GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY, MALAYSIA
PERLIS-KEDAH-PULAU PINANG
REGIONAL WATER RESOURCES STUDY
PART 1

VOL. 5
ANNEX
E. METEOROLOGY AND HYDROLOGY
F. GROUNDWATER RESOURCES

GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY, MALAYSIA
PERLIS-KEDAH-PULAU PINANG
REGIONAL WATER RESOURCES STUDY
PART 1

VOL. 5

ANNEX

E. METEOROLOGY AND HYDROLOGY

F. GROUNDWATER RESOURCES

FEBRUARY 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

NATIONAL WATER RESOURCES STUDY, MALAYSIA
PERLIS-KEDAH-PULAU PINANG
REGIONAL WATER RESOURCES STUDY
PART 1

LIST OF VOLUMES

ABBREVIATIONS

(1) Organization/Plan

4MP	:	Fourth Malaysia Plan
DID (JPT)	:	Drainage and Irrigation Department
EPU	:	Economic Planning Unit
FELCRA	:	Federal Land Consolidation and Rehabilitation Authority
FELDA	:	Federal Land Development Authority
GSD	:	Geological Survey Department
JICA	:	Japan International Cooperation Agency
MADA	:	Muda Agricultural Development Authority
NEB (LIN)	:	National Electricity Board
NWRS	:	National Water Resources Study
PWD (JKR)	:	Public Works Department
RISDA	:	Rubber Industry Small-Holders Development Authority
WHO	:	World Health Organization

(2) Others

B	:	Benefit
BOD	:	Biochemical Oxygen Demand
C	:	Cost
COD	:	Chemical Oxygen Demand
D&I	:	Domestic and Industrial
dia.	:	Diameter
EIRR	:	Economic Internal Rate of Return
El.	:	Elevation Above Mean Sea Level
Eq.	:	Equation
Fig.	:	Figure
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
H	:	Height, or Water Head
NHWL	:	Normal High Water Level
O&M	:	Operation and Maintenance
Q	:	Discharge
Ref.	:	Reference
SS	:	Suspended Solid

ABBREVIATIONS OF MEASUREMENT

Length

mm = millimeter
cm = centimeter
m = meter
km = kilometer
ft = foot
yd = yard

Area

cm^2 = square centimeter
m^2 = square meter
ha = hectare
km^2 = square kilometer

Volume

cm^3 = cubic centimeter
l = lit = liter
kl = kiloliter
m^3 = cubic meter
gal. = gallon

Weight

mg = milligram
g = gram
kg = kilogram
ton = metric ton
lb = pound

Time

s = second
min = minute
h = hour
d = day
y = year

Electrical Measures

V = Volt
A = Ampere
Hz = Hertz (cycle)
W = Watt
kW = Kilowatt
MW = Megawatt
GW = Gigawatt

Other Measures

% = percent
PS = horsepower
° = degree
' = minute
" = second
°C = degree in centigrade
10^3 = thousand
10^6 = million
10^9 = billion (milliard)

Derived Measures

m^3/s = cubic meter per second
cusec = cubic feet per second
mgd = million gallon per day
kWh = kilowatt hour
MWh = Megawatt hour
GWh = Gigawatt hour
kWh/y = kilowatt hour per year
kVA = kilovolt ampere
BTU = British thermal unit
psi = pound per square inch

Money

M$ = Malaysian ringgit
US$ = US dollar
¥ = Japanese Yen

CONVERSION FACTORS

	From Metric System	To Metric System
Length	1 cm = 0.394 inch 1 m = 3.28 ft = 1.094 yd 1 km = 0.621 mile	1 inch = 2.54 cm 1 ft = 30.48 cm 1 yd = 91.44 cm 1 mile = 1.609 km
Area	1 cm^2 = 0.155 sq.in 1 m^2 = 10.76 sq.ft 1 ha = 2.471 acres k km^2 = 0.386 sq.mile	1 sq.ft = 0.0929 m^2 1 sq.yd = 0.835 m^2 1 acre = 0.4047 ha 1 sq.mile = 2.59 km^2
Volume	1 cm^3 = 0.0610 cu.in 1 lit = 0.220 gal.(imp.) 1 kl = 6.29 barrels 1 m^3 = 35.3 cu.ft 10^6 m^3 = 811 acre-ft	1 cu.ft = 28.32 lit 1 cu.yd = 0.765 m^3 1 gal.(imp.) = 4.55 lit 1 gal.(US) = 3.79 lit 1 acre-ft = 1,233.5 m^3
Weight	1 g = 0.0353 ounce 1 kg = 2.20 lb 1 ton = 0.984 long ton = 1.102 short ton	1 ounce = 28.35 g 1 lb = 0.4536 kg 1 long ton = 1.016 ton 1 short ton = 0.907 ton
Energy	1 kWh = 3,413 BTU	1 BTU = 0.293 Wh
Temperature	°C = (°F - 32)·5/9	°F = 1.8°C + 32
Derived Measures	1 m^3/s = 35.3 cusec 1 kg/cm^2 = 14.2 psi 1 ton/ha = 891 lb/acre 10^6 m^3 = 810.7 acre-ft 1 m^3/s = 19.0 mgd	1 cusec = 0.0283 m^3/s 1 psi = 0.703 kg/cm^2 1 lb/acre = 1.12 kg/ha 1 acre-ft = 1,233.5 m^3 1 mgd = 0.0526 m^3/s
Local Measures	1 lit = 0.220 gantang 1 kg = 1.65 kati 1 ton = 16.5 pikul	1 gantang = 4.55 lit 1 kati = 0.606 kg 1 pikul = 60.6 kg

ANNEX E

METEOROLOGY AND HYDROLOGY

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

1. INTRODUCTION

This ANNEX describes the results of meteorological and hydrological study carried out during the PART 1 STUDY.

The objectives of the study are:

(1) to estimate daily runoff for continuous 20 years period from 1961 to 1980 at the proposed dam sites and at an arbitrary location of any river within the Region for the water demand and supply balance study;

(2) to estimate design flood hydrographs for the proposed dam projects; and

(3) to estimate sediment inflow to the reservoirs to be created by the proposed dams.

Although the runoff in the Region has been preliminary studied by NWRS, all the meteorological and hydrological data were reevaluated in this study for preparing runoff data satisfactory for the water balance study.

The study results of the Kedah-Perlis Water Resources Management Study were also reviewed and taken into consideration in the current study.

2. THE STUDY AREA

2.1 Location

The study area covers a region which is located in the northern part of the west coast of Peninsular Malaysia, between approximately 100°7' and 101°8' east in longitude and between 5°8' and 6°44' north in latitude.

The Region includes the Perlis, Kedah, Merbok, Muda and Perai river basins and the Pinang island. It is roughly corresponding to the land of the States of Perlis, Kedah and Pulau Pinang. Furthermore the Region includes a northern part of the State of Perak, because water transfer from the Rui river, a tributary of the Perak river, to the Muda river basin is probably necessary as has been indicated by NWRS.

On the other hand, the Pulau Langkawi and the Kerian river basin are excluded from the Region because they can form separate water resources systems.

The total area of the Region is about 11,200 km^2 including 10,300 km^2 of the three States of Perlis, Kedah and Pulau Pinang and 900 km^2 of the Rui river basin in the State of Perak.

2.2 Rivers

The main rivers in the Region are the Perlis, Kedah, Merbok, Muda and Perai rivers. They are running through the Region generally from north or east to south, and finally to Straight of Melaka.

The Perlis river basin, located in the north portion of the Region, is composed of the main system of Temenggong, Korok, Timah, Tasoh and other tributaries which feed the northwestern part of the State of Perlis including Kangar. The Arau river and northern half of the Gial river, the tributary of the Perlis river basin, are mostly integrated into the irrigation system of MADA, which is the nation's largest scheme encompassing the major portion of the coastal plain area of the States of Perlis and Kedah.

The Kedah and the Muda rivers originate in the mountainous lands of northeastern area of the Region adjoining Thailand. The drainage areas of the Kedah and Muda rivers are about 3,600 km^2 and 4,300 km^2 respectively, both the drainage areas occupy about 70% of the total area of the Region. These two rivers are characterized by the irrigation system of MADA. In order to supply irrigation water to MADA irrigation scheme, the Muda and Pedu dams were constructed in the upstream of the Muda and Kedah rivers and started their operation in 1969. These two dams were connected by the Saiong tunnel. The Muda dam conveys water from its catchment area of 984 km^2 in the upper Muda river basin through the Saiong tunnel to the upper tributary of the Kedah river. The Pedu dam in the upper Kedah river regulates the water from the Muda reservoir and inflow from its own catchment area of 171 km^2.

The Merbok river basin is located in the western area of the States of Kedah, having a catchment area of about 410 km^2. Most of the stretches of the main stream is a tidal river of having a wide river-mouth.

The Perai river of 410 km^2 in catchment area originates in the southern part of the Region, having 3 major tributaries of the Kulim, Jarak and Kerah. In the upstream basin of the Kulim river, the Mengkuang dam is now under construction to supply urban water to the Sungai Dua water supply system.

The Muda river is interconnected with the Perai river through the River Muda Canal and some irrigation canals. These 2 rivers supply domestic and industrial water for the Pinang island through a submarine pipeline system.

3. AVAILABLE DATA

3.1 Meteorological Data

3.1.1 Rainfall data

There are 123 rainfall gauging stations in the Region, of which 108 stations are operated and maintained by DID and others by MMS.

These stations are located densely in the coastal low land, while they are dispersed in the upstream basins of the Kedah, Muda and Rui rivers. The inventory of rainfall gauging stations is compiled in Tables 1 to 4 (Refs. 1, 2).

Among these stations, Alor Setar Hospital station (6103047) has the longest daily record since 1907, though data are occasionally interrupted.

The rainfall data are compiled and stored in a hydrologic data bank of a computer system in DID on daily basis. The monthly rainfall data are compiled in publications of DID.

Automatic rainfall gauges have been operated at Jeniang (5806066), Alor Setar (6103047), Kuala Nerang (6206035) and Kangar (6401001). Hourly rainfall data are available at these stations for 11 to 22 years.

For the purpose of preparing an isohyetal map in the Region based on rainfall records in 20 years between 1961 and 1980, 67 rainfall gauging stations were selected among the 123 stations taking into account the duration of record, interruptions and correlation to the record at nearby stations. All the selected stations in low land areas have 20-year record with a few interruptions but the stations selected for mountainous areas involve shorter recorded periods.

The location map of the selected stations is shown in Fig. 1 and the duration of record at each selected station is illustrated in Figs. 2 & 3.

The annual rainfall records for 20 years from 1961 to 1980 at the selected 67 stations are summarized in Tables 5 to 8 (Ref. 2).

3.1.2 Pan-evaporation data

Pan-evaporation is observed by MMS, DID and NEB. There are 9 pan-evaporation stations in the Region, where daily evaporation is measured by the U.S. Class A pan.

The observation records are compiled in the "Evaporation in Peninsular Malaysia". This report gives information on the monthly potential evaporation rate from open water (lakes and reservoirs) and other vegetative surface (forest, crops and grassland) at 2 principal climatological stations and 15 secondary climatological stations within the Region including 9 pan-evaporation stations.

In the report, the evaporation rates at principal station are estimated by using the Penman's method and those at secondary station are by Hargreaves method.

The location and availability of pan-evaporation stations in the Region are shown in Table 9.

3.1.3 Other meteorological data

In the Region, there are 2 principal climatological stations operated by MMS, where air temperature, relative humidity and sunshine hours are observed.

In addition, 15 secondary climatological stations are in operation observing air temperature and relative humidity.

Table 10 shows the available record length of meteorological data.

3.2 Hydrological Data

3.2.1 Stream flow data

Stream flow data are available at 22 hydrological stations in the Region. Their locations are shown in Fig. 1 together with the selected rainfall stations.

The hydrological stations are operated and maintained by DID. Water stage records at these stations are converted into discharge records by applying rating curves at the headquarter of DID. The rating curves are occasionally updated on the basis of discharge measurement data regularly carried out once a month.

The daily water stage and discharge of these stations are stored in the data bank of DID.

Fig. 4 shows the inventories of the hydrological station and the available length of daily discharge records (Ref. 3).

Among these stations, Jeniang (5806414) has the longest daily record since 1947, although the record has been affected by the construction and operation of the Muda dam after 1968.

In the Perlis river, the runoff observation was started in 1975 at Titi Konkerit Baru (6502431 and 6502432).

Runoff in the Kedah river basin is available at Lengkuas (6204421). The observation was started in 1946 but was closed in 1968 when the Pelubang barrage was completed at just upstream of the Lengkuas station, where most of the river water is diverted to the MADA irrigation canal.

There is Jam. Jalan Raya (5610401) gauging station in the Rui river, which is located downstream of the proposed dam site of the Rui dam. Its water stage observation was started in 1979, but no discharge measurement has been made. Thus no discharge record is available.

3.2.2 Reservoir operation data of the Muda and the Pedu dams

As described in Section 2.2, the Muda and the Pedu dams were constructed for irrigation water supply to the MADA irrigation scheme in 1969.

The Muda dam conveys water from the upper Muda river basin through a diversion tunnel, named the Saiong tunnel, to the upper tributary of the Kedah river. The Pedu dam in the upper Kedah river regulates the water from the Muda reservoir and natural flow from its drainage area.

The operation of these reservoirs has been recorded by MADA since 1969. The daily reservoir operation record includes the reservoir water level, reservoir storage volume, spillout volume, estimated inflow of the two dams and the discharge volume conveyed through the tunnel, but no record is available for the outflow through the river outlet of two dams.

3.2.3 Sediment load data

Suspended load measurement is carried out regularly once a month at the hydrological stations by DID.

Laboratory analysis of samples estimating suspended load concentration etc. is made by Research station of DID in Kuala Lumpur.

Although suspended load measurement station numbers 69 in Peninsular Malaysia, there is one measurement station in the Muda river since 1976.

No data is available for bed load, because bed load measurement has not been made in Malaysia.

4. METEOROLOGY

4.1 Climate

The climate of Peninsular Malaysia is generally characterized by the northeast monsoon and the southwest monsoon.

The variation in the climate under the influence of these monsoons is quite different between the east coast and west coast regions of Peninsular Malaysia because of the sheltering effect of the central mountain chain running from north to south in Peninsular Malaysia and the Sumatra island.

The northeast monsoon brings moisture from the South China Sea usually in November to February, striking the northeastern parts of Peninsular Malaysia first and then covers almost whole Peninsular Malaysia. All places exposed to the northeast monsoon receive heavy rainfall, especially in the northern part of the east coast. On the other hand, the Region of the northern part of the west coast where is sheltered from the monsoon receives a little rain during this season.

Generally in April or May, the southwest monsoon reaches to the west coast from across the Indian Ocean. The monsoon is prevailing over Peninsular Malaysia from May to July and causes fairly heavy rainfall in the west coast including the Region, while it is not significant in the east coast area.

In the transition period between the monsoons, from August to October, the northern portion of the west coast has a peak in rainfall brought by western winds and receives stronger effect on rainfall than that of other monsoons.

4.2 Rainfall

Figure 5 shows an isohyetal map of the Region which is constructed on the basis of 1961 - 1980 rainfall records at the selected 67 gauges.

Annual rainfall in the south of the Region is generally higher than in the north. In the southern border of the Region the annual rainfall is 2,400 mm - 3,200 mm, while it is 1,800 mm in the northern border.

The monthly variation of rainfall is illustrated in Fig. 6 for the basin mean rainfall of the selected river basins (key basins as stated in the Section 6.7).

In order to examine a long-term variation of rainfall for the period of more than 50 years, four rainfall stations in the Region are selected, though they include some missing data periods. These selected stations are the Selama Sungai Duri Estate, Kulim Hospital, Alor Setar Hospital and Baling Hospital (Ref. 2).

The Alor Setar Hospital is located in the low plain land and other stations are in the mountainous land. Especially two stations of the Selama Sungai Duri Estate and the Kulim Hospital are located in the area of more than 3,000 mm in annual rainfall.

Based on the annual rainfall at these 4 stations, 5-year moving average of annual rainfall is calculated as shown in Fig. 7.

The figure indicates that the long-term rainfall at the 4 stations extremely descended in 1970's. This tendency is more remarkable in the southern part of the Region, at the Selawa Sungai Duri Estate and Kulim Hospital stations.

4.3 Evaporation

Tables 11 and 12 show monthly open water evaporation and monthly forest evaporation (Ref. 4). The maximum evaporation occurs in March and the minimum during northeast monsoon months from November to December. Annual mean open water evaporation ranges from 1,700 to 2,000 mm.

4.4 Other Meteorological Conditions

4.4.1 Air temperature

Table 13 shows the monthly mean air temperature. The annual mean air temperature at 6 stations except the Penang Hill station ranges from 26°C to 28°C. The highest air temperature usually occurs from April to May and lowest is recorded from December to January. Monthly mean air temperature within the Region is almost constant throughout the year with a variation of less than 2°C.

4.4.2 Relative humidity

Monthly mean relative humidity at 2:00 p.m. is summarized in Table 14 for 17 stations.

Relative humidity within the Region is generally high and its seasonal variation is almost conformable to rainfall pattern of the area concerned.

Usually the highest occurs from October to November and the lowest is in February.

4.4.3 Sunshine hours

The daily sunshine hours records are available at 4 stations as shown in Table 15.

The annual mean daily sunshine hours in the Region is almost 7 hours.

The sunshine hours in the dry season of January to April are longest and 7 to 9 hours. On the other hand, in the rainy season of September to November is usually shortest ranging between 5 to 6 hours.

5. HYDROLOGY

5.1 General

This chapter presents a general idea of hydrology in the Region. The figures described here are based on the runoff and flood studies in the succeeding chapters.

The annual runoff balance in the study area of about 11,210 km^2 is 2,254 mm of basin mean rainfall, 894 mm of runoff depth and 1,360 mm of loss for the average of 20 years from 1961 to 1980. The annual loss includes losses due to evapotranspiration and groundwater recharge.

The annual runoff balance for the Perlis, Kedah, Merbok, Muda, Perai, P. Pinang and Julu & other southern river basins are summarized in Table 16.

5.2 Runoff at Major Facilities Sites

Table 17 shows the estimated annual natural runoff at the studied water source facilities sites in the Region which includes the existing, under planning and proposed facilities.

The monthly natural runoff at the 6 proposed dam sites of Badak-Temin, Sari, Durian, Tawar-Muda, Beris and Rui are estimated for the 20-year period of 1961 to 1980. They are shown in Tables 18 to 20.

Generally, the wet season is September to December, in which 50 to 70% of annual runoff occurs. There is a minor peak of runoff in May. Driest month is February or March.

5.3 Flow Duration Curves

Flow duration curves of natural runoff in each year during 1961 and 1980 are constructed for the 4 key hydrological stations set in each river basin of the Perlis, Kedah, Muda and Perai river. The curves in the Perlis and Kedah river basins relative to those in the Muda and Perai river basins have a sharp peak and long duration of small runoff.

Daily mean runoff of 99%; 361 days/365 days in probability of exceedance in each year between 1961 and 1980 are estimated for major river basins and proposed dam sites as summarized in Tables 21 & 22 respectively.

5.4 Floods

The probable hourly rainfall depth with a return period of 2 to 10,000 years at the 3 selected rainfall gauging stations is estimated. The direct runoff hydrograph is generated from probable rainfall depth

by means of the dimensionless hydrograph method described in the U.S. Bureau of Reclamation Manual and Hydrological Procedure No. 11.

The specific discharge of the 1,000-year probable flood at the proposed dam sites varies from 2.3 $m^3/s/km^2$ to 4.1 $m^3/s/km^2$.

The probable maximum floods are estimated at 7.0 $m^3/s/km^2$ for the Rui 2 and Rui 3 dam sites and 7.0 $m^3/s/km^2$ to 9.3 $m^3/s/km^2$ for other dam sites.

5.5 Sediment

The measurement record of suspended load is available since 1976 only at the Jam. Syed Omar hydrological station of 3,330 km^2 in the catchment area, which is located in the downstream of Muda river. No data is available for bed load. According to the sediment studies discussed in Chapter 8, the average specific annual yield in the Muda river basin is estimated to be 220 $m^3/km^2/y$.

6. RUNOFF STUDIES

6.1 General

The objective of the runoff studies is to provide runoff data at an arbitrary location in the Region on the 5-day basis for the continuous 20-year period from 1961 to 1980.

Taking into account local characteristics of runoff in the Region, the Region is divided into five major river basins.

Four hydrological stations in each major river basin among 22 existing stations are selected as the key stations as representing hydrological conditions of major river concerned with relatively long and accurate records.

The daily runoff records of the selected hydrological stations are more or less interrupted. Lacking period is interpolated by assuming a linear increase or decrease in runoff, if the interrupted period is short. If it is necessary to interpolate record for a long period, the runoff characteristics of river basin at key stations are examined by applying a simulation model called the Tank Model Method on the basis of daily rainfall and runoff records. Then the runoff records at the key station are supplemented by generated runoff by the model.

Finally the runoff depth in an arbitrary location was estimated by introducing the rainfall-loss relation obtained in the major river basin.

6.2 Basin Division

(1) Major river basin

The Region is divided into five basins of major river basin as shown in Fig. 8. They are the Perlis, Kedah, Muda, Perai and Rui river basins. Their basin areas are as follows:

Perlis	880 km^2
Kedah	3,590 km^2
Muda (including Merbok)	4,840 km^2
Perai (including P. Pinang)	1,010 km^2
Rui	890 km^2
Total	11,210 km^2

(2) Sub-basins

Each river basin is further divided into two to seven sub-basins and runoff depth is assumed to be uniform over a sub-basin for estimating runoff at an arbitrary location. The number of sub-basins in the major river basins is as follows:

Perlis river basin	3 sub-basins
Kedah river basin	6 sub-basins
Muda river basin	7 sub-basins
Perai river basin	3 sub-basins
Rui river basin	2 sub-basins

6.3 Definitions

(1) 5-day runoff

For the convenience of analysis, each calendar month is divided into six periods; 1st - 5th, 6th - 10th, 11th - 15th, 16th - 20th, 21st - 25th and the remainder of the month. Each period is called the 5-day period and the arithmetic mean of daily discharges in each 5-day period is named the 5-day runoff which might be expressed in m^3/s or 10^6 m^3.

This definition is applied if there are daily discharge records in two or more days in a 5-day period but such 5-day period as having daily discharge records in only one day or none is regarded as no data is available.

(2) Natural runoff

The daily runoff at a hydrological station which is not affected by any water uses in the catchment area is named the natural runoff. It is principally a measured discharge and is supplemented by a simulation model if it is interrupted or doubtful in accuracy.

(3) Rainfall loss

Rainfall loss is composed of evapotranspiration, increase in soil moisture and ground water recharge. Annual rainfall loss is calculated as the difference between rainfall and natural runoff and therein the increase in soil moisture is negligible.

(4) Key station

One hydrological station is selected for each major river basin after evaluation of runoff records. The station is named the key station and it is regarded as representing the hydrological conditions of the river basin concerned. In the case of the Rui river, no runoff observation has been carried out. Thus the key station is not selected in the basin. The runoff of the basin is estimated on the basis of the key station of the Muda river.

6.4 Selection of Key Station

For selection of key stations of major river basins, runoff records of the following 10 stations are evaluated. These stations have the catchment area bigger than 100 km^2 and data length longer than 5 years.

River Basin	Station
Perlis	Titi Konkerit Baru
Kedah	Lengkuas
Muda	Jeniang
	Nami
	Victoria
	Jam. Syed Omar
	Batu Pekaka
	Kuala Pegang
Perai	Ara Kuda

There are two Titi Konkerit Baru stations in the Perlis river. One is in the Timah river having a catchment area of 57 km^2 and the other is in the Tasoh river having a catchment area of 117 km^2. These hydrological stations are herein put together and called the Titi Konkerit Baru hydrological station. The total catchment area of the station is 174 km^2, but it is regarded to be 150 km^2 because a swamp of 24 km^2 located in the northern part of the Timah river little contributes surface runoff to the Perlis river basin.

Monthly discharge records at the 10 hydrological stations are calculated from the daily discharge records extracted from DID data bank and summarized in Tables 23 to 28.

Annual runoff calculated from the monthly discharge records is plotted against annual basin rainfall for the 10 hydrological stations which is estimated by weighted mean of selected 2 rainfall stations in each basin (selected stations as stated in the Section 6.7).

In plotting of annual runoff at 5 stations, such as the Nami, Jeniang, Jam. Syed Omar, Batu Pekaka and Ldg. Victoria hydrological stations, which are located in the Muda river basin, the outflow record through the spillway of the Muda dam since 1968 is taken into account, because their records are affected by the operation of the Muda dam.

Among 6 stations in the Muda river basin, Jeniang station is judged to be acceptable as the key station of the river basin because of the location, length of data and the rainfall-runoff relationship.

On the other hand only one station is available in each of the other river basins. Lengkuas and Ara Kuda stations have good rainfall-runoff relationship with sufficient length of records. The rainfall-runoff relationship of Titi Konkerit Baru is also good although the length of data is only 6 years.

Accordingly, Jeniang, Lengkuas, Ara Kuda and Titi Konkerit Baru stations are selected as key stations of the major river basins as summarized below.

River Basin	Key Station
Perlis	Titi Konkerit Baru (6502431 & 6502432)
Kedah	Lengkuas (6204421)
Muda	Jeniang (5806414)
Perai	Ara Kuda (5405421)

No large storage dam and no large scale intake structures are observed within the catchment area of the selected 4 stations except the Jeniang hydrological station.

On the other hand, no runoff record is available in the Rui river basin. Thus the Jeniang station is assumed to the key station of the Rui basin because the basin characteristics are the most similar to the Jeniang catchment.

6.5 Procedure of Simulation Study

(1) The basic tank model was constructed at the Jeniang hydrological station for the Muda river basin. The concept of the method is described in the following Section 6.6.

(2) The calibration of the model was mainly based on the following three aspects:

(a) annual loss,

(b) duration curve of daily runoff in each year, and

(c) monthly mean runoff.

The best combination of parameters of the model was determined by several trials.

(3) The basic model developed at the Jeniang hydrological station was applied to the Lengkuas hydrological station in the Kedah river basin. The model was calibrated by the runoff record at the Lengkuas hydrological station for 14 years from 1954 to 1967 and it was judged that the model was acceptable with a minor adjustment of parameters.

(4) This procedure was repeated for the other river basins. After evaluation of the results, it was found that the runoff at the Titi Konkerit Baru station could be simulated by the same model of Lengkuas station, while the Jeniang model could apply to the Ara Kuda station without any adjustment of parameters.

(5) Thus, daily runoff was generated for continuous 20 years from 1961 to 1980 at 4 key stations for each major river basin.

(6) In the preparation of daily natural runoff at key stations, the simulated runoff data were used instead of recorded runoff when they were not available and reliable. The detailed of the supplement procedure is described in the Section 6.9.

(7) The estimated daily natural runoff at key stations were converted into the 5-day natural runoff, because water demand and supply balance study was carried out on the basis of 5-day runoff data obtained by the runoff studies.

6.6 Simulation Model

There are some simulation methods widely used for estimating runoff from rainfall data. They are Tank Model, Stanford Watershed Model, Sacramento Model, etc. Among them, the Tank Model method developed by Dr. Sugawara was applied in this Study (Ref. 5).

(1) Basic concept of tank model

Suppose a tank having two holes, one at the bottom and the other at the side as shown in Fig. 10. When the tank is filled with water, the water will be released from these holes. In the runoff analysis, water released from the side hole corresponds to runoff to a stream and water from the bottom hole goes into the ground water zone.

The depth of water released from a hole is given by the following relation:

$$I = \alpha \cdot H$$

where, I: Depth of water released (mm/day)
α: Coefficient of hole
H: Water depth above hole (mm)

For the purpose of natural runoff simulation, four tanks combined vertically are usually used as shown in Fig. 11. The top tank corresponds to the surface runoff, the second tank to the subsurface runoff and the third and fourth to base flow from the ground water, respectively.

In the simulating process, daily rainfall depth is put into the top tank and the depth of water released from a hole is calculated by the above equation. The water from the bottom hole is put into the second tank and the same process is repeated to the fourth tank. The depth of stream runoff is given as the sum of the water released from side holes. Loss due to evapotranspiration is expressed by subtracting the depth of daily evapotranspiration from the storage of the top tank.

(2) Soil moisture content

The top tank has a special structure simulating soil moisture content in surface soil layers as shown in Fig. 12. This structure is effective for the area having distinct wet and dry seasons where surface soils are usually dried up in the dry season.

In this model soil moisture structure is divided into two parts, the primary and the secondary soil moisture. These soil moisture zones are set in the bottom of the top tank.

Moisture in these two zones is transferable depending on their relative moisture ratio as expressed below.

$$T2 = TC\ (\ XP/PS - XS/SS\ )$$

where, T2: Transfer of moisture between primary and secondary layers (plus sign indicates transfer from primary to secondary and minus sign vice versa)

PS: Primary soil moisture capacity

SS: Secondary soil moisture capacity

XP: Primary soil moisture depth

XS: Secondary soil moisture depth

TC: Constant

When primary soil moisture is not saturated and there is free water in lower tanks water goes up by capillary action so as to fill the primary soil moisture with the transfer speed T1 as given below.

$$T1 = TB\ (1 - XP/PS\ )$$

where, T1: Transfer of capillary action from lower tank

TB: Constant

(3) Zoning

In the non-humid basin, where some part is wet and the remaining part dry, the surface runoff occurs only in the wet area while in the dry area all the rainfall is absorbed as soil moisture. When the rainy season begins, the wet area grows larger, starting from a small area along the river. It can be assumed that the wet area spreads along the river.

In order to approximate the continuous change of wet area, the drainage area is divided into four zones from the uppermost zone to the lowermost zone as shown in Fig. 13. In the beginning of the dry season the uppermost zone (S1) from the river is firstly dried up and the dried up area is expanded to S2, S3 and S4 from the mountainous area to the river sides with the dry season goes by.

The areal ratios of zone S1 : S2 : S3 : S4 are the important parameters in this model. In this study, the areal ratio of zoning is assumed to be expressed by a geometrical progression as shown below.

$$A1 : A2 : A3 : A4 = a^3 : a^2 : a^1 : 1$$

where, Ai: Area of zone i
a : Equal ratio

Equal ratio is determined based on the calibration.

The vertical structure of each zone is assumed to be expressed by the series of four tanks with the same parameters.

(4) Composite tank model

Consequently the tank model for a river basin is composed of 4 x 4 tanks as shown in Fig. 11. In this Figure, the direction of water released from hole is illustrated.

In addition, a tank having two holes at the side is used for simulating the river channel storage.

6.7 Input Data

(1) Evapotranspiration

Potential forest evaporation was adopted as potential evapotranspiration for simulation study. The forest evaporation data are available in the study report "Evaporation in Peninsular Malaysia", which is published by DID.

Average annual basin forest evaporation of a river basin was calculated based on the map of "Peninsular Malaysia Forest Evaporation", which is included in the above-mentioned report.

A key evaporation station was selected for each basin. The annual forest evaporation at the selected station was adjusted so as to give the same average annual basin forest evaporation obtained by the above-mentioned map. They are listed below.

River Basin	Key Station
Perlis	Jpt. Kangar
Kedah	Jitra
Muda	Muda dam
Perai	Bukit Mertajam

The monthly evaporation data of these stations thus adjusted are shown in Table 29.

In the simulation model, the depth of daily evaporation is substructing from the top tanks of the composite tank model.

In the dry season of the non-humid region, when a part of the basin becomes dry, it corresponds to the condition that supply to the top tank is limited to the speed of capillary action. Therefore, loss due to evapotranspiration from the total basin is smaller than the potential evapotranspiration.

(2) Basin mean rainfall

Average annual basin rainfall of the key basins was estimated on the basis of the regional isohyetal map as shown in Fig. 5 and it is tabulated in Table 30.

The daily basin rainfall of a key station is estimated by means of the weighted average of two rainfall stations in the basin, which have good consistency with the runoff at the key station.

They are as follows:

Key Basin	Rainfall Station
Perlis, Titi Konkerit Baru	Kaki Bukit (6602002) Tasoh (6502003)
Kedah, Lengkuas	Kuala Nerang (6206035) Ladang Tanjong Pauh (6204028)
Muda, Jeniang	Sik (5807067) Kg. Gajah Puteh (5806065)
Perai, Ara Kuda	Kelang Baharu Kulim (5406083) Rumah Sakit Kulim (5305091)

Table 31 shows weight of rainfall station of each key basin. There were no missing data at all the selected stations for the 20 years period from 1961 to 1980.

The mean monthly basin rainfall is summarized in Tables 32 & 33 and illustrated in Fig. 6.

6.8 Calibration

The simulation models developed at four key stations were calibrated by examining the following three aspects of the calculated runoff:

(a) annual loss,

(b) daily duration curve in each year, and

(c) monthly mean runoff.

Calibration of daily basis runoff is not valid because areal distribution of a storm is usually not uniform in the basin and the basin mean rainfall does not coincide the peak of runoff in the runoff records.

A certain long duration of record is necessary for a reliable calibration. The runoff record at the Lengkuas hydrological station is available since 1946 and no longer operated since 1968. Daily rainfall records of two key stations selected for a simulation are available since 1954. Thus, in the simulation of the Lengkuas model, its simulation period was expanded into the duration between 1954 and 1980. For the other three hydrological stations, the simulation was made for the 20 years of 1961 - 1980.

(1) Annual loss

Table 34 shows the annual basin rainfall, runoff depth and loss of observed data.

The annual losses of the actual records at the Titi Konkerit Baru and the Lengkuas hydrological stations remain within a range of 1,000 and 2,000 mm in the whole period.

On the other hand, the annual loss of less than 1,000 mm is recorded in 1968 and 1973 at the Jeniang hydrological station and in 1962, 1978, 1979 and 1980 at the Ara Kuda hydrological station.

Table 35 shows the difference of annual loss of runoff observed and calculated at four key hydrological stations.

The errors at the Titi Konkerit Baru and Lengkuas hydrological stations range from 0 to 15%, which is considered to be acceptable in this calibration.

