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RENARDET ENGINEERING

HYDROLOGICAL STUDY FOR MINI HYDROS PROJECTS IN WEST SUMATRA (INDONESIA)

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C O N T E N T S

INTRODUCTION

1 - As part of the second stage of the mini-hydro-projects in WEST SUMATRA (Feasibility study) the purpose of this study was to assess the main hydrological parameters for the six proposed sites.

Because of lack of available data for the concerned catchments, the hydrological study would be carried out using indirect methods based upon the knowledge of climatic and physical data and comparison with similar catchment areas.

As a matter of fact, direct stream measurement have only started in the middle of 1985 on the concerned rivers and at the present time, the first gathered data are not still adequate to be used for such a study.

2 - As all the mini-hydros are run-of-river projects, long time series of daily discharges are required and especially low flow data for the firm discharge estimation.

The most interesting formulation of mean daily flows for such run-of-river hydropowers is so-called "duration curve" representing empirical marginal distribution function of mean daily flows.

3 - For generation of daily flow data a conceptual rainfall-runoff model has been used.

Unfortunately, only monthly rainfalls records were available on the stations retained as the most representative for each proposed site and daily records have been collected only for two stations located in the area of the study.

So, in a first step, daily rainfall data, used as input of the hydrological model, have been generated from observed monthly precipitations and the two available series of daily data.

4 - After the calibration of the model from records of gaged catchments in the neighboring region (national hydrometric network) and transposition of the parameters to the concerned sites, sequences of simulated daily flows have been generated.

5 - At the end a statistical analysis of results has been undertaken to assess the required hydrological parameters.

6 - For design flood estimation on each site, the "Rational Method" has been used.

To estimate the design rainstorm required by this procedure, results of a regional precipitations frequency study in peninsular MALAYSIA (under similar climatic conditions) have been transposed to WEST SUMATRA.

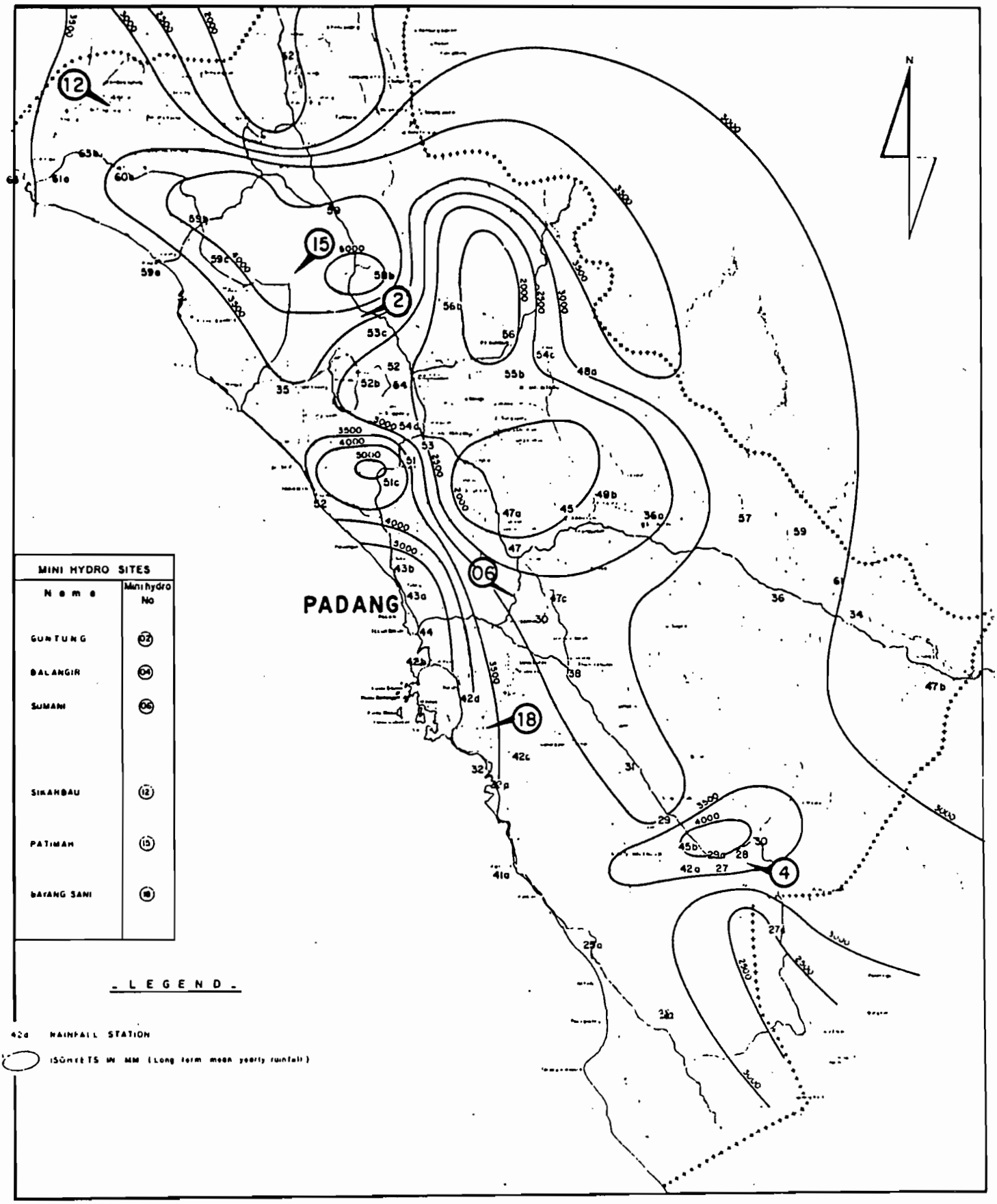


Fig. 1 **SITUATION MAP**

1. CATCHMENTS DESCRIPTION

1.1. Location

All the sites are located in WEST SUMATRA between the parallel 01° of north latitude and the parallel 02° of south latitude (see situation map fig. 1 and table 1).

TABLE 1. LIST OF THE SITES

CODE N°	NAME	DISTRICT	COORDINATES OF INTAKE
02	Batang Air GUNTUNG	Agam	S 00° 09' 00 E 100° 14' 22
04	Batang BALANGIR	Solok	S 01° 35' 55 E 101° 13' 46
06	Batang SUMANI	Solok	S 00° 54' 08 E 100° 37' 05
12	Batang SIKARBAU	Pasaman	S 00° 24' 06 E 99° 34' 32
15	Sunger PATIMAH	Pasaman	S 00° 00' 50 E 100° 04' 12
18	Batang BAYANG SANI	Pesisir Selatan	S 01° 13' 36 E 100° 34' 11

1.2. Characteristics of basins

The main physical characteristics are given in tables 2a to 2f.
All the catchments have a mountainous relief with a steep slope as shown by the global slope index (IG) which remains between 30 and 176 m/km.

Geology is typically volcanic with andesite, tuff, breccia or lava formations and deeply weathered residual soils in surface containing a high proportion of clay in the low parts.

Vegetation cover is mainly constitued by secondary forest, jungle and sometimes plantations (rubber, coffee, cacao). The SUMANI catchment is more cultivated with padi fields in the low part of the basin.

Table 2a PHYSICAL CHARACTERISTICS OF GUNTUNG

HYPSOMETRY	
elevation greater than (m)	% of basin
450	100
600	96.5
800	61.4
1000	30.4
1200	10.9
1400	2.2
1600	0.8
1850	0.0

RELIEF	Area	147 km2
	Perimeter	58.3 km
	Slope global index	30 m/km
	Mean elevation	912 m
	Median elevation	860 m
GEOLOGY	Volcanic tuff (about 50%), andesite, metamorphic sandstones	
VEGETATION	Secondary jungle	
CLIMATE	Mean annual rainfall	3200 mm
	Mean annual potential evaporation	1100 mm

Table 2b PHYSICAL CHARACTERISTICS OF BALANGIR

HYPSOMETRY	
elevation greater than (m)	% of basin
170	100
250	98.5
500	86.2
750	70.8
1000	56.3
1250	35.3
1500	13.9
1750	2.2
1996	0.0

RELIEF	Area	40.6 km2
	Perimeter	29 km
	Slope global index	176 m/km
	Mean elevation	1560 m
	Median elevation	1330 m
GEOLOGY	Volcanic rocks, tuff breccia and lava	
VEGETATION	Forest, some rubber plantation near the intake	
CLIMATE	Mean annual rainfall	3000 mm
	Mean annual potential evaporation	1000 mm

Table 2c PHYSICAL CHARACTERISTICS OF SUMANI

HYPSOMETRY	
elevation greater than (m)	% of basin
600	100
750	99.0
1000	77.8
1250	28.0
1500	11.2
1750	4.8
2000	2.1
2470	0.0

RELIEF	Area	80.9 km2
	Perimeter	36.9 km
	Slope global index	79 m/km
	Mean elevation	1190 m
	Median elevation	2100 m
GEOLOGY	Volcanic formations : undifferenciated flows and colluvial deposits	
VEGETATION	Secondary forest with cultivated areas, padi fields very little forest cover remains	
CLIMATE	Mean annual rainfall	2750 mm
	Mean annual potential evaporation	875 mm

Table 2d PHYSICAL CHARACTERISTICS OF SIKARBAU

HYPSOMETRY	
elevation greater than (m)	% of basin
170	100
250	98.5
500	86.2
750	70.8
1000	56.3
1250	35.3
1500	13.9
1750	2.2
1996	0.0

RELIEF	Area	115 km2
	Perimeter	53 km
	Slope global index	63 m/km
	Mean elevation	1054 m
	Median elevation	1090 m
GEOLOGY	Volcanic formations	
VEGETATION	Mainly jungle, very little cultivated areas	
CLIMATE	Mean annual rainfall	3500 mm
	Mean annual potential evaporation	1050 mm

Table 2e PHYSICAL CHARACTERISTICS OF PATIMAH

HYPSOMETRY	
elevation greater than (m)	% of basin
150	100
250	85.8
500	57.2
750	24.4
1000	11.0
1250	7.1
1500	5.2
1750	3.8
2000	2.6
2200	1.7
2400	0.9
2600	0.3
2800	0.1
2912	0.0

RELIEF	Area	142 km2
	Perimeter	55 km
	Slope global index	63 m/km
	Mean elevation	644 m
	Median elevation	550 m
GEOLOGY	Recent lava and volcanic tuff	
VEGETATION	Forest (50% of the area), jungle and a part cultivated (about 40%)	
CLIMATE	Mean annual rainfall	4500 mm
	Mean annual potential evaporation	1275 mm

Table 2f PHYSICAL CHARACTERISTICS OF BAYANG SANI

HYPSOMETRY	
elevation greater than (m)	% of basin
270	100
300	99.3
400	87.4
500	60.4
750	27.2
1000	12.3
1250	4.9
1500	0.3
1520	0.0

RELIEF	Area	9.74 km2
	Perimeter	17 km
	Slope global index	122 m/km
	Mean elevation	646 m
	Median elevation	560 m
GEOLOGY	Volcanic rocks, tuff, breccia and lava	
VEGETATION	Forest and some rubber plantations	
CLIMATE	Mean annual rainfall	4000 mm
	Mean annual potential evaporation	1270 mm

1.3. Climate

The province of West SUMATRA is situated astride the equator and is bordered by the Indian Ocean. The climate is almost entirely controlled by the monsoon circulations of south east Asia.

West SUMATRA is under two monsoons, the north west monsoon (called the "wet monsoon") from november to march and the south east monsoon (called the "dry monsoon") from march to october. However, local climatic effects due to the relief march disturb the monsoonal system.

Due to the structure of the island and its geographical location, the air over the area is warm and moist.

The monthly mean temperature and humidity do not change very much throughout the year (PADANG : mean annual temperature 29°C ; mean annual relative humidity : 80 %).

The very humid and warm air masses produce heavy rainfall by combination of 3 trigger mechanisms : convergence, convection and orographics effects.

West SUMATRA is one of the most rainy place in the world : annual average rainfall exceeds 5000 mm at many locations with recorded values in excess of 6000 mm [1].

Rainfall lows actually occur in february and july, the low in february usually being less pronounced than that of july.

The main wet season occurs from october to january and a secondary peak in rainfall occurs in april.

2. AVAILABLE DATA

2.1. Rainfall

2.1.1. Selected rainfall stations. Monthly records for about 100 rainfall stations in West SUMATRA had been collected for the prilimi-nary screening of the sites (first stage report [2]). The location of these stations and the long time mean isohyets are shown on the situation map (fig. 1).

The following stations (table 3) have been selected for their geographical location and period of records as the most representative for each catchment :

TABLE 3 : SELECTED RAINFALL STATIONS

NUMBER	NAME	PERIOD OF RECORDS
27	LIKI	1916-41 ; 1952-57 ; 1960
28	SUNGEI LANDEI	1916-21
38	ALAHAN PANDJANG	1916-41 ; 1953 ; 1957-75
38a	INDRAPURA	1924-41 ; 1951-57 ; 1961 ; 1963 ; 1966-67 ; 1979-81
42b	BARUNG BALANTAI	1924-41 ; 1953-59 ; 1961 ; 1963 ; 1973 ; 1975
47	SOLOK	1916-41 ; 1951-61 ; 1967-69 ; 1973 ; 1976-78
47c	KUBANGNAN DUA	1924 ; 1926-41
53	PADANG PANJANG	1916-41 ; 1954-60 ; 1963-79
53c	PAALEMBAJAN	1924 ; 1926-41 ; 1954-57
54	BUKITTINGGI	1916-41 ; 1951-66 ; 1981
56	SULIKI	1924 ; 1926-41 ; 1951-56 ; 1974-81
59	LUBUKSIKAPING	1916-41 ; 1951-57 ; 1973-80
59c	BATANG PASAMAN	1930-39 ; 1940-41
63b	PARIT	1924 ; 1926-1938 ; 1940-41

For the stations of table 3, only monthly data and the annual maximal daily rainfall are available.

Fortunately, during this second stage (feasibility study) recent daily data for 2 stations have been collected at the meteorological office of PADANG Airport :

PADANG TABING	1971-1985
SUKARAMI	1975-1985

2.1.2. Critical review. At first rainfall data have been reviewed from a qualitative point of view before to be used.

The temporal and spatial homogeneity of annual records has been checked by using the method of the "Regional vector" [3] , [4].

In this method, a reference vector with annual components is computed from all the regional available data.

Then, each station is checked up against such a vector. The elaboration of the vector lies on the principle that the most likely information is that which repeats itself the most frequently.

In West SUMATRA, the quality control indicates that for the most stations, data are not reliable past 1941.

As far as possible the gaps in the time series have been filled from near stations and some corrections have been introduced when systematic errors have been detected (for instance : station 42b from 1937 to 1941). The too uncertain years have been deleted as, for example, the years since 1941 at the station number 59. The resulting operational data set of monthly rainfall is given in appendix 1.

2.1.3. Statistical analysis. A statistical analysis has been undertaken on the main rainfall stations (with long time series) for the annual total rainfall and for the annual maximum daily rainfall.

Each sample of observed values has been fitted to 9 usual distribution models by the method of maximum likelihood :

Normal distribution (GAUSS)
GUMBEL distribution
Log normal distribution (GALTON)
PEARSON 3 distribution (incomplete gamma in X)
PEARSON 5 distribution (incomplete gamma in 1/X)
GOODRICH distribution
FRECHET distribution
Log gamma distribution
Cox and Miller distribution (law of "leaks")

The following tables resume the results obtained with the most adequate distribution model :

table 4 : for annual total rainfall
table 5 : for annual maximum daily rainfall

TABLE 4. ANNUAL RAINFALL (mm)

STATIONS		PROBABILITY						
		DRY YEARS			MEDIAN	WET YEARS		
NAME	Nc	0.01	0.02	0.10	0.50	0.90	0.98	0.99
LIKI	27	2611	2778	3270	4047	4704	5043	5154
ALAHANPANDJANG	38	1781	1812	1927	2258	2986	3876	4343
INDRAPURA	38a	2498	2556	2799	3437	4260	4779	4994
BARUNG BALANTAI	42b	2414	2655	3328	3688	5074	5455	5578
SOLOK	47	1464	1508	1648	1952	2386	2738	2884
SUNGEI PANJANG	28	984	1156	1642	2450	3257	3744	3916
PADANG PANJANG	53	2759	2791	2905	3217	3909	4802	5289
PAALEMBAJAN	53c	1735	1839	2140	2597	2970	3160	3221
BUKITTINGGI	54	1717	1745	1845	2123	2638	3143	3372
LUBUKSIKAPING	59	3225	3352	3741	4502	5430	6087	6338

TABLE 5. MAXIMUM DAILY RAINFALL (mm)

STATIONS		PROBABILITY						
		DRY YEARS			MEDIAN	WET YEARS		
NAME	No	0.01	0.02	0.10	0.50	0.90	0.98	0.99
LIKI	27	74.5	76.4	83.2	102	144	195	221
INDRAPURA	38a	80.4	88.2	113	160	215	252	266
BARUNG BALANTAI	42b	90.5	98.0	122	178	265	241	373
SOLOK	47	54.5	57.3	66.9	88.9	122	150	161
PADANG PANJANG	53	65.4	70.2	85.9	121	177	226	246
PAALEMBAJAN	53c	34.4	36.7	45.6	74.2	153	273	345
BUKITTINGGI	54	45.4	47.6	55.1	73.0	102	129	140
LUBUKSIKAPING	59	74.0	77.7	88.4	115	165	214	237

2.2. Evaporation

Because of high intensity rainstorms, accurate pan evaporation records are difficult to achieve in West SUMATRA, especially during the monsoon months.

Pan evaporation (class A) records were available at two climatological stations :

PADANG GUNUNG NAGO (coastal station) : 1977-1984
SUKARAMI (928 m above the sea level) : 1975

The total depth for 1975 at SUKARAMI is 1668 mm ; average of the monthly and annual values at PADANG are given in the table 6.

TABLE 6. AVERAGE OF PAN EVAPORATION AT PADANG (mm)

J	F	M	A	M	J	J	A	S	O	N	D	YEAR
147	133	143	136	142	138	132	147	132	142	127	141	1660

- According to the location of the station (on the seaside), these values seem to be very low and the reliability of data is questionable.

So, for calculation of evaporation on the forested catchments, only the monthly distribution observed at PADANG have been kept and transposed results of a previous study of evaporation in Peninsular MALAYSIA [5] have been prefered to assess the annual depth of evaporation.

Potential evaporation from forested area is assumed to be a decreasing function of the elevation as shown by the summarised results of the table 7.

TABLE 7. EVAPORATION-ELEVATION RELATIONSHIP FOR FOREST AREA

Mean elevation (m above sea level)	0	250	500	1000	1500
Annual evaportation (mm)	1635	1325	1240	1078	812

2.3. River flow

All the selected sites have been instrumented with staff gauges in the middle of 1985.

The gauging stations are operating since a very short time and the rating curves are still without sufficient reliability to be use for accurate discharge calculation.

There are some permanent recorder stations (national hydrological network) in the study area but most of them are recent stations and data processing of the new records is not still executed.

Four stations are interesting for the study but the quality of the records is somewhat variable, particulary during period of low stage. These stations are the following :

BATANG BATAHAN at SILAPING	(1 170 00 01)	1973-1979
BATANG TONGAR at LUBUK TOREH	(1 165 00 03)	1974-1980
BATANG MASANG at SIPISANG	(1 164 00 01)	1975, 1978, 1980-1981
BATANG SUMANI at BANDAR PADUNG	(1 006 00 05)	1977-1981

All the gauging stations are instrumented with automatic level recorders (OTT-R10) and the records are send to the Central Office of Hydrology for data processing.

3. FLOW DATA ELABORATION

3.1. Method

The lack of actual site data has necessitated simulating river flows using a rainfall-runoff model.

3.2. Restoration of daily rainfalls

As the conceptual model is working in a daily time step, daily data were requested to be used as input.

To restore daily rainfalls at the selected stations (see paragraph 2.1.) the following procedure has been used :

a) Ranging the monthly rainfalls RM at the station where daily data were available (PADANG) and RMB at the selected stations where only monthly data were available.

b) Attributing to each monthly values RMB the observed daily data corresponding to the monthly value RM of the similar rank with a RMB/RM ponderation.

Such generated records are not the true historical values but are approximately equivalent in a statistical sense. They are suitable for low and mean flow data elaboration but frequently high generated values are not very reliable.

3.3. Model description

- A conceptual model is constructed by forming a simplified representation of hydrological processes involved in producing runoff from rainfall on a catchment.

The selected model is a tank model developped by IBIZA [6] and adapted for small steep basins under rainy climates.

The "runoff production function" is based on the water balance equation. The input data are the daily rainfalls and the potential evaporation providing the climate characteristics and some physical parameters providing the watershed characteristics.

