The industrial areas in the states of Kedah and Pulau Pinang were projected in the Study as described in SECTOR V, WATERSHED MANAGEMENT AND MONITORING PLAN. Based on this projection, the projected industrial area as well as industrial demand is estimated.

3.1.5 Projected Domestic and Industrial Water Demand

By integrating all items mentioned above, the total domestic and industrial water demand in each scheme is projected as shown in Table III.3.1.6 and Table III.3.1.7. It is shown from these two tables that the domestic/industrial demand will be about 1,300 million liters/day from the Muda river basin and about 400 million liters/day from the Kedah river basin in 2010 and thus the total demand will be doubled.

3.2 Irrigation Water Demand

3.2.1 Methodology

In the Study, the daily irrigation water demand is estimated by the formulas given below. Details of the premises, as well as factors used in the formulas, are described in the succeeding sections.

$$\textit{Gross Demand} = DS(t) - DS(t-1) + ET(t) + P(t) + DR(t)$$

$$\textit{Net Demand} = \textit{Gross Demand} - R(t)$$

$$\textit{Demand from River} = (\textit{Net Demand}) / IF$$

Where,

DS(t)	:	Standing water depth in the field including soil saturation on day "t". *[DS(t) - DS(t-1)* herein represents the water depth stored in the field from day "t-1" to "t".]
R(t)	:	Rainfall depth
ET(t)	:	Evapotranspiration
P(t)	:	Percolation
DR(t)	:	Discharge drained from the field
IF	:	Irrigation losses (consisting of conveyance/diversion losses and field distribution losses).

3.2.2 Irrigation Area and Farming Activities

There exist two (2) main granaries; namely Muda and a part of Seberang Perai around the Muda river basin. There are also several non-main granary areas relying on the water resources in Muda and Kedah rivers. In the Feasibility Study on Rationalization and Crop Diversification in Non-Granary Irrigated Areas in Malaysia, 1990, conducted by JICA, the existing non-main granary areas were classified into

the following eight (8) categories based on the future agricultural development potentials:

Category 1	To be converted to high value crop cultivation fields under irrigated conditions.
Category 2	To be converted to tree crop cultivation fields.
Category 3	With two-cropping system: planting paddy during the main season and short-term annual crops during the off-season.
Category 4	To be converted to animal feed crop cultivation fields or cattle raising fields.
Category 5	To be converted to culture ponds of freshwater fish.
Category 6	To be maintained as paddy cultivation (mini-granary) fields.
Category 7	To be maintained as paddy cultivation fields for a definite period of time due to social consideration and therefore to be further diversified.
Category 8	To be converted to housing/industrial and other uses.

The non-main granary areas in Category 6 are particularly defined as the secondary granary areas by the Malaysian Government as described in "The National Agricultural Policy (1992-2000)."

The Malaysian Government prepared "The National Agricultural Policy (1992-2010)" in 1991. In the Policy, the present self-supporting rice production ratio of 65% would be maintained by the year 2010 refraining an expansion of the present eight (8) main granary areas and seventy-four (74) secondary granary areas. In fact, the minimum area expansion is projected for these granary areas, as shown in Table III.3.2.1.

In accordance with the national policy mentioned above, it is assumed that the extent of the main and secondary irritation areas in 2010 remain the same as that of the present. The present irrigation intensity in the main granary areas has already reached the maximum limit and, therefore, will also remain the same as that of the present. However, the intensity of the secondary granary areas in the off-season will increase from the present rate of 80% to 100% in 2010, considering the current activities done by MADA, DID and other related agencies.

As for other non-granary areas, those classified in Category 7 mentioned above will be maintained as the irrigation areas relying on the source in Muda and Kedah Rivers in due consideration of their agricultural development potentials.

Based on the assumptions mentioned above, the irrigation areas in 2010 are projected as below and shown in Fig. III.3.2.1 and Tables III.3.2.2 and III.5.2.5. The projected irrigation areas in 2010 are about 118,000 ha, which are 5% smaller than the current ones of 124,000 ha. This is because 27 schemes out of 48 non-granary area schemes are classified into crop diversification schemes and, as a result, it will not be necessary to irrigate about 6,000 ha of the non-granary area planned to be cultivated.

Farming activities and irrigation schedules shown in Table III.3.2.4 and Fig. III.3.2.2 are adopted for projection in the Study referring to the recent studies and actual schedules.

3.2.3 Key Parameters for Projection

The calculation bases applied to the estimation of the irrigation water demand are described as follows:

(1) Evapotranspiration and Percolation

Evapotranspiration in paddy field varies seasonally correlating with meteorological condition and the growing stage of paddy. In the Study, the evapotranspiration is calculated by the following formula:

$$ET = Ep \times Kc$$

where,

ET	:	Evapotranspiration in paddy field
Ep	:	Pan evaporation
Kc	:	Crop coefficient = Crop evapotranspiration / open water evaporation

The 10-day *Kc* value which was decided from the measurement and standardized by Yashima is shown in Table III.3.2.5.

Table III.3.2.6 shows the average monthly pan evaporation at Alor Setar and Komplek Rumah Muda stations. In relevant studies, the 120 cm pan evaporation was converted into open water evaporation by using a conversion factor of 0.9.

However, the annual average pan evaporation at the two stations mentioned above are 1,636 mm and 1,787 mm, and they are not as big as the open water evaporation (=1,796 mm) used in relevant studies. In addition, Yashima obtained the ratio [(open water evaporation) / (pan evaporation)], that is between 0.89 to 1.00.

Based on the above, the conversion factor was determined to be 1.0 in the Study. The average monthly pan evaporation at Alor Setar station is used for the Muda irrigation scheme and the fringe area, and that at the Komlek Rumah Muda station is used for the Muda river basin and the Seberang Perai area.

The percolation rate measured in Muda irrigation scheme is 1 mm/day and the irrigation water demand of the scheme is calculated by using this.

On the other hand, no observed records of percolation rates are available in minor irrigation schemes. In relevant studies, the percolation rate assumed for minor schemes is mostly from 1 mm/day to 3 mm/day by considering more permeable soil conditions and a rough field maintenance. Therefore, the percolation rate in minor irrigation schemes can be assumed higher than the one in the Muda irrigation scheme.

In the Study, the percolation rate of 1 mm/day is assumed for main granaries (Muda and Seberang Perai irrigation schemes), and 2.5 mm/day is assumed for minor irrigation schemes.

(2) Presaturation and Standing Water

In the Study, the presaturation and standing water depths are as assumed by previous studies and the information from related government agencies.

The presaturation depth for all irrigation schemes is 150 mm. The standing water depth for Seberang Perai scheme is assumed to be 100 mm, and for other irrigation schemes, 75 mm.

3.2.4 Projected Irrigation Water Demand

The projected irrigation water demand for all objective schemes was estimated, as shown in Tables III.3.2.7 and III.3.2.8 which include the actual daily rainfall depth.

The net water demand in 2010 is about 2,500 million m^3, of which 88% (about 2,200 million m^3) is consumed in the main granary area, while 12% (about 300 million m^3) is consumed in the secondary and non-granary areas. During off-season, though irrigation water demand per unit of land increases, the irrigated area in non-granary area decreases. Hence both the demands for irrigated water during the off-season and the main season are about 1,200 million m^3 and they are almost the same.

3.3 Integrated Water Demand Projection

Based on the estimation in Sections 3.1 and 3.2, the integrated water demand for domestic/industrial as well as irrigation water is as projected below.

Projected Water Demand

Demand Items	Present				Projected in 2010			
	Gross Demand		Required from River		Gross Demand		Required from River	
	($10^6 m^3$/yr)	(%)	($10^6 m^3$/yr)	(%)	($10^6 m^3$/yr)	(%)	($10^6 m^3$/yr)	(%)
1. Domestic/Industrial								
(a) Kedah State	129	4.5	136	6.7	271	9.0	281	13.1
(b) Pulau Pinang State	166	5.8	194	9.6	300	9.9	350	16.2
(c) Perlis	9	0.3	9	0.4	9	0.3	9	0.4
Sub-Total	304	10.6	339	16.7	580	19.2	640	29.7
2. Irrigation Water								
(a) Muda scheme	1,977	68.9	1,391	68.6	2,010	66.6	1,230	57.2
(b) Balik/Seberang	156	5.4	80	4.0	170	5.6	100	4.4
(c) Others	433	15.1	216	10.7	260	8.6	180	8.4
Sub-Total	2,566	89.4	1,687	83.3	2,440	80.8	1,510	70.3
Grand Total	2,870	100.0	2,026	100.0	3,020	100.0	2,150	100.0

As estimated above, the domestic and industrial water demand taken from the river source will increase from 339 million m^3/year at present to 640 million m^3/year or 1.9 times of the present value in the year 2010. This remarkable increment is attributed to the population growth, the increment of per capita water consumption and the intensive industrial development.

In contrast with the domestic/industrial water demand, the total irrigation water demand will slightly decrease due to the following reasons:

(a) The total irrigation area in off-season is projected to decrease from the present 116,683 ha to 111,556 ha in the year 2010;

(b) In the Muda irrigation scheme, the tertiary irrigation canals are being improved; hence, the irrigation efficiency is increased from 56% at present to 63% in the year 2010; and

It is herein noted that among others, the irrigation water demand for Seberang Perai only will increase. This is due to the projected alternation of irrigation schedule, which was clarified through the interview survey made in this study.

4. WATER DEMAND AND SUPPLY BALANCE

4.1 Introduction

The purpose in this section is to clarify the water demand and supply balance in the Study and to select the necessary water resources development structures to guarantee the full supply for the water demand in 2010 under the design drought. The design drought level is herein proposed to correspond to a 10-year return period in drought recurrence probability that is generally applied in the water development plan. The water supply and demand balance is simulated for a 30-year period from 1962 to 1991, and the objective drought year is assumed as the third largest water deficit year in the simulation period.

The water resources in the Muda river basin are currently utilized by Pedu Dam in place of Muda Dam which was originally served for the basin. Moreover, Jeniang Transfer System will divert the water to the southern part of the Muda irrigation scheme in the future. Thus, to formulate a water resources management plan in the Muda river basin, it is required to consider not only the water balance in the Muda river basin but that of the Kedah river basin in which the Muda irrigation scheme is included. To do so, the water management rules should cover a large extent of neighborhood of the Muda river basin (the Kedah river basin is included in the rules).

As described above, it is necessary to take into account the State of Kedah and a part of the states of Pulau Pinang and Perlis as the Study area in order to analyze the water demand and supply balance in the Muda river basin. Hence, the simulation model should be able to deal with a water balance in these large areas.

In the next Section, fundamentals used for modeling the water demand and supply balance in the Study area are explained. Specifically, in order to construct the model, how much volumes of water are abstracted at which locations of intakes, which water management structures are considered, at which locations water balances are calculated, which methods are used to estimate natural runoff are explained. Besides, a diagram of a water demand and supply system is provided to summarize the outline of modeling.

In Section 4.3, the configuration of the water demand and supply balance simulation model in the Muda and Kedah river systems is explained. Then tentative management rules of dam reservoirs are proposed so as to determine a scale of water

management structures newly constructed. (In SECTION 5, details of the analysis of the rules are discussed.)

Section 4.4 runs the simulation model and gives basic indices used for planning a water resources management such as safe supplies and river utilization ratios to each scale of structures, drought damages, etc. The water demand used in this section is the estimated one in the year 2010. The scales of structures considered in the model are as follows:

(a) Existing structures only (Peru Dam, Muda Dam, and Ahning Dam)

(b) Existing structures + Beris Dam

(c) Existing structures + Beris Dam + Jeniang Transfer + Naok Dam

(d) Existing structures + Beris Dam + Jeniang Transfer + Naok Dam + Reman Dam

4.2 Simulation Model

4.2.1 Representative Intakes in the Model

Both the Muda river basin and the Kedah river basin including the Muda irrigation canal where the water demand and supply balance is analyzed have more than 100 water intakes in total that convey water to the schemes and the service areas considered in the Study.

It is, however, difficult to take into account all intakes in the simulation of the water resources management; thus, it is usual to focus on major intakes which are critical to calculate water balances and to make them represent other minor intakes. Moreover, it usually does not make sense to consider all intakes in the simulation model from the viewpoint of accuracy in data used in the simulation. The representative intakes represent other neighboring intakes by combining their own volumes of discharge with those of their neighbors, so that the model becomes simplified.

Table III.4.2.1 shows load factors of water utilization (annual total amount of abstraction in the upstream from a location concerned divided by annual amount of natural runoff at the location). From the table it is understood that the load factors at Muda Barrage in the Muda river system and at Perbang Barrage in the Kedah river system are overwhelmingly large.

Based on these results, representative intakes in the simulation model are formed, considering the water management rules, drought damages in each user and area, and security of maintenance flows.

4.2.2 Determination of Abstraction Volumes and Maintenance Flows

SECTION 3 estimated the irrigation water demand and the domestic/industrial water demand in 2010. To determine volumes of intake water, it is required to determine losses caused during abstracting and distributing water. With respect to

domestic/industrial water, in most cases except for Sg. Dua Treatment Plant, locations of intakes and treatment plants are close enough and the water conveyance between them is made by pipelines, so that a rate of loss to treated water is determined to be 5% of an abstraction volume which is lost at a treatment plant. At Lahar Tiang Pump Station, 15% is used to consider a loss of water from the station to Sg. Dua Treatment Plant through rough open canals. With respect to irrigation water carried through open canals, the following rates are used based on existing survey results and the hearing survey conducted by the Study.

Irrigation Scheme	Rate of Loss (%)
Seberang Perai	0.56
Conveyance/Diversion Loss	80.00
Field Distribution Loss	70.00
Muda	0.64
Conveyance/Diversion Loss	85.00
Field Distribution Loss	75.00
Other Small Schemes	0.55

Regarding maintenance flows, based on the results obtained in SECTION 3, a natural runoff of 1 m^3/sec/100 km^2 is planned to be maintained at three locations of Jeniang, the confluence of Beris River, and the foot of the downstream of Beris Dam that are important locations for the water resources management.

4.2.3 Objective Water Supply Facilities Examined in the Simulation Model

The existing water supply facilities are, indisputably, included in the simulation model. The major existing facilities are enumerated as Muda Dam, Pedu Dam, and Ahning Dam.

Muda Dam constructed in 1968 with the active storage capacity of 160 million m^3 conveys water from the catchment area of 984 km^2 through Saiong Tunnel to the Pedu reservoir. Pedu Dam constructed in 1969 with the active storage capacity of 1,049 million m^3 regulates water from the Muda catchment area and from its own catchment area of 171 km^2. Ahning Dam was constructed in 1988 for the purpose of water supply, irrigation and hydropower generation. Its catchment area is 120 km^2 and its active storage capacity is 200 million m^3.

The following facilities related to the proposed Jeniang Transfer System is also examined in the simulation model: Beris Dam; Jeniang Diversion Canal; Naok Dam; and Reman Dam. Among these water supply facilities, those necessary for the projected water demand in a drought year are selected.

Detailed design of Beris Dam has been completed, and the dam will be constructed along Beris River, a tributary of Muda River, with the active storage capacity of 102 million m^3 and its catchment area is 116 km^2. Envisaged purposes are water supply, irrigation and retention of maintenance flows. A feasibility study of Jeniang Transfer System has been already carried out.

Surplus water in Muda River will be taken by the Jeniang Weir and conveyed to the southern part of the Muda irrigation scheme by a diversion canal. Some parts of

surplus water are stored in Naok and Reman dams and released to the MUDA central canal during a drought. The active storage capacity of Naok Dam is 27.4 million m^3 and its catchment area is only 15 km^2.

Reman Dam will be constructed along Reman River, a tributary of Muda River, to provide 240 million m^3 storage capacity in the system. It is a pumped-storage cycle-regulation dam lifting water from a diversion canal and regulates the water from its own catchment area of 32.2 km^2.

In addition to the above mentioned water supply facilities, four (4) potential dam sites were identified in the previous studies. They are Tawar Muda Dam, Betak-Terin Dam, Sari Dam, and Durian Dam. Active storage capacities of these potential dams are, however, extremely small and these potential dams will not guarantee the water supply during the reference dry year. Thus, these potential dams are excluded from the objective facilities in the simulation model.

4.2.4 Reference Points of Water Demand and Supply Balance

The reference points used in the calculation of the water demand and supply balance are explained below. They were determined by considering locations of intakes and other water management facilities and junctions of rivers and tributaries. The estimation methods of natural runoff at these reference points are described in Table III.4.2.2.

(1) Main Reference Points

(a) The existing Muda Barrage is assumed as a critical point of water deficit in the Muda river basin and the evaluation of water deficit on the entire basin is made at this point.

(b) The proposed site for Jeniang Barrage is assumed as the point to evaluate the effectiveness of the proposed diversion system.

(2) Sub-Reference Points

In addition to the main reference points mentioned above, the following sub-reference points are selected to evaluate the water deficit on the basin:

(a) Existing and proposed dam sites;

(b) Pelubang Barrage on Kedah River;

(c) Intake/Outlet points of canals in Muda irrigation scheme (northern, central and southern canals); and

(d) Confluence of the main tributaries, such as Chepir, Ketil and Sedim Rivers.

4.2.5 Diagram of Water Demand and Supply System

Based on the results described above, modeling representative intakes, determining abstraction volumes and reference periods, the water demand and supply balance in the Muda river system and the Kedah river system including the MUDA irrigation canal are presented in Fig. III.4.2.1.

4.3 Configuration of the Simulation Model

The simulation model includes the Kedah river system as well as the Muda river system, because the water resources in Muda River is conveyed to Kedah River. Both river systems are connected by a diversion tunnel from the Muda Dam reservoir at present, and the connection between the two systems will be enhanced by the proposed Jeniang Transfer System in the future.

The simulation model is divided into four (4) components; namely, the main stream model, the tributary model, the transfer model, and the damage model for simulating water deficits. These components of the models have the following features:

(a) The tributary model is to calculate a deficit in a tributary basin and a surplus runoff flowing into the main stream.

(b) The transfer model is to express Jeniang Transfer System and to calculate the requirement in the Muda irrigation scheme as well as the available water supply from Muda River.

(c) The main stream model is to cover all concerned dam reservoirs and to collectively calculate all inflows from the tributary model, outflows into the transfer model, and abstraction of water at an intake point placed in the model. The model is also to simulate the movements of dam reservoirs by the water demand and supply balance simulation.

(d) The damage model is to calculate the several indices such as deficit volumes, drought percent days, square drought percent days, and effects of drought on paddy yield at each scheme and intake point.

The simulation model contains the five (5) dam reservoirs; namely, Muda, Pedu, Ahning, Beris, and Naok and Reman, as stated in Subsection 4.2.3. The water supply from these dam reservoirs is temporarily assumed to be made in accordance with the following priorities:

(1) Kedah River System

First Use	Pedu and Muda reservoirs fill the entire deficit in the Kedah river system.
Second Use	Ahning reservoir fills the deficit in the northern part of the Kedah river system; Naok and Reman reservoirs fill the deficit in southern part of the Kedah river system.

(2) Muda River System

First Use	Beris reservoir fills the entire deficit in the Muda river system.
Second Use	Naok and Reman reservoirs fill the entire deficit in the Muda river system.

Based on the above concept, the simulation model is prepared as shown in Fig. III.4.3.1 and Fig. III.4.3.2.

4.4 Results of the Simulation

The water demand and supply balance will be finally described assuming all of the proposed water resources structures including (a) Beris Dam, and (b) Jeniang Transfer System. However, there is a possibility that some of the proposed water resources development structures could not be completed by the year 2010 due to financial constraints and/or other associated social problems. From these viewpoints, a further study on water demand and supply balance was carried out in the Study, assuming the following three (3) cases:

(a) Among others, only Beris Dam is constructed in the year 2010;

(b) Among the Jeniang Transfer System, Reman Dam is not constructed in the year 2010; and

(c) All proposed water development structures are constructed by the year 2010.

4.4.1 Conditions of Integrated Water Use in Each Case

In case that Beris Dam is solely constructed without Jeniang Transfer System, the water conveyance system from Muda River to Kedah River is not improved, and the surplus water of Muda River cannot be effectively used in Kedah River. Accordingly, the sole construction of Beris Dam will increase the present water supply capacity only to the area within the Muda river basin as well as the State of Pulau Pinang, but will not improve to a substantial part of the State of Kedah that is located out of the Muda river basin.

In case that the Jeniang Transfer Canal with Naok Dam is constructed, the surplus water of Muda River can be conveyed to Kedah River, therefore, the water supply condition of a substantial part of the State of Kedah will be improved. However, in case of sole construction of Naok Dam, the storage capacity is only 27.4 million m^3, which is not enough to store surplus water in a rainy season and use it in a dry season.

After the proposed water development structures are constructed, it will be possible to store the surplus water from the Muda river system to the Naok and Reman reservoirs during a rainy season and to supply it during a drought period. In addition, integrated

use of water resources in the Muda and Kedah river systems will also be possible by comprehensive operation.

4.4.2 Water Deficit

The annual minimum storage volumes of the existing dams (Muda, Pedu, and Ahning) and the proposed Beris dam reservoir are estimated based on the water supply and demand balance simulation, as shown in Table III.4.4.1 and Fig. III.4.4.1. In this case, the Muda river system causes water deficit for 5 years in 30 years of simulation period; i.e., the annual minimum storage volume of Beris Dam becomes zero for 5 years. As for the Kedah river system, the deficit occurs for 10 years; i.e., the annual minimum storage volume of Ahning Dam becomes zero for 10 years.

Thus, a recurrence probability of water deficit for Muda River is evaluated at 6-year return period [(30 years of total simulation period) / (5 years of water deficit)], while that for the Kedah river system is at 3-year return period on condition that the water demand is assumed to be the projected value in 2010.

The Muda river system will have a minimal water deficit and its deficit period will continue for less than one (1) month in the typical drought year 1981. However, the Kedah river system will have a very serious water deficit which exceeds 50% of the total water requirement in some deficit years (refer to Table III.4.4.2 and Figs. III.4.4.2 and III.4.4.3).

The annual minimum storage volumes in case of the Jeniang Transfer Canal with Naok Dam will be constructed are shown in Table III.4.4.3. This simulation is based on the aforesaid fixed priority use of dam reservoirs. The storage water of the Naok dam reservoir can be supplied to both the Muda and Kedah river systems. Since a feeder canal is connected to the central canal for Muda irrigation scheme, however, the water supply from the Naok dam reservoir cannot cover the northern part of the Muda irrigation scheme.

As shown in Tables III.4.4.3 and III.4.4.4, the recurrence probability of water deficit for the Muda river system is about 7-year return period; therefore, the regulating effect of the Naok dam reservoir is very little. On the contrary, the recurrence probability of water deficit for the Kedah river system is improved from 3-year return period to 5-year return period except for the northern part of the Muda scheme.

Table III.4.4.5 and Fig. III.4.4.4 show the annual minimum storage volumes of all proposed dam reservoirs in the aforesaid fixed priority use. As shown in Table III.4.4.5, the annual minimum storage volumes of the proposed Naok and Reman dams decline to zero for only 2 years during a 30-year simulation period. This means that the water deficit occurs for the third largest water deficit year among an entire period of 30 years in all the study area except for the northern part of the Kedah river system (refer to Table III.4.4.6). The third largest deficit year corresponds to a 10-year return period of recurrence probability.

The water demand in the northern part of the Kedah river system could be met only by supplying water from the existing Muda, Pedu and Ahning dams due to the topographic conditions. Accordingly, the area mentioned above will have a water

deficit when the annual minimum storage volumes of the existing dams become zero. As shown in Table III.4.4.5, the existing dams will have their annual minimum storage volumes at zero for 7 years among a 30-year simulation period. That is, the northern part of the Kedah river system will have about a 5-year return period of recurrence probability of water deficit.

The recurrence probability of water deficit in the northern part is, however, subject to the aforesaid fixed priority use of the dam reservoirs, because the proposed dams still keep the storage when the storage volumes of the existing dams become zero. Thus fixed priority use of the dam reservoirs could be improved by an integrated dam operation, and thereby, a less recurrence probability of water deficit could be given to the northern part of the Kedah river system. The water demand and supply balance of the Muda and Kedah river systems are as shown in Fig. III.4.4.5 and Fig. III.4.4.6, respectively.

4.4.3 River Use Ratio

The "river use ratio" is herein defined by the following formula:

$$R = WI \div Vq$$

where,

R	:	River use ratio in terms of annual average or monthly average
$WI(i)$	:	Annual or monthly total volume of water intake from runoff discharge
Vq	:	Annual or monthly total volume of natural runoff discharge

In the Study, the runoff discharge from the Muda dam catchment area is regarded as a part of runoff discharge in the Kedah river system, considering that most of runoff discharge from the Muda dam catchment area is conveyed to the Kedah river system through the Pedu dam reservoir.

Details of the 30-year river use ratio for the Muda and the Kedah river systems in each case are shown in Tables III.4.4.7 to III.4.4.9. A changing tendency in the process of dam construction is summarized as below.

The annual average river use ratio of the Muda river system will be extremely increased from the present 14% to the projected 30%, when all of the proposed water resources development structures are constructed. This increment of river use ratio could be attributed to the increment of demand and also the possible use of surplus water. Especially, the effect of the Beris dam reservoir is conspicuous, therefore, the annual average river use ratio will be increased to 25% solely by the Beris dam construction.

A particular increment occurs in the drought year such as 1978 and 1979. In contrast to the Muda river system, the present river use ratio of the Kedah river system has already reached over 60%, so the water utilization in the Kedah river system has reached almost the critical level. Thus, the increment of the river use ratio in the

Kedah river system is made by surplus water in the Muda river system. The annual average river use ratio is estimated at 74% when all the proposed water resources development structures are constructed.

4.4.4 Water Allocation

In the Study, estimated was a possible water allocation for each demand item in water deficit years. In the estimation, the priority of water supply in deficit years is given to the supply for the domestic/industrial water demand rather than for the irrigation water demand. That is, the supply volume for each irrigation scheme is first curtailed according to the ratio of its demand volume to total volume. If a deficit still remains, the necessary curtailed volume is allotted to the domestic/industrial water demand. Thus, the possible allocation in water deficit years are estimated as shown in Tables III.4.4.10 to III.4.4.12.

The proposed water management structures are to be constructed in several stages. As the construction stage advances, the capability of water management in the study area is improved. The water allocation at each stage of construction of water management structures is summarized as follows.

(1) First Stage (Beris Dam)

For the Muda river system, particular attention is given to the deficit in domestic/industrial water demand. The curtailed irrigation water could not cover the full supply level for domestic/industrial water demand for several days in a dry season, and the water deficit extended to domestic/industrial water. Among the typical deficit years from 1979 to 1983, the annual average curtailed rate of irrigation water in the State of Pulau Pinang is 18.5%, and the annual maximum curtailed rate of 46.5% is obtained in 1983.

In the State of Kedah, the annual average curtailed rate of irrigation water is 15.1% and the annual maximum is 28.0% in 1983. In domestic/industrial water, the annual average curtailed rate of the above mentioned deficit years is 3.9%, and the annual maximum is 7.5% in 1980. The curtailed rates of both the states of Kedah and Pulau Pinang are almost the same.

As for the Kedah river system, the water deficit will be more serious than in the Muda river system. The water deficit occurs for 10 years out of the 30-year simulation period. The annual average curtailed rate of irrigation water from 1979 to 1983 is 60.0% in the northern part of Muda irrigation scheme and 36.9% in the southern part.

The annual maximum curtailed rate of the northern part of Muda irrigation scheme is 45.2% in 1982, and that of southern part of Muda irrigation scheme exceeds 58.8% in the same year. In actual water allocation, however, the curtailing of water supply will be made gradually in advance, therefore, the maximum curtailed ratio could be leveled off for a longer period.

The domestic/industrial water demand is much smaller than the irrigation water demand in the Kedah river system. Due to this fact, the water deficit is

compensated by curtailing the supply for irrigation water demand, and the water deficit for domestic/industrial water demand does not occur so seriously unlike the case of the Muda river system.

(2) Second Stage (Jeniang Transfer System and Naok Dam)

After the Jeniang Transfer System and Naok Dam are constructed, water supply conditions of both the Muda and Kedah river systems will be improved. As for the Muda river system, depending on the Naok dam reservoir, the curtailed rate of both irrigation and domestic/industrial water is slightly decreased. Among the deficit years as described above, the annual average curtailed rate of irrigation water is 13.8% in the State of Kedah and 16.8% in the State of Pulau Pinang. The annual maximum curtailed rate is 25.3% in the State of Kedah and 42.7% in the State of Pulau Pinang, and they occurred in the same year 1983. In domestic/industrial water, both the average and the maximum curtailed rates are slightly decreased from the first stage in which only Beris Dam is constructed.

On the other hand, as for the Kedah river system, the security of water supply will be more improved by the effect of conveyance of surplus water in the Muda river system. Thus, the deficit of domestic/industrial water occurs in only one year out of the 30-year simulation period, and the curtailed water is negligibly small. In irrigation water in the southern area of Kedah, the annual average curtailed rate in deficit years from 1979 to 1983 is decreased to 23.0%, and the annual maximum is decreased to 55.0% in 1982. Similarly, the annual average curtailed rate in the northern part of Kedah is decreased to 11.2%, and the annual maximum is decreased to 42.6% in 1982.

(3) Final Stage (All Structures)

When all proposed water resources development structures are constructed, security of water supply from both the Muda and Kedah river systems is extremely improved. The deficit of water use occurs in only two (2) years out of the 30-year simulation period (excluding the northern part of Muda irrigation scheme).

The maximum curtailed ratio of irrigation water is estimated at about 20% in the State of Pulau Pinang, and 16% in a part of the State of Kedah where the northern part of the Muda irrigation scheme is excluded. This maximum curtailed ratio of irrigation water occurs in 1982. In this year, the domestic/industrial water demand is also curtailed at the ratio of 2.1% in the State of Pulau Pinang and 1.9% in the State of Kedah.

The water deficit in the northern part of the Muda irrigation scheme is more serious than in other areas. The maximum curtailed ratio of irrigation water demand reaches about 45% in 1982 in the northern part. However, the domestic/industrial demand in the area will not need to be curtailed, since its total demand volume is much smaller than the irrigation water demand.

The above excessive curtailed ratio of irrigation water demand in the northern part could be reduced by the comprehensive dam reservoir management (refer to SECTION 5).

4.4.5 Rate of Decrease of Paddy Yield

The rate of decrease of paddy yield is calculated by using a deficit term and a decrease ratio of paddy yield which correlates with the growing stage of paddy. The deficit term means the number of days when the standing water depth reaches zero. Table III.4.4.13 shows a "decrease ratio at different growth stages of paddy" by Matsushima. The results of calculation are as shown in Table III.4.4.14, and by these results, a paddy yield decrease in each case is described as follows.

In case that Beris Dam is solely constructed, the annual average rate in 30-year of paddy yield decrease is 7.3%, and 28.4% in the 5-year drought period from 1979 to 1983. However, in case that all projected water resources development structures are constructed, the annual average rate is reduced to 2.2%, and the diminution for the drought years mentioned above is 7.0%, because the drought occurs for only 2 years (1980 and 1982) excluding the northern area of Muda irrigation scheme.

As mentioned above, the diminution of paddy yield in the northern part of the Muda irrigation scheme could be reduced by the integrated dam operation (refer to SECTION 5). Then, if Jeniang Transfer System will be constructed without Reman Dam, the annual average rate of paddy yield decrease is 3.8%n in a 30-year drought and 15.0% in a particular year of drought.

5. COMPREHENSIVE OPERATION RULE

5.1 Introduction

Under the inflexible operation rules of dam reservoirs described in the previous section, there still exist the following problems for effective use of water resources of the Muda river basin:

(a) Due to geographical and structural constraints, the surplus water from the Muda river system cannot be conveyed directly to the northern part of the Muda irrigation scheme, and this is the reason for imbalance of safe supply in the northern part and the other areas of Muda.

(b) Since there is no restriction on water use during an excessive drought, drought damages worsens.

The purpose of this Section is to develop the comprehensive operation rules by which the above mentioned problems are solved and the most effective use of water resources in the Muda river basin is accomplished. The following items are focused to develop the rules:

(a) Priority in use of dam reservoirs;

(b) Rule to allocate the necessary water supply volume to each dam reservoir;

(c) Rule to draw off water from each dam reservoir based on reservoir conditions (such as storage volume and climate); and

(d) Rule to allocate a possible dam water supply volume to each water user in a drought year.

5.2 Evaluation of Effectiveness of Operation Rules

The effect of each alternative dam operation rules will be evaluated by the water deficit attributable to the operation rules. In this connection, the following items are enumerated as the conventional indices to evaluate water deficit.

(a) Drought Percent Day = $\sum$ [deficit (%)× (number of drought days)]

(b) Square Drought Percent Day = $\sum$ [deficit $(\%)^2$ × [number of drought days)]

(c) Function of Drought = $\sum$ [(deficit $(\%)^2$ × water demand) × (number of drought days)]

(d) Amount of damage caused by a drought

Item (d) will be the most reliable index to evaluate the effect. It is, however, difficult to adopt the item in the Study due to lack of available basic data for the item. Instead of amount of damage, the magnitude of water deficit could be expressed by a combination of deficit ratio and the number of deficit days as expressed by items (a) to (c).

In item (a), the deficit ratio and the number of deficit days are equally evaluated. For example, magnitudes of deficits are evaluated as equal for the following two (2) cases:

Case 1	100% of deficit ratio × 10 days of deficit = 1000 % day
Case 2	10% of deficit ratio × 100 days of deficit = 1000 % day

However, the condition of deficit in Case 1 is more serious than in Case 2 during a deficit period. From this viewpoint, the deficit ratio should be emphasized more than the number of deficit days, and items (b) and (c) could be more preferable than item (a). In the Study, item (c) is finally selected as the most preferable index to evaluate, since item (b) cannot express differences in water deficit by water demand volume.

5.3 Analysis of Comprehensive Operation Rule

5.3.1 Balancing Safe Supplies

The measures for balancing safe supply are to improve safe supply in the northern part of the Muda irrigation scheme, where the recurrence probability of water deficit is estimated to be 5-year return period under the aforesaid simple priority use in dam reservoir. This improvement can be done by using the storage water in Naok and Reman dam reservoirs ahead of that in Pedu dam reservoir so that the storage water in

the Pedu dam reservoir can be saved. In other words, when the storage water in the Pedu dam reservoir is less than a certain level of volume, the origin of water supply to the southern part of the Muda irrigation scheme is changed from the Pedu dam reservoir to the Naok and Reman dam reservoirs. Thus, the future water deficit can be relieved by the water supply from the Pedu dam reservoir.

Based on this idea, the relationships between starting times of water supply from the Naok and Reman dam reservoirs (i.e., a storage level of the Pedu dam reservoir) and indices for drought evaluation are analyzed, as shown in Fig. III.5.3.1. From this figure, it is derived that as the starting time of water supply from the Naok and Reman dam reservoirs becomes earlier (i.e., as a storage level of the Pedu dam reservoir becomes larger), the deficit in the northern part of the Muda irrigation scheme gets smaller, while deficits in the southern part of the Muda irrigation scheme and in the Muda river basin get larger. On the other hand, even in a drought season, some water is stored in the Ahning dam reservoir.

Therefore, for the effective use of water, it is necessary to establish a rule for cooperative use of water not only between the Naok and Reman dam reservoirs and the Pedu dam reservoir, but also the Naok and Reman dam reservoirs and the Ahning dam reservoir, as below:

(a) Until the storage water level in the Pedu dam reservoir decreases to a certain level, water supply to the whole Muda irrigation scheme is made by the Pedu dam reservoir alone.

