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GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY, MALAYSIA

REGIONAL WATER RESOURCES STUDY OF SOUTH JOHOR

VOL. 7

ANNEX

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K. DESIGN AND COST ESTIMATE OF PROPOSED DEVELOPMENT PLAN
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JAPAN INTERNATIONAL COOPERATION AGENCY

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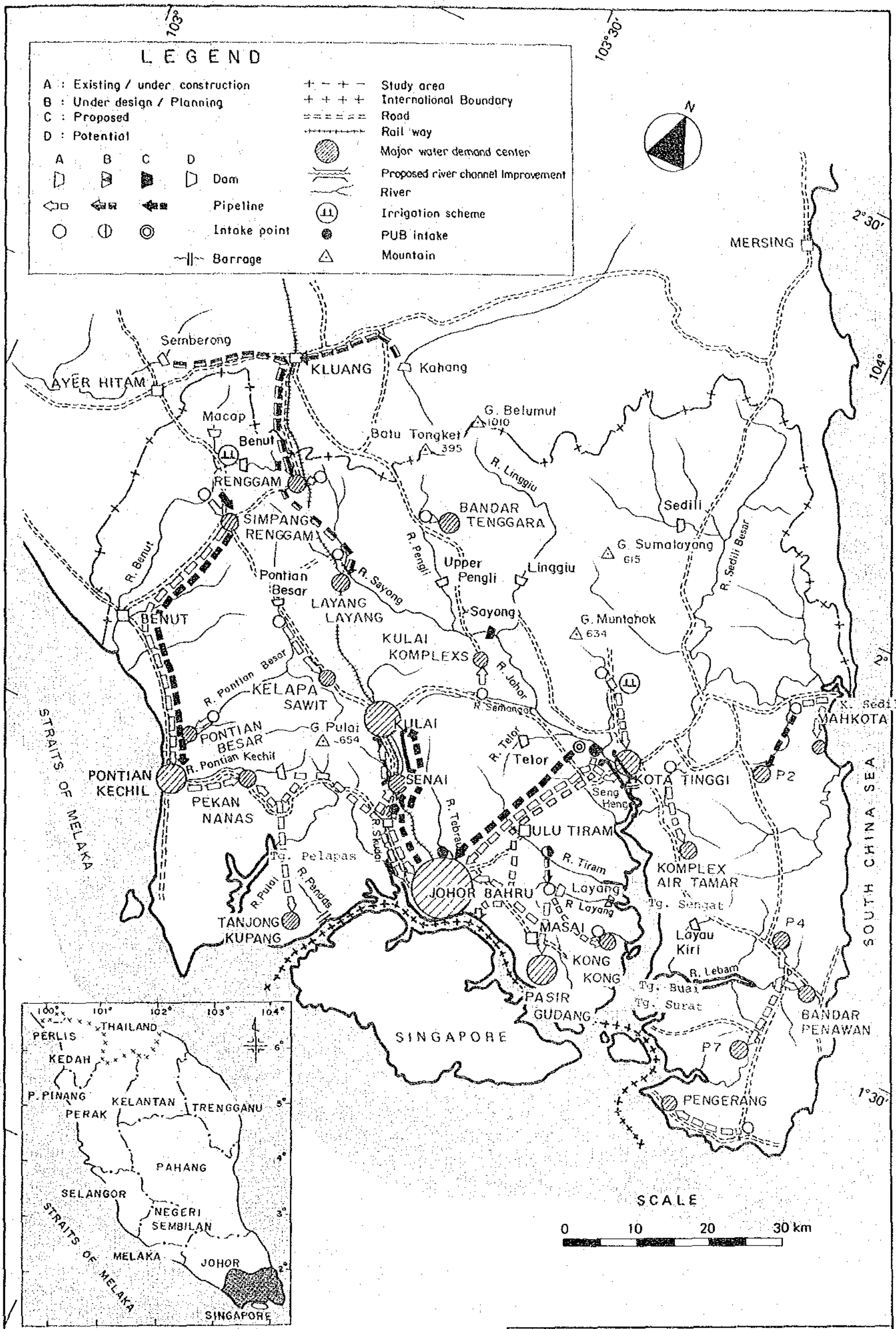
LIST OF VOLUMES



GOVERNMENT OF MALAYSIA
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ABBREVIATIONS

(1) Oreganization/Plan

4MP (5MP)	:	Fourth (Fifth) Malaysia Plan
DID (JPT)	:	Drainage and Irrigation Department
DOA	:	Department of Agriculture
DOE	:	Department of Environment
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
KEJORA	:	Lembaga Kemajuan Johor Tenggara
MOA	:	Ministry of Agriculture
MOH	:	Ministry of Health
MTR	:	Mid-Term Review of 4MP
NEB	:	National Electricity Board
NWRS	:	National Water Resources Study
PUB	:	Public Utility Board (Singapore)
PWD (JKR)	:	Public Works Department
RESP	:	Rural Environmental Sanitation Program
RISDA	:	Rubber Industry Smallholders 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
DRC	:	Dry Rubber Content
EIRR	:	Economic Internal Rate of Return
EL.	:	Elevation Above Mean Sea Level
Eq.	:	Equation
FFB	:	Fresh Fruit Bunch
Fig.	:	Figure
GDP	:	Gross Domestic Project
GNP	:	Gross National Product
GRP	:	Gross Regional Project
HWL	:	Normal High Water Level
O & M	:	Operation and Maintenance
Q	:	Discharge
Ref.	:	Reference
SS	:	Suspended Solid
VA	:	Value Added

ABBREVIATIONS OF MEASUREMENT

Length

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

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

Weight

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

Time

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

Other Measures

% = percent
° = degree
' = minute
" = second
°C = degree in centigrade
10^3 = thousand
10^6 = million

Derived Measures

m^3/s = cubic meter per second
Mgd = million gallon per day
Mld = million litre per day

Money

M$ = Malaysian Ringgit
M¢ = Malaysian Cent

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 1 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

Exchange Rate

(1985)

US$1 = M$2.41
¥100 = M$0.980

ANNEX J
REGIONAL WATER DEMAND AND SUPPLY SYSTEM

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1. INTRODUCTION

This ANNEX report describes the result of the regional water demand and supply balance study carried out for the water demand and supply balance plan.

The objectives of the study are:

(1) To project the water deficits by year and river at the intake points and to evaluate the total deficit at the points in the Region on the basis of 5-day.

(2) To carry out the reservoir operation simulation to determine the necessary storage capacity to supplement the deficit.

2. INPUT DATA FOR BALANCE SIMULATION

2.1 Runoff

2.1.1 Runoff simulation

Tank model is constructed at six hydrological stations to estimate runoff for interrupted period. After caribration in the viewpoints of annual loss, monthly runoff and duration curve, runoff data at four key stations was completed for 22 years from 1963 to 1984 through the simulation study. 5-day natural runoff data is finally compiled at the key stations. Then 5-day runoff in the sub-basin is estimated by assuming that the rainfall loss of the key stations during the period of 1963-1984 evenly distributes in the river basin. Division of sub-basins is shown in Fig. 1. Further, the natural runoff is assumed as the generated runoff data because water abstraction in the catchment area is presently deemed insignificant.

Detail of method applied to estimate runoff is described in the ANNEX D.

2.1.2 Available runoff

Mean annual runoff volume between 1963 to 1984 at proposed damsites in the Region are summarized in Table 1. The total available water resources of the major rivers are approximately 2,760 x 10^6 m^3 in the Johor river, 510 x 10^6 m^3 in the Benut river, 400 x 10^6 m^3 in the Pontian Besar river, 340 x 10^6 m^3 in the Pulai river, 310 x 10^6 m^3 in the Skudai river, 270 x 10^6 m^3 in the Tebrau river, 1,830 x 10^6 m^3 in the Sedili Besar river and 400 x 10^6 m^3 in the Sedili Kechil river. The figures show the mean annual runoff at the estuary of the mainstream.

2.1.3 Return flow

The ratio of return flow of 20% for irrigation water and 40% of domestic and industrial water are assumed.

2.2 Water Demand

2.2.1 Demand projection of the Region

In order to examine water supply and demand balance at the point of intakes and source facilities, it is necessary to formulate water demand at the points. The target year of the demand projection are set in 1983 (present condition), 1985, 1990, 1995, 2000 and 2005. As for irrigation water supply, the demand is projected on 10-day basis.

The domestic and industrial water demand in the Region is discussed in ANNEX B "DOMESTIC AND INDUSTRIAL WATER SUPPLY". The projected D&I water demand in the Region is tabulated by district in Tables 2 and 3. Based on this table, the water demand at each intake point is estimated for the target years as shown in Table 4. In order to estimate the water demand at each intake point the following assumptions were applied:

(1) PUB intakes Res 8 (Gunong Pulai), R31 (Skudai) and R32 (Tebrau) draw off water in the same volume as the present abstraction in 1983.

(2) A new intake R42 of PWD will be constructed by 1990 near Kg. Tai Hong a little upstream of PUB Kota Tinggi intake (R41) to abstract the water which exceeds the prsent intake capacity of 160 Mgd.

(3) PWD tapps 5.8 Mld of water from the Gunong Pulai System and 104 Mld of water from the system of PUB Kota Tinggi (R41) except for 115 Mld in 1983.

2.2.2 Water supply to Singapore

The abstraction by the PUB is assumed two different cases. One is the case that it will reach 250 Mgd in 1995 and it will be kept consttant thereafter. The other is the case that it will reach 160 Mgd in 1990 and it is kept constant thereafter. The demand for the years between 1985 and 1990 for both cases and ones for the years between 1990 and 1995 were interporated by the figures estimated in proportion to the whole water demand of Singapore. The amount of supply to Singapore from 1983 to 2005 is summarized in Table 5.

2.2.3 Case study for water supply and demand balance

As mentioned in Section 2.2.2, the water abstraction from the Johor river by Singapore is assumed by two cases. In addition, two types of development of water facilities are contemplated. One is joint development. The other is solo development. The alternative cases for water balance and resources development study are summarized as below:

Case 1: The abstraction by the PUB will reach 266 x 10^6 m^3/y or 160 Mgd in 1990 and 415 x 10^6 m^3/y or 250 Mgd in 1995. After 1995, the abstraction is kept constant of 250 Mgd up to 2005. The water resources and supply facilities are to meet water demand in both the State and Singapore.

Case 1a: The abstraction amount is the same as that in Case 1. However, water resources facilities are developed only to secure the water supply to the State of Johor but water deficit of Singapore is not looked after.

Case 2: The abstraction by the PUB will reach 160 Mgd in 1990. After 1990, the abstraction is kept constant of 160 Mgd. The water resources and supply facilities are developed to meet the water deficits of both the State and Singapore.

Case 2a: The abstraction by the PUB is the same as that in case 2. However, water resources and supply facilities are developed only to secure the water supply to the State of Johor but water deficit in Singapore is not looked after.

2.2.4 River maintenance flow

The river maintenance flow is the minimum discharge which is required to maintain water depth, flow velocity, water quality, channel stability, aquatic eco-system and scenery to the extent necessary for navigation, fish catch, operation and maintenance of intakes, maintenance of river facilities, sea water repulsion, prevention of estuary clogging, conservation of groundwater, preservation of reparian land and people's amenity.

The river maintenance flow is the indicator of the allowable limit of water withdrawal from the river, to be considered in allocating and developing water resources.

No special environmental problem due to drought has been recorded in the Region except for the Johor river. A simulation study on the water quality was performed for each river assuming a low flow of 99% in probability of exceedance and the projected future BOD concentration load to the river (See ANNEX F). If the result of the simulation study entails a BOD concentration less than 5 mg/l at an intake point for water supply or less than 10 mg/l in the river flow, the low flow of 99% in probability of exceedance was adopted as the river maintenance flow of the river.

For the Benut river, the river water quality is considered to be the decisive item to the river maintenance flow of this river. The river water quality is herein represented by the concentration of BOD. In 2005, the BOD load is estimated at 0.92 ton/d in the downstream reach which is the most critical in terms of water quality along the river. Hydrological data shows that flow of 99% in probability of exceedance is 2.3 m^3/s in the same reach. A result of a simulation study on BOD concentration attested that the BOD concentration at the Simpang Renggam intake was 2.1 mg/l and one in the downstream reach was 7.6 mg/l in the case that river is 99% in probability of exceedance. In this respect, the specific discharge of 0.4 $m^3/s/100$ km^2 or flow of 99% probability of exceedance is proposed as the river maintenance flow.

A similar simulation study entailed that the concentration of BOD is 9.7 mg/l for the Pontian Besar river and 5.6 mg/l for the Pulai river at the most critical site of each river in 2005 if the flow with 99% dependability is adopted as the river maintenance flow. The adopted are 0.51 $m^3/s/100$ km^2 for the Pontian Besar river and 0.33 $m^3/s/100$ km^2 for the Pulai river.

The BOD concentration of 16.4 mg/l is derived by means of the same simulation for the Pontian Kechil river in its river mouth in

2005 in case the flow with 99% dependability is adopted as the river maintenance flow assuming that whole effluent is drained into the river. However at least a half of the effluent of Pontian Kechil town would be discharged directly to the sea. And thereby the concentration is expected to be decreased to 9.2 mg/l.

The land use in the Sedili Besar and the Sedili Kechil river basins are not intensive at present. The BOD concentration of 2 mg/l and 0.3 mg/l are estimated for the Sedili Besar river and the Sedili Kechil river against the river maintenance flow with dependability of 99%. The flow equivalent to the flow with 99% exceedance probability is adopted as the river maintenance flow of both rivers considering future development in the river basins.

It is reported that the pumps in the PUB's intake located near Kota Tinggi shut down once on April 21th, 1983 for the first time due to high salinity caused by sea water intrusion. The water quality has been monitored at the highway bridge site a little downstream from the intake point. On that occasion the runoff at the intake site is estimated at 4.1 m^3/s and the withdrawal at the PUB's intake was 60 Mgd or 3.2 m^3/s. The eventual runoff at the highway bridge is estimated at 0.9 m^3/s. Another minimum flow series was observed on January 2, 1981. The minimum runoff at the intake point was estimated at 5.6 m^3/s and the withdrawal at the PUB's intake was 60 Mgd or 3.2 m^3/s. The eventual runoff at the highway bridge is estimated at 2.4 m^3/s. Pumping was not disturbed by saline water on this occasion. Considering these facts, the runoff of 2.4 m^3/s or specific discharge of 0.15 $m^3/s/100\ km^2$ is contemplated as the safe discharge against saline water intrusion.

Though the conditions of water withdrawal at the pump station is not known, another minimum flow of 2.4 m^3/s is assumably occurred in 1976. And no distinctive effect on the river nor the environment has been recorded. The simulation sutdy on the BOD concentration resulted in 9 mg/l in 2005 assuming the discharge of 2.4 m^3/s. In consequence, the specific discharge of 0.15 $m^3/s/100\ km^2$ is adopted as the river maintenance flow of the Johor river.

The BOD concentration of 10 mg/l is derived at the upper reach of Skudai river by the simulation study in case that 0.33 $m^3/s/100\ km^2$ or the runoff with dependability of 99% is adopted as the river maintenance flow in 2005. While that in the Tebrau river is less than 1 mg/l. The results of the simulation imply that sewerage system is necessary in the Skudai river basin.

3. SOURCE FACILITIES

3.1 Existing Source Facilities

There are five dams and 16 intakes in the Region. The Layang river, a tributary of the Johor river, Layang dam is under construction and is expected to be completed in 1985. In the South Johor region, eight dams are comtemplated in the South Johor Regional Water Resources Study. The locations of existing and proposed damsites, intake and pipeline route are illustrated in Fig. 2. The Macap is one of them and constructed by DID Lebam dam is operated by PWD. The Macap dam is located in the Macap river, a tributary of the Benut river. The catchment area is 78 km^2 and the active storage capacity is 31 x 10^6 m^3. The primary purpose of the Macap dam is flood detention. However it is also utilized to impound water for domestic and industrial water supply. The supply capacity thereof is 16.6 x 10^6 m^3 or 10 Mgd. Dam is used also to power generation of a mini-hydroelectric scheme (approximately 50 KW) by NEB. The Lebam dam located in the Lebam river is operated for the purpose of domestic and industrial water supply. The catchment area thereof is 18 km^2.

PWD has 14 intakes in the Region. In 1983, PWD supplied the treated water of 72.5 x 10^6 m^3 (198.6 Mld) to the Region. Among them, 44 x 10^6 m^3 (120.5 Mld) is water tapped from PUB system.

The three dams in the Gunong Pulai area are owned and are operated by PUB of Singapore. One of the three dams is located in the Pontian Kechil river and the other two dams are located in the Pulai river with intakes. Those intakes are connected by pipelines and called Gunong Pulai dam system. The purpose of the Gunong Pulai dam system is to supply domestic and industrial water to Singapore. PUB possesses four intakes located in the Gunong Pulai damsite, in the Skudai, Tebrau and Johor river near Kota Tinggi. PUB abstracted raw water totalling 145 x 10^6 m^3 (397 Mld) from the Gunong Pulai, Skudai and Tebrau intakes and 99 x 10^6 m^3 (271 Mld) from the Johor intake in 1983. An abstraction record of raw water by PUB is shown in Table 6.

All these facilities were incorporated in the demand and supply balance study.

3.2 On-Going Source Development Plan

In addition to the existing water source or intake facilities, there are several development schemes which are either committed for implementation thereof or under construction. A source development project of Layang Scheme (Ia) is under construction. Further source development projects of the Layang Scheme (Ib), Kluang Scheme State I, and Simpang Renggam Scheme Stage I are under planning and the implementation thereof is committed by PWD.

(1) Layang Scheme (Ia)

The first phase of the Johor Bahru New Water Supply Scheme undertaken by PWD is called the Layang Scheme Ia. Upper Layang dam together with experimental estuary barrage are scheduled to be completed in the upstream of the Layang river by 1985 (Ref. 1). The furnished supply capacity is 104 Mld or 23 Mgd. A treatment plant with a capacity of 180.8 Mld (40 Mgd) will also be constructed.

(2) Layang Scheme (Ib)

The second phase of the Johor Bahru New Water Scheme undertaken by PWD is called the Layang Scheme (Ib).

Under the Layang scheme (Ib), a pump station in the upstream reach of Chabang Tiram river, a tributary of the Johor river, low lift pumps at the estuary barrage and water way between the pump station and the Layang dam will be constructed by 1986. Thereby the increased supply capacity of Layang dam by 76.7 Mld (17 Mgd) is envisaged. Consequently the water supply capacity of the Layang scheme will be 180.8 Mld (40 Mgd).

Main supply areas of Layang scheme are Johor Bahru, Ulu Tiram, Senai and Pasir Gudang.

(3) Kluang Scheme Stage I

The main purpose of the Kluang Scheme Stage I is to supply water to Kluang district up to year 1995. Renggam, Sayong and Layang Layang in the Region form the southernmost part of the district and are included in the target area of water supply by the scheme. A treatment plant with a capacity of 80 Mld will be withdrawn from the Semberong dam to supply the impounded water. At the same time, a ground water project with an estimated yield of 10 Mld will be developed at the Kahang river flood plain. The scheme will supply 0.27 Mld to Sayong, 4.1 Mld to Renggam and 3.0 Mld to Layang Layang by 1987 (Ref. 2).

(4) Simpang Renggam Scheme Stage I

In the Simpang Renggam Scheme Stage I a treatment plant with a capacity of 25 Mld will be constructed in the upstream reach of the Benut river by 1990, in order to abstract released water from Macap dam for the water supply in the Pontian district and a part of Kluang district.

All these on-going schemes were incorporated in this demand and supply balance study.

3.3 Proposed Dam Project

Various suitable damsites were identified in the Region and eight of them were envisaged in the this Study. They are the Benut, Pontian Besar, Linggiu, Upper Pengli, Sayong, Telor, Sedili and Layau Kiri dams. Table 7 shows the principal features of these dams.

In addition to dams three estuary barrages were also implicated in the candidates of source facilities. They are the extension of Layang barrage, Sg. Pendas and Seng Heng barrages.

The Benut damsite is located in the main stream of the Benut river, 4 km upstream from Kg. Ulu Benut. The catchment area is 37 km^2 and the annual inflow is estimated to be 33 x 10^6 m^3 on an average based on the generated data for 22 years from 1963 to 1984. The effective storage capacity is 10 x 10^6 m^3 in case that the normal HWL of the reservoir is assumed at EL. 26.7 m.

The pontian Besar damsite is located in the main stream of the Pontian Besar river, 2.5 km northwest of Kg. Bukit Batu. Annual inflow discharge from catchment area of 40 km^2 is estimated to be 41 x 10^6 m^3. The effective storage capacity is 8 x 10^6 m^3, in case that the normal HWL is set at EL. 18.6 m.

The Linggiu damsite is located in the Linggiu river, 15 km upstream from the confluence of the Johor river and the Linggiu river. The average annual inflow from the catchment area of 206 km^2 is estimated to be 216 x 10^6 m^3. The effective storage capacity is 58 x 10^6 m^3 under the condition of EL 31.0 m of the normal HWL of the reservoir.

The Upper Pengli damsite is located in the Pengli river, about 10 km upstream from the confluence of the Sayong and the Pengli rivers. The catchment area is 127 km^2 and the annual average inflow is estimated to be 126 x 10^6 m^3. The effective storage capacity is 36 x 10^6 m^3 for the normal HWL of EL. 36.0 m.

The Sayong damsite is located in the Sayong river, 0.5 km upstream from the confluence of the Sayong and Linggiu rivers. The average annual inflow from the catchment area of 662 km^2 is estimated to be 655 x 10^6 m^3. The effective storage capacity is 128 x 10^6 m^3 in case that the normal HWL is EL. 18.0 m.

The Telor damsite is located in the Telor river, approximately 6 km upstream from the confluence of the Johor and the Telor rivers. The catchment area is 38 km^2 collecting the average annual runoff of 43 x 10^6 m^3. The effective storage capacity is set at 30 x 10^6 m^3 if the normal HWL is EL. 26.0 m.

The Sedili damsite is located in the main stream of the Sedili Besar river, 3 km upstream from the bridge over the river on the national highway connecting Kota Tinggi and Mersing. The catchment area is 224 km^2 and the average annual inflow from catchment area is estimated to be 290 x 10^6 m^3. The effective storage capacity is 61 x 10^6 m^3 if the normal HWL is set at EL. 20.0 m.

The Layau Kiri damsite is located in the Layau Kiri river, a tributary of the Lebam river, 10 km upstream of the confluence of the Layau Kiri river and the Lebam river. The average annual inflow from the catchment of 31 km^2 is estimated to be 38 x 10^6 m^3. The effective storage capacity is 11 x 10^6 m^3 in case that the normal HWL is EL. 16.5 m.

4. RIVER BASIN MODEL

4.1 General

The water demand and supply balance study on the basis of the 5-day natural runoff was carried out for each river system located water resources facility. The river flow was expressed mathematically establishing a model at each intake point, damsite and confluence. Thereby the balance of inflow, outflow and withdrawal were calculated. The model established are nine for tributaries and six for mainstreams in the Region. The schematic river models utilized for water demand and supply balance study is shown in Fig. 3.

Inflow data for mainstream model are the discharge from tributaries, natural flow from the remaining catchment area (See ANNEX D) and return flow of once withdrawn water in the upstream reach. At each point where the model is established, river maintenance flow was discharged to the downstream reach. ANNEX D discussed the river maintenance flow. Withdrawal is the water demand projected in ANNEX B. In case that high BOD concentration is presumed at certain stretch, treatment facilities for sewerage water is proposed. Detailed criteria of BOD and treatment method is explained in detail in ANNEX F.

The balance at a point where a model is established is basically expressed by the equation shown below:

$$B = (O1+O2+R+T)-(W+D)$$

where, B: Balance at the point

O1: Outflow from the upstream reach

O2: Outflow from the upstream tributary

R: Runoff from the remnant catchment area

T: Return flow

W: Withdrawal

D: Discharge to the downstream reach

For each river, the balances in the tributaries were calculated first and then the balance in the mainstream was calculated applying the balances in the tributaries thus obtained. The models for a mainstream and a tributaries are depicted in Fig. 4 and Fig. 5.

4.2 Benut-Pontian River Basin

The Benut-Pontian Basin is located in the western part of the Region. This basin was represented by three main stream models which are Benut, Pontian Besar and Pontian Kechil river model. This basin has three intake points for D&I water supply and an intake point for Ulu Benut irrigation scheme. The Benut river is divided into five stretches. The Pontian Besar river is divided into three stretches. The Benut river model has six balance points which are Macap and Benut damsites, two intake points (for irrigation and D&I water supply), confluence of Macap river and estuary of the river. Pontian Besar river model has four balance points which are Pontian Besar damsite, two intake points (for D&I water supply) and estuary. Pontian Kechil river model has only one balance point at estuary because no intake exists along this river.

4.3 Skudai-Tebrau River Basin

This basin was expressed by three main stream models which are Pulai, Skudai and Tebrau river model. This basin has two intake points for D&I water supply by PUB. The Tebrau river and Skudai river models has each two balance points which are an intake point for D&I water supply for Singapore (PUB) and estuary. The Pulai river model has only one balance point at estuary. This river model was constructed only for water quality control study such as Pontian Kechil river model.

4.4 Johor River Basin

This basin was expressed by one main stream model, eight tributary models and one tributary model (Rengit river model) which directly flows into South China Sea. This basin has ten intake points for D&I water supply, of which one intake point is owned by PUB to Singapore, and an intake point for Lukut irrigation scheme. The mainstream model of the Johor river has three intake points (including PUB intake R41). Further new intake is recommended to abstract water at Kg. Tai Hong (R42) nearly 1.5 km upstream from the PUB intake in order to abstract water if the demand exceeds the existing 160 Mgd. In the water deficit calculation, total abstraction volume of Malaysia and Singapore is loaded on R41 and R42. The balance point consists of three hydrological stations and five proposed damsites (Sayong, Upper Pengli, Linggiu, Telor and Layau Kiri), two existing dams (Layang and Lebam), 10 intakes (nine for D&I water supply and one for irrigation water use) and confluences of nine tributary models.