- The movement of water over, into and through the soil is simulated by transfers from one level to another through a combination of stores :

The rainfalls supply a first storage at the vegetal layer (upper soil store) in which the vegetation takes evaporation. The water in excess is divided into two parts according to the soil permeability :

- a first part producing the fast runoff EC is determined by the fast flow rate q.

- the second part feeds by infiltration the underground storage constitued by the groundwater body (subsoil store HNO).

This last store HNO produces the base flow with a depletion coefficient AL but can also overflow in another store (interflow store HNO1). The store HNO1 produces a slow interflow with a coefficient R2 and also fast runoff, added to EC, when it is full.

The slow interflow is interpreted as a supplemental temporary drainage of the watertable by high points ("overflowing of the watertable") and the quantity of overflow is an increasing function of the watertable level.

The saturation of the subsoil store induces a reduction of infiltration which can be revealed by a concept of "rejected infiltration".

So for small basins under rainy climate, a balance occurs between input and output of the watertable which is termed as "maximum balance". Under these conditions the main parameters which govern the different slow flows are linked to one another and to the physical characteristics of the basin (permeability and slope) as shown by figures 2 to 4 which give such graphical relationships drawn from results of analysis of many volcanic basins in humid zone.

3.4. Calibration of the model

The three recorded catchments of BATAHAN (310 km²), TONGAR (266 km²) and MASANG (458 km²) were assumed to be pilot basins for the mountainous areas and have been used to compute the regional values of the model parameters :

AL	coefficient of depletion
HNO	capacity of the subsoil store
R2	coefficient of slow interflow
HNO1	capacity of the interflow store.

A first assessment of parameters is given by examination of the hydrographs (in logarithmic coordinates); then calibration is carried out by comparison between observed and computed discharges.

Because daily rainfall input were fictitious elaborated data (see paragraph 3.2) only monthly values have been compared.

Final optimised parameters are given in table 8.

TABLE 8. MAIN MODEL PARAMETERS FOR RECORDED BASINS

BASIN	Area km²	Slope global index m/km	AL day -1	HNO mm	R2 day -1	HNO1	q
BATAHAN	310	30.2	0.008	670	0.168	130	0.30
TONGAR	266	31.6	0.005	870	0.192	100	0.35
MASANG	458	25.0	0.0035	935	0.158	100	0.40

3.5. Transposition to the sites

Figures 2 to 4 indicate that these results are in a good accordance with relationships carried out for volcanic basins in similar conditions.

So it was assumed that the relationships (fig. 2 to 4) between the model parameters and the physical characteristics were suitable for the sites.

Fig. 2 **RELATION BETWEEN THE DEPLETION COEFFICIENT (AL) AND THE SLOPE INDEX (IG)**

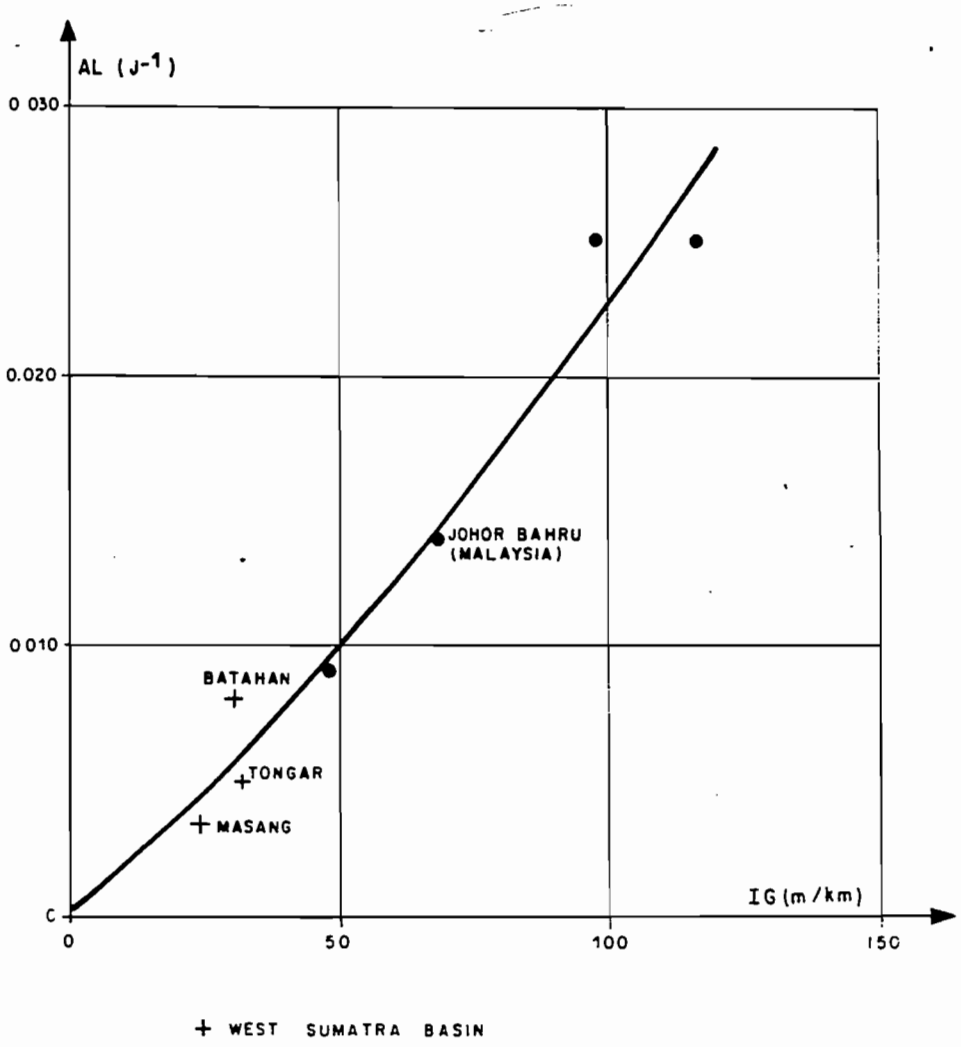


Fig. 3 RELATION BETWEEN THE SUBSOIL STORE CAPACITY (HNO), THE FAST FLOW RATE (q) AND THE DEPLETION COEFFICIENT (AL)

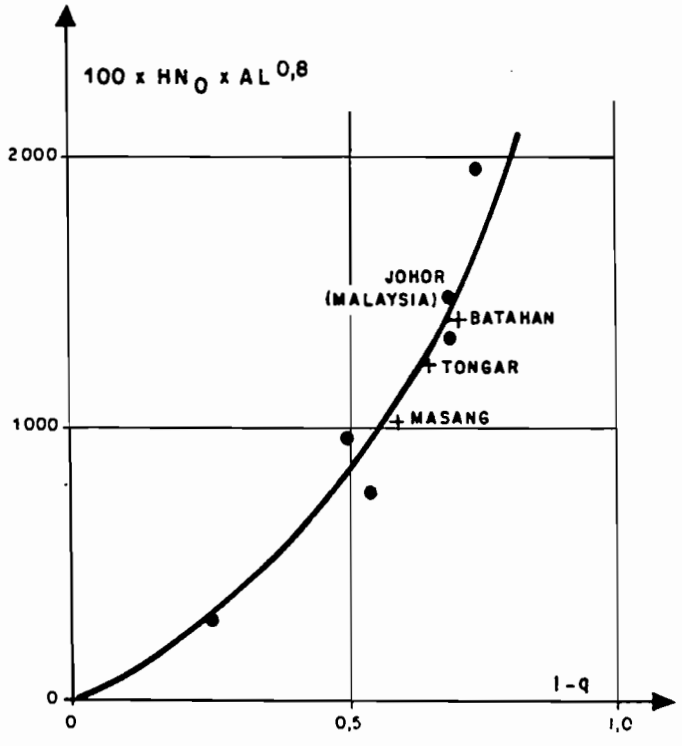
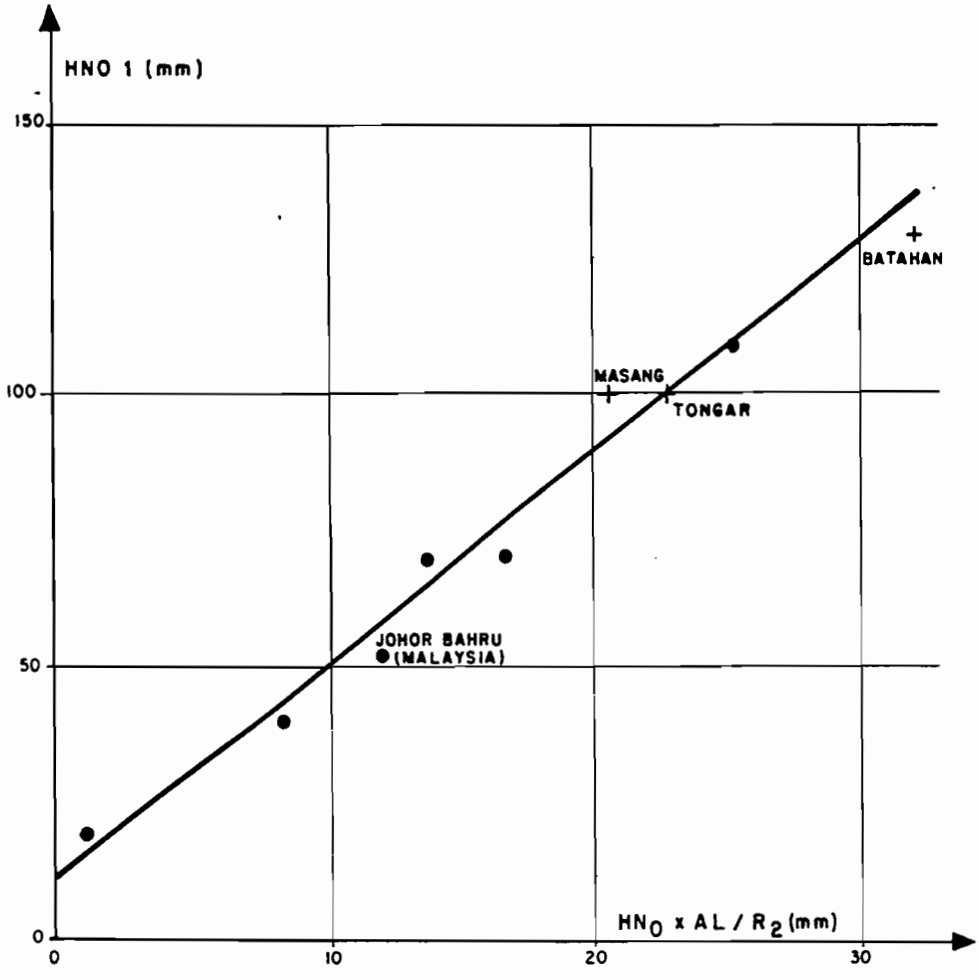


Fig. 4 **RELATION BETWEEN THE INTERFLOW STORE CAPACITY (HN_{o1}), THE DEPLETION COEFFICIENT (AL) AND THE INTERFLOW COEFFICIENT (R2)**



+ WEST SUMATRA BASIN

The fast flow rate q was assumed to be constant for the region and equalled to the mean value 0.35 which is in accordance with a great permeability. Then the other parameters have been estimated by using the previous empirical relationships.

3.6. Generation of flow data

The monthly and yearly computed discharges of the 6 sites are given in appendix 2. Mean daily discharges are not included in this report.

4. ANALYSIS OF GENERATED FLOWS

4.1. Monthly and yearly flows

The overall quantity of surface water that is available in each basin for water ressources managment is well characterized by the mean annual flow.

Mean monthly flows serve as the main tool for describing intra-year distribution of runoff.

Monthly and annual discharges have been put in order by increasing values. Results are given in appendix 3 and are summarised in tables 9a and 9b.

Mean specific discharges are large and range from 106 l/s/km² for PATIMAH to 60.4 l/s/km² for SUMANI.

However, for a low-head water power development, with no or relatively small flow regulating capactity, the total annual electric output will depend much less on the annual volume of runoff than on its distribution throughout the year.

In such case with limited possibilities of water redistribution the main importance is the day-to-day water inventory and especially for the low flows period.

TABLE 9a. SUMMARY OF MEAN MONTHLY AND ANNUAL FLOWS (m^3/s)

SITE		J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
GUNTUNG	Mean	11.2	8.77	9.71	11.2	9.45	6.52	5.43	5.74	8.73	11.8	15.2	16.2	9.98
	Min	6.88	6.02	5.52	5.91	5.26	4.18	3.49	3.45	4.58	7.10	11.9	7.64	6.75
	Max	21.3	12.4	21.9	20.4	16.8	11.2	8.44	7.85	16.0	16.9	24.6	24.5	13.2
BALANGIR	Mean	6.46	4.49	4.60	3.90	3.63	2.78	2.04	2.52	3.54	4.01	4.26	4.59	3.96
	Min	2.97	1.28	1.56	1.98	1.62	0.445	0.256	0.416	1.06	0.833	1.040	0.688	2.52
	Max	13.8	11.1	9.01	9.60	6.71	5.49	5.89	6.46	6.88	7.24	8.73	9.32	5.18
SUMANI	Mean	6.38	4.65	5.87	5.99	5.41	3.43	2.35	2.73	3.48	5.31	6.94	6.33	4.89
	Min	1.85	1.45	1.65	1.29	1.54	1.13	1.18	0.982	1.22	2.22	2.11	2.00	3.12
	Max	16.2	13.7	21.9	10.9	11.7	8.28	4.61	8.55	6.28	9.36	13.0	10.9	7.36

TABLE 9b. SUMMARY OF MEAN MONTHLY AND ANNUAL FLOWS (m^3/s)

SITE		J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
	Mean	9.97	6.78	8.50	11.3	9.12	6.85	4.85	5.79	8.17	12.1	14.5	11.3	9.09
SIKARBAU	Min	4.92	3.14	4.41	6.27	6.04	3.66	2.62	2.50	3.70	5.04	4.77	5.52	6.05
	Max	18.5	15.1	12.5	19.3	18.3	14.4	10.1	10.4	14.2	32.2	34.7	21.4	13.0
	Mean	15.8	10.4	14.1	19.0	14.9	10.7	7.40	9.46	14.0	21.6	24.3	18.3	15.0
PATIMAH	Min	7.96	4.76	7.84	9.48	9.96	5.46	3.91	3.88	6.17	8.35	7.47	8.85	10.0
	Max	29.5	24.4	20.9	32.8	30.4	24.5	16.4	17.6	25.5	57.1	56.2	36.1	21.5
	Mean	1.04	0.581	0.873	0.996	0.664	0.425	0.427	0.554	0.934	1.23	1.38	1.39	0.861
BAYANG SANI	Min	0.206	0.152	0.130	0.301	0.232	0.139	0.068	0.073	0.072	0.070	0.348	0.577	0.471
	Max	2.32	1.44	1.62	2.53	1.79	0.944	1.65	1.50	3.05	2.41	2.59	3.39	1.16

4.2. Low flows

The daily discharges computed by the hydrological model are corresponding to natural discharges without abstraction by irrigation.

For water management purpose (and especially for run of river projects) it is very interesting to express mean daily flow by the duration curve.

For the mini-hydros of West SUMATRA, the analysis of low flows has been carried out as follows :

- In a first step, for each individual year, all the daily discharges have been ranged in decreasing order giving the annual flow duration curve.

  So discharges DDn not exceeded n days by year have been computed for different values of n and are given in appendix 4.

- In a second step, annual values of DDn, for each specified time n, have been ranged in order from the whole period with computation of the observed frequency.

  Tables in appendix 4 give the results of these operations.

- In a third step, different duration curves for low flows have been drawn from the previous results on figures 5 to 10 :

  - the average duration curve Tm which give an average value of mean daily flow for a specified time of exceedance (in % of the time)

  - the duration curves Ti (with i = 2, 5, 10) which give the value of mean daily flow for a specified time of exceedance (in % of the time) for a i year-return period.

TABLE 10a. LOW FLOW DISCHARGES (m^3/s)

SITE : GUNTUNG (147 km^2)										
Return period (years)	% of Time discharge is equalled or exceeded									
	5	10	20	30	50	70	80	90	95	100
2	28.0	18.9	11.3	8.65	6.70	5.98	5.45	4.85	4.70	4.25
5	22.3	12.1	7.97	6.64	5.80	4.71	4.60	3.90	3.60	3.45
10	15.7	9.89	7.11	5.95	5.15	4.33	3.85	3.30	3.20	3.00
mean year	29.1	17.6	11.0	8.52	6.70	5.74	5.25	4.70	4.50	4.25

TABLE 10b. LOW FLOW DISCHARGES (m^3/s)

SITE : BALANGIR (40.6 km^2)										
Return period (years)	% of Time discharge is equalled or exceeded									
	5	10	20	30	50	70	80	90	95	100
2	12.5	8.52	5.34	3.60	2.35	1.70	1.53	1.20	1.00	0.700
5	9.88	6.64	4.07	3.00	2.00	1.35	1.03	0.710	0.575	0.380
10	8.99	6.32	3.40	2.42	1.70	1.12	0.900	0.575	0.440	0.300
mean year	12.0	8.42	5.09	3.54	2.30	1.71	1.44	1.10	0.950	0.700

TABLE 10c. LOW FLOW DISCHARGES (m^3/s)

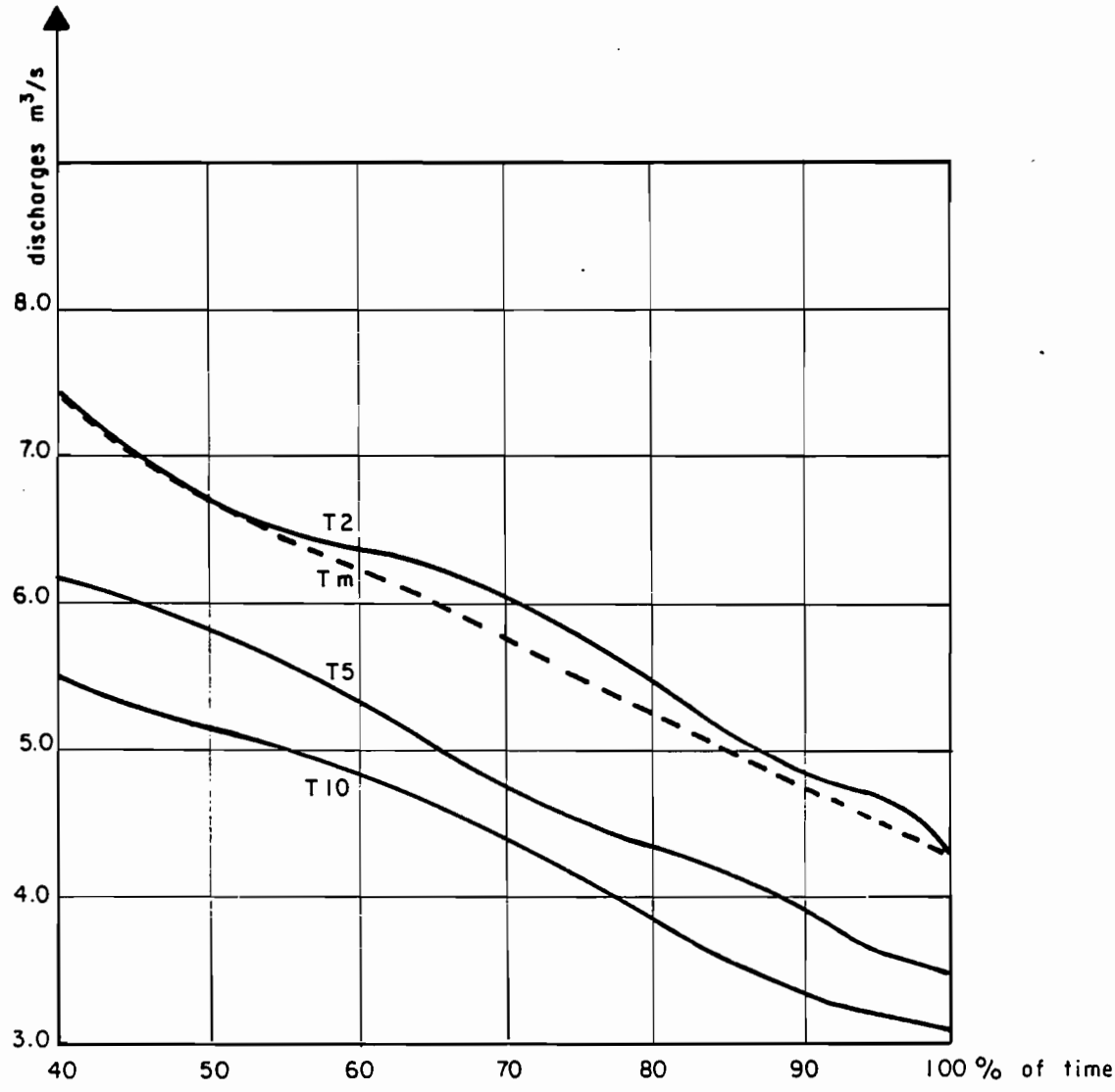
SITE : SUMANI (80.9 km^2)										
Return period (years)	% of Time discharge is equalled or exceeded									
	5	10	20	30	50	70	80	90	95	100
2	13.4	8.36	5.48	4.27	3.50	2.64	2.30	1.85	1.60	1.35
5	10.8	6.61	4.56	3.47	2.65	1.83	1.50	1.20	1.10	1.00
10	10.2	6.29	4.10	3.26	2.35	1.62	1.35	1.10	0.950	0.800
mean year	14.3	8.92	5.65	4.36	3.20	2.50	2.15	1.80	1.60	1.35