On the other hand, losses at the Jeniang hydrological station for 1968 - 1980 do not give good correlation between observed and calculated ones, although losses in 1961 - 1967 remains in acceptable range. This may be due to the effect of the operation of the Muda dam.

At the Ara Kuda hydrological station, errors in 1978, 1979 and 1980 are high compared to those in the other 17 years. Judging from potential evapotranspiration in this area of about 1,400 mm, these high values are not likely occurred. This indicates that observed runoff data involves unreasonably high discharge between 1978 and 1980. The calibration did not care these years.

(2) Daily duration curve

Tank parameters of the simulation model were adjusted so as to fit the daily duration curve of the runoff calculated to that of the runoff observed in each year.

Generally there may be some errors in the large discharge, because the stage discharge curve in high stage is not based on the actual observations. On the other hand, lower stage runoff based on the actual observations is usually reliable and accuracy of lower stage runoff is required in the water balance study. Thus fitting of the duration curve was mainly made in the lower stage discharge.

(3) Monthly mean runoff

Monthly mean runoff calculated by the model were compared with the monthly observed runoff. Figure 14 shows the monthly runoff comparison of the runoff calculated with the observed runoff at four key stations.

The calculated runoff is satisfactorily similar to the recorded runoff especially in the dry season.

(4) Tank parameters

Tank parameters of the model are summarized in Table 36. After the final calibration, two types of the model were developed. One was for the Perlis and the Kedah river basins and the other was for the Muda and Perai river basins.

Initial storages of each tank and initial channel storage for the simulation model are tabulated in Table 37. All simulations started in the same initial condition.

6.9 Natural Runoff at Key Stations

The daily runoff records of key stations are more or less interrupted during 1961 - 1980. The methods of supplement are as follows:

(a) If the interpolated period is less than one month, the interpolated period is assumed to be linear between in the last day of the antecedent period and that in the first day of the subsequent period; and

(b) If the interpolated period is more than one month or a certain period is judged unreliable, daily runoff data estimated by the simulation model are used.

The details of supplementing at each key station are described below.

(1) Titi Konkerit Baru hydrological stations

Daily runoff record for the period of 1975 - 1980 is available and reliable. That for 1961 - 1974 is estimated by means of the simulation model.

Annual runoff at the Titi Konkerit Baru hydrological station is estimated to be 77.1 x 10^6 m^3 on an average in 1961 - 1980; Basin rainfall is 1,890 mm, surface runoff is 514 mm and rainfall loss is 1,376 mm.

(2) Lengkuas hydrological station

Daily runoff record is available from 1946 to 1967 without missing data period. That from 1968 to 1980 is estimated by means of the simulation model.

Annual runoff at the Lengkuas hydrological station is estimated to be 713 x 10^6 m^3 on an average during the 20-year period of 1961 - 1980; basin rainfall is 1,927 mm, runoff is 561 mm and rainfall loss is 1,366 mm.

(3) Jeniang hydrological station

Daily runoff record is available for the period of 1947 - 1980. The record has been affected by the operation of the Muda dam since 1968. Daily outflow through the spillway of the Muda dam has been recorded, but no record is available for the outflow through the river outlet of the dam. According to MADA, test operation of river outlet was frequently carried out between 1968 and 1975 but river outlet has not been operated since 1976.

Taking into account the above-mentioned facts, daily runoff for 1968 - 1975 is estimated by means of simulation model. For the period of 1976 - 1980, daily runoff originating from the catchment area between the Muda dam and the Jeniang hydrological station is estimated to be the recorded runoff at Jeniang less spillout from the Muda dam. Daily runoff above the Muda dam in the same period is estimated by transposing the daily runoff originated from the catchment area between the Muda dam and the Jeniang hydrological gauge by the method to be described in the following Section 6.10.

Annual runoff at the Jeniang hydrological station is estimated to be 1,461 x 10^6 m^3 on an average during the 20-year period of 1961 - 1980; basin rainfall is 2,187 mm, runoff is 840 mm and rainfall loss is 1,347 mm.

(4) Ara Kuda hydrological station

Daily runoff record between 1961 and 1980 is available, but it involves unreasonably high discharge between the middle of 1964 and the middle of 1965, and 1978 to 1980, compared with rainfall record. Daily runoff in these suspicious period is replaced by the products of the simulation model.

Annual runoff at the Ara Kuda hydrological station is estimated to be 185 x 10^6 m^3 on an average during the period of 1961 - 1980; basin rainfall is 2,826 mm, runoff is 1,429 mm and rainfall loss is 1,397 mm.

The basin rainfall, natural runoff and rainfall loss at the 4 key stations are shown on annual basis for 1961 - 1980 in Table 38.

The estimated natural runoff at key stations are compiled in Tables 39 & 40 on monthly basis and Tables 41 to 52 on 5-day basis.

For reference, Plates 1 to 5 show the comparison of daily runoff recorded and simulated in the whole simulation period at key stations.

6.10 Sub-Basin Runoff

In order to estimate the 5-day natural runoff at an arbitrary location from the 5-day natural runoff data of key stations, each river system is divided into several sub-basins as shown in Fig. 8.

The sub-basin 5-day natural runoff for the period of 1961 - 1980 is estimated by transposing the 5-day natural runoff at key hydrological station in the same river basin by assuming that the rainfall loss during the period of 1961 - 1980 is evenly distributed in the river basin.

The method of conversion from the key hydrological station is expressed by the following equation:

$$Q = C \cdot Q_O$$

$$C = A \cdot (R - L_O)/A_O \cdot (R_O - L_O)$$

where, C : Conversion ratio

Q : Daily runoff at the objective sub-basin

Q_O: Daily runoff at the key hydrological station in the same river basin

A : Catchment area of the objective sub-basin

A_O: Catchment area at the key hydrological station

R : 1961 - 1980 average annual basin rainfall of the objective sub-basin

R_O: 1961 - 1980 average annual basin rainfall at the key hydrological station

I_O: 1961 - 1980 average annual rainfall loss at the key hydrological station

Conversion ratios from the key hydrological station to sub-basin are shown in Table 53. As shown in Table 53, the Jeniang hydrological station is used as key station for the Rui river basin.

The 5-day natural runoff at an arbitrary location within sub-basin is estimated by the specific 5-day natural runoff of the objective sub-basin derived from the runoff at key station.

6.11 Flow Duration Curve

Flow duration curves of natural runoff between 1961 and 1980 are constructed for the four hydrological stations based on the daily natural runoff records as shown in Figs. 15 to 18. The curves of the stations in the Perlis and Kedah river basins relative to those in the Muda and Perai river basins have sharp peak and long duration of small runoff.

Some details of the duration curves are shown in Tables 54 to 57.

7. FLOOD STUDIES

7.1 Review of Storm Rainfall and Flood Runoff Data

Flood runoff record is available only at Lengkuas (6204421) in the Kedah river, Jeniang (5806414) and Ldg. Victoria (5505412) in the Muda river, and Kg. Lintang (4911445) and Jambutan Iskandar (4809443) in the Perak river. Though these stream flow gauging stations are the nearest stations to the proposed dam sites in respective river basin, these are still too isolated from the objective sites. That is, these runoff records do not necessarily represent the flood runoff at the sites in the small and mountainous catchment area. In addition it is analyzed that the high stage records at these stations are by far smaller than the actual peak runoff due to the overflow and retardation effect in the flat plane (see Ref. 6).

The flood runoff at the proposed dam sites is therefore generated using the point storm rainfall data (1 - 24 hours) at the nearest representative stations. The hourly rainfall data (1 - 24 hours) are available only at Jeniang (5806066), Alor Setar (6103047), Kuala Nerang (6206035) and Kangar (6401001). At the stations 5609073, 6710061 and 5411068, only daily rainfall data (24 hours) is available. Tables 58 to 61 show the annual extreme values of hourly point rainfalls (1 - 24 hours) at Jeniang, Alor Setar, Kuala Nerang and Kangar respectively. Table 62 shows the annual extreme values of daily rainfalls (24 hours) at Kolamair Baling (5609073), Dispensari Kroh (5710061), Rumah Sakit Grik (5411068) and Naka (6106034).

The total rainfall depth does not increase remarkably from the duration of 3 hours; accordingly, the storm rainfall occurs mostly within 3 hours. This is due to not tropical cyclone but tropical shower.

7.2 Probable Flood

The probable rainfall depth with a return period of 2 - 10,000 years at Alor Setar, Jeniang and Kuala Nerang, which is shown in Tables 63, 64 and 65 respectively, is estimated by the Gumbel method.

On the basis of the foregoing review the direct runoff hydrograph, which represents the peak discharge and the time distribution, is generated by the dimensionless hydrograph method described in the U.S. Bureau of Reclamation Manual (Ref. 7) and Hydrological Procedure No. 11 (Ref. 8). The rainfall depth at Alor Setar (Table 61) is used for the Badak-Temin, Sari and Durian sites, and that at Jeniang (Table 64) is used for the Tawar-Muda, Beris and Rui sites. The basin characteristics of the proposed dam sites are presented in Table 66. Table 67 shows the main parameters of the triangular flood runoff hydrographs generated for respective dam site. The rainfall duration which generates the largest peak runoff is 3 hours except Badak-Temin site. Table 68 shows the peak discharge of the maximum probable flood with recurrence interval of 2 - 10,000 years at the proposed dam sites. The base flow component is estimated to be 0.03 $m^3/s/km^2$ from the daily runoff records at Jeniang (5806414) and Lengkuas (6204421).

7.3 Design Flood Discharge

The criteria of the design flood discharges for the main dam and auxiliary structures are set out below.

(a) River diversion

- 20 year flood for free flow condition
- 50 year flood for pressure flow condition

(b) Spillway

- 1,000 year flood without reservoir retardation effect or probable maximum flood (PMF) with reservoir retardation effect

(c) Spillway energy dissipator

- 1,000 year flood

The details of the criteria are described in ANNEX L, Proposed Dam Projects. Table 69 shows the design flood discharges by structure by site. The Creager's C-values are also presented for comparison.

The probable flood is estimated using the data plotted on the design flood envelope curves presented in Ref. 6 because the reliable data required for generating the probable maximum precipitation and PMF are not available.

Fig. 15 shows the PMF envelope curve estimated for the proposed project area. The envelope is discontinued at the catchment area of about 150 km^2. For the five dam sites the envelope of less than 150 km^2 is applied. This portion corresponds to the Creager's curve having the C-value of 20. For the Rui 2 and Rui 3 sites the straight envelope, of which specific discharge and range of drainage area are 7.0 $m^3/s/km^2$ and larger than 200 km^2 respectively, is applied.

The Creager's equation is given as follows:

$$q = C \cdot A^{(A^{-0.05} - 1)}$$

where, q: Flood ($m^3/s/km^2$)

A: Catchment area (km^2)

C: A coefficient depending upon the characteristic of the drainage basin (C-value)

8. SEDIMENT STUDIES

8.1 Sediment Loads

(1) Suspended load

The data on the suspended load concentration measured at the Jam. Syed Omar hydrological station in the Muda river are logarithmically plotted against the corresponding discharge as shown in Fig. 20. In general, the relation between suspended load and stream flow may be expressed by the following equation (Ref. 9):

$$Qs = K \cdot Q^n$$

where, Qs : Suspended load (ton/d)
Q : Discharge (m^3/s)
K,n: Constants

The constants of K and n are obtained by the observed data. K, the intercept when Q is unity, is usually quite small and n is statistically known to be between 2 and 3. The determined K and n are also shown in Fig. 20.

(2) Bed load

No bed load measurements have been performed in Malaysia. Therefore the bed load is obliged to be estimated based on suspended load. It is usually said that the rate of bed load is about 10 to 20% of the total sediment load, and this study only assumed that the proportion of bed load is 20% of total sediment load.

8.2 Annual Sediment Yield

The total sediment load is expressed by adding the bed load to the suspended load. Annual sediment yield is estimated at the Jam. Syed Omar hydrological station of 3,330 km^2 in the catchment area on the basis of 1961 - 1980 hydrological condition. In this calculation, the daily natural flow record at the above station are converted from the daily natural flow at the Jeniang hydrological station in the same river basin. The annual yield is given by summing up the daily suspended load. The resulting average annual sediment yield for the period of 1961 to 1980 is 734 x 10^3 ton at Jam. Syed Omar.

The average specific annual yield is estimated to be 220 $m^3/km^2/y$ for the Muda river basin. In the above estimation, the specific weight of the deposit is assumed to be 1.0 ton/m^3. It is noted that the suspended load is derived by the land use condition of the catchment for 1976 to 1980. In addition the estimated specific annual yield will change in the future with the change of the land use condition.

REFERENCES

1. HYDROLOGICAL STATION NUMBERING SYSTEM, 1974, Hydrological Procedure No. 6

2. HYDROLOGICAL DATA RAINFALL RECORDS FOR PENINSULAR MALAYSIA, 1879-1958, 1959-1965, 1965-1970, 1970-1975 (4 volumes), Drainage and Irrigation Publication

3. HYDROLOGICAL DATA STREAM FLOW RECORDS, 1941-1960, 1960-1965, 1965-1970, 1970-1975 (4 volumes), Drainage and Irrigation Publication

4. EVAPORATION IN PENINSULAR MALAYSIA, 1976, Water Resources Publication No. 5, DID

5. TANK MODEL AND ITS APPLICATION TO BIRD CREEK, WOLLOMBI BROOK, BIKIN RIVER, KITSU RIVER, SANAGA RIVER AND NAM MUNE, 1974, M. Sugawara and Others, The National Research Center for Disaster Prevention, Science and Technology Agency, Japan

6. NATIONAL WATER RESOURCES STUDY, MALAYSIA, SECTORAL REPORT VOL. 2 METEOROLOGY AND HYDROLOGY, 1982, JICA, Fig. 15

7. DESIGN OF SMALL DAMS, 1968, U.S. Department of Interior, Bureau of Reclamation

8. DESIGN FLOOD HYDROGRAPH ESTIMATION FOR RURAL CATCHMENTS IN PENINSULAR MALAYSIA, 1976, Hydrological Procedure No. 11, MOA

9. HYDROLOGY FOR ENGINEERS, 1975, R.K. Linsley, 2nd Edition

TABLES

Table 1 INVENTORY OF RAINFALL GAUGING STATIONS (1/4)

Station Number	Station Name	State	Recorded Period	Nos. of Recorded Years
6301001	Kg. Behor Lateh	Perlis	1979 - 1980	2
6301009	Seriap	Perlis	1950 - 1979	30
6401001*	Kg. Behor, Kanger	Perlis	1963 - 1975	13
6401002	Padang Katong, Kanger	Perlis	1974 - 1980	7
6401008	Store JPT, Kanger	Perlis	1909 - 1973	65
6402006	Guar Nangka	Perlis	1958 - 1980	23
6402007	Arau	Perlis	1947 - 1980	34
6403001	Ulu Pauh	Perlis	1974 - 1980	7
6501004	Abi	Perlis	1946 - 1969	24
6501005	Abi Kg. Bahru	Perlis	1963 - 1980	18
6502001	Ladang Perlis Utara	Perlis	1974 - 1980	7
6502003	Tasoh	Perlis	1958 - 1980	23
6502010	Bukit Temiang	Perlis	1967 - 1980	14
6503001	Ladang Perlis Selatan	Perlis	1974 - 1980	7
6602002	Kaki Bukit	Perlis	1946 - 1980	35
6603001	Padang Besar	Perlis	1954 - 1975	22
6603002	Pdg. Besar, Titi Keretapi	Perlis	1974 - 1980	7
5105105	Kerjaair Bukit Panchor	Kedah	1926 - 1980	55
5105106	Rumah Penjaga JPT, Parit Nibong	Kedah	1908 - 1980	73
5106104	Ladang Inchong	Kedah	1949 - 1964	16
5206102	Terap	Kedah	1958 - 1980	23
5206103	Ladang Selama, Serdang	Kedah	1912 - 1980	69
5305001	Kg. Dusun	Kedah	1963 - 1980	18
5305091	Rumah Sakit Kulim	Kedah	1908 - 1980	73
5305092	Bukit Besar. Kulim	Kedah	1946 - 1971	26
5307101	Sekolah Menengah Mahang	Kedah	1959 - 1980	22
5406081	Ladang Bagan Sena	Kedah	1947 - 1980	34
5406083	Kelang Baharu. Kulim	Kedah	1958 - 1980	23
5407080	Ladang Dublin	Kedah	1958 - 1980	23
5504085	Rantau Panjang	Kedah	1949 - 1980	32
5505084	Ladang Henrietta	Kedah	1947 - 1980	34
5506078	Merbau Pulas	Kedah	1968 - 1980	13
5506082	Ladang Bukit Karangan	Kedah	1947 - 1980	34
5507076	Batu 27 Jln. Baling	Kedah	1964 - 1980	17
5507079	Ladang Pelam	Kedah	1948 - 1980	33
5604001	Stor JPT, Sg. Petani	Kedah	1971	1
5604002	Jabatan Penjara Sg. Petani	Kedah	1971 - 1980	10

Remarks; Daily record is available at the above-listed stations and hourly record is also available at the station marked by star (*).

Table 2 INVENTORY OF RAINFALL GAUGING STATIONS (2/4)

Station Number	Station Name	State	Recorded Period	Nos. of Recorded Years
5604059	Rumah Sakit Sg. Petani	Kedah	1913 - 1969	57
5606077	Ladang Lubok Segintah	Kedah	1958 - 1980	23
5608074	Pulai	Kedah	1950 - 1980	31
5609072	Rumah Sakit Baling	Kedah	1915 - 1980	66
5609073	Kolamair Baling	Kedah	1949 - 1980	32
5704054	Ibu Bekalan Yen	Kedah	1946 - 1980	35
5704055	Kedah Peak	Kedah	1950 - 1980	31
5704056	Sekolah Menengah Gurun	Kedah	1972 - 1980	9
5704057	Ibu Bekalan Tupah	Kedah	1948 - 1980	33
5704058	Semeling	Kedah	1945 - 1980	36
5708071	Kg. Terabak	Kedah	1958 - 1980	23
5803052	Sg. Limau	Kedah	1942 - 1980	39
5804053	Guar Chempadak	Kedah	1943 - 1977	35
5804056	Lombong Batu Gurun	Kedah	1949 - 1972	24
5806065	Kg. Gajah Puteh	Kedah	1958 - 1980	23
5806066*	Jeniang Klinik	Kedah	1947 - 1980	34
5807067	Sik	Kedah	1947 - 1980	34
5808001	Batu 61 Jln. Baling	Kedah	1972 - 1980	9
5808069	Batu 62 Jln. Baling	Kedah	1958 - 1972	15
5808070	Kg. Lubok Badak	Kedah	1958 - 1980	23
5903151	Pintu Kawalan P/S Kuala Sala	Kedah	1961 - 1980	20
5904043	Pendang	Kedah	1948 - 1980	33
5904051	Kota Sarang Semut	Kedah	1942 - 1980	39
5904152	Simpang Tiga, Sg. Limau	Kedah	1961 - 1979	19
5905042	Sg. Tiang	Kedah	1968 - 1980	13
6003049	Telok Chengai	Kedah	1942 - 1980	39
6004045	Stn. Keretapi Tokai	Kedah	1958 - 1980	23
6005001	Kg. Bendang Bukit	Kedah	1977 - 1980	4
6005044	Kg. Jelutong	Kedah	1958 - 1980	23
6007063	Nami	Kedah	1964 - 1980	17
6103047*	Stor JPT, Alor Star	Kedah	1964 - 1980	17
6103048	Alor Janggus	Kedah	1942 - 1980	39
6105037	Gajah Mati	Kedah	1932 - 1980	49
6105038	Pokok Sena	Kedah	1965 - 1970	6
6106034	Naka	Kedah	1947 - 1980	34
6108001	Komplek Rumah Muda	Kedah	1972 - 1980	9
6108062	Ampang Muda	Kedah	1964 - 1972	9

Remarks; Daily record is available at the above-listed stations and hourly record is also available at the station marked by star (*).

Table 3 INVENTORY OF RAINFALL GAUGING STATIONS (3/4)

Station Number	Station Name	State	Recorded Period	Nos. of Recorded Years
6202001	Pintu Kawalan P/S K. Sanglang	Kedah	1971 - 1979	9
6202011	Kg. Sanglang	Kedah	1942 - 1971	30
6204022	Setesyen Keretapi Tunjang	Kedah	1958 - 1980	23
6203124	Telaga Batu. Jitra	Kedah	1959 - 1979	21
6204023	Stn. Petak Ujian Jitra	Kedah	1965 - 1980	16
6204028	Ladang Tanjong Pauh	Kedah	1947 - 1980	34
6204039	Stn. Kajicuaca Kepala Batas	Kedah	1936 - 1980	45
6205036	Kg. Paya	Kedah	1958 - 1980	23
6206035*	Kuala Nerang	Kedah	1942 - 1980	39
6207032	Ampang Pedu	Kedah	1964 - 1980	17
6207033	Tong Pelu. Kg. Pinang	Kedah	1948 - 1980	33
6302021	Kddiang	Kedah	1942 - 1980	39
6303122	Megat Dewa	Kedah	1961 - 1971	11
6304026	Kerjaair Bukit Wang	Kedah	1944 - 1980	37
6304027	Ladang Paya Kamunting	Kedah	1907 - 1980	74
6305029	Kg. Tengah	Kedah	1947 - 1980	34
6306031	Padang Sanai	Kedah	1942 - 1980	39
6403025	Batu 8, Changlun	Kedah	1965 - 1980	16
6404001	Changlun	Kedah	1977 - 1980	4
6405024	Sintok	Kedah	1947 - 1969	23
5202021	Stn. Kajicuaca Bayan Lepas	P. Pinang	1934 - 1980	47
5204048	Sg. Simpang Ampat	P. Pinang	1951 - 1980	30
5204049	Ladang Batu Kawan	P. Pinang	1947 - 1980	34
5205050	Sekolah Kebangsaan Sg. Bakap	P. Pinang	1946 - 1980	35
5302001	Taliair Besar Sg. Pinang	P. Pinang	1952 - 1980	29
5302002	Pintuair Bagan Air Itam	P. Pinang	1946 - 1980	35
5302003	Kolam Takongan Air Itam	P. Pinang	1975 - 1980	6
5303001	Rumah Kebajikan Pulau Pinang	P. Pinang	1975 - 1980	6
5303053	Komplek Prai	P. Pinang	1970 - 1980	11
5304045	Kolamair Bukit Berapit	P. Pinang	1935 - 1980	46
5304046	Permatang Rawa	P. Pinang	1953 - 1980	28
5304047	Kolamair Cherok To' Kun	P. Pinang	1935 - 1980	46
5402001	Klinik BT. Bendera	P. Pinang	1975 - 1980	6
5402002	Kolam Bersih Pulau Pinang	P. Pinang	1975 - 1980	6
5402011	Stn. Pertanian Air Itam	P. Pinang	1943 - 1973	31
5403042	Stn. Kajicuaca Butterworth	P. Pinang	1955 - 1980	26
5404041	Ladang Malakoff	P. Pinang	1933 - 1980	48

Remarks; Daily record is available at the above-listed stations and hourly record is also available at the station marked by star (*).

Table 4 INVENTORY OF RAINFALL GAUGING STATIONS (4/4)

Station Number	Station Name	State	Recorded Period	Nos. of Recorded Years
5404043	Ibu Bekalan Sg. Kulim	P. Pinang	1946 - 1980	35
5404044	Stn. Petak Ujian Bukit Merah	P. Pinang	1946 - 1980	35
5503031	Permatang Bendahari	P. Pinang	1949 - 1980	32
5503034	Permatang Binjai	P. Pinang	1958 - 1980	23
5504032	Rumah Pam Bumbong Lima	P. Pinang	1963 - 1980	18
5504034	Permatang Sintok	P. Pinang	1955 - 1957	3
5504035	Lahar Ikan Mati, Kepala Batas	P. Pinang	1949 - 1980	32
5505033	Rumah Pam Pinang Tunggal	P. Pinang	1949 - 1980	32
5710061	Dispensari Kroh	Perak	1971 - 1980	10
5710062	Dispensari Klian Intar	Perak	1910 - 1970	61
5411068	Rumah Sakit Grik	Perak	1900 - 1976	77
5210069	Stn. Pemereksaan Hutan Lawin	Perak	1966 - 1971	6

Table 5 ANNUAL RAINFALL (1/4)

Unit: mm

Year	Station Number 6602002	6502003	6501005	6402006	6402007	6306031	6305029	6304027	6304026
1961	1,975	1,766	-	1,628	1,831	2,314	-	1,985	2,480
1962	1,886	1,694	-	1,611	1,903	2,155	-	2,006	2,483
1963	1,750	1,445	2,222	1,877	1,984	2,379	1,439	1,965	2,150
1964	1,599	1,434	1,756	1,141	1,786	2,651	1,613	1,765	2,218
1965	2,033	1,821	2,289	1,747	2,003	-	2,009	2,172	2,475
1966	2,391	1,955	1,942	1,969	2,438	-	1,895	2,116	2,584
1967	2,458	1,999	2,370	2,401	2,497	-	1,939	2,261	2,805
1968	1,567	1,631	1,833	1,898	1,808	-	2,139	1,961	2,134
1969	2,298	2,167	2,216	2,357	2,061	-	2,105	2,665	2,441
1970	2,192	1,867	2,529	2,512	2,298	-	2,305	2,234	2,690
1971	2,030	2,065	2,647	2,546	2,143	1,886	1,834	2,586	2,461
1972	2,162	2,250	2,545	2,866	2,217	1,657	2,019	2,353	2,958
1973	2,035	2,022	2,052	1,960	2,143	2,033	2,028	2,295	2,248
1974	1,541	1,493	1,685	1,197	1,344	-	1,898	1,963	2,111
1975	2,101	1,928	2,150	2,156	2,726	2,252	1,948	2,705	2,373
1976	2,206	1,892	1,936	1,739	2,077	2,045	2,035	2,210	2,069
1977	1,663	1,406	1,446	1,187	1,702	1,632	1,431	1,878	1,649
1978	2,308	1,819	1,905	1,646	1,764	1,937	1,694	2,075	2,489
1979	2,210	1,771	1,906	1,970	1,635	-	2,102	1,650	2,018
1980	2,131	1,849	1,685	1,797	1,907	-	2,095	2,451	1,923
Average	2,025	1,814	2,062	1,911	2,014	2,086	1,918	2,167	2,338

Unit: mm

Year	Station Number 6302021	6301009	6207032	6206035	6204039	6204028	6108001	6105037	6103048
1961	1,748	2,005	-	2,010	2,094	2,036	-	2,797	2,811
1962	1,620	1,751	-	1,989	1,995	2,052	-	2,366	2,332
1963	1,459	1,678	-	1,720	1,816	1,807	-	2,542	2,048
1964	2,784	1,666	-	1,338	1,752	1,812	-	2,283	1,907
1965	2,371	2,055	-	2,304	2,411	2,206	-	2,618	2,549
1966	2,281	2,008	-	1,891	2,318	2,227	-	2,266	3,018
1967	2,292	2,535	-	2,041	2,292	2,050	-	2,251	2,532
1968	1,765	1,779	-	2,077	1,707	1,820	-	1,989	2,695
1969	1,775	2,003	-	2,012	2,331	2,442	-	2,875	2,736
1970	2,021	2,323	-	1,795	2,395	2,638	-	3,257	2,633
1971	1,935	1,750	2,092	2,173	2,482	2,852	-	2,591	2,229
1972	2,160	2,538	2,347	2,333	2,298	2,551	-	2,632	2,334
1973	1,829	1,813	2,889	2,279	2,253	2,448	2,338	2,976	2,335
1974	1,627	1,570	2,292	2,051	2,570	2,295	2,049	2,468	2,038
1975	2,578	2,611	2,699	2,023	2,178	2,059	2,570	2,257	2,463
1976	1,878	2,032	2,239	2,172	2,247	2,342	2,203	2,956	2,122
1977	1,774	1,814	1,996	1,289	1,943	1,512	2,073	2,090	2,068
1978	1,583	1,713	2,137	1,729	2,011	1,826	1,775	2,525	2,137
1979	1,753	-	2,173	1,801	1,770	1,810	2,128	1,915	1,948
1980	1,822	-	-	1,944	2,357	2,345	-	2,440	2,500
Average	1,952	1,980	2,318	1,949	2,161	2,159	2,162	2,505	2,372

Table 6 ANNUAL RAINFALL (2/4)

Unit: mm

Year	Station Number 6103047	6005044	6004045	6003049	5904051	5904043	5808070	5807067	5806066
1961	-	2,585	2,773	2,591	2,809	2,297	2,426	2,222	-
1962	-	2,276	2,079	2,426	2,172	2,057	2,463	2,104	-
1963	-	1,702	1,874	2,056	2,110	1,933	2,135	2,015	-
1964	-	2,046	1,913	1,837	2,497	2,036	2,347	2,244	-
1965	1,488	2,655	2,305	2,430	2,449	2,070	2,478	2,165	1,868
1966	2,352	2,537	2,358	2,668	2,581	2,412	2,035	2,250	2,370
1967	2,471	2,489	2,832	2,297	2,319	2,296	2,829	1,660	2,213
1968	1,976	2,249	2,768	2,134	2,376	2,257	1,742	1,653	2,330
1969	2,329	2,382	2,443	2,465	2,511	2,440	3,053	2,922	2,720
1970	2,377	2,428	2,690	2,206	2,802	2,388	2,647	2,894	2,876
1971	2,454	2,434	2,435	2,365	2,800	2,415	2,472	2,364	2,399
1972	2,718	2,554	2,116	2,271	2,200	1,988	2,729	2,357	2,663
1973	2,577	2,469	2,663	2,826	2,856	2,876	2,856	2,310	2,403
1974	2,121	1,949	1,933	2,169	2,186	1,827	2,154	1,815	2,071
1975	2,551	1,791	2,695	2,514	2,773	2,293	3,065	2,722	2,587
1976	2,282	1,984	2,439	2,607	2,766	2,473	2,876	2,693	3,058
1977	2,051	1,595	1,542	2,355	2,760	2,198	2,374	2,516	2,807
1978	2,190	1,254	3,448	2,739	2,747	2,316	2,020	2,475	2,838
1979	1,785	1,762	1,874	1,856	2,107	2,053	2,301	2,163	2,487
1980	-	2,065	2,595	3,049	2,464	2,413	2,903	2,666	-
Average	2,248	2,161	2,389	2,393	2,514	2,252	2,495	2,311	1,885

Unit: mm

Year	Station Number 5806065	5803052	5710061	5708071	5704058	5704057	5704055	5610062	5609073
1961	2,080	3,195	2,302	3,000	2,582	4,063	3,341	1,049	2,427
1962	2,317	1,778	2,162	2,371	2,273	3,000	3,856	2,061	2,561
1963	2,435	2,024	1,989	2,106	2,275	2,691	3,571	1,759	2,127
1964	2,289	2,252	2,360	2,098	2,393	3,060	4,076	2,913	[illegible]28
1965	2,867	2,321	3,107	2,746	2,326	2,752	4,001	2,008	1,847
1966	2,656	2,263	3,193	2,336	2,050	2,361	3,207	2,468	2,430
1967	2,325	2,567	2,611	2,443	1,947	2,620	2,969	2,024	2,454
1968	2,491	2,609	1,636	2,011	2,301	2,633	3,496	1,620	1,714
1969	2,696	2,222	2,414	3,070	2,443	2,495	3,494	1,514	2,424
1970	2,362	3,102	-	2,174	2,441	2,982	4,018	-	1,501
1971	2,189	2,997	1,977	2,040	2,566	3,100	5,122	-	1,541
1972	2,365	2,957	-	2,659	1,759	2,573	3,199	-	2,127
1973	2,370	3,393	-	2,516	2,294	2,924	3,713	-	1,683
1974	2,152	3,092	-	1,881	2,265	2,243	2,865	-	1,506
1975	2,464	2,746	-	2,438	2,091	2,604	3,799	-	1,929
1976	2,854	3,091	-	2,324	1,496	2,961	3,833	-	2,134
1977	2,195	2,723	-	1,364	1,667	3,072	2,214	-	3,471
1978	2,295	2,487	-	1,823	1,816	3,781	4,048	-	1,347
1979	2,071	1,955	-	2,128	1,264	3,440	3,429	-	1,731
1980	2,992	2,835	-	3,020	3,020	3,571	3,183	-	1,421
Average	2,424	2,631	2,375	2,327	2,164	2,947	3,572	1,935	2,010

Table 7 ANNUAL RAINFALL (3/4)

Unit: mm

Year	Station Number								
	5609072	5608074	5606077	5503031	5504085	5507079	5507076	5506082	5505084
1961	2,392	2,138	2,709	2,534	2,587	3,238	-	2,340	2,516
1962	2,354	2,140	2,500	2,158	1,839	2,854	-	2,465	2,302
1963	2,187	1,913	3,018	2,248	2,077	2,507	2,475	2,451	2,315
1964	1,937	1,492	2,377	2,732	2,795	2,728	2,355	2,548	2,757
1965	2,245	2,268	2,906	2,407	2,422	2,596	3,004	2,986	2,465
1966	2,282	2,640	2,851	2,511	2,451	3,405	2,193	2,800	2,684
1967	2,523	2,203	2,603	2,003	1,798	2,621	2,301	1,432	2,081
1968	1,468	1,741	2,392	2,670	2,310	2,646	2,034	2,093	2,022
1969	2,543	3,004	3,373	2,511	2,409	3,103	2,214	2,225	2,188
1970	2,477	3,128	3,020	2,458	3,552	2,980	2,853	2,642	2,257
1971	1,935	2,895	2,729	2,771	3,404	2,923	2,386	2,540	2,266
1972	2,497	2,667	2,425	1,800	1,862	2,703	1,843	2,446	2,623
1973	2,183	3,355	2,062	2,514	2,387	2,876	2,335	2,658	2,146
1974	1,931	1,945	1,546	1,817	1,898	2,474	2,025	1,912	1,765
1975	2,570	2,079	2,200	2,374	2,421	3,318	2,989	2,618	2,465
1976	2,401	-	2,744	2,326	2,205	2,598	2,625	2,547	2,321
1977	1,984	-	2,753	2,180	2,345	2,971	2,278	2,052	2,244
1978	1,773	-	2,283	2,393	2,541	2,598	2,147	2,087	2,016
1979	2,115	1,742	2,233	2,085	2,272	2,744	2,174	2,220	2,259
1980	2,477	2,207	2,631	2,391	2,690	3,090	-	2,504	2,183
Average	2,214	2,327	2,568	2,344	2,413	2,848	2,367	2,274	2,290