4.5 Sedili River Basin

This basin model consists of two main stream models which are Sedili Besar and Sedili Kechil river models. The basin has only one intake point in the Gembot river for D&I water supply. The Sedili Besar river is divided into five stretches. Balance points in the Sedili Besar River Model are Sedili damsite, an intake point in R. Gembot (R36), major confluences and estuary. Sedili Kechil river model has only one balance point at estuary.

5. WATER DEFICIT

5.1 Basic Concept

The objective of the water deficit calculation is to examine the capability of the natural runoff to supply water for D&I and irrigation water demand in the Region by means of a simulation method. Water demand and supply system in the Region is illustrated in Plate 1.

As stated in Chapter 4, the simulation model consists of a tributary and a main model. The tributary model computes deficit at intakes along the tributary and surplus runoff running into the main stream. The main model computes water supply and demand balance at arbitrary location of the mainstream. The available runoff is the discharge from tributaries, the natural flow from own catchment area of along the mainstream and return flow from outlets along the mainstream. The mechanism of tributary and mainstream models are illustrated in Figs. 4 and 5.

The water deficit calculation is carried out for the target years of 1983, 1985, 1990, 1995, 2000 and 2005. While the estimated river runoff for the period of 1963 to 1984 were used as the natural runoff.

5.2 Water Balance at Intake

(1) Benut-Pontian river basin

Natural runoff at Simpang Renggam intake (R24) showing with water demand in 1983, 1995 and 2005 is illustrated in Figs. 6 and 7. Water deficit at the intake is estimated at 3 x 10^6 m^3/y in 1990 and 17 x 10^6 m^3/y in 2005 under the hydrological condition of 1971. This deficit is mainly caused by rapid increase in domestic and industrial water demand in urban areas in the west coast of the Region. However PWD's Simpang Renggam Scheme Stage I and II augments the natural flow and the deficit becomes zero up to 2005.

(2) Skudai-Tebrau river basin

It is considered that the abstraction at PUB intakes in the Skudai and Tebrau rivers will not extend beyond the present capacity because the present abstraction is already reached to the potentials of both rivers. Further according to the present agreement concluded between Malaysia and Singapore in 1961, water resources development by Malaysia is restricted. Thus, future abstraction at the intakes is assumed same value of the one in 1985 up to 2005. Based on this assumption, water deficit is calculated 16 x 10^6 m^3/y and 33 x 10^6 m^3/y at the Skudai and Tebrau rivers respectively.

(3) Johor River Basin

Water deficit at intake, R25, located at the upstream of the Sayong river is projected at 0.4 against the water demand in 1995 and 1.6 x 10^6 m^3/y against the demand in 2005. At intake R26 in Layang Layang, the deficit is estimated 0.1 x 10^6 m^3/y and 0.2 x 10^6 m^3/y against water demand in 1995 and 2005. The main demand center of these intakes are urbanized area of Renggam and Layang Layang. These deficits were well supplemented by the water to be transferred from Kuluang Scheme. And consequent deficit becomes zero upto 2005. Water deficit at two intakes, R39 and R40, along the Pengli and Linggiu rivers are 1.8 x 10^6 m^3/y and 0.2 x 10^6 m^3/y against water demand in 2005 respectively. The estimated water deficit at these two intakes are small in comparison with the value at R41 in Kota Tinggi.

Water demand in Towns of Johor Bahru, Senai, Kulai, Tebrau and Masai incurs the largest water deficit in the Johor river at R41 and hypothetical intake R42 together with abstraction by Singapore.

5-day natural runoff at Kota Tinggi (R41) for the period of 22 years from 1963 to 1984 is illustrated in Figs. 8 to 10 against water demand of 1983, 1995 and 2005. In these figures water deficit is expressed in the enclosed area of the histogram below the demand line. Although a new intake is recommended at Kg. Tai Hong located at 1.5 km upstream from PUB intake, the water balance based on the total water abstraction of Malaysia and Singapore is calculated integrated at Kota Tinggi.

The estimated total deficit is 5 x 10^6 m^3/y in 1985 for both Cases 1 and 2 assuming that the hydrological condition experienced in 1971 would recur. In year 1995, the deficit will increase to 74 x 10^6 m^3/y for Case 1, 28 x 10^6 m^3/y for Case 2, 19 x 10^6 m^3/y for Case 1-A and 10 x 10^6 m^3/y for Case 2-A. In year 2005, they will increase to 144 x 10^6 m^3/y for Case 1, 69 x 10^6 m^3/y for Case 2, 86 x 10^6 m^3/y for Case 1-A and 52 x 10^6 m^3/y for Case 2-A. The monthly water deficit at Kota Tinggi (R41 & R42) estimated based on the accumulated water abstraction against water demand of target year 1983, 1985, 1990, 1995, 2000 and 2005 are tabulated in Table 8 to 10.

(4) Sedili river basin

The water deficit at the intake of Telok Mahkota located at a tributary of the Sedili Besar river is estimated to be 0.9 against the demand of 2005.

5.3 Summary of Water Deficit

Water deficit at Kota Tinggi in hydrological year 1971-1972 and 1976-1977 are illustrated for Case 1 and 2 in the top and middle figures in Fig. 11. Two hydrographs without dam and with Sayong and Linggiu dams in the figures are drawn assuming that runoff from upper reach of the dams is completely shut at the damsites. As for determination of scale of dam, an effective storage volume shall be set to supply water against the water deficit identified by the hydrograph with dams.

Further, in case of water resources development by Malaysia alone, water deficit due to the abstraction by Malaysia and Singapore can be separately estimated. The bottom figure of Fig. 11 shows the water deficit to be sufficed by both Governments against hydrological condition of 1971-1972. In the figure water deficit of Singapore is identified as the enclosed area by the hydrograph of natural flow and Singapore's own demand line. On the other hand water deficit caused by the construction of dam by Malaysia is identified as the remaining area of the deficit by the total water abstraction of Malaysia and Singapore.

Trend of the demand of Case 1 and Case 2 and calculated water deficit for four study cases of Case 1, 2 and Case 1-A, 2-A is illustrated in Fig. 12. The maximum and mean water deficit during the period from 1963 to 1984 at all intake points is summarized in Table 11 by each target year.

6. RESERVOIR OPERATION

6.1 Basic Concept

The objective of reservoir operation study is to evaluate net water output of the proposed dams to supplement water deficit calculated based on 22 years hydrological data from 1963 to 1984. Net water output is defined as regulated outflow from a dam to supplement water deficit downstream of the dam. It is assumed that the dam releases impounded water to the downstream in accordance with the deficit in the contemplated demand area.

As mentioned in previous chapter, it is clarified that the largest water deficit will recur in Johor river basin. Among other river basins, a comparatively large water deficit is estimated in the Benut river basin if Simpang Renggam Scheme Stage I and II are not realized. Thus, reservoir operation study was carried out at the Johor and the Benut river basin.

6.2 Procedure of Reservoir Water Balance

Basic flow of the reservoir operation is schematically shown in Fig. 13.

(1) The water balance of reservoir during a 5-day period is given by the following equation:

$$Send = Sbig + Qin - Qout - Sp - Ep$$

where, Send: Reservoir storage at the end of the 5-day period
Sbig: Reservoir storage at the beginning of the period
Qin: Inflow to the reservoir during the period
Qout: Outflow from the reservoir during the period
Sp: Spillout discharge during the period, if any
Ep: Evaporation from the reservoir water surface during the period

(2) Inflow to the reservoir consists of two sources. One is the surface runoff from the catchment area of the damsite except the reservoir surface area and the other is rainfall on the reservoir surface. Evaporation rate was referred to the potential open water evaporation rate summarized in DID study report (Ref. 4). Table 11 shows the monthly rate of open water evaporation of Benut-Pontian and Johor river basins.

(3) The release from the reservoir coincides with the water deficit in the contemplated downstream demand area. Conveyance loss of the surface runoff from existing and proposed reservoirs to intakes is assumed 10% of water released from the reservoir.

(4) River maintenance flow in each major river is set in ANNEX D. Based on the analysis of low flow data at Kg. Rantau Panjang, the volume at R41 intake site was set 2.4 m^3/s at the Johor river and 99% dependable discharge at the Benut river. In the reservoir operation procedure, maintenance flow is firstly deducted from inflow discharge. In case that total inflow discharge is insufficient to secure the river maintenance flow, water stored in reservoir is the released if the water level is above Low Water Level.

(5) The excess water is discharged through the spillway if the water level becomes higher than HWL.

6.3 Reservoir Operation of Existing Dam in Benut River Basin

Through the water balance study, water deficit at intake R24 near Simpang Renggam is estimated at 17 x 10^6 m^3 in hydrological year 1976 against demand in 2005. In this conformity the reservoir operation of the Macap dam is examined. Schematic diagram for reservoir operation in the Benut river is shown in Fig. 14.

The Macap dam located along the Macap river, a tributary of the Benut river, is operated as a multipurpose dam project controlled under the Johor State DID. The function of the dam is flood control, water supply and hydropower generation. The catchment area is 78 km^2 and its effective storage volume for water supply is 13 x 10^6 m^3. A river outlet with capacity 0.52 m^3/s is provided. A hydropower generating facility with generating capacity of 50 kw is installed. Though plant discharge for power generation is not specified in a hydrological report of the Macap Dam (Ref. 5), the intake capacity for power generation is considered to be 1.0 m^3/s on the basis of the drawing attached. Accordingly total outflow capacity is accounted 1.52 m^3/s. The principal feature of the Macap dam is given in Table 13.

Because no observed runoff record is available in the Benut river basin, the tank model developed at Kg. Rantau Panjang (R. Johor) was utilized for generating runoff in this basin. Average daily rainfall in the catchment area from 1963 to 1984 were applied in the Tank Model. The natural 5-day runoff at the Macap dam for simulation period of 22 years is thus obtained and tabulated in Tables 14 to 16.

The impounded water in the reservoir is released to supplement the deficit at Simpang Renggam up to 1.52 m^3/s without condition if the reservoir water could afford it. In other words, it is assumed to put first priority on water supply to utilize the reservoir water.

Tables 17 and 18 show the result of the reservoir operation of the Macap dam under the hydrological condition from January to December in 1971 against demand in 2005. Remaining deficit at Simpang Renggam occurs once between Jul. 16 to Aug. 10 in the whole simulation period though the reservoir water is released. Water deficit of 1.2 x 10^6 m^3 was entailed during the period between Jul. 21-25 against the demand in 2005. However this amount is considered to be negligible in the light of the accuracy of the Study.

6.4 Reservoir Operation of Dams in Johor River Basin

The operation procedure shown in Fig. 13 was applied to the assumed reservoir which is provided by the first dam in simulation study on the demand and supply balance. Natural runoff at the dam was generated for 22 years by the Tank Model working out at Kg. Rantau Panjang, Jam. Johor

Tenggara and Ran. Tanah Jengeli hydrological stations. Annual supply capacity of a dam was obtained for each assumed effective storage volume. If a significant deficit is entailed by the simulation study, the second dam is introduced to supplement the deficit. In this case some operation rules were testified against the projected demand at the intakes R41 and R42 (Kg. Tai Hong). The operation procedure in the Johor river is schematically shown in Fig. 15. The operation rule testified are:

(1) Release water from a dam first until the stored water in the reservoir becomes nil and then the second dam starts to release water.

(2) Both dams release water at the same time in proportion to the remaining water in the reservoir.

Through the several trials, it was clarified that second rule had an advantage compared with first one for effective utilization of storage of the reservoir. According to the first rule, second dam will function as for emergency use in drought year. Except severe drought condition, spill-out from second dam will continue. Thus, second rule was applied for examining combination of two dams.

The generated 5-day runoff for 22 years at the proposed damsites, Sayong and Linggiu, are presented in Tables 18 to 23. Tables 24 to 26 shows the result of operation with Sayong and Linggiu dams against estimated water deficit of Case I during hydrological condition from Jan. 1971 to Jun. 1972.

The lowest water level simultaneously occurs when the period of Aug. 6-10, 1971 and then the water levels of both reservoirs recovered upto the High Water Levels at the beginning of 1972.

As the result of the simulation, several comvination of dam listed in Table 27 was testified. The storage of dams can meet the demand up to 2005 without causing deficit.

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5. HYDROLOGICAL STUDIES - MACAP DAM

TABLES

Table 1 ANNUAL NATURAL RUNOFF AT MAJOR WATER SOURCE FACILITIES

Name of Key Station, Dam and Intake	River Basin	Catch-ment Area (km^2)	Annual Rainfall (mm)	Annual Runoff ($10^6 m^3/y$)	Key Station
Kg. Rantau Panjang	Johor	1,130	2,299	1,092	-
Jam. Johor Tenggara	Sayong	624	2,246	576	-
Ran. Tanah Jengeli	Linggiu	209	2,418	216	-
Saleng	Skudai	91	2,354	93	-
Benut	Benut	37	2,193	33	Kg. Rantau Panjang
Pontian Besar	Pontain Besar	40	2,350	41	"
Sayong	Sayong	662	2,312	655	Jam. Johor Tenggara
Upper Pengli	Pengli	127	2,312	126	"
Linggiu	Linggiu	206	2,435	216	Ran Tanah Jengeli
Telor	Telor	38	2,294	37	Kg. Rantau Panjang
Layau Kiri	Lebam	31	2,546	38	"
Sedili	Sedili Besar	224	2,613	290	"
Macap	Benut	78	2,193	70	Kg. Rantau Panjang
Res 8 (G.Pulai,PUB)	Pontian Besar	12	2,490	14	"
Res 9 (Layang)	Layang	31	2,321	31	"
Res 10 (Lebam)	Lebam	18	2,546	22	"
R24	Benut	170	2,193	152	Kg. Rantau Panjang
R25	Sayong	8	2,312	8	Jam. Johor Tenggara
R26	Sayong	98	2,312	97	"
R29	Pontian Besar	160	2,350	163	Kg. Rantau Panjang
R30	Pontian Besar	53	2,350	54	"
R31 (PUB)	Skudai	187	2,379	196	Saleng
R32 (PUB)	Tebrau	118	2,383	124	"
R33	Serai	12	2,321	12	Kg. Rantau Panjang
R34	Panti	8	2,496	9	"
R35	Semangar	46	2,294	45	"
R36	Sedili Besar	78	2,721	109	"
R37	Seluyut	7	2,496	8	"
R38	Rengit	4	2,546	5	"
R39	Pengli	55	2,312	54	Jam. Johor Tenggara
R40	Linggiu	387	2,435	406	Ran. Tanah Jengeli
R41 (PUB)	Johor	1,550	2,496	1,826	Kg. Rantau Panjang

Table 2 PROJECTED D&I WATER DEMAND IN THE REGION BY DISTRICT OF SUPPLY FOR 1983 - 2005 (1/2)

Unit : Mld

DISTRICT NAME	MUKIM NAME	TOWN/RURAL NAME	INTAKE POINT	1983	1985	1990	1995	2000	2005
1.Johor Bahru	Johor Bahru, Pelentong, Tebrau	Johor Bahru	R41/R42	131.9	96.7	84.4	191.0	287.4	472.9
			Res9		61.6	139.7	124.7	108.2	90.1
		Masai & Pasir Gudang	R33 (1983) Res9(1985-)	29.3	32.1	40.8	52.6	64.4	74.2
		TOWN TOTAL		161.2	190.4	264.9	368.3	460.0	637.2
		Rural	R33(1983) Res9(1985-)	4.7	5.5	6.0	6.3	6.6	6.7
	MUKIMS TOTAL			165.9	195.9	270.9	374.6	466.6	643.9
	Pulai, Tg.Kupang	Rural	R42/Res8	2.5	3.3	4.1	4.7	4.9	5.2
	MUKIMS TOTAL			2.5	3.3	4.1	4.7	4.9	5.2
	Senai Kulai, Sedenak	Kulai	R41/R42/Res9	13.0	15.8	25.4	37.4	48.7	82.8
		Senai	R41/R42/Res9			4.7	6.8	9.0	13.2
		Kelapa Sawit	R30				5.8	7.3	10.5
		TOWN TOTAL		13.0	15.8	30.1	50.0	65.0	106.5
		Rural	R30/R41/R42/ RES9	12.3	11.8	11.2	9.7	10.2	10.1
	MUKIMS TOTAL			25.3	27.6	41.3	59.7	75.2	116.6
	Sg.Tiram	Ulu Tiram	R33(1983) Res9(1985-)			5.6	8.2	12.4	20.0
		Rural	R33(1983) Res9(1985-)	3.2	4.1	1.8	2.1	2.1	2.1
	MUKIM TOTAL			3.2	4.1	7.4	10.3	14.5	22.1
DISTRICT URBAN				174.2	206.2	300.6	426.5	537.4	763.7
RURAL				22.7	24.7	23.1	22.7	23.8	24.1
DISTRICT TOTAL				196.9	230.9	323.7	449.2	561.2	787.8
2.Kota Tinggi	Johor Lama, Pa.Timur, Pengerang, Tg.Surat	Ba.Penawan	Res10						9.0
		P4	Res10					6.7	9.5
		P7	Res10				5.8	7.6	10.5
		TOWN TOTAL					5.8	14.3	29.0
		Rural	R37/R38/Res10	7.6	11.6	16.1	16.4	16.4	15.6
	MUKIMS TOTAL			7.6	11.6	16.1	22.2	30.7	44.6
	Kota Tinggi	Kota Tinggi	R34/R41/R42	7.4	9.3	13.1	18.3	24.6	34.9
		Rural	R34/R41/R42	1.9	2.2	3.6	4.6	6.0	6.8
	MUKIM TOTAL			9.3	11.5	16.7	22.9	30.6	41.7
	Sedili Kechil,	P2	R36					6.7	9.5
	Sedili Besar	Rural	R36	0.8	3.1	3.6	5.7	1.9	1.9
	MUKIMS TOTAL			0.8	3.1	3.6	5.7	8.6	11.4
	Ulu Sg.Sedili Besar, Sedili Kambau	Rural	R36	1.1	1.4	2.2	2.7	4.1	4.9
	MUKIMS TOTAL			1.1	1.4	2.2	2.7	4.1	4.9
	Ulu Sg.Johor	Ba.Tenggara	R39		3.6	5.9	9.0	14.2	21.2
		Rural	R35/R39/R40	4.7	4.1	4.9	6.6	7.7	8.5
	MUKIM TOTAL			4.7	7.7	10.8	15.6	21.9	29.7
DISTRICT URBAN				7.4	12.9	19.0	33.2	59.8	94.5
RURAL				16.1	22.4	30.4	36.0	36.1	37.8
DISTRICT TOTAL				23.5	35.3	49.4	69.2	95.9	132.3

Remarks : R42,Hypothetical intake to be provided at Kg. Tai Hong by PWD.

Table 3 PROJECTED D&I WATER DEMAND IN THE REGION BY DISTRICT OF SUPPLY FOR 1983 - 2005 (2/2)

3.Pontian	Api-Api, Ayer Baloi, Benut, Sg.Pinggan	Rural	R24/Res8	4.7	5.2	6.0	7.1	7.9	7.9
	MUKIMS TOTAL			4.7	5.2	6.0	7.1	7.9	7.9
	Pontian,	Pontian Kechil	R24/Res8	12.8	15.6	19.8	34.3	45.1	68.3
	Rimba Terjum	Rural	R29/Res8	2.7	2.8	3.0	3.8	4.1	4.4
	MUKIMS TOTAL			15.5	18.4	22.8	38.1	49.2	72.7
	Jeram Batu	Pekan Nanas	R24/Res8	4.6	4.9	5.3	7.3	7.9	9.6
	Pengkalan-Raja	Rural	R24/Res8	0.8	0.8	0.9	1.4	1.9	1.9
	MUKIMS TOTAL			5.4	5.7	6.2	8.7	9.8	11.5
	Ayer Masin, Serkat, Sg.Karang	Rural	R24/Res8	1.4	1.9	2.2	2.5	2.3	2.8
	MUKIMS TOTAL			1.4	1.9	2.2	2.5	2.3	2.8
DISTRICT URBAN				17.4	20.5	25.1	41.6	53.0	77.9
RURAL				9.6	10.7	12.1	14.8	16.2	17.0
DISTRICT TOTAL				27.0	31.2	37.2	56.4	69.2	94.9
4.Kluang & Mersing	Ulu Benut, Macap	Rural	R24	1.1	1.4	2.2	3.3	4.4	6.3
	MUKIMS TOTAL			1.1	1.4	2.2	3.3	4.4	6.3
	Layang-Layang	Layang-Layang	R26						8.9
		Rural	R26	2.7	3.5	4.5	5.7	7.5	3.3
	MUKIM TOTAL			2.7	3.5	4.5	5.7	7.5	12.2
	Renggam	Renggam	R25						8.9
		Simpang-Renggam	R24						9.0
		TOWN TOTAL							17.9
		Rural	R24/R25	5.6	7.0	8.6	11.8	14.1	7.4
	MUKIM TOTAL			5.6	7.0	8.6	11.8	14.1	25.3
	Mersing	Rural	R36	1.5	1.9	1.9	2.8	2.5	2.5
	MUKIM TOTAL			1.5	1.9	1.9	2.8	2.5	2.5
DISTRICT URBAN									26.8
RURAL				10.9	13.8	17.2	23.6	28.5	19.5
DISTRICT TOTAL				10.9	13.8	17.2	23.6	28.5	46.3
THE REGION	URBAN TOTAL			199.0	239.6	344.7	501.4	650.2	963.0
	RURAL TOTAL			59.3	71.6	82.8	97.0	104.7	98.3
THE REGION TOTAL				258.3	311.2	427.5	598.4	754.8	1,061.3

Table 4 PROJECTED WATER DEMAND BY INTAKE

Unit : 10^6 m^3/y

INTAKE No.	RIVER NAME	1983	1985	1990	1995	2000	2005	REMARKS
R24	Benut	6.1	7.7	11.7	17.6	22.9	35.6	
R25	Sayong	0.7	0.9	1.4	2.1	2.9	4.4	
R26	Sayong	0.4	0.6	1.0	1.4	2.2	4.0	
R29	Pontian Besar	0.7	0.7	0.9	1.1	1.2	1.2	
R30	Pontian Besar	0.9	0.8	1.0	2.7	3.4	4.6	
R31*	Skudai	53.0	53.0	53.0	53.0	53.0	53.0	PUB intake
R32*	Tebrau	70.0	70.0	70.0	70.0	70.0	70.0	PUB intake
R33	Serai	9.2	--	--	--	--	--	
R34	Panti	0.4	0.7	1.1	1.3	1.5	1.6	
R35	Semangar	0.3	0.3	0.4	0.6	0.8	1.0	
R36	Sedili Besar	0.4	1.2	1.8	2.7	4.0	5.4	
R37	Seluyut	0.4	0.8	1.2	1.3	1.3	1.2	
R38	Rengit	0.5	0.6	0.7	0.8	0.9	1.0	
R39	Pengli	0.2	1.4	2.3	3.6	5.6	8.4	
R40	Linggiu	0.2	0.2	0.2	0.4	0.5	0.6	
R41*	Johor	65.7	114.9	227.8	227.8	227.8	227.8	PUB intake
R41**	Johor	41.9	37.9	37.9	37.9	37.9	37.9	PUB intake
R42	Johor	--	--	3.3	49.4	92.4	178.3	Kg.Tai Hong
Res 8*	G.Pulai	19.9	19.9	19.9	19.9	19.9	19.9	PUB intake
Res 8**	G.Pulai	2.1	2.1	2.1	2.1	2.1	2.1	PUB intake
Res 9	Layang	--	34.1	66.4	66.4	66.4	66.4	40MGD supply
Res 10	Lebam	0.3	1.2	2.2	4.5	7.4	12.4	
Private intakes***		21.2	21.9	20.8	21.5	20.9	20.3	
Total		294.5	370.9	527.1	588.1	645.0	757.1	

Remarks ; R42 : Hypothetical intake to be provided at Kg. Tai Hong by PWD
* : Water supply from PUB's intake to Singapore
** : Water supply from PUB's intake to Johor
*** : excluding RESP water demand

Table 5 ASSUMED VOLUME OF ABSTRACTION BY SINGAPORE FROM THE JOHOR RIVER

Unit: MGD

	CASE 1	CASE 2
1983	60	60
1985	92	92
1990	160	160
1995	250	160
2000	250	160
2005	250	160

Table 6 WATER ABSTRACTION RECORD OF RAW WATER BY PUD

Unit: Mld

	Source				
Year	Pulai River	Skudai River	Tebrau River	Johor River	Total
1980	71	153	203	219	646
1981	66	140	159	249	614
1982	66	137	200	274	677
1983	60	145	192	271	668

Source: State PWD (Unpublished)