TABLE 10d. LOW FLOW DISCHARGES (m^3/s)

SITE : SIKARBAU (115 km^2)										
Return period (years)	% of the Time discharge is equalled or exceeded									
	5	10	20	30	50	70	80	90	95	100
2	25.3	17.0	10.2	7.92	5.80	4.87	4.40	3.90	3.60	3.20
5	19.8	12.7	7.98	6.52	5.00	4.36	3.80	3.30	3.05	2.80
10	18.2	10.9	7.54	5.84	4.60	4.04	3.30	2.70	2.45	2.20
mean year	26.2	17.2	10.6	8.03	5.80	4.85	4.40	3.90	3.60	3.20

Fig. 5

SITE : GUNTUNG (147 km²)

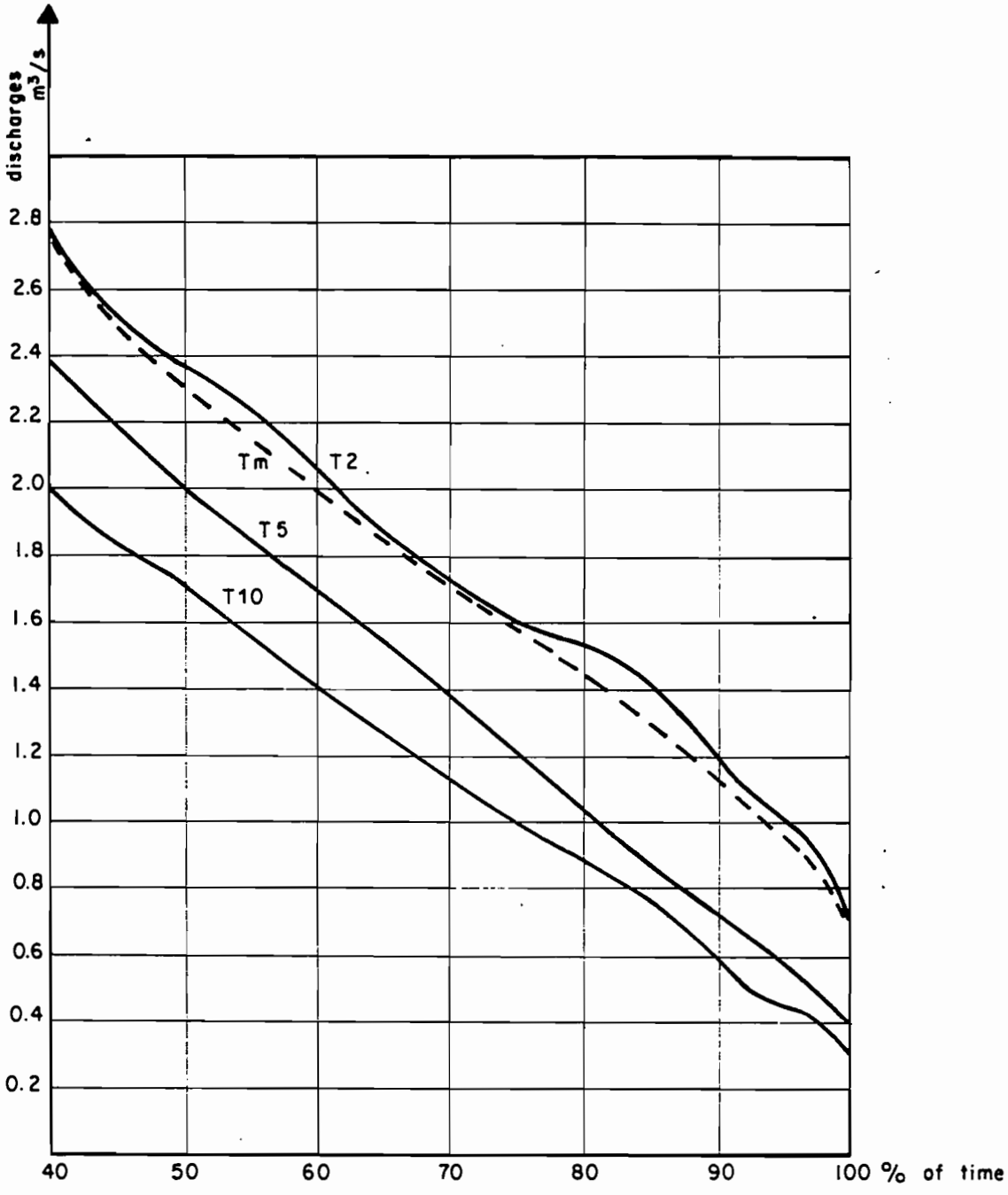


Tm : meon
T2 : 2-year return period
T5 : 5-year return period
T10 : 10-year return period

LOW FLOW DURATION CURVES

Fig. 6

SITE : BALANGIR (40.6 km²)

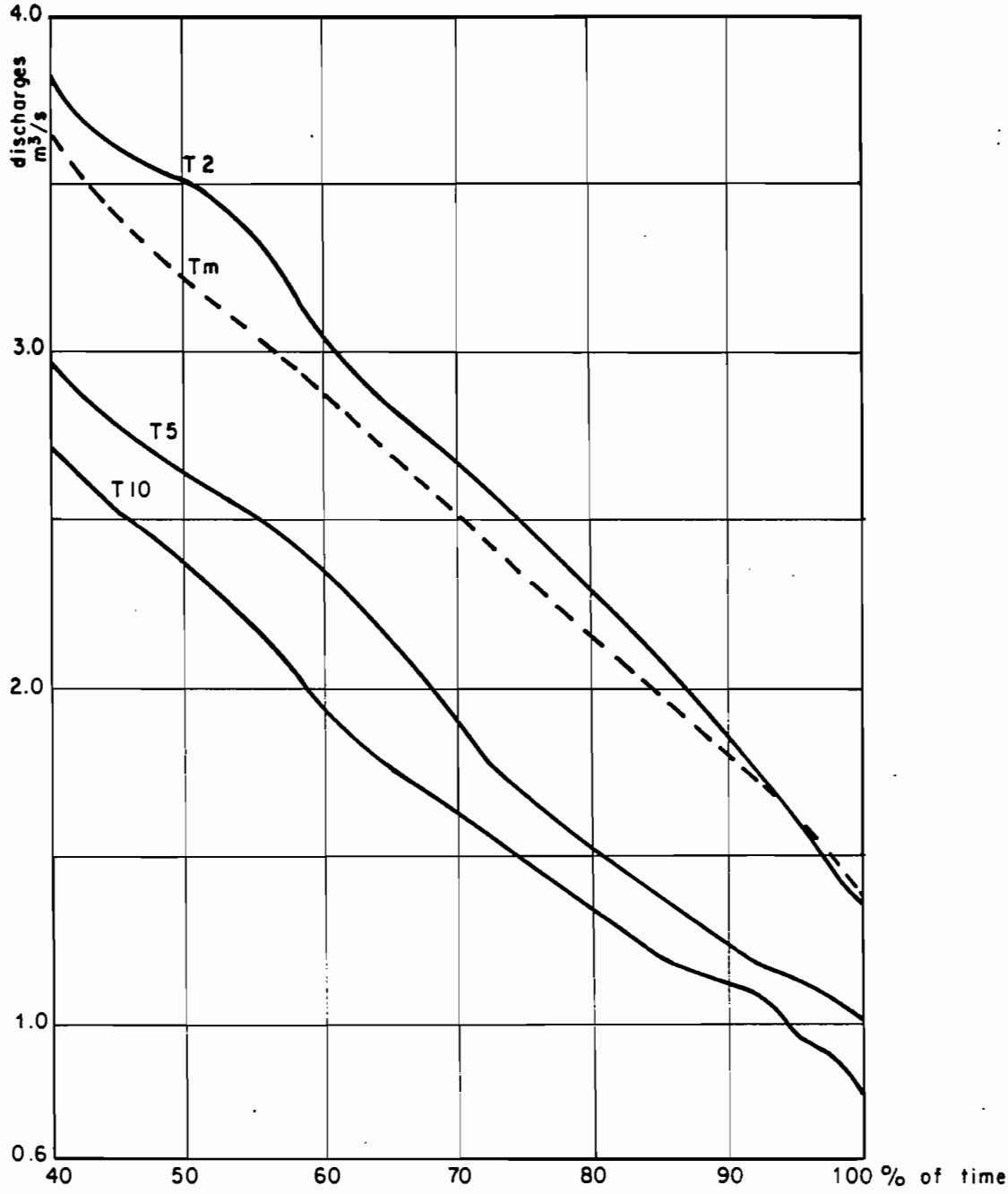


Tm : mean
T2 : 2-year return period
T5 : 5-yeor return period
T10 : 10-year return period

LOW FLOW DURATION CURVES

Fig. 7

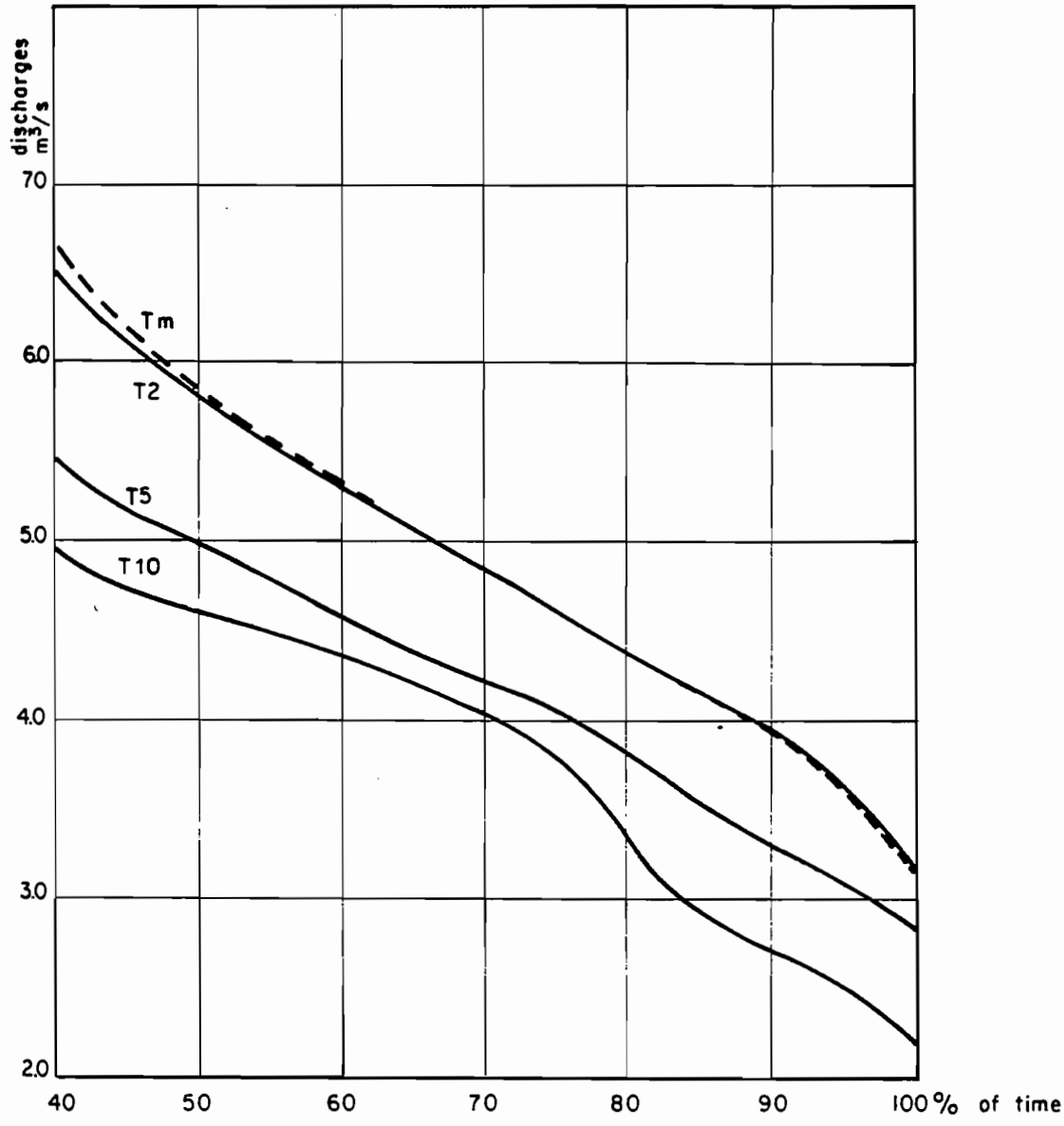
SITE : SUMANI (80.9 km²)



Tm : meon
T 2 : 2-year return period
T 5 : 5-year return period
T10 ; 10-year return period

LOW FLOW DURATION CURVES

Fig. 8 **SITE : SIKARBAU (115 km²)**

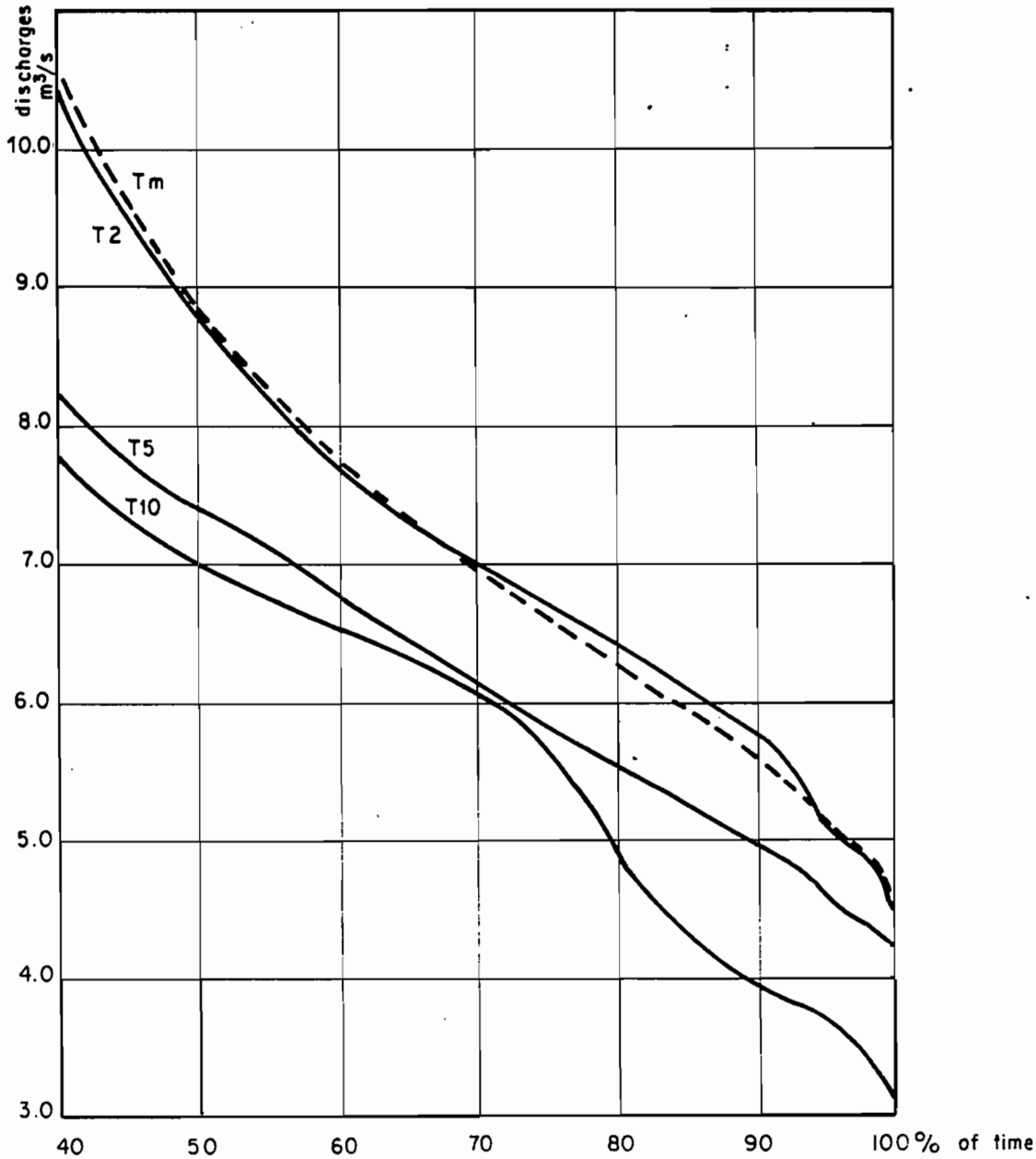


Tm : mean
T 2 : 2 - year return period
T 5 : 5 - year return period
T 10 : 10 - year return period

LOW FLOW DURATION CURVES

Fig. 9

SITE: PATIMAH (142 km²)

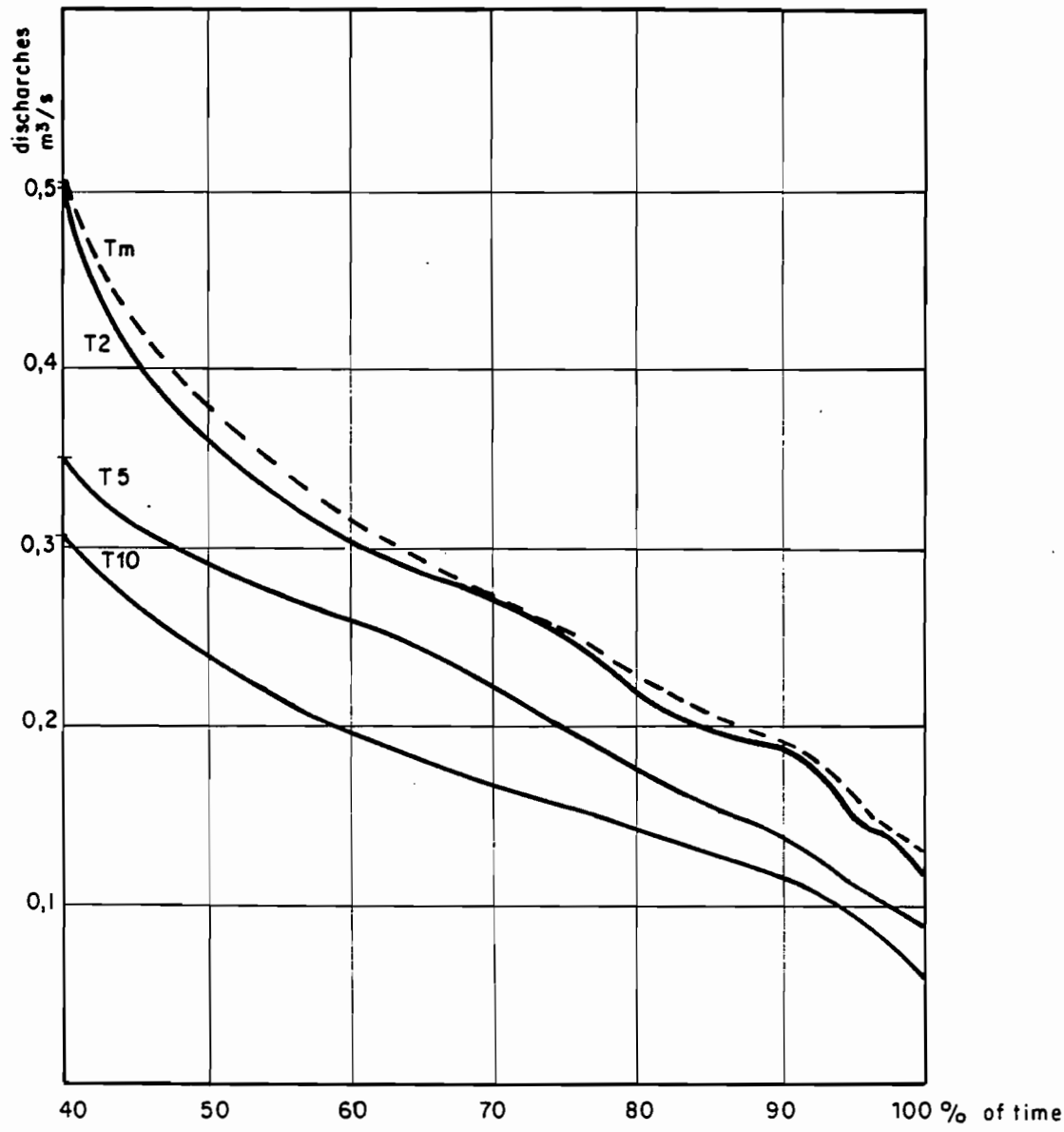


Tm : mean
T 2 : 2 - year return period
T 5 : 5 - year return period
T 10 : 10 - year return period

LOW FLOW DURATION CURVES

Fig. 10

SITE : BAYANG SANI (9.74 km²)



Tm : mean
T2 : 2-year return period
T5 : 5-year return period
T10 : 10-year return period

LOW FLOW DURATION CURVES

TABLE 10e. LOW FLOW DISCHARGES (m^3/s)

SITE : PATIMAH (142 km^2)										
Return period (years)	% of Time discharge is equalled or exceeded									
	5	10	20	30	50	70	80	90	95	100
2	42.6	29.4	18.7	13.1	8.80	6.98	6.40	5.75	5.05	4.40
5	34.3	23.6	13.8	10.0	7.40	6.12	5.50	4.95	4.55	4.20
10	32.4	20.3	12.4	9.05	7.00	6.04	4.85	3.95	3.70	3.15
mean year	44.7	29.4	18.4	13.2	8.80	6.97	6.25	5.60	5.10	4.40

TABLE 10f. LOW FLOW DISCHARGES (m^3/s)

SITE : BAYANG SANI (9.74 km^2)										
Return period (years)	% of Time discharge is equalled or exceeded									
	5	10	20	30	50	70	80	90	95	100
2	2.89	2.09	1.26	0.810	0.360	0.270	0.220	0.185	0.150	0.115
5	2.25	1.36	0.734	0.454	0.290	0.220	0.175	0.140	0.110	0.900
10	2.11	1.27	0.624	0.394	0.240	0.164	0.140	0.115	0.950	0.600
mean year	2.94	1.89	1.15	0.735	0.380	0.270	0.230	0.190	0.160	0.130

5. FLOOD ESTIMATION

5.1. Procedure

To estimate the design flood peaks at the different sites, the "Rational Method" has been used by considering the following conventional formula :

$$Q_T = u\ C\ i_T\ A$$

where :

Q_T is the peak discharge of the design flood with return period T years.

i_T is the average intensity of the design rainstorm of duration equal to the "time of concentration" (Tc) and of return period T years.