Unit: mm

Year	Station Number								
	5505033	5503034	5411068	5406081	5403042	5404041	5404044	5406083	5407080
1961	2,757	2,145	2,109	2,915	2,202	2,909	2,283	3,099	3,478
1962	2,760	2,107	2,084	2,800	2,270	2,406	2,231	3,134	3,495
1963	2,658	1,848	2,012	2,602	1,911	2,345	1,902	2,727	2,981
1964	2,399	2,666	1,904	3,309	3,086	2,838	2,588	3,048	4,130
1965	2,536	2,234	2,506	3,672	2,390	2,787	2,171	2,815	4,110
1966	2,036	2,421	2,445	3,879	2,038	2,612	1,805	3,181	4,402
1967	1,901	1,969	2,388	3,216	1,856	2,182	1,732	3,163	3,706
1968	2,027	2,875	1,794	3,368	2,205	2,678	1,963	2,360	2,835
1969	1,995	2,197	2,152	3,542	2,163	2,030	1,841	2,734	4,370
1970	1,797	2,884	2,167	3,244	2,763	2,441	2,576	3,199	4,192
1971	1,818	2,817	2,159	3,066	2,427	2,923	1,845	2,771	3,436
1972	2,001	1,981	1,929	2,969	1,972	2,227	1,655	2,825	3,461
1973	1,977	1,950	-	2,719	2,109	2,226	1,974	3,533	3,396
1974	1,801	1,895	655	2,402	1,876	1,574	1,375	2,166	2,581
1975	2,407	2,304	2,765	2,863	2,342	2,449	1,959	2,986	3,019
1976	2,063	2,438	1,514	2,097	2,356	2,153	1,639	2,458	3,391
1977	2,231	2,256	-	2,426	2,207	2,233	2,013	2,589	2,078
1978	1,929	2,117	-	2,514	1,959	2,407	1,873	1,952	1,747
1979	2,028	2,212	-	2,382	2,108	2,174	1,869	2,579	2,796
1980	2,171	2,630	-	2,809	2,217	2,492	2,283	3,040	3,614
Average	2,164	2,297	2,039	2,940	2,223	2,405	1,979	2,819	3,360

Table 8 ANNUAL RAINFALL (4/4)

Unit: mm

Year	Station Number 5302001	5302002	5304045	5304046	5304047	5305091	5210069	5204048	5204049
1961	3,095	3,193	2,223	2,403	2,602	2,907	-	2,147	2,045
1962	5,454	2,768	1,832	2,256	2,480	2,620	-	2,002	2,090
1963	2,652	2,257	2,052	2,316	2,333	2,684	-	1,870	2,283
1964	3,601	3,419	1,916	2,441	2,462	2,844	-	1,988	2,294
1965	2,952	2,573	1,859	1,631	2,554	2,756	-	2,375	1,931
1966	2,590	2,650	1,958	1,932	2,279	2,864	1,154	1,175	1,963
1967	2,469	2,496	2,029	1,722	2,611	2,663	1,730	1,767	1,838
1968	1,981	2,032	1,[illegible]14	1,860	2,340	2,905	1,275	2,320	1,874
1969	2,543	2,398	2,[illegible]25	2,351	2,376	2,855	1,592	2,327	1,844
1970	3,376	3,454	2,792	3,126	2,796	3,610	1,908	3,194	2,751
1971	3,251	3,251	2,320	2,435	2,509	2,773	1,630	2,348	2,077
1972	2,768	2,768	1,986	1,966	2,315	3,019	-	2,056	2,276
1973	3,047	3,047	2,105	2,436	2,732	3,500	-	2,494	2,332
1974	2,354	2,354	1,926	2,582	2,030	2,371	-	2,903	1,732
1975	3,022	2,905	2,097	3,630	2,306	3,216	-	2,770	1,847
1976	2,621	2,637	1,839	3,520	1,985	2,864	-	2,161	1,968
1977	-	2,463	1,590	3,321	1,985	2,504	-	2,330	2,130
1978	2,552	2,535	1,810	2,604	1,702	2,103	-	2,124	1,869
1979	1,072	2,422	1,968	3,573	2,066	2,465	-	2,006	2,034
1980	-	3,002	2,281	3,725	2,227	3,054	-	2,522	2,229
Average	2,856	2,731	2,030	2,591	2,334	2,829	1,548	2,245	2,070

Unit: mm

Year	Station Number 5307101	5206102	5206103	5105106
1961	3,122	3,756	3,524	2,299
1962	3,498	2,925	3,340	1,920
1963	3,283	2,996	3,523	2,182
1964	2,835	3,273	3,213	2,471
1965	2,747	3,421	3,645	2,113
1966	2,005	3,436	3,646	2,158
1967	-	3,333	2,727	1,851
1968	-	2,735	2,726	2,005
1969	3,262	3,654	3,785	2,386
1970	3,326	3,044	2,685	2,582
1971	3,048	2,961	3,383	2,186
1972	3,187	3,357	3,370	2,279
1973	3,201	3,391	3,804	2,633
1974	2,548	2,642	2,770	1,693
1975	-	3,192	3,870	2,651
1976	-	2,574	2,650	1,545
1977	-	2,779	2,490	1,870
1978	1,650	2,941	2,874	2,089
1979	2,025	3,010	2,693	1,935
1980	3,921	3,253	3,530	2,887
Average	2,911	3,133	3,263	2,187

Table 9 INVENTORY OF PAN-EVAPORATION STATIONS

Station Number	Station Name	Altitude (El. m)	Location	No. of Years	State
6401308	Jat. Kangar	3	06°27'N 100°11'E	14	Perlis
6204323	Petak Ujian. Jitra	5	06°16'N 100°25'E	10	Kedah
6203324	Telaga Batu	4	06°15'N 100°22'E	8	Kedah
6207332	Pedu Dam	59	06°14'N 100°46'E	6	Kedah
6105337	Gajah Mati	15	06°10'N 100°32'E	8	Kedah
6108301	Muda Dam	110	06° 7'N 100°51'E	7	Kedah
5903351	Kuala Sala	3	05°58'N 100°22'E	10	Kedah
5904352	Simpang Tiga, Sg. Rimau	3	05°55'N 100°26'E	8	Kedah
5504332	Bumbong Lima	4	05°33'N 100°26'E	8	P. Pinang

Table 10 INVENTORY OF METEOROLOGICAL STATIONS

Station Number	Station Name	Altitude (El. m)	Location	Data				State
				Air Temperature	Relative Humidity	Sunshine Hour	No. of Days with Thunderstorm	
0614	Kangar	3	06°26'N 100°12'E	1961 - 1981	1961 - 1981	-	-	Perlis
0619	Pedu Dam	59	06°14'N 100°46'E	1969 - 1981	1969 - 1981	-	-	Kedah
0620	Alor Setar	5	06°12'N 100°25'E	1975 - 1981	1975 - 1981	1970 - 1981	1961 - 1981	Kedah
0635	Gajah Mati	15	06°10'N 100°33'E	1969 - 1981	1969 - 1981	1981	-	Kedah
0638	Muda Dam	110	06° 7'N 100°51'E	1975 - 1981	1975 - 1981	-	-	Kedah
0553	Sala Kanan	15	05°58'N 100°24'E	1961 - 1981	1961 - 1981	-	-	Kedah
0549	Batu Seketul	76	05°58'N 100°48'E	1974 - 1981	1974 - 1981	-	-	Kedah
0548	Charok Padang	31	05°48'N 100°43'E	1969 - 1981	1969 - 1981	-	-	Kedah
0545	Baling	54	05°41'N 100°55'E	1961 - 1981	1961 - 1981	-	-	Kedah
0543	Sungai Patani	8	05°39'N 100°30'E	1961 - 1981	1961 - 1981	-	-	Kedah
0540	Kulim	32	05°23'N 100°33'E	1961 - 1981	1961 - 1981	-	-	Kedah
0542	Bumbong Lima	4	05°32'N 100°28'E	1974 - 1981	1974 - 1981	1978 - 1981	-	P. Pinang
0537	Butterworth	2	05°28'N 100°23'E	1969 - 1981	1969 - 1981	-	-	P. Pinang
0538	Bukit Mertajam	14	05°22'N 100°28'E	1961 - 1981	1961 - 1981	-	-	P. Pinang
0533	Penang Hill	732	05°25'N 100°16'E	1961 - 1981	1961 - 1981	-	-	P. Pinang
0532	Penang Hospital	5	05°25'N 100°19'E	1961 - 1980	1961 - 1980	-	-	P. Pinang
0530	Bayan Lepas	3	05°18'N 100°16'E	1975 - 1981	1975 - 1981	1970 - 1981	1961 - 1981	P. Pinang

Table 11 MONTHLY OPEN WATER EVAPORATION

Station	Method	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kangar	H	144	153	180	161	153	137	142	147	141	138	128	132	1,756
Jpt. Kangar	AP	160	176	200	174	143	123	126	128	121	119	112	123	1,705
Jitra	AP	166	185	200	170	150	130	134	138	136	129	118	131	1,787
Telaga Batu	AP	167	175	193	167	148	127	141	139	129	128	123	143	1,780
Pedu Dam	H	148	155	179	174	159	150	154	157	146	143	131	130	1,826
Pedu Dam	AP	196	199	214	172	146	124	139	140	129	126	120	142	1,847
Alor Setar	P	151	152	177	175	155	145	146	147	143	136	130	130	1,787
Gajah Mati	H	154	159	189	168	169	154	160	164	150	148	135	141	1,891
Gajah Mati	AP	161	179	197	171	143	119	133	133	123	121	141	129	1,723
Muda Dam	H	141	147	176	162	166	143	146	144	133	121	122	117	1,718
Muda Dam	AP	186	191	207	173	145	134	146	145	134	124	106	143	1,834
Sala Kanan	H	144	146	171	154	140	131	140	140	131	127	121	121	1,666
Batu Seketul	H	149	152	179	169	150	142	161	142	144	143	122	124	1,777
Kuala Sala	AP	178	173	185	155	140	129	136	141	129	120	123	136	1,745
Simpang Tiga	AP	162	171	186	168	155	136	156	149	141	134	127	134	1,819
Charok Padang	H	155	160	187	183	182	171	176	178	169	167	152	151	2,031
Baling	H	163	161	194	177	179	169	173	180	167	165	149	151	2,028
Sungai Patani	H	156	159	185	172	172	163	169	173	161	157	140	142	1,949
Kulim	H	151	153	174	159	158	153	158	161	151	148	135	135	1,836
Bumbong Lima	H	138	133	159	151	154	141	150	154	136	138	121	132	1,707
Bumbong Lima	AP	171	181	189	154	152	131	147	140	137	136	125	139	1,802
Butterworth	H	148	147	168	156	152	145	154	157	140	142	129	134	1,772
Bukit Mertajam	H	154	155	182	166	165	161	165	162	159	155	140	143	1,907
Penang Hill	H	112	109	127	108	104	100	102	102	95	97	88	94	1,238
Penang Hospital	H	158	161	182	168	159	154	157	159	147	146	139	144	1,874
Bayan Lepas	P	158	154	176	168	151	147	147	147	142	138	136	137	1,801

Remarks; Estimate Method

P: Penman H: Hargreaves AP: Class A Evaporation Pan

Table 12 MONTHLY FOREST EVAPORATION

Station	Method	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kangar	H	126	133	157	141	133	119	124	128	123	120	111	115	1,530
Jpt. Kangar	AP	143	157	178	155	127	109	112	114	108	106	100	109	1,518
Jitra	AP	148	164	178	151	133	116	119	123	120	115	105	116	1,588
Telaga Batu	AP	148	156	171	149	131	113	126	124	114	113	109	127	1,581
Pedu Dam	H	129	135	157	151	139	131	134	137	127	124	114	114	1,592
Pedu Dam	AP	175	176	190	153	130	111	123	124	115	112	107	126	1,642
Alor Setar	P	130	132	153	152	135	126	128	129	[illegible]	118	113	113	1,554
Gajah Mati	H	134	139	165	147	147	134	140	143	131	129	118	123	1,650
Gajah Mati	AP	143	159	175	152	127	106	118	118	109	108	102	115	1,532
Muda Dam	H	123	128	154	141	145	124	127	125	115	105	106	102	1,495
Muda Dam	AP	165	170	184	154	129	119	129	128	119	111	94	127	1,629
Sala Kanan	H	126	127	149	134	121	114	122	122	114	110	105	106	1,450
Batu Seketul	H	130	132	156	147	131	123	140	124	125	125	106	108	1,547
Kuala Sala	AP	158	154	164	138	125	115	121	125	115	107	109	121	1,552
Simpang Tiga	AP	144	151	165	149	138	121	138	132	125	120	113	119	1,615
Charok Padang	H	134	140	163	160	159	149	154	155	148	146	133	132	1,773
Baling	H	142	141	169	154	156	147	151	157	146	144	129	131	1,767
Sungai Patani	H	136	139	161	150	150	142	147	151	141	137	122	123	1,699
Kulim	H	131	133	152	138	138	133	138	140	131	129	117	118	1,598
Bumbong Lima	H	120	116	139	131	134	123	131	134	119	120	106	115	1,488
Bumbong Lima	AP	151	161	168	137	135	116	130	124	122	121	112	124	1,601
Butterworth	H	129	128	146	136	132	127	134	137	122	124	112	117	1,544
Bukit Mertajam	H	134	135	159	145	144	141	144	141	139	135	122	125	1,664
Penang Hill	H	97	95	110	94	91	87	89	88	82	84	77	82	1,076
Penang Hospital	H	138	141	159	147	139	134	137	138	128	127	121	125	1,634
Bavan Lepas	P	137	134	153	146	132	129	128	128	124	120	119	120	1,570

Remarks; Estimate Method

P: Penman H: Hargreaves AP: Class A Evaporation Pan

Table 13 MONTHLY MEAN AIR TEMPERATURE

Unit: °C

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Kangar	26.9	27.8	28.4	28.8	28.3	28.4	27.6	27.4	27.3	27.3	27.1	26.9	27.7
Pedu Dam	26.5	27.5	28.0	28.3	27.9	27.4	27.1	26.9	26.7	26.9	26.5	26.4	27.2
Alor Setar	27.2	28.4	28.8	28.8	28.4	27.8	27.6	27.5	27.3	27.5	27.2	26.9	27.8
Gajah Mati	26.8	27.9	28.2	28.5	28.0	27.5	27.1	27.2	26.8	27.1	26.7	26.5	27.4
Muda Dam	26.0	27.1	28.1	28.2	27.9	27.2	26.9	26.8	26.7	26.9	26.3	26.0	27.0
Sala Kanan	26.5	27.5	27.8	27.8	27.5	27.3	27.1	27.1	26.9	27.0	27.0	26.7	27.2
Batu Seketul	25.5	26.9	27.3	27.7	27.4	26.8	26.4	26.6	26.5	26.5	26.1	25.5	26.6
Charok Padang	26.0	27.0	27.6	28.0	27.7	27.4	22.6	22.6	26.8	26.9	26.7	26.3	26.3
Baling	26.8	27.4	28.0	27.8	27.5	27.2	27.0	26.9	26.8	26.9	26.9	26.9	27.2
Sungal Patani	27.7	28.3	28.4	27.9	28.2	27.9	28.6	27.8	27.5	27.4	27.5	27.6	27.9
Kulim	26.7	27.6	27.9	27.9	27.9	27.8	27.5	27.5	27.0	26.9	26.8	26.7	27.4
Bumbong Lima	26.4	27.1	27.8	27.9	27.8	27.4	27.1	27.1	26.8	27.0	26.9	26.6	27.2
Butterworth	26.8	27.4	27.7	27.9	27.8	27.6	27.4	27.1	26.8	26.7	26.7	26.8	27.2
Bukit Mertajam	27.6	28.2	28.3	28.5	28.6	28.4	28.3	27.9	27.8	27.5	27.5	27.5	28.0
Penang Hill	22.4	23.1	23.3	23.4	23.2	22.[illegible]	22.5	22.4	22.3	22.3	22.4	22.2	22.7
Penang Hospital	27.8	28.5	28.6	28.8	28.4	28.0	27.8	27.5	27.2	27.1	27.3	27.5	27.9
Bayan Lepas	27.6	27.7	28.0	28.0	27.9	27.6	27.3	27.2	26.9	27.0	27.0	27.4	27.5

Table 14 MONTHLY MEAN RELATIVE HUMIDITY AT 2:00 P.M.

Unit: %

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Kangar	63.6	57.7	57.5	62.0	69.2	72.0	73.3	72.9	73.5	74.1	72.2	69.3	68.0
Pedu Dam	57.4	52.7	52.5	57.6	61.0	67.5	66.3	66.8	69.5	69.4	70.4	65.7	63.2
Alor Setar	58.3	55.1	58.9	66.5	74.0	75.4	75.6	75.0	76.4	74.8	73.6	66.0	69.1
Gajah Mati	56.3	51.8	52.3	57.1	63.8	66.4	65.8	66.5	70.3	68.0	69.6	64.4	62.3
Muda Dam	57.7	51.0	50.0	56.9	64.7	68.9	63.9	66.0	68.6	68.9	68.9	63.6	62.6
Sala Kanan	67.7	64.9	64.0	68.5	73.1	75.4	74.5	74.3	75.0	75.3	74.0	74.1	72.7
Batu Seketul	52.3	49.1	51.8	58.7	65.9	66.6	66.6	66.0	70.1	69.1	70.7	64.3	62.0
Charok Padang	56.9	51.5	52.2	52.2	55.9	57.7	58.8	61.0	60.7	60.0	62.2	56.8	54.4
Baling	53.1	49.8	48.7	55.6	58.3	57.7	57.2	57.2	60.3	61.3	61.1	58.0	56.1
Sungal Patani	54.9	51.4	54.2	59.1	62.5	62.1	63.4	62.4	61.9	65.8	65.1	62.1	60.5
Kulim	58.4	56.3	57.9	64.6	65.2	63.8	60.9	63.9	67.1	68.1	67.6	65.2	63.1
Bumbong Lima	62.1	63.4	62.7	67.3	71.3	70.9	69.9	68.1	72.0	70.6	71.0	65.8	68.1
Butterworth	59.5	54.9	62.5	66.5	69.8	67.6	66.3	67.4	71.9	70.7	70.8	64.5	66.3
Bukit Mertajam	59.0	57.1	58.1	62.4	63.6	59.7	62.1	63.8	65.9	67.1	70.6	62.8	..1
Penang Hill	73.7	71.0	75.3	81.8	84.1	83.4	83.6	85.0	86.3	85.7	84.6	80.2	81.8
Penang Hospital	57.3	54.4	56.8	62.2	66.5	66.3	66.0	67.2	70.3	70.8	68.3	63.5	64.0
Bayan Lepas	61.8	65.6	69.5	73.9	75.4	74.8	74.2	76.0	77.5	77.1	74.3	66.1	72.1

Table 15 MEAN DAILY SUNSHINE HOURS

Unit: hr

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Alor Setar	8.6	8.4	8.6	8.3	7.1	6.2	6.5	6.2	5.6	5.3	5.3	6.5	6.9
Gajah Mati	8.2	8.3	9.3	6.9	6.4	7.4	6.5	7.4	5.6	6.3	4.6	6.7	7.0
Bumbong Lima	8.8	8.3	8.2	7.6	7.2	6.9	6.7	6.4	5.7	6.1	5.8	7.5	7.1
Bayan Lepas	8.3	7.9	7.9	7.4	6.7	6.5	6.5	6.2	5.4	5.3	5.7	6.6	6.7

Table 16 ANNUAL RUNOFF BALANCE

Basin	Catchment Area (km^2)	Rainfall (10^6 m^3)	Runoff (10^6 m^3)	Evapo-transpiration (10^6 m^3)	Groundwater Recharge* (10^6 m^3)
Perlis	883	1,685	470	1,112	103
Kedah	3,593	7,682	2,774	4,648	260
Merbok	412	1,044	489	551	4
Muda	4,355	10,243	4,377	5,544	322
Perai	411	1,022	448	524	50
P. Pinang	300	802	383	417	2
Julu & Other Southern Rivers	371	867	349	503	15
Rui	889	1,912	715	1,121	76
Total	11,214	25,257	10,005	14,420	832

Source; *: ANNEX F GROUNDWATER RESOURCES

Table 17 ANNUAL NATURAL RUNOFF AT MAJOR WATER SOURCE FACILITIES

Water Source Facility	River Basin	Catchment Area (km^2)	Annual Runoff (10^6 m^3)
Timah Tasoh Dam Site	Perlis	150	78.3
Arau Dam Site	Perlis	58	27.9
Ahning Dam Site	Kedah	120	61.7
Pedu Dam	Kedah	173	88.9
Pelubang Barrage	Kedah	1,076*	612.7
Kedah Barrage	Kedah	1,961*	1,376.5
Muda Dam	Muda	984	743.3
Jeniang Diversion Site	Muda	667**	632.7
Muda Barrage	Muda	3,070**	3,329.6
Perai Barrage	Perai	411	449.1
Badak-Temin Dam Site	Kedah	112	57.6
Sari Dam Site	Kedah	61	32.4
Durian Dam Site	Kedah	74	38.0
Tawar-Muda Dam Site	Muda	129	123.3
Beris Dam Site	Muda	116	110.0
Rui Dam Site	Rui	278	249.8

Remarks; * : The catchment area of the Pedu dam is not included.
**: The catchment area of the Muda dam is not included.

Table 18 MONTHLY NATURAL RUNOFF AT PROPOSED DAM SITE (1/3)

Proposed Damsite: Badak-Temin
Catchment Area : 112 km^2

Unit: 10^6 m^3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	1.2	0.7	1.4	2.0	2.9	1.7	0.8	0.7	1.6	8.2	5.9	3.9	30.8
1962	2.8	0.5	0.7	0.9	4.8	1.1	3.8	2.8	9.0	18.5	6.1	0.6	51.8
1963	0.5	0.3	0.2	0.2	0.8	0.1	0.4	0.2	2.1	10.3	10.2	1.7	27.2
1964	0.1	0.1	0.2	0.2	1.6	0.9	1.2	0.8	5.6	5.6	12.2	2.2	30.6
1965	0.3	0.2	0.7	1.2	1.5	0.5	0.9	4.4	7.8	15.0	16.9	20.1	69.6
1966	3.0	1.1	1.1	1.0	2.5	3.9	1.1	1.0	4.3	15.6	12.8	10.9	58.5
1967	9.7	1.0	1.0	1.4	5.1	4.6	5.0	3.6	5.3	20.5	12.1	7.8	77.0
1968	1.9	0.9	2.1	6.5	2.5	1.5	1.9	2.5	5.7	11.8	7.5	7.3	52.1
1969	3.7	1.4	0.8	0.5	0.6	2.4	2.9	12.0	6.5	9.8	15.4	8.1	64.2
1970	3.3	1.5	0.9	0.4	2.8	2.0	2.9	4.9	6.3	9.5	8.9	8.0	51.5
1971	4.7	3.1	8.8	1.9	1.1	4.3	3.6	7.1	11.9	17.0	13.7	8.4	85.6
1972	4.2	2.0	1.8	11.3	4.3	1.7	0.9	0.9	27.9	10.7	16.2	12.1	94.0
1973	5.0	2.3	1.4	4.5	8.2	9.8	3.3	6.2	4.9	14.5	14.0	11.2	85.2
1974	4.6	2.3	1.4	0.8	11.5	3.7	2.5	4.0	17.1	13.3	7.0	4.4	72.6
1975	3.6	1.4	1.2	0.7	0.7	1.1	1.9	2.2	5.1	8.6	6.5	11.6	44.7
1976	4.0	1.6	0.8	1.7	12.6	3.6	8.3	3.9	12.2	16.8	11.8	6.8	84.0
1977	3.1	1.5	0.8	0.4	2.6	0.6	0.3	2.0	3.8	11.9	5.7	2.7	35.4
1978	1.2	0.5	0.2	0.2	0.8	3.7	4.3	2.6	10.4	8.2	3.8	4.0	39.9
1979	1.2	0.5	0.2	1.9	3.8	2.1	2.5	2.6	8.6	4.4	9.4	5.1	42.2
1980	2.0	0.8	0.3	0.3	0.5	0.3	0.7	2.5	6.2	17.3	13.7	9.8	54.7
Mean	3.0	1.2	1.3	1.9	3.6	2.5	2.5	3.3	8.1	12.4	10.5	7.3	57.6

Proposed Damsite: Sari
Catchment Area : 61 km^2

Unit: 10^6 m^3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	0.7	0.4	0.8	1.1	1.6	1.0	0.4	0.4	0.9	4.6	3.3	2.2	17.3
1962	1.6	0.3	0.4	0.5	2.7	0.6	2.1	1.6	5.1	10.4	3.5	0.4	29.1
1963	0.3	0.2	0.1	0.1	0.5	0.1	0.2	0.1	1.2	5.8	5.8	1.0	15.3
1964	0.1	0.0	0.1	0.1	0.9	0.5	0.7	0.4	3.2	3.1	6.8	1.2	17.2
1965	0.2	0.1	0.4	0.7	0.9	0.3	0.5	2.5	4.4	8.5	9.5	11.3	39.1
1966	1.7	0.6	0.6	0.6	1.4	2.2	0.6	0.6	2.4	8.8	7.2	6.1	32.9
1967	5.4	0.5	0.5	0.8	2.9	2.6	2.8	2.0	3.0	11.5	6.8	4.4	43.3
1968	1.1	0.5	1.2	3.6	1.4	0.8	1.1	1.4	3.2	6.6	4.2	4.1	29.3
1969	2.1	0.8	0.5	0.3	0.4	1.4	1.6	6.8	3.6	5.5	8.7	4.6	36.1
1970	1.8	0.9	0.5	0.2	1.6	1.1	1.6	2.7	3.6	5.4	5.0	4.5	28.9
1971	2.6	1.7	4.9	1.1	0.6	2.4	2.0	4.0	6.7	9.6	7.7	4.7	48.1
1972	2.4	1.1	1.0	6.3	2.4	1.0	0.5	0.5	15.7	6.0	9.1	6.8	52.9
1973	2.8	1.3	0.8	2.5	4.6	5.5	1.9	3.5	2.8	8.2	7.9	6.3	47.9
1974	2.6	1.3	0.8	0.4	6.5	2.1	1.4	2.3	9.6	7.5	3.9	2.5	40.8
1975	2.0	0.8	0.6	0.4	0.4	0.6	1.1	1.2	2.9	4.9	3.6	6.5	25.1
1976	2.2	0.9	0.5	1.0	7.1	2.0	4.6	2.2	6.8	9.5	6.6	3.8	47.3
1977	1.8	0.8	0.5	0.2	1.5	0.3	0.2	1.1	2.2	6.7	3.2	1.5	19.9
1978	0.7	0.3	0.1	0.1	0.5	2.1	2.4	1.5	5.9	4.6	2.1	2.2	22.5
1979	0.7	0.3	0.1	1.1	2.1	1.2	1.4	1.4	4.8	2.5	5.3	2.9	23.7
1980	1.1	0.5	0.2	0.2	0.3	0.2	0.4	1.4	3.5	9.7	7.7	5.5	30.7
Mean	1.7	0.7	0.7	1.1	2.0	1.4	1.4	1.9	4.6	7.0	5.9	4.1	32.4

Table 19 MONTHLY NATURAL RUNOFF AT PROPOSED DAM SITE (2/3)

Proposed Damsite: Durian
Catchment Area : 74 km^2

Unit: 10^6 m^3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	0.8	0.4	0.9	1.3	1.9	1.1	0.5	0.4	1.1	5.4	3.9	2.6	20.4
1962	1.8	0.4	0.5	0.6	3.2	0.7	2.5	1.8	6.0	12.2	4.1	0.4	34.2
1963	0.4	0.2	0.1	0.1	0.5	0.1	0.3	0.1	1.4	6.8	6.8	1.2	18.0
1964	0.1	0.0	0.1	0.2	1.1	0.6	0.8	0.5	3.7	3.7	8.0	1.4	20.2
1965	0.2	0.1	0.5	0.8	1.0	0.4	0.6	2.9	5.1	9.9	11.2	13.3	46.0
1966	2.0	0.8	0.7	0.7	1.7	2.5	0.7	0.7	2.9	10.3	8.5	7.2	38.6
1967	6.4	0.6	0.6	0.9	3.4	3.0	3.3	2.4	3.5	13.6	8.0	5.2	50.9
1968	1.3	0.6	1.4	4.3	1.6	1.0	1.3	1.6	3.8	7.8	5.0	4.8	34.4
1969	2.4	0.9	0.5	0.4	0.4	1.6	1.9	7.9	4.3	6.5	10.2	5.4	42.4
1970	2.2	1.0	0.6	0.3	1.9	1.3	1.9	3.2	4.2	6.3	5.9	5.3	34.0
1971	3.1	2.0	5.8	1.3	0.7	2.8	2.4	4.7	7.9	11.3	9.1	5.6	56.5
1972	2.8	1.3	1.2	7.5	2.8	1.1	0.6	0.6	18.4	7.1	10.7	8.0	62.1
1973	3.3	1.5	0.9	3.0	5.4	6.5	2.2	4.1	3.2	9.6	9.2	7.4	56.3
1974	3.1	1.5	0.9	0.5	7.6	2.5	1.6	2.7	11.3	8.8	4.6	2.9	48.0
1975	2.4	0.9	0.8	0.5	0.5	0.7	1.2	1.5	3.4	5.7	4.3	7.7	29.5
1976	2.6	1.0	0.6	1.2	8.3	2.4	5.5	2.5	8.0	11.1	7.8	4.5	55.5
1977	2.1	1.0	0.5	0.3	1.8	0.4	0.2	1.3	2.5	7.9	3.7	1.8	23.4
1978	0.8	0.3	0.2	0.1	0.5	2.4	2.9	1.7	6.9	5.4	2.5	2.6	26.4
1979	0.8	0.3	0.1	1.3	2.5	1.4	1.7	1.7	5.7	2.9	6.2	3.4	27.9
1980	1.3	0.5	0.2	0.2	0.3	0.2	0.5	1.6	4.1	11.4	9.1	6.5	36.1
Mean	2.0	0.8	0.9	1.3	2.4	1.6	1.6	2.2	5.4	8.2	6.9	4.9	38.0

Proposed Damsite: Tawar-Muda
Catchment Area : 129 km^2

Unit: 10^6 m^3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	6.0	4.0	3.7	5.6	8.2	7.5	5.3	4.3	4.7	14.8	14.7	8.2	87.1
1962	6.8	2.7	4.0	4.4	10.9	6.3	8.9	9.0	10.5	23.6	10.6	7.6	105.2
1963	6.4	2.9	2.0	2.1	10.4	7.1	8.0	8.7	15.2	29.8	29.8	14.9	137.1
1964	5.1	2.4	2.3	2.7	9.3	7.6	10.9	6.4	12.8	13.2	25.1	8.7	106.5
1965	4.1	2.2	2.2	5.8	10.9	4.1	3.9	9.3	11.1	24.3	25.3	29.5	132.7
1966	10.5	6.7	5.3	5.7	11.5	11.9	7.2	5.5	10.7	25.6	27.3	22.2	150.2
1967	30.1	7.4	4.6	4.3	11.0	9.7	9.6	7.6	7.3	18.7	13.3	8.7	132.3
1968	3.1	1.9	1.3	1.0	1.2	1.1	6.2	13.4	8.4	21.6	14.0	6.5	79.7
1969	6.9	3.7	3.7	10.5	8.3	7.3	7.5	18.7	14.7	33.1	26.8	19.9	161.1
1970	7.3	4.2	3.5	4.6	14.8	13.4	13.0	7.7	19.0	22.6	24.7	15.5	150.5
1971	8.2	4.4	5.7	2.7	2.5	7.9	6.5	8.4	23.8	18.8	15.7	13.4	118.1
1972	7.1	3.6	2.7	2.8	2.4	4.4	4.4	3.0	10.4	18.6	46.3	18.7	124.5
1973	7.7	4.3	3.3	6.8	6.4	7.3	5.7	20.9	7.8	19.5	16.0	16.4	122.1
1974	7.2	3.5	2.7	2.7	6.6	3.8	2.6	6.2	12.3	14.7	13.1	9.2	84.8
1975	8.5	5.2	5.7	5.8	5.7	3.4	8.4	7.2	20.8	18.8	15.9	22.9	128.1
1976	10.4	5.4	3.8	5.5	16.8	9.3	12.6	8.7	18.5	42.4	35.6	14.4	183.5
1977	5.8	2.1	1.3	1.0	2.0	3.8	1.8	6.9	11.0	40.6	20.5	4.7	101.5
1978	2.0	0.8	1.4	3.8	7.6	4.3	11.0	7.4	15.2	18.7	17.0	5.2	94.4
1979	1.2	0.7	0.7	5.3	5.7	8.4	6.1	6.7	22.3	10.8	25.6	5.9	99.3
1980	1.7	1.1	2.2	2.5	6.3	8.0	5.2	16.1	23.0	52.4	30.2	18.8	167.4
Mean	7.3	3.5	3.1	4.3	7.9	6.8	7.2	9.1	14.0	24.1	22.4	13.6	123.3

Table 20 MONTHLY NATURAL RUNOFF AT PROPOSED DAM SITE (3/3)

