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SECTORAL REPORT

VOL. 15

WATER RESOURCES ENGINEERING

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COMPOSITION OF THIS VOLUME

This Volume consists of two parts: Part 1 deals with the subject matters of Peninsular Malaysia and Part 2 is devoted to the States of Sabah and Sarawak.

ABBREVIATIONS

(1) Plan

FMP	:	First Malaysia Plan
SMP	:	Second Malaysia Plan
TMP	:	Third Malaysia Plan
4MP	:	Fourth Malaysia Plan
5MP	:	Fifth Malaysia Plan
6MP	:	Sixth Malaysia Plan
7MP	:	Seventh Malaysia Plan
NEP	:	New Economic Policy
OPP	:	Outline Perspective Plan
RESP	:	Rural Environmental Sanitation Program

(2) Domestic Organization

DID (JPT)	:	Drainage and Irrigation Department
DOA	:	Department of Agriculture
DOE	:	Division of Environment
DOF	:	Department of Forestry
DOFS	:	Department of Fishery
DOM	:	Department of Mines
DOS	:	Department of Statistics
EPU	:	Economic Planning Unit
FAMA	:	Federal Agricultural Marketing Authority
FELCRA	:	Federal Land Consolidation and Rehabilitation Authority
FELDA	:	Federal Land Development Authority
ICU	:	Implementation and Coordination Unit
MARDI	:	Malaysian Agricultural Research and Development Institute
MIDA	:	Malaysian Industrial Development Authority
MLRD	:	Ministry of Land and Regional Development
MMS	:	Malaysian Meteorological Service
MOA	:	Ministry of Agriculture
MOF	:	Ministry of Finance

MOH	:	Ministry of Health
MOPI	:	Ministry of Primary Industries
MRRDB	:	Malaysia Rubber Research and Development Board
NDPC	:	National Development Planning Committee
NEB (LLN)	:	National Electricity Board
PORIM	:	Palm Oil Research Institute of Malaysia
PWD (JKR)	:	Public Works Department
RDA	:	Regional Development Authority
RISDA	:	Rubber Industry Small-holders Development Authority
RRIM	:	Rubber Research Institute of Malaysia
SEB	:	Sabah Electricity Board
SEBC	:	State Economic Development Corporation
S(E)PU	:	State (Economic) Planning Unit
SESCO	:	Sarawak Electricity Supply Corporation
UDA	:	Urban Development Authority

(3) <u>International or Foreign Organization</u>

ADAA	:	Australian Development Assistance Agency
ADB	:	Asian Development Bank
ASCE	:	American Society of Civil Engineers
FAO	:	Food and Agriculture Organization of the United Nations
IBRD	:	International Bank for Reconstruction and Development
ILO	:	International Labour Organization
IMF	:	International Monetary Fund
IRRI	:	International Rice Research Institute
JICA	:	Japan International Cooperation Agency
JSCE	:	Japan Society of Civil Engineers
MOC	:	Ministry of Construction, Japan
OECD	:	Organization for Economic Cooperation and Development
OECF	:	Overseas Economic Cooperation Fund, Japan
UK	:	United Kingdom
UNDP	:	United Nations Development Program

UNSF	:	United Nations Special Fund
US or USA	:	United States of America
US/AID	:	United States Agency for International Development
USBR	:	United States Bureau of Reclamation
WHO	:	World Health Organization
WMO	:	World Meteorological Organization

(4) Others

B	:	Benefit
BOD	:	Biochemical Oxygen Demand
C	:	Cost
CIF	:	Cost, Insurance and Freight
COD	:	Chemical Oxygen Demand
D&I	:	Domestic and Industrial
dia	:	Diameter
EIRR	:	Economic Internal Rate of Return
El.	:	Elevation above mean sea level
Eq.	:	Equation
Fig.	:	Figure
FOB	:	Free on Board
FSL	:	Full Supply Level
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
H	:	Height, or Water Head
HWL	:	Reservoir High Water Level
LWL	:	Reservoir Low Water Level
O&M	:	Operation and Maintenance
Q	:	Discharge
Ref.	:	Reference
SITC	:	Standard International Trade Classification
SS	:	Suspended Solid
V	:	Volume
W	:	Width

ABBREVIATIONS OF MEASUREMENT

Length

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

Area

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

Volume

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

Weight

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

Time

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

Electrical Measures

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

Other Measures

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

Derived Measures

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

Money

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

CONVERSION FACTORS

	From Metric System	To Metric System
Length	1 cm = 0.394 inch 1 m = 3.28 ft = 1.094 yd 1 km = 0.621 mile	1 inch = 2.54 cm 1 ft = 30.48 cm 1 yd = 91.44 cm 1 mile = 1.609 km
Area	1 cm^2 = 0.155 sq.in 1 m^2 = 10.76 sq.ft 1 ha = 2.471 acres 1 km^2 = 0.386 sq.mile	1 sq.ft = 0.0929 m^2 1sq.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^2
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
(as average between July and December 1980)

$1 = M$2.22
¥100 = M$1.03

PART 1

PENINSULAR MALAYSIA

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SPECIAL ABBREVIATIONS

GOM: Government of Malaysia

MWB: Melaka Water Board

PWA: Pinang Water Authority

SWW: Selangor Water Works

MWL: Maximum Water Level

WL : Water Level

1. INTRODUCTION

The objective of the sector of Water Resources Engineering is to clarify the present conditions of the major water resources facilities which include dams and reservoirs, headworks, barrages and weirs, to review the proposed or identified water resources development and use plans, and finally to establish the water resources development and use alternative plans for the target years 1990 and 2000.

This report presents only the results of the field survey done in Peninsular Malaysia from July 16, 1980 to January 31, 1981. The methodology and results of the water source and hydropower development plans are presented in the Sectoral Report, Vol. 16 WATER SOURCE AND HYDROPOWER DEVELOPMENT PLANNING.

Chapter 2 presents first the definition of the theoretical region for water resources development (i.e. Basin). Chapter 3 compiles the survey results of the present conditions of dams, reservoirs and hydropower stations and potential dam sites, and it also summarizes the historic background of the dams and hydropower development of the Peninsular. Chapter 4 compiles the results of interview survey regarding the present and anticipated problems and needs in water resources development and use. Chapter 5 presents the price of principal construction materials, price escalation trend and compensation cost in Peninsular Malaysia from 1975 to 1980.

2. BASIN DIVISION

BASIN

Peninsular Malaysia, which is composed of 11 states, was divided into 41 Basins for the purpose of engineering study. The Basin number, name of river system, catchment area and river length are listed in Tables 1 to 3. The Basin division is shown in Fig. 1.

The Basin boundaries were delineated and the catchment area was measured on the map of 1/500,000 scale based on the following criteria:

(1) The Basin boundary is washershed,

(2) Each Basin is a river system or a group of river systems,

(3) If an international boundary crosses a river basin, it is adopted as a Basin boundary.

In Peninsular Malaysia there are 17 inter-state rivers and an international river (the Golock river). Table 9 shows correlation among Basins and States.

In 13 Basins inter-basin water diversion is operated. Table 6 shows the condition of inter-basin water usage at the end of 1980.

EFFECTIVE AREA OF BASIN

Rainfall is classified into effective rainfall and ineffective rainfall. Practically some effective rainfall also can not be used effectively depending on physical and regional conditions.