Table 7 CONDITION OF ALTERNATIVE DAMSITES

SITE CONDITIONS	BENUT	PONTIAL BESAR	LINGGIU	UPPER PENGLI	SAYONG	TELOR	SEDILI	LAYAU KIRI Main	LAYAU KIRI Sub
River System	Benut River	Pontian Besar River	Johor river	Johor River	Johor River	Johor River	Sedili Besar River	Johor River	Johor River
Location of Damsite	1°52'53"N 103°19'44"E	1°44'28"N 103°25'49"E	1°54'27"N 103°41'38"E	1°51'31"N 103°35'34"E	1°48'59"N 103°41'24"E	1°43'00"N 103°47'08"E	2°02'21"N 103°50'42"E	1°35'54"N 104°04'24"E	1°35'30"N 104°06'12"E
Catchment Area	37 Km^2	40 Km^2	206 Km^2	127 Km^2	662 Km^2	38 Km^2	224 Km^2	31 Km^2	
Damsite Topography	Flat and wide valley	Flat and wide valley	Steep left abutment	Flat and wide valley	Gentle slope valley	Gentle slope valley	Rather steep slope on both abutment	Flat and wide valley	
Valley Bottom Width	1.1 Km	1.7 Km	0.4 Km	1.3 Km	0.4 Km	0.6 Km	0.4 Km	1.0 Km	
Geology & Construction Materials 1) Geology	Shale and sandstone of Mesozoic	Shale and sandstone of Mesozoic	Mainly sandstone of Paleozoic, fractured by fault, highly permeable	Semi-consolidated clayey silt of Pleistocene to Pliocene	Flesh tight granite partly weathered	Weathered granite	Phyllite of Paleozoic, moderarely weathered	Weathered granite	
2) Soils	Mostly sandy silt	Silty sand	Clayey to sandy silt	Silty sand	Mainly sandy silt	Sandy silt to silty sand	Sandy silt	Sandy silt to clay	
Scale of Dam and Reservoir									
1) Gross Storage at H.W.L. (m^3)	20×10^6	51×10^6	123×10^6	130×10^6	179×10^6	49×10^6	85×10^6	41×10^6	
2) Effective Storage at H.W.L. (m^3)	18×10^6	48×10^6	107×10^6	120×10^6	128×10^6	46×10^6	61×10^6	38×10^6	
3) High water Level (m)	29.0	25.5	34.0	41.0	18.0	28.0	20.0	22.0	
4) Flood Water Level (m)	31.1	27.3	35.2	43.1	20.1	29.6	21.1	23.8	
5) Dam Height (m)	30	29	32	33	31	29	32	29	27
6) Crest Length (m)	2,000	2,400	560	2,200	1,140	2,200	490	1,600	1,100
7) Dam Volume (m^3)	1.9×10^6	3.1×10^6	0.9×10^6	2.8×10^6	0.8×10^6	0.9×10^6	0.7×10^6	1.3×10^6	0.6×10^6
Land Use in Reservoir Area EL.(m)	31.1	27.3	35.2	43.1	20.1	29.6	21.1	23.8	
1. Rubber (ha)	322	675	-	-	203	-	-	-	
2. Oil Palm (ha)	379	316	-	1,060	1,853	53	-	658	
3. Other Agricultural Land (ha)	-	38	-	-	502	-	-	-	
4. Residential Land (ha)	-	-	-	-	-	-	-	48	
5. Factory Area (ha)	-	64	-	-	-	-	-	-	
6. Forest (ha)	-	254	2,027	1,850	1,747	1,087	2,140	4	
7. Mine (ha)	-	-	73	-	-	-	-	-	
Total Area (ha)	701	1,347	2,100	2,910	4,305	1,140	2,140	710	
8. Houses (nos)	-	89	-	13	33	-	-	66	
9. Road (main) (km)	-	8.2	-	3.6	5.0	-	-	7.6	
10. Transmission Line (km)	-	-	-	-	2.7	-	-	-	
11. Pumping Station (nos)	-	-	-	1	-	-	-	-	
Investment Cost of Dam (M$ 10^6)									
Total Cost	99	163	132	181	132	65	61	117	
(Compensation)	(13)	(35)	(-)	(35)	(55)	(7)	(-)	(19)	
Special Problems		Submerge highway	Permeable foundation		Land acquistion			Lebam dam is enough	

Table 8 MONTHLY WATER DEFICIT AT KOTA TINGGI (R41 & R42) (1/3)

Target year: 1983 Unit: $10^6\ m^3/y$

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1964	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.12*	0.72*	0.84*
1965	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1966	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1967	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1968	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1969	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1970	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1971	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1972	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1973	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1974	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1975	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1976	0.	1.62*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.62*
1977	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1980	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1981	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1982	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1983	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MEAN	0.	0.07	0.	0.	0.	0.	0.	0.	0.	0.	0.01	0.03	0.11

Target year: 1985 Unit: $10^6\ m^3/y$

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1964	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.75*	1.34*	2.09*
1965	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1966	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1967	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1968	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1969	0.	0.	0.07*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.07*
1970	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1971	0.	0.	0.	0.	1.14*	0.	0.	0.	0.	0.	0.	0.	1.14*
1972	0.	0.	0.07*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.07*
1973	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1974	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1975	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1976	0.03*	4.49*	0.30*	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.83*
1977	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1980	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1981	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1982	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1983	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MEAN	0.00	0.20	0.02	0.	0.05	0.	0.	0.	0.	0.	0.03	0.06	0.37

Target year: 1990 Unit: $10^6\ m^3/y$

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	0.	0.	0.	0.	0.	0.	0.26*	0.	0.	0.	0.	0.	0.26*
1964	0.	0.	0.	0.	0.	0.	0.	1.46*	0.	0.45*	3.42*	4.43*	9.75*
1965	0.	0.	2.88*	0.	0.	0.	0.04*	0.	0.	0.	0.	0.	2.93*
1966	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1967	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1968	0.	0.	0.	0.	0.	0.	0.	0.	0.36*	0.	0.	0.	0.36*
1969	0.	0.	6.76*	0.	0.	0.	0.	0.	0.	0.	0.	0.	6.76*
1970	0.	0.	1.09*	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.09*
1971	0.	0.	0.	0.	9.27*	4.38*	2.52*	0.	0.	0.22*	0.	0.	16.39*
1972	0.	0.05*	7.26*	0.	0.	0.	4.34*	2.16*	0.	0.	0.	0.	13.81*
1973	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1974	2.50*	0.	0.79*	0.	0.	0.	0.	0.	0.	0.	0.04*	0.	3.33*
1975	0.	1.66*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.66*
1976	3.99*	13.65*	2.41*	0.	0.	0.	0.	0.	0.	0.	0.	0.	20.06*
1977	0.	0.	0.20*	4.44*	0.95*	0.	0.	0.	0.	0.	0.	0.	5.60*
1978	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1980	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1981	0.	3.54*	0.97*	0.	0.	0.	0.	0.88*	0.	0.	0.	0.	5.39*
1982	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1983	0.	0.	0.04*	0.90*	0.	0.	0.	0.	0.	0.	0.	0.	0.94*
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MEAN	0.29	0.86	1.02	0.24	0.46	0.20	0.33	0.20	0.02	0.03	0.16	0.20	4.01

Table 9 MONTHLY WATER DEFICIT AT KOTA TINGGI (R41 & R42) (2/3)

Target year: 1995 (Case 1) Unit: $10^6\ m^3/y$

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	0.	0.	0.	0.	0.	0.04*	11.32*	0.	3.35*	0.	0.	0.	14.70*
1964	0.56*	0.	0.	0.	0.	4.25*	0.	10.59*	0.40*	5.58*	14.19*	13.50*	49.36*
1965	0.95*	1.89*	18.55*	0.	0.	1.12*	9.54*	0.	2.45*	0.	0.	0.	34.50*
1966	0.	0.	0.	0.39*	0.	0.	0.	0.	0.	0.	0.	0.	0.39*
1967	0.	0.	0.	0.	0.	0.	0.51*	4.74*	0.	0.	0.	0.	5.26*
1968	0.	1.25*	4.19*	0.	0.	0.	0.	1.57*	5.61*	0.	0.	0.	12.82*
1969	0.	5.92*	20.37*	0.	0.	0.	0.	0.02*	0.	0.	0.	0.	26.31*
1970	0.	3.07*	9.10*	0.	0.	0.	0.	0.	0.	0.	0.	0.	12.17*
1971	0.	5.14*	0.	2.03*	26.14*	15.16*	14.55*	0.03*	0.	7.70*	3.62*	0.	74.35*
1972	1.66*	4.57*	24.14*	0.	0.	0.	18.92*	11.65*	0.	0.78*	0.	0.	61.76*
1973	0.	0.49*	0.	0.	0.	0.	0.	0.01*	0.	0.	0.	0.	0.51*
1974	15.47*	3.22*	8.20*	1.40*	0.	0.	0.	6.22*	0.	0.79*	4.04*	0.	40.14*
1975	4.62*	11.50*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	16.12*
1976	15.56*	29.25*	7.83*	0.	0.	2.94*	1.14*	4.14*	4.55*	0.	2.41*	0.	67.81*
1977	0.	0.02*	10.38*	19.79*	3.61*	0.46*	0.63*	3.18*	0.	0.	0.	0.	35.28*
1978	0.	0.89*	0.	0.	0.	0.73*	0.	0.36*	1.25*	0.97*	0.	0.	4.19*
1979	0.	0.34*	0.	0.	1.84*	0.	1.29*	0.84*	0.	0.	0.	0.	4.31*
1980	0.	0.07*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.07*
1981	3.01*	17.89*	10.36*	0.	0.	0.35*	1.98*	10.38*	0.	0.	0.	0.	43.98*
1982	0.	1.63*	0.76*	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.39*
1983	0.	0.61*	7.26*	16.23*	0.	0.22*	0.53*	0.	0.	0.	0.	0.	24.85*
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.39*	0.	0.	0.39*
MEAN	1.90	3.99	5.59	1.72	1.45	1.15	2.74	2.31	0.81	0.75	1.16	0.61	24.18

Target year: 1995 (Case 2) Unit: $10^6\ m^3/y$

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	0.	0.	0.	0.	0.	0.	1.82*	0.	0.	0.	0.	0.	1.82*
1964	0.	0.	0.	0.	0.	0.39*	0.	2.49*	0.	1.78*	6.00*	6.35*	17.01*
1965	0.	0.	5.99*	0.	0.	0.	0.99*	0.	0.10*	0.	0.	0.	7.08*
1966	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1967	0.	0.	0.	0.	0.	0.	0.	0.29*	0.	0.	0.	0.	0.29*
1968	0.	0.	0.33*	0.	0.	0.	0.	0.	1.13*	0.	0.	0.	1.46*
1969	0.	0.46*	10.13*	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.59*
1970	0.	0.22*	2.95*	0.	0.	0.	0.	0.	0.	0.	0.	0.	3.17*
1971	0.	0.01*	0.	0.	13.44*	6.97*	4.57*	0.	0.	0.97*	0.	0.	25.96*
1972	0.	0.70*	11.44*	0.	0.	0.	7.52*	4.15*	0.	0.	0.	0.	23.81*
1973	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1974	5.12*	0.	2.25*	0.	0.	0.	0.	0.	0.	0.	0.72*	0.	8.09*
1975	0.68*	3.95*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.63*
1976	6.40*	17.37*	3.73*	0.	0.	0.	0.	0.	0.	0.	0.36*	0.	27.87*
1977	0.	0.	2.16*	7.80*	1.63*	0.	0.	0.	0.	0.	0.	0.	11.60*
1978	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1980	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1981	0.	6.56*	2.72*	0.	0.	0.	0.	2.40*	0.	0.	0.	0.	11.67*
1982	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1983	0.	0.	1.41*	2.72*	0.	0.	0.	0.	0.	0.	0.	0.	4.13*
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MEAN	0.55	1.33	1.96	0.45	0.49	0.34	0.68	0.42	0.06	0.13	0.32	0.29	7.23

Target year: 2000 (Case 1) Unit: $10^6\ m^3/y$

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	0.	0.47*	0.	0.	0.51*	0.73*	14.53*	0.54*	5.17*	0.	0.	0.	21.95*
1964	1.21*	0.	0.	0.	0.52*	5.90*	0.	13.78*	1.01*	7.16*	16.76*	15.99*	62.33*
1965	1.68*	3.34*	22.40*	0.10*	0.	3.03*	12.83*	0.	3.70*	0.	0.	0.	47.09*
1966	0.	0.16*	0.01*	1.00*	0.	0.	0.	0.	0.	0.	0.	0.	1.17*
1967	0.	0.	0.	0.	0.	0.	1.29*	7.87*	0.	0.	0.	0.	9.17*
1968	0.	2.42*	5.44*	0.	0.	0.	0.	4.16*	7.65*	0.	0.	0.	19.65*
1969	0.	8.78*	23.45*	0.	0.	0.	0.	0.84*	0.	0.	0.	0.	33.06*
1970	0.	4.61*	11.02*	0.	0.	0.	0.	0.	0.27*	0.	0.	0.	15.91*
1971	0.	7.60*	0.	3.32*	29.94*	17.69*	17.78*	0.84*	0.11*	10.16*	7.25*	0.75*	95.45*
1972	2.69*	7.16*	27.93*	0.	0.	0.	22.82*	14.85*	0.18*	1.91*	0.	0.	77.55*
1973	0.	1.78*	0.	0.	0.	0.	0.	0.79*	0.	0.	0.	0.	2.58*
1974	19.46*	4.52*	10.21*	2.04*	0.	0.	0.52*	8.86*	0.	2.14*	6.72*	0.	54.47*
1975	6.97*	14.46*	0.	0.	0.	0.	0.	0.62*	0.	0.52*	0.	0.	22.57*
1976	18.77*	32.73*	9.07*	0.	0.24*	5.10*	2.38*	7.34*	8.51*	0.30*	3.05*	0.	87.27*
1977	0.	0.62*	13.04*	23.51*	5.11*	1.10*	2.47*	0.83*	0.60*	0.	0.	0.	47.28*
1978	0.	1.49*	0.	0.	0.	1.33*	0.	1.68*	1.89*	2.22*	0.	0.	8.60*
1979	0.	1.47*	0.	0.	3.47*	0.50*	2.50*	2.13*	0.	0.49*	0.	0.	10.57*
1980	0.	0.67*	0.23*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.90*
1981	4.42*	21.32*	14.16*	0.	0.	1.00*	3.27*	12.91*	0.	0.	0.	0.	57.08*
1982	0.40*	3.56*	2.02*	0.	0.	0.	0.	0.39*	0.	0.	0.	0.	6.38*
1983	0.	1.39*	11.97*	18.14*	0.	1.00*	1.14*	0.	0.	0.	0.	0.	33.64*
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.17*	0.99*	0.	0.	1.16*
MEAN	2.57	5.39	6.87	2.19	1.81	1.70	3.72	3.58	1.32	1.18	1.56	0.77	32.54

Table 10 MONTHLY WATER DEFICIT AT KOTA TINGGI (R41 & R42) (3/3)

Target year: 2000 (Case 2)

Unit: 10^6 m^3/y

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	0.	0.	0.	0.	0.	0.	4.36*	0.	0.	0.	0.	0.	4.36*
1964	0.	0.	0.	0.	0.	1.41*	0.	4.71*	0.	3.67*	6.57*	8.23*	25.99*
1965	0.	0.	9.70*	0.	0.	0.	3.28*	0.	0.74*	0.	0.	0.	13.73*
1966	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1967	0.	0.	0.	0.	0.	0.	0.	1.24*	0.	0.	0.	0.	1.24*
1968	0.	0.	1.34*	0.	0.	0.	0.	0.	2.37*	0.	0.	0.	3.71*
1969	0.	1.52*	13.21*	0.	0.	0.	0.	0.	0.	0.	0.	0.	14.73*
1970	0.	0.80*	4.88*	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.68*
1971	0.	1.03*	0.	0.50*	17.24*	9.50*	7.22*	0.	0.	2.21*	0.	0.	37.70*
1972	0.	1.34*	15.24*	0.	0.	0.	10.82*	6.08*	0.	0.	0.	0.	33.47*
1973	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1974	8.16*	0.43*	3.65*	0.	0.	0.	0.	1.13*	0.	0.	1.32*	0.	14.69*
1975	1.40*	6.31*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	7.71*
1976	6.97*	20.85*	4.97*	0.	0.	0.	0.	0.	0.	0.	1.00*	0.	35.80*
1977	0.	0.	4.43*	11.22*	2.27*	0.	0.	0.	0.	0.	0.	0.	17.93*
1978	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1980	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1981	0.74*	9.85*	4.70*	0.	0.	0.	0.	4.72*	0.	0.	0.	0.	20.00*
1982	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1983	0.	0.	3.68*	5.64*	0.	0.	0.	0.	0.	0.	0.	0.	9.31*
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MEAN	0.88	1.92	2.98	0.80	0.89	0.50	1.17	0.81	0.14	0.24	0.50	0.37	11.19

Target year: 2005 (Case 1)

Unit: 10^6 m^3/y

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	0.	1.90*	0.43*	0.	3.00*	2.76*	20.67*	2.83*	9.26*	0.	0.	0.	40.84*
1964	2.46*	1.05*	0.	0.	2.03*	11.62*	0.85*	20.26*	2.26*	9.61*	22.67*	20.97*	93.76*
1965	3.86*	7.57*	30.12*	1.35*	0.	6.81*	19.30*	0.	6.67*	0.	0.	0.	75.67*
1966	0.	0.98*	1.75*	2.24*	0.	0.51*	0.98*	0.	0.	0.	0.	0.	6.46*
1967	0.	0.	0.	0.	0.	0.	2.79*	14.39*	0.	1.04*	0.	0.	18.21*
1968	0.	5.51*	7.93*	0.	0.	0.	2.25*	11.53*	11.38*	0.	0.	0.	38.60*
1969	0.	15.77*	30.02*	0.	0.	0.	0.15*	3.34*	0.	0.	0.	0.	49.28*
1970	0.	8.00*	14.80*	0.	0.	0.	0.	0.	2.44*	0.	0.	0.	25.25*
1971	0.	12.63*	1.15*	5.92*	37.66*	23.65*	24.16*	3.37*	1.31*	16.16*	14.63*	3.23*	143.87*
1972	6.30*	13.10*	35.61*	0.	0.	0.	30.45*	21.03*	2.33*	5.72*	0.45*	0.	114.99*
1973	0.	4.27*	0.29*	0.	0.	0.	0.58*	2.92*	0.	1.02*	0.	0.	9.07*
1974	27.09*	7.01*	14.19*	3.28*	0.	0.89*	2.64*	14.94*	0.	6.17*	10.62*	1.72*	88.55*
1975	12.24*	20.55*	0.	0.	0.	0.	0.	1.87*	0.48*	3.74*	0.	0.	38.88*
1976	25.45*	39.61*	11.51*	1.28*	1.73*	12.09*	5.47*	13.56*	15.82*	1.55*	4.29*	0.	132.37*
1977	1.08*	1.87*	18.95*	30.80*	8.19*	2.96*	8.04*	2.07*	2.07*	0.	0.	0.	76.03*
1978	0.	3.96*	0.	0.	0.	2.80*	0.	6.62*	3.74*	5.00*	0.	0.	22.13*
1979	0.	5.25*	0.	0.	7.41*	1.83*	5.93*	4.58*	0.	1.72*	0.	0.	26.72*
1980	0.	3.08*	1.67*	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.76*
1981	7.93*	28.13*	21.66*	0.	0.	2.24*	6.96*	18.86*	0.65*	1.03*	0.	0.	87.47*
1982	1.92*	7.26*	4.51*	0.	0.	0.	0.	2.88*	0.93*	0.	0.	0.	17.50*
1983	0.	4.40*	17.23*	25.46*	0.99*	4.48*	2.38*	0.	0.	0.	0.	0.	55.40*
1984	0.	0.	0.	0.	0.	0.	0.	0.72*	2.60*	3.79*	0.	0.	7.11*
MEAN	4.02	8.72	9.63	3.19	2.77	3.30	6.09	6.62	2.82	2.57	2.39	1.18	53.31

Target year: 2005 (Case 2)

Unit: 10^6 m^3/y

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	0.	0.	0.	0.	0.	0.	10.43*	0.	2.76*	0.	0.	0.	13.19*
1964	0.41*	0.	0.	0.	0.	3.92*	0.	9.94*	0.21*	5.51*	13.50*	12.78*	46.25*
1965	0.72*	1.55*	17.42*	0.	0.	0.72*	8.65*	0.	2.05*	0.	0.	0.	31.11*
1966	0.	0.	0.	0.20*	0.	0.	0.	0.	0.	0.	0.	0.	0.20*
1967	0.	0.	0.	0.	0.	0.	0.33*	4.22*	0.	0.	0.	0.	4.54*
1968	0.	1.01*	3.83*	0.	0.	0.	0.	1.32*	5.24*	0.	0.	0.	11.41*
1969	0.	5.35*	19.43*	0.	0.	0.	0.	0.	0.	0.	0.	0.	24.78*
1970	0.	2.82*	8.57*	0.	0.	0.	0.	0.	0.	0.	0.	0.	11.39*
1971	0.	4.67*	0.	1.70*	24.96*	14.39*	13.52*	0.	0.	6.92*	2.73*	0.	68.88*
1972	1.42*	4.08*	22.91*	0.	0.	0.	17.75*	10.79*	0.	0.68*	0.	0.	57.63*
1973	0.	0.34*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.34*
1974	14.55*	2.92*	7.63*	1.24*	0.	0.	0.	5.39*	0.	0.67*	4.31*	0.	36.71*
1975	4.05*	10.72*	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	14.78*
1976	14.33*	27.73*	7.42*	0.	0.	2.37*	0.77*	3.42*	3.62*	0.	2.25*	0.	61.90*
1977	0.	0.	9.48*	18.52*	3.48*	0.30*	0.34*	0.03*	0.	0.	0.	0.	32.14*
1978	0.	0.69*	0.	0.	0.	0.52*	0.	0.12*	1.13*	0.65*	0.	0.	3.11*
1979	0.	0.18*	0.	0.	1.39*	0.	1.13*	0.48*	0.	0.	0.	0.	3.18*
1980	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1981	2.66*	16.66*	9.22*	0.	0.	0.20*	1.70*	9.69*	0.	0.	0.	0.	40.13*
1982	0.	1.29*	0.41*	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.71*
1983	0.	0.49*	3.60*	13.18*	0.	0.05*	0.34*	0.	0.	0.	0.	0.	22.66*
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.13*	0.	0.	0.13*
MEAN	1.74	3.66	5.23	1.58	1.35	1.02	2.50	2.06	0.68	0.66	1.04	0.58	22.10

Table 11 WATER DEFICIT AT INTAKE POINT

Intake No.	River	1983 MEAN (10^6m^3)	1983 MAX (10^6m^3)	1983 No. of Deficit Year	1985 MEAN (10^6m^3)	1985 MAX (10^6m^3)	1985 No. of Deficit Year	1990 MEAN (10^6m^3)	1990 MAX (10^6m^3)	1990 No. of Deficit Year
R24	BENUT *	0.4	1.1	15	0.5	1.4	17	0.0	0.0	0
R25	SAYONG **	0.0	0.1	6	0.0	0.1	7	0.0	0.2	12
R26	SAYONG **	0.0	0.0	2	0.0	0.0	2	0.0	0.1	2
R29	PONTIAN B.	0.1	0.5	6	0.1	0.5	6	0.1	0.6	7
R30	PONTIAN B.	0.0	0.3	10	0.0	0.2	9	0.0	0.3	10
R31	SKUDAI	5.6	16.1	21	5.6	16.1	21	5.6	16.1	21
R32	TEBRAU	16.4	33.0	22	16.4	33.0	22	16.3	32.9	22
R33	SERAI	2.3	4.3	20						
R34	PANTI	0.0	0.0	0	0.0	0.0	0	0.0	0.0	2
R35	SEMANGAR	0.0	0.0	2	0.0	0.0	2	0.0	0.0	2
R36	SEDILI	0.0	0.3	4	0.0	0.4	7	0.0	0.5	8
R37	SELUYUT	0.0	0.0	2	0.0	0.0	3	0.0	0.1	11
R38	RENGIT	0.0	0.0	6	0.0	0.0	9	0.0	0.0	11
R39	PENGLI	0.0	0.0	2	0.0	0.1	2	0.0	0.1	3
R40	LINGGIU	0.0	0.2	1	0.0	0.2	1	0.0	0.2	1
R41	JOHOR									
	CASE 1	0.1	1.6	3	0.4	4.8	6	4.0	20.1	14
	CASE 2	0.1	1.6	3	0.4	4.8	6	4.0	20.1	14
	CASE 1-A	-	-	-	-	-	-	0.2	0.7	14
	CASE 2-A	-	-	-	-	-	-	0.2	0.7	14
RES 8	G.PULAI	-	-	-	-	-	-	-	-	-
RES 9	LAYANG	-	-	-	-	-	-	-	-	-
RES 10	LEBAM	-	-	-	-	-	-	-	-	-
IRRIGATION SCHEME										
LUKUT		0.2	0.5	20	0.2	0.5	20	0.5	0.8	20
ULU BENUT		0.3	1.0	15	0.3	1.0	15	0.4	1.4	19
TOTAL	CASE 1	26.0	59.0		24.1	58.3		38.9	75.9	
	CASE 2	26.0	59.0		24.1	58.3		28.9	75.9	
	CASE 1-A	-	-		-	-		24.7	56.5	
	CASE 2-A	-	-		-	-		24.7	56.5	

Intake No.	River	1995 MEAN (10^6m^3)	1995 MAX (10^6m^3)	1995 No. of Deficit Year	2000 MEAN (10^6m^3)	2000 MAX (10^6m^3)	2000 No. of Deficit Year	2005 MEAN (10^6m^3)	2005 MAX (10^6m^3)	2005 No. of Deficit Year
R24	BENUT*	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
R25	SAYONG**	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
R26	SAYONG**	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
R29	PONTIAN B.	0.1	0.6	8	0.1	0.6	8	0.1	0.6	8
R30	PONTIAN B.	0.1	0.5	12	0.1	0.6	12	0.2	0.7	14
R31	SKUDAI	5.7	16.2	21	5.7	16.2	21	5.7	16.2	21
R32	TEBRAU	16.4	33.1	22	16.4	33.1	22	16.4	33.1	22
R33	SERAI									
R34	PANTI	0.0	0.0	2	0.0	0.0	2	0.0	0.0	2
R35	SEMANGAR	0.0	0.0	2	0.0	0.0	2	0.0	0.0	2
R36	SEDILI	0.1	0.6	9	0.1	0.7	9	0.1	0.9	11
R37	SELUYUT	0.0	0.1	11	0.0	0.1	11	0.0	0.1	11
R38	RENGIT	0.0	0.1	13	0.0	0.1	14	0.0	0.1	15
R39	PENGLI	0.0	0.3	4	0.1	0.6	7	0.2	1.8	12
R40	LINGGIU	0.0	0.2	1	0.0	0.2	1	0.0	0.2	1
R41	JOHOR									
	CASE 1	24.1	74.4	22	32.6	95.5	22	53.3	143.9	22
	CASE 2	7.3	27.9	15	11.2	37.7	15	22.7	68.9	21
	CASE 1-A	7.0	18.8	22	15.1	39.1	22	34.9	86.0	22
	CASE 2-A	3.3	10.2	15	7.0	21.1	15	17.6	51.6	21
RES 8	G.PULAI	-	-		-	-		-	-	
RES 9	LAYANG	-	-		-	-		-	-	
RES 10	LEBAM	-	-		-	-		-	-	
IRRIGATION SCHEME										
LUKUT		0.5	0.8	20	0.5	0.8	20	0.5	0.8	20
ULU BENUT		0.4	1.4	19	0.4	1.4	19	0.4	1.4	19
TOTAL	CASE 1	51.5	133.9		61.9	158.7		88.9	218.3	
	CASE 2	33.9	87.4		39.6	100.2		57.2	142.4	
	CASE 1-A	33.5	78.3		43.6	101.6		70.1	159.5	
	CASE 2-A	29.6	69.7		35.2	83.6		51.9	125.1	

Remarks: Case 1: Joint Development to meet the assumed water abstraction of Singapore of 250 MGD in 1995
Case 2: Joint Development to meet the assumed water abstraction of Singapore of 160 MGD in 1990
Case 1-A: Development by Malaysia alone to meet the same volume of Case 1
Case 2-A: Development by Malaysia alone to meet the same volume of Case 2
* : Water deficit at R24 after 1990 will be supplemented by Simpang Renggam Scheme Stage I.
** : Water deficit at R25 and R26 after 1995 will be supplemented by Kluang Scheme Stage I.

