

STATISTICAL ANALYSIS FOR STREAMFLOW PREDICTION

by

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Thesis submitted to the Graduate Faculty of the
Virginia Polytechnic Institute
in candidacy for the degree of
MASTER OF SCIENCE
in
Civil Engineering

May, 1965

Blacksburg, Virginia

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I. INTRODUCTION

The prediction of stream discharges is a problem which has been attempted many ways. Although most investigations are concerned with floods, droughts are also of importance to any person with interest in a river. Business interests are dependent upon the river's resources, and certainly the welfare of the people living adjacent to the river depends upon the river's actions. There is property damage, and consequently financial loss, caused by both floods and droughts each year. The loss of human life as a result of the river ravages cannot be estimated monetarily.

Correct prediction of discharges would not only provide safety for the people along a river, but it would also provide the information needed for the design of storage facilities. The numerous benefits from storage are apparent -- not the least of which is flood protection.

If a relationship could be established which would relate flow amounts for a group of watersheds, the problem of prediction of discharges would be partially solved. The following analysis of average monthly flows attempts to establish such a relationship.

If a particular watershed is known to vary greatly in its monthly discharges, its coefficient of variation is expected to be large with respect to other areas with less

variation in their discharges. Synthesis of streamflow data is made from the prediction of the standard deviation by methods involving techniques such as Markov chains. Since the coefficient of variation is a quotient which is not affected by the number of values of the random variable, it was the logical choice for comparison.

There remained the problem of choosing some means of comparing the flow parameter to the watershed. The most fundamental basin parameter is the area. Therefore, it was the object of this project to compare the coefficients of variation to the drainage areas.

A flow duration curve is used to predict the potential of a stream for water supply. The flow-duration curve, which is obtained for a particular basin, is a frequency relationship of discharge; it is the more basic prediction relationship for stream flow estimation. The shape of the flow-duration curve roughly indicates the coefficient of variation for that basin. The range of the discharges on a particular flow-duration curve dictates the level of the coefficient of variation; therefore, it can be concluded that the coefficient of variation is a function of the flow-duration curve.

II. LITERATURE SURVEY

In the investigation of the literature on the subject of streamflow prediction, it was found that there exists very little information on the topic as stated herein. There is an abundance of information on flood prediction, and there are also technical papers on drought prediction; however, no attempt has been made to cover the entire range from lowest to highest flows. As might be anticipated, the investigations into flood prediction are much more thorough and span a greater period of time. In recent years, drought studies have become the topic of much more investigation.

In almost every case encountered, the drainage area was the parameter investigated first or the item which headed the list of considerations in multiple regression studies. M. A. Benson (1), in his flood investigations in the Southwest, stated that the drainage area size was the most important single factor in areas of rainfall as well as in areas of snowmelt. His primary interest was the variation of flood magnitudes and frequencies.

N. C. Matalas (2) made rather recent investigations into low flow probability distribution. His approach to the subject differed from others that were encountered. He was careful in his selection of areas to be studied, but generally only one river was investigated throughout its

entire reaches. He then compared his data to four theoretical probabilities for comparison fit.

In other works with low-flow frequency, Hardison and Martin (3) made adjustments to data to fit curves of discharge versus the recurrence interval. Their work was more general and was developed to serve the entire eastern United States east of the Mississippi. Low-flow prediction was shown to be very valuable in the estimation of impounded volumes needed to maintain water supplies.

Factors which influenced flood recurrence over a vast area of the eastern United States were studied by Benson (2). Although he used a statistical multiple regression method of comparison, he concluded that the area of the drainage basin was of primary importance and main channel slope was of secondary importance. Although other items were considered, these two items were the most significant to his study.

In New Mexico, flood frequency investigations were published by Leon A. Wiard (8). In the prediction of flood discharges, the drainage basin area was the only physical parameter found to be of significance to the flood frequency relationship. The discharge function used in the flood magnitude relationship was the mean annual flow. It was felt that in an area of consistent runoff, the average annual

runoff would be an indicator of discharge trends, but in an area where great fluctuation occurs, a shorter time period was needed as a base.

In the southeastern United States, Speer and Gamble (6) reached the same conclusions about runoff amounts and drainage area relationships as did Wiard (7) in New Mexico. In the northeastern United States, an investigation was made by Sopper and Lull (5) which paralleled this study closely. The geographical area was very carefully investigated, and separation was made by the physical characteristics of each section; their thoroughness produced results with consistent accuracy.

In the light of these studies, it was felt that the drainage area should be the physical parameter to be compared to the average monthly flows.

III. ANALYTICAL METHOD

The coefficient of variation of monthly flows was the statistical function used for comparison within a geographical area. Attention was given to assure the selection of basins with sufficient data to yield accurate statistics. No basins were used which had fewer than fifty monthly discharge values. Within this constraint, the parameter produces a result which is not related to the number of values of the random variable. The standard deviation gives an indication as to whether the distribution of the random variable for an area differs appreciably from a normal distribution with standard deviation of unity. The coefficient of variation is the quotient of the standard deviation and the mean of that data (7).

It was proposed that data be examined for selected watersheds and the value of the coefficient of variation be computed. A comparison was made with a representative number of basins for a particular region.

A digital computer expedited the calculations of these statistics. To have handled this amount of data and to have calculated values of such magnitude as these, by any other available method than that which was used would have been far too impractical.

IV. INVESTIGATION

The shaded areas of Figure 1 show those portions of each region which were used in this investigation. The selection of basins for analysis by this proposed method was not arbitrary. Figure 2 is an example of how the gages were located in the Ohio River Basin. The selection of this example was arbitrary and shows that the selection of stations covers the region under investigation as thoroughly as possible. It was essential to the success of this study that all variables of climate, geology, and precipitation be held as nearly constant as possible by a careful selection of basins. Basins were intentionally chosen which were tributary to other basins; likewise, basins were compared to basins in other watersheds.

Atlantic Slopes

In the eastern United States, the area under consideration was the Tidewater and Piedmont regions of Virginia and North Carolina. The selection of basins to study was determined by that area which did not fall on the mountain slopes. No attempt was made to separate the Piedmont from the Tidewater regions; an insufficient number of basins were available to establish a relationship for either area separately. A more detailed investigation might warrant this separate

consideration. As in every region studied, a full range of areas was required. An effort was exerted to get basins of every intermediate size from several square miles to fifteen hundred square miles or larger -- depending upon the region. Considerably more recorded data was available for the eastern United States. Most gaging stations in this region are older, and it was also noted that generally the river was more extensively gaged than in any other region of the United States.

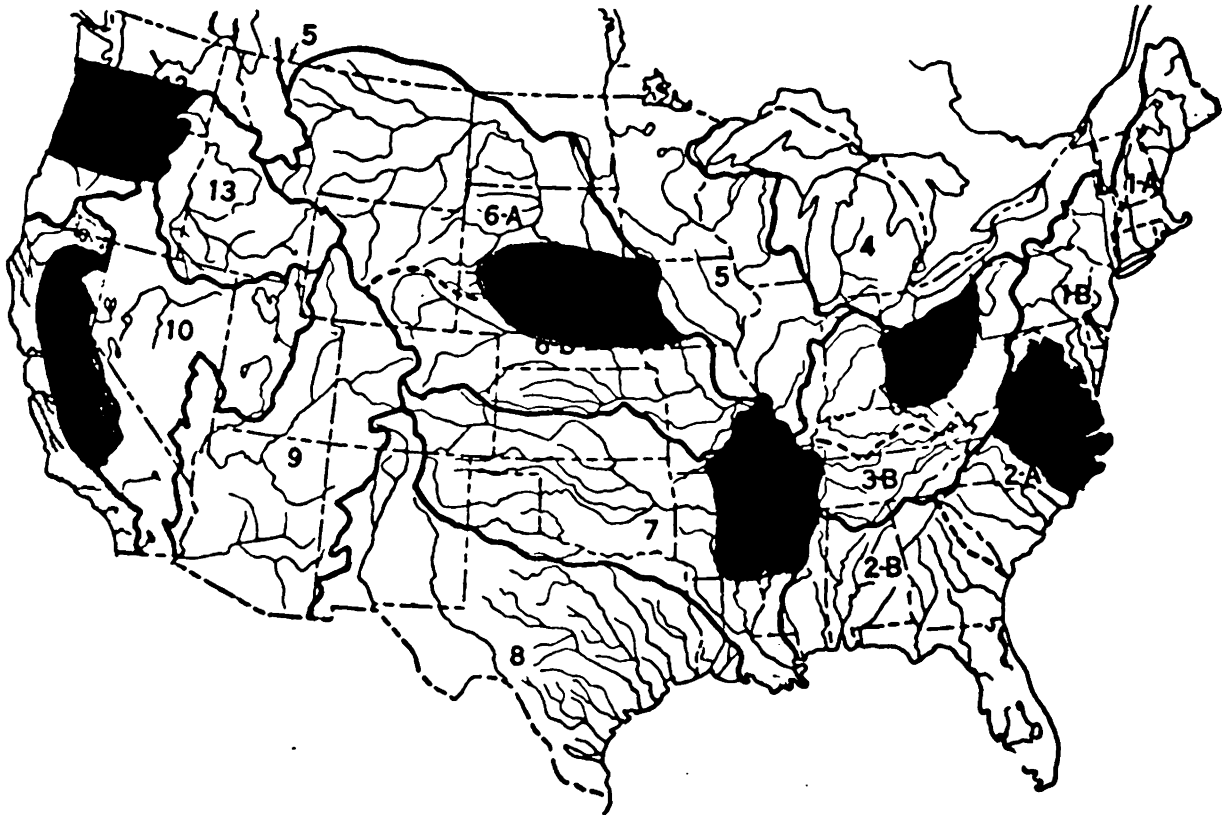
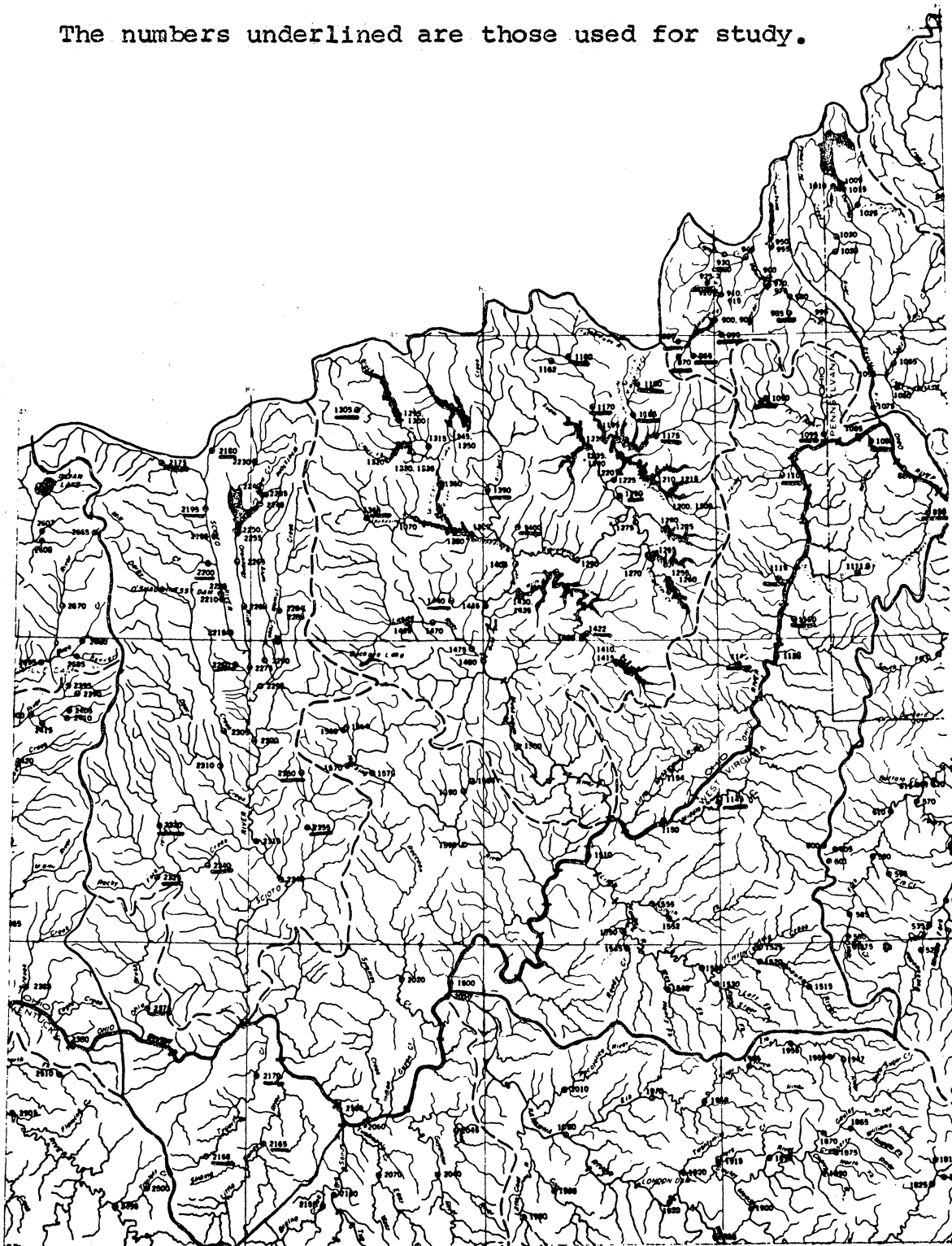


Figure 1. Regions of United States Used for Investigation.

Shaded regions indicate those regions used in the investigation. Corresponding numbers are those part numbers of the water supply papers.

Figure 2. Basins Under Investigation, Ohio River Basin.

The numbers underlined are those used for study.



Missouri River Tributaries

The Great Plains region of the Missouri River Basin in the vicinity of Sioux City, Iowa, was another region studied. Two items were noted: the discharge per square mile of drainage area was much less than in the East, and the seasonal effect on streamflow was apparent. After careful consideration of the information obtained from this region, insufficient data points existed to establish a relationship.

In this area the rainfall was primarily limited to the spring season. A large percentage of the total streamflow was recorded during the period from March to July each year. Consequently, in an effort to establish a relationship for this region, seasonal examination was made. This produced essentially the same poor results. Generally the basin areas were larger than in other regions. A great variation in these large basins was noticed. This effect was inconsistent with that which would have been anticipated from extrapolation in other regions.

Ohio River Basin

The Ohio River Basin exhibited individual characteristics. In this area care was exerted to be certain that only those streams were examined which were not affected by regulation or diversion. Again, as in the Atlantic slope basins, only those basins that were completely off of the

western mountain slopes were considered in this part of the study. The entire Ohio River Basin was considered as the feasible region, within the limitations mentioned. Greater variation was noted in the northern region of this area. The terrain in this area is flatter than the rolling, hilly region to the south. Since this northern region is close to the Great Lakes, the runoff in this region is affected by the lakes, causing more variation in the streamflow data.

An attempt was made to examine regions in the Western United States. For this portion of the investigation the mountain slopes in Washington and Oregon were chosen to represent one type terrain; for a different region the Central Valley of California was chosen as the second region.

Pacific Mountain Slopes

In the Columbia River Basin difficulty was encountered in finding streams not drastically affected by diversion or regulation. Streams which had appreciable regulation were eliminated from consideration. It was necessary to use basins which were affected by diversion although if diversion was considerable, they were avoided. The results formed a straight line nearly parallel to the area axis. As might be anticipated, the points of data were more scattered than in other regions. This was caused by

regulated basins being compared with unregulated basins. The high amount of regulation tends to retard any fluctuation of the discharge in some basins and this was confirmed by this analysis (see Figure 8). In a region of high regulation, as this region is, this method of prediction is adequate to accomplish those results. It is not advisable to attempt an investigation where some basins are regulated and some not.

Central Valley of California

The Central Valley of California was an area also regulated to some minor extent. Most regulation was for irrigation and although relatively insignificant, was avoided. The smaller basins were noted as more variable than the larger. This gives the impression that rainfall which might approach serious flood levels for small basins, affected the larger stations only to minor degrees. The steepness of the curve indicated that fluctuation of streams was a problem for this region.

Lower Mississippi River

As shown by the relationship for the lower Mississippi River (Figure 6) there was very little scatter of points of data. Basins were examined both east and west of the river, but care was taken to stay close enough to the river so that the topography was not affected within the region. The results were plotted and found to be very good. This along

with the closeness to fit to a straight line led the author to conclude with high degree of confidence that this method was very effective in the prediction of flow quantities in this region. With the experience obtained from the Missouri River, the areas were limited to two thousand square miles.

V. CONCLUSIONS

This investigation had as its primary basis the assumption that streamflow prediction was dependent upon geographical area. The regions under investigation were:

1. Middle Atlantic slopes
2. Missouri River tributaries
3. Ohio River Basin
4. Lower Mississippi River Basin
5. Central Valley of California
6. Pacific mountain slopes

From the curves of coefficient of variation versus the drainage area for each geographical area, the trend was toward diminishing variation for increasing area. The one exception to this was the Missouri River Basin.

After consideration of several plots of the data, the best relationship between the variables was the log-log plot. It was apparent from this plot that the straight line was the best fit of the data points. The steepness of the graph indicated whether a stream was susceptible to rapid fluctuations in discharge. Some scatter of data points was noticed in all areas of investigation. It was felt that if the choice of geographical areas had been even more limited, less variation would have occurred.

In the region of Middle Atlantic slopes, confidence can be felt in the use of this relationship. The fit to the straight line relationship shows that the points do not vary appreciably at any point from that line (Figure 3).

The Missouri River Basin does not provide a relationship by this method. As a suggestion to the solution of the problem in this region, closer physiographic analysis is needed. Also it is suggested that a smaller range of basins be examined (Figure 4).

In the Ohio River basin a relationship was established upon which much confidence can be placed. The resulting plot shows that from the beginning and throughout the range of areas, the relationship function accurately fits the data (Figure 5).

The lower Mississippi River basins provide a relationship but not quite the range of areas as in other regions. The scatter of points is moderate but nevertheless the relationship is established (Figure 6). In this area, perhaps more effort could be exerted to eliminate this variation of data. The solution would probably be to limit the geographical area to only those close to the Mississippi River; and, consider those farther away from the river in separate studies.

In both the Central Valley of California and the Pacific mountain slopes, more variation of data points on the

curves occurred than is desirable. This was due to regulation of some streams and natural, undisturbed condition in other streams. The Central Valley displayed a steeper curve showing more fluctuation among smaller and larger basins (Figure 7).

Generally, this method is quite useful in streamflow prediction. Its value is apparent in the several cases where the straight line relationship was established on the log-log plot. In the one region where no relationship existed, it is believed that with more constraints, a relationship could be established. One general improvement might add accuracy to the results; to take more care in selection of basins within a physiographic area would possibly be an advantageous contribution to the result.

It is believed that all other variables should remain the same. With particular reference to the time base of streamflow data, it is believed that the monthly flow is the optimum. To use a shorter base would cause more variation in the calculated values and possibly resulting in no conclusions being made. A longer time period would be of very little value in flow prediction. To predict an average annual flow tells very little - if anything at all - about the action of a river during that year.

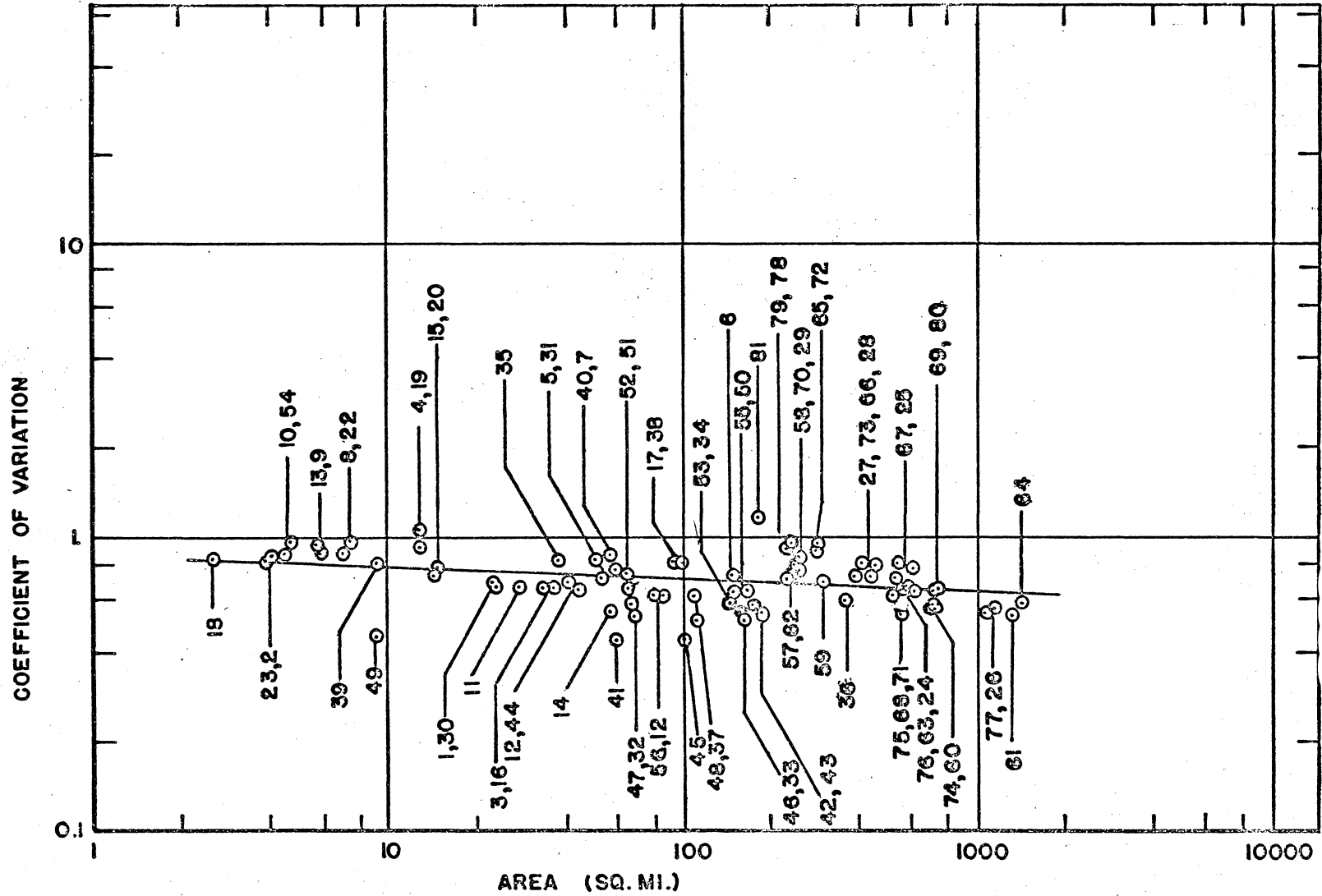


FIGURE 3. COEFFICIENT OF VARIATION VS. AREA, MIDDLE ATLANTIC SLOPES.

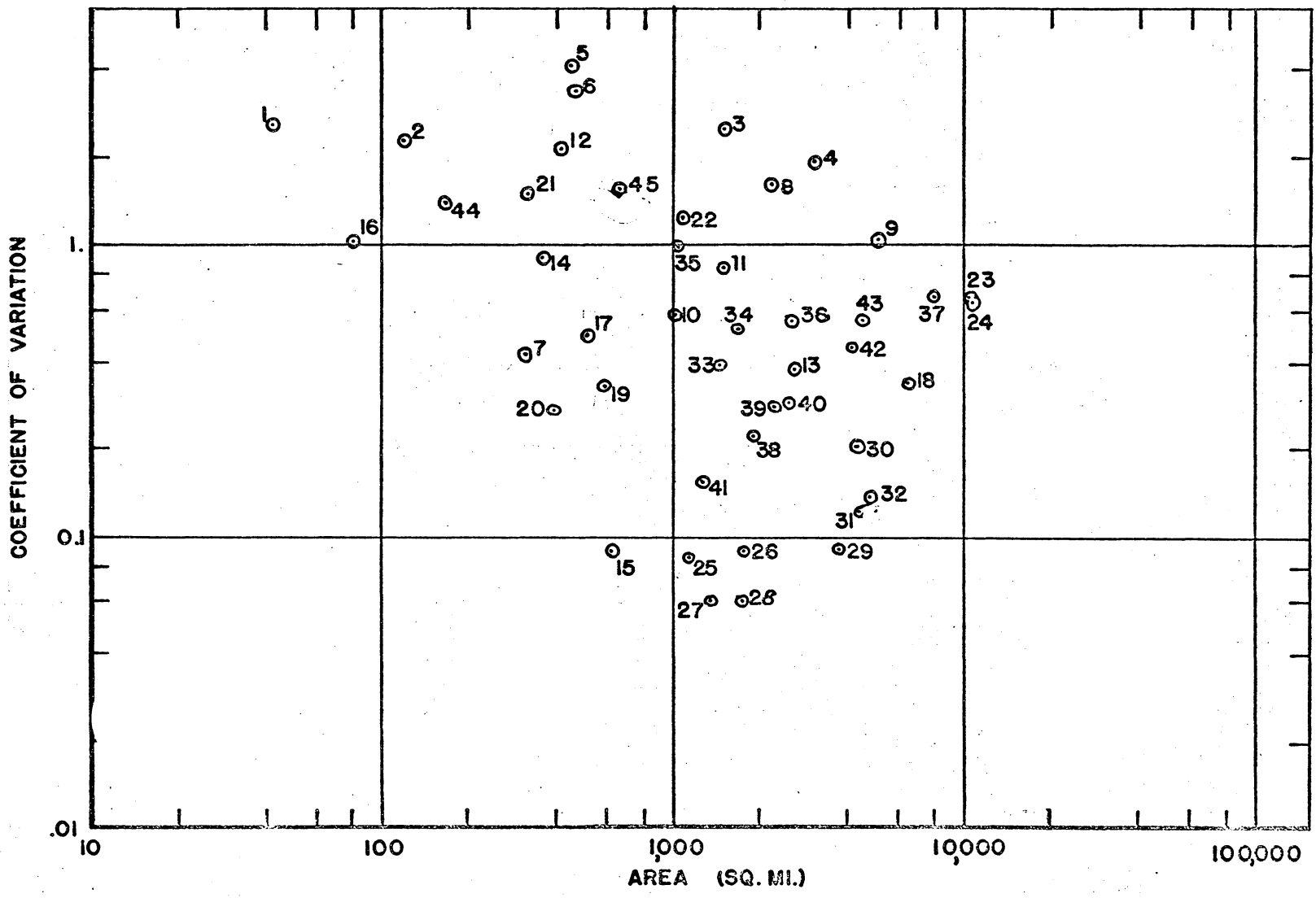


FIGURE 4. COEFFICIENT OF VARIATION VS. AREA, MISSOURI RIVER TRIBUTARIES

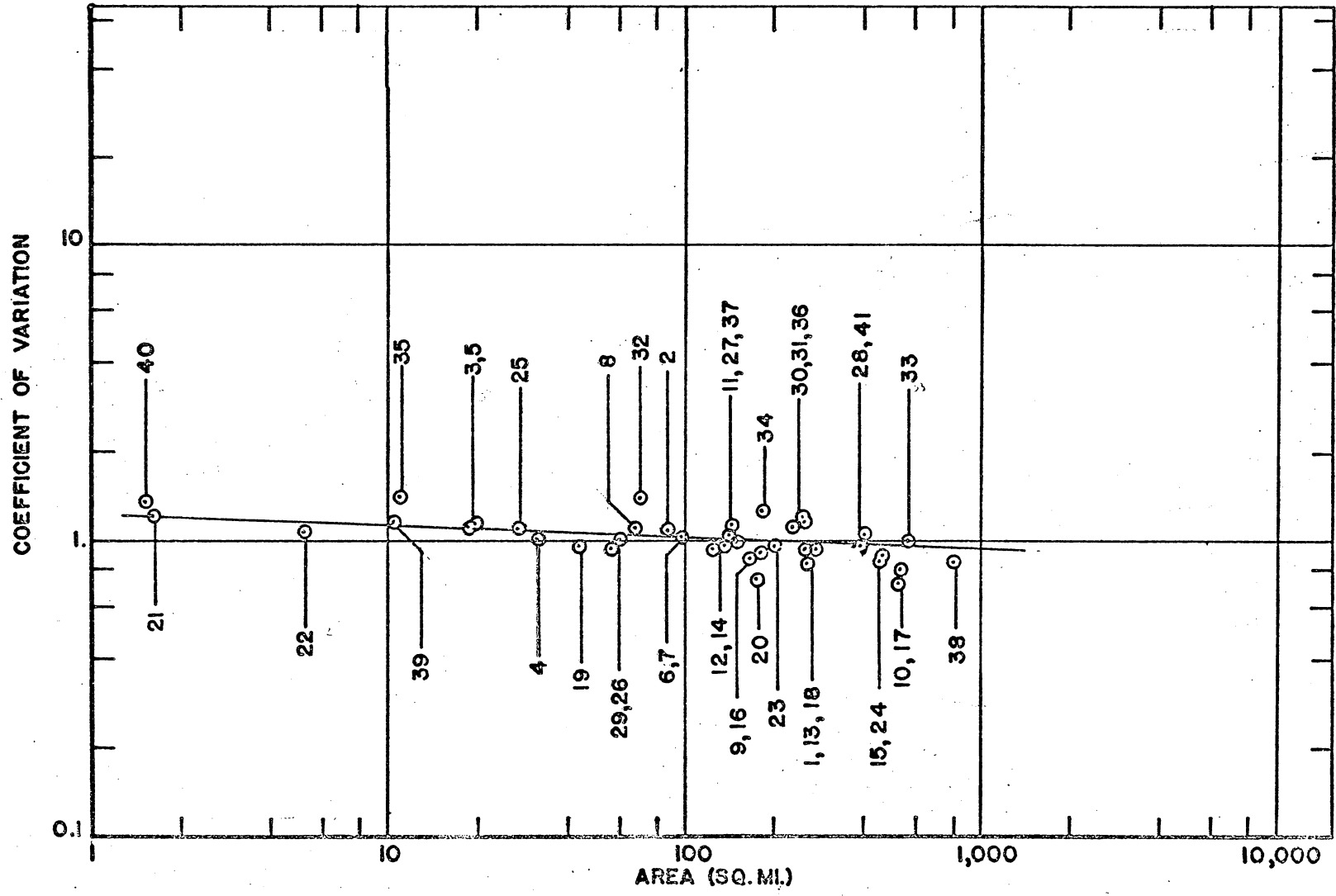


FIGURE 5. COEFFICIENT OF VARIATION VS. AREA, OHIO RIVER BASIN.

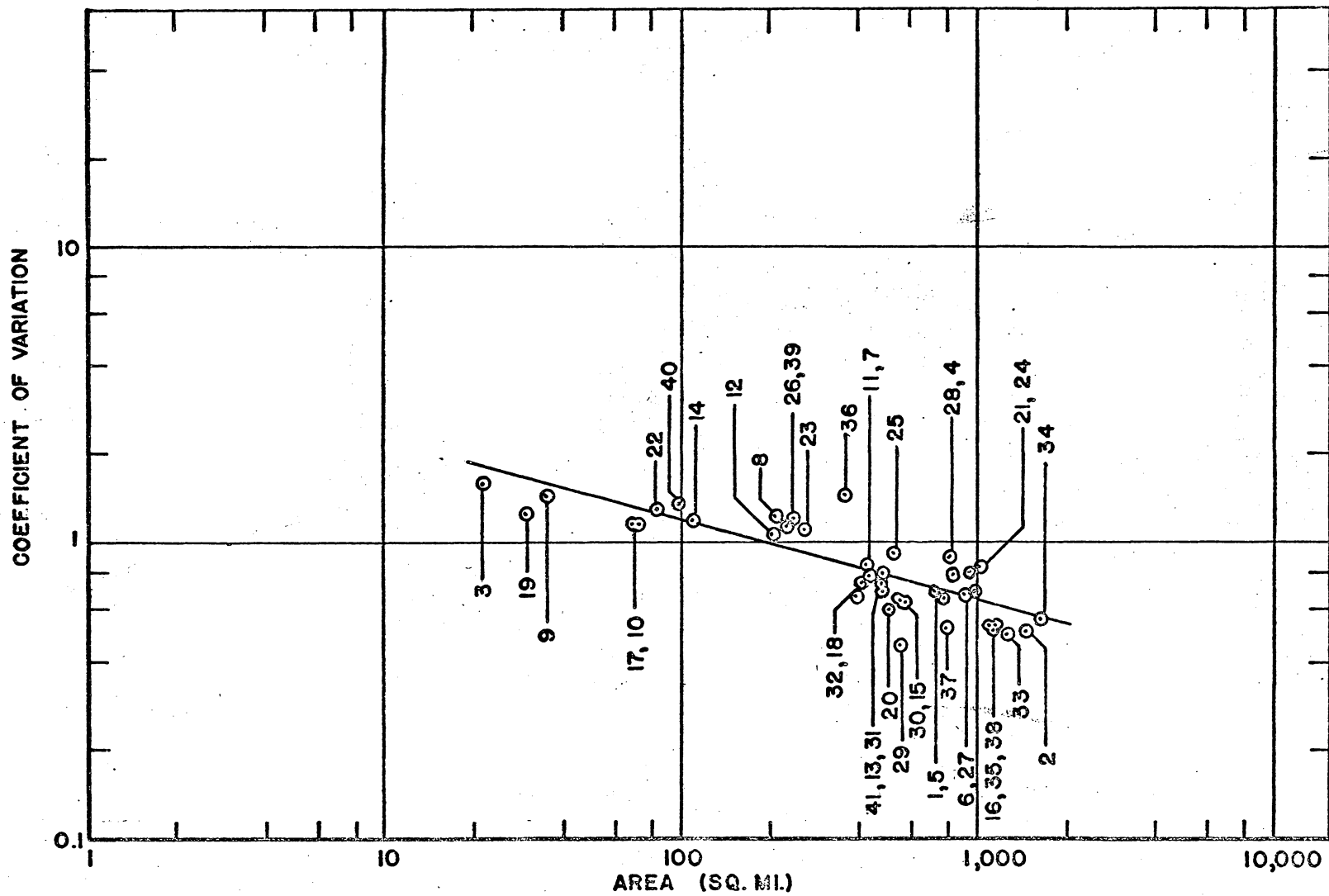


FIGURE 6. COEFFICIENT OF VARIATION. VS. AREA, LOWER MISSISSIPPI RIVER BASIN.

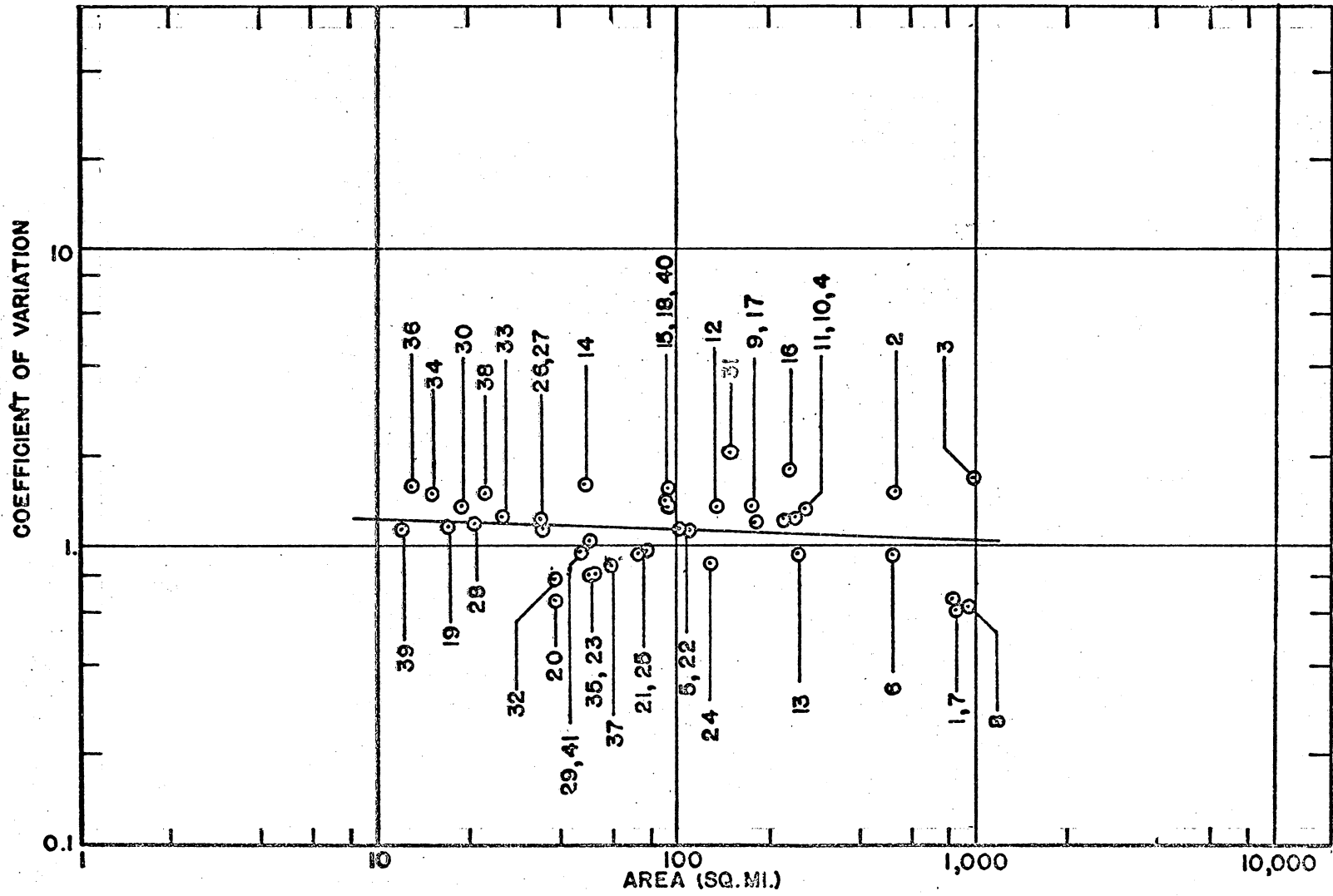


FIGURE 7. COEFFICIENT OF VARIATION VS. AREA, CENTRAL VALLEY OF CALIFORNIA

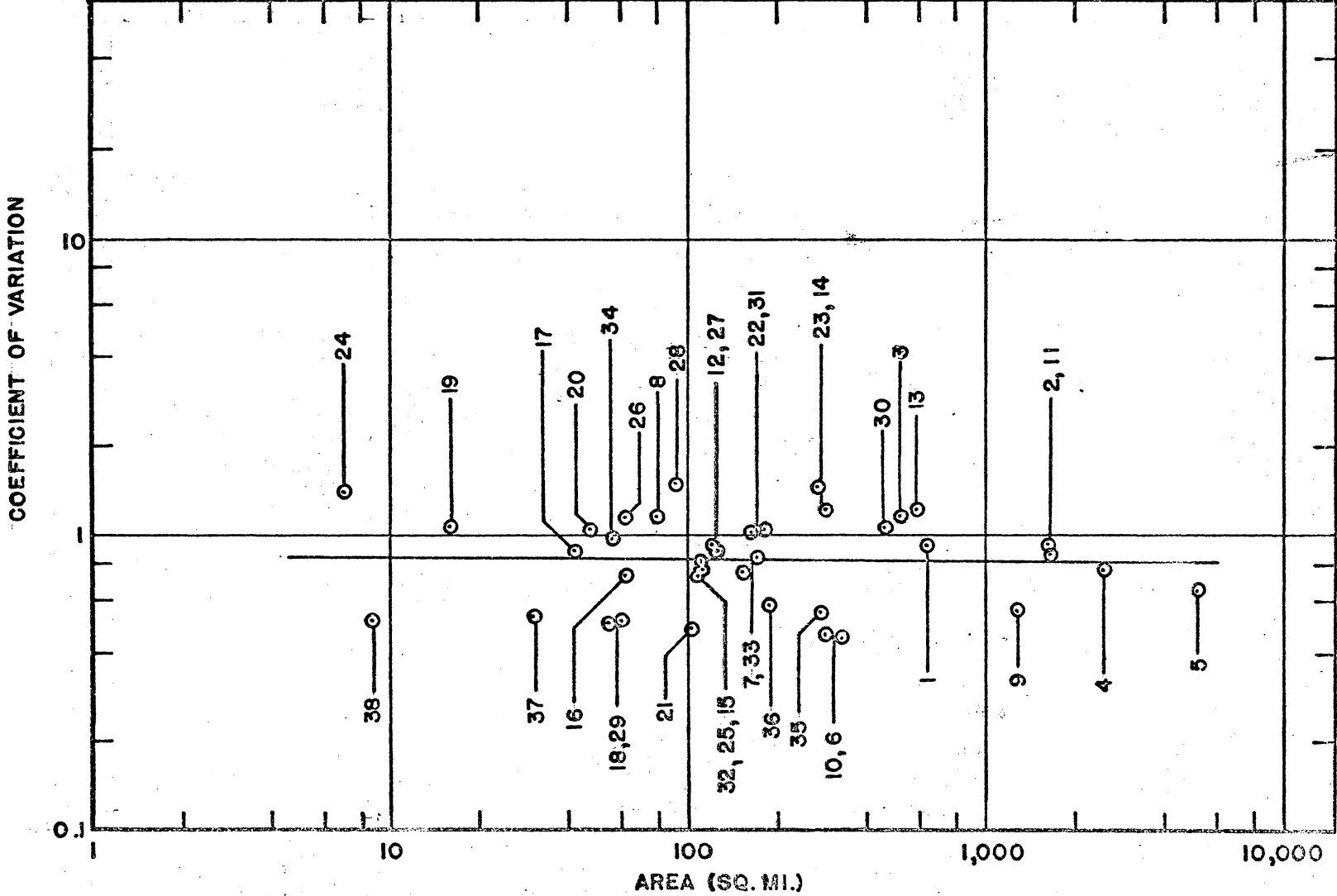


FIGURE 8. COEFFICIENT OF VARIATION VS. AREA, PACIFIC MOUNTAIN SLOPES.

VI. ACKNOWLEDGEMENTS

The initial portion of the graduate program undertaken by the author was supported by a graduate teaching assistantship from the Virginia Polytechnic Institute. For this assistance the author expresses his appreciation.

The author wishes also to express his appreciation to Dr. James M. Wiggert, thesis advisor, for his suggestions and guidance. Dr. Wiggert's advice and constructive criticisms were very much appreciated during the research investigation.

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IX. APPENDIX I

1. MIDDLE ATLANTIC SLOPE BASINS IN VIRGINIA AND N. CAR.
 U.S.G.S. WATER SUPPLY PAPERS 1302-03, 1722-23

TITLE	AREA
ACCOTINK CREEK NEAR ANNANDALE, VA	23.6
LONG BRANCH NEAR ANNANDALE, VA	3.9
ACCOTINK CREEK NEAR ACCOTINK STATION, VA	37.0
CEDAR RUN NEAR WARRENTON, VA	13.0
BROAD RUN NEAR BUCKLAND, VA	50.3
BULL RUN NEAR MANNASSES, VA	147.
MATTAWOMAN CREEK NEAR POMONKEY, MD	57.7
S FK QUANTICO CREEK , INDEPENDENT HALL, VA	7.5
N BR CHOPAWAMSIC CRK, INDEPENDENT HALL, VA	5.8
MIDDLE FORK CHOPAWAMSIC CREEK	4.5
PISCATAWAY CREEK NEAR TAPPAHANNOCK, VA	28.1
DRAGON RUN NEAR CHURCH VIEW, VA	86.
TOTOPOTOMY CREEK NEAR ATTLEE, VA	6.0
DIFFICULT RUN NEAR GREAT FALLS, VA	58.0
FOURMILE RUN AT ALEXANDRIA, VA	14.4
CAMERON RUN AT ALEXANDRIA, VA	33.7
CEDAR RUN NEAR CATTLETT, VA	93.5
S BR CHOPAWAMSIC CREEK , GARRISONVILLE, VA	2.6
BEAVERDAM RUN NEAR GARRISONVILLE, VA	12.7
MOUNTAIN RUN NEAR CULPEPER, VA	14.7

CATPOINT CREEK NEAR MONTROSS, VA	45.0
BEAVERDAM SWAMP NEAR ARK, VA	7.1
HUDSON CREEK NEAR BOSWELLS TAVERN, VA	4.1
MATTAPONI RIVER NEAR BEULAVILLE, VA	619.
OCCOQUAN CREEK NEAR OCCOQUAN, VA	546.
PAMUNKY RIVER NEAR HANOVER, VA	1072.
SOUTH ANNA RIVER NEAR ASHLAND, VA	393.
NORTH ANNA RIVER NEAR DOSWELL, VA	439.
MATTAPONI RIVER NEAR BOLLING GREEN, VA	251.
FINE CREEK AT FINE CREEK MILLS, VA.	23.
FALLING CREEK NEAR DREWRY'S BLUFF, VA	54.
BUFFALO CREEK NEAR HAMPDEN SYDNEY, VA	70.
DEEP CREEK NEAR MANNBORO, VA	156.
SWIFT CREEK NEAR CHESTER, VA	143.
NOTTOWAY RIVER NEAR BURKEVILLE, VA	38.
NOTTOWAY RIVER NEAR MC KENNEY, VA	362.
STONY CREEK NEAR DINWIDDIE, VA	111.
SEACOCK CREEK AT UNITY, VA	102.
NORTH MEHERRIN RIVER NEAR KEYSVILLE, VA	9.2
NORTH MEHERRIN RIVER NEAR LUNENBURG, VA	60.0
SNOW CREEK AT SAGO, VA	60.
GOOSE CREEK NEAR HUDDLESTON, VA	187.
FALLING RIVER NEAR NARUNA, VA	172.
LITTLE FALLING CREEK AT HAT CREEK, VA	43.
CUB CREEK AT PHENIX, VA	102.

ROANOKE CREEK AT SAXE, VA	162.
LEATHERWOOD CREEK NEAR OLD LIBERTY, VA	68.
SANDY RIVER NEAR DANVILLE, VA	113.
GEORGES CREEK NEAR GRETNA, VA	9.2
TAR RIVER NEAR TAR RIVER, N C	167.
SAPONY CREEK NEAR NASHVILLE, N C	64.8
ENO RIVER AT HILLSBORO, N C	66.5
FLAT RIVER AT BAHAMA, N C	150.
DIAL CREEK NEAR BAHAMA, N C	4.7
FLAT RIVER AT DAM, NEAR BAHAMA, N C	171.
MIDDLE CREEK NEAR CLAYTON, N C	80.7
SLATE RIVER NEAR ARVONIA, VA	235.
WILLIS RIVER AT FLANAGAN MILLS, VA.	247.
APPOMATTOX RIVER AT FARMVILLE, VA	306.
APPOMATTOX RIVER AT MATTOAX, VA	729.
APPOMATTOX RIVER NEAR PETERSBURG, VA	1335.
CHICKAHOMINY RIVER NEAR PROV. FORGE, VA	249.
NOTTOWAY RIVER NEAR STONY CREEK, VA	586.
NOTTOWAY RIVER NEAR SEBRELL, VA	1451.
BLACKWATER RIVER NEAR DENDRON, VA	285.
BLACKWATER RIVER AT ZUNI, VA	448.
BLACKWATER RIVER NEAR FRANKLIN, VA	613.
NORTH MEHERRIN RIVER NEAR LAWRENCEVILLE, VA	553.
MEHERRIN RIVER AT EMPORIA, VA	749.
FALLING RIVER NEAR BROOKNEAL, VA	228.

BANISTER RIVER AT HALIFAX, VA	552.
HYCO RIVER NEAR DENNISTON, VA	289.
HYCO RIVER NEAR OMEGA, VA	413.
TAR RIVER NEAR NASHVILLE, N C	701.
FISHING CREEK NEAR ENFIELD, N C	521.
NEUSE RIVER NEAR NORTHSIDE, N C	526.
NEUSE RIVER NEAR CLAYTON, N C	1140.
LITTLE RIVER NEAR PRINCETON, N C	229.
CONTENTNEA CREEK NEAR WILSON, N C	236 .
CONTENTNEA CREEK AT HOOKERTON, N C	729.
SWIFT CREEK NEAR VANCEBORO, N C	182.

2. MISSOURI RIVER BASIN IN VICINITY OF SIOUX CITY, IOWA
 U.S.G.S. WATER SUPPLY PAPERS 1309-10, 1729-30

TITLE	AREA
BAD RIVER NEAR MIDLAND, S D	1500.
BAD RIVER NEAR FORT PIERRE, S D	3107.
MEDICINE KNOLL CREEK NEAR BLUNT, S D	455.
MEDICINE CREEK AT KENNEBEC, S D	465.
WHITE RIVER AT CRAWFORD, NEBR	313.
WHITE RIVER BELOW COTTONWOOD CREEK, WHITNE	676.
WHITE RIVER NEAR OGLALA, S D	2200.
WHITE RIVER NEAR KODOKA, S D	5000.
SO FK WHITE RIVER NEAR ROSEBUD, S D	1020.
SO FK WHITE RIVER BELOW WHITE RIVER, S D	1570.
PONCA CREEK AT ANOKA, NEBR	410.
NIOBRARA RIVER NEAR GORDON, NEBR	2595.
BEAR CREEK NEAR ELI, NEBR	360.
SNAKE RIVER NEAR BURGE, NEBR	620.
MINNECHADUZA CREEK NEAR KILGORE, NEBR	80.
MINNECHADUZA CREEK AT VALENTINE, NEBR	510.
NIOBRARA RIVER NEAR SPARKS, NEBR	6406.
PLUM CREEK NEAR MEADVILLE, NEBR	581.
LONGPINE CREEK NEAR RIVERVIEW, NEBR	390.
KEYA PAHA RIVER NEAR HIDDEN TIMBER, S D	320.

KEYA PAHA RIVER AT WEWELA, S D	1070.
NIOBRARA RIVER NEAR SPENCER, NEBR	0400.
NIOBRARA RIVER NEAR VERDEL, NEBR	0900.
MIDDLE LOOP RIVER NEAR SENECA, NEBR	1140.
MIDDLE LOOP RIVER AT DUNNING, NEBR	1760.
DISMAL RIVER NEAR GEM, NEBR	1360.
DISMAL RIVER AT DUNNING, NEBR	1780.
MIDDLE LOOP RIVER NEAR MILBURN, NEBR	3690.
MIDDLE LOOP RIVER AT WALWORTH, NEBR	4340.
MIDDLE LOOP RIVER AT SARGENT, NEBR	4480.
MIDDLE LOUP RIVER AT ARCADIA, NEBR	4730.
SO LOUP RIVER NEAR CUMRO, NEBR	1340.
SOUTH LOUP RIVER AT RAVENNA, NEBR	1660.
MUD CREEK NEAR SWEETWATER, NEBR	1020.
SOUTH LOUP RIVER AT ST MICHAEL, NEBR	2560.
OAK CREEK NEAR LOUP CITY, NEBR	42.9
OAK CREEK NEAR DANNEBROG, NEBR	122.
MIDDLE LOUP RIVER AT ST PAUL, NEBR	7720.
NORTH LOUP RIVER AT BREWSTER, NEBR	1890.
NORTH LOUP RIVER AT TAYLOR, NEBR	2210.
NORTH LOUP RIVER AT BURWELL, NEBR	2510.
CALMUS RIVER NEAR BURWELL, NEBR	1260.
NORTH LOUP RIVER AT SCOTIA, NEBR	4110.
NORTH LOUP RIVER NEAR ST PAUL, NEBR	4460.
SPRING CREEK AT CUSHING, NEBR	164.

3. OHIO RIVER BASIN

U.S.G.S. WATER SUPPLY PAPERS 1305, 1725

TITLE	AREA
CHARTIERS CREEK AT CARNEGIE, PA	257.
MAHONING RIVER AT ALLIANCE, OHIO	88.
BEECH CREEK NEAR BOLRON, OHIO	18.8
DEER CREEK NEAR LIMAVILLE, OHIO	31.9
MILL CREEK NEAR BERLIN CENTER, OHIO	19.7
W BR MAHONING RIVER NEAR NEWTON FALLS, OHIO	97.8
EAGLE CREEK AT PHALANX STATION, OHIO	97.
MILL CREEK AT YOUNGSTOWN, OHIO	68.4
RACCOON CREEK AT MOFFATTS MILL, PA.	178.
LITTLE BEAVER CREEK NEAR LIVERPOOL, OHIO	535.
YELLOW CREEK NEAR HAMMONDSVILLE, OHIO	148.
SHORT CREEK NEAR DILLONVALE, OHIO	124.
WHEELING CREEK AT ELM GROVE, W VA	282.
CAPTINA CREEK AT ARMSTRONGS, MILLS, OHIO	135.
MIDDLE ISLAND CREEK AT LITTLE, W VA	458.
TUSCARAWAS RIVER AT CLINTON, OHIO	165.
TUSCARAWAS RIVER AT MASSILLON, OHIO	526.
SANDY CREEK AT WAYNESBURG, OHIO	254.
MIDDLE BR NIMISHILLEN CREEK AT CANTON, OHIO	44.2
NIMISHILLEN CREEK AT NORTH INDUSTRY, OHIO	175.

HOME CREEK NEAR NEW PHILADELPHIA, OHIO	1.6
TOUBY RUN AT MANSFIELD, OHIO	5.2
KOKOSING RIVER AT MOUNT VERNON, OHIO	200.
KILLBUCK CREEK AT KILLBUCK, OHIO	466.
MILL CREEK NEAR COSHOCTON, OHIO	27.5
SALT FORK NEAR CAMBRIDGE, OHIO	55.6
WAKATOMIKA CREEK NEAR FRAZEYSBURG, OHIO	140.
LITTLE SANDY RIVER NEAR GRAYSON, KY	402.
TYGARTS CREEK AT OLIVE HILL, KY	59.6
TYGARTS CREEK NEAR GREENUP, KY	242.
SCIOTO RIVER AT LA RUE, OHIO	255.
LITTLE SCIOTO RIVER ABOVE MARION, OHIO	70.
SCIOTO RIVER NEAR PROSPECT, OHIO	571.
MILL CREEK NEAR BELLEPOINT, OHIO	181.
SCIOTO BIG RUN AT BRIGGSDALE, OHIO	11.
PAINT CREEK NEAR GREENFIELD, OHIO	251.
ROCKY FORK NEAR BARRETTS MILLS, OHIO	141.
PAINT CREEK NEAR BOURNEVILLE, OHIO	808.
SALT CREEK AT TARLTON , OHIO	10.6
TAR HOLLOW CREEK AT TER HOLLOW ST PARK, OHI	1.5
OHIO BRUSH CREEK NEAR WEST UNION, OHIO	388.

4. LOWER MISSISSIPPI RIVER BASIN

U.S.G.S. WATER SUPPLY PAPERS 1311, 1731

TITLE	AREA
MERAMEC RIVER NEAR STEELVILLE, MO	781.
MERAMEC RIVER NEAR SULLIVAN, MO	1475.
BOURBEUSE RIVER NEAR ST JAMES, MO	21.3
BOURBEUSE RIVER AT UNION, MO	808.
BIG RIVER NEAR DE SOTO, MO	718.
BIG RIVER AT BYRNESVILLE, MO	917.
CASTOR RIVER AT ZALMA, MO	423.
MAYFIELD CREEK AT LOVELACEVILLE, KY	212.
OBION CREEK AT PRYORSBURG, KY	36.8
BAYOU DU CHIEN NEAR CLINTON, KY	68.7
SOUTH FORK OBION RIVER NEAR GREENFIELD, TEN	431.
RUTHERFORD FORK OBION RIVER NEAR BRADFORD,	203.
NORTH FORK OBION RIVER NEAR UNION CITY, TEN	480.
REELFOOT CREEK NEAR SAMBURG, TENN	110.
SOUTH FORK FORKED DEER RIVER AT JACKSON, TEN	574.
SOUTH FORK FORKED DEER RIVER AT CHESTNUT BL	1100.
NORTH FORK FORKED DEER RIVER AT TRENTON, TE	71.3
MIDDLE FORK FORKED DEER RIVER NEAR ALAMO, T	410.
CANE CREEK AT RIPLEY, TENN	30.
WOLF RIVER AT ROSSVILLE, TENNESSEE	503.

ST FRANCIS RIVER NEAR PATTERSON, MO	956.
WEST FORK WHITE RIVER AT GREENLAND, ARK	83.
WAR EAGLE CREEK NEAR HINDSVILLE, ARK	262.
WHITE RIVER NEAR ROGERS, ARK	1020.
KINGS RIVER NEAR BERRYVILLE, ARK	532.
JAMES RIVER NEAR SPRINGFIELD, MO	246.
JAMES RIVER AT GALENA, MO	987.
BUFFALO RIVER NEAR ST JOE, ARK	825.
NORTH FORK RIVER NEAR TECUMSEH, MO	561.
BRYANT CREEK NEAR TECUMSEH, MO	570.
BLACK RIVER NEAR ANNAPOLIS, MO	484.
JACKS FORK AT EMINENCE, MO	398.
CURRENT RIVER NEAR EMINENCE, MO	1272.
CURRENT RIVER AT VAN BUREN, MO	1567.
SPRING RIVER AT IMBODEN, ARK	1162.
ELEVEN POINT RIVER NEAR THOMASVILLE, MO	361.
ELEVEN POINT RIVER NEAR BARDLEY, MO	793.
ELEVEN POINT RIVER NEAR RAVENDEN SPRINGS, A	1123.
STRAWBERRY RIVER NEAR EVENING SHADE, ARK	225.
PINEY FRK STRAWBERRY RIVER AT EVENING SHADE	99.
STRAWBERRY RIVER NEAR POUGHKEEPSIE, ARK	476.

5. CENTRAL VALLEY OF CALIFORNIA

U.S.G.S. WATER SUPPLY PAPERS 1315A, 1735

TITLE	AREA
KERN RIVER NEAR KERNVILLE, CALIF	65.0
SOUTH FORK KERN RIVER NEAR ONYX, CALIF	30.0
SOUTHFORK KERN RIVER NEAR ISABELLA, CALIF	83.0
TULE RIVER NEAR PORTERVILLE, CALIF	66.0
MIDDLE FORK KEWEAH RIVER NEAR POTWISHA CAM	00.0
KAWEAH RIVER NEAR THREE RIVERS CALIF	20.0
KINGS RIVER NEAR HUME, CALIF	33.0
KINGS RIVER ABOVE NORTH FORK, CALIF	56.0
N FK KINGS RIVER NEAR CLIFF CAMP, CALIF	74.0
N FK KINGS RIVER BELOW RANCHERIA CREEK, CA	25.0
N FK KINGS CREEK ABOVE DINKEY CREEK CALIF	46.0
DINKEY CREEK AT MOUTH, CALIF	36.0
SAN JOAQUON RIVER AT MILLER CROSSING, CALI	54.0
GRANITE CREEK NEAR CATTLE MOUNTAIN, CALIF	48.8
MONO CREEK NEAR VERMOLLION VALLEY, CALIF	92.0
CHOWCHILLA RIVER NEAR BUCHANNAN DAM SITE ,	38.0
MERCED RIVER AT HAPPY ISLES BRIDGE, NEAR	81.0
WHITE RIVER NEAR DUCOR, CALIF	92.9
DEER CREEK NEAR CALIF HOT SPRINGS, CALIF	16.9
N FK OF MIDDLE FORKTULE RIVER NEAR SPRINGV	39.5

SOUTH FORK TULE RIVER NEAR PORTERVILLE, CA	79.3
SOUTH FORK TULE RIVER NEAR SUCCESS CALIF	09.0
MARBLE FORK KEWEAH RIVER AT POTWISHA, CALI	50.6
NOTH FORK KAWEAH RIVER AT KAWEAH CALIF	28.0
S FK KAWEAH RIVER NEAR THREE RIVERS, CALIF	72.7
N. FK KINGS RIVER BELOW MEADOW BROOK, CALI	35.3
HELMS CREEK AT SANDS MEADOW, CALIF	34.7
RANCHERIA CREEK NEAR SMITH MEADOW, CALIF	21.3
DINKEY CREEK AT DINKEY MEADOW, CALIF	50.8
DEER CREEK BELOW EAST FORK, CALIF	19.0
LOS GADOS CREEK NEQR COALINGA, CALIF	05.0
N FK SAN JOAQUIN RIVER BELOW IRON CREEK, C	38.0
WEST FK GRANITE CREEK NEAR TIMBER KNOB, CA	26.4
EAST FK GRANITE CREEK NEAR CATLE MOUNTAIN,	15.0
BEAR CREEK NEAR VERMILLION, CALIF	53.5
JACKASS CREEK NEAR JACKASS MEADOW, CALIF	12.8
CHIQUITO CREEE NEAR ARNOLD MEADOW, CALIF	59.6
PITMAN CREEK NEAR TAMARACK, CALIF	22.7
WISKEY CREEK NEAR NORTH FORK, CALIF	11.8
FINE GOLD CREEK ENAR FRIANT , CALIF	92.8
TENAYA CREEK NEAR YOSEMITE, CALIF	47.0

6. PACIFIC MOUNTAIN SLOPES IN WASHINGTON AND OREGON

U.S.G.S. WATER SUPPLY PAPERS 1316, 1318, 1736, 1738

TITLE	AREA
210 UMATILLA RIVER AT PENDLETON, OREGON	637.
405 JOHN DAY RIVER AT PICTURE GORGE	1680.
440 MIDDLE FK JOHN DAY RIVER AT RITTER, O	515.
460 N FK JOHN DAY RIVER AT MONUMENT, ORE	2520.
465 JOHN DAY RIVER AT SERVICE CREEK , ORE	5090.
915 METOLIUS RIVER NEAR GRANDVIEW, ORE	324.
1070 KLICKTAT RIVER ABOVE WEST FORK, NEAR GLENWO	151.
1120 LITTLE KLICKTAT RIVER NEAR GOLDENDALE, WASH	78.
1130 KLICKITAT RIVER NEAR PITT, WASH	1290.
1230 WHITE SALMON RIVER NEAR HUSUM, WASH	294.
185 WALLA WALLA RIVER NEAR TOUCHET, WASH	1660.
200 UMATILLA RIVER ABOVE MECHAM CREEK NEAR GIBB	125.
395 SO FK JOHN DAY RIVER NEAR DAYVILLE, O	590.
790 N FK CROOKED RIVER BELOW DEEP CREEK, O	264.
1270 WIND RIVER ABOVE TROUT CREEK NEAR CARSON WA	108.
100 SO FK WALLA WALLA RIVER NEAR MILTON, O)	63.
110 NO FK WALLA WALLA RIVER NEAR MILTON, O)	42.
130 MILL CREEK NEAR WALLA WALLA, WASH	60.
135 BLUE CREEK NEAR WALLA WALLA, WASH	17.
160 DRY CREEK NEAR WALLA WALLA, WASH	48.4

165 E. FK TOUCHET RIVER NEAR DAYTON, WASH	102.
225 MC KAY CREEK NEAR PILOT ROCK, OREGON	178.
250 BIRCH CREEK AT RIETH, OREGON	291.
375 STRAWBERRY CREEK ABOVE SLIDE CREEK	7.
410 DESOLATION CREEK NEAR DALE OREGON	108.
420 CAMAS CREEK NEAR LEHMAN, OREGON	61.
425 CAMAS CREEK NEAR UKIAH, O	121.
445 FOX CREEK AT GORGE NEAR FOX, ORE	90.2
750 SQUAW CREEK NEAR SISTERS, ORE	54.8
780 BEAVER CREEK NEAR PAULINA, ORE	450.
785 N FK CROOKED RIVER ABOVE DEEP CREEK, O	159.
955 WARM SPRINGS RIVER AT HEHE MILL	108.
1045 FIFTEENMILE CREEK NEAR WRENTHAM(ORE	171.
1050 EIGHT MILE CREEK NEAR BOYD ORE	56.
1125 LITTLE KLICKTAT RIVER NEAR WAHKIACUS, WASH	280.
1220 WHITE SALMON RIVER NEAR TROUT LAKE, WASH	185.
1280 PANTHER CREEK NEAR CARSON, WASH	30.1
1340 SALMON RIVER NEAR GOVERNMENT CAMP, O	8.7

APPENDIX II

MIDDLE ATLANTIC SLOPE BASINS IN VIRGINIA AND NORTH CAROLINA

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
1.	Accotink Creek, Annandale, Va.	25.08	17.44	0.695
2.	Long Branch, Annandale	4.84	3.69	0.818
3.	Accotink Creek, Accotink Station	33.14	22.34	0.674
4.	Cedar Run, Warrenton	12.05	10.95	0.909
5.	Broad Run, Buckland	34.97	28.76	0.822
6.	Bull Run, Manasses	39.99	29.27	0.731
7.	Mattawoman Creek, Pomonkey, Md.	31.45	27.64	0.879
8.	S. Fk. Quantico Creek	6.84	6.55	0.958
9.	N. Br. Chopawamsic Creek	4.66	4.38	0.940
10.	Mid. Fk. Chopwamsie Crk.	3.57	3.17	0.888
11.	Piscataway Creek	28.80	19.88	0.690
12.	Dragon Run	45.57	28.32	0.621
13.	Totopotomy Creek	6.09	5.38	0.883
14.	Difficult Run	43.55	24.11	0.554
15.	Fourmile Run	14.15	10.34	0.731
16.	Cameron Run	26.27	17.80	0.668
17.	Cedar Run	34.31	28.37	0.827
18.	S. Br. Chopawamsic	2.22	1.84	0.829
19.	Beaverdam Run	10.52	11.01	1.047
20.	Mountain Run	15.33	12.01	0.783

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
21.	Catpoint Creek	36.36	24.05	0.661
22.	Beaverdam Swamp	6.75	5.92	0.877
23.	Hudson Creek	4.51	3.83	0.849
24.	Mattaponi River	377.52	251.34	0.666
25.	Occoquan Creek	332.82	270.36	0.812
26.	Pamunky River	481.00	269.59	0.560
27.	S. Anna River, Ashland	320.81	237.98	0.742
28.	N. Anna River, Doswell	329.54	242.95	0.737
29.	Mattaponi River, Bolling Green	226.84	194.86	0.859
30.	Fine Creek	19.20	13.49	0.702
31.	Falling Creek	38.02	27.41	0.721
32.	Buffalo Creek	45.98	24.89	0.541
33.	Deep Creek	51.50	28.55	0.554
34.	Swift Creek	46.60	27.76	0.596
35.	Nottoway River, Burkeville	32.94	27.47	0.834
36.	Nottoway River, McKenney	44.83	27.70	0.618
37.	Stony Creek	42.53	26.74	0.629
38.	Seacock Creek	37.65	30.98	0.823
39.	N. Meherrin River, Keysville	9.50	7.83	0.824
40.	N. Meherrin River, Lunenburg	35.86	27.83	0.776

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
41.	Snow Creek	49.70	22.03	0.443
42.	Goose Creek	50.42	28.02	0.556
43.	Falling River	47.45	28.00	0.590
44.	Little Falling River	29.79	20.91	0.702
45.	Cub Creek	53.92	24.04	0.446
46.	Roanoke Creek	49.87	26.03	0.522
47.	Leatherwood Creek	45.13	26.73	0.592
48.	Sandy River	52.61	27.42	0.521
49.	Georges Creek	9.37	4.22	0.451
50.	Tar River	43.61	28.80	0.660
51.	Sapony Creek	35.27	27.22	0.772
52.	Eno River	40.04	27.01	0.674
53.	Flat River, Bahama, N.C.	43.06	27.94	0.649
54.	Dial Creek	4.43	4.20	0.948
55.	Flat River at Dam	43.80	29.14	0.665
56.	Middle Creek	41.69	26.72	0.641
57.	Slate River	217.96	163.37	0.750
58.	Willis River	234.21	188.34	0.804
59.	Appomattox River, Farmville	275.67	193.23	0.701
60.	Appomattox River, Mattoax	435.95	254.22	0.583
61.	Appomattox River, Petersburg	489.31	270.64	0.553
62.	Chickahominy River	251.63	192.86	0.766

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
63.	Nottoway River, Stony Creek	385.44	268.56	0.697
64.	Nottoway River, Sebrell	468.42	282.21	0.602
65.	Blackwater R., Dendron	262.98	237.76	0.904
66.	Blackwater R., Zuni	337.27	271.48	0.805
67.	Blackwater R., Franklin	358.61	283.13	0.790
68.	N. Meherrin R., Lawrenceville	362.15	252.14	0.696
69.	Meherrin R., Emporia	394.89	264.04	0.669
70.	Falling R., Brookneal	267.04	201.31	0.729
71.	Banister River	405.99	238.57	0.588
72.	Hyc0 R., Denniston	244.78	227.09	0.928
73.	Hyc0 R. Omega	305.33	251.65	0.824
74.	Tar R., Nashville, N.C.	451.98	269.76	0.597
75.	Fishing Creek	393.09	255.11	0.649
76.	Neuse R., Northside, N.C.	356.46	263.02	0.738
77.	Neuse R., Clayton	469.97	272.34	0.580
78.	Little Neuse R.	246.12	221.20	0.899
79.	Contentnea Creek, Wilson	220.84	211.64	0.958
80.	Contentnea Creek, Hookerton	385.68	264.41	0.686
81.	Swift Creek, Vanceboro, N. C.	167.55	198.94	1.187

MISSOURI RIVER BASIN IN VICINITY SIOUX CITY, IOWA

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
1.	Oak Creek, Loup City, Nebraska	1.60	4.14	2.595
2.	Oak Creek, Dannebrog	7.92	18.20	2.297
3.	Bad R., Midland, S.D.	59.92	150.15	2.506
4.	Bad R., Ft. Pierre, S.D.	101.53	197.37	1.944
5.	Medicine Knoll Creek	9.51	40.33	4.238
6.	Medicine Creek	21.03	71.51	3.400
7.	White R., Crawford	21.00	8.91	0.424
8.	White R., Ogala	63.02	102.67	1.629
9.	White R., Kodoka	199.84	208.73	1.044
10.	S.Fk. White R., Rosebud	115.07	67.02	0.582
11.	S.Fk. White, White R., South Dakota	135.66	116.34	0.858
12.	Ponca Creek	54.81	117.69	2.147
13.	Niobrara R., Gordon	132.11	50.32	0.381
14.	Bear Creek, Eli	11.96	10.92	0.904
15.	Snake River	253.60	23.97	0.094
16.	Minnechaduza Creek, Kilgore	8.10	8.21	1.013
17.	Minnechaduza Creek, Valentine	36.09	17.98	0.498
18.	Niobrara R., Sparks	712.81	244.95	0.344
19.	Plumb Creek, Meadville	107.00	34.81	0.325
20.	Longpine Crk., Riverview	131.04	35.56	0.271

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
21.	Keya Paha River, Hidden Timber	34.47	52.92	1.535
22.	Keya Paha R., Wewela	74.23	93.26	1.256
23.	Niobrara R., Spencer	436.18	313.52	0.677
24.	Niobrara R., Verdel	420.58	274.94	0.654
25.	Middle Loup R., Seneca	197.49	17.05	0.086
26.	Middle Loup R., Dunning	389.87	35.33	0.091
27.	Dismal R., Gem	278.48	16.95	0.061
28.	Dismal R., Dunning	319.76	19.48	0.061
29.	Middle Loup R., Milburn	793.97	77.55	0.098
30.	Middle Loup R., Walworth	761.23	164.54	0.216
31.	Middle Loup R., Sargent	761.07	185.67	0.244
32.	Middle Loup R., Arcadia	683.59	252.94	0.370
33.	S. Loup R., Cumbro	164.10	64.89	0.395
34.	S. Loup R., Ravenna	195.29	102.40	0.524
35.	Mud Crk., Sweetwater	40.19	40.11	0.998
36.	S. Loup, St. Michael	236.08	130.37	0.552
37.	Middle Loup R., St. Paul	447.84	307.08	0.686
38.	N. Loup R., Brewster	377.99	83.32	0.220
39.	N. Loup R., Taylor	453.02	129.30	0.285
40.	N. Loup R. Burwell	544.52	159.20	0.292
41.	Calmus R., Burwell	293.23	45.02	0.154
42.	N. Loup R., Scotia	626.76	282.10	0.450

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
43.	N. Loup R., St. Paul	567.12	317.61	0.560
44.	Spring Creek	16.16	27.93	1.419
45.	White R., Cottonwood Creek	20.42	30.27	1.483

OHIO RIVER BASIN

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
1.	Chartiers Creek	280.81	234.78	0.836
2.	Mahoning River	85.95	92.88	1.081
3.	Beech Creek	18.67	20.75	1.111
4.	Deer Creek	31.96	31.94	0.999
5.	Mill Crk., Berlin Ctr.	18.63	20.99	1.125
6.	W. Br. Mahoning R., Newton Falls	100.19	104.14	1.040
7.	Eagle Creek	106.50	107.20	1.007
8.	Mill Crk., Youngstown	63.41	70.65	1.114
9.	Raccoon Crk.	195.43	178.48	0.913
10.	Little Beaver Crk.	351.62	281.03	0.799
11.	Yellow Crk.	165.31	164.25	0.994
12.	Short Crk.	126.65	117.67	0.929
13.	Wheeling Crk.	286.97	267.78	0.933
14.	Captina Crk.	153.04	149.10	0.974
15.	Middle Island Crk.	318.61	282.36	0.886
16.	Tuscarawas R., Clinton	142.45	122.50	0.860
17.	Tuscarawas R., Massillon	349.01	247.72	0.710
18.	Sandy Crk.	260.22	240.97	0.926
19.	Mid. Br. Nimishillen, Canton	34.37	33.26	0.968
20.	Nimishillen Crk., N. Industry	167.76	123.53	0.736
21.	Home Crk.	1.34	1.63	1.216

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
22.	Touby Run	4.86	5.24	1.076
23.	Kokosing R.	176.32	170.37	0.966
24.	Killbuck Crk.	292.43	251.09	0.859
25.	Mill Crk.	28.03	30.83	1.100
26.	Salt Fk.	48.45	45.10	0.931
27.	Wakatomka Crk.	146.07	151.58	1.038
28.	Little Sandy R.	283.64	287.98	1.015
29.	Tygarts Crk., Olive Hill	74.13	73.80	0.996
30.	Tygarts Crk., Greenup	226.67	249.71	1.102
31.	Scioto R., LaRue	200.51	230.06	1.147
32.	Little Scioto R., Marion	51.50	70.46	1.368
33.	Scioto R., Prospect	275.85	272.14	0.986
34.	Mill Creek	153.38	193.15	1.259
35.	Scioto Big Run	10.98	15.26	1.389
36.	Paint Crk., Greenfield	194.58	232.40	1.194
37.	Rocky Fk.	148.63	106.91	1.123
38.	Paint Crk., Bourneville	322.64	272.64	0.845
39.	Salt Crk., Tarlton	10.14	11.82	1.166
40.	Tar Hollow Crk.	1.22	1.66	1.364
41.	Ohio Brush Crk.	292.29	274.79	0.940

PACIFIC MOUNTAIN SLOPES IN WASHINGTON AND OREGON

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
1.	Umatilla R., Pendleton, Oregon	291.54	270.91	0.929
2.	John Day R., Picture Gorge	298.57	264.23	0.885
3.	Mid. Fk. John Day R.	205.84	237.74	1.155
4.	N. Fk. John Day R.	344.84	269.04	0.780
5.	John Day R., Service C.	415.28	269.84	0.650
6.	Metolius R., Grandview	452.97	203.76	0.450
7.	Klickitat R.	265.70	199.07	0.749
8.	Little Klickitat R.	64.81	75.54	1.166
9.	Klickitat R.	559.97	294.26	0.526
10.	White Salmon R.	549.81	255.04	0.464
11.	Walla Walla R.	322.11	301.03	0.935
12.	Umatilla R.	225.62	201.29	0.892
13.	S. Fk. John Day R.	159.25	192.09	1.206
14.	N. Fk. Crooked R.	142.22	203.72	1.432
15.	Wind R.	399.53	284.81	0.713
16.	S. Fk. Walla Walla R.	43.99	31.13	0.708
17.	N. Fk. Walla Walla R.	31.55	28.36	0.899
18.	Mill Crk.	46.94	23.55	0.502
19.	Blue Crk.	15.85	17.02	1.073
20.	Dry Crk.	23.14	23.93	1.034
21.	E. Fk. Touchet R.	48.80	23.79	0.488

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
22.	McKay Crk.	29.79	30.88	1.037
23.	Birch Crk.	23.02	27.90	1.212
24.	Strawberry Crk.	12.75	17.46	1.369
25.	Desolation Crk.	30.41	24.45	0.804
26.	Camas Crk.	23.26	26.91	1.157
27.	Camas Crk., Ukiah	32.76	29.55	0.902
28.	Fox Crk.	17.01	25.38	1.492
29.	Squaw Crk.	53.73	26.28	0.489
30.	Beaver Crk.	26.34	27.71	1.052
31.	N. Fk. Crooked R.	28.41	28.65	1.008
32.	Warm Springs R.	37.51	27.76	0.738
33.	Fifteenmile Crk.	35.09	29.42	0.838
34.	Eightmile Crk.	23.03	22.58	0.980
35.	Little Klickitat R.	46.28	24.93	0.538
36.	White Salmon R.	51.12	29.49	0.577
37.	Panther Crk.	54.65	29.37	0.537
38.	Salmon River	40.61	20.46	0.504

LOWER MISSISSIPPI RIVER BASIN

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
1.	Meramec R., Steelville, Missouri	368.81	241.43	0.655
2.	Meramec R., Sullivan	476.35	238.02	0.500
3.	Bourbeuse R., St. James	18.10	28.70	1.586
4.	Bourbeuse R., Union	312.38	277.96	0.890
5.	Big R., DeSoto	388.97	266.84	0.686
6.	Big R., Byrnesville	384.45	259.29	0.674
7.	Castor R., Zalma	294.13	248.03	0.843
8.	Mayfield Crk.	189.83	232.60	1.225
9.	Obion Crk.	32.18	46.76	1.453
10.	Bayou du Chien	87.37	101.26	1.159
11.	S. Fk. Obion R.	331.76	251.12	0.757
12.	Rutherford Fk, Obion R.	211.53	223.60	1.057
13.	N. Fk. Obion R.	335.94	242.05	0.720
14.	Reelfoot Crk.	108.51	130.64	1.204
15.	S. Fk. Forked Deer R., Jackson	388.84	247.07	0.635
16.	S. Fk. Forked Deer R., Chestnut Bluff	473.14	252.25	0.533
17.	N. Fk. Forked Deer R., Trenton	104.58	119.60	1.144
18.	Mid. Fk. Forked Deer R., Alamo	334.09	251.78	0.754
19.	Cane Crk., Ripley	49.21	59.58	1.211
20.	Wolf R., Possville	407.20	244.10	0.600

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
21.	St. Francis R., Patterson	350.06	278.83	0.796
22.	W. Fk. White R.	117.87	152.76	1.296
23.	War Eagle Crk.	230.83	254.31	1.102
24.	White River, Rogers	333.22	275.73	0.828
25.	Kings R., Berryville	322.05	293.13	0.910
26.	James R., Springfield	162.97	196.99	1.209
27.	James R., Galena	380.55	259.46	0.682
28.	Buffalo R., St. Joe	385.83	303.93	0.788
29.	N. Fork R., Tecumseh	488.41	223.20	0.457
30.	Bryant Crk.	361.00	228.67	0.633
31.	Black R., Annapolis, Mo.	378.59	263.31	0.696
32.	Jacks Fk.	329.58	219.26	0.665
33.	Current R., Eminence	549.85	272.10	0.495
34.	Current R., Van Buren	551.01	303.32	0.550
35.	Spring R., Imboden	487.64	256.62	0.526
36.	Eleven Pt. R., Thomasville	95.03	137.37	1.446
37.	Eleven Pt. R., Bardley	462.94	238.64	0.516
38.	Eleven Pt. R., Ravenden	515.36	258.54	0.502
39.	Strawberry R., Evening Shade	189.99	216.46	1.139
40.	Piney Fk., Strawberry R.	97.09	132.33	1.363
41.	Strawberry R., Poughkeepsie	326.45	260.64	0.798

CENTRAL VALLEY CALIFORNIA

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
1.	Kern R., Kernville, California	369.15	227.52	0.616
2.	S. Fk. Kern R., Onyx	91.76	143.80	1.567
3.	S. Fk. Kern R., Isabella	91.30	158.83	1.740
4.	Tule R., Porterville	134.87	179.26	1.329
5.	Mid Fk. Keweah R.	154.69	177.45	1.147
6.	Keweah R., Three Rivers	283.20	266.27	0.940
7.	Kings R., Hume	382.08	259.25	0.678
8.	Kings R., N. Fk.	400.26	252.11	0.630
9.	N. Fk. Kings R., Cliff Camp	178.49	246.57	1.381
10.	N. Fk. Kings R., Rancheria	217.86	268.63	1.233
11.	N. Fk. Kings R., Dinkey Crk.	197.14	249.87	1.268
12.	Dinkey Crk., Mouth	154.58	208.61	1.350
13.	San Joaquin R.	298.33	274.82	0.921
14.	Granite Crk.	126.48	204.80	1.619
15.	Mono Crk.	142.21	192.87	1.356
16.	Chowchilla R.	83.32	151.18	1.814
17.	Merced R.	205.88	249.75	1.213
18.	White R. Ducor	7.84	12.13	1.547
19.	Deer Crk.	7.99	9.24	1.157
20.	N. Fk. Tule R.	35.95	24.12	0.671

No.	Station Title	Average	Standard Deviation	Coefficient of Variation
21.	S. Fk. Tule R., Porterville	24.69	24.21	0.980
22.	S. Fk. Tule R., Success	22.62	25.50	1.127
23.	Marble Fk., Keweah R.	36.87	28.96	0.785
24.	N. Marble Fk., Keweah	30.19	26.94	0.892
25.	S. Marble Fk., Three Rivers	29.29	27.59	0.942
26.	N. Fk. Kings R., Meadow Brook	24.24	28.14	1.161
27.	Helms Crk., Sands Meadow	19.82	24.57	1.240
28.	Rancheria Crk.	20.01	23.95	1.197
29.	Dinkey Crk., Din. Meadow	28.04	28.75	1.025
30.	Deer Crk., East Fork	15.32	21.06	1.374
31.	Los Gados Crk.	5.55	11.97	2.160
32.	N. Fk. San Joaquin R. Iron Crk.	33.52	26.48	0.790
33.	W. Fk. Granite Crk. Timber Knob	20.94	26.26	1.254
34.	E. Fk. Granite Crk. Cattle Mountain	16.91	25.39	1.502
35.	Bear Crk., Vermillion	30.94	25.21	0.815
36.	Jackass Crk., Jackass Meadow	16.07	25.56	1.590
37.	Chiquito Creek	29.83	25.93	0.869
38.	Pitman Crk.	17.56	26.39	1.503
39.	Wiskey Crk.	20.42	22.90	1.121
40.	Fine Gold Crk.	17.01	24.51	1.441
41.	Tenaya Crk.	29.95	28.42	0.949

ABSTRACT

Statistical Analysis for Streamflow Prediction

For the six regions taken under investigation a statistical analysis of mean monthly flows was attempted. The relationship was established for all but one region.

The analysis compared the coefficient of variation of the monthly flows to the size of the drainage area for each basin in a region. The regions were defined by basins of similar topography and climate. Streamflow prediction would be made by mathematical synthesis from the standard deviation parameter computed from the graphical relationships established for each region.

The value of such a relationship was evidenced by the general consistency of the results.