In this study, an area of a Basin of which surface water can be practically used for the purpose of domestic and industrial water supply and irrigation is defined as 'Effective Area'. That is the Basin catchment is divided into effective area and ineffective area. The border of effective area of the Basin is established based on the following assumptions:

(1) The upstream catchment from the lowest end sites of dams, headworks, barrages or intakes for irrigation, water supply and/or hydropower be effective.

(2) The area of the large scale irrigation schemes of which the return flow can not be used, for example the flow is planned to be directly discharged to the sea, be ineffective.

(3) The area of the drainage schemes of which the return flow can not be used depending on the direction of drainage channels, the location of rivers and the topography be ineffective.

(4) The swamp area of which discharge can not be used because of inadequancy of water quality and/or topographic conditions be ineffective.

(5) If the area is fallen outside the above-mentioned four categories and is located within 5 km along the coastal line, it be ineffective.

Tables 4 and 5 show the effective area, rainfall and natural discharge by Basin. The bourder of effective area is denoted as a broken line (-----) in Figs. 2 to 9.

3. PRESENT CONDITIONS OF WATER RESOURCES FACILITIES

3.1 Number and Records of Existing and Potential Dam Sites

The existing dams and potential dam sites were summarized from previous study reports and papers listed in the references and hearing at related Federal or State Agencies and NEB. Table 7 shows the number of existing and potential dam sites in Peninsular Malaysia. Tables 10 to 51 show the principal feature of dam projects compiled by Basin; river system located, year of completion or plan, purpose, catchment area, reservoir water level, storage volume, reservoir area, type and size of dam, supply capacity of water use, and hydropower capacity. The location of the dams is shown in Figs. 2 - 9. DID and PWD have not established the overall technical records of water related facilities, such as dams and reservoirs, headworks, barrages, weirs, intakes and dikes. The figures filled in these tables therefore are not necessarily exact and involve in a matter of modification. Twenty eight dams and 17 small run-of-river hydropower stations are operated and 11 dams are under construction at the end of 1980. Twenty eight dams were proposed by the study reports to be implemented within 5 to 20 years in the future. One hundred and eleven potential dam sites and 4 small run-of-river hydropower sites were identified by the study reports, and some 40 potential sites are found by the study team.

As for small intake structures, 216 intakes were operated for domestic and industrial water supply in 1978 in the Peninsula. There were 635 irrigation intakes in the Peninsula in 1975.

3.2 Historic Background of Dams in Operation and Under Construction

The Ulu Gombak hydropower station of 800 kW is believed to be the earliest hydropower plant constructed in Malaysia. It was completed in 1905 and supplied the first electricity to the public of Kuala Lumpur, but it was retired. The small hydropower stations (0.5 - 1.0 MW) owned by private companies in Perak State were operated from the beginning of 1900's. The IHT 0.9 MW hydropower station was constructed by the Idris Hydraulic Tin Mine Company around the same time 1905.

In the Basin 13 in Johor State there are three small dams which were constructed around 1920 - 1930 for the domestic water supply to Singapore where Singapore was under the British colonization. The Chenderoh hydropower scheme in the Perak river was completed in 1930 and was the largest low-head hydropower scheme (27 MW) in the 1930's. Several mini hydropower projects were developed from the end of 1950's to the end of 1960's. The Cameron Highland scheme, which is a series of 105.5 MW integrated mini hydropower development, was constructed between 1960 and 1963. The 154.2 MW Batang Padang Hydro-electric scheme was developed from 1964 to 1968.

From the end of 1960's construction of regular size dam was begun. The Pedu dam (60 m high) and the Muda dam (37 m high) were constructed for the Muda irrigation scheme in 1968 and 1969 respectively. The Muda tidal barrage was completed in 1976. The Klang gate concrete gravity arch dam, which aimed to supply domestic water to Kuala Lumpur, was enlarged 3.05 m (10 feet) high for flood mitigation and additional domestic water supply at the end of 1979.

The Temengor rockfill dam is the largest dam in Malaysia at the end of 1980. The height, the volume of the main dam and the active storage volume are 127 m, 7.28 x 10^6 m^3 and 1,270 x 10^6 m^3 respectively. It was constructed for hydropower generation of 348 MW in the Perak river in 1979. The Kenering (41 m high) and the Bersia (32 m high) dams are under construction downstream of Temengor dam in the Perak river and are planned to be completed in 1983. The Kenyir multipurpose dam (Trengganu project) is a 150 m high and 16.5 x 10^6 m^3 rockfill dam which is scheduled to be completed around 1985 - 1985 in the Trengganu river. The active storage volume is 7,400 x 10^6 m^3 and it will be the largest dam in Peninsular Malaysia. It aims primarily at 400 MW hydropower generation and flood mitigation of the Trengganu river.

In the west Johor area, (basins 22 to 24), 5 small flood mitigation and water supply dams are under construction or in tendering stage; that is, Semberong (1983), Bekok (1984), Simpang Kiri (1984), Machap (end 1981) and Layang dams (end 1981).

Table 8 shows the number of different purpose of dam in operation and under construction for each State. In the Peninsular 7 multipurpose dams, 32 single purpose dams and 17 run-of-river hydropower stations are operated and under construction at the end of 1980. These dams are classified in the following six different purpose of water usage:

			Number
(1)	Multi-purpose	; In operation	3
		Under construction	4
(2)	Hydropower	; In operation	3
		Under construction	2
(3)	D/I water supply	; In operation	15
		Under construction	3
(4)	Irrigation	; In operation	6
		Under construction	0
(5)	Flood mitigation	; In operation	0
		Under construction	1
(6)	Drainage	; In operation	1
		Under construction	1
(7)	Run-of-river hydropower	; In operation	17
		Under construction	0
	Total		56

As for the Malaysia Plan concerned, the three major irrigation schemes of Muda, Kembu and Besut were completed under the Second Malaysia Plan (1971 - 1975). The Trans-Perak Stage IV and a number of small irrigation schemes were developed under the Third Malaysia Plan (TMP; 1976 - 1980). The Temenggor hydro-electric project (87 MW) was completed under the TMP. The Tembeling hydro-electric project (110 MW) was on the shelf though it was scheduled in the TMP. The Trengganu river hydro-electric scheme (400 MW) was started under the TMP and will be completed under the Fourth Malaysia Plan (1981 - 1985).

3.3 Proposed Schemes and Potential Dam Sites

About one hundred and forty potential dam sites were identified in the Peninsular Malaysia in the existing study reports. From these 140 sites 28 dams of different purpose have been proposed to be implemented up to 2000 year. Some of these 28 sites will be implemented under the 4 MP or 5 MP. Especially the major hydropower potential sites will be mostly developed up to around 1990.

4. PROBLEMS AND NEEDS

4.1 Problems and Needs in Peninsular Malaysia

The problems and needs in the Peninsular after 1980's, which reflect the rapid progress of the development from the middle 1970's, would rather be classified as a type of urbanized society. These clearly differs from those of the States of Sabah and Sarawak which possess a huge potential water resources.

The interview survey on the present and anticipated problems and needs regarding water resources development was done at the state PWD, DID, water authority and/or district offices from the beginning of October to the middle of December, 1980.

The interview was done for the items listed below. Figure 10 shows mutual correlation among the problems and needs in water resources development. The results are compiled separately for each state in Section 4.2.