A is the area of the supplying catchment.

C is the runoff coefficient which is a dimensionless coefficient normally considered to be a function of the catchment and design storm characteristics.

u is a constant coefficient depending of the units.

If Q_T is in m^3/s, i_T in mm/h, A in km^2, u is equal to 0,278.

Two calculations have been undertaken using this procedure and corresponding to different approaches for estimation of the "time of concentration" (or characteristic time) and the runoff coefficient :

- method 1 is based on results of a regional study of flood estimation for rural cathments in Peninsular MALAYSIA [7].
- method 2 is based on results of similar studies carried out by ORSTOM [6], [8] on small volcanic basins under same climatic conditions.

5.2. Average intensity of the design rainstorm (i_T)

The rainfall dephts corresponding to selected return periods and a range of durations from minutes up to several days are required for flood design purpose.

Unfortunately, until very recently, there were few automatic rainrecorders in West SUMATRA an not any results of regional statistical analysis of rain-records are available for a duration less than the day.

Therefore, results of such a frequency analysis of short duration rainfall data in MALAYSIA [9] have been adapted and used.

The design intensity for a ponctual station has been adjusted to take account of the reduction in storm intensity with catchment area. Table 11 give values of the point rainfall depths adopted for all the sites.

TABLE 11. RAINFALL DEPTHS (in mm)

Return Period (years)	STORM DURATION (hours)						
	1/4	1/2	1	2	3	6	24
5	33	46	62	-	99	143	155
10	39	53	70	-	118	174	190
20	46	59	79	109	136	205	220
50	54	67	90	-	160	243	260

5.3. "Time of Concentration" (Tc)

In a theorical concept this time is defined as being the time taken for the most renote part of the catchment to contribute to flow at the design point.

For a natural catchment, a more realistic concept of this characteristic time is defined as follows :

- In the method 1. This time is considered to be the minimum time of rise of a flood hydrograph that reflects total catchment contribution to flow at the design point (PILGRIM, 1972).

  An empirical relationship derived in MALAYSIA study [9] relates Tc to measurable catchment physiographic characteristics.

  It is of the form :

$$Tc = \frac{0.241\ A^{0.117}\ L}{S^{0.467}}$$

  where :

  Tc is the "time of concentration" in hours
  A is the catchment area in km²
  L is the lenght of the main stream in km
  S is the slope from the main stream in %.

- In the method 2. The characteristic time (θ) is defined as the ratio between the volume of the surface runoff (V) and the peak discharge of the flood (Q_T).

$$\theta = V/Q_T$$

  IBIZA [6] gives empirical graphs which relate θ to the physical characteristics and the vegetative cover of the catchment.

5.4. Runoff coefficient (C)

- In the method 1 values of C are derived from an empirical relationship between the runoff coefficient and the intensity of the design storm. This relationship is the result of computation of C for observed flood data in the most rainy part of MALAYSIA.

- In the method 2 the runoff coefficient is taken depending of the daily rainfall for the selected return period and can be written for a return period T :

$$C_T = 1 - FJ/(aR_T)$$

where :

FJ is the daily capacity of infiltration which is estimated as a result of the hydrological model

R_T is the point daily rainfall for the return period T

a is the reduction in rainstorm with catchment area.

5.5. Computed peak discharges

Peak discharges for each site have been computed by the two methods for return period corresponding to the available rainstorms (5, 10, 20, 50 years).

Estimation of peak discharges for the 100 year-return period has been obtained by fitting a GALTON distribution model. Results are given in table 12 for method 1 and table 13 for method 2.

5.6. Design flood

For design flood estimation the higher value resulting of the 2 methods of calculation for the 100 years return period has been retained. Results are given in table 14.

Specific flood dicharges are relatively high and range from 5,31 m^3/s for the GUNTUNG (147 km^2) to 18,5 $m^3/s/km^2$ for the BAYANG SANI (10 km^2).

These high values, due to the very steep gradient of the catchments and to the heavy rainfall intensities, are in agreement with other results of observed maximum floods in this part of INDONESIA [10] having regard to the areas of the drainage basins.

TABLE 12. PEAK DISCHARGE Q_T WITH RETURN PERIOD T YEARS (method 1)

SITE	Q_5		Q_{10}		Q_{20}		Q_{50}		Q_{100}	
	m^3/s	$m^3/s.km^2$	m^3/s	$m^3/1.Km^2$	m^3/s	$m^3/1.km^2$	m^3/s	$m^3/1.km^2$	m^3/s	$m^3/1.km^2$
GUNTUNG 147 km^2	274	1.87	330	2.25	392	2.67	464	3.16	520	3.54
BALANGIR 40.6 km^2	332	8.18	375	9.23	428	10.55	493	12.1	540	13.3
SUMANI 80.9 km^2	360	4.44	410	5.07	475	5.87	553	6.84	620	7.66
SIKARBAU 115 km^2	415	3.61	495	4.30	575	5.00	666	5.79	730	6.35
PATIMAH 142 km^2	501	3.53	598	4.21	694	4.89	804	5.66	880	6.20
BAYANG SANI 9.74 km^2	115	11.8	126	12.7	143	14.7	165	16.9	180	18.5

TABLE 13. PEAK DISCHARGE Q_T WITH RETURN PERIOD T YEARS (method 2)

SITE	Q_5		Q_{10}		Q_{20}		Q_{50}		Q_{100}	
	m^3/s	$m3/s.km^2$	m^3/s	$m^3/s.km^2$	m^3/s	$m^3/s.km^2$	m^3/s	$m^3/s.km^2$	m^3/s	$m^3/s.km^2$
GUNTUNG 147 km^2	393	2.7	465	3.16	542	3.69	691	4.70	780	5.31
BALANGIR 40.6 km^2	198	4.9	292	7.19	381	9.4	485	11.9	580	14.3
SUMANI 80.9 km^2	289	3.6	335	4.14	433	5.4	629	7.8	810	10.0
SIKARBAU 115 km^2	368	3.2	435	3.8	498	4.3	748	6.5	1020	8.87
PATIMAH 142 km^2	439	3.1	511	3.6	589	4.1	852	6.0	1150	8.10
BAYANG SANI 9.74 km^2	70	7.1	9.3	9.5	116	11.9	147	15.1	176	18.1

TABLE 14. ESTIMATION OF THE DESIGN FLOOD

SITE	AREA (km^2)	PEAK DISCHARGE	
		m^3/s	$m^3/s.km^2$
GUNTUNG	147	780	5.31
BALANGIR	40.6	580	14.3
SUMANI	80.9	810	10.0
SIKARBAU	115	1020	8.87
PATIMAH	142	1150	8.10
BAYANG SANI	9.74	180	18.5

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APPENDICES

APPENDIX 1

MONTHLY RAINFALLS

(Operational data set)

STATION NUMBER 540270 INDONESIA SUMATRA LIKI

MONTHLY RAINFALLS (IN MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1916	556	153	296	463	379	169	304	338	208	338	111	290	3605
1917	843	625	298	705	202	243	255	368	451	169	72	217	4448
1918	551	94	379	301	373	329	292	500	225	329	665	196	4234
1920	425	207	573	207	167	323	49	202	160	107	370	7	2797
1921	421	263	239	364	291	135	106	53	409	494	269	289	3333
1922	532	181	256	762	219	443	218	318	401	493	308	122	4253
1924	511	267	511	381	438	214	125	239	332	175	31	183	3407
1926	345	576	576	275	392	254	252	324	288	450	325	359	4416
1927	314	439	170	228	104	23	45	175	265	443	421	419	3046
1929	182	262	335	502	344	303	197	219	293	511	392	586	4126
1930	349	255	532	340	452	196	31	81	428	615	335	229	3843
1931	588	728	447	388	300	384	344	179	375	149	426	595	4903
1932	461	186	239	273	251	108	268	266	348	568	430	209	3607
1933	987	341	275	365	448	270	314	354	527	201	182	99	4363
1934	695	149	295	290	151	223	201	173	362	563	161	449	3712
1935	396	472	344	223	169	488	149	288	343	301	398	755	4326
1936	273	623	506	263	501	225	74	314	380	547	378	492	4576
1937	588	603	313	409	320	209	179	236	629	419	491	473	4869
1938	441	210	487	430	219	172	231	225	352	342	260	421	3790
1939	286	154	286	404	179	189	47	138	346	303	225	670	3227
1940	277	495	345	496	225	151	101	211	366	358	560	619	4204
1941	376	522	321	447	362	208	190	255	307	297	507	308	4100
1952	616	476	230	118	306	156	173	165	301	166	221	309	3237
1953	362	433	555	418	403	260	485	69	309	430	246	458	4428
1954	584	557	675	167	202	355	334	272	190	437	170	284	4227
1955	1005	253	677	485	97	408	484	401	368	263	89	389	4919
1956	370	440	410	267	142	109	189	257	238	356	528	317	3623
1957	520	294	252	683	415	115	153	150	250	407	653	687	4579
MEAN	495	366	387	381	288	238	207	242	338	365	329	373	4007

STATION NUMBER 540380 INDONESIA SUMATRA ALAHANPANDJANG

MONTHLY RAINFALLS (IN MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1916	128	46	130	356	132	142	184	256	220	172	90	263	2119
1917	293	317	200	197	179	121	141	408	193	55	57	125	2286
1918	177	43	387	187	168	158	101	177	178	262	491	69	2398
1920	285	156	504	335	168	315	38	95	130	136	281	85	2528
1921	0	125	114	80	123	64	157	40	311	376	205	220	1815
1922	132	59	88	261	110	112	61	84	124	464	273	369	2137
1924	182	120	303	132	315	132	103	155	284	218	132	231	2307
1926	215	430	713	298	283	82	156	93	182	284	288	120	3144
1927	105	239	110	175	92	12	55	132	177	266	438	203	2004
1928	545	65	182	380	228	37	94	194	344	365	383	333	3150
1933	408	83	177	219	196	9	72	290	122	297	209	128	2210
1934	233	101	146	167	86	251	36	144	223	216	147	164	1914
1935	127	202	144	172	147	150	126	191	161	290	280	393	2383
1936	166	206	279	153	254	57	23	133	133	261	121	149	1935
1937	447	283	136	205	203	85	39	54	247	356	339	239	2633
1938	155	114	381	277	191	40	61	106	185	253	297	238	2298
1939	91	73	134	265	148	79	9	28	195	322	209	410	1963
1940	82	240	316	242	356	84	81	117	147	185	374	286	2510
1941	226	157	189	391	270	83	51	87	170	216	492	181	2513
MEAN	210	161	244	236	192	106	84	147	196	263	269	221	2329

STATION NUMBER 540381 INDONESIA SUMATRA INDRAPURA

MONTHLY RAINFALLS (IN MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1924	395	380	184	273	287	138	185	556	264	387	394	263	3706
1926	404	218	192	457	216	166	69	144	122	665	357	218	3228
1929	479	283	221	295	54	69	7	176	311	272	486	297	2950
1930	257	125	284	372	140	198	26	198	370	532	290	198	2990
1931	343	458	290	518	218	290	276	97	235	346	167	290	3528
1932	161	119	156	213	135	221	27	97	364	742	235	182	2652
1933	387	449	78	113	60	112	158	236	342	324	347	319	2925
1934	356	74	387	506	51	285	277	141	118	195	451	248	3089
1935	409	549	236	306	99	384	139	128	417	413	466	450	3996
1936	386	403	284	211	203	70	181	285	196	336	266	300	3121
1937	226	252	270	377	169	135	108	355	471	532	603	633	4131
1938	236	105	376	204	310	115	419	266	337	436	784	420	4008
1939	383	168	107	155	125	123	104	161	144	251	322	498	2541
1940	145	136	415	147	288	133	72	107	307	483	460	772	3465
1941	321	378	295	326	388	112	178	308	438	415	598	389	4146
1951	487	335	173	235	192	312	182	259	588	390	582	542	4277
1952	437	231	447	301	208	177	188	233	402	553	644	162	3983
1953	250	232	631	206	73	120	131	115	113	154	554	434	3013
1954	161	132	67	250	123	178	308	497	496	433	413	174	3232
1955	221	142	57	105	50	45	60	230	130	795	780	750	3365
1956	192	134	238	85	40	95	165	235	472	275	375	492	2798
1957	200	245	370	425	235	115	345	280	520	585	564	415	4299
1979	326	330	229	566	156	317	496	287	223	569	640	253	4392
MEAN	311	256	260	289	166	170	178	234	321	438	469	378	3471

STATION NUMBER 540422 INDONESIA SUMATRA BARUNG BALANTAI

MONTHLY RAINFALLS (IN MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1924	484	364	573	156	454	184	347	251	417	602	417	478	4727
1926	150	266	405	804	126	183	324	352	321	594	323	611	4459
1927	213	262	504	330	221	71	123	333	506	493	618	342	4016
1928	305	166	418	214	230	163	192	396	327	335	631	198	3575
1929	454	336	301	330	350	70	24	345	353	626	653	625	4467
1930	382	302	408	435	277	258	233	225	483	694	378	258	4333
1931	503	379	375	301	221	355	244	142	441	611	394	750	4716
1932	159	127	125	400	159	120	0	241	236	600	481	400	3048
1933	521	230	280	300	272	119	86	248	229	228	515	275	3303
1934	383	10	184	357	239	414	359	76	197	571	714	363	3867
1935	207	394	430	450	348	368	361	458	537	823	407	587	5370
1936	425	377	268	446	458	141	301	376	376	381	560	348	4457
1937	375	340	120	488	191	175	91	79	324	311	407	365	3266
1938	81	114	532	226	244	152	276	249	698	530	801	1115	5018
1939	722	393	274	517	164	138	49	421	497	741	211	464	4591
1940	353	291	494	364	340	284	113	402	426	771	485	565	4888
1941	269	261	402	677	301	154	160	421	406	518	603	712	4884
1953	439	116	560	404	135	293	575	120	1095	760	277	500	5274
1954	708	278	189	495	185	213	391	560	260	295	859	262	4695
1955	390	425	249	585	610	215	90	165	205	165	380	270	3749
1956	525	135	395	115	100	315	410	315	305	100	511	875	4101
1957	210	150	615	413	335	120	205	205	315	425	320	645	3958
1958	385	270	520	150	165	60	0	100	85	70	425	445	2675
MEAN	376	260	375	389	266	198	215	282	393	489	494	498	4236

STATION NUMBER 540470 INDONESIA SUMATRA SOLOK

MONTHLY RAINFALLS (IN MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1916	124	77	242	189	190	82	119	215	110	245	78	160	1831
1917	329	365	242	107	201	236	102	413	152	58	6	93	2304
1918	178	48	163	149	156	205	55	155	157	195	363	225	2049
1920	249	41	432	350	126	169	19	16	43	212	298	55	2010
1921	283	209	220	89	152	71	109	86	235	296	145	224	2119
1922	207	72	215	260	89	58	38	27	71	300	217	127	1681
1924	302	192	274	66	171	97	149	88	232	136	84	142	1933
1926	235	321	118	179	301	113	24	186	170	210	455	130	2442
1927	94	248	131	46	55	48	18	147	295	161	246	210	1699
1928	352	109	173	289	162	29	116	89	58	151	191	101	1820
1929	41	182	206	327	146	153	10	92	196	227	115	351	2046
1931	387	340	301	282	114	204	131	57	308	125	206	473	2928
1932	242	76	389	178	212	83	110	173	125	303	124	82	2097
1933	397	114	183	167	271	43	92	231	109	126	134	49	1916
1934	216	67	170	93	48	128	36	202	123	281	101	150	1615
1935	207	363	319	197	69	153	73	122	108	175	204	503	2493
1936	211	126	234	183	333	58	64	241	117	232	240	115	2154
1937	196	254	68	301	92	124	53	98	380	259	349	175	2349
1938	184	72	266	206	92	44	69	76	290	273	171	183	1926
1939	236	61	126	256	86	38	40	25	234	244	101	347	1794
1940	58	83	221	285	198	31	23	88	68	232	209	299	1795
1941	244	222	210	260	250	92	127	123	98	162	312	122	2222
1952	305	247	138	154	194	38	44	93	180	122	9	60	1584
1953	208	172	266	201	115	92	238	39	120	163	60	173	1847
1954	304	364	273	68	104	7	101	78	84	228	97	117	1825
1955	267	163	163	112	35	2	30	173	218	133	19	124	1439
1957	63	76	272	348	173	18	50	60	67	265	252	261	1905
1959	177	160	136	380	160	110	14	72	230	162	204	75	1880
1960	185	319	99	153	3	51	246	83	68	155	59	274	1695
1967	98	80	82	437	176	102	86	101	136	100	333	189	1920
1969	270	125	153	269	126	34	85	162	111	139	260	302	2036
1977	181	135	288	229	191	35	159	0	0	125	423	166	1932
1978	162	247	390	457	181	0	52	56	89	282	165	384	2465
MEAN	218	174	217	220	151	83	81	117	151	196	189	195	1992

STATION NUMBER 540473 INDONESIA SUMATRA KUBANGNAN DUA

MONTHLY RAINFALLS (IN MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1924	110	63	351	38	53	164	60	117	138	185	20	53	1352
1926	300	170	305	365	270	205	30	180	115	350	360	120	2770
1927	165	335	400	185	190	15	25	145	290	275	250	160	2435
1928	320	80	65	220	220	75	165	105	75	195	260	20	1800
1929	140	60	160	200	110	264	45	115	240	319	218	606	2477
1933	507	64	142	125	340	10	20	176	163	133	236	14	1930
1934	253	5	77	222	154	196	5	66	151	197	124	170	1620
1935	187	210	196	224	84	185	39	297	94	212	305	504	2537
1936	111	233	134	183	177	41	37	124	297	264	228	195	2024
1937	334	284	66	193	138	139	58	168	425	296	497	198	2796
1938	260	79	448	416	265	105	55	340	162	351	402	496	3379
1939	540	113	130	468	27	60	0	23	298	287	112	478	2536
1940	306	267	246	372	208	122	55	164	236	296	440	321	3033
1941	317	275	265	372	346	157	27	303	299	288	678	284	3611
MEAN	275	160	213	256	184	124	44	166	213	261	295	259	2450