Proposed Damsite: Beris
Catchment Area : 116 km^2

Unit: 10^6 m^3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	5.4	3.5	3.3	5.0	7.4	6.7	4.8	3.9	4.2	13.2	13.1	7.3	77.8
1962	6.1	2.4	3.6	3.9	9.7	5.7	7.9	8.1	9.3	21.1	9.4	6.7	93.9
1963	5.7	2.6	1.8	1.8	9.3	6.3	7.1	7.8	13.5	26.6	26.6	13.3	122.3
1964	4.6	2.2	2.0	2.4	8.3	6.8	9.8	5.7	11.4	11.7	22.4	7.7	95.0
1965	3.7	2.0	2.0	5.2	9.7	3.7	3.5	8.3	9.9	21.6	22.5	26.3	118.4
1966	9.4	6.0	4.7	5.1	10.3	10.6	6.4	5.0	9.5	22.8	24.4	19.9	134.1
1967	26.9	6.6	4.1	3.8	9.8	8.7	8.6	6.7	6.5	16.7	11.9	7.8	118.1
1968	2.7	1.7	1.2	0.9	1.1	1.0	5.5	11.9	7.5	19.3	12.5	5.8	71.1
1969	6.1	3.3	3.3	9.4	7.4	6.6	6.7	16.7	13.1	29.5	23.9	17.8	143.7
1970	6.5	3.8	3.1	4.1	13.2	12.0	11.6	6.9	17.0	20.2	22.1	13.8	134.3
1971	7.3	3.9	5.1	2.4	2.2	7.0	5.8	7.5	21.3	16.8	14.0	12.0	105.4
1972	6.3	3.3	2.4	2.5	2.1	4.0	3.9	2.7	9.3	16.6	41.3	16.7	111.1
1973	6.9	3.9	2.9	6.1	5.7	6.5	5.1	18.7	6.9	17.4	14.3	14.6	109.0
1974	6.4	3.2	2.4	2.4	5.9	3.4	2.3	5.5	11.0	13.1	11.7	8.2	75.7
1975	7.6	4.6	5.1	5.1	5.1	3.0	7.5	6.5	18.5	16.8	14.2	20.4	114.3
1976	9.3	4.8	3.4	4.9	15.0	8.3	11.2	7.8	16.5	37.8	31.8	12.9	163.7
1977	5.2	1.9	1.1	0.9	1.8	3.4	1.6	6.1	9.9	36.2	18.3	4.2	90.6
1978	1.8	0.7	1.2	3.4	6.8	3.8	9.8	6.6	13.6	16.6	15.2	4.6	84.3
1979	1.0	0.6	0.6	4.7	5.1	7.5	5.5	5.9	19.9	9.7	22.8	5.3	88.6
1980	1.5	1.0	1.9	2.2	5.7	7.1	4.6	14.4	20.5	46.8	26.9	16.8	149.4
Mean	6.5	3.1	2.8	3.8	7.1	6.1	6.5	8.1	12.5	21.5	20.0	12.1	110.0

Proposed Damsite: Rui
Catchment Area : 278 km^2

Unit: 10^6 m^3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	12.2	8.0	7.5	11.4	16.7	15.2	10.8	8.8	9.6	30.0	29.7	16.6	176.5
1962	13.9	5.5	8.1	8.8	22.0	12.9	18.0	18.3	21.2	47.9	21.4	15.3	213.2
1963	12.9	5.8	4.1	4.2	21.1	14.3	16.2	17.6	30.7	60.4	60.3	30.1	277.7
1964	10.3	5.0	4.6	5.4	18.9	15.4	22.1	13.0	26.0	26.6	50.8	17.5	215.8
1965	8.3	8.3	4.5	11.7	22.1	8.4	8.0	18.7	22.5	49.1	51.2	59.7	268.8
1966	21.4	13.6	10.7	11.6	23.4	24.1	14.6	11.2	21.6	51.8	55.3	45.1	304.3
1967	61.0	15.0	9.4	8.7	22.2	19.6	19.5	15.3	14.8	37.8	27.0	17.7	268.0
1968	6.2	3.8	2.7	2.1	2.4	2.2	12.5	27.1	17.0	43.8	28.4	13.2	161.4
1969	13.9	7.4	7.5	21.3	16.7	14.9	15.2	37.9	29.8	67.0	54.2	40.4	326.3
1970	14.9	8.5	7.1	9.4	30.0	27.2	26.3	15.6	38.6	45.8	50.1	31.4	304.9
1971	16.7	8.9	11.6	5.4	5.1	15.9	13.2	17.0	48.3	38.1	31.8	27.2	239.3
1972	14.3	7.4	5.5	5.7	4.8	9.0	8.9	6.1	21.2	37.6	93.8	37.8	252.1
1973	15.7	8.8	6.6	13.7	12.9	14.8	11.6	42.4	15.7	39.5	32.4	33.2	247.3
1974	14.6	7.2	5.6	5.5	13.4	7.8	5.3	12.5	25.0	29.7	26.6	18.6	171.8
1975	17.2	10.5	11.5	11.7	11.5	6.8	16.9	14.7	42.1	38.1	32.2	46.4	259.6
1976	21.1	10.9	7.7	11.1	34.1	18.9	25.4	17.6	37.4	85.9	72.2	29.2	371.6
1977	11.9	4.3	2.6	2.0	4.0	7.7	3.6	13.9	22.4	82.2	41.5	9.5	205.6
1978	4.1	1.6	2.7	7.7	15.4	8.7	22.3	15.1	30.9	37.8	34.4	10.5	191.3
1979	2.4	1.4	1.4	10.7	11.6	17.0	12.4	13.5	45.1	21.9	51.8	12.0	201.1
1980	3.4	2.2	4.4	5.0	12.9	16.2	10.5	32.6	46.5	106.2	61.1	38.1	339.1
Mean	14.8	7.0	6.3	8.7	16.1	13.9	14.7	18.4	28.3	48.9	45.3	27.5	249.8

Table 21 MINIMUM NATURAL RUNOFF (99% EXCEEDANCE) FOR MAJOR RIVER BASIN

River Basin	Location	Catchment Area (km^2)	Natural Runoff of 99% in Probability of Exceedance (m^3/s)		
			Maximum	Minimum	20-Year Average
Perlis	At the Confluence with the Tok Nin River	339	1.6	0.0	0.5
Kedah	Kedah Barrage	1,961*	8.7	0.4	3.9
Muda	Muda Barrage	3,070**	42.9	6.6	20.2
Perai	Perai Barrage	411	8.7	1.5	5.1

Remarks; * : The catchment area of the Pedu dam is not included.
**: The catchment area of the Muda dam is not included.

Table 22 MINIMUM NATURAL RUNOFF (99% EXCEEDANCE) AT PROPOSED DAM SITE

Proposed Dam Site	Catchment Area (km^2)	Natural Runoff of 99% in Probability of Exceedance (m^3/s)		
		Maximum	Minimum	20-Year Average
Badak-Temin	112	0.36	0.02	0.16
Sari	61	0.20	0.01	0.09
Durian	74	0.24	0.01	0.11
Tawar-Muda	129	1.58	0.24	0.74
Beris	116	1.42	0.22	0.67
Rui	278	3.21	0.50	1.51

Table 23 MONTHLY MEAN RUNOFF RECORD (1/6)

Station: Titi Konkerit Baru (6502432)
River: Tasoh
Catchment Area: 117 km^2

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1975	5.2	0.3	0.3	0.3	0.9	1.4	0.5	0.7	1.8	1.4	2.2	3.2	1.5
1976	0.3	0.2	0.2	0.2	1.4	0.7	2.4	1.3	5.9	3.3	7.2	0.8	2.0
1977	0.3	0.2	0.2	0.1	0.2	0.5	0.1	0.8	3.0	1.9	0.5	0.1	0.7
1978	0.1	0.1	0.3	0.2	0.4	0.1	0.3	1.3	0.8	1.4	2.7	1.6	0.8
1979	0.1	0.1	0.1	0.7	1.9	0.3	2.2	0.5	0.7	0.8	4.6	0.5	1.0
1980	0.3	0.3	0.1	0.4	0.4	0.4	0.3	2.0	2.1	4.8	2.4	1.2	1.2
Average	1.1	0.2	0.2	0.3	0.9	0.6	1.0	1.1	2.4	2.3	3.3	1.2	1.2

Station: Titi Konkerit Baru (6502431)
River: Timah
Catchment Area: 57 km^2

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1975	2.5	0.2	0.2	0.1	0.7	0.7	0.3	0.3	1.0	1.3	0.9	1.0	0.8
1976	0.1	0.1	0	0	1.0	0.4	1.8	1.4	4.1	2.0	3.4	0.7	1.3
1977	0.1	0.1	0	0	0.2	0.2	0.2	1.8	3.1	1.8	0.3	0.1	0.7
1978	0.2	0.1	0.4	0.5	0.5	0.4	1.2	1.6	2.1	1.5	1.2	1.2	0.9
1979	0.2	0.2	0.1	0.9	1.9	1.1	3.3	0.9	1.1	1.3	3.5	1.0	1.3
1980	0.8	0.7	0.7	0.8	0.8	0.9	1.0	4.0	3.0	4.9	2.0	1.3	1.7
Average	0.6	0.2	0.2	0.4	0.9	0.6	1.3	1.7	2.4	2.1	1.9	0.9	1.1

Station: Nami (6007415)
River: Muda
Catchment Area: 1,220 km^2

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1961	69.6	58.7	55.2	66.3	72.8	73.6	14.4	13.3	14.4	40.5	36.3	34.4	45.8
1962	21.5	9.8	10.2	9.2	17.0	10.8	18.9	19.8	30.3	45.2	25.3	22.3	20.0
1963	16.9	8.9	7.1	7.0	18.3	10.5	13.9	14.2	30.7	88.5	55.7	27.0	24.9
1964	14.4	10.2	7.9	5.0	16.2	19.5	27.2	15.0	35.3	35.4	61.2	24.2	22.6
1965	9.2	6.0	4.9	14.8	38.1	13.8	10.8	28.2	35.0	77.9	70.3	93.9	33.6
1966	31.9	26.9	20.5	21.3	37.3	42.9	22.1	17.4	33.8	80.0	100.9	80.6	43.0
1967	113.5	36.0	19.1	21.1	44.0	35.5	30.8	25.0	25.6	55.4	51.1	35.5	41.0
1968	12.7	8.9	7.4	8.7	17.9	18.0	18.9	19.2	16.1	44.8	17.4	13.2	16.9
1969	15.9	4.2	3.1	2.7	8.5	4.5	4.5	10.1	4.8	16.5	15.8	6.9	8.1
1970	3.8	2.4	2.4	3.0	6.9	8.0	7.2	7.0	15.0	20.5	36.4	11.9	10.4
1971	13.0	3.7	14.0	4.3	4.5	5.3	3.1	8.9	23.5	38.3	33.5	50.4	16.9
1972	11.7	3.6	2.3	6.4	4.0	3.4	2.8	3.2	5.3	18.8	82.8	55.1	16.6
1973	12.5	3.3	2.1	6.2	6.6	41.0	-	-	-	-	-	-	12.0
Average	26.7	14.0	12.0	13.5	22.5	22.1	14.6	15.1	22.5	46.8	48.9	38.0	25.0

Table 24 MONTHLY MEAN RUNOFF RECORD (2/6)

Station: Lengkuas (6204421)
River: Kedah
Catchment Area: 1,270 km^2

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1946	-	-	-	-	-	-	-	5.4	39.4	108.8	82.6	53.0	57.8
1947	19.4	7.4	6.2	16.9	48.2	30.8	33.6	36.2	34.2	85.1	76.1	60.5	37.9
1948	15.6	6.0	8.5	27.3	22.2	5.3	18.0	56.1	21.2	67.4	46.4	11.5	25.4
1949	2.8	2.2	2.7	16.1	-	18.2	-	24.5	-	98.[illegible]	94.2	67.1	36.2
1950	-	8.0	-	12.4	33.4	15.8	-	12.0	53.4	58.3	81.8	26.9	33.6
1951	11.4	12.4	5.3	9.4	13.8	6.6	21.2	14.9	74.1	51.7	123.7	66.3	34.2
1952	8.4	7.4	10.6	19.4	28.4	12.0	11.7	9.5	9.0	31.5	95.1	44.8	24.0
1953	12.0	11.8	5.7	34.5	24.4	28.0	24.7	10.0	67.2	100.8	109.7	15.5	37.0
1954	15.6	4.2	4.7	6.5	27.9	12.2	7.7	34.8	22.9	97.1	37.8	11.8	23.6
1955	5.3	3.6	1.2	13.4	38.6	23.9	8.4	57.3	49.3	78.5	122.1	21.0	35.2
1956	9.6	3.2	9.1	18.4	41.4	40.7	35.0	39.3	44.4	81.1	82.7	16.5	35.1
1957	6.4	3.7	4.2	6.9	13.8	16.2	37.6	16.3	24.2	43.3	68.9	12.0	21.1
1958	4.5	1.9	2.5	1.2	14.2	9.3	2.8	6.2	7.3	64.4	57.9	10.3	15.2
1959	2.0	0.9	2.2	1.2	32.4	27.8	6.0	13.9	42.9	28.5	76.1	44.0	23.2
1960	6.6	2.2	2.2	5.5	23.7	12.7	30.3	12.0	54.9	21.3	74.5	15.2	21.8
1961	5.4	3.4	6.5	9.4	13.5	8.2	3.6	3.1	7.6	37.8	28.0	17.9	12.0
1962	12.8	2.8	3.4	4.4	22.2	5.2	17.6	12.8	43.1	85.5	29.3	2.9	20.2
1963	2.5	1.6	1.0	0.9	3.8	0.6	2.0	0.9	10.0	47.8	48.8	8.1	10.7
1964	0.6	0.3	0.7	1.2	7.4	4.1	5.7	3.6	26.8	25.9	58.1	10.0	12.0
1965	1.3	0.9	3.1	5.9	7.1	2.6	4.3	20.4	37.1	69.5	80.8	92.8	27.2
1966	13.7	5.8	5.2	4.9	11.8	18.4	5.2	4.7	20.6	72.1	61.2	50.5	22.8
1967	44.8	4.9	4.5	6.7	23.5	22.0	23.1	16.6	25.4	94.8	57.6	36.2	30.0
Average	10.0	4.5	4.5	10.6	22.6	15.3	15.7	18.7	34.0	65.9	72.4	31.6	24.7

Station: Kuala Pegang (5608418)
River: Ketil
Catchment Area: 704 km^2

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1975	18.4	15.1	12.1	16.1	19.6	19.3	-	-	-	-	36.4	43.7	22.6
1976	19.0	9.2	-	-	-	-	-	-	-	-	-	-	14.1
1977	-	7.5	4.4	7.4	5.8	8.4	8.2	19.1	22.3	86.8	42.4	16.1	20.8
1978	8.9	4.5	3.9	8.3	19.3	9.5	15.9	10.7	17.9	29.8	32.3	10.3	14.3
1979	3.5	1.4	1.0	10.4	11.2	9.4	10.9	8.0	27.9	16.4	42.1	14.8	13.1
1980	4.5	3.1	7.7	7.6	10.7	12.9	6.5	20.5	29.0	77.8	61.9	34.1	23.0
Average	10.9	6.8	5.8	10.0	13.3	11.9	10.4	14.6	24.3	52.7	43.0	23.8	16.8

Table 25 MONTHLY MEAN RUNOFF RECORD (3/6)

Station: Jeniang (5806414)
River: Muda
Catchment Area: 1,740 km^2

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1947	40.9	28.0	29.0	48.4	50.9	39.0	45.2	35.3	46.3	98.3	108.1	100.9	55.9
1948	42.0	27.8	22.9	35.7	34.7	22.1	28.7	39.6	30.6	58.0	53.7	28.5	35.4
1949	17.5	17.4	11.2	22.9	49.7	37.6	52.3	35.8	64.2	117.4	86.6	98.8	51.0
1950	39.6	31.0	25.1	37.1	55.9	34.5	29.2	25.3	48.1	67.9	71.5	41.7	42.2
1951	27.2	24.1	17.7	20.2	33.0	27.7	37.9	27.5	57.2	50.2	117.3	118.8	46.6
1952	34.7	25.1	30.1	30.6	33.6	29.0	30.4	22.1	25.6	55.5	110.3	54.0	40.1
1953	31.4	24.6	21.7	33.2	32.9	33.7	46.9	31.1	78.6	131.4	83.2	38.7	49.0
1954	34.0	21.1	18.1	22.9	32.4	32.1	33.2	49.7	28.3	112.8	53.6	35.0	39.4
1955	23.7	19.7	10.6	21.2	47.6	31.4	20.5	59.2	48.0	92.4	128.6	45.7	45.7
1956	35.6	20.2	23.8	27.5	41.1	39.7	32.5	44.8	59.6	108.7	117.4	47.0	49.8
1957	30.2	22.2	18.2	26.3	48.5	38.2	41.2	37.9	37.0	74.4	89.7	38.8	41.9
1958	28.0	17.0	13.7	8.6	49.6	32.2	14.1	25.1	24.0	96.2	103.2	42.3	37.8
1959	15.4	10.9	9.9	11.4	60.8	46.7	34.1	39.4	36.7	65.2	114.2	62.8	42.3
1960	23.0	12.2	14.1	18.7	44.5	35.4	62.6	40.5	94.8	51.4	108.9	56.8	46.9
1961	26.7	19.4	16.4	25.7	36.5	34.3	23.6	19.2	21.7	65.3	67.1	36.3	32.7
1962	30.2	13.3	17.7	19.9	48.0	29.0	39.2	40.0	47.8	104.5	48.3	33.5	39.3
1963	28.1	14.0	8.9	9.4	46.1	32.3	35.4	38.4	69.3	131.9	136.0	65.8	51.3
1964	22.5	11.6	10.0	12.3	41.3	34.8	48.3	28.4	58.6	58.2	114.6	38.3	39.9
1965	18.2	11.0	9.9	26.4	48.3	18.9	17.4	40.9	50.7	107.3	115.4	130.2	49.6
1966	46.6	32.8	23.3	26.2	51.1	54.5	31.8	24.5	48.8	113.1	124.7	98.4	56.3
1967	133.1	36.3	20.6	19.6	48.5	44.3	42.5	33.4	33.5	82.5	60.9	38.6	49.5
1968	16.7	11.7	10.6	13.4	19.9	24.8	36.8	35.9	24.2	61.5	26.7	18.1	25.0
1969	19.5	11.0	11.5	12.6	17.3	13.7	13.3	29.8	17.3	59.3	46.2	28.2	23.3
1970	9.7	7.4	6.4	9.1	0	15.1	45.6	30.7	48.6	67.3	80.1	35.0	32.3
1971	28.8	20.8	29.5	19.8	20.6	27.9	23.8	31.5	55.5	66.3	58.2	60.7	37.0
1972	24.9	20.2	20.4	22.6	21.4	22.0	17.7	17.1	29.3	44.7	116.5	77.0	36.2
1973	19.3	17.1	17.3	21.9	21.1	32.6	36.0	52.8	45.4	83.3	97.8	170.8	51.3
1974	36.8	30.0	28.5	18.9	28.6	24.8	12.2	26.8	33.5	31.8	25.0	11.1	25.7
1975	12.4	10.2	12.6	15.5	11.7	11.5	22.2	14.4	27.2	33.8	43.1	80.3	24.6
1976	28.9	12.5	8.2	12.3	36.6	21.0	27.3	18.9	41.4	93.6	63.5	31.4	33.0
1977	12.7	5.1	3.0	2.2	4.3	8.6	4.0	14.9	24.8	88.2	39.4	10.1	18.1
1978	4.2	1.8	2.9	8.6	16.5	9.6	23.9	16.2	34.2	40.5	38.1	11.2	17.3
1979	2.6	1.6	1.4	11.9	12.5	18.8	13.3	14.5	50.0	23.5	57.3	12.8	18.4
1980	3.6	2.5	4.7	5.6	8.7	15.0	11.2	35.0	51.5	113.8	67.8	40.9	30.0
Average	27.9	17.4	15.6	20.0	35.0	28.6	30.4	31.7	43.9	77.9	81.6	54.1	38.9

Table 26 MONTHLY MEAN RUNOFF RECORD (4/6)

Station: Ara Kuda (5405421)
River: Perai
Catchment Area: 129 km^2

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1960	-	-	-	-	-	-	8.2	3.3	4.7	3.4	10.2	7.0	6.1
1961	4.9	4.1	5.2	6.3	6.1	2.9	3.4	2.5	2.7	7.1	13.7	11.9	5.9
1962	13.5	5.4	5.1	8.0	8.9	5.6	5.6	4.7	4.2	20.4	10.4	6.7	8.2
1963	5.4	3.0	4.2	3.1	4.8	3.1	2.5	2.6	2.8	9.6	20.4	11.4	6.1
1964	4.7	2.8	2.3	3.7	6.8	3.0	5.4	4.6	19.9	13.1	9.5	4.4	6.7
1965	2.9	1.8	2.2	2.9	3.5	2.1	6.1	7.5	7.8	10.0	13.4	12.7	6.1
1966	8.1	7.3	8.2	7.9	6.8	6.8	6.8	4.6	4.5	8.7	7.3	8.9	7.2
1967	8.1	6.1	4.8	7.4	10.5	6.1	5.5	4.3	4.6	8.4	10.2	6.8	6.9
1968	4.1	2.5	2.5	6.7	6.4	3.6	4.4	4.8	3.9	5.6	8.0	5.7	4.8
1969	4.8	3.1	3.8	-	-	5.8	3.7	4.9	3.7	12.0	8.0	7.5	5.7
1970	7.0	3.4	2.4	-	-	-	7.1	4.3	9.3	18.6	20.1	10.7	9.2
1971	5.4	5.5	5.3	4.6	3.8	3.4	2.9	5.8	7.7	9.8	4.8	8.8	5.7
1972	4.8	4.3	2.9	10.5	4.5	3.7	2.8	2.6	5.2	11.4	13.3	9.9	6.3
1973	4.4	3.1	3.9	6.0	7.6	6.3	4.5	5.5	4.2	8.6	11.2	11.2	6.4
1974	4.2	4.5	3.1	5.9	5.7	3.1	3.1	3.1	4.6	4.9	5.4	3.6	4.3
1975	5.6	5.8	7.6	9.2	5.4	5.0	4.4	3.3	5.0	4.1	9.2	7.8	6.0
1976	4.1	2.8	3.6	3.7	4.6	3.1	2.4	2.9	8.1	11.8	8.5	5.9	5.1
1977	4.9	3.1	2.0	2.1	3.3	2.7	1.9	2.5	5.7	13.7	8.8	8.2	4.9
1978	4.9	4.0	5.2	6.2	9.1	4.9	4.8	5.3	6.9	9.6	6.7	4.2	6.0
1979	3.0	3.3	3.3	7.1	5.3	5.2	4.7	5.0	12.1	8.5	17.6	9.0	7.0
1980	6.1	5.3	6.1	6.9	7.2	7.9	6.6	10.7	12.4	15.0	18.4	15.7	9.9
Average	5.5	4.1	4.2	6.0	6.1	4.4	4.6	4.5	6.7	10.2	11.2	8.5	6.3

Station: Jam. Syed Omar (5606410)
River: Muda
Catchment Area: 3,330 km^2

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1970	-	-	-	-	-	-	-	-	-	332.3	378.9	144.3	285.2
1971	65.4	20.7	120.2	0	1.5	32.0	17.9	74.9	260.1	164.1	104.3	183.8	87.1
1972	50.9	27.7	16.4	71.2	35.0	46.9	22.2	55.5	142.7	183.2	330.7	172.7	96.3
1973	70.5	38.2	24.7	28.0	113.9	110.9	84.2	105.0	113.6	130.5	160.6	157.7	94.8
1974	69.0	57.9	41.3	50.8	110.8	52.7	28.9	75.4	125.8	93.9	104.4	40.4	70.9
1975	44.0	24.4	34.3	40.3	41.1	32.2	21.7	33.1	87.8	120.2	137.0	98.6	59.6
1976	-	-	23.2	38.1	116.3	37.8	71.3	-	135.1	251.2	193.9	93.4	106.7
1977	67.3	33.8	9.0	8.6	40.8	45.4	25.3	58.2	94.8	311.1	121.3	55.9	72.6
1978	28.4	8.0	14.6	25.1	-	-	8.8	46.0	90.9	122.5	133.5	43.6	52.1
1979	15.3	4.4	2.9	37.5	49.0	49.8	51.3	50.1	121.3	73.6	106.6	53.7	51.3
1980	16.8	6.0	18.3	-	-	-	-	-	-	-	-	-	13.7
Average	47.5	24.6	30.5	33.3	63.5	51.0	36.8	62.3	130.2	178.3	177.1	104.4	76.1

Table 27 MONTHLY MEAN RUNOFF RECORD (5/6)

Station: Batu Pekaka (5506413)
River: Muda
Catchment Area: 3,340 km^2

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1947	90.2	63.1	91.1	150.1	138.0	120.7	116.3	102.8	137.6	229.2	246.8	221.7	142.3
1948	99.3	55.6	44.3	74.9	78.1	37.6	63.1	93.3	64.0	159.4	136.7	56.7	80.3
1949	16.0	19.7	21.4	97.4	141.8	102.9	165.1	104.8	170.2	320.0	229.1	201.9	132.5
1950	81.7	73.2	46.4	107.1	130.0	108.1	65.4	43.1	117.0	173.5	211.8	-	105.2
1951	54.9	59.2	50.5	65.3	102.8	72.5	102.7	57.1	145.8	142.2	282.8	207.9	112.0
1952	41.3	28.7	120.5	106.4	62.1	44.3	47.3	43.7	-	-	-	-	61.8
1953	-	-	31.9	79.0	46.8	21.7	117.9	44.0	291.9	287.2	177.5	56.2	115.4
1954	49.8	35.5	38.5	41.6	65.4	274.8	129.1	163.5	56.3	232.8	184.2	92.1	113.6
1955	34.4	57.9	23.2	57.5	108.7	83.2	48.9	106.0	115.3	193.8	294.6	145.5	105.8
1956	102.6	50.8	56.5	78.0	111.8	96.1	116.7	130.0	168.6	259.3	290.7	108.0	130.8
1957	55.1	53.3	64.7	108.7	124.4	91.2	100.8	106.9	126.0	150.9	222.8	99.1	108.7
1958	73.8	43.3	32.9	34.1	146.1	87.9	48.2	83.8	66.1	206.8	241.6	79.0	95.3
1959	38.7	19.7	39.8	86.1	121.1	78.5	66.1	82.7	105.9	157.9	216.5	89.0	91.8
1960	55.5	27.3	33.3	48.1	74.2	60.9	103.9	80.4	169.4	59.9	187.8	150.5	87.6
1961	62.8	41.8	44.0	56.2	89.5	64.6	51.2	51.2	55.8	152.9	171.7	105.2	78.9
1962	79.0	25.1	44.7	43.8	139.3	66.6	90.2	91.6	112.4	251.3	140.8	97.3	98.5
1963	71.4	24.2	22.8	14.7	75.2	43.6	45.4	45.8	117.4	284.1	344.3	157.1	103.8
1964	52.1	31.5	18.2	22.2	86.3	55.9	127.9	81.8	179.4	154.0	315.7	93.5	101.5
1965	34.3	20.8	15.8	60.1	111.4	36.3	52.8	121.8	158.8	352.4	376.7	330.3	139.3
1966	115.5	78.5	67.2	88.8	137.2	133.3	91.2	77.4	118.9	321.1	289.5	274.8	149.5
1967	358.5	87.3	46.8	61.5	137.3	114.7	92.7	76.8	94.9	247.1	212.8	131.1	138.5
1968	30.1	17.3	11.4	22.5	50.3	45.1	74.9	101.5	59.4	191.6	104.7	49.3	63.2
1969	61.9	18.9	27.8	43.7	90.8	80.9	51.5	103.5	62.1	257.7	224.5	151.2	97.9
1970	48.6	18.2	11.0	24.1	56.8	49.2	69.7	55.1	96.7	180.6	222.1	94.7	77.2
1971	60.8	35.6	62.9	28.5	29.2	41.4	33.1	64.6	126.9	107.2	88.4	107.6	65.5
1972	40.8	23.8	13.2	31.6	38.5	39.2	23.3	20.2	65.9	127.3	280.0	122.7	68.9
Average	72.4	40.4	41.6	62.8	95.9	78.9	80.6	82.1	119.3	208.0	227.8	134.3	103.6

Table 28 MONTHLY MEAN RUNOFF RECORD (6/6)

Station: Ldg. Victoria (5505412)
River: Muda
Catchment Area: 4,010 km^2

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1961	66.5	50.2	58.0	78.3	115.8	70.2	53.1	51.5	66.6	195.3	211.6	127.0	95.3
1962	105.8	32.8	46.9	44.3	162.6	68.3	96.7	115.6	113.5	196.7	158.2	91.9	102.8
1963	69.6	23.1	22.8	17.1	64.8	36.0	37.1	38.1	102.7	268.2	343.3	101.6	98.7
1964	52.1	27.4	18.1	25.6	91.0	50.1	127.6	82.5	214.2	166.2	318.0	94.0	105.6
1965	36.1	23.9	22.0	65.6	104.2	33.8	46.7	102.8	125.0	280.9	318.0	256.2	117.9
1966	100.6	72.2	69.7	84.9	111.9	104.5	80.2	63.6	98.3	250.4	221.6	219.4	123.1
1967	257.4	81.0	51.4	61.8	128.6	99.1	81.6	71.1	90.1	200.0	180.4	132.9	119.6
1968	41.6	24.9	18.3	31.4	56.2	52.9	70.3	101.6	56.5	159.2	108.6	57.6	64.9
1969	67.2	26.4	33.1	46.2	94.9	89.8	58.5	89.2	58.9	225.1	192.3	139.7	93.4
1970	63.1	27.2	18.3	37.1	72.0	55.9	5.7	5.7	6.3	7.1	7.6	6.4	26.0
1971	5.8	5.2	5.7	5.1	5.3	5.5	5.1	5.8	6.7	6.6	6.1	6.7	5.8
1972	6.6	5.0	4.6	5.4	5.2	5.1	4.8	4.7	5.6	6.6	7.9	6.5	5.7
1973	5.3	4.7	4.6	5.5	5.8	5.8	5.3	5.9	5.7	6.4	6.8	7.2	5.8
1974	5.4	5.1	4.7	5.1	5.8	5.3	4.9	5.2	5.9	5.8	6.0	5.2	5.4
1975	5.3	5.1	5.2	5.4	5.3	5.0	5.4	5.2	6.1	5.9	6.4	6.8	5.6
1976	139.6	50.0	59.7	88.3	167.7	118.1	116.9	89.5	188.2	366.0	323.6	190.8	158.2
1977	88.9	36.3	15.5	16.8	75.3	68.3	33.3	84.0	149.2	408.0	225.1	96.2	108.1
1978	50.0	18.6	26.8	74.2	130.7	67.5	100.5	76.6	157.2	185.9	183.1	53.4	93.7
1979	21.9	9.6	4.6	62.4	81.9	84.8	83.7	70.7	182.0	116.8	234.2	82.3	86.2
1980	12.0	1.9	16.3	29.7	48.7	67.9	30.2	118.2	191.2	409.3	304.5	197.8	119.0
Average	60.0	26.5	25.3	39.5	76.7	54.7	52.4	59.4	91.5	173.3	168.2	97.0	77.0

Table 29 POTENTIAL BASIN EVAPOTRANSPIRATION

Unit: mm

River Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Perlis	150	162	186	161	130	113	117	117	113	111	104	114	1,578
Kedah	144	158	171	146	129	114	114	120	116	111	102	111	1,536
Muda	149	154	167	138	118	108	118	115	108	99	84	115	1,473
Perai	113	114	134	122	121	120	121	119	117	116	105	105	1,407

Table 30 BASIN MEAN RAINFALL

River Basin	Drainage Area (km^2)	Annual Basin Mean Rainfall (mm)
Perlis	150	1,890
Kedah	1,270	1,927
Muda	1,740	2,187
Perai	129	2,826

Table 31 WEIGHT OF RAINFALL STATION

River Basin	Rainfall Station	Area Weight
Perlis	Kali Bukit	0.5
	Tasoh	0.5
Kedah	Kuala Nerang	0.7
	Ladang Tanjong Pauh	0.3
Muda	Sik	0.5
	Kg. Gajah Puteh	0.5
Perai	Kelang Baharu Kulim	0.5
	Rumah Sakit Kulim	0.5

Table 32 BASIN MEAN MONTHLY RAINFALL (1/2)

Basin: Perlis
Catchment Area: 150 km^2

Unit: mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	36	71	100	139	175	187	152	95	215	258	108	303	1,837
1962	28	0	129	187	245	138	254	177	228	250	83	46	1,762
1963	24	4	69	43	200	141	51	88	340	330	243	36	1,568
1964	10	38	17	151	299	31	101	107	207	211	263	57	1,494
1965	0	77	88	118	189	114	182	233	231	178	225	243	1,878
1966	60	24	104	92	359	136	156	183	275	286	244	213	2,134
1967	245	21	16	165	358	268	170	170	263	323	174	11	2,185
1968	3	7	154	191	168	99	111	264	186	302	26	63	1,572
1969	166	3	202	242	217	175	91	180	157	371	352	40	2,195
1970	90	0	158	123	193	168	268	125	308	213	139	209	1,993
1971	123	96	128	22	271	267	98	135	227	379	152	125	2,020
1972	0	26	61	296	26	186	89	103	629	133	447	175	2,170
1973	15	35	114	200	178	159	182	312	131	279	156	235	1,996
1974	6	80	47	106	202	152	97	137	225	136	223	79	1,489
1975	274	49	148	110	241	137	183	122	209	166	178	187	2,004
1976	0	11	44	182	231	186	254	163	418	262	258	28	2,037
1977	32	19	5	28	232	134	70	345	366	208	58	29	1,527
1978	131	1	240	115	191	138	206	298	143	251	219	109	2,043
1979	5	14	40	397	145	96	348	141	166	199	296	80	1,926
1980	0	21	130	217	187	138	138	368	253	277	178	72	1,977
Average	62	30	100	156	215	153	160	187	259	251	201	117	1,890