(b) When the storage water level in the Pedu dam reservoir becomes lower than a certain level, the water in the Naok and Reman dam reservoirs starts to be supplied to the southern part of the Muda irrigation scheme. (The water to the northern part of the Muda irrigation scheme is supplied from the Pedu dam reservoir.)

(c) When the storage water level in the Naok and Reman dam reservoirs becomes lower than a certain level, integrated use of water stored in Ahning Dam and Naok and Reman dams is started. The basic method of the integrated use of water is to calculate the ratios based on the volumes of storage water in the three dams and to apply them to determine the allocations of water supply from the three dams to the southern part of Muda irrigation scheme. The particular rule is when the volume of supply allocation from Naok and Reman dams is bigger than the water deficit in the southern part of Muda irrigation scheme, Naok and Reman dams supply only the volume of the deficit, and Pedu Dam supplies water to the northern part of the Muda irrigation scheme.

(d) Basically, the water stored in Beris Dam is independently used for the Muda river basin, but in case that the storage volumes in the other dams become lower than the special values specified for drought damage mitigation, Beris Dam is also to be involved in the integrated use of water.

5.3.2 Measures for Drought Damage Mitigation

Usually, measures for drought damage mitigation are to restrain abstraction volumes from rivers when storage water in dam reservoirs is less than a specified level so as to avoid drastic water shortages and mitigate drought damages. Under the current circumstances in which the long-term weather forecast is not reliable, it is difficult to predict the scale of drought damage and to change the specified level mentioned above in every occasion of drought.

Therefore, there is a possibility that an excessive water supply restraint could occur. In the comprehensive operation rule, the indices of drought damages described in Section 5.2 are minimized and the case of the unnecessary constraint described above is avoided by determining appropriate specified levels of water storage and restraint rates of water supply through the step-trial method.

5.4 Results of Study on Comprehensive Operation Rules

The results in the previous section to develop the comprehensive operation rules of water management structures in the Muda river basin through the step-trial method is explained in this section.

Tables III.5.4.1 to III.5.4.3 are the results derived from the rules which are the most effective ones to improve safe supply in the northern part of the Muda irrigation scheme. The starting times of operation of the Naok and Reman dams and Ahning Dam are as follows:

(1) Naok and Reman Dams	The time when the volume of storage water in the Reman dam reservoir becomes 400 million m^3.
(2) Ahning Dam	The time when the volume of storage water in the Naok and Reman dam reservoirs becomes 150 million m^3.

By the rules, the recurrence probability of water deficit in the whole study area including the northern part of Muda irrigation scheme is improved to 10-year return period. The reservoir storage movement and the water demand and supply balance are shown in Fig. III.5.4.1 and Fig. III.5.4.2, respectively.

At the start of saving water, the residual storage of the reservoirs and the water saving ratio determined to mitigate drought damages by the step-trial method are assumed as below (refer to Tables III.5.4.4 to III.5.4.6),

(1) Step 1

(a) The total residual storage in Pedu, Ahning and Naok and Reman reservoirs was assumed as 300 million m^3.

(b) The saving ratio of replenishment from reservoirs was assumed as 10%.

(2) Step 2

(a) The total residual storage in the dam reservoirs above mentioned in SECTION 4 was assumed as 200 million m^3.

(b) The saving ratio of replenishment from reservoirs was assumed as 30%.

(3) Step 3

(a) The total residual storage in reservoirs was assumed as 100 million m^3.

(b) The saving ratio of replenishment from reservoirs was assumed as 50%.

As a result, the water supply needs to be restrained in the extraordinary two (2) drought years (1982 and 1983), as well as the other three (3) semi-drought years (1980, 1985 and 1987). Nevertheless, the function of drought [= $\sum$ {(deficit (%)^2 × (water demand) × (number of drought days)}, refer to Section 5.2] is reduced from 21.5 million to 11.3 million in the excessive drought years 1982 and 1983, and from 723 thousand to 406 thousand in annual average, which shows the effectiveness of the saving rules against the excessive drought. Figs. III.5.4.4 and III.5.4.5 are the figures of water demand and supply balance during the period of application of the saving rules.

5.5 Water Resources Management Plan

What should be considered in the water resources management plan are to control effectively the water management structures in the Muda river system as well as the related structures in the Kedah river basin (e.g., Pedu Dam and Ahning Dam) and the Jeniang Transfer System as a whole, and to secure the safe supplies, conserve the environment in the study area, and mitigate drought damages during an excessive drought period. The comprehensive management plan developed in this Section is as summarized below.

(a) The surplus water in the Muda river basin is transferred to the central canal for Muda irrigation scheme through the Jeniang Transfer System. When the Naok and Reman dam reservoirs is likely to be empty, the water in the reservoir is to be stored before being used for any other purposes.

(b) When the storage volume in the Pedu and Muda dam reservoirs exceeds 400 million m^3, the water supply to the Kedah river system is to be done only by Pedu and Muda dams.

(c) When the total volume of storage water in Pedu, Muda, Ahning ,and Naok and Reman dams exceeds 300 million m^3, the water stored in Beris Dam is to be used only for the Muda river system.

(d) When the residual volume of the Pedu and Muda dam reservoirs falls below 400 million m^3, the Naok and Reman dam reservoirs start distributing the water to the southern part of the Muda irrigation scheme.

(e) When the volume of storage water in the Naok and Reman dam reservoirs falls below 150 million m^3, the integrated use of water in Ahning, and Naok and Reman starts to be implemented. The rule of the integrated use of water is to use the ratios of the volumes of water remaining in the reservoirs.

(f) When the total residual volume of all five dam reservoirs falls short of 300 million m^3, the rule of saving water is started to be used and the replenishment from reservoirs is cut down, as follows:

  (i) When residual volume falls short of 300 million m^3, replenishment is cut down to 90% (Step 1).

  (ii) When residual volume falls short of 200 million m^3, replenishment is cut down to 70% (Step 2).

  (iii) When residual volume falls short of 100 million m^3, replenishment is cut down to 50 % (Step 3).

At the stage, Beris Dam is to be included in the integrated management plan, so that the water in all six dam reservoirs are collectively managed under the plan. When the volume of water stored in the Naok and Reman reservoirs is less than the one allocated by the rule to be distributed, the water in the Naok and Reman dam reservoirs is to be distributed first to the Muda river system instead of any other area.

TABLES

SECTOR III

WATER RESOURCES MANAGEMENT PLAN

TABLE III. 2.1.1 PRINCIPAL FEATURES OF INTAKE FACILITIES (DOMESTIC/INDUSTRIAL WATER)

No .	NAME of Pumping Station	OPERATION	FACALITY	CAPACITY (cum/day)	NOTE
MD- 1	Lahar Tiang	P.W.A	p	315,000	E
MD- 2	Sungai Petai	P.W.D	p	68,300	E
MD- 3	Pinang Tunggal	P.W.D	p	27,300	E
MD- 4	Kulim	P.W.D	p	160,000	U
MD- 5	Kuara Ketil	P.W.D	p	15,000	E
MD- 6	Teloi	P.W.D	p	21,400	E
MD- 7	Jeniang	P.W.D	p	14,600	E
MD- 8	Jeneri	P.W.D	p	8,700	E
MD- 9	Lubuk Merbau	P.W.D	p	1,400	E
MD-10	Nami	P.W.D	p	4,000	E
SD- 1	Bikan	P.W.D	p	6,000	E
KD- 1	Sungai Lima	P.W.D	p	18,200	E
CD- 1	Batu Lima	P.W.D	p	10,000	E

Remarks ; E : Existing U : Under construction
P.W.A : Penang Water Authority
P.W.D : Public Works Department

TABLE III. 2.1.2 ACTUAL INTAKE DISCHARGE FROM MUDA RIVER SYSTEM (DOMESTIC/INDUSTRIAL WATER)

(UNIT : 1000 m3)

PUMPING STATION	93 JAN	FEB	MAR	APR	MEI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANUAL
Lahar Tiang	15,856	15,495	17,547	17,366	16,961	16,503	17,347	17,084	15,706	14,639	14,672	14,777	193,953
Pinang Tunggal	669	631	683	624	708	662	682	675	692	714	673	648	8,064
Sg Petani	2,475	2,397	2,504	2,414	2,538	2,347	2,508	2,514	2,416	2,510	2,391	2,528	29,542
Kuala Ketil	93	93	93	93	93	93	93	93	93	93	93	93	1,116
Nami	27	33	41	46	49	41	49	47	48	49	37	41	507
Batu Lima	248	252	175	166	172	163	95	172	162	161	144	139	2,048
Jeniang	401	349	398	395	439	407	393	409	408	416	384	385	4,786
Jenari	6	38	15	20	23	17	19	50	63	56	205	227	738
Lubuk Merbau	41	41	41	41	41	41	41	41	41	41	41	41	493
Sg. Limau	195	195	195	195	195	195	195	195	195	195	195	195	2,343
Bikan	92	92	92	92	92	92	92	92	92	92	92	92	1,107
Teloi	32	32	32	32	32	32	32	32	32	32	32	32	380
TOTAL	20,135	19,648	21,816	21,484	21,343	20,593	21,546	21,404	19,948	18,998	18,959	19,198	245,077

TABLE III. 2.2.1

FEATURES OF ACTUAL IRRIGATION SCHEME (1/2)

STATE DISTRICT	No	NAME OF SCHEME	CATEGORY	NAME OF INTAKE FACILITY	IRRIGATION AREA (ha) MAIN	IRRIGATION AREA (ha) OFF	WATER SOURCE	NOTES
P. Pinang Seberang Peral Utara	1	Sg. Muda	Main Grana Arles	Bumbung Lima	6,777	6,777	Sg. Muda	pumping capasity (1,223,000 cum/day
	2	Pinang Tunggal	Main Grana Arles	Pinang Tunggal *	1,178	1,178	Sg. Muda	(985,000 cum/day)
Kedah Kuala Muda	3	Kota - II	6	Kota - II	2,390	2,390	Sg. Muda	(598,000 cum/day)
	4	Pekura	6	Pekura	1,557	885	Sg. Muda	(330,000 cum/day)
	5	Pinang Tunggal	6	Pinang Tunggal	257	253	Sg. Muda	(88,000 cum/day)
Kulim	6	Terat Batu	7	Terat Batu	28	28	Sg. Muda	(14,000 cum/day)
Kuala Muda	7	Pantai Peral/Serukam	2	Pantai Peral	259	160	Sg. Muda	(132,000 cum/day)
Kulim	8	Sidam Kanan	7	Sidam Kanan	453	283	Sg. Muda	(60,000 cum/day)
Kuala Muda	9	Sidam Kiri	7	Sidam Kiri	219	219	Sg. Muda	(88,000 cum/day)
	10	Kg. Kemumbong	2	Kg. Kemumbong	55	—	Sg. Muda	(18,000 cum/day)
	11	Kg. Lubuk Klab	2	Kg. Lubuk Klab	53	—	Sg. Muda	(12,000 cum/day)
Baling	12	Pantai Cicak	3	Pantai Cicak	40	—	Sg. Muda	(14,000 cum/day)
Sik	13	Padang Cicak	3	Padang Cicak	71	35	Sg. Muda	(24,000 cum/day)
Kedah Kulim	14	Merbau Pulas	7	Merbau Pulas	95	14	Sg. Sedim	pumping capasity (23,000 cum/day)
Baling	15	Ulu Sedim/ Siputeh	1	Ulu Sedim/ Siputeh	114	79	Sg. Sedim	Head Work
	16	Ulu Bakal	1	Ulu Bakal	75	49	Sg. Sedim	Head Work
	17	Kg. Badang	3	Kg. Badang	75	75	Sg. Sedim	Head Work
	18	Kg. Mempelam	3	Kg. Mempelam	67	67	Sg. Sedim	Head Work
Kulim	19	Kg. Padang Meha	7	Kg. Padang Meha	150	6	Sg. Karangan	Head Work
Kulim	20	Titi Karangan	7	Titi Karangan	225	10	Sg. Karangan	Head Work
Baling	21	Kg. Tawar	2	Kg. Tawar	40	40	Sg. Ketil	Head Work
Kulim	22	Kg. Landak	2	Kg. Landak	40	40	Sg. Ketil	pumping capasity (24,000 cum/day)
Baling	23	Kg. Ibol	7	Kg. Ibol	158	158	Sg. Ketil	Head Work
	24	Simpang Empat	2	Simpang Empat	28	18	Sg. Ketil	Head Work
	25	Putat	6	Putat	239	212	Sg. Ketil	pumping capasity (73,000 cum/day)
	26	Tanjung Pari	2	Tanjung Pari	101	101	Sg. Ketil	Head Work
	27	Sg. Tiak	2	Sg. Tiak	109	109	Sg. Ketil	Head Work
Kedah Baling	28	Sg. Limau/ Corok Sikir	2	Sg. Limau	92	—	Sg. Limau	pumping capasity (22,000 cum/day)
	29	Kg. Luar	7	Kg. Luar	181	83	Sg. Limau	pumping capasity (51,000 cum/day)
Sik	30	Tanjung Besar	6	Tanjung Besar	172	172	Sg. Chepir	pumping capasity (59,000 cum/day)
	31	Sg. Telol	3	Sg. Telol	71	71	Sg. Chepir	pumping capasity (22,000 cum/day)
	32	Sg. Chepir	2	Sg. Chepir	118	—	Sg. Chepir	
	33	Tanjung Sik	7	Tanjung Sik	91	61	Sg. Chepir	Head Work
	34	Kg. Parit	6	Kg. Parit	192	192	Sg. Jeneri	Head Work
Kulim	35	Jeneri	2	Jeneri	445	—	Sg. Sedim	Head Work
	36	Padang Meha	7	Padang Meha	150	6	Sg. Sedim	Head Work

Ref : . Information from D.I.O
. Information from I.A.D.P (P.Pinang)
. Feasibility Study on Rationalization and Crop Diversion in Non-Granary Irrigation Areas

* Notes Included JARAK (Pokok Tampang) SCHEME -172ha-

TABLE III. 2.2.1

FEATURES OF ACTUAL IRRIGATION SCHEME (2/2)

STATE DISTRICT	No	NAME OF SCHEME	CATEGORY	NAME OF INTAKE FACILITY	IRRIGATION AREA (ha) MAIN	IRRIGATION AREA (ha) OFF	WATER SOURCE	NOTES
Perlis	37	Alor Melaka	6	Alor Melaka	209	0	Sg. Arau	I.A.D.P
	38	Kampung Lanjut	—	Kampung Lanjut	378	177	Central Canal	National Small Scale Irrigation Schemes
Kedah Kota Setar	39	Gua Ginu	3	Gua Ginu	111	62	Southern Canal	-ditto-
	40	Nawa Gajah Mati	1	Sg. Nawa	1,269	243	Sg.Padang Kerbau	-ditto-
Pendang	41	Sg. Lampan/ Rambai	7	Sg. Lampan	1,667	226	Sg. Lampan	-ditto-
	42	Padang Pusing	2	Padang Pusing	1,449	745	Northern Canal	-ditto-
	43	Paya Rawa I	6	Raya Rawa	363	162	Central Canal	-ditto-
Kubang Pasu	44	Padang Kerbau I & II	7	Padang Kerbau	850	850	Sg.Padang Kerbau	-ditto-
	45	Padang Kerbau III	7	Padang Kerbau	423	227	Sg.Padang Kerbau	-ditto-
Padang Terap	46	Janing	7	Janing	137	57	Sg. Janing	Rancangan Telah Siap
	47	Carok Kejal	7	Carok Kejal	90	30	Sg. Kejal	National Small Scale Irrigation Schemes
	48	Kurung Hitam	7	Kurung Hitam	100	100	Sg. Perik	-ditto-
Kubang Pasu	49	Kg. Binjal	7	Kg. Binjal	172	172	Sg. Temin	I.A.D.P
	50	Lembah Bata I	7	Lembah Bata	324	324	Sg. Temin/ Sg. Bata	National Small Scale Irrigation Schemes
	51	Sg. Pering	6	Sg. Pering	445	324	Southern Canal	-ditto-
	52	Che Kedo/ Putat	6	Che Kedo	324	299	Southern Canal	-ditto-
	53	Sg. Gelong	7	Sg. Gelong	283	194	Southern Canal	-ditto-
	54	Lembah Bata II	7	Lembah Bata	930	648	Sg. Temin/ Sg. Bata	-ditto-
Padang Terap	55	Corak Sena	—	Corak Sena	73	73	Sg. Ahning	
	56	Kg. Pisang	—	Kg. Pisang	101	101	Sg. Padang Sona	
	57	Kg. Carok Rasau	—	Kg. Carok Rasau	81	81	Sg. Pedu	
	58	Kg. Tekal	—	Kg. Tekal	81	81	Sg. Pedu	
	59	Kg. Tandop Besar	—	Kg. Tandop Besar	61	28	Sg. Pedu	
Yan	60	Bakong Lubuk Boi	6	Sg. Udang	506	445	Sg. Udang Southern Canal	National Small Scale Irrigation Schemes
KEDA PERLIS		MADA	Main Grana Aria	Pelubang Barrage	9,7267	9,7267		

Ref : . Information from D.I.D
. Information from I.A.D.P (P.Pinang)
. Feasibility Study on Rationalization and Crop Diversion in Non-Granary Irrigation Areas

TABLE III. 2.2.2 GROSS IRRIGATION WATER DEMAND IN EACH SCHEME (PRESENT WATER DEMAND)

NAME OF SCHEME	ACTUAL IRRIGATION WATER DEMAND AT 1993 1/2 (Unit : million litter)												
	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1 SG.MUDA	6642	0	11079	17082	15165	14679	10014	2835	14985	12920	13628	14249	133278
2 PINANG.TUNGGAL	1831	54	1118	2997	2507	2604	2180	389	2227	2325	2308	2625	23165
TOTAL OF P. PINANG	8473	54	12197	20079	17672	17283	12194	3224	17212	15245	15936	16874	156443
3 PEKULA & KOTA-2	4182	0	7273	10372	10721	10210	6500	2784	8548	8660	9716	9858	88824
4 PINANG.TUNGGAL	408	0	308	663	680	682	544	63	580	526	628	681	5763
5 TERAT BATU	0	0	87	76	79	68	19	45	55	69	69	61	628
6 PENTAI PERAI	0	0	808	703	736	632	181	419	511	642	648	568	5845
7 SIDAM KANAN	217	0	1174	1147	1268	1150	557	367	1029	1080	1131	1077	10197
8 SIDAM KIRI	105	0	567	554	612	555	269	177	497	521	546	520	4923
9 KG.KEMUBONG	0	0	189	156	137	127	11	94	119	140	134	88	1215
10 KG.LUBUK KIAB	0	0	183	150	151	122	11	90	115	135	129	85	1171
11 PANTAI CICAK	0	0	138	113	114	92	8	68	86	102	98	64	883
12 PADANG CICAK	0	0	245	201	203	164	14	121	154	181	174	113	1570
13 MERBAU PULAS	0	0	296	257	270	232	66	153	187	235	237	207	2140
14 ULU SEDIM	0	0	356	309	325	278	79	184	225	282	284	249	2571
15 ULU BAKAI	0	0	259	212	214	173	15	128	162	192	183	120	1658
16 KG.BADANG	0	0	259	212	214	173	15	128	162	192	183	120	1658
17 KG.MEMPELAM	0	0	231	190	191	154	14	114	145	171	164	107	1481
18 KG.PADANG MERA	0	0	468	407	427	366	105	243	296	371	374	327	3384
19 TITI KARANGAN	0	0	702	611	641	549	157	364	444	557	561	491	5077
20 KG.TAYAR	0	0	138	113	114	92	8	68	86	102	98	64	883
21 KG.LANDAK	0	0	138	113	114	92	8	68	86	102	98	64	883
22 KG.IBOI	0	0	493	429	450	386	110	256	312	391	394	345	3566
23 SIMPANG EMPAT	0	0	96	79	80	64	5	47	60	71	68	44	614
24 PULAI	114	0	619	604	668	607	294	193	543	569	596	568	5375
25 TANJUNG PARI	0	0	315	274	288	246	70	163	199	250	252	220	2277
26 SG.TIAK	0	0	340	295	310	266	76	176	215	270	272	238	2459
27 SG.LIMAU/CROK SIKIR	0	0	287	249	262	224	64	149	181	228	229	201	2074
28 KG.LUAR	0	0	565	491	516	442	126	293	357	448	451	395	4084
29 SG.TELOI	0	0	245	201	203	164	14	121	154	181	174	113	1570
30 SG.CHPIR	0	0	407	334	338	272	24	202	256	302	289	189	2613
31 TANJUNG SIK	0	0	284	247	259	222	63	147	179	225	227	198	2051
32 TANJUNG BESAR	82	0	445	435	481	436	211	139	390	410	429	408	3866
33 KG.PARIT	92	0	497	483	536	487	236	155	436	457	479	455	4315
34 JEMERLI	213	0	1153	1126	1245	1129	547	360	1011	1060	1111	1057	10012
35 PEDANG MERA	0	0	468	407	427	366	105	243	296	371	374	327	3384
(total of muda)	5413	0	20033	22216	23296	21222	10526	8322	18076	19493	20798	19620	189015

NAME OF SCHEME	ACTUAL IRRIGATION WATER DEMAND AT 1993 2/2 (Unit : million litter)												
	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
36 MADA SOUTH(phase-1)	42603	12042	35235	58597	47041	43301	37812	24466	42844	51743	40263	50447	486396
37 MADA SOUTH(phase-2)	54820	24778	15693	39173	44511	42722	42938	27035	27929	42015	37753	31672	451041
38 ALOR MELAKA	117	0	718	580	596	522	377	358	448	524	524	494	5158
39 KG.LANJUT	324	0	1152	973	972	856	543	538	737	872	868	918	8753
40 GUA GINU	63	0	371	292	287	247	132	187	213	260	254	262	2568
41 NAWA GAJAH MATI	1092	0	3870	3268	3264	2875	1825	1810	2477	2929	2914	3085	29409
42 PADANG KERBAU 1,2,3	1065	0	3773	3186	3182	2803	1779	1765	2414	2855	2840	3007	28669
43 SG.LAMPAN/RAMBAI	1434	0	5085	4294	4288	3778	2397	2379	3253	3849	3828	4052	38637
44 PADANG PUSING	1246	0	4420	3732	3727	3284	2084	2067	2828	3345	3328	3522	33583
45 RAYA RAYA 1	728	0	718	884	989	968	852	140	935	833	899	965	8911
46 BAKONG LUBUK BOI	424	0	1581	1375	1434	1287	809	729	1088	1249	1270	1229	12475
47 MADA NORTH(phase-1)	47210	13344	39046	64932	52127	47983	41899	27114	47475	57335	44617	35902	538984
48 MADA NORTH(phase-2)	60747	27457	17391	43407	49324	47341	47579	29981	30949	46556	41838	37259	499809
49 KG.BINJAL	98	0	575	452	445	383	205	291	330	403	395	407	3984
50 LEMBAH BATA 1	277	0	988	834	833	733	465	462	631	748	744	787	7502
51 SG.PENING	384	0	1296	1094	1093	962	611	606	829	980	976	1033	9844
52 CHE KEDO/PUTAT	277	0	988	834	833	733	465	462	631	748	744	787	7502
53 SG.OBLONG	237	0	884	769	801	719	452	407	608	698	710	688	6973
54 LEMBAH BATA-2	780	0	2906	2528	2637	2367	1487	1341	2000	2297	2335	2260	22938
55 JAING	78	0	458	360	354	305	163	231	263	321	314	324	3171
56 CAROK REJAL	51	0	301	236	232	200	107	152	173	211	206	213	2082
57 KURUNG HITAM	57	0	334	263	258	222	119	169	192	234	229	236	2313
58 CORAK SENA	41	0	244	192	188	162	87	123	140	171	167	172	1687
59 KG.PISANG	57	0	338	265	261	225	120	170	194	236	231	239	2336
60 KG.CAROK RASAU	45	0	271	213	209	180	96	137	155	190	186	191	1874
61 KG.TEKAI	45	0	278	225	231	202	107	138	173	203	203	191	1996
62 KG.TANDOP BESAR	34	0	209	169	174	152	81	104	130	153	153	144	1503
(total of mada)	205380	77621	107365	206109	193003	181347	170228	108576	149197	197649	164475	215280	1976230
(total of fringe)	8935	0	31758	27018	27288	24165	15263	14765	20842	24309	24318	25206	243868
TOTAL OF KEDAH (& part of perlis)	219728	77621	159156	255343	243587	226734	196017	131664	188115	241451	209591	260108	2409113
TOTAL OF SCHEME	228201	77675	171353	275422	261259	244017	208211	134888	205327	256698	225527	276980	2565556

TABLE III. 2.2.3 NET IRRIGATION WATER DEMAND IN EACH SCHEME (PRESENT WATER DEMAND) (1/4)

ACTUAL IRRIGATION WATER DEMAND (Unit : million liter)

YEAR	P.PINANG	KEDAH			TOTAL
		(MADA)	(MUDA BASIN)	(OTHERS)	(TOTAL)	
1962	40746	822173	50187	66819	939179	979925
1963	49428	882287	46608	59052	987947	1037375
1964	36112	827122	45272	64249	936643	972755
1965	47245	675643	44104	45786	765533	812778
1966	23395	540418	45285	46468	632171	655566
1967	47335	637776	56245	61442	755463	802798
1968	49862	765112	54532	67965	887609	937471
1969	47846	733948	44064	64323	842335	890181
1970	39081	647071	38785	61327	747183	786264
1971	55918	676644	48073	57019	781736	837654
1972	34005	692606	49934	56109	798649	832654
1973	33214	616260	43239	43391	702890	736104
1974	53105	806128	67075	69315	942518	995623
1975	46846	467257	48508	53182	568947	615793
1976	33490	685182	56142	60253	801577	835067
1977	41776	827360	61747	72733	961840	1003616
1978	55453	824895	64244	77493	966632	1022085
1979	39368	815868	53978	79387	949233	988601
1980	50281	707345	49419	61267	818031	868312
1981	51978	973472	68332	106191	1147995	1199973
1982	30801	662285	42663	58195	763143	793944
1983	43427	803264	57420	74434	935118	978545
1984	51840	716499	61882	76731	855112	906952
1985	52067	844477	53551	73324	971352	1023419
1986	38107	759396	53681	58715	871792	909899
1987	47299	814333	52361	67555	934249	981548
1988	53315	624114	60741	58741	743596	796911
1989	50022	830335	55751	74089	960175	1010197
1990	44678	747954	58866	78001	884821	929499
1991	48757	779866	62229	69704	911799	960556
AVERAGE	44559	740236	53163	65442	858842	903402
ABSTRAC TION	79569	1391421	96659	118985	1607065	1686634

ACTUAL IRRIGATION WATER DEMAND (Unit : million litter)

NAME OF SCHEME	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
AVERAGE													
TOTAL OF P. PINANG	4160	40	8388	8423	2143	5068	3725	1354	6474	1583	180	3015	44559
(total of muda)	3891	0	9849	6407	3737	5721	2874	4334	5677	1552	1998	7118	53163
(total of mada)	172447	67246	88736	117980	30710	20952	20207	18958	69485	58385	4116	71009	740236
(total of fringe)	7354	0	14607	6545	2742	3245	1560	10233	4482	1094	1715	11849	65442
TOTAL OF KEDAH (& part of perlis)	183703	67246	113193	130933	37190	29919	24642	33526	79645	61032	7830	89977	858842
TOTAL OF SCHEME	187863	67287	121582	139356	39334	34987	28368	34881	86119	62616	8011	92992	903402

TABLE III. 2.2.3 NET IRRIGATION WATER DEMAND IN EACH SCHEME (PRESENT WATER DEMAND) (2/4)

(Unit : million litter)

NAME OF SCHEME	ACTUAL IRRIGATION WATER DEMAND												
	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1962													
TOTAL OF P. PINANG	3725	54	7660	9177	197	6778	1788	902	8527	698	0	1240	40746
(total of muda)	2492	0	7709	8019	3771	5512	498	3230	8606	569	2282	7499	50187
(total of mada)	185360	77675	88353	123193	52370	24758	3994	11114	86613	60959	1675	106109	822173
(total of fringe)	8156	0	12149	7332	4977	4946	71	6456	4738	1631	405	15958	66819
TOTAL OF KEDAH (& part of perlis)	196008	77675	108211	138344	61118	35216	4563	20800	99937	63159	4362	129566	939179
TOTAL OF SCHEME	199733	77729	115871	147721	61315	41994	6351	21702	108484	63857	4362	130806	979925
1963													
TOTAL OF P. PINANG	268	54	9006	14670	329	5249	9003	1022	9186	641	0	0	49428
(total of muda)	909	0	10084	11003	1961	2876	4911	5052	6614	666	0	2532	46608
(total of mada)	183568	74666	95957	200397	53584	19988	68477	33662	72804	41399	236	37549	882287
(total of fringe)	5285	0	16073	14868	4104	1656	2094	6964	1914	0	0	6094	59052
TOTAL OF KEDAH (& part of perlis)	189762	74666	122114	226268	59649	24520	75482	45678	81932	42065	236	46175	987947
TOTAL OF SCHEME	190030	74720	131120	240938	59978	29769	84485	46700	90518	42706	236	46175	1037375
1964													
TOTAL OF P. PINANG	4818	54	11896	10479	0	53	969	1335	4693	1138	0	675	36112
(total of muda)	3801	0	12179	5577	2430	4995	740	5549	1391	486	0	8124	45272
(total of mada)	193143	66431	106760	108913	17005	35037	44994	36276	70621	70697	2271	74974	827122
(total of fringe)	8842	0	17939	4519	691	6126	873	11987	2092	1541	719	8920	64249
TOTAL OF KEDAH (& part of perlis)	205786	66431	136878	119009	20126	46158	46607	53812	74104	72724	2990	92018	936643
TOTAL OF SCHEME	210604	66485	148774	129488	20126	46211	47576	55147	76799	73862	2990	92693	972755
1965													
TOTAL OF P. PINANG	8349	0	8132	5286	1719	15143	2772	1129	3653	1062	0	0	47245
(total of muda)	5416	0	9426	3648	2476	10041	2582	3637	4745	496	187	1450	44104
(total of mada)	205557	60205	92258	114991	25172	21457	15254	8575	71350	54700	1745	4379	675643
(total of fringe)	8936	0	14045	5210	1096	3056	2002	8312	1956	0	0	1173	45786
TOTAL OF KEDAH (& part of perlis)	219909	60205	115729	123849	28744	34554	19838	20524	78051	55196	1932	7002	765533
TOTAL OF SCHEME	228258	60205	123861	129135	30463	49697	22610	21653	81704	56258	1932	7002	812778
1966													
TOTAL OF P. PINANG	0	0	7159	4452	41	211	0	818	9885	829	0	0	23395
(total of muda)	2197	0	8462	6183	753	6730	1373	3197	7268	1927	2574	4621	45285
(total of mada)	144609	57604	76962	94340	8292	0	3246	17373	78056	59358	1434	146	540418
(total of fringe)	5723	0	13449	6047	232	126	331	12774	6177	230	0	1379	46468
TOTAL OF KEDAH (& part of perlis)	152529	57604	98873	106570	9277	6856	3950	33344	91501	61515	4008	6144	632171
TOTAL OF SCHEME	152529	57604	106032	111022	9318	7067	3950	34162	101386	62344	4008	6144	655566
1967													
TOTAL OF P. PINANG	0	0	10614	9485	62	7475	4217	1875	11508	740	0	1359	47335
(total of muda)	1748	0	11317	7354	8314	4786	1330	2951	7997	2326	1746	6366	56243
(total of mada)	71073	72237	104782	88929	13582	4144	0	13243	74434	54074	5352	136526	637776
(total of fringe)	1554	0	17436	3208	740	2669	0	10369	3841	10	884	20731	61442
TOTAL OF KEDAH (& part of perlis)	74375	72237	133535	98891	22636	11599	1330	26573	86272	56410	7982	163623	755463
TOTAL OF SCHEME	74375	72237	144149	108376	22698	19074	5547	28448	97780	57150	7982	164982	802798
1968													
TOTAL OF P. PINANG	5582	54	8086	9917	2459	8249	1129	1501	8239	4636	0	0	49852
(total of muda)	5304	0	10175	6361	2322	6281	554	5441	7628	4116	1889	4461	54532
(total of mada)	205126	75643	89526	122880	26861	3341	8067	15443	79152	56642	3824	78607	765112
(total of fringe)	8936	0	13741	8329	2163	724	541	10902	2497	755	3322	16055	67965
TOTAL OF KEDAH (& part of perlis)	219366	75643	113442	137570	31346	10346	9162	31785	89277	61513	9035	99123	887609
TOTAL OF SCHEME	224948	75697	121528	147487	33815	18595	10291	33287	97516	66149	9035	99123	937471
1969													
TOTAL OF P. PINANG	1050	54	8724	14241	1313	4918	2198	2169	12663	516	0	0	47846
(total of muda)	3029	0	9201	8923	2391	4346	1062	3386	13240	26	0	460	44064
(total of mada)	98951	68320	88512	159479	48910	23499	5820	26316	89800	70617	1606	54118	733948
(total of fringe)	1961	0	15225	10545	5549	2678	738	8881	7224	372	0	11150	64323
TOTAL OF KEDAH (& part of perlis)	103941	68320	110938	178947	56850	30523	7620	38583	108264	71015	1606	65728	842335
TOTAL OF SCHEME	104991	68374	119662	193188	58163	35441	9818	40752	120927	71531	1606	65728	890181
1970													
TOTAL OF P. PINANG	310	51	9304	9463	2061	9108	169	1585	6475	555	0	0	39081
(total of muda)	2118	0	10711	4441	5043	6635	381	4992	3852	120	0	492	38785
(total of mada)	174500	77615	89262	134948	22055	575	842	14561	42251	46743	172	49487	647071
(total of fringe)	7761	0	14665	7847	2012	4154	461	11999	3185	0	173	9047	61327
TOTAL OF KEDAH (& part of perlis)	184379	77675	108658	147236	29110	11364	1684	31552	49291	46863	345	59026	747183
TOTAL OF SCHEME	184689	77726	117962	156699	31171	20472	1853	33137	55766	47418	345	59026	786264
1971													
TOTAL OF P. PINANG	3795	54	8615	15762	8329	7190	6164	132	3675	2139	63	0	55918
(total of muda)	2480	0	10891	8843	5571	5932	1732	1863	4932	685	3821	1523	48073
(total of mada)	140370	65247	87215	191372	14409	248	6254	36844	63567	51873	1987	17258	676644
(total of fringe)	5075	0	12614	12779	297	573	189	12348	4945	41	351	7807	57019
TOTAL OF KEDAH (& part of perlis)	147925	65247	110520	212994	20277	6753	8175	51055	73444	52599	6159	26588	781736
TOTAL OF SCHEME	151720	65301	119135	228756	28606	13943	14339	51187	77119	54738	6222	26588	837654

TABLE III. 2.2.3 NET IRRIGATION WATER DEMAND IN EACH SCHEME (PRESENT WATER DEMAND) (3/4)

(Unit : million litter)