Table 12 MONTHLY EVAPORATION RATE FOR RESERVOIR OPERATION STUDY

Unit: mm

Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Benut - Pontian	141	139	160	148	145	137	146	138	143	152	139	134	1722
Johor, Sedili	140	132	153	139	138	128	138	141	138	149	136	129	1661

Table 13 PRINCIPAL FEATURE OF MACAP DAM

1. Reservoir

Catchment area	:	77.7 km^2
Reservoir area at EL 18.3 m	:	9.1 km^2
Normal operating level	:	EL 15.8 m
Maximum operating level	:	EL 18.4 m
Total reservoir storage capacity	:	24,800 ac-ft
Storage capacity for sedimentation	:	1,600 ac-ft
Storage capacity for water supply	:	8,400 ac-ft
Storage capacity for flood detention	:	8,400 ac-ft
Storage capacity for surcharge	:	6,400 ac-ft

2. Dam

Type	:	Zoned earthfill
Core material	:	Impervious inorganic clay of high plasticity and elastic silty soil
Shell material	:	Semi-impervious clayey sand, silty sand and silty gravel
Foundation treatment	:	Cutoff trench refilled with impervious material
Slope	:	u/s 1:3 to 8 d/s 1:3 to 8 to 20
Embankment Volume	:	344,000 m^3
Maximum Height	:	EL 9.2 m
Crest level	:	EL 19.8 m
Crest length	:	570 m

Table 14 5-DAY INFLOW DISCHARGE AT MACAP DAM (1/3)

YEAR : 1963 ANNUAL MEAN : 0.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.6	1.1	3.0	1.2	0.7	2.2	0.9	1.0	0.8	2.2	2.0	5.6
6-10	2.8	1.0	1.6	1.0	0.7	2.0	0.8	0.8	0.8	2.8	2.1	4.2
11-15	2.2	0.9	1.3	1.0	0.9	1.7	0.6	0.8	0.7	2.8	2.5	4.0
16-20	1.7	0.5	1.1	1.4	1.4	1.5	0.5	0.6	0.6	2.4	4.4	3.1
21-25	1.3	1.0	0.8	1.1	3.2	1.2	0.4	0.5	0.8	2.1	3.7	3.2
26-END	1.1	5.0	1.4	0.9	3.2	1.0	0.6	0.7	2.3	2.5	4.7	3.6
MEAN	2.1	1.4	1.6	1.1	1.7	1.6	0.6	0.8	1.0	2.5	3.2	4.3

YEAR : 1964 ANNUAL MEAN : 1.6

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.7	2.5	14.9	2.9	5.0	1.5	1.7	3.3	2.0	1.5	3.4	1.9
6-10	2.9	2.2	7.1	3.6	4.9	1.2	1.7	2.5	3.1	1.2	2.9	1.7
11-15	2.3	1.8	9.6	5.5	4.2	1.7	1.5	2.1	2.7	1.5	2.6	1.7
16-20	2.9	1.7	6.1	5.2	3.2	1.5	2.0	2.0	2.6	3.7	2.2	1.8
21-25	4.2	2.7	4.0	5.7	2.6	1.2	2.2	1.7	2.1	5.7	1.9	7.7
26-END	3.3	15.6	3.2	5.8	2.0	1.7	3.4	1.5	1.8	4.4	1.7	7.0
MEAN	3.2	4.0	7.3	4.8	3.6	1.5	2.1	2.2	2.3	3.0	2.5	3.7

YEAR : 1965 ANNUAL MEAN : 0.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.4	0.8	0.8	1.0	1.3	1.8	1.0	0.7	2.0	1.0	4.2	6.1
6-10	3.7	0.6	0.6	1.0	1.5	1.4	1.0	0.8	2.1	0.8	3.5	4.1
11-15	2.8	0.7	0.6	1.1	1.6	1.0	1.0	1.0	1.8	1.7	3.2	4.9
16-20	2.1	0.8	0.5	1.2	3.5	0.8	1.0	1.2	1.5	1.6	4.0	3.7
21-25	1.5	0.8	0.4	1.2	3.3	1.0	0.8	1.5	1.3	2.3	6.5	3.0
26-END	1.1	0.8	0.5	1.2	2.3	1.0	0.8	1.9	1.1	6.2	5.0	2.7
MEAN	2.7	0.8	0.6	1.2	2.3	1.2	1.0	1.2	1.6	2.4	4.4	3.7

YEAR : 1966 ANNUAL MEAN : 0.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.5	1.5	0.7	1.9	2.5	2.5	0.9	0.9	1.5	0.6	1.8	3.2
6-10	2.2	1.3	3.0	2.3	2.1	2.0	1.0	1.0	1.2	0.6	2.2	2.7
11-15	1.8	1.2	2.5	3.1	1.7	1.8	1.0	0.9	1.2	0.9	3.1	4.6
16-20	1.5	1.0	2.6	2.6	1.3	1.6	1.1	1.1	1.0	2.5	2.5	3.1
21-25	1.7	0.8	2.7	3.2	1.2	1.4	1.1	1.3	0.9	2.7	5.0	2.4
26-END	1.8	0.8	2.3	2.8	1.0	1.1	1.0	1.5	0.7	2.0	4.0	2.5
MEAN	1.9	1.1	2.3	2.7	1.6	1.7	1.0	1.1	1.1	1.6	3.1	3.1

YEAR : 1967 ANNUAL MEAN : 1.3

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	4.6	1.8	4.8	1.3	1.9	2.2	1.5	1.1	0.4	0.6	3.6	3.2
6-10	4.0	1.5	3.3	1.2	2.5	1.7	1.4	0.9	0.4	0.6	3.1	2.7
11-15	7.8	2.9	2.5	1.3	2.8	1.4	1.5	0.7	0.4	0.6	3.3	5.1
16-20	5.2	12.0	2.0	1.6	2.3	1.6	1.6	0.5	0.2	0.4	3.6	16.0
21-25	3.4	7.5	1.6	1.7	3.0	1.7	1.5	0.4	0.2	0.4	4.3	7.6
26-END	2.5	5.2	1.7	1.9	2.9	1.7	1.3	0.4	0.6	1.4	4.1	7.2
MEAN	4.5	5.2	2.6	1.5	2.6	1.7	1.5	0.7	0.4	0.7	3.7	7.0

YEAR : 1968 ANNUAL MEAN : 1.2

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	16.2	1.1	0.4	3.3	3.0	2.3	1.4	0.4	0.9	2.4	3.0	3.1
6-10	7.7	1.0	0.4	3.1	2.3	2.1	1.1	0.4	0.7	3.2	3.7	2.9
11-15	4.4	0.8	0.8	2.7	3.6	2.2	0.8	2.1	0.7	4.1	3.5	3.1
16-20	2.9	0.7	2.0	2.2	3.3	2.6	0.7	2.1	1.2	3.4	6.8	4.7
21-25	2.2	0.6	4.5	2.0	3.1	2.0	0.6	1.5	1.8	3.5	4.2	3.1
26-END	1.6	0.6	5.6	2.4	3.0	1.7	0.5	1.1	1.5	3.3	3.2	2.4
MEAN	5.7	0.8	2.4	2.6	3.0	2.2	0.8	1.3	1.1	3.3	4.1	3.2

YEAR : 1969 ANNUAL MEAN : 1.4

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.0	1.5	1.0	1.2	2.5	3.0	2.3	1.2	4.5	1.3	3.7	5.3
6-10	1.7	1.3	1.0	1.5	2.8	2.7	4.5	0.9	3.4	1.7	2.9	12.6
11-15	1.6	1.1	0.5	1.5	2.3	2.3	4.7	1.0	2.7	3.2	2.6	23.1
16-20	1.7	0.6	0.7	1.7	2.0	2.1	3.0	3.5	2.1	3.6	3.1	15.2
21-25	1.7	0.7	0.6	2.6	1.9	1.9	2.2	5.1	1.6	3.8	2.5	8.6
26-END	1.7	0.6	1.2	2.0	1.8	2.0	1.7	5.1	1.4	4.2	2.4	4.8
MEAN	1.7	1.0	0.9	1.7	2.2	2.3	3.0	2.9	2.6	3.0	2.9	11.4

YEAR : 1970 ANNUAL MEAN : 1.4

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.3	1.4	1.0	2.3	3.8	4.3	6.0	3.0	1.2	2.6	2.6	4.3
6-10	2.5	2.7	0.8	2.7	3.2	3.5	4.3	2.8	0.9	4.3	2.3	3.5
11-15	2.2	2.3	0.8	3.1	2.7	2.9	3.2	2.6	0.8	5.5	2.2	3.1
16-20	2.1	1.7	0.8	4.4	3.2	2.4	2.7	2.3	0.6	4.5	4.9	3.0
21-25	1.7	1.4	0.8	5.7	3.6	2.2	3.0	2.0	1.8	3.4	8.0	3.2
26-END	1.0	1.2	2.3	5.3	3.5	3.6	3.4	1.5	2.6	3.0	5.5	3.6
MEAN	2.2	1.8	1.1	3.9	3.4	3.2	3.8	2.3	1.3	3.9	4.3	3.5

Table 15 5-DAY INFLOW DISCHARGE AT MACAP DAM (2/3)

YEAR : 1971 ANNUAL MEAN : 0.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	12.5	1.5	1.2	1.6	0.8	0.8	1.2	0.7	2.1	0.8	0.8	2.5
6-10	11.6	1.1	1.0	1.3	0.6	0.6	1.0	1.0	1.9	0.6	1.0	3.2
11-15	6.2	0.9	1.0	1.8	0.5	0.6	0.9	1.6	1.7	0.5	1.2	5.6
16-20	4.0	0.8	0.6	1.6	0.7	0.6	1.3	2.5	1.5	0.4	1.2	7.6
21-25	3.0	0.7	1.0	1.3	0.8	0.4	1.2	2.6	1.2	1.0	1.2	5.5
26-END	2.2	1.0	1.0	1.1	0.7	0.4	0.9	2.3	1.0	0.8	1.5	4.4
MEAN	6.5	1.0	1.0	1.5	0.7	0.6	1.1	1.8	1.6	0.7	1.2	4.8

YEAR : 1972 ANNUAL MEAN : 1.1

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.3	0.6	1.9	1.5	5.5	2.1	1.7	0.4	1.0	2.5	1.7	4.0
6-10	2.6	1.2	1.5	2.1	3.6	1.8	1.4	0.5	1.2	1.9	2.2	3.7
11-15	2.0	2.0	1.1	2.8	2.6	1.5	1.1	0.6	3.7	1.5	3.7	3.6
16-20	1.4	1.5	0.9	3.1	2.0	1.7	0.8	0.6	4.2	1.0	4.6	3.3
21-25	1.0	3.2	0.8	4.0	1.5	2.0	0.6	0.7	3.5	2.0	4.4	4.5
26-END	0.8	2.4	0.8	8.4	1.5	2.0	0.6	0.8	2.9	2.6	4.5	5.5
MEAN	1.8	1.8	1.1	3.7	2.7	1.9	1.0	0.6	2.8	1.9	3.5	4.1

YEAR : 1973 ANNUAL MEAN : 1.3

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.0	1.9	3.4	2.4	4.0	2.9	2.4	4.0	1.5	2.0	3.1	1.6
6-10	5.4	1.5	2.5	3.3	3.5	2.3	1.9	7.5	1.8	1.6	5.5	1.6
11-15	4.4	1.2	2.1	3.1	3.3	1.9	1.9	4.4	1.7	1.3	3.5	2.0
16-20	3.6	5.8	1.7	3.4	2.8	1.5	1.7	3.0	1.8	1.2	2.8	2.7
21-25	3.1	5.2	1.5	4.9	2.5	1.2	1.6	2.2	2.7	2.5	2.3	2.2
26-END	2.5	4.2	1.6	5.3	2.8	1.2	4.8	1.8	2.5	2.7	2.0	1.8
MEAN	4.0	3.3	2.1	3.7	3.1	1.8	2.4	3.8	2.0	1.9	3.2	2.0

YEAR : 1974 ANNUAL MEAN : 0.7

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	1.4	0.9	1.6	3.3	1.7	1.4	0.4	1.5	1.2	3.8	0.7	1.7
6-10	1.1	1.1	1.1	6.6	1.3	1.1	0.6	1.2	1.2	2.6	0.6	1.5
11-15	0.8	1.0	1.0	5.1	2.1	0.9	0.4	1.1	1.6	2.0	0.8	1.2
16-20	0.6	0.8	0.7	4.5	2.0	0.6	0.4	0.9	2.6	1.5	2.6	1.2
21-25	0.5	1.0	0.5	3.0	2.1	0.5	0.6	0.6	2.5	1.2	3.0	2.0
26-END	0.4	1.8	0.4	2.3	1.7	0.4	1.2	1.2	4.4	0.9	2.0	1.5
MEAN	0.8	1.1	0.8	4.1	1.8	0.8	0.6	1.1	2.3	2.0	1.6	1.5

YEAR : 1975 ANNUAL MEAN : 1.0

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	1.2	1.0	1.7	2.1	2.6	4.6	1.9	1.5	1.5	1.2	2.5	2.2
6-10	1.0	2.0	2.1	2.6	2.0	2.9	1.5	1.4	2.4	1.0	2.3	1.7
11-15	2.1	3.7	1.8	5.5	1.7	2.4	1.2	1.2	2.2	1.0	2.5	1.5
16-20	1.7	2.5	1.6	5.8	1.4	4.3	0.9	1.0	1.8	1.0	3.1	1.2
21-25	1.5	2.0	2.2	4.3	1.2	3.1	1.2	1.0	1.5	1.0	2.6	0.9
26-END	1.2	1.9	1.9	3.2	3.6	2.3	1.7	0.8	1.2	0.8	2.4	0.7
MEAN	1.5	2.2	1.9	3.9	2.1	3.3	1.4	1.2	1.8	1.0	2.6	1.3

YEAR : 1976 ANNUAL MEAN : 0.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	0.6	0.2	0.2	1.9	2.0	0.7	0.6	3.5	1.9	1.8	4.3	2.0
6-10	0.4	0.2	0.7	2.0	1.7	0.5	0.9	2.6	1.6	3.2	4.2	1.6
11-15	0.4	0.2	2.0	1.8	1.6	0.4	2.5	1.8	1.3	5.2	3.8	2.1
16-20	0.4	0.2	3.0	1.5	1.4	0.4	2.7	1.5	1.2	4.7	3.5	4.3
21-25	0.4	0.2	2.0	1.8	1.2	0.5	2.9	1.5	1.1	5.1	2.9	3.4
26-END	0.2	0.2	1.9	2.4	0.9	0.6	4.2	2.6	1.4	5.0	2.4	4.6
MEAN	0.4	0.2	1.6	1.9	1.5	0.5	2.4	2.2	1.4	4.2	3.5	3.0

YEAR : 1977 ANNUAL MEAN : 0.8

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.5	1.0	1.2	0.4	0.2	1.3	0.9	0.9	2.2	9.0	1.7	1.7
6-10	4.1	0.8	1.1	0.4	0.4	1.5	0.6	1.9	2.5	5.8	1.5	1.5
11-15	3.1	0.7	0.9	0.4	1.4	2.1	1.2	1.3	2.0	4.3	1.6	1.2
16-20	2.5	0.6	0.7	0.4	1.6	1.7	1.3	1.5	1.6	3.4	1.7	0.9
21-25	1.8	0.9	0.6	0.4	1.2	1.5	1.0	2.5	1.8	2.7	2.0	0.7
26-END	1.4	1.5	0.4	0.3	1.1	1.2	1.0	2.5	6.4	2.2	2.0	1.9
MEAN	3.0	0.9	0.8	0.4	1.0	1.5	1.0	1.8	2.7	4.5	1.8	1.3

YEAR : 1978 ANNUAL MEAN : 0.8

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.0	1.4	0.5	1.6	1.7	1.9	1.0	0.7	0.6	1.7	2.2	3.7
6-10	3.2	1.0	0.8	1.3	1.7	0.9	1.3	0.5	1.1	1.4	1.9	3.0
11-15	5.0	0.7	0.9	1.3	1.8	0.7	1.6	0.4	1.2	1.2	1.8	3.0
16-20	3.3	0.6	1.0	2.4	1.6	0.6	1.5	0.4	1.0	1.4	1.9	2.5
21-25	2.5	0.4	2.1	2.1	1.5	0.5	1.2	0.4	2.4	2.0	1.7	4.4
26-END	1.9	0.4	1.9	1.7	1.3	0.5	1.0	0.4	2.3	3.0	3.2	3.7
MEAN	2.9	0.8	1.2	1.7	1.6	0.7	1.3	0.5	1.4	1.8	2.1	3.6

Table 16 5-DAY INFLOW DISCHARGE AT MACAP DAM (3/3)

YEAR : 1979 ANNUAL MEAN : 0.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.8	0.7	0.4	2.4	2.5	0.6	1.3	2.2	2.4	1.4	2.2	5.7
6-10	2.9	0.6	0.6	3.1	2.0	0.6	1.1	1.7	2.2	1.1	2.3	3.6
11-15	2.2	0.5	0.8	4.5	1.6	0.8	0.8	1.4	2.3	0.8	2.7	2.6
16-20	1.7	0.4	0.7	3.0	1.3	2.2	0.6	1.1	2.0	0.9	3.0	2.0
21-25	1.3	0.4	0.9	2.4	1.0	2.2	1.0	0.8	1.9	1.7	6.7	1.4
26-END	1.0	0.4	1.2	2.6	0.7	1.6	2.7	2.6	1.6	2.5	10.6	1.0
MEAN	2.0	0.5	0.8	3.0	1.5	1.3	1.3	1.7	2.1	1.4	4.6	2.7

YEAR : 1980 ANNUAL MEAN : 1.0

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	0.7	1.0	0.6	1.2	2.8	2.9	1.0	0.6	1.7	3.3	3.1	4.6
6-10	0.6	0.8	0.6	1.2	3.2	3.2	0.7	0.9	2.3	3.2	3.5	5.7
11-15	0.6	0.7	0.6	1.8	2.5	2.5	0.6	3.2	2.1	3.0	3.0	4.2
16-20	1.1	0.5	0.9	2.7	1.9	2.1	0.4	2.7	1.8	3.1	3.4	3.5
21-25	2.5	0.4	1.0	3.2	1.5	1.7	0.6	2.4	3.9	2.6	5.5	2.9
26-END	1.4	0.6	1.0	2.9	2.6	1.3	0.6	1.9	4.2	2.7	5.7	2.3
MEAN	1.2	0.7	0.6	2.2	2.4	2.3	0.7	2.0	2.7	3.0	4.0	3.8

YEAR : 1981 ANNUAL MEAN : 1.0

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.0	0.7	0.6	1.5	4.6	1.7	0.6	1.3	0.4	1.4	2.6	1.9
6-10	1.7	0.6	0.7	3.1	4.2	1.4	0.4	1.2	0.6	1.2	3.6	2.5
11-15	1.5	0.6	0.8	6.2	3.5	1.1	0.4	1.0	2.0	1.6	2.6	4.0
16-20	1.3	0.6	0.6	5.1	3.0	0.9	0.7	0.7	2.2	1.8	2.0	13.1
21-25	1.1	0.4	0.6	5.6	2.6	0.7	1.4	0.6	1.9	1.6	2.2	6.9
26-END	0.9	0.5	1.0	5.2	2.2	0.6	1.5	0.4	1.7	1.7	2.1	3.7
MEAN	1.4	0.6	0.7	4.5	3.3	1.1	0.9	0.8	1.5	1.6	2.5	5.3

YEAR : 1982 ANNUAL MEAN : 1.0

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.4	0.5	1.0	1.7	2.9	3.8	1.0	1.2	2.0	0.4	4.2	4.4
6-10	1.7	0.4	0.9	3.6	2.3	3.2	0.8	0.9	1.6	0.4	3.7	3.2
11-15	1.3	0.4	1.2	2.6	1.9	2.5	0.7	2.2	1.3	0.4	2.9	2.5
16-20	1.0	0.4	1.7	3.0	1.5	2.1	1.3	4.5	1.0	0.5	2.5	3.0
21-25	0.7	0.9	1.7	3.7	1.2	1.7	1.7	3.1	0.7	1.0	4.1	9.4
26-END	0.6	1.2	1.4	3.5	3.3	1.4	1.4	2.4	0.6	2.3	5.2	5.8
MEAN	1.3	0.6	1.3	3.0	2.2	2.5	1.1	2.4	1.2	0.9	3.8	4.7

YEAR : 1983 ANNUAL MEAN : 0.8

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.4	0.9	0.4	0.2	0.2	1.0	0.4	1.2	2.5	2.5	2.3	1.5
6-10	2.6	0.7	0.4	0.2	0.6	0.8	1.0	1.0	5.5	1.9	2.2	1.2
11-15	2.0	0.6	0.4	0.2	1.5	0.8	2.2	1.3	5.2	1.5	3.6	2.0
16-20	1.7	0.5	0.4	0.2	1.2	0.7	1.9	1.3	4.8	1.1	2.8	1.6
21-25	1.4	0.4	0.2	0.2	1.2	0.6	1.8	3.5	3.8	1.7	2.2	3.0
26-END	1.1	0.4	0.2	0.2	1.2	0.6	1.5	2.4	2.9	2.4	1.8	9.7
MEAN	2.0	0.6	0.3	0.2	1.0	0.8	1.5	1.8	4.1	1.9	2.5	3.4

YEAR : 1984 ANNUAL MEAN : 1.4

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	4.4	7.9	11.4	2.5	3.7	2.1	1.5	1.5	1.0	2.5	2.1	3.3
6-10	2.7	9.4	8.4	3.5	3.8	2.0	1.4	1.2	0.8	2.5	2.6	3.5
11-15	1.8	7.5	4.4	2.7	3.2	2.4	1.4	1.1	0.8	2.1	2.6	2.8
16-20	1.3	6.3	2.9	2.3	2.7	2.3	2.5	0.9	0.8	1.7	3.2	2.2
21-25	1.8	4.4	4.0	2.0	2.4	2.0	2.2	0.9	1.2	1.3	5.5	2.7
26-END	3.6	3.4	2.9	2.5	2.4	1.8	1.7	1.0	2.0	1.5	4.7	3.6
MEAN	2.6	6.6	5.6	2.6	3.0	2.1	1.8	1.1	1.1	1.9	3.3	3.1

Table 17 RESULT OF RESERVOIR OPERATION OF MACAP DAM (HYDROLOGICAL CONDITION OF 1971)

BENHUT RIVER OPERATION MODEL SYSTEM TARGET YEAR 2005 CASE NO. 1
DAM1=MACAP DAM / HWL1= 15.8(M) LWL1= 12.8(M), DAM2=BENHUT DAM / HWL2= 0. (M) LWL2= 0. (M).

PERIOD	DEFICIT		INITIAL W.L.			FINAL W.L.			RESERVOIR STORAGE VOLUME			SPILL-OUT			PIPELINE		OUTFLOW			REMAINING DEFICIT
1971	DEF	IRR.	DAM1	DAM2	DAM3	DAM1	DAM2	DAM3	DAM1	DAM2	DAM3	DAM1	DAM2	DAM3	DAM1	DAM2	DAM1	DAM2	DAM3	
(UNIT)	(CMS)		(M)			(M)			(MCM)	(MCM)	(MCM)	(CMS)			(CMS)		(CMS)			(CMS)
JAN																				
1- 5	0.	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	11.6	0.	0.	1.0	0.	0.	0.	0.	0.
6- 10	0.	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	11.9	0.	0	1.0	0.	0.	0.	0.	0.
11- 15	0.	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	3.4	0.	0	1.0	0.	0.	0.	0.	0.
16- 20	0.	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	0.8	0.	0.	1.0	0.	0.	0.	0.	0.
21- 25	0.	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	0.2	0.	0.	1.0	0.	0.	0.	0.	0.
26-END	0.1	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	0.	0.	0	0.7	0.	0.	0.	0.	0.
MONTHLY	0.1	0.										12.0	0.	0.	2.5	0.	0.	0.	0.	0.
FEB																				
1- 5	0.5	0.	15.8	0.	0.	15.8	0.	0.	10.24	0.	0.	0.	0.	0.	0.6	0.	0.	0.	0.	0.
6- 10	0.8	0.	15.8	0.	0.	15.7	0.	0.	9.73	0.	0.	0.	0.	0.	0.9	0.	0.	0.	0.	0.
11- 15	0.9	0.	15.7	0.	0.	15.5	0.	0.	9.13	0.	0.	0.	0.	0.	1.0	0.	0.	0.	0.	0.
16- 20	0.9	0.	15.5	0.	0.	15.4	0.	0.	8.46	0.	0.	0.	0.	0.	1.0	0.	0.	0.	0.	0.
21- 25	0.9	0.	15.4	0.	0.	15.3	0.	0.	8.17	0.	0.	0.	0.	0.	1.0	0.	0.	0.	0.	0.
26-END	0.	0.	15.3	0.	0.	15.5	0.	0.	9.00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MONTHLY	1.7	0.										0.	0.	0.	1.9	0.	0.	0.	0.	0.
MAR																				
1- 5	0.	0.	15.5	0.	0.	15.7	0.	0.	9.86	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6- 10	0.1	0.	15.7	0.	0.	15.6	0.	0.	10.16	0.	0.	0.	0.	0.	0.1	0.	0.	0.	0.	0.
11- 15	0.4	0.	15.8	0.	0.	15.7	0.	0.	10.11	0.	0.	0.	0.	0.	0.5	0.	0.	0.	0.	0.
16- 20	0.6	0.	15.7	0.	0.	15.7	0.	0.	10.06	0.	0.	0.	0.	0.	0.7	0.	0.	0.	0.	0.
21- 25	0.2	0.	15.7	0.	0.	15.6	0.	0.	10.40	0.	0.	0.	0.	0.	0.8	0.	0.	0.	0.	0.
26-END	0.3	0.	15.8	0.	0.	15.6	0.	0.	10.40	0.	0.	0.	0.	0.	0.5	0.	0.	0.	0.	0.
MONTHLY	0.7	0.										0.	0.	0.	1.1	0.	0.	0.	0.	0.
APR																				
1- 5	0.1	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	0.2	0.	0.	1.0	0.	0.	0.	0.	0.
6- 10	0.1	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	0.	0.	0.	0.2	0.	0.	0.	0.	0.
11- 15	0.2	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	0.	0.	0.	0.4	0.	0.	0.	0.	0.
16- 20	0.4	0.	15.8	0.	0.	15.8	0.	0.	10.32	0.	0.	0.	0.	0.	0.4	0.	0.	0.	0.	0.
21- 25	0.7	0.	15.8	0.	0.	15.7	0.	0.	9.97	0.	0.	0.	0.	0.	0.8	0.	0.	0.	0.	0.
26-END	0.9	0.	15.7	0.	0.	15.6	0.	0.	9.66	0.	0.	0.	0.	0.	1.0	0.	0.	0.	0.	0.
MONTHLY	1.0	0.										0.1	0.	0.	1.9	0.	0.	0.	0.	0.
MAY																				
1- 5	1.0	0.	15.6	0.	0.	15.5	0.	0.	8.24	0.	0.	0.	0.	0.	1.0	0.	0.1	0.	0.	0.
6- 10	1.3	0.	15.5	0.	0.	15.3	0.	0.	7.60	0.	0.	0.	0.	0.	1.0	0.	0.5	0.	0.	0.
11- 15	1.2	0.	15.3	0.	0.	15.1	0.	0.	6.95	0.	0.	0.	0.	0.	1.0	0.	0.3	0.	0.	0.
16- 20	1.1	0.	15.1	0.	0.	14.9	0.	0.	6.14	0.	0.	0.	0.	0.	1.0	0.	0.2	0.	0.	0.
21- 25	1.3	0.	14.9	0.	0.	14.7	0.	0.	5.20	0.	0.	0.	0.	0.	1.0	0.	0.4	0.	0.	0.
26-END	1.0	0.	14.7	0.	0.	14.5	0.	0.	4.36	0.	0.	0.	0.	0.	1.0	0.	0.1	0.	0.	0.
MONTHLY	3.1	0.										0.	0.	0.	2.2	0.	0.7	0.	0.	0.
JUN																				
1- 5	1.0	0.	14.5	0.	0.	14.3	0.	0.	3.44	0.	0.	0.	0.	0.	1.0	0.	0.1	0.	0.	0.
6- 10	1.0	0.	14.3	0.	0.	14.1	0.	0.	2.98	0.	0.	0.	0.	0.	1.0	0.	0.1	0.	0.	0.
11- 15	1.1	0.	14.1	0.	0.	13.9	0.	0.	2.18	0.	0.	0.	0.	0.	1.0	0.	0.2	0.	0.	0.
16- 20	1.1	0.	13.9	0.	0.	13.6	0.	0.	1.36	0.	0.	0.	0.	0.	1.0	0.	0.2	0.	0.	0.
21- 25	0.7	0.	13.6	0.	0.	13.6	0.	0.	1.34	0.	0.	0.	0.	0.	0.8	0.	0.	0.	0.	0.
26-END	0.5	0.	13.6	0.	0.	13.7	0.	0.	1.55	0.	0.	0.	0.	0.	0.4	0.	0.	0.	0.	0.
MONTHLY	2.3	0.										0.	0.	0.	2.3	0.	0.3	0.	0.	0.
JUL																				
1- 5	0.4	0.	13.7	0.	0.	13.8	0.	0.	1.66	0.	0.	0.	0.	0.	0.4	0.	0.	0.	0.	0.
6- 10	1.0	0.	13.8	0.	0.	13.4	0.	0.	0.97	0.	0.	0.	0.	0.	1.0	0.	0.1	0.	0.	0.
11- 15	1.1	0.	13.4	0.	0.	12.9	0.	0.	0.19	0.	0.	0.	0.	0.	1.0	0.	0.2	0.	0.	0.
16- 20	0.9	0.	12.9	0.	0.	12.8	0.	0.	0.	0.	0.	0.	0.	0.	0.5	0.	0.	0.	0.	0.48
21- 25	1.1	0.	12.8	0.	0.	12.8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.27
26-END	0.9	0.	12.8	0.	0.	12.8	0.	0.	0.	0.	0.	0.	0.	0.	0.2	0.	0.0	0.	0.	0.80
MONTHLY	2.4	0.										0.	0.	0.	1.4	0.	0.3	0.	0.	1.15
AUG																				
1- 5	0.8	0.	12.8	0.	0.	12.8	0.	0.	0.	0.	0.	0.	0.	0.	0.5	0.	0.	0.	0.	0.39
6- 10	0.7	0.	12.8	0.	0.	12.8	0.	0.	0.	0.	0.	0.	0.	0.	0.7	0.	0.0	0.	0.	0.12
11- 15	0.3	0.	12.8	0.	0.	13.0	0.	0.	0.32	0.	0.	0.	0.	0.	0.3	0.	0.	0.	0.	0.
16- 20	0.	0.	13.0	0.	0.	13.9	0.	0.	1.49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21- 25	0.	0.	13.9	0.	0.	14.1	0.	0.	2.35	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26-END	0.6	0.	14.1	0.	0.	14.1	0.	0.	2.99	0.	0.	0.	0.	0.	0.6	0.	0.	0.	0.	0.
MONTHLY	1.0	0.										0.	0.	0.	0.9	0.	0.0	0.	0.	0.22
SEP																				
1- 5	0.2	0.	14.1	0.	0.	14.3	0.	0.	3.48	0.	0.	0.	0.	0.	0.2	0.	0.	0.	0.	0.
6- 10	0.	0.	14.3	0.	0.	14.6	0.	0.	4.27	0.	0.	0.	0	0.	0.	0.	0.	0.	0.	0.
11- 15	0.2	0.	14.6	0.	0.	14.8	0.	0.	5.52	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16- 20	0.	0.	14.8	0.	0.	14.9	0.	0.	6.13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21- 25	0.5	0.	14.9	0.	0.	14.9	0.	0.	6.02	0.	0.	0.	0.	0.	0.6	0.	0.	0.	0.	0.
26-END	0.3	0.	14.9	0.	0.	14.9	0.	0.	6.14	0.	0.	0.	0.	0.	0.3	0.	0.	0.	0.	0.
MONTHLY	0.4	0.										0.	0.	0.	0.5	0.	0.	0.	0.	0.
OCT																				
1- 5	0.7	0.	14.9	0.	0.	14.8	0.	0.	5.74	0.	0.	0.	0.	0.	0.8	0.	0.	0.	0.	0.
6- 10	0.9	0.	14.8	0.	0.	14.7	0.	0.	5.64	0.	0.	0.	0.	0.	1.0	0.	0.	0.	0.	0.
11- 15	0.8	0.	14.7	0.	0.	14.5	0.	0.	5.51	0.	0.	0.	0.	0.	0.9	0.	0.	0.	0.	0.
16- 20	0.8	0.	14.5	0.	0.	14.5	0.	0.	5.65	0.	0.	0.	0.	0.	0.9	0.	0.	0.	0.	0.
21- 25	0.	0.	14.5	0.	0.	14.7	0.	0.	5.35	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26-END	0.5	0.	14.7	0.	0.	14.7	0.	0.	5.22	0.	0.	0.	0.	0.	0.6	0.	0.	0.	0.	0.
MONTHLY	1.6	0.										0.	0.	0.	1.8	0.	0.	0.	0.	0.
NOV																				
1- 5	0.6	0.	14.7	0.	0.	14.6	0.	0.	4.45	0.	0.	0.	0.	0.	0.2	0.	0.	0.	0.	0.
6- 10	0.7	0.	14.6	0.	0.	14.4	0.	0.	4.33	0.	0.	0.	0.	0.	0.8	0.	0.	0.	0.	0.
11- 15	0.6	0.	14.4	0.	0.	14.5	0.	0.	4.62	0.	0.	0.	0.	0.	0.2	0.	0.	0.	0.	0.
16- 20	0.7	0.	14.5	0.	0.	14.4	0.	0.	4.23	0.	0.	0.	0.	0.	0.8	0.	0.	0.	0.	0.
21- 25	0.9	0.	14.4	0.	0.	14.3	0.	0.	3.83	0.	0.	0.	0.	0.	1.0	0.	0.	0.	0.	0.
26-END	0.8	0.	14.3	0.	0.	14.3	0.	0.	3.52	0.	0.	0.	0.	0.	0.9	0.	0.	0.	0.	0.
MONTHLY	1.2	0.										0.	0.	0.	2.1	0.	0.	0.	0.	0.
DEC																				
1- 5	0.8	0.	14.3	0.	0.	14.2	0.	0.	3.23	0.	0.	0.	0.	0.	0.9	0.	0.	0.	0.	0.
6- 10	0.7	0.	14.2	0.	0.	14.1	0.	0.	3.05	0.	0.	0.	0.	0.	0.8	0.	0.	0.	0.	0.
11- 15	0.	0.	14.1	0.	0.	14.6	0.	0.	5.52	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16- 20	0.	0.	14.6	0.	0.	15.8	0.	0.	10.40	0.	0.	0.4	0.	0.	1.0	0.	0.	0.	0.	0.
21- 25	0.	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	4.3	0.	0.	1.0	0.	0.	0.	0.	0.
26-END	0.	0.	15.8	0.	0.	15.8	0.	0.	10.40	0.	0.	2.5	0.	0.	1.0	0.	0.	0.	0.	0.
MONTHLY	0.6	0.										3.4	0.	0.	2.1	0.	0.	0.	0.	0.
YEARLY	12.9	0.										15.6	0.	0.	21.1	0.	1.2	0.	0.	1.37

Table 18 5-DAY INFLOW DISCHARGE AT SAYONG DAM (1/3)

YEAR : 1963 ANNUAL MEAN : 13.6

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	24.2*	12.6*	21.2*	19.3*	9.9*	13.8*	6.4*	12.0*	7.6*	19.3*	24.3*	32.8*
6-10	20.0*	10.4*	14.0*	13.5*	3.2*	11.7*	5.8*	10.3*	8.0*	16.3*	35.2*	27.0*
11-15	16.7*	9.2*	11.0*	13.6*	7.9*	10.5*	5.2*	9.3*	9.3*	13.6*	24.2*	28.8*
16-20	13.5*	7.9*	9.0*	20.1*	9.3*	9.5*	4.7*	8.2*	7.3*	19.6*	31.9*	16.6*
21-25	10.8*	9.3*	11.0*	14.7*	16.8*	8.3*	5.0*	7.8*	17.8*	16.9*	23.5*	30.3*
26-END	11.3*	30.6*	33.3*	12.0*	13.0*	7.4*	10.9*	13.1*	21.9*	25.1*	27.4*	30.8*
MEAN	15.9	12.1	17.1	15.5	11.9	10.2	6.5	10.2	12.0	18.7	27.8	27.8

YEAR : 1964 ANNUAL MEAN : 19.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	21.8*	13.6*	130.3*	17.2*	46.6*	11.6*	9.4*	15.5*	14.9*	6.3*	10.4*	6.0*
6-10	14.0*	16.8*	45.6*	17.1*	43.2*	10.3*	12.5*	9.2*	33.6*	12.0*	11.2*	2.6*
11-15	9.1*	14.3*	88.5*	42.8*	43.1*	10.0*	11.8*	7.2*	23.2*	6.2*	6.6*	4.9*
16-20	22.4*	10.3*	62.8*	40.0*	27.3*	7.2*	16.3*	7.3*	20.7*	21.3*	5.7*	8.1*
21-25	33.6*	11.6*	32.1*	35.4*	16.5*	8.9*	20.0*	6.5*	14.9*	18.5*	3.5*	70.0*
26-END	22.6*	75.4*	22.1*	38.4*	10.3*	6.4*	20.3*	4.8*	9.4*	13.2*	5.9*	82.7*
MEAN	20.6	21.9	62.2	31.8	31.3	9.1	15.2	8.3	19.5	12.9	7.2	30.8

YEAR : 1965 ANNUAL MEAN : 14.6

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	70.7*	7.8*	5.7*	6.7*	12.3*	13.8*	6.9*	6.4*	7.1*	12.9*	47.8*	39.9*
6-10	33.2*	7.5*	5.0*	8.4*	12.6*	10.7*	5.0*	6.5*	8.5*	11.4*	35.8*	31.6*
11-15	21.6*	10.9*	4.6*	9.6*	15.0*	8.1*	7.6*	7.1*	6.2*	25.9*	28.3*	35.7*
16-20	14.9*	9.5*	3.9*	10.5*	32.6*	10.1*	5.1*	7.6*	8.8*	23.5*	35.8*	39.4*
21-25	10.8*	7.8*	5.5*	12.1*	30.1*	7.8*	4.8*	8.3*	9.4*	25.8*	37.5*	31.1*
26-END	8.5*	8.1*	4.8*	11.1*	39.5*	7.2*	4.9*	8.1*	9.3*	48.5*	45.7*	34.2*
MEAN	26.0	8.6	4.9	9.7	20.3	9.6	5.7	7.4	8.2	25.4	38.5	35.3

YEAR : 1966 ANNUAL MEAN : 16.4

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	28.9*	14.7*	8.6*	8.5*	25.2*	19.9*	9.3*	15.8*	20.0*	11.0*	15.9*	24.9*
6-10	21.2*	12.2*	17.9*	12.6*	15.9*	20.2*	14.4*	19.4*	14.9*	11.5*	22.2*	27.1*
11-15	24.8*	10.3*	11.3*	23.9*	12.5*	16.4*	18.1*	17.2*	17.0*	16.2*	39.0*	39.1*
16-20	18.7*	10.9*	10.3*	18.4*	11.4*	13.8*	21.4*	19.8*	11.9*	27.9*	32.4*	30.6*
21-25	23.1*	11.0*	13.7*	20.2*	11.0*	11.6*	21.0*	19.7*	13.8*	27.7*	36.7*	29.7*
26-END	21.6*	8.5*	10.1*	22.6*	10.2*	9.8*	17.5*	20.5*	10.9*	20.0*	33.0*	32.1*
MEAN	23.0	11.4	11.9	17.7	14.2	15.3	17.0	18.8	14.7	19.1	29.9	30.6

YEAR : 1967 ANNUAL MEAN : 23.6

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	34.1*	23.2*	54.1*	15.6*	27.5*	16.3*	11.0*	6.3*	6.9*	6.8*	19.0*	31.1*
6-10	32.6*	14.8*	32.4*	18.2*	24.1*	12.8*	11.4*	5.6*	7.5*	6.9*	19.7*	26.7*
11-15	84.7*	30.4*	28.2*	15.0*	35.9*	12.1*	13.4*	6.8*	7.0*	7.2*	25.5*	53.4*
16-20	65.3*	118.9*	20.6*	16.1*	33.2*	23.3*	13.1*	7.1*	5.8*	6.6*	30.2*	155.0*
21-25	31.3*	84.9*	18.8*	20.4*	28.3*	18.3*	10.7*	6.0*	6.2*	9.5*	36.8*	79.9*
26-END	22.8*	43.7*	14.3*	31.7*	21.9*	14.2*	7.4*	6.1*	7.3*	10.2*	39.5*	85.6*
MEAN	44.4	53.3	27.6	19.5	28.3	16.2	11.1	6.3	6.8	7.9	28.5	72.4

YEAR : 1968 ANNUAL MEAN : 21.4

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	206.9*	16.5*	6.6*	41.7*	25.1*	16.6*	15.0*	8.2*	6.0*	17.0*	29.3*	21.4*
6-10	105.6*	13.7*	6.0*	25.3*	21.6*	18.6*	12.4*	7.4*	5.0*	20.1*	35.9*	20.7*
11-15	55.5*	11.6*	16.7*	21.5*	22.3*	20.2*	10.3*	8.3*	7.2*	33.4*	26.8*	26.5*
16-20	34.7*	9.9*	34.8*	16.1*	31.5*	20.4*	9.6*	8.6*	31.5*	19.8*	47.7*	38.0*
21-25	25.3*	8.4*	39.8*	16.8*	23.4*	14.1*	9.8*	7.9*	30.0*	15.4*	32.0*	22.2*
26-END	18.7*	7.3*	64.2*	17.4*	17.6*	12.8*	9.1*	7.1*	21.2*	24.6*	29.3*	20.1*
MEAN	72.7	11.4	29.2	23.1	23.4	17.1	10.9	7.9	16.8	21.8	33.5	24.7

YEAR : 1969 ANNUAL MEAN : 21.8

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	25.1*	10.6*	5.5*	18.7*	24.7*	26.1*	17.6*	8.9*	37.1*	12.3*	24.4*	28.2*
6-10	24.9*	9.8*	4.2*	21.2*	28.4*	28.6*	26.3*	8.9*	25.4*	14.7*	19.1*	50.0*
11-15	17.4*	8.7*	4.3*	18.2*	20.1*	25.8*	23.7*	11.5*	16.5*	27.1*	15.7*	218.1*
16-20	16.7*	7.6*	4.1*	20.6*	16.5*	26.1*	17.5*	29.0*	12.8*	39.0*	26.2*	98.6*
21-25	13.0*	6.7*	3.9*	31.7*	26.0*	24.0*	17.8*	47.2*	17.2*	45.9*	23.1*	59.7*
26-END	16.6*	6.5*	10.3*	23.3*	18.5*	16.7*	10.9*	47.5*	14.7*	35.5*	18.5*	32.2*
MEAN	18.9	8.5	5.5	22.3	22.3	24.6	18.7	26.2	20.6	29.3	21.2	79.6

YEAR : 1970 ANNUAL MEAN : 17.1

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	23.6*	10.2*	5.7*	19.9*	26.8*	25.3*	18.0*	21.4*	9.5*	23.2*	16.3*	35.1*
6-10	26.1*	20.7*	4.9*	19.4*	26.8*	17.6*	19.1*	19.0*	9.6*	22.9*	19.9*	30.4*
11-15	21.8*	14.4*	5.7*	22.1*	22.8*	18.9*	14.7*	23.4*	10.3*	20.3*	15.3*	29.0*
16-20	19.3*	8.8*	9.9*	24.6*	32.0*	14.3*	20.9*	14.9*	12.7*	13.3*	24.2*	25.5*
21-25	13.1*	7.1*	3.0*	32.2*	36.2*	13.9*	27.3*	12.3*	10.9*	15.7*	44.1*	21.5*
26-END	11.8*	6.3*	14.7*	33.1*	32.3*	13.5*	29.4*	12.4*	12.3*	15.5*	40.9*	24.6*
MEAN	19.1	11.6	8.3	25.2	29.6	17.3	21.8	17.1	10.9	18.6	26.8	27.6

Table 19 5-DAY INFLOW DISCHARGE AT SAYONG DAM (2/3)

YEAR : 1971 ANNUAL MEAN : 11.3

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	84.9*	11.6*	16.5*	12.8*	4.6*	4.1*	6.4*	4.0*	10.3*	6.5*	5.1*	4.7*
6-10	100.4*	9.2*	12.1*	12.5*	3.5*	3.8*	4.5*	6.8*	15.9*	4.9*	4.9*	5.1*
11-15	47.1*	7.6*	10.3*	11.3*	3.7*	3.3*	3.6*	9.2*	13.9*	5.0*	4.8*	29.1*
16-20	26.7*	6.6*	9.7*	10.0*	4.0*	3.3*	4.5*	15.4*	11.5*	4.9*	4.4*	67.6*
21-25	19.7*	6.6*	11.9*	3.4*	3.2*	5.3*	3.3*	12.5*	8.4*	7.2*	3.9*	46.7*
26-END	15.4*	15.6*	11.2*	6.6*	4.2*	6.0*	3.7*	9.7*	9.0*	5.6*	3.9*	34.3*
MEAN	47.9	9.1	11.7	10.3	3.9	4.3	4.3	9.6	11.5	5.7	4.5	31.4

YEAR : 1972 ANNUAL MEAN : 12.7

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	20.0*	5.7*	5.4*	6.3*	21.7*	13.8*	6.7*	3.9*	6.7*	20.9*	10.3*	36.4*
6-10	11.0*	8.6*	3.9*	6.9*	14.7*	8.3*	5.1*	3.3*	7.3*	10.5*	17.5*	29.4*
11-15	7.8*	12.1*	4.9*	12.3*	11.9*	10.4*	4.1*	3.4*	13.0*	10.1*	29.2*	22.8*
16-20	9.1*	5.7*	4.0*	14.6*	19.1*	17.6*	3.5*	5.6*	19.4*	8.6*	49.0*	25.4*
21-25	8.6*	10.4*	4.6*	19.0*	25.1*	18.8*	3.7*	4.1*	32.4*	12.6*	41.7*	29.9*
26-END	5.8*	11.9*	3.2*	25.9*	25.6*	12.1*	3.4*	9.1*	34.6*	16.1*	51.0*	26.2*
MEAN	10.2	9.0	4.4	14.1	18.4	13.5	4.4	5.0	18.9	13.2	33.1	28.3

YEAR : 1973 ANNUAL MEAN : 19.8

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	20.1*	8.9*	23.7*	19.5*	31.6*	43.0*	42.8*	30.5*	14.5*	9.8*	27.1*	14.2*
6-10	30.6*	6.5*	10.2*	23.1*	33.4*	37.3*	22.9*	27.2*	12.7*	6.5*	47.5*	20.3*
11-15	28.2*	7.0*	13.3*	25.3*	34.6*	22.1*	17.7*	23.5*	7.3*	8.8*	25.0*	15.6*
16-20	21.4*	53.1*	13.5*	33.0*	22.9*	14.2*	13.0*	12.7*	8.3*	27.1*	25.8*	39.6*
21-25	18.8*	36.8*	16.4*	52.6*	22.0*	12.0*	11.4*	9.2*	21.2*	39.2*	24.3*	20.3*
26-END	10.4*	29.7*	14.8*	53.3*	34.2*	25.5*	22.8*	7.6*	9.4*	32.9*	20.1*	10.7*
MEAN	21.2	23.2	14.8	34.5	29.9	25.7	21.8	18.1	12.2	21.1	28.3	19.8

YEAR : 1974 ANNUAL MEAN : 8.6

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	8.2*	16.3*	9.0*	4.7*	7.7*	9.1*	4.0*	7.9*	5.1*	32.4*	4.8*	11.2*
6-10	6.1*	17.2*	14.1*	17.9*	11.3*	6.4*	2.4*	5.2*	4.9*	17.1*	3.2*	6.9*
11-15	4.8*	7.8*	3.8*	15.2*	13.3*	5.5*	2.5*	4.4*	17.6*	8.8*	4.3*	8.6*
16-20	3.9*	7.0*	4.7*	18.9*	6.6*	7.4*	4.9*	3.5*	37.5*	6.3*	9.8*	5.8*
21-25	3.4*	20.2*	3.5*	11.0*	7.1*	9.0*	13.5*	3.5*	26.9*	5.3*	16.6*	7.5*
26-END	5.6*	19.1*	3.2*	11.1*	10.0*	7.1*	13.9*	3.3*	29.1*	6.0*	7.3*	8.6*
MEAN	5.4	14.3	7.1	13.1	9.4	7.4	7.1	4.6	20.2	12.4	7.7	8.1