(1) Water shortage and induced problems

- (a) Irrigation (DID) V.S. water supply (PWD)
- (b) Hydropower (NEB) V.S. irrigation and water supply
- (c) Problems among residents

(2) Water management

- (a) Agreement (inter-states and inter-agencies)
- (b) Register of water usage and water related facilities
- (c) Water management committees
- (d) Problems associated with multi-purpose development
- (e) Operation and maintenance
- (f) River maintenance flow

(3) Floods and river control

- (a) Flood
- (b) Silting
- (c) Salinity intrusion
- (d) Drought
- (e) Watershed management

(4) Quality of water resources

(a) Acid water

(b) Hard water

(5) Water pollution and environmental impact

(a) Oil palm, rubber and sugar processing

(b) Mining

(c) Pig waste water

(d) Sewage and sewerage systems

(e) Impacts on environment (ecology, fishery, forestry, irrigation and domestic water usages)

(f) Monitoring water quality

(6) Water resources development plans and needs

(a) Surface water

(b) Ground water

(c) Development plans and needs (irrigation, flood mitigation and river control, hydropower, and water supply)

(d) Demand projection

(7) Water saving measures

(a) Intensification of water usage efficiency

(b) Reduction of leakage water

(c) Water recycle use

(d) Cultivation change

(8) Problems associated with project implementation

(a) Land acquisition and resettlement

(b) Compensation cost (land value and resettlement cost)

(c) Society, politics, government

(d) Budgeting

(e) Water rate

(f) Construction cost and materials

(9) Manpower requirement

(a) Quantity of manpower

(b) Qualification of manpower

For the floods, river control and water management, more details are presented in Sectoral Reports RIVER CONDITIONS and WATER RESOURCES POLICY AND MANAGEMENT.

4.2 Results of State Interview Survey

4.2.1 Outline of the interview survey

(1) Water shortage and induced problems

All the States along the west coast of the Peninsula experienced water shortage in some manner. The countermeasure of preventing or lightening the drought damages has been well discussed or studied among the agencies or organizations concerned. The future demand projection, however, seems to be slightly generous. Many officials think of the prospective crisis of water shortage but the concrete way of solution seems to be just on they way. Refer to Tables 52 to 55.

(2) Water management

The need of comprehensive water management is very strong. The inter-state water usage has been well discussed among agencies whenever the need arises. Need of a realistic and effective operation rule of water withdrawal during dry spell is significantly recognized by the officials between irrigation schemes (DID) and schemes of domestic water supply (PWD). The main water consumer of large scale are the irrigation schemes and they have been mostly developed already. The major development of domestic water is planned to start from now. The irrigation intake sites are located in the upstream of a river and the intakes of domestic water are located in the downstream generally. As a result the intakes of the domestic water are hit by water shortage more frequently and severely than those of irrigation. No trouble is reported between NEB and DID except in the Perak River though DID feels dissatisfaction with few contact or information regarding the NEB hydropower development plan. There are several international cooperation plans of water usage among Malaysia, Thailand and Singapore. The purpose is domestic water supply and irrigation. Refer to Tables 52 to 55.

(3) Floods and river control

Everybody recognizes that floods are the most significant disasters in Malaysia, but the damage is generally rather light. Such a large flood which caused death of people was not reported so frequently. Independent flood mitigation plans are generally not so feasible and they are recognized by the officials to be proceeded as multi-purpose development.

(4) *Quality of water resources*

Natural water quality of the Peninsular is generally good. Existtence of severe acid water is reported only in the Batu Pahat and the Benut Rivers in Johor. Hard groundwater is reported in Perlis.

(5) Water pollution and environmental impact

The major pollutant sources are oil palm and rubber processing in the Peninsular. Pollution due to tin mining and sugarcane mills is rather minor. Physical quantity of waste of pig raising is small but religious objection by Moslems is very strong and several conflicts on domestic water and paddy are reported. Industrial pollution other than oil palm, rubber and sugar is reported only at Tikan Batu industrial site in Kadah and it seems to be not so serious at present (1980) but it will be severe in the future.

Need of sewerage system which aims to prevent from breakout of epidemics during dry spell in Alor Setar or flood season in Kota Bharu is reported.

Refer to Tables 56 to 58.

(6) Water resources development plans and needs

The Kota Bharu city (Kelantan) and the Arau city (Perlis) use groundwater for the domestic water supply. Positive need of developing groundwater is not so strong.

Need of developing reliable surface water source for domestic water supply is very large. The main reasons are reported as:

(a) The reliability is high. There is few past experience of using groundwater. The pumping capacity is unknown until the drilling is done.

(b) Groundwater is sometimes hard.

(c) Operation and maintenance cost will be raised in the future due to hike of oil price and wage of O&M staff. The intake sites are distributed and it causes management problems.

(7) Water saving measure

The leakage rate of domestic water supply pipe lines is estimated around 30 - 40%. Improvement measures are studied to reduce the leakage rate to some 20%.

Intensification programs of irrigation canal systems are ongoing. In the area where water shortage is anticipated, possibility of cultivating less water consuming crops has been studied.

(8) Problems associated with implementation

The problems due to land acquisition and resettlement are the largest constraint. The social and political objection is very active and strong in the Peninsular and several development plans are on the shelf. Refer to Tables 59 and 60. Escalation of land value is significant, too. The average escalation rate of land value is reported to be some 30% in 1980. In some projects the land acquisition and resettlement cost are estimated to be more than 50% of the total investment cost. It is recognized by the officials that the development cost of surface water will be escalated significantly in the future.

(9) Manpower requirement

Increase of manpower is strongly requested to the Government concerned especially by PWD. Many staff reported that shortage of manpower was one of the major causes of delaying project implementation. The manpower shortage is also significant in management, operation and maintenance. Necessity of improving the quality of staff was reported, too.

4.2.2 State individual report

Information obtained in the interview made by the study with officials of some state departments and statutory bodies is herein described. The listed opinions, which were made verbally, do not always represent the policy of the organizations concerned, but they are regarded as indications of the major problems and needs recognized by the officials.

PERLIS DID

Water Shortage and Induced Problems

(1) Paddies outside the Muda Scheme are single cropping and then water shortage is not so serious for them. Refer to Ref. 39.

Floods and River Control

(1) There is a port study at Kuala Perlis at the estuary of the Perlis River.

(2) Floods is the biggest natural disaster in Perlis State and therefore is the biggest problem.

(3) The Perlis river inundates part of Kangar city in October or November every year, especially associated with spring high tide. The damage is usually rather light and no injury or death is reported.

There is a study report regarding flood mitigation of the Perlis River. Refer to Ref. 40.

(4) The Arau River is connected with the MADA Canal at the Arau Regulater. In 1979 the Arau river catchment was hit by a flood and the flood flowed into the canal from the river and it was diverted to Kangar city. Then Kangar city was hit by a flood due to this miss-operation of the Arau Regulater when no heavy rainfall was reported in the Perlis River.

Water Pollution and Environmental Impact

(1) The Perlis River was polluted several times during flood spell in recent years by the some 10 tin mine sites located around the bounder between Malaysia and Thailand.

(2) Environmental impact on fish cultivation is reported in Ref. 39.

Water Resources Development Plans and Needs

(1) Timah-Tasoh flood mitigation and irrigation project, which is recommended to be commenced on 1985 in the Kedah-Perlis Water Resources Management Report (Ref. 10), is considered to be viable because the land belongs to the State and the scale of resettlement is rather small. The limestone area around the project site is considered to be a technical constraint.