NAME OF SCHEME	ACTUAL IRRIGATION WATER DEMAND												
	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1972													
TOTAL OF P. PINANG	2771	27	7575	3763	6372	452	4555	2002	3586	2902	0	0	34005
(total of muda)	3032	0	11041	3689	9205	2417	5442	6862	3221	951	0	4074	49934
(total of mada)	192035	55515	90839	110543	38033	12983	47404	17209	53365	68887	146	5646	692606
(total of fringe)	8426	0	15227	5279	3822	2239	3532	12854	3235	68	0	1426	56109
TOTAL OF KEDAH (& part of perlis)	203493	55515	117107	119511	51060	17639	56378	36925	59823	69906	146	11146	798649
TOTAL OF SCHEME	206264	55542	124682	123274	57432	18091	60933	38927	63409	72808	146	11146	832654
1973													
TOTAL OF P. PINANG	2426	54	4964	6207	644	1431	3185	451	12271	1571	0	0	33214
(total of muda)	4843	0	8736	4313	4455	4708	1334	2246	9576	1278	512	1178	43239
(total of mada)	162970	71069	91427	80823	18852	13636	23792	12070	92182	46101	937	2401	616260
(total of fringe)	8307	0	15276	2749	0	2407	399	3856	4346	116	270	5665	43391
TOTAL OF KEDAH (& part of perlis)	176120	71069	115439	87945	23307	20751	25525	18172	106104	47495	1719	9244	702890
TOTAL OF SCHEME	178546	71123	120403	94152	23951	22182	28710	18633	118375	49066	1719	9244	736104
1974													
TOTAL OF P. PINANG	3333	54	9129	5914	885	7934	6285	1954	6789	852	113	9863	53105
(total of muda)	4978	0	10535	3169	3001	8900	5323	6623	5060	883	2189	16419	67075
(total of mada)	165994	58331	83145	135018	27956	14554	0	12933	66021	59815	20537	161823	806128
(total of fringe)	8487	0	15627	6496	980	3251	1308	9115	3201	24	2775	18051	69315
TOTAL OF KEDAH (& part of perlis)	179452	58331	109308	144683	31937	26705	6631	28673	74282	60722	25501	196293	942518
TOTAL OF SCHEME	182785	58385	118437	150597	32822	34639	12916	30627	81071	61574	25614	206156	995623
1975													
TOTAL OF P. PINANG	2257	43	5765	7741	7466	10290	3674	1552	5498	2560	0	0	46846
(total of muda)	1815	0	8518	7615	5191	8061	4107	5213	4493	2637	0	838	48508
(total of mada)	62091	51081	84570	90151	5821	4476	33143	13925	48737	65098	1579	6585	467257
(total of fringe)	4622	0	12954	4091	848	1804	4256	12255	3073	141	2581	6557	53182
TOTAL OF KEDAH (& part of perlis)	68528	51081	106042	101857	11860	24361	41506	31393	56303	67876	4160	13980	568947
TOTAL OF SCHEME	70785	51124	111807	109598	19326	24651	45180	32945	61801	70436	4160	13980	615793
1976													
TOTAL OF P. PINANG	1535	54	8592	7387	0	995	4384	2027	7613	903	0	0	33490
(total of muda)	3428	0	9410	6222	544	5407	2669	4159	8992	2947	2440	9924	56142
(total of mada)	164627	76006	87592	99569	8015	26976	17484	8953	49882	45604	1450	99024	685182
(total of fringe)	8206	0	13643	5478	194	4788	1034	8921	6459	0	0	11530	60253
TOTAL OF KEDAH (& part of perlis)	176261	76006	110645	111269	8753	37171	21187	22033	65333	48551	3890	120478	801577
TOTAL OF SCHEME	177796	76060	119237	118656	8753	38166	25571	24060	72946	49454	3890	120478	835067
1977													
TOTAL OF P. PINANG	2079	54	11664	11452	329	2814	7664	1408	4265	47	0	0	41776
(total of muda)	3747	0	12616	11544	5132	5387	4944	3735	4988	133	659	8852	61747
(total of mada)	154618	67651	102095	165464	8684	23845	46394	10001	46479	42851	3573	155694	827360
(total of fringe)	5203	0	17458	10606	20	2988	1847	8676	3574	0	602	21759	72733
TOTAL OF KEDAH (& part of perlis)	163568	67651	132169	187614	13836	32221	53185	22412	55041	42984	4834	186315	961840
TOTAL OF SCHEME	165647	67715	143833	199066	14165	35035	60849	23820	59306	43031	4834	186315	1003616
1978													
TOTAL OF P. PINANG	2552	54	7929	13123	0	4258	0	884	9530	861	967	15295	55453
(total of muda)	4436	0	8944	9896	381	1792	1489	4436	8235	2741	4819	17075	64244
(total of mada)	162193	72396	86031	147399	43934	22954	0	13660	61848	54427	13305	140746	824893
(total of fringe)	8730	0	13240	8892	2384	893	0	12128	2016	3079	6965	19166	77493
TOTAL OF KEDAH (& part of perlis)	175361	72396	108215	166187	46699	25639	1489	30224	78099	60247	25089	176987	966632
TOTAL OF SCHEME	177913	72450	116144	179310	46699	29897	1489	31108	87629	61108	26056	192282	1022085
1979													
TOTAL OF P. PINANG	5630	54	8119	5980	146	822	2912	774	7868	5719	0	1344	39368
(total of muda)	4281	0	11592	4734	3775	3187	3510	4480	6445	4389	332	7253	53978
(total of mada)	203642	77675	88548	83296	54282	34337	0	13039	74730	83991	231	102097	815868
(total of fringe)	8936	0	16292	2738	6502	2113	2055	7038	7470	8209	851	17183	79387
TOTAL OF KEDAH (& part of perlis)	216859	77675	116432	90768	64559	39637	5565	24557	88645	96589	1414	126533	949233
TOTAL OF SCHEME	222489	77729	124551	96748	64705	40459	8477	25331	96513	102308	1414	127877	988601
1980													
TOTAL OF P. PINANG	8317	54	8891	9827	6143	8355	4623	1076	2830	165	0	0	50281
(total of muda)	5356	0	9324	6944	7067	8116	3540	3620	2264	0	0	3188	49419
(total of mada)	205557	66315	87967	105428	54501	24131	252	10332	80393	61243	1334	9892	707345
(total of fringe)	8936	0	14858	6486	5085	2011	620	10642	9455	412	288	2474	61267
TOTAL OF KEDAH (& part of perlis)	219849	66315	112149	118858	66653	34258	4412	24594	92112	61655	1622	15554	818031
TOTAL OF SCHEME	228166	66369	121040	128685	72795	42613	9035	25670	94942	61820	1622	15554	868312
1981													
TOTAL OF P. PINANG	1615	0	8379	1689	589	6527	9226	2315	2988	4820	0	13830	51978
(total of muda)	4012	0	11108	5104	2981	7345	4747	6205	2291	3378	3363	17798	68332
(total of mada)	199485	58314	95127	76162	74018	86843	31406	37670	98903	100604	253	114627	973472
(total of fringe)	8773	0	16298	1726	6574	8102	3111	13222	9808	12502	4506	21469	106191
TOTAL OF KEDAH (& part of perlis)	212270	58314	122533	82992	83733	102290	39264	57097	111002	116484	8122	153894	1147995
TOTAL OF SCHEME	213885	58314	130912	84681	84322	108817	48490	59412	113990	121304	8122	167724	1199973

TABLE III. 2.2.3 NET IRRIGATION WATER DEMAND IN EACH SCHEME (PRESENT WATER DEMAND) (4/4)

NAME OF SCHEME	ACTUAL IRRIGATION WATER DEMAND (Unit : million litter)												
	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1982													
TOTAL OF P. PINANG	8081	54	7046	6202	0	0	238	2507	6021	552	0	0	30801
(total of muda)	5398	0	9140	2409	2626	5568	2421	5947	7031	376	0	2347	42663
(total of mada)	205557	71359	99673	77456	14447	298	0	11297	94830	54823	630	31915	662285
(total of fringe)	8936	0	17198	1809	1147	3507	443	7529	6274	1208	317	9827	58195
TOTAL OF KEDAH (& part of perlis)	219891	71359	126011	81674	18220	9373	2864	24173	108135	56407	947	44089	763143
TOTAL OF SCHEME	227972	71413	133057	87876	18220	9373	3102	26780	114156	56959	947	44089	793944
1983													
TOTAL OF P. PINANG	6108	54	8690	16604	0	0	2178	1906	1346	2478	0	4063	43427
(total of muda)	5176	0	10344	12970	0	154	2545	5286	1943	1005	7340	10656	57420
(total of mada)	192339	77271	95356	189373	20703	0	0	13782	46203	66224	9512	92501	803264
(total of fringe)	8217	0	14486	13952	2896	803	669	12425	2157	0	3639	15190	74434
TOTAL OF KEDAH (& part of perlis)	205732	77271	120186	216295	23599	957	3215	31493	50303	67229	20491	118347	935118
TOTAL OF SCHEME	211840	77325	128876	232899	23599	957	5393	33399	51649	69707	20491	122410	978545
1984													
TOTAL OF P. PINANG	5763	0	8527	3718	169	8377	5281	449	8502	4149	1266	5639	51840
(total of muda)	4327	0	9469	3559	1245	6989	2500	5316	7956	4759	6835	8927	61882
(total of mada)	165074	68161	81694	87826	48172	9547	0	15539	84665	73997	6708	74916	716499
(total of fringe)	8012	0	12975	2558	3410	3476	2144	12410	4925	2428	12716	11677	76731
TOTAL OF KEDAH (& part of perlis)	177413	68161	104338	93943	52827	20012	4644	33265	97546	81184	26259	95520	855112
TOTAL OF SCHEME	183176	68161	112865	97661	52996	28389	9925	33714	106048	85333	27525	101159	906952
1985													
TOTAL OF P. PINANG	4848	0	7293	7085	7863	10518	5531	1347	7468	114	0	0	52067
(total of muda)	4781	0	8773	5327	4515	9421	5225	4936	5634	239	0	4700	53551
(total of mada)	179802	49766	81227	111091	53424	59219	85987	33462	68508	58395	529	62167	844477
(total of fringe)	8763	0	10241	7056	6800	6998	4329	12924	4647	0	47	11519	73324
TOTAL OF KEDAH (& part of perlis)	193346	49766	100241	124374	64739	75638	95541	51322	78789	58634	576	78386	971352
TOTAL OF SCHEME	198194	49766	107534	131459	72602	86156	101072	52669	86257	58748	576	78386	1023419
1986													
TOTAL OF P. PINANG	6720	54	8917	12586	1058	0	3467	1176	1970	102	0	2057	38107
(total of muda)	5265	0	10251	8120	2268	7565	4741	4223	2744	356	0	8148	53681
(total of mada)	188932	71585	89274	99316	32324	29163	68258	21537	60600	43248	0	55159	759396
(total of fringe)	8313	0	14890	4932	4869	4758	2494	8367	3287	0	0	6805	58715
TOTAL OF KEDAH (& part of perlis)	202510	71585	114415	112368	39461	41486	75493	34127	65631	43504	0	70112	871792
TOTAL OF SCHEME	209230	71639	123332	124954	40519	41486	78960	35303	68601	43706	0	72169	909899
1987													
TOTAL OF P. PINANG	8479	54	9758	8418	6	4724	3768	1734	5165	5193	0	0	47299
(total of muda)	5372	0	10241	7419	4515	7872	4479	5795	3960	1355	772	581	52361
(total of mada)	204857	77675	88586	139667	35549	68853	48424	19294	44975	52839	719	32695	814333
(total of fringe)	8926	0	13512	10705	3048	3519	4680	13459	4016	0	0	5689	67555
TOTAL OF KEDAH (& part of perlis)	219155	77675	112339	157792	43112	80244	57583	38548	52951	54194	1491	39165	934249
TOTAL OF SCHEME	227634	77729	122097	166210	43118	84968	61351	40282	58116	59387	1491	39165	981548
1988													
TOTAL OF P. PINANG	5199	17	7992	3975	6167	10398	5218	892	4255	127	101	8974	53315
(total of muda)	4506	0	8905	3504	7821	6086	4665	1285	4015	748	5272	13934	60741
(total of mada)	199767	27605	68069	67249	17292	24598	0	6694	55674	59526	25054	72586	624114
(total of fringe)	8925	0	13318	598	3401	6538	66	6108	2742	0	3781	13064	58741
TOTAL OF KEDAH (& part of perlis)	213198	27605	90492	71351	28514	37222	4731	14087	62431	60274	34107	99584	743596
TOTAL OF SCHEME	218397	27622	98484	75326	34681	47620	9949	14979	66686	60401	34208	108558	796911
1989													
TOTAL OF P. PINANG	6423	54	8573	3188	9954	2255	2232	922	4218	907	271	11025	50022
(total of muda)	4151	0	7670	1269	7482	3888	1428	2909	4278	1031	6144	15501	55751
(total of mada)	193613	75998	79507	77964	42982	37179	41531	21763	59885	50397	2705	146811	830335
(total of fringe)	8773	0	14589	1312	2282	3926	3405	12208	2703	0	3270	21621	74089
TOTAL OF KEDAH (& part of perlis)	206537	75998	101766	80545	52748	44993	46364	36880	66866	51428	12119	183933	950175
TOTAL OF SCHEME	212960	76052	110339	83733	62700	47248	48596	37802	71084	52335	12390	194958	1010197
1990													
TOTAL OF P. PINANG	5559	54	9461	4790	0	5523	7489	1866	6558	20	0	3356	44678
(total of muda)	3569	0	10297	7625	2209	7117	4988	5792	5707	2435	0	9127	58866
(total of mada)	166939	73686	91765	123061	23600	1922	6203	52348	83900	50453	570	71506	747954
(total of fringe)	6844	0	15031	7390	4945	5884	2960	13805	4749	79	0	16314	78001
TOTAL OF KEDAH (& part of perlis)	179352	73686	117094	138076	30754	14923	14151	71945	94356	52967	570	96947	884821
TOTAL OF SCHEME	184911	73740	126555	142866	30754	20448	21640	73811	100914	52987	570	100303	929499
1991													
TOTAL OF P. PINANG	7208	54	5207	10127	0	2015	1449	618	6973	521	2642	11743	48757
(total of muda)	4773	0	8618	6379	2669	3513	982	2270	7221	3520	6789	15495	62229
(total of mada)	199091	74229	77818	132808	16438	0	0	9838	78136	45972	13414	132132	779666
(total of fringe)	4351	0	13543	10834	1120	648	167	8069	7776	0	2998	20188	69704
TOTAL OF KEDAH (& part of perlis)	208215	74229	99979	150021	20227	4161	1149	20177	93133	49492	23201	167815	911799
TOTAL OF SCHEME	215423	74283	105186	160148	20227	6176	2598	20995	100106	50013	25843	179558	960556

TABLE III. 2.2.4 PRINCIPAL FEATURES OF INTAKE FACILITIES (IRRIGATION WATER)

No	SUPPLY SCHEME	OPERATION	FACA LITY	CAPACITY (cum/day)	IRRIGATION AREA(ha.)	RIVER SYSTEM
MA- 1	Kota-2	D.I.D(S.Petani)	p	598,000	2,390	Muda river
MA- 2	Pekura	D.I.D(S.Petani)	p	329,000	1,780	Muda river
MA- 3	Sungai Muda	D.I.D(Perai)	p	1,223,000	6,777	Muda river
MA- 4	Pinang Tunggal	D.I.D(Perai)	p	990,000	1,178*	Muda river
MA- 5	Pinang Tunggal	D.I.D(S.Petani)	p	88,000	279	Muda river
MA- 6	Terat Batu	D.I.D(Kulim)	p	14,000	28	Muda river
MA- 7	Pantai Perai	D.I.D(S.Petani)	p	132,000	259	Muda river
MA- 8	Sidam Kanan	D.I.D(Kulim)	p	60,000	453	Muda river
MA- 9	Sidam Kiri	D.I.D(S.Petani)	p	88,000	219	Muda river
MA-10	Kg. Kemumbong	D.I.D(S.Petani)	p	18,000	55	Muda river
MA-11	Lubok Kiab	D.I.D(S.Petani)	p	12,000	53	Muda river
MA-12	Pantai Cicak	D.I.D(S.Petani)	p	14,000	40	Muda river
MA-13	Padang Cicak	D.I.D(S.Petani)	p	24,000	71	Muda river
SA- 1	Merbau Pulas	D.I.D(S.Petani)	p	23,000	95	Sedim river
SA- 2	Ulu Sedim/Siputeh	D.I.D(S.Petani)	w		114	Sedim river
SA- 3	Ulu Bakai	D.I.D(S.Petani)	w		75	Sedim river
SA- 4	Kg. Badang	D.I.D(S.Petani)	w		75	Sedim river
SA- 5	Kg. Mempelam	D.I.D(S.Petani)	w		67	Sedim river
SA- 6	Padang Meha	D.I.D(S.Petani)	w		150	Karangan river
SA- 7	Titi Karangan	D.I.D(Kulim)	w		225	Karangan river
KA- 1	Kg. Tawar	D.I.D(S.Petani)	w		40	Ketil river
KA- 2	Kg. Landak	D.I.D(S.Petani)	p	24,000	40	Ketil river
KA- 3	Kg. Iboi	D.I.D(S.Petani)	w		186	Ketil river
KA- 4	Pulai	D.I.D(S.Petani)	p	73,000	239	Ketil river
KA- 5	Simpang Empat	D.I.D(S.Petani)	w		28	Ketil river
KA- 6	Kg. Luar	D.I.D(S.Petani)	p	51,000	181	Ketil river
KA- 7	Tanjung Pari	D.I.D(S.Petani)	w		101	Ketil river
KA- 8	Sg. Tiak	D.I.D(S.Petani)	w		109	Ketil river
KA- 9	Limau/Corok Sikin	D.I.D(S.Petani)	p	22,000	85	Ketil river
CA- 1	Tanjung Besar	D.I.D(S.Petani)	p	59,000	172	Chepir river
CA- 2	Sg. Teloi	D.I.D(S.Petani)	p	22,000	71	Chepir river
CA- 3	Tanjung Sik	D.I.D(S.Petani)	w		91	Chepir river
CA- 4	Sg. Chepir	D.I.D(S.Petani)	p		118	Chepir river
JA- 1	Kg. Parit	D.I.D(S.Petani)	w		192	Jeneri river

Remarks; p : Pumping w : Headwork
Source; Information from State DID (kedah)
IADP Pulau Pinang
Note; Including a part of Jarak Scheme (173 ha.)

TABLE III. 2.2.5 ACTUAL INTAKE DISCHARGE from MUDA RIVER SYSTEM (IRRIGATION WATER)

(UNIT : 1000 m3)

PUMPING STATION	93 JAN	FEB	MAR	APR	MEI	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANUAL
Pinang Tunggal	4,927	327	2,808	3,551	5,225	3,362	770	12	4,006	2,671	1,618	3,429	32,706
Bumbung Lima	2,516	4,115	1,964	4,294	5,157	4,097	5,723	0	4,753	5,148	3,597	3,574	44,938
Kota-2	7,737	0	1,293	7,326	6,785	5,933	647	0	5,865	4,104	4,235	6,010	49,935
Pinang Tunggal (Kedah)	311	0	707	411	750	425	132	0	768	263	176	217	4,160
Pentai Perai	0	0	1,070	1,349	1,321	888	0	479	806	576	615	0	7,104
Other's *	9,060	0	8,791	8,595	13,248	9,020	1,467	0	12,781	5,895	5,024	6,765	80,646
TOTAL	24,551	4,442	16,633	25,526	32,486	23,725	8,739	491	28,979	18,657	15,265	19,995	219,489

note; * : estimated from Pinang Tunggal (Kedah) without Pekura,

(* Pekura; estimated from Kota-2)

TABLE III. 3.1.1

FEATURES OF ACTUAL AND PROJECTED DOMESTIC/INDUSTRIAL WATER SERVICE AREAS

(1/3)

STATE	DISTRICT	MUKIM	ACTUAL			AT 2000			AT 2010		
			POPULATION	SERVICE FACTOR	SOURCE OF SUPPLY	POPULATION	SERVICE FACTOR	SOURCE OF SUPPLY	POPULATION	SERVICE FACTOR	SOURCE OF SUPPLY
KEDAH	BALING	Bakel	12,587	urban :83%	Kuala Ketil	13,700	100%	Bikan	19,000	100%	Bikan
		Baling	8,189	rural :45%	New Baling	8,200	100%	New Baling	8,200	100%	New Baling
		Bongor	5,741		-ditto-	6,300	100%	-ditto-	7,300	100%	-ditto-
		Kupang	29,845		-ditto-	25,300	100%	-ditto-	27,600	100%	-ditto-
		Purai	20,629		-ditto-	23,000	100%	-ditto-	*27,500	100%	-ditto-
		Siong	11,958		-ditto-	12,400	100%	-ditto-	15,100	100%	-ditto-
		Tawar	18,865		Kuala Ketil	20,100	100%	Kuala Ketil	22,700	100%	Kuala Ketil
		Teloi Kanan	15,137		-ditto-	16,900	100%	Teloi	20,000	100%	Teloi
	BANDAR BAHARU	Bagan Samak	12,762	urban :88%	(Sg.Krian)	13,100	100%	(Sg.Krian)	13,500	100%	(Sg.Krian)
		Kuala Selama	9,507	rural :91%	-ditto-	9,300	100%	-ditto-	9,100	100%	-ditto-
		Kulau	2,139		-ditto-	2,300	100%	-ditto-	2,700	100%	-ditto-
		Serdang	9,725		-ditto-	10,600	100%	-ditto-	12,200	100%	-ditto-
		Sungai Batu	3,197		-ditto-	3,200	100%	-ditto-	3,200	100%	-ditto-
		Sungai Kechil Hilir	1,979		-ditto-	2,100	100%	-ditto-	2,400	100%	-ditto-
	KOTA SETAR	Alor Malai	31,288	urban :75%	Bukit Pinang	37,200	100%	Bukit Pinang	47,300	100%	Bukit Pinang
		Alor Merah	12,170		-ditto-	12,200	100%	-ditto-	12,100	100%	-ditto-
		Ank Bukit	8,986		-ditto-	11,700	100%	-ditto-	17,300	100%	-ditto-
		Bukit Lada	4,499		-ditto-	4,800	100%	-ditto-	5,300	100%	-ditto-
		Bukit Pinang	6,520		-ditto-	7,400	100%	-ditto-	9,000	100%	-ditto-
		Derang	3,776		-ditto-	4,800	100%	-ditto-	6,200	100%	-ditto-
		Derga	23,053		-ditto-	25,400	100%	-ditto-	29,400	100%	-ditto-
		Gajah Mati	9,419		-ditto-	9,900	100%	-ditto-	10,600	100%	-ditto-
		Gunong	6,561		-ditto-	7,000	100%	-ditto-	7,200	100%	-ditto-
		Hutan Kampong	5,022		-ditto-	6,400	100%	-ditto-	9,300	100%	-ditto-
		Jabi	7,935		-ditto-	9,100	100%	-ditto-	11,200	100%	-ditto-
		Kangkong	7,149		-ditto-	7,600	100%	-ditto-	8,400	100%	-ditto-
		Kota Setar	35,373		-ditto-	31,100	100%	-ditto-	26,300	100%	-ditto-
		Kuala Kedah	16,553		-ditto-	17,100	100%	-ditto-	17,800	100%	-ditto-
		Kubang Rotan	5,078		-ditto-	5,000	100%	-ditto-	4,900	100%	-ditto-
		Langgar	7,259		-ditto-	7,600	100%	-ditto-	8,200	100%	-ditto-
		Langkuas	1,259		-ditto-	1,200	100%	-ditto-	1,200	100%	-ditto-
		Lepai	2,594		-ditto-	2,700	100%	-ditto-	2,800	100%	-ditto-
		Lesong	5,707		-ditto-	5,800	100%	-ditto-	5,900	100%	-ditto-
		Limbong	1,478		-ditto-	1,600	100%	-ditto-	1,800	100%	-ditto-
		Mergong	13,413		-ditto-	17,800	100%	-ditto-	26,600	100%	-ditto-
		Padang Hang	4,297		-ditto-	4,200	100%	-ditto-	4,100	100%	-ditto-
		Padang Lalang	8,000		-ditto-	8,400	100%	-ditto-	9,100	100%	-ditto-
		Pengkalan Kundor	39,119		-ditto-	44,000	100%	-ditto-	52,100	100%	-ditto-
		Pumpong	16,880		-ditto-	26,100	100%	-ditto-	45,400	100%	-ditto-
		Sala Ketil	8,978		-ditto-	9,800	100%	-ditto-	12,500	100%	-ditto-
		Sungai Baharu	1,755		-ditto-	1,700	100%	-ditto-	1,600	100%	-ditto-
		Tajar	9,958		-ditto-	10,200	100%	-ditto-	10,600	100%	-ditto-
		Tebengau	4,087		-ditto-	4,100	100%	-ditto-	4,100	100%	-ditto-
		Telaga Mas	2,447		-ditto-	2,500	100%	-ditto-	2,700	100%	-ditto-
		Telok Chengai	4,031		-ditto-	5,800	100%	-ditto-	10,400	100%	-ditto-
		Telok Kechai	8,177		-ditto-	13,400	100%	-ditto-	21,000	100%	-ditto-
		Titi Gajah	4,520		-ditto-	4,700	100%	-ditto-	4,900	100%	-ditto-
		Tualang	6,159		-ditto-	6,100	100%	-ditto-	6,000	100%	-ditto-

TABLE III. 3.1.1

FEATURES OF ACTUAL AND PROJECTED DOMESTIC/INDUSTRIAL WATER SERVICE AREAS

(2/3)

DISTRICT	MUKIM	ACTUAL			AT 2000			AT 2010		
		POPULATION	SERVICE FACTOR	SOURCE OF SUPPLY	POPULATION	SERVICE FACTOR	SOURCE OF SUPPLY	POPULATION	SERVICE FACTOR	SOURCE OF SUPPLY
KUALA MUDA	Bujang	6,048	urban :66%	----	6,600	100%	(Merbok)	7,500	100%	(Merbok)
	Bukit Meriam	5,015	rural :41%	Pinang Tunggal Padang	5,100	100%	Pinang Tunggal Padang	3,300	100%	Pinang Tunggal Padang
	Gurun	32,765		Jeniang	35,800	100%	Jeniang	40,700	100%	Jeniang
	Haji Kudong	1,141		Pinang Tunggal	1,100	100%	Pinang Tunggal	1,100	100%	Pinang Tunggal
	Kota	3,043		-ditto-	3,300	100%	-ditto-	3,700	100%	-ditto-
	Kuala	2,647		-ditto-	2,800	100%	-ditto- Sg.petani	3,000	100%	-ditto- Sg.petani
	Merbok	12,344		---	13,000	100%	(Merbok)	10,100	100%	(Merbok)
	Pekula	9,165		Pinang Tunggal	11,200	100%	Pinang Tunggal	15,200	100%	Pinang Tunggal
	Pinang Tunggal	3,341		-ditto-	3,100	100%	-ditto-	2,700	100%	-ditto-
	Rantau Panjang	2,705		-ditto-	2,800	100%	-ditto- Sg.Petani	2,900	100%	-ditto- Sg.Petani
	Semeling	13,562		---	13,200	100%	(Tupah)	12,700	100%	(Tupah)
	Sidam Kiri	6,843		Kuala Ketil	6,600	100%	Kuala Ketil	6,300	100%	Kuala Ketil
	Simpor	4,738		Pinang Tunggal	5,200	100%	Pinang Tunggal	5,600	100%	Pinang Tunggal
	Sungai Pasir	50,870		-ditto- Pinang Tunggal	79,500	100%	Sg.Petani 1	51,700	100%	Sg.Petani 1
	Sungai Petani	106,699		Sg.petani Jeniang	135,700	100%	-ditto- 1 Sg.petani,Jeniang,Kuala Ketil	94,000	100%	-ditto- 1 Sg.petani,Jeniang,Kuala Ketil
	Telui Kiri	8,556		Sg.petani	8,700	100%		8,400	100%	
KUBANG PASU	Ah	7,182	urban	Kodiang Changloon	7,600	100%	Changloon Pinang	8,300	100%	Changloon Pinang
	Binjai	3,095	:90%	Changloon	3,400	100%	Changloon	4,000	100%	Changloon
	Bukit Tinggi	6,158	rural	Pelubang	8,000	100%	Pelubang	11,700	100%	Pelubang
	Gelong	5,793	:60%	-ditto-	6,200	100%	-ditto-	6,700	100%	-ditto-
	Huda	2,659		Changloon Pelubang	2,700	100%	Changloon Pinang	2,800	100%	Changloon Pinang
	Jaras	8,084		Pinang	8,000	100%	Pelubang	8,600	100%	Pelubang
	Jerlun	18,524		Bitam	18,400	100%	Pelubang	18,100	100%	Pelubang
	Jitra	18,455		Pelubang Changloon	24,400	100%	-ditto- Changloon	36,800	100%	-ditto- Changloon
	Kepala	9,171		Kodiang	8,900	100%	Pinang	8,600	100%	Pinang
	Kubang Pasu	3,631		Changloon	2,700	100%	Changloon	2,800	100%	Changloon
	Matang	2,745		Pelubang Pinang	3,000	100%	Pelubang Pinang	3,300	100%	Pelubang Pinang
	Naga	18,175		Pelubang	25,400	100%	Pelubang	38,000	100%	Pelubang
	Padang Perahu	3,302		-ditto-	3,300	100%	-ditto-	3,400	100%	-ditto-
	Pelubang	3,048		-ditto- Changloon	2,300	100%	Pelubang Changloon	2,600	100%	Pelubang Changloon
	Paring	7,016		Kodiang Pinang	7,200	100%	Pinang Pinang	7,600	100%	Pinang Pinang
	Putat	5,217		Pelubang	5,500	100%	Pelubang	6,000	100%	Pelubang
	Sanglang	8,408		Sanglang	9,500	100%	Pelubang	9,700	100%	Pelubang
	Sungai Laku	8,572		Changloon	13,400	100%	Changloon	25,800	100%	Changloon
	Temin	17,545		-ditto- Pinang	26,700	100%	-ditto- Pinang	48,300	100%	-ditto- Pinang
	Tunjang	7,006		Pelubang	7,100	100%	Pelubang	7,100	100%	Pelubang
	Wang Tepus	1,427		Pelubang	1,500	100%	Pelubang	1,600	100%	Pelubang
KULIM	Bagan Sena	5,398	urban :88%	Karangan Bikam	5,600	100%	Bikam Kulim	5,800	100%	Bikam Kulim
	Junjong	4,119	rural :91%	Karangan	4,500	100%	(Sg.Uia)	5,000	100%	(Sg.Uia)
	Karangan	7,563	rural	-ditto-	10,100	100%	Kulim Kulim	15,700	100%	Kulim Kulim
	Keladi	16,247		---	26,600	100%	(Sg.Uia)	53,200	100%	(Sg.Uia)
	Kulim	32,955		---	51,800	100%	-ditto- Kulim	82,800	100%	-ditto- Kulim
	Lunas	12,135		---	16,600	100%	(Bt.Alok Along) Kulim	26,500	100%	Bt.Alok Along) Kulim
	Mahang	3,192		--- (Bt Atok Along)	3,100	100%	(Sg.Uia)	3,000	100%	Sg.Uia)
	Naga Lilit	7,033		Pinang Tunggal	8,200	100%	-ditto-	10,500	100%	-ditto-
	Padang China	7,782		Karangan Kuala Ketil	8,100	100%	Kulim Kulim	7,900	100%	Kulim Kulim
	Padang Meha	7,549		Pinang Tunggal	7,400	100%	Pinang Tunggal Kulim	7,200	100%	Pinang Tunggal Kulim
	Sedim	3,231		---	2,900	100%	(Sg.Uia)	2,500	100%	(Sg.Uia)
	Sidam Kanan	9,999		Pinang Tunggal	11,500	100%	Pinang Tunggal Kulim	14,200	100%	Pinang Tunggal Kulim
	Sungai Seluang	13,039		Karangan	20,700	100%	(Sg.Lua)	44,700	100%	(Sg.Lua)
	Sungai Ular	3,510		---	4,800	100%	-ditto-	6,600	100%	-ditto-
	Terap	4,376		---	4,600	100%	-ditto-	4,900	100%	-ditto-

TABLE III. 3.1.1

FEATURES OF ACTUAL AND PROJECTED DOMESTIC/INDUSTRIAL WATER SERVICE AREAS

(3/3)

STATE	DISTRICT	MUKIM	ACTUAL			AT 2000			AT 2010		
			POPULATION	SERVICE FACTOR	SOURCE OF SUPPLY	POPULATION	SERVICE FACTOR	SOURCE OF SUPPLY	POPULATION	SERVICE FACTOR	SOURCE OF SUPPLY
	PADANG TERAP	Batang Tunggang Kanan	1,257	urban :90%	Padang Serai Kuala Nerang	1,400	100%	Padang Serai Kuala Nerang	1,500	100%	Padang Serai Kuala Nerang
		Batang Tunggang Kiri	1,367		-ditto-	1,800	100%	-ditto-	2,600	100%	-ditto-
		Belimbing Kanan	7,469	rural :71%	-ditto-	8,800	100%	-ditto-	11,100	100%	-ditto-
		Belimbing Kiri	2,607		-ditto-	2,900	100%	-ditto-	3,500	100%	-ditto-
		Kurong Hitam	2,507		-ditto-	2,900	100%	-ditto-	3,500	100%	-ditto-
		Padang Tenak	4,800		-ditto-	5,000	100%	-ditto-	5,900	100%	-ditto-
		Padang Terap Kanan	1,678		-ditto-	1,900	100%	-ditto-	2,400	100%	-ditto-
		Padang Terap Kiri	4,226		-ditto-	5,100	100%	-ditto-	6,800	100%	-ditto-
		Pedu	5,380		-ditto-	5,600	100%	-ditto-	6,000	100%	-ditto-
		Tekai	19,061		Padang Serai Lubuk Merbau2 Kuala Nerang	1,500	100%	Padang Serai Lubuk Merbau Padang Serai	25,400	100%	Padang Serai Lubuk Merbau Padang Serai
		Telak	2,303		Padang Serai	2,800	100%	Kuala Nerang	4,200	100%	Kuala Nerang
	SIK	Jeneri	11,669	rural :20%	Jeniang,Batu Lima,Merbauu1 Batu Lima	1,900	100%	Jeniang,Batu Lima,Merbauu Batu Lima	12,100	100%	Jeniang,Batu Lima,Merbauu Batu Lima
		Sik	37,112		Jeniang	45,300	100%	Jeniang	61,200	100%	Jeniang
		Sok	8,506		Nami	10,400	100%	Nami	13,800	100%	Nami
	YAN	Dulang	4,389	rural :70%	---	4,400	100%	Bukit Pinang	4,500	100%	Bukit Pinang
		Sala Besar	25,956		---	27,000	100%	-ditto-	28,400	100%	-ditto-
		Singkir	2,999		---	3,000	100%	-ditto-	3,100	100%	-ditto-
		Sungai Daun	11,917		---	11,900	100%	-ditto-	12,200	100%	-ditto-
		Yan	15,955		---	15,500	100%	-ditto-	14,700	100%	-ditto-
	PENDANG	Ayer Puteh	28,235	rural :70%	Pendang	30,600	100%	Jeniang Pendang	36,450	100%	Jeniang Pendang
		Bukit Raya	12,612		-ditto-	12,100	100%	Pendang	11,200	100%	Pendang
		Guar Kepayang	7,197		-ditto-	7,300	100%	-ditto-	7,900	100%	-ditto-
		Padang Kerbau	9,851		Jeneri	9,900	100%	Jeneri	10,000	100%	Jeneri
		Padang Pelliang	4,173		-ditto-	5,700	100%	-ditto-	8,900	100%	-ditto-
		Padang Pusing	8,851		Pendang Jeneri	9,300	100%	Pedang Jeneri	10,000	100%	Pedang Jeneri
		Rambai	7,741		-ditto-	8,400	100%	-ditto-	9,500	100%	-ditto-
		Tobiar	9,823		Pedang	6,200	100%	Pedang	6,700	100%	Pedang
	PULAU PINANG	(All mukim)	1,104,430	97%	(Sg.Dua)	1,398,200	100%	(Sg.Dua)	1,940,800	100%	(Sg.Dua)
	PERLIS	(All mukim)	192,851		(Sg.Alau)	228,300	100%	(Sg.Alau)	300,700	100%	(Sg.Alau)