STATION NUMBER 540530 INDONESIA SUMATRA PADANG PANJANG

MONTHLY RAINFALLS (IN MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1916	415	105	273	291	140	98	206	194	282	332	440	476	3252
1917	396	370	238	360	169	86	134	285	250	244	160	486	3178
1918	263	194	239	195	136	199	139	125	236	258	476	348	2808
1920	311	339	244	293	201	111	250	200	154	237	259	282	2881
1921	401	303	212	364	239	86	99	150	194	244	321	249	2862
1922	275	217	326	268	137	54	98	277	342	490	561	430	3475
1924	226	228	440	175	331	58	97	254	225	297	290	400	3021
1926	258	210	329	267	329	207	127	130	162	412	341	217	2989
1927	245	153	290	306	96	71	111	78	385	264	576	543	3118
1928	331	204	324	334	233	84	233	156	272	316	471	209	3167
1929	219	434	186	213	279	72	86	122	353	408	340	388	3100
1930	204	41	318	253	388	214	31	149	307	317	327	261	2810
1931	424	305	225	230	144	326	156	199	208	291	220	491	3219
1932	170	186	280	427	173	145	108	196	303	479	319	342	3128
1933	530	267	323	287	245	55	119	234	155	358	480	340	3393
1934	358	74	183	293	97	196	233	202	180	393	500	306	3015
1935	136	338	175	325	344	128	171	165	228	293	491	460	3254
1936	302	75	200	264	273	331	114	247	170	252	766	460	3454
1937	274	430	204	301	162	137	220	79	226	310	369	379	3091
1938	311	134	266	496	304	105	75	133	261	299	488	400	3272
1939	266	218	311	335	280	224	88	194	219	424	326	521	3406
1940	218	204	224	309	298	146	191	239	264	223	252	475	3043
1941	212	205	245	531	349	137	129	423	162	210	307	440	3350
1954	147	424	418	584	295	380	179	184	300	458	509	277	4155
1955	465	233	341	473	296	286	160	235	196	295	451	628	4059
1956	358	204	211	173	85	78	216	192	296	245	590	409	3057
1957	227	103	281	490	291	41	252	169	239	256	282	498	3129
1959	129	151	345	248	143	60	20	231	172	167	315	822	2803
1960	324	165	135	374	123	164	360	230	460	322	234	493	3384
1963	240	155	278	353	595	92	289	47	160	503	349	732	3793
1964	405	413	333	502	201	101	443	204	370	490	413	622	4497
1965	202	192	563	270	563	317	146	236	346	388	382	457	4062
1966	864	119	317	597	202	186	160	211	165	326	541	299	3987
1967	406	121	195	255	251	146	406	129	294	164	357	444	3168
1969	371	392	431	459	339	301	415	417	206	204	582	465	4582
1970	186	111	338	381	181	194	137	62	295	413	557	258	3113
1971	243	168	448	220	195	176	229	209	416	384	400	518	3606
1972	346	355	559	573	216	248	185	64	263	109	290	551	3759
1975	224	236	134	339	169	86	203	308	321	262	287	354	2923
1976	161	112	393	329	112	260	324	217	421	490	709	193	3721
1977	240	228	162	308	153	112	80	163	380	245	567	398	3036
1979	162	208	170	356	245	312	218	165	141	498	423	216	3114
MEAN	296	222	288	343	238	162	182	193	261	323	412	418	3339

STATION NUMBER 540533 INDONESIA SUMATRA PAALEMBAJAN

MONTHLY RAINFALLS (IN MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1924	335	253	402	118	330	228	105	119	390	403	229	160	3072
1927	187	197	191	266	148	27	38	31	550	327	384	333	2679
1928	237	212	176	273	219	74	170	60	60	328	327	153	2289
1929	109	286	111	113	74	87	14	139	234	253	343	235	1998
1933	280	220	159	285	347	40	38	248	387	167	265	345	2781
1934	101	53	279	313	101	175	66	75	344	353	286	252	2398
1935	94	215	88	224	54	108	114	217	165	246	344	417	2286
1936	160	88	207	106	124	47	64	114	284	279	318	139	1930
1937	168	149	125	179	151	55	37	71	246	446	475	398	2500
1938	115	45	247	344	220	120	168	150	194	405	428	417	2853
1939	284	43	197	293	245	32	39	130	267	477	224	459	2690
1940	157	204	279	349	233	103	113	187	219	423	453	364	3084
1941	141	140	169	190	202	195	73	215	263	267	333	440	2628
1955	131	217	245	404	166	64	71	218	108	377	342	329	2672
1956	211	211	297	116	140	75	160	196	223	281	418	368	2696
MEAN	181	169	211	238	184	95	85	145	262	335	345	321	2570

STATION NUMBER 540540 INDONESIA SUMATRA BUKITTINGGI

MONTHLY RAINFALLS (IN MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1916	170	50	194	173	174	110	101	212	203	237	153	172	1949
1917	262	292	230	155	128	161	165	296	164	80	28	189	2150
1918	209	58	242	138	209	188	154	227	179	280	395	94	2373
1920	140	74	236	285	151	214	50	75	168	142	290	53	1878
1921	261	142	166	196	94	94	105	94	215	153	156	249	1925
1922	206	105	74	247	96	42	59	68	228	313	149	214	1801
1924	264	163	440	175	231	58	97	254	225	297	290	400	2894
1926	181	135	190	117	169	59	67	87	130	164	234	195	1728
1927	112	61	174	224	77	13	80	90	300	249	274	196	1850
1928	324	234	146	251	133	53	112	99	72	206	280	77	1987
1929	96	195	140	338	211	148	23	101	233	303	214	155	2157
1930	253	55	231	219	116	181	21	83	213	418	278	290	2358
1931	456	275	258	154	130	213	150	53	270	271	152	408	2790
1932	141	62	262	383	99	169	44	172	154	229	197	258	2170
1933	263	119	236	253	241	67	117	203	97	224	234	87	2141
1934	258	64	159	216	128	126	92	187	183	243	199	140	1995
1935	104	291	180	283	112	82	101	257	191	302	296	313	2512
1936	184	114	213	138	211	82	61	115	255	178	249	187	1987
1938	94	111	371	244	98	67	48	139	213	214	176	158	1933
1940	118	172	148	280	206	30	82	164	113	259	291	282	2145
1941	184	116	212	299	127	84	90	146	256	163	185	275	2137
1954	454	340	250	215	49	88	159	106	103	310	303	154	2531
1955	399	168	138	252	151	65	112	169	130	275	206	376	2441
1957	200	176	317	322	287	83	154	195	140	352	403	306	2935
1960	180	239	226	237	7	103	226	102	289	202	210	355	2376
1963	234	300	140	322	374	83	93	13	47	340	211	380	2537
1964	158	366	145	279	123	117	140	82	95	148	88	269	2010
1965	96	175	136	182	106	46	44	132	182	173	408	152	1832
1966	308	71	135	348	74	225	87	326	146	113	230	66	2129
MEAN	218	163	207	239	149	105	98	146	179	236	234	222	2195

STATION NUMBER 540590 INDONESIA SUMATRA LUBUKSIKAPING

MONTHLY RAINFALLS (IN MM)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1916	224	106	347	525	311	156	284	222	347	312	382	575	3791
1917	409	283	273	331	338	99	231	476	260	345	146	382	3573
1918	216	117	458	386	417	450	239	197	516	668	1070	333	5067
1920	367	294	550	684	286	256	231	214	212	387	623	438	4542
1921	401	359	327	349	290	260	203	295	394	583	406	254	4121
1922	441	227	283	535	267	98	44	329	264	782	367	492	4129
1924	311	253	571	177	372	246	241	314	484	235	404	302	3910
1926	203	183	293	388	425	255	274	144	345	289	385	197	3381
1927	178	106	387	476	115	88	98	186	723	720	539	366	3982
1928	511	199	290	578	274	121	232	175	264	382	536	387	3949
1929	179	385	292	581	356	288	115	320	537	719	732	227	4731
1930	557	169	447	578	408	341	140	377	356	1315	569	369	5626
1931	580	496	442	643	290	601	471	77	491	599	610	760	6060
1932	260	222	486	636	679	248	88	507	310	745	529	631	5341
1933	618	202	523	522	542	209	390	347	260	317	532	336	4798
1934	395	83	438	506	126	537	164	252	364	703	605	260	4433
1935	230	447	363	464	237	349	124	403	426	606	889	581	5119
1936	420	96	365	297	390	239	207	229	690	638	497	332	4400
1937	338	442	480	339	216	82	133	296	512	499	487	639	4463
1938	325	198	543	437	485	122	360	465	451	494	403	434	4717
1940	262	407	419	428	415	159	129	492	365	696	656	450	4878
1941	390	365	535	534	436	207	198	221	552	673	626	419	5156
1952	215	214	195	277	276	18	92	161	311	201	212	207	2379
1953	189	280	376	284	370	56	332	154	317	646	286	324	3614
1954	467	288	488	408	244	221	348	304	153	510	284	324	4039
1955	224	216	383	431	176	76	131	274	371	462	307	483	3534
1956	368	244	564	191	82	208	246	216	333	238	472	323	3485
1974	89	205	200	446	328	108	188	214	620	205	410	444	3457
1975	117	288	284	403	287	117	478	236	405	237	250	203	3305
1976	146	119	182	375	207	332	369	414	316	516	491	230	3697
1977	285	202	265	844	211	268	155	307	295	523	600	252	4207
1978	274	239	547	625	687	199	335	246	219	550	756	354	5031
1979	204	264	279	300	136	354	551	312	282	372	716	247	4017
1980	177	219	589	587	555	262	300	256	292	469	391	501	4598
MEAN	311	248	396	458	330	224	239	283	383	519	505	384	4280

APPENDIX 2

COMPUTED MONTHLY DISCHARGES

INDONESIA WEST-SUMATRA SITE OF GUNTUNG (147.0 Km2)

STATION NUMBER 11000002

COMPUTED MEAN MONTHLY AND ANNUAL DISCHARGES (M3/S)

YEAR	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
24	21.3	12.4	21.9	7.69	15.2	11.2	6.97	6.48	16.0	16.9	14.2	8.65	13.3
25													
26													
27	10.3	8.69	8.81	12.9	7.27	5.62	4.77	4.01	13.1	13.6	17.1	21.3	10.6
28	11.8	10.6	10.3	10.5	10.0	6.99	8.44	5.29	4.58	8.74	12.8	7.98	9.00
29	6.88	11.6	5.52	5.91	5.26	4.18	3.49	3.45	5.32	7.10	12.2	10.7	6.76
30													
31													
32													
33	11.7	9.81	9.68	12.0	16.8	6.41	5.31	6.44	13.9	8.06	11.9	15.1	10.6
34	8.14	6.02	9.61	13.4	8.13	7.08	5.14	4.59	10.1	12.5	12.0	12.1	9.08
35	7.88	8.99	5.98	7.99	6.35	5.00	4.56	7.85	6.14	8.12	13.6	17.2	8.30
36	9.89	6.43	7.72	6.63	5.92	4.58	4.08	3.81	7.48	8.67	12.4	7.64	7.10
37	7.18	7.37	6.44	6.63	6.05	4.54	3.82	3.57	5.46	13.9	19.7	19.1	8.65
38	9.16	6.25	8.24	15.5	11.0	7.27	6.94	7.17	7.69	14.3	20.8	24.5	11.6
39	17.2	6.98	7.34	12.8	11.0	6.20	5.26	5.01	8.75	15.7	11.9	20.4	10.8
40	12.2	8.53	12.8	18.9	12.5	7.23	6.07	7.50	8.56	15.4	24.6	19.7	12.8
41	12.1	6.99	7.67	8.23	10.1	9.37	5.38	7.07	10.3	11.3	12.2	23.1	10.3
42													
43													
44													
45													
46													
47													
48													
49													
50													
51													
52													
53													
54													
55	9.70	10.4	11.2	20.4	9.67	6.36	5.48	6.99	5.02	12.3	15.5	17.2	10.8
56	12.0	10.5	12.5	8.28	6.57	5.73	5.69	6.89	8.62	11.2	16.5	19.0	10.3
MEAN:													
24-56	11.2	8.77	9.71	11.2	9.45	6.52	5.43	5.74	8.73	11.9	15.2	16.2	10.0

INDONESIA WEST-SUMATRA SITE OF BALANGIR (40.6 Km2)

STATION NUMBER 11000004

COMPUTED MEAN MONTHLY AND ANNUAL DISCHARGES (M3/S)

YEAR	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
16	11.5	2.68	3.37	8.06	6.20	3.29	4.32	6.46	3.94	4.50	3.21	4.63	5.20
17	10.5	8.42	4.30	9.47	2.40	2.70	1.73	4.80	5.60	1.77	1.25	1.51	4.50
18	6.61	1.36	2.89	3.20	4.77	3.83	3.28	5.57	3.25	3.53	8.63	2.52	4.14
19													
20	5.65	1.70	7.01	2.77	1.97	2.68	1.08	.870	1.14	.833	3.33	1.34	2.54
21	4.00	2.23	3.14	2.92	4.17	2.28	.752	.416	2.60	4.96	3.85	4.38	2.98
22	6.69	1.92	2.71	9.60	2.56	5.49	2.32	3.35	5.20	4.69	4.26	2.33	4.26
23													
24	4.94	3.58	6.00	5.65	4.91	2.77	1.16	1.84	3.50	1.76	1.04	.688	3.15
25													
26	2.97	6.72	8.36	3.75	4.83	3.16	2.13	3.48	3.09	5.21	4.50	4.18	4.35
27	4.38	5.10	1.56	2.76	1.62	.445	.255	.453	1.06	4.72	5.15	5.28	2.72
28													
29	3.01	2.35	3.17	6.87	3.51	3.87	2.45	2.41	2.53	5.54	5.91	7.08	4.06
30	4.37	3.27	6.20	3.77	6.57	2.45	.953	.438	2.78	7.22	5.12	2.52	3.81
31	7.06	11.1	5.25	4.27	4.29	4.71	2.88	2.83	4.39	1.49	4.24	7.65	4.97
32	6.22	2.24	1.85	3.44	2.41	1.70	1.46	3.25	3.88	7.24	4.85	3.44	3.51
33	12.9	3.93	4.00	4.43	5.21	2.90	3.34	4.77	6.40	2.54	1.58	1.22	4.45
34	7.36	2.53	2.38	3.10	2.61	1.70	1.60	1.81	4.20	6.37	2.40	4.30	3.38
35	5.84	5.19	3.95	3.45	1.73	5.00	2.04	2.41	4.44	3.04	5.14	9.32	4.29
36	4.54	7.37	6.31	3.55	6.71	2.62	.936	1.85	4.97	5.77	5.35	6.14	4.67
37	7.88	7.33	4.89	5.27	4.15	1.87	1.78	2.08	6.88	5.87	5.94	6.25	5.00
38	6.02	2.60	5.28	6.04	2.39	2.17	1.73	2.53	3.52	3.60	3.45	4.58	3.67
39	4.44	1.28	2.14	4.20	2.89	1.95	.868	.604	2.82	3.08	2.55	8.07	2.92
40	4.25	5.59	4.00	6.57	2.43	1.99	.908	1.22	4.51	3.40	7.10	8.04	4.15
41	5.87	5.94	4.08	5.80	3.63	2.73	2.15	2.39	3.18	3.26	5.99	4.75	4.13
42													
43													
44													
45													
46													
47													
48													
49													
50													
51													
52	7.21	6.48	2.26	1.99	3.06	1.59	1.55	1.24	2.38	1.65	2.31	3.64	2.94
53	3.77	5.80	7.08	5.29	5.12	3.25	5.89	1.17	2.19	4.46	3.38	4.84	4.35
54	8.68	6.75	9.01	2.81	1.77	3.90	3.26	3.24	1.92	4.56	2.31	2.92	4.26
55	13.8	2.97	8.85	6.19	2.29	3.66	4.63	5.98	4.72	2.96	1.36	3.09	5.07
56	4.56	5.28	5.13	3.20	2.58	.835	.737	2.02	2.57	3.58	6.32	4.55	3.44
57	5.86	3.95	3.71	8.67	5.00	2.31	.995	.944	1.40	4.62	8.73	9.32	4.62
MEAN:													
16-57	6.46	4.49	4.60	4.90	3.63	2.78	2.04	2.52	3.54	4.01	4.26	4.59	3.98

INDONESIA WEST-SUMATRA SITE OF SUMANI (80.9 Km2)

STATION NUMBER 11000006

COMPUTED MEAN MONTHLY AND ANNUAL DISCHARGES (M3/S)

YEAR	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
16	5.94	2.97	2.65	7.59	3.93	3.47	4.61	5.86	5.35	3.74	3.32	5.12	4.55
17	7.32	8.57	5.98	5.00	5.47	3.99	3.01	8.55	6.12	3.01	2.11	2.00	5.07
18	2.89	1.72	7.05	4.36	4.27	4.48	2.54	3.20	4.13	5.84	13.0	4.31	4.82
19													
20	6.45	5.08	12.3	10.9	5.12	8.28	3.38	2.27	2.26	2.22	5.63	3.26	5.59
21	1.85	1.45	1.65	1.29	1.54	1.13	1.57	1.40	5.19	8.69	5.91	5.89	3.14
22	4.55	2.50	1.79	3.53	3.95	2.41	1.58	1.34	1.22	8.41	6.89	10.9	4.11
23													
24	6.15	4.07	6.54	4.88	7.63	3.97	2.88	3.42	5.92	5.71	3.65	5.38	5.03
25													
26	5.46	13.7	21.9	9.46	8.06	3.38	3.50	2.55	3.82	5.65	7.42	4.12	7.38
27	3.07	5.44	2.89	4.10	3.57	1.68	1.18	1.14	1.65	4.50	9.89	7.68	3.88
28	16.2	3.60	3.47	10.2	6.51	3.05	2.02	2.77	6.28	9.36	11.5	10.8	7.16
29													
30													
31													
32													
33	12.6	3.92	4.28	5.93	5.21	2.34	1.57	4.10	2.60	5.73	4.87	4.79	4.85
34	6.24	2.82	2.96	3.52	3.36	4.58	2.05	1.96	4.45	4.23	3.66	4.65	3.71
35	2.78	4.28	4.08	3.59	3.47	3.49	2.80	3.68	3.47	6.17	7.93	10.6	4.70
36	6.40	5.12	6.78	5.07	6.30	2.93	1.90	1.52	1.64	4.46	3.65	3.06	4.07
37	10.8	7.41	4.80	4.72	5.07	3.89	2.17	1.52	3.18	6.02	9.37	7.31	5.51
38	5.91	3.06	8.39	8.27	6.20	2.73	1.82	1.54	2.43	4.48	7.46	6.11	4.88
39	4.29	2.38	2.31	5.06	3.33	2.45	1.56	.982	2.00	4.48	5.90	10.0	3.74
40	4.51	5.44	7.62	6.12	11.7	3.62	2.29	2.25	2.28	3.93	7.62	7.83	5.44
41	7.84	4.87	4.17	10.2	8.03	3.36	2.29	1.74	2.11	4.25	12.0	6.47	5.60
MEAN 16-41	6.38	4.65	5.87	5.99	5.41	3.43	2.35	2.73	3.48	5.31	6.94	6.33	4.91

INDONESIA WEST-SUMATRA SITE OF SIKARBAU (115.0 Km2)

STATION NUMBER 11000012

COMPUTED MEAN MONTHLY AND ANNUAL DISCHARGES (M3/S)