Basin: Kedah
Catchment Area: 1,270 km^2

Unit: mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	145	90	168	167	148	162	54	62	211	329	182	203	1,920
1962	26	16	197	222	250	161	241	203	208	345	97	29	1,995
1963	25	0	175	77	233	64	104	115	232	306	300	40	1,671
1964	13	7	16	132	197	56	187	110	266	207	191	28	1,410
1965	0	38	124	171	222	63	123	281	186	407	243	305	2,161
1966	58	67	112	159	213	173	102	140	270	339	167	106	1,905
1967	141	10	15	200	287	255	130	159	206	334	215	3	1,956
1968	2	18	168	275	174	112	183	195	196	319	153	116	1,911
1969	98	37	150	119	156	223	95	362	149	333	308	19	2,047
1970	48	0	101	112	272	117	194	207	272	260	210	165	1,957
1971	12	174	190	35	197	246	121	237	291	421	248	102	2,275
1972	0	110	120	374	91	93	41	105	649	248	300	167	2,296
1973	43	16	116	333	286	156	104	234	166	385	246	156	2,239
1974	89	58	87	77	402	135	153	161	479	182	156	44	2,024
1975	108	118	111	149	150	135	168	118	236	278	142	232	1,944
1976	1	19	55	215	315	155	270	122	292	388	252	40	2,125
1977	8	0	1	95	186	103	65	214	236	352	43	10	1,313
1978	33	0	132	99	203	185	246	132	258	225	96	80	1,689
1979	1	14	51	273	170	149	192	195	254	146	280	1	1,727
1980	0	30	114	192	160	75	167	224	282	346	267	116	1,974
Average	43	41	110	174	216	141	147	179	269	308	205	98	1,927

Table 33 BASIN MEAN MONTHLY RAINFALL (2/2)

Basin: Muda
Catchment Area: 1,740 km^2

Unit: mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	60	154	130	245	103	143	131	73	272	239	265	166	1,982
1962	41	7	215	148	243	159	214	192	163	463	79	108	2,034
1963	68	10	65	63	391	188	116	118	239	340	369	81	2,049
1964	29	63	17	178	284	98	371	88	317	299	287	72	2,101
1965	0	24	101	246	223	82	195	282	280	413	232	195	2,272
1966	72	125	104	174	287	180	187	142	283	244	285	140	2,222
1967	184	34	[illegible]	236	312	226	104	159	164	260	199	14	1,912
1968	1	49	[illegible]	181	125	174	241	266	166	400	82	107	1,819
1969	157	55	243	180	243	182	129	373	192	498	299	72	2,621
1970	60	0	156	199	407	88	246	192	312	342	287	142	2,430
1971	23	119	130	66	159	248	112	256	318	327	171	179	2,107
1972	0	102	58	213	93	230	52	124	332	345	515	80	2,145
1973	36	12	121	288	170	162	210	291	133	355	184	199	2,162
1974	35	75	54	134	246	110	154	174	350	177	227	46	1,783
1975	177	167	132	231	175	82	268	132	379	258	211	287	2,500
1976	0	46	90	279	288	198	269	195	330	441	357	51	2,543
1977	84	58	7	95	254	235	87	280	281	616	119	79	2,194
1978	90	1	224	206	283	250	193	249	172	348	199	39	2,254
1979	2	26	48	334	135	160	278	144	357	213	280	0	1,975
1980	0	32	88	179	277	136	215	295	356	587	372	80	2,617
Average	56	58	101	194	235	167	189	201	270	358	251	107	2,187

Basin: Perai
Catchment Area: 129 km^2

Unit: mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	127	217	356	309	156	186	221	87	217	436	375	325	3,009
1962	188	22	146	340	285	209	235	158	201	763	197	142	2,884
1963	115	102	223	77	268	124	204	162	217	460	535	223	2,707
1964	160	83	86	328	313	119	403	166	624	318	263	90	2,950
1965	7	46	241	170	171	56	187	288	300	538	362	423	2,788
1966	141	150	265	301	175	181	249	160	205	457	371	363	3,015
1967	260	123	97	359	372	191	210	161	250	478	359	60	2,917
1968	78	46	259	412	220	163	203	267	121	475	191	206	2,638
1969	155	107	208	134	373	225	105	327	159	551	299	159	2,800
1970	200	10	145	401	282	143	209	134	363	641	616	265	3,406
1971	65	289	186	131	140	142	104	282	372	425	184	456	2,772
1972	92	183	91	505	116	170	100	68	335	469	472	326	2,925
1973	97	109	353	351	496	224	217	273	188	525	396	292	3,519
1974	88	194	115	288	272	89	159	118	347	237	274	90	2,270
1975	191	223	316	420	183	75	256	130	320	264	384	345	3,104
1976	10	49	230	266	195	133	189	207	379	510	338	163	2,666
1977	78	92	32	170	275	157	67	311	348	546	297	177	2,548
1978	40	81	179	220	303	126	124	237	202	381	103	35	2,028
1979	39	28	101	334	217	191	164	288	360	263	569	62	2,522
1980	84	113	142	203	205	187	164	440	453	307	459	293	3,048
Average	111	113	189	286	246	155	189	213	298	452	352	225	2,826

Table 34 ANNUAL LOSS AT KEY STATION

Basin: Perlis
Station: Titi Konkerit Baru (6502431 & 6502432)

Unit: mm

Year	Basin Rainfall	Observed Runoff	Observed Loss	Simulated Runoff	Simulated Loss
1961	1,837	-	-	379	1,458
1962	1,762	-	-	544	1,218
1963	1,568	-	-	378	1,190
1964	1,494	-	-	319	1,175
1965	1,878	-	-	406	1,472
1966	2,134	-	-	686	1,448
1967	2,185	-	-	842	1,343
1968	1,572	-	-	358	1,214
1969	2,195	-	-	625	1,570
1970	1,993	-	-	512	1,481
1971	2,020	-	-	620	1,400
1972	2,170	-	-	814	1,356
1973	1,996	-	-	609	1,387
1974	1,489	-	-	249	1,240
1975	2,004	483	1,521	468	1,536
1976	2,037	683	1,354	722	1,315
1977	1,527	280	1,247	435	1,092
1978	2,043	386	1,657	494	1,549
1979	1,926	493	1,433	613	1,313
1980	1,977	625	1,352	574	1,403
Average	1,890	492	1,427	532	1,358

Basin: Kedah
Station: Lengkuas (6204421)

Unit: mm

Year	Basin Rainfall	Observed Runoff	Observed Loss	Simulated Runoff	Simulated Loss
1954	1,863	591	1,272	595	1,268
1955	2,312	875	1,437	906	1,406
1956	2,528	873	1,655	1,026	1,502
1957	2,172	526	1,646	778	1,394
1958	1,788	379	1,409	549	1,239
1959	2,038	576	1,462	561	1,477
1960	1,869	540	1,329	528	1,341
1961	1,920	300	1,620	462	1,458
1962	1,995	504	1,491	694	1,301
1963	1,671	265	1,406	409	1,262
1964	1,410	298	1,112	268	1,142
1965	2,161	678	1,482	631	1,530
1966	1,905	570	1,335	563	1,342
1967	1,956	751	1,205	664	1,292
1968	1,911	-	-	508	1,403
1969	2,047	-	-	626	1,421
1970	1,957	-	-	502	1,455
1971	2,275	-	-	834	1,441
1972	2,296	-	-	916	1,380
1973	2,239	-	-	831	1,408
1974	2,024	-	-	708	1,316
1975	1,944	-	-	435	1,509
1976	2,125	-	-	819	1,306
1977	1,313	-	-	345	968
1978	1,689	-	-	389	1,300
1979	1,727	-	-	411	1,316
1980	1,974	-	-	533	1,441
Average	1,967	552	1,419	611	1,356

Basin: Muda
Station: Jeniang (5806414)

Unit: mm

Year	Basin Rainfall	Observed Runoff	Observed Loss	Simulated Runoff	Simulated Loss
1961	1,982	593	1,389	647	1,335
1962	2,034	717	1,317	811	1,223
1963	2,049	933	1,116	772	1,277
1964	2,101	725	1,376	852	1,249
1965	2,272	903	1,369	875	1,397
1966	2,222	1,023	1,199	830	1,392
1967	1,912	901	1,011	794	1,118
1968	1,819	931	888	542	1,277
1969	2,621	866	1,755	1,097	1,524
1970	2,430	906	1,524	1,025	1,405
1971	2,107	936	1,171	804	1,303
1972	2,145	1,077	1,068	848	1,297
1973	2,162	1,450	712	831	1,331
1974	1,783	740	1,043	577	1,206
1975	2,500	848	1,652	872	1,628
1976	2,543	1,125	1,418	1,255	1,288
1977	2,194	635	1,559	994	1,200
1978	2,254	638	1,616	909	1,345
1979	1,975	674	1,301	783	1,192
1980	2,617	1,082	1,535	1,184	1,433
Average	2,187	885	1,301	865	1,321

Basin: Perai
Station: Ara Kuda (5405421)

Unit: mm

Year	Basin Rainfall	Observed Runoff	Observed Loss	Simulated Runoff	Simulated Loss
1961	3,009	1,445	1,564	1,609	1,400
1962	2,884	2,016	868	1,701	1,183
1963	2,707	1,487	1,220	1,272	1,435
1964	2,950	1,636	1,314	1,685	1,265
1965	2,788	1,492	1,296	1,378	1,410
1966	3,015	1,754	1,261	1,594	1,421
1967	2,917	1,683	1,234	1,614	1,303
1968	2,638	1,190	1,448	1,272	1,366
1969	2,800	1,172	1,628	1,409	1,391
1970	3,406	1,645	1,761	1,859	1,547
1971	2,772	1,351	1,421	1,461	1,311
1972	2,925	1,407	1,518	1,508	1,417
1973	3,519	1,564	1,955	2,081	1,438
1974	2,270	1,045	1,225	1,081	1,189
1975	3,104	1,466	1,638	1,484	1,620
1976	2,666	1,259	1,407	1,402	1,264
1977	2,548	1,203	1,345	1,251	1,297
1978	2,028	1,466	562	925	1,103
1979	2,522	1,713	809	1,166	1,356
1980	3,048	2,422	626	1,460	1,588
Average	2,826	1,521	1,305	1,461	1,365

Table 35 ERROR IN ANNUAL LOSS AT KEY STATION

Basin: Perlis
Station: Titi Konkerit Baru (6502431 & 6502432)

Unit: mm

Year	Annual Loss (mm) Observed	Simulated	Error (%)
1975	1,521	1,536	1
1976	1,354	1,315	-3
1977	1,247	1,092	-12
1978	1,657	1,549	-7
1979	1,433	1,313	-8
1980	1,352	1,403	4
Average	1,427	1,368	-4

Basin: Kedah
Station: Lengkuas (6204421)

Unit: mm

Year	Annual Loss (mm) Observed	Simulated	Error (%)
1954	1,272	1,268	0
1955	1,437	1,406	-2
1956	1,655	1,502	-9
1957	1,646	1,394	-15
1958	1,409	1,239	-12
1959	1,462	1,477	1
1960	1,329	1,341	1
1961	1,620	1,458	-10
1962	1,491	1,301	-13
1963	1,406	1,262	-10
1964	1,112	1,142	3
1965	1,482	1,530	3
1966	1,335	1,342	1
1967	1,205	1,292	7
Average	1,419	1,354	6

Basin: Muda
Station: Jeniang (5806414)

Unit: mm

Year	Annual Loss (mm) Observed	Simulated	Error (%)
1961	1,389	1,335	-4
1962	1,317	1,223	-7
1963	1,116	1,277	14
1964	1,376	1,249	-9
1965	1,369	1,397	2
1966	1,199	1,392	16
1967	1,011	1,118	11
1968	888	1,277	44
1969	1,755	1,524	-13
1970	1,524	1,405	-8
1971	1,171	1,303	11
1972	1,068	1,297	21
1973	712	1,331	90
1974	1,043	1,206	16
1975	1,652	1,628	-1
1976	1,418	1,288	-9
1977	1,559	1,200	-23
1978	1,616	1,345	-17
1979	1,301	1,192	-8
1980	1,535	1,433	-7
Average	1,301	1,321	16

Basin: Perai
Station: Ara Kuda (5405421)

Unit: mm

Year	Annual Loss (mm) Observed	Simulated	Error (%)
1961	1,564	1,400	-10
1962	868	1,183	36
1963	1,220	1,435	18
1964	1,314	1,265	-4
1965	1,296	1,410	9
1966	1,261	1,421	13
1967	1,234	1,303	6
1968	1,448	1,366	-6
1969	1,628	1,391	-15
1970	1,761	1,547	-12
1971	1,421	1,311	-8
1972	1,518	1,417	-7
1973	1,955	1,438	-26
1974	1,225	1,189	-3
1975	1,638	1,620	-1
1976	1,407	1,264	-10
1977	1,345	1,297	-4
1978	562	1,103	96
1979	809	1,356	68
1980	626	1,588	154
Average	1,305	1,365	25

Table 36 TANK PARAMETERS

		Model I	Model II
Applied Basin		Perlis & Kedah	Muda & Perai
Top Tank	H1	10 mm	10 mm
	H2	30 mm	40 mm
	H3	45 mm	45 mm
	A0	0.22	0.25
	A1	0.25	0.3
	A2	0.5	0.5
	A3	0.0	0.0
	PS	50 mm	50 mm
	SS	250 mm	250 mm
Second Tank	B0	0.02	0.025
	B1	0.064	0.1
Third Tank	C0	0.005	0.004
	C1	0.02	0.02
Fourth Tank	D1	0.002	0.0025
River Channel	HR	2 mm	2 mm
	R1	0.15	0.15
	R2	0.15	0.15
Area Ratio	a	2	3
Constant	TB	3	3
	TC	4	4

Remarks; Refer to Fig. 12

Table 37 INITIAL VALUES

Unit: mm

	1st Zone	2nd Zone	3rd Zone	4th Zone
XP	30	30	40	40
XS	50	50	100	200
XB	30	40	50	60
XC	100	200	300	400
XD	200	500	700	1,500

Remarks; Refer to Fig. 12

Table 38 ANNUAL LOSS OF NATURAL FLOW

Basin: Perlis
Station: Titi Konkerit Baru (6502431 & 6502432)

Unit: mm

Year	Basin Rainfall	Proposed Runoff	Proposed Loss	Remarks
1961	1,837	379	1,458	Simulated
1962	1,762	544	1,218	"
1963	1,568	378	1,190	"
1964	1,494	319	1,175	"
1965	1,878	406	1,472	"
1966	2,134	686	1,448	"
1967	2,185	842	1,343	"
1968	1,572	358	1,214	"
1969	2,195	625	1,570	"
1970	1,993	512	1,481	"
1971	2,020	620	1,400	"
1972	2,170	814	1,356	"
1973	1,996	609	1,387	"
1974	1,489	249	1,240	"
1975	2,004	483	1,521	Observed
1976	2,037	683	1,354	"
1977	1,527	280	1,247	"
1978	2,043	386	1,657	"
1979	1,926	493	1,433	"
1980	1,977	625	1,352	"
Average	1,890	514	1,376	

Basin:
Station: Lengkuas (6204421)

Unit: mm

Year	Basin Rainfall	Proposed Runoff	Proposed Loss	Remarks
1961	1,920	300	1,620	Observed
1962	1,995	504	1,491	"
1963	1,671	265	1,406	"
1964	1,410	298	1,112	"
1965	2,161	678	1,482	"
1966	1,905	570	1,335	"
1967	1,956	751	1,205	"
1968	1,911	508	1,403	Simulated
1969	2,047	626	1,421	"
1970	1,957	502	1,455	"
1971	2,275	834	1,441	"
1972	2,296	916	1,380	"
1973	2,239	831	1,408	"
1974	2,024	708	1,316	"
1975	1,944	435	1,509	"
1976	2,125	819	1,306	"
1977	1,313	345	968	"
1978	1,689	389	1,300	"
1979	1,727	411	1,316	"
1980	1,974	533	1,441	"
Average	1,927	561	1,366	

Basin: Muda
Station: Jeniang (5806414)

Unit: mm

Year	Basin Rainfall	Proposed Runoff	Proposed Loss	Remarks
1961	1,982	593	1,389	Observed
1962	2,034	717	1,317	"
1963	2,049	933	1,116	"
1964	2,101	725	1,376	"
1965	2,272	903	1,369	"
1966	2,222	1,023	1,199	"
1967	1,912	901	1,011	"
1968	1,819	542	1,277	Simulated
1969	2,621	1,097	1,524	"
1970	2,430	1,025	1,405	"
1971	2,107	804	1,303	"
1972	2,145	848	1,297	"
1973	2,162	831	1,331	"
1974	1,783	577	1,206	"
1975	2,500	872	1,628	"
1976	2,543	1,248	1,295	Observed
1977	2,194	692	1,502	"
1978	2,254	643	1,611	"
1979	1,975	676	1,299	"
1980	2,617	1,140	1,477	"
Average	2,187	840	1,347	

Basin: Perai
Station: Ara Kuda (5405421)

Unit: mm

Year	Basin Rainfall	Proposed Runoff	Proposed Loss	Remarks
1961	3,009	1,445	1,564	Observed
1962	2,884	2,016	868	"
1963	2,707	1,487	1,220	"
1964	2,950	1,636	1,314	"
1965	2,788	1,381	1,407	Simulated (July-Dec)
1966	3,015	1,426	1,589	Simulated (Jan-Aug)
1967	2,917	1,684	1,234	Observed
1968	2,638	1,190	1,448	"
1969	2,800	1,379	1,421	"
1970	3,406	2,005	1,401	"
1971	2,772	1,387	1,385	"
1972	2,925	1,463	1,462	"
1973	3,519	1,564	1,955	"
1974	2,270	1,045	1,225	"
1975	3,104	1,466	1,638	"
1976	2,666	1,259	1,407	"
1977	2,548	1,203	1,345	"
1978	2,028	925	1,103	Simulated
1979	2,522	1,166	1,356	"
1980	3,048	1,460	1,588	"
Average	2,826	1,429	1,397	

Table 39 MONTHLY NATURAL RUNOFF AT KEY STATION (1/2)

Basin: Perlis
Station: Titi Konkerit Baru (6502431, 6502432)
Catchment Area: 150 km^2

Unit: 10^6 m^3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	4.2	2.0	1.2	0.8	2.1	5.1	3.8	2.7	3.9	11.2	5.5	14.2	56.8
1962	11.2	2.0	1.1	0.6	14.5	2.8	5.4	6.8	16.8	11.9	5.5	3.0	81.8
1963	1.5	0.7	0.4	0.3	0.3	1.1	1.0	0.3	14.9	13.9	13.5	8.7	56.5
1964	3.4	1.5	0.7	0.3	12.7	2.1	0.5	0.3	0.8	5.4	14.0	6.2	47.8
1965	2.4	0.9	0.4	0.1	0.7	1.0	8.1	7.0	7.9	6.3	10.4	15.9	60.9
1966	7.0	2.6	1.4	0.5	14.9	4.3	2.7	4.3	8.9	18.8	15.9	21.5	102.8
1967	22.7	4.5	2.3	1.1	12.0	13.9	6.9	10.6	15.1	20.1	9.2	7.5	125.9
1968	3.2	1.5	2.1	5.5	1.4	0.7	0.6	6.3	7.2	14.6	7.1	3.3	53.6
1969	4.6	1.6	0.9	12.4	6.8	3.9	2.7	2.5	4.2	17.7	23.7	12.6	93.7
1970	5.5	2.6	1.5	1.0	4.9	4.2	10.4	6.7	11.7	8.1	8.8	11.5	76.9
1971	15.4	3.3	3.9	1.3	3.4	11.2	4.9	2.6	7.4	20.1	11.0	8.4	93.0
1972	4.6	1.9	1.0	7.3	2.2	1.6	1.1	0.5	40.3	10.9	28.4	22.1	122.0
1973	7.2	3.0	1.8	3.0	2.2	4.1	4.4	19.2	5.9	12.2	9.8	18.5	91.4
1974	4.5	1.9	1.1	0.5	1.9	2.3	1.4	1.0	2.6	7.4	8.3	4.3	37.2
1975	20.7	1.1	1.5	1.2	4.2	5.5	2.1	2.7	7.2	7.2	8.3	11.5	72.9
1976	1.2	0.8	0.7	0.6	6.4	2.9	11.5	7.1	25.8	14.0	27.4	4.1	102.4
1977	1.2	0.7	0.6	0.3	1.1	1.9	0.8	7.0	15.7	9.9	2.1	0.7	42.0
1978	0.9	0.6	1.8	2.1	5.9	1.3	4.2	7.7	7.7	7.7	10.0	7.7	57.5
1979	0.9	0.7	0.5	4.0	10.2	3.5	14.9	3.7	4.9	5.5	21.0	4.1	74.0
1980	2.7	2.5	2.3	3.2	3.4	3.3	3.4	16.0	13.0	26.1	11.4	6.4	93.7
Mean	6.3	1.8	1.3	2.3	5.5	3.8	4.5	5.7	11.1	12.5	12.6	9.6	77.1

Basin: Kedah
Station: Lengkuas (6204421)
Catchment Area: 1,270 km^2

Unit: 10^6 m^3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	14.5	8.1	17.3	24.3	36.1	21.4	9.7	8.4	19.8	101.3	72.6	48.0	381.5
1962	34.2	6.7	9.0	11.5	59.5	13.6	47.2	34.4	111.7	228.9	76.1	7.9	640.7
1963	6.7	3.7	2.7	2.3	10.2	1.5	5.3	2.5	26.0	127.9	126.7	21.6	337.0
1964	1.7	0.8	2.0	3.0	19.8	10.5	15.4	9.6	69.4	69.3	150.6	26.8	378.9
1965	3.3	2.2	8.4	15.2	19.0	6.7	11.5	54.6	96.1	186.2	209.4	248.6	861.3
1966	36.8	14.0	14.0	12.7	31.5	47.7	13.8	12.7	53.5	193.1	158.5	135.3	723.6
1967	119.9	11.8	12.0	17.4	62.9	57.0	61.8	44.5	65.8	253.9	149.3	96.9	953.0
1968	23.8	11.1	26.0	80.1	30.9	18.2	24.0	30.8	70.5	145.9	92.9	90.7	644.9
1969	45.9	17.2	10.1	6.6	8.0	30.2	35.8	148.6	79.8	121.4	191.2	100.4	795.1
1970	40.4	19.0	10.6	5.1	35.2	25.2	35.4	60.3	78.5	117.8	109.9	99.5	636.8
1971	57.7	38.1	108.4	23.5	13.3	53.3	44.5	87.8	147.3	210.9	170.0	104.3	1059.1
1972	52.3	25.3	21.9	139.7	53.1	21.0	10.8	11.1	345.1	132.4	201.0	149.4	1163.1
1973	62.1	28.2	17.3	55.3	101.3	121.3	41.4	76.1	60.7	179.4	172.8	139.1	1054.9
1974	57.5	28.5	17.1	9.5	142.1	46.1	30.5	49.7	212.2	164.2	86.4	54.9	898.6
1975	44.6	17.8	14.3	8.8	9.1	14.0	23.3	27.2	63.2	106.9	80.2	143.7	552.8
1976	49.4	19.5	10.4	21.6	156.2	44.2	102.3	47.7	150.5	208.3	145.7	84.3	1040.0
1977	38.7	18.3	9.9	5.0	32.8	7.0	3.9	24.3	47.6	147.3	70.2	33.1	438.2
1978	14.6	6.1	3.0	2.4	10.2	45.5	53.7	32.5	129.0	101.4	46.7	48.9	494.0
1979	14.7	5.7	2.3	23.5	46.6	25.7	31.4	31.8	106.0	54.6	116.3	63.7	522.2
1980	24.6	10.2	4.2	3.8	6.5	4.3	9.1	30.7	76.8	214.4	170.1	121.7	676.5
Mean	37.2	14.6	16.1	23.6	44.2	30.7	30.5	41.3	100.5	153.3	129.8	90.9	712.6

Table 40 MONTHLY NATURAL RUNOFF AT KEY STATION (2/2)

Basin: Muda
Station: Jeniang (5806414)
Catchment Area: 1,740 km^2

Unit: 10^6 m^3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	71.4	46.9	43.8	66.7	97.7	88.8	63.3	51.4	56.1	175.0	173.9	97.3	1032.3
1962	81.0	32.1	47.5	51.7	128.5	75.2	105.1	107.0	123.8	279.9	125.3	89.5	1246.5
1963	75.3	34.0	23.8	24.4	123.5	83.7	94.9	102.9	179.5	353.4	352.5	176.1	1623.9
1964	60.4	29.0	26.8	31.8	110.6	90.2	129.5	75.9	151.9	155.8	297.0	102.6	1261.7
1965	48.7	26.6	26.4	68.6	129.2	49.1	46.6	109.6	131.5	287.4	299.2	348.9	1571.9
1966	124.9	79.5	62.3	68.0	136.8	141.2	85.2	65.7	126.4	302.9	323.4	263.5	1779.8
1967	356.5	87.9	55.0	50.7	129.8	114.9	113.9	89.6	86.8	221.1	158.0	103.4	1567.5
1968	36.2	22.3	15.7	12.0	14.3	12.8	73.2	158.2	99.4	255.9	166.3	77.4	943.6
1969	81.3	43.4	43.7	124.8	97.9	87.0	89.1	221.4	174.4	392.0	317.1	236.1	1908.3
1970	86.9	49.9	41.8	55.0	175.7	158.8	154.0	91.3	225.5	267.8	292.8	183.6	1783.0
1971	97.4	52.2	67.6	31.8	29.7	93.1	77.4	99.5	282.4	223.0	185.8	159.2	1399.2
1972	83.8	43.2	31.9	33.4	28.3	52.7	52.1	35.4	123.7	220.1	548.5	221.3	1474.4
1973	91.6	51.4	38.8	80.4	75.4	86.4	68.1	247.7	92.0	230.9	189.6	194.1	1446.4
1974	85.6	41.9	32.5	32.3	78.5	45.4	31.2	73.3	146.0	173.8	155.6	108.5	1004.4
1975	100.5	61.5	67.2	68.2	67.1	40.0	99.0	85.7	246.2	222.6	188.4	271.5	1517.9
1976	123.2	63.6	44.8	65.1	199.4	110.7	148.7	103.2	218.8	502.2	422.3	171.0	2173.1
1977	69.3	25.2	15.1	11.9	23.5	45.3	21.1	81.2	130.9	480.9	242.8	55.3	1202.5
1978	24.1	9.1	16.0	45.2	90.1	51.1	130.5	88.1	180.6	221.0	201.4	61.3	1118.5
1979	13.9	8.1	7.9	62.6	68.1	99.3	72.6	79.0	263.9	128.2	302.7	69.9	1176.0
1980	19.8	12.8	25.7	29.4	75.2	94.6	61.2	190.9	272.1	621.0	357.6	223.0	1983.1
Mean	86.6	41.0	36.7	50.7	94.0	81.0	85.8	107.8	165.6	285.7	265.0	160.7	1460.7

Basin: Perai
Station: Ara Kuda (5405421)
Catchment Area: 129 km^2

Unit: 10^6 m^3

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1961	13.2	9.9	13.8	16.2	16.3	7.6	9.1	6.9	7.0	18.9	35.6	31.9	186.5
1962	36.2	13.1	13.7	20.9	23.9	14.4	14.9	12.6	11.0	54.6	26.8	17.9	260.1
1963	14.5	7.3	11.2	8.1	12.7	7.9	6.6	7.1	7.3	25.7	52.7	30.6	191.8
1964	12.5	6.9	6.2	9.6	18.2	7.8	14.6	12.2	51.5	35.1	24.6	11.9	211.0
1965	7.7	4.3	5.9	7.6	9.3	5.4	8.3	10.5	14.4	30.6	35.3	38.6	178.0
1966	15.5	10.2	12.8	18.4	14.1	12.3	12.3	10.2	11.6	23.5	18.9	23.9	183.7
1967	21.5	14.7	12.8	19.2	28.0	15.8	14.7	11.4	11.9	22.4	26.6	18.1	217.1
1968	11.0	6.4	6.6	17.4	17.1	9.4	11.7	12.9	10.1	15.1	20.6	15.3	153.4
1969	13.0	7.5	10.2	8.8	17.9	15.1	9.8	13.2	9.5	32.1	20.9	20.0	177.9
1970	18.6	8.3	6.5	17.4	18.7	10.5	18.9	11.4	23.6	49.9	52.1	28.8	264.6
1971	14.5	13.2	14.1	11.9	10.1	8.9	7.8	15.1	20.0	26.2	13.4	23.6	178.8
1972	12.9	10.7	7.8	19.1	12.0	9.6	7.4	7.0	13.4	30.5	34.9	26.6	191.9
1973	11.9	7.4	10.4	15.6	20.4	16.3	12.2	14.7	10.8	23.0	28.9	30.1	201.7
1974	11.3	11.0	8.4	15.3	15.2	7.9	8.3	8.3	11.8	13.2	14.0	9.7	134.5
1975	14.9	14.1	20.2	23.9	14.6	12.8	11.9	8.7	12.8	11.0	23.8	20.9	189.7
1976	11.0	7.1	9.7	9.6	12.4	8.2	6.4	7.7	21.0	31.6	22.1	15.8	162.5
1977	13.1	7.5	5.4	5.5	8.9	6.9	5.0	6.7	14.6	36.7	22.7	21.9	155.0
1978	9.7	5.1	6.0	9.7	18.5	7.7	6.1	7.8	10.8	20.9	11.3	5.6	119.2
1979	3.5	2.4	1.9	9.0	8.4	7.8	5.7	10.7	26.4	16.8	40.4	17.4	150.4
1980	8.0	5.0	4.7	6.4	7.4	12.0	5.5	23.4	27.5	26.8	31.8	29.7	188.1
Mean	13.7	8.6	9.4	13.5	15.2	10.2	9.9	10.9	16.4	27.2	27.9	21.9	184.8

Table 41 5-DAY NATURAL RUNOFF AT TITI KONKERIT BARU (6502431 & 6502432) (1/3)

Basin: Perlis Catchment Area: 150 km^2

YEAR : 1961 UNIT : CMS

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.2*	1.0*	0.6*	0.3*	0.3*	0.5*	1.5*	1.2*	0.7*	7.3*	2.4*	1.7*
6-10	1.9*	0.9*	0.5*	0.3*	1.5*	0.5*	1.0*	1.1*	0.6*	6.9*	2.3*	1.5*
11-15	1.6*	0.8*	0.5*	0.3*	1.0*	0.4*	0.9*	1.0*	0.6*	3.8*	2.2*	1.3*
16-20	1.4*	0.8*	0.4*	0.3*	0.7*	0.5*	0.9*	1.0*	0.6*	2.6*	2.1*	3.2*
21-25	1.3*	0.7*	0.6*	0.3*	0.7*	6.0*	1.5*	0.9*	3.5*	2.5*	2.0*	2.1*
26-END	1.1*	0.6*	0.4*	0.3*	0.6*	3.9*	2.5*	0.8*	3.1*	2.4*	1.8*	19.3*

YEAR : 1962

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	14.3*	1.2*	0.5*	0.3*	0.9*	1.3*	0.7*	3.6*	6.4*	2.1*	2.5*	1.5*
6-10	4.0*	1.0*	0.5*	0.2*	18.4*	1.4*	3.1*	1.8*	19.4*	4.8*	2.4*	1.4*
11-15	2.3*	0.8*	0.5*	0.2*	5.6*	1.1*	2.1*	1.5*	5.6*	9.2*	2.2*	1.2*
16-20	1.9*	0.7*	0.4*	0.2*	2.6*	1.0*	1.4*	1.6*	2.9*	3.9*	2.1*	1.0*
21-25	1.7*	0.6*	0.4*	0.2*	1.5*	0.9*	1.2*	3.3*	2.4*	3.8*	1.9*	0.9*
26-END	1.5*	0.5*	0.3*	0.2*	1.3*	0.8*	3.4*	3.2*	2.3*	3.2*	1.7*	0.8*

YEAR : 1963

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	0.7*	0.4*	0.2*	0.1*	0.1*	0.1*	0.6*	0.1*	10.9*	1.9*	7.9*	5.2*
6-10	0.7*	0.3*	0.2*	0.1*	0.1*	0.1*	0.5*	0.1*	14.3*	1.9*	4.8*	3.7*
11-15	0.6*	0.3*	0.1*	0.1*	0.1*	0.1*	0.4*	0.1*	3.7*	1.9*	4.2*	3.2*
16-20	0.5*	0.2*	0.1*	0.1*	0.1*	0.1*	0.3*	0.1*	1.6*	5.3*	3.8*	2.9*
21-25	0.5*	0.2*	0.1*	0.1*	0.1*	1.0*	0.2*	0.1*	2.0*	10.8*	3.6*	2.6*
26-END	0.4*	0.2*	0.1*	0.1*	0.1*	1.1*	0.2*	0.1*	2.1*	8.7*	7.0*	2.2*

YEAR : 1964

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	1.9*	0.8*	0.4*	0.1*	4.9*	1.2*	0.3*	0.1*	0.1*	0.7*	3.6*	2.9*
6-10	1.6*	0.7*	0.3*	0.1*	2.6*	1.0*	0.3*	0.1*	0.1*	0.7*	5.3*	2.7*
11-15	1.3*	0.6*	0.3*	0.1*	0.7*	0.9*	0.2*	0.1*	0.4*	0.7*	6.5*	2.5*
16-20	1.1*	0.5*	0.2*	0.1*	6.1*	0.7*	0.2*	0.1*	0.3*	0.7*	9.4*	2.2*
21-25	1.0*	0.5*	0.2*	0.1*	12.1*	0.6*	0.1*	0.1*	0.3*	2.8*	4.5*	2.0*
26-END	0.9*	0.4*	0.1*	0.1*	2.6*	0.4*	0.1*	0.1*	0.7*	5.7*	3.2*	1.7*