TABLE III. 3.1.2 ACTUAL AND PROJECTED POPULATION (ABSTRACTED FORM MUDA RIVER SYSTEM)

NO	NAME OF INTAKE FACILITIES	NAME OF TREATMENT PLANT	NAME OF SCHEME	ACTUAL		IN 2000		IN 2010		NOTES
				SERVICE AREA	POPULATION	SERVICE AREA	POPULATION	SERVICE AREA	POPULATION	
1	Lahar Tiang	Sg.Dua	Muda river	68% of P.Pinang	1,104,400	P.Pinang (all of P.Pinang)	1,037,000 1,398,000	P.Pinang (all of P.Pinang)	1,612,000 1,940,000	supplied from other T/W :165,000 cum/d
2	Pinang Tunggal (old.new)	Pinang Tunggal Sg.Petani	Kuala Muda	Sg.Petani,Sg.Pasir Bt.Meriam,Kuala, Pinang Tunggal,Kota Haji Kudong,Simpor Pekura,Pantau Panjang (Sidam Kanan,Padang Meha,part of Kulim, part of Naga Lilit)	209,000	Sg.Petani,Sg.Pasir Bt.Meriam,Kuala, Pinang Tunggal,Kota Haji Kudong,Simpor Pekura,Pantau Panjang	294,800	Sg.Petani,Sg.Pasir Bt.Meriam,Kuala, Pinang Tunggal,Kota Haji Kudong,Simpor Pekura,Pantau Panjang	418,300	supplied from Merbok & Tupah : 3,600 cum/d supply to Kulim : 9,080 cum/d
3	Kulim phase 2 atage-1 atage-2	Kukim phase 2	Kulim Water supply	----------	-----	Bagan Sena,Junjong Keladi,Kulim,Lunas Mahang,Naga Lilit Padang Meha,Sedim, Sidam Kanan,Sg.Seluang Sg.Ular Terap	183,700	Bagan Sena,Junjong Keladi,Kulim,Lunas Mahang,Naga Lilit Padang Meha,Sedim, Sidam Kanan,Sg.Seluang Sg.Ular Terap	292,700	supplied from Pinang Tunggal : 9,080 cum/d Sg.ular T/W : 27,000 cum/d Bkt Tok Alang : 10,000 cum/d
4	Kuala Ketil	Kuala Ketil	Kuala Ketil	Sidam Kili,Tawar part of Telui Kili	19,800	Sidam Kili,Tawar part of Telui Kili(30%	28,200	Sidam Kili,Tawar part of Telui Kili(30%)	31,400	
5	Telui	Telui	Telui Kanan	Telui Kanan	7,300	Telui Kanan	18,000	Telui Kanan	20,000	
6	Jeniang	Jeniang	Jeniang	part of Telui Kiri Gurun,Sik, Sik, Ayer Puteh Jeneri	15,400	part of Telui Kiri Gurun (30%) Sik, (20%) Ayer Puteh(20%) Jeneri (33%)	33,500	part of Telui Kiri Gurun (30%) Sik, (20%) Ayer Puteh(20%) Jeneri (33%)	37,000	
7	Jeneri	Jeneri	Jeneri	Padang Kerbau Padang Peliang part of Rambai Padang Pusing	13,100	Padang Kerbau Padang Peliang part of Rambai (30%) Padang Pusing(30%)	27,700	Padang Kerbau Padang Peliang part of Rambai (30%) Padang Pusing(30%)	30,500	
8	Lubuk Merbau	Lubuk Merbau	Lubuk Merbau	part of Tekai Jeneri	6,700	part of Tekai (20%) Jeneri (33%)	7,500	part of Tekai (20%) Jeneri (33%)	9,100	
9	Nami	Nami	Nami	Sok,part of Tekai	5,800	Sok,part of Tekai (20%)	14,600	Sok,part of Tekai (20%)	18,900	
10	Sg.Limau	Sg.Limau	New Baling	Kupang,Baling,Pulai Bongor,Siong	42,200	Kupang,Baling,Pula Bongor,Siong	75,000	Kupang,Baling,Pula Bongor,Siong	83,400	
11	Batu Lima	Sik(Bt.5)	Sik	part of Sik Jeneri	13,900	part of Sik (80%) Jeneri (33%)	41,100	part of Sik (80%) Jeneri (33%)	53,100	
12	Bikan	Bikan	Kg.Bikan	Bakal, part of Bagan Sena	8,200	Bakal,	12,700	Bakal,	12,900	

TABLE III. 3.1.3 ACTUAL AND PROJECTED POPULATION (ABSTRACTED FORM KEDAH RIVER SYSTEM)

NO	NAME OF INTAKE FACILITIES	NAME OF TREATMENT PLANT	NAME OF SCHEME	ACTUAL		IN 2000		IN 2010		SOURCE
				SERVICE AREA	POPULATION	SERVICE AREA	POPULATION	SERVICE AREA	POPULATION	SUPPLY
1	Bukit Pinang	Bukit Pinang	Kota Setar	part of KOTA SETAR Putat Nega Tunjang Jeham Padang Perahu	193,000	part of KOTA SETAR(40%) Putat (50%) Nega (50%) Tunjang (50%) Jeham (50%) Padang Perahu(50%) Ah (50%) Pering (50%) Kepelu (50%) Gurun (70%) YAN	249,200	part of KOTA SETAR(40%) Putat (50%) Nega (50%) Tunjang (50%) Jeham (50%) Padang Perahu(50%) Ah (50%) Pering (50%) Kepelu (50%) Gurun (70%) YAN	314,200	Central Canal
2	Kodiang	Kodiang	Kodiang	part of Keperu, Ah Pering	7,300	closed	------	closed	-----	Sg.Padang Terap
3	Changloon	Changloon	Changloon	Sg.Kaka,Temin, Kubang Pasu Binjal Husba part of Pering Ah Kepelu	30,800	Sg.Kaka,Temin, Kubang Pasu Binjal Husba part of Pering (50%) Ah (50%) Kepelu (50%)	71,500	Sg.Kaka,Temin, Kubang Pasu Binjal Husba part of Pering (50%) Ah (50%) Kepelu (50%)	96,000	Southern Canal
4	Air Hitam	Air Hitam	Air Hitam	Hitam	4,500	closed	----	closed	----	Air Cadang
5	Pelubang	Pelubang	Pelubang	part of KOTA SETAR Nega Jeham Putat Tunjang Padang Perahu Gelong,Malau,Jitra Wang Tepus,Pelubang Bt.Tinggal	191,000	part of KOTA SETAR(60%) Nega (50%) Jeham (50%) Putat (50%) Tunjang (50%) Padang Perahu(50%) Gelong,Malau,Jitra Wang Tepus,Peluban Bt.Tinggal,Jerlun Sang Lang	324,500	part of KOTA SETAR(60%) Nega (50%) Jeham (50%) Putat (50%) Tunjang (50%) Padang Perahu(50%) Gelong,Malau,Jitra Wang Tepus,Peluban Bt.Tinggal,Jerlun Sang Lang	395,300	Sg.Padang Terap
6	Sanglang	Sanglang	Sanglang	Sanglang	8,300	closed	----	closed	----	Lana Bulu Canal
7	Kuala Nerang Padang Sanai	Kuala Nerang Padang Sanai	Kuala Nerang	PADANG TERAP (excluding a part of Tekai)	34,200	PADANG TERAP (excluding a part of Tekai)---40%-	51,200	PADANG TERAP (excluding a part of Tekai)---40%-	62,000	Sg.Padang Terap Sg.Padang Senai
8	Jenun	Pendang	Pendang	Bukit Raya,Tobiar Guar Kepayang part of Rambai Padang Pusing Ayer Puteh	56,200	Bukit Raya,Tobiar Guar Kepayang part of Rambai (70%) Padang Pusing(70%) Ayer Puteh (80%)	60,900	Bukit Raya,Tobiar Guar Kepayang part of Rambai (70%) Padang Pusing(70%) Ayer Puteh (80%)	60,900	
9	Arau Canal	Arau Canal	Kangar		42,000		41,000		40,000	

TABLE III. 3.1.4 PRINCIPAL FEATURES OF WATER SUPPLY IN ASIAN CITIES

AT 1992

CITY OR SERVICE	NUMBER OF HOUSEHOUDS	SERVICE AREA (sq.km)	PEOPLE SERVED (*1000)	DAILY CONSUMPTION DOMESTIC (%)	OTHERS (%)	U/C (%)	PER CAPITA CONSUMPTION (l/d/c)
BANG KOK	1,027,623	710	4,454	32.5	32.3	35.2	230
S.PORE	799,049	633	3,057	42.3	48.5	9.2	170
JAKARTA	328,745	286	2,073	27.0	15.4	57.6	150
PENANG	205,438	1,031	1,145	49.2	27.7	23.1	210
K.L		180	524	31.5	30.8	37.7	220
OKINAWA			1,119	61.5	30.0	8.5	250
FUKUOKA			1,236	67.6	23.7	8.7	230

notes ; U/G : Unaccounted For Water
Ref : Water Utilities Data Bank - 1993-
: Statistics of Drinking Water JAPAN

TABLE III. 3.1.5

PRINCIPAL FEATURES FOR DOMESTIC/INDUSTRIAL WATER DEMAND ESTIMATION IN RELEVANT STUDIES

REFERENCE	SERVICE FACTOR %	PER CAPITA CONSUMPTION RATES URBAN (l/cap/day)	SEMI URBAN (l/cap/day)	RURAL (l/cap/day)	DETAILS OF WATER DEMAND DOMESTIC	COMMERCIAL & INSTITUTIONAL	INDUSTRIAL	NRW (NFW) % OF NRW/WATER DEMAND
DCSWSS		230 ~ 320	180 ~ 230	135 ~ 180	** PCCR x population	large scale included 10% of domestic	L.Industrial 22,000 lha/day H.Industrial 45,000 lha/day	Higher than 25% (included in 25%) net cap consumption
PJKP (at 2000)	100	270	230	PWD 175 MHO 70	PCCR x population	—	unit industrial use x gross output	Included in a PCCR (20%)
KULIM	100	318	—	160	PCCR x population	large scale institutional 10% of domestic	L.Industrial 22,000 lha/day H.Industrial 45,000 lha/day	15%
SUNGEI PETANI	100	318	227	160	PCCR x population	large institutional + 10% of domestic	33,000 lha/day	17.5%
KEDAH UTARA	100	284	—	191	PCCR x population + New Townships Development	Included in a domestic	L.Industrial 22,000 lha/day H.Industrial 45,000 lha/day	30%
RURAL WATER	100			220 ~ 290	PCCR x population	Included in a PCCR	Included in a PCCR	Included in a PCCR
INFORMATION from PWA	100	computing by average increase rate					60% of domestic use	
THIS STUDY	100	280	200	160	PCCR x population	Urban : 15% *** Others : 10%	33,000 lha/day	URBAN : 15 % RURAL SEMI URBAN : 20%

Notes DCSWSS : Design Criteria and Standards for Water Supply Systems 1989
PJKP : PERLIS - KEDAH - PULAU PINANG REGIONAL WATER RESOURCES STUDY
KULIM : KULIM WATER SUPPLY - PHASE 2 FEASIBILITY STUDY AND PRELIMINERY DESIGN REPORT -1992-
SUNGEI PETANI : SUNGAI PETANI DISTRIBUTION STUDY REPORT -1990-
KEDAH UTARA : KEDAH UTARA DISTRIBUTION SYSTEM IMPROVEMENT REPORT -1993-
RURAL WATER : INVESTIGATION AND PREPARATION OF A DEVELOPMENT PROGRAMME FOR RURAL WATER SUPPLY SCHEMES IN MALAYSIA -1992-

** PCCR : PER CAPITA CONSUMPTION RATES
*** P.Pinang : 30%

TABLE III. 3.1.6 FEATURES OF PROJECTED DOMESTIC/INDUSTRIAL WATER DEMAND IN 2000

NAME OF INTAKE FACILITIES	NAME OF TREATMENT PLANT	NAME OF SOURCE	POPULATION (urban) (semi urban) (rural)	SURICE FACTER (%)	PAR CAPITA CONSUMPTION (l/cap/day)	DOMESTIC WATER DEMAND (m3/day)	COMMERTIAL & INSTITUTIONAL WATER DEMAND (m3/day)	INDUSTRIAL ARIA (ha)	INDUSTRIAL DEMAND (m3d)	UNCOUNTABLE WATER RATIO	UNCOUNTABLE WATER DEMAND (m3d)	TOTAL WATER DEMAND (m3d)	ABSTRACTION FROM RIBER & CANAL (m3)
1 Lebar Tiang	Sg.Dua	Muda river	1,234,800 97,800 85,500	100 100 100	280 180 150	345.7 17.6 9.6	103.7 1.8 1.0	1,550	50.5	20.6%	109.2	639.3	(639.3-165.0 *174.3) + /0.85=560.
2 Sg.Petani	Sg.Petani	Muda river	158,700 5,700 -	100 100 100	250 180 150	39.7 1.0 -	8.0 0.1 -	450	14.9	20.1%	12.4	74.1	76.0
3 Pinang Tunggal	Pinang Tunggal	Muda river	109,400 11,400 8,600	100 100 100	250 180 150	27.4 2.1 1.3	4.1 0.2 0.1	50	1.0	21.2%	7.7	44.1	(44.1-9.1-3.8 *49.6) 53.
4 Kulim phase 2	Kulim phase 2	Muda river	165,700 10,200 7,800	100 100 100	250 180 150	41.4 1.8 1.2	6.2 0.2 0.1	280	9.2	20.6%	12.4	72.5	(72.5-9.1- 27-10-26.4 20.
5 Kuala Ketil	Kuala Ketil	Muda river	20,600 7,600 -	100 100 100	250 180 150	5.2 1.4 -	0.8 0.1 -	90	3.0	21.0%	2.2	12.7	13.
6 Teloi	Teloi	Muda river	- - 18,000	100 100 100	250 180 150	- - 2.7	- - 0.3	-	-	40.0%	1.2	4.2	4.4
7 Jeniang	Jeniang	Muda river	31,600 1,900 -	100 100 100	250 180 150	7.9 0.3 -	1.2 0.1 -	10	0.3	20.4%	2.0	11.8	12.
8 Jeneri	Jeneri	Muda river	- 27,700 -	100 100 100	250 180 150	- 5.0 -	- 0.8 -	-	-	25.0%	1.4	6.9	7.3
9 Lubuk Merbau	Lubuk Merbau	Muda river	- 3,500 4,200	100 100 100	250 180 150	- 0.6 0.6	- 0.1 0.1	-	-	32.5%	0.5	1.9	2.0
10 Nami	Nami	Muda river	- - 15,000	100 100 100	250 180 150	- - 2.3	- - 0.2	-	-	40.0%	1.0	3.5	3.7
11 Sg.Limau	Sg.Limau	Ketil river	- 38,350 9,400	100 100 100	250 180 150	- 6.8 1.4	- 0.7 0.1	10	0.3	27.7%	2.6	12.0	13.
12 Batu Lima	Sik(St.5)	Chepir river	37,400 5,700 -	100 100 100	250 180 150	9.4 0.7 -	1.4 0.1 -	20	0.6	20.5%	2.5	14.7	16.
13 Bikam	Bikam	Sedim river	- - 12,700	100 100 100	250 180 150	- - 1.9	- - 0.2	-	-	40.0%	0.8	2.9	3.1

NAME OF INTAKE FACILITIES	NAME OF TREATMENT PLANT	NAME OF SOURCE	POPULATION (urban) (semi urban) (rural)	SURICE FACTER (%)	PAR CAPITA CONSUMPTION (l/cap/day)	DOMESTIC WATER DEMAND (m3/day)	COMMERTIAL & INSTITUTIONAL WATER DEMAND (m3/d)	INDUSTRIAL ARIA (ha)	INDUSTRIAL DEMAND (m3d)	UNCOUNTABLE WATER RATIO	UNCOUNTABLE WATER DEMAND (m3d)	TOTAL WATER DEMAND (m3d)	ABSTRACTION FROM RIBER & CANAL (m3)
1 Bukit Pinang	Bukit Pinang	MADA Central Canal	187,950 41,200 20,100	100 100 100	250 180 150	47.0 7.4 3.0	7.1 0.7 0.3	170	5.6	21.5%	15.9	86.4	91.
2 Changloon	Changloon	Tenia river	594,800 3,400 9,000	100 100 100	250 180 150	14.9 0.6 1.4	2.2 0.1 0.1	120	4.0	21.5%	5.0	24.3	26.
3 Pelubang	Pelubang	Padang Terap river	230,100 81,400 19,500	100 100 100	250 180 150	57.5 14.7 2.0	8.6 1.5 0.2	150	4.3	21.4%	19.0	103.5	110.
4 Kuala Nerang	Kuala Nerang	Padang Terap river	8,830 7,800 2,100	100 100 100	250 180 150	2.2 1.4 0.3	0.3 0.1 0.1	10	0.3	25.0%	1.1	5.8	6.1
5 Padang Sanai	Padang Sanai	Padang Sanai river	- 6,930 6,200	100 100 100	250 180 150	- 1.2 0.9	- 0.1 0.1	-	-	31.5%	0.7	3.0	3.2
6 Jenun	Pendang	MADA Central Canal	35,500 15,000 -	100 100 100	250 180 150	8.8 2.7 -	1.3 0.3 -	10	0.3	21.4%	3.8	16.2	17.
7 Arau Canal	Arau	Arau Canal	182,000 32,100 14,200	100 100 100	250 180 150	45.5 5.8 2.1	6.8 0.6 0.2	800	26.4	20.9%	18.9	105.7	105.7-81.9 *23.8 25.

TABLE III. 3.1.7 FEATURES OF PROJECTED DOMESTIC/INDUSTRIAL WATER DEMAND IN 2010

	NAME OF INTAKE FACILITIES	NAME OF TREATMENT PLANT	NAME OF SOURCE	POPULATION (urban) (semi urban) (rural)	SURICE FACTER (%)	PAR CAPITA CONSUMPTION (l/cap/day)	DOMESTIC WATER DEMAND (m3/day)	COMMERTIAL & INSTITUTIONAL WATER DEMAND (m3/d)	INDUSTRIAL ARIA (ha)	INDUSTRIAL DEMAND (m3d)	UNCOUNTABLE WATER RATIO	UNCOUNTABLE WATER DEMAND (m3d)	TOTAL WATER DEMAND (m3d)	ABSTRACTION FROM RIBER & CANAL (m3d)
1	Lahar Tiang	Sg.Dua	Muda river	1,714,100 535,800 90,900	100 100 100	300 200 160	514.2 27.2 14.5	54.3 2.7 1.4	3,890	131.3	15.5%	130.7	976.3	(976.3-165.0 +811.3) + /0.85-960.
2	Sg.Petani	Sg.Petani	Muda river	325,200 8,100 -	100 100 100	280 200 160	63.1 1.6 -	8.5 0.2 -	1,290	41.6	15.0%	17.6	154.8	140.
3	Pinang Tunggal	Pinang Tunggal	Muda river	155,200 17,800 12,200	100 100 100	280 200 160	43.5 3.5 2.0	6.5 0.4 0.2	80	2.6	15.6%	9.5	68.0	(68.0-9.1-3.6 -73.3) 77.
4	Kulim phase 2	Kulim phase 2	Muda river	264,000 16,300 12,400	100 100 100	260 200 160	73.9 3.3 2.0	11.1 0.3 0.2	800	26.4	15.4%	18.1	135.5	(135.5-9.1- 27-10-89.2 84.
5	Kuala Ketil	Kuala Ketil	Muda river	22,900 8,500 -	100 100 100	280 200 160	6.4 1.7 -	1.0 0.2 -	260	8.8	15.6%	2.8	20.7	22.
6	Telui	Telui	Muda river	- - 20,000	100 100 100	280 200 160	- - 3.2	- - 0.5	-	-	20.0%	0.7	4.2	4.4
7	Jeniang	Jeniang	Muda river	34,900 2,100 -	100 100 100	280 200 160	9.8 0.4 -	1.5 0.1 -	30	1.0	15.0%	1.9	14.7	16.
8	Jeneri	Jeneri	Muda river	- 30,500 -	100 100 100	280 200 160	- 6.1 -	- 0.6 -	-	-	20.0%	1.3	8.0	8.4
9	Lubuk Merbau	Lubuk Merbau	Muda river	- 4,000 5,100	100 100 100	280 200 160	- 0.8 0.8	- 0.1 0.1	-	-	25.0%	0.3	2.1	2.2
10	Kasi	Kasi	Muda river	- - 19,000	100 100 100	280 200 160	- - 3.0	- - 0.5	-	-	30.0%	0.7	4.0	4.2
11	Sg.Limau	Sg.Limau	Ketil river	- 42,600 10,500	100 100 100	280 200 160	- 6.5 1.7	- 0.8 0.2	40	1.3	22.1%	2.7	15.3	16.
12	Batu Lima	Sik(St.5)	Chepir river	45,300 4,800 -	100 100 100	280 200 160	13.5 0.9 -	2.0 0.1 -	70	2.3	15.1%	2.9	21.7	21.
13	Siken	Siken	Sedim river	- - 13,900	100 100 100	280 200 160	- - 2.1	- - 0.2	-	-	20.0%	0.5	2.8	2.9

	NAME OF INTAKE FACILITIES	NAME OF TREATMENT PLANT	NAME OF SOURCE	POPULATION (urban) (semi urban) (rural)	SURICE FACTER (%)	PAR CAPITA CONSUMPTION (l/cap/day)	DOMESTIC WATER DEMAND (m3/day)	COMMERTIAL & INSTITUTIONAL WATER DEMAND (m3/day)	INDUSTRIAL ARIA (ha)	INDUSTRIAL DEMAND (m3d)	UNCOUNTABLE WATER RATIO	UNCOUNTABLE WATER DEMAND (m3d)	TOTAL WATER DEMAND (m3d)	ABSTRACTION FROM RIBER & CANAL (m3)
1	Bukit Pinang	Bukit Pinang	MADA Central Canal	236,900 52,000 25,300	100 100 100	280 200 160	66.3 10.4 4.1	10.0 1.0 0.4	490	16.2	16.1%	17.5	125.9	132.5
2	Changloon	Changloon	Tenia river	- 798,000 4,500 11,700	100 100 100 100	280 200 160	22.3 0.9 1.9	3.3 0.1 0.2	350	11.6	15.0%	8.4	46.7	49.2
3	Pelubang	Pelubang	Padang Terap river	280,100 99,100 16,200	100 100 100	280 200 160	78.4 19.8 2.6	11.8 2.0 0.3	380	12.5	16.2%	20.6	148.8	153.8
4	Kuala Nerang	Kuala Nerang	Padang Terap river	10,700 9,400 2,600	100 100 100	280 200 160	3.0 1.9 0.4	0.5 0.2 0.1	30	1.0	16.9%	1.2	8.3	8.7
5	Padang Sanai	Padang Sanai	Padang Sanai river	- 6,300 7,500	100 100 100	280 200 160	- 1.7 1.2	- 0.2 0.1	-	-	25.0%	0.6	4.0	4.2
6	Jonun	Pendang	MADA Central Canal	42,700 16,200 -	100 100 100	280 200 160	12.0 3.6 -	1.8 0.4 -	20	0.7	16.2%	3.0	21.5	22.6
7	Arau Canal	Arau	Arau Canal	355,200 28,400 17,100	100 100 100	280 200 160	71.5 5.7 2.7	10.7 0.6 0.3	2,000	66.0	15.5%	24.4	181.9	(181.9-158.1 +23.8) 25.0

TABLE III. 3.2.1

THE NATIONAL AGRICULTURAL POLICY (1992 - 2010)

				GROWTH RATE (%)		
	1990	2000	2010	1991–2000	2001–2010	1991–2010
Population (million)	18.010	22.608	28.381	2.30	2.30	2.30
Per Capita Consumption (kg/yr/person)	87	75	65	(1.47)	(1.42)	(1.45)
Consumption of Rice (million tonnes)	1.567	1.696	1.845	0.79	0.85	0.82
Prod. of Padi (mil. t)	1.751	1.695	1.846	(0.32)	0.86	0.27
Prod. of Rice (mil. t)	1.138 *	1.102	1.200	(0.32)	0.85	0.27
Resultant SSL (%)	72.63	64.99	65.05	(1.10)	0.01	(0.55)
MAIN GRANARIES (8 schemes)						
Area (ha)	212,497	212,497	212,497	0.00	0.00	0.00
CI (%)	166	180	180	0.81	0.00	0.41
Cropped Area (ha)	352,745	382,495	382,495	0.81	0.00	0.41
Yield (tonnes/ha)	3.34	4.20	4.85	2.32	1.45	1.88
Production of Padi	1,060,352	1,445,830	1,669,589	3.15	1.45	2.30
Production of Rice	689,228	939,789	1,085,233	3.15	1.45	2.30
% Share of total national production	60.6	85.3	90.4	3.48	0.59	2.02
SECONDARY GRANARIES (74 schemes)						
Area (ha)	28,441	28,441	28,441	0.00	0.00	0.00
CI (%)	120	150	170	2.26	1.26	1.76
Cropped Area (ha)	34,129	42,662	48,350	2.26	1.26	1.76
Yield (tonnes/ha)	3.34	3.80	4.06	1.30	0.66	0.98
Production of Padi	102,592	145,902	176,574	3.58	1.93	2.75
Production of Rice	66,685	94,837	114,773	3.58	1.93	2.75
% Share of total national production	5.86	8.61	9.56	3.92	1.06	2.48
TOTAL GRANARIES						
Area (ha)	240,938	240,938	240,938	0.00	0.00	0.00
Cropped Area (ha)	386,874	425,156	430,844	0.95	0.13	0.54
Production (padi)	1,162,944	1,591,732	1,846,163	3.19	1.49	2.34
Production (rice)	755,914	1,034,626	1,200,006	3.19	1.49	2.34
Prod. capacity to meet national rice prod. targe	66%	94%	100%	3.52	0.63	2.07

* Estimated for 1990 . Resultant overall SSL is 72.6%. Note that figures for 1990 and for year 2000 include production of rice from non-granary areas.
Based on 10% allowance of padi yield for post-harvest losses and padi to rice conversion rate of 65%.

Source : MOA's calculations (1991)

TABLE III. 3.2.2 FEATURES OF PROJECTED IRRIGATION SCHEME (MUDA RIVER BASIN)

STATE DISTRICT	No	NAME OF SCHEME	CATEGORY	NAME OF INTAKE FACILITY	IRRIGATION AREA (ha) AT 2000 MAIN	AT 2000 OFF	AT 2010 MAIN	AT 2010 OFF	WATER SOURCE	NOTES
P. Pinang Seberang Perai Utara	1	Sg. Muda	Main Grana Arles	Bumbung Lima	6,777	6,777	6,777	6,777	Sg. Muda	pumping capasity (1,223,000 cum/day)
	2	Pinang Tunggal	Main Grana Arles	Pinang Tunggal*	1,178	1,178	1,178	1,178	Sg. Muda	(985,000 cum/day)
Kedah Kuala Muda	3	Kota - II	6	Kota - II	2,390	2,390	2,390	2,390	Sg. Muda	(598,000 cum/day)
	4	Pekura	6	Pekura	1,557	94*	1,557	1,557	Sg. Muda	(330,000 cum/day)
	5	Pinang Tunggal	6	Pinang Tunggal	257	279	279	279	Sg. Muda	(88,000 cum/day)
Kulim	6	Teral Batu	7	Teral Batu	28	26	—	—	Sg. Muda	(14,000 cum/day)
Kuala Muda	7	Pantai Peral/Serukam	2	Pantai Peral	---	---	—	—	Sg. Muda	(132,000 cum/day)
Kulim	8	Sidam Kanan	7	Sidam Kanan	453	263	453	227	Sg. Muda	(60,000 cum/day)
Kuala Muda	9	Sidam Kiri	7	Sidam Kiri	219	219	219	110	Sg. Muda	(88,000 cum/day)
	10	Kg. Kemumbong	2	Kg. Kemumbong	---	—	—	—	Sg. Muda	(18,000 cum/day)
	11	Kg. Lubuk Klab	2	Kg. Lubuk Klab		—	—	—	Sg. Muda	(12,000 cum/day)
Baling	12	Pantai Cicak	3	Pantai Cicak	---	—	—	—	Sg. Muda	(14,000 cum/day)
Sik	13	Padang Cicak	3	Padang Cicak	71	35	---	—	Sg. Muda	(24,000 cum/day)
Kedah Kulim	14	Merbau Pulas	7	Merbau Pulas	95	14	95	—	Sg. Sedim	pumping capasity (23,000 cum/day)
Baling	15	Ulu Sedim/ Siputeh	1	Ulu Sedim/ Siputeh	---	---	—	—	Sg. Sedim	Head Work
	16	Ulu Bakal	1	Ulu Bakal	---	---	—	—	Sg. Sedim	Head Work
	17	Kg. Badang	3	Kg. Badang	75	75	--	—	Sg. Sedim	Head Work
	18	Kg. Mempelam	3	Kg. Mempelam	67	67	----	—	Sg. Sedim	Head Work
Kulim	19	Kg. Padang Meha	7	Kg. Padang Meha	150	6	150	—	Sg. Karangan	Head Work
Kulim	20	Titi Karangan	7	Titi Karangan	225	10	225	—	Sg. Karangan	Head Work
Baling	21	Kg. Tawar	2	Kg. Tawar	---	---	—	—	Sg. Ketil	Head Work
Kulim	22	Kg. Landak	2	Kg. Landak	---	---	—	—	Sg. Ketil	pumping capasity (24,000 cum/day)
Baling	23	Kg. Ibol	7	Kg. Ibol	158	158	158	80	Sg. Ketil	Head Work
	24	Simpang Empat	2	Simpang Empat	---	---	—	—	Sg. Ketil	Head Work
	25	Pulai	6	Pulai	239	239	239	239	Sg. Ketil	pumping capasity (73,000 cum/day)
	26	Tanjung Pari	2	Tanjung Pari	101	---	—	—	Sg. Ketil	Head Work
	27	Sg. Tiek	2	Sg. Tiek	---	---	—	—	Sg. Ketil	Head Work
Kedah Baling	28	Sg. Limau/ Corok Sikin	2	Sg. Limau	92	—	—	—	Sg. Limau	pumping capasity (22,000 cum/day)
	29	Kg. Luar	7	Kg. Luar	181	83	181	80	Sg. Limau	pumping capasity (51,000 cum/day)
Sik	30	Tanjung Besar	6	Tanjung Besar	172	172	172	172	Sg. Chepir	pumping capasity (59,000 cum/day)
	31	Sg. Telol	3	Sg. Telol	71	71	—	—	Sg. Chepir	pumping capasity (22,000 cum/day)
	32	Sg. Chepir	2	Sg. Chepir	---	—	—	—	Sg. Chepir	
	33	Tanjung Sik	7	Tanjung Sik	91	61	91	50	Sg. Chepir	Head Work
	34	Kg. Parit	6	Kg. Parit	192	192	192	192	Sg. Jeneri	Head Work
Kulim	35	Jemeril	2	Jemeril	---	—	—	—	Sg. Sedim	Head Work
	36	Padang Meha	7	Padang Meha	150	6	150	—	Sg. Sedim	Head Work

Ref : . Information from D.I.D
. Information from I.A.D.P (P.Pinang)
. Feasibility Study on Rationalization and Crop Diversion in Non-Granary Irrigation Areas

* Notes Included JARAK (Pokok Tampang) SCHEME -172ha-

TABLE III.3.2.3 FEATURES OF PROJECTED IRRIGATION SCHEME (KEDAH RIVER BASIN AND MUDA IRRIGATION SCHEME)

STATE DISTRICT	No	NAME OF SCHEME	CATEGORY	NAME OF INTAKE FACILITY	IRRIGATION AREA (ha) AT 2000 MAIN	AT 2000 OFF	AT 2010 MAIN	AT 2010 OFF	WATER SOURCE	NOTES
Perlis	37	Alor Melaka	6	Alor Melaka	209	209	209	209	Sg. Arau	I.A.D.P.
	38	Kampung Lanjut	—	Kampung Lanjut	378	177	378	378	Central Canal	National Small Scale Irrigation Schemes
Kedah Kota Setar	39	Gua Ginu	3	Gua Ginu	111	62	—	—	Southern Canal	-ditto-
	40	Nawa Gajah Mati	1	Sg. Nawa	----	----	—	—	Sg Padang Kerbau	-ditto-
Pendang	41	Sg. Lampan/ Rambai	7	Sg. Lampan	1,667	226	1,667	—	Sg. Lampan	-ditto-
	42	Padang Pusing	2	Padang Pusing	1,449	----	—	—	Northern Canal	-ditto-
	43	Paya Rawa I	6	Raya Rawa	363	363	363	363	Central Canal	-ditto-
Kubang Pasu	44	Padang Kerbau I & II	7	Padang Kerbau	850	850	850	—	Sg Padang Kerbau	-ditto-
	45	Padang Kerbau III	7	Padang Kerbau	423	----	423	—	Sg Padang Kerbau	-ditto-
Padang Terap	46	Janing	7	Janing	137	57	137	—	Sg. Janing	Rancangan Telah Siap
	47	Carok Kejal	7	Carok Kejal	90	30	90	—	Sg. Kejal	National Small Scale Irrigation Schemes
	48	Kurung Hitam	7	Kurung Hitam	100	100	100	—	Sg. Perik	-ditto-
Kubang Pasu	49	Kg. Binjal	7	Kg. Binjal	172	172	172	—	Sg. Temin	I.A.D.P.
	50	Lembah Bata I	7	Lembah Bata	324	324	324	—	Sg. Temin/ Sg. Bata	National Small Scale Irrigation Schemes
	51	Sg. Pering	6	Sg. Pering	445	445	445	445	Southern Canal	-ditto-
	52	Che Kedo/ Pulat	6	Che Kedo	324	324	324	324	Southern Canal	-ditto-
	53	Sg. Gelong	7	Sg. Gelong	283	----	283	—	Southern Canal	-ditto-
	54	Lembah Bata II	7	Lembah Bata	930	----	930	—	Sg. Temin/ Sg. Bata	-ditto-
Padang Terap	55	Corak Sena	—	Corak Sena	73	73	—	—	Sg. Ahning	
	56	Kg. Pisang	—	Kg. Pisang	101	101	—	—	Sg. Padang Sona	
	57	Kg. Carok Rasau	—	Kg. Carok Rasau	81	81	—	—	Sg. Padu	
	58	Kg. Tekal	—	Kg. Tekal	81	81	—	—	Sg. Padu	
	59	Kg. Tandop Besar	—	Kg. Tandop Besar	61	28	—	—	Sg. Padu	
Yan	60	Bakong Lubuk Bol	6	Sg. Udang	506	446	506	506	Sg. Udang Southern Canal	National Small Scale Irrigation Schemes
KEDA PERLIS		MADA	Main Grana Aria	Pelubang Barrage	95,000	95,000	95,000	95,000		

TABLE III. 3.2.4 FARMING ACTIVITIES AND IRRIGATION SCHEDULES (1/3)