(2) Need of developing the Perlis river catchment is strongly recognized by the State officials.

PERLIS PWD

Water Shortage and Induced Problems

(1) Water shortage was experienced in dry spell, usually from February to March but it was not so serious than that in Kedah.

Water Management

(1) The domestic water of 5 cusec (0.14 m^3/s) is diverted from the Papang Terap barrage of the MADA Scheme, Kedah to Kangar city. Perlis pays some M$1,000 annually for this water usage to Kedah.

(2) Financially the balance of revenue and expenditure of domestic water supply is bad.

In FY 1979, domestic water of 3.7 MGD (16.8×10^3 m^3/d: 2.5 MGD from surface and 1.2 MGD from underground) was produced. The expenditure was M$1.5 million and the revenue was M$0.7 million (46% of the expenditure). The PWD tried to raise the water rate

by 40%, but it was rejected by the Government politically. The present water rate is M$1.0 - M$2.0/1,000 gallons (4.55 m^3) depending on purpose of user.

Quality of Water Resources

(1) Groundwater is pumped and used in Arau city, but it is very hard water due to limestone. The hard water is mixed with soft water and distributed to the area other than Kangar city. Softening of hard water is very costly.

(2) The spring at Batu Pahat is soft water which is originated from surface water.

Water Pollution and Environmental Impact

(1) There are two estates of sugarcane plantation in the northern part of Perlis River, each 10,000 acres (4,050 ha), but no pollution was experienced for the domestic water supply.

(2) Development of sugarcane plantation causes floods.

(3) Cholera broke out from 1977 to 1978. It usually occurs during dry spell. It is not clear whether the cause of disease was brought by well water or piped water. There is no organized sewerage system at present but it must be necessary.

Water Resources Development Plans and Needs

(1) The supply quantity of 1980 domestic water is 4.3 MGD (19.6 x 10^3 m^3/d); surface water 2.9 MGD and groundwater 1.4 MGD. Expansion of the capacity of treatment plants is requested by PWD to the Government from 2.5 MGD to 5.0 MGD in the 4 MP.

(2) There is one water diversion plan from Thailand which was contacted unofficially; 5 - 10 MGD (22.7 - 45.5 x 10^3 m^3/d) clean gravity water (no treatment is required) from the Reben Lake to Kangar. This project can be combined with the road construction plan to Thailand. This is proposed to the PWD Headquarters.

(3) Industrial water demand, which is from cement and sugarcane factories, is negligible; less than 5% of the total demand.

(4) There are two kind of aquifer regarding quality of groundwater in Perlis. The main aquifer in Arau city produces hard water, but the aquifer around sugarcane estates near the Thailand border line produces soft water.

(5) 250 production tubewells for rural water supply are planned to be drilled in Kedah and Perlis from January 1981 to end of 1982 based on the recommendation by the Kedah-Perlis Water Management

Study (1980). 50 wells have been planned near the pipe line system in order to use them for supplying water in dry spell in Perlis. Refer to Ref. 41.

(6) The Perlis PWD was discouraged by the results of the test wells, which were done by the Kedah-Perlis Water Management Study. The estimation by the French consultant was optimistic. The potential of groundwater is considered to be not reliable by the officials. The PWD needs guarantee for quality of groundwater. As a result the PWD needs alternative reliable surface water source. There is a possibility to get additional water for the future demand from MADA.

Water Saving Measures

(1) The rate of leakage including illegal usage is 40% at present (1980). Improvement measures of reducing leakage are planned by the Federal grant.

There is a possibility that the public hydrants are opened and water is stolen for paddy during dry spell.

Problems Associated with Implementation

(1) Geology in Perlis is generally limestone.

(2) Land acquisition is extremely difficult because of shortage of land in Perlis.

KEDAH DID

Water Shortage and Induced Problems

(1) Three consecutive driest years have been experienced in 1977, 1978 and 1979. The return-period is estimated to be once in 30 years.

From a statistical analysis over a period of 27 years (1953 - 1979), 1963 is the driest year for the Muda-Pedu whole system (once in 30 - 50 years) and 1968 is the driest year at Jeniang in Muda River (once in 50 years). Refer to Ref. 10.

Water Management

(1) The agreement between Kedah & Pulau Pinang to meet the future (2000 year) domestic water demand has not been signed yet, and it is still in negotiation under ADB. The projected minimum water withdrawal in 2000 from the Muda River to Pinang is 100 - 120 MGD (455 - 546 x 10^3 m^3/d; 5.3 - 6.4 m^3/S), (Ref. 14).

(2) Need of making a time scheduling of water withdrawal in dry spell from the Muda River is recognized by the officials.

(3) Agreement on water charge in MADA Scheme: M$15/acre/year for double cropping.

(4) The top priority of development or water usage is domestic water supply and the second is hydropower, infrastructures or agriculture.

(5) Royalty of getting earth or aggregates in Kedah is: latherite M$0.5/cuyd, two inch aggregate M$1.25/cuyd and coarse aggregate M$1.05/cuyd. No royalty is required in Pulau Pinang.

Floods and River Control

(1) Silting is observed in the Kedah River.

(2) Most floods of Alor Star city have been originated from the Kedah River.

Water Pollution and Environmental Impact

(1) Sewage from towns and industry to the Merbok River was reported, especially pollutants were leaked from Yasuda battery and others into paddy at Tikan Batu industrial site.

(2) The officials recognize need of environmental study on a development plan of brakish water fish cultivation (projected aquiculture is 5,000 ha) in the Merbok River. Refer to Ref. 43. The Muda River and the Merbok River are connected.

(3) There are rubber processing factories in the Merbok River and there is only a sugar factory (Pdg. Sanai Sugar Mill) in the Anning River.

(4) Alor Star drainage and sewerage system was studied by JICA.

Water Resources Development Plans and Needs

(1) There is a development plan of brakish water fish cultivation in the Merbok River (Ref. 43). The projected aquiculture is 5,000 ha.

(2) There is a storage proposal near Tikam Batu in the Merbok River.

(3) There is a proposal of construction of a barrage, jointed with a highway bridge proposal, in the Merbok River. The need of study of environmental impact due to the barrage construction is recognized by the officials.

(4) New development projects is presented in 4 MP.

(5) The improvement plans on the existing small structures including intakes were reported in Ref. 39.

(6) Usage of groundwater is not economic for irrigation.

Water Saving Measures

(1) Cultivation of the crops of low water consumption (i.e. tobacco, onions, maize) is suggested in Ref. 39.

KEDAH STATE PWD

Quality of Water Resources

(1) No water quality problems.

Water Pollution and Environmental Impact

(1) There is one sugar processing factory, Pdg. Sanai Sugar mill in the Anning River.

Water Resources Development Plans and Needs

(1) Detailed activity charts (Time schedule) was requested for Kedah-Perlis Water Management Study (Ref. 10) from the official (1980).

(2) 200 production tube wells for rural water supply (out of 250 wells) are planned to be drilled in Kedah from Janaury 1981 to end of 1982. Refer to Appendix 2 Hydrogeological Data of Ref. 10.

(3) All the development plans in Kedah are discussed in Kedah-Perlis Water Management Study (Ref. 10).

(4) Consumption of domestic water is 40 gallons (0.182 m^3)/person/day in Kedah at present (1980).

Water Saving Measures

(1) The rate of leakage including illegal usage is about 40% at present (1980).