YEAR : 1975 ANNUAL MEAN : 14.3

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.9*	3.0*	9.8*	27.6*	22.6*	22.6*	17.6*	6.9*	19.8*	7.0*	22.1*	10.8*
6-10	4.8*	3.6*	18.1*	36.6*	34.6*	15.8*	19.7*	9.1*	13.2*	8.5*	15.2*	7.8*
11-15	7.7*	9.1*	17.3*	17.7*	35.1*	17.1*	14.0*	9.5*	15.5*	5.1*	12.1*	12.3*
16-20	7.3*	7.2*	18.8*	46.2*	21.6*	37.7*	15.3*	10.8*	12.1*	5.6*	21.0*	5.4*
21-25	5.2*	4.5*	22.5*	61.1*	26.8*	23.7*	25.4*	11.8*	8.0*	5.0*	14.7*	3.9*
26-END	3.8*	4.7*	21.7*	29.5*	44.0*	31.9*	12.1*	12.1*	12.2*	5.7*	24.8*	5.5*
MEAN	5.4	5.4	18.1	36.8	31.2	24.8	17.2	10.1	13.5	6.1	18.3	7.5

YEAR : 1976 ANNUAL MEAN : 11.1

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.6*	1.5*	2.1*	9.2*	28.3*	7.2*	5.3*	8.2*	8.0*	8.2*	19.0*	21.8*
6-10	3.1*	1.4*	3.6*	10.6*	20.2*	6.5*	5.5*	6.7*	7.7*	17.3*	19.8*	13.8*
11-15	2.4*	1.3*	11.9*	11.2*	12.3*	5.5*	7.6*	6.7*	6.5*	35.9*	22.1*	16.5*
16-20	2.0*	1.1*	17.9*	10.0*	12.9*	5.3*	10.6*	7.3*	6.9*	31.4*	4.3*	29.6*
21-25	1.7*	1.0*	13.2*	33.0*	10.8*	5.1*	11.3*	7.8*	6.3*	30.5*	11.0*	34.5*
26-END	1.6*	2.1*	11.2*	44.9*	8.2*	6.1*	10.7*	11.4*	7.1*	25.6*	23.4*	65.9*
MEAN	2.4	1.4	10.0	19.8	15.2	6.0	8.6	8.1	7.1	24.8	16.6	31.5

YEAR : 1977 ANNUAL MEAN : 14.5

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	92.6*	6.8*	16.4*	2.8	3.3	8.5	5.6	7.1	13.3	60.2	18.4	19.9
6-10	45.6*	9.3	7.7*	3.2	7.8	19.8	7.8	10.8	16.0	51.7	16.6	16.7
11-15	21.8*	18.9	5.3*	3.3	18.2	13.1	6.7	11.9	11.0	36.4	40.9	9.7
16-20	14.3*	6.7	2.7	5.2	11.3	19.6	6.2	12.5	6.1	27.5	34.7	10.2
21-25	10.3*	8.3	2.7	2.6	6.5	7.7	6.3	19.8	7.9	21.1	47.6	16.6
26-END	7.6*	72.5	3.5*	2.2	9.0	5.2	9.0	23.0	34.7	26.7	27.0	14.2
MEAN	31.2	16.7	6.3	3.2	9.3	12.3	7.0	14.4	14.9	36.9	30.9	14.5

YEAR : 1978 ANNUAL MEAN : 17.8

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	17.8	3.8	12.3	16.1	19.5	13.5	19.6	9.3	12.9	7.9	18.1	110.1
6-10	38.7	6.0	8.2	15.6	41.7	9.9	19.8	8.6	10.0	8.1	21.3	90.8
11-15	94.2	4.5	7.3	13.6	54.2	7.5	20.5	7.0	9.9	9.2	48.4	36.0
16-20	58.1	9.7	7.5	24.6	31.7	5.1	19.0	10.3	6.1	5.5	20.5	20.1
21-25	28.9	7.8	24.9	28.0	16.3	7.9	13.9	8.9	10.6	7.0	15.4	30.9
26-END	14.2	5.3	18.6	24.9	11.5	7.9	10.6	7.1	10.5	20.7	29.4	30.6
MEAN	41.1	7.1	13.3	20.5	28.6	8.6	17.0	8.5	10.0	10.1	25.5	32.0

Table 20 5-DAY INFLOW DISCHARGE AT SAYONG DAM (3/3)

YEAR : 1979 ANNUAL MEAN : 20.5

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	24.2	5.1	16.2	48.6	22.1	6.7	7.7	19.7	19.0	11.3	20.4	79.9*
6-10	87.5	17.9	14.6*	58.6	13.0	12.6	5.7	10.9	19.3	8.4	27.8	39.9*
11-15	25.5	5.4	15.1	43.8	13.4	22.5	8.5	7.1	16.9	10.3	53.8	22.1*
16-20	12.6	6.0	13.1	30.1	7.3	18.3	11.2	7.0	19.1	8.8	38.9	17.3*
21-25	10.0	8.6	26.0	16.0	5.8	18.6	17.9	11.3	23.5	18.4	87.9*	9.2
26-END	8.2	7.5	18.2	21.2	6.0	9.7	29.1	12.2	16.1	13.8	254.0*	5.7
MEAN	27.4	6.5	17.2	36.4	11.1	14.7	13.9	11.4	19.0	11.9	80.5	28.3

YEAR : 1980 ANNUAL MEAN : 20.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.0	9.9	14.2	10.2	24.0	25.9	14.8	25.6	31.1	26.8	30.8	68.2
6-10	15.3	16.8	14.3	8.5	23.9	22.3	8.8	14.7	41.5	18.5	31.9	64.2
11-15	8.0	8.1	8.9	19.0	18.8	17.0	8.9	54.6	21.2	12.4	26.2	61.3
16-20	7.8	5.9	8.0	31.0	13.2	28.4	13.7	41.2	16.1	17.9	21.6	29.7
21-25	63.6	6.2	10.8	29.5	8.9	18.0	17.8	45.7	45.5	32.2	46.7	19.3
26-END	17.2	15.9	6.2	25.0	22.6	13.3	10.9	26.4	50.2	24.7	75.1	22.9
MEAN	19.4	10.3	10.3	20.5	18.7	20.8	12.4	34.4	34.3	22.2	38.7	43.6

YEAR : 1981 ANNUAL MEAN : 15.1

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	12.9	5.0	6.4	3.3	15.7	18.5	6.4	11.2	9.9	8.1	22.5	16.9
6-10	19.2	4.0	4.1	24.9	40.5	16.0	8.9	5.4	9.4	13.5	28.2	17.4
11-15	12.8	3.3	2.0	27.9	43.7	9.9	9.2	4.3	17.6	15.9	11.5	27.6
16-20	7.3	3.6	0.9	16.1	56.3	10.9	6.9	3.7	14.2	19.7	15.5	152.4*
21-25	5.7	2.7	0.9	24.4	38.9	6.9	12.4	5.1	10.0	21.0	23.0	97.7*
26-END	4.9	3.6	1.1	25.2	24.8	10.4	13.4	7.9	9.8	20.3	26.4	28.1*
MEAN	10.3	3.7	2.5	20.3	36.3	12.1	9.7	6.3	11.8	16.6	21.2	55.8

YEAR : 1982 ANNUAL MEAN : 25.1

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	29.5	6.7	7.1	15.8	48.6	40.5	11.6	7.7	28.3	21.3	28.3	52.3
6-10	47.2	16.5	6.2	57.0	22.3	41.0	11.1	8.2	12.4	12.6	37.6	27.5
11-15	23.5	16.2	18.1	27.2	20.4	32.1	15.7	39.5	8.8	11.6	47.7	28.7
16-20	11.9	6.6	19.2	25.2	49.8	53.2	15.6	36.6	9.9	13.6	39.6	37.0
21-25	8.2	8.2	33.1	64.2	27.6	22.3	25.1	23.9	17.2	12.0	58.4	164.4*
26-END	6.9	13.1	19.6	82.8	32.9	14.1	10.4	16.1	10.8	18.6	62.2	113.9*
MEAN	20.7	11.1	17.3	45.4	33.6	33.9	14.8	21.8	14.6	15.1	45.6	68.8

YEAR : 1983 ANNUAL MEAN : 20.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	44.7*	13.3	15.9	6.2	6.3	8.4	8.5	25.9	25.3	14.8	36.1	12.3
6-10	27.8*	10.0	10.6	6.9	13.6	6.1	10.8	20.5	52.0	14.2	40.4	15.5
11-15	31.4*	8.5	6.4	5.7	14.6	13.0	17.0	16.9	64.8	11.4	40.8	175.2
16-20	46.8*	9.1	5.1	4.0	14.2	16.5	13.7	25.4	33.6	11.3	30.1	44.0
21-25	27.4*	8.0	5.3	5.0	13.3	16.3	19.0	34.5	31.8	17.0	22.8	24.9
26-END	18.0	6.8	6.5	5.8	10.3	10.5	11.1	29.5	19.8	20.3	15.3	202.1
MEAN	32.2	9.5	8.2	5.6	12.0	11.8	13.3	25.6	37.9	15.0	30.9	83.0

YEAR : 1984 ANNUAL MEAN : 28.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	74.5	149.5	54.4	25.5	36.7	41.2	14.8	29.2	9.4	49.5	9.9	15.5*
6-10	39.9	153.2	77.2	36.0	34.9	31.2	30.0	25.8	13.4	27.9	20.1	18.5*
11-15	40.2	107.4	27.6	28.3	33.9	22.1	29.7	20.1	11.7	4.1	16.3*	21.0*
16-20	19.4	61.0	27.4	19.8	32.1	27.4	39.2	14.2	9.7	2.8	16.6*	17.8*
21-25	31.4	65.3	41.3	21.3	51.5	26.2	44.7	11.7	10.6	1.6	8.6*	29.6*
26-END	84.5	33.4	36.0	19.8	28.2	20.2	19.5	10.2	16.7	2.3	14.1*	67.4*
MEAN	49.5	93.6	43.7	25.1	35.9	28.1	29.3	18.3	11.9	14.3	14.3	29.6

Table 21 5-DAY INFLOW DISCHARGE AT LINGGIU DAM (1/3)

YEAR : 1963 ANNUAL MEAN : 6.1

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	8.8*	5.7*	14.4*	6.3*	3.2*	8.6*	1.9*	5.8*	1.3	5.5	9.1	12.2
6-10	6.7*	3.9*	7.1*	4.6*	2.4*	6.1*	1.7*	4.6*	1.7	4.0	11.4	8.8
11-15	5.0*	3.1*	4.4*	4.9*	2.6*	4.9*	1.5*	3.7*	2.8	2.6	4.9	12.1
16-20	3.5*	2.4*	2.9*	9.4*	4.7*	4.0*	1.6*	2.8*	1.4	6.3	10.5	3.4
21-25	2.5*	4.1*	4.3*	6.0*	15.3*	3.0*	1.8*	2.3*	15.6	4.4	6.5	14.2
26-END	3.5*	27.2*	13.6*	4.3*	14.5*	2.4*	5.8*	3.9*	6.6	11.2	9.4	12.2
MEAN	5.0	6.3	8.0	6.0	7.4	4.9	2.4	3.9	4.9	5.9	8.6	10.5

YEAR : 1964 ANNUAL MEAN : 7.6

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	6.6	2.4	54.4	3.7	20.8	1.9	2.6	6.2	4.0	0.5	1.8	0.7
6-10	2.7	4.8	9.6	3.7	22.3	1.7	4.9	1.7	6.8	2.7	2.2	0.1
11-15	1.1	3.5	32.2	10.6	20.1	2.0	4.2	1.1	4.8	0.7	0.7	0.5
16-20	8.8	1.8	23.6	9.8	8.0	1.0	9.6	1.2	4.0	11.2	0.5	1.3
21-25	11.5	2.3	8.5	11.0	2.8	2.0	17.6	1.0	2.7	6.2	0.2	34.6
26-END	5.5	24.0	5.3	14.3	1.2	0.9	14.9	0.6	1.2	2.9	0.7	46.4
MEAN	6.0	5.9	21.8	6.8	12.2	1.6	9.1	1.9	3.9	4.0	1.0	15.0

YEAR : 1965 ANNUAL MEAN : 7.1

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	69.5	1.4	1.3	3.2	10.4	4.2	2.6	6.8	2.5	6.7	20.4	16.6
6-10	13.0	1.7	1.0	5.6	11.9	2.6	1.4	7.8	3.1	5.1	12.8	10.3
11-15	6.1	6.0	0.9	7.3	17.3	1.6	5.6	8.5	1.3	6.8	9.6	10.5
16-20	3.1	4.3	0.8	7.9	9.0	3.4	2.0	8.1	3.3	7.1	15.0	17.6
21-25	1.8	2.7	1.9	11.2	9.9	2.2	1.8	8.1	4.2	9.2	8.7	10.3
26-END	1.3	3.1	1.6	7.2	7.1	2.3	2.2	4.9	3.5	16.3	17.4	13.1
MEAN	12.1	3.2	1.3	7.1	10.8	2.7	2.6	7.3	3.0	8.8	14.0	13.1

YEAR : 1966 ANNUAL MEAN : 8.1

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	10.8	5.0	2.4	1.6	12.3	3.9	2.3	6.0	10.9	5.6	4.5	10.3
6-10	5.8	3.5	7.4	2.9	4.4	7.3	6.0	11.8	5.2	8.1	7.3	12.1
11-15	10.5	2.6	3.1	11.3	2.8	6.8	11.0	8.8	8.4	26.0	17.8	11.7
16-20	5.9	3.5	2.7	7.6	2.6	5.1	13.2	14.1	3.5	9.8	19.7	11.3
21-25	13.3	6.0	5.2	9.2	2.9	3.5	11.7	12.9	6.5	7.3	21.7	13.6
26-END	13.0	2.2	2.4	10.8	3.0	2.5	7.5	10.7	4.1	6.0	17.3	16.0
MEAN	10.0	3.6	3.8	7.2	4.6	4.8	8.6	10.7	6.5	10.3	14.7	12.6

YEAR : 1967 ANNUAL MEAN : 15.0

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	11.4	6.4	35.8	4.5	26.3	4.8	2.6	1.7	5.6	7.7	16.4*	19.5*
6-10	10.0	3.3	14.0	7.5	14.2	3.1	3.2	1.5	9.2	6.7	15.4*	14.5*
11-15	54.9	9.9	12.6	4.7	26.1	3.2	5.7	2.8	7.9	6.0	16.1*	31.4*
16-20	38.5	81.2	6.2	4.8	24.2	9.7	6.5	4.0	4.7	3.5	23.4*	75.9*
21-25	9.8	48.0	5.8	9.7	17.8	6.6	4.5	2.6	6.9	12.6	27.3*	30.6*
26-END	6.3	15.5	3.1	50.7	9.2	4.4	2.1	3.2	14.2	10.8	28.6*	46.0*
MEAN	21.3	28.6	12.6	13.7	19.3	5.3	4.0	2.6	8.1	8.0	21.2	36.2

YEAR : 1968 ANNUAL MEAN : 7.8

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	91.6*	3.7*	1.4*	17.3*	7.3	4.1	4.1*	2.2*	1.5*	4.4*	13.6	4.5
6-10	33.8*	3.0*	1.2*	7.3	7.8	3.9	3.0*	1.9*	1.1*	4.3	9.4	4.4
11-15	17.2*	2.6*	5.5*	6.3	4.7	5.2	2.3*	2.5*	2.1*	11.3	5.2	8.2
16-20	10.7*	2.2*	11.7*	3.6	12.9	5.8	2.3*	2.7*	15.1*	4.4	13.2	13.2
21-25	7.2*	1.8*	17.3*	4.6	7.8	2.8	2.8*	2.4*	12.3*	2.9	8.5	5.3
26-END	4.7*	1.6*	26.1*	5.1	4.1	2.5	2.6*	2.0*	8.7*	8.8	7.6	5.3
MEAN	26.8	2.5	11.0	7.3	7.3	4.1	2.8	2.3	6.8	6.1	9.6	6.8

YEAR : 1969 ANNUAL MEAN : 8.6

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	9.0	1.4	0.8	11.3*	8.1*	11.7	5.0	1.7	15.9	3.7	5.9	8.5
6-10	10.6	1.4	0.5	11.3*	9.8	17.7	11.1	2.1	8.5	5.7	4.2	11.6
11-15	4.6	1.2	0.5	8.6*	5.7	7.7	8.7	3.5	3.4	7.7	3.0	121.3
16-20	4.5	1.1	0.6	9.7*	4.1	8.3	5.1	7.6	2.2	12.9	6.4	22.3
21-25	2.6	0.9	0.6	15.7*	11.2	8.9	6.4	14.2	5.4	19.9	6.6	13.6
26-END	3.0	1.0	2.4	10.4*	5.5	4.1	2.2	19.5	4.5	12.8	5.0	7.1
MEAN	5.6	1.2	1.0	11.2	7.3	9.7	6.3	8.4	6.7	10.5	5.2	30.0

YEAR : 1970 ANNUAL MEAN : 7.5

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.4	2.6	1.0	8.1	14.7	8.0	7.3	7.1*	1.8	12.3	5.6	15.9
6-10	9.1	12.0	0.8	11.9	18.2	4.0	8.2	5.4	2.2	11.2	11.3	13.8
11-15	7.3	5.4	1.2	11.9	12.8	5.4	4.6*	7.0	3.4	6.7	5.9	10.3
16-20	6.7	1.9	6.7	16.1	9.3	3.0	10.3*	2.9	7.5	3.2	7.7	7.6
21-25	3.1	1.3	3.6	17.8	9.3	3.2	13.4*	2.2	4.2	5.0	12.6	5.9
26-END	3.0	1.0	4.8	18.4	10.6	3.5	13.3*	2.7	4.2	5.0	17.4	9.2
MEAN	5.7	4.3	3.1	14.0	12.4	4.5	9.6	4.5	3.9	7.5	10.1	10.4

Table 22 5-DAY INFLOW DISCHARGE AT LINGGIU DAM (2/3)

YEAR : 1971 ANNUAL MEAN : 6.3

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	54.1	2.3	6.9*	3.2*	0.7*	1.4	5.6	4.0	4.2	2.0	3.3*	3.8*
6-10	65.5	1.7	4.5*	3.5*	0.5	1.3	1.9	3.1	10.3	1.3	3.2*	3.9*
11-15	19.6	1.3	3.4*	3.3*	0.6	1.1	1.2	4.1	7.5	1.9	3.8*	14.7*
16-20	7.8	1.2	2.5*	2.6*	0.9	1.1	2.8	15.5	5.2	2.5	3.4*	38.8
21-25	4.9	1.4*	3.7*	1.9*	0.6	4.1	1.3	7.8	2.5	11.9*	3.0*	22.4
26-END	3.5	6.9*	3.5*	1.3*	1.3	5.2	2.5	3.4	3.7	4.1*	3.3*	16.3
MEAN	25.2	2.1	4.1	2.6	0.8	2.3	2.5	6.2	5.6	3.9	3.3	16.6

YEAR : 1972 ANNUAL MEAN : 4.3

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	6.1*	2.3*	0.7*	5.3*	10.0*	6.4*	2.3*	1.6*	3.3*	2.5*	2.2*	6.7*
6-10	3.5*	1.4*	0.6*	8.5*	7.2*	3.9*	1.7*	1.5*	3.3*	1.4*	5.0*	6.1*
11-15	2.6*	1.5*	0.8*	9.3*	5.5*	4.5*	1.3*	1.6*	2.6*	1.4*	6.1*	5.5*
16-20	3.0*	1.0*	0.7*	10.5*	6.4*	6.5*	1.2*	3.3*	3.0*	1.2*	7.1*	9.5*
21-25	3.0*	0.9*	0.9*	11.1*	11.5*	5.6*	1.2*	3.2*	4.1*	1.8*	7.7*	9.0*
26-END	2.2*	1.0*	0.8*	10.8*	11.8*	3.9*	1.3*	5.2*	3.6*	2.6*	9.6*	7.4*
MEAN	3.4	1.4	0.8	9.3	8.5	5.1	1.5	2.8	3.3	1.8	6.3	7.4

YEAR : 1973 ANNUAL MEAN : 5.6

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	6.2*	3.6*	4.6*	4.2*	5.8*	7.4*	3.3*	6.3*	5.3*	5.9*	5.9*	3.7*
6-10	10.9*	2.5*	2.5*	3.4*	8.1*	7.0*	2.6*	5.8*	9.6*	3.7*	6.9*	4.7*
11-15	21.0*	2.7*	3.2*	4.1*	12.0*	4.1*	2.3*	5.7*	5.5*	3.6*	4.6*	3.3*
16-20	13.9*	9.9*	3.2*	6.1*	7.3*	2.7*	1.8*	3.3*	5.8*	4.2*	5.4*	5.1*
21-25	9.5*	7.6*	3.9*	8.0*	6.5*	2.3*	1.6*	2.6*	14.1*	9.5*	5.6*	3.7*
26-END	4.5*	5.9*	3.5*	8.6*	6.6*	3.6*	2.3*	2.4*	6.0*	9.3*	5.1*	2.5*
MEAN	10.8	5.3	3.5	5.7	7.7	4.5	2.3	4.3	7.7	6.1	5.6	3.8

YEAR : 1974 ANNUAL MEAN : 5.3

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	2.1*	1.9*	3.6*	2.8*	4.2*	7.5*	10.0*	6.5*	6.1*	12.7*	3.2*	5.8*
6-10	1.7*	1.9*	6.8*	3.8*	5.9*	5.1*	5.8*	4.5*	5.9*	8.2*	2.3*	3.4*
11-15	1.5*	1.1*	5.6*	2.5*	8.1*	4.3*	5.1*	3.5*	9.7*	4.3*	3.1*	4.6*
16-20	1.2*	1.1*	2.7*	3.2*	6.8*	6.4*	9.3*	2.8*	10.6*	3.3*	5.8*	4.6*
21-25	1.1*	6.0*	2.0*	3.7*	3.7*	10.9*	13.1*	2.9*	10.2*	2.9*	8.2*	7.2*
26-END	1.2*	7.3*	2.0*	6.1*	10.3*	11.2*	9.7*	3.5*	9.9*	3.6*	4.0*	7.7*
MEAN	1.5	2.9	3.7	3.7	7.4	7.6	8.9	3.9	8.7	5.8	4.4	5.6

YEAR : 1975 ANNUAL MEAN : 6.9

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.6*	1.7*	3.2*	7.6*	6.6*	5.7*	5.8*	2.8*	8.6*	3.5*	17.9*	11.4*
6-10	4.1*	1.9*	7.3*	9.5*	11.1*	4.9*	7.0*	4.2*	5.8*	6.5*	12.6*	12.5*
11-15	4.6*	2.9*	6.7*	5.5*	12.1*	5.2*	5.4*	5.5*	6.2*	4.8*	6.3*	24.0*
16-20	4.6*	2.4*	7.6*	9.6*	7.8*	6.4*	5.1*	6.7*	4.8*	4.7*	6.8*	11.1*
21-25	3.2*	1.5*	9.9*	12.1*	7.4*	5.7*	7.4*	8.0*	3.4*	3.9*	6.4*	7.1*
26-END	2.2*	1.5*	10.7*	7.6*	7.8*	9.6*	4.7*	8.1*	5.5*	5.9*	14.4*	8.8*
MEAN	3.7	2.0	7.7	8.6	8.7	6.3	5.9	5.9	5.7	4.9	10.7	12.4

YEAR : 1976 ANNUAL MEAN : 4.2

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.6*	1.6*	1.3*	2.5*	3.9*	3.5*	3.1*	2.0*	2.1*	2.3*	5.1*	8.7*
6-10	4.3*	1.4*	1.7*	2.6*	3.2*	3.2*	3.0*	1.7*	2.1*	4.8*	4.8*	5.2*
11-15	3.1*	1.2*	3.0*	2.6*	2.0*	2.7*	3.5*	1.7*	1.8*	9.2*	5.7*	6.1*
16-20	2.4*	1.1*	3.9*	2.3*	2.8*	2.7*	3.4*	1.8*	2.0*	8.7*	2.1*	16.1*
21-25	2.0*	1.0*	3.4*	5.1*	2.7*	2.8*	2.7*	1.9*	2.0*	8.5*	5.7*	18.6*
26-END	1.8*	1.7*	3.0*	4.7*	2.6*	3.8*	2.4*	2.8*	2.1*	7.1*	10.5*	27.2*
MEAN	3.2	1.3	2.7	3.3	2.9	3.1	3.0	2.0	2.0	6.8	5.7	16.1

YEAR : 1977 ANNUAL MEAN : 6.2

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	40.5*	2.9*	7.2*	2.1*	1.5*	4.3*	3.1*	2.5*	4.4*	10.0*	8.4*	9.8*
6-10	24.7*	6.3*	3.2*	2.2*	2.1*	5.6*	4.2*	2.6*	4.6*	10.6*	8.6*	9.8*
11-15	11.3*	8.2*	2.2*	1.8*	5.2*	4.2*	3.4*	2.4*	4.0*	9.9*	15.5*	7.3*
16-20	6.7*	4.5*	2.7*	2.1*	6.0*	5.2*	3.1*	2.4*	3.2*	9.5*	13.2*	5.9*
21-25	4.5*	5.6*	2.5*	1.5*	4.0*	3.4*	3.0*	3.5*	3.7*	10.1*	13.8*	7.2*
26-END	3.2*	12.4*	2.3*	1.6*	5.0*	3.2*	2.9*	5.1*	6.9*	8.5*	10.2*	5.5*
MEAN	14.6	6.3	3.3	1.9	4.0	4.3	3.3	3.1	4.5	9.7	11.6	7.5

YEAR : 1978 ANNUAL MEAN : 6.3

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	5.8	4.1	7.2	3.9	6.8	4.8	7.7	2.9	3.1	1.8	8.8	15.0
6-10	12.8	3.8	4.5	5.0	10.5	3.7	7.2	2.7	2.7	3.2	15.2	11.3
11-15	17.0	3.3	5.7	4.1	13.2	4.6	13.5	2.8	2.5	3.4	18.6	10.8
16-20	9.8	7.0	4.3	6.5	7.8	3.1	7.7	4.0	2.1	3.1	9.1	7.9
21-25	6.9	5.7	5.0	5.6	6.7	4.2	5.4	2.5	2.5	6.3	5.9	10.2
26-END	5.2	5.4	4.9	7.8	6.0	3.7	3.7	2.6	2.3	7.6	6.0	8.2
MEAN	9.5	4.8	5.3	5.5	8.4	4.0	7.4	2.9	2.5	4.3	10.6	10.5