NAME OF SCHEME	NO.	AREA (ha)	SCHEDULE DATE OF START									
			PS-1	PU-1	S-1	G-1	D-1	PS-2	PU-2	S-2	G-2	D-1
Sg. Muda	I	1,159	MAR/1	MAR/15	MAR/18	MAR/20	JUL/8	AUG/20	SEP/3	SEP/6	SEP/8	DEC/27
	II	2,248	MAR/15	MAR/29	APR/1	APR/3	JUL/22	SEP/3	SEP/17	SEP/20	SEP/22	JAN/10
	III	2,115	MAR/29	APR/12	APR/15	APR/17	AUG/5	SEP/17	OCT/1	OCT/4	OCT/6	JAN/24
	IV	1,255	APR/12	APR/26	APR/29	MAY/1	AUG/19	OCT/1	OCT/15	OCT/18	OCT/20	FEB/7
Pinang Tunggal (P. Pinang)	I	398	MAR/15	MAR/29	APR/1	APR/3	JUL/22	SEP/3	SEP/17	SEP/20	SEP/22	JAN/10
	II	402	MAC/29	APR/12	APR/15	APR/17	AUG/5	SEP/17	OCT/1	OCT/4	OCT/6	JAN/24
	III	378	APR/12	APR/26	APR/29	MAY/1	AUG/19	OCT/1	OCT/15	OCT/18	OCT/20	FEB/7
Pekula & Kota II	I	1,315	MAR/1	MAR/15	MAR/18	MAR/20	JUL/8	AUG/20	SEP/3	SEP/6	SEP/10	DEC/27
	II	1,315	MAR/15	MAR/29	APR/1	APR/3	JUL/22	SEP/3	SEP/17	SEP/20	SEP/22	JAN/10
	III	1,317	MAR/29	APR/12	APR/15	APR/17	AUG/5	SEP/17	OCT/1	OCT/4	OCT/6	JAN/24
Pinang Tunggal (Kedah)	I	140	MAR/15	MAR/29	APR/1	APR/3	JUL/22	SEP/3	SEP/17	SEP/20	SEP/22	JAN/10
	II	139	MAR/29	APR/12	APR/15	APR/17	AUG/5	SEP/17	OCT/1	OCT/4	OCT/6	JAN/24
Sidam Kanan	I	(114) 227	MAR/1	MAR/15	MAR/18	MAR/20	JUL/8	AUG/20	SEP/3	SEP/6	SEP/8	DEC/27
	II	(113) 226	MAR/15	MAR/29	APR/1	APR/3	JUL/22	SEP/3	SEP/17	SEP/20	SEP/22	JAN/10
Sidam Kiri	I	(60) 110	MAR/1	MAR/15	MAR/18	MAR/20	JUL/8	AUG/20	SEP/3	SEP/6	SEP/8	DEC/27
	II	(50) 109	MAR/15	MAR/29	APR/1	APR/3	JUL/22	SEP/3	SEP/17	SEP/20	SEP/22	JAN/10
Merbau Pulas	I	95	----	----	----	----	----	AUG/20	SEP/3	SEP/6	SEP/8	DEC/27
Titi Karangan	I	225	----	----	----	----	----	AUG/20	SEP/3	SEP/6	SEP/8	DEC/27
Kg. Ibol	I	(80) 158	MAR/1	MAR/15	MAR/18	MAR/20	JUL/8	AUG/20	SEP/3	SEP/6	SEP/8	DEC/27
Kg. Luar	I	(83) 181	MAR/1	MAR/15	MAR/18	MAR/20	JUL/8	AUG/20	SEP/3	SEP/6	SEP/8	DEC/27
Tanjung Sik	I	(61) 91	MAR/1	MAR/15	MAR/18	MAR/20	JUL/8	AUG/20	SEP/3	SEP/6	SEP/8	DEC/27
Tanjung Besar	I	86	MAR/1	MAR/15	MAR/18	MAR/20	JUL/8	AUG/20	SEP/3	SEP/6	SEP/8	DEC/27
	II	86	MAR/15	MAR/29	APR/1	APR/3	JUL/22	SEP/3	SEP/17	SEP/20	SEP/22	JAN/10
Kg. Parit	I	96	MAR/1	MAR/15	MAR/18	MAR/20	JUL/8	AUG/20	SEP/3	SEP/6	SEP/8	DEC/27
	II	96	MAR/15	MAR/29	APR/1	APR/3	JUL/22	SEP/3	SEP/17	SEP/20	SEP/22	JAN/10

NOTES
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O : DRAINING

REF . Information from D.I.D
. A review of the available water resources and irrigation schedule in Seberang Peral

TABLE III. 3.2.4 FARMING ACTIVITIES AND IRRIGATION SCHEDULES (2/3)

NAME OF SCHEME	NO.	AREA (ha)	SCHEDULE DATE OF START PS-1	PU-1	S-1	G-1	D-1	PS-2	PU-2	S-2	G-2	D-1
Alor Melaka	I	109	MAR/1	MAR/8	MAR/11	MAR/13	JUL/1	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
	II	100	MAR/8	MAR/15	MAR/18	MAR/20	JUL/8	AUG/27	SEP/3	SEP/6	SEP/8	DEC/27
Kampung Lanjut	I	200	MAR/1	MAR/8	MAR/11	MAR/13	JUL/1	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
	II	178	MAR/8	MAR/15	MAR/18	MAR/20	JUL/8	AUG/27	SEP/3	SEP/6	SEP/8	DEC/27
Padang Kerbau I, II, III	I	637	—	—	—	—	—	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
	II	600	—	—	—	—	—	AUG/27	SEP/3	SEP/6	SEP/8	DEC/27
Sg. Lampan/ Rambai	I	867	—	—	—	—	—	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
	II	800	—	—	—	—	—	AUG/27	SEP/3	SEP/6	SEP/8	DEC/27
Raya Rawa I	I	183	MAR/15	MAR/8	MAR/11	MAR/13	JUL/1	SEP/3	SEP/10	SEP/13	SEP/15	JAN/3
	II	180	MAR/22	MAR/29	APR/1	APR/3	JUL/22	SEP/10	SEP/17	SEP/20	SEP/22	JAN/10
Janing	I	137	—	—	—	—	—	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
Carok Kejal	I	90	—	—	—	—	—	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
Kurung Hitam	I	100	—	—	—	—	—	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
Kg. Binjal	I	172	—	—	—	—	—	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
Lembah Bata I	I	164	—	—	—	—	—	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
	II	160	—	—	—	—	—	AUG/27	SEP/3	SEP/6	SEP/8	DEC/27
Sg. Pering	I	225	MAR/1	MAR/8	MAR/11	MAR/13	JUL/1	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
	II	200	MAR/8	MAR/15	MAR/18	MAR/20	JUL/8	AUG/27	SEP/3	SEP/6	SEP/8	DEC/27
Che Kedo/ Pulat	I	164	MAR/1	MAR/8	MAR/11	MAR/13	JUL/1	AUG/20	SEP/10	SEP/13	SEP/15	JAN/3
	II	160	MAR/8	MAR/22	MAR/25	MAR/27	JUL/15	AUG/27	SEP/3	SEP/6	SEP/8	DEC/27
Sg. Gelong	I	143	—	—	—	—	—	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
	II	140	—	—	—	—	—	AUG/27	SEP/3	SEP/6	SEP/8	DEC/27
Lembah Bata II	I	470	—	—	—	—	—	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
	II	460	—	—	—	—	—	AUG/27	SEP/3	SEP/6	SEP/8	DEC/27
Bakong Lubuk Boi	I	256	MAR/1	MAR/8	MAR/11	MAR/13	JUL/1	AUG/20	AUG/27	AUG/30	SEP/1	DEC/20
	II	250	MAR/8	MAR/15	MAR/18	MAR/20	JUL/8	AUG/27	SEP/3	SEP/6	SEP/8	DEC/27

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REF
. Information from D.I.D
. Information from MADA
. P.K.P Report -1985-
. Present field activities of MADA Area
. Present field activities of Fringe Area

TABLE III. 3.2.4 FARMING ACTIVITIES AND IRRIGATION SCHEDULES (3/3)

NAME OF SCHEME	NO.	SCHEDULE										
		AREA	DATE OF START									
		(ha)	PS-1	PU-1	S-1	G-1	D-1	PS-2	PU-2	S-2	G-2	D-2
MADA SOUTH		2,800	MAR/01	MAR/08	MAR/11	MAR/13	JUL/18	AUG/20	AUG/27	AUG/30	SEP/01	JAN/06
(Phase 1)		2,850	MAR/08	MAR/15	MAR/18	MAR/20	JUL/25	AUG/27	SEP/03	SEP/06	SEP/08	JAN/13
Pelubang		2,850	MAR/15	MAR/22	MAR/25	MAR/27	AUG/01	SEP/03	SEP/10	SEP/13	SEP/15	JAN/20
Guar		2,850	MAR/22	MAR/29	APR/01	APR/03	AUG/08	SEP/10	SEP/17	SEP/20	SEP/22	JAN/27
kepayang		2,850	MAR/29	APR/05	APR/08	APR/10	AUG/15	SEP/17	SEP/24	SEP/27	SEP/29	FEB/03
Tokai		2,850	APR/05	APR/12	APR/15	APR/17	AUG/22	SEP/24	OCT/01	OCT/04	OCT/06	FEB/10
Junun		2,850	APR/12	APR/19	APR/22	APR/24	AUG/29	OCT/01	OCT/08	OCT/11	OCT/13	FEB/17
		2,850	APR/19	APR/26	APR/29	MAY/01	SEP/05	OCT/08	OCT/15	OCT/18	OCT/20	FEB/24
(Phase 2)		2,850	MAR/08	MAR/15	MAR/18	MAR/20	JUL/25	AUG/27	SEP/03	SEP/06	SEP/08	JAN/13
		2,850	MAR/15	MAR/22	MAR/25	MAR/27	AUG/01	SEP/03	SEP/10	SEP/13	SEP/15	JAN/20
		2,850	MAR/22	MAR/29	APR/01	APR/03	AUG/08	SEP/10	SEP/17	SEP/20	SEP/22	JAN/27
		2,850	MAR/29	APR/05	APR/08	APR/10	AUG/15	SEP/17	SEP/24	SEP/27	SEP/29	FEB/03
		2,850	APR/05	APR/12	APR/15	APR/17	AUG/22	SEP/24	OCT/01	OCT/04	OCT/06	FEB/10
		2,850	APR/12	APR/19	APR/22	APR/24	AUG/29	OCT/01	OCT/08	OCT/11	OCT/13	FEB/17
		2,850	APR/19	APR/26	APR/29	MAY/01	SEP/05	OCT/08	OCT/15	OCT/18	OCT/20	FEB/24
		2,850	APR/26	MAY/03	MAY/06	MAY/08	SEP/12	OCT/15	OCT/22	OCT/22	OCT/25	MAR/03
MADA NORTH		2,850	MAR/01	MAR/08	MAR/11	MAR/13	JUL/18	AUG/20	AUG/27	AUG/30	SEP/01	JAN/06
(Phase 1)		3,200	MAR/08	MAR/15	MAR/18	MAR/20	JUL/25	AUG/27	SEP/03	SEP/06	SEP/08	JAN/13
Lana Batu		3,200	MAR/15	MAR/22	MAR/25	MAR/27	AUG/01	SEP/03	SEP/10	SEP/13	SEP/15	JAN/20
Jitra		3,200	MAR/22	MAR/29	APR/01	APR/03	AUG/08	SEP/10	SEP/17	SEP/20	SEP/22	JAN/27
Pelubang		3,200	MAR/29	APR/05	APR/08	APR/10	AUG/15	SEP/17	SEP/24	SEP/27	SEP/29	FEB/03
		3,200	APR/05	APR/12	APR/15	APR/17	AUG/22	SEP/24	OCT/01	OCT/04	OCT/06	FEB/10
		3,200	APR/12	APR/19	APR/22	APR/24	AUG/29	OCT/01	OCT/08	OCT/11	OCT/13	FEB/17
		3,200	APR/19	APR/26	APR/29	MAY/01	SEP/05	OCT/08	OCT/15	OCT/18	OCT/20	FEB/24
(Phase 2)		2,850	MAR/08	MAR/15	MAR/18	MAR/20	JUL/25	AUG/27	SEP/03	SEP/06	SEP/08	JAN/13
		3,200	MAR/15	MAR/22	MAR/25	MAR/27	AUG/01	SEP/03	SEP/10	SEP/13	SEP/15	JAN/20
		3,200	MAR/22	MAR/29	APR/01	APR/03	AUG/08	SEP/10	SEP/17	SEP/20	SEP/22	JAN/27
		3,200	MAR/29	APR/05	APR/08	APR/10	AUG/15	SEP/17	SEP/24	SEP/27	SEP/29	FEB/03
		3,200	APR/05	APR/12	APR/15	APR/17	AUG/22	SEP/24	OCT/01	OCT/04	OCT/06	FEB/10
		3,200	APR/12	APR/19	APR/22	APR/24	AUG/29	OCT/01	OCT/08	OCT/11	OCT/13	FEB/17
		3,200	APR/19	APR/26	APR/29	MAY/01	SEP/05	OCT/08	OCT/15	OCT/18	OCT/20	FEB/24
		3,200	APR/26	MAY/03	MAY/06	MAY/08	SEP/12	OCT/15	OCT/22	OCT/22	OCT/25	MAR/03

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REF
. Information from D.I.D
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. Present field activities of MADA Area
. Present field activities of Fringe Area

TABLE III. 3.2.5 CROP COEFFICIENT

PERIOD AFTER TRANSPLANTING	0-10	-20	-30	-40	-50	-60	-70	-80	-90	-100	-110	-120	-130	-140
135-DAY VARIETY	1.01	1.06	1.16	1.29	1.38	1.44	1.45	1.42	1.31	1.16	1.00	DRAINAGE		
145-DAY VARIETY	1.01	1.06	1.16	1.28	1.36	1.42	1.44	1.45	1.41	1.31	1.16	1.00	DRAINAGE	

TABLE III. 3.2.6 AVERAGE MONTHLY PAN EVAPORATION

(unit : mm)

NAME OF KEY STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ALOR SETAR	5.65	6.10	5.84	5.07	4.03	3.76	3.78	3.92	3.72	3.82	3.63	4.51	1636
KAMPLEK RUMAH MUDA	5.45	6.21	6.22	5.51	4.67	4.47	4.50	4.59	4.38	4.22	4.11	4.48	1787

TABLE III. 3.2.7 PROJECTED IRRIGATION WATER DEMAND - GROSS DEMAND -

NAME OF SCHEME	PROJECTED IRRIGATION WATER DEMAND AT 2010 (Unit : million litter)												
	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1 SG.MUDA	8677	813	9427	19223	15932	14649	10848	4174	13639	16541	13475	14455	141853
2 PINANG.TUNGGAL	1965	244	918	3304	2837	2581	2209	623	1931	3100	2316	2619	24647
TOTAL OF P. PINANG	10642	1057	10345	22527	18769	17230	13057	4797	15570	19641	15791	17074	166500
3 PEKULA & KOTA-2	4182	0	8400	13192	10721	10210	6500	2784	10709	10445	9716	9858	96717
4 PINANG.TUNGGAL	442	0	335	999	738	740	591	69	719	761	681	739	6814
5 SIDAM KANAN	217	0	685	704	634	576	279	367	1402	1160	1131	1077	8232
6 SIDAM KIRI	105	0	331	341	307	279	135	177	677	561	546	520	3979
7 MERBAU PULAS	0	0	0	0	0	0	0	153	282	235	237	207	1114
8 KG.PADANG MEHA	0	0	0	0	0	0	0	243	446	371	374	327	1761
9 TITI KARANGAN	0	0	0	0	0	0	0	364	669	557	561	491	2642
10 KG.IBOI	0	0	318	228	228	195	56	256	470	391	394	345	2881
11 PULAI	114	0	721	741	668	607	294	193	739	612	596	568	5853
12 KG.LUAR	0	0	330	237	236	202	58	293	538	448	451	395	3188
13 TANJUNG SIK	0	0	242	174	173	149	42	147	270	225	227	198	1847
14 TANJUNG BESAR	82	0	519	533	481	436	211	139	531	440	429	408	4209
15 KG.PARIT	92	0	580	595	536	487	236	155	593	492	479	455	4700
(total of muda)	5234	0	12461	17744	14722	13881	8402	5340	18045	16698	15822	15588	143937
16 MADA SOUTH(phase-1)	42013	11875	34137	56567	45779	42702	37288	24128	41023	49805	39707	49748	474778
17 MADA SOUTH(phase-2)	54060	24435	16999	47770	50293	42131	42342	26661	32416	50878	39974	50956	478915
18 KG.LANJUT	524	0	1436	973	972	856	543	538	1021	872	868	918	9321
19 PADANG KERBAU 1,2,3	1065	0	0	0	0	0	0	1765	3342	2855	2840	3007	14874
20 SG.LAMPAN/RAMBAI	1434	0	0	0	0	0	0	2379	4503	3849	3828	4052	20045
21 RAYA RAWA 1	746	0	807	1014	898	861	763	127	1168	779	823	965	8951
22 BAKONG LUBUK BOI	435	0	1922	1302	1300	1146	727	722	1367	1167	1162	1229	12479
23 MADA NORTH(phase-1)	46629	13181	37891	62783	50811	47393	41387	26779	45540	55278	44069	55214	526955
24 MADA NORTH(phase-2)	60000	27121	18868	53019	55821	46761	46997	29590	35980	56468	44367	56555	531547
25 KG.BINJAL	98	0	0	0	0	0	0	291	459	403	395	407	2053
26 LEMBAH BATA 1	277	0	0	0	0	0	0	462	875	748	744	787	3893
27 SG.PENING	364	0	1614	1094	1093	952	611	606	1147	980	976	1033	10480
28 CHE KEDO/PUTAT	277	0	1230	834	833	733	465	462	875	748	744	787	7988
29 SG.OELONG	243	0	0	0	0	0	0	403	764	652	650	688	3400
30 LEMBAH BATA-2	799	0	0	0	0	0	0	1326	2512	2146	2136	2260	11179
31 ALOR MELAKA	178	0	794	537	537	472	300	297	564	482	480	507	5148
32 JAING	78	0	0	0	0	0	0	231	366	321	314	324	1634
33 CAROK REJAL	51	0	0	0	0	0	0	152	240	211	206	213	1073
34 KURUNG HITAM	57	0	0	0	0	0	0	169	267	234	229	236	1192
(total of muda)	202702	76612	107895	220139	202704	176987	168014	107158	154965	212429	168117	212473	2012195
(total of fringe)	6426	0	7803	5754	5633	5030	3409	9930	19470	16447	16395	17413	113710
TOTAL OF KEDAH (& part of perlis)	214362	76612	128159	243637	223059	197898	179825	122428	192480	245574	200334	245474	2269842
TOTAL OF SCHEME	225004	77669	138504	266164	241828	215128	192882	127225	208050	265215	216125	262548	2436342

TABLE III. 3.2.8 PROJECTED IRRIGATION WATER DEMAND - NET DEMAND -

PROJECTED IRRIGATION WATER DEMAND - (Unit : million liter)

YEAR	P.PINANG	KEDAH			TOTAL
		(MADA)	(MUDA BASIN)	(OTHERS) (TOTAL)	
1962	49460	868899	52322	43459 964680	1014140
1963	54684	922711	49807	33028 1005546	1060230
1964	39664	870957	47342	39297 957596	997260
1965	62739	716808	46202	29671 792681	855420
1966	26667	580419	51376	32871 664666	691333
1967	58668	681974	56002	40179 778155	836823
1968	61611	811060	51748	46847 909655	971266
1969	54304	781441	46480	37759 865680	919984
1970	47102	687938	40823	35803 764564	811666
1971	67274	720751	48969	38642 808362	875636
1972	48112	736489	53874	35029 825392	873504
1973	44674	659712	49149	29431 738292	782966
1974	66531	852540	67435	44669 964644	1031175
1975	55607	508797	53007	35326 597130	652737
1976	38002	729152	61673	40682 831507	869509
1977	49603	864762	65674	46757 977193	1026796
1978	63728	870852	63898	51715 986465	1050193
1979	50297	863655	58129	51049 972833	1023130
1980	59782	751568	52402	39728 843698	903480
1981	68650	1019035	69708	70285 1159028	1227678
1982	42148	704154	49462	38344 791960	834108
1983	56621	844112	58616	44932 947660	1004281
1984	63174	766386	59539	53312 879237	942411
1985	58706	889695	54564	45877 990136	1048842
1986	45900	799527	57029	36515 893071	938971
1987	59694	855737	56942	41221 953900	1013594
1988	71885	667175	65148	38076 770399	842284
1989	64050	866074	55885	49496 971455	1035505
1990	53338	788656	63906	46241 898803	954141
1991	60048	820312	65005	44159 929476	989524
AVERAGE	54824	783378	55737	42013 881128	935952
ABSTRAC TION	97899	1229792	101339	76387 1407518	1505417

NAME OF SCHEME	PROJECTED IRRIGATION WATER DEMAND (Unit : million litter)												
	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
AVERAGE													
TOTAL OF P. PINANG	5845	794	7345	10902	3886	5275	4237	1602	6473	4550	569	3341	54824
(total of muda)	3692	0	9488	9600	3636	5319	3005	2524	7509	3197	1821	5940	55737
(total of mada)	170397	66373	89160	131196	40308	21861	20236	18795	73531	69868	9397	72250	783378
(total of fringe)	5366	0	6955	2723	1008	1382	693	6859	7117	834	989	6092	42015
TOTAL OF KEDAH (& part of perlis)	179457	66373	105604	143520	44953	28563	23925	28180	88159	73900	12207	86283	881128
TOTAL OF SCHEME	185302	67167	112949	154423	48839	33838	28163	29785	94632	78451	12777	89625	935952

TABLE III. 3.2.8 PROJECTED IRRIGATION WATER DEMAND - NET DEMAND -

NAME OF SCHEME	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
PROJECTED IRRIGATION WATER DEMAND (Unit : million litter)													
1962													
TOTAL OF P. PINANG	5501	1057	6898	11817	1799	7601	2352	523	8808	1063	0	2041	49460
(total of muda)	2239	0	7596	10992	3712	4500	532	1715	10926	2003	2090	6017	52322
(total of muda)	182940	76664	89127	136457	62497	25794	3943	10972	93397	71155	6994	109059	868899
(total of fringe)	5977	0	6343	3204	1829	1946	78	4365	7589	1795	174	10159	43459
TOTAL OF KEDAH (& part of perlis)	191156	76664	103066	150653	68038	32240	4553	17052	111812	74953	9258	125235	964680
TOTAL OF SCHEME	196657	77721	109964	162470	69837	39841	6905	17575	120620	76016	9258	127276	1014140
1963													
TOTAL OF P. PINANG	740	1057	7278	17547	1180	5437	9733	1598	8731	1383	0	0	54684
(total of muda)	899	0	10101	13783	1582	2074	4943	2776	9328	2289	0	2032	49807
(total of muda)	181185	73695	96632	214168	61697	22196	67920	33240	77411	50855	3254	40458	922711
(total of fringe)	3719	0	7471	6010	1747	1056	1544	4410	3356	37	0	3678	33028
TOTAL OF KEDAH (& part of perlis)	185803	73695	114204	233951	65026	25326	74407	40426	90095	53181	3254	46168	1005545
TOTAL OF SCHEME	186543	74752	121482	251508	66206	30763	84140	42024	98826	54564	3254	46168	1060230
1964													
TOTAL OF P. PINANG	6492	1016	10087	11349	2017	2	896	1218	2661	3104	0	822	39664
(total of muda)	3519	0	11155	8249	2524	4840	594	3035	3149	3101	0	7176	47342
(total of muda)	190535	65570	107297	121965	24320	38139	44441	35818	76258	83965	7218	75330	870957
(total of fringe)	6425	0	8324	2511	138	2714	945	7943	2742	1210	282	6083	39297
TOTAL OF KEDAH (& part of perlis)	200579	65570	126776	132725	26982	45693	45980	46796	82149	88277	7500	88589	957596
TOTAL OF SCHEME	207071	66586	136863	144074	28999	45695	46876	48014	84810	91381	7500	89391	997260
1965													
TOTAL OF P. PINANG	10436	809	7411	7958	5721	15064	3283	1177	6178	4381	321	0	62739
(total of muda)	5145	0	8155	7539	2029	8742	2671	2113	7009	1715	142	942	45202
(total of muda)	202880	59435	92683	128163	34450	21944	15075	8465	76234	64892	6977	6210	716806
(total of fringe)	6518	0	7224	2585	458	1424	943	5717	4043	247	0	512	29671
TOTAL OF KEDAH (& part of perlis)	214543	59435	108062	138287	36937	32110	18689	16295	87286	66854	6519	7664	792681
TOTAL OF SCHEME	224979	60244	115473	146245	42658	47174	21972	17472	93464	71235	6840	7664	855420
1966													
TOTAL OF P. PINANG	0	26	6336	4453	1777	1716	0	385	8133	3700	141	0	26667
(total of muda)	1992	0	8140	10231	674	6597	1629	1561	9452	4019	2593	4488	51376
(total of muda)	143564	56856	77207	109391	12529	394	4216	17154	81259	71850	5460	539	580419
(total of fringe)	4300	0	6496	2117	44	298	355	8540	9819	200	0	702	32871
TOTAL OF KEDAH (& part of perlis)	149856	56856	91843	121739	13247	7289	6200	27255	100530	76069	8053	5729	664666
TOTAL OF SCHEME	149856	56882	98179	126192	15024	9005	6200	27640	108663	79769	8194	5729	691333
1967													
TOTAL OF P. PINANG	672	992	9052	11429	2182	8585	5207	3145	10901	4864	0	1639	58568
(total of muda)	1714	0	10565	10845	9253	3662	1335	1435	9293	3060	372	4468	56002
(total of muda)	72564	71294	105342	100362	19292	6373	0	13071	79185	65056	12857	136578	681974
(total of fringe)	1212	0	8087	1382	156	999	100	7118	5748	195	635	14547	40179
TOTAL OF KEDAH (& part of perlis)	75490	71294	123994	112589	28701	11034	1435	21624	94226	68311	13864	155593	778155
TOTAL OF SCHEME	76162	72286	133046	124018	30883	19619	6642	24769	105127	73175	13864	157232	836823
1968													
TOTAL OF P. PINANG	7396	713	7644	10667	6448	8197	1232	1161	9156	8997	0	0	61611
(total of muda)	5033	0	9657	8055	836	5333	337	2916	9789	5734	1134	2922	51748
(total of muda)	202455	74663	90284	134879	37390	3028	9594	15565	84052	68923	10207	80020	811060
(total of fringe)	6518	0	6760	5246	866	766	469	7559	6433	351	2283	11598	46847
TOTAL OF KEDAH (& part of perlis)	214006	74663	106701	146180	39092	9129	10400	26040	100274	75008	13624	94538	909655
TOTAL OF SCHEME	221402	75376	114345	156847	45540	17326	11632	27201	109430	84005	13624	94538	971266
1969													
TOTAL OF P. PINANG	2242	1057	7226	18432	2327	4863	2742	2809	10570	2032	4	0	54304
(total of muda)	3043	0	8507	12442	2145	4075	1037	1983	11588	1523	0	137	46480
(total of muda)	97691	67438	85955	174154	59602	23264	5748	26992	94328	84975	5888	54806	781441
(total of fringe)	1322	0	6587	3935	1912	911	339	5811	10107	130	0	6705	37759
TOTAL OF KEDAH (& part of perlis)	102056	67438	101049	191131	63659	28250	7124	34765	116023	86628	5888	61648	865680
TOTAL OF SCHEME	104298	68495	108275	209563	65986	33113	9866	37595	126593	88660	5892	61648	919984
1970													
TOTAL OF P. PINANG	842	1044	8400	13293	4150	8975	470	1595	7348	985	0	0	47102
(total of muda)	1828	0	9907	7254	5048	6054	445	2943	6025	1092	0	227	40823
(total of muda)	172226	76664	82747	150803	30706	1429	830	14372	45572	56299	3851	51439	687938
(total of fringe)	5765	0	6783	3094	559	1165	214	7994	4827	13	0	5389	35803
TOTAL OF KEDAH (& part of perlis)	179819	76664	99437	161151	36313	8648	1489	25309	57424	57404	3851	57055	764564
TOTAL OF SCHEME	180661	77708	107837	174444	40463	17623	1959	26904	64772	58389	3851	57055	811666
1971													
TOTAL OF P. PINANG	5633	1057	7445	18415	9423	7094	6726	321	5472	4332	1356	0	67274
(total of muda)	2456	0	10333	11116	4138	5148	1540	1029	6631	1441	3706	1421	48969
(total of muda)	138972	64395	88000	205091	21522	1045	7217	38380	69564	61214	7237	20014	720751
(total of fringe)	3607	0	6824	5557	345	690	208	8273	7756	111	0	5471	38642
TOTAL OF KEDAH (& part of perlis)	145045	64395	104957	221764	26005	6883	8965	45682	84051	62766	10943	26906	808362
TOTAL OF SCHEME	150678	65452	112402	240179	35428	13977	15691	46003	89523	67098	12299	26906	875636

TABLE III. 3.2.8 PROJECTED IRRIGATION WATER DEMAND - NET DEMAND -

NAME OF SCHEME	PROJECTED IRRIGATION WATER DEMAND (Unit : million litter)												
	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1972													
TOTAL OF P. PINANG	5092	653	6612	7221	9267	362	5169	3663	4369	5704	0	0	48112
(total of muda)	2768	0	10563	7482	8377	2437	5850	4366	4383	3449	0	4199	53874
(total of mada)	189543	54805	90738	124115	51615	13300	46759	16980	57247	81856	3955	5566	736489
(total of fringe)	6016	0	7268	2212	2036	866	1350	8819	5083	137	0	1242	35029
TOTAL OF KEDAH (& part of perlis)	198327	54805	108569	133809	62028	16603	53959	30165	66713	85452	3955	11007	825392
TOTAL OF SCHEME	203419	55458	115181	141030	71295	16965	59128	33828	71082	91156	3955	11007	873504
1973													
TOTAL OF P. PINANG	4106	1037	4844	6083	4817	1512	3999	344	11526	6139	247	0	44674
(total of muda)	4580	0	8636	8047	5141	4624	1328	939	11463	2385	511	1695	49149
(total of mada)	161231	70146	92159	91421	29831	17352	23843	11916	95658	56144	6453	2558	659712
(total of fringe)	6227	0	6990	1348	13	1586	478	2616	6698	46	43	3386	29431
TOTAL OF KEDAH (& part of perlis)	172038	70146	107785	100816	34985	23562	25549	15471	114819	58575	6807	7639	738292
TOTAL OF SCHEME	176144	71203	112629	106899	39802	25074	29648	15815	126345	64714	7054	7639	782966
1974													
TOTAL OF P. PINANG	4765	1057	7684	8757	1199	8908	6704	1663	7107	6372	1113	11202	66531
(total of muda)	4699	0	9723	6545	5365	6071	5475	4001	6707	2926	2402	13521	67435
(total of mada)	163831	57574	82431	151237	36804	15974	0	12767	70163	72169	27631	161959	852540
(total of fringe)	6070	0	7156	2628	610	1714	271	6012	6431	78	1113	12586	44669
TOTAL OF KEDAH (& part of perlis)	174600	57574	99310	160410	40779	25759	5746	22780	83301	75173	31146	188068	964644
TOTAL OF SCHEME	179365	58631	106994	169167	41978	34667	12450	24443	90408	81545	32259	199268	1031175
1975													
TOTAL OF P. PINANG	3648	420	4921	12014	8630	10168	3858	1178	4079	6689	2	0	55607
(total of muda)	1752	0	8912	11398	3998	7011	4295	2968	7014	4246	0	1413	53007
(total of mada)	61270	50404	85384	100647	13373	7289	33751	13744	51032	77707	7574	6622	508797
(total of fringe)	3281	0	6556	1691	510	1053	1591	8415	5873	250	1525	4781	35326
TOTAL OF KEDAH (& part of perlis)	66303	50404	100852	113736	17681	15353	39637	25127	63919	82203	9099	12816	597130
TOTAL OF SCHEME	69951	50824	105773	125750	26311	25521	43495	26305	67998	88892	9101	12816	652737
1976													
TOTAL OF P. PINANG	3442	352	8074	8862	209	1353	4858	2816	6186	1850	0	0	38002
(total of muda)	3465	0	9120	8847	1278	6019	2725	2844	10665	4984	2452	9274	61673
(total of mada)	164208	75016	88380	112423	16359	29763	17269	8837	51693	56411	6881	101912	729152
(total of fringe)	6078	0	6820	2322	199	1869	629	5904	9437	0	0	7424	40682
TOTAL OF KEDAH (& part of perlis)	173751	75016	104320	123592	17836	37651	20623	17585	71795	61395	9333	118610	831507
TOTAL OF SCHEME	177193	75368	112394	132454	18045	39004	25481	20401	77981	63245	9333	118610	869509
1977													
TOTAL OF P. PINANG	4292	412	10006	14028	1356	3001	8526	2313	3875	504	514	776	49603
(total of muda)	3544	0	11609	14714	5460	5584	5335	2038	7328	1097	1189	7658	65674
(total of mada)	152589	66788	102689	178497	17100	25332	45821	9871	46387	51088	10605	157995	864762
(total of fringe)	3974	0	8038	4697	62	1541	838	5360	6908	0	174	14965	46757
TOTAL OF KEDAH (& part of perlis)	160207	66788	122336	197908	22622	32457	51994	17489	60621	52185	11968	180618	977193
TOTAL OF SCHEME	164499	67200	132342	211936	23978	35458	60520	19802	64496	52689	12482	181394	1026796
1978													
TOTAL OF P. PINANG	4556	559	6328	15263	39	4064	0	767	9445	3630	3403	15676	63728
(total of muda)	4289	0	6943	13102	401	708	1776	2679	10445	4225	3698	13632	63898
(total of mada)	160073	71461	86053	162951	52482	23312	0	13483	72798	67371	21611	139257	870852
(total of fringe)	6274	0	6536	3697	1362	846	0	8039	5821	2145	3914	13081	51715
TOTAL OF KEDAH (& part of perlis)	170636	71461	101532	179750	54245	24866	1776	24201	89064	73741	29223	165970	986465
TOTAL OF SCHEME	175190	72020	107860	195013	54284	28930	1776	24968	98509	77371	32626	181646	1050193
1979													
TOTAL OF P. PINANG	7709	1033	7125	6737	4453	1149	3408	869	7515	6683	0	1616	50297
(total of muda)	4004	0	11196	8501	3810	2940	3475	2494	9729	5804	334	8842	58129
(total of mada)	200987	76664	88549	95372	68690	33917	0	12869	81811	96931	3219	104646	863655
(total of fringe)	6518	0	7255	1264	2294	1310	568	4735	9506	5437	303	11859	51049
TOTAL OF KEDAH (& part of perlis)	211509	76664	107000	103137	74794	38167	4043	20098	101046	108172	3856	122347	972833
TOTAL OF SCHEME	219218	77697	114125	111874	79247	39316	7451	20967	108561	116855	3856	123963	1023130
1980													
TOTAL OF P. PINANG	10321	1016	8231	13097	7307	8231	5043	733	2718	3005	80	0	59782
(total of muda)	5087	0	9369	9704	6343	6027	3677	1998	3906	891	101	3299	52402
(total of mada)	202880	65448	88577	119605	66412	24357	246	10195	84249	75445	4389	9765	751568
(total of fringe)	6518	0	7037	2493	2228	905	268	7196	11101	146	107	1731	39728
TOTAL OF KEDAH (& part of perlis)	214485	65448	104983	131802	74983	33289	4189	19389	99258	76482	4597	14795	843698
TOTAL OF SCHEME	224806	66464	113214	144899	82290	41520	9232	20122	101974	79487	4677	14795	903480
1981													
TOTAL OF P. PINANG	4050	0	7873	7336	2071	6384	9926	3592	3053	8694	345	15124	68650
(total of muda)	3733	0	10504	9492	3303	6900	4880	4001	4425	5682	2878	13910	69708
(total of mada)	196885	57546	95812	86439	88439	85736	31020	37159	104543	112858	5220	117348	1019035
(total of fringe)	6427	0	7665	1030	2314	3082	1068	8973	12469	8499	2899	15859	70285
TOTAL OF KEDAH (& part of perlis)	207045	57546	113981	96961	94056	95718	36968	50133	121437	127059	10997	147117	1159028
TOTAL OF SCHEME	211095	57546	121854	104297	98127	102102	46894	53725	124492	135753	11342	162241	1227678