YEAR : 1965

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	1.4*	0.5*	0.2*	0.1*	0. *	0.4*	0.3*	0.4*	3.5*	2.4*	3.1*	5.1*
6-10	1.1*	0.5*	0.2*	0.1*	0. *	0.4*	4.8*	1.3*	1.7*	1.9*	2.1*	3.3*
11-15	0.9*	0.4*	0.1*	0.1*	0.1*	0.4*	10.1*	1.3*	3.5*	1.7*	2.0*	8.5*
16-20	0.8*	0.3*	0.1*	0. *	0.1*	0.4*	2.1*	0.6*	3.7*	1.5*	8.8*	4.4*
21-25	0.7*	0.3*	0.1*	0. *	0.6*	0.4*	0.8*	0.5*	2.2*	2.1*	4.4*	9.6*
26-END	0.6*	0.2*	0.1*	0. *	0.6*	0.3*	0.5*	10.0*	3.7*	4.1*	3.6*	4.9*

YEAR : 1966

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.5*	1.5*	0.7*	0.3*	0.2*	1.9*	1.1*	1.8*	1.4*	8.5*	6.3*	16.5*
6-10	3.1*	1.3*	0.6*	0.3*	13.3*	1.8*	1.0*	1.7*	1.3*	3.2*	3.7*	16.6*
11-15	2.8*	1.1*	0.5*	0.2*	10.0*	1.8*	1.0*	1.5*	2.0*	2.3*	3.2*	5.9*
16-20	2.5*	0.9*	0.5*	0.2*	5.9*	1.7*	1.0*	1.6*	1.4*	13.5*	5.4*	4.6*
21-25	2.2*	0.8*	0.4*	0.1*	2.6*	1.5*	1.0*	1.5*	3.5*	7.9*	11.0*	4.1*
26-END	1.8*	0.8*	0.4*	0.1*	2.0*	1.3*	0.9*	1.5*	11.0*	6.7*	7.3*	3.8*

YEAR : 1967

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	4.5*	2.6*	1.1*	0.5*	10.2*	1.9*	3.5*	2.6*	2.9*	12.7*	3.9*	4.1*
6-10	27.9*	2.2*	1.0*	0.5*	6.3*	1.9*	2.4*	2.0*	8.9*	13.2*	3.5*	3.1*
11-15	8.8*	1.9*	0.9*	0.4*	4.2*	1.7*	2.2*	1.8*	8.5*	4.8*	3.4*	2.8*
16-20	4.3*	1.6*	0.8*	0.4*	2.7*	1.7*	2.2*	1.6*	7.2*	3.6*	3.4*	2.6*
21-25	3.4*	1.4*	0.7*	0.4*	2.2*	15.2*	2.6*	3.0*	4.6*	6.4*	3.3*	2.3*
26-END	3.0*	1.2*	0.6*	0.4*	1.9*	9.8*	2.7*	11.3*	2.9*	4.9*	3.7*	2.0*

YEAR : 1968

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	1.7*	0.8*	0.4*	1.0*	0.8*	0.6*	0.2*	0.5*	5.9*	4.1*	3.3*	1.7*
6-10	1.4*	0.7*	0.3*	0.6*	0.5*	0.3*	0.2*	8.0*	2.3*	3.1*	3.2*	1.5*
11-15	1.2*	0.6*	0.3*	0.5*	0.5*	0.3*	0.2*	1.9*	1.6*	5.3*	2.9*	1.3*
16-20	1.1*	0.5*	0.2*	0.4*	0.5*	0.2*	0.2*	0.9*	1.5*	8.5*	2.7*	1.1*
21-25	1.0*	0.5*	0.2*	7.8*	0.5*	0.2*	0.2*	1.2*	1.5*	8.1*	2.4*	1.0*
26-END	0.9*	0.4*	2.8*	2.6*	0.4*	0.2*	0.3*	1.8*	3.9*	4.0*	2.0*	0.9*

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 42 5-DAY NATURAL RUNOFF AT TITI KONKERIT BARU (6502431 & 6502432) (2/3)

Basin: Perlis Catchment Area: 150 km^2

YEAR : 1969 UNIT : CMS

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	0.8*	1.4*	0.3*	18.7*	1.6*	1.7*	1.4*	0.6*	1.1*	3.0*	10.7*	7.7*
6-10	3.5*	0.7*	0.3*	5.6*	1.1*	1.5*	1.2*	1.3*	1.2*	4.6*	10.0*	5.2*
11-15	1.3*	0.5*	0.2*	1.7*	0.9*	1.4*	1.1*	1.0*	1.2*	7.0*	6.7*	4.5*
16-20	0.9*	0.5*	0.2*	1.0*	2.2*	1.3*	0.9*	0.8*	1.1*	4.6*	11.4*	4.1*
21-25	0.7*	0.4*	0.2*	0.8*	4.8*	1.2*	0.8*	0.9*	1.0*	3.0*	6.6*	3.8*
26-END	2.8*	0.4*	0.8*	0.9*	4.3*	2.0*	0.7*	1.0*	4.1*	15.6*	9.5*	3.3*

YEAR : 1970

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.9*	1.4*	0.7*	0.4*	0.5*	0.8*	10.1*	6.2*	4.9*	2.9*	3.8*	2.6*
6-10	2.5*	1.2*	0.6*	0.4*	1.9*	1.7*	4.3*	2.3*	11.0*	2.7*	4.4*	2.5*
11-15	2.1*	1.1*	0.6*	0.3*	4.7*	2.4*	1.9*	1.7*	3.7*	2.6*	3.4*	2.4*
16-20	1.8*	1.0*	0.5*	0.3*	2.1*	1.5*	1.4*	1.9*	2.4*	3.1*	3.1*	2.2*
21-25	1.6*	0.9*	0.5*	0.2*	1.1*	2.1*	1.2*	1.6*	2.3*	2.9*	2.9*	2.0*
26-END	1.5*	0.8*	0.4*	0.7*	0.9*	1.2*	4.4*	1.5*	2.7*	3.8*	2.8*	12.5*

YEAR : 1971

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	16.3*	1.9*	1.0*	0.8*	0.3*	1.6*	2.0*	1.3*	1.0*	1.8*	4.6*	4.3*
6-10	7.7*	1.6*	0.9*	0.6*	0.7*	1.2*	1.9*	1.2*	1.0*	6.5*	3.6*	3.1*
11-15	3.6*	1.3*	0.8*	0.5*	0.5*	4.7*	1.7*	1.0*	1.2*	17.9*	3.3*	3.0*
16-20	2.8*	1.1*	2.5*	0.4*	1.6*	11.4*	1.9*	0.9*	6.7*	9.1*	3.1*	3.1*
21-25	2.6*	1.0*	2.5*	0.4*	1.5*	4.6*	2.1*	0.8*	5.0*	5.8*	6.9*	2.8*
26-END	2.3*	1.1*	1.1*	0.3*	2.7*	2.4*	1.5*	0.7*	2.3*	4.6*	4.0*	2.6*

YEAR : 1972

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.4*	1.0*	0.5*	0.2*	1.1*	0.4*	0.6*	0.2*	3.7*	7.3*	7.0*	6.2*
6-10	2.1*	0.9*	0.5*	0.2*	1.0*	0.6*	0.5*	0.2*	24.6*	4.1*	6.9*	4.7*
11-15	1.9*	0.8*	0.4*	6.3*	0.9*	0.6*	0.5*	0.2*	12.8*	3.5*	9.4*	4.6*
16-20	1.6*	0.7*	0.5*	6.6*	0.8*	0.6*	0.4*	0.2*	25.5*	3.4*	18.0*	22.6*
21-25	1.3*	0.6*	0.3*	2.1*	0.6*	0.7*	0.3*	0.2*	17.3*	3.2*	16.4*	7.6*
26-END	1.1*	0.6*	0.3*	1.6*	0.5*	0.7*	0.3*	0.2*	9.3*	3.2*	8.1*	4.6*

YEAR : 1973

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.7*	1.6*	0.9*	0.5*	1.0*	3.4*	1.0*	2.7*	2.7*	4.7*	3.0*	2.5*
6-10	3.3*	1.4*	0.8*	0.5*	0.9*	1.4*	1.2*	4.7*	2.1*	5.5*	3.1*	20.1*
11-15	2.9*	1.3*	0.7*	0.4*	0.8*	1.0*	3.2*	1.9*	1.9*	2.5*	7.3*	10.5*
16-20	2.5*	1.1*	0.6*	0.4*	0.8*	0.9*	1.9*	1.4*	2.9*	2.2*	3.6*	3.9*
21-25	2.2*	1.0*	0.5*	2.7*	0.8*	1.8*	1.4*	23.9*	2.1*	7.2*	2.9*	2.9*
26-END	1.8*	0.9*	0.5*	2.5*	0.7*	1.1*	1.2*	8.2*	1.9*	5.2*	2.7*	2.5*

YEAR : 1974

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.3*	1.0*	0.5*	0.2*	0.2*	0.7*	0.7*	0.3*	0.4*	7.5*	1.8*	1.9*
6-10	2.1*	0.9*	0.5*	0.2*	0.2*	0.7*	0.7*	0.4*	0.4*	3.1*	1.8*	1.8*
11-15	1.9*	0.8*	0.4*	0.2*	0.2*	1.2*	0.5*	0.4*	0.4*	1.8*	1.3*	1.7*
16-20	1.6*	0.7*	0.4*	0.2*	0.2*	1.0*	0.5*	0.3*	0.4*	1.6*	6.4*	1.6*
21-25	1.3*	0.6*	0.3*	0.2*	1.0*	0.9*	0.4*	0.4*	1.5*	1.5*	5.6*	1.4*
26-END	1.1*	0.6*	0.3*	0.2*	2.2*	0.8*	0.3*	0.4*	3.0*	1.4*	2.4*	1.2*

YEAR : 1975

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	7.6	0.7	0.5	0.4	0.5	2.3	0.3	1.1	0.4	1.0	6.9	0.9
6-10	12.7	0.5	0.8	0.6	3.2	2.5	0.2	1.8	2.7	0.4	3.0	1.1
11-15	9.8	0.4	0.5	0.3	0.6	2.5	0.2	1.4	1.2	0.5	2.4	1.5
16-20	13.5	0.3	0.4	0.2	1.2	3.1	0.2	0.9	7.3	4.7	1.2	6.4
21-25	2.8	0.3	0.5	0.6	2.0	1.5	1.1	0.5	3.5	3.9	3.3	14.6
26-END	1.2	0.4	0.6	0.6	1.8	0.8	2.3	0.4	1.6	5.2	2.3	1.7

YEAR : 1976

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	0.8	0.3	0.3	0.2	1.0	0.5	0.9	2.1	2.4	3.1	9.9	3.4
6-10	0.6	0.3	0.2	0.2	1.0	1.1	2.0	0.7	0.8	5.9	8.9	1.7
11-15	0.4	0.3	0.2	0.3	1.4	1.2	0.6	0.4	7.6	5.1	4.4	1.2
16-20	0.4	0.3	0.2	0.2	1.6	0.4	0.4	0.5	24.9	2.5	7.5	1.1
21-25	0.3	0.3	0.3	0.2	8.9	0.5	3.4	9.7	19.1	6.8	13.2	0.9
26-END	0.3	0.3	0.3	0.3	0.7	2.9	16.1	2.6	4.9	7.6	19.6	0.9

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 43 5-DAY NATURAL RUNOFF AT TITI KONKERIT BARU (6502431 & 6502432) (3/3)

Basin: Perlis Catchment Area: 150 km^2

YEAR : 1977 UNIT : CMS

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	0.6	0.3	0.3	0.1	0.1	0.2	0.3	0.2	5.4	3.6	1.8	0.2
6-10	0.6	0.3	0.3	0.1	0.1	0.6	0.4	0.7	6.5	3.9	1.2	0.3
11-15	0.4	0.3	0.2	0.1	0.6	0.4	0.6	0.3	1.9	6.5	0.8	0.2
16-20	0.4	0.3	0.2	0.1	0.5	1.1	0.2	6.9	6.1	4.1	0.4	0.5
21-25	0.4	0.3	0.2	0.1	0.8	1.6	0.2	6.1	2.9	1.8	0.4	0.2
26-END	0.3	0.3	0.1	0.1	0.3	0.4	0.2	1.7	13.6	2.6	0.3	0.2

YEAR : 1978

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	0.3	0.2	0.2	0.5	1.4	0.4	2.4	2.2	5.4	0.7	2.6	1.1
6-10	0.3	0.2	0.5	1.1	1.5	0.5	0.6	1.6	4.5	0.8	7.4	11.9
11-15	0.3	0.2	0.7	0.4	8.6*	0.8	0.6	4.5	2.9	2.2	2.0	1.9
16-20	0.6	0.3	0.8	0.4	0.9	0.4	0.6	4.5	1.3	2.9	8.2	1.2
21-25	0.2	0.3	0.9	0.6	0.8	0.4	1.0	1.5	2.6	7.7	2.0	0.8
26-END	0.3	0.2	0.8	1.9	0.4	0.6	3.7	2.9	1.1	3.0	0.9	0.7

YEAR : 1979

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	0.5	0.3	0.3	0.1	8.0	1.6	1.6	1.8	1.5	1.1	3.6	3.4
6-10	0.4	0.3	0.2	0.1	6.7	1.4	8.3	1.3	2.0	3.2	3.5	2.1
11-15	0.3	0.3	0.2	0.3	2.4	1.8	8.3	1.1	3.4	2.2	6.6	1.3
16-20	0.3	0.3	0.2	0.2	1.4	1.3	3.1	0.8	2.3	2.0	14.7	1.0
21-25	0.3	0.3	0.1	1.6	3.7	1.2	2.0	1.3*	1.0	1.1	2.8	0.9
26-END	0.3	0.3	0.1	6.9	1.1	0.7	9.4	1.9	1.1	2.7	17.5	0.7

YEAR : 1980

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	1.0	1.1	1.0	0.7	1.0	1.2	1.2	1.5	6.9	14.7	5.0	4.1
6-10	1.0	1.0	1.0	0.8	1.8	1.6	1.3	1.2	3.0	12.0	9.2	2.8
11-15	1.0	1.0	0.8	0.9	1.1	1.3	0.9	3.4	1.9	15.3	3.4	2.4*
16-20	0.9	0.9	0.9	1.0	1.1	1.0	1.2	16.7	1.3	11.2	2.5	2.1
21-25	1.0	0.9	0.8	2.7	1.0	1.0	1.9	2.8	6.7	2.8	3.7	1.8*
26-END	1.2	1.0	0.7	1.2	1.5	1.5	1.1	9.6	10.3	3.7	2.7	1.4

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 44 5-DAY NATURAL RUNOFF AT LENGKUAS (6204421) (1/3)

Basin: Kedah Catchment Area: 1,270 km^2

YEAR : 1961 UNIT : CMS

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.2	2.7	4.1	4.4	21.5	3.2	5.9	2.9	3.4	15.8	45.6	9.9
6-10	7.9	2.5	6.0	4.5	25.5	2.7	3.1	2.6	3.8	13.4	43.7	5.7
11-15	8.0	2.3	6.8	17.0	17.6	2.9	3.0	3.3	3.9	30.7	13.7	3.6
16-20	4.7	0.4	7.7	14.5	7.7	11.6	3.1	3.2	3.5	33.6	10.5	4.8
21-25	3.8	2.6	7.0	8.0	8.0	5.2	3.3	3.2	15.1	61.3	9.9	11.4
26-END	3.4	3.8	7.1	7.8	2.7	23.9	3.4	3.5	16.1	66.4	44.7	63.0

YEAR : 1962

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	42.8	3.1	2.7	2.4	11.4	2.4	9.3	11.1	17.6	9.1	75.1	2.9
6-10	15.5	3.1	6.0	3.3	12.7	2.4	49.1	2.7	137.1	35.2	39.6	1.9
11-15	7.9	2.6	4.3	2.6	41.0	2.2	28.3	2.3	45.5	86.9	34.6	4.1
16-20	5.6	2.2	2.8	11.6	68.5	2.5	15.1	7.2	39.0	120.5	15.5	4.8
21-25	3.6	2.8	2.2	4.3	17.9	13.1	4.6	13.2	13.8	146.8	7.3	1.9
26-END	3.1	2.9	2.0	2.5	5.2	8.8	2.4	35.9	5.6	109.5	4.0	2.2

YEAR : 1963

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.5	1.5	0.2	0.8	0.6	0.6	0.5	0.7	1.1	17.7	48.5	25.6
6-10	3.7	2.0	0.7	0.7	2.3	0.5	0.8	1.9	10.4	25.6	81.8	17.6
11-15	2.2	1.5	0.6	0.8	4.6	0.8	0.9	0.7	3.2	42.5	56.4	2.8
16-20	2.2	1.4	0.6	0.9	4.1	0.4	0.9	0.8	0.8	88.6	32.1	1.9
21-25	2.2	1.5	2.2	1.0	6.2	0.7	2.2	0.9	8.1	70.7	17.4	1.2
26-END	2.3	1.3	1.6	1.1	4.8	0.4	5.8	0.6	36.5	42.7	57.0	0.9

YEAR : 1964

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	0.9	0.3	0.3	0.9	1.6	2.0	1.4	3.4	30.6	14.9	74.4	28.6
6-10	0.9	0.3	0.4	0.7	1.6	2.9	1.5	5.0	54.1	6.2	45.0	10.7
11-15	0.7	0.3	0.5	0.9	7.1	7.9	1.5	3.6	33.4	12.1	90.3	8.1
16-20	0.6	0.3	1.3	1.5	11.2	3.6	2.9	3.1	18.2	11.9	63.3	8.1
21-25	0.5	0.3	1.0	1.5	17.5	3.2	8.2	2.6	8.1	41.1	51.6	4.0
26-END	0.3	0.3	0.9	1.5	5.6	4.8	16.7	3.8	16.3	61.8	24.1	2.2

YEAR : 1965

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	1.5	1.0	3.0	3.6	7.7	2.9	4.0	4.7	24.8	26.9	182.4	87.6
6-10	2.0	0.9	2.7	7.6	8.3	2.7	3.9	5.7	20.1	39.1	132.8	57.5
11-15	0.9	0.9	3.4	3.3	8.4	3.1	3.9	9.1	42.9	78.1	59.0	131.9
16-20	1.1	0.9	3.5	2.8	8.8	1.9	4.5	14.9	63.7	66.3	52.8	111.4
21-25	1.1	0.9	3.0	5.5	6.4	2.3	4.9	18.3	33.0	80.7	34.0	108.5
26-END	0.9	0.9	3.3	12.4	3.7	2.6	4.6	61.4	37.9	116.6	23.8	65.4

YEAR : 1966

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	23.3	5.1	4.6	3.7	4.8	18.3	9.5	4.9	4.6	40.9	20.1	75.2
6-10	17.4	4.9	4.6	3.9	6.3	55.6	4.3	4.6	4.6	26.4	34.3	124.5
11-15	10.5	5.6	3.8	3.4	10.0	11.3	3.1	4.4	7.4	59.8	37.0	41.6
16-20	6.6	4.3	3.8	3.8	38.0	4.0	4.8	5.3	23.1	163.1	75.9	36.0
21-25	12.3	9.8	9.3	5.8	9.1	6.2	4.8	4.4	13.2	109.0	114.4	18.1
26-END	12.5	4.7	5.2	8.8	4.0	15.1	4.6	4.8	70.9	39.8	85.2	14.8

YEAR : 1967

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	25.5	5.5	4.6	4.6	9.7	4.6	39.8	18.7	9.6	88.6	76.8	77.4
6-10	157.3	4.7	4.8	4.8	33.3	4.9	27.7	20.5	11.6	164.8	46.1	36.8
11-15	58.0	5.1	4.3	4.9	25.5	4.9	11.7	11.4	19.3	63.7	92.5	28.2
16-20	16.7	4.8	4.2	4.6	32.3	22.1	20.5	10.8	33.0	52.4	25.8	25.8
21-25	9.4	4.4	4.6	5.8	36.6	35.6	13.0	15.5	33.9	93.0	30.0	25.3
26-END	8.8	4.7	4.0	15.5	6.9	59.8	25.2	21.7	44.8	104.4	74.4	25.6

YEAR : 1968

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	12.4*	5.8*	2.8*	20.4*	13.0*	9.6*	4.9*	9.1*	43.7*	29.9*	38.5*	59.9*
6-10	10.5*	5.1*	2.3*	8.3*	11.3*	8.6*	4.6*	10.3*	20.1*	67.0*	30.5*	26.5*
11-15	9.1*	4.5*	2.0*	5.7*	10.6*	7.3*	4.6*	10.7*	16.0*	86.8*	27.7*	19.5*
16-20	8.1*	4.1*	1.7*	84.4*	10.6*	6.3*	15.2*	13.2*	24.8*	52.6*	26.0*	50.6*
21-25	7.3*	3.6*	1.6*	45.6*	13.2*	5.3*	14.2*	12.6*	17.4*	32.0*	24.0*	31.7*
26-END	6.5*	3.2*	41.5*	21.1*	10.7*	5.0*	10.0*	12.8*	41.1*	57.8*	68.4*	18.2*

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 45 5-DAY NATURAL RUNOFF AT LENGKUAS (6204421) (2/3)

Basin: Kedah Catchment Area: 1,270 km^2

YEAR : 1969 UNIT : CMS

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	16.2*	9.2*	4.8*	3.0*	1.7*	3.9*	23.1*	8.7*	65.5*	22.2*	89.5*	67.3*
6-10	31.6*	8.0*	4.3*	3.1*	1.9*	3.7*	13.4*	7.3*	28.8*	33.3*	47.8*	41.1*
11-15	17.9*	7.1*	3.9*	2.8*	2.8*	26.6*	11.8*	6.1*	23.0*	68.1*	43.7*	34.8*
16-20	14.6*	6.5*	3.6*	2.4*	3.5*	15.3*	11.4*	117.4*	21.6*	58.4*	131.6*	31.4*
21-25	12.8*	5.8*	3.2*	2.1*	3.8*	9.5*	11.0*	128.5*	20.3*	46.3*	56.3*	28.2*
26-END	10.9*	5.3*	2.9*	1.8*	4.0*	11.0*	10.1*	63.3*	25.6*	43.9*	73.6*	24.7*

YEAR : 1970

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	21.1*	9.8*	5.2*	2.5*	1.8*	11.2*	19.7*	24.4*	16.0*	33.3*	37.4*	42.1*
6-10	18.2*	9.0*	4.5*	2.2*	2.0*	10.1*	16.4*	23.2*	17.6*	38.6*	52.1*	34.9*
11-15	15.7*	8.1*	4.1*	2.0*	34.8*	10.1*	10.5*	20.9*	17.1*	55.4*	45.1*	32.8*
16-20	13.6*	7.3*	3.8*	1.8*	19.3*	9.7*	9.1*	18.9*	32.2*	64.5*	40.2*	29.3*
21-25	12.0*	6.4*	3.6*	1.6*	10.0*	9.0*	8.2*	30.4*	57.8*	37.0*	33.1*	27.1*
26-END	10.7*	5.8*	2.9*	1.6*	11.3*	8.3*	15.0*	18.1*	40.9*	36.5*	46.6*	53.5*

YEAR : 1971

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	31.0*	12.6*	120.5*	13.6*	4.8*	6.1*	24.7*	11.4*	18.9*	27.2*	116.6*	62.6*
6-10	25.0*	11.0*	54.1*	11.6*	4.3*	5.7*	15.2*	20.6*	17.2*	47.7*	53.3*	40.7*
11-15	22.3*	9.9*	22.9*	9.6*	4.2*	6.9*	13.3*	17.6*	20.3*	63.3*	59.4*	35.5*
16-20	20.0*	9.0*	17.3*	7.8*	4.8*	40.2*	15.5*	48.7*	125.3*	185.7*	53.3*	34.6*
21-25	17.5*	12.6*	17.6*	6.4*	5.2*	28.4*	18.4*	71.9*	115.2*	68.3*	57.5*	32.8*
26-END	14.8*	55.1*	15.5*	5.4*	6.3*	36.1*	13.2*	27.5*	44.1*	80.0*	53.5*	29.3*

YEAR : 1972

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	26.4*	12.1*	8.2*	4.6*	38.8*	11.6*	4.9*	2.9*	20.1*	58.4*	105.1*	41.9*
6-10	23.7*	11.1*	7.3*	4.2*	19.8*	10.0*	4.5*	5.7*	209.1*	37.6*	53.4*	39.2*
11-15	20.9*	10.1*	6.3*	76.2*	16.7*	8.4*	4.2*	5.0*	195.3*	34.3*	67.5*	37.5*
16-20	18.1*	9.2*	14.9*	29.4*	16.1*	7.2*	3.9*	4.2*	120.7*	32.5*	84.6*	130.7*
21-25	15.7*	9.0*	7.5*	58.2*	15.2*	6.1*	3.6*	3.9*	129.2*	46.7*	102.8*	53.2*
26-END	13.6*	8.7*	5.5*	150.8*	13.6*	5.4*	3.2*	3.3*	124.5*	80.8*	51.8*	36.1*

YEAR : 1973

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	31.0*	14.4*	8.4*	4.4*	30.7*	126.4*	21.0*	24.7*	17.3*	89.7*	39.0*	32.9*
6-10	27.8*	12.9*	7.6*	6.2*	26.0*	48.7*	18.7*	16.4*	43.5*	106.4*	59.2*	102.4*
11-15	24.6*	11.8*	6.8*	5.6*	21.6*	31.4*	16.5*	12.4*	23.6*	38.1*	164.0*	82.6*
16-20	21.5*	10.8*	6.1*	8.8*	68.8*	27.5*	14.4*	11.4*	19.4*	39.6*	63.5*	39.7*
21-25	19.0*	9.9*	5.4*	39.8*	38.2*	25.5*	12.4*	74.6*	18.1*	68.8*	38.8*	31.1*
26-END	16.5*	9.2*	4.8*	63.2*	40.9*	23.3*	10.7*	30.6*	18.5*	60.5*	35.5*	27.7*

YEAR : 1974

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	24.9*	16.8*	8.0*	4.4*	63.9*	21.7*	14.3*	30.6*	13.3*	158.0*	39.7*	26.4*
6-10	22.2*	13.3*	7.3*	6.1*	105.0*	19.1*	12.7*	25.9*	13.0*	54.7*	34.9*	24.2*
11-15	19.3*	11.6*	6.8*	3.8*	29.0*	17.9*	11.3*	14.3*	12.8*	35.7*	30.7*	21.8*
16-20	16.6*	10.1*	6.1*	3.5*	15.4*	16.5*	10.4*	12.6*	58.0*	32.2*	33.5*	19.5*
21-25	14.3*	9.1*	5.5*	3.2*	69.6*	15.3*	9.5*	14.3*	165.5*	52.3*	32.6*	17.2*
26-END	29.8*	8.6*	4.9*	2.9*	38.5*	16.3*	10.4*	14.4*	228.5*	39.3*	28.6*	14.9*

YEAR : 1975

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	13.0*	8.9*	7.2*	3.8*	3.7*	3.8*	6.7*	10.6*	12.5*	14.7*	54.3*	23.3*
6-10	31.8*	8.0*	6.3*	3.5*	3.8*	3.8*	6.0*	10.1*	66.5*	14.1*	29.3*	22.3*
11-15	21.0*	7.3*	5.5*	3.3*	3.7*	3.7*	5.5*	10.5*	21.0*	24.6*	24.8*	24.2*
16-20	13.5*	6.9*	4.8*	3.1*	3.4*	4.7*	5.1*	10.6*	14.7*	41.5*	23.6*	55.2*
21-25	11.6*	6.4*	4.3*	3.0*	3.0*	6.8*	10.2*	10.1*	16.6*	40.6*	26.7*	155.0*
26-END	10.2*	6.1*	4.1*	3.6*	2.8*	9.5*	17.0*	9.2*	15.1*	93.3*	26.9*	43.8*

YEAR : 1976

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	25.8*	10.1*	5.1*	2.5*	181.7*	17.6*	15.1*	29.8*	13.0*	116.3*	44.6*	45.0*
6-10	22.1*	8.8*	4.5*	2.2*	79.5*	16.4*	58.5*	18.3*	11.7*	59.0*	65.7*	35.6*
11-15	19.8*	8.0*	4.1*	2.0*	26.4*	14.8*	40.7*	15.5*	10.7*	144.7*	43.4*	32.0*
16-20	17.3*	7.2*	3.7*	1.9*	18.5*	13.1*	17.4*	13.7*	192.6*	70.5*	38.0*	29.0*
21-25	14.8*	6.4*	3.3*	11.3*	31.0*	11.2*	13.8*	15.9*	86.0*	40.0*	58.5*	26.1*
26-END	12.2*	5.8*	2.9*	30.1*	20.3*	29.2*	76.1*	14.3*	34.3*	43.0*	87.0*	22.9*

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 46 5-DAY NATURAL RUNOFF AT LENGKUAS (6204421) (3/3)

Basin: Kedah Catchment Area: 1,270 km^2

YEAR : 1977 UNIT : CMS

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	19.9*	9.5*	4.9*	2.2*	1.7*	4.1*	1.6*	1.3*	12.5*	19.8*	35.8*	18.2*
6-10	17.4*	8.7*	4.6*	2.0*	1.7*	3.3*	1.5*	1.5*	18.0*	75.9*	29.3*	15.6*
11-15	15.0*	7.8*	4.0*	1.9*	30.7*	2.7*	1.5*	1.7*	10.7*	99.2*	27.3*	13.1*
16-20	13.1*	6.9*	3.5*	1.9*	27.5*	2.3*	1.4*	22.5*	17.9*	35.7*	25.6*	11.0*
21-25	11.6*	6.1*	3.1*	1.8*	8.3*	2.0*	1.4*	20.7*	17.2*	60.4*	23.5*	9.3*
26-END	10.5*	5.5*	2.6*	1.8*	5.0*	1.8*	1.4*	7.2*	33.8*	41.7*	20.9*	7.9*

YEAR : 1978

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	7.1*	3.6*	1.3*	1.0*	0.9*	4.2*	40.5*	18.6*	18.2*	17.4*	21.0*	13.8*
6-10	6.4*	3.1*	1.2*	1.0*	1.0*	3.7*	21.3*	12.8*	126.0*	16.2*	19.0*	44.4*
11-15	5.7*	2.6*	1.1*	0.9*	6.1*	70.1*	10.1*	11.3*	84.7*	19.5*	18.1*	19.2*
16-20	5.1*	2.2*	1.1*	0.9*	5.2*	16.2*	8.3*	10.8*	27.2*	47.4*	17.8*	13.3*
21-25	4.5*	1.8*	1.0*	0.9*	5.0*	6.6*	8.3*	10.0*	23.4*	94.2*	16.8*	11.2*
26-END	4.1*	1.5*	1.0*	0.9*	4.5*	4.6*	29.8*	9.7*	19.1*	33.4*	15.5*	9.4*

YEAR : 1979

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	7.7*	3.4*	1.1*	0.7*	36.5*	10.3*	7.8*	9.8*	36.2*	21.0*	19.5*	34.7*
6-10	6.5*	2.9*	0.9*	0.6*	13.8*	10.0*	7.1*	9.1*	56.6*	19.8*	33.5*	26.9*
11-15	5.6*	2.4*	0.9*	0.7*	17.0*	9.7*	17.9*	9.4*	74.3*	18.6*	35.2*	24.3*
16-20	5.0*	2.0*	0.8*	0.9*	14.5*	11.0*	12.1*	8.8*	33.4*	17.2*	49.4*	22.1*
21-25	4.4*	1.6*	0.8*	1.7*	12.3*	9.8*	8.2*	9.2*	23.2*	15.6*	55.8*	19.6*
26-END	4.0*	1.3*	0.7*	49.7*	11.5*	8.8*	16.3*	22.7*	21.7*	28.4*	76.0*	16.6*

YEAR : 1980

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	13.7*	5.5*	2.3*	0.9*	2.5*	2.4*	2.3*	4.3*	13.5*	76.1*	92.4*	40.4*
6-10	11.3*	4.8*	2.0*	0.9*	2.3*	2.1*	3.4*	7.9*	30.0*	122.3*	76.8*	80.3*
11-15	9.4*	4.2*	1.7*	0.8*	2.5*	1.8*	3.1*	9.0*	18.8*	82.5*	76.9*	56.4*
16-20	8.0*	3.7*	1.4*	1.0*	2.6*	1.5*	2.9*	6.1*	14.5*	118.2*	44.8*	37.5*
21-25	7.1*	3.2*	1.2*	2.7*	2.4*	1.2*	4.2*	22.7*	20.1*	51.0*	60.1*	32.4*
26-END	6.3*	2.8*	1.0*	2.5*	2.2*	1.0*	4.4*	17.5*	80.9*	38.5*	42.8*	28.9*

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 47 5-DAY NATURAL RUNOFF AT JENIANG (5806414) (1/3)

Basin: Muda Catchment Area: 1,740 km^2

UNIT : CMS

YEAR : 1961

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	32.3	16.1	15.9	13.9	52.1	30.7	25.8	22.6	11.5	31.2	96.1	35.6
6-10	32.9	16.3	19.8	13.6	49.5	16.5	21.0	22.2	17.5	36.6	96.2	27.0
11-15	35.9	16.6	16.0	23.0	50.7	22.1	21.0	21.1	17.7	39.5	52.8	22.9
16-20	25.1	33.0	15.0	22.9	32.0	45.2	19.8	21.9	26.9	52.3	48.5	29.0
21-25	19.1	17.4	14.7	36.5	21.6	48.0	20.3	16.6	30.4	113.3	55.0	25.8
26-END	16.6	15.4	16.7	44.5	16.8	43.1	32.2	12.1	25.9	110.1	53.9	70.8

YEAR : 1962

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	63.4	15.1	11.4	14.4	55.2	29.7	36.8	31.7	40.7	30.9	78.2	32.5
6-10	33.6	14.6	20.5	23.1	30.7	26.1	56.8	28.9	102.2	52.4	58.1	30.7
11-15	25.0	13.8	24.5	16.9	48.2	23.4	40.6	37.0	51.9	115.2	47.1	28.5
16-20	24.6	12.1	20.6	22.5	72.5	23.2	44.0	50.2	40.4	164.3	41.3	47.7
21-25	20.9	11.3	13.1	21.8	49.8	35.3	32.7	41.9	27.4	146.5	34.4	36.2
26-END	16.8	12.2	16.5	20.9	34.3	36.3	26.9	48.4	24.0	115.5	30.9	26.4