YEAR	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
16	10.1	4.64	5.84	10.8	7.32	4.73	4.84	4.97	6.96	6.27	7.19	12.5	7.19
17	10.8	7.69	7.62	6.65	8.43	3.98	3.70	8.60	5.88	6.43	4.77	6.47	6.76
18	5.40	3.41	7.09	8.23	9.57	10.8	5.76	5.19	9.45	13.0	34.4	11.2	10.3
19													
20	9.78	6.66	11.8	19.2	7.37	7.69	5.11	4.47	3.88	7.14	12.1	11.4	8.88
21	10.6	9.27	8.98	7.99	6.95	5.69	4.62	5.59	9.20	11.2	10.8	7.74	8.21
22	9.35	5.52	7.46	11.0	6.76	4.89	3.01	2.99	3.70	15.4	8.66	11.4	7.53
23													
24	8.56	8.13	11.6	6.27	6.68	7.13	4.77	5.69	10.7	5.54	9.05	7.01	7.58
25													
26	5.13	4.48	5.00	7.09	9.99	6.87	5.37	3.92	6.18	5.04	8.11	5.52	6.06
27	4.92	3.14	4.41	8.00	6.04	3.66	2.62	2.50	9.01	18.3	15.0	9.57	7.28
28	13.1	5.88	6.06	13.6	7.03	4.55	3.83	3.96	4.58	6.17	11.0	9.39	7.43
29	6.98	6.72	6.52	13.7	10.0	6.90	4.27	4.74	10.4	15.7	22.6	8.13	9.71
30	13.3	5.58	9.10	14.4	10.9	8.88	4.68	6.53	8.11	32.2	19.4	9.48	11.9
31	15.3	15.1	9.75	18.3	7.36	14.4	10.1	6.89	9.75	12.5	15.6	21.9	13.0
32	10.1	5.02	9.32	17.6	18.3	7.81	4.34	7.91	6.90	17.7	13.6	17.4	11.4
33	18.5	6.12	11.0	13.9	14.3	6.82	7.05	8.49	6.09	7.47	11.2	9.86	10.1
34	10.3	4.47	6.21	9.49	7.03	10.6	5.38	5.19	6.65	13.3	16.3	8.86	8.66
35	7.35	8.95	8.43	9.66	7.42	8.65	4.48	7.86	8.81	12.2	25.4	16.7	10.5
36	11.4	5.32	6.25	7.28	8.46	6.16	4.22	4.22	14.2	14.5	15.0	9.77	8.90
37	7.51	10.5	10.8	9.34	6.64	3.95	3.05	3.71	9.49	9.45	10.6	18.2	8.59
38	9.07	6.34	12.2	11.6	11.0	5.33	6.53	10.4	10.9	10.5	11.2	10.1	9.62
39													
40	8.78	8.50	9.17	9.36	12.0	5.36	4.05	8.86	7.77	12.9	19.6	12.7	9.92
41	13.1	7.73	12.5	14.6	11.2	5.95	4.99	4.64	11.2	12.8	18.1	12.6	10.8
MEAN:													
16-41	9.97	6.78	8.50	11.3	9.12	6.85	4.85	5.79	8.17	12.1	14.5	11.3	9.10

INDONESIA WEST-SUMATRA SITE OF PATIMAH (142.0 Km2)

STATION NUMBER 11000015

COMPUTED MEAN MONTHLY AND ANNUAL DISCHARGES (M3/S)

YEAR	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
16	14.4	5.95	9.28	18.3	11.8	7.22	7.65	8.34	11.8	10.5	12.1	22.5	11.7
17	18.4	11.9	12.0	10.6	14.0	5.75	5.98	14.7	9.61	10.9	7.47	11.1	11.1
18	8.87	5.26	12.4	14.2	16.8	18.2	8.89	8.01	16.2	25.1	55.8	16.9	17.2
19													
20	15.2	10.1	20.0	32.8	10.8	11.9	7.74	6.88	6.17	12.2	21.3	20.0	14.6
21	17.5	14.8	14.2	12.9	11.1	9.07	7.29	9.32	15.8	19.8	18.4	12.0	13.5
22	15.4	8.46	12.0	19.1	10.7	7.36	4.31	4.72	6.45	28.6	14.2	20.3	12.7
23													
24	12.9	12.7	19.8	9.48	10.5	11.6	7.70	9.29	19.5	8.35	15.2	11.4	12.3
25													
26	8.11	7.01	8.38	12.1	17.9	11.0	8.51	6.09	10.4	8.44	14.0	8.85	10.1
27	7.96	4.76	7.84	14.1	10.1	5.46	3.91	3.88	16.7	34.2	24.7	14.9	12.4
28	21.6	8.37	9.26	23.0	11.1	6.70	6.12	6.39	7.62	10.6	19.5	16.0	12.2
29	11.0	10.9	10.7	23.7	16.7	10.7	6.28	7.68	18.2	29.4	36.6	11.6	16.1
30	22.0	7.81	14.9	24.3	17.8	14.3	6.54	10.9	13.6	57.1	30.2	14.3	19.6
31	25.7	24.4	15.6	30.8	10.8	24.5	16.4	9.99	16.5	21.5	26.3	36.1	21.5
32	15.4	6.96	15.5	30.4	30.4	11.3	5.68	13.3	11.2	31.8	22.1	28.9	18.6
33	29.5	8.63	18.0	23.9	23.7	9.67	10.8	14.2	9.53	12.3	19.4	16.4	16.4
34	17.1	6.00	10.3	16.5	11.5	17.9	8.14	8.29	11.2	24.6	29.0	12.3	14.4
35	11.0	14.6	13.9	16.4	12.1	14.0	6.37	13.2	14.9	21.5	43.6	26.6	17.3
36	18.0	7.00	9.80	11.7	14.1	9.74	6.73	6.88	25.5	26.5	24.2	14.8	14.6
37	11.3	17.7	18.5	15.0	9.96	5.48	4.35	6.52	16.7	16.3	19.5	30.9	14.3
38	13.4	9.48	20.7	19.5	18.1	7.40	10.3	17.6	18.7	17.2	18.9	17.0	15.7
39													
40	13.6	13.6	15.3	15.4	20.9	7.49	5.72	14.8	12.9	24.8	32.1	20.4	16.4
41	20.3	11.7	20.9	24.9	17.9	8.45	7.40	7.10	19.3	24.3	29.1	20.5	17.7
MEAN 16-41	15.8	10.4	14.1	19.0	14.9	10.7	7.40	9.46	14.0	21.6	24.3	18.4	15.0

INDONESIA WEST-SUMATRA SITE OF BAYANG SANI (9.74 Km2)

STATION NUMBER 11000018

COMPUTED MEAN MONTHLY AND ANNUAL DISCHARGES (M3/S)

YEAR	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
24	1.33	1.27	1.62	1.03	1.13	.755	.926	.541	1.27	1.35	1.14	1.34	1.14
25													
26	.468	.391	.931	2.53	.479	.211	.367	.932	.765	1.61	.968	1.45	0.927
27	.618	.526	1.30	.774	.488	.305	.159	.398	1.26	1.23	1.83	1.04	0.827
28	.851	.223	.807	.575	.310	.267	.293	.834	.810	.758	1.72	.637	0.674
29	1.24	.642	.770	.618	.943	.222	.110	.227	.864	1.51	2.01	1.85	0.919
30	1.18	.536	.957	1.29	.461	.603	.450	.424	1.39	1.74	1.06	.716	0.902
31	1.27	.845	1.01	.746	.419	.917	.399	.321	1.01	1.63	1.05	2.16	0.983
32	.557	.190	.130	.742	.359	.168	.088	.137	.211	1.43	1.58	1.08	0.557
33	1.27	.534	.652	.585	.706	.336	.134	.242	.333	.296	1.48	.654	0.601
34	.849	.195	.183	.451	.665	.944	.850	.256	.194	1.33	2.12	1.18	0.771
35	.492	.716	1.10	1.28	.904	.850	.786	1.27	1.39	2.41	1.16	1.64	1.17
36	1.32	.788	.703	1.12	1.21	.276	.475	.806	1.06	.998	1.62	.780	0.929
37	1.12	.680	.251	1.11	.389	.372	.162	.113	.314	.667	.955	1.11	0.602
38	.206	.152	1.00	.404	.593	.239	.395	.596	1.94	1.36	2.55	3.39	1.07
39	2.32	.839	.660	1.52	.393	.204	.116	.674	1.32	1.95	.644	1.17	0.986
40	.985	.612	1.10	.836	1.08	.559	.243	.704	1.35	2.05	1.37	1.56	1.04
41	.679	.546	.889	2.17	.536	.345	.238	1.07	.914	1.24	1.92	2.07	1.05
42													
43													
44													
45													
46													
47													
48													
49													
50													
51													
52													
53	1.36	.226	1.30	.858	.550	.403	1.65	.241	3.05	2.29	.821	1.21	1.17
54	2.19	.750	.375	1.13	.425	.450	.738	1.50	.512	.832	2.59	.577	1.01
55	.858	1.44	.568	1.51	1.79	.503	.185	.170	.197	.152	.739	.652	0.724
56	1.41	.280	.773	.301	.232	.460	.720	.911	.646	.282	1.19	2.63	0.824
57	.476	.301	1.62	.905	.937	.249	.260	.303	.617	1.14	.832	1.70	0.784
58	.888	.690	1.38	.423	.265	.139	.068	.073	.072	.070	.348	1.37	0.483
MEAN:													
24-58	1.04	.581	.873	.996	.664	.425	.427	.554	.934	1.23	1.38	1.39	0.875

APPENDIX 3

COMPUTED MONTHLY DISCHARGES IN ORDER

STATION NUMBER 11000002 INDONESIA WEST-SUMATRA SITE OF GUNTUNG (147.0 Km2)

MONTHLY AND ANNUAL DISCHARGES IN ORDER (M3/S)

R	P	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
1	0.033	6.88	6.02	5.52	5.91	5.26	4.18	3.49	3.45	4.58	7.10	11.90	7.64	6.75
2	0.100	7.18	6.25	5.98	6.63	5.92	4.54	3.82	3.57	5.02	8.06	11.90	7.98	7.08
3	0.167	7.88	6.43	6.44	6.63	6.05	4.58	4.08	3.81	5.32	8.12	12.00	8.65	8.28
4	0.233	8.14	6.98	7.34	7.69	6.35	5.00	4.56	4.01	5.46	8.67	12.20	10.70	8.63
5	0.300	9.16	6.99	7.67	7.99	6.57	5.62	4.77	4.59	6.14	8.74	12.20	12.10	8.97
6	0.367	9.70	7.37	7.72	8.23	7.27	5.73	5.14	5.01	7.48	11.20	12.40	15.10	9.06
7	0.433	9.89	8.53	8.24	8.28	8.13	6.20	5.26	5.29	7.69	11.30	12.80	17.20	10.27
8	0.500	10.30	8.69	8.81	10.50	9.67	6.36	5.31	6.44	8.56	12.30	13.60	17.20	10.33
9	0.567	11.70	8.99	9.61	12.00	10.00	6.41	5.38	6.48	8.62	12.50	14.20	19.00	10.57
10	0.633	11.80	9.81	9.68	12.80	10.10	6.99	5.48	6.89	8.75	13.60	15.50	19.10	10.60
11	0.700	12.00	10.40	10.30	12.90	11.00	7.08	5.69	6.99	10.10	13.90	16.50	19.70	10.73
12	0.767	12.10	10.50	11.20	13.40	11.00	7.23	6.07	7.07	10.30	14.30	17.10	20.40	10.82
13	0.833	12.20	10.60	12.50	15.50	12.50	7.27	6.94	7.17	13.10	15.40	19.70	21.30	11.58
14	0.900	17.20	11.60	12.80	18.90	15.20	9.37	6.97	7.50	13.90	15.70	20.80	23.10	12.81
15	0.967	21.30	12.40	21.90	20.40	16.80	11.20	8.44	7.85	16.00	16.90	24.60	24.50	13.23
AVERAGE		11.16	8.77	9.71	11.18	9.45	6.52	5.43	5.74	8.73	11.85	15.16	16.24	9.98

R = RANK P = PROBABILITY

STATION NUMBER 11000004 INDONESIA WEST-SUMATRA SITE OF BALANGIR (40.6 Km2)

MONTHLY AND ANNUAL DISCHARGES IN ORDER (M3/S)

R	P	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
1	0.018	2.970	1.280	1.560	1.990	1.620	0.445	0.255	0.416	1.060	0.833	1.040	0.688	2.522
2	0.054	3.010	1.360	1.850	2.760	1.730	0.835	0.737	0.438	1.140	1.490	1.250	1.220	2.699
3	0.089	3.770	1.700	2.140	2.770	1.770	1.590	0.752	0.453	1.400	1.650	1.360	1.340	2.901
4	0.125	4.000	1.920	2.260	2.810	1.970	1.700	0.868	0.604	1.920	1.760	1.580	1.510	2.921
5	0.161	4.250	2.230	2.380	2.920	2.290	1.700	0.908	0.870	2.190	1.770	2.310	2.330	2.962
6	0.196	4.370	2.240	2.710	3.100	2.390	1.870	0.936	0.944	2.380	2.540	2.310	2.520	3.134
7	0.232	4.380	2.350	2.890	3.200	2.400	1.950	0.953	1.170	2.530	2.960	2.400	2.520	3.353
8	0.268	4.440	2.530	3.140	3.200	2.410	1.990	0.995	1.220	2.570	3.040	2.550	2.920	3.423
9	0.304	4.54	2.60	3.17	3.44	2.43	2.17	1.08	1.24	2.60	3.08	3.21	3.09	3.49
10	0.339	4.56	2.68	3.37	3.45	2.56	2.28	1.16	1.81	2.78	3.26	3.33	3.44	3.65
11	0.375	4.94	2.97	3.71	3.55	2.58	2.31	1.46	1.84	2.82	3.40	3.38	3.64	3.80
12	0.411	5.65	3.27	3.95	3.75	2.61	2.45	1.55	1.85	3.09	3.53	3.45	4.18	4.05
13	0.446	5.84	3.58	4.00	3.77	2.89	2.62	1.60	2.02	3.18	3.58	3.85	4.30	4.11
14	0.482	5.86	3.93	4.00	4.20	3.06	2.68	1.73	2.08	3.25	3.60	4.24	4.38	4.12
15	0.518	5.87	3.95	4.08	4.27	3.51	2.70	1.73	2.39	3.50	4.46	4.26	4.55	4.13
16	0.554	6.02	5.10	4.30	4.43	3.63	2.73	1.78	2.41	3.52	4.50	4.50	4.58	4.24
17	0.589	6.22	5.19	4.89	5.27	4.15	2.77	2.04	2.41	3.88	4.56	4.85	4.63	4.24
18	0.625	6.61	5.28	5.13	5.29	4.17	2.90	2.13	2.53	3.94	4.62	5.12	4.75	4.27
19	0.661	6.69	5.59	5.25	5.65	4.29	3.16	2.15	2.83	4.20	4.69	5.14	4.84	4.33
20	0.696	7.06	5.80	5.28	5.80	4.77	3.25	2.32	3.24	4.39	4.72	5.15	5.28	4.34
21	0.732	7.21	5.94	6.00	6.04	4.83	3.29	2.45	3.25	4.44	4.96	5.35	6.14	4.42
22	0.768	7.36	6.48	6.20	6.19	4.91	3.66	2.88	3.35	4.51	5.21	5.91	6.25	4.48
23	0.804	7.88	6.72	6.31	6.57	5.00	3.83	3.26	3.48	4.72	5.54	5.94	7.08	4.61
24	0.839	8.68	6.75	7.01	6.87	5.12	3.87	3.28	4.77	4.97	5.77	5.99	7.65	4.65
25	0.875	10.50	7.33	7.08	8.06	5.21	3.90	3.34	4.80	5.20	5.87	6.32	8.04	4.95
26	0.911	11.50	7.37	8.36	8.67	6.20	4.71	4.32	5.57	5.60	6.37	7.10	8.07	4.98
27	0.946	12.90	8.42	8.85	9.47	6.57	5.00	4.63	5.98	6.40	7.22	8.63	9.32	5.05
28	0.982	13.80	11.10	9.01	9.60	6.71	5.49	5.89	6.46	6.88	7.24	8.73	9.32	5.18
AVERAGE		6.46	4.49	4.60	4.90	3.63	2.78	2.04	2.52	3.54	4.01	4.26	4.59	3.96

R = RANK P = PROBABILITY

STATION NUMBER 11000006 INDONESIA WEST-SUMATRA SITE OF SUMANI (80.9 Km2)

MONTHLY AND ANNUAL DISCHARGES IN ORDER (M3/S)

R	P	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
1	0.026	1.850	1.450	1.650	1.290	1.540	1.130	1.180	0.982	1.220	2.220	2.110	2.000	3.123
2	0.079	2.78	1.72	1.79	3.52	3.33	1.68	1.56	1.14	1.64	3.01	3.32	3.06	3.69
3	0.132	2.89	2.38	2.31	3.53	3.36	2.34	1.57	1.34	1.65	3.74	3.65	3.26	3.72
4	0.184	3.07	2.50	2.65	3.59	3.47	2.41	1.57	1.40	2.00	3.93	3.65	4.12	3.87
5	0.237	4.29	2.82	2.89	4.10	3.57	2.45	1.58	1.52	2.11	4.23	3.66	4.31	4.06
6	0.289	4.51	2.97	2.96	4.36	3.93	2.73	1.82	1.52	2.26	4.25	4.87	4.65	4.09
7	0.342	4.55	3.06	3.47	4.72	3.95	2.93	1.90	1.54	2.28	4.46	5.63	4.79	4.53
8	0.395	5.46	3.60	4.08	4.88	4.27	3.05	2.02	1.74	2.43	4.48	5.90	5.12	4.68
9	0.447	5.91	3.92	4.17	5.00	5.07	3.36	2.05	1.96	2.60	4.48	5.91	5.38	4.81
10	0.500	5.94	4.07	4.28	5.06	5.12	3.38	2.17	2.25	3.18	4.50	6.89	5.89	4.83
11	0.553	6.15	4.28	4.80	5.07	5.21	3.47	2.29	2.27	3.47	5.65	7.42	6.11	4.86
12	0.605	6.24	4.87	5.98	5.93	5.47	3.49	2.29	2.55	3.82	5.71	7.46	6.47	5.01
13	0.658	6.40	5.08	6.54	6.12	6.20	3.62	2.54	2.77	4.13	5.73	7.62	7.31	5.05
14	0.711	6.45	5.12	6.78	7.59	6.30	3.89	2.80	3.20	4.45	5.84	7.93	7.68	5.42
15	0.763	7.32	5.44	7.05	8.27	6.51	3.97	2.88	3.42	5.19	6.02	9.37	7.83	5.49
16	0.816	7.84	5.44	7.62	9.46	7.63	3.99	3.01	3.68	5.35	6.17	9.89	10.00	5.57
17	0.868	10.80	7.41	8.39	10.20	8.03	4.48	3.38	4.10	5.92	8.41	11.50	10.60	5.58
18	0.921	12.60	8.57	12.30	10.20	8.06	4.58	3.50	5.86	6.12	8.69	12.00	10.80	7.14
19	0.974	16.20	13.70	21.90	10.90	11.70	8.28	4.61	8.55	6.28	9.36	13.00	10.90	7.36
AVERAGE		6.38	4.65	5.87	5.99	5.41	3.43	2.35	2.73	3.48	5.31	6.94	6.33	4.89

R = RANK P = PROBABILITY

STATION NUMBER 11000012 INDONESIA WEST-SUMATRA SITE OF SIKARBAU (115.0 Km2)

MONTHLY AND ANNUAL DISCHARGES IN ORDER (M3/S)

R	P	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
1	0.023	4.92	3.14	4.41	6.27	6.04	3.66	2.62	2.50	3.70	5.04	4.77	5.52	6.05
2	0.068	5.13	3.41	5.00	6.65	6.64	3.95	3.01	2.99	3.88	5.54	7.19	6.47	6.75
3	0.114	5.40	4.47	5.84	7.09	6.68	3.98	3.05	3.71	4.58	6.17	8.11	7.01	7.17
4	0.159	6.98	4.48	6.06	7.28	6.76	4.55	3.70	3.92	5.88	6.27	8.66	7.74	7.26
5	0.205	7.35	4.64	6.21	7.99	6.95	4.73	3.83	3.96	6.09	6.43	9.05	8.13	7.41
6	0.250	7.51	5.02	6.25	8.00	7.03	4.89	4.05	4.22	6.18	7.14	10.60	8.86	7.51
7	0.295	8.56	5.32	6.52	8.23	7.03	5.33	4.22	4.47	6.65	7.47	10.80	9.39	7.57
8	0.341	8.78	5.52	7.09	9.34	7.32	5.36	4.27	4.64	6.90	9.45	11.00	9.48	8.19
9	0.386	9.07	5.58	7.46	9.36	7.36	5.69	4.34	4.74	6.96	10.50	11.20	9.57	8.57
10	0.432	9.35	5.88	7.62	9.49	7.37	5.95	4.48	4.97	7.77	11.20	11.20	9.77	8.64
11	0.477	9.78	6.12	8.43	9.66	7.42	6.16	4.62	5.19	8.11	12.20	12.10	9.86	8.86
12	0.523	10.10	6.34	8.98	10.80	8.43	6.82	4.68	5.19	8.81	12.50	13.60	10.10	8.88
13	0.568	10.10	6.66	9.10	11.00	8.46	6.87	4.77	5.59	9.01	12.80	15.00	11.20	9.60
14	0.614	10.30	6.72	9.17	11.60	9.57	6.90	4.84	5.69	9.20	12.90	15.00	11.40	9.68
15	0.659	10.60	7.69	9.32	13.60	9.99	7.13	4.99	6.53	9.45	13.00	15.60	11.40	9.90
16	0.705	10.80	7.73	9.75	13.70	10.00	7.69	5.11	6.89	9.49	13.30	16.30	12.50	10.08
17	0.750	11.40	8.13	10.80	13.90	10.90	7.81	5.37	7.86	9.75	14.50	18.10	12.60	10.27
18	0.795	13.10	8.50	11.00	14.40	11.00	8.65	5.38	7.91	10.40	15.40	19.40	12.70	10.46
19	0.841	13.10	8.95	11.60	14.60	11.20	8.88	5.76	8.49	10.70	15.70	19.60	16.70	10.77
20	0.886	13.30	9.27	11.80	17.60	12.00	10.60	6.53	8.60	10.90	17.70	22.60	17.40	11.35
21	0.932	15.30	10.50	12.20	18.30	14.30	10.80	7.05	8.86	11.20	18.30	25.40	18.20	11.91
22	0.977	18.5	15.1	12.5	19.2	18.3	14.4	10.1	10.4	14.2	32.2	34.4	21.9	13.0
AVERAGE		9.97	6.78	8.50	11.28	9.12	6.85	4.85	5.79	8.17	12.08	14.53	11.27	9.09

