社会開発協力部報告書

JICA LIBRARY
1031243[7]

国際協力事業団

受入月日 '86.7.30	113
	617
登録No. 12986	SDS

113
60
SDS

GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY, MALAYSIA

REGIONAL WATER RESOURCES STUDY OF SOUTH JOHOR

VOL. 3
ANNEX

B. DOMESTIC AND INDUSTRIAL WATER SUPPLY
C. AGRICULTURE AND IRRIGATION DEVELOPMENT

DECEMBER 1985

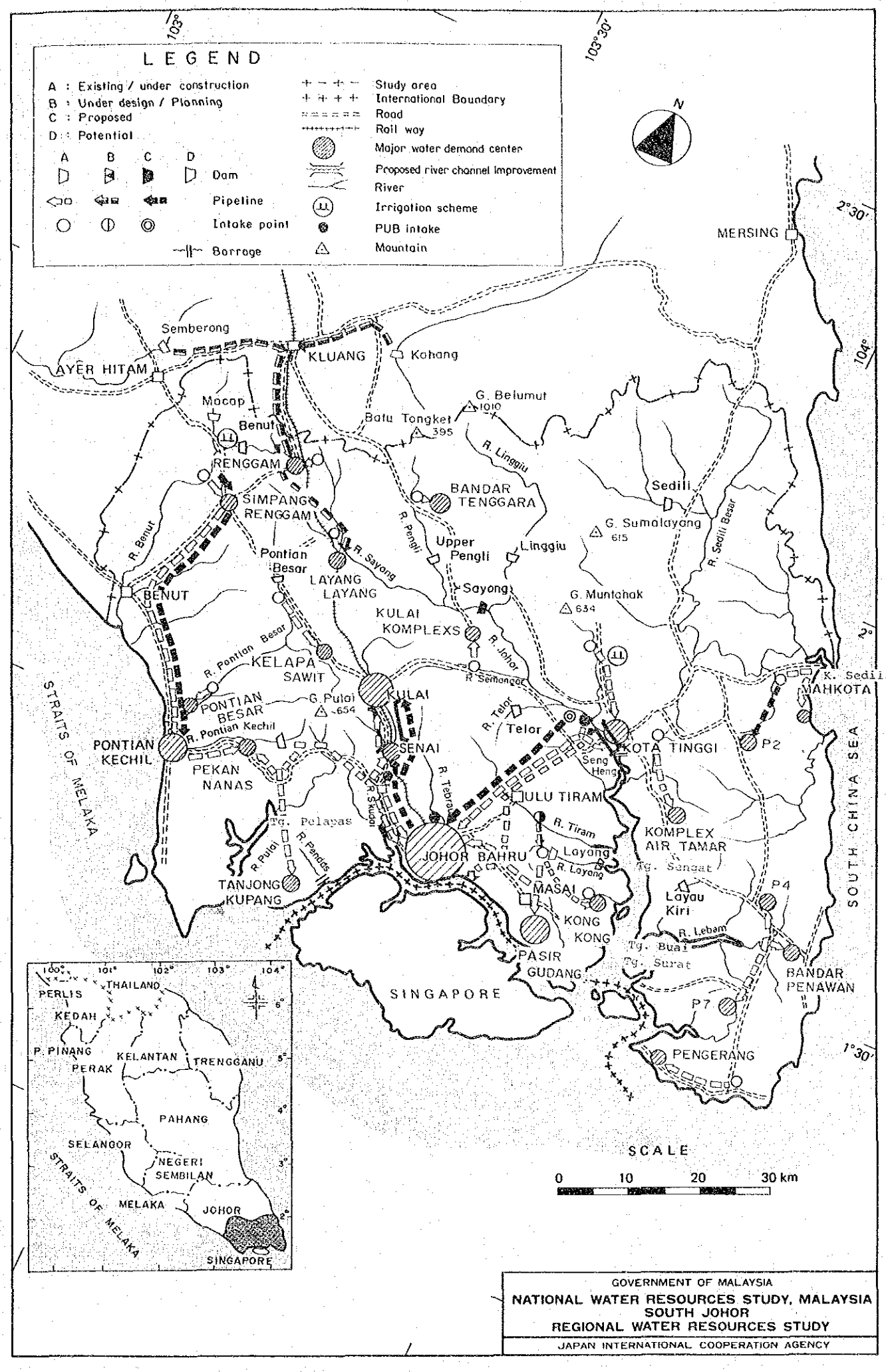
JAPAN INTERNATIONAL COOPERATION AGENCY

NATIONAL WATER RESOURCES STUDY, MALAYSIA

REGIONAL WATER RESOURCES STUDY OF SOUTH JOHOR

LIST OF VOLUMES

Vol. 1	MAIN REPORT	
Vol. 2	ANNEX A	SOCIO-ECONOMY
Vol. 3	ANNEX B	DOMESTIC AND INDUSTRIAL WATER SUPPLY
	ANNEX C	AGRICULTURE AND IRRIGATION DEVELOPMENT
Vol. 4	ANNEX D	METEOROLOGY AND HYDROLOGY
	ANNEX E	GROUNDWATER RESOURCES
	ANNEX F	WATER QUALITY
Vol. 5	ANNEX G	FLOOD MITIGATION PLAN
Vol. 6	ANNEX H	ENGINEERING GEOLOGY
	ANNEX I	CONSTRUCTION MATERIAL
Vol. 7	ANNEX J	REGIONAL WATER DEMAND AND SUPPLY SYSTEM
	ANNEX K	DESIGN AND COST ESTIMATE OF PROPOSED DEVELOPMENT PLAN
	ANNEX L	ECONOMIC EVALUATION OF PROPOSED DEVELOPMENT PLAN
Vol. 8	ANNEX M	LAND USE IN THE PROPOSED RESERVOIR AREA
	ANNEX N	ENVIRONMENTAL IMPACT OF PROPOSED PLAN
	ANNEX O	LEGAL AND INSTITUTIONAL ARRANGEMENT


LEGEND
A : Existing / under construction
B : Under design / Planning
C : Proposed
D : Potential
A B C D
Dam
Pipeline
Intake point
Barrage
Study area
International Boundary
Road
Rail way
Major water demand center
Proposed river channel improvement
River
Irrigation scheme
PUB intake
Mountain
N
103°
103°30'
2°30'
104°
2°
1°30'
MERSING
Semberong
AYER HITAM
KLUANG
Kahang
G. Belumut 1010
Batu Tongket 395
Mocap
Benut
RENGGAM
SIMPANG RENGGAM
R. Benut
R. Linggiu
BANDAR TENGGARA
Sedili
G. Sumalayang 615
R. Sedili Besar
R. Pengli
Upper Pengli
Linggiu
Pontian Besar
R. Sayong
LAYANG LAYANG
BENUT
Sayong
G. Muntahak 634
KULAI KOMPLEXS
R. Pontian Besar
KELAPA SAWIT
R. Johor
R. Semangar
K. Sedili
MAHKOTA
STRAITS OF MELAKA
PONTIAN BESAR
G. Pulai 654
R. Pontian Kechil
KULAI
R. Telor
Telor
PONTIAN KECHIL
PEKAN NANAS
SENAI
KOTA TINGGI
P2
Seng Heng
R. Tebrau
R. Skudai
ULU TIRAM
Tg. Pelapas
R. Tiram
KOMPLEX AIR TAMAR
R. Pulai
R. Pandas
JOHOR BAHRU
Layang
R. Layang
Tg. Sengat
TANJONG KUPANG
MASAI
P4
Layau Kiri
KONG KONG
R. Leban
Tg. Buai
Tg. Surat
PASIR GUDANG
BANDAR PENAWAN
SINGAPORE
P7
PENGERANG
SOUTH CHINA SEA
SCALE
0 10 20 30 km
100° 101° 102° 103° 104°
6°
5°
4°
3°
2°
THAILAND
PERLIS
KEDAH
P. PINANG
PERAK
KELANTAN
TRENGGANU
PAHANG
SELANGOR
NEGERI SEMBILAN
MELAKA
JOHOR
SINGAPORE
STRAITS OF MELAKA
GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY, MALAYSIA
SOUTH JOHOR
REGIONAL WATER RESOURCES STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY

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 B
DOMESTIC AND INDUSTRIAL WATER SUPPLY

TABLE OF CONTENTS

		Page
1.	INTRODUCTION	B-1
2.	PRESENT CONDITION OF D&I WATER SUPPLY AND USE IN THE REGION	B-3
	2.1 Organization	B-3
	2.2 PWD Water Supply and Use	B-3
	2.3 Rural Environmental Sanitation Program	B-5
	2.4 Processing Water Use in Palm Oil Mills and Rubber Factories and Pineapple Factories	B-5
	2.5 Water Tariff, Revenues and Expenditures	B-6
	2.6 Water Supply to Singapore	B-6
3.	EXISTING PUBLIC WATER SUPPLY PROJECTS	B-7
	3.1 Water Supply Plan in the Region	B-7
	3.2 On-Going Source Development Plan	B-7
4.	PROJECTION OF D&I WATER DEMAND	B-11
	4.1 Assumptions	B-11
	4.2 Projection of Domestic Water Demand	B-13
	4.2.1 Methodology	B-13
	4.2.2 Population projection	B-13
	4.2.3 Projection of service factor	B-13
	4.2.4 Projection of per capita daily use	B-14
	4.2.5 Projected served population	B-14
	4.2.6 Projected domestic water demand	B-14
	4.3 Projection of Manufacturing Water Demand	B-15
	4.3.1 Methodology	B-15
	4.3.2 Projection of gross output value of manufacturing sector	B-16
	4.3.3 Net unit industrial water use	B-16
	4.3.4 Projection of manufacturing water demand in the Region	B-16
	4.3.5 Projected manufacturing water demand	B-17
	4.4 Projected D&I Water Demand	B-18
	4.5 Projected D&I Water Abstraction at River Intakes	B-18

Page

4.6 Water Supply to Singapore B-18

PREFERENCE B-21

LIST OF TABLES

		Page
1.	DETAILS OF EXISTING WATER SUPPLY FACILITIES (1/2)	B-23
2.	DETAILS OF EXISTING WATER SUPPLY FACILITIES (2/2)	B-24
3.	WATER TARIFF OF THE STATE OF JOHOR AS OF SEP. 1983	B-25
4.	REVENUE OF THE WATER SUPPLY DIVISION OF PWD OF THE STATE OF JOHOR IN 1983	B-25
5.	REVENUES AND EXPENDITURES OF WATER SUPPLY IN THE STATE OF JOHOR IN 1982	B-26
6.	ABSTRACTION RECORD OF RAW WATER FROM JOHOR STATE OF JOHOR BY SINGAPORE	B-26
7.	UA RATIO OF PWD WATER IN THE STATE OF JOHOR IN 1980 AND 1982	B-27
8.	UA AND TP RATIOS FOR PWD WATER SUPPLY	B-28
9.	PROJECTED POPULATION IN THE REGION BY TOWN AND DISTRICT RURAL (1/2)	B-29
10.	PROJECTED POPULATION IN THE REGION BY TOWN AND DISTRICT RURAL (2/2)	B-30
11.	SERVICE FACTOR OF PWD WATER SUPPLY IN TOWNS	B-31
12.	SERVICE FACTORS OF PWD AND RESP WATER SUPPLY IN RURAL AREA	B-31
13.	HISTORICAL PER CAPITA DAILY USE IN THE CITIES OF THE WORLD IN 1974 AND 1975	B-32
14.	HISTORICAL PER CAPITA DAILY USE IN JAPAN IN 1976	B-33
15.	PROJECTED PER CAPITA DAILY USE OF WATER	B-34
16.	PROJECTED SERVED POPULATION OF PWD WATER SUPPLY IN THE REGION BY TOWN AND DISTRICT RURAL (2/1)	B-35
17.	PROJECTED SERVED POPULATION OF PWD WATER SUPPLY IN THE REGION BY TOWN AND DISTRICT RURAL (2/2)	B-36
18.	PROJECTED NET UNIT WATER USE PER GROSS VALUE OF MANUFACTURING OUTPUT BY COMMODITY GROUP	B-37
19.	PROJECTED MANUFACTURING WTAER DEMAND OF THE PASIR GUDANG INDUSTRIAL ESTATE	B-38

Page

20. ESTIMATED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 1983 ..... B-39

21. ESTIMATED D&I WTAER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 1985 ..... B-40

22. PROJECTED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 1990 ..... B-41

23. PROJECTED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 1995 ..... B-42

24. PROJECTED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 2000 ..... B-43

25. PROJECTED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 2005 ..... B-44

26. PROJECTED D&I WATER DEMAND BY SUPPLY AREA AND INTAKE POINTS B-45

27. ASSUMED VOLUME OF ABSTRACTION BY SINGAPORE FROM THE JOHOR RIVER B-46

LIST OF FIGURE

1. Existing Water Supply Facilities (Intake Point)

2. Existing Water Supply System

3. Location Map of RESP Water Supply Facilities

1. INTRODUCTION

This Annex was prepared to present the data used, methods applied and consequent results of the domestic and industrial water demand (D&I water demand) study for the Region in the years of 1983, 1985, 1990, 1995, 2000 and 2005. Both water demands to be supplied by public system, i.e., Public Works Department (PWD) and Rural Environmental Sanitation Program (RESP), and by private supply system, were estimated.

The D&I water demand was classified into (1) domestic water demand including commercial and public water use (D water demand), (2) water demand of manufacturing industires (M water demand) and (3) agro-based industries water demand such as palm oil mills, rubber factories, and pineapple canning factories. All the demand were estimated in terms of source demand (S.D.), either at intake points in rivers or wells on the basis of customer demand (C.D.). In order to serve for the water balance study, and water pollution study, S.D. and C.D. were estimated by water intake, by type of supply system, by purpose of supply and by town and rural area.

2. PRESENT CONDITION OF D&I WATER SUPPLY AND USE IN THE REGION

2.1 Organization

Public water supply in the Region is administered by the following public organizations:

(1) Public Works Department (PWD) and
(2) State Government, under Rural Environmental Sanitation Program (RESP)

In principle, PWD of the State is responsible for domestic and industrial water supply in the State of Johor. However, untreated water is supplied with the technical and financial assistance of Ministry oif Health (MOH) to the isolated rural area that will not be reached by PWD water supply system near future under RESP.

Recently, PWD and MOH discussed on the coordination of activities and both parties reached an agreement concerning the allotment of supply areas for PWD and RESP with the target of full supply of potable water to the State population including the Region.

2.2 PWD Water Supply and Use

In the State of Johor, PWD has 46 intakes for water supply and each intake has its own treatment plant adjacent to it. Out of these, 15 facilities are located within the Region. Direct pumping from the river is normal practice, but dams are provided for the Simpang Renggam, Layang and Lebam schemes.

Furthermore, there are three dams with intakes in Gunong Pulai area represented by Gunong Pulai dam and three river intakes in the Johor, Skudai and Tebrau rivers owned by the Public Utility Board (PUB) of Singapore. The locations of intake are shown in Fig. 1. Some details of intakes are shown in Tables 1 and 2.

PWD supplied treated water of 72.6 x 10^6 m^3 in 1983 including 44 x 10^6 m^3 tapped from the water pipe lines of PUB system.

Unaccounted-for water is defined as the balance between the total treatment plant output and the total quantity of water metered. It comprises the followings:

(1) Leakage from service reservoirs, mains, service connections,
(2) Operation of hydrants and flushing mains,
(3) Losses due to metering inefficiency, and
(4) Unauthorized water abstraction.

Unaccounted-for water ratio (UA ratio) is defined as unaccounted-for water against treatment plant output. UA ratio varies from 20% in Kluang district to 40% in Kota Tinggi district having the average value of 30% according to the statistics of PWD in 1983 (Ref. 4).

With regard to domestic water use, present per cpaita consumption is 242 l/d in urban area and 140 l/d in rural area according to the statistics of PWD (Ref. 5). The domestic water consumption in Johor Bahru district is by far the largest in the Region. It amounted to 32 x 10^6 m^3 or 69% of the total domestic consumption.

The manufacturing water use in Johor Bahru district shared almost 80% of the total manufacturing water use in the Region in 1983, attributable to the highly populated towns such as Johor Bahru, Senai, Kulai and others and Pasir Gudang industrial estate.

Treatment plant use (TP) is defined in this Study as the amount of treatment plant water use for its own operation and loss between intake point and treatment point. TP ratio (treatment plant water use ratio) is defined as the ratio of treatment plant use against the quantity of water abstracted at intake point. In this study, the TP ratio was assumed at 5% for all facilities in the Region.

Each water supply facility is connected by the pipeline forming water supply network except eastern part of the Region. This network enables to supply water to a service area from multiple supply systems. Existing water supply system is shown in Fig. 2.

2.3 Rural Environmental Sanitation Program

Rural areas located distant considerably from PWD's water supply system have been supplied untreated water through RESP with the technical and financial assistance of MOH. Water supply facilities are constructed by local people who are to be benefitted. Operation and maintenance are also carried out by themselves. Almost all of facilities in the Region are simple wells except one direct intake from the river and one rain water collection system. In 1983, RESP systems in the Region supplied water to the population of about 10,000. The locations of RESP facilities are shown in Fig. 3. RESP supplied 0.5 x 10^6 m^3 of water in 1983.

2.4 Processing Water Use in Palm Oil Mills and Rubber Factories and Pineapple Factories

Palm oil processing is one of the thriving industry in the Region. A large scale palm oil refinery is constructed in the Pasir Gudang Industrial Estate. It is estimated that palm oil processing industry consumed about 4,800 x 10^3 m^3/y of water in 1983 in the Region (Annex C).

In 1983, 20 rubber factories were on operation in the Region, which is estimated to have consumed water of 1,700 x 10^3 m^3/y (Annex C). However, rubber production have been decreasing recently because rubber is substituted by oil palm.

In 1983, 5 pineapple factories are operated. Canneries were three factories and remaining two are only cutting. Pineapple factories are estimated to have consumed 500 x 10^3 m^3/y of water in 1983 (Annex C).

2.5 Water Tariff, Revenues and Expenditures

In the State of Johor, a unique water tariff is charged to a water use both in urban or rural. However, different water tariff are charged to different water use. That for industrial use is rather higher than that for domestic and public water use.

In Sept. 1983, kinds of water tariff was increased from 2 categories to 4 categories as shown in Table 3.

Revenues and expenditures of the water supply division of PWD of the State of Johor are shown in Tables 4 and 5.

2.6 Water Supply to Singapore

The Public Utility Board (PUB) of Singapore has been abstracting raw water from rivers in the State of Johor for the purpose of domestic and industrial water supply. With this regard, State of Johor and Singapore have agreements, Indenture and Deed.

PUB has a dam in the Pontian Kechil river and two dams in the Pulai river with intakes. Those intakes are connected by pipelines and called Gunong Pulai dam system. In addition, it has intakes in the Skudai and the Tebrau rivers. Furthermore, it has an intake in the Johor river near Kota Tinggi. An abstraction record of raw water by PUB is shown in Table 6. In 1983, PUB abstracted raw water of 145 x 10^6 m^3 (241 Mgd) from the former three intake systems and 99 x 10^6 m^3 (60 Mgd) from the Johor river. Treated water of 44 x 10^6 m^3 (121 Mld, 26.5 Mgd) was diverted from the PUB system to PWD system in 1983.

The abstraction from the former three intakes are presumed to have reached to the upper most potentials of each river. The discharge capacity of the Kota Tinggi system was expanded from 1.6 m^3/s (30 Mgd) to 3.2 m^3/s (60 Mgd) in 1980 and further expansion to 4.7 m^3/s (90 Mgd) is under construction. The capacity is to be increased to 6.3 m^3/s (120 Mgd) in the near future. The expansion is committed to reach upto 8.4 m^3/s (160 Mgd).

3. EXISTING PUBLIC WATER SUPPLY PROJECTS

3.1 Existing Development Plan in the Region for Water Supply

There are various water supply development plans in the Region. The schemes which are presently being implemented or committed for their implementation are identified in the following existing development plans:

(1) Johor Bahru New Water Supply Scheme, Long Term Raw Water Sources, 1983, State PWD (Ref. 18);
(2) Feasitiliby Study of Water Supply for West Johor Phase I & Phase II, 1983, Government of Malaysia (Ref. 19);
(3) Feasibility Study for the Bekalau Air Baru Keluang (Ref. 20), Johor, 1984, Government of Malaysia;
(4) Johor Timur Physical Regional Planning (Ref. 21); and
(5) Water Supply to Johor Tenggara Development, 1974, Government of Malaysia (Ref. 22).

3.2 On-going Source Development Plan

In this study, the schemes, implementation thereof have been committed are called the on-going schemes. The outlines of on-going schemes are given below:

(1) Layang Scheme (Ib)

The second phase of the Johor Bahru New Water Supply Scheme undertaken by PWD is called the Layang Scheme Ib. In the first phase (Ia), Layang dam will be constructed in the upstream reach of the Layang river, a tributary of the Johor river by 1985, with a supply capacity of 38 x 10^6 m^3/y (23 Mgd, 104 Mld). A treatment plant with a capacity of 66 x 10^6 m^3/y (40 Mgd, 181 Mld) is also provided. An experimental estuary storage is to be formed by construction of the estuary barrage in the river mouth of the Layang river.

Under the Layang scheme (Ib), a pump station in the upstream reach of Chabang Tiram river, a tributary of the Johor river, and water way between the pump station and the Layang dam will be constructed by 1986, in order to increase the supply capacity of Layang dam by 28 x 10^6 m^3/y (17 Mgd). Consequently the water supply capacity of the Layang scheme will be 66 x 10^6 m^3/y (40 Mgd). Main supply areas of Layang scheme are Johor Bahru and Pasir Gudang.

(2) Simpang Renggam Scheme Stage I

In the Simpang Renggam Scheme Stage I, a treatment plant with a capacity of 9.1 x 10^6 m^3/y (25 Mld) will be constructed at Simpang Renggam in the upstream reach of the Benut river by 1990, in order to abstract the released water from Macap dam. The water is to be supplied to the Pontian district and a part of Kluang district.

(3) Kluang Scheme Stage I

The main purpose of the Kluang Scheme Stage I is to supply water to Kluang district. Renggam, Sayong and Layang Layang in the Region belong to 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 29.2 x 10^6 m^3/y (80 Mld) will be provided at the Semberong dam to abstract and supply the impounded water. At the same time, a groundwater project with an estimated yield of 3.7 x 10^6 m^3/y (10 Mld) will be developed at the Kahang river flood plain. The scheme will supply 0.1 x 10^6 m^3/y (0.3 Mld) to Sayong, 1.5 x 10^6 m^3/y (4.1 Mld) to Renggam and 1.1 x 10^6 m^3/y (3 Mld) to Layang Layang by 1987.

(4) Tapping of PUB water

The State of Johor have tapped treated water of 44 x 10^6 m^3/y (121 Mld) on an average from the PUB's water supply facilities. It is confirmed that this rate of tapping will be maintained upto year 2005.

(5) Expansion of the capacity of Leban facility

Present supply capacity of Leban facility, 10.8 m^3/s (6.5 Mgd), will be expanded to be 16.6 m^3/s (10.0 Mgd) by 1990.

4. PROJECTION OF D&I WATER DEMAND

4.1 Assumptions

Domestic and industrial water demand is and will be attributable to following 3 uses in the Region: (1) Domstic including commercial and public, (2) Manufacturing, (3) Palm oil mill, rubber factory and pineapple factory.

(1) Household, commercial and public water demands, which have significant correlation with the size of population and with location, urban area or rural area.

(2) Water demand of manufacturing industries, which varies by commodities. The water demand of a manufacturing industry is almost in proportion to the output.

(3) The water demands by agro-based factories such as palm oil mill, rubber factory and pineapple factory, which are usually located in the vicinity of plantations rather than in urban areas.

Water demand were projected for town and district.

The towns and districts defined in this Study are shown in Table 6.

Domestic water demand is assumed to be partly met by public supply systems and partly by private. In urban area, state PWD is responsible for public water supply. In rural area, both state PWD and RESP are responsible.

Part of manufacturing water demand is assumed to be supplied by state PWD and the rest to be supplied by private facilities.

All of the agro-based factories water demand are assumed to be supplied by private water supply system by direct abstruction of surface water and by private wells.

For PWD water supply, the following target was set to reduce UA ratio (unaccounted-for water ratio) for 1985 during the Senior Water Engineers' Conference.

Supply Area	UA Ratio (%)
Individual Supply District	less than 20
Individual State	less than 25
Overall % for Peninsular Malaysia	less than 20

However, the current UA ratio in Peninsular Malaysia and the State of Johor are considerably high (Table 7).

After an investigation and the discussion with State PWD, following assumption was adopted for each district for 2005.

District	UA ratio in 2005
Johor Bahru	20%
Pontian	25%
Kota Tinggi	25%
Kluang	20%
Mersing	25%

The assumed UA ratio for each district in 1983, 1985, 1990, 1995, 2000 are also shown in Table 8.

TP ratio (treatment plant water use ratio) was assumed at 5% of the quantity of water abstracted at intake point.

Source demand (S.D.) is obtained as follows:

$$S.D. = C.D./(1 - UA\ Ratio) \times (1 - TP\ Ratio)$$

The UA ratio and TP ratio for water supply except by PWD were assumed nil since intake points and consumption points of water are closely located and the customer demand is considered to be equal to source demand.

4.2 Projection of Domestic Water Demand

4.2.1 Methodology

Domestic water demand for public supply (PWD and RESP water) was projected for towns and the rural areas in the Region. Customer Demand (C.D.) for treated water was obtained for each area as follows:

Treated Water Demand (C.D.) =
Population x Service Factor x PCDU (Per Capita Daily Use)

Accordingly C.D. for private water was estimated for each area as follows:

Private Water Demand = Population x (1 - Service Factor) x PCDU

Source demand (S.D.) can be obtained based on C.D., UA ratio and TP ratio as stated in Section 4.1.

4.2.2 Population projection

Population projection for towns and rural areas in 1983, 1985, 1990, 1995, 2000 and 2005 were made and the results for the Region were given in Annex A (Socio-economy) which are also shown in Tables 9 to 10 in this Annex.

4.2.3 Projection of service factor

The 1980's is the United Nations Water and Sanitation decade and it is proclaimed that all the inhabitants be served water by public systems and sewerage systems by 1990.

In this respect and after discussions with state PWD and MOH and considering the present service factor, future service factor was assumed by district and urban-rural as shown in Tables 11 and 12.

4.2.4 Projection of per capita daily use

Per capita daily water use in Peninsular Malaysia including the Region was projected applying its correlation with per capita GDP observed in some countries based on the data given in Tables 13 and 14. Projected per capita daily use for urban and rural area thus estimated is shown in Table 15.

Per capita daily use for private domestic use was assumed at 40 liters up to 2005.

4.2.5 Projected served population

Based on the projected population and service factor, population to be served by public supply system, PWD and RESP, was estimated. During 1983-2005 period, served population in the region will grow at the average annual growth rate of 4.7% and 1,554 x 10^3 population will be served by public systems in 2005.

Projected served population of public water in the Region are given in Tables 16 and 17.

4.2.6 Projected domestic water demand

Source demand of the total domestic water demand will grow at the average annual growth rate of 6.3% during 1983-2005 period, reaching 187.7 x 10^6 m^3/y (514 Mld) in 2005 in the Region. Around 86% thereof will be incurred in urban area and the rest in rural area. The total domestic water demand will account for 48% of the total demand in 2005.

Domestic water demand for public supply was projected to grow rapidly reflecting the following increases:

(1) Population increase;

(2) Rise of urbanization ratio;

(3) Improvement of service factor; and

(4) increase of per capita daily use.

Total domestic water demand for public supply will grow at the average anual growth rate of 6.6% during the period from 1983 to 2005. In 2005, domestic water demand will almost fully be met by public supply systems, namely 99% or 186.4 x 106 m^3/y (511 Mld) will be supplied by PWD and 0.6% or 1.1 x 10^6 m^3/y (3 Mld) by RESP.

Projected domestic water demand is given in Tables 20 to 25.

4.3 Projection of Manufacturing Water Demand

4.3.1 Methodology

Manufacturing water demand was projected for the Region in 1983, 1985, 1990, 1995, 2000 and 2005 based on the gross output values of manufacturing industries and net unit manufacturing water use (NUIW) for producing unit gross output value for each commodity, considering the availability and reliability of the data which may be utilized for manufacturing water demand projection.

Manufacturing (M) water demand in terms of C.D. will be obtained as the sum of water demand of each commodity that is obtained as the product of gross output value and NUIW. S.D. of manufacturing water is obtained as follows:

S.D. = C.D./(1-UA Ratio) x (1-TP Ratio)

The methodology is explained further in the subsequent sections.

4.3.2 Projection of gross output value of manufacturing sector

Gross output value of the State of Johor in 1983, 1985, 1990, 1995, 2000 and 2005 has been projected in Annex A (Socio-Economic Study).

It was assumed in this Study that all of production of the manufacturing sector will be born in urban area except agro-based industries.

4.3.3 Net unit industrial water use

Manufacturing water use was estimated based on NUIW by industrial classification, excluding the recyclic water use.

Industrial classification was determined based on the current Malaysian Industrial Classification as well as Japanese Industrial Classificaiton as same with Annex A.

NUIW declines as the recyclic water use develops. The industrial water use data of Japan from 1960 to 1983 show that the NUIW has dropped sharply until 1980 and then remained almost constant after 1980 while gross unit water use including recycling water has not shown significant change after 1970. During the period of 1985 to 2005, manufacturing industries in Peninsular Malaysia are expected to make sharp growth, accompanying the modernization of manufacturing technology including water use. It was, therefore, assumed that NUIW in Peninsular Malaysia including the State of Johor in 2000 will reach the values of Japan in 1983 and keep constant until 2005. The projected NUIW is shown in Table 18.

4.3.4 Projection of manufacturing water demand in the Region

As stated in Section 4.3.1, manufacturing water demand in terms of C.D. in the State of Johor will be obtained multiplying gross output value with NUIW.

Out of total manufacturing water demand, water demands of agro-based factories water demand such as palm oil mills, rubber and pineapple factories which are estimated in Annex C (Agriculture and Irrigation Development) was located in rural area. Other water demand was assumed to be located at towns such as Johor Bahru and industrial estates.

SEDC has the estimation of present water demand of each industrial estate and future development plan, which shows only Pasir Gudang Industrial Estate will have some water demand and the others will be negligible. Therefore, the water demand of Pasir Gudang Industrial Estate was taken into account with the projected figure of "Pasir Gudang Development: Master Plan for Infrastructure Services" (Table 19).

Then manufacturing water demand less water demands of agro-based factories and Pasir Gudang was allocated to each town in proportion to the population sizes.

4.3.5 Projected manufacturing water demand

Manufacturing water demand of the Region was projected to rise sharply due to the rapid growth of manufacturing industries.

Source demand of total manufacturing water demand will grow at the average annual growth rate of 6.8% during 1983-2005 period, reaching 204.9 x 106 m3/y (561 Mld) in 2005, of which 93% will be attributable to demand in urban area and the rest in rural area. The public supply system will supply 90% of the total manufacturing water demand. The rest, 10%, will be met by private facilities.

Projected manufacturing water demand is given in Tables 20 to 25.

4.4 Projected D&I Water Demand

Total D&I water demand was projected to rise due to the combined effect of i) population increase, ii) service factor improvement, iii) per capita consumption increase, and iv) growth of manufacturing industries.

Source demand of total D&I water demand will grow at the average annual growth rate of 6.5% during 1983-2005 period, reaching 397.2 x 10^6 m^3/y (239 Mgd) in 2005. About 88% thereof will be occurred in urban area and the rest in rural area.

Total D&I water demand for public supply will grow at the average annual growth rate of 7.2% during the same period, reaching 366.0 x 10^6 m^3/y (220 Mgd) in 2005. About 93% thereof will be incurred by the water demand in urban area and the rest in rural area. In 2005, about 92% of the total D&I water demand will be met by public systems.

Total D&I water demand in 1983, 1985, 1990, 1995, 2000 and 2005 are given in Tables 20 to 25.

4.5 Projected D&I Water Abstraction at River Intakes

All the D&I water demand projected were allocated and loaded on the existing and proposed intakes with due regard to the existing water supply networks.

The allocations of water demand were summarized in Table 26.

4.6 Water Supply to Singapore

The present water abstraction by Singapore is deemed to have reached full scale with regard to the water resources potential at Gunong Pulai, Skudai and Tebrau intake sites. And it is presumed that no future extension of intake facilities is conceivable for these

intake sites. With this accord, the present volume of abstraction for each intake mentioned above is assumed to be kept constant upto 2005.

For Johor river, present abstraction by Singapore at Kota tinggi is 4.7 m^3/sec or 90 Mgd which is controlled by the installed capacity of the treatment plant. The capacity of pipeline is 6.3 m^3/sec or 120 Mgd. Further extension of capacity by 2.1 m^3/sec or 40 Mgd is under design aiming to secure an abstraction capacity of 8.4 m^3/sec or 160 Mgd.

So far, the future amount of abstraction from the Johor river by Singapore is not projected but assumed arbitrarily that the abstraction will reach 160 Mgd in year 1990. For this preliminary study stage, two different cases are assumed for the abstractions after 1990. That is:

Case 1: Abstraction amount will reach 250 Mgd in year 1995 after it reaches 160 Mgd in 1990. After 1995 it will be kept constant, 250 Mgd, upto 2005.

Case 2: Abstraction will reach 160 Mgd in year 1990 and after that it will be kept constant, 160 Mgd, up to 2005.

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 water demands by Singapore to be abstracted from the Johor river are presented in Table 27 for both case.

It is noted that the projected abstraction volume includes the treated water supply to PWD which is assumed to be 40 x 10^6 m^3/y (110 Mld) constantly from 1985 to 2005.

REFERENCES

1. DATA FOR THE PREPARATION OF FOURTH MALAYSIA PLAN, 1980, PWD (Unpublished)

2. INFORMATION ON TREATMENT PLANT WATER USE, 1979, PWD (Unpublished)

3. K1 AND K2 TABLES, 1974-1982, Johor PWD

4. PWD WATER SUPPLY RECORD, 1980-1983, Johor PWD (Unpublished)

5. WATER SUPPLY ENACTMENT (NO.119), Sep. 1, 1983, Johor State

6. REVENUE RECORD, 1976-1978, Johor PWD (Unpublished)

7. ANNUAL REPORT OF WAER RESOURCES DEVELOPMENT AND USE (JAPANESE), 1978-1979, Water Resources Bureau, National Land Agency, Government of Japan

8. SURVEY OF MANUFACTURING INDUSTRIES, 1970-1974, DOE

9. EXISTING WATER SUPPLY FACILITIES MAP FOR THE STATE OF JOHOR, 1983 (Unpublished)

10. INFORMATION ON SENIOR WATER ENGINEERS' CONFERENCE, 1980, PWD (Unpublished)

11. INFORMATION ON THE DEVELOPMENT OF INDUSTRIAL ESTATES, 1983, MIDA (Unpublished)

12. MALAYSIA INDUSTRIAL CLASSIFICAITON, 1972, DOS

13. FOURTH MALAYSIA PLAN, 1981, EPU

14. MIDTERM REVIEW OF FOURTH MALAYSIA PLAN, 1984, EPU

15. RURAL ENVIRONMENTAL SANITATION PROGRAM, 1981, MOH

16. ANNUAL REPORT 1983, State MOH

17. CENSUS OF MANUFACTURES, 1963-1983, REPORT ON INDUSTRIAL LAND AND WATER, MITI OF JAPAN

18. JOHOR BAHRU NEW WATER SUPPLY SCHEME LONG TERM RAW WATER SOURCES, 1983, STATE PWD

19. FEASIBILITY STUDY OF WATER SUPPLY FOR WEST JOHOR PHASE I & PHASE II, 1983, GOM

20. FEASIBILITY STUDY FOR THE BEKALAN AIR BARU KELUANG, JOHOR, 1984, GOM

21. JOHOR TIMUR PHYSICAL REGIONAL PLANNING STUDY, 1983

22. *WATER SUPPLY TO JOHOR TENGGARA DEVELOPMENT, 1974, GOM*

23. PASIR GUDANG DEVELOPMENT, MASTER PLAN FOR INFRASTRUCTURE SERVICES, SEDC, 1981

TABLES

Table 1 DETAILS OF EXISTING WATER SUPPLY FACILITIES (1/2)

Intake Number	R30	R31(PUB)	R32(PUB)	R33
District	Johor Bahru	Johor Bahru	Johor Bahru	Johor Bahru
Name of Treatment Plant	Bkt. Batu	Skudai	Tebrau	Kong Kong
Water Source	Ulu Pontian-Kechil R.	Skudai R.	Tebrau R.	Serai R.
Design Capacity (Mgd)	0.61	35.00	30.00	0.19
Demand Center	Bukit Baru Sedenak Kelapa Sawit	Johor Bahru Singapore	Singapore	FELDA Kong Kong

Intake Number	R34	R35	R36	R37
District	Kota tinggi	Kota Tinggi	Kota Tinggi	Kota Tinggi
Name of Treatment Plant	Kota Tinggi	Kulai Kompleks	Telok Mahkota	Air Tawar
Water Source	Pelepha-Kenan R.	Semangar R.	Gembut R.	Seluyut R.
Design Capacity (Mgd)	1.00	0.50	0.40	0.55
Demand Center	Kota Tinggi-Town	Kulai Complex-FELDA	Tenjong Lembu Telok Mahkota FELDA Bukit-Aping	Air Tawar FELDA Complex Johor Lama Telok Sengat

Intake Number	R38	R39	R40	R41(PUB)
District	Kota Tinggi	Kota Tinggi	Kota Tinggi	Kota Tinggi
Name of Treatment Plant	Pengerang	Bandar Tenggara	Sungai Linggiu	Kota Tinggi
Water Source	Rengit R.	Pengli R.	Linggiu R.	Johor R.
Water Capacity (Mgd)	0.10	0.50	0.25	60.00
Demand Center	Sungai Rengit Pengerang Buklt Ramunia	Bandar Tenggara Sungai Sebol		Ulu Tebrau Ulu Tiram Pulada Pacir Gudang Johor Bahru Kota Tinggi Singapore

Table 2 DETAILS OF EXISTING WATER SUPPLY FACILITIES (2/2)

Intake Number	Res 9	Res 10	R24	R25
District	Kota Tinggi	Kota Tinggi	Kluang	Kluang
Name of Treatment Plant	J. Bahru	Sungai Lebam	Simpang Renggam	Renggam
Water Source	Layang R.	Lebam R.	Ulu Benut R.	Sayong R.
Desing Capacity (Mgd)	23.00	1.60	0.55	0.18
Demand Center	Johor Bahru Pasir Gudang FELDA-Kong Kong Masai Plentong		Simpang Renggam Macap	Remggam

Intake Number	R26	R29	Res 8 (PUB)	
District	Kluang	Pontian	Pontian	
Name of Treatment Plant	Layang Layang	Kayu Ara Pasong	G. Pulai	
Water Source	Sayong R.	Pontian Besar R.	Pontian Kechil R.	
Design Capacity (Mgd)	0.42	0.16	15.00	Total 165.01 MGD (751×10^3 m^3/d)
Demand Center	Layang Layang FELDA Bkt. Permai	Pontian Besar	Pontian Town and Rural Areas: Skudai-Senai-Kulai: Ulu Choh-Gelang Patah -Tanjong Kupang: Tampoi: Johor Bahru Singapore	

Table 3 WATER TARIFF OF THE STATE OF JOHOR AS OF SEP. 1983

Type of Consumption	Volume	Charge ($/m^3)
A. comestic Use	First 23m^3/month	0.29
	23 to 45m^3/month	0.53
	over 45m^3/month	0.66
		(minimum charge of $2/month)
B. Governmental Buildings and Hospitals		0.70
		(minimum charge of $4/month)
C. Commercial Use		0.75
		(minimum charge of $4/month)
D. Ships	Less than 100 tons	1.20
	More than 100 tons	2.30

Source; Ref. 5

Table 4 REVENUE OF THE WATER SUPPLY DIVISION OF PWD OF THE STATE OF JOHOR IN 1983

District	Supply Volume (10^3m^3)			Revenue ($10^3)		
	Domestic	Commercial	Total	Domestic	Commercial	Total
1. Johor Bahru	11,523	9,892	21,415	5,632	4,968	10,600
2. Muar	7,161	1,534	8,695	1,643	665	2,308
3. Batu Pahat	8,118	2,116	10,234	1,674	1,112	2,786
4. Kluang	4,835	1,185	6,020	1,533	604	2,137
5. Segamat	3,781	1,092	4,873	1,288	596	1,884
6. Pontiun	2,448	765	3,213	758	390	1,148
7. Kota Tinggi	3,422	1,166	4,588	933	718	1,651
8. Mersing	811	250	1,061	224	126	350
Total	42,099	18,000	60,099	13,685	9,179	22,864

Source : Ref. 4

Table 5 REVENUES AND EXPENDITURES OF WATER SUPPLY IN THE STATE OF JOHOR IN 1982

Unit: 10^3 M$

District	Revenues	Recurrent Expenditures /1
1. Johor Bahru	13,077 (0.30) /2	7,999 (0.18) /2
2. Muar	2,082 (0.13)	4,465 (0.27)
3. Batu Pahat	2,067 (0.13)	4,557 (0.29)
4. Kluang	3,301 (0.28)	2,624 (0.22)
5. Segamat	1,348 (0.20)	2,358 (0.35)
6. Pontian	939 (0.20)	1,518 (0.33)
7. Kota Tinggi	970 (0.14)	4,290 (0.62)
8. Mersing	454 (0.06)	914 (0.12)
Total	24,238	29,719

Remark; /1 : Consists of maintenance of water supplies,other maintenance expenditures, administration and collection cost and capital charges

/2 : Figures in parenthesis are unit revenues or expenditures (M/m^3)

Source; Ref. 3

Table 6 ABSTRACTION RECORD OF RAW WATER FROM THE STATE OF JOHOR BY SINGAPORE

Unit: 10^6 m^3/y

	Source				
Year	Pulai River	Skudai River	Tebrau River	Johor River	Total
1980	26	56	74	80	236
1981	24	51	58	91	224
1982	24	50	73	100	247
1983	22	53	70	99	244

Source: State PWD (Unpublished)

Table 7 UA RATIO OF PWD WATER IN THE STATE OF JOHOR IN 1980 AND 1982

Unit : %

District	1980	1982
Johor Bahru	24.8	20.6
Pontian	39.1	37.2
Kota Tinggi	32.3	51.4
Kluang	33.0	21.0
Mersing	23.5	16.8
Batu Pahat	51.2	54.6
Segamat	49.5	33.1
Muar	45.4	42.7
Averate of the State of Johor	35.5	32.4

Source ; Ref.3

Table 8 UA AND TP RATIOS FOR PWD WATER SUPPLY

Unit: %

District	1980/1	1983	1985	1990	1995	2000	2005/2
UA ratio							
Johor Bahru	25	24	24	23	22	21	20
Pontian	39	37	35	33	30	28	25
Kota Tinggi	40	37	35	33	30	28	25
Kluang	20	20	20	20	20	20	20
Mersing	25	25	25	25	25	25	25
TP ratio	5	5	5	5	5	5	5

Sources: /1 Ref.3

/2 From State JKR

Table 9 PROJECTED POPULATION IN THE REGION
BY TOWN AND DISTRICT RURAL (1/2)

Unit: 10^3

District	Town/Rural	Historical 1970	1980	Projected 1983	1985	1990	1995	2000	2005
1. Johor Bahru	Johor Bahru	142	256	300	335	432	540	663	797
	Kulai	12	25	31	35	51	70	96	123
	Ulu Tiram	4	7	8	9	13	17	23	30
	Senai	5	7	8	8	11	14	17	20
	Kelapa Sawit	5	6	7	7	8	12	14	15
	Masai & Pasir Gudang	5	14	17	19	23	30	37	45
	urban total	154	295	348	389	530	683	850	1,030
	district rural	129	132	135	136	113	92	75	57
	Total	283	427	483	525	643	775	925	1,087
2. Kota Tinggi	Kota Tinggi	9	14	16	18	24	31	41	49
	Bandar Penawan	-	-	-	1	2	4	6	13
	P2	-	-	-	7	8	9	12	14
	P4	-	-	-	8	8	9	12	14
	P7	-	-	-	8	9	12	14	15
	Bandar Tenggara	-	-	-	10	12	18	25	31
	urban total	0	14	16	28	36	61	104	136
	district rural	64	99	109	112	133	134	123	117
	Total	64	113	125	140	169	195	227	253

Table 10 PROJECTED POPULATION IN THE REGION
BY TOWN AND DISTRICT RURAL (2/2)

Unit: 10^3

District	Town/Rural	Historical 1970	1980	Projected 1983	1985	1990	1995	2000	2005
3. Pontian	Pontian Kechil	9	22	28	32	44	59	76	97
	Pontian Nanas	9	10	10	10	11	12	12	13
	urban total	0	32	38	42	55	71	88	110
	district rural	123	92	90	87	80	72	64	54
	Total	123	124	128	129	135	143	152	164
4. Kluang	Simpang Renggam	4	5	6	6	7	8	9	13
	Layang-Layang	3	4	5	5	6	7	9	13
	Renggam	3	4	5	5	6	7	8	13
	urban total	0	0	0	0	0	0	0	39
	district rural (a part within the Region)	43	52	59	63	71	79	85	56
	Total (a part within the Region)	43	52	59	63	71	79	85	95
5. Mersing	district rural (a part within the Region)	7	3	3	3	3	3	2	1
Region Total	Urban	154	341	402	459	621	815	1,042	1,315
	Rural	366	378	396	401	400	380	349	285
	Total	520	719	798	860	1,021	1,195	1,391	1,600

Table 11 SERVICE FACTOR OF PWD WATER SUPPLY IN TOWNS

Unit : %

District	1980/1	1983/2	1985/2	1990/2	1995/2	2000/2	2005/3
Johor Bahru	99	99	99	99	99	99	99
Kota Tinggi	86	88	89	91	94	96	99
Pontian	83	85	86	89	93	96	99
Kluang	92	93	93	95	96	98	99
Mersing	76	79	81	85	90	94	99

Remarks; /1 : Ref.3
/2 : Estimated
/3 : Assumed by State PWD for the use of the Study

Table 12 SERVICE FACTORS OF PWD AND RESP WATER SUPPLY IN RURAL AREA

Unit : %

District	1983			1985			1995			2005		
	PWD	RESP	Total	PWD	RESP	Total	PWD	RESP	Total	PWD	RESP	Total
Johor Bahru	30	10	40	37	11	48	62	13	75	87	13	100
Kota Tinggi	45	8	53	48	9	57	68	11	79	87	13	100
Pontian	48	1	49	52	3	55	69	9	78	87	13	100
Kluang	35	9	44	41	9	50	64	11	75	87	13	100
Mersing	57	9	66	60	10	70	73	11	84	87	13	100

Table 13 HISTORICAL PER CAPITA DAILY USE IN THE CITIES OF THE WORLD IN 1974 AND 1975

City	Population Size (10^3 persons)	Per Capita Daily Use Including UA /1 (lpcd)	Per Capita Daily Use Excluding UA (lpcd)	Per Capita GDP (US$)	Year
Madrid	3,520	330	264	2,276	1974
Rome	2,884	616	493	2,758	1975
Ottawa	2,798	362	290	7,340	1974
Paris	2,290	320	256	4,510	1974
West Berlin	1,951	244	195	6,007	1975
Hamburg	1,699	204	163	5,470	1974
Vienna	1,593	317	254	3,892	1974
Brussels	1,042	141	113	5,028	1974
Lisbon	832	200	160	1,442	1974
Amsterdam	745	215	172	5,442	1975
Copenhagen	699	271	217	5,357	1974
Capetown	691	270	216	1,147	1974
Stockholm	661	452	362	7,526	1975
Montreal	626	647	518	7,340	1974

Remarks; /1: UA ratio was assumed at 20%.

Table 14 HISTORICAL PER CAPITA DAILY USE IN JAPAN IN 1976

City	Population Size (10^3 persons)	Per Capita Daily Use Including UA/1 (lpcd)	Per Capita Daily Use Excluding UA/1 (lpcd)
Tokyo	11,496	444	360
Osaka	3,007	600	486
Yokohama	2,868	417	338
Nagoya	2,270	454	368
Kyoto	1,571	431	349
Kobe	1,287	399	328
Sapporo	1,211	295	239
Kitakyushu	1,144	385	312
Kawasaki	1,125	465	377
Fukuoka	1,032	405	328
Hiroshima	783	428	347
Sakai	718	368	298
Sendai	649	334	271
Amagasaki	596	412	334
Okayama	562	431	349
Higashiosaka	559	358	290
Other Cities	500 - 250	386	316
	250 - 100	357	289
	100 - 50	352	285
	50 - 30	330	267
	30 - 20	307	249
	20 - 10	295	239
	10 - 5	277	224

Remarks; (1): Per capita GDP of Japan was US$4,500 in 1976.
/1 : UA ratio was about 19%.

Table 15 PROJECTED PER CAPITA DAILY USE OF WATER

Unit : ℓpcd

Polulation Size (10^3)	1983	1985	1990	1995	2000	2005
Town						
1,000 - 500	195.0	205.0	220.0	235.0	250.0	265.0
500 - 100	175.0	185.0	200.0	215.0	230.0	245.0
100 - 10	165.0	175.0	190.0	205.0	220.0	235.0
Rural						
PWD	85.0	100.0	125.0	150.0	175.0	200.0
RESP	40.0	45.0	55.0	62.0	70.0	80.0
Private	40.0	40.0	40.0	40.0	40.0	40.0

Table 16 PROJECTED SERVED POPULATION OF PWD WATER SUPPLY IN THE REGION BY TOWN AND DISTRICT RURAL

(1/2)

Unit: 10^3

District	Town/Rural	Projected					
		1983	1985	1990	1995	2000	2005
1. Johor Bahru	Johor Bahru	297	332	428	535	656	789
	Kulai	31	35	50	69	95	122
	Ulu Tiram	2	3	7	12	19	30
	Senai	2	3	6	10	14	20
	Kelapa Sawit	2	3	4	8	12	15
	Masai & Pasir Gudang	17	19	23	30	37	45
	urban total	345	386	514	664	833	1,021
	district rural	40	50	55	57	56	50
	Total	385	436	569	721	889	1,071
2. Kota Tinggi	Kota Tinggi	14	16	22	29	39	49
	Bandar Penawan	-	0	1	3	5	13
	P2	-	3	5	6	10	14
	P4	-	4	5	6	10	14
	P7	-	4	5	9	12	15
	Bandar Tenggara	-	5	7	14	22	31
	urban total	14	21	29	52	93	136
	district rural	49	65	77	91	96	102
	Total	63	86	106	143	189	238

Table 17 PROJECTED SERVED POPULATION OF PWD WATER SUPPLY IN THE REGION BY TOWN AND DISTRICT RURAL

(2/2)

Unit: 10^3

District	Town/Rural	Projected 1983	1985	1990	1995	2000	2005
3. Pontian	Pontial Kechil	23	28	39	55	73	96
	Pontian Nanas	8	9	10	11	12	13
	urban total	31	37	49	66	85	109
	district rural	43	45	49	50	50	47
	Total	74	82	98	116	135	156
4. Kluang	Simpang Renggam	2	2	4	5	7	13
	Layang-Layang	2	2	3	4	7	13
	Renggam	2	2	3	4	6	13
	urban total	0	0	0	0	0	39
	district rural (a part within the Region)	21	26	37	51	64	49
	Total (a part within the Region)	21	26	37	51	64	88
5. Mersing	district rural (a part within the Region)	2	2	2	3	2	1
Region Total							
	Urban	390	444	592	782	1,011	1,305
	Rural	155	185	220	252	268	249
	Total	545	632	812	1,034	1,279	1,554

Table 18 PROJECTED NET UNIT WATER USE PER GROSS VALUE OF MANUFACTURING OUTPUT BY COMMODITY GROUP

COMMODITY GROUP	1983	1985	1990	1995	2000	2005
				UNIT: $M^3/DAY/10^6$ MS/Y		
1. Food Products	75	70	58	46	35	35
2. Textile Products	99	94	81	68	55	55
3. Wood Products	7	7	7	7	7	7
4. Paper Products	607	572	483	395	306	306
5. Publishing	10	9	7	5	4	4
6. Chemical Product	203	188	151	114	77	77
7. Rubber Products	66	61	48	35	22	22
8. Non-metal Product	73	69	59	49	39	39
9. Basic-Metal	62	58	48	39	30	30
10. Machinary Product	18	16	12	8	4	4
11. Miscellaneous	34	33	31	28	25	25

Remarks: The values indicated are net manufacturing fresh water use excluding sea water and water used cyclically per $M\$10^6$ of the gross output at 1970 price.

Table 19 PROJECTED MANUFACTURING WATER DEMAND OF THE PASIR GUDANG INDUSTRIAL ESTATE

	1983	1985	1990	1995	2000	2005
Water Demand ($10^6 m^3/y$)	6.4	7.1	9.2	11.9	15.4	15.4

Remark; Based on the unit water use of 3,000 gallons/acre/day for the manufacturing factory except 12,500 gallons/acre/day for Palm oil refinery factories.

Source; Ref.23

Table 20 ESTIMATED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 1983

Unit: Mld

	DISTRICT NAME	MUKIM NAME	CITY/RURAL NAME	DOMESTIC PWD	DOMESTIC RESP	DOMESTIC PRIVATE	DOMESTIC TOTAL	INDUSTRY PWD	INDUSTRY PRIVATE	INDUSTRY TOTAL	TOTAL
1	JOHOR BAHRU	JOHOR BAHRU &	JOHOR BAHRU	72.1			72.1	43.7	16.2	59.9	132.0
		PLENTONG &	MASAI &	3.8			3.8	18.8	6.7	25.5	29.3
		TEBRAU	PASIR.GUDANG								
			CITY TOTAL	75.9			75.9	62.5	22.9	85.4	161.3
			RURAL	1.1	0.3	0.8	2.2		2.5	2.5	4.7
		MUKIMS TOTAL		77.0	0.3	0.8	78.1	62.5	25.4	87.9	166.0
		PULAI &									
		TG.KUPANG	RURAL	1.1	0.3	0.8	2.2		0.3	0.3	2.5
		MUKIMS TOTAL		1.1	0.3	0.8	2.2		0.3	0.3	2.5
		SENAI &	KULAI	6.8			6.8	4.5	1.6	6.1	12.9
		KULAI &	SENAI								
		SEDENAK	KELAPA SAWIT								
			CITY TOTAL	6.8			6.8	4.5	1.6	6.1	12.9
			RURAL	3.3	0.3	1.4	5.0	2.2	5.2	7.4	12.4
		MUKIMS TOTAL		10.1	0.3	1.4	11.8	6.7	6.8	13.5	25.3
		SG.TIRAM	ULU TIRAM								
			RURAL	0.3		0.3	0.6	1.2	1.5	2.7	3.3
		MUKIMS TOTAL		0.3		0.3	0.6	1.2	1.5	2.7	3.3
		DISTRICT URBAN		82.7			82.7	67.0	24.5	91.5	174.2
		RURAL		5.8	0.9	3.3	10.0	3.4	9.5	12.9	22.9
	DISTRICT TOTAL			88.5	0.9	3.3	92.7	70.4	34.0	104.4	197.1
2	KOTA TINGGI	JOHOR LAMA &	BA.PENAWAR								
		PA.TINGGI &	P4								
		PENGERANG &	P7								
		TG.SURAT	CITY TOTAL								
			RURAL	3.3	0.3	0.8	4.4		3.3	3.3	7.7
		MUKIMS TOTAL		3.3	0.3	0.8	4.4		3.3	3.3	7.7
		KOTA TINGGI	KOTA TINGGI	3.6			3.6	2.8	1.0	3.8	7.4
			RURAL	1.4		0.3	1.7		0.3	0.3	2.0
		MUKIMS TOTAL		5.0		0.3	5.3	2.8	1.3	4.1	9.4
		SEDILI KECHIL	P2								
		SEDILI BESAR	RURAL						0.8	0.8	0.8
		MUKIMS TOTAL							0.8	0.8	0.8
		U.S.SEDILI BESAR									
		& SEDILI KAMBAU	RURAL	0.8		0.3	1.1				1.1
		MUKIMS TOTAL		0.8		0.3	1.1				1.1
		ULU SG.JOHOR	BA.TENGGARA								
			RURAL	1.9		0.5	2.4		2.2	2.2	4.6
		MUKIMS TOTAL		1.9		0.5	2.4		2.2	2.2	4.6
		DISTRICT URBAN		3.6			3.6	2.8	1.0	3.8	7.4
		RURAL		7.4	0.3	1.9	9.6		6.6	6.6	16.2
	DISTRICT TOTAL			11.0	0.3	1.9	13.2	2.8	7.6	10.4	23.6
3	PONTIAN	API-API &									
		AYER BALOI & BENUT									
		& SG.PINGGAN	RURAL	3.3		0.8	4.1		0.5	0.5	4.6
		MUKIMS TOTAL		3.3		0.8	4.1		0.5	0.5	4.6
		PONTIAN &	PONTIAN KECHIL	6.3		0.3	6.6	4.9	1.3	6.2	12.8
		RIMBA TERJUN	RURAL	1.9		0.5	2.4		0.3	0.3	2.7
		MUKIMS TOTAL		8.2		0.8	9.0	4.9	1.6	6.5	15.5
		JERAM BATU	PEKAN NANAS	2.2			2.2	1.8	0.6	2.4	4.6
			RURAL	0.5			0.5		0.3	0.3	0.8
		MUKIMS TOTAL		2.7			2.7	1.8	0.9	2.7	5.4
		AYER MASIN &									
		SERKAT & SG.KARANG	RURAL	0.8		0.3	1.1		0.3	0.3	1.4
		MUKIMS TOTAL		0.8		0.3	1.1		0.3	0.3	1.4
		DISTRICT URBAN		8.5		0.3	8.8	6.7	1.9	8.6	17.4
		RURAL		6.5		1.6	8.1		1.4	1.4	9.5
	DISTRICT TOTAL			15.0		1.9	16.9	6.7	3.3	10.0	26.9
4	KLUANG &	ULU BENUT &									
	MERSING	MACAP	RURAL	0.5		0.5	1.0				1.0
		MUKIMS TOTAL		0.5		0.5	1.0				1.0
		LAYANG-LAYANG	LAYANG-LAYANG								
			RURAL	0.3		0.3	0.6	0.7	1.4	2.1	2.7
		MUKIMS TOTAL		0.3		0.3	0.6	0.7	1.4	2.1	2.7
		RENGGAM	RENGGAM								
			SIMPANG RENGGAM								
			CITY TOTAL								
			RURAL	1.1	0.3	0.8	2.2	1.5	2.0	3.5	5.7
		MUKIMS TOTAL		1.1	0.3	0.8	2.2	1.5	2.0	3.5	5.7
		MERSING	RURAL	0.3			0.3		1.2	1.2	1.5
		MUKIMS TOTAL		0.3			0.3		1.2	1.2	1.5
		DISTRICT URBAN									
		RURAL		2.2	0.3	1.6	4.1	2.2	4.6	6.8	10.9
	DISTRICT TOTAL			2.2	0.3	1.6	4.1	2.2	4.6	6.8	10.9
	THE REGION	URBAN TOTAL		94.8		0.3	95.1	76.5	27.4	103.9	199.0
		RURAL TOTAL		21.9	1.5	8.4	31.8	5.6	22.1	27.7	59.5
	THE REGION TOTAL			116.7	1.5	8.7	126.9	82.1	49.5	131.6	258.5

Table 21 ESTIMATED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 1985

Unit: Mld

DISTRICT NAME	MUKIM NAME	CITY/RURAL NAME	DOMESTIC PWD	DOMESTIC RESP	DOMESTIC PRIVATE	DOMESTIC TOTAL	INDUSTRY PWD	INDUSTRY PRIVATE	INDUSTRY TOTAL	TOTAL
1 JOHOR BAHRU	JOHOR BAHRU &	JOHOR BAHRU	84.9		0.3	85.2	56.9	16.2	73.1	158.3
	PLENTONG &	MASAI &	4.4			4.4	21.1	6.7	27.8	32.2
	TEBRAU	PASIR GUDANG								
		CITY TOTAL	89.3		0.3	89.6	78.0	22.9	100.9	190.5
		RURAL	1.9	0.3	0.8	3.0		2.5	2.5	5.5
	MUKIMS TOTAL		91.2	0.3	1.1	92.6	78.0	25.4	103.4	196.0
	PULAI &									
	TG.KUPANG	RURAL	1.9	0.3	0.8	3.0		0.3	0.3	3.3
	MUKIMS TOTAL		1.9	0.3	0.8	3.0		0.3	0.3	3.3
	SENAI &	KULAI	8.2			8.2	5.9	1.6	7.5	15.7
	KULAI &	SENAI								
	SEDENAK	KELAPA SAWIT								
		CITY TOTAL	8.2			8.2	5.9	1.6	7.5	15.7
		RURAL	2.5	0.3	1.4	4.2	2.6	5.1	7.7	11.9
	MUKIMS TOTAL		10.7	0.3	1.4	12.4	8.5	6.7	15.2	27.6
	SG.TIRAM	ULU TIRAM								
		RURAL	0.8		0.3	1.1	1.5	1.5	3.0	4.1
	MUKIMS TOTAL		0.8		0.3	1.1	1.5	1.5	3.0	4.1
	DISTRICT URBAN		97.5		0.3	97.8	83.9	24.5	108.4	206.2
	RURAL		7.1	0.9	3.3	11.3	4.1	9.4	13.5	24.8
DISTRICT TOTAL			104.6	0.9	3.6	109.1	88.0	33.9	121.9	231.0
2 KOTA TINGGI	JOHOR LAMA &	BA.PENAWAN								
	PA.TINGI &	P4								
	PENGERANG &	P7								
	TG.SURAT	CITY TOTAL								
		RURAL	3.6	0.3	1.1	5.0	3.4	3.3	6.7	11.7
	MUKIMS TOTAL		3.6	0.3	1.1	5.0	3.4	3.3	6.7	11.7
	KOTA TINGGI	KOTA TINGGI	4.7			4.7	3.7	1.0	4.7	9.4
		RURAL	1.6		0.3	1.9		0.3	0.3	2.2
	MUKIMS TOTAL		6.3		0.3	6.6	3.7	1.3	5.0	11.6
	SEDILI KECHIL	P2								
	SEDILI BESAR	RURAL	0.5		0.3	0.8	1.5	0.8	2.3	3.1
	MUKIMS TOTAL		0.5		0.3	0.8	1.5	0.8	2.3	3.1
	U.S.SEDILI BESAR									
	& SEDILI KAMBAU	RURAL	1.1		0.3	1.4				1.4
	MUKIMS TOTAL		1.1		0.3	1.4				1.4
	ULU SG.JOHOR	BA.TENGGARA	1.4		0.3	1.7	1.9		1.9	3.6
		RURAL	1.6		0.3	1.9		2.2	2.2	4.1
	MUKIMS TOTAL		3.0		0.6	3.6	1.9	2.2	4.1	7.7
	DISTRICT URBAN		6.1		0.3	6.4	5.6	1.0	6.6	13.0
	RURAL		8.4	0.3	2.3	11.0	4.9	6.6	11.5	22.5
DISTRICT TOTAL			14.5	0.3	2.6	17.4	10.5	7.6	18.1	35.5
3 PONTIAN	API-API &									
	AYER BALOI & BENUT									
	& SG.PINGGAN	RURAL	3.8		0.8	4.6		0.5	0.5	5.1
	MUKIMS TOTAL		3.8		0.8	4.6		0.5	0.5	5.1
	PONTIAN &	PONTIAN KECHIL	7.7		0.3	8.0	6.4	1.3	7.7	15.7
	RIMBA TERJUN	RURAL	1.9		0.5	2.4		0.3	0.3	2.7
	MUKIMS TOTAL		9.6		0.8	10.4	6.4	1.6	8.0	18.4
	JERAN BATU	PEKAN NANAS	2.5			2.5	1.8	0.6	2.4	4.9
		RURAL	0.5			0.5		0.3	0.3	0.8
	MUKIMS TOTAL		3.0			3.0	1.8	0.9	2.7	5.7
	AYER MASIN &									
	SERKAT & SG.KARANG	RURAL	1.1		0.3	1.4		0.5	0.5	1.9
	MUKIMS TOTAL		1.1		0.3	1.4		0.5	0.5	1.9
	DISTRICT URBAN		10.2		0.3	10.5	8.2	1.9	10.1	20.6
	RURAL		7.3		1.6	8.9		1.6	1.6	10.5
DISTRICT TOTAL			17.5		1.9	19.4	8.2	3.5	11.7	31.1
4 KLUANG &	ULU BENUT &									
MERSING	MACAP	RURAL	0.8	0.3	0.3	1.4				1.4
	MUKIMS TOTAL		0.8	0.3	0.3	1.4				1.4
	LAYANG-LAYANG	LAYANG-LAYANG								
		RURAL	0.8		0.5	1.3	0.8	1.4	2.2	3.5
	MUKIMS TOTAL		0.8		0.5	1.3	0.8	1.4	2.2	3.5
	RENGGAM	RENGGAM								
		SIMPANG RENGGAM								
		CITY TOTAL								
		RURAL	1.6	0.3	0.8	2.7	1.7	2.5	4.2	6.9
	MUKIMS TOTAL		1.6	0.3	0.8	2.7	1.7	2.5	4.2	6.9
	MERSING	RURAL	0.3			0.3		1.6	1.6	1.9
	MUKIMS TOTAL		0.3			0.3		1.6	1.6	1.9
	DISTRICT URBAN									
	RURAL		3.5	0.6	1.6	5.7	2.5	5.5	8.0	13.7
DISTRICT TOTAL			3.5	0.6	1.6	5.7	2.5	5.5	8.0	13.7
THE REGION	URBAN TOTAL		113.8		0.9	114.7	97.7	27.4	125.1	239.8
	RURAL TOTAL		26.3	1.8	8.8	36.9	11.5	23.1	34.6	71.5
THE REGION TOTAL			140.1	1.8	9.7	151.6	109.2	50.5	159.7	311.3

Table 22 PROJECTED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 1990

Unit: Mld

DISTRICT NAME	MUKIM NAME	CITY/RURAL NAME	DOMESTIC PWD	DOMESTIC RESP	DOMESTIC PRIVATE	DOMESTIC TOTAL	INDUSTRY PWD	INDUSTRY PRIVATE	INDUSTRY TOTAL	TOTAL
1 JOHOR BAHRU	JOHOR BAHRU &	JOHOR BAHRU	117.0		0.3	117.3	90.7	16.2	106.9	224.2
	PLENTONG &	MASAI &	6.0			6.0	28.0	6.7	34.7	40.7
	TEBRAU	PASIR.GUDANG								
		CITY TOTAL	123.0		0.3	123.3	118.7	22.9	141.6	264.9
		RURAL	2.7	0.3	0.5	3.5		2.5	2.5	6.0
	MUKIMS TOTAL		125.7	0.3	0.8	126.8	118.7	25.4	144.1	270.9
	PULAI &									
	TG.KUPANG	RURAL	3.0	0.3	0.5	3.8		0.3	0.3	4.1
	MUKIMS TOTAL		3.0	0.3	0.5	3.8		0.3	0.3	4.1
	SENAI &	KULAI	13.2			13.2	10.7	1.6	12.3	25.5
	KULAI &	SENAI	1.4		0.3	1.7	2.4	0.6	3.0	4.7
	SEDENAK	KELAPA SAWIT								
		CITY TOTAL	14.6		0.3	14.9	13.1	2.2	15.3	30.2
		RURAL	4.4	0.3	0.8	5.5	1.8	3.9	5.7	11.2
	MUKIMS TOTAL		19.0	0.3	1.1	20.4	14.9	6.1	21.0	41.4
	SG.TIRAM	ULU TIRAM	1.9		0.3	2.2	2.8	0.6	3.4	5.6
		RURAL	0.8			0.8		1.0	1.0	1.8
	MUKIMS TOTAL		2.7		0.3	3.0	2.8	1.6	4.4	7.4
	DISTRICT URBAN		139.5		0.9	140.4	134.6	25.7	160.3	300.7
	RURAL		10.9	0.9	1.8	13.6	1.8	7.7	9.5	23.1
DISTRICT TOTAL			150.4	0.9	2.7	154.0	136.4	33.4	169.8	323.8
2 KOTA TINGGI	JOHOR LAMA &	BA.PENAWAN								
	PA.TIMUR &	P4								
	PENGERANG &	P7								
	TG.SURAT	CITY TOTAL								
		RURAL	6.8	0.3	0.8	7.9	4.6	3.6	8.2	16.1
	MUKIMS TOTAL		6.8	0.3	0.8	7.9	4.6	3.6	8.2	16.1
	KOTA TINGGI	KOTA TINGGI	6.6			6.6	5.6	1.0	6.6	13.2
		RURAL	2.7	0.3	0.3	3.3		0.3	0.3	3.6
	MUKIMS TOTAL		9.3	0.3	0.3	9.9	5.6	1.3	6.9	16.8
	SEDILI KECHIL	P2								
	SEDILI BESAR	RURAL	0.8			0.8	1.9	0.8	2.7	3.5
	MUKIMS TOTAL		0.8			0.8	1.9	0.8	2.7	3.5
	U.S.SEDILI BESAR									
	& SEDILI KAMBAU	RURAL	1.9		0.3	2.2				2.2
	MUKIMS TOTAL		1.9		0.3	2.2				2.2
	ULU SG.JOHOR	BA.TENGGARA	2.5		0.3	2.8	3.2		3.2	6.0
		RURAL	2.5		0.3	2.8		2.2	2.2	5.0
	MUKIMS TOTAL		5.0		0.6	5.6	3.2	2.2	5.4	11.0
	DISTRICT URBAN		9.1		0.3	9.4	8.8	1.0	9.8	19.2
	RURAL		14.7	0.6	1.7	17.0	6.5	6.9	13.4	30.4
DISTRICT TOTAL			23.8	0.6	2.0	26.4	15.3	7.9	23.2	49.6
3 PONTIAN	API-API &									
	AYER BALOI & BENUT									
	& SG.PINGGAN	RURAL	4.7	0.3	0.5	5.5		0.5	0.5	6.0
	MUKIMS TOTAL		4.7	0.3	0.5	5.5		0.5	0.5	6.0
	PONTIAN &	PONTIAN KECHIL	11.8		0.3	12.1	6.5	1.3	7.8	19.9
	RIMBA TERJUN	RURAL	2.5		0.3	2.8		0.3	0.3	3.1
	MUKIMS TOTAL		14.3		0.6	14.9	6.5	1.6	8.1	23.0
	JERAN BATU	PEKAN NANAS	3.0			3.0	1.7	0.6	2.3	5.3
		RURAL	0.5			0.5		0.3	0.3	0.8
	MUKIMS TOTAL		3.5			3.5	1.7	0.9	2.6	6.1
	AYER MASIN &									
	SERKAT & SG.KARANG	RURAL	1.4		0.3	1.7		0.5	0.5	2.2
	MUKIMS TOTAL		1.4		0.3	1.7		0.5	0.5	2.2
	DISTRICT URBAN		14.8		0.3	15.1	8.2	1.9	10.1	25.2
	RURAL		9.1	0.3	1.1	10.5		1.6	1.6	12.1
DISTRICT TOTAL			23.9	0.3	1.4	25.6	8.2	3.5	11.7	37.3
4 KLUANG &	ULU BENUT &									
MERSING	MACAP	RURAL	1.6	0.3	0.3	2.2				2.2
	MUKIMS TOTAL		1.6	0.3	0.3	2.2				2.2
	LAYANG-LAYANG	LAYANG-LAYANG								
		RURAL	1.6		0.3	1.9	1.3	1.4	2.7	4.6
	MUKIMS TOTAL		1.6		0.3	1.9	1.3	1.4	2.7	4.6
	RENGGAM	RENGGAM								
		SIMPANG RENGGAM								
		CITY TOTAL								
		RURAL	2.7	0.3	0.3	3.3	2.7	2.5	5.2	8.5
	MUKIMS TOTAL		2.7	0.3	0.3	3.3	2.7	2.5	5.2	8.5
	MERSING	RURAL	0.3			0.3		1.6	1.6	1.9
	MUKIMS TOTAL		0.3			0.3		1.6	1.6	1.9
	DISTRICT URBAN									
	RURAL		6.2	0.6	0.9	7.7	4.0	5.5	9.5	17.2
DISTRICT TOTAL			6.2	0.6	0.9	7.7	4.0	5.5	9.5	17.2
THE REGION	URBAN TOTAL		163.4		1.5	164.9	151.6	28.6	180.2	345.1
	RURAL TOTAL		40.9	2.4	5.5	48.8	12.3	21.7	34.0	82.8
THE REGION TOTAL			204.3	2.4	7.0	213.7	163.9	50.3	214.2	427.9

Table 23 PROJECTED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 1995

Unit: Mld

DISTRICT NAME	MUKIM NAME	CITY/RURAL NAME	DOMESTIC PWD	DOMESTIC RESP	DOMESTIC PRIVATE	DOMESTIC TOTAL	INDUSTRY PWD	INDUSTRY PRIVATE	INDUSTRY TOTAL	TOTAL
1 JOHOR BAHRU	JOHOR BAHRU &	JOHOR BAHRU	169.6		0.3	169.9	129.5	16.2	145.7	315.6
	PLENTONG &	MASAI &	8.2		0.3	8.5	37.6	6.7	44.3	52.8
	TEBRAU	PASIR GUDANG								
		CITY TOTAL	177.8		0.6	178.4	167.1	22.9	190.0	368.4
		RURAL	3.3	0.3	0.3	3.9		2.5	2.5	6.4
	MUKIMS TOTAL		181.1	0.3	0.9	182.3	167.1	25.4	192.5	374.8
	PULAI &									
	TG.KUPANG	RURAL	3.6	0.3	0.3	4.2		0.5	0.5	4.7
	MUKIMS TOTAL		3.6	0.3	0.3	4.2		0.5	0.5	4.7
	SENAI &	KULAI	19.2			19.2	16.7	1.6	18.3	37.5
	KULAI &	SENAI	2.5		0.3	2.8	3.4	0.6	4.0	6.8
	SEDENAK	KELAPA SAWIT	2.2		0.3	2.5	2.8	0.5	3.3	5.8
		CITY TOTAL	23.9		0.6	24.5	22.9	2.7	25.6	50.1
		RURAL	5.2	0.3	0.3	5.8		3.9	3.9	9.7
	MUKIMS TOTAL		29.1	0.3	0.9	30.3	22.9	6.6	29.5	59.8
	SG.TIRAM	ULU TIRAM	3.3		0.3	3.6	4.0	0.6	4.6	8.2
		RURAL	1.1			1.1		1.0	1.0	2.1
	MUKIMS TOTAL		4.4		0.3	4.7	4.0	1.6	5.6	10.3
	DISTRICT URBAN		205.0		1.5	206.5	194.0	26.2	220.2	426.7
	RURAL		13.2	0.9	0.9	15.0		7.9	7.9	22.9
DISTRICT TOTAL			218.2	0.9	2.4	221.5	194.0	34.1	228.1	449.6
2 KOTA TINGGI	JOHOR LAMA &	BA.PENAWAN								
	PA.TIMUR &	P4								
	PENGERANG &	P7	2.7			2.7	3.1		3.1	5.8
	TG.SURAT	CITY TOTAL	2.7			2.7	3.1		3.1	5.8
		RURAL	8.8	0.3	0.3	9.4	3.5	3.6	7.1	16.5
	MUKIMS TOTAL		11.5	0.3	0.3	12.1	6.6	3.6	10.2	22.3
	KOTA TINGGI	KOTA TINGGI	9.0			9.0	8.3	1.0	9.3	18.3
		RURAL	3.8	0.3	0.3	4.4		0.3	0.3	4.7
	MUKIMS TOTAL		12.8	0.3	0.3	13.4	8.3	1.3	9.6	23.0
	SEDILI KECHIL	P2								
	SEDILI BESAR	RURAL	1.6			1.6	2.4	1.6	4.0	5.6
	MUKIMS TOTAL		1.6			1.6	2.4	1.6	4.0	5.6
	U.S.SEDILI BESAR									
	& SEDILI KAMBAU	RURAL	2.7			2.7				2.7
	MUKIMS TOTAL		2.7			2.7				2.7
	ULU SG.JOHOR	BA.TENGGARA	4.1		0.1	4.2	4.8		4.8	9.0
		RURAL	3.8	0.3	0.3	4.4		2.2	2.2	6.6
	MUKIMS TOTAL		7.9	0.3	0.4	8.6	4.8	2.2	7.0	15.6
	DISTRICT URBAN		15.8		0.1	15.9	16.2	1.0	17.2	33.1
	RURAL		20.7	0.9	0.9	22.5	5.9	7.7	13.6	36.1
DISTRICT TOTAL			36.5	0.9	1.0	38.4	22.1	8.7	30.8	69.2
3 PONTIAN	API-API &									
	AYER BALOI & BENUT									
	& SG.PINGGAN	RURAL	5.8	0.3	0.3	6.4		0.8	0.8	7.2
	MUKIMS TOTAL		5.8	0.3	0.3	6.4		0.8	0.8	7.2
	PONTIAN &	PONTIAN KECHIL	17.0		0.3	17.3	15.8	1.3	17.1	34.4
	RIMBA TERJUN	RURAL	3.0		0.3	3.3		0.5	0.5	3.8
	MUKIMS TOTAL		20.0		0.6	20.6	15.8	1.8	17.6	38.2
	JERAN BATU	PEKAN NANAS	3.6			3.6	3.1	0.6	3.7	7.3
		RURAL	0.5			0.5		0.8	0.8	1.3
	MUKIMS TOTAL		4.1			4.1	3.1	1.4	4.5	8.6
	AYER MASIN &									
	SERKAT & SG.KARANG	RURAL	1.9			1.9		0.5	0.5	2.4
	MUKIMS TOTAL		1.9			1.9		0.5	0.5	2.4
	DISTRICT URBAN		20.6		0.3	20.9	18.9	1.9	20.8	41.7
	RURAL		11.2	0.3	0.6	12.1		2.6	2.6	14.7
DISTRICT TOTAL			31.8	0.3	0.9	33.0	18.9	4.5	23.4	56.4
4 KLUANG &	ULU BENUT &									
MERSING	MACAP	RURAL	2.7	0.3	0.3	3.3				3.3
	MUKIMS TOTAL		2.7	0.3	0.3	3.3				3.3
	LAYANG-LAYANG	LAYANG-LAYANG								
		RURAL	2.5			2.5	1.5	1.8	3.3	5.8
	MUKIMS TOTAL		2.5			2.5	1.5	1.8	3.3	5.8
	RENGGAM	RENGGAM								
		SIMPANG RENGGAM								
		CITY TOTAL								
		RURAL	4.9	0.3	0.3	5.5	3.3	3.0	6.3	11.8
	MUKIMS TOTAL		4.9	0.3	0.3	5.5	3.3	3.0	6.3	11.8
	MERSING	RURAL	0.5			0.5		2.2	2.2	2.7
	MUKIMS TOTAL		0.5			0.5		2.2	2.2	2.7
	DISTRICT URBAN									
	RURAL		10.6	0.6	0.6	11.8	4.8	7.0	11.8	23.6
DISTRICT TOTAL			10.6	0.6	0.6	11.8	4.8	7.0	11.8	23.6
THE REGION	URBAN TOTAL		241.4		1.9	243.3	229.1	29.1	258.2	501.5
	RURAL TOTAL		55.7	2.7	3.0	61.4	10.7	25.2	35.9	97.3
THE REGION TOTAL			297.1	2.7	4.9	304.7	239.8	54.3	294.1	598.8

Table 24 PROJECTED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 2000

Unit: Mld

DISTRICT NAME	MUKIM NAME	CITY/RURAL NAME	DOMESTIC PWD	DOMESTIC RESP	DOMESTIC PRIVATE	DOMESTIC TOTAL	INDUSTRY PWD	INDUSTRY PRIVATE	INDUSTRY TOTAL	TOTAL
1 JOHOR BAHRU	JOHOR BAHRU &	JOHOR BAHRU	218.6		0.5	219.1	160.1	16.3	176.4	395.5
	PLENTONG &	MASAI &	9.0			9.0	48.7	6.7	55.4	64.4
	TEBRAU	PASIR.GUDANG								
		CITY TOTAL	227.6		0.5	228.1	208.8	23.0	231.8	459.9
		RURAL	3.6	0.3		3.9		2.7	2.7	6.6
	MUKIMS TOTAL		231.2	0.3	0.5	232.0	208.8	25.7	234.5	466.5
	PULAI &									
	TG.KUPANG	RURAL	4.1	0.3		1.4		0.5	0.5	4.9
	MUKIMS TOTAL		1.1	0.3		4.4		0.5	0.5	4.9
	SENAI &	KULAI	23.8			23.8	23.4	1.6	25.0	48.8
	KULAI &	SENAI	4.1			4.1	4.2	0.6	4.8	8.9
	SEDENAK	KELAPA SAWIT	3.3			3.3	3.5	0.5	4.0	7.3
		CITY TOTAL	31.2			31.2	31.1	2.7	33.8	65.0
		RURAL	5.8	0.3	0.3	6.4		3.9	3.9	10.3
	MUKIMS TOTAL		37.0	0.3	0.3	37.6	31.1	6.6	37.7	75.3
	SG.TIRAM	ULU TIRAM	5.8		0.3	6.1	5.8	0.6	6.4	12.5
		RURAL	1.1			1.1		1.0	1.0	2.1
	MUKIMS TOTAL		6.9		0.3	7.2	5.8	1.6	7.4	14.6
	DISTRICT URBAN		264.6		0.8	265.4	245.7	26.3	272.0	537.4
	RURAL		14.6	0.9	0.3	15.8		8.1	8.1	23.9
DISTRICT TOTAL			279.2	0.9	1.1	281.2	245.7	34.4	280.1	561.3
2 KOTA TINGGI	JOHOR LAMA &	BA.FENAWAN								
	PA.TIMUR &	P4	3.3			3.3	3.4		3.4	6.7
	PENGERANG &	P7	3.8			3.8	3.8		3.8	7.6
	TG.SURAT	CITY TOTAL	7.1			7.1	7.2		7.2	14.3
		RURAL	10.4	0.5	0.3	11.2	1.7	3.6	5.3	16.5
	MUKIMS TOTAL		17.5	0.5	0.3	18.3	8.9	3.6	12.5	30.8
	KOTA TINGGI	KOTA TINGGI	12.6			12.6	10.9	1.1	12.0	24.6
		RURAL	5.2	0.3	0.3	5.8		0.3	0.3	6.1
	MUKIMS TOTAL		17.8	0.3	0.3	18.4	10.9	1.4	12.3	30.7
	SEDILI KECHIL	P2	3.3			3.3	3.4		3.4	6.7
	SEDILI BESAR	RURAL	0.3			0.3		1.6	1.6	1.9
	MUKIMS TOTAL		3.6			3.6	3.4	1.6	5.0	8.6
	U.S.SEDILI BESAR									
	& SEDILI KAMBAU	RURAL	3.8	0.3		4.1				4.1
	MUKIMS TOTAL		3.8	0.3		4.1				4.1
	ULU SG.JOHOR	BA.TENGGARA	7.1		0.3	7.4	6.8		6.8	14.2
		RURAL	4.9	0.3	0.3	5.5		2.2	2.2	7.7
	MUKIMS TOTAL		12.0	0.3	0.6	12.9	6.8	2.2	9.0	21.9
	DISTRICT URBAN		30.1		0.3	30.4	28.3	1.1	29.4	59.8
	RURAL		24.8	1.4	0.9	26.9	1.7	7.7	9.4	36.3
DISTRICT TOTAL			54.7	1.4	1.2	57.3	30.0	8.8	38.8	96.1
3 PONTIAN	API-API &									
	AYER BALOI & BENUT									
	& SG.PINGGAN	RURAL	6.6	0.3	0.3	7.2		0.8	0.8	8.0
	MUKIMS TOTAL		6.6	0.3	0.3	7.2		0.8	0.8	8.0
	PONTIAN &	PONTIAN KECHIL	23.6			23.6	20.2	1.3	21.5	45.1
	RIMBA TERJUN	RURAL	3.3			3.3		0.8	0.8	4.1
	MUKIMS TOTAL		26.9			26.9	20.2	2.1	22.3	49.2
	JERAN BATU	PEKAN NANAS	3.8			3.8	3.4	0.7	4.1	7.9
		RURAL	0.8			0.8		1.1	1.1	1.9
	MUKIMS TOTAL		4.6			4.6	3.4	1.8	5.2	9.8
	AYER MASIN &									
	SERKAT & SG.KARANG	RURAL	1.9			1.9		0.3	0.3	2.2
	MUKIMS TOTAL		1.9			1.9		0.3	0.3	2.2
	DISTRICT URBAN		27.4			27.4	23.6	2.0	25.6	53.0
	RURAL		12.6	0.3	0.3	13.2		3.0	3.0	16.2
DISTRICT TOTAL			40.0	0.3	0.3	40.6	23.6	5.0	28.6	69.2
4 KLUANG &	ULU BENUT &									
MERSING	MACAP	RURAL	3.8	0.3	0.3	4.4				4.4
	MUKIMS TOTAL		3.8	0.3	0.3	4.4				4.4
	LAYANG-LAYANG	LAYANG-LAYANG								
		RURAL	3.8			3.8	2.3	1.4	3.7	7.5
	MUKIMS TOTAL		3.8			3.8	2.3	1.4	3.7	7.5
	RENGGAM	RENGGAM								
		SIMPANG RENGGAM								
		CITY TOTAL								
		RURAL	7.1	0.3	0.3	7.7	4.2	2.3	6.5	14.2
	MUKIMS TOTAL		7.1	0.3	0.3	7.7	4.2	2.3	6.5	14.2
	MERSING	RURAL	0.3			0.3		2.2	2.2	2.5
	MUKIMS TOTAL		0.3			0.3		2.2	2.2	2.5
	DISTRICT URBAN									
	RURAL		15.0	0.6	0.6	16.2	6.5	5.9	12.4	28.6
DISTRICT TOTAL			15.0	0.6	0.6	16.2	6.5	5.9	12.4	28.6
THE REGION	URBAN TOTAL		322.1		1.1	323.2	297.6	29.4	327.0	650.2
	RURAL TOTAL		66.8	3.2	2.1	72.1	8.2	24.7	32.9	105.0
THE REGION TOTAL			388.9	3.2	3.2	395.3	305.8	54.1	359.9	755.2

Table 25 PROJECTED D&I WATER DEMAND IN THE REGION BY DISTRICT AND BY PURPOSE BY TYPE OF SUPPLY FOR 2005

Unit: Mld

DISTRICT NAME	MUKIM NAME	CITY/RURAL NAME	DOMESTIC PWD	DOMESTIC RESP	DOMESTIC PRIVATE	DOMESTIC TOTAL	INDUSTRY PWD	INDUSTRY PRIVATE	INDUSTRY TOTAL	TOTAL
1 JOHOR BAHRU	JOHOR BAHRU &	JOHOR BAHRU	275.1		0.5	275.6	271.0	16.3	287.3	562.9
	PLENTONG &	MASAI &	13.7			13.7	53.9	6.7	60.6	74.3
	TEBRAU	PASIR GUDANG								
		CITY TOTAL	288.8		0.5	289.3	324.9	23.0	347.9	637.2
		RURAL	3.8	0.1		3.9		2.7	2.7	6.6
	MUKIMS TOTAL		292.6	0.1	0.5	293.2	324.9	25.7	350.6	643.8
	PULAI &									
	TG.KUPANG	RURAL	4.4	0.3		4.7		0.5	0.5	5.2
	MUKIMS TOTAL		4.4	0.3		4.7		0.5	0.5	5.2
	SENAI &	KULAI	39.2			39.2	42.1	1.6	43.7	82.9
	KULAI &	SENAI	6.0			6.0	6.5	0.6	7.1	13.1
	SEDENAK	KELAPA SAWIT	4.7			4.7	5.2	0.7	5.9	10.6
		CITY TOTAL	49.9			49.9	53.8	2.9	56.7	106.6
		RURAL	6.0	0.1		6.1		3.9	3.9	10.0
	MUKIMS TOTAL		55.9	0.1		56.0	53.8	6.8	60.6	116.6
	SG.TIRAM	ULU TIRAM	9.0			9.0	10.4	0.6	11.0	20.0
		RURAL	1.1			1.1		1.0	1.0	2.1
	MUKIMS TOTAL		10.1			10.1	10.4	1.6	12.0	22.1
	DISTRICT URBAN		347.7		0.5	348.2	389.1	26.5	415.6	763.8
	RURAL		15.3	0.5		15.8		8.1	8.1	23.9
DISTRICT TOTAL			363.0	0.5	0.5	364.0	389.1	34.6	423.7	787.7
2 KOTA TINGGI	JOHOR LAMA &	BA.PENAWAN	4.1			4.1	4.8		4.8	8.9
	PA.TIMUR &	P4	4.7			4.7	4.8		4.8	9.5
	PENGERANG &	P7	4.9			4.9	5.5		5.5	10.4
	TG.SURAT	CITY TOTAL	13.7			13.7	15.1		15.1	28.8
		RURAL	11.2	0.5		11.7		3.8	3.8	15.5
	MUKIMS TOTAL		24.9	0.5		25.4	15.1	3.8	18.9	44.3
	KOTA TINGGI	KOTA TINGGI	15.9			15.9	18.0	1.0	19.0	34.9
		RURAL	6.3	0.3		6.6		0.3	0.3	6.9
	MUKIMS TOTAL		22.2	0.3		22.5	18.0	1.3	19.3	41.8
	SEDILI KECHIL	P2	4.7			4.7	4.8		4.8	9.5
	SEDILI BESAR	RURAL	0.3			0.3		1.6	1.6	1.9
	MUKIMS TOTAL		5.0			5.0	4.8	1.6	6.4	11.4
	U.S.SEDILI BESAR									
	& SEDILI KAMBAU	RURAL	4.7	0.3		5.0				5.0
	MUKIMS TOTAL		4.7	0.3		5.0				5.0
	ULU SG.JOHOR	BA.TENGGARA	10.1			10.1	11.1		11.1	21.2
		RURAL	6.0	0.3		6.3		2.2	2.2	8.5
	MUKIMS TOTAL		16.1	0.3		16.4	11.1	2.2	13.3	29.7
	DISTRICT URBAN		44.4			44.4	49.0	1.0	50.0	94.4
	RURAL		28.5	1.4		29.9		7.9	7.9	37.8
DISTRICT TOTAL			72.9	1.4		74.3	49.0	8.9	57.9	132.2
3 PONTIAN	API-API &									
	AYER BALOI & BENUT									
	& SG.PINGGAN	RURAL	6.8	0.3		7.1		0.8	0.8	7.9
	MUKIMS TOTAL		6.8	0.3		7.1		0.8	0.8	7.9
	PONTIAN &	PONTIAN KECHIL	31.8			31.8	35.3	1.3	36.6	68.4
	RIMBA TERJUN	RURAL	3.3	0.3		3.6		0.8	0.8	4.4
	MUKIMS TOTAL		35.1	0.3		35.4	35.3	2.1	37.4	72.8
	JERAN BATU	PEKAN NANAS	4.1			4.1	4.8	0.6	5.4	9.5
		RURAL	0.8			0.8		1.1	1.1	1.9
	MUKIMS TOTAL		4.9			4.9	4.8	1.7	6.5	11.4
	AYER MASIN &									
	SERKAT & SG.KARANG	RURAL	2.2			2.2		0.5	0.5	2.7
	MUKIMS TOTAL		2.2			2.2		0.5	0.5	2.7
	DISTRICT URBAN		35.9			35.9	40.1	1.9	42.0	77.9
	RURAL		13.1	0.6		13.7		3.2	3.2	16.9
DISTRICT TOTAL			49.0	0.6		49.6	40.1	5.1	45.2	94.8
4 KLUANG &	ULU BENUT &									
MERSING	MACAP	RURAL	6.0	0.3		6.3				6.3
	MUKIMS TOTAL		6.0	0.3		6.3				6.3
	LAYANG-LAYANG	LAYANG-LAYANG	4.1			4.1	4.5	0.3	4.8	8.9
		RURAL	2.2			2.2		1.1	1.1	3.3
	MUKIMS TOTAL		6.3			6.3	4.5	1.4	5.9	12.2
	RENGGAM	RENGGAM	4.1			4.1	4.5	0.3	4.8	8.9
		SIMPANG RENGGAM	4.1			4.1	4.5	0.3	4.8	8.9
		CITY TOTAL	8.2			8.2	9.0	0.6	9.6	17.8
		RURAL	4.9	0.3		5.2		2.2	2.2	7.4
	MUKIMS TOTAL		13.1	0.3		13.4	9.0	2.8	11.8	25.2
	MERSING	RURAL	0.3			0.3		2.2	2.2	2.5
	MUKIMS TOTAL		0.3			0.3		2.2	2.2	2.5
	DISTRICT URBAN		12.3			12.3	13.5	0.9	14.4	26.7
	RURAL		13.4	0.6		14.0		5.5	5.5	19.5
DISTRICT TOTAL			25.7	0.6		26.3	13.5	6.4	19.9	46.2
THE REGION	URBAN TOTAL		440.3		0.5	440.8	491.7	30.3	522.0	962.8
	RURAL TOTAL		70.3	3.1		73.4		24.7	24.7	98.1
THE REGION TOTAL			510.6	3.1	0.5	514.2	491.7	55.0	546.7	1060.9

Table 26 PROJECTED WATER DEMAND BY SUPPLY AREA AND AT INTAKE POINTS

Unit: $10^6 m^3/y$

SUPPLY AREA NO.	INTAKE NO.	1983	1985	1990	1995	2000	2005	NAME OF INTAKE
1	R24	6.1	7.7	12.0	17.6	22.9	35.6	SIMPANG RENGGAM
	R29	0.7	0.7	0.9	1.1	1.2	1.2	PONTIAN BESAR /1
	RES 8	1.7	1.7	1.7	1.7	1.7	1.7	G. PULAI
2	R25	0.7	0.9	1.4	2.1	2.9	4.4	RENGGAM
	R26	0.4	0.6	1.1	1.5	2.2	4.0	LAYANG-LAYANG
3	R30	0.9	0.8	1.0	2.7	3.4	4.6	KELAPA SAWIT
4	RES 8	0.4	0.4	0.4	0.4	0.4	0.4	G. PULAT /1
	R41	0.0	0.3	0.7	0.9	1.1	1.2	KOTA TINGGI /1
5	R39	0.2	1.4	2.3	3.6	5.6	8.4	PENGLI
6	R41	47.5	35.5	36.1	80.0	120.2	201.9	KOTATINGGI /1
	RES 9		22.5	51.0	45.5	39.5	32.9	LAYANG
7	R35	0.3	0.3	0.4	0.6	0.8	0.9	SEMANGAR
8	R40	0.2	0.2	0.3	0.4	0.5	0.6	LINGGIU
9	R41	0.5	0.6	1.0	1.4	1.9	2.3	KOTATINGI
10	RES 9		10.8	15.5	21.0	27.0	33.5	LAYANG
	R33	9.2						SERAI
11	R34	0.4	0.7	1.1	1.3	1.5	1.6	PANTI
	R41	1.9	2.3	3.3	5.0	7.1	10.8	KOTATINGI /1
12	R36	0.4	1.2	1.8	2.7	4.0	5.4	SEDILI
13	R37	0.4	0.8	1.3	1.3	1.3	1.2	SELUYUT
14	R38	0.5	0.6	0.7	0.8	0.9	1.0	RENGIT
	RES 10	0.3	1.2	2.2	4.5	7.4	12.4	LEBAN
PRIVATE AND RESP WATER DEMAND		21.6	22.5	20.7	22.3	21.9	21.4	
TOTAL DEMAND		94.3	113.6	156.9	218.4	275.4	387.4	

Remark /1; PUB Intakes

Table 27 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

FIGURES

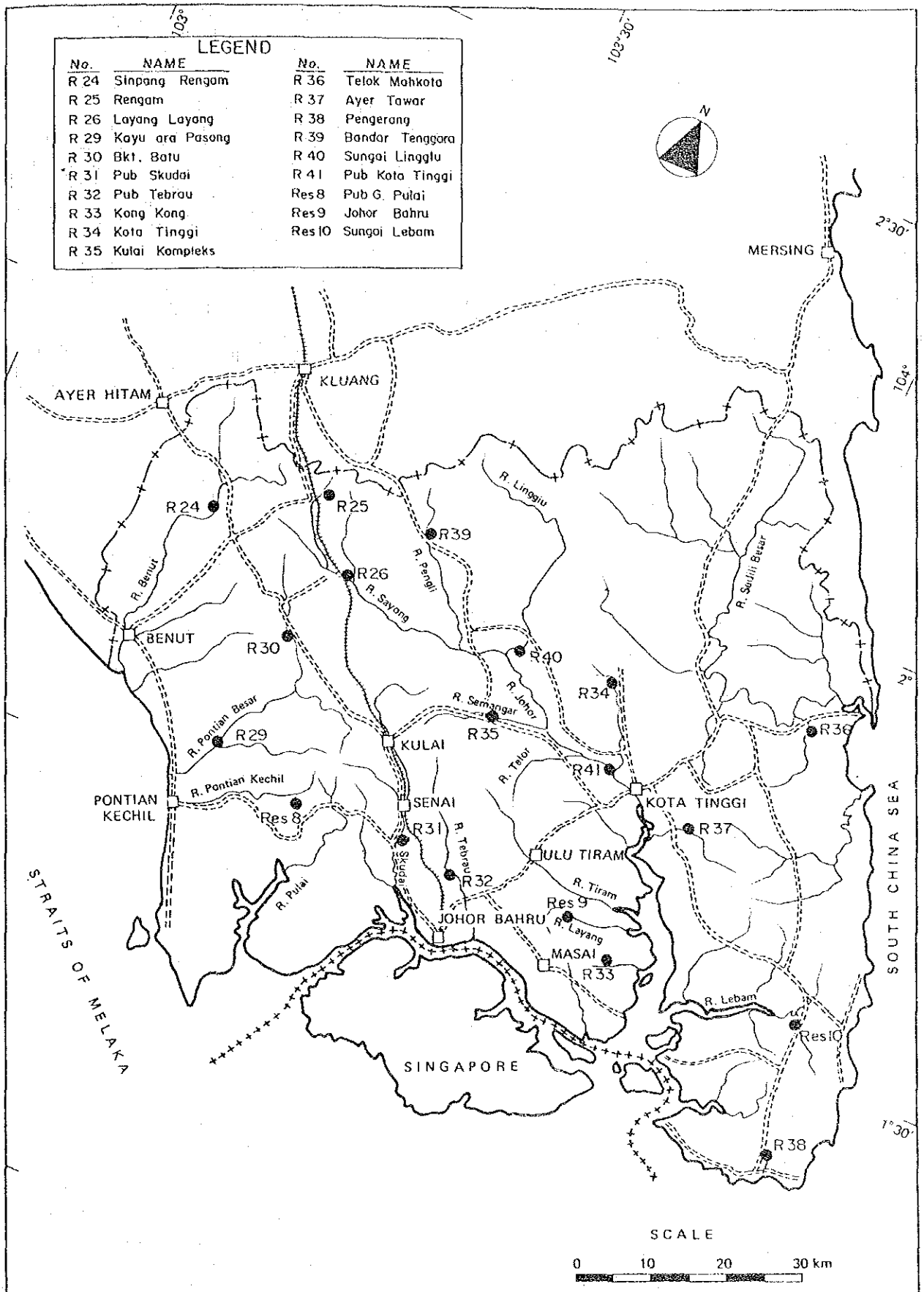


Fig. 1 Existing Water Supply Facilities (Intake Point)

GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY, MALAYSIA
SOUTH JOHOR
REGIONAL WATER RESOURCES STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY

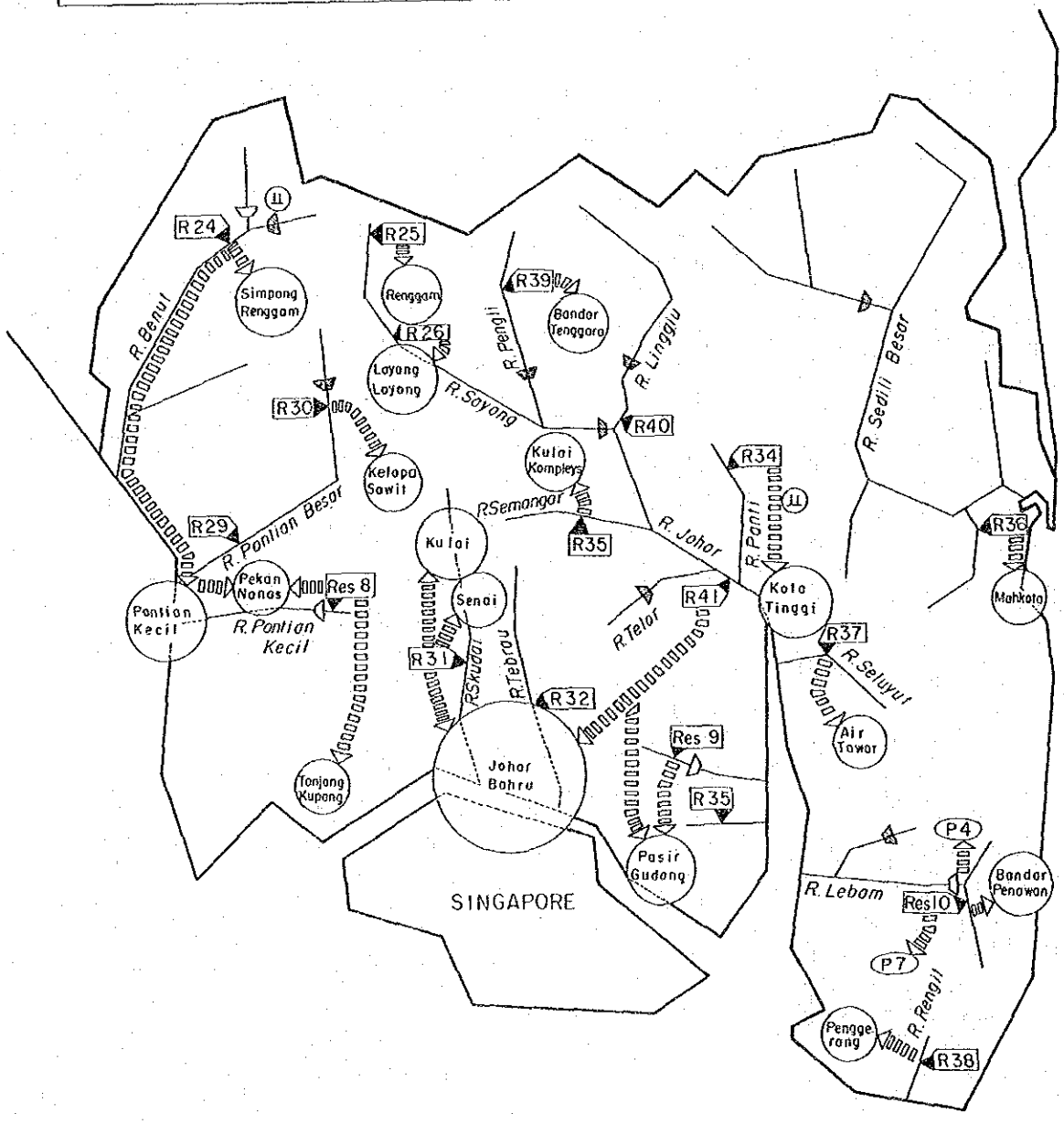


Fig. 2 Existing Water Supply System

GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY, MALAYSIA
SOUTH JOHOR
REGIONAL WATER RESOURCES STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY

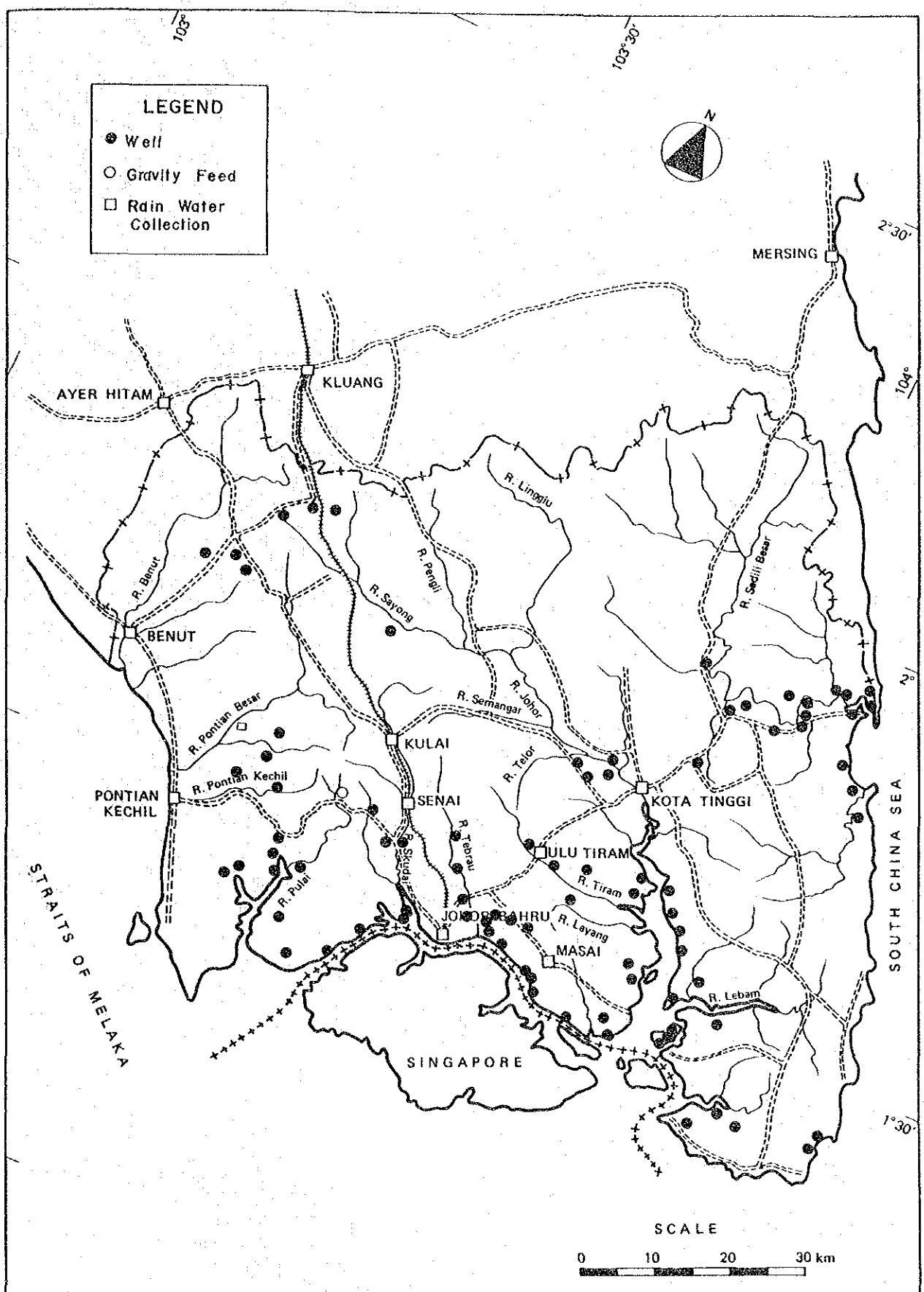


Fig. 3 Location Map of RESP Water Supply Facilities

GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY, MALAYSIA
SOUTH JOHOR
REGIONAL WATER RESOURCES STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX C
AGRICULTURE AND IRRIGATION DEVELOPMENT

TABLE OF CONTENTS

Page

1. INTRODUCTION C-1

2. BACKGROUND OF AGRICULTURE C-3
   2.1 Role of Agriculture C-3
   2.2 Organization Responsible for Agriculture C-3

3. PRESENT STATUS OF AGRICULTURAL PRODUCTION IN THE REGION... C-5
   3.1 Soils C-5
   3.2 Land Use C-5
   3.3 Tree Crops Cultivation C-6
   3.4 Rice Cultivation C-7

4. AGRICULTURAL DEVELOPMENT PLAN C-9
   4.1 Development Policy C-9
   4.2 Projection of Tree Crops Area C-9
   4.3 Anticipated Tree Crops Production C-10
   4.4 Processing Facilities C-10
   4.5 Projection of Processing Water Requirement C-11
   4.6 Irrigation Development for Paddy C-11
      4.6.1 Irrigation area C-11
      4.6.2 Estimation of irrigation water demand C-12

REFERENCES C-16

LIST OF TABLES

		Page
1.	AREAL EXTENT OF SOILS IN THE REGION	C-17
2.	ESTIMATED RUBBER AREA IN 1983	C-18
3.	ESTIMATED OIL PALM AREA IN 1983	C-18
4.	ESTIMATED PINEAPPLE AREA IN 1983	C-18
5.	ESTIMATED COCONUT AREA IN 1983	C-19
6.	ESTIMATED COCOA AREA IN 1983	C-19
7.	ESTIMATED COFFEE AREA IN 1983	C-19
8.	OIL PALM YIELD ESTIMATED FOR PRESENT CONDITION AND ANTICIPATED FOR FUTURE CONDITION	C-20
9.	RUBBER YIELD ESTIMATED FOR PRESENT CONDITION AND ANTICIPATED FOR FUTURE CONDITION	C-21
10.	AVERAGE COCONUT YIELD IN 1983	C-22
11.	AVERAGE COCOA YIELD IN 1983	C-22
12.	AVERAGE COFFEE YIELD IN 1983	C-22
13.	PROJECTED PLANTING AREA OF RUBBER BY DISTRICT	C-23
14.	PROJECTED PLANTING AREA OF OIL PALM BY DISTRICT	C-23
15.	PROJECTED PLANTING AREA OF PINEAPPLE BY DISTRICT	C-23
16.	ESTIMATED PROCESSING REQUIREMENT OF RUBBER BY RUBBER FACTORIES IN THE REGION	C-24
17.	ESTIMATED PROCESSING REQUIREMENT OF OIL PALM BY PALM OIL MILLS IN THE REGION	C-25
18.	ESTIMATED PROCESSING REQUIREMENT OF PINEAPPLE BY PINEAPPLE FACTORIES IN THE REGION	C-26
19.	PROJECTED PROCESSING WATER DEMAND BY RUBBER FACTORIES IN THE REGION	C-27
20.	PROJECTED PROCESSING WATER DEMAND BY PALM OIL MILLS IN THE REGION	C-28

Page

21. PROJECTED PROCESSING WATER DEMAND BY PINEAPPLE FACTORIES IN THE REGION C-29

22. FEATURE OF IRRIGATED PADDY SCHEMES IN THE REGION C-30

23. 10-DAY OPEN WATER EVAPORATION AT KOTA TINGGI C-31

24. 10-DAY IRRIGATION WATER DEMAND FOR THE LUKUT IRRIGATION SCHEME C-32

25. 10-DAY IRRIGATION WATER DEMAND FOR THE ULU BENUT IRRIGATION SCHEME C-33

26. IRRIGATION AREA AND WATER DEMAND IN THE REGION C-34

LIST OF FIGURES

1. General Land Use Map

2. Location of the Existing and Proposed Processing Facilities in the Region

3. Location of Irrigation Schemes

4. Proposed Cropping Pattern and Irrigation Schedule

5. Plot-to-plot Irrigation Model

6. Variation of Crop Coefficient with Growing Stage

1. INTRODUCTION

The objective of agriculture and irrigation development is to estimate the water demand in both sectors up to year 2005. For this purpose, information and data concerning land use, crop cultivation, future development plan, were collected at offices and corporations concerned. Interview surveys were also conducted in plantations and fields. Discussions with officials were effective.

2. BACKGROUND OF AGRICULTURE

2.1 Role of Agriculture

Agriculture is one of the largest sectors which have sustained the national economy. Although the contribution of the agricultural sector to the national economy has been decreasing gradually in recent years because of the structural change in the Malaysian economy, this sector in 1983 accounts for M$7,030 x 10^6 in 1970 constant prices or 22.4% of GDP. It absorbed 1.94 x 10^6 workers or 37.0% of the total employment and entailed M$10,961 x 10^6 in 1983 constant prices or 33% of the gross export.

The growth rate of GDP in the agricultural sector during the first three years of Fourth Malaysia Plan (4MP, 1981-85) attained to 4.0% per annum exceeding the target growth rate of 3.0% per annum under 4MP. This is due mainly to the notable increase in palm oil production. In the Mid-term Review of 4MP, therefore, the average growth rate of the agricultural sector is swelled to 4.2% per annum.

2.2 Organization Responsible for Agriculture Development

Ministry of Agriculture, Ministry of Land and Regional Development and Ministry of Primary Industry are the responsible agencies for agricultural development. The Ministry of Agriculture is responsible for (1) all crop production except for export crops, (2) fish and livestock production, (3) agricultural credit, marketing and research except for rubber and oil palm, and (4) farmer's organizations, community and cooperative development. The Ministry of Lands and Regional Development performs the duties of land development and rehabilitation. The Ministry of Primary Industry handles export crops.

schemes, while the Department of Agriculture is responsible for agricultural extension services.

Under the Ministry of Lands and Regional Development, there are three nationwide authorities; Federal Land Development Authority (FELDA), Federal Land Consolidation and Rehabilitation Authority (FELCRA) and Rubber Industry Smallholders Development Authority (RISDA). FELDA develops new land and distribute the developed land to eligible person. FELCRA is responsible for rehabilitation of unsuccessful state land schemes and for development of new land schemes at a smaller scale than FELDA's schemes. RISDA is responsible for encouraging rubber smallholders to replant the existing non-productive rubber trees with high-yielding varieties or other crops, to extend rubber planting areas and to obtain shares in RISDA block plantings run on an estate basis.

3. PRESENT STATUS OF AGRICULTURAL PRODUCTION IN THE REGION

3.1 Soils

Soils in the Region are broadly classified into (1) alluvial soils extending over coastal plains, riverine flood plains and riverine terraces, (2) sedimentary soils occurring on undulating plains, rolling hills and mountainous area, and (3) soils of urban and mined land.

Based on the soil map prepared by MOA, covering area for each soil in the Region is estimated at 2,814 Km^2 for alluvial soils, 4,484 Km^2 for sedimentary soils and 52 Km^2 for soils of urban and mined land as shown in Table 1. Twenty of soil series are identified in the Region.

3.2 Land Use

Department of Agriculture prepared a land use map in a scale of 1 to 126,720. The map shows the land use of the Region as of 1974 through interpretation of areal photographs with a scale of 1 : 25,000. The Department prepared another land use map as of 1981 in the same scale, revising the change in land use since 1974. This map has not been published yet, but it was made available to the Study. The information in the maps were confirmed by interviews and reconnaissance surveys conducted by the Study team. Various governmental offices and corporations concerned were interviewed to collect the information.

A general land use map of the Region as of 1981 covering 735,000 ha, is shown in Fig. 1. The Region includes main towns such as Johor Bahru, Kota Tinggi, Pontian Kechil, Senai, Kulai, Benut, Ulu Tiram and Masai. National road, public road and farm road are running in all directions, connecting main towns and rural centers. The international railway connecting Singapore and Bangkok is running from north to south through the Region.

Agricultural land of 395,702 ha occupying 54% of the whole Region comprises 167,967 ha of oil palm, 155,223 ha of rubber, 15,053 ha of coconut, 14,148 ha of pineapple, 9,155 ha of sugarcane and 34,156 ha of other crops including cocoa, banana, pepper, orchards, paddy, diversified crops and mixed horticulture. Forest of 228,275 ha (31%) mostly covers mountainous area in the north-eastern part of the Region. Swamps of 71,971 ha (10%) develop along coastal plains. Other areas of 39,232 ha (5%) are used for urban area, rural centers, estate compounds, mining, railway and roads.

Compared with the land use in 1974, agricultural land increased by 56,000 ha and non-agricultural land expanded by 30,000 ha. On the other hand, forest area reduced by 58,000 ha and swamps by 28,000 ha. In agricultural land, rubber decreased by 27,000 ha. Expansion of agricultural land is attribute largely to development of oil palm.

As for agricultural land use, the State DOA prepared the agricultural statistics as of 1983. The statistics shows the agricultural land use area of various crops by management sector. There exists a considerable difference regarding the area for sugarcane between this statistics and the interpretation of land use map. The statistics shows the existence of only about 10 ha of sugarcane land in the Region while the land use map indicates more than 9,000 ha. It is unnatural to consider that a sugarcane land of 9,000 ha was abandoned within the lapse of 2 years. This discrepancy should be solved in further study. Agricultural statistics shows the consistency to the land use map regarding agricultural land use except for sugarcane. The land use areas in the statistics were used for the estimation of the agricultural production after the confirmation through interview surveys.

3.3 Tree Crops Cultivation

As shown in the previous section, oil palm and rubber are the dominant crops in the Region. Based on the Agricultural Statistics in 1983 prepared by the State DOA, planting area of these crops are estimated at 175 x 10^3 ha for oil palm and 123 x 10^3 ha for rubber.

Other main tree crops are coconut (21.5 x 10^3 ha), pineapple (8.1 x 10^3 ha), cocoa (5.6 x 10^3 ha) and coffee (2.0 x 10^3 ha). They are cultivated by small-holders, estates and FELDA. The breakdown thereof are presented in Tables 2 to 7.

Productions in the Region in 1983 are estimated at 3,345 x 10^3 tons as fresh fruit bunch (FFB) for oil palm and 117 x 10^3 tons as dry rubber content (DRC) for rubber, applying present annual yield of FELDA schemes and present annual average yield of private estates and smallholders for both crops as shown in Table 8 and Table 9.

Pineapple production is estimated at 177 x 10^3 tons as fresh fruit using an unit yield of 22.1 tons/ha estimated by the Western Johor Agricultural Development Project. Production of other crops are estimated at 27.7 x 10^3 tons for coconut, 4.5 x 10^3 tons for cocoa and 7.9 x 10^3 tons for coffee, based on the average yield of each crop by district and by sector as shown in Tables 10 to 12.

Of these above tree crops, the harvests of oil palm, rubber and pineapple are preliminarily processed in factories located in vicinities of planting area. Those factories consume much water to process them. At present 24 of palm oil mills, 20 of rubber factories and 5 of pineapple cannery factories are in operation in the Region.

3.4 Rice Cultivation

In the Region, only 2 irrigation schemes for paddy cultivation have been maintained by the State DID of Johor. The total irrigation area is 255 ha. Location of these schemes is shown in Fig. 3. The Lukut scheme of 78 ha is a single paddy cropping area due to water shortage during dry season and is owned by 106 farmers (0.74 ha per farmer). On the other hand, the Ulu Benut scheme of 177 ha is a double cropping area owned by 436 farmers (0.41 ha per farmer). The unit paddy yield in these schemes has been fluctuating between 0.9 and 2.7 tons per ha mainly using Madu Tiga (3X) variety with growing period of 130 days. Most paddy farmers in the Region are working in

oil palm or rubber estates to make a livelihood according to interview to farmers. The feature of these schemes is shown in Table 22.