YEAR : 1963

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	35.3	18.1	7.4	9.2	18.1	35.6	32.3	48.6	47.4	61.9	124.8	99.6
6-10	37.6	15.9	7.5	9.2	42.0	32.1	27.8	45.8	60.4	70.7	190.5	96.6
11-15	29.1	13.9	8.1	9.2	41.8	31.7	29.9	36.4	56.4	128.6	145.2	66.1
16-20	25.4	12.5	7.6	9.2	53.7	29.5	32.9	30.7	79.2	206.4	126.6	51.9
21-25	21.9	11.9	13.4	9.2	74.8	29.4	34.9	32.4	83.0	179.1	102.1	45.4
26-END	20.8	10.6	9.2	10.4	46.2	35.5	51.5	37.0	89.2	142.7	126.7	38.4

YEAR : 1964

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	30.0	12.6	10.8	10.6	28.0	34.9	22.0	47.9	55.4	37.6	114.1	57.4
6-10	27.0	10.6	10.6	10.5	37.0	32.2	31.9	38.2	96.7	29.6	132.3	42.5
11-15	22.3	12.2	10.6	10.6	37.0	55.6	33.5	22.7	77.3	43.5	177.9	39.4
16-20	21.5	12.1	9.3	14.8	39.4	34.4	41.5	22.0	46.8	38.9	113.4	38.4
21-25	20.2	11.1	9.2	11.3	73.3	27.1	65.1	21.0	35.1	91.6	88.2	28.8
26-END	15.7	10.6	9.6	15.9	34.5	24.7	88.1	20.0	42.4	99.5	61.7	25.8

YEAR : 1965

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	22.5	12.6	10.2	29.8	57.3	29.1	12.2	13.3	45.0	50.6	185.3	189.3
6-10	19.8	11.3	10.4	36.6	45.9	25.9	14.5	19.3	41.6	41.0	139.1	106.1
11-15	19.5	10.4	10.0	29.0	42.8	19.1	27.5	26.0	62.4	71.1	94.9	149.8
16-20	18.1	10.7	8.8	21.6	44.3	14.3	18.8	34.3	46.4	133.9	109.8	98.9
21-25	15.9	10.5	8.8	22.0	53.8	12.8	16.8	50.4	38.8	132.7	90.0	149.5
26-END	14.2	10.1	10.8	19.7	45.9	12.4	15.1	92.0	70.2	196.6	73.6	95.0

YEAR : 1966

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	63.4	30.6	23.1	19.4	24.6	64.5	46.1	28.4	20.5	62.6	84.2	124.1
6-10	53.6	27.4	26.8	19.3	36.4	114.9	37.8	21.9	20.3	51.6	99.3	129.5
11-15	45.4	24.7	20.1	19.1	60.5	56.6	35.2	25.0	22.2	127.1	108.4	95.8
16-20	36.7	23.8	21.0	20.6	112.7	34.6	25.4	25.2	35.0	217.8	182.6	94.1
21-25	41.9	61.1	29.2	33.4	42.0	29.9	24.4	23.6	61.1	134.8	151.8	83.5
26-END	40.1	27.2	20.0	45.5	35.4	26.4	23.6	23.4	133.6	89.3	122.2	69.2

YEAR : 1967

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	133.9	49.3	26.1	15.1	29.6	18.4	74.7	25.3	27.6	99.5	67.6	80.7
6-10	316.4	41.2	23.5	16.9	58.5	17.1	44.2	19.6	25.5	139.3	46.8	45.5
11-15	130.9	35.0	23.2	17.2	58.4	26.0	34.1	22.4	32.9	46.1	40.7	32.4
16-20	95.5	33.7	18.9	17.2	69.9	46.6	44.9	33.3	42.6	32.4	69.0	28.6
21-25	76.0	29.8	16.7	20.0	54.1	52.4	35.9	25.7	35.5	85.6	42.1	25.1
26-END	60.4	24.1	15.8	31.0	25.0	105.5	24.8	67.5	36.9	90.7	99.3	22.5

YEAR : 1968

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	17.4*	10.4*	6.9*	4.7*	5.9*	3.9*	10.2*	39.4*	46.8*	54.1*	92.8*	40.3*
6-10	15.1*	9.7*	6.4*	4.5*	5.9*	3.8*	12.6*	41.2*	42.1*	105.9*	71.3*	34.7*
11-15	13.5*	9.1*	6.0*	4.4*	5.8*	4.0*	27.5*	97.4*	37.6*	108.3*	63.7*	29.7*
16-20	12.6*	8.5*	5.7*	4.2*	5.4*	4.2*	40.5*	80.2*	38.4*	67.1*	58.3*	25.8*
21-25	11.9*	7.9*	5.4*	4.1*	4.9*	4.6*	42.1*	53.5*	34.0*	82.5*	52.4*	22.7*
26-END	11.1*	7.4*	5.0*	5.8*	4.3*	9.1*	30.5*	45.4*	31.2*	145.4*	46.4*	21.6*

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 48 5-DAY NATURAL RUNOFF AT JENIANG (5806414) (2/3)

Basin: Muda Catchment Area: 1,740 km^2

UNIT : CMS

YEAR : 1969

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	21.7*	24.5*	12.7*	121.6*	18.8*	38.6*	36.2*	23.6*	71.5*	80.1*	157.7*	180.3*
6-10	42.0*	21.2*	12.2*	54.4*	15.5*	36.3*	33.1*	20.4*	58.5*	80.1*	103.3*	95.8*
11-15	29.6*	17.9*	12.8*	34.0*	51.4*	34.3*	31.7*	31.2*	53.7*	183.6*	97.9*	77.2*
16-20	32.0*	15.4*	13.7*	30.0*	36.2*	31.2*	37.3*	96.9*	47.7*	139.7*	125.9*	68.8*
21-25	30.1*	13.7*	14.0*	26.6*	30.0*	30.8*	34.9*	131.3*	40.8*	128.1*	96.0*	61.1*
26-END	27.4*	12.9*	29.8*	22.6*	62.2*	30.3*	27.6*	174.2*	131.6*	246.5*	153.3*	52.7*

YEAR : 1970

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	44.5*	23.4*	16.7*	22.8*	71.8*	106.9*	114.4*	31.1*	36.7*	94.1*	77.2*	79.7*
6-10	38.1*	22.2*	15.6*	24.5*	57.0*	65.2*	84.7*	31.2*	39.5*	129.5*	128.2*	72.7*
11-15	32.9*	21.0*	14.5*	20.7*	32.3*	57.3*	45.8*	28.9*	170.1*	91.5*	156.2*	64.4*
16-20	29.2*	19.8*	13.5*	19.6*	33.2*	51.8*	38.4*	27.6*	79.9*	105.9*	130.4*	55.8*
21-25	26.7*	18.6*	12.5*	18.5*	74.6*	46.7*	34.7*	42.9*	117.6*	81.3*	100.0*	47.6*
26-END	24.8*	17.7*	19.9*	21.3*	114.9*	39.7*	32.0*	41.3*	76.1*	98.1*	85.8*	87.3*

YEAR : 1971

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	50.6*	23.9*	33.1*	15.7*	9.5*	9.3*	44.4*	25.9*	41.5*	51.9*	75.0*	54.6*
6-10	41.2*	22.3*	28.4*	13.7*	11.8*	8.3*	32.1*	23.2*	42.6*	56.1*	75.4*	49.9*
11-15	37.7*	21.1*	26.2*	12.3*	12.5*	10.2*	28.7*	42.6*	40.5*	103.7*	80.6*	44.9*
16-20	34.1*	19.9*	24.5*	11.4*	11.4*	50.2*	26.0*	29.1*	275.6*	87.5*	73.6*	80.3*
21-25	30.2*	18.8*	21.9*	10.6*	11.2*	33.7*	23.5*	60.1*	182.3*	79.1*	65.9*	81.3*
26-END	26.6*	24.8*	18.6*	10.0*	10.3*	103.7*	20.4*	41.2*	71.2*	115.0*	59.6*	48.0*

YEAR : 1972

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	41.5*	19.7*	14.1*	10.3*	13.3*	9.3*	25.4*	9.5*	18.0*	49.8*	222.5*	112.1*
6-10	38.1*	18.5*	13.2*	12.8*	12.3*	9.3*	24.6*	12.7*	45.0*	78.3*	363.3*	96.6*
11-15	33.9*	17.5*	12.4*	14.3*	10.6*	14.6*	22.4*	14.0*	62.3*	63.6*	219.5*	86.3*
16-20	29.3*	16.6*	11.5*	13.1*	8.9*	24.8*	18.8*	14.6*	41.8*	89.5*	172.7*	79.7*
21-25	25.3*	15.7*	10.7*	13.2*	8.5*	38.3*	15.2*	14.4*	53.2*	109.8*	168.8*	68.3*
26-END	21.8*	14.9*	9.9*	13.7*	10.0*	25.7*	11.9*	13.9*	66.0*	98.7*	122.9*	57.7*

YEAR : 1973

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	48.1*	24.0*	17.3*	11.3*	34.0*	48.8*	24.6*	215.0*	42.9*	139.0*	81.3*	54.2*
6-10	40.6*	22.8*	16.1*	11.7*	30.3*	35.7*	21.4*	119.5*	40.1*	77.8*	75.8*	134.8*
11-15	34.7*	21.6*	15.1*	11.4*	28.6*	31.4*	19.5*	56.2*	36.6*	42.6*	94.8*	87.5*
16-20	30.3*	20.4*	14.0*	11.4*	25.8*	30.6*	17.7*	47.2*	34.1*	73.6*	69.2*	58.7*
21-25	27.6*	19.2*	13.0*	76.4*	22.8*	28.5*	15.9*	72.6*	30.8*	101.7*	61.7*	53.6*
26-END	25.6*	18.3*	12.0*	63.8*	27.5*	25.1*	48.7*	52.4*	28.4*	83.1*	56.1*	50.5*

YEAR : 1974

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	45.7*	19.5*	14.4*	9.5*	19.5*	25.6*	11.0*	25.6*	22.7*	100.4*	58.3*	54.2*
6-10	40.0*	18.4*	13.4*	14.2*	19.1*	22.6*	10.6*	20.5*	31.4*	69.9*	61.1*	50.0*
11-15	33.9*	17.4*	12.6*	13.9*	16.2*	18.6*	9.8*	31.8*	44.5*	59.7*	58.7*	44.4*
16-20	28.5*	16.5*	11.7*	13.7*	62.3*	14.5*	9.2*	34.4*	48.0*	54.5*	62.9*	38.1*
21-25	24.3*	16.0*	10.9*	12.7*	32.2*	12.5*	8.5*	27.6*	95.2*	50.2*	61.1*	32.2*
26-END	21.4*	15.4*	10.1*	10.7*	27.0*	11.4*	19.4*	24.8*	96.1*	56.3*	58.0*	26.9*

YEAR : 1975

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	22.7*	25.4*	27.1*	15.3*	24.2*	19.6*	10.3*	41.3*	76.8*	66.6*	84.6*	60.4*
6-10	21.2*	22.3*	32.6*	45.3*	30.0*	17.5*	42.1*	35.6*	67.8*	58.4*	75.0*	101.6*
11-15	22.4*	19.4*	27.3*	30.5*	27.3*	16.1*	22.4*	33.0*	40.5*	111.4*	64.2*	101.7*
16-20	86.1*	17.0*	24.1*	19.9*	25.5*	14.7*	18.7*	31.5*	145.1*	113.7*	76.4*	94.4*
21-25	43.4*	28.1*	21.9*	22.3*	23.4*	13.2*	48.9*	27.6*	128.3*	87.0*	70.9*	169.6*
26-END	29.1*	50.6*	18.7*	24.5*	20.8*	11.6*	72.3*	24.4*	111.4*	65.1*	65.1*	83.9*

YEAR : 1976

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	65.4	34.2	17.9	8.1	92.5	51.3	30.8	48.7	31.8	148.5	187.2*	112.2
6-10	59.7	34.6	11.2	8.1	81.9	76.0	102.1	29.1	20.8	165.8	288.0*	73.7
11-15	40.1	29.5	16.3	10.8	92.5	50.3	50.3	22.8	20.8	341.2	115.3	54.6
16-20	36.1	22.0	16.1	9.8	45.4	28.5	26.9	26.5	155.4	178.8	95.3	47.3
21-25	38.3	14.5	14.7	24.2	97.0	23.2	38.9	61.7	175.8	151.3	98.2	45.6
26-END	36.3	15.5	23.0	89.6	43.6	26.9	79.4	41.8	101.9	147.5*	193.5	52.1

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 49 5-DAY NATURAL RUNOFF AT JENIANG (5806414) (3/3)

Basin: Muda Catchment Area: 1,740 km^2

YEAR : 1977 UNIT : CMS

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	36.5	14.1	9.0	3.7	5.1	10.6	7.5	7.7	51.3	130.0	120.6	30.4
6-10	46.0	12.0	6.3	3.5	10.2	20.2	5.7*	11.2	68.9	196.4	163.0*	29.7
11-15	25.5	12.4	5.7	3.5	15.5	24.0	13.4	9.6	28.1	259.1	101.9*	20.6
16-20	20.6	8.8	4.9	4.1	7.7	30.1	7.3	55.2	44.8	166.8	66.8	17.7
21-25	13.9	6.5	4.3*	3.7	4.7	12.6	5.7	71.5	61.8	167.2	64.8	14.5
26-END	14.9	7.5	3.9	9.0	9.4	7.3	7.7	27.3	68.0	161.5	45.0	12.6

YEAR : 1978

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	10.8*	4.5	2.9	7.5	14.5	15.3	67.8	38.7	65.8	23.8	106.1	31.8
6-10	8.6*	3.9	6.3	11.4	21.0	18.9	44.6	23.6	167.0	46.2	76.6	49.7
11-15	6.5	3.7	4.9	14.5	67.0	33.0	33.6	43.6	71.3	89.0	69.9	20.4
16-20	14.9	3.5	8.4	31.4	45.8	14.1	41.6	43.8	40.7	99.6	112.8	15.3
21-25	8.1	3.5*	6.1	26.9	36.9	13.9	47.5	19.1	42.4	126.1	64.8	12.8
26-END	5.7	3.1*	7.1	13.0	19.4	23.0	35.8	29.3	30.8	105.7	36.1	10.0

YEAR : 1979

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	7.3	3.7	3.1	3.5	57.0	10.6	7.7	24.0	87.0	33.8	67.8	61.9
6-10	6.1	3.5*	2.9	17.1	42.8	39.9	6.5	35.9	88.8	35.9	89.6	35.9
11-15	5.1	3.3	2.9	10.2	20.2	98.8	12.0	28.9	152.4	37.9	156.2	26.1
16-20	4.5	3.1	2.9	7.1	6.7	48.3	22.8	18.1	151.3	41.6	119.8	16.5
21-25	4.1	2.9	2.9	18.1	16.5	21.2	35.4	14.1	73.7	45.0	107.8	11.0
26-END	4.3	3.7	2.9	89.0	12.0	11.0	69.7	51.5	57.6	85.4	159.5	8.6

YEAR : 1980

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	9.6	5.3	15.3	5.1	14.3	50.1*	13.0	77.6	171.7	124.7	129.3	108.6
6-10	7.5	4.9	14.9	7.9	18.7	46.4*	12.2	57.9	86.8	414.7	144.4	148.5
11-15	6.9	4.5	6.1	13.0	14.7*	50.5	7.3	88.2	85.6	314.3	155.4	93.1
16-20	7.3	4.1	9.0	14.9	15.7*	25.5	9.2	68.9	44.2	241.4	143.0	65.6
21-25	7.1	6.1	8.1	10.4	16.1*	17.7	46.6	50.1	107.8	171.7	149.9	51.5
26-END	6.1	5.9	5.1	16.7	78.8*	28.7	44.4	82.7	133.8	142.2	105.7	40.7

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 50 5-DAY NATURAL RUNOFF AT ARA KUDA (5405421) (1/3)

Basin: Perai Catchment Area: 129 km^2

YEAR : 1961 UNIT : CMS

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	6.1	3.2	3.3	4.2	7.0	2.7	2.1	2.6	2.6	4.1	7.1	19.6
6-10	7.0	2.6	5.0	4.8	9.3	2.3	1.9	3.9	2.6	2.7	13.0	6.6
11-15	6.4	2.9	5.4	7.1	9.1	3.2	3.5	3.0	2.8	10.5	17.7	5.9
16-20	3.8	6.9	4.7	5.7	5.1	3.7	3.1	2.5	2.2	9.3	18.9	15.0
21-25	3.4	5.1	4.2	7.6	3.5	3.4	2.6	1.9	3.6	8.7	13.3	14.0
26-END	3.3	3.7	7.8	8.2	3.1	2.2	6.6	1.7	2.5	7.0	12.5	10.6

YEAR : 1962

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	23.8	6.6	4.6	5.9	7.3	4.8	6.2	5.1	5.1	5.2	10.7	8.9
6-10	14.5	5.8	5.4	9.4	8.7	5.6	6.9	4.2	5.1	12.3	20.0	9.2
11-15	10.5	5.3	5.2	6.2	11.9	4.6	4.7	4.3	4.1	26.1	9.0	6.0
16-20	15.7	4.8	5.2	12.3	12.8	4.5	4.3	4.8	3.7	15.6	8.8	6.0
21-25	9.9	5.0	5.4	6.7	7.8	6.5	4.3	4.8	3.8	41.6	7.7	5.9
26-END	7.8	4.6	4.9	7.8	5.7	7.4	6.7	5.0	3.7	21.4	5.9	4.6

YEAR : 1963

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	9.4	3.3	2.8	3.5	2.4	4.1	2.4	2.7	2.7	2.4	11.0	20.9
6-10	7.7	3.1	7.3	3.4	3.5	3.6	2.3	2.6	2.7	14.6	13.1	12.6
11-15	4.7	3.1	3.8	3.1	5.3	2.9	2.3	2.6	2.6	7.7	35.8	12.9
16-20	4.4	2.9	3.6	3.0	4.4	2.7	2.3	2.5	3.4	8.3	32.7	8.9
21-25	3.5	2.8	3.7	3.1	8.8	2.5	2.6	2.7	3.0	8.2	16.4	7.1
26-END	3.3	2.9	3.9	2.7	4.2	2.4	2.9	2.7	2.4	15.3	13.0	7.1

YEAR : 1964

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	4.4	2.9	2.8	2.1	4.8	3.7	2.3	7.2	15.4	10.6	7.9	4.9
6-10	3.8	2.7	2.6	2.7	4.2	3.5	2.5	4.6	34.8	8.6	16.0	4.3
11-15	4.5	2.7	2.4	3.5	11.5	3.2	3.3	3.9	20.9	9.3	13.8	4.6
16-20	7.3	2.9	2.3	3.6	5.8	2.8	4.3	3.6	10.0	15.6	9.6	4.3
21-25	4.2	2.7	2.0	3.5	11.0	2.6	5.5	3.8	12.8	22.0	6.8	4.3
26-END	4.0	2.7	1.8	6.8	4.0	2.3	13.2	4.4	25.2	12.7	4.8	4.2

YEAR : 1965

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.7	1.9	1.8	2.8	5.8	2.5	1.1*	1.5*	5.9*	7.6*	12.3*	7.5*
6-10	3.6	1.8	2.1	3.0	3.0	2.3	1.1*	1.4*	4.4*	4.3*	7.7*	7.8*
11-15	3.5	1.7	1.9	2.8	2.9	2.0	1.1*	4.0*	3.9*	12.8*	7.6*	8.8*
16-20	2.6	1.8	1.8	2.7	4.1	2.0	8.8*	3.2*	3.8*	12.1*	20.2*	20.1*
21-25	2.0	1.7	1.7	2.8	2.7	1.9	4.8*	6.8*	3.8*	16.0*	23.0*	29.6*
26-END	2.0	1.7	3.7	3.6	2.6	1.8	2.0*	6.2*	11.6*	16.6*	10.8*	13.0*

YEAR : 1966

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	7.5*	4.1*	4.9*	8.8*	5.4*	7.2*	4.9*	3.7*	3.3	6.5	6.2	6.5
6-10	6.4*	3.7*	4.5*	6.4*	6.0*	6.4*	4.1*	3.4*	3.3	5.7	6.2	8.1
11-15	5.7*	3.4*	4.4*	5.7*	5.8*	4.3*	5.8*	3.2*	3.9	10.7	6.7	12.9
16-20	5.1*	5.1*	4.9*	5.3*	5.6*	3.8*	5.0*	2.9*	4.6	12.5	9.0	7.8
21-25	5.0*	5.1*	5.5*	8.2*	4.7*	3.6*	4.1*	5.6*	5.9	9.9	9.1	7.4
26-END	5.1*	3.8*	4.5*	8.2*	4.2*	3.2*	3.3*	4.1*	5.9	7.5	6.6	10.6

YEAR : 1967

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	9.6	6.9	4.8	5.4	8.5	6.3	6.2	6.3	4.1	11.3	11.2	9.4
6-10	9.6	6.2	4.6	6.4	11.9	5.4	5.4	3.9	3.8	6.4	9.0	7.6
11-15	8.6	6.0	5.0	7.1	13.1	5.7	5.6	3.4	4.8	6.2	8.6	6.2
16-20	7.0	5.9	4.4	7.4	9.9	6.3	6.1	3.3	5.3	5.7	10.2	6.0
21-25	6.2	5.9	4.0	8.2	12.8	5.6	4.7	3.2	4.9	7.7	10.2	5.9
26-END	7.3	5.4	5.6	10.0	7.2	7.2	5.1	5.2	4.6	12.1	12.3	5.7

YEAR : 1968

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.7	2.9	1.9	3.5	6.5	3.6	3.9	4.8	4.2	3.6	10.0	5.6
6-10	4.7	2.8	1.8	5.4	6.2	3.4	4.1	5.9	3.6	3.6	9.5	5.8
11-15	4.6	2.7	1.9	6.9	7.0	3.2	4.4	5.0	2.8	5.6	9.5	7.0
16-20	3.8	2.4	2.2	6.6	8.5	3.9	4.8	4.4	4.5	4.6	7.9	5.5
21-25	4.5	2.3	3.3	9.0	5.9	4.0	4.6	4.6	4.3	4.5	5.7	4.6
26-END	3.5	2.0	3.5	8.8	4.5	3.6	4.4	4.3	3.9	10.8	5.2	5.7

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 51 5-DAY NATURAL RUNOFF AT ARA KUDA (5405421) (2/3)

Basin: Perai Catchment Area: 129 km^2

YEAR : 1969 UNIT : CMS

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	4.8	3.4	4.5	5.7*	2.2*	5.5	4.6	2.8	4.2	4.1	9.9	8.8
6-10	4.1	3.1	4.1	3.6*	6.8*	5.0	4.0	2.7	3.9	8.4	7.4	8.7
11-15	4.1	3.4	5.8	3.1*	7.6*	8.0	3.6	3.3	3.0	18.2	7.2	7.9
16-20	6.7	2.4	3.8	2.9*	4.5*	5.2	3.7	4.2	2.7	17.2	7.6	8.3
21-25	5.5	2.9	3.1	2.7*	6.2*	6.2	3.4	6.8	3.0	12.1	7.8	6.5
26-END	4.1	3.6	3.5	2.4*	11.7*	5.0	2.9	8.9	5.3	11.9	8.4	5.1

YEAR : 1970

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	7.8	3.9	2.7	1.9*	6.7*	5.0*	15.1	4.4	5.1	6.2	12.9	11.7
6-10	9.5	3.3	2.6	2.3*	5.1*	4.4*	6.7	4.1	6.2	18.1	26.0	13.7
11-15	8.1	3.7	2.7	6.4*	12.8*	3.9*	4.9	4.9	26.0	19.8	20.2	9.0
16-20	6.7	3.3	2.8	9.8*	7.3*	3.9*	6.7	4.7	6.9	25.3	24.5	10.0
21-25	5.2	3.2	2.0	11.9*	5.2*	3.7*	4.7	3.8	6.0	18.7	24.1	7.7
26-END	4.8	2.9	2.1	7.9*	5.1*	3.3*	4.7	3.7	4.5	22.8	12.9	12.1

YEAR : 1971

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	7.3	4.3	8.8	6.0	3.9	3.5	2.9	4.1	4.8	4.0	5.4	7.9
6-10	6.3	3.9	5.2	5.6	3.6	3.1	2.9	3.1	5.1	3.4	5.8	8.1
11-15	5.2	3.8	3.9	4.0	4.6	3.2	2.9	3.6	4.7	26.3	4.7	9.6
16-20	5.8	4.9	4.0	3.6	4.0	4.2	2.8	4.2	16.9	9.4	3.9	9.2
21-25	4.4	9.3	4.9	3.1	3.3	2.8	3.0	14.5	9.8	10.3	3.7	10.9
26-END	3.9	7.4	4.9	5.2	3.3	3.7	3.0	4.6	4.9	6.0	7.5*	7.5

YEAR : 1972

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	4.8	3.6	3.1	6.3*	6.2	4.8	2.9	3.0	2.9	3.4	15.4	11.9
6-10	8.5	4.5	2.8	4.6*	5.2	3.4	2.6	2.9	2.8	4.9	11.9	10.6
11-15	4.9	5.7	2.7	3.6*	4.2	3.5	2.6	2.8	9.6	6.0	16.2	7.7
16-20	4.1	3.8	2.7	6.3	3.7	3.9	3.0	2.3	4.1	12.8	14.9	8.4
21-25	3.7	3.8	3.0	12.3	3.8	3.6	2.9	2.4	7.1	18.0	11.3	15.1
26-END	3.3	4.1	3.1	11.2	3.9	3.1	2.7	2.4	4.6	21.3	11.0	6.5

YEAR : 1973

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.2	3.1	2.6	4.6	5.1	7.6	5.5	9.3	4.3	8.1	26.4	21.2
6-10	4.6	2.9	3.1	4.4	4.5	9.3	4.5	4.6	4.0	5.0	9.3	9.8
11-15	4.1	2.9	3.9	3.8	4.3	5.6	3.8	4.6	4.3	4.6	10.0	6.8
16-20	4.4	3.4	2.8	4.2	5.2	4.6	3.3	4.6	4.4	5.1	6.2	17.5
21-25	4.9	2.9	3.9	11.8	8.2	5.4	3.5	5.0	4.0	10.7	6.3	7.6
26-END	3.6	3.3	6.4	7.4	16.6	5.3	6.3	4.9	4.1	16.7	8.7	5.6

YEAR : 1974

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.0	3.9	3.3	4.8	6.3	3.1	3.1	4.3	2.8	7.3	5.2	4.3
6-10	4.5	3.5	3.4	9.0	5.4	3.1	2.8	3.2	3.0	4.1	4.1	3.7
11-15	4.0	5.0	2.8	5.9	7.9	2.9	2.9	2.9	2.8	3.6	4.8	3.4
16-20	3.6	7.6	2.9	5.9	6.7	3.0	2.8	2.8	7.1	3.5	5.7	4.0
21-25	3.7	5.0	2.6	4.9	4.4	3.1	3.6	2.8	6.2	3.4	6.0	3.2
26-END	4.4	4.0	3.8	4.9	3.8	3.2	3.4	2.6	5.5	7.2	6.7	3.2

YEAR : 1975

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.9	4.3	8.4	10.4	6.1	4.9	4.8	3.2	5.2	3.6	6.9	5.7
6-10	8.0	5.3	6.8	8.7	5.8	4.6	4.0	3.3	4.2	3.4	6.0	9.2
11-15	6.7	6.0	5.3	10.9	5.3	5.2	2.6	3.3	3.6	3.6	10.1	6.3
16-20	5.5	5.5	8.3	8.4	5.1	5.3	4.9	2.9	6.6	4.7	8.2	4.8
21-25	5.0	5.2	8.8	9.9	4.7	4.6	5.5	3.4	5.7	4.4	17.2	8.5
26-END	4.5	10.7	7.7	7.0	5.7	5.0	4.7	3.4	4.4	4.8	6.7	11.6

YEAR : 1976

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.9	3.2	3.0	3.0	8.2	3.2	2.3	2.4	4.0	11.9	9.1	5.6
6-10	5.0	3.1	2.7	2.8	5.1	3.9	2.5	2.0	2.6	20.2	8.2	4.5
11-15	4.1	2.7	4.4	3.0	3.7	3.2	2.2	1.9	2.9	15.4	7.6	5.4
16-20	3.6	2.8	2.9	2.8	3.6	3.0	1.9	2.2	20.6	7.5	8.7	5.5
21-25	3.2	2.6	4.7	3.8	4.3	2.6	2.2	3.8	11.7	6.8	7.8	7.8
26-END	3.1	2.6	3.9	6.8	3.2	3.0	3.0	4.6	6.8	9.5	9.8	6.4

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 52 5-DAY NATURAL RUNOFF AT ARA KUDA (5405421) (3/3)

Basin: Perai Catchment Area: 129 km^2

YEAR : 1977 UNIT : CMS

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	7.7	3.8	2.3	1.9	3.4	2.5	1.9	1.5	4.8	22.6	12.0	9.1
6-10	7.6	2.9	2.0	2.0	3.0	3.7	2.5	1.3	4.7	11.3	9.6	8.5
11-15	4.6	3.4	1.9	1.6	3.9	2.9	2.0	2.0	2.9	7.6	6.5	8.9
16-20	3.6	3.1	2.1	2.7	4.8	2.5	1.7	4.3	4.5	14.4	7.8	9.0
21-25	3.4	2.6	1.9	2.2	2.6	2.5	1.7	2.6	9.0	13.5	7.5	6.3
26-END	3.1	2.6	1.9	2.3	2.4	1.9	1.4	3.2	8.0	13.0	9.2	7.5

YEAR : 1978

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	4.6*	2.4*	1.9*	2.2*	5.8*	4.1*	2.4*	1.8*	5.2*	3.3*	5.8*	2.9*
6-10	4.3*	2.3*	1.9*	2.1*	7.1*	3.5*	2.1*	1.7*	5.4*	4.1*	4.8*	2.5*
11-15	3.8*	2.1*	1.9*	1.9*	12.4*	3.2*	2.0*	4.2*	3.9*	7.1*	4.4*	2.1*
16-20	3.4*	2.0*	2.1*	4.5*	7.1*	2.7*	1.9*	3.3*	3.5*	4.8*	4.1*	1.9*
21-25	3.0*	1.9*	3.3*	8.1*	5.1*	2.3*	3.1*	2.3*	3.5*	13.4*	3.7*	1.7*
26-END	2.7*	1.9*	2.4*	3.7*	4.5*	2.1*	2.1*	4.0*	3.4*	13.1*	3.3*	1.6*

YEAR : 1979

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	1.5*	1.1*	0.8*	0.9*	4.8*	1.9*	2.1*	1.7*	16.2*	5.3*	4.8*	8.5*
6-10	1.4*	1.1*	0.8*	1.1*	3.2*	4.9*	1.8*	1.7*	10.7*	4.6*	15.0*	8.3*
11-15	1.3*	1.0*	0.7*	3.3*	3.1*	4.1*	1.6*	1.5*	12.4*	5.4*	19.0*	6.9*
16-20	1.3*	0.9*	0.7*	2.1*	2.9*	2.5*	1.4*	2.9*	7.0*	6.9*	24.5*	6.1*
21-25	1.2*	0.9*	0.7*	4.3*	2.7*	2.3*	3.8*	4.8*	8.3*	4.1*	17.9*	5.3*
26-END	1.2*	0.9*	0.6*	9.2*	2.3*	2.3*	2.0*	10.2*	6.4*	10.5*	12.3*	4.4*

YEAR : 1980

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.6*	2.4*	1.7*	1.5*	2.7*	9.5*	2.2*	13.6*	7.8*	11.3*	6.1*	9.3*
6-10	3.0*	2.2*	1.7*	2.6*	2.5*	6.1*	1.9*	12.9*	13.8*	10.6*	10.2*	16.8*
11-15	2.6*	2.0*	1.7*	3.8*	3.4*	3.6*	1.8*	7.7*	8.4*	8.1*	19.3*	13.5*
16-20	2.3*	1.9*	2.0*	2.4*	3.2*	3.1*	2.1*	5.5*	6.1*	15.6*	13.2*	10.5*
21-25	2.1*	1.7*	1.8*	2.2*	2.4*	2.9*	2.3*	5.0*	9.6*	8.3*	13.4*	9.5*
26-END	4.1*	1.6*	1.7*	2.2*	2.4*	2.6*	2.1*	7.9*	18.0*	6.7*	11.3*	7.7*

REMARKS : ASTERISK (*) MEANS SIMULATED VALUE.