Table 23 5-DAY INFLOW DISCHARGE AT LINGGIU DAM (3/3)

YEAR : 1979 ANNUAL MEAN : 7.0

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	9.7	3.5	5.9	6.6	9.3	3.0	2.4	3.7	7.7	2.8	10.6	14.8
6-10	18.6	10.1	10.3	9.5	6.2	2.5	2.3	2.8	7.5	2.1	13.8	11.4
11-15	3.2	3.8	3.1	12.0	4.5	4.0	2.7	2.4	7.3	2.7	15.0	7.7
16-20	5.8	3.6	2.8	6.8	2.9	3.2	3.3	2.3	8.5	3.4	13.5	9.1
21-25	5.5	4.3	4.4	6.9	2.4	4.3	4.6	3.1	5.8	9.7	26.4	7.7
26-END	4.7	4.3	4.8	9.3	2.3	2.9	5.2	5.0	4.1	8.7	46.0	6.0
MEAN	8.6	5.0	5.2	8.8	4.0	3.7	3.5	3.3	6.8	5.0	20.9	9.4

YEAR : 1980 ANNUAL MEAN : 8.0

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	6.4	4.3	4.6	4.0	12.7	6.2	5.5	8.3*	5.9*	20.0	12.2	13.2
6-10	13.8	5.3	3.9	3.6	9.3	5.0	3.9	6.6*	4.8*	19.2	11.8	16.6
11-15	7.6	3.6	4.6	6.3	7.0	5.6	4.2	5.2*	6.8*	9.8	11.2	16.3
16-20	5.4	3.2	3.9	7.0	6.2	6.1	5.5	6.3*	15.4*	8.6	8.5	6.6
21-25	12.2	3.8	5.8	8.7	4.6	4.8	6.1	6.3*	18.1	12.6	13.0	2.7
26-END	6.2	4.1	3.5	9.3	6.3	4.3	6.0	6.2*	21.0	14.9	13.5	9.5
MEAN	8.5	4.1	4.3	6.5	7.6	5.3	5.2	6.5	12.0	14.2	11.7	10.8

YEAR : 1981 ANNUAL MEAN : 5.3

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	3.9	2.1	3.0	7.9	7.1	7.5	2.3	2.5	2.3	2.8	7.5	3.6
6-10	6.7	1.8	4.1	18.8	6.9	4.2	3.0	1.8	2.9	4.1	8.7	4.8
11-15	4.8	1.5	4.5	15.8	8.9	3.1	2.5	1.6	3.9	6.8	4.5	9.3
16-20	3.5	1.5	3.2	12.5	14.3	3.3	1.8	1.6	3.0	4.8	5.9	34.2
21-25	2.9	1.3	3.0	10.1	8.1	2.6	2.7	2.1	3.0	8.7	3.6	10.5
26-END	2.1	2.2	3.6	7.7	5.9	3.0	3.6	3.1	3.9	5.6	4.3	4.5
MEAN	3.9	1.7	3.6	12.1	8.4	3.9	2.7	2.2	3.2	5.5	5.8	10.9

YEAR : 1982 ANNUAL MEAN : 5.4

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	11.1	2.8	2.2	7.7	7.2	9.4	4.7	2.4	6.6	4.1	3.7	3.9
6-10	17.9	2.1	2.9	8.4	8.6	6.8	3.8	2.5	3.3	3.4	3.2	2.8
11-15	8.2	1.9	4.4	5.3	7.9	5.1	3.8	4.5	2.5	2.6	3.4	2.5
16-20	4.9	1.8	5.8	7.7	17.9*	5.0	4.1	4.3	2.8	3.9	3.6	8.3
21-25	3.5	1.8	6.3	5.6	12.0*	3.7	4.1	3.6	3.0	2.6	3.1	27.0
26-END	3.0	1.9	5.0	12.0	10.4	2.7	3.0	4.1	2.9	2.6	3.6	11.6*
MEAN	7.9	2.1	4.5	7.8	10.6	5.4	3.9	3.6	3.5	3.2	3.4	9.4

YEAR : 1983 ANNUAL MEAN : 8.1

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	17.9*	6.2*	7.0	1.7	4.9	3.2	2.1	7.8	6.0	5.8	10.2	6.8
6-10	11.4*	4.9	4.5	1.9	11.0	3.7	3.0	5.6	10.4	7.3	17.6	8.5
11-15	12.7*	4.0	2.6	2.5	18.2	4.5	2.9	3.9	9.7	6.1	13.7	15.9
16-20	21.7*	3.9	2.0	1.9	8.8	2.9	3.9	6.4	7.4	6.4	11.2	34.3
21-25	12.5*	3.3	2.1	1.9	4.9	2.6	3.4	9.3	8.2	7.3	8.3	21.1*
26-END	9.1*	2.8	1.7	2.7	4.2	2.5	5.5	5.9	6.1	7.6	7.4	59.9*
MEAN	14.1	4.3	3.3	2.1	8.5	3.2	3.5	6.5	8.0	6.8	11.4	25.6

YEAR : 1984 ANNUAL MEAN : 13.7

PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1- 5	30.1*	50.2	13.2	8.0	10.1	8.4	5.9	7.7	3.0*	5.4*	10.8	17.2
6-10	18.7*	49.1	16.4	10.7	14.3	7.3	6.4	6.7	4.0*	13.6*	10.5	17.3*
11-15	22.0	81.7	8.2	9.0	11.8	7.5	6.6	5.1	3.3*	8.6	15.7	12.0*
16-20	11.4	29.6	11.0	8.5	15.7	6.3	6.4	3.7	2.7*	7.4	18.2	10.4*
21-25	9.1	18.9	13.0	7.4	13.0	6.3	7.4	3.4	3.6*	6.0	15.1	23.0*
26-END	28.2	13.0	14.1	8.7	9.6	6.5	6.0	3.3*	4.8*	6.7	18.1	62.1*
MEAN	20.2	41.4	12.7	8.7	12.2	7.1	6.4	4.9	3.6	8.2	14.7	24.9

Table 24 RESULT OF RESERVOIR OPERATION OF SAYONG AND LINGGIU DAMS
(HYDROLOGICAL CONDITION FROM JANUARY 1971 TO JUNE 1972) (1/3)

JOHOR RIVER OPERATION MODEL SYSTEM TERGET YEAR 2005
DAM1=SAYONG DAM; HWL= 18.0(M) LWL= 12.0(M),DAM2=LINGGIU DAM; HWL= 31.0(M) LWL= 25.0(M),DAM3=SEDILI DAM; HWL= 0. (M) LWL= 0. (M)

PERIOD	DEFICIT		INITIAL W.L.			FINAL W.L.			RESERVOIR STORAGE VOLUME			SPILL-OUT			PIPELINE		OUTFLOW			REMAINING DEFICIT
1971 (UNIT)	DRI (CMS)	IRR.	DAM1 (M)	DAM2	DAM3	DAM1 (M)	DAM2	DAM3	DAM1 (MCM)	DAM2 (MCM)	DAM3 (MCM)	DAM1 (CMS)	DAM2	DAM3	DAM1 (CMS)	DAM2	DAM1 (CMS)	DAM2	DAM3	(CMS)
JAN																				
1- 5	0.	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	92.0	56.8	0.	0.	0.	0.	0.	0.	0.
6- 10	0.	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	96.2	63.3	0.	0.	0.	0.	0.	0.	0.
11- 15	0.	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	42.7	17.9	0.	0.	0.	0.	0.	0.	0.
16- 20	0.	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	22.8	6.5	0.	0.	0.	0.	0.	0.	0.
21- 25	3.9	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	12.1	4.0	0.	0.	0.	4.3	0.	0.	0.
26-END	7.9	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	3.0	2.4	0.	0.	0.	8.8	0.	0.	0.
MONTHLY	5.8	0.										116.3	65.4	0.	0.	0.	6.4	0.	0.	0.
FEB																				
1- 5	11.5	0.	18.0	31.0	0.	17.9	30.9	0.	126.31	57.24	0.	0.	0.	0.	0.	0.	10.5	2.3	0.	0.
6- 10	13.5	0.	17.9	30.9	0.	17.8	30.7	0.	123.13	54.71	0.	0.	0.	0.	0.	0.	10.4	4.6	0.	0.
11- 15	14.7	0.	17.8	30.7	0.	17.7	30.5	0.	118.49	51.79	0.	0.	0.	0.	0.	0.	11.4	5.0	0.	0.
16- 20	15.3	0.	17.7	30.5	0.	17.5	30.2	0.	112.95	48.61	0.	0.	0.	0.	0.	0.	11.9	5.1	0.	0.
21- 25	14.9	0.	17.5	30.2	0.	17.4	30.1	0.	109.59	46.58	0.	0.	0.	0.	0.	0.	11.6	4.9	0.	0.
26-END	1.9	0.	17.4	30.1	0.	17.6	30.3	0.	116.91	49.73	0.	0.	0.	0.	0.	0.	1.5	0.6	0.	0.
MONTHLY	30.7	0.										0.	0.	0.	0.	0.	24.5	9.6	0.	0.
MAR																				
1- 5	1.7	0.	17.6	30.3	0.	17.9	30.6	0.	124.45	53.15	0.	0.	0.	0.	0.	0.	1.3	0.6	0.	0.
6- 10	7.6	0.	17.9	30.6	0.	17.9	30.7	0.	125.85	53.82	0.	0.	0.	0.	0.	0.	6.3	2.1	0.	0.
11- 15	10.1	0.	17.9	30.7	0.	17.9	30.6	0.	124.82	53.31	0.	0.	0.	0.	0.	0.	8.1	3.1	0.	0.
16- 20	12.2	0.	17.9	30.6	0.	17.9	30.5	0.	123.57	52.25	0.	0.	0.	0.	0.	0.	9.5	4.0	0.	0.
21- 25	9.0	0.	17.9	30.5	0.	18.0	30.7	0.	126.61	53.97	0.	0.	0.	0.	0.	0.	8.6	1.4	0.	0.
26-END	9.7	0.	18.0	30.7	0.	17.9	30.7	0.	125.84	54.50	0.	0.	0.	0.	0.	0.	9.0	1.8	0.	0.
MONTHLY	22.6	0.										0.	0.	0.	0.	0.	19.3	5.8	0.	0.
APR																				
1- 5	9.5	0.	17.9	30.7	0.	18.0	30.9	0.	128.00	56.88	0.	1.2	0.	0.	0.	0.	10.6	0.	0.	0.
6- 10	9.0	0.	18.0	30.9	0.	18.0	31.0	0.	128.00	58.00	0.	0.	1.5	0.	0.	0.	9.9	0.1	0.	0.
11- 15	9.8	0.	18.0	31.0	0.	18.0	31.0	0.	127.54	57.79	0.	0.	0.	0.	0.	0.	8.4	2.4	0.	0.
16- 20	11.5	0.	18.0	31.0	0.	17.9	30.9	0.	125.63	56.93	0.	0.	0.	0.	0.	0.	9.8	3.0	0.	0.
21- 25	13.4	0.	17.9	30.9	0.	17.8	30.7	0.	122.19	54.70	0.	0.	0.	0.	0.	0.	10.3	4.6	0.	0.
26-END	15.0	0.	17.8	30.7	0.	17.7	30.5	0.	118.14	51.98	0.	0.	0.	0.	0.	0.	11.6	5.1	0.	0.
MONTHLY	29.5	0.										0.5	0.6	0.	0.	0.	26.2	6.6	0.	0.
MAY																				
1- 5	17.0	0.	17.7	30.5	0.	17.4	30.2	0.	110.95	48.27	0.	0.	0.	0.	0.	0.	13.2	5.7	0.	0.
6- 10	17.7	0.	17.4	30.2	0.	17.2	29.9	0.	102.75	44.51	0.	0.	0.	0.	0.	0.	13.7	5.9	0.	0.
11- 15	17.6	0.	17.2	29.9	0.	16.9	29.6	0.	95.23	40.84	0.	0.	0.	0.	0.	0.	13.7	5.9	0.	0.
16- 20	16.9	0.	16.9	29.6	0.	16.6	29.3	0.	87.94	37.35	0.	0.	0.	0.	0.	0.	13.2	5.6	0.	0.
21- 25	17.8	0.	16.6	29.3	0.	16.3	28.9	0.	79.57	33.55	0.	0.	0.	0.	0.	0.	13.9	5.9	0.	0.
26-END	16.0	0.	16.3	28.9	0.	15.9	28.6	0.	71.23	30.08	0.	0.	0.	0.	0.	0.	12.5	5.3	0.	0.
MONTHLY	45.9	0.										0.	0.	0.	0.	0.	35.7	15.3	0.	0.
JUN																				
1- 5	15.9	0.	15.9	28.6	0.	15.6	28.3	0.	64.06	27.09	0.	0.	0.	0.	0.	0.	12.4	5.3	0.	0.
6- 10	16.1	0.	15.6	28.3	0.	15.3	28.0	0.	57.64	24.33	0.	0.	0.	0.	0.	0.	12.6	5.3	0.	0.
11- 15	16.8	0.	15.3	28.0	0.	14.9	27.6	0.	49.98	21.02	0.	0.	0.	0.	0.	0.	13.1	5.5	0.	0.
16- 20	16.7	0.	14.9	27.6	0.	14.6	27.3	0.	42.41	17.94	0.	0.	0.	0.	0.	0.	13.0	5.5	0.	0.
21- 25	10.5	0.	14.6	27.3	0.	14.5	27.3	0.	40.61	18.52	0.	0.	0.	0.	0.	0.	8.0	3.7	0.	0.
26-END	8.2	0.	14.5	27.3	0.	14.4	27.5	0.	39.04	19.59	0.	0.	0.	0.	0.	0.	6.1	3.0	0.	0.
MONTHLY	36.4	0.										0.	0.	0.	0.	0.	28.2	12.2	0.	0.

Table 25 RESULT OF RESERVOIR OPERATION OF SAYONG AND LINGGIU DAMS (HYDROLOGICAL CONDITION FROM JANUARY 1971 TO JUNE 1972) (2/3)

JOHOR RIVER OPERATION MODEL SYSTEM TERGET YEAR 2005
DAM1=SAYONG DAM; HWL= 18.0(M) LWL= 12.0(M),DAM2=LINGGIU DAM; HWL= 31.0(M) LWL= 25.0(M),DAM3=SEDILI DAM; HWL= 0. (M) LWL= 0. (M)

PERIOD	DEFICIT		INITIAL W.L.			FINAL W.L.			RESERVOIR STORAGE VOLUME			SPILL-OUT			PIPELINE		OUTFLOW			REMAINING DEFICIT
1971 (UNIT)	DEI (CMS)	IRR.	DAM1	DAM2 (M)	DAM3	DAM1	DAM2 (M)	DAM3	DAM1 (MCM)	DAM2 (MCM)	DAM3 (MCM)	DAM1	DAM2 (CMS)	DAM3	DAM1 (CMS)	DAM2	DAM1	DAM2 (CMS)	DAM3	(CMS)
JUL																				
1- 5	7.3	0.	14.4	27.5	0.	14.4	27.6	0.	38.46	23.23	0.	0.	0.	0.	0.	0.	5.2	2.9	0.	0.
6- 10	15.0	0.	14.4	27.6	0.	14.1	27.3	0.	32.82	18.10	0.	0.	0.	0.	0.	0.	10.7	5.9	0.	0.
11- 15	16.7	0.	14.1	27.3	0.	13.7	26.9	0.	26.25	14.33	0.	0.	0.	0.	0.	0.	12.0	6.6	0.	0.
16- 20	13.3	0.	13.7	26.9	0.	13.5	26.6	0.	22.25	12.48	0.	0.	0.	0.	0.	0.	9.5	5.3	0.	0.
21- 25	16.5	0.	13.5	26.6	0.	13.1	26.1	0.	15.28	8.56	0.	0.	0.	0.	0.	0.	11.8	6.6	0.	0.
26-END	14.0	0.	13.1	26.1	0.	12.7	25.7	0.	9.17	5.61	0.	0.	0.	0.	0.	0.	9.7	5.9	0.	0.
MONTHLY	37.0	0.										0.	0.	0.	0.	0.	26.3	14.8	0.	0.
AUG																				
1- 5	11.2	0.	12.7	25.7	0.	12.5	25.7	0.	6.83	4.91	0.	0.	0.	0.	0.	0.	7.2	5.2	0.	0.
6- 10	11.9	0.	12.5	25.7	0.	12.4	25.5	0.	5.98	3.85	0.	0.	0.	0.	0.	0.	8.0	5.2	0.	0.
11- 15	9.2	0.	12.4	25.5	0.	12.5	25.5	0.	7.22	4.12	0.	0.	0.	0.	0.	0.	6.5	3.7	0.	0.
16- 20	0.	0.	12.5	25.5	0.	13.1	26.8	0.	16.34	14.15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21- 25	1.1	0.	13.1	26.8	0.	13.5	27.3	0.	23.09	18.50	0.	0.	0.	0.	0.	0.	0.7	0.5	0.	0.
26-END	10.3	0.	13.5	27.3	0.	13.6	27.2	0.	23.89	17.08	0.	0.	0.	0.	0.	0.	6.7	4.8	0.	0.
MONTHLY	19.8	0.										0.	0.	0.	0.	0.	13.2	8.8	0.	0.
SEP																				
1- 5	8.7	0.	13.6	27.2	0.	13.7	27.2	0.	26.44	17.37	0.	0.	0.	0.	0.	0.	5.8	3.8	0.	0.
6- 10	0.	0.	13.7	27.2	0.	14.3	28.0	0.	36.09	24.06	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11- 15	1.0	0.	14.3	28.0	0.	14.6	28.4	0.	43.04	28.16	0.	0.	0.	0.	0.	0.	0.7	0.4	0.	0.
16- 20	6.5	0.	14.6	28.4	0.	14.8	28.5	0.	46.40	29.29	0.	0.	0.	0.	0.	0.	4.4	2.8	0.	0.
21- 25	12.4	0.	14.8	28.5	0.	14.7	28.3	0.	44.63	27.17	0.	0.	0.	0.	0.	0.	8.6	5.2	0.	0.
26-END	10.0	0.	14.7	28.3	0.	14.7	28.2	0.	44.51	26.44	0.	0.	0.	0.	0.	0.	7.0	4.1	0.	0.
MONTHLY	16.7	0.										0.	0.	0.	0.	0.	11.4	7.1	0.	0.
OCT																				
1- 5	14.1	0.	14.7	28.2	0.	14.5	27.9	0.	40.95	23.58	0.	0.	0.	0.	0.	0.	9.9	5.7	0.	0.
6- 10	15.7	0.	14.5	27.9	0.	14.2	27.5	0.	35.63	19.98	0.	0.	0.	0.	0.	0.	11.2	6.3	0.	0.
11- 15	14.6	0.	14.2	27.5	0.	14.0	27.2	0.	30.95	17.17	0.	0.	0.	0.	0.	0.	10.4	5.8	0.	0.
16- 20	13.5	0.	14.0	27.2	0.	13.8	27.0	0.	27.40	15.57	0.	0.	0.	0.	0.	0.	9.6	5.4	0.	0.
21- 25	0.	0.	13.8	27.0	0.	14.0	27.8	0.	30.92	23.04	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26-END	10.3	0.	14.0	27.8	0.	13.9	27.7	0.	28.71	21.91	0.	0.	0.	0.	0.	0.	6.5	5.0	0.	0.
MONTHLY	30.4	0.										0.	0.	0.	0.	0.	21.1	12.6	0.	0.
NOV																				
1- 5	12.1	0.	13.9	27.7	0.	13.7	27.5	0.	25.90	19.85	0.	0.	0.	0.	0.	0.	7.6	5.8	0.	0.
6- 10	12.2	0.	13.7	27.5	0.	13.5	27.3	0.	23.12	18.23	0.	0.	0.	0.	0.	0.	7.6	6.0	0.	0.
11- 15	11.2	0.	13.5	27.3	0.	13.4	27.1	0.	20.48	16.75	0.	0.	0.	0.	0.	0.	6.8	5.6	0.	0.
16- 20	12.0	0.	13.4	27.1	0.	13.2	26.9	0.	17.20	14.54	0.	0.	0.	0.	0.	0.	7.2	6.1	0.	0.
21- 25	12.9	0.	13.2	26.9	0.	13.0	26.6	0.	14.15	12.17	0.	0.	0.	0.	0.	0.	7.7	6.6	0.	0.
26-END	12.4	0.	13.0	26.6	0.	12.8	26.3	0.	11.43	10.08	0.	0.	0.	0.	0.	0.	7.3	6.5	0.	0.
MONTHLY	31.4	0.										0.	0.	0.	0.	0.	19.1	15.8	0.	0.
DEC																				
1- 5	11.3	0.	12.8	26.3	0.	12.7	26.1	0.	9.20	8.49	0.	0.	0.	0.	0.	0.	6.5	6.0	0.	0.
6- 10	10.9	0.	12.7	26.1	0.	12.5	25.9	0.	7.53	7.09	0.	0.	0.	0.	0.	0.	6.2	5.9	0.	0.
11- 15	0.	0.	12.5	25.9	0.	13.8	27.2	0.	27.85	17.36	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16- 20	0.	0.	13.8	27.2	0.	15.9	29.7	0.	70.97	42.35	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21- 25	0.	0.	15.9	29.7	0.	17.1	30.9	0.	101.25	56.63	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26-END	0.	0.	17.1	30.9	0.	17.9	31.0	0.	126.16	58.00	0.	0.	14.2	0.	0.	0.	0.	0.	0.	0.
MONTHLY	9.6	0.										0.	7.4	0.	0.	0.	5.5	5.1	0.	0.
YEARLY	315.6	0.										116.9	73.4	0.	0.	0.	236.9	113.8	0.	0.

Table 26 RESULT OF RESERVOIR OPERATION OF SAYONG AND LINGGIU DAMS (HYDROLOGICAL CONDITION FROM JANUARY 1971 TO JUNE 1972) (3/3)

JOHOR RIVER OPERATION MODEL SYSTEM TERGET YEAR 2005
DAM1=SAYONG DAM; HWL= 18.0(M) LWL= 12.0(M),DAM2=LINGGIU DAM; HWL= 31.0(M) LWL= 25.0(M),DAM3=SEDILI DAM; HWL= 0. (M) LWL= 0. (M)

PERIOD	DEFICIT		INITIAL W.L.			FINAL W.L.			RESERVOIR STORAGE VOLUME			SPILL-OUT			PIPELINE		OUTFLOW			REMAINING DEFICIT
1972 (UNIT)	DRI (CMS)	IRR.	DAM1 (M)	DAM2	DAM3	DAM1 (M)	DAM2	DAM3	DAM1 (MCM)	DAM2 (MCM)	DAM3 (MCM)	DAM1 (CMS)	DAM2	DAM3	DAM1 (CMS)	DAM2	DAM1 (CMS)	DAM2	DAM3	(CMS)
JAN																				
1- 5	1.7	0.	17.9	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	12.2	4.8	0.	0.	0.	1.9	0.	0.	0.
6- 10	9.7	0.	18.0	31.0	0.	18.0	31.0	0.	127.76	57.89	0.	0.	0.	0.	0.	0.	8.1	2.7	0.	0.
11- 15	12.5	0.	18.0	31.0	0.	17.9	30.9	0.	124.24	56.29	0.	0.	0.	0.	0.	0.	9.9	3.9	0.	0.
16- 20	11.2	0.	17.9	30.9	0.	17.9	30.8	0.	124.30	56.00	0.	0.	0.	0.	0.	0.	8.6	3.9	0.	0.
21- 25	11.5	0.	17.9	30.8	0.	17.8	30.7	0.	122.11	54.68	0.	0.	0.	0.	0.	0.	8.8	4.0	0.	0.
26-END	13.9	0.	17.8	30.7	0.	17.6	30.5	0.	115.90	51.90	0.	0.	0.	0.	0.	0.	10.7	4.8	0.	0.
MONTHLY	27.3	0.										5.3	2.'	0.	0.	9.	21.6	8.7	0.	0.
FEB																				
1- 5	13.8	0.	17.6	30.5	0.	17.5	30.4	0.	112.22	50.12	0.	0.	0.	0.	0.	0.	10.6	4.7	0.	0.
6- 10	14.0	0.	17.5	30.4	0.	17.5	30.2	0.	112.79	47.99	0.	0.	0.	0.	0.	0.	10.9	4.6	0.	0.
11- 15	12.5	0.	17.5	30.2	0.	17.5	30.0	0.	112.04	45.69	0.	0.	0.	0.	0.	0.	9.9	4.0	0.	0.
16- 20	15.9	0.	17.5	30.0	0.	17.3	29.7	0.	105.64	42.55	0.	0.	0.	0.	0.	0.	12.6	5.1	0.	0.
21- 25	14.2	0.	17.3	29.7	0.	17.3	29.5	0.	107.49	40.13	0.	0.	0.	0.	0.	0.	11.5	4.3	0.	0.
26-END	13.5	0.	17.3	29.5	0.	17.3	29.4	0.	106.20	38.93	0.	0.	0.	0.	0.	0.	11.0	4.0	0.	0.
MONTHLY	35.1	0.										0.	0.	0.	0.	0.	27.8	11.2	0.	0.
MAR																				
1- 5	16.6	0.	17.3	29.4	0.	17.0	29.1	0.	98.83	35.75	0.	0.	0.	0.	0.	0.	13.5	4.9	0.	0.
6- 10	17.4	0.	17.0	29.1	0.	16.7	28.8	0.	90.06	32.39	0.	0.	0.	0.	0.	0.	14.2	5.1	0.	0.
11- 15	16.6	0.	16.7	28.8	0.	16.4	28.5	0.	83.55	29.59	0.	0.	0.	0.	0.	0.	13.6	4.8	0.	0.
16- 20	17.0	0.	16.4	28.5	0.	16.1	28.2	0.	75.46	26.41	0.	0.	0.	0.	0.	0.	14.0	4.9	0.	0.
21- 25	16.5	0.	16.1	28.2	0.	15.8	27.9	0.	68.85	23.54	0.	0.	0.	0.	0.	0.	13.7	4.7	0.	0.
26-END	17.0	0.	15.8	27.9	0.	15.4	27.5	0.	59.50	20.40	0.	0.	0.	0.	0.	0.	14.1	4.8	0.	0.
MONTHLY	45.1	0.										0.	0.	0.	0.	0.	37.1	13.0	0.	0.
APR																				
1- 5	8.7	0.	15.4	27.5	0.	15.4	28.0	0.	60.22	24.47	0.	0.	0.	0.	0.	0.	6.9	2.8	0.	0.
6- 10	3.0	0.	15.4	28.0	0.	15.6	28.6	0.	63.88	30.13	0.	0.	0.	0.	0.	0.	2.3	1.1	0.	0.
11- 15	0.	0.	15.6	28.6	0.	15.9	29.2	0.	71.37	36.54	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16- 20	0.	0.	15.9	29.2	0.	16.3	29.9	0.	81.03	44.61	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21- 25	0.	0.	16.3	29.9	0.	16.8	30.6	0.	94.15	52.57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26-END	0.	0.	16.8	30.6	0.	17.5	31.0	0.	111.84	58.00	0.	0.	6.6	0.	0.	0.	0.	0.	0.	0.
MONTHLY	5.1	0.										0.	2 6	0.	0.	0.	3.9	1.7	0.	0.
MAY																				
1- 5	0.	0.	17.5	31.0	0.	17.9	31.0	0.	124.67	58.00	0.	0.	9.2	0.	0.	0.	0.	0.	0.	0.
6- 10	2.1	0.	17.9	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	6.4	7.4	0.	0.	0.	2.3	0.	0.	0.
11- 15	6.0	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	2.8	4.4	0.	0.	0.	6.7	0.	0.	0.
16- 20	8.6	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	0.	2.8	0.	0.	0.	7.6	2.0	0.	0.
21- 25	0.	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	24.3	11.4	0.	0.	0.	0.	0.	0.	0.
26-END	0.	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	23.2	11.3	0.	0.	0.	0.	0.	0.	0.
MONTHLY	7.2	0.										26.5	21.0	0.	0.	0.	7.2	0.8	0.	0.
JUN																				
1- 5	3.6	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	8.2	6.4	0.	0.	0.	4.0	0.	0.	0.
6- 10	10.1	0.	18.0	31.0	0.	18.0	31.0	0.	126.91	57.51	0.	0.	0.	0.	0.	0.	7.4	3.9	0.	0.
11- 15	8.1	0.	18.0	31.0	0.	16.0	31.0	0.	128.00	58.00	0.	0.7	4.4	0.	0.	0.	9.0	0.	0.	0.
16- 20	1.9	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	16.1	6.3	0.	0.	0.	2.1	0.	0.	0.
21- 25	2.9	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	13.9	4.9	0.	0.	0.	3.2	0.	0.	0.
26-END	8.5	0.	18.0	31.0	0.	18.0	31.0	0.	128.00	58.00	0.	0.	2.4	0.	0.	0.	9.0	0.5	0.	0.
MONTHLY	15.2	0.										16.8	10.6	0.	0.	0.	15.0	1.9	0.	0.