TABLE III. 3.2.8 PROJECTED IRRIGATION WATER DEMAND - NET DEMAND -

NAME OF SCHEME	PROJECTED IRRIGATION WATER DEMAND (Unit : million litter)												
	JAN.	FEB.	MAR.	APR.	MEY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1982													
TOTAL OF P. PINANG	10170	1057	7079	8693	965	0	596	3634	4885	5069	0	0	42148
(total of muda)	5128	0	8455	5526	3408	6086	2733	3197	9970	2062	0	2892	49462
(total of mada)	202880	70426	100299	88663	20516	1274	0	11149	101373	64513	6804	35257	704154
(total of fringe)	6518	0	7936	969	107	1149	108	5145	8858	730	103	6721	38344
TOTAL OF KEDAH (& part of perlis)	214526	70426	116690	95158	24031	8509	2846	19491	120201	67305	6907	45870	791960
TOTAL OF SCHEME	224696	71483	123769	103851	24996	8509	3442	23125	125086	72374	6907	45870	834108
1983													
TOTAL OF P. PINANG	8173	1057	7146	19618	209	0	2829	2016	1930	7250	561	5832	56621
(total of muda)	4956	0	10171	15128	0	128	2776	3072	2512	3375	6913	9585	58616
(total of mada)	189912	76265	96246	202970	27687	63	0	13604	48532	78913	16919	92899	844112
(total of fringe)	5821	0	7210	5746	557	75	166	8351	3984	174	2230	10618	44932
TOTAL OF KEDAH (& part of perlis)	200689	76265	113827	223844	28244	265	2942	25027	55128	82464	26062	113102	947660
TOTAL OF SCHEME	208862	77322	120773	243462	28453	266	5771	27043	57058	89714	26623	118934	1004281
1984													
TOTAL OF P. PINANG	6787	0	7728	4280	3130	9851	5453	544	8897	9531	1523	5350	63174
(total of muda)	4048	0	9145	5700	885	5487	2247	3268	9581	6383	6194	6601	59539
(total of mada)	162910	67280	82390	100689	60021	9558	0	15337	91187	88197	13292	75525	766386
(total of fringe)	5997	0	6128	1352	1794	987	304	8327	6011	2766	8342	9304	53312
TOTAL OF KEDAH (& part of perlis)	172955	67280	97663	107741	62700	16032	2551	26932	108779	97346	27828	91430	879237
TOTAL OF SCHEME	179742	67280	105391	112021	65830	25883	8004	27476	117676	106977	29351	96780	942411
1985													
TOTAL OF P. PINANG	6707	649	6939	8759	9854	10464	6041	1255	6320	1009	709	0	58706
(total of muda)	4556	0	9318	8393	3370	8948	5543	3178	6070	641	0	4547	54564
(total of mada)	177456	49116	80811	126628	65469	59755	85084	33031	72886	70842	4689	63927	889693
(total of fringe)	6409	0	6177	2750	2217	2733	1874	8608	8216	12	0	6881	45877
TOTAL OF KEDAH (& part of perlis)	188421	49116	96306	137771	71056	71437	92501	44817	87172	71495	4689	75355	990136
TOTAL OF SCHEME	195128	49765	103245	146530	80910	81901	98542	46072	93492	72504	5398	75355	1048842
1986													
TOTAL OF P. PINANG	9071	1057	7773	14683	1835	0	4622	982	2609	929	0	2339	45900
(total of muda)	4934	0	9983	10892	2304	7992	4876	2504	3785	2031	0	7668	57029
(total of mada)	186476	70656	89827	113883	44479	29547	67460	21266	63669	52661	911	58692	799527
(total of fringe)	6026	0	7029	2057	1803	2145	1472	5679	6113	9	0	4182	36515
TOTAL OF KEDAH (& part of perlis)	197496	70656	106839	126832	48386	39684	73808	29449	73567	54701	911	70542	893071
TOTAL OF SCHEME	206567	71713	114612	141515	50421	39684	78430	30431	76176	55630	911	72881	938971
1987													
TOTAL OF P. PINANG	10648	1057	8530	11940	928	5422	4713	1394	5981	9101	0	0	59694
(total of muda)	5101	0	10216	10520	4716	8302	5043	3177	4626	4015	900	326	56942
(total of mada)	202189	76654	89358	153793	46103	68005	48651	19041	46507	65147	4705	35574	855737
(total of fringe)	6511	0	6808	4057	1349	1914	1885	9261	5913	50	0	3473	41221
TOTAL OF KEDAH (& part of perlis)	213801	76664	106382	168370	52168	78221	55579	31479	57046	69212	5605	39373	953900
TOTAL OF SCHEME	224449	77721	114912	180310	53096	83643	60292	32873	63007	78313	5605	39373	1013594
1988													
TOTAL OF P. PINANG	7499	542	6782	5667	9429	10344	6100	2026	7007	4617	2006	9866	71685
(total of muda)	4229	0	9023	7478	8205	5472	5262	915	5995	2591	4995	11283	65148
(total of mada)	197159	27262	69123	76306	28515	27365	0	6608	56812	73516	32204	72105	667175
(total of fringe)	6507	0	5674	366	364	2100	0	3995	6827	66	2577	9500	38076
TOTAL OF KEDAH (& part of perlis)	207895	27262	83820	83850	37084	35137	5262	11518	69634	76173	39778	92988	770399
TOTAL OF SCHEME	215394	27804	90602	89517	46513	45481	11362	13544	76641	80790	41782	102854	842284
1989													
TOTAL OF P. PINANG	7757	1057	7539	8128	11586	2114	2624	582	3877	5339	1157	12290	64050
(total of muda)	3880	0	7066	4353	7353	4016	1536	1919	5845	2529	5886	11501	55885
(total of mada)	191092	75009	79512	90544	53277	37724	41263	21484	61615	59762	9871	144921	865074
(total of fringe)	6394	0	6694	740	924	1924	1325	8203	6226	0	1951	15115	49496
TOTAL OF KEDAH (& part of perlis)	201366	75009	93272	95637	61554	43664	44124	31606	73687	62291	17708	171537	971455
TOTAL OF SCHEME	209123	76066	100811	103765	73140	45778	46748	32188	77564	67630	18865	183827	1035505
1990													
TOTAL OF P. PINANG	7426	903	7590	7340	1059	5479	8190	3346	8206	2335	0	3464	55338
(total of muda)	3470	0	10065	11739	2485	6607	5186	3401	8568	4922	0	7463	63906
(total of mada)	166755	72724	92468	137495	33378	2413	6947	52820	88859	59201	3961	71635	788656
(total of fringe)	4735	0	7045	2969	1257	1339	985	9201	7363	77	0	11270	46241
TOTAL OF KEDAH (& part of perlis)	174960	72724	109578	152203	37120	10359	13118	65422	104790	64200	3961	90368	898803
TOTAL OF SCHEME	182386	73627	117168	159543	38179	15838	21308	68768	112996	66535	3961	93832	954141
1991													
TOTAL OF P. PINANG	9187	1037	3779	13217	1214	1924	1821	434	6667	5128	3400	12220	60048
(total of muda)	4525	0	8518	10246	2951	3198	1076	1251	9085	5723	6350	12072	65005
(total of mada)	190486	73264	78730	146192	24690	0	0	9711	79566	56093	21677	133903	820312
(total of fringe)	3338	0	5952	3677	397	363	136	5008	10281	115	1024	13868	44159
TOTAL OF KEDAH (& part of perlis)	204349	73264	93200	160115	28048	3561	1212	15970	98932	61931	29051	159843	929476
TOTAL OF SCHEME	213536	74321	96979	173332	29262	5485	3033	16404	105599	67059	32451	172063	989524

TABLE III. 4.2.1 LOAD FACTOR OF WATER UTILIZATION

NAME OF POINT	ANNUAL NATURAL FLOW (million cum)	TOTAL ABSTRACTION (million cum)	LOAD FACTOR (%)
MUDA RIVER SYSTEM (excluded muda dam basin)			
JENIANG	620	15	2.4
JAM.SYED OMAR	1,940	50	2.6
LDG.VICTORIA	2,500	70	2.8
MUDA BARRAGE	2,660	700	26.3
BATU LIMA	250	8	3.2
KUALA PEGANG	760	15	2.0
MERBAU PULAS	480	9	1.9
KEDAH RIVER SYSTEM (included muda dam basin)			
KUALA NERANG	1,200	8	0.6
PERUBAN BARRAGE SG.TEMIN & SG.ARAU	1,820	1,430	78.5

TABLE III. 4.2.2 ESTIMATION METHODS OF NATURAL FLOW

Calculating Point	Integrated Intakes	Conversion Factor and Key Station
Muda Dam	-----	(Natural Flow of Nami)*984/1220
Beris Dam	-----	(Natural Flow of Nami)*116/1220
Kaok and Reman Dam	-----	(Natural Flow of Padu Dam)*47/171/2 + (Natural Flow of Kuala Pegang)*47/704/2
Jeniang Barrage	D/I : Jeneri,Telui A : Kg.Parit	(Natural Flow of Jeniang)*1651/1740 -(Natural Flow of Muda Dam)
Jam Syed Omar	D/I : Kuara Ketil A : Sidam Kanan,Sidam Kiri	(Natural Flow of Jam Syed Omar)*3330/4010 -(Natural Flow of Muda Dam)
Muda Barrage	D/I : Kulim,Sg.Petani,Pinang Tunggal, Lahar Tiang A : Sg.Muda,Kota-2,Pinang Tunggal,Pekula	(Natural Flow of Ldg.Victoria)*4201/4010 -(Natural Flow of Muda Dam)
Ahning Dam	D/I : Padan Senai	(Natural Flow of Lengkuas)*120/1270
Kuala Nerang	D/I : Kuala Nerang A : Jaing,Carok Kejai,Kurung Hitam	(Natural Flow of Lengkuas)*971/1270+(Natural Flow of Muda Dam)
Pelubang Barrage MADA south	D/I : Pelubang,Bt.Pinang,Jenun A : MADA south,MADA central,Kg.Lanjut Padang Kerubau,Sg.Lampan/Rabai, Raya Rawa, Bakong Lubuk Boi	(Natural Flow of Lengkuas)*1247/1270+(Natural Flow of Muda Dam)
Pelubang Barrage	D/I : Arou A : MADA north,Kg.Binjai,Lambah Bata, Sg.Pening,Cha Kedo/Putat,Sg.Gelong, Lambah Bata,Alor Melaka	
Sg.Temin		(Natural Flow of Lengkuas)*461/1270
Sg.Arau		(Natural Flow of Lengkuas)*317/1270

TABLE III. 4.4.1 ANNUAL MINIMUM STORAGE VOLUME OF DAM RESERVOIR (IN CASE OF ONLY BERIS DAM CONSTRUCTED)

(unit : 1,000 cum)

YEAR	MUDA & PEDU	AHNING	BERIS
1962	575219.3	200000.0	103426.5
1963	100951.9	200000.0	75568.8
1964	.0	99988.5	68699.5
1965	.0	.0	85836.5
1966	175048.1	68556.8	108607.4
1967	280791.3	113397.6	101521.6
1968	233092.8	172962.0	89545.9
1969	149072.8	200000.0	100826.5
1970	.0	164972.4	95637.1
1971	157936.3	200000.0	105645.8
1972	73149.3	200000.0	96470.7
1973	354419.4	200000.0	105553.5
1974	677283.6	200000.0	102242.9
1975	506777.8	200000.0	102316.2
1976	514032.7	200000.0	96410.1
1977	316018.9	200000.0	53577.4
1978	26027.0	200000.0	56986.7
1979	.0	.0	.0
1980	.0	.0	.0
1981	.0	.0	.0
1982	.0	.0	.0
1983	.0	.0	.0
1984	.0	.0	10859.3
1985	.0	.0	23354.4
1986	.0	.0	41174.6
1987	.0	.0	41990.7
1988	369408.4	86299.5	96591.2
1989	660367.9	177752.3	107298.2
1990	275804.6	199536.7	100520.0
1991	10470.0	199680.2	90905.2

TABLE III. 4.4.2 RESULT OF WATER DEMAND AND SUPPLY BALANCE SIMU LATION (IN CASE OF ONLY BERIS DAM CONSTRUCTED)

WATER BARANCE OF MUDA & KEDAH RIVER SYSTEM CASE ---- 0 (unit : million cum)

YEAR	MUDA RIVER SYSTEM						KEDAH RIVER SYSTE					
	REPLENISHMENT		DIFICIT				REPLENISHMENT				DIFICIT	
	BERIS DAM	N/R DAM	MAINTENANCE FLOW BEFORE CONTROL	MAINTENANCE FLOW AFTER CONTROL	WATER-USE BEFORE CONTROL	WATER-USE AFTER CONTROL	P/M DAM	AHNING DAM	N/R DAM	J.TRASFER	BEFORE CONTROL	AFTER CONTROL
1962	11.7	.0	10.8	.0	11.7	.0	830.6	.0	.0	.0	830.6	.0
1963	38.7	.0	23.6	.0	38.7	.0	924.8	.0	.0	.0	924.8	.0
1964	46.7	.0	23.1	.0	46.7	.0	639.8	100.1	.0	.0	739.8	.0
1965	26.4	.0	21.2	.0	26.4	.0	435.3	127.3	.0	.0	610.5	47.9
1966	6.1	.0	4.5	.0	6.1	.0	460.9	.0	.0	.0	460.9	.0
1967	12.5	.0	11.0	.0	12.5	.0	440.4	.0	.0	.0	440.4	.0
1968	25.5	.0	20.5	.0	25.5	.0	645.5	.0	.0	.0	645.5	.0
1969	15.5	.0	11.5	.0	15.5	.0	598.4	.0	.0	.0	598.4	.0
1970	18.6	.0	15.7	.0	18.6	.0	571.6	35.0	.0	.0	606.6	.0
1971	14.5	.0	12.8	.0	14.5	.0	594.7	.0	.0	.0	594.7	.0
1972	18.5	.0	17.4	.0	18.5	.0	587.7	.0	.0	.0	587.7	.0
1973	8.5	.0	8.2	.0	8.5	.0	333.0	.0	.0	.0	333.0	.0
1974	15.2	.0	13.0	.0	15.2	.0	677.0	.0	.0	.0	677.0	.0
1975	12.2	.0	10.8	.0	12.2	.0	456.1	.0	.0	.0	456.1	.0
1976	17.7	.0	14.5	.0	17.7	.0	546.6	.0	.0	.0	546.6	.0
1977	61.4	.0	24.7	.0	61.4	.0	783.6	.0	.0	.0	783.6	.0
1978	48.5	.0	29.8	.0	48.5	.0	943.3	.0	.0	.0	943.3	.0
1979	63.2	.0	49.2	16.7	103.3	40.1	247.0	205.6	.0	.0	771.4	316.6
1980	21.6	.0	45.7	33.6	90.2	68.5	229.5	68.2	.0	.0	721.9	426.1
1981	35.9	.0	27.7	6.2	40.0	4.1	604.8	63.9	.0	.0	941.9	273.2
1982	24.0	.0	31.2	20.3	81.5	57.5	103.5	.8	.0	.0	687.2	583.0
1983	26.8	.0	32.5	16.0	99.9	73.2	436.2	60.4	.0	.0	898.6	402.1
1984	26.6	.0	16.4	.0	26.8	.0	849.0	76.2	.0	.0	786.9	61.7
1985	11.9	.0	8.8	.0	11.9	.0	304.6	18.2	.0	.0	808.5	485.7
1986	31.5	.0	11.6	.0	31.5	.0	414.4	30.5	.0	.0	749.2	304.3
1987	35.9	.0	12.4	.0	35.9	.0	459.2	43.7	.0	.0	654.2	351.3
1988	8.5	.0	3.9	.0	8.3	.0	406.6	.2	.0	.0	406.8	.0
1989	6.8	.0	4.4	.0	6.8	.0	621.5	.2	.0	.0	621.6	.0
1990	15.1	.0	10.4	.0	15.1	.0	812.1	.8	.0	.0	812.9	.0
1991	23.4	.0	19.2	.0	23.4	.0	655.7	.3	.0	.0	656.1	.0

TABLE III. 4.4.3 ANNUAL MINIMUM STORAGE VOLUME OF DAM RESERVOIR (IN CASE OF JENIANG TRANSFER CANAL AND NAOK DAM CONSTRUCTED)

(unit : 1,000 cum)

YEAR	MUDA & PEDU	AHNING	BERIS	NAOK
1962	624223.0	200000.0	103248.9	27400.0
1963	236591.5	200000.0	75563.0	27400.0
1964	101150.1	200000.0	68798.3	27400.0
1965	43229.1	200000.0	85888.4	27400.0
1966	335182.8	200000.0	108456.1	27400.0
1967	525418.1	200000.0	101440.8	27400.0
1968	574765.6	200000.0	89542.9	27400.0
1969	601050.8	200000.0	100808.2	27400.0
1970	499403.4	200000.0	95799.3	27400.0
1971	724259.3	200000.0	105582.5	27400.0
1972	717233.3	200000.0	96455.6	27400.0
1973	963170.9	200000.0	105435.4	27400.0
1974	783514.1	200000.0	101982.2	27400.0
1975	700277.5	200000.0	101889.4	27400.0
1976	789776.6	200000.0	96531.3	27400.0
1977	571171.5	200000.0	53826.1	27400.0
1978	338732.8	200000.0	57689.3	27400.0
1979	.0	128590.5	.0	.0
1980	.0	.0	.0	.0
1981	.0	14805.8	.0	.0
1982	.0	.0	.0	.0
1983	.0	.0	.0	.0
1984	.0	60520.0	11018.2	27400.0
1985	.0	.0	23538.7	.0
1986	.0	.0	41397.8	5622.5
1987	.0	.0	42334.0	.0
1988	431586.1	86948.8	96865.6	27400.0
1989	795413.1	178760.3	107331.4	27400.0
1990	585031.0	199540.8	100599.1	27400.0
1991	372255.1	199680.2	91097.0	27400.0

TABLE III. 4.4.4 RESULT OF WATER DEMAND AND SUPPLY BALANCE SIMULATION (IN CASE OF JENIANG TRANSFER CANAL AND NAOK DAM CONSTRUCTED)

(unit : million cum)

YEAR	MUDA RIVER SYSTEM						KEDAH RIVER SYSTE					
	REPLENISHMENT		DIFICIT MAINTENANCE FLOW		WATER-USE		REPLENISHMENT				DIFICIT	
	BERIS DAM	M/R DAM	BEFORE CONTROL	AFTER CONTROL	BEFORE CONTROL	AFTER CONTROL	P/M DAM	AHNING DAM	M/R DAM	J.TRASFER	BEFORE CONTROL	AFTER CONTROL
1962	11.9	.0	11.0	.0	11.9	.0	739.9	.0	.0	108.7	739.9	.0
1963	38.8	.0	23.6	.0	38.8	.0	870.6	.0	.0	68.6	870.6	.0
1964	46.5	.0	25.0	.0	46.5	.0	690.0	.0	.0	74.3	690.0	.0
1965	26.4	.0	21.1	.0	26.4	.0	529.2	.0	.0	128.1	529.2	.0
1966	6.2	.0	4.7	.0	6.2	.0	387.0	.0	.0	94.3	387.0	.0
1967	12.6	.0	11.1	.0	12.6	.0	374.9	.0	.0	111.5	374.9	.0
1968	25.6	.0	20.5	.0	25.6	.0	607.3	.0	.0	76.0	607.3	.0
1969	15.5	.0	11.5	.0	15.5	.0	531.2	.0	.0	103.0	531.2	.0
1970	18.4	.0	15.5	.0	18.4	.0	580.0	.0	.0	53.7	580.0	.0
1971	14.8	.0	13.1	.0	14.8	.0	538.6	.0	.0	98.3	538.6	.0
1972	18.6	.0	17.5	.0	18.6	.0	518.7	.0	.0	108.3	518.7	.0
1973	8.7	.0	8.4	.0	8.7	.0	279.5	.0	.0	115.6	279.5	.0
1974	15.6	.0	13.4	.0	15.6	.0	610.5	.0	.0	90.2	610.5	.0
1975	12.6	.0	11.2	.0	12.6	.0	384.3	.0	.0	90.6	384.3	.0
1976	17.6	.0	14.4	.0	17.6	.0	485.1	.0	.0	106.0	485.1	.0
1977	61.2	.0	24.4	.0	61.2	.0	731.2	.0	.0	76.4	731.2	.0
1978	47.9	.0	29.0	.0	47.9	.0	895.5	.0	.0	56.7	895.5	.0
1979	65.9	7.7	47.6	13.8	96.0	32.2	564.0	77.0	33.5	109.0	726.3	52.0
1980	21.6	4.8	44.1	29.0	87.9	66.3	271.0	194.8	44.1	101.7	498.4	188.8
1981	35.9	9.3	26.9	.0	35.9	.0	690.4	53.2	91.1	201.4	837.4	2.8
1982	24.0	1.4	31.3	16.8	80.8	58.8	55.5	15.8	21.7	124.5	440.1	347.3
1983	26.8	8.9	31.3	11.8	93.6	68.9	509.2	81.6	25.9	99.2	864.2	267.5
1984	26.3	.0	15.9	.0	26.3	.0	677.9	10.7	.0	134.1	688.6	.0
1985	11.9	.0	8.7	.0	11.9	.0	547.2	82.2	75.9	180.8	741.1	235.8
1986	31.3	.0	11.3	.0	31.3	.0	485.9	53.3	60.5	114.5	691.1	111.4
1987	35.7	.0	12.0	.0	35.7	.0	465.1	43.8	58.5	113.2	818.7	253.3
1988	8.3	.0	3.9	.0	8.3	.0	544.7	.2	.0	135.9	544.9	.0
1989	6.8	.0	4.4	.0	6.8	.0	516.1	.2	.0	137.8	516.2	.0
1990	15.1	.0	10.4	.0	15.1	.0	722.5	.8	.0	124.9	723.3	.0
1991	23.2	.0	19.0	.0	23.2	.0	607.2	.3	.0	81.4	607.5	.0

TABLE III. 4.4.5 ANNUAL MIMIMUM STORAGE VOLUME OF DAM RESERVOIR (IN CASE OF ALL PROPOSED WATER RESOURCE DEVELOPMENT STRUCTURES CONSTRUCTED)

(unit : 1,000 cum)

YEAR	MUDA & PEDU	AHNING	BERIS	NAOK & REMAN
1962	624223.0	200000.0	103248.9	267400.0
1963	236591.5	200000.0	75563.0	267400.0
1964	101150.1	200000.0	68798.3	267400.0
1965	43229.1	200000.0	85888.4	267400.0
1966	335182.8	200000.0	108456.1	267400.0
1967	525418.1	200000.0	101440.8	267400.0
1968	574765.6	200000.0	89542.9	267400.0
1969	601050.8	200000.0	100808.2	267400.0
1970	499403.4	200000.0	95799.3	267400.0
1971	724259.3	200000.0	105582.5	267400.0
1972	717233.3	200000.0	96455.6	267400.0
1973	963170.9	200000.0	105435.4	267400.0
1974	783514.1	200000.0	101982.2	267400.0
1975	700277.5	200000.0	101889.4	267400.0
1976	789776.6	200000.0	96531.3	267400.0
1977	571171.5	200000.0	53826.1	267400.0
1978	338732.8	200000.0	57689.3	267400.0
1979	.0	128590.5	.0	153516.3
1980	.0	.0	.0	.0
1981	.0	.0	.0	226165.7
1982	.0	.0	.0	.0
1983	.0	.0	.0	1120.5
1984	.0	28718.3	11018.2	267217.1
1985	.0	.0	23538.7	102601.0
1986	.0	.0	41397.8	241237.4
1987	.0	.0	42334.0	157911.4
1988	431586.1	86948.8	96885.6	267400.0
1989	795413.1	178760.3	107331.4	267400.0
1990	585031.0	199540.8	100599.1	267400.0
1991	372255.1	199680.2	91097.0	267400.0

TABLE III. 4.4.6 RESULT OF WATER DEMAND AND SUPPLY BALANCE SIMULATION (IN CASE OF ALL PROPOSED WATER RESOURCE DEVELOPMENT STRUCTURES CONSTRUCTED)

(unit : million cum)

YEAR	MUDA RIVER SYSTEM						KEDAH RIVER SYSTE					
	REPLENISHMENT		DIFICIT MAINTENANCE FLOW		WATER-USE		REPLENISHMENT			DIFICIT		
	BERIS DAM	N/R DAM	BEFORE CONTROL	AFTER CONTROL	BEFORE CONTROL	AFTER CONTROL	P/M DAM	AHNING DAM	N/R DAM	J.TRASFER	BEFORE CONTROL	AFTER CONTROL
1962	11.9	.0	11.0	.0	11.9	.0	739.9	.0	.0	108.7	739.9	.0
1963	38.8	.0	25.8	.0	38.8	.0	870.6	.0	.0	68.6	870.6	.0
1964	46.5	.0	25.0	.0	46.5	.0	690.0	.0	.0	74.3	690.0	.0
1965	26.4	.0	21.1	.0	26.4	.0	529.2	.0	.0	128.1	529.2	.0
1966	6.2	.0	4.7	.0	6.2	.0	387.0	.0	.0	94.3	387.0	.0
1967	12.6	.0	11.1	.0	12.6	.0	374.9	.0	.0	111.5	374.9	.0
1968	25.6	.0	20.5	.0	25.6	.0	607.3	.0	.0	76.0	607.3	.0
1969	15.5	.0	11.5	.0	15.5	.0	531.2	.0	.0	103.0	531.2	.0
1970	18.4	.0	15.5	.0	18.4	.0	580.0	.0	.0	53.7	580.0	.0
1971	14.8	.0	13.1	.0	14.8	.0	538.6	.0	.0	96.5	538.6	.0
1972	18.6	.0	17.5	.0	18.6	.0	518.7	.0	.0	108.5	518.7	.0
1973	8.7	.0	8.4	.0	8.7	.0	279.5	.0	.0	111.6	279.5	.0
1974	15.6	.0	13.4	.0	15.6	.0	610.5	.0	.0	90.2	610.5	.0
1975	12.6	.0	11.2	.0	12.6	.0	384.3	.0	.0	90.8	384.3	.0
1976	17.6	.0	14.4	.0	17.6	.0	485.1	.0	.0	166.0	485.1	.0
1977	61.2	.0	24.4	.0	61.2	.0	731.2	.0	.0	76.4	731.2	.0
1978	47.9	.0	29.0	.0	47.9	.0	895.5	.0	.0	56.7	895.5	.0
1979	63.9	42.1	47.8	.0	63.9	.0	568.1	77.0	85.3	173.7	730.4	.0
1980	21.6	76.1	44.1	1.8	21.6	.0	288.7	194.1	209.3	271.3	721.2	29.1
1981	35.9	9.3	26.9	.0	35.9	.0	632.5	66.7	148.0	231.9	852.2	5.2
1982	24.0	29.3	31.3	4.6	55.3	31.3	91.1	.8	233.3	287.6	674.8	349.7
1983	26.8	78.3	31.3	.0	26.8	.0	453.6	41.2	197.4	279.0	868.5	157.3
1984	26.3	.0	15.9	.0	26.3	.0	645.2	42.5	3.2	134.1	689.0	.0
1985	11.9	.0	8.7	.0	11.9	.0	348.5	52.4	228.6	281.6	769.1	141.6
1986	31.3	.0	11.3	.0	31.3	.0	472.8	30.7	65.7	115.1	695.3	126.0
1987	35.7	.0	12.0	.0	35.7	.0	482.2	43.8	142.3	188.6	821.0	172.7
1988	8.3	.0	5.9	.0	8.3	.0	344.7	.3	.0	135.9	345.0	.0
1989	6.8	.0	6.4	.0	6.8	.0	516.1	.3	.0	137.8	516.4	.0
1990	15.1	.0	10.6	.0	15.1	.0	721.5	1.4	.0	124.9	723.0	.0
1991	23.2	.0	18.0	.0	23.2	.0	607.2	.7	.0	81.4	607.8	.0

TABLE III. 4.4.7 RIVER USE RATIO (IN CASE OF ONLY BERIS DAM CONSTRUCTED)

YEAR	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
MUDA RIVER SYSTEM															
NATURAL RANOFF AT MUDA BARAGE	3721.5	3432.7	3618.2	4001.0	3784.9	4106.2	2773.2	4099.0	4079.3	3821.7	3885.1	4501.0	2632.7	3515.1	3865.2
NATURAL RANOFF AT MUDA DAM	710.2	654.7	668.4	694.6	598.0	781.4	515.8	650.5	606.4	653.5	720.3	943.3	482.5	623.6	649.7
NATURAL RANOFF OF MUDA RIVER	3011.4	2798.0	2949.8	3306.4	3186.9	3324.8	2257.4	3448.5	3472.9	3168.2	3164.8	3557.7	2150.2	2891.5	3215.4
TRANSFER FROM JENIANG SYSTEM	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
RETURN WATER FROM REMAN DAM	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
ABSTRACTION FROM RIVER	668.7	662.3	623.3	668.7	623.5	690.8	682.3	667.4	644.1	679.9	658.2	648.7	703.2	685.4	657.6
ABSTRACTION & TRANSFER	668.7	662.3	623.3	668.7	623.5	690.8	682.3	667.4	644.1	679.9	658.2	648.7	703.2	685.4	657.6
RIVER UTILIZATION RATIO	22.2 %	23.7 %	21.1 %	20.2 %	19.6 %	20.8 %	30.2 %	19.4 %	18.5 %	21.5 %	20.8 %	18.2 %	32.7 %	23.7 %	20.5 %
KEDAH RIVER SYSTEM															
NATURAL RANOFF AT PERBAN BAR.	619.9	503.7	601.4	849.2	599.5	821.6	697.5	804.4	841.8	730.5	945.3	998.1	499.5	806.7	884.0
NATURAL RANOFF AT MUDA DAM	710.2	654.7	668.4	694.6	598.0	781.4	515.8	650.5	606.4	653.5	720.3	943.3	482.5	623.6	649.7
NATURAL RANOFF OF TEMIN & ARAU	384.3	312.3	372.9	526.5	371.7	509.4	432.4	498.7	521.9	452.9	586.1	618.8	309.7	500.1	548.1
NATURAL RANOFF OF KEDAH RIVER	1714.4	1470.8	1642.7	2070.2	1569.2	2112.5	1645.7	1953.7	1970.1	1837.0	2251.7	2560.3	1291.7	1930.4	2081.7
ABSTRACTION FROM RIVER	1439.8	1468.0	1339.9	1139.7	938.1	984.6	1358.6	1328.4	1142.1	1198.6	1232.7	1030.2	1296.2	1060.5	1165.0
RIVER UTILIZATION RATIO	84.0 %	99.8 %	81.6 %	55.1 %	59.8 %	46.6 %	82.6 %	68.0 %	58.0 %	65.2 %	54.7 %	40.2 %	100.3 %	54.9 %	56.0 %

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	AVERAGE
MUDA RIVER SYSTEM																
NATURAL RANOFF AT MUDA BARAGE	3272.2	2079.3	2356.2	3267.6	2652.8	2793.4	2913.4	2577.3	3493.6	3224.9	4295.5	4217.1	3648.0	3147.3	3750.8	3451.5
NATURAL RANOFF AT MUDA DAM	642.6	330.9	427.2	535.8	454.3	477.2	545.1	456.3	693.2	565.8	789.8	885.3	656.3	573.4	780.2	625.5
NATURAL RANOFF OF MUDA RIVER	2629.5	1748.4	1929.1	2731.8	2198.5	2316.2	2368.2	2121.1	2800.4	2659.1	3505.7	3331.8	2991.8	2574.0	2970.6	2826.0
TRANSFER FROM JENIANG SYSTEM	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
RETURN WATER FROM REMAN DAM	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
ABSTRACTION FROM RIVER	678.6	685.9	641.6	603.8	711.1	593.6	592.7	698.0	687.1	650.9	687.5	693.8	693.5	696.5	672.3	665.0
ABSTRACTION & TRANSFER	678.6	685.9	641.6	603.8	711.1	593.6	592.7	698.0	687.1	650.9	687.5	693.8	693.5	696.5	672.3	665.0
RIVER UTILIZATION RATIO	25.8 %	39.2 %	33.3 %	22.1 %	32.3 %	25.6 %	25.0 %	32.9 %	24.5 %	24.5 %	19.6 %	20.8 %	23.2 %	27.1 %	22.6 %	24.4 %
KEDAH RIVER SYSTEM																
NATURAL RANOFF AT PERBAN BAR.	714.9	562.5	788.0	747.7	353.1	837.6	826.2	333.0	630.2	746.1	1193.0	1112.3	697.0	543.7	1023.4	743.7
NATURAL RANOFF AT MUDA DAM	642.6	330.9	427.2	535.8	454.3	477.2	545.1	456.3	693.2	565.8	789.8	885.3	656.3	573.4	780.2	625.5
NATURAL RANOFF OF TEMIN & ARAU	443.2	348.8	488.6	463.6	218.9	519.3	512.3	206.4	390.7	462.6	739.7	689.6	432.2	337.1	634.5	461.1
NATURAL RANOFF OF KEDAH RIVER	1800.7	1242.2	1703.7	1747.1	1026.3	1834.2	1883.6	995.7	1714.0	1774.5	2722.5	2687.2	1785.5	1454.1	2438.1	1830.4
ABSTRACTION FROM RIVER	1360.2	1485.7	1132.3	933.1	1329.6	688.1	993.2	1252.2	1026.5	1008.2	1131.5	1062.9	1319.9	1385.9	1262.7	1183.1
RIVER UTILIZATION RATIO	75.5 %	119.6 %	66.5 %	53.4 %	129.6 %	37.5 %	52.7 %	125.8 %	59.9 %	56.8 %	41.6 %	39.6 %	73.9 %	95.3 %	51.8 %	69.5 %

TABLE III. 4.4.8 RIVER USE RATIO (IN CASE OF JENIANG TRANSFER CANAL AND NAOK DAM CONSTRUCTED)

YEAR	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
MUDA RIVER SYSTEM															
NATURAL RANOFF AT MUDA BARAGE	3721.5	3452.7	3618.2	4001.0	3784.9	4106.2	2773.2	4099.0	4079.3	3821.7	3885.1	4501.0	2632.7	3515.1	3865.2
NATURAL RANOFF AT MUDA DAM	710.2	654.7	668.4	694.6	598.0	781.4	515.8	650.5	606.4	653.5	720.3	943.3	482.5	623.6	649.7
NATURAL RANOFF OF MUDA RIVER	3011.4	2798.0	2949.8	3306.4	3186.9	3324.8	2257.4	3448.5	3472.9	3168.2	3164.8	3557.7	2150.2	2891.5	3215.4
TRANSFER FROM JENIANG SYSTEM	108.7	68.6	74.3	128.1	94.3	111.5	76.0	103.0	53.7	96.3	108.3	111.6	90.2	90.6	106.0
RETURN WATER FROM REMAN DAM	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
ABSTRACTION FROM RIVER	668.7	662.3	623.3	668.7	623.5	690.8	682.3	667.4	644.1	679.9	658.2	648.7	703.2	685.4	657.6
ABSTRACTION & TRANSFER	777.4	731.0	697.6	796.7	717.8	802.3	758.3	770.3	697.8	776.2	766.4	760.3	793.4	776.0	763.6
RIVER UTILIZATION RATIO	25.8 %	26.1 %	23.6 %	24.1 %	22.5 %	24.1 %	33.6 %	22.3 %	20.1 %	24.5 %	24.2 %	21.4 %	36.9 %	26.8 %	23.7 %
KEDAH RIVER SYSTEM															
NATURAL RANOFF AT PERBAN BAR.	619.9	503.7	601.4	849.2	599.5	821.6	697.5	804.4	841.8	730.5	945.3	998.1	499.5	806.7	884.0
NATURAL RANOFF AT MUDA DAM	710.2	654.7	668.4	694.6	598.0	781.4	515.8	650.5	606.4	653.5	720.3	943.3	482.5	623.6	649.7
NATURAL RANOFF OF TEMIN & ARAU	384.3	312.3	372.9	526.5	371.7	509.4	432.4	498.7	521.9	452.9	586.1	618.8	309.7	500.1	548.1
NATURAL RANOFF OF KEDAH RIVER	1714.4	1470.8	1642.7	2070.2	1569.2	2112.5	1645.7	1953.7	1970.1	1837.0	2251.7	2560.3	1291.7	1930.4	2081.7
ABSTRACTION FROM RIVER	1439.8	1468.0	1339.9	1187.6	938.1	984.6	1358.6	1328.4	1142.1	1198.6	1232.7	1030.2	1296.2	1060.5	1165.0
RIVER UTILIZATION RATIO	84.0 %	99.8 %	81.6 %	57.4 %	59.8 %	46.6 %	82.6 %	68.0 %	58.0 %	65.2 %	54.7 %	40.2 %	100.3 %	54.9 %	56.0 %

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	AVERAGE
MUDA RIVER SYSTEM																
NATURAL RANOFF AT MUDA BARAGE	3272.2	2079.3	2356.2	3267.6	2652.8	2793.4	2913.4	2577.3	3493.6	3224.9	4295.5	4217.1	3648.0	3147.3	3750.8	3451.5
NATURAL RANOFF AT MUDA DAM	642.6	330.9	427.2	535.8	454.3	477.2	545.1	456.3	693.2	565.8	789.8	885.3	656.3	573.4	780.2	625.5
NATURAL RANOFF OF MUDA RIVER	2629.5	1748.4	1929.1	2731.8	2198.5	2316.2	2368.2	2121.1	2800.4	2659.1	3505.7	3331.8	2991.8	2574.0	2970.6	2826.0
TRANSFER FROM JENIANG SYSTEM	76.4	56.7	109.0	101.7	201.4	124.5	99.2	134.1	180.6	114.5	113.2	135.9	137.8	124.9	81.4	107.1
RETURN WATER FROM REMAN DAM	.0	.0	7.7	4.8	9.3	1.4	8.9	.0	.0	.0	.0	.0	.0	.0	.0	1.1
ABSTRACTION FROM RIVER	678.6	685.9	649.5	606.0	715.2	594.3	599.1	698.0	687.1	650.9	687.5	693.8	693.5	696.5	672.3	665.7
ABSTRACTION & TRANSFER	755.0	742.6	758.8	702.8	907.4	717.4	689.4	832.1	867.7	765.4	800.7	829.7	831.4	821.4	753.7	771.8
RIVER UTILIZATION RATIO	28.7 %	42.5 %	38.9 %	25.7 %	41.3 %	31.0 %	29.1 %	39.2 %	31.0 %	28.8 %	22.8 %	24.9 %	27.8 %	31.9 %	25.4 %	28.3 %
KEDAH RIVER SYSTEM																
NATURAL RANOFF AT PERBAN BAR.	714.9	562.5	788.0	747.7	353.1	837.6	826.2	333.0	630.2	746.1	1193.0	1112.3	697.0	543.7	1023.4	743.7
NATURAL RANOFF AT MUDA DAM	642.6	330.9	427.2	535.8	454.3	477.2	545.1	456.3	693.2	565.8	789.8	885.3	656.3	573.4	780.2	625.5
NATURAL RANOFF OF TEMIN & ARAU	443.2	348.8	488.6	463.6	218.9	519.3	512.3	206.4	390.7	462.6	739.7	689.6	432.2	337.1	634.5	461.1
NATURAL RANOFF OF KEDAH RIVER	1800.7	1242.2	1703.7	1747.1	1026.3	1834.2	1883.6	995.7	1714.0	1774.5	2722.5	2687.2	1785.5	1454.1	2438.1	1830.4
ABSTRACTION FROM RIVER	1360.2	1485.7	1399.1	1170.6	1600.0	723.8	1127.8	1313.9	1276.4	1201.1	1229.5	1062.9	1319.9	1385.9	1262.7	1236.3
RIVER UTILIZATION RATIO	75.5 %	119.6 %	82.1 %	67.0 %	155.9 %	39.5 %	59.9 %	132.0 %	74.5 %	67.7 %	45.2 %	39.6 %	73.9 %	95.3 %	51.8 %	72.9 %

TABLE III. 4.4.9 RIVER USE RATIO
(IN CASE OF ALL PROPOSED WATER RESOURCES DEVELOPMENT STRUCTURES CONSTRUCTED)

YEAR	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
MUDA RIVER SYSTEM															
NATURAL RANOFF AT MUDA BARAGE	3721.5	3452.7	3618.2	4001.0	3784.9	4106.2	2773.2	4099.0	4079.3	3821.7	3885.1	4501.0	2632.7	3515.1	3865.2
NATURAL RANOFF AT MUDA DAM	710.2	654.7	668.4	694.6	598.0	781.4	515.8	650.5	606.4	653.5	720.3	943.3	482.5	623.6	649.7
NATURAL RANOFF OF MUDA RIVER	3011.4	2798.0	2949.8	3306.4	3186.9	3324.8	2257.4	3448.5	3472.9	3168.2	3164.8	3557.7	2150.2	2891.5	3215.4
TRANSFER FROM JENIANG SYSTEM	108.7	68.6	74.3	128.1	94.3	111.5	76.0	103.0	53.7	96.3	108.3	111.6	90.2	90.6	106.0
RETURN WATER FROM REMAN DAM	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
ABSTRACTION FROM RIVER	668.7	662.3	623.3	668.7	623.5	690.8	682.3	667.4	644.1	679.9	658.2	648.7	703.2	685.4	657.6
ABSTRACTION & TRANSFER	777.4	731.0	697.6	796.7	717.8	802.3	758.3	770.3	697.8	776.2	766.4	760.3	793.4	776.0	763.6
RIVER UTILIZATION RATIO	25.8 %	26.1 %	23.6 %	24.1 %	22.5 %	24.1 %	33.6 %	22.3 %	20.1 %	24.5 %	24.2 %	21.4 %	36.9 %	26.8 %	23.7 %
KEDAH RIVER SYSTEM															
NATURAL RANOFF AT PERBAN BAR.	619.9	503.7	601.4	849.2	599.5	821.6	697.5	804.4	841.8	730.5	945.3	998.1	499.5	806.7	884.0
NATURAL RANOFF AT MUDA DAM	710.2	654.7	668.4	694.6	598.0	781.4	515.8	650.5	606.4	653.5	720.3	943.3	482.5	623.6	649.7
NATURAL RANOFF OF TEMIN & ARAU	384.3	312.3	372.9	526.5	371.7	509.4	432.4	498.7	521.9	452.9	586.1	618.8	309.7	500.1	548.1
NATURAL RANOFF OF KEDAH RIVER	1714.4	1470.8	1642.7	2070.2	1569.2	2112.5	1645.7	1953.7	1970.1	1837.0	2251.7	2560.3	1291.7	1930.4	2081.7
ABSTRACTION FROM RIVER	1439.8	1468.0	1339.9	1187.6	938.1	984.6	1358.6	1328.4	1142.1	1198.6	1232.7	1030.2	1296.2	1060.5	1165.0
RIVER UTILIZATION RATIO	84.0 %	99.8 %	81.6 %	57.4 %	59.8 %	46.6 %	82.6 %	68.0 %	58.0 %	65.2 %	54.7 %	40.2 %	100.3 %	54.9 %	56.0 %

YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	AVERAGE
MUDA RIVER SYSTEM																
NATURAL RANOFF AT MUDA BARAGE	3272.2	2079.3	2356.2	3267.6	2652.8	2793.4	2913.4	2577.3	3493.6	3224.9	4295.5	4217.1	3648.0	3147.3	3750.8	3451.5
NATURAL RANOFF AT MUDA DAM	642.6	330.9	427.2	535.8	454.3	477.2	545.1	456.3	693.2	565.8	789.8	885.3	656.3	573.4	780.2	625.5
NATURAL RANOFF OF MUDA RIVER	2629.5	1748.4	1929.1	2731.8	2198.5	2316.2	2368.2	2121.1	2800.4	2659.1	3505.7	3331.8	2991.8	2574.0	2970.6	2826.0
TRANSFER FROM JENIANG SYSTEM	76.4	56.7	173.7	271.3	231.9	287.6	279.0	134.1	281.6	115.1	188.6	135.9	137.8	124.9	81.4	133.2
RETURN WATER FROM REMAN DAM	.0	.0	42.1	76.1	9.3	29.3	76.3	.0	.0	.0	.0	.0	.0	.0	.0	7.8
ABSTRACTION FROM RIVER	678.6	685.9	681.6	672.3	715.2	619.7	665.9	698.0	687.1	630.9	687.5	693.8	693.5	696.5	672.3	672.1
ABSTRACTION & TRANSFER	755.0	742.6	813.2	867.5	937.9	878.0	868.6	832.1	968.7	766.0	876.2	829.7	831.4	821.4	753.7	797.6
RIVER UTILIZATION RATIO	28.7 %	42.5 %	42.2 %	31.8 %	42.7 %	37.9 %	36.7 %	39.2 %	34.6 %	28.8 %	25.0 %	24.9 %	27.8 %	31.9 %	25.4 %	29.3 %
KEDAH RIVER SYSTEM																
NATURAL RANOFF AT PERBAN BAR.	714.9	562.5	788.0	747.7	353.1	837.6	826.2	333.0	630.2	746.1	1193.0	1112.3	697.0	543.7	1023.4	743.7
NATURAL RANOFF AT MUDA DAM	642.6	330.9	427.2	535.8	454.3	477.2	545.1	456.3	693.2	565.8	789.8	885.3	656.3	573.4	780.2	625.5
NATURAL RANOFF OF TEMIN & ARAU	443.2	348.8	488.6	463.6	218.9	519.3	512.3	206.4	390.7	462.6	739.7	689.6	432.2	337.1	634.5	461.1
NATURAL RANOFF OF KEDAH RIVER	1800.7	1242.2	1703.7	1747.1	1026.3	1834.2	1883.6	995.7	1714.0	1774.5	2722.5	2687.2	1785.5	1454.1	2438.1	1830.4
ABSTRACTION FROM RIVER	1360.2	1485.7	1451.1	1330.0	1597.5	921.3	1237.9	1313.9	1370.6	1186.5	1310.2	1062.9	1319.9	1385.9	1262.7	1258.9
RIVER UTILIZATION RATIO	75.5 %	119.6 %	85.2 %	76.1 %	155.7 %	50.2 %	65.7 %	132.0 %	80.0 %	66.9 %	48.1 %	39.6 %	73.9 %	95.3 %	51.8 %	74.2 %

TABLE III. 4.4.10 WATER ALLOCATION (IN CASE OF ONLY BERIS DAM CONSTRUCTED)

(unit : million cum)

YEAR	MUDA RIVER SYSTEM								KEDAH RIVER SYSTE						DRAW OFF FROM RESERVOIR AND SPILL				CONVEYANCE	
	DOMESTIC/INDUSTRIAL				IRRIGATION				D / I		IRRIGATION									
	P.PINANG		MUDA		P.PINANG		MUDA		KEDAH		MADA NORTH FRINGE		MADA SOUTH FRINGE		MUDA & PEDU	AKNING	BERIS	NAOK & REMAN	MUDA TO PEDU	JENIANG TRANSFER
	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT						
1962	350.6	.0	150.5	.0	89.8	.0	77.8	.0	145.2	.0	755.0	.0	539.5	.0	1091.1	66.8	83.7	.0	707.7	.0
1963	350.6	.0	150.5	.0	87.2	.0	74.0	.0	145.2	.0	816.5	.0	506.3	.0	1166.0	50.9	77.2	.0	654.7	.0
1964	351.6	.0	150.9	.0	56.3	.0	64.5	.0	145.6	.0	760.3	.0	434.0	.0	904.3	105.7	81.1	.0	668.4	.0
1965	350.6	.0	150.5	.0	92.5	.0	75.1	.0	145.2	.0	565.8	2.5	428.7	45.3	644.0	133.3	79.6	.0	694.6	.0
1966	350.6	.0	150.5	.0	45.0	.0	77.4	.0	145.2	.0	448.1	.0	344.8	.0	642.8	7.3	70.5	.0	598.0	.0
1967	350.6	.0	150.5	.0	99.7	.0	90.1	.0	145.2	.0	371.6	.0	467.8	.0	638.8	5.8	92.1	.0	781.4	.0
1968	351.6	.0	150.9	.0	97.3	.0	82.5	.0	145.6	.0	602.5	.0	610.5	.0	814.0	35.2	60.8	.0	515.8	.0
1969	350.6	.0	150.5	.0	88.2	.0	78.1	.0	145.2	.0	729.0	.0	454.1	.0	848.7	62.8	76.7	.0	650.5	.0
1970	350.6	.0	150.5	.0	77.1	.0	65.8	.0	145.2	.0	604.0	.0	392.9	.0	703.1	76.0	71.5	.0	606.4	.0
1971	350.6	.0	150.5	.0	108.4	.0	70.5	.0	145.2	.0	634.9	.0	418.4	.0	802.6	66.7	77.0	.0	653.5	.0
1972	351.6	.0	150.9	.0	73.9	.0	81.8	.0	145.6	.0	566.9	.0	320.2	.0	826.8	68.9	84.9	.0	720.3	.0
1973	350.6	.0	150.5	.0	66.3	.0	81.2	.0	145.2	.0	542.9	.0	342.0	.0	591.2	61.9	111.2	.0	943.3	.0
1974	350.6	.0	150.5	.0	92.4	.0	109.8	.0	145.2	.0	684.1	.0	466.8	.0	919.4	37.1	59.4	.0	482.5	.0
1975	350.6	.0	150.5	.0	96.5	.0	87.8	.0	145.2	.0	490.0	.0	425.3	.0	668.4	80.3	71.0	.0	623.6	.0
1976	351.6	.0	150.9	.0	57.4	.0	97.8	.0	145.6	.0	579.6	.0	439.8	.0	747.3	82.5	76.6	.0	649.7	.0
1977	350.6	.0	150.5	.0	71.9	.0	105.6	.0	145.2	.0	714.4	.0	500.6	.0	981.3	67.9	94.5	.0	642.6	.0
1978	350.6	.0	150.5	.0	86.1	.0	98.7	.0	145.2	.0	789.7	.0	550.8	.0	1092.0	49.0	76.5	.0	330.9	.0
1979	337.9	12.7	145.6	4.9	78.1	9.6	80.0	12.9	145.2	.0	601.0	151.4	386.0	167.4	402.0	227.5	88.7	.0	427.2	.0
1980	324.5	27.0	140.5	10.4	68.6	15.7	70.1	15.4	145.6	.0	437.6	206.2	349.9	219.9	375.3	77.7	50.2	.0	535.8	.0
1981	350.6	.1	150.5	.0	102.5	1.9	107.5	2.1	145.2	.0	658.7	90.8	525.6	182.4	886.4	73.8	64.3	.0	454.3	.0
1982	330.9	19.8	142.9	7.6	50.7	16.9	69.1	13.2	145.2	.0	319.6	263.9	223.2	319.1	263.9	6.5	52.4	.0	477.2	.0
1983	340.4	10.3	146.5	3.9	37.0	32.2	68.9	26.8	145.2	.0	486.8	213.6	361.1	188.5	571.5	64.7	54.7	.0	545.1	.0
1984	351.6	.0	150.9	.0	100.2	.0	95.3	.0	145.6	.0	556.7	44.9	549.9	16.9	904.2	82.0	56.5	.0	456.3	.0
1985	350.6	.0	150.5	.0	98.9	.0	87.1	.0	145.2	.0	562.7	221.5	318.6	264.2	640.3	23.0	44.6	.0	693.2	.0
1986	350.6	.0	150.5	.0	71.4	.0	78.4	.0	145.2	.0	580.5	185.8	282.4	118.6	612.2	33.3	59.6	.0	565.8	.0
1987	350.6	.0	150.5	.0	93.6	.0	92.8	.0	145.2	.0	653.8	211.7	332.5	139.6	664.2	46.3	66.0	.0	789.8	.0
1988	351.6	.0	150.9	.0	94.3	.0	97.0	.0	145.6	.0	516.0	.0	401.3	.0	627.7	2.2	94.0	.0	885.3	.0
1989	350.6	.0	150.5	.0	109.0	.0	83.5	.0	145.2	.0	696.1	.0	478.6	.0	934.1	17.6	77.4	.0	656.3	.0
1990	350.6	.0	150.5	.0	95.8	.0	99.6	.0	145.2	.0	676.0	.0	564.7	.0	1101.0	18.8	67.5	.0	573.4	.0
1991	350.6	.0	150.5	.0	72.8	.0	98.4	.0	145.2	.0	642.5	.0	475.0	.0	856.7	76.6	92.0	.0	780.2	.0
AVERAGE	348.5	2.3	149.7	.9	82.0	2.5	84.9	2.3	145.3	.0	601.4	53.1	436.4	55.4	764.0	60.3	73.7	.0	625.5	.0

TABLE III. 4.4.11 WATER ALLOCATION (IN CASE OF JENIANG TRANSFER CANAL AND NAOK DAM CONSTRUCTED)

(unit : million cum)

YEAR	MUDA RIVER SYSTEM								KEDAH RIVER SYSTE						DRAW OFF FROM RESERVOIR AND SPILL				CONVEYANCE	
	DOMESTIC/INDUSTRIAL				IRRIGATION				D / I		IRRIGATION									
	P.PINANG		MUDA		P.PINANG		MUDA		KEDAH		MADA NORTH FRINGE		MADA SOUTH FRINGE		MUDA & PEDU	AHNING	BERIS	NAOK & REMAN	MUDA TO PEDU	JENIANG TRANSFER
	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT						
1962	350.6	.0	150.5	.0	89.8	.0	77.8	.0	145.2	.0	755.0	.0	539.5	.0	979.4	66.8	83.7	134.3	707.7	108.7
1963	350.6	.0	150.5	.0	87.2	.0	74.0	.0	145.2	.0	816.5	.0	506.3	.0	1093.6	50.9	77.2	95.2	654.7	68.6
1964	351.6	.0	150.9	.0	56.3	.0	64.5	.0	145.6	.0	760.3	.0	434.0	.0	926.4	30.4	81.0	99.6	668.4	74.3
1965	350.6	.0	150.5	.0	92.5	.0	75.1	.0	145.2	.0	568.3	.0	474.0	.0	687.3	77.0	79.6	147.8	694.6	128.1
1966	350.6	.0	150.5	.0	45.0	.0	77.4	.0	145.2	.0	448.1	.0	344.8	.0	543.7	52.3	70.5	128.1	598.0	94.3
1967	350.6	.0	150.5	.0	99.7	.0	90.1	.0	145.2	.0	371.6	.0	467.8	.0	528.4	65.4	92.1	146.4	781.4	111.5
1968	351.6	.0	150.9	.0	97.3	.0	82.5	.0	145.6	.0	602.5	.0	610.5	.0	738.1	62.3	60.8	100.3	515.8	76.0
1969	350.6	.0	150.5	.0	88.2	.0	78.1	.0	145.2	.0	729.0	.0	454.1	.0	742.4	62.8	76.7	143.1	650.5	103.0
1970	350.6	.0	150.5	.0	77.1	.0	65.8	.0	145.2	.0	604.0	.0	392.9	.0	683.4	76.0	71.5	97.7	606.4	53.7
1971	350.6	.0	150.5	.0	108.4	.0	70.5	.0	145.2	.0	634.9	.0	418.4	.0	713.3	66.7	77.0	129.8	653.5	96.3
1972	351.6	.0	150.9	.0	73.9	.0	81.8	.0	145.6	.0	566.9	.0	520.2	.0	836.7	68.9	84.9	153.0	613.1	108.3
1973	350.6	.0	150.5	.0	66.3	.0	81.2	.0	145.2	.0	542.9	.0	342.0	.0	1135.4	61.9	111.2	158.4	371.3	111.6
1974	350.6	.0	150.5	.0	92.4	.0	109.8	.0	145.2	.0	684.1	.0	466.8	.0	831.5	37.1	59.5	120.2	480.5	90.2
1975	350.6	.0	150.5	.0	96.5	.0	87.8	.0	145.2	.0	490.0	.0	425.3	.0	574.3	80.3	70.9	138.1	623.6	90.6
1976	351.6	.0	150.9	.0	57.4	.0	97.8	.0	145.6	.0	579.6	.0	439.8	.0	770.2	82.5	76.6	137.9	553.0	106.0
1977	350.6	.0	150.5	.0	71.9	.0	105.6	.0	145.2	.0	714.4	.0	500.6	.0	903.7	67.9	94.3	104.7	642.6	76.4
1978	350.6	.0	150.5	.0	86.1	.0	98.7	.0	145.2	.0	789.7	.0	550.8	.0	1032.8	49.0	76.0	78.2	330.9	56.7
1979	340.9	9.7	146.8	3.7	80.2	7.4	81.6	11.3	145.2	.0	752.4	.0	501.4	52.0	693.6	97.2	89.4	126.5	427.2	109.0
1980	326.1	25.5	141.1	9.8	68.6	13.7	70.1	15.4	143.7	1.9	636.8	7.0	390.1	179.7	383.8	204.9	50.2	124.6	535.8	101.7
1981	350.6	.0	150.5	.0	104.5	.0	109.6	.0	145.2	.0	749.5	.0	705.2	2.8	947.3	62.1	64.3	225.7	454.3	201.4
1982	331.3	19.3	143.1	7.4	50.7	16.9	69.1	13.2	144.8	.4	335.0	248.4	243.9	298.4	170.5	20.0	52.4	143.1	477.2	124.5
1983	341.1	9.5	146.8	3.6	39.6	29.5	71.5	24.2	145.2	.0	572.8	127.6	409.8	139.9	610.2	65.5	54.7	137.0	545.1	99.2
1984	351.6	.0	150.9	.0	100.2	.0	95.3	.0	145.6	.0	601.5	.0	566.8	.0	890.0	16.3	56.2	152.9	456.3	134.1
1985	350.6	.0	150.5	.0	98.9	.0	87.1	.0	145.2	.0	685.5	98.7	445.7	137.1	635.8	86.4	44.7	219.0	693.2	180.6
1986	350.6	.0	150.5	.0	71.4	.0	78.4	.0	145.2	.0	654.9	111.4	401.0	.0	673.0	36.1	59.5	152.2	565.8	114.5
1987	350.6	.0	150.5	.0	93.6	.0	92.8	.0	145.2	.0	694.3	171.2	390.0	82.1	643.2	45.6	65.9	165.9	789.8	113.2
1988	351.6	.0	150.9	.0	94.3	.0	97.0	.0	145.6	.0	516.0	.0	401.3	.0	576.2	1.9	94.3	172.2	814.2	135.9
1989	350.6	.0	150.5	.0	109.0	.0	83.5	.0	145.2	.0	696.1	.0	478.6	.0	800.7	18.6	77.4	166.4	646.7	137.8
1990	350.6	.0	150.5	.0	95.8	.0	99.6	.0	145.2	.0	676.0	.0	564.7	.0	975.6	18.8	67.5	150.3	573.4	124.9
1991	350.6	.0	150.5	.0	72.8	.0	98.4	.0	145.2	.0	642.5	.0	475.0	.0	776.1	76.6	92.0	108.4	780.2	81.4
AVERAGE	348.7	2.1	149.8	.8	82.2	2.3	85.1	2.1	145.2	.1	629.0	23.5	462.0	29.7	749.9	60.3	73.7	138.6	596.8	107.1

TABLE III. 4.4.12 WATER ALLOCATION (IN CASE OF ALL PROPOSED WATER RESOURCES DEVELOPMENT STRUCTURES CONSTRUCTED)

(unit : million cum)

YEAR	MUDA RIVER SYSTEM								KEDAH RIVER SYSTE						DRAW OFF FROM RESERVOIR AND SPILL				CONVEYANCE	
	DOMESTIC/INDUSTRIAL				IRRIGATION				D / I		IRRIGATION									
	P.PINANG		MUDA		P.PINANG		MUDA		KEDAH		MADA NORTH FRINGE		MADA SOUTH FRINGE		MUDA & PEDU	AHNING	BERIS	NAOK & REMAN	MUDA TO PEDU	JENIANG TRANSFER
	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT						
1962	350.6	.0	150.5	.0	89.8	.0	77.8	.0	145.2	.0	755.0	.0	539.5	.0	979.4	66.8	83.7	134.3	707.7	108.7
1963	350.6	.0	150.5	.0	87.2	.0	74.0	.0	145.2	.0	816.5	.0	506.3	.0	1093.6	50.9	77.2	95.2	654.7	68.6
1964	351.6	.0	150.9	.0	56.3	.0	64.5	.0	145.6	.0	760.3	.0	434.0	.0	926.4	30.4	81.0	99.6	668.4	74.3
1965	350.6	.0	150.5	.0	92.5	.0	75.1	.0	145.2	.0	568.3	.0	474.0	.0	687.3	77.0	79.6	147.8	694.6	128.1
1966	350.6	.0	150.5	.0	45.0	.0	77.4	.0	145.2	.0	448.1	.0	344.8	.0	543.7	52.3	70.5	128.1	598.0	94.3
1967	350.6	.0	150.5	.0	99.7	.0	90.1	.0	145.2	.0	371.6	.0	467.8	.0	528.4	65.4	92.1	146.4	781.4	111.5
1968	351.6	.0	150.9	.0	97.3	.0	82.5	.0	145.6	.0	602.5	.0	610.5	.0	738.1	62.3	60.8	100.3	515.8	76.0
1969	350.6	.0	150.5	.0	88.2	.0	78.1	.0	145.2	.0	729.0	.0	454.1	.0	742.4	62.8	76.7	143.1	650.5	103.0
1970	350.6	.0	150.5	.0	77.1	.0	65.8	.0	145.2	.0	604.0	.0	392.9	.0	683.4	76.0	71.5	97.7	606.4	53.7
1971	350.6	.0	150.5	.0	108.4	.0	70.5	.0	145.2	.0	634.9	.0	418.4	.0	713.3	66.7	77.0	129.8	653.5	96.3
1972	351.6	.0	150.9	.0	73.9	.0	81.8	.0	145.6	.0	566.9	.0	320.2	.0	836.7	68.9	84.9	153.0	613.1	108.3
1973	350.6	.0	150.5	.0	66.3	.0	81.2	.0	145.2	.0	542.9	.0	342.0	.0	1135.4	61.9	111.2	158.4	371.3	111.6
1974	350.6	.0	150.5	.0	92.4	.0	109.8	.0	145.2	.0	684.1	.0	466.8	.0	831.5	37.1	59.5	120.2	480.5	90.2
1975	350.6	.0	150.5	.0	96.5	.0	87.8	.0	145.2	.0	490.0	.0	425.3	.0	574.3	80.3	70.9	138.1	623.6	90.6
1976	351.6	.0	150.9	.0	57.4	.0	97.8	.0	145.6	.0	579.6	.0	439.8	.0	770.2	82.5	76.6	137.9	553.0	106.0
1977	350.6	.0	150.5	.0	71.9	.0	105.6	.0	145.2	.0	714.4	.0	500.6	.0	903.7	67.9	94.3	104.7	642.6	76.4
1978	350.6	.0	150.5	.0	86.1	.0	98.7	.0	145.2	.0	789.7	.0	550.8	.0	1032.8	49.0	76.0	78.2	330.9	56.7
1979	350.6	.0	150.5	.0	87.6	.0	92.9	.0	145.2	.0	752.4	.0	553.4	.0	703.7	97.8	89.4	186.4	427.2	173.7
1980	351.6	.0	150.9	.0	84.3	.0	85.5	.0	145.6	.0	629.9	13.8	554.5	15.3	425.4	205.5	50.2	299.6	535.8	271.3
1981	350.6	.0	150.5	.0	104.5	.0	109.6	.0	145.2	.0	744.2	5.2	708.0	.0	895.6	75.7	64.3	258.7	454.3	231.9
1982	343.1	7.5	147.6	2.9	54.2	13.5	74.8	7.5	145.2	.0	320.2	263.2	455.9	86.4	231.4	5.6	52.4	301.2	477.2	287.6
1983	350.6	.0	150.5	.0	69.1	.0	95.7	.0	145.2	.0	543.1	157.3	549.6	.0	584.0	65.3	54.7	321.4	545.1	279.0
1984	351.6	.0	150.9	.0	100.2	.0	95.3	.0	145.6	.0	601.5	.0	566.8	.0	855.3	48.1	56.2	155.9	456.3	134.1
1985	350.6	.0	150.5	.0	98.9	.0	87.1	.0	145.2	.0	642.6	141.6	582.8	.0	648.9	57.0	44.7	324.0	693.2	281.6
1986	350.6	.0	150.5	.0	71.4	.0	78.4	.0	145.2	.0	640.2	126.0	401.0	.0	659.9	33.5	59.5	153.5	565.8	115.1
1987	350.6	.0	150.5	.0	93.6	.0	92.8	.0	145.2	.0	692.9	172.7	472.1	.0	643.2	45.6	65.9	241.2	789.8	188.6
1988	351.6	.0	150.9	.0	94.3	.0	97.0	.0	145.6	.0	516.0	.0	401.3	.0	576.2	2.0	94.3	172.2	814.2	135.9
1989	350.6	.0	150.5	.0	109.0	.0	83.5	.0	145.2	.0	696.1	.0	478.6	.0	800.7	18.4	77.4	166.4	646.7	137.8
1990	350.6	.0	150.5	.0	95.8	.0	99.6	.0	145.2	.0	676.0	.0	564.7	.0	975.8	18.8	67.5	150.3	573.4	124.9
1991	350.6	.0	150.5	.0	72.8	.0	98.4	.0	145.2	.0	642.5	.0	475.0	.0	776.1	76.6	92.0	108.4	780.2	81.4
AVERAGE	350.6	.2	150.5	.1	84.1	.4	87.0	.3	145.3	.0	625.2	29.3	488.4	3.4	749.9	60.3	73.7	165.1	596.8	133.2

TABLE III. 4.4.13 DECREASE RATIO AT DIFFERENT GROWTH STAGE OF PADDY

TREATMENT PERIOD (Day from heading)	-92	-88	-68	-56	-44	-32	-28	-14	-8	+6	+16	+28
EFFECT OF DROUGHT (Rate of decreasing paddy yield)	14%	13%	0%	7%	4%	15%	17%	43%	51%	33%	18%	22%

Ref : MATSUSHIMA,1962,
Some Experiments on Soil Water-Plant Relationship in Rice.
Agricultural Bulletin Malaya - 112

TABLE III. 4.4.14 RATE OF DECREASING PADDY YIELD

(UNIT : %)

YEAR	CONSTRUCTING STAGE OF STRUCTURES			
	PRESENT DAMS (MUDA DAM,PEDU DAM,AHNING DAM)	PRESENT DAMS + BERIS DAM	PREAENT+BERIS DAM + TRUNSFER CANNAL + NAOK DAM	PRESENT+BERIS DAM + TRUNSFER CANNAL + NAOK & REMAN DAM
1962	.18	.00	.00	.00
1963	1.06	.00	.00	.00
1964	.91	.00	.00	.00
1965	1.42	1.11	.00	.00
1966	.00	.00	.00	.00
1967	.27	.00	.00	.00
1968	.62	.00	.00	.00
1969	.44	.00	.00	.00
1970	.38	.00	.00	.00
1971	.37	.00	.00	.00
1972	.14	.00	.00	.00
1973	.03	.00	.00	.00
1974	.09	.00	.00	.00
1975	.00	.00	.00	.00
1976	.46	.00	.00	.00
1977	2.38	.00	.00	.00
1978	2.26	.00	.00	.00
1979	28.48	26.26	1.48	.00
1980	35.14	34.32	13.61	.96
1981	14.78	13.84	.39	.26
1982	54.84	52.39	48.98	28.24
1983	15.20	14.99	10.50	5.65
1984	2.12	1.66	.00	.00
1985	39.49	39.43	12.85	9.29
1986	20.06	19.47	11.67	13.39
1987	16.86	15.81	11.37	8.98
1988	.29	.00	.00	.00
1989	.04	.00	.00	.00
1990	.21	.00	.00	.00
1991	.31	.00	.00	.00

TABLE III. 5.4.1 ANNUAL MINIMUM STORAGE VOLUME OF DAM RESERVOIR (IN CASE OF INTEGRATED DAM RESERVOIR OPERATION)

(unit : 1,000 cum)

YEAR	MUDA & PEDU	AHNING	BERIS	NAOK & REMAN
1962	624223.0	200000.0	103248.9	267400.0
1963	287147.8	200000.0	75563.0	215923.7
1964	278996.3	200000.0	68798.3	150420.9
1965	293876.3	200000.0	85888.4	190875.9
1966	597117.0	200000.0	108456.1	267400.0
1967	787351.9	200000.0	101440.8	267400.0
1968	594455.5	200000.0	89542.9	267400.0
1969	620740.6	200000.0	100808.2	267400.0
1970	519093.4	200000.0	95799.3	267400.0
1971	743949.0	200000.0	105582.5	267400.0
1972	736923.1	200000.0	96455.6	267400.0
1973	963170.9	200000.0	105435.4	267400.0
1974	783514.1	200000.0	101982.2	267400.0
1975	700277.5	200000.0	101889.4	267400.0
1976	789776.6	200000.0	96531.3	267400.0
1977	571171.5	200000.0	53826.1	267400.0
1978	369350.2	200000.0	57689.3	236520.2
1979	131262.5	117453.3	.0	53741.5
1980	32190.9	40251.5	.0	1960.6
1981	137943.4	63082.2	.0	108542.3
1982	.0	.0	.0	.0
1983	.0	.0	.0	.0
1984	100817.8	50968.5	11018.2	137816.4
1985	40368.5	21459.1	23538.7	68117.5
1986	37122.0	34090.2	41397.8	110946.4
1987	.0	2295.4	42334.0	57430.8
1988	416646.3	88984.5	96885.6	267400.0
1989	795413.1	180796.0	107331.4	267400.0
1990	585031.0	199540.8	100599.1	267400.0
1991	387034.6	199680.2	91097.0	253044.7

TABLE III. 5.4.2 RESULT OF WATER DEMAND AND SUPPLY BALANCE SIMULATION (IN CASE OF INTEGRATED DAM RESERVOIR OPERATION)

WATER BARANCE OF MUDA & KEDAH RIVER SYSTEM CASE (unit : million cum)