Table 53 CONVERSION RATIO FROM KEY STATION TO BASINS

Key Station					Applied Basin			
River Basin	Station Name	A_O Catchment Area (km^2)	R_O Rainfall (mm)	L_O Loss (mm)	Sub-basin	A Catchment Area (km^2)	R Rainfall (mm)	Conversion Ratio
Perlis	Titi Konkerit Baru	150	1,890	1,376	PL1	341	1,898	2.309
	Titi Konkerit Baru	150	1,890	1,376	PL2	317	1,856	1.974
	Titi Konkerit Baru	150	1,890	1,376	PL3	225	1,996	1.809
Kedah	Lengkuas	1,270	1,927	1,366	KD1	1,343	1,880	0.969
	Lengkuas	1,270	1,927	1,366	KD2	365	2,043	0.347
	Lengkuas	1,270	1,927	1,366	KD3	345	2,280	0.443
	Lengkuas	1,270	1,927	1,366	KD4	503	2,156	0.558
	Lengkuas	1,270	1,927	1,366	KD5	974	2,417	1.437
	Lengkuas	1,270	1,927	1,366	KD6	63	2,973	0.142
Muda	Jeniang	1,740	2,187	1,347	MD1	984	2,103	0.509
	Jeniang	1,740	2,187	1,347	MD2	756	2,296	0.491
	Jeniang	1,740	2,187	1,347	MD3	812	2,400	0.585
	Jeniang	1,740	2,187	1,347	MD4	895	2,354	0.617
	Jeniang	1,740	2,187	1,347	MD5	569	2,786	0.560
	Jeniang	1,740	2,187	1,347	MD6	559	2,354	0.385
	Jeniang	1,740	2,187	1,347	MD7	263	2,692	0.242
Perai	Ara Kuda	129	2,826	1,397	PR1	258	2,576	1.651
	Ara Kuda	129	2,826	1,397	PR2	453	2,337	2.312
	Ara Kuda	129	2,826	1,397	PR3	300	2,673	2.077
Rui	Jeniang	1,740	2,187	1,347	RU1	611	2,108	0.318
	Jeniang	1,740	2,187	1,347	RU2	278	2,245	0.171

Remarks; Conversion ratio = $\frac{A \cdot (R - L_O)}{A_O \cdot (R_O - L_O)}$

Table 54 DETAILS OF FLOW DURATION CURVE AT KEY STATION (1/4)

River: Perlis
Station: Titl Kankerit Baru (6502431, 6502432)
Catchment Area: 150 km^2

Unit: %

Duration (%)	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
5	322	400	478	467	405	373	390	388	350	313
10	156	181	256	253	253	261	205	229	247	179
15	133	131	206	193	205	161	138	188	190	138
20	122	104	156	147	168	127	115	159	153	125
25	111	92	117	113	132	112	100	118	130	117
30	94	85	106	80	105	94	88	94	103	108
35	83	77	39	60	89	79	85	88	70	104
40	67	69	33	53	74	67	80	76	53	96
45	61	62	28	47	47	58	70	65	47	88
50	56	58	17	40	32	52	65	53	40	79
55	50	50	11	33	26	45	60	47	37	67
60	44	46	11	27	21	42	55	35	37	63
65	39	42	6	20	21	39	50	29	33	54
70	33	35	6	13	21	33	48	29	30	46
75	33	31	6	13	16	30	43	24	27	42
80	28	23	6	7	5	24	38	18	23	33
85	22	19	6	7	5	18	28	18	20	25
90	17	12	6	7	5	12	18	12	13	21
95	17	8	6	7	0	6	10	12	7	17
97	17	8	6	7	0	3	10	12	7	13
99	17	8	6	7	0	3	10	12	7	8
Average	100	100	100	100	100	100	100	100	100	100
Annual Volume (10^6 m^3)	57	82	57	47	60	104	126	54	95	76

Unit: %

Duration (%)	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
5	393	451	293	292	500	563	546	472	491	463
10	210	290	179	183	235	328	277	217	213	213
15	159	205	131	150	157	197	185	167	143	137
20	131	149	110	142	135	144	115	133	126	107
25	114	115	100	125	109	100	85	111	104	87
30	103	87	93	117	87	69	54	89	87	77
35	93	62	86	100	74	47	38	78	78	67
40	83	44	79	83	57	38	31	61	65	53
45	69	28	69	67	48	28	31	56	61	47
50	62	23	66	58	39	22	23	50	52	43
55	55	18	55	50	35	19	23	39	43	40
60	48	18	48	42	30	17	23	33	39	37
65	41	15	41	33	26	13	23	28	35	37
70	38	13	38	33	22	13	15	28	26	33
75	34	10	31	33	17	9	15	22	13	33
80	31	8	28	25	17	9	15	17	13	33
85	28	8	28	25	17	9	15	17	13	30
90	21	5	21	17	13	6	8	17	9	30
95	14	5	17	17	9	6	8	11	4	23
97	14	5	14	17	9	6	8	11	4	23
99	10	5	10	17	9	6	8	11	4	23
Average	100	100	100	100	100	100	100	100	100	100
Annual Volume (10^6 m^3)	92	123	92	38	73	101	41	57	73	95

Table 55 DETAILS OF FLOW DURATION CURVE AT KEY STATION (2/4)

River: Kedah
Station: Lengkuas (6204421)
Catchment Area: 1,270 km^2

Unit: %

Duration (%)	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
5	458	459	545	521	502	476	351	349	391	263
10	237	292	400	314	292	293	248	221	240	213
15	177	208	210	210	233	192	196	164	187	188
20	125	143	136	143	182	155	145	140	159	170
25	107	95	48	92	132	110	128	125	137	160
30	80	77	35	71	107	80	101	108	110	143
35	72	59	22	56	70	66	87	88	90	113
40	66	45	21	43	34	52	83	77	78	92
45	50	33	16	33	23	40	80	63	61	84
50	40	27	13	27	19	31	64	57	48	75
55	36	19	11	21	17	26	47	52	44	58
60	32	16	10	16	14	22	38	49	37	50
65	31	15	8	13	13	21	30	45	29	47
70	28	14	7	11	12	20	24	37	23	43
75	27	13	7	8	11	20	17	30	16	39
80	26	12	7	6	10	20	16	25	15	29
85	24	11	6	4	6	19	15	24	13	19
90	22	10	5	3	3	17	15	20	12	12
95	21	10	4	3	3	15	15	11	8	9
97	20	9	3	3	3	14	14	9	7	8
99	18	9	2	3	3	11	14	8	7	8
Average	100	100	100	100	100	100	100	100	100	100
Annual Volume (10^6 m^3)	382	640	337	379	861	722	952	643	795	637

Unit: %

Duration (%)	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
5	337	399	295	381	355	402	332	367	345	439
10	224	277	217	196	191	222	236	206	223	293
15	171	210	161	136	145	155	187	143	172	211
20	142	149	129	118	134	128	151	122	147	182
25	120	116	109	108	118	116	129	113	131	151
30	103	103	101	90	87	104	106	103	119	94
35	90	89	92	78	81	86	90	88	109	65
40	79	64	85	69	70	75	79	75	94	47
45	68	47	79	62	61	65	67	66	72	31
50	60	42	71	56	56	57	55	55	63	23
55	54	35	62	53	50	51	43	45	58	20
60	50	29	57	49	41	46	32	34	55	16
65	44	24	53	47	36	42	25	29	49	14
70	39	21	46	44	31	38	18	26	40	12
75	35	17	38	38	27	34	14	18	27	11
80	29	14	34	33	22	27	13	10	16	10
85	21	12	28	26	22	18	12	7	7	8
90	17	11	22	18	21	12	12	6	5	6
95	15	9	17	13	18	8	10	6	4	4
97	13	8	16	12	17	6	10	6	4	4
99	13	8	13	10	16	6	9	6	4	4
Average	100	100	100	100	100	100	100	100	100	100
Annual Volume (10^6 m^3)	1060	1161	1057	899	552	1038	438	495	524	675

Table 56 DETAILS OF FLOW DURATION CURVE AT KEY STATION (3/4)

River: Muda
Station: Jeniang (5806414)
Catchment Area: 1,740 km^2

Unit: %

Duration (%)	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
5	264	246	301	280	320	272	245	321	296	246
10	181	175	236	216	244	214	188	235	222	201
15	154	149	191	164	200	182	152	200	186	178
20	135	127	158	144	172	159	130	162	158	158
25	121	112	125	115	142	138	116	146	131	143
30	107	102	106	106	104	115	103	129	104	129
35	94	95	93	97	90	93	94	115	91	111
40	88	89	86	90	77	81	85	102	83	93
45	81	83	76	82	69	70	78	75	67	81
50	73	78	69	77	58	63	70	47	60	71
55	68	74	64	69	48	59	63	40	56	67
60	67	70	60	65	43	53	60	34	53	62
65	61	66	53	55	39	47	58	28	50	56
70	59	60	51	55	32	45	52	22	46	52
75	54	56	38	44	28	42	48	20	42	47
80	50	54	27	31	27	40	45	18	36	40
85	49	41	20	27	24	38	41	16	32	35
90	47	35	18	27	21	37	36	14	24	32
95	43	31	17	27	21	34	33	14	21	26
97	37	31	15	23	18	34	31	13	21	24
99	36	27	14	23	18	33	29	13	21	22
Average	100	100	100	100	100	100	100	100	100	100
Annual Volume (10^6 m^3)	1031	1246	1624	1258	1571	1779	1567	940	1908	1782

Unit: %

Duration (%)	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
5	242	381	256	227	267	282	427	297	352	337
10	187	242	189	192	205	227	311	224	270	241
15	164	190	157	177	173	192	208	195	223	203
20	141	158	134	165	153	154	146	162	181	174
25	123	123	121	151	141	132	117	141	141	144
30	108	92	112	130	131	114	82	123	116	118
35	100	76	103	107	118	98	66	107	97	97
40	91	57	91	90	86	79	52	91	80	81
45	83	52	81	83	71	70	43	78	63	66
50	73	43	71	77	63	62	37	63	49	52
55	65	37	68	69	56	58	32	53	39	30
60	59	33	63	60	52	52	28	44	29	25
65	54	31	58	54	50	47	23	38	25	23
70	49	29	53	48	48	41	20	33	20	19
75	44	28	48	43	45	36	18	28	16	13
80	37	26	43	41	42	30	15	22	12	11
85	27	23	38	36	39	26	14	17	9	10
90	24	21	32	33	34	19	11	13	8	9
95	21	20	26	30	30	15	10	10	8	7
97	20	20	25	29	27	14	9	10	8	7
99	18	18	24	27	22	11	8	8	8	7
Average	100	100	100	100	100	100	100	100	100	100
Annual Volume (10^6 m^3)	1400	1470	1448	1003	1517	2167	1202	1120	1176	1977

Table 57 DETAILS OF FLOW DURATION CURVE AT KEY STATION (4/4)

River: Perai
Station: Ara Kuda (5405421)
Catchment Area: 129 km^2

Unit: %

Duration (%)	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
5	268	241	292	343	336	184	172	188	225	307
10	208	183	218	206	248	152	157	153	171	201
15	168	141	169	163	195	134	138	143	150	167
20	137	122	134	131	152	128	125	127	138	133
25	120	106	110	107	129	116	113	120	127	115
30	107	95	79	91	89	110	106	112	109	100
35	98	90	70	81	73	107	100	102	98	86
40	92	80	62	71	68	102	96	94	91	77
45	81	77	57	64	63	97	91	90	86	71
50	69	73	56	61	55	90	88	88	80	64
55	64	67	52	60	50	86	86	84	75	60
60	58	63	49	57	46	83	84	82	71	56
65	54	60	48	55	43	78	83	80	68	52
70	51	59	44	49	36	74	78	76	64	49
75	47	56	44	43	36	71	75	71	60	46
80	44	56	43	40	32	67	71	69	55	43
85	41	52	43	39	32	64	67	57	52	39
90	37	52	39	36	30	60	64	53	50	35
95	34	48	38	34	25	55	54	39	46	25
97	31	45	38	30	20	53	48	39	43	25
99	29	44	38	27	20	50	48	37	41	23
Average	100	100	100	100	100	100	100	100	100	100
Annual Volume (10^6 m^3)	186	259	192	211	177	183	218	155	177	265

Unit: %

Duration (%)	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
5	221	259	266	184	205	239	278	232	354	283
10	147	211	183	151	148	176	218	163	240	227
15	126	179	138	135	135	153	171	137	190	192
20	112	143	116	121	123	131	151	124	156	169
25	105	118	102	112	115	118	139	116	129	153
30	95	97	95	107	105	104	114	108	108	131
35	89	82	89	100	98	94	90	97	94	114
40	86	74	84	95	93	84	76	92	83	97
45	79	69	78	91	92	75	69	87	65	75
50	75	66	73	86	87	69	63	82	54	54
55	72	59	70	81	83	65	59	71	48	49
60	70	57	69	79	82	63	53	66	40	44
65	67	56	67	77	78	61	51	61	35	41
70	65	52	64	74	75	57	49	58	31	39
75	61	51	61	72	73	55	45	55	29	37
80	58	48	58	70	68	53	43	53	25	36
85	54	44	55	67	62	49	39	50	21	32
90	53	43	48	65	55	45	35	50	19	29
95	49	41	44	60	50	41	33	47	15	29
97	49	38	44	58	48	39	31	45	15	29
99	46	36	41	58	45	31	27	42	15	27
Average	100	100	100	100	100	100	100	100	100	100
Annual Volume (10^6 m^3)	180	192	202	136	189	161	155	120	151	186

Table 58 ANNUAL EXTREME RAINFALL BY DURATION
AT JENIANG (5806066)

Record period: 1 - 12 hours 1957/58 - 1977/78
24 hours 1952/53 - 1977/78

Unit: mm

No.	Rainfall Duration				
	1 hour	3 hours	6 hours	12 hours	24 hours
1	94	138	138	138	184
2	94	132	133	133	154
3	90	117	117	117	146
4	89	110	110	111	133
5	77	94	97	105	132
6	74	91	96	97	130
7	74	89	95	97	124
8	69	82	91	96	112
9	65	82	87	96	108
10	64	81	85	94	106
11	64	78	84	92	105
12	64	78	83	91	104
13	63	77	81	85	98
14	63	72	78	84	97
15	61	69	69	78	97
16	56	60	66	75	97
17	56	60	65	73	96
18	52	59	63	73	94
19	48	56	59	59	93
20	45	55	59	59	92
21	43	53	54	54	85
22	-	-	-	-	85
23	-	-	-	-	75
24	-	-	-	-	73
25	-	-	-	-	69

Table 59 ANNUAL EXTREME RAINFALL BY DURATION
AT ALOR SETAR (6103047)

Record period: 1 - 12 hours 1965/66 - 1977/78
24 hours 1946/47 - 1977/78

Unit: mm

No.	Rainfall Duration				
	1 hour	3 hours	6 hours	12 hours	24 hours
1	85	141	142	149	198
2	84	111	130	142	193
3	76	104	114	137	192
4	76	93	111	134	184
5	75	92	104	115	153
6	74	91	102	114	149
7	73	87	94	104	144
8	72	84	94	97	140
9	68	83	87	94	139
10	65	77	81	94	137
11	63	77	78	89	127
12	53	69	69	80	125
13	36	57	64	78	118
14	-	-	-	-	115
15	-	-	-	-	114
16	-	-	-	-	114
17	-	-	-	-	110
18	-	-	-	-	106
19	-	-	-	-	104
20	-	-	-	-	102
21	-	-	-	-	102
22	-	-	-	-	98
23	-	-	-	-	98
24	-	-	-	-	94
25	-	-	-	-	93
26	-	-	-	-	91
27	-	-	-	-	91
28	-	-	-	-	87
29	-	-	-	-	81
30	-	-	-	-	80
31	-	-	-	-	78

Table 60 ANNUAL EXTREME RAINFALL BY DURATION
AT KUALA NERANG (6206035)

Record period: 1 - 12 hours 1957/58 - 1978/79
24 hours 1952/53 - 1978/79

Unit: mm

No.	Rainfall Duration				
	1 hour	3 hours	6 hours	12 hours	24 hours
1	83	132	157	157	158
2	78	125	133	133	133
3	76	109	112	112	128
4	76	107	108	108	117
5	76	102	103	103	112
6	71	95	98	102	108
7	70	86	95	95	103
8	70	83	89	93	102
9	68	81	85	89	100
10	68	79	84	87	98
11	67	78	84	85	95
12	61	76	82	85	95
13	61	75	82	85	93
14	59	72	81	84	93
15	56	67	78	84	86
16	56	67	72	81	86
17	48	67	70	76	86
18	47	64	70	74	85
19	43	64	65	72	85
20	39	55	64	70	83
21	39	50	62	66	82
22	28	49	50	50	75
23	-	-	-	-	75
24	-	-	-	-	73
25	-	-	-	-	70
26	-	-	-	-	56

Table 61 ANNUAL EXTREME RAINFALL BY DURATION
AT KANGER (6401001)

Record period: 1 - 24 hours 1960/61 - 1974/75

Unit: mm

No.	Rainfall Duration				
	1 hour	3 hours	6 hours	12 hours	24 hours
1	88	166	199	235	235
2	86	164	169	169	169
3	86	113	133	149	154
4	82	105	116	131	149
5	76	102	105	105	140
6	60	73	102	104	131
7	55	71	98	98	129
8	52	71	73	85	105
9	48	69	71	81	104
10	47	61	68	79	100
11	42	48	55	71	98
12	-	-	-	-	94
13	-	-	-	-	93
14	-	-	-	-	91
15	-	-	-	-	81
16	-	-	-	-	80
17	-	-	-	-	74
18	-	-	-	-	72

Table 62 ANNUAL EXTREME 24 HOUR RAINFALL AT 5609073, 5710061, 5411068 AND 6106034

Station Name :	Kolamair Baling	Dispensari Kroh	Rumah Sakit Grik	Naka
Station No. :	5609073	5710061	5411068	6106034
Record Period:	1948-1979	1959-1979	1959-1976	1953-1980
No.				Unit: mm
1	176	141	131	191
2	148	120	130	136
3	139	118	124	131
4	121	108	123	130
5	121	102	116	128
6	118	100	100	124
7	118	97	96	123
8	110	94	94	123
9	109	91	90	122
10	102	89	80	122
11	102	89	75	117
12	99	88	73	116
13	98	87	72	115
14	97	83	70	105
15	92	79	68	102
16	92	72	61	84
17	91	65	28	84
18	89	65	-	83
19	88	50	-	82
20	86	48	-	80
21	83	-	-	80
22	81	-	-	75
23	78	-	-	74
24	76	-	-	74
25	76	-	-	74
26	74	-	-	65
27	73	-	-	64
28	56	-	-	61
29	56	-	-	-
30	50	-	-	-
31	33	-	-	-

Table 63 PROBABLE RAINFALL BY DURATION
AT ALOR SETAR (6103047)

Unit: mm

Return Period	Rainfall Duration				
	1 hour	3 hours	6 hours	12 hours	24 hours
2	67	87	95	107	116
5	82	110	120	133	150
10	91	125	136	150	173
20	100	139	152	167	195
50	112	158	173	189	223
100	121	172	188	205	245
200	130	186	203	221	266
1,000	150	218	239	258	315
10,000	179	265	290	312	385

Table 64 PROBABLE RAINFALL BY DURATION
AT JENIANG (5806066)

Unit: mm

Return Period	Rainfall Duration				
	1 hour	3 hours	6 hours	12 hours	24 hours
2	65	79	83	88	104
5	81	104	107	111	131
10	91	121	123	126	149
20	101	137	139	141	167
50	114	158	159	160	189
100	124	174	174	174	206
200	133	189	189	189	223
1,000	156	225	225	225	262
10,000	188	277	277	277	318

Table 65 PROBABLE RAINFALL BY DURATION AT KUALA NERANG (6206035)

Unit: mm

Return Period	Rainfall Duration				
	1 hour	3 hours	6 hours	12 hours	24 hours
2	59	78	84	87	92
5	74	101	109	111	114
10	84	116	126	126	129
20	94	131	142	142	143
50	107	150	162	162	162
100	116	164	178	178	178
200	125	179	193	193	193
1,000	147	212	229	229	229
10,000	178	259	280	280	280

Table 66 CHARACTERISTICS OF CATCHMENT AREA AT PROPOSED DAM SITES

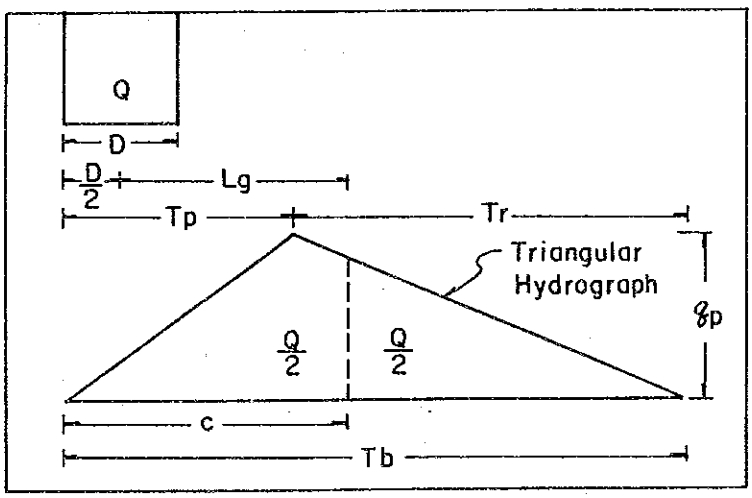
Dam Site	Topography and Vegetation	Catchment Area (km^2)	Stream Length L (km)	Stream Length Lc (km)	Stream Slope S
Badak - Temin	Upper catchment steep and jungle covered lower catchment reaches undulating and covered predominantly with rubber	112	24.1	13.3	0.012
Sari	Upper catchment steep and jungle covered, lower catchment reaches hilly and covered predominantly with sugarcane	61	15.2	7.6	0.021
Durian	Upper catchment steep and jungle covered, lower catchment reaches hilly and covered predominantly with sugarcane	74	15.8	6.4	0.009
Tawar - Muda	Northern catchment steep and jungle covered, lower catchment reaches hilly and covered predominantly with rubber, north-east catchment partly consists undulating village area	129	17.7	7.6	0.005
Beris	Upper and lower catchment steep and jungle covered, middle reaches to north-east catchment hilly or undulating with variable vegetation including jungle rubber and village area	116	21.5	7.4	0.014
Rui 2	Whole catchment steep and covered with jungle	278	36.7	20.3	0.016
Rui 3	Whole catchment steep and covered with jungle, northern reach consists tine mine tailing dam	305	37.9	18.8	0.016

Remarks: L; main stream length from the outlet to the catchment boundary
Lc; main stream length from the outlet to the catchment centroid
S; weighted mean stream slope

Table 67 TRIANGULAR DIRECT FLOOD RUNOFF HYDROGRAPH BY SITE

Dam Site	Tb (hours)	Tp (hours)	Rainfall Duration (hours)
Badak - Temin	30.0	11.7	6.0
Sari	18.1	7.0	3.0
Durian	19.7	7.7	3.0
Tawar - Muda	23.1	9.0	3.0
Beris	21.3	8.3	3.0
Rui 2	33.2	12.9	3.0
Rui 3	32.7	12.7	3.0

Remarks: Triangular Representation of Direct Runoff Hydrograph



where, Tp = time to peak, hours

Tb = time length of base of hydrograph, hours

qp = direct peak discharge in m^3/s

D = rainfall excess period, hours

Q = volume of runoff, mm

Table 68 PEAK DISCHARGE OF MAXIMUM PROBABLE FLOOD AT PROPOSED DAM SITES

Unit: m^3/s

Dam Site	Flood Peak Discharge by Return Period in Years									
	2	5	10	20	50	100	200	1,000	10,000	PMF
Badak - Temin	78	112	136	160	192	218	243	304	395	784
Sari	63	90	110	130	157	177	199	249	325	427
Durian	68	97	119	140	169	192	215	269	351	518
Tawar - Muda	88	136	171	207	255	293	331	423	561	903
Beris	86	132	166	200	247	283	320	409	543	812
Rui 2	134	205	257	310	382	437	495	632	837	1,946
Rui 3	149	228	286	345	425	487	550	703	931	2,135

Remarks: The peak discharges include the base flow component of 3 m^3/s for Badak - Temin, 2 m^3/s for Sari and Durian, 4 m^3/s for Tawar - Muda and Beris, 8 m^3/s for Rui 2 and 9 m^3/s for Rui 3.

Table 69 DESIGN FLOOD DISCHARGE AND C-VALUE OF CREAGER'S CURVE

Dam Site	Design Flood Discharge						
	River Diversion		Spillway				
	20 year (m^3/s)	50 year (m^3/s)	1.2x200 year (m^3/s)	1,000 Year Discharge (m^3/s)	1,000 Year C-Value	PMF Discharge (m^3/s)	PMF C-Value
Badak - Temin	160	192	292	304	7.3	831	20.0
Sari	130	157	239	249	8.6	568	20.0
Durian	140	169	258	269	8.3	643	20.0
Tawar - Muda	207	255	397	423	9.1	904	20.0
Beris	200	247	384	409	9.5	849	20.0
Rui 2	310	382	594	632	8.7	1,946	27.8
Rui 3	345	425	660	703	9.5	2,135	29.0

FIGURES

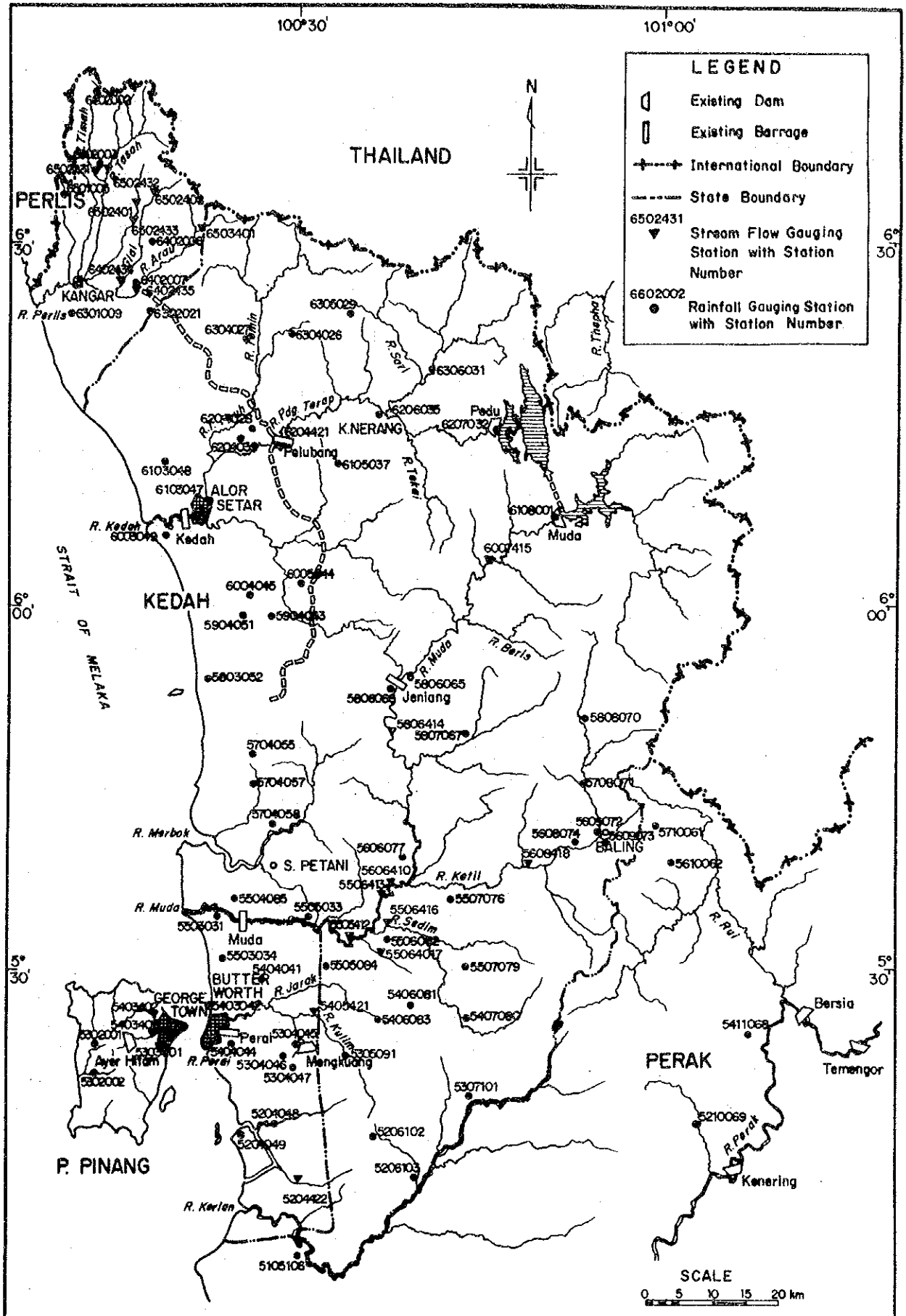


Fig. 1 Location Map of Stream Flow and Rainfall Gauging Stations

GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY, MALAYSIA
PERLIS-KEDAH-PULAU PINANG
REGIONAL WATER RESOURCES STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 2 Duration of Record at Selected Rainfall Gauging Stations (1/2)

Station Number	Station Name	Latitude (D.M.S.)	Longitude (D.M.S.)	Period of Record 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80	Nos yrs	State
6602002	Kaki Bukit	06 38 40	100 12 38		20	Perlis
6502003	Tasoh	06 35 30	100 13 20		20	Perlis
6501005	Abi kg. Baharu	06 30 20	100 10 55		18	Perlis
6402006	Guar Nangka	06 28 40	100 17 30		20	Perlis
6402007	Arau	06 25 50	100 16 15		20	Perlis
6306031	Padang Sanai	06 20 35	100 41 25		11	Kedah
6305029	Kg. Tengah	06 20 19	100 34 10		18	Kedah
6304027	Ladang Paya Kemunting	06 18 15	100 25 15		20	Kedah
6304026	Kerjaair Bukit Wang	06 20 05	100 28 55		20	Kedah
6302021	Kodiang	06 22 15	100 18 00		20	Kedah
6301009	Seriap	06 23 55	100 11 15		18	Perlis
6207032	Ampang Padu	06 14 25	100 46 20		9	Kedah
6206035	Kuala Nerang	06 15 15	100 36 45		20	Kedah
6204039	Stn Kajicuacakapaka Batas	06 12 05	100 24 45		20	Kedah
6204028	Ladang Tanjong Pauh	06 14 35	100 26 00		20	Kedah
6108001	Kompiek Rumah Muda	06 06 20	100 50 50		7	Kedah
6105037	Gajah Mati	06 10 05	100 32 15		20	Kedah
6103048	Ator Janggus	06 10 15	100 18 15		20	Kedah
6103047	Stor Jpt. Ator Star	06 07 00	100 21 25		15	Kedah
6005044	Kg. Jelutong	06 02 45	100 30 15		20	Kedah
6004045	Stn. Keretapi Tokai	06 01 45	100 24 40		20	Kedah
6003049	Tetek Chengai	06 05 45	100 20 00		20	Kedah
5904051	Kota Sarang Semut	05 58 10	100 24 05		20	Kedah
5904043	Pendang	05 59 40	100 28 50		20	Kedah
5808070	Kg. Lubok Bodak	05 50 15	100 53 45		20	Kedah
5807067	Sik	05 49 20	100 44 50		20	Kedah
5806066	Jeniang Klinik	05 48 50	100 37 55		15	Kedah
5806065	Kg. Gajah Puteh	05 53 55	100 38 45		20	Kedah
5803052	Sg. Limau	05 54 00	100 22 40		20	Kedah
5710061	Dispensari Kroh	05 42 30	101 00 00		10	Perak
5708071	Kg. Terasek	05 45 05	100 53 35		20	Kedah
5704058	Semeling	05 42 25	100 28 25		20	Kedah
5704057	Ibu Bekalah Tupah	05 45 05	100 26 35		20	Kedah
5704055	Kedah Peak	05 47 50	100 26 15		20	Kedah
5610062	Dispensari Kilan Intan	05 38 10	101 01 30		9	Perak

GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY, MALAYSIA
PERLIS-KEDAH-PULAU PINANG
REGIONAL WATER RESOURCES STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 3 Duration of Record at Selected Rainfall Gauging Stations (2/2)

Station Number	Station Name	Latitude (D.M.S.)	Longitude (D.M.S.)	Period of Record 61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	Nos yrs	State
5609073	Kolamair Baling	05 40 25	100 55 20																					20	Kedah
5609072	Rumah Sakit Baling	05 40 50	100 55 00																					20	Kedah
5608074	Pulai	05 39 25	100 53 55																					17	Kedah
5606077	Ladang Lubok Segintah	05 38 30	100 38 55																					20	Kedah
5503031	Permatang Bendahari	05 34 50	100 23 30																					20	Pinang
5504085	Rantau Panjang	05 30 40	100 24 25																					20	Kedah
5507079	Ladang Pelam	05 30 30	100 44 15																					20	Kedah
5507076	Batu 27 Jlm. Baling	05 35 35	100 42 10																					17	Kedah
5506082	Ladang Bukit Kerangan	05 32 00	100 37 25																					20	Kedah
5505084	Ladang Henrietta	05 30 55	100 32 15																					20	Kedah
5505033	Rumah Pam Pinang Tunggal	05 33 25	100 30 25																					20	Pinang
5503034	Permatang Binjal	05 30 10	100 23 40																					20	Pinang
5411068	Rumah Sakit Grik	05 25 50	101 07 50																					15	Perak
5406081	Ladang Bagan Sena	05 27 30	100 40 25																					20	Kedah
5403042	Stn. Kajicuaca Butterworth	05 27 45	100 23 20																					20	Pinang
5404041	Ladang Malakoff	05 29 20	100 27 55																					20	Pinang
5404044	Stn. Petak Ujian Bukit Merah	05 24 50	100 25 50																					20	Pinang
5406083	Kelang Baharu. Kulim	05 25 45	100 36 20																					20	Kedah
5407080	Ladang Dublin	05 24 05	100 44 10																					20	Kedah
5302001	Tallah Besar SG. Pinang	05 23 30	100 12 45																					18	Pinang
5302002	Pintuair Bagan Air Ilam	05 21 15	100 12 00																					20	Pinang
5304045	Kolamair Bukit Bera Pit	05 22 40	100 29 50																					20	Pinang
5304046	Permatang Rawa	05 21 45	100 27 35																					20	Pinang
5304047	Kolamair Cherok To Kun	05 21 30	100 29 40																					20	Pinang
5305091	Rumah Sakit Kulim	05 22 10	100 33 30																					20	Kedah
5210069	Stn. Pemerhatian Hutan Lawin	05 17 55	101 03 30																					6	Perak
5204048	Sg. Simpang Ampat	05 17 10	100 28 40																					20	Pinang
5204049	Ladang Batu Kawan	05 15 25	100 25 50																					20	Pinang
5307101	Sekolah Menengan Mahang	05 19 30	100 44 00																					15	Kedah
5206102	Terap	05 16 55	100 37 45																					20	Kedah
5206103	Ladang Selama. Serdang	05 13 30	100 39 30																					20	Kedah
5105106	Rumah Penjaga Jpl. Parit Nibong	05 07 40	100 30 25																					20	Kedah

GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY, MALAYSIA
PERLIS-KEDAH-PULAU PINANG
REGIONAL WATER RESOURCES STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY