTHS:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN LENGTH (YEARS)	LENGTH EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	4.3	5.6	7.1	9.7
25	0.35	3.1	4.1	5.3	7.2
25	0.20	1.9	2.5	3.3	4.5
50	0.50	5.2	6.5	8.1	10.7
50	0.35	3.7	4.8	6.0	7.9
50	0.20	2.3	2.9	3.7	5.0
100	0.50	6.2	7.7	9.2	11.7
100	0.35	4.5	5.6	6.8	8.7
100	0.20	2.7	3.4	4.2	5.5

DROUGHT MAGNITUDES:

SAMPLE SIZE (YEARS)	TRUNC LEVEL q(o)	MEDIAN DEFICIT cfs-days	DEFICIT EXCEEDED IN P% OF SAMPLES 25%	10%	2%
25	0.50	280380	376482	491142	688359
25	0.35	183563	249179	328278	465872
25	0.20	94439	130407	174471	252492
50	0.50	346290	448428	566178	761250
50	0.35	226714	296798	378432	515204
50	0.20	116640	155328	201127	279229
100	0.50	427695	534124	652679	841860
100	0.35	280010	353517	436249	569759
100	0.20	144059	185011	231855	308797

HISTORICAL DROUGHTS, BASED ON 40 CONSECUTIVE YEARS:

TRUNC LEVEL	MAX RUN LENGTH	RETURN PERIOD	MAX DEFICIT	RETURN PERIOD
0.50	8	259	668933	504
0.35	4	46	271906	58
0.20	3	111	82811	63

TABLE C- 63

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NORTH FORK CLEARWATER AT AHSAHKA,IDA
STATION NO.  13.3410.00          (PROJECT ID NUMBER 124)

TOTAL RECORD LENGTH = 58 YEARS ( 1927 TO 1984 )
LONGEST CONSECUTIVE HIST. PERIOD = 38 YEARS ( 1927 TO 1964 )
TOTAL YEARS, HIST. DATA = 38    TOTAL YEARS, ADDED DATA = 20
ANNUAL STATISTICS FOR THE TOTAL AUGMENTED DATA PERIOD:

  MEAN ANN. FLOW  = 2140453 cfs-days   SERIAL CORR. = 0.114
  STANDARD DEVIATION = 557911 cfs-days   SKEW COEFF.= 0.206
  FOR q(o)=.50, TRUNCATION LEVEL = 2121363  cfs-days
  FOR q(o)=.35, TRUNCATION LEVEL = 1908692  cfs-days
  FOR q(o)=.20, TRUNCATION LEVEL = 1667488  cfs-days

DROUGHT LENGTHS:

   SAMPLE    TRUNC    MEDIAN   LENGTH EXCEEDED  IN P%
    SIZE     LEVEL    LENGTH        OF SAMPLES
   (YEARS)   q(o)     (YEARS)     25%      10%       2%
  ------------------------------------------------------------
      25      0.50      4.3       5.7      7.2       9.9
      25      0.35      3.1       4.1      5.3       7.3
      25      0.20      1.9       2.5      3.3       4.6
      50      0.50      5.2       6.6      8.2      10.8
      50      0.35      3.8       4.9      6.1       8.1
      50      0.20      2.3       3.0      3.8       5.1
     100      0.50      6.3       7.8      9.4      11.9
     100      0.35      4.6       5.7      6.9       8.9
     100      0.20      2.8       3.5      4.3       5.6

DROUGHT MAGNITUDES:

   SAMPLE    TRUNC     MEDIAN         DEFICIT EXCEEDED  IN P%
    SIZE     LEVEL     DEFICIT               OF SAMPLES
   (YEARS)   q(o)      cfs-days        25%         10%          2%
  ---------------------------------------------------------------------
      25      0.50     1961250     2640143     3452078     4852275
      25      0.35     1284019     1747413     2307358     3283953
      25      0.20      660602      914501     1226302     1779831
      50      0.50     2422293     3144681     3979485     5366089
      50      0.35     1585862     2081347     2659875     3631695
      50      0.20      815893     1089264     1413656     1968299
     100      0.50     2991718     3745637     4587469     5934311
     100      0.35     1958660     2479099     3066250     4016260
     100      0.20     1007690     1297425     1629633     2176725