YEAR	MUDA RIVER SYSTEM								KEDAH RIVER SYSTE					
	DOMESTIC/INDUSTRIAL				IRRIGATION				D / I		IRRIGATION			
	P.PINANG		MUDA		P.PINANG		MUDA		KEDAH		MADA NORTH FRINGE		MADA SOUTH FRINGE	
	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT
1962	350.6	.0	150.5	.0	89.8	.0	77.8	.0	145.2	.0	755.0	.0	539.5	.0
1963	350.6	.0	150.5	.0	87.2	.0	74.0	.0	145.2	.0	816.5	.0	506.5	.0
1964	351.6	.0	150.9	.0	56.3	.0	64.5	.0	145.6	.0	760.3	.0	434.0	.0
1965	350.6	.0	150.5	.0	92.5	.0	75.1	.0	145.2	.0	568.3	.0	474.0	.0
1966	350.6	.0	150.5	.0	45.0	.0	77.4	.0	145.2	.0	448.1	.0	344.8	.0
1967	350.6	.0	150.5	.0	99.7	.0	90.1	.0	145.2	.0	571.6	.0	467.8	.0
1968	351.6	.0	150.9	.0	97.3	.0	82.5	.0	145.6	.0	602.5	.0	610.5	.0
1969	350.6	.0	150.5	.0	88.2	.0	78.1	.0	145.2	.0	729.0	.0	454.1	.0
1970	350.6	.0	150.5	.0	77.1	.0	65.8	.0	145.2	.0	604.0	.0	392.9	.0
1971	350.6	.0	150.5	.0	106.4	.0	70.5	.0	145.2	.0	634.9	.0	418.4	.0
1972	351.6	.0	150.9	.0	73.9	.0	81.8	.0	145.6	.0	566.9	.0	520.2	.0
1973	350.6	.0	150.5	.0	65.3	.0	81.2	.0	145.2	.0	542.9	.0	342.0	.0
1974	350.6	.0	150.5	.0	92.4	.0	109.8	.0	145.2	.0	684.1	.0	456.8	.0
1975	350.6	.0	150.5	.0	95.5	.0	87.8	.0	145.2	.0	490.0	.0	425.3	.0
1976	351.6	.0	150.9	.0	57.4	.0	97.8	.0	145.6	.0	579.6	.0	439.8	.0
1977	350.6	.0	150.5	.0	71.9	.0	105.6	.0	145.2	.0	714.4	.0	500.6	.0
1978	350.6	.0	150.5	.0	86.1	.0	98.7	.0	145.2	.0	789.7	.0	550.8	.0
1979	350.6	.0	150.5	.0	87.6	.0	92.9	.0	145.2	.0	752.4	.0	553.4	.0
1980	351.6	.0	150.9	.0	84.3	.0	85.5	.0	145.6	.0	643.7	.0	569.8	.0
1981	350.6	.0	150.5	.0	104.5	.0	109.6	.0	145.2	.0	749.5	.0	708.0	.0
1982	343.1	7.5	147.6	2.9	54.2	13.5	74.8	7.5	145.2	.0	522.0	61.5	456.5	85.8
1983	344.7	6.0	148.2	2.3	53.4	15.7	84.7	11.0	145.2	.0	690.8	9.8	469.8	80.0
1984	351.6	.0	150.9	.0	100.2	.0	95.3	.0	145.6	.0	601.5	.0	566.8	.0
1985	350.6	.0	150.5	.0	98.9	.0	87.1	.0	145.2	.0	784.2	.0	582.8	.0
1986	350.6	.0	150.5	.0	71.4	.0	78.4	.0	145.2	.0	766.3	.0	401.0	.0
1987	350.6	.0	150.5	.0	93.6	.0	92.8	.0	145.2	.0	865.5	.0	472.1	.0
1988	351.6	.0	150.9	.0	94.3	.0	97.0	.0	145.6	.0	516.0	.0	491.3	.0
1989	350.6	.0	150.5	.0	109.0	.0	83.5	.0	145.2	.0	696.1	.0	478.6	.0
1990	350.6	.0	150.5	.0	95.8	.0	99.6	.0	145.2	.0	876.0	.0	564.7	.0
1991	350.6	.0	150.5	.0	72.8	.0	98.4	.0	145.2	.0	642.5	.0	475.0	.0
AVERAGE	350.4	.4	150.4	.2	83.5	1.0	85.6	.6	145.3	.0	652.1	3.4	486.3	5.5

WATER BARANCE OF MUDA & KEDAH RIVER SYSTEM CASE ---- 11 (unit : million cum)

YEAR	MUDA RIVER SYSTEM						KEDAH RIVER SYSTE					
	REPLENISHMENT		DIFICIT				REPLENISHMENT				DIFICIT	
	BERIS DAM	N/R DAM	MAINTENANCE FLOW BEFORE CONTROL	MAINTENANCE FLOW AFTER CONTROL	WATER-DUTY BEFORE COTROL	WATER-DUTY AFTER CONTROL	P/M DAM	ANNING DAM	N/R DAM	JENIANG TRANSFER	BEFORE CONTROL	AFTER CONTROL
1962	11.9	.0	11.0	.0	11.9	.0	739.9	.0	.0	108.7	739.9	.0
1963	38.8	.0	23.6	.0	38.8	.0	609.2	.0	72.4	120.9	881.5	.0
1964	46.5	.0	25.0	.0	46.5	.0	564.4	.0	142.5	183.5	706.9	.0
1965	26.4	.0	21.1	.0	26.4	.0	428.8	.0	155.3	198.6	584.2	.0
1966	6.2	.0	4.7	.0	6.2	.0	387.0	.0	.0	94.3	387.0	.0
1967	12.6	.0	11.1	.0	12.6	.0	374.9	.0	.0	111.5	374.9	.0
1968	25.6	.0	20.5	.0	25.6	.0	607.3	.0	.0	76.0	607.3	.0
1969	15.5	.0	11.5	.0	15.5	.0	531.2	.0	.0	103.0	531.2	.0
1970	18.4	.0	15.5	.0	18.4	.0	580.0	.0	.0	53.7	580.0	.0
1971	14.8	.0	13.1	.0	14.8	.0	538.6	.0	.0	95.3	538.6	.0
1972	18.8	.0	17.5	.0	18.8	.0	518.7	.0	.0	108.3	518.7	.0
1973	8.7	.0	8.4	.0	8.7	.0	279.5	.0	.0	111.6	279.5	.0
1974	15.6	.0	13.4	.0	15.6	.0	610.5	.0	.0	90.2	610.5	.0
1975	12.6	.0	11.2	.0	12.6	.0	384.3	.0	.0	90.5	384.3	.0
1976	17.6	.0	14.4	.0	17.6	.0	485.1	.0	.0	105.0	485.1	.0
1977	61.2	.0	24.4	.0	61.2	.0	731.2	.0	.0	78.4	731.2	.0
1978	47.9	.0	29.0	.0	47.9	.0	864.9	.0	31.7	82.7	895.5	.0
1979	63.9	42.1	47.6	.0	63.9	.0	429.1	89.7	251.0	246.2	769.9	.0
1980	21.6	77.9	44.1	.0	21.6	.0	382.9	144.3	194.5	285.5	721.7	.0
1981	35.9	9.3	26.9	.0	35.9	.0	302.2	32.1	385.4	338.5	919.7	.0
1982	24.0	29.3	31.3	4.6	55.3	31.3	231.5	72.8	223.7	314.7	675.3	147.3
1983	26.8	40.8	31.3	6.2	61.7	35.0	483.3	61.2	250.2	279.6	884.6	89.8
1984	26.3	.0	15.9	.0	26.3	.0	482.0	17.7	268.8	279.3	768.8	.0
1985	11.9	.0	8.7	.0	11.9	.0	421.8	46.8	333.7	325.9	802.3	.0
1986	31.3	.0	11.3	.0	31.3	.0	470.1	24.1	241.3	230.7	735.5	.0
1987	35.7	.0	12.0	.0	35.7	.0	497.5	75.8	265.4	270.2	838.7	.0
1988	8.3	.0	3.9	.0	8.3	.0	344.7	.2	.0	135.9	344.9	.0
1989	6.8	.0	4.4	.0	6.8	.0	516.1	.2	.0	137.8	516.2	.0
1990	15.1	.0	10.4	.0	15.1	.0	722.5	.8	.0	124.9	723.3	.0
1991	23.2	.0	19.0	.0	23.2	.0	592.2	.3	16.7	91.7	609.2	.0

TABLE III. 5.4.3 DROUGHT DAMAGE INDICES
(IN CASE OF INTEGRATED DAM : RESERVOIR OPERATION)

year	DROUGHT PERCENT DAY (%·DAY)								FUNCTION OF DROUGHT ($\%^2$·DAY·million l)							
	D/P	D/M	I/P	I/M	D/K	I/MS	I/MN	A/DE	D/P	D/M	I/P	I/M	D/K	I/MS	I/MN	A/DE
1962	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1963	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1964	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1965	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1966	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1967	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1968	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1969	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1970	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1971	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1972	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1973	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1974	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1975	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1976	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1977	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1980	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1981	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1982	778.	697.	1612.	1669.	0.	1941.	2693.	2032.	572592.	197387.	1524279.	822396.	0.	5357675.	9386047.	14292810.
1983	621.	556.	1159.	1259.	0.	295.	1676.	895.	372648.	128461.	1786645.	1265143.	0.	873411.	9742537.	7382879.
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1985	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1986	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1987	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1988	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1989	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1990	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1991	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

note
D/P : Domestic / Industrial Water Use in State of P.Pinang
D/M : Domestic / Industrial Water Use in State of Kedah (Muda River Basin)
I/P : Irrigation Water Use in State of P.Pinang
I/M : Irrigation Water Use in State of Kedah (Muda River Basin)
D/K : Domestic / Industrial Water Use in State of Kedah (Kedah River Basin)
D/MS : Irrigation Water Use in Southern Part of MADA
D/MN : Irrigation Water Use in Northern Part of MADA
A/DE : Total Water Use of All Service Area

TABLE III. 5.4.4 ANNUAL MINIMUM STORAGE VOLUME OF DAM RESERVOIR (IN CASE OF WATER SAVING OPERATION)

(unit : 1,000 cum)

YEAR	MUDA & PEDU	AHNING	BERIS	NAOK & REMAN
1962	624223.0	200000.0	103248.9	267400.0
1963	287147.8	200000.0	75563.0	215923.7
1964	278996.3	200000.0	68798.3	150420.9
1965	293876.3	200000.0	85888.4	190875.9
1966	597117.0	200000.0	108456.1	267400.0
1967	787351.9	200000.0	101440.8	267400.0
1968	594455.5	200000.0	89542.9	267400.0
1969	620740.6	200000.0	100808.2	267400.0
1970	519093.4	200000.0	95799.3	267400.0
1971	743949.0	200000.0	105582.5	267400.0
1972	736923.1	200000.0	96455.6	267400.0
1973	963170.9	200000.0	105435.4	267400.0
1974	783514.1	200000.0	101982.2	267400.0
1975	700277.5	200000.0	101889.4	267400.0
1976	789776.6	200000.0	96531.3	267400.0
1977	571171.5	200000.0	53826.1	267400.0
1978	369350.2	200000.0	57689.3	236520.2
1979	131262.5	117453.3	.0	53741.5
1980	57911.3	57029.5	.0	11315.6
1981	154100.4	82312.9	.0	118784.8
1982	.1	602.5	.0	7129.3
1983	55366.5	.0	.0	12.6
1984	132504.4	68725.2	11159.1	154839.2
1985	80139.9	33433.8	23850.9	80870.0
1986	67929.9	47860.1	41756.0	120688.8
1987	17996.1	36335.2	42884.4	70555.6
1988	435681.6	123757.6	97483.2	267400.0
1989	795761.0	199861.5	107331.4	267400.0
1990	585031.0	199540.8	100599.1	267400.0
1991	387034.6	199680.2	91097.0	253044.7

TABEL III. 5.4.5 RESULT OF WATER DEMAND AND SUPPLY BALANCE SIMULATION (IN CASE OF WATER SAVING OPERATION)

(unit : million cum)

YEAR	MUDA RIVER SYSTEM								KEDAH RIVER SYSTE					
	DOMESTIC/INDUSTRIAL				IRRIGATION				D / I		IRRIGATION			
	P.PINANG		MUDA		P.PINANG		MUDA		KEDAH		MADA NORTH FRINGE		MADA SOUTH FRINGE	
	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT	ABSTRACTION	DEFICIT
1962	350.6	.0	150.5	.0	89.8	.0	77.8	.0	145.2	.0	755.0	.0	539.5	.0
1963	350.6	.0	150.5	.0	87.2	.0	74.0	.0	145.2	.0	816.5	.0	506.3	.0
1964	351.6	.0	150.9	.0	56.3	.0	64.5	.0	145.6	.0	760.3	.0	434.0	.0
1965	350.6	.0	150.5	.0	92.5	.0	75.1	.0	145.2	.0	568.3	.0	474.0	.0
1966	350.6	.0	150.5	.0	45.0	.0	77.4	.0	145.2	.0	448.1	.0	344.8	.0
1967	350.6	.0	150.5	.0	99.7	.0	90.1	.0	145.2	.0	371.6	.0	457.8	.0
1968	351.6	.0	150.9	.0	97.5	.0	82.5	.0	145.6	.0	602.5	.0	610.5	.0
1969	350.6	.0	150.5	.0	88.2	.0	78.1	.0	145.2	.0	729.0	.0	454.1	.0
1970	350.6	.0	150.5	.0	77.1	.0	65.8	.0	145.2	.0	604.0	.0	392.9	.0
1971	350.6	.0	150.5	.0	108.4	.0	70.5	.0	145.2	.0	634.9	.0	418.4	.0
1972	351.6	.0	150.9	.0	73.9	.0	81.6	.0	145.6	.0	566.9	.0	520.2	.0
1973	350.6	.0	150.5	.0	66.3	.0	81.2	.0	145.2	.0	542.9	.0	342.0	.0
1974	350.6	.0	150.5	.0	92.4	.0	109.8	.0	145.2	.0	684.1	.0	466.8	.0
1975	350.6	.0	150.5	.0	96.5	.0	87.8	.0	145.2	.0	490.0	.0	425.3	.0
1976	351.6	.0	150.9	.0	87.4	.0	97.8	.0	145.6	.0	579.6	.0	439.8	.0
1977	350.6	.0	150.5	.0	71.9	.0	103.8	.0	145.2	.0	714.4	.0	500.6	.0
1978	350.6	.0	150.5	.0	86.1	.0	98.7	.0	145.2	.0	789.7	.0	550.8	.0
1979	350.6	.0	150.5	.0	87.6	.0	92.9	.0	145.2	.0	752.4	.0	553.4	.0
1980	351.6	.0	150.9	.0	84.3	.0	85.5	.0	145.6	.0	641.3	2.4	529.1	40.7
1981	350.6	.0	150.5	.0	104.5	.0	109.6	.0	145.2	.0	749.5	.0	708.0	.0
1982	350.6	.1	150.5	.0	67.2	.4	82.2	.1	145.2	.0	565.2	18.3	481.3	61.1
1983	350.6	.0	150.5	.0	69.1	.0	95.7	.0	144.2	1.0	658.9	41.3	433.7	115.9
1984	351.6	.0	150.9	.0	100.2	.0	95.3	.0	145.6	.0	601.5	.0	566.8	.0
1985	350.6	.0	150.5	.0	98.9	.0	87.1	.0	145.2	.0	782.8	1.8	572.3	10.5
1986	350.6	.0	150.5	.0	71.4	.0	78.4	.0	145.2	.0	766.3	.0	491.0	.0
1987	350.6	.0	150.5	.0	93.8	.0	92.8	.0	145.2	.0	851.4	14.1	483.1	9.0
1988	351.6	.0	150.9	.0	94.3	.0	97.0	.0	145.6	.0	516.0	.0	491.3	.0
1989	350.6	.0	150.5	.0	109.0	.0	89.5	.0	145.2	.0	695.1	.0	478.6	.0
1990	350.6	.0	150.5	.0	95.8	.0	99.6	.0	145.2	.0	676.0	.0	564.7	.0
1991	350.6	.0	150.5	.0	72.8	.0	88.4	.0	145.2	.0	642.5	.0	475.0	.0
AVERAGE	350.8	.0	150.6	.0	84.5	.0	87.2	.0	145.3	.0	651.9	2.6	483.9	7.9

(unit : million cum)

YEAR	MUDA RIVER SYSTEM						KEDAH RIVER SYSTE					
	REPLENISHMENT		DIFICIT				REPLENISHMENT				DIFICIT	
	BERIS DAM	M/R DAM	MAINTENANCE FLOW BEFORE CONTROL	MAINTENANCE FLOW AFTER CONTROL	WATER-USE BEFORE CONTROL	WATER-USE AFTER CONTROL	P/M DAM	ANNING DAM	M/R DAM	J.TRASPER	BEFORE CONTROL	AFTER CONTROL
1962	11.9	.0	11.0	.0	11.9	.0	739.9	.0	.0	108.7	739.9	.0
1963	38.8	.0	23.6	.0	38.8	.0	809.1	.0	72.4	120.9	881.5	.0
1964	46.5	.0	25.0	.0	46.5	.0	564.4	.0	142.5	183.5	706.9	.0
1965	26.4	.0	21.1	.0	26.4	.0	428.8	.0	155.3	198.6	584.2	.0
1966	6.2	.0	4.7	.0	6.2	.0	387.0	.0	.0	94.3	387.0	.0
1967	12.8	.0	11.1	.0	12.8	.0	374.9	.0	.0	111.5	374.9	.0
1968	25.8	.0	20.5	.0	25.8	.0	607.3	.0	.0	76.0	607.3	.0
1969	15.5	.0	11.5	.0	15.5	.0	531.2	.0	.0	103.0	531.2	.0
1970	18.4	.0	15.5	.0	18.4	.0	580.0	.0	.0	53.7	580.0	.0
1971	14.8	.0	13.1	.0	14.8	.0	538.6	.0	.0	96.3	538.6	.0
1972	18.6	.0	17.5	.0	18.6	.0	518.7	.0	.0	108.3	518.7	.0
1973	8.7	.0	8.4	.0	8.7	.0	279.5	.0	.0	111.6	279.5	.0
1974	15.6	.0	13.4	.0	15.6	.0	610.5	.0	.0	90.2	610.5	.0
1975	12.6	.0	11.2	.0	12.6	.0	384.3	.0	.0	90.5	384.3	.0
1976	17.6	.0	14.4	.0	17.6	.0	485.1	.0	.0	106.0	485.1	.0
1977	61.2	.0	24.4	.0	61.2	.0	731.2	.0	.0	76.4	731.2	.0
1978	47.9	.0	29.0	.0	47.9	.0	864.9	.0	31.7	82.7	896.5	.0
1979	63.9	42.1	47.6	.0	63.9	.0	429.1	89.7	251.0	246.2	769.9	.0
1980	21.4	77.9	44.1	.1	21.5	.1	354.1	126.8	197.6	275.8	721.7	43.1
1981	36.1	9.1	26.9	.0	36.1	.0	514.6	30.3	373.9	330.3	919.0	.0
1982	23.9	55.7	31.3	2.7	24.5	.5	247.1	89.6	258.7	310.4	674.8	79.4
1983	26.7	76.3	31.3	.1	26.7	.0	428.2	63.5	256.9	279.0	907.0	158.4
1984	26.3	.0	15.9	.0	26.3	.0	510.1	.5	256.7	268.9	767.3	.0
1985	11.7	.0	8.7	.2	11.7	.0	412.6	50.6	327.7	315.4	802.3	12.1
1985	31.3	.0	11.3	.0	31.3	.0	480.9	24.2	227.7	221.8	732.7	.0
1987	35.5	.0	12.0	.2	35.5	.0	510.2	54.9	248.0	253.5	835.3	23.1
1988	8.3	.0	3.9	.0	8.3	.0	344.7	.2	.0	135.9	344.9	.0
1989	6.8	.0	4.4	.0	6.8	.0	516.1	.2	.0	197.8	516.2	.0
1990	15.1	.0	10.4	.0	15.1	.0	722.5	.8	.0	124.9	723.3	.0
1991	23.2	.0	19.0	.0	23.2	.0	592.2	.3	16.7	91.7	609.2	.0

TABLE III. 5.4.6 DROUGHT DAMAGE INDICES
(IN CASE OF WATER SAVING OPERATION)

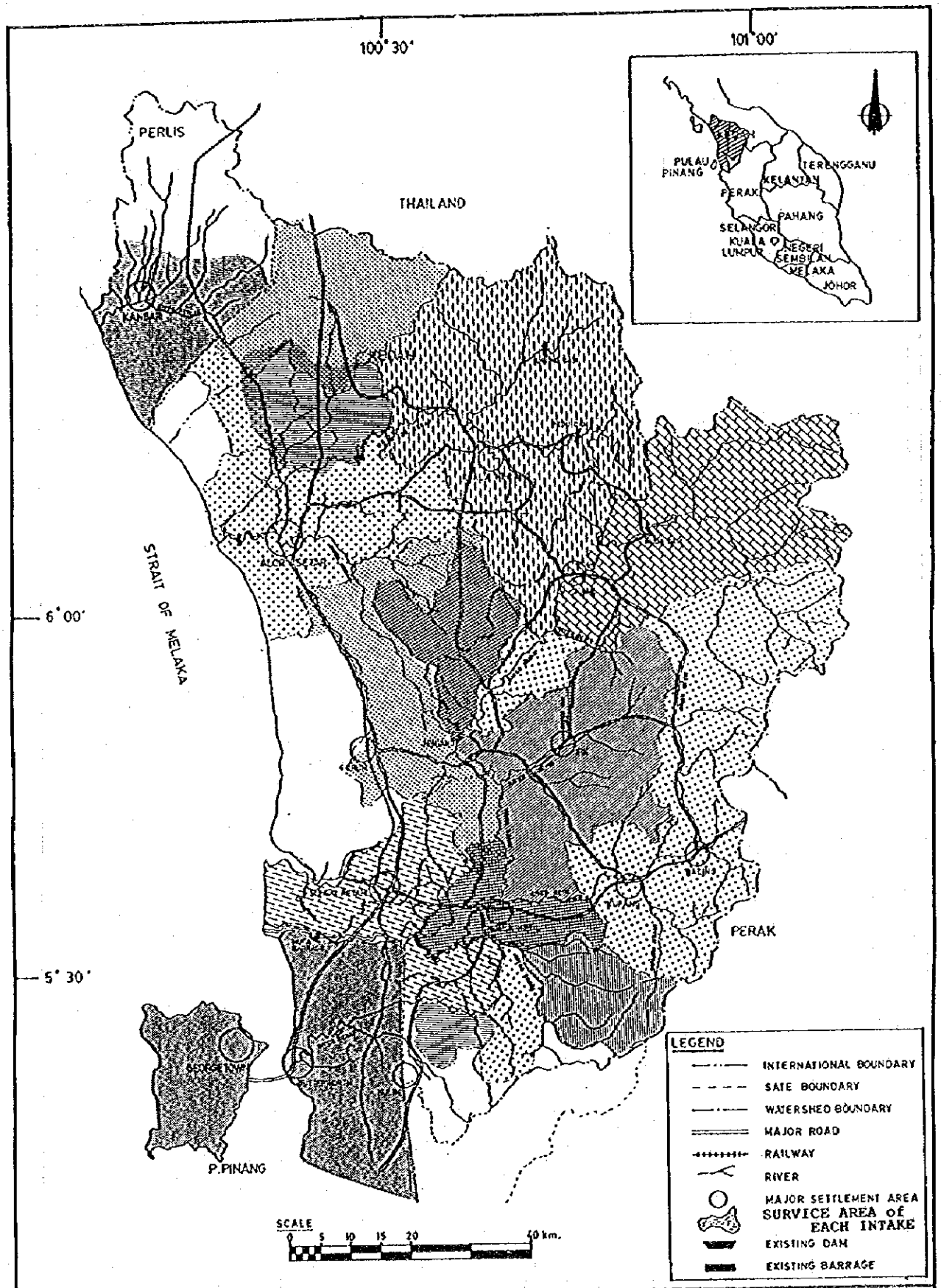
year	DROUGHT PERCENT DAY (%·DAY)								FUNCTION OF DROUGHT ($\%^2$·DAY·million l)							
	D/P	D/M	I/P	I/M	D/K	I/MS	I/MN	A/DE	D/P	D/M	I/P	I/M	D/K	I/MS	I/MN	A/DE
1962	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1963	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1964	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1965	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1966	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1967	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1968	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1969	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1970	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1971	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1972	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1973	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1974	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1975	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1976	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1977	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1980	0.	0.	4.	4.	0.	46.	1417.	411.	0.	0.	194.	167.	0.	34918.	1719423.	629245.
1981	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1982	6.	5.	137.	29.	0.	517.	2476.	980.	181.	62.	8882.	439.	0.	466326.	2346449.	1477889.
1983	0.	0.	1.	1.	253.	770.	2553.	1163.	0.	0.	2.	2.	295842.	2079385.	15538480.	9867305.
1984	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1985	0.	0.	0.	0.	0.	37.	568.	139.	0.	0.	0.	0.	0.	9540.	202835.	67565.
1986	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1987	0.	0.	0.	0.	0.	290.	1125.	286.	0.	0.	0.	0.	0.	115942.	211078.	124999.
1988	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1989	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1990	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1991	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

note
D/P : Domestic / Industrial Water Use in State of P.Pinang
D/M : Domestic / Industrial Water Use in State of Kedah (Muda River Basin)
I/P : Irrigation Water Use in State of P.Pinang
I/M : Irrigation Water Use in State of Kedah (Muda River Basin)
D/K : Domestic / Industrial Water Use in State of Kedah (Kedah River Basin)
D/MS : Irrigation Water Use in Southern Part of MADA
D/MN : Irrigation Water Use in Northern Part of MADA
A/DE : Total Water Use of All Service Area

FIGURES

SECTOR III

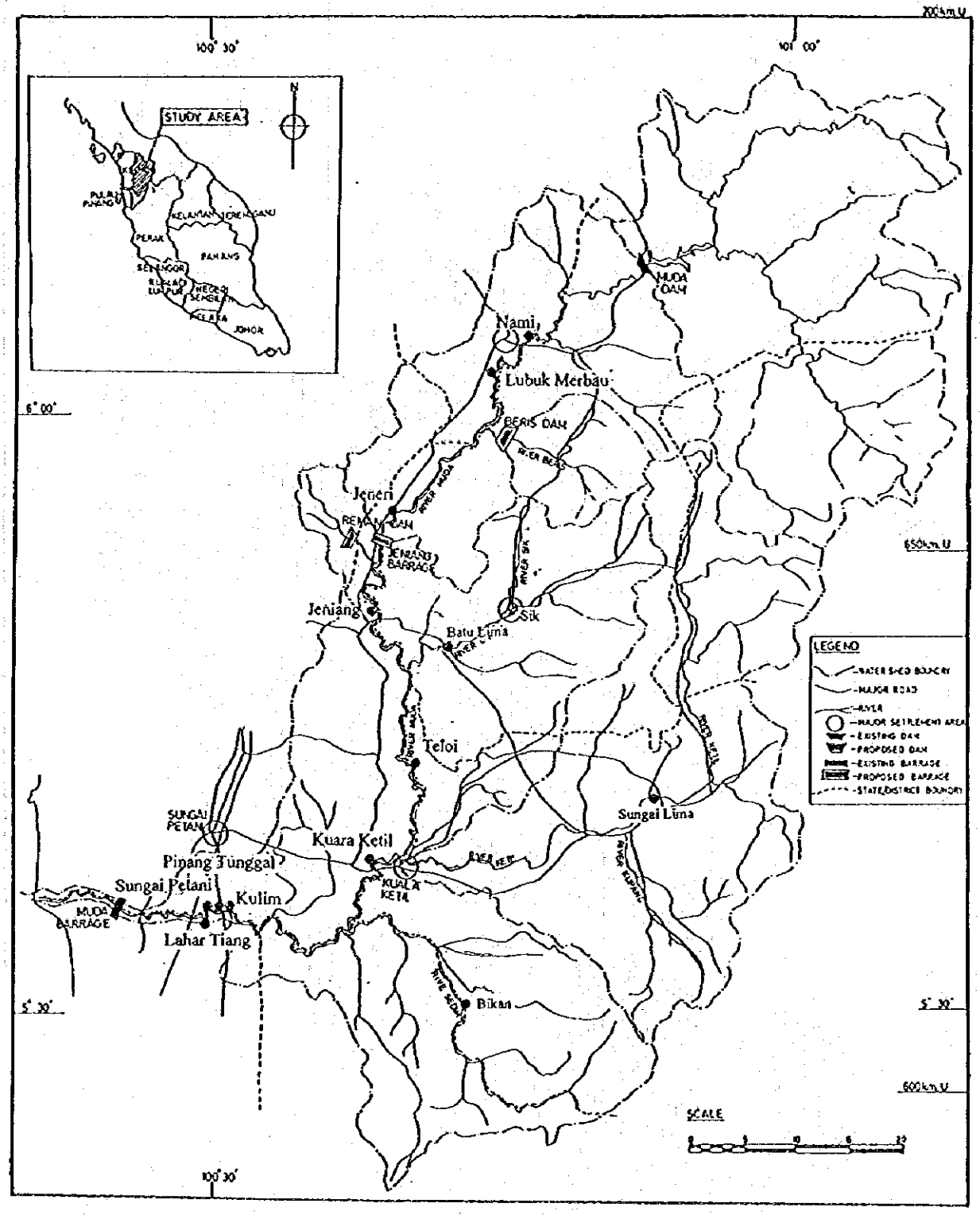
WATER RESOURCES MANAGEMENT PLAN



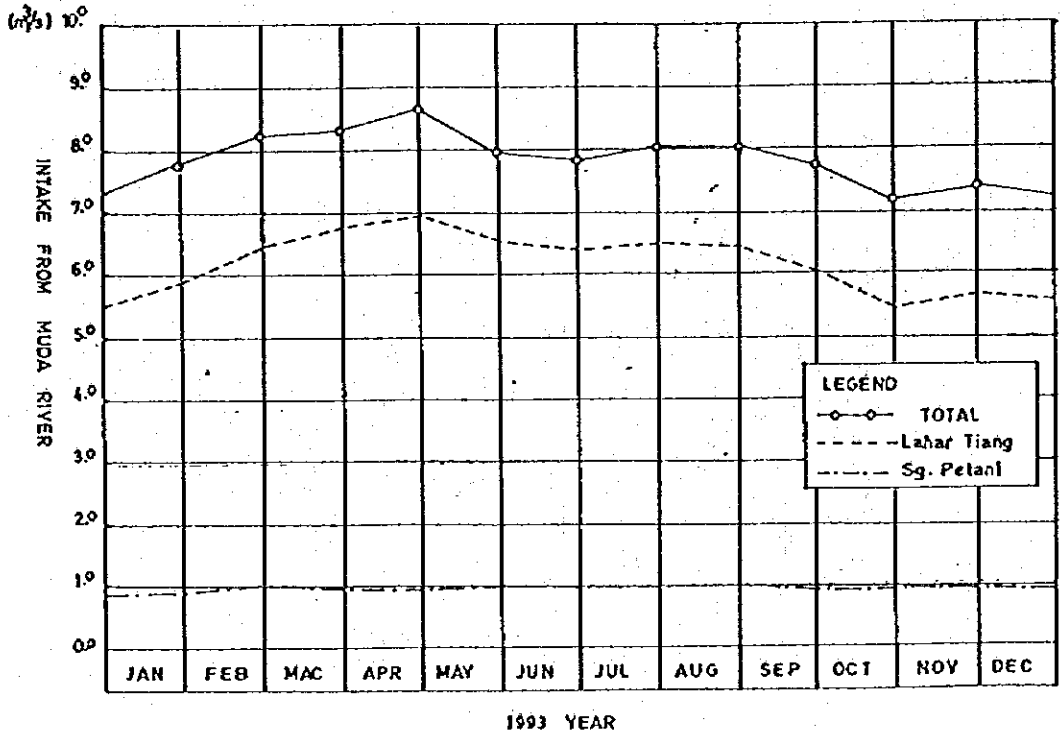
COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

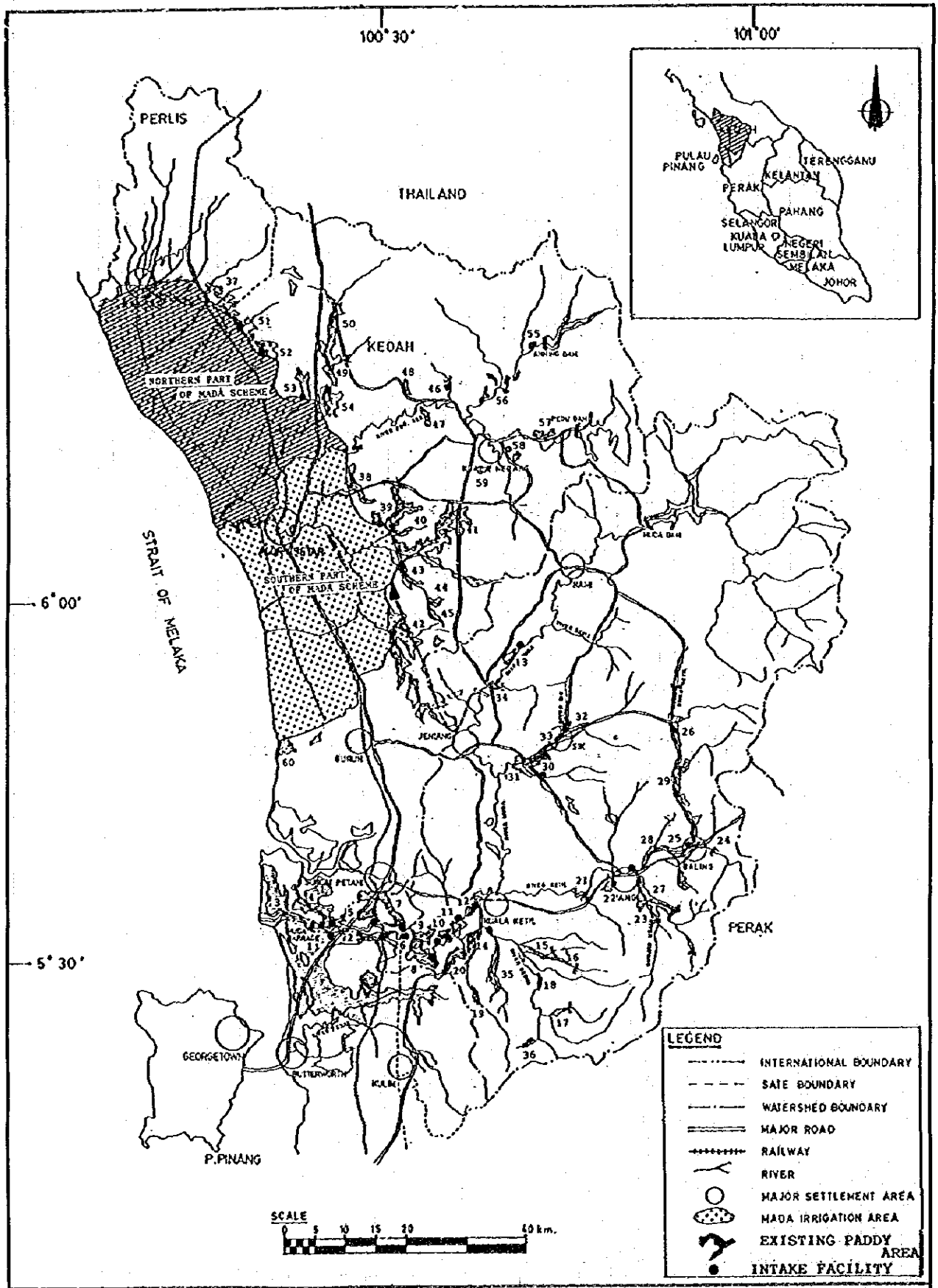
FIG.III. 2.1.1 DOMESTIC/INDUSTRIAL WATER SUPPLY SERVICE AREA - ACTUAL



COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN	FIG.III. 2.1.2 LOCATION MAP OF INTAKE FACILITIES FOR DOMESTIC/INDUSTRIAL WATER
JAPAN INTERNATIONAL COOPERATION AGENCY	