R = RANK P = PROBABILITY

STATION NUMBER 11000015 INDONESIA WEST-SUMATRA SITE OF PATIMAH (142.0 Km2)

MONTHLY AND ANNUAL DISCHARGES IN ORDER (M3/S)

R	P	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
1	0.023	7.96	4.76	7.84	9.48	9.96	5.46	3.91	3.88	6.17	8.35	7.47	8.85	10.05
2	0.068	8.11	5.26	8.38	10.60	10.10	5.48	4.31	4.72	6.45	8.44	12.10	11.10	11.04
3	0.114	8.87	5.95	9.26	11.70	10.50	5.75	4.35	6.09	7.62	10.50	14.00	11.40	11.66
4	0.159	11.00	6.00	9.28	12.10	10.70	6.70	5.68	6.39	9.53	10.60	14.20	11.60	12.17
5	0.205	11.00	6.96	9.80	12.90	10.80	7.22	5.72	6.52	9.61	10.90	15.20	12.00	12.33
6	0.250	11.30	7.00	10.30	14.10	10.80	7.36	5.98	6.88	10.40	12.20	18.40	12.30	12.39
7	0.295	12.90	7.01	10.70	14.20	11.10	7.40	6.12	6.88	11.20	12.30	18.90	14.30	12.65
8	0.341	13.40	7.81	12.00	15.00	11.10	7.49	6.28	7.10	11.20	16.30	19.40	14.80	13.48
9	0.386	13.60	8.37	12.00	15.40	11.50	8.45	6.37	7.68	11.80	17.20	19.50	14.90	14.30
10	0.432	14.40	8.46	12.40	16.40	11.80	9.07	6.54	8.01	12.90	19.80	19.50	16.00	14.40
11	0.477	15.20	8.63	13.90	16.50	12.10	9.67	6.73	8.29	13.60	21.50	21.30	16.40	14.55
12	0.523	15.40	9.48	14.20	18.30	14.00	9.74	7.29	8.34	14.90	21.50	22.10	16.90	14.56
13	0.568	15.40	10.10	14.90	19.10	14.10	10.70	7.40	9.29	15.80	24.30	24.20	17.00	15.72
14	0.614	17.10	10.90	15.30	19.50	16.70	11.00	7.65	9.32	16.20	24.60	24.70	20.00	16.07
15	0.659	17.50	11.70	15.50	23.00	16.80	11.30	7.70	9.99	16.50	24.80	26.30	20.30	16.39
16	0.705	18.00	11.90	15.60	23.70	17.80	11.60	7.74	10.90	16.70	25.10	29.00	20.40	16.40
17	0.750	18.40	12.70	18.00	23.90	17.90	11.90	8.14	13.20	16.70	26.50	29.10	20.50	17.20
18	0.795	20.30	13.60	18.50	24.30	17.90	14.00	8.51	13.30	18.20	28.60	30.20	22.50	17.29
19	0.841	21.60	14.60	19.80	24.90	18.10	14.30	8.89	14.20	18.70	29.40	32.10	26.60	17.65
20	0.886	22.0	14.8	20.0	30.4	20.9	17.9	10.3	14.7	19.3	31.8	36.6	28.9	18.6
21	0.932	25.7	17.7	20.7	30.8	23.7	18.2	10.8	14.8	19.5	34.2	43.6	30.9	19.5
22	0.977	29.5	24.4	20.9	32.8	30.4	24.5	16.4	17.6	25.5	57.1	55.8	36.1	21.5
AVERAGE		15.85	10.37	14.06	19.05	14.94	10.69	7.40	9.46	14.02	21.64	24.26	18.35	15.00

R = RANK P = PROBABILITY

STATION NUMBER 11000018 INDONESIA WEST-SUMATRA SITE OF BAYANG SANI (9.74 Km2)

MONTHLY AND ANNUAL DISCHARGES IN ORDER (M3/S)

R	P	JAN	FEB	MAR	APR	MAI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
1	0.022	0.206	0.152	0.130	0.301	0.232	0.139	0.068	0.073	0.072	0.070	0.348	0.577	0.471
2	0.065	0.468	0.190	0.183	0.404	0.265	0.168	0.088	0.113	0.194	0.152	0.644	0.637	0.546
3	0.109	0.476	0.195	0.251	0.423	0.310	0.204	0.110	0.137	0.197	0.282	0.739	0.652	0.586
4	0.152	0.492	0.223	0.375	0.451	0.359	0.211	0.116	0.170	0.211	0.296	0.821	0.654	0.589
5	0.196	0.557	0.226	0.568	0.575	0.389	0.222	0.134	0.227	0.314	0.667	0.832	0.716	0.661
6	0.239	0.618	0.280	0.652	0.585	0.393	0.239	0.159	0.241	0.333	0.758	0.955	0.780	0.710
7	0.283	0.679	0.301	0.660	0.618	0.419	0.249	0.162	0.242	0.512	0.832	0.968	1.040	0.753
8	0.326	0.849	0.391	0.703	0.742	0.425	0.267	0.185	0.256	0.617	0.998	1.050	1.080	0.770
9	0.370	0.851	0.526	0.770	0.746	0.461	0.276	0.238	0.303	0.646	1.140	1.060	1.110	0.809
10	0.413	0.858	0.534	0.773	0.774	0.479	0.305	0.243	0.321	0.765	1.230	1.140	1.170	0.814
11	0.457	0.888	0.536	0.807	0.836	0.488	0.336	0.260	0.398	0.810	1.240	1.160	1.180	0.885
12	0.500	0.985	0.546	0.889	0.858	0.536	0.345	0.293	0.424	0.864	1.330	1.190	1.210	0.901
13	0.543	1.120	0.612	0.931	0.905	0.550	0.372	0.367	0.541	0.914	1.350	1.370	1.340	0.904
14	0.587	1.180	0.642	0.957	1.030	0.593	0.403	0.395	0.596	1.010	1.360	1.480	1.370	0.907
15	0.630	1.240	0.680	1.000	1.110	0.665	0.450	0.399	0.674	1.060	1.430	1.580	1.450	0.964
16	0.674	1.270	0.690	1.010	1.120	0.706	0.460	0.450	0.704	1.260	1.510	1.620	1.560	0.970
17	0.717	1.270	0.716	1.100	1.130	0.904	0.503	0.475	0.806	1.270	1.610	1.720	1.640	0.984
18	0.761	1.320	0.750	1.100	1.280	0.937	0.559	0.720	0.834	1.320	1.630	1.830	1.700	1.025
19	0.804	1.330	0.788	1.300	1.290	0.943	0.603	0.738	0.911	1.350	1.740	1.920	1.850	1.041
20	0.848	1.360	0.839	1.300	1.510	1.080	0.755	0.786	0.932	1.390	1.950	2.010	2.070	1.063
21	0.891	1.410	0.845	1.380	1.520	1.130	0.850	0.850	1.070	1.390	2.050	2.120	2.160	1.126
22	0.935	2.190	1.270	1.620	2.170	1.210	0.917	0.926	1.270	1.940	2.290	2.550	2.630	1.156
23	0.978	2.320	1.440	1.620	2.530	1.790	0.944	1.650	1.500	3.050	2.410	2.590	3.390	1.156
AVERAGE		1.041	0.581	0.873	0.996	0.664	0.425	0.427	0.554	0.934	1.232	1.378	1.390	0.861

R = RANK P = PROBABILITY

APPENDIX 4

LOW FLOW DISCHARGES IN ORDER

11000002 INDONESIA WEST-SUMATRA SITE OF GUNTUNG (147.0 Km2)

DISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR (M3/S)

YEAR	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
24	5.480	5.660	5.860	6.170	6.370	6.470	6.620	7.150	9.150	17.200	35.900
27	3.650	3.760	3.850	3.970	4.160	4.400	4.630	5.750	7.020	12.400	35.900
28	4.050	4.260	4.440	4.590	4.780	5.010	5.170	5.950	6.830	9.730	25.000
29	3.020	3.060	3.100	3.140	3.190	3.270	3.370	3.870	5.110	7.070	18.200
33	4.580	4.740	4.950	5.140	5.310	5.420	5.710	6.110	7.350	12.500	32.200
34	4.190	4.370	4.550	4.750	4.920	5.070	5.250	5.640	6.870	9.520	26.000
35	3.980	4.110	4.170	4.270	4.340	4.410	4.490	4.780	6.040	8.240	30.800
36	3.420	3.490	3.580	3.710	3.890	4.050	4.140	4.550	6.020	7.710	17.100
37	3.100	3.210	3.260	3.340	3.470	3.650	3.790	4.450	5.400	10.300	28.500
38	4.910	5.050	5.190	5.340	5.460	5.490	5.580	5.980	7.310	16.400	37.500
39	4.330	4.590	4.690	4.770	4.900	5.020	5.150	5.850	7.450	13.100	33.100
40	5.300	5.440	5.550	5.630	5.700	5.800	5.930	6.560	8.640	17.400	39.700
41	4.990	5.170	5.260	5.400	5.490	5.610	5.680	6.040	7.030	13.000	28.400
55	4.540	4.720	4.860	5.040	5.140	5.240	5.390	6.100	7.690	13.000	34.400
56	4.540	4.670	4.760	4.820	4.910	5.000	5.080	5.580	6.940	12.200	31.500

11000002 INDONESIA WEST-SUMATRA SITE OF GUNTUNG (147.0 Km2)

DISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR IN ORDER (M3/S)

R	P	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
1	0.033	3.020	3.060	3.100	3.140	3.190	3.270	3.370	3.870	5.110	7.070	17.100
2	0.100	3.100	3.210	3.260	3.340	3.470	3.650	3.790	4.450	5.400	7.710	18.200
3	0.167	3.420	3.490	3.580	3.710	3.890	4.050	4.140	4.550	6.020	8.240	25.000
4	0.233	3.650	3.760	3.850	3.970	4.160	4.400	4.490	4.780	6.040	9.520	26.000
5	0.300	3.980	4.110	4.170	4.270	4.340	4.410	4.630	5.580	6.830	9.730	28.400
6	0.367	4.050	4.260	4.440	4.590	4.780	5.000	5.080	5.640	6.870	10.300	28.500
7	0.433	4.190	4.370	4.550	4.750	4.900	5.010	5.150	5.750	6.940	12.200	30.800
8	0.500	4.330	4.590	4.690	4.770	4.910	5.020	5.170	5.850	7.020	12.400	31.500
9	0.567	4.540	4.670	4.760	4.820	4.920	5.070	5.250	5.950	7.030	12.500	32.200
10	0.633	4.540	4.720	4.860	5.040	5.140	5.240	5.390	5.980	7.310	13.000	33.100
11	0.700	4.580	4.740	4.950	5.140	5.310	5.420	5.580	6.040	7.350	13.000	34.400
12	0.767	4.910	5.050	5.190	5.340	5.460	5.490	5.680	6.100	7.450	13.100	35.900
13	0.833	4.990	5.170	5.260	5.400	5.490	5.610	5.710	6.110	7.690	16.400	35.900
14	0.900	5.300	5.440	5.550	5.630	5.700	5.800	5.930	6.560	8.640	17.200	37.500
15	0.967	5.480	5.660	5.860	6.170	6.370	6.470	6.620	7.150	9.150	17.400	39.700
AVERAGE		4.272	4.420	4.538	4.672	4.802	4.927	5.065	5.624	6.990	11.985	30.280

R = RANK P = PROBABILITY

11000004 INDONESIA WEST-SUMATRA SITE OF BALANGIR (40.6 Km2)

DISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR (M3/S)

YEAR	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
16	1.460	1.710	1.860	1.940	2.070	2.180	2.320	2.810	3.440	6.260	15.500
17	0.660	0.740	0.830	0.900	1.000	1.070	1.140	1.470	2.210	6.350	18.900
18	0.870	1.130	1.230	1.380	1.500	1.590	1.660	1.850	2.510	5.840	12.300
20	0.510	0.600	0.670	0.710	0.750	0.790	0.810	0.960	1.510	2.980	9.480
21	0.320	0.380	0.410	0.460	0.560	0.620	0.710	1.200	2.250	4.610	10.000
22	1.100	1.200	1.300	1.380	1.460	1.550	1.670	1.940	2.810	5.590	13.800
24	0.400	0.490	0.630	0.720	0.810	0.870	0.950	1.230	2.080	4.200	10.800
26	0.910	1.070	1.260	1.420	1.580	1.730	1.830	2.190	2.910	6.010	13.200
27	0.170	0.210	0.240	0.260	0.270	0.300	0.390	0.620	1.810	3.850	10.300
29	0.890	1.110	1.200	1.280	1.400	1.510	1.570	1.780	2.550	5.960	13.400
30	0.300	0.410	0.450	0.500	0.600	0.860	1.160	1.610	2.590	6.060	13.600
31	0.970	1.170	1.340	1.450	1.550	1.610	1.680	2.020	2.910	7.140	15.100
32	0.510	0.620	0.770	1.010	1.060	1.180	1.220	1.570	2.290	5.110	12.200
33	0.760	1.020	1.130	1.240	1.350	1.420	1.490	1.680	2.350	5.930	14.900
34	0.920	0.970	1.040	1.090	1.160	1.230	1.260	1.500	2.250	4.500	10.500
35	0.930	1.100	1.200	1.270	1.310	1.390	1.460	1.630	2.470	6.010	14.400
36	0.520	0.670	0.850	1.000	1.050	1.240	1.450	1.890	3.010	7.320	14.100
37	0.850	1.040	1.130	1.240	1.340	1.450	1.520	1.970	3.220	7.990	17.800
38	0.800	1.030	1.200	1.350	1.460	1.520	1.580	1.780	2.550	5.340	11.100
39	0.280	0.410	0.510	0.590	0.700	0.810	0.870	1.060	1.850	4.020	10.600
40	0.630	0.710	0.810	0.870	1.010	1.150	1.220	1.590	2.650	6.130	13.700
41	0.930	1.240	1.350	1.440	1.520	1.580	1.640	1.900	2.690	5.930	13.400
52	0.610	0.870	0.970	1.010	1.050	1.080	1.120	1.300	1.830	3.530	9.200
53	0.690	0.890	1.010	1.080	1.350	1.550	1.640	1.890	2.540	6.310	15.600
54	1.020	1.200	1.330	1.400	1.490	1.540	1.560	1.790	2.480	5.410	13.600
55	0.830	1.000	1.110	1.190	1.260	1.370	1.480	1.800	2.650	6.640	18.800
56	0.460	0.500	0.580	0.660	0.740	0.810	0.900	1.410	2.310	4.950	11.100
57	0.380	0.490	0.560	0.640	0.720	0.810	0.880	1.450	2.710	6.890	16.300

11000004 INDONESIA WEST-SUMATRA SITE OF BALANGIR (40.6 Km2)

DISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR IN ORDER (M3/S)

R	P	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
1	0.018	0.170	0.210	0.240	0.260	0.270	0.300	0.390	0.620	1.510	2.980	9.200
2	0.054	0.280	0.380	0.410	0.460	0.560	0.620	0.710	0.960	1.810	3.530	9.480
3	0.089	0.300	0.410	0.450	0.500	0.600	0.790	0.810	1.060	1.830	3.850	10.000
4	0.125	0.320	0.410	0.510	0.590	0.700	0.810	0.870	1.200	1.850	4.020	10.300
5	0.161	0.380	0.490	0.560	0.640	0.720	0.810	0.880	1.230	2.080	4.200	10.500
6	0.196	0.400	0.490	0.580	0.660	0.740	0.810	0.900	1.300	2.210	4.500	10.600
7	0.232	0.460	0.500	0.630	0.710	0.750	0.860	0.950	1.410	2.250	4.610	10.800
8	0.268	0.510	0.600	0.670	0.720	0.810	0.870	1.120	1.450	2.250	4.950	11.100
9	0.304	0.510	0.620	0.770	0.870	1.000	1.070	1.140	1.470	2.290	5.110	11.100
10	0.339	0.520	0.670	0.810	0.900	1.010	1.080	1.160	1.500	2.310	5.340	12.200
11	0.375	0.610	0.710	0.830	1.000	1.050	1.150	1.220	1.570	2.350	5.410	12.300
12	0.411	0.630	0.740	0.850	1.010	1.050	1.180	1.220	1.590	2.470	5.590	13.200
13	0.446	0.660	0.870	0.970	1.010	1.060	1.230	1.260	1.610	2.480	5.840	13.400
14	0.482	0.690	0.890	1.010	1.080	1.160	1.240	1.450	1.630	2.510	5.930	13.400
15	0.518	0.760	0.970	1.040	1.090	1.260	1.370	1.460	1.680	2.540	5.930	13.600
16	0.554	0.800	1.000	1.110	1.190	1.310	1.390	1.480	1.780	2.550	5.960	13.600
17	0.589	0.830	1.020	1.130	1.240	1.340	1.420	1.490	1.780	2.550	6.010	13.700
18	0.625	0.850	1.030	1.130	1.240	1.350	1.450	1.520	1.790	2.590	6.010	13.800
19	0.661	0.870	1.040	1.200	1.270	1.350	1.510	1.560	1.800	2.650	6.060	14.100
20	0.696	0.890	1.070	1.200	1.280	1.400	1.520	1.570	1.850	2.650	6.130	14.400
21	0.732	0.910	1.100	1.200	1.350	1.460	1.540	1.580	1.890	2.690	6.260	14.900
22	0.768	0.920	1.110	1.230	1.380	1.460	1.550	1.640	1.890	2.710	6.310	15.100
23	0.804	0.930	1.130	1.260	1.380	1.490	1.550	1.640	1.900	2.810	6.350	15.500
24	0.839	0.930	1.170	1.300	1.400	1.500	1.580	1.660	1.940	2.910	6.640	15.600
25	0.875	0.970	1.200	1.330	1.420	1.520	1.590	1.670	1.970	2.910	6.890	16.300
26	0.911	1.020	1.200	1.340	1.440	1.550	1.610	1.680	2.020	3.010	7.140	17.800
27	0.946	1.100	1.240	1.350	1.450	1.580	1.730	1.830	2.190	3.220	7.320	18.800
28	0.982	1.460	1.710	1.860	1.940	2.070	2.180	2.320	2.810	3.440	7.990	18.900
AVERAGE		0.703	0.857	0.963	1.053	1.147	1.243	1.328	1.639	2.480	5.602	13.346

R = RANK P = PROBABILITY

11000006 INDONESIA WEST-SUMATRA SITE OF SUMANI (80.9 Km2)

DISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR (M3/S)

YEAR	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
16	1.870	1.970	2.270	2.340	2.410	2.470	2.550	2.790	3.330	5.000	12.600
17	1.500	1.650	1.760	1.890	2.050	2.160	2.300	2.640	3.970	6.670	14.200
18	1.400	1.530	1.650	1.760	1.960	2.020	2.120	2.460	3.300	6.210	14.800
20	1.360	1.510	1.620	1.790	1.860	1.920	2.000	2.560	3.700	6.490	18.100
21	0.790	0.880	0.910	0.990	1.090	1.110	1.140	1.230	1.540	4.570	11.000
22	1.020	1.080	1.130	1.170	1.250	1.310	1.380	1.600	2.520	5.410	14.600
24	2.080	2.300	2.420	2.520	2.740	2.830	2.880	3.100	3.730	5.900	15.600
26	2.060	2.190	2.270	2.360	2.430	2.520	2.610	3.010	4.310	9.110	24.900
27	0.900	0.990	1.030	1.090	1.150	1.170	1.220	1.540	2.780	5.030	13.300
28	1.760	1.850	1.970	2.080	2.210	2.260	2.310	2.740	4.370	9.840	25.400
33	1.380	1.450	1.520	1.660	1.850	2.040	2.190	2.710	3.620	5.750	13.700
34	1.290	1.450	1.630	1.850	2.000	2.110	2.170	2.440	3.020	4.230	10.100
35	1.870	2.050	2.150	2.210	2.260	2.330	2.370	2.540	3.050	5.570	14.900
36	1.130	1.190	1.240	1.300	1.400	1.490	1.570	2.360	3.260	5.010	12.200
37	1.240	1.350	1.440	1.630	1.920	2.080	2.160	2.660	3.890	7.400	16.900
38	1.260	1.360	1.420	1.470	1.530	1.610	1.720	2.520	3.800	6.250	16.900
39	0.800	0.910	0.950	1.110	1.290	1.350	1.420	1.760	2.540	4.420	14.000
40	1.400	1.490	1.600	1.730	1.820	1.960	2.080	2.570	3.970	6.640	16.600
41	1.240	1.340	1.450	1.590	1.720	1.840	1.960	2.620	3.920	6.870	18.100