Table 27 LIST OF ALTERNATIVE DEVELOPMENT PLANS

Case	Present Value/1 of Dam Cost in 1986 (M$10^6)	First Dam: Dam	First Dam: HWL /2	First Dam: S /3	Year /4	Second Dam: Dam	Second Dam: HWL	Second Dam: S	Year /4	Ranking
1	132.6	Sayong	17	98	1991	Linggiu	33	89	1995	5
	113.9	Sayong	18	128	"	Linggiu	31	58	2001	1
	122.7	Sayong	21	247	"	-		-	-	2
	158.3	Linggiu	33	89	"	Sayong	18	128	1992	7
	136.6	Linggiu	34	107	"	Sayong	17	98	1995	6
	118.5	Linggiu	35	126	"	Sayong	16	73	1999	3
	122.6	Linggiu	40	253	"	-		-	-	4
2	85.2	Sayong	16	73	"	Telor	24	18	2000	3
	75.6	Sayong	17	98	"	-		-	-	1
	96.6	Linggiu	33	89	"	Telor	24	18	2002	4
	85.0	Linggiu	34	107	"	-		-	-	2
1-A	86.5	Sayong	17	98	"	Telor	22	10	2003	3
	82.3	Sayong	18	128	"	-		-	-	1
	96.0	Linggiu	34	107	"	Telor	22	10	2003	4
	86.3	Linggiu	35	126	"	-		-	-	2
2-A	99.6	Sayong	15	25	"	Linggiu	31	58	2000	5
	69.3	Sayong	16	73	"	-		-	-	1
	95.4	Linggiu	31	58	"	Telor	24	18	2001	4
	82.3	Linggiu	32	73	"	-		-	-	2
	83.5	Linggiu	33	89	"	-		-	-	3

Note:
- /1: Time basis; 1986, the commencement of service; 1992 and discount rate; 10%
- /2: High water level
- /3: Active storage
- /4: Completion of dam construction

FIGURES

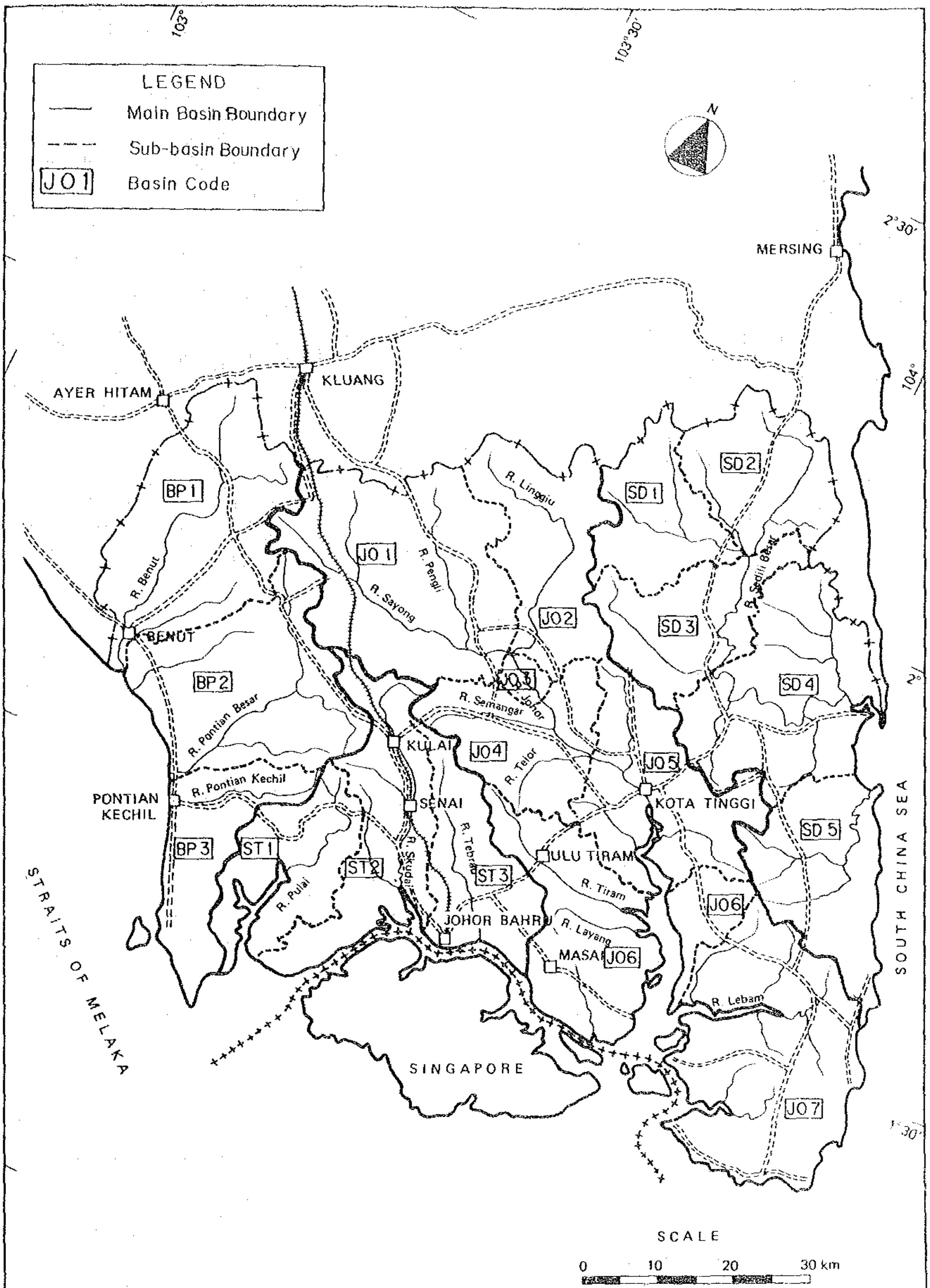

Fig. 1 Basin Division

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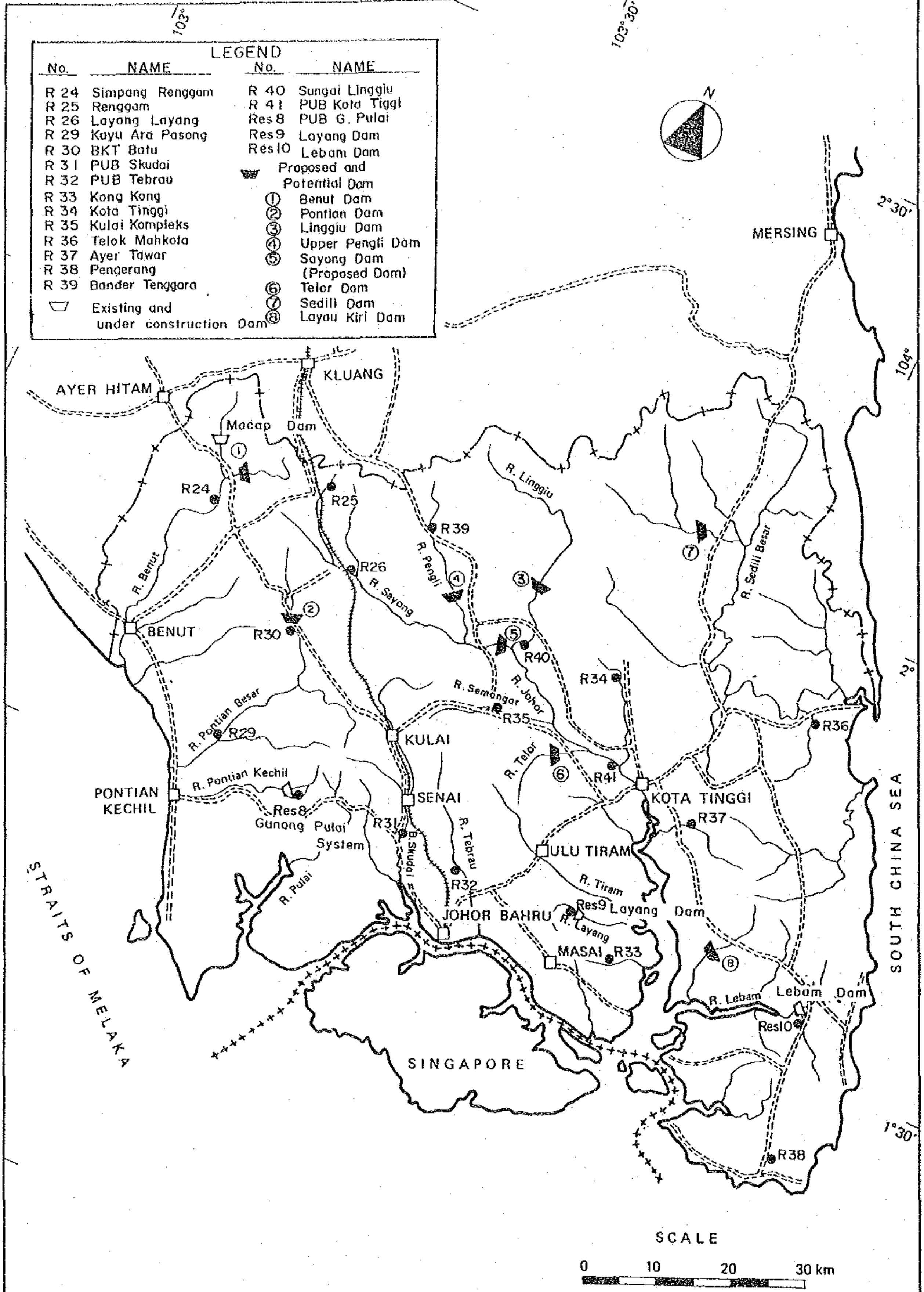

Fig. 2 Location Map of Existing Water Supply Facilities and Proposed Damsites

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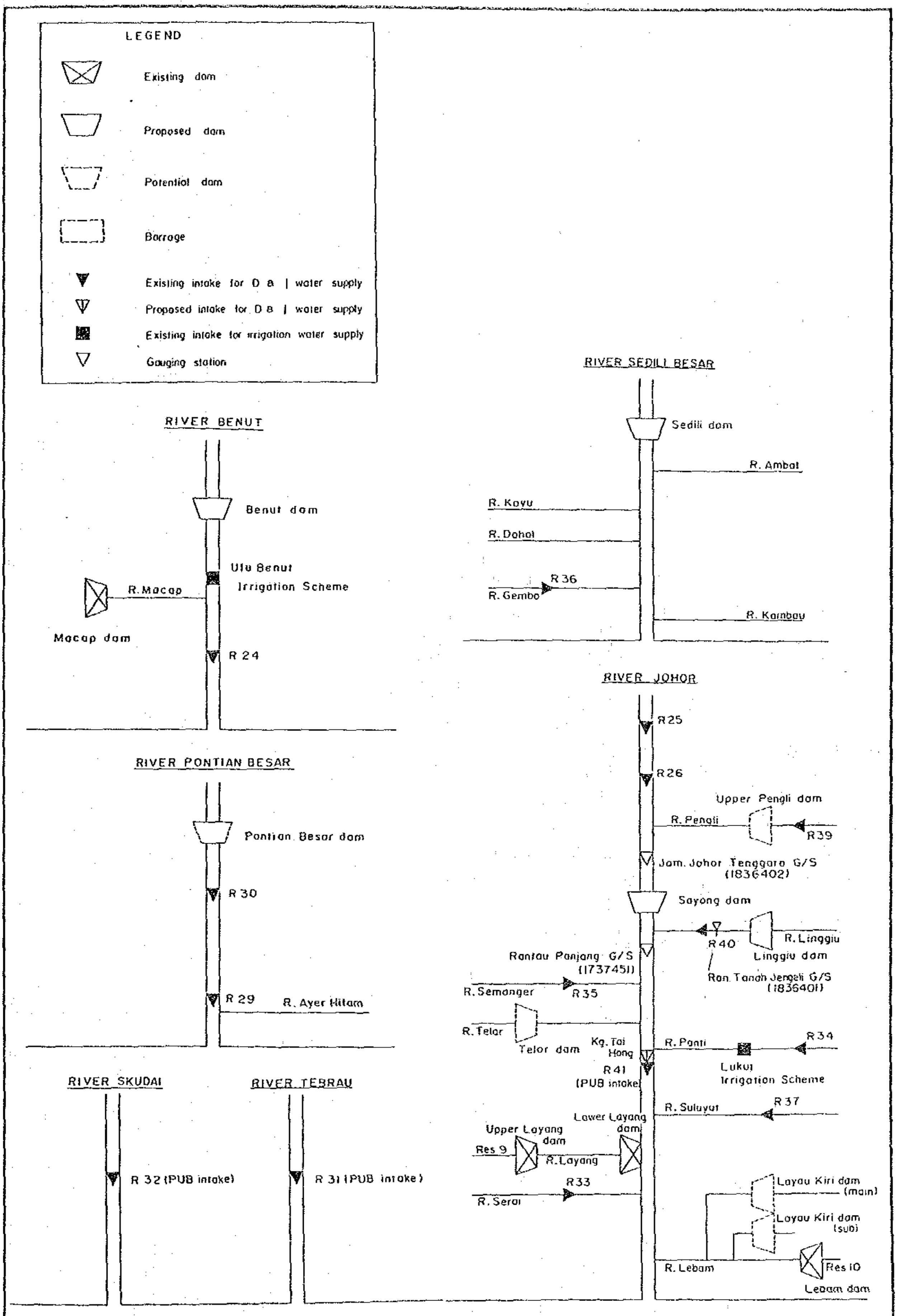

Fig.3 Schematic Diagram of Model

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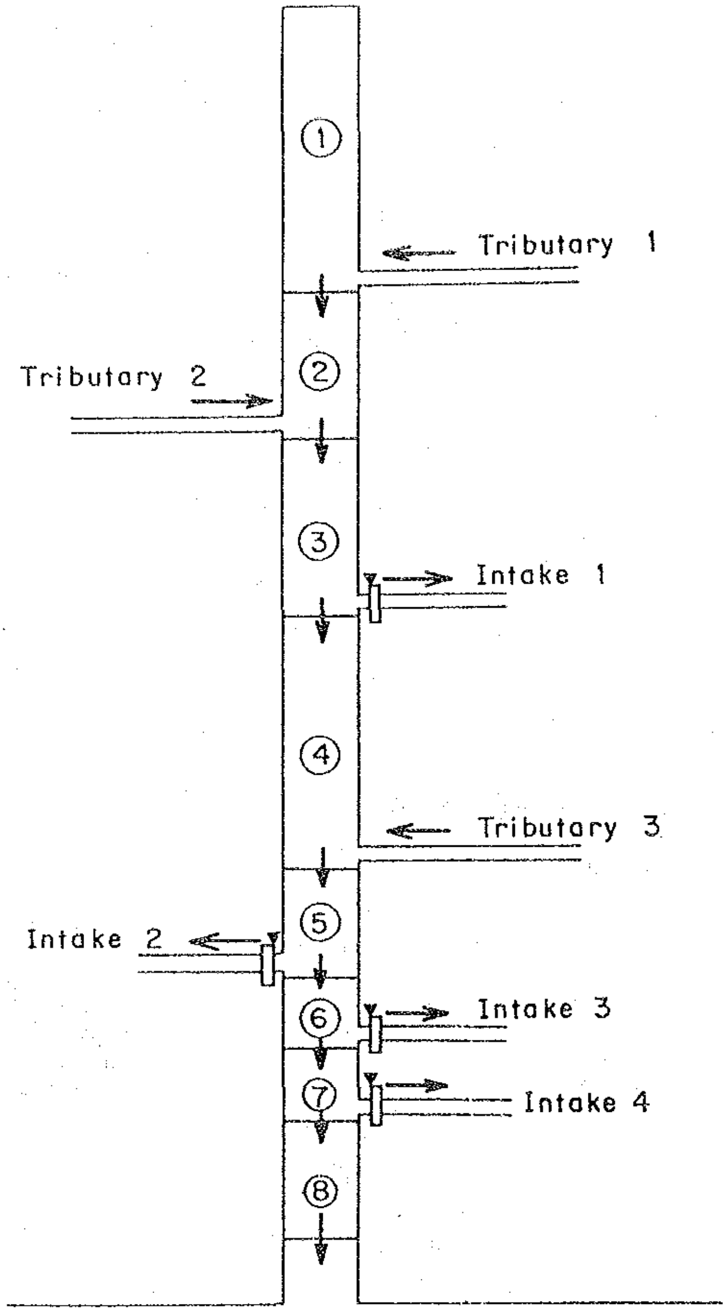

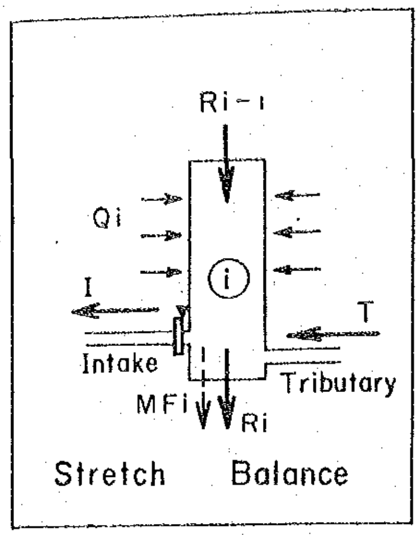

$R_i = R_{i-1} + Q_i + T$

IF ; $R_i > MF_i$

$MF_i = MF_i$

$R_i = R_i - MF_i$

$DMF_i = 0$

IF ; $R_i \leq MF_i$

$MF_i = R_i$

$DMF_i = MF_i - R_i$

$R_i = 0$

IF ; $R_i - I \geq 0$

$R_i = R_i - I + MF_i$

$DF_i = 0$

IF ; $R_i - I < 0$

$R_i = 0$

$DF_i = -(R_i - I) + DMF_i$

Ri-1	Runoff from the upstream stretch
Ri	Surplus runoff to downstream
Qi	Runoff from catchment of stretch
DFi	Deficit at strech i
T	Tributary inflow
I	Intake outfrow
MFi	Maintenance flow at strech i
DMFi	Deficit for maintenance flow at strech i

Fig.4 Mainstream Model

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$R_1 = Q_1$

$R_2 = Q_2$

$R_3 = Q_3 + S_1 + S_2 + RF_3$

$R_4 = Q_4 + S_3 + RF_4$

IF ; $R_i > MF_i$

$MF_i = MF_i$

$R_i = R_i - MF_i$

$DMF_i = 0$

IF ; $R_i \leq MF_i$

$MF_i = R_i$

$DMF_i = MF_i - R_i$

$R_i = 0$

IF ; $R_i > D_i$

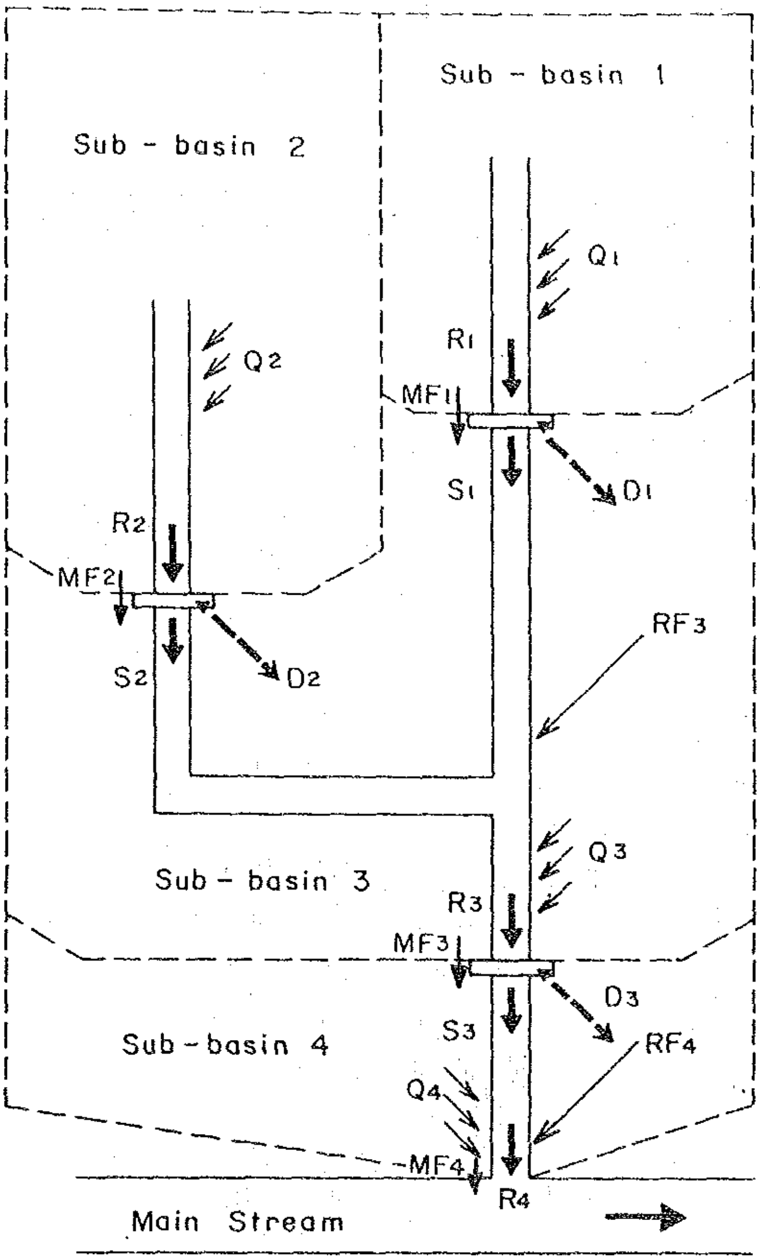
$DF_i = 0$

$S_i = R_i - D_i + MF_i$

IF ; $R_i \leq D_i$

$DF_i = D_i - R_i + DMF_i$

$S_i = 0$



Ri	Available runoff	at	intake i (i = 1 ~ 3)
Di	Water demand	at	〃
Si	Excess runoff	at	〃
DFi	Water deficit	at	〃
Qi	Natural runoff	in	Sub - basin i (i = 1 ~ 4)
RFi	Return flow	in	〃
Ri	Runoff into the main stream		
MFi	Maintenance flow	at	intake i (i = 1 ~ 4)
DMFi	Deficit for maintenance flow		〃

Fig. 5 Tributary Model

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