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ON THE FLOOD FREQUENCY ANALYSIS AT IMPORTANT DISCHARGE MEASURING SITES OF PAKISTANI RIVERS

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1. INTRODUCTION.

A study is reported on the topic which is a continuation and significant extension of the previous work published and presented in the proceedings of Pakistan Engineering Congress (1 , 2). The data is based on actual maximum yearly flows at almost all important discharge measuring sites of Pakistani rivers. At the end normalized flood frequency curves based on Pearsons type 111 distribution have been plotted on the log- probability paper in terms of normalized discharges, percentage exceedance of previous yearly maxima and corresponding return periods.The results have also been compared by graphical method and Gumbles distribution approach. Picking up an arbitrary constant flood level of 200,000 cusecs, the corresponding probability of future occurrence of this magnitude of flood is repoited alongwith the necessary supporting hydraulic data plotted again on probability paper. The results of analysis are very interesting and may be used to determine the probability of occurrence of any given magnitude of flood at the desired discharge measuring sites and also to judge the adequacy of maximum design discharges used for the existing hydraulic structures considering return periods alongwith their useful service life from structural and hydraulic considerations.

2. ANALYTICAL METHOD OF FLOOD FREQUENCY ANALYSIS.

The phenomena of floods is common in Pakistan. In order to get a better probabilistic idea of the problem based on theory of probability, present investigation has been undertaken. Fig 1. presents the location of barrages on various rivers while table 1. gives the details of characteristics of Pakistani rivers.Gaussian or normal distribution is one of the most commonly used probability distribution which is closely approximated by most of the natural phenomena. This distribution is completely specified by the two parameters,viz,population mean and population variance in general. Usually the size of sample in hydrological records is not infinite as assumed therefore usually an assumption is made that the sample mean is equal to population mean and the sample standard deviation is equal to that of population standard deviation. Generally stream flow data does not seem to be adequately described by the normal distribution because the lower bound on stream flow is zero rather than minus infinity. However if logarithms of stream flows are used in the analysis, the resulting data conforms to known characteristics of normal distribution as when stream flow approaches zero its logarithm approaches minus infinity (3). The method of frequency curve computations has already been explained in detail in an earlier investigation (1) ,however,a brief mathematical formulation is given below. Analytical method of frequency curve computation is almost exclusively limited to maximum annual stream flows as it gives more reliable results than those predicted by graphical methods (3,4).Logarithmic Pearsons type 111 distribution requires three parameters in general for the complete specification of the hydrologic problem mathematically.These parameters include sample mean $\overline{X}$, sample variance $S^2$and skew coefficient g. If g is taken as zero, for less than 100 events, this distribution becomes a two parameter normal distribution. The three parameters mentioned above are calculated by the following equations.

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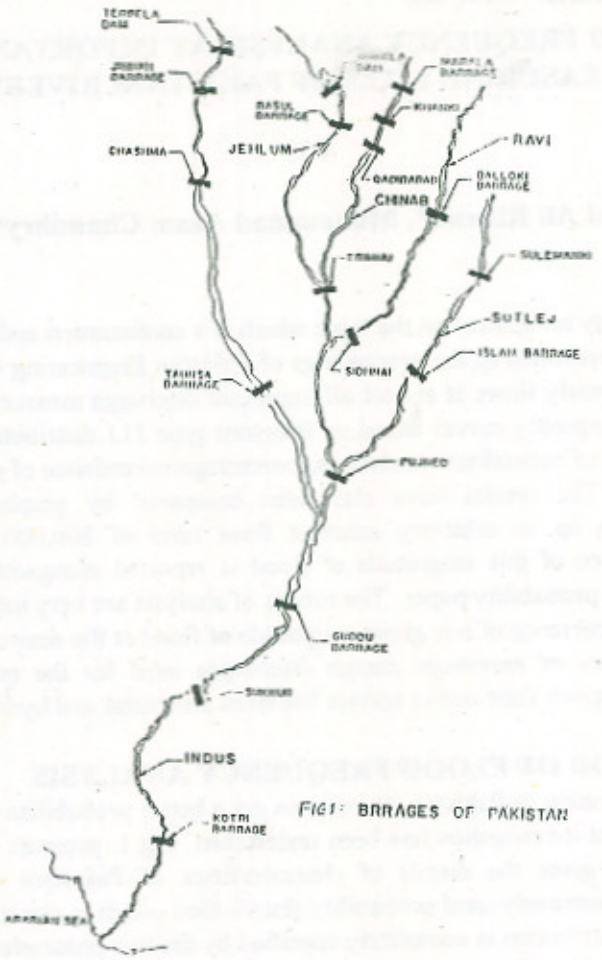


FIG: BRRAGES OF PAKISTAN

$$\bar{X} = \frac{\sum X}{N} \qquad [1]$$

$$S^2 = \frac{\sum x^2}{N-1} = \frac{\sum X^2 - (\sum X)^2 / N}{N-1} \qquad [2]$$

$$g = \frac{N(\sum x^3)}{(N-1)(N-2)S^3} = \frac{N^2 - (\sum X^3) - 3N(\sum X)(\sum X^2) + 2(\sum X)^3}{(N)(N-1)(N-2)S^3} \qquad [3]$$

Where

X = Logarithm of maximum annual flow.

$\bar{X}$ = Mean of logarithm of maximum annual floods.

x = $X - \bar{X}$, the deviation of a single maximum flood from the mean flood.

N = No. of years of record.

S^2 = Unadjusted variance.

g = Unadjusted skew coefficient.

S = Standard deviation.

Table-1: DETAILS OF MAJOR CHARACTERISTICS OF RIVERS

River	Length Km	Catchment Area (Sq.Km)	Number Of Dams / Barrages		Peak Year	Flood Discharge Cusecs x 1000
Indus upto Guddu	2400	960000	1	3	1992	1087
Chenab	1240	66760	0	5	1957	1100
Jhelum	820	62720	1	1	1929	1100
Ravi	890	39680	0	2	1955	680
Sutlej	1540	120600	0	2	1955	597

The square root of variance is standard deviation S representing the slope of the curve and skew coefficient g represents the degree of curvature of the curve.

Frequently first two parameters i.e. mean and variance are required for fitting cumulative frequency curves. Computation of unadjusted frequency curve is accomplished by computing the logarithms of stream flows corresponding to the selected points (exceeding frequency) on frequency scale. The points ordinarily selected are shown as column headings in table 2. The number of points needed to define a curve depends upon degree of curvature i.e. skew. For skew values near zero fewer points are needed while for skew values near one, all points shown in table 2 should be used. The selected exceedance frequency points are labeled as P_∞ where the subscript indicating indefinite sample size. Since sample size is usually finite in hydrological studies, an adjustment of exceedance frequency P_∞ is necessary before plotting the frequency curves by using table 3. The logarithm of event magnitudes corresponding to each of selected P_∞ points are computed from the following equation.

Table-2: Pearson Type III Coordinates

Skew Coeffi-cient	k = Magnitude in standard deviation from mean for excedence percentages of:												
	0.01	0.1	1.0	5	10	30	50	70	90	95	99	99.9	99.99
1.0	5.92	4.54	3.03	1.87	1.34	0.38	-0.16	-0.61	-1.12	-1.31	-1.59	-1.80	-1.88
0.8	5.48	4.25	2.90	1.83	1.34	0.42	-0.13	-0.60	-1.16	-1.38	-1.74	-2.03	-2.18
0.6	5.04	3.96	2.77	1.79	1.33	0.45	-0.09	-0.58	-1.19	-1.45	-1.88	-2.28	-2.53
0.4	4.60	3.67	2.62	1.74	1.32	0.48	-0.06	-0.57	-1.22	-1.51	-2.03	-2.54	-2.92
0.2	4.16	3.38	2.48	1.69	1.30	0.51	-0.03	-0.55	-1.25	-1.58	-2.18	-2.81	-3.32
0.0	3.73	3.09	2.33	1.64	1.28	0.52	0.00	-0.52	-1.28	-1.64	-2.33	-3.09	-3.73
-0.2	3.32	2.82	2.18	1.58	1.25	0.55	0.03	-0.51	-1.30	-1.69	-2.48	-3.38	-4.16
-0.4	2.92	2.54	2.03	1.51	1.22	0.57	0.06	-0.48	-1.32	-1.74	-2.62	-3.67	-4.6
-0.6	2.53	2.28	1.88	1.45	1.19	0.58	0.09	-0.45	-1.33	-1.79	-2.77	-3.96	-5.04
-0.8	2.16	2.03	1.74	1.38	1.16	0.60	0.13	-0.42	-1.34	-1.83	-2.90	-4.25	-5.48
-1.0	1.88	1.80	1.59	1.31	1.12	0.61	0.16	-0.38	-1.34	-1.87	-3.03	-4.54	-5.92
Skew Coefficients Commonly Used													
0.00	3.73	3.09	2.33	1.64	1.28	0.52	0.00	-0.52	-1.28	-1.64	-2.33	-3.09	-3.73
-0.04	3.65	3.03	2.30	1.63	1.27	0.53	0.01	-0.52	-1.28	-1.65	-2.36	-3.15	-3.82
-0.12	3.48	2.92	2.24	1.60	1.26	0.54	0.02	-0.51	-1.29	-1.67	-2.42	-3.26	-3.99
-0.23	3.26	2.77	2.16	1.57	1.25	0.55	0.03	-0.50	-1.30	-1.70	-2.50	-3.42	-4.23
-0.32	3.08	2.68	2.09	1.54	1.23	0.56	0.05	-0.49	-1.31	-1.72	-2.56	-3.55	-4.42
-0.37	2.98	2.58	2.05	1.52	1.22	0.57	0.06	-0.48	-1.32	-1.73	-2.60	-3.63	-4.53
-0.40	2.92	2.54	2.03	1.51	1.22	0.57	0.06	-0.48	-1.32	-1.74	-2.62	-3.67	-4.60

Note: Approximate transformation between normal deviate (X) and Pearson Type III deviate k can be accomplished with the following equation:

$$k = 2/g\{\{g/6(x - g/6) + 1\}^3 - 1\}$$

Table -3: P_N Versus P_∞ in Percent
For use with samples drawn from a normal population

N-1 \ P_∞	50.0	30.0	10.0	5.0	1.0	0.1	0.01
1	50.0	37.2	24.3	20.4	15.40	12.1	10.200
2	50.0	34.7	19.3	14.6	9.00	5.7	4.300
3	50.0	33.6	16.9	11.9	6.40	3.5	2.300
4	50.0	33.0	15.4	10.4	5.00	2.4	1.370
5	50.0	32.5	14.6	9.4	4.20	1.79	0.920
6	50.0	32.2	13.8	8.8	3.60	1.38	0.660
7	50.0	31.9	13.5	8.3	3.20	1.13	0.500
8	50.0	31.7	13.1	7.9	2.90	0.94	0.390
9	50.0	31.6	12.7	7.6	2.70	0.82	0.310
10	50.0	31.5	12.5	7.3	2.50	0.72	0.250
11	50.0	31.4	12.3	7.1	2.30	0.64	0.210
12	50.0	31.3	12.1	6.9	2.20	0.58	0.180
13	50.0	31.2	11.9	6.8	2.10	0.52	0.160
14	50.0	31.1	11.8	6.7	2.00	0.48	0.140
15	50.0	31.1	11.7	6.6	1.96	0.45	0.130
16	50.0	31.0	11.6	6.5	1.90	0.42	0.120
17	50.0	31.0	11.5	6.4	1.84	0.40	0.110
18	50.0	30.9	11.4	6.3	1.79	0.38	0.100
19	50.0	30.9	11.3	6.2	1.74	0.36	0.091
20	50.0	30.8	11.3	6.2	1.70	0.34	0.084
21	50.0	30.8	11.2	6.1	1.67	0.33	0.078
22	50.0	30.7	11.1	6.1	1.63	0.31	0.073
23	50.0	30.7	11.1	6.0	1.61	0.30	0.068
24	50.0	30.7	11.0	6.0	1.58	0.29	0.064
25	50.0	30.7	11.0	5.9	1.55	0.28	0.060
26	50.0	30.6	10.9	5.9	1.53	0.278	0.057
27	50.0	30.6	10.9	5.9	1.51	0.26	0.054
28	50.0	30.6	10.9	5.8	1.49	0.26	0.051
29	50.0	30.6	10.8	5.8	1.47	0.25	0.049
30	50.0	30.5	10.8	5.8	1.45	0.24	0.046
40	50.0	30.4	10.6	5.6	1.33	0.20	0.034
60	50.0	30.3	10.4	5.4	1.22	0.16	0.025
120	50.0	30.2	10.2	5.2	1.11	0.13	0.017
∞	50.0	30.0	10.0	5.0	1.00	0.10	0.010

Note: P_N values above are usable approximately with Pearson Type III distributions having small skew coefficients.

$$\text{Log } Q @ P\alpha = X = K @ P\alpha \, S \qquad [4]$$

Where;

$P\alpha$ = Selected exceedance frequency points for an infinite sample size.

Log Q @ $P\alpha$ = The logarithm of flow corresponding to a specified value of $P\alpha$.

K @ P∝ =The deviation from mean ((X - $\bar{X}$)/ S) of the event with an exceedance frequency of P∝. k values are obtained from table 2. for each value of P∝ required to define a curve.

Equation 4 is solved by using computed values of $\bar{X}$ and S and obtaining k values from table 2 corresponding to assumed or computed skew g and to the selected point P∝.An adjustment is then made to account for the actual sample size by modifying the P∝ exceeding frequency values to an expected probability value Pn. This adjustment is carried out by substituting Pn Values from table 3 instead of P∝ before plotting frequency curves. For samples having less than 100 events, skew g is often assumed to be zero. The skew ness of annual flood peaks is affected by physical geographic features. * In Pearsons type 111 distribution, negative skew indicates wide flood plain or a sizeable area in form of ponds (4), whereas a positive skew coefficient indicates that peaks from two or more tributaries may arrive at the concerned discharge measuring site at the same time *.

3,COMPUTATION AND PLOTTING OF THE FREQUENCY CURVES

The following steps are taken to plot the probability curves.

1. For selected values of P∝, tabulate k values obtained from table 1 corresponding to adopted skew coefficient (Zero for less than 100 events).
2. Multiply each of these by standard deviation and add each product in turn to the mean logarithm according to equation 4.
3. Tabulate Pn values from table 3 corresponding to the selected P∝ values and the value of N-1 where N is the number of years of record.
4. Plot antilogarithms of each of the sums obtained in step 2 above against corresponding Pn values obtained in step 3.
5. The normalized discharge is defined as the ratio of maximum yearly discharge to the average discharge corresponding to the years of record. On the probability paper ,originally designed by the Codex company of U.S.A, the normalized discharge has been plotted as ordinate and the other plotting procedures remain the same as was done in an earlier investigation (1).On one graph all the curves corresponding to important discharge measuring sites of a particular river have been plotted.

4. GUMBLE DISTRIBUTION FOR FLOOD FREQUENCY ANALYSIS.

A side investigation at some sites have also been carried out by using Gumbles Distribution utilizing the probability weighted moment method for paramertric evaluation of α and μ and the results are presented in table 6.However it must be kept in mind that every distribution is based on certain assumptions and therefore if a comparison is desired between results of any two distributions, their assumptions must be kept in mind before the interpretation of results.

5. RESULTS OF ANALYSIS

The results of the probability analysis have been presented in form of probability curves and tables 4 and 5.The normalized curves given as figs. 2 to 5 correspond to rivers Chenab, Indus,Jehlum and Ravi respectively. The remaining single curves, given for the purpose of reading the hydraulic data presented in form of tables in (1), have been labeled as figs. 6 to 9 also correspond to above mentioned sequence of rivers.A good agreement between the observed and the fitted curves pertaining to Pearsons type 111 distribution and Gumbles Distribution exists due mainly to the availability of a lot of data points in that range. However, a scatter exists at higher flood levels due to availability of lesser number of points.

TABLE- 4 : Results Of Analysis

River / Sites	Year of record	Mean flood cfs	CV Graphical	Analytical Computed Values of S	g	%Pn for Previous Maxima	Exceeding Chance of Average flood %
Ravi / Balloki	65	82536.6	0.6615	0.251	0.4619	0.16	39
Ravi / Shahdra	70	95457.1	0.945	0.263	1.1593	0 16	37
Ravi / Sadhani	71	59299	0.765	0.323	-0.783	0.16	32
Indus / Kotri	69	4541138	0.6519	0.181	-0.717	0.15	87.5
Indus / Guddu	28	684357	0.6713	0.18	0.0567	1.51	41
Indus / Sukkur	70	629134	0.3467	0.15	-0.130	0.155	43
Indus / Kalabagh	65	488015	0.2944	0.104	0.2966	1 21	59
Indus / Taunsa	37	461437	0.23	0.097	0.1769	0 2	43
Chenab / Punjnad	71	328554	0.4973	0.201	0.0794	1.202	44
Alexendra Bridge	60	264395	0.708	0.245	0.6543	1.14	39
Chenab / Trimmu	54	323746	0.5487	0.497	-4.959	1.20	39
Chenab / Khanki	71	344818	0.7099	0.253	0.5506	0.15	49
Chenab / Marala	68	278608	0.5571	0.256	0.5254	0.15	11
Chenab / Shershah	63	293588	0.547	0.21	0.6512	1 2	34
Jhelum / Mangala	71	212177	0.987	0.265	1.28	4	32
Jhelum / Rasul	71	242098	0.934	0.326	0.43		32

Table 5 : Results of Analytical Flood Frequency Computations

RIVER / LOCATIONS	g	S^2	For a given Discharge of 20,000 cusecs	
			Return period,yrs	%age of exceedance
Ravi at, Shahdara	1.1593	0.069	16	7
Ravi at, Sidhnai	-0.783	0.104	10	9
Ravi at, Balloki	0.4619	0.0628	12	9
Jhelum at,Mangla	1.28	0.07	14	7
Jhelum at,Rasool	0.4396	0.106	15	8
Indus at, Kotri	-0.717	0.0328	30	3
Indus at, Kalabagh	0.2966	0.0107	67	1.5
Indus at, Taunsa	0.177	0.00947	100	3
Indus at, Sukhar	-0.13	0.02247	20	3
Chenab at, Trimmu	-4.95	0.055	10	10
Chenab at, Marala	0.5254	0.0657	8	12
Chenabat,Pangnad	0.0794	0.0404	20	5

Table 6: Prediction of Selected High Floods by Gumbles Distribution

	River / Site	Return Period years
	Chenab / Khanki	200
Jhelum / Rasool	800	81
Indus / Sukhar	1200	58
Sutlej / Islam Head	400	130
Ravi / Balloki	200	40

6.CONCLUSIONS

1.The probability curves and the parameters calculated in the tables are very useful in understanding the behavior of rivers in terms of their flood producing characteristics on the basis of laws of probability.Many things including the flood producing characteristics of a river at any of the analyzed discharge measuring site may be known in terms of average flood, calculated skew coefficient, standard deviation, return periods and probability of occurrence/exceedance of previous maxima of any magnitude of flood at any site which of course is a very useful and interesting.

2. The flood peaks in the fitted lines may deviate from the observed ones at higher flood levels due to breaching effects.

3.The probability curves of discharge measuring sites of a particular river containing some reservoirs etc. should be drawn both for pre-reservoir and post reservoir conditions.

7. ACKNOWLEDGMENTS.

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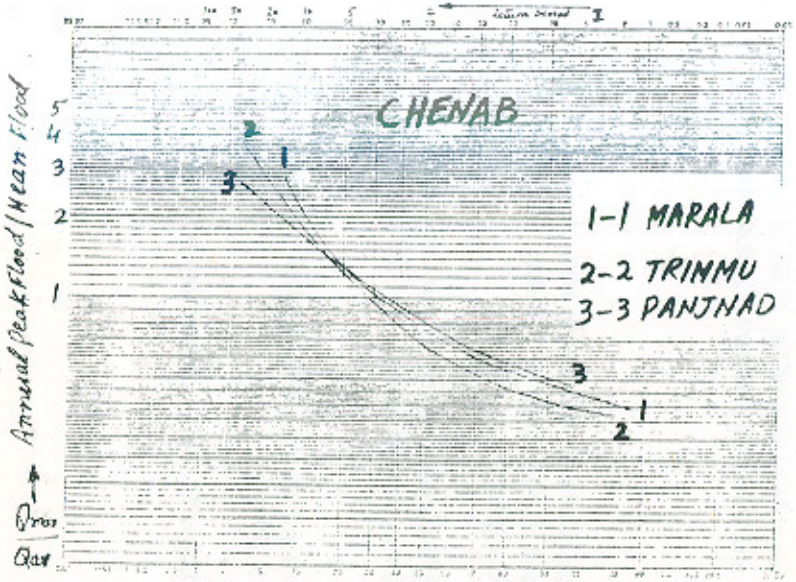


FIG.2 — P → % age of probable future years wherein previous maxima is likely to be exceeded.

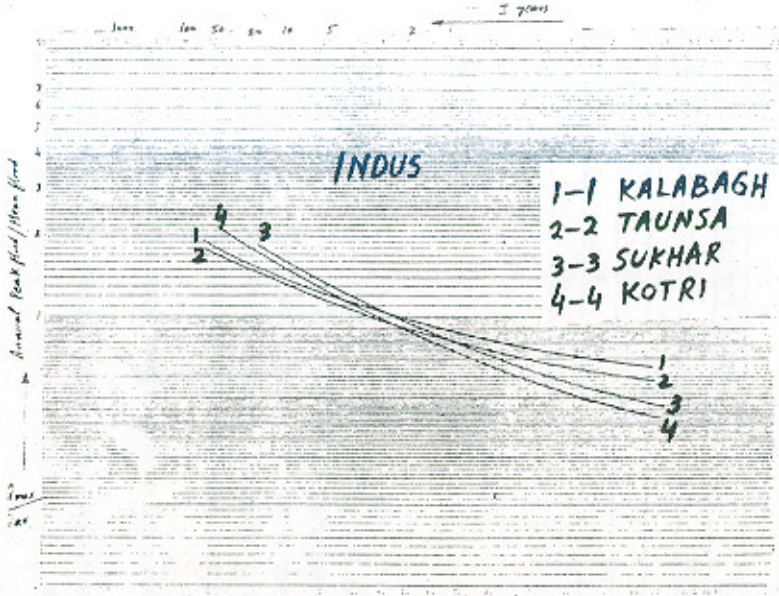


FIG.3 — P → % age of probable future years wherein previous maxima is likely to be exceeded

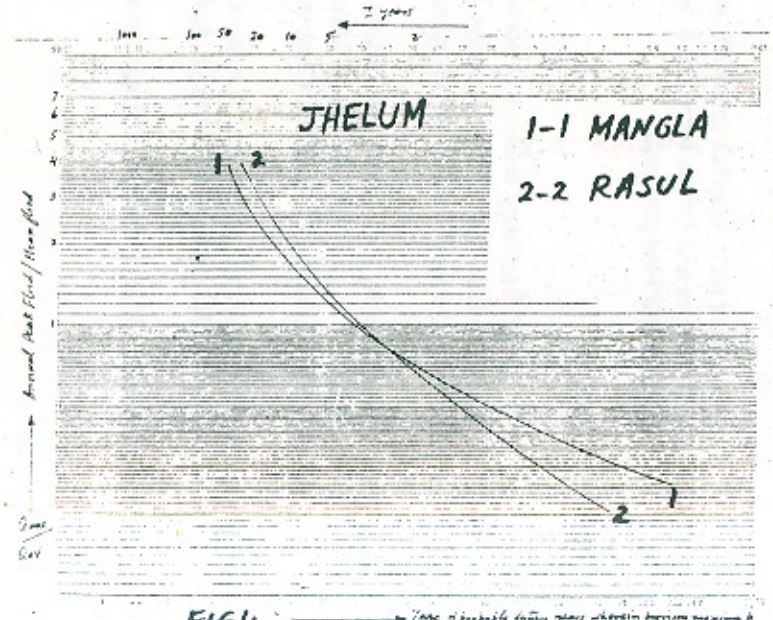


FIG4 — P → % age of probable future years wherein previous maxima is likely to be exceeded.

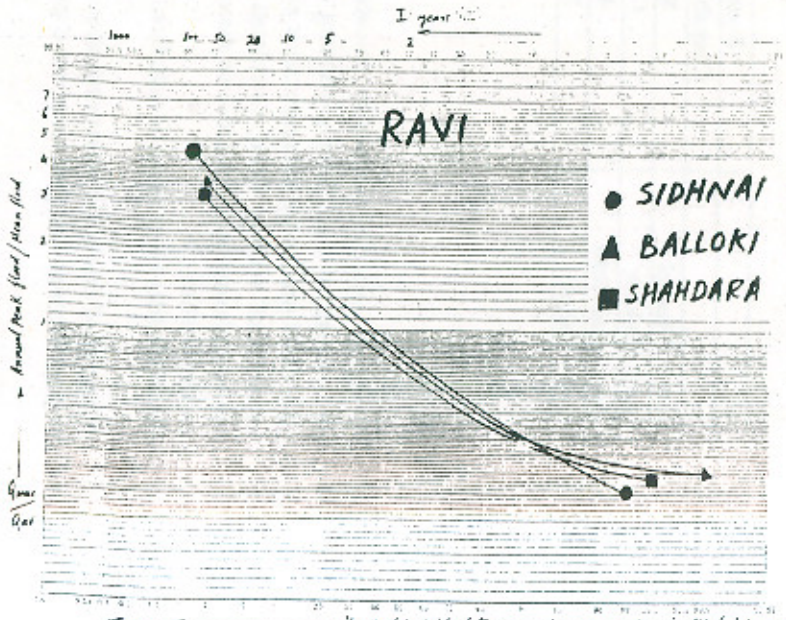
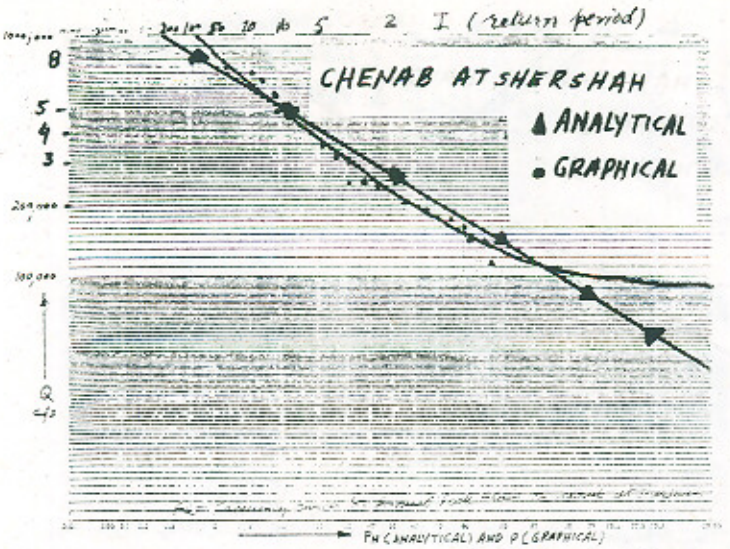


FIG.5 — P → % age of probable future years previous maxima is likely to be exceeded



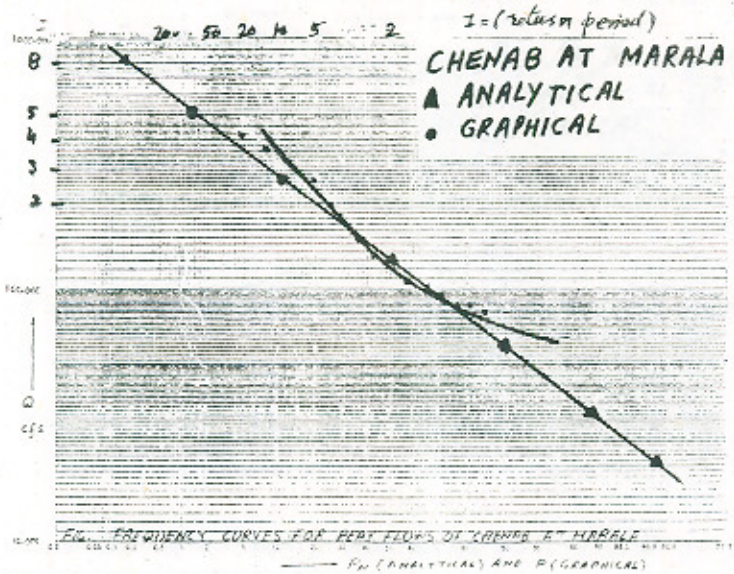


FIG. FREQUENCY CURVES FOR PEAK FLOWS OF CHENAB AT MARALA

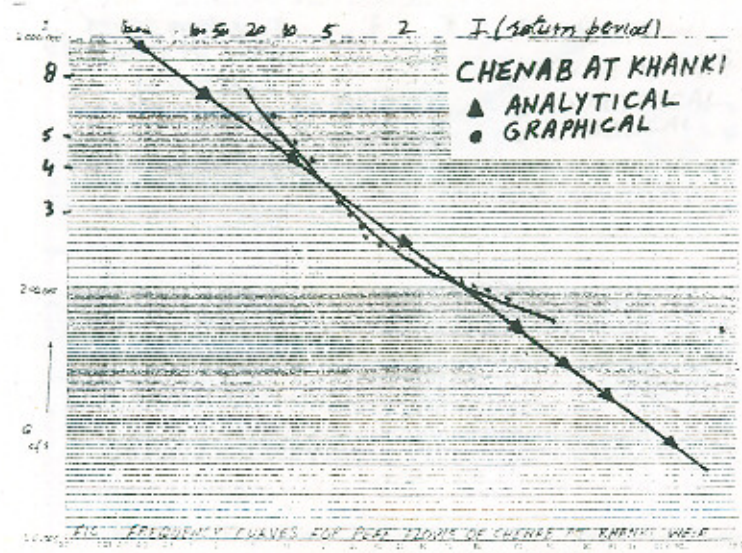


FIG. FREQUENCY CURVES FOR PEAK FLOWS OF CHENAB AT KHANKI WEIR

FIG 6. ..COND

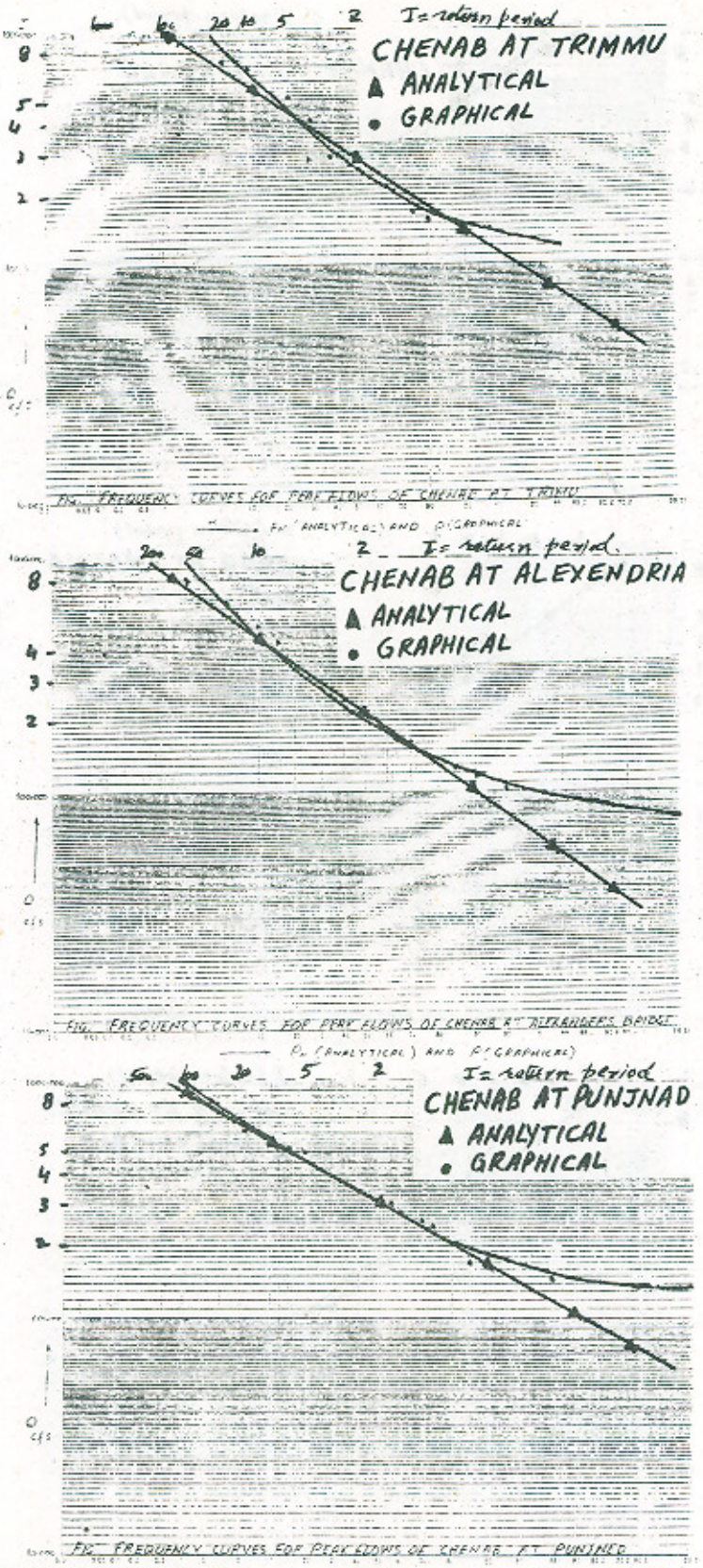


FIG 6 ANALYTICAL/GRAPHICAL FLOOD FREQUENCY CURVES.

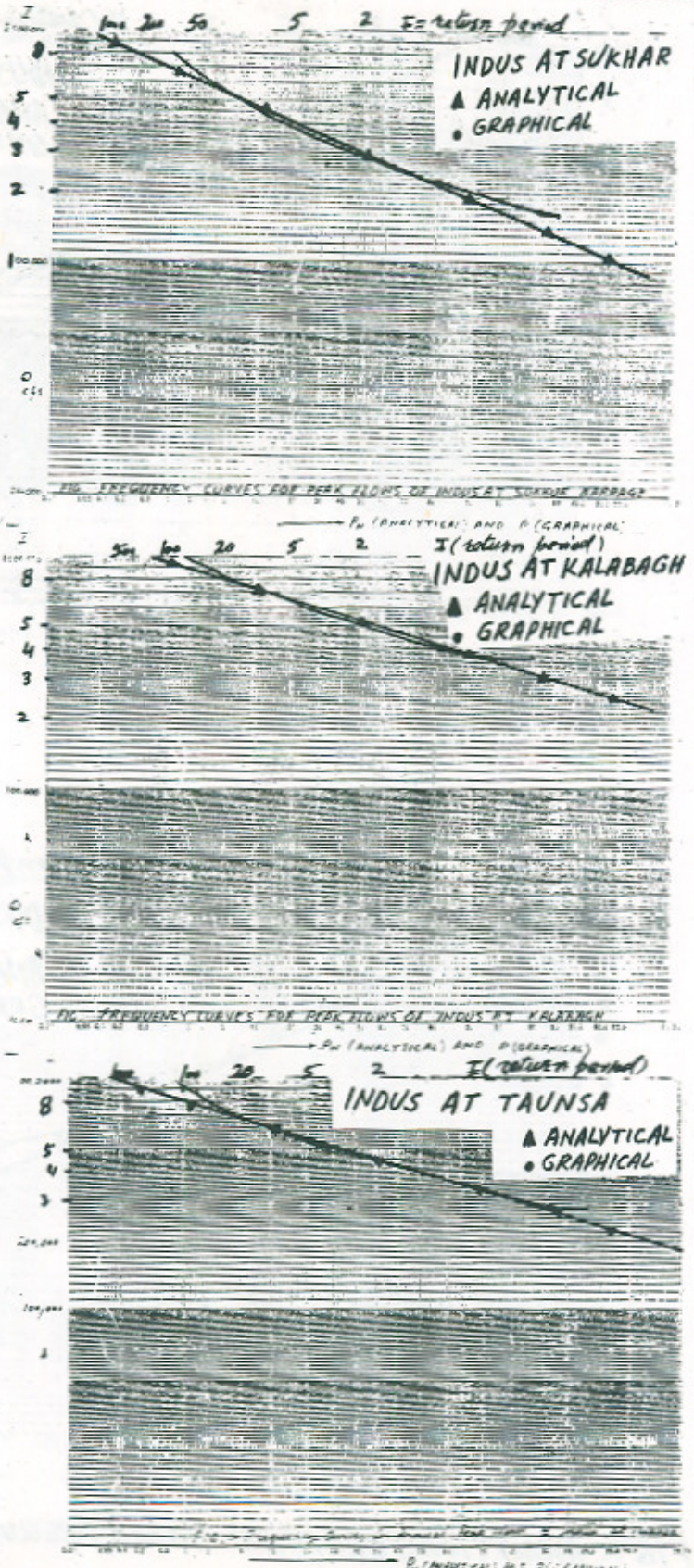
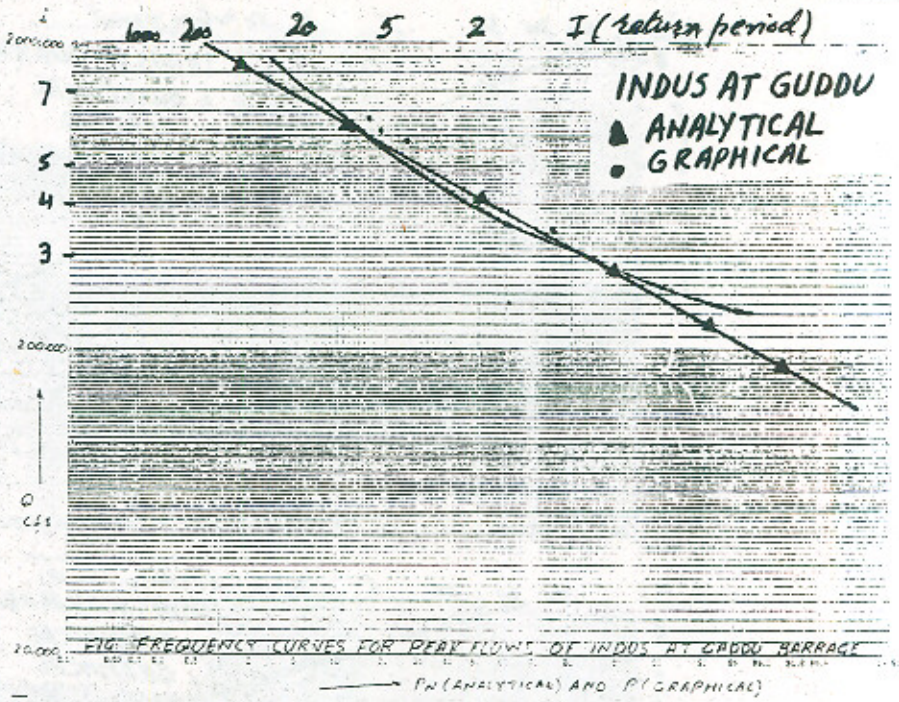

INDUS AT SUKHAR
▲ ANALYTICAL
• GRAPHICAL
INDUS AT KALABAGH
▲ ANALYTICAL
• GRAPHICAL
INDUS AT TAUNSA
▲ ANALYTICAL
• GRAPHICAL

FIG7 ... COND



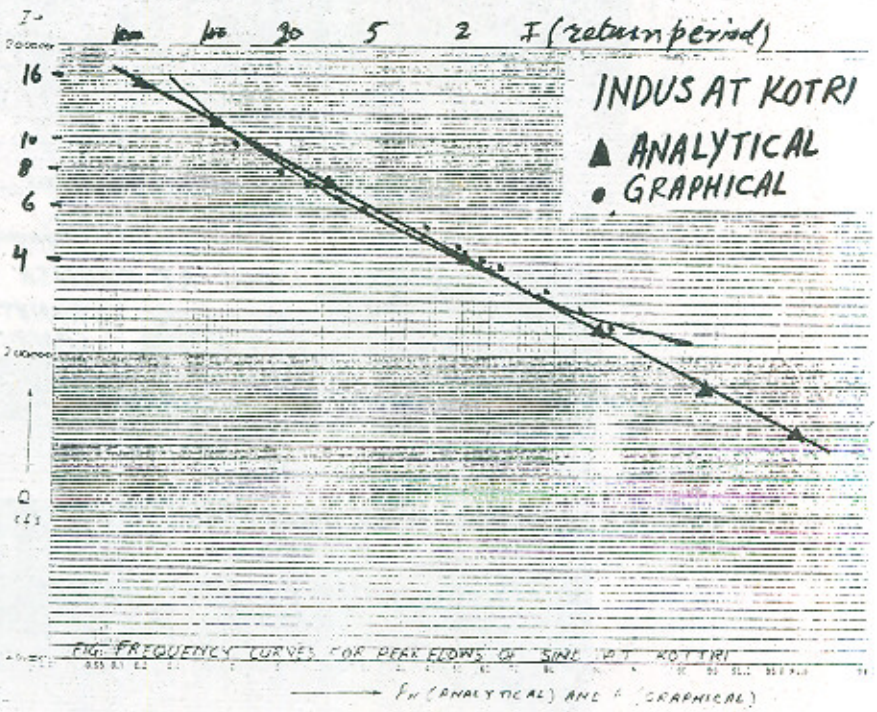
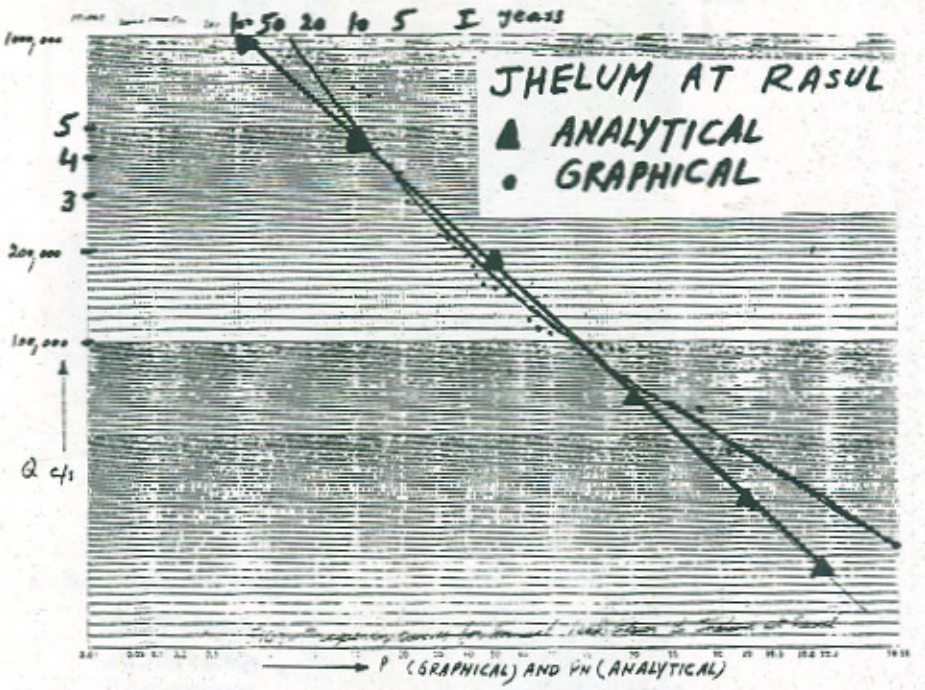


FIG 7. ANALYTICAL/GRAPHICAL FLOOD FREQUENCY CURVES



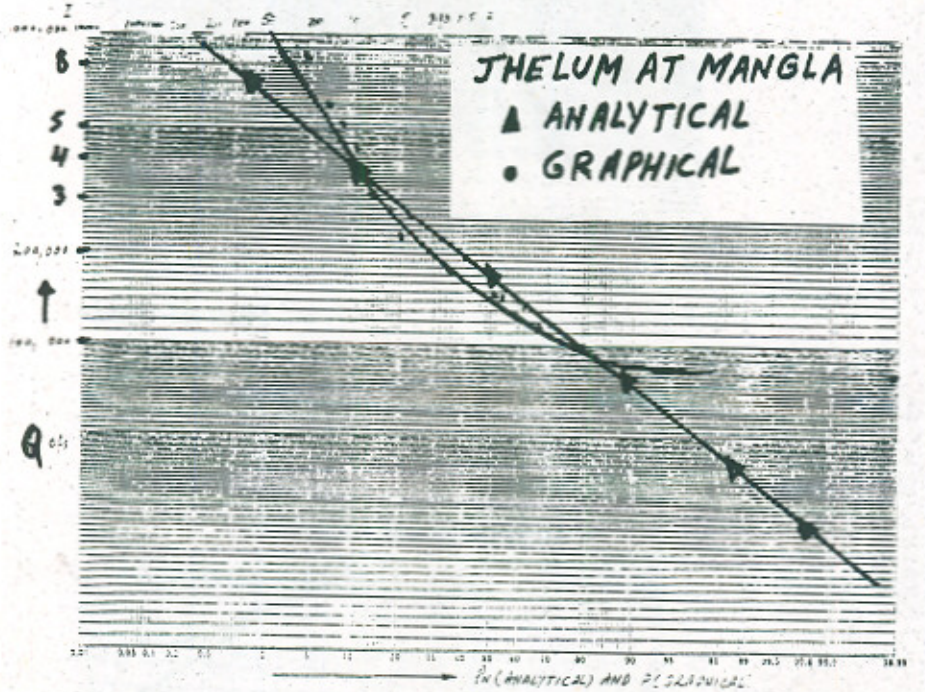


FIG.8 ANALYTICAL AND GRAPHICAL FLOOD PROBABILITY CURVES

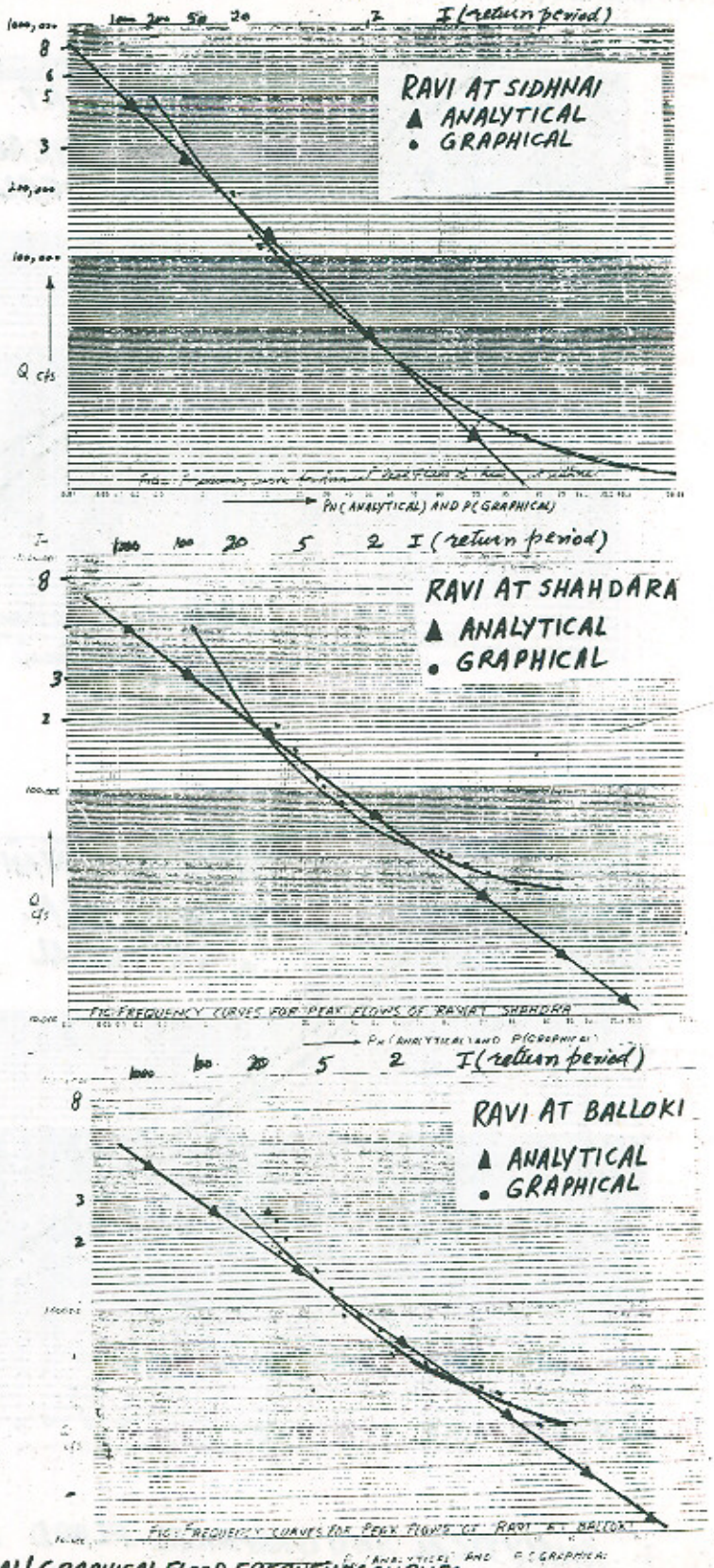


FIG. 9. ANALYTICAL/ GRAPHICAL FLOOD FREQUENCY CURVES

Table 6: Prediction of Selected High Floods by Gumbles Distribution

River / Site	Flood Level x 1000 cfs	Return Period years
Chenab / Khanki	1100	200
Jhelum / Rasool	800	81
Indus / Sukhar	1200	58
Sutlej / Islam Head	400	130
Ravi / Balloki	200	40

6.CONCLUSIONS

1.The probability curves and the parameters calculated in the tables are very useful in understanding the behavior of rivers in terms of their flood producing characteristics on the basis of laws of probability.Many things including the flood producing characteristics of a river at any of the analyzed discharge measuring site may be known in terms of average flood, calculated skew coefficient, standard deviation, return periods and probability of occurrence/exceedance of previous maxima of any magnitude of flood at any site which of course is a very useful and interesting.

2. The flood peaks in the fitted lines may deviate from the observed ones at higher flood levels due to breaching effects.

3.The probability curves of discharge measuring sites of a particular river containing some reservoirs etc. should be drawn both for pre-reservoir and post reservoir conditions.

7. ACKNOWLEDGMENTS.

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APPENDIX

HYDRAULIC DATA AND GRAPHICAL FLOOD FREQUENCY COMPUTATIONS

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY OF

RAVI AT SIDHNAI BARRAGE

YEARS	YEARLY PEAK FLOW Q (CFS)	Q IN ASCENDING ORDER	NO OF TIME PEAK WAS EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY f	COL 3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 'V'
1922	43007.58	11899.47	71	100.00	1.00	0.201	-0.799	0.639
1923	55683.87	12287.88	70	98.59	1.01	0.207	-0.793	0.629
1924	35980.89	17407.83	69	97.18	1.03	0.294	-0.706	0.499
1925	65182.26	18996.78	68	95.77	1.04	0.320	-0.680	0.462
1926	45903	18996.78	67	94.37	1.06	0.320	-0.680	0.462
1927	33297.33	19597.05	66	92.96	1.08	0.330	-0.670	0.448
1928	38381.97	21609.72	65	91.55	1.09	0.364	-0.636	0.404
1929	31884.93	22104.06	64	90.14	1.11	0.373	-0.627	0.393
1930	31496.52	22492.47	63	88.73	1.13	0.379	-0.621	0.385
1931	43078.2	25882.23	62	87.32	1.15	0.436	-0.564	0.318
1932	35486.55	25988.16	61	85.92	1.16	0.438	-0.562	0.316
1933	47986.29	26200.02	60	84.51	1.18	0.442	-0.558	0.312
1934	28212.69	27294.63	59	83.10	1.20	0.460	-0.540	0.291
1935	38699.76	27506.49	58	81.69	1.22	0.464	-0.536	0.287
1936	48586.56	28212.69	57	80.28	1.25	0.476	-0.524	0.275
1937	26200.02	29413.23	56	78.87	1.27	0.496	-0.504	0.254
1938	22492.47	30084.12	55	77.46	1.29	0.507	-0.493	0.243
1939	17407.83	30084.12	54	76.06	1.31	0.507	-0.493	0.243
1940	18996.78	30295.98	53	74.65	1.34	0.511	-0.489	0.239
1941	18996.78	31496.52	52	73.24	1.37	0.531	-0.469	0.220
1942	62180.91	31884.93	51	71.83	1.39	0.538	-0.462	0.214
1943	51905.7	32308.65	50	70.42	1.42	0.545	-0.455	0.207
1944	27294.63	33297.33	49	69.01	1.45	0.562	-0.438	0.192
1945	32308.65	33509.19	48	67.61	1.48	0.565	-0.435	0.189
1946	33509.19	33685.74	47	66.20	1.51	0.568	-0.432	0.187
1947	58579.29	35486.55	46	64.79	1.54	0.598	-0.402	0.161
1948	69207.6	35980.89	45	63.38	1.58	0.607	-0.393	0.155
1949	46185.48	37499.22	44	61.97	1.61	0.632	-0.368	0.135
1950	85909.23	38381.97	43	60.56	1.65	0.647	-0.353	0.124
1951	33685.74	38699.76	42	59.15	1.69	0.653	-0.347	0.121
1952	51587.91	38805.69	41	57.75	1.73	0.654	-0.346	0.119
1953	73303.56	41383.32	40	56.34	1.78	0.698	-0.302	0.091
1954	91276.35	41595.18	39	54.93	1.82	0.701	-0.299	0.089
1955	109990.65	43007.58	38	53.52	1.87	0.725	-0.275	0.075
1956	67583.34	43078.2	37	52.11	1.92	0.726	-0.274	0.075
1957	112462.35	45903	36	50.70	1.97	0.774	-0.226	0.051
1958	100986.6	46185.48	35	49.30	2.03	0.779	-0.221	0.049
1959	104976.63	46997.61	34	47.89	2.09	0.793	-0.207	0.043
1960	25882.23	47986.29	33	46.48	2.15	0.809	-0.191	0.036
1961	86156.4	48586.56	32	45.07	2.22	0.819	-0.181	0.033
1962	100986.6	50210.82	31	43.66	2.29	0.847	-0.153	0.023
1963	30084.12	51587.91	30	42.25	2.37	0.870	-0.130	0.017
1964	76198.98	51905.7	29	40.85	2.45	0.875	-0.125	0.016
1965	21609.72	55683.87	28	39.44	2.54	0.939	-0.061	0.004
1966	75704.64	58579.29	27	38.03	2.63	0.988	-0.012	0.000
1967	29413.23	61898.43	26	36.62	2.73	1.044	0.044	0.002
1968	46997.61	62180.91	25	35.21	2.84	1.049	0.049	0.002
1969	19597.05	63805.17	24	33.80	2.96	1.076	0.076	0.006
1970	38805.69	65005.71	23	32.39	3.09	1.096	0.096	0.009
1971	63805.17	65182.26	22	30.99	3.23	1.099	0.099	0.010
1972	22104.06	67583.34	21	29.58	3.38	1.140	0.140	0.020
1973	180010.38	69207.6	20	28.17	3.55	1.167	0.167	0.028
1974	30295.98	73303.56	19	26.76	3.74	1.236	0.236	0.056
1975	121996.05	75492.78	18	25.35	3.94	1.273	0.273	0.075
1976	197983.17	75704.64	17	23.94	4.18	1.277	0.277	0.077
1977	61898.43	76198.98	16	22.54	4.44	1.285	0.285	0.081
1978	75492.78	77081.73	15	21.13	4.73	1.300	0.300	0.090
1979	12287.88	85909.23	14	19.72	5.07	1.449	0.449	0.201
1980	77081.73	86156.4	13	18.31	5.46	1.453	0.453	0.205
1981	195970.5	91276.35	12	16.90	5.92	1.539	0.539	0.291
1982	37499.22	93889.29	11	15.49	6.45	1.583	0.583	0.340
1983	25988.16	100986.6	10	14.08	7.10	1.703	0.703	0.494
1984	27506.49	100986.6	9	12.68	7.89	1.703	0.703	0.494
1985	41595.18	104976.63	8	11.27	8.88	1.770	0.770	0.593
1986	41383.32	109990.65	7	9.86	10.14	1.855	0.855	0.731
1987	11899.47	112462.35	6	8.45	11.83	1.897	0.897	0.804
1988	254973.51	121996.05	5	7.04	14.20	2.057	1.057	1.118
1989	65005.71	180010.38	4	5.63	17.75	3.036	2.036	4.144
1990	50210.82	195970.5	3	4.23	23.67	3.305	2.305	5.312
1991	30084.12	197983.17	2	2.82	35.50	3.339	2.339	5.469
1992	93889.29	254973.51	1	1.41	71.00	4.300	3.300	10.888

SUM =	4210293.8			SUM =	41.26
		N =	71	CV =	0.77
	MEAN FLOOD =		59299.91		

CALCULATIONS FOR PROBABILITY PLOTTINGS OF PEAK FLOOD DISCHARGE OF

RAVI AT BALLOKI

S.NO	YEARS	PEAK YEARLY FLOW (CFS)	Q IN ACENDING ORDER	NO OF TIMES PEAK EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY T	COL 3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 V
1	1922	44400	20000	65	100.00	1.00	0.242	-0.758	0.574
2	1923	57400	28000	64	98.46	1.02	0.339	-0.661	0.437
3	1924	56000	29000	63	96.92	1.03	0.351	-0.649	0.421
4	1925	91000	30000	62	95.38	1.05	0.363	-0.637	0.405
5	1926	59500	35000	61	93.85	1.07	0.424	-0.576	0.332
6	1927	42500	36000	60	92.31	1.08	0.436	-0.564	0.318
7	1928	61400	37000	59	90.77	1.10	0.448	-0.552	0.304
8	1929	41500	39000	58	89.23	1.12	0.473	-0.527	0.278
9	1930	44680	41000	57	87.69	1.14	0.497	-0.503	0.253
10	1931	48000	41000	56	86.15	1.16	0.497	-0.503	0.253
11	1932	42000	41500	55	84.62	1.18	0.503	-0.497	0.247
12	1933	54000	42000	54	83.08	1.20	0.509	-0.491	0.241
13	1934	36000	42500	53	81.54	1.23	0.515	-0.485	0.235
14	1935	45000	43000	52	80.00	1.25	0.521	-0.479	0.229
15	1936	97000	44400	51	78.46	1.27	0.538	-0.462	0.213
16	1937	41000	44680	50	76.92	1.30	0.541	-0.459	0.210
17	1938	29000	45000	49	75.38	1.33	0.545	-0.455	0.207
18	1939	28000	46000	48	73.85	1.35	0.557	-0.443	0.196
19	1940	52000	48000	47	72.31	1.38	0.582	-0.418	0.175
20	1941	30000	49000	46	70.77	1.41	0.594	-0.406	0.165
21	1942	133000	51000	45	69.23	1.44	0.618	-0.382	0.146
22	1943	71000	51000	44	67.69	1.48	0.618	-0.382	0.146
23	1944	51000	52000	43	66.15	1.51	0.630	-0.370	0.137
24	1945	54000	53000	42	64.62	1.55	0.642	-0.358	0.128
25	1946	61000	53000	41	63.08	1.59	0.642	-0.358	0.128
26	1947	154000	54000	40	61.54	1.63	0.654	-0.346	0.120
27	1948	101000	54000	39	60.00	1.67	0.654	-0.346	0.120
28	1949	59000	54000	38	58.46	1.71	0.654	-0.346	0.120
29	1950	275000	55000	37	56.92	1.76	0.666	-0.334	0.111
30	1951	53000	56000	36	55.38	1.81	0.678	-0.322	0.103
31	1952	61000	57400	35	53.85	1.86	0.695	-0.305	0.093
32	1953	87000	59000	34	52.31	1.91	0.715	-0.285	0.081
33	1954	175000	59500	33	50.77	1.97	0.721	-0.279	0.078
34	1955	144000	61000	32	49.23	2.03	0.739	-0.261	0.068
35	1956	75000	61000	31	47.69	2.10	0.739	-0.261	0.068
36	1957	159000	61400	30	46.15	2.17	0.744	-0.256	0.066
37	1958	116000	62000	29	44.62	2.24	0.751	-0.249	0.062
38	1959	154000	71000	28	43.08	2.32	0.860	-0.140	0.020
39	1960	39000	72000	27	41.54	2.41	0.872	-0.128	0.016
40	1961	101000	75000	26	40.00	2.50	0.909	-0.091	0.008
41	1962	118000	76000	25	38.46	2.60	0.921	-0.079	0.006
42	1963	37000	79000	24	36.92	2.71	0.957	-0.043	0.002
43	1964	79000	87000	23	35.38	2.83	1.054	0.054	0.003
44	1965	49000	91000	22	33.85	2.95	1.103	0.103	0.011
45	1966	138500	91000	21	32.31	3.10	1.103	0.103	0.011
46	1967	54000	94000	20	30.77	3.25	1.139	0.139	0.019
47	1968	62000	97000	19	29.23	3.42	1.175	0.175	0.031
48	1969	35000	101000	18	27.69	3.61	1.224	0.224	0.050
49	1970	72000	101000	17	26.15	3.82	1.224	0.224	0.050
50	1971	104000	104000	16	24.62	4.06	1.260	0.260	0.068
51	1972	41000	111000	15	23.08	4.33	1.345	0.345	0.119
52	1973	244000	116000	14	21.54	4.64	1.405	0.405	0.164
53	1974	46000	118000	13	20.00	5.00	1.430	0.430	0.185
54	1975	180000	133000	12	18.46	5.42	1.611	0.611	0.374
55	1976	234000	138500	11	16.92	5.91	1.678	0.678	0.460
56	1977	111000	144000	10	15.38	6.50	1.745	0.745	0.555
57	1978	91000	154000	9	13.85	7.22	1.866	0.866	0.750
58	1979	20000	154000	8	12.31	8.13	1.866	0.866	0.750
59	1980	154000	154000	7	10.77	9.29	1.866	0.866	0.750
60	1981	94000	159000	6	9.23	10.83	1.926	0.926	0.858
61	1982	43000	175000	5	7.69	13.00	2.120	1.120	1.255
62	1983	51000	180000	4	6.15	16.25	2.181	1.181	1.394
63	1984	53000	234000	3	4.62	21.67	2.835	1.835	3.368
64	1985	76000	244000	2	3.08	32.50	2.956	1.956	3.827
65	1986	55000	275000	1	1.54	65.00	3.332	2.332	5.438
	SUM =	5364680		N	65			SUM =	28.01
				MEAN FLOOD =	82536.615			Cv =	0.66

CALCULATIONS FOR PROBABILITY PLOTTINGS OF PEAK FLOOD DISCHARGE OF

CHENAB AT KHANKI WEIR

YEARS	PEAK YEARLY FLOW Q(CFS)	Q IN ACENDING ORDER	NO OF TIMES PEAK EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY f	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 V
1922	159493	95107	71	100.00	1.00	0.276	-0.724	0.524
1923	257720	98745	70	98.59	1.01	0.286	-0.714	0.509
1924	202759	121740	69	97.18	1.03	0.353	-0.647	0.419
1925	265808	123429	68	95.77	1.04	0.358	-0.642	0.412
1926	221509	131556	67	94.37	1.06	0.382	-0.618	0.383
1927	212443	151571	66	92.96	1.08	0.440	-0.560	0.314
1928	606286	156430	65	91.55	1.09	0.454	-0.546	0.298
1929	742293	159493	64	90.14	1.11	0.463	-0.537	0.289
1930	205502	171395	63	88.73	1.13	0.497	-0.503	0.253
1931	349246	184776	62	87.32	1.15	0.536	-0.464	0.215
1932	266371	186435	61	85.92	1.16	0.541	-0.459	0.211
1933	278132	189446	60	84.51	1.18	0.549	-0.451	0.203
1934	193682	193682	59	83.10	1.20	0.562	-0.438	0.192
1935	207233	194814	58	81.69	1.22	0.565	-0.435	0.189
1936	171395	202759	57	80.28	1.25	0.588	-0.412	0.170
1937	123429	204065	56	78.87	1.27	0.592	-0.408	0.167
1938	255616	205502	55	77.46	1.29	0.596	-0.404	0.163
1939	184776	206244	54	76.06	1.31	0.598	-0.402	0.162
1940	131556	207233	53	74.65	1.34	0.601	-0.399	0.159
1941	272275	209188	52	73.24	1.37	0.607	-0.393	0.155
1942	267798	209767	51	71.83	1.39	0.608	-0.392	0.153
1943	209188	212443	50	70.42	1.42	0.616	-0.384	0.147
1944	206244	215564	49	69.01	1.45	0.625	-0.375	0.141
1945	151571	217858	48	67.61	1.48	0.632	-0.368	0.136
1946	215564	221509	47	66.20	1.51	0.642	-0.358	0.128
1947	236583	224949	46	64.79	1.54	0.652	-0.348	0.121
1948	438529	230490	45	63.38	1.58	0.668	-0.332	0.110
1949	224949	235397	44	61.97	1.61	0.683	-0.317	0.101
1950	986556	236583	43	60.56	1.65	0.686	-0.314	0.099
1951	217858	246867	42	59.15	1.69	0.716	-0.284	0.081
1952	204065	251954	41	57.75	1.73	0.731	-0.269	0.073
1953	315330	255616	40	56.34	1.78	0.741	-0.259	0.067
1954	806774	257720	39	54.93	1.82	0.747	-0.253	0.064
1955	230490	261844	38	53.52	1.87	0.759	-0.241	0.058
1956	340663	265808	37	52.11	1.92	0.771	-0.229	0.053
1957	1086405	266371	36	50.70	1.97	0.772	-0.228	0.052
1958	401692	267798	35	49.30	2.03	0.777	-0.223	0.050
1959	1021018	270015	34	47.89	2.09	0.783	-0.217	0.047
1960	709524	272275	33	46.48	2.15	0.790	-0.210	0.044
1961	353993	274357	32	45.07	2.22	0.796	-0.204	0.042
1962	326495	278132	31	43.66	2.29	0.807	-0.193	0.037
1963	186435	281723	30	42.25	2.37	0.817	-0.183	0.033
1964	376590	293293	29	40.85	2.45	0.851	-0.149	0.022
1965	95107	295362	28	39.44	2.54	0.857	-0.143	0.021
1966	631670	309068	27	38.03	2.63	0.896	-0.104	0.011
1967	209767	315330	26	36.62	2.73	0.914	-0.086	0.007
1968	235397	326495	25	35.21	2.84	0.947	-0.053	0.003
1969	274357	340663	24	33.80	2.96	0.988	-0.012	0.000
1970	251954	341000	23	32.39	3.09	0.989	-0.011	0.000
1971	293293	349246	22	30.99	3.23	1.013	0.013	0.000
1972	281723	353993	21	29.58	3.38	1.027	0.027	0.001
1973	1000496	376590	20	28.17	3.55	1.092	0.092	0.008
1974	189446	401692	19	26.76	3.74	1.165	0.165	0.027
1975	556241	433095	18	25.35	3.94	1.256	0.256	0.066
1976	615043	438529	17	23.94	4.18	1.272	0.272	0.074
1977	472136	472136	16	22.54	4.44	1.369	0.369	0.136
1978	433095	512205	15	21.13	4.73	1.485	0.485	0.236
1979	246867	556241	14	19.72	5.07	1.613	0.613	0.376
1980	194814	569856	13	18.31	5.46	1.653	0.653	0.426
1981	569856	606286	12	16.90	5.92	1.758	0.758	0.575
1982	261844	615043	11	15.49	6.45	1.784	0.784	0.614
1983	295362	631670	10	14.08	7.10	1.832	0.832	0.692
1984	156430	709524	9	12.68	7.89	2.058	1.058	1.119
1985	309068	742293	8	11.27	8.88	2.153	1.153	1.329
1986	341000	806774	7	9.86	10.14	2.340	1.340	1.795
1987	98745	864340	6	8.45	11.83	2.507	1.507	2.270
1988	864340	910000	5	7.04	14.20	2.639	1.639	2.687
1989	512205	986556	4	5.63	17.75	2.861	1.861	3.464
1990	270015	1000496	3	4.23	23.67	2.902	1.902	3.616
1991	121740	1021018	2	2.82	35.50	2.961	1.961	3.846
1992	910000	1086405	1	1.41	71.00	3.151	2.151	4.625

SUM = 24482109 N 71 MEAN FLOOD = 344818.44

sum = 35.27

Cv = 0.71

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD DISCHARGE OF

CHENAB AT SHERSHAH BRIDGE

YEARS	YEARLY PEAK FLOW Q (CFS)	Q IN ACENDING ORDER	NO OF TIMES FLO WAS EQUAL OR EXCEED	PERCENTA YEARS P	FUTURE FLOOD FREQUENC	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 V
1930	384949.62	90993.87	63	100.00	1.00	0.310	-0.690	0.476
1931	206987.22	100001.97	62	87.32	1.15	0.371	-0.629	0.396
1932	240990.75	140004.15	61	85.92	1.16	0.477	-0.523	0.274
1933	252960.84	143994.18	60	84.51	1.18	0.490	-0.510	0.260
1934	286893.75	144982.86	59	83.10	1.20	0.494	-0.506	0.256
1935	298909.77	152998.23	58	81.69	1.22	0.521	-0.479	0.229
1936	198971.85	159000.93	57	80.28	1.25	0.542	-0.458	0.210
1937	152998.23	163979.64	56	78.87	1.27	0.569	-0.441	0.195
1938	226972.68	167069.67	55	77.46	1.29	0.572	-0.428	0.183
1939	197983.17	174996.36	54	76.06	1.31	0.596	-0.404	0.163
1940	205963.23	175085.04	53	74.65	1.34	0.599	-0.401	0.160
1941	192969.15	176973.72	52	73.24	1.37	0.603	-0.397	0.158
1942	289905.72	180999.06	51	71.83	1.39	0.617	-0.383	0.147
1943	205963.23	180999.06	50	70.42	1.42	0.617	-0.383	0.147
1944	233964.06	184089.09	49	69.01	1.45	0.630	-0.370	0.137
1945	205903.23	185077.77	48	67.61	1.48	0.633	-0.367	0.134
1946	240990.75	187990.44	47	66.20	1.51	0.640	-0.360	0.129
1947	170973.72	192969.15	46	64.79	1.54	0.657	-0.343	0.117
1948	459948.06	197983.17	45	63.38	1.58	0.674	-0.326	0.106
1949	239066.76	197983.17	44	61.97	1.61	0.674	-0.326	0.106
1950	497941.62	198971.85	43	60.56	1.65	0.678	-0.322	0.104
1951	265990.23	205963.23	42	59.15	1.69	0.702	-0.298	0.089
1952	233964.06	205963.23	41	57.75	1.73	0.702	-0.298	0.089
1953	244980.78	205963.23	40	56.34	1.78	0.702	-0.298	0.089
1954	274958.97	206987.22	39	54.93	1.82	0.705	-0.295	0.087
1955	299958.45	215814.72	38	53.52	1.87	0.735	-0.265	0.070
1956	379970.91	220972.68	37	52.11	1.92	0.773	-0.227	0.051
1957	639923.13	232975.38	36	50.70	1.97	0.794	-0.206	0.043
1958	439962.6	233964.06	35	49.30	2.03	0.797	-0.203	0.041
1959	722936.94	233964.06	34	47.89	2.09	0.797	-0.203	0.041
1960	344978.7	235076.73	33	46.48	2.15	0.804	-0.196	0.039
1961	279972.99	239966.76	32	45.07	2.22	0.817	-0.183	0.033
1962	163979.64	240990.75	31	43.66	2.29	0.821	-0.179	0.032
1963	185077.77	240990.75	30	42.25	2.37	0.821	-0.179	0.032
1964	309986.49	244980.78	29	40.85	2.45	0.834	-0.166	0.027
1965	174996.36	249994.8	28	39.44	2.54	0.852	-0.148	0.022
1966	232975.38	250983.48	27	38.03	2.63	0.855	-0.145	0.021
1967	100001.97	252960.84	26	36.62	2.73	0.862	-0.138	0.019
1968	250083.48	265990.23	25	35.21	2.84	0.906	-0.094	0.009
1969	184089.09	274958.97	24	33.80	2.96	0.937	-0.063	0.004
1970	90993.87	279972.99	23	32.39	3.09	0.954	-0.046	0.002
1971	175085.04	281985.66	22	30.99	3.23	0.960	-0.040	0.002
1972	180999.06	286893.75	21	29.58	3.38	0.977	-0.023	0.001
1973	140004.15	289965.72	20	28.17	3.55	0.988	-0.012	0.000
1974	704928.84	298909.77	19	26.76	3.74	1.018	0.018	0.000
1975	159000.93	299958.45	18	25.35	3.94	1.022	0.022	0.000
1976	371955.54	308962.5	17	23.94	4.18	1.052	0.052	0.003
1977	215814.72	309986.49	16	22.54	4.44	1.056	0.056	0.003
1978	729928.32	344978.7	15	21.13	4.73	1.175	0.175	0.031
1979	235076.73	371955.54	14	19.72	5.07	1.267	0.267	0.071
1980	180999.06	379970.91	13	18.31	5.46	1.294	0.294	0.087
1981	457970.7	384949.62	12	16.90	5.92	1.311	0.311	0.097
1982	187990.44	439962.6	11	15.49	6.45	1.499	0.499	0.249
1983	167969.67	457970.7	10	14.08	7.10	1.560	0.560	0.313
1984	144982.86	459948.06	9	12.68	7.89	1.567	0.567	0.321
1985	308962.5	497871	8	11.27	8.88	1.696	0.696	0.484
1986	281985.66	497941.62	7	9.86	10.14	1.696	0.696	0.484
1987	143994.18	551930.61	6	8.45	11.83	1.880	0.880	0.774
1988	551930.61	639923.13	5	7.04	14.20	2.180	1.180	1.392
1989	497871	704928.84	4	5.63	17.75	2.401	1.401	1.963
1990	197983.17	722936.94	3	4.23	23.67	2.462	1.462	2.139
1991	249994.8	729928.32	2	2.82	35.50	2.486	1.486	2.209
1992	978087	978087	1	1.41	71.00	3.331	2.331	5.436
SUM	18490084						SUM =	20.99
		N	63				CV =	0.58
	MEAN FLOOD =		293588.64					

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY OF

CHENAB AT TRIMU

YEARS	YEARLY PEAK FLOW Q (CFS)	Q IN ACENDING ORDER	NO OF TIMES PEAK WAS EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY T	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	Z V
1939	207465	113698	54	100.00	1.00	0.351	-0.649	0.421
1940	160992	132336	53	98.15	1.02	0.409	-0.591	0.350
1941	229031	134555	52	96.30	1.04	0.416	-0.584	0.342
1942	251169	141909	51	94.44	1.06	0.438	-0.562	0.315
1943	259500	143547	50	92.59	1.08	0.443	-0.557	0.310
1944	267500	147034	49	90.74	1.10	0.454	-0.546	0.298
1945	262800	150172	48	88.89	1.13	0.464	-0.536	0.287
1946	293000	154517	47	87.04	1.15	0.477	-0.523	0.273
1947	227935	154862	46	85.19	1.17	0.478	-0.522	0.272
1948	536329	156558	45	83.33	1.20	0.484	-0.516	0.267
1949	210600	159730	44	81.48	1.23	0.493	-0.507	0.257
1950	715560	160992	43	79.63	1.26	0.497	-0.503	0.253
1951	197570	166595	42	77.78	1.29	0.515	-0.485	0.236
1952	260813	168373	41	75.93	1.32	0.520	-0.480	0.230
1953	256586	168630	40	74.07	1.35	0.521	-0.479	0.230
1954	510193	182081	39	72.22	1.38	0.562	-0.438	0.191
1955	285700	197570	38	70.37	1.42	0.610	-0.390	0.152
1956	344928	207465	37	68.52	1.46	0.641	-0.359	0.129
1957	559575	210600	36	66.67	1.50	0.651	-0.349	0.122
1958	530543	227512	35	64.81	1.54	0.703	-0.297	0.088
1959	807594	227935	34	62.96	1.59	0.704	-0.296	0.088
1960	605132	229031	33	61.11	1.64	0.707	-0.293	0.086
1961	289008	234765	32	59.26	1.69	0.725	-0.275	0.076
1962	156558	251169	31	57.41	1.74	0.776	-0.224	0.050
1963	168373	256586	30	55.56	1.80	0.793	-0.207	0.043
1964	415790	259500	29	53.70	1.86	0.802	-0.198	0.039
1965	310885	260813	28	51.85	1.93	0.806	-0.194	0.038
1966	415497	262800	27	50.00	2.00	0.812	-0.188	0.035
1967	132336	267500	26	48.15	2.08	0.826	-0.174	0.030
1968	134555	276988	25	46.30	2.16	0.856	-0.144	0.021
1969	234765	285700	24	44.44	2.25	0.882	-0.118	0.014
1970	113698	287806	23	42.59	2.35	0.889	-0.111	0.012
1971	159730	289008	22	40.74	2.45	0.893	-0.107	0.012
1972	141909	293000	21	38.89	2.57	0.905	-0.095	0.009
1973	698000	293266	20	37.04	2.70	0.906	-0.094	0.009
1974	150172	306171	19	35.19	2.84	0.946	-0.054	0.003
1975	458247	310885	18	33.33	3.00	0.960	-0.040	0.002
1976	706433	344928	17	31.48	3.18	1.065	0.065	0.004
1977	293266	403187	16	29.63	3.38	1.245	0.245	0.060
1978	287806	415497	15	27.78	3.60	1.283	0.283	0.080
1979	168630	415790	14	25.93	3.86	1.284	0.284	0.081
1980	182081	431517	13	24.07	4.15	1.333	0.333	0.111
1981	306171	458247	12	22.22	4.50	1.415	0.415	0.173
1982	147034	510193	11	20.37	4.91	1.576	0.576	0.332
1983	276988	530543	10	18.52	5.40	1.639	0.639	0.408
1984	154862	536329	9	16.67	6.00	1.657	0.657	0.431
1985	227512	559575	8	14.81	6.75	1.728	0.728	0.531
1986	403187	584110	7	12.96	7.71	1.804	0.804	0.647
1987	143547	605132	6	11.11	9.00	1.869	0.869	0.755
1988	584110	698000	5	9.26	10.80	2.156	1.156	1.336
1989	431517	706433	4	7.41	13.50	2.182	1.182	1.397
1990	154517	715560	3	5.56	18.00	2.210	1.210	1.465
1991	166595	807594	2	3.70	27.00	2.495	1.495	2.234
1992	888000	888000	1	1.85	54.00	2.743	1.743	3.038

SUM = 17482294 CFS SUM = 18.67

N 54

MEAN FLOOD = 323746.19 CV = 0.59

CALCULATIONS FOR PROBABILITY PLOTTINGS OF PEAK FLOOD DISCHARGE OF

CHENAB AT PUNJNED

YEARS	PEAK YEARLY FLOW (CUSEC)	Q IN ACENDING ORDER	NO OF TIMES PEAK EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY f	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	V^2
1922	295000	132926	71	100.00	1.00	0.405	-0.595	0.355
1923	330000	133000	70	98.59	1.01	0.405	-0.595	0.354
1924	310000	138948	69	97.18	1.03	0.423	-0.577	0.333
1925	405000	141000	68	95.77	1.04	0.429	-0.571	0.326
1926	330000	150000	67	94.37	1.06	0.457	-0.543	0.295
1927	405000	151038	66	92.96	1.08	0.460	-0.540	0.292
1928	500000	151122	65	91.55	1.09	0.460	-0.540	0.292
1929	550000	154000	64	90.14	1.11	0.469	-0.531	0.282
1930	348000	158929	63	88.73	1.13	0.484	-0.516	0.267
1931	301000	167000	62	87.32	1.15	0.508	-0.492	0.242
1932	251000	171460	61	85.92	1.16	0.522	-0.478	0.229
1933	333000	172000	60	84.51	1.18	0.524	-0.476	0.227
1934	755000	189168	59	83.10	1.20	0.576	-0.424	0.180
1935	317000	202000	58	81.69	1.22	0.615	-0.385	0.148
1936	252000	205000	57	80.28	1.25	0.624	-0.376	0.141
1937	172000	206000	56	78.87	1.27	0.627	-0.373	0.139
1938	254000	214000	55	77.46	1.29	0.651	-0.349	0.122
1939	206000	223000	54	76.06	1.31	0.679	-0.321	0.103
1940	223000	238000	53	74.65	1.34	0.724	-0.276	0.076
1941	154000	245000	52	73.24	1.37	0.746	-0.254	0.065
1942	435000	245370	51	71.83	1.39	0.747	-0.253	0.064
1943	332000	248000	50	70.42	1.42	0.755	-0.245	0.060
1944	277000	251000	49	69.01	1.45	0.764	-0.236	0.056
1945	263000	252000	48	67.61	1.48	0.767	-0.233	0.054
1946	248000	254000	47	66.20	1.51	0.773	-0.227	0.051
1947	205000	258000	46	64.79	1.54	0.785	-0.215	0.046
1948	490000	263000	45	63.38	1.58	0.800	-0.200	0.040
1949	312000	272000	44	61.97	1.61	0.828	-0.172	0.030
1950	650000	277000	43	60.56	1.65	0.843	-0.157	0.025
1951	245000	279000	42	59.15	1.69	0.849	-0.151	0.023
1952	334000	295000	41	57.75	1.73	0.898	-0.102	0.010
1953	279000	296000	40	56.34	1.78	0.901	-0.099	0.010
1954	383000	301000	39	54.93	1.82	0.916	-0.084	0.007
1955	550000	310000	38	53.52	1.87	0.944	-0.056	0.003
1956	386000	312000	37	52.11	1.92	0.950	-0.050	0.003
1957	560000	317000	36	50.70	1.97	0.965	-0.035	0.001
1958	570000	319420	35	49.30	2.03	0.972	-0.028	0.001
1959	493000	330000	34	47.89	2.09	1.004	0.004	0.000
1960	355000	330000	33	46.48	2.15	1.004	0.004	0.000
1961	388000	331998	32	45.07	2.22	1.010	0.010	0.000
1962	214000	332000	31	43.66	2.29	1.010	0.010	0.000
1963	238000	333000	30	42.25	2.37	1.014	0.014	0.000
1964	441000	333000	29	40.85	2.45	1.014	0.014	0.000
1965	296000	334000	28	39.44	2.54	1.017	0.017	0.000
1966	415000	348000	27	38.03	2.63	1.059	0.059	0.003
1967	167000	355000	26	36.62	2.73	1.080	0.080	0.006
1968	202000	355480	25	35.21	2.84	1.082	0.082	0.007
1969	333000	367220	24	33.80	2.96	1.118	0.118	0.014
1970	133000	383000	23	32.39	3.09	1.166	0.166	0.027
1971	258000	386000	22	30.99	3.23	1.175	0.175	0.031
1972	150000	388000	21	29.58	3.38	1.181	0.181	0.033
1973	802570	405000	20	28.17	3.55	1.233	0.233	0.054
1974	141000	405000	19	26.76	3.74	1.233	0.233	0.054
1975	477000	415000	18	25.35	3.94	1.263	0.263	0.069
1976	702000	421350	17	23.94	4.18	1.282	0.282	0.080
1977	272000	435000	16	22.54	4.44	1.324	0.324	0.105
1978	331998	441000	15	21.13	4.73	1.342	0.342	0.117
1979	132925	477000	14	19.72	5.07	1.452	0.452	0.204
1980	171460	490000	13	18.31	5.46	1.491	0.491	0.241
1981	367220	493000	12	16.90	5.92	1.501	0.501	0.251
1982	138948	500000	11	15.49	6.45	1.522	0.522	0.272
1983	319420	507345	10	14.08	7.10	1.544	0.544	0.296
1984	151122	550000	9	12.68	7.89	1.674	0.674	0.454
1985	245370	550000	8	11.27	8.88	1.674	0.674	0.454
1986	355480	560000	7	9.86	10.14	1.704	0.704	0.496
1987	151038	570000	6	8.45	11.83	1.735	0.735	0.540
1988	507345	650000	5	7.04	14.20	1.978	0.978	0.957
1989	421350	702000	4	5.63	17.75	2.137	1.137	1.292
1990	189168	755000	3	4.23	23.67	2.298	1.298	1.685
1991	158929	802570	2	2.82	35.50	2.443	1.443	2.081
1992	872000	872000	1	1.41	71.00	2.654	1.654	2.736
							SUM =	17.51

SUM = 23327344

N = 71

MEAN FLOOD = 328554.14

Cv = 0.50

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY ANALYSIS OF

JEHLUM AT MANGLA

YEARS	YEARLY PEAK FLOW Q (CFS)	Q IN ASCENDING ORDER	NO OF TIME PEAK WAS EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY	COL 3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 V
1922	103000	20000	71	100.00	1.00	0.105	-0.895	0.800
1923	84000	23000	70	98.59	1.01	0.121	-0.879	0.772
1924	156000	35000	69	97.18	1.03	0.184	-0.816	0.665
1925	107000	50000	68	95.77	1.04	0.263	-0.737	0.543
1926	145000	60000	67	94.37	1.06	0.316	-0.684	0.468
1927	165000	69000	66	92.96	1.08	0.363	-0.637	0.405
1928	590000	76000	65	91.55	1.09	0.400	-0.600	0.360
1929	1040000	77000	64	90.14	1.11	0.405	-0.595	0.353
1930	170000	80000	63	88.73	1.13	0.421	-0.579	0.335
1931	230000	84000	62	87.32	1.15	0.442	-0.558	0.311
1932	118000	85000	61	85.92	1.16	0.448	-0.552	0.305
1933	195000	86000	60	84.51	1.18	0.453	-0.547	0.299
1934	183000	88000	59	83.10	1.20	0.463	-0.537	0.288
1935	106000	89000	58	81.69	1.22	0.469	-0.531	0.282
1936	146000	89000	57	80.28	1.25	0.469	-0.531	0.282
1937	89000	89000	56	78.87	1.27	0.469	-0.531	0.282
1938	132000	96000	55	77.46	1.29	0.505	-0.495	0.245
1939	96000	101000	54	76.06	1.31	0.532	-0.468	0.219
1940	107000	103000	53	74.65	1.34	0.542	-0.458	0.209
1941	162000	104000	52	73.24	1.37	0.548	-0.452	0.205
1942	89000	104000	51	71.83	1.39	0.548	-0.452	0.205
1943	125000	105000	50	70.42	1.42	0.553	-0.447	0.200
1944	199000	106000	49	69.01	1.45	0.558	-0.442	0.195
1945	101000	107000	48	67.61	1.48	0.563	-0.437	0.191
1946	225000	107000	47	66.20	1.51	0.563	-0.437	0.191
1947	131000	109000	46	64.79	1.54	0.574	-0.426	0.182
1948	441000	114000	45	63.38	1.58	0.600	-0.400	0.160
1949	155000	117000	44	61.97	1.61	0.616	-0.384	0.147
1950	279000	118000	43	60.56	1.65	0.621	-0.379	0.143
1951	121000	119000	42	59.15	1.69	0.627	-0.373	0.139
1952	233000	121000	41	57.75	1.73	0.637	-0.363	0.132
1953	311000	125000	40	56.34	1.78	0.658	-0.342	0.117
1954	232000	131000	39	54.93	1.82	0.690	-0.310	0.096
1955	175000	132000	38	53.52	1.87	0.695	-0.305	0.093
1956	303000	140000	37	52.11	1.92	0.737	-0.263	0.069
1957	140000	141000	36	50.70	1.97	0.742	-0.258	0.066
1958	520000	146000	35	49.30	2.03	0.769	-0.231	0.053
1959	845000	148000	34	47.89	2.09	0.779	-0.221	0.049
1960	150000	149000	33	46.48	2.15	0.785	-0.215	0.046
1961	149000	150000	32	45.07	2.22	0.790	-0.210	0.044
1962	155000	154000	31	43.66	2.29	0.811	-0.189	0.036
1963	80000	155000	30	42.25	2.37	0.816	-0.184	0.034
1964	85000	155000	29	40.85	2.45	0.816	-0.184	0.034
1965	88000	156000	28	39.44	2.54	0.821	-0.179	0.032
1966	89000	162000	27	38.03	2.63	0.853	-0.147	0.022
1967	77000	163000	26	36.62	2.73	0.858	-0.142	0.020
1968	60000	165000	25	35.21	2.84	0.869	-0.131	0.017
1969	105000	170000	24	33.80	2.96	0.895	-0.105	0.011
1970	20000	170000	23	32.39	3.09	0.895	-0.105	0.011
1971	23000	175000	22	30.99	3.23	0.921	-0.079	0.006
1972	114000	183000	21	29.58	3.38	0.964	-0.036	0.001
1973	220000	195000	20	28.17	3.55	1.027	0.027	0.001
1974	50000	198000	19	26.76	3.74	1.043	0.043	0.002
1975	109000	199000	18	25.35	3.94	1.048	0.048	0.002
1976	198000	207000	17	23.94	4.18	1.090	0.090	0.008
1977	69000	220000	16	22.54	4.44	1.158	0.158	0.025
1978	104000	225000	15	21.13	4.73	1.185	0.185	0.034
1979	78000	230000	14	19.72	5.07	1.211	0.211	0.045
1980	86000	232000	13	18.31	5.46	1.222	0.222	0.049
1981	117000	233000	12	16.90	5.92	1.227	0.227	0.051
1982	104000	240000	11	15.49	6.45	1.264	0.264	0.070
1983	207000	243000	10	14.08	7.10	1.280	0.280	0.078
1984	119000	279000	9	12.68	7.89	1.469	0.469	0.220
1985	35000	303000	8	11.27	8.88	1.595	0.595	0.355
1986	163000	311000	7	9.86	10.14	1.638	0.638	0.406
1987	141000	441000	6	8.45	11.83	2.322	1.322	1.748
1988	243000	520000	5	7.04	14.20	2.738	1.738	3.021
1989	154000	590000	4	5.63	17.75	3.107	2.107	4.438
1990	170000	845000	3	4.23	23.67	4.449	3.449	11.898
1991	240000	932000	2	2.82	35.50	4.907	3.907	15.268
1992	932000	1040000	1	1.41	71.00	5.476	4.476	20.036