PULAU PINANG DID

Water Management

(1) The Federal Government has considered that the normal annual operation and maintenance cost for the barrage, causeway, deviation road and drainage and irrigation works should be the responsibility of the State government.

Floods and River Control

(1) There are evidences of blockage of river mouth. The annual silting in the Perai River, after the Perai barrage is constructed (around 1981), was estimated to be 130,000 cuyd (99,450 m^3) by Japanese consultants (in relation to the JICA study of 1969). Silting is observed in the Pinang River.

(2) The Pinang River is the only major flood source, but it is not so serious. Flood occurs mostly every year and it is withdrawn within 5 or 6 hours. As the housing development in the upstream of the river around the Ayer Item area progresses the floods are becoming larger and occur more frequent. Some records are available for the flood occurred on September 29th, 1980. A feasibility study on the drainage and river improvement for the Pinang river is proposed for the 4 MP. The actual works will be governed by the municipal council.

(3) There occur minor floods at Bagan Jermal in the Bahi River and in the Ara River.

(4) No flood warning system is installed in Pinang because the arrival time of flood is very short and a warning system is not effective in this area.

(5) There is inland navigation from the estury to the Perai barrage site in the Perai River.

Water Pollution and Environmental Impact

(1) A master plan for sewerage and drainage system of Butterworth and Bukit Mertajam Metropolitan area was done by JICA in 1978 (Ref. 44).

(2) The plan to establish a pig raising reserve area at the downstream of the Jawi River is on the shelf because of the objection from fishery people.

Water Resources Development Plans and Needs

(1) There is a plan to connect the Ara River with the Relau River by a canal for flood mitigation.

(2) There is a DID project in the Bayan Lepas River.

(3) The feasibility study on the Juru Dam (gate structure) in the Rambai River is proposed to the DID Headquarters. In an area of the Rambai River catchment area paddy has been converted to be housing area and accordingly drainage is necessary.

PINANG WATER AUTHORITY (PWA)

Water Management

(1) The domestic water of 14 MGD (63.7 x 10^3 m^3/day; 0.74 m^3/s) is diverted from Butterworth to Pinang island by twin 30" (76.2 cm) submarine pipelines at present (1980). The total consumption of the domestic water in Pinang State is 60 MGD (273 x 10^3 m^3/day; 3.2 m^3/s): 32 MGD (1.69 m^3/s) in Pinang island 28 MGD (1.48 m^3/s) in Butterworth area. 30 MGD (1.58 m^3/s) is withdrawn from the Muda River for Pinang State at present: 14 MGD to Pinang island and 16 MGD to Butterworth area.

(2) If the agreement on the withdrawal of the domestic water supply from the Muda River is made between Pulau Pinang and Kedah successfully the maximum withdrawal of 100 - 120 MGD (5.27 - 6.32 m^3/s) will meet the projected 2000-year demand of domestic water in Pinang State (Ref. 14).

(3) The Ayer Itam Dam, which was constructed in the upstream of the Pinang River in the Pinang island in 1962 for domestic water supply and hydropower generation, and its hydropower station belongs to PWA and PWA sells the electric power (400 kW, installed capacity 800 kW) to NEB.

Quality of Water Resources

(1) Water quality in Pinang island is very good.

Water Resources Development Plans and Needs

(1) No exploitation of underground water is planned.

(2) No development plan except the Mengkuang Dam in the Mengkuang River which is under construction. Refer to Ref. 14.

Problems Associated with Implementation

(1) The compensation value for the land acquisition of the Sungai Mengkuang water supply project has not been determined.

PERAK DID

Water Shortage and Induced Problems

(1) There is no problem regarding water usage between PWD and DID.

(2) There is a problem due to water shortage in dry spell in the Perak River between NEB and DID (Refer to Water Management).

(3) Water shortage was experienced in dry spell in 1977 at Kerian Irrigation Scheme.

Water Management

(1) The agreement which was made in 1976 between NEB and DID regarding the river maintenance flow is not fulfilled by NEB during drought season. The second cropping season, therefore, is hit by water shortage. The Temengor and Chenderoh reservoirs should be operated to keep the minimum maintenance discharge of 4,000 cusec (113.2 m^3/s) at Iskandar Bridge in the Perak River through the year according to the agreement.

(2) The requirement of the minimum river maintenance discharge is determined based on (a) the quantity of water withdrawal and (b) the minimum water level for intakes or pumping.

(3) Since 1964 water from the Plau'ur River (catchment area; 6 km^2) in Kelantan has been diverted into Pahang State for combined use with the waters of the Telom, Kial and Kodol Rivers in Pahang for the Cameron Highlands Hydro-Electric Scheme, which was completed in 1963. As from November 1963, flow from the Ringlet Reservoir in the Bertam River in Pahang has been diverted through a series of tunnels into the Batang Pahang River in Perak. The average discharge released through the Jor Tailrace in Perak was 725,000 m^3/day (8.39 m^3/s). See Ref. 48.

(4) Water diversion from Perak to Kedah has not been requested from Kedah State to Perak State yet.

Floods and River Control

(1) Flood control is a significant need.

Quality of Water Resources

(1) For use of irrigation water, no problem is observed.

Water Pollution and Environmental Impact

(1) Tin mining is the major source of water pollution.

(2) Mining ponds are used for reservoir of pig sewage and flood regulation ponds. The pig sewage therefore is not serious.

(3) Water pollution due to oil palm processing is serious. The primary industries of the Perak State are rubber and mining. Agriculture (paddy) is subordinate.

Water Resources Development Plans and Needs

(1) There is a potential dam site in the Pelus River. The aim is water supply to Ipoh and flood mitigation. The maximum discharge of about 14,000 cusec (396 m^3/s) was observed at Kampong. Lintang of the Pelus River (See Ref. 49).

(2) There is a potential dam site in the Kinta River. The purpose is water supply to Ipoh and flood mitigation. A feasibility study was done by PWD with a local consultant and the study result was concluded to be no feasibility. DID, however, doubts about the conclusion because the operation cost of small intakes including pumping energy and manpower will be significantly increased.

PERAK PWD

Water Management

(1) Irrigation water demand and domestic water supply demand concurred several times in dry spell in Taiping area and Sungai Bernam area. That is supply quantity to these areas is very tight.

SELANGOR WATER WORKS (SWW)

Water Shortage and Induced Problems

(1) For three years in succession from 1976 to 1978 the Klang Valley area was suffered from water shortage during the dry months. Drought conditions of the return period of once in 60 years were experienced.

Water Management

(1) It is generally considered among officials that the priority of new development is higher than that of operation and maintenance. Manpower is generally concentrated to new development. The shortage of manpower therefore is more serious at work of operation and maintenance.

(2) The total length of the water supply pipe lines of the Selangor State is over 3,350 miles, and therefore maintenance of preventing water leakage is very difficult.

(3) Inhabitants often open the public hydraulant and use water illegally.

Water Resources Development Plans and Needs

(1) Ground water potential seems to be doubtful.

(2) There is a development plan for the new water source for domestic and industrial water supply in the Selangor River.

(3) The demand projection of industrial water is generally very difficult. The applied water use quantity from factories to SWW is generally small at first but water use is often increased timely depending on production rate. Identification of water intensive factories is also very difficult.

(4) The Sungai Benus Scheme (water supply) is proposed to be operated by the end of 1981. Water of 6 MGD (0.32 m^3/s) is pumped about 900 feet (275 m) in two stages from the Benus River in Pahang and gravitates along the Penulas River to the reservoir of the Klang Gate Dam.

Problems Associated with Project Implementation

(1) Shortage of manpower is one of the obstacles against project implementation.

(2) Policy of the Government is often changed.

Manpower Requirement

(1) Shortage of manpower is one of the main obstacles against not only project implementation but also operation and maintenance of water supply facilities. Only about 10 engineers work for 160 MGD water supply in the State.

(2) The ratio of the senior engineer whose experience is more than 20 years is only 15%.

DISTRICT OFFICE GOMBAK, SELANGOR

Water Pollution and Environmental Impact

(1) The official thinks that the Environmental Conservation (or Quality) Act is too old and does not meet the actual conditions at present (1980). For example, the maximum penalty of M$50 is not effective to prevent from releasing pollutants.

(2) Change of vegetation by land development causes floods and drought especially in the Klang River basin.

(3) Waste water from pig raising is objected by the Moslems in the Sepang and Pang rivers and in the Gombak district. They never drink water polluted by pig waste even if it is purified by treatment plants. Only natural purification can be accepted, and therefore there is no way but disposal to the sea. Pigs of 215,500 heads are raised in Selangor and the total waste water is estimated to be 674 ton/day. See Ref. 51.

Water Resources Development Plans and Needs

(1) The official recognized need to study the treatment of pig waste.

(2) The official recognizes need to study the possibility of water usage from mining ponds.

Problems Associated with Implementation

(1) Political organization should be taken into consideration in project implementation.

Organization under the new act of 1979:

(a) Municipality

(b) City council (minimum unit)

(c) District council

There were town board and local council under the old Act.

(2) The Gombak water supply dam projeft is on the shelf because of strong objection of land acquisition and resettlement.

(3) Generally the old generation objects to the development and the young generation agrees with the development.

Information Regarding Land Acquisition

(1) Lands can be classified into four categories as follows:

(a) Private and commercial land: It can be acquired by money following the standard valuation principles.

(b) Malay reserve area: It is protected by the Malay Reservation Act and can not be acquired by money. New alternative land is necessarily required to replace with the equal size land.

The customary land, which is owned by a mother and is the same custom as Sumatra Island of Indonesia, can not be acquired by money. It can be considered to be a kind of customary land. There are customary lands in Melaka and Negeri Sembilan.

The land owned by Sultan also can not be acquired by money.

(c) Federal land: The mining land belongs to the Federal land. The mining land is leased to the developer by the Federal. For acquisition of the land for other purpose the developer should surrender or it should be waited until expiration of the lease period.

(d) State land: No compensation is required if concrete and reliable benefit can be attained by the State concerned. The compensation cost for the state land is generally much cheaper than the standard market value.

(2) Principle of money solution is as follows:

(a) Pay by cash

(b) Standard valuation principle: It should be evaluated by the standard market value. See Ref. 36.

(c) Pay by replacement value: It includes replanting cost of vegetations and additional cost of assisting and improving life standard.

(3) Laws concerned

(a) Land Acquisition Act: It does not include mining land.

(b) Malay Reservation (Land) Act

(4) Agencies or organizations concerned

(a) Ministry of Land, Ministry of Finance (standard valuation principles) and Evaluation Office Calculaters (detailed information of land value)

(b) Department of Land: The District Offices carry out the actual work for the department.

(c) Survey Department: The land value can be obtained from here except Pulau Pinang.

(d) State Commissioner of Land and Mine

NEGERI SEMBILAN DID

Water Management

(1) There is no agreement with co-basin States regarding the water usage of interstate rivers for the time being.

(2) There is a case of water shortage arised from the Felda development.

(3) It is necessary to change paddies to the other non-water consuming farm products in order to decrease water consumption especially at small tributaries.

Floods and River Control

(1) There is neither existing dam nor tidal barrage in the State, but there are about 110 small intakes and one middle size intake in Sungai Muar II.

(2) There are 11 small tidal bunds (about 2 m high) for drainage systems. The crest elevation of the bund is approximately 10 feet:

Mean Sea Level + 7.5 feet (high tide) + 1.5 feet (free board) + 1 foot (extra-embankment)

Water Pollution and Environmental Impact

(1) It is necessary to develop measures to produce gas from faces of pig raising.

(2) In the Sepang River there are problems regarding brakish water and smell from oil palm processing water in Selangor State but not inside Negeri Sembilan.

Problems Associated with Project Implementation

(1) There are customary Lands in the following two areas: one in Rembau district, and the other in Kuala Pilah and Jelebu districts. The customary Lands are not acquired for irrigation

schemes but approval of land usage is obtained and houses and trees are compensated.

NEGERI SEMBILAN PWD

Water Management

(1) Multi-purpose dam projects will cause conflict in small rivers.

(2) All pig raising in the Negeri Sembilan is tried to be gathered into the designated area, Bukit Pelandok of Port Dickson district.

(3) There is a trouble regarding water usage at Pantai headworks between DID and PWD especially during dry spell.

Quality of Water Resources

(1) There is no problem regarding water quality of surface and ground water at present.

Water Resources Development Plans and Needs

(1) Port Dickson is the only district where no treatment plant is installed.

(2) New water source costs are very expensive: for example, M$1.1 for 1,000 MGD in Sungai Linggi. It was 5 cents for 1,000 MGD in Pantai and Seremban districts several years ago.

(3) There are two cool potential resort areas in Ulu Keiawang and Tampin.

Problems Associated with Project Implementation

(1) There occurred no problem regarding land acquisition in the Terip Dam Project. The project area is composed of few oil palm and mining areas and pasture land for cattles.

MELAKA DID

Water Management

(1) A steering committee was established between Johor and Melaka for monitoring the World Bank project of canalization of the Kesang River. It will be dissolved after the project, within 5 years from now.

(2) No documentary agreement is made among related agencies on the priority of water usage during drought spell, but the first priority of the domestic water supply is a habitual understanding among agencies.

Water Pollution and Environmental Impact

(1) There are three pig raising area; Paya Menkuang in the Tuang river, Sungai Udan and Kanpong Kuda. There is a problem in Sungai Udan.

(2) Rubber processing factories are the major pollutant source in the Melaka River.

Water Resources Development Plans and Needs

(1) No new development of irrigation scheme will be planned in Melaka.

MELAKA WATER AUTHORITY (LAM)

Water Management

(1) At present (1980), there is no coordination body for planning between DID and LAM, and therefore problems regarding water shortage occurs during dry spell.

(2) There is no agreement among co-basin States on the usage of the interstate rivers at present.

(3) The compensation flow of 10 MGD (45.5×10^3 m^3/d; 10.527 m^3/s) from the Durian Tunggal reservoir was set at the planning stage but after the dam construction it has not been maintained. The officials think that no problem will be occurred concerning the maintenance flow for the time being.

(4) Water of 1.0 MGD (0.053 m^3/s) is diverted from Johor, the Asahan Dam which constructed in 1930 in the Gemas river.

(5) The officials think that interstate water diversion will be required after 1985. Water diversion from the Muar river at the intake near Gerisek is considered as one of alternatives. EPU Muar River Basin Study is ongoing.

Quality of Water Resources

(1) Water quality is good, pH 6.5 - 6.8. Acid water was experienced in some intakes in coastal area, but the intakes are not used now.

Water Pollution and Environmental Impact

(1) There is no intake site near the area of pig raising and therefore there is no problem.

Water Resources Development Plans and Needs

(1) The officials think that development of new water source will be required after 1985 because the supply capacity of the Durian Tunggal Scheme was planned to meet the demand before 1985.

(2) There is no plan of developing ground water because the potential is considered to be small.

(3) The domestic water demand of Melaka is estimated as: 35 MGD (1.84 m^3/s) for 1985, 45 MGD (2.37 m^3/s) for 1990 and 65 MGD (3.43 m^3/s) for 2000.

Problems Associated with Implementation

(1) Water rate is decided politically and is independent on expenditure and revenue. The water rate differs depending on quantity and purpose of user.

(2) In 1980 the annual deficit will be M$3.0 million.

Expenditure in 1980	
Operation cost	M$1.45/1,000 gallons (4.55 m^3)
Loan and capital cost	M$0.82/1,000 gallons
Additional cost	M$0.10/1,000 gallons
Total expenditure	M$2.37/1,000 gallons
Revenue in 1980	M$1.75/1,000 gallons
Deficit in 1980	M$0.62/1,000 gallons

(3) Raw water cost is normally M$3.0/1,000 gallons in Singapore.

JOHOR DID AND PWD

Water Shortage and Induced Problem

(1) The suburbs of the Muar city to Batu Pahat along the coast is provided with the pipelines of domestic water supply, but PWD often stops water supply and mobilizes water tank trucks for inhabitants during dry spell. The condition is getting severe recently for the residents. (from the interview of inhabitants)

Water Management

(1) Johor PWD buys water from Negeri Sembilan, Melaka and Pahang to supply domestic water to the towns located around the state boundary.

(2) Johor PWD sends domestic water to Singapore Public Utilities Board (the former Singapore Municipality Council) through the causeway in Selat Johor.

10 MGD (4.55×10^3 m^3/d; 0.53 m^3/s) is sent from three reservoirs: Pontian Kechil (built under the British colonization) in the Pontian Kechil River, Gunong Pulai (built 1927) in the Pulai River and Pulai III (built Pre-World War II) in the Pulai River.

(3) There is an agreement on the present and future domestic water supply between Johor PWD and Singapore Public Utilities Board.

(4) The PWD tried to promote the management but failed because of manpower shortage. In this connection, Johor PWD hope the National Water Resources a useful recommendation.

(5) Two management committees have been established for the Muar River by Johor and Negeri Sembilan: Joint Consultative Committee (for policy making) and Joint Management Committee (for technical matters). However no agreement has been made at present (1980). It will be required in the near future.

(6) The dams and reservoirs are not used for recreational purpose because all the domestic water supply facilities (dams, reservoirs, intakes, pumping stations, gated stations) are designated to be the security area and are not opened for the public. Flood mitigation dams and reservoirs may be used for recreational purpose in the future.

Floods and River Control

(1) Flood is the biggest problem in the monsoon rain season.

(2) Salinity intrusion is not serious except the spell of high tide or drought.

Quality of Water Resources

(1) Water quality of the Batu Pahat River (Basin 22) and the Benut River (Basin 23) is sulphate acid (pH 4-6). These are flooding area and peaty soil produces sulphate acid reacted by sunlight. Treatment is required for domestic usage.

Water Pollution and Environmental Impact

(1) A water project including a barrage in the Terbau River was gave up because of severe water pollution.

Water Resources Development Plans and Needs

(1) There is no hydropower project in Johor.

(2) There is a potential recreational site in the Endau River. There are water falls, which are 5 - 6 feet high, and boulders at Kua in the Jasin River. Speed boats can be accessible to the sites during the high tide.

(3) The peak domestic water demand is 2 - 3 times of the average. The target design reservoir capacity is the average one day supply quantity, but usually the capacity is planned to be 0.5 - 1.0 day water demand at present.

(4) The average water development cost including administration in Johor (1980) is 25 cents/m^3 (M$1.01 - 1.02/1,000 gallons).

Problems Associated with Implementation

(1) The order of land acquisition or frozen is made to the district officer concerned by the state headquarters after the decision of project commencement. However, the officers sometimes forget to freeze the land because of too much work, and as a result the project can not be proceeded. Such problems were often reported.

(2) The Johor Bahru urban development plan was on the shelf because it was obstructed strongly by the inhabitants and politicians. In this case the negotiation of the implementation was commenced after the project plan was completely finalized. However, the negotiation with the residents and politicians should have been started at the beginning of the basic planning.

Manpower Requirement

(1) Increase of the PWD staff, both engineers and staff of operation and maintenance has been strongly requested to the headquarters every year, but it has been failed.

SINGAPORE PUBLIC UTILITIES BOARD

Water Management

(1) Johor River Water Agreement was made on 29 September, 1962 between the Government of the State of Johor (the Johor State)

and the City Council of the State of Singapore (the City Council). The content of the agreement is 'The full and exclusive right and liberty to draw off, take impound and use the water from the Johor River by the Council up to 250 MGD (1.14×10^6 m^3/d; 13.8 m^3/s) for 99 years'.

(2) 'Tebrau and Scudai Rivers (Water Agreement)' was made on 1 September, 1961, between the Johor State and the City Council for the rivers, Gunong Pulai, Sungei Tebrau and Sungei Scudai for 50 years.

The City Council shall pay to the Johor State an annual rental of $5/per acre.

The agreement stipulated 'The right to lay relay repair and maintain pipelines have the sole and absolute right to draw off and take all the water available in under or upon any part of the said land'.

PAHANG DID AND PWD

Water Shortage and Induced Problems

(1) No water shortage was experienced.

Water Management

(1) There is no problem at present (1980) but neither information nor chance of discussion regarding hydropower development projects were provided by NEB to the State until the project commencement.

Floods and River Control

(1) Flooding is the major problem.

(2) A flood forecasting system is installed in the Pahang river basin. Rainfall and water level in the basin within 24 hours are projected using the computer system in the DID Head-quarters, Kuala Lumpur. The accuracy of the projected water level is not necessarily enough, but projection of flood occurrence is reliable.

(3) Salinity intrusion was experienced in the Pahang, Romping, Kuantan and Bebar (6 miles from the estuary) rivers.

Quality of Water Resources

(1) Acid water is found in the Endau-Rompin area, but it is minor.

Water Pollution and Environmental Impact

(1) Oil palm processing is a pollutant source in Kuantan river.

Water Resources Development Plans and Needs

(1) In Daerah Temerloh Scheme water shortage is anticipated because the water source is far from the project site.

(2) Quantity of ground water is considered to be minor and therefore it is not taken into account for an irrigation water source. However, if the potential is high, the rain-fed paddy can be improved from single cropping to double cropping.

(3) The state officials have not obtained information from H.Q. DID regarding viability of the feasibility study of the Sungai Dayang Recreational Reservoir Project (1974). See Ref. 4.

(4) The PWD single purpose anti-salinity barrage project in the Kuantan river was decided to promote, and it is in the stage of detailed design. In the Kuantan Salinity Study (1978) compensation water and barrage construction were compared. See Ref. 3.

PAHANG TENGGARA DEVELOPMENT AUTHORITY (DARA)

Water Management

(1) The legal system and management of DARA project is very controversial. DARA belongs to the Federal. Refer to Ref. 2. The final report will be issued at the end of November 1980.

Water Pollution and Environmental Impact

(1) Pollution control of oil palm processing is required and the minimum compensation discharge is discussed in the Pahang Tenggara Report (1980). See Ref. 2.

Water Resources Development Plans and Needs

(1) In the project area no single purpose dam will be required before 2000 year. The water supply capacity will be enough up to the year. The Jeram multi-purpose dam, which is composed of the Endau-Rompin irrigation project, mini-hydropower and domestic water supply to the seven schemes for the towns in Pahang Tenggara, is prepared for the need after 2000 year. The project implementation will be decided by the steering committee based on the conclusion of the final report.

(2) The proposed dam and reservoir area has already been frozen for the coming year. No land acquisition problem is experienced; because jungle area and state land costed very minor compensation cost.

TRENGGANU DID

Quality of Water Resources

(1) There is no water quality problem because water which contains salinity more than 1,000 ppm is not used for irrigation.

Problems Associated with Implementation

(1) Land acquisition is the only social problem.

(2) Large elevation change due to topography becomes a technical constraint for plan and implementation of irrigation canal schemes.

TRENGGANU PWD

Water Resources Development Plans and Needs

(1) There is no dam for domestic water supply and no need will be prospected in the near future, too.

(2) Industrial water might be required for the Chukai industrial development. See Ref. 50.

(3) Exploitation of ground water for Kuala Trengganu city is under planning because salinity intrusion occurs during drought spell (in Trengganu River).

KELANTAN DID

Water Management

(1) There is a Malaysia-Thailand cooperation agricultural project in the Golok River (Ref. 46).

Water Resources Development Plans and Needs

(1) There is a integrated rural development project in Kemasin-Semerak area.

(2) Need of the Dabong (Galas) multi-purpose dam project (flood mitigation, hydropower and irrigation) in the Kelantan River is considered to be very high by the officials.

Problems Associated with Implementation

(1) The Dabong project is on the shelf due to strong objections by residents in the reservoir area and politicians. However, the Dabong Project will be viable in the near future because the dam is necessary for the development of Kelantan State.

(2) All or most of the land in Kelantan State is Malay reserve.

KELANTAN PWD

Water Shortage and Induced Problems

(1) Shortage of domestic water supply was experienced at five schemes.

Quality of Water Resources

(1) Quality of deep well groundwater is not necessarily good. The aquifer of deep wells might be connected to the sea.

Water Pollution and Environmental Impact

(1) Present shallow wells might be polluted by surface pollutant source in the future.

(2) A sewerage system will be recommended by "Kota Bharu Urban Development Study", which will be finalized in the middle of 1981, because there is a possibility of breakout of epidemics during flood season.

Water Resources Development Plans and Needs

(1) There is no water supply dams at present (1980).

(2) Capacity of groundwater supply will not meet the demand of domestic water after 1990. Refer to Ref. 45.

(3) Development of reliable surface water is required for Kota Bharu because the reliability of the groundwater will be doubtful in the future.

(4) Usage of groundwater is limited for the area of Tumat and Kota Bharu.

(5) Schemes of domestic water supply under construction (1980).

(a) Tanah Merah/Machang; capacity 4.5 MGD (0.24 m^3/s), intake in the Kelantan River.

(b) Pasir Putih; capacity 1.67 MGD (0.09 m^3/s), intake in the Rasau River.

(c) Pasir Mas; capacity 2.4 MGD (0.13 m^3/s), intake in the Kelantan River.

(d) Gua Musang; capacity 0.6 MGD (0.03 m^3/s), intake in the Galas River.

(6) The Kuala Krai scheme is proposed for the 4 MP: capacity of phase I 2.5 MGD (0.13 m^3/s), intake in the Lebir River.

Problems Associated with Implementation

(1) Water rate in Kelantan is fixed as: domestic water M$1.0/1,000 gallons (4.55 m^3) and industrial and commercial M$1.5/1,000 gallons.

5. CONSTRUCTION COST SURVEY

5.1 Data on Price of Principal Construction Materials

Construction cost was surveyed in Peninsular Malaysia from September 1981 to December 1981 and the following data was obtained:

(1) The schedule of rate prepared by PWD for small works which do not exceed M$25,000; issues of 1973, 1975, 1977, 1979 and 1980 (Ref. 37).

(2) The average monthly wholesale prices of steel, cement, diesoline, fuel oil and bitumen prepared by the Department of Statistics; issues from January 1975 to December 1980 (Ref. 38).

(3) Rate of road construction (1980); verbal information obtained from the PWD Contract Officers.

(4) Rate of excavation, reinforced concrete and reinforcement bars (1980); verbal information obtained from the PWD Contract Officers.

(5) Rate of the West Johor Project (1978 - 1979): restricted information from DID.

5.2 Price Escalation Trend

The consumer price indices of Malaysia are shown in Fig. 11 (1970 = 100 for a group and 1975 = 100 for another). In the Peninsula the consumer price was raised by 78% in 10 years from 1970 to 1980 and by 26% in 5 years from 1975 to 1980 (Ref. 35). The average annual escalation rate is estimated to be about 4.8% in these five years.

Table 61 shows the average monthly whole sale prices and price indices (1975 = 100) of mild steel round bars and ordinary portland cement at Kuala Lumpur from January 1975 to December 1980. The indices are raised by 23 - 55% in the five years, but these were constant from January 1975 to January 1979. These were actually raised in two years from 1979 to 1980. The trend of the prices of these items in the schedule of rate of PWD's small works is similar to that of the wholesale prices. Figure 12 and Table 62 show the price indices of labours and major construction materials, such as skilled and unskilled labours, aggregates, cement and steel bars (Ref. 37). The rates of public works were controlled to be constant from 1975 to 1978, but they suddenly raised by 55 - 75% from the beginning of 1979 to 1980. The nominal simple average price index is estimated to be about 160 at the beginning of 1980 if it is 100 at the beginning of 1975. The annual escalation rate of nominal simple average is about 10% from 1975 to 1980. Very severe escalation was experienced in Peninsular Malaysia after the second oil shock in two years from the beginning of 1979 to 1980. The annual escalation rate of nominal average is estimated to be about 26 - 27% in these two years.

The price index of water and power construction cost in the United States of America is 147 in January 1980 if it is 100 in January 1975. The average annual escalation rate is estimated to be 8% in the past consecutive five years (Ref. 42).

Accordingly the escalation of labour cost and material cost is regarded to be slightly larger in Peninsular Malaysia than that of the international trend in five years from 1975.

Annual escalation rate of construction cost is approximately estimated as follows:

(1)	Foreign portion	6 - 10%/year	1975 - 1980
(2)	Domestic portion	8 - 10%/year	1975 - 1980
		15 - 25%/year	beginning 1979 - end 1980

5.3 Compensation Cost

The problems due to land acquisition and resettlement have been very significant according to the state interview survey. Not only the social and political objection to the development and resettlement is strong but also escalation of land value, which was induced by development, is very severe. The average escalation rate of land value is reported to be about 30% in the Peninsula in 1980 (Ref. 36). It is not seldom that the land acquisition and resettlement cost accounts more than 50% of the total investment cost.

The lands should be compensated by the replacement value based on the standard valuation principle (i.e. the standard market value) according to the Land Acquisition Act. Tables 63 to 65 show the standard land market value and classification for each state issued by the Ministry of Finance in 1979 (Ref. 36). Several actual results of land acquisition were also obtained from the Kedah, P. Pinang, Melaka and Johor States as shown in Table 66.

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