HISTORICAL DROUGHTS, BASED ON  38  CONSECUTIVE YEARS:

   TRUNC        MAX RUN        RETURN       MAX            RETURN
   LEVEL        LENGTH         PERIOD       DEFICIT        PERIOD
  ------------------------------------------------------------------
   0.50            8            249         4199471          305
   0.35            4             44         1733160           47
   0.20            4            212          984483           96
```

APPENDIX D

TABLE D-1: BASIN CHARACTERISTICS

STATION NUMBER (USGS)	DRAINAGE AREA (MI**2)	MEAN ALT (FT)	MEAN PRECP (IN)	CHANNEL LENGTH (MILES)	CHANNEL SLOPE (FT/MI)	FOREST COVER (%)
10.0410	113.00	7290	29	11.8	127	39
10.0475	49.50	7370	27	12.8	82	43
10.0586	24.00	7960	31	8.3	261	17
10.0728	22.60	7570	24	8.7	211	90
10.0845	61.70	6650	23	17.8	70	55
10.0930	31.60	6890	24	6.4	205	30
10.1047	62.10	6730	29	11.0	222	50
10.1135	260.00	7150	25	18.0	171	58
10.1190	120.00	6080	24	16.8	60	21
10.1255	485.00	5540	20	48.9	33	9
12.3055	53.00	4980	40	13.0	152	100
12.3065	570.00	4870	33	55.0	41	100
12.3075	755.00	4710	28	76.0	21	100
12.3110	133.00	3400	36	14.0	19	95
12.3168	23.00	4800	22	7.5	288	95
12.3205	29.00	5260	48	14.0	109	100
12.3210	70.00	5100	48	18.0	156	100
12.3215	97.00	4650	45	18.8	164	100
12.3923	124.00	4210	46	23.0	132	100
12.3940	611.00	4050	43	46.9	10	88
12.3950	902.00	3820	41	87.0	12	95
12.4110	335.00	4120	52	42.0	37	90
12.4130	895.00	3610	51	73.0	24	95
12.4131	14.90	4380	52	6.7	249	97
12.4135	1220.00	3900	50	78.0	22	90
12.4145	1030.00	4210	51	53.0	64	95
12.4149	275.00	3740	42	26.0	20	97
12.4150	437.00	3560	40	42.0	19	95
12.4160	22.00	3580	35	6.9	319	100
13.0115	169.00	8160	30	31.0	69	81
13.0119	323.00	9270	41	39.0	59	53
13.0230	448.00	8080	40	55.2	46	75
13.0250	27.40	8550	18	10.5	275	74
13.0275	829.00	8470	31	56.2	38	50
13.0320	77.10	7130	24	15.2	106	70
13.0440	656.00	6860	31	72.8	25	85
13.0475	351.00	7520	16	41.2	80	80
13.0522	335.00	7350	36	28.1	50	35
13.0550	890.00	6900	26	64.0	27	45
13.0580	627.00	6390	16	73.8	22	15
13.0730	570.00	6080	18	48.0	17	15
13.0750	355.00	5630	19	37.5	21	15
13.0777	7.84	8570	25	4.8	464	25
13.0780	412.00	6150	24	33.7	42	12
13.0790	20.20	7870	28	8.8	409	35

TABLE D-1: BASIN CHARACTERISTICS

STATION NUMBER (USGS)	DRAINAGE AREA (MI**2)	MEAN ALT (FT)	MEAN PRECP (IN)	CHANNEL LENGTH (MILES)	CHANNEL SLOPE (FT/MI)	FOREST COVER (%)
13.0825	633.00	6030	22	50.8	34	10
13.0830	53.70	6360	18	13.0	168	15
13.0920	80.00	6330	15	17.8	160	20