SUM = 13484000 CFS SUM= 68.13

N = 71

MEAN FLOOD = 189915.5 CV= 0.99

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY OF

JEHLUM AT RASUL

YEARS	YEARLY PEAK FLOW Q cfs	Q IN ASCENDING ORDER	NO OF TIME PEAK WAS EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY t	COL 3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 'V'
1922	133000	21000	71	100.00	1.00	0.087	-0.913	0.834
1923	136000	43000	70	98.59	1.01	0.178	-0.822	0.676
1924	154000	59000	69	97.18	1.03	0.244	-0.756	0.572
1925	132000	63000	68	95.77	1.04	0.260	-0.740	0.547
1926	154000	64000	67	94.37	1.06	0.264	-0.736	0.541
1927	205000	68000	66	92.96	1.08	0.281	-0.719	0.517
1928	663000	69000	65	91.55	1.09	0.285	-0.715	0.511
1929	875000	86000	64	90.14	1.11	0.355	-0.645	0.416
1930	249000	89000	63	88.73	1.13	0.368	-0.632	0.400
1931	274000	93000	62	87.32	1.15	0.384	-0.616	0.379
1932	110000	96000	61	85.92	1.16	0.397	-0.603	0.364
1933	138000	98000	60	84.51	1.18	0.405	-0.595	0.354
1934	149000	101000	59	83.10	1.20	0.417	-0.583	0.340
1935	115000	101000	58	81.69	1.22	0.417	-0.583	0.340
1936	180000	105000	57	80.28	1.25	0.434	-0.566	0.321
1937	93000	105000	56	78.87	1.27	0.434	-0.566	0.321
1938	124000	106000	55	77.46	1.29	0.438	-0.562	0.316
1939	112000	106000	54	76.06	1.31	0.438	-0.562	0.316
1940	106000	110000	53	74.65	1.34	0.454	-0.546	0.298
1941	208000	110000	52	73.24	1.37	0.454	-0.546	0.298
1942	105000	112000	51	71.83	1.39	0.463	-0.537	0.289
1943	155000	112000	50	70.42	1.42	0.463	-0.537	0.289
1944	231000	113000	49	69.01	1.45	0.467	-0.533	0.284
1945	150000	115000	48	67.61	1.48	0.475	-0.525	0.276
1946	140000	119000	47	66.20	1.51	0.492	-0.508	0.259
1947	68000	124000	46	64.79	1.54	0.512	-0.488	0.238
1948	730000	125000	45	63.38	1.58	0.516	-0.484	0.234
1949	165000	126000	44	61.97	1.61	0.520	-0.480	0.230
1950	350000	132000	43	60.56	1.65	0.545	-0.455	0.207
1951	275000	133000	42	59.15	1.69	0.549	-0.451	0.203
1952	240000	136000	41	57.75	1.73	0.562	-0.438	0.192
1953	375000	136000	40	56.34	1.78	0.570	-0.430	0.185
1954	425000	140000	39	54.93	1.82	0.578	-0.422	0.178
1955	210000	143000	38	53.52	1.87	0.591	-0.409	0.168
1956	375000	149000	37	52.11	1.92	0.615	-0.385	0.148
1957	175000	150000	36	50.70	1.97	0.620	-0.380	0.145
1958	675000	154000	35	49.30	2.03	0.636	-0.364	0.132
1959	876000	154000	34	47.89	2.09	0.636	-0.364	0.132
1960	860000	155000	33	46.48	2.15	0.640	-0.360	0.129
1961	110000	163000	32	45.07	2.22	0.673	-0.327	0.107
1962	143000	165000	31	43.66	2.29	0.682	-0.318	0.101
1963	96000	175000	30	42.25	2.37	0.723	-0.277	0.077
1964	335000	180000	29	40.85	2.45	0.743	-0.257	0.066
1965	185000	185000	28	39.44	2.54	0.764	-0.236	0.056
1966	270000	205000	27	38.03	2.63	0.847	-0.153	0.023
1967	106000	208000	26	36.62	2.73	0.859	-0.141	0.020
1968	63000	210000	25	35.21	2.84	0.867	-0.133	0.018
1969	101000	231000	24	33.80	2.96	0.954	-0.046	0.002
1970	43000	240000	23	32.39	3.09	0.991	-0.009	0.000
1971	21000	241000	22	30.99	3.23	0.995	-0.005	0.000
1972	105000	249000	21	29.58	3.38	1.029	0.029	0.001
1973	270000	255000	20	28.17	3.55	1.053	0.053	0.003
1974	69000	269000	19	26.76	3.74	1.111	0.111	0.012
1975	126000	270000	18	25.35	3.94	1.115	0.115	0.013
1976	269000	270000	17	23.94	4.18	1.115	0.115	0.013
1977	59000	274000	16	22.54	4.44	1.132	0.132	0.017
1978	101000	275000	15	21.13	4.73	1.136	0.136	0.018
1979	650000	335000	14	19.72	5.07	1.384	0.384	0.147
1980	760000	350000	13	18.31	5.46	1.446	0.446	0.199
1981	112000	375000	12	16.90	5.92	1.549	0.549	0.301
1982	86000	375000	11	15.49	6.45	1.549	0.549	0.301
1983	241000	425000	10	14.08	7.10	1.755	0.755	0.571
1984	98000	650000	9	12.68	7.89	2.685	1.685	2.839
1985	64000	663000	8	11.27	8.88	2.739	1.739	3.023
1986	113000	675000	7	9.86	10.14	2.788	1.788	3.197
1987	125000	730000	6	8.45	11.83	3.015	2.015	4.061
1988	255000	760000	5	7.04	14.20	3.139	2.139	4.576
1989	163000	860000	4	5.63	17.75	3.552	2.552	6.514
1990	119000	875000	3	4.23	23.67	3.614	2.614	6.834
1991	89000	876000	2	2.82	35.50	3.618	2.618	6.856
1992	952000	952000	1	1.41	71.00	3.932	2.932	8.598

SUM = 17189000 SUM = 61.14

N = 71 CV= 0.93

MEAN FLOOD = 242098.6

CALCULATIONS FOR PROBABILITY PLOTTINGS OF PEAK FLOOD DISCHARGE OF

INDUS AT KOTRI BARRAGE

YEARS	PEAK YEARLY FLOW Q(CFS)	Q IN ACENDING ORDER	NO OF TIMES PEAK EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY T	COL.3 IN TERMS OF MEAN FLOOD	VARIATION FROM MEAN V	V^2
1922	415000	122640	69	100.00	1.00	0.270	-0.730	0.533
1923	438000	133472	68	98.55	1.01	0.294	-0.706	0.499
1924	552000	156489	67	97.10	1.03	0.345	-0.655	0.430
1925	457000	186326	66	95.65	1.05	0.410	-0.590	0.348
1926	415000	219661	65	94.20	1.06	0.484	-0.516	0.267
1927	418000	253857	64	92.75	1.08	0.559	-0.441	0.194
1928	325000	255496	63	91.30	1.10	0.563	-0.437	0.191
1929	550000	266183	62	89.86	1.11	0.586	-0.414	0.171
1930	349000	270917	61	88.41	1.13	0.597	-0.403	0.163
1931	390000	274840	60	86.96	1.15	0.605	-0.395	0.156
1932	510000	277000	59	85.51	1.17	0.610	-0.390	0.152
1933	608000	292000	58	84.06	1.19	0.643	-0.357	0.127
1934	497000	293562	57	82.61	1.21	0.646	-0.354	0.125
1935	481000	302172	56	81.16	1.23	0.665	-0.335	0.112
1936	372000	308000	55	79.71	1.25	0.678	-0.322	0.104
1937	389000	323107	54	78.26	1.28	0.711	-0.289	0.083
1938	405000	324000	53	76.81	1.30	0.713	-0.287	0.082
1939	396000	325000	52	75.36	1.33	0.716	-0.284	0.081
1940	349000	334000	51	73.91	1.35	0.735	-0.265	0.070
1941	324000	337000	50	72.46	1.38	0.742	-0.258	0.067
1942	529000	348893	49	71.01	1.41	0.768	-0.232	0.054
1943	555000	349000	48	69.57	1.44	0.768	-0.232	0.054
1944	604000	349000	47	68.12	1.47	0.768	-0.232	0.054
1945	535000	372000	46	66.67	1.50	0.819	-0.181	0.033
1946	421000	381000	45	65.22	1.53	0.839	-0.161	0.026
1947	292000	389000	44	63.77	1.57	0.857	-0.143	0.021
1948	715000	390600	43	62.32	1.60	0.859	-0.141	0.020
1949	622000	396000	42	60.87	1.64	0.872	-0.128	0.016
1950	663000	405000	41	59.42	1.68	0.892	-0.108	0.012
1951	334000	415000	40	57.97	1.73	0.914	-0.086	0.007
1952	483000	415000	39	56.52	1.77	0.914	-0.086	0.007
1953	527000	418000	38	55.07	1.82	0.920	-0.080	0.006
1954	337000	421000	37	53.62	1.86	0.927	-0.073	0.005
1955	791000	434000	36	52.17	1.92	0.956	-0.044	0.002
1956	981000	438000	35	50.72	1.97	0.964	-0.036	0.001
1957	542000	457000	34	49.28	2.03	1.006	0.006	0.000
1958	754000	471369	33	47.83	2.09	1.038	0.038	0.001
1959	658000	474311	32	46.38	2.16	1.044	0.044	0.002
1960	481000	476436	31	44.93	2.23	1.049	0.049	0.002
1961	434000	481000	30	43.48	2.30	1.059	0.059	0.003
1962	277000	481000	29	42.03	2.38	1.059	0.059	0.003
1963	308000	483000	28	40.58	2.46	1.064	0.064	0.004
1964	524000	497000	27	39.13	2.56	1.094	0.094	0.009
1965	381000	504000	26	37.68	2.65	1.110	0.110	0.012
1966	612000	510000	25	36.23	2.76	1.123	0.123	0.015
1967	504000	524000	24	34.78	2.88	1.154	0.154	0.024
1968	545000	527000	23	33.33	3.00	1.160	0.160	0.026
1969	530000	529000	22	31.88	3.14	1.165	0.165	0.027
1970	255495	530000	21	30.43	3.29	1.167	0.167	0.028
1971	266183	535000	20	28.99	3.45	1.178	0.178	0.032
1972	186326	542000	19	27.54	3.63	1.193	0.193	0.037
1973	785829	545000	18	26.09	3.83	1.200	0.200	0.040
1974	133472	550000	17	24.64	4.06	1.211	0.211	0.045
1975	476436	552000	16	23.19	4.31	1.215	0.215	0.046
1976	765392	555000	15	21.74	4.60	1.222	0.222	0.049
1977	323107	604000	14	20.29	4.93	1.330	0.330	0.109
1978	701774	608000	13	18.84	5.31	1.339	0.339	0.115
1979	293562	612000	12	17.39	5.75	1.348	0.348	0.121
1980	253857	622000	11	15.94	6.27	1.370	0.370	0.137
1981	302172	658000	10	14.49	6.90	1.449	0.449	0.202
1982	219661	663000	9	13.04	7.67	1.460	0.460	0.212
1983	474311	673809	8	11.59	8.63	1.484	0.484	0.234
1984	348893	701774	7	10.14	9.86	1.545	0.545	0.297
1985	156489	715000	6	8.70	11.50	1.574	0.574	0.330
1986	471369	754000	5	7.25	13.80	1.660	0.660	0.436
1987	122640	765392	4	5.80	17.25	1.685	0.685	0.470
1990	274840	785829	3	4.35	23.00	1.730	0.730	0.533
1991	270917	791000	2	2.90	34.50	1.742	0.742	0.550
1992	673809	981000	1	1.45	69.00	2.160	1.160	1.346
							SUM =	9.77
SUM =	31335534						Cv =	0.38
		N =	69					
	MEAN FLOOD =		454138.17					

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY OF

INDUS AT KALABAGH

YEARS	YEARLY PEAK FLOW Q(CFS)	Q IN ACENDING ORDER	NO OF TIMES PEAK WAS EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY T	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 'V
1928	357000	313000	65	100.00	1.00	0.641	-0.359	0.129
1929	819000	339000	64	98.46	1.02	0.695	-0.305	0.093
1930	484000	351000	63	96.92	1.03	0.719	-0.281	0.079
1931	339000	354000	62	95.38	1.05	0.725	-0.275	0.075
1932	570000	357000	61	93.85	1.07	0.732	-0.268	0.072
1933	520000	371000	60	92.31	1.08	0.760	-0.240	0.057
1934	591000	374000	59	90.77	1.10	0.766	-0.234	0.055
1935	535000	374000	58	89.23	1.12	0.766	-0.234	0.055
1936	460000	397000	57	87.69	1.14	0.813	-0.187	0.035
1937	474000	415000	56	86.15	1.16	0.850	-0.150	0.022
1938	502000	417000	55	84.62	1.18	0.854	-0.146	0.021
1939	540000	421000	54	83.08	1.20	0.863	-0.137	0.019
1940	491000	428600	53	81.54	1.23	0.877	-0.123	0.015
1941	468000	443000	52	80.00	1.25	0.908	-0.092	0.009
1942	917000	446000	51	78.46	1.27	0.914	-0.086	0.007
1943	562000	446000	50	76.92	1.30	0.914	-0.086	0.007
1944	692000	451000	49	75.38	1.33	0.924	-0.076	0.006
1945	708000	460000	48	73.85	1.35	0.943	-0.057	0.003
1946	511000	461000	47	72.31	1.38	0.945	-0.055	0.003
1947	528000	463000	46	70.77	1.41	0.949	-0.051	0.003
1948	769000	464000	45	69.23	1.44	0.951	-0.049	0.002
1949	690000	465000	44	67.69	1.48	0.953	-0.047	0.002
1950	744000	467000	43	66.15	1.51	0.957	-0.043	0.002
1951	446000	468000	42	64.62	1.55	0.959	-0.041	0.002
1952	463000	474000	41	63.08	1.59	0.971	-0.029	0.001
1953	690000	484000	40	61.54	1.63	0.992	-0.008	0.000
1954	417000	491000	39	60.00	1.67	1.006	0.006	0.000
1955	521000	491000	38	58.46	1.71	1.006	0.006	0.000
1956	567000	493000	37	56.92	1.76	1.010	0.010	0.000
1957	443000	497000	36	55.38	1.81	1.018	0.018	0.000
1958	776000	502000	35	53.85	1.86	1.029	0.029	0.001
1959	598000	511000	34	52.31	1.91	1.047	0.047	0.002
1960	529000	520000	33	50.77	1.97	1.066	0.066	0.004
1961	523000	521000	32	49.23	2.03	1.068	0.068	0.005
1962	428000	523000	31	47.69	2.10	1.072	0.072	0.005
1963	464000	528000	30	46.15	2.17	1.082	0.082	0.007
1964	576000	529000	29	44.62	2.24	1.084	0.084	0.007
1965	497000	535000	28	43.08	2.32	1.096	0.096	0.009
1966	547000	540000	27	41.54	2.41	1.107	0.107	0.011
1967	548000	546000	26	40.00	2.50	1.119	0.119	0.014
1968	467000	546000	25	38.46	2.60	1.119	0.119	0.014
1969	461000	547000	24	36.92	2.71	1.121	0.121	0.015
1970	415000	548000	23	35.38	2.83	1.123	0.123	0.015
1971	421000	558000	22	33.85	2.95	1.143	0.143	0.021
1972	397000	562000	21	32.31	3.10	1.152	0.152	0.023
1973	546000	567000	20	30.77	3.25	1.162	0.162	0.026
1974	374000	568000	19	29.23	3.42	1.164	0.164	0.027
1975	603000	570000	18	27.69	3.61	1.168	0.168	0.028
1976	862000	576000	17	26.15	3.82	1.180	0.180	0.033
1977	568000	591000	16	24.62	4.06	1.211	0.211	0.045
1978	640000	598000	15	23.08	4.33	1.225	0.225	0.051
1979	451000	598000	14	21.54	4.64	1.225	0.225	0.051
1980	374000	603000	13	20.00	5.00	1.236	0.236	0.056
1981	354000	640000	12	18.46	5.42	1.311	0.311	0.097
1982	465000	690000	11	16.92	5.91	1.414	0.414	0.171
1983	493000	690000	10	15.38	6.50	1.414	0.414	0.171
1984	491000	692000	9	13.85	7.22	1.418	0.418	0.175
1985	313000	708000	8	12.31	8.13	1.451	0.451	0.203
1986	371000	744000	7	10.77	9.29	1.525	0.525	0.275
1987	351000	769000	6	9.23	10.83	1.576	0.576	0.332
1988	598000	776000	5	7.69	13.00	1.590	0.590	0.348
1989	558000	819000	4	6.15	16.25	1.678	0.678	0.460
1990	546000	846000	3	4.62	21.67	1.734	0.734	0.538
1991	446000	862000	2	3.08	32.50	1.766	0.766	0.587
1992	846000	917000	1	1.54	65.00	1.879	0.879	0.773

SUM = 31721000 CFS SUM = 5.37

N 65

MEAN FLOOD = 488015.38 CV = 0.29

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY OF

INDUS AT GADDU

YEARS	YEARLY PEAK FLOW Q (CFS)	Q IN ACENDING ORDER	NO OF TIMES PEAK WAS EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY I	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	V^2
1963	469000	314000	28	100.00	1.00	0.459	-0.541	0.293
1964	654000	316000	27	96.43	1.04	0.462	-0.538	0.290
1965	486000	335000	26	92.86	1.08	0.490	-0.510	0.261
1966	639000	373000	25	89.29	1.12	0.545	-0.455	0.207
1967	602000	398000	24	85.71	1.17	0.582	-0.418	0.175
1968	570000	463000	23	82.14	1.22	0.677	-0.323	0.105
1969	524000	469000	22	78.57	1.27	0.685	-0.315	0.099
1970	335000	486000	21	75.00	1.33	0.710	-0.290	0.084
1971	585000	503000	20	71.43	1.40	0.735	-0.265	0.070
1972	373000	524000	19	67.86	1.47	0.766	-0.234	0.055
1973	1063000	570000	18	64.29	1.56	0.833	-0.167	0.028
1974	316000	576000	17	60.71	1.65	0.842	-0.158	0.025
1975	988000	585000	16	57.14	1.75	0.855	-0.145	0.021
1976	1176000	602000	15	53.57	1.87	0.880	-0.120	0.014
1977	576000	623000	14	50.00	2.00	0.910	-0.090	0.008
1978	1138000	625000	13	46.43	2.15	0.913	-0.087	0.008
1979	503000	639000	12	42.86	2.33	0.934	-0.066	0.004
1980	623000	654000	11	39.29	2.55	0.956	-0.044	0.002
1981	694000	694000	10	35.71	2.80	1.014	0.014	0.000
1982	463000	736000	9	32.14	3.11	1.075	0.075	0.006
1983	736000	914000	8	28.57	3.50	1.336	0.336	0.113
1984	625000	988000	7	25.00	4.00	1.444	0.444	0.197
1985	398000	1063000	6	21.43	4.67	1.553	0.553	0.306
1986	1171000	1087000	5	17.86	5.60	1.588	0.588	0.346
1987	314000	1138000	4	14.29	7.00	1.663	0.663	0.439
1988	1140000	1140000	3	10.71	9.33	1.666	0.666	0.443
1989	914000	1171000	2	7.14	14.00	1.711	0.711	0.506
1992	1087000	1176000	1	3.57	28.00	1.718	0.718	0.516

SUM = 19162000 CFS

N = 28

MEAN FLOOD = 684357.14

SUM = 4.62

CV = 0.41

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY OF

INDUS AT TAUNSA

YEARS	YEARLY PEAK FLOW Q cfs	Q IN ACENDING ORDER	NO OF TIME PEAK WAS EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY I	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 "V
1956	517962.39	301971.12	37	100.00	1.00	0.654	-0.346	0.119
1957	525942.45	306985.14	36	97.30	1.03	0.665	-0.335	0.112
1958	788931.33	311963.85	35	94.59	1.06	0.676	-0.324	0.105
1959	511959.69	312952.53	34	91.89	1.09	0.678	-0.322	0.104
1960	376969.56	353982.75	33	89.19	1.12	0.767	-0.233	0.054
1961	475943.49	367965.51	32	86.49	1.16	0.797	-0.203	0.041
1962	311963.85	368954.19	31	83.78	1.19	0.800	-0.200	0.040
1963	353982.75	375980.88	30	81.08	1.23	0.815	-0.185	0.034
1964	502955.64	375980.88	29	78.38	1.28	0.815	-0.185	0.034
1965	433959.9	376969.56	28	75.68	1.32	0.817	-0.183	0.034
1966	512948.37	387950.97	27	72.97	1.37	0.841	-0.159	0.025
1967	449955.33	391976.31	26	70.27	1.42	0.849	-0.151	0.023
1968	435972.57	392964.99	25	67.57	1.48	0.852	-0.148	0.022
1969	464962.08	424955.85	24	64.86	1.54	0.921	-0.079	0.006
1970	367965.51	433959.9	23	62.16	1.61	0.940	-0.060	0.004
1971	392964.99	435972.57	22	59.46	1.68	0.945	-0.055	0.003
1972	375980.88	442963.95	21	56.76	1.76	0.960	-0.040	0.002
1973	566654.88	442963.95	20	54.05	1.85	0.960	-0.040	0.002
1974	368954.19	449955.33	19	51.35	1.95	0.975	-0.025	0.001
1975	523965.09	456946.71	18	48.65	2.06	0.990	-0.010	0.000
1976	674950.65	464962.08	17	45.95	2.18	1.008	0.008	0.000
1977	442963.95	475943.49	16	43.24	2.31	1.031	0.031	0.001
1978	442963.95	501966.96	15	40.54	2.47	1.088	0.088	0.008
1979	387950.97	502955.64	14	37.84	2.64	1.090	0.090	0.008
1980	424955.85	504968.31	13	35.14	2.85	1.094	0.094	0.009
1981	391976.31	509947.02	12	32.43	3.08	1.105	0.105	0.011
1982	375980.88	511959.69	11	29.73	3.36	1.109	0.109	0.012
1983	301971.12	512948.37	10	27.03	3.70	1.112	0.112	0.012
1984	509947.02	517962.39	9	24.32	4.11	1.122	0.122	0.015
1985	306985.14	523965.09	8	21.62	4.63	1.136	0.136	0.018
1986	504968.31	525942.45	7	18.92	5.29	1.140	0.140	0.020
1987	312952.53	558957.3	6	16.22	6.17	1.211	0.211	0.045
1988	560934.66	560934.66	5	13.51	7.40	1.216	0.216	0.046
1989	558957.3	566654.88	4	10.81	9.25	1.228	0.228	0.052
1990	501966.96	654929.88	3	8.11	12.33	1.419	0.419	0.176
1991	456946.71	674950.65	2	5.41	18.50	1.463	0.463	0.214
1992	654929.88	788931.33	1	2.70	37.00	1.710	0.710	0.504

SUM = 17073197 CFS

N = 37

MEAN FLOOD = 461437.8

SUM = 1.92

CV = 0.23

CALCULATIONS FOR PROBABILITY PLOTTINGS OF PEAK FLOOD DISCHARGE OF

INDUS AT SUKKUR BARRAGE

YEARS	PEAK YEARLY FLOW (Q)	Q IN ACENDING ORDER	NO OF YEARS PEAK EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY	COL 3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	V^2
1922	582000	241210	70	100.00	1.00	0.383	-0.617	0.380
1923	633000	263830	69	98.57	1.01	0.419	-0.581	0.337
1924	706000	288000	68	97.14	1.03	0.458	-0.542	0.294
1925	645000	320685	67	95.71	1.04	0.510	-0.490	0.240
1926	607000	336533	66	94.29	1.06	0.535	-0.465	0.216
1927	625000	359000	65	92.86	1.08	0.571	-0.429	0.184
1928	447000	407000	64	91.43	1.09	0.647	-0.353	0.125
1929	572000	414857	63	90.00	1.11	0.659	-0.341	0.116
1930	657000	426000	62	88.57	1.13	0.677	-0.323	0.104
1931	447000	435000	61	87.14	1.15	0.691	-0.309	0.095
1932	572000	440000	60	85.71	1.17	0.699	-0.301	0.090
1933	607000	447000	59	84.29	1.19	0.711	-0.289	0.084
1934	585000	447000	58	82.86	1.21	0.711	-0.289	0.084
1935	632000	458000	57	81.43	1.23	0.728	-0.272	0.074
1936	500000	458766	56	80.00	1.25	0.729	-0.271	0.073
1937	435000	458825	55	78.57	1.27	0.729	-0.271	0.073
1938	519000	483000	54	77.14	1.30	0.768	-0.232	0.054
1939	485000	485000	53	75.71	1.32	0.771	-0.229	0.052
1940	458000	489791	52	74.29	1.35	0.779	-0.221	0.049
1941	407000	500000	51	72.86	1.37	0.795	-0.205	0.042
1942	574000	500592	50	71.43	1.40	0.796	-0.204	0.042
1943	696000	504000	49	70.00	1.43	0.801	-0.199	0.040
1944	694000	519000	48	68.57	1.46	0.825	-0.175	0.031
1945	633000	523000	47	67.14	1.49	0.831	-0.169	0.028
1946	504000	523892	46	65.71	1.52	0.833	-0.167	0.028
1947	359000	527000	45	64.29	1.56	0.838	-0.162	0.026
1948	760000	560301	44	62.86	1.59	0.891	-0.109	0.012
1949	775000	560304.1	43	61.43	1.63	0.891	-0.109	0.012
1950	776000	565000	42	60.00	1.67	0.898	-0.102	0.010
1951	483000	572000	41	58.57	1.71	0.909	-0.091	0.008
1952	594000	572000	40	57.14	1.75	0.909	-0.091	0.008
1953	608000	574000	39	55.71	1.79	0.912	-0.088	0.008
1954	426000	585000	38	54.29	1.84	0.930	-0.070	0.005
1955	805000	586000	37	52.86	1.89	0.931	-0.069	0.005
1956	998000	592000	36	51.43	1.94	0.941	-0.059	0.003
1957	661000	594000	35	50.00	2.00	0.944	-0.056	0.003
1958	1098000	607000	34	48.57	2.06	0.965	-0.035	0.001
1959	972000	607000	33	47.14	2.12	0.965	-0.035	0.001
1960	755000	607000	32	45.71	2.19	0.965	-0.035	0.001
1961	787000	608000	31	44.29	2.26	0.966	-0.034	0.001
1962	440000	625000	30	42.86	2.33	0.993	-0.007	0.000
1963	523000	632000	29	41.43	2.41	1.005	0.005	0.000
1964	682000	633000	28	40.00	2.50	1.006	0.006	0.000
1965	565000	633000	27	38.57	2.59	1.006	0.006	0.000
1966	665000	645000	26	37.14	2.69	1.025	0.025	0.001
1967	657000	657000	25	35.71	2.80	1.044	0.044	0.002
1968	586000	657000	24	34.29	2.92	1.044	0.044	0.002
1969	607000	661000	23	32.86	3.04	1.051	0.051	0.003
1970	288000	665000	22	31.43	3.18	1.057	0.057	0.003
1971	527000	682000	21	30.00	3.33	1.084	0.084	0.007
1972	320685	694000	20	28.57	3.50	1.103	0.103	0.011
1973	1076548	696000	19	27.14	3.68	1.106	0.106	0.011
1974	241210	706000	18	25.71	3.89	1.122	0.122	0.015
1975	1024882	711187	17	24.29	4.12	1.130	0.130	0.017
1976	1161472	755000	16	22.86	4.38	1.200	0.200	0.040
1977	523892	760000	15	21.43	4.67	1.208	0.208	0.043
1978	1092770	775000	14	20.00	5.00	1.232	0.232	0.054
1979	458766	776000	13	18.57	5.38	1.233	0.233	0.054
1980	560301	787000	12	17.14	5.83	1.251	0.251	0.063
1981	500592	805000	11	15.71	6.36	1.280	0.280	0.078
1982	414857	972000	10	14.29	7.00	1.545	0.545	0.297
1983	711187	998000	9	12.86	7.78	1.586	0.586	0.344
1984	560304.1	1022065	8	11.43	8.75	1.625	0.625	0.390
1985	336533	1024882	7	10.00	10.00	1.629	0.629	0.396
1986	1122874	1069000	6	8.57	11.67	1.699	0.699	0.489
1987	263830	1076548	5	7.14	14.00	1.711	0.711	0.506
1988	1069000	1092770	4	5.71	17.50	1.737	0.737	0.543
1990	489791	1098000	3	4.29	23.33	1.745	0.745	0.555
1991	458825	1122874	2	2.86	35.00	1.785	0.785	0.616
1992	1022065	1161472	1	1.43	70.00	1.846	0.846	0.716
							SUM =	8.30
SUM =	44039382							
		N	70				Cv =	0.35
	MEAN FLOOD =		629134.03					