11000006 INDONESIA WEST-SUMATRA SITE OF SUMANI (80.9 Km2)

DISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR IN ORDER (M3/S)

R	P	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
1	0.026	0.790	0.880	0.910	0.990	1.090	1.110	1.140	1.230	1.540	4.230	10.100
2	0.079	0.800	0.910	0.950	1.090	1.150	1.170	1.220	1.540	2.520	4.420	11.000
3	0.132	0.900	0.990	1.030	1.110	1.250	1.310	1.380	1.600	2.540	4.570	12.200
4	0.184	1.020	1.080	1.130	1.170	1.290	1.350	1.420	1.760	2.780	5.000	12.600
5	0.237	1.130	1.190	1.240	1.300	1.400	1.490	1.570	2.360	3.020	5.010	13.300
6	0.289	1.240	1.340	1.420	1.470	1.530	1.610	1.720	2.440	3.050	5.030	13.700
7	0.342	1.240	1.350	1.440	1.590	1.720	1.840	1.960	2.460	3.260	5.410	14.000
8	0.395	1.260	1.360	1.450	1.630	1.820	1.920	2.000	2.520	3.300	5.570	14.200
9	0.447	1.290	1.450	1.520	1.660	1.850	1.960	2.080	2.540	3.330	5.750	14.600
10	0.500	1.360	1.450	1.600	1.730	1.860	2.020	2.120	2.560	3.620	5.900	14.800
11	0.553	1.380	1.490	1.620	1.760	1.920	2.040	2.160	2.570	3.700	6.210	14.900
12	0.605	1.400	1.510	1.630	1.790	1.960	2.080	2.170	2.620	3.730	6.250	15.600
13	0.658	1.400	1.530	1.650	1.850	2.000	2.110	2.190	2.640	3.800	6.490	16.600
14	0.711	1.500	1.650	1.760	1.890	2.050	2.160	2.300	2.660	3.890	6.640	16.900
15	0.763	1.760	1.850	1.970	2.080	2.210	2.260	2.310	2.710	3.920	6.670	16.900
16	0.816	1.870	1.970	2.150	2.210	2.260	2.330	2.370	2.740	3.970	6.870	18.100
17	0.868	1.870	2.050	2.270	2.340	2.410	2.470	2.550	2.790	3.970	7.400	18.100
18	0.921	2.060	2.190	2.270	2.360	2.430	2.520	2.610	3.010	4.310	9.110	24.900
19	0.974	2.080	2.300	2.420	2.520	2.740	2.830	2.880	3.100	4.370	9.840	25.400
AVERAGE		1.387	1.502	1.602	1.713	1.839	1.925	2.008	2.413	3.401	6.125	15.679

R = RANK P = PROBABILITY

11000012 INDONESIA WEST-SUMATRA SITE OF SIKARBAU (115.0 Km2)

DISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR (M3/S)

YEAR	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
16	2.900	3.110	3.410	3.530	3.580	3.690	3.790	4.140	4.960	6.040	22.300
17	2.910	3.070	3.220	3.380	3.540	3.700	3.770	4.160	5.200	7.810	19.600
18	2.950	3.120	3.330	3.750	3.940	4.080	4.170	4.600	6.060	11.800	35.600
20	2.860	3.070	3.260	3.330	3.520	3.700	3.900	4.600	6.090	11.000	26.200
21	3.160	3.520	3.770	3.900	3.970	4.090	4.200	4.840	6.060	10.000	22.900
22	2.180	2.280	2.400	2.550	2.670	2.750	2.810	4.130	5.490	9.390	22.300
24	3.590	3.810	3.970	4.100	4.260	4.330	4.400	4.710	5.650	8.710	20.800
26	2.990	3.240	3.350	3.420	3.490	3.550	3.620	3.950	4.600	6.260	17.900
27	1.850	1.980	2.070	2.150	2.220	2.330	2.390	2.800	4.240	10.400	28.500
28	2.730	2.850	2.930	3.030	3.170	3.260	3.370	3.940	5.150	8.550	22.500
29	3.040	3.320	3.470	3.790	4.080	4.190	4.280	4.770	6.150	13.400	32.600
30	3.950	4.240	4.450	4.620	4.730	4.840	4.920	5.320	6.940	14.800	43.900
31	4.540	4.830	5.160	5.330	5.440	5.590	5.730	6.210	8.270	17.600	42.900
32	3.210	3.460	3.830	4.190	4.370	4.490	4.620	5.220	7.220	15.500	40.800
33	3.860	4.150	4.320	4.450	4.590	4.690	4.840	5.260	6.750	12.300	33.000
34	3.630	3.800	3.880	3.980	4.050	4.140	4.220	4.620	5.750	11.200	25.600
35	3.450	3.810	4.190	4.490	4.600	4.760	4.970	5.320	6.930	14.300	32.700
36	3.280	3.420	3.560	3.660	3.780	3.940	4.110	4.550	6.430	10.800	26.900
37	2.200	2.470	2.650	2.770	3.030	3.250	3.540	4.700	6.460	11.400	26.800
38	3.750	3.990	4.220	4.780	4.940	5.080	5.210	5.670	7.160	11.500	28.500
40	3.290	3.490	3.710	4.060	4.450	4.680	4.800	5.250	6.990	13.700	27.500
41	3.340	3.650	3.850	4.090	4.270	4.440	4.650	5.390	7.400	14.900	33.000

11000012 INDONESIA WEST-SUMATRA SITE OF SIKARBAU (115.0 Km2)

DISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR IN ORDER (M3/S)

R	P	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
1	0.023	1.850	1.980	2.070	2.150	2.220	2.330	2.390	2.800	4.240	6.260	17.900
2	0.068	2.180	2.280	2.400	2.550	2.670	2.750	2.810	3.940	4.600	7.810	19.600
3	0.114	2.200	2.470	2.650	2.770	3.030	3.250	3.370	3.950	4.960	8.040	20.800
4	0.159	2.730	2.850	2.930	3.030	3.170	3.260	3.540	4.130	5.150	8.550	22.300
5	0.205	2.860	3.070	3.220	3.330	3.490	3.550	3.620	4.140	5.200	8.710	22.300
6	0.250	2.900	3.070	3.260	3.380	3.520	3.690	3.770	4.160	5.490	9.390	22.500
7	0.295	2.910	3.110	3.330	3.420	3.540	3.700	3.790	4.550	5.650	10.000	22.900
8	0.341	2.950	3.120	3.350	3.530	3.580	3.700	3.900	4.600	5.750	10.400	25.600
9	0.386	2.990	3.240	3.410	3.660	3.780	3.940	4.110	4.600	6.060	10.800	26.200
10	0.432	3.040	3.320	3.470	3.750	3.940	4.080	4.170	4.620	6.060	11.000	26.800
11	0.477	3.160	3.420	3.560	3.790	3.970	4.090	4.200	4.700	6.090	11.200	26.900
12	0.523	3.210	3.460	3.710	3.900	4.050	4.140	4.220	4.710	6.150	11.400	27.500
13	0.568	3.280	3.490	3.770	3.980	4.080	4.190	4.280	4.770	6.430	11.500	28.500
14	0.614	3.290	3.520	3.830	4.060	4.260	4.330	4.400	4.840	6.460	11.800	28.500
15	0.659	3.340	3.650	3.850	4.090	4.270	4.440	4.620	5.220	6.750	12.300	32.600
16	0.705	3.450	3.800	3.880	4.100	4.370	4.490	4.650	5.250	6.930	13.400	32.700
17	0.750	3.590	3.810	3.970	4.190	4.450	4.680	4.800	5.260	6.940	13.700	33.000
18	0.795	3.630	3.810	4.190	4.450	4.590	4.690	4.840	5.320	6.990	14.300	33.000
19	0.841	3.750	3.990	4.220	4.490	4.600	4.760	4.920	5.320	7.160	14.800	35.600
20	0.886	3.860	4.150	4.320	4.620	4.730	4.840	4.970	5.390	7.220	14.900	40.800
21	0.932	3.950	4.240	4.450	4.780	4.940	5.080	5.210	5.670	7.400	15.500	42.900
22	0.977	4.540	4.830	5.160	5.330	5.440	5.590	5.730	6.210	8.270	17.600	43.900
AVERAGE		3.166	3.395	3.591	3.789	3.941	4.071	4.196	4.734	6.180	11.516	28.764

R = RANK P = PROBABILITY

11000015 INDONESIA WEST-SUMATRA SITE OF PATIMAH (142.0 Km2)

DISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR (M3/S)

YEAR	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
16	4.190	4.490	4.660	4.990	5.200	5.300	5.420	5.930	7.410	14.500	39.100
17	4.210	4.460	4.710	5.050	5.350	5.530	5.640	6.200	7.910	13.800	32.600
18	4.500	4.740	5.030	5.560	5.890	6.140	6.310	7.090	9.800	20.100	64.600
20	4.320	4.600	4.830	4.980	5.170	5.480	5.620	6.590	8.800	19.000	45.600
21	4.710	5.310	5.580	5.740	5.990	6.220	6.390	6.990	9.240	18.600	40.400
22	3.290	3.480	3.670	3.800	3.960	4.060	4.180	5.920	8.260	16.900	43.100
24	5.340	5.620	5.840	5.970	6.110	6.240	6.350	6.750	8.580	15.900	36.100
26	4.520	4.860	5.090	5.180	5.250	5.340	5.450	5.930	7.240	11.100	31.500
27	2.760	2.950	3.130	3.260	3.380	3.530	3.640	4.250	6.660	17.500	52.000
28	4.190	4.350	4.470	4.640	4.740	4.900	5.120	5.970	7.440	14.300	39.500
29	4.450	4.810	5.060	5.560	5.810	5.910	6.100	6.950	9.370	23.600	53.600
30	5.480	5.810	6.190	6.330	6.530	6.730	6.870	7.500	10.800	24.700	68.500
31	6.040	6.400	6.870	7.050	7.320	7.590	7.850	8.650	13.200	27.900	72.400
32	4.250	4.550	5.060	5.640	5.870	6.060	6.190	7.160	10.700	25.400	69.600
33	5.330	5.640	5.930	6.330	6.480	6.600	6.700	7.450	10.100	21.100	56.400
34	5.080	5.360	5.550	5.720	5.870	6.000	6.140	6.650	8.620	20.400	43.400
35	4.870	5.350	5.890	6.250	6.450	6.620	6.900	7.590	11.400	25.500	54.800
36	4.940	5.160	5.390	5.570	5.720	5.840	5.980	6.560	9.640	18.100	46.900
37	3.100	3.480	3.740	3.930	4.270	4.680	5.150	6.420	10.200	20.400	44.600
38	5.140	5.480	5.800	6.360	6.670	6.830	7.010	8.010	11.300	20.800	48.400
40	4.520	4.880	5.140	5.520	6.320	6.500	6.620	7.470	11.300	22.300	46.900
41	4.700	5.280	5.580	5.810	5.980	6.170	6.400	7.330	11.500	25.100	53.300

11000015 INDONESIA WEST-SUMATRA SITE OF PATIMAH (142.0 Km2)

DISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR IN ORDER (M3/S)

R	P	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
1	0.023	2.760	2.950	3.130	3.260	3.380	3.530	3.640	4.250	6.660	11.100	31.500
2	0.068	3.100	3.480	3.670	3.800	3.960	4.060	4.180	5.920	7.240	13.800	32.600
3	0.114	3.290	3.480	3.740	3.930	4.270	4.680	5.120	5.930	7.410	14.300	36.100
4	0.159	4.190	4.350	4.470	4.640	4.740	4.900	5.150	5.930	7.440	14.500	39.100
5	0.205	4.190	4.460	4.660	4.980	5.170	5.300	5.420	5.970	7.910	15.900	39.500
6	0.250	4.210	4.490	4.710	4.990	5.200	5.340	5.450	6.200	8.260	16.900	40.400
7	0.295	4.250	4.550	4.830	5.050	5.250	5.480	5.620	6.420	8.580	17.500	43.100
8	0.341	4.320	4.600	5.030	5.180	5.350	5.530	5.640	6.560	8.620	18.100	43.400
9	0.386	4.450	4.740	5.060	5.520	5.720	5.840	5.980	6.590	8.800	18.600	44.600
10	0.432	4.500	4.810	5.060	5.560	5.810	5.910	6.100	6.650	9.240	19.000	45.600
11	0.477	4.520	4.860	5.090	5.560	5.870	6.000	6.140	6.750	9.370	20.100	46.900
12	0.523	4.520	4.880	5.140	5.570	5.870	6.060	6.190	6.950	9.640	20.400	46.900
13	0.568	4.700	5.160	5.390	5.640	5.890	6.140	6.310	6.990	9.800	20.400	48.400
14	0.614	4.710	5.280	5.550	5.720	5.980	6.170	6.350	7.090	10.100	20.800	52.000
15	0.659	4.870	5.310	5.580	5.740	5.990	6.220	6.390	7.160	10.200	21.100	53.300
16	0.705	4.940	5.350	5.580	5.810	6.110	6.240	6.400	7.330	10.700	22.300	53.600
17	0.750	5.080	5.360	5.800	5.970	6.320	6.500	6.620	7.450	10.800	23.600	54.800
18	0.795	5.140	5.480	5.840	6.250	6.450	6.600	6.700	7.470	11.300	24.700	56.400
19	0.841	5.330	5.620	5.890	6.330	6.480	6.620	6.870	7.500	11.300	25.100	64.600
20	0.886	5.340	5.640	5.930	6.330	6.530	6.730	6.900	7.590	11.400	25.400	68.500
21	0.932	5.480	5.810	6.190	6.360	6.670	6.830	7.010	8.010	11.500	25.500	69.600
22	0.977	6.040	6.400	6.870	7.050	7.320	7.590	7.850	8.650	13.200	27.900	72.400
AVERAGE		4.542	4.866	5.146	5.420	5.651	5.831	6.001	6.789	9.521	19.864	49.241

R = RANK P = PROBABILITY

11000018 INDONESIA WEST-SUMATRA SITE OF BAYANG SANI (9.74 Km2)

OISCHARGES DDn NOT EXCEEDED n DAYS BY YEAR (M3/S)

YEAR	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
24	0.250	0.260	0.290	0.320	0.350	0.360	0.400	0.570	0.950	1.490	2.920
26	0.100	0.120	0.140	0.160	0.170	0.190	0.200	0.260	0.430	1.410	3.550
27	0.086	0.100	0.130	0.150	0.160	0.180	0.200	0.270	0.470	1.270	3.030
28	0.150	0.170	0.180	0.180	0.190	0.200	0.210	0.250	0.370	1.000	2.170
29	0.074	0.097	0.110	0.140	0.170	0.180	0.190	0.240	0.380	1.460	3.340
30	0.180	0.210	0.230	0.240	0.250	0.260	0.270	0.290	0.500	1.350	3.200
31	0.190	0.210	0.230	0.250	0.250	0.260	0.280	0.320	0.530	1.510	3.560
32	0.054	0.068	0.086	0.100	0.110	0.110	0.120	0.140	0.220	0.670	2.650
33	0.095	0.100	0.110	0.130	0.150	0.160	0.170	0.220	0.310	0.810	2.390
34	0.094	0.110	0.130	0.140	0.150	0.160	0.160	0.200	0.340	1.370	3.040
35	0.180	0.220	0.250	0.260	0.270	0.290	0.300	0.340	0.640	1.780	4.410
36	0.150	0.180	0.210	0.230	0.240	0.250	0.260	0.290	0.480	1.530	3.140
37	0.091	0.100	0.110	0.120	0.130	0.140	0.150	0.210	0.300	0.780	2.290
38	0.110	0.130	0.140	0.150	0.160	0.160	0.170	0.220	0.370	1.600	4.180
39	0.088	0.100	0.110	0.130	0.150	0.180	0.190	0.260	0.420	1.380	4.040
40	0.160	0.200	0.220	0.230	0.240	0.250	0.260	0.290	0.560	1.720	3.860
41	0.170	0.190	0.200	0.210	0.220	0.230	0.240	0.270	0.430	1.590	4.750
53	0.160	0.180	0.190	0.200	0.210	0.210	0.220	0.260	0.430	1.760	5.080
54	0.180	0.200	0.210	0.230	0.240	0.250	0.260	0.280	0.400	1.250	4.110
55	0.110	0.120	0.130	0.140	0.140	0.150	0.150	0.190	0.310	0.830	2.630
56	0.120	0.140	0.150	0.180	0.190	0.200	0.200	0.230	0.360	1.010	2.760
57	0.140	0.160	0.170	0.180	0.190	0.200	0.210	0.250	0.360	1.270	3.090
58	0.030	0.039	0.046	0.054	0.060	0.064	0.067	0.084	0.250	0.610	2.020

11000018 INDONESIA WEST-SUMATRA SITE OF BAYANG SANI (9.74 Km2)

DISCHARGES DOn NOT EXCEEDED n DAYS BY YEAR IN ORDER (M3/S)

R	P	DD 1	DD 10	DD 20	DD 30	DD 40	DD 50	DD 60	DD100	DD200	DD300	DD350
1	0.022	0.030	0.039	0.046	0.054	0.060	0.064	0.067	0.084	0.220	0.610	2.020
2	0.065	0.054	0.068	0.086	0.100	0.110	0.110	0.120	0.140	0.250	0.670	2.170
3	0.109	0.074	0.097	0.110	0.120	0.130	0.140	0.150	0.190	0.300	0.780	2.290
4	0.152	0.086	0.100	0.110	0.130	0.140	0.150	0.150	0.200	0.310	0.810	2.390
5	0.196	0.088	0.100	0.110	0.130	0.150	0.160	0.160	0.210	0.310	0.830	2.630
6	0.239	0.091	0.100	0.110	0.140	0.150	0.160	0.170	0.220	0.340	1.000	2.650
7	0.283	0.094	0.100	0.130	0.140	0.150	0.160	0.170	0.220	0.360	1.010	2.760
8	0.326	0.095	0.110	0.130	0.140	0.160	0.180	0.190	0.230	0.360	1.250	2.920
9	0.370	0.100	0.120	0.130	0.150	0.160	0.180	0.190	0.240	0.370	1.270	3.030
10	0.413	0.110	0.120	0.140	0.150	0.170	0.180	0.200	0.250	0.370	1.270	3.040
11	0.457	0.110	0.130	0.140	0.160	0.170	0.190	0.200	0.250	0.380	1.350	3.090
12	0.500	0.120	0.140	0.150	0.180	0.190	0.200	0.200	0.260	0.400	1.370	3.140
13	0.543	0.140	0.160	0.170	0.180	0.190	0.200	0.210	0.260	0.420	1.380	3.200
14	0.587	0.150	0.170	0.180	0.180	0.190	0.200	0.210	0.260	0.430	1.410	3.340
15	0.630	0.150	0.180	0.190	0.200	0.210	0.210	0.220	0.270	0.430	1.460	3.550
16	0.674	0.160	0.180	0.200	0.210	0.220	0.230	0.240	0.270	0.430	1.490	3.560
17	0.717	0.160	0.190	0.210	0.230	0.240	0.250	0.260	0.280	0.470	1.510	3.860
18	0.761	0.170	0.200	0.210	0.230	0.240	0.250	0.260	0.290	0.480	1.530	4.040
19	0.804	0.180	0.200	0.220	0.230	0.240	0.250	0.260	0.290	0.500	1.590	4.110
20	0.848	0.180	0.210	0.230	0.240	0.250	0.260	0.270	0.290	0.530	1.600	4.160
21	0.891	0.180	0.210	0.230	0.250	0.250	0.260	0.280	0.320	0.560	1.720	4.410
22	0.935	0.190	0.220	0.250	0.260	0.270	0.290	0.300	0.340	0.640	1.760	4.750
23	0.978	0.250	0.260	0.290	0.320	0.350	0.360	0.400	0.570	0.950	1.780	5.080
AVERAGE		0.129	0.148	0.164	0.179	0.191	0.202	0.212	0.258	0.427	1.281	3.314

R = RANK P = PROBABILITY