13.1135	220.00	7260	22	29.0	62	14
13.1160	165.00	7520	25	24.2	86	20
13.1200	114.00	8540	39	20.0	83	40
13.1205	450.00	8590	38	36.8	48	25
13.1355	137.00	8120	41	19.0	76	50
13.1415	648.00	5600	18	50.0	12	5
13.1625	84.60	7600	19	21.3	125	25
13.1675	620.00	5420	11	64.0	30	0
13.1695	253.00	5150	13	44.2	77	0
13.1780	440.00	5780	15	40.6	33	30
13.1850	830.00	6350	42	54.8	62	75
13.1860	635.00	6840	37	51.8	52	20
13.1910	1090.00	6270	31	89.6	35	25
13.1965	5.75	5200	30	4.5	96	70
13.2000	399.00	4960	28	45.0	92	85
13.2005	15.80	4960	20	8.1	356	80
13.2010	426.00	5260	27	38.0	42	50
13.2140	910.00	4900	16	49.2	45	29
13.2165	355.00	5360	19	34.4	67	50
13.2265	539.00	4150	18	52.0	39	4
13.2350	456.00	6780	40	45.9	79	90
13.2450	626.00	5960	25	66.2	12	75
13.2506	47.40	3990	31	14.8	64	0
13.2513	3.96	4940	35	4.3	366	95
13.2515	36.50	4690	34	14.7	56	85
13.2585	605.00	4650	34	59.0	32	55
13.2600	54.00	4730	35	13.9	14	25
13.2610	81.90	5300	34	18.8	215	50
13.2635	1160.00	4280	30	92.0	22	35
13.2670	56.00	4860	34	18.2	174	40
13.2730	309.00	4500	24	23.0	48	82
13.2755	219.00	5170	25	28.6	57	75
13.2882	156.00	5791	45	26.4	143	59
13.2920	622.00	5690	28	56.0	73	51
13.2950	147.00	7400	26	22.2	60	75
13.2955	501.00	7800	33	36.4	40	60
13.2960	195.00	7980	32	26.2	91	90
13.2965	802.00	7790	34	47.2	37	70
13.2985	1800.00	7820	38	80.5	28	55
13.2990	85.00	7830	30	15.0	219	70
13.3065	529.00	7030	28	42.2	99	95
13.3085	138.00	7370	28	16.8	95	95

TABLE D-1: BASIN CHARACTERISTICS

STATION NUMBER (USGS)	DRAINAGE AREA (MI**2)	MEAN ALT (FT)	MEAN PRECP (IN)	CHANNEL LENGTH (MILES)	CHANNEL SLOPE (FT/MI)	FOREST COVER (%)
13.3090	180.00	7040	35	22.0	33	90
13.3105	92.00	6630	42	15.6	92	90
13.3130	213.00	7170	38	34.5	71	100
13.3165	576.00	5430	32	48.2	61	80
13.3190	678.00	4640	24	44.8	27	84
13.3200	105.00	5320	25	26.4	114	86
13.3235	1250.00	4193	23	68.0	35	63
13.3250	10.30	7890	47	6.0	422	50
13.3295	29.60	7460	43	10.8	296	53
13.3300	70.90	6820	38	20.1	189	80
13.3305	68.00	5810	38	18.4	178	85
13.3347	170.00	3550	24	27.1	140	46
13.3365	1910.00	5640	46	92.0	39	95
13.3370	1180.00	5250	50	98.0	44	100
13.3375	261.00	5150	30	30.0	34	100
13.3380	865.00	5160	32	66.0	47	100
13.3405	996.00	4930	58	50.0	40	100
13.3410	2440.00	4220	50	133.0	23	95
13.3445	431.00	3000	23	50.6	72	35
13.3450	317.00	3080	31	28.5	206	78
13.3480	132.00	2770	22	23.6	19	8
13.3485	27.10	2670	21	15.0	28	4
13.3492	796.00	2990	25	58.9	19	34
14.0185	1657.00	1600	22	59.4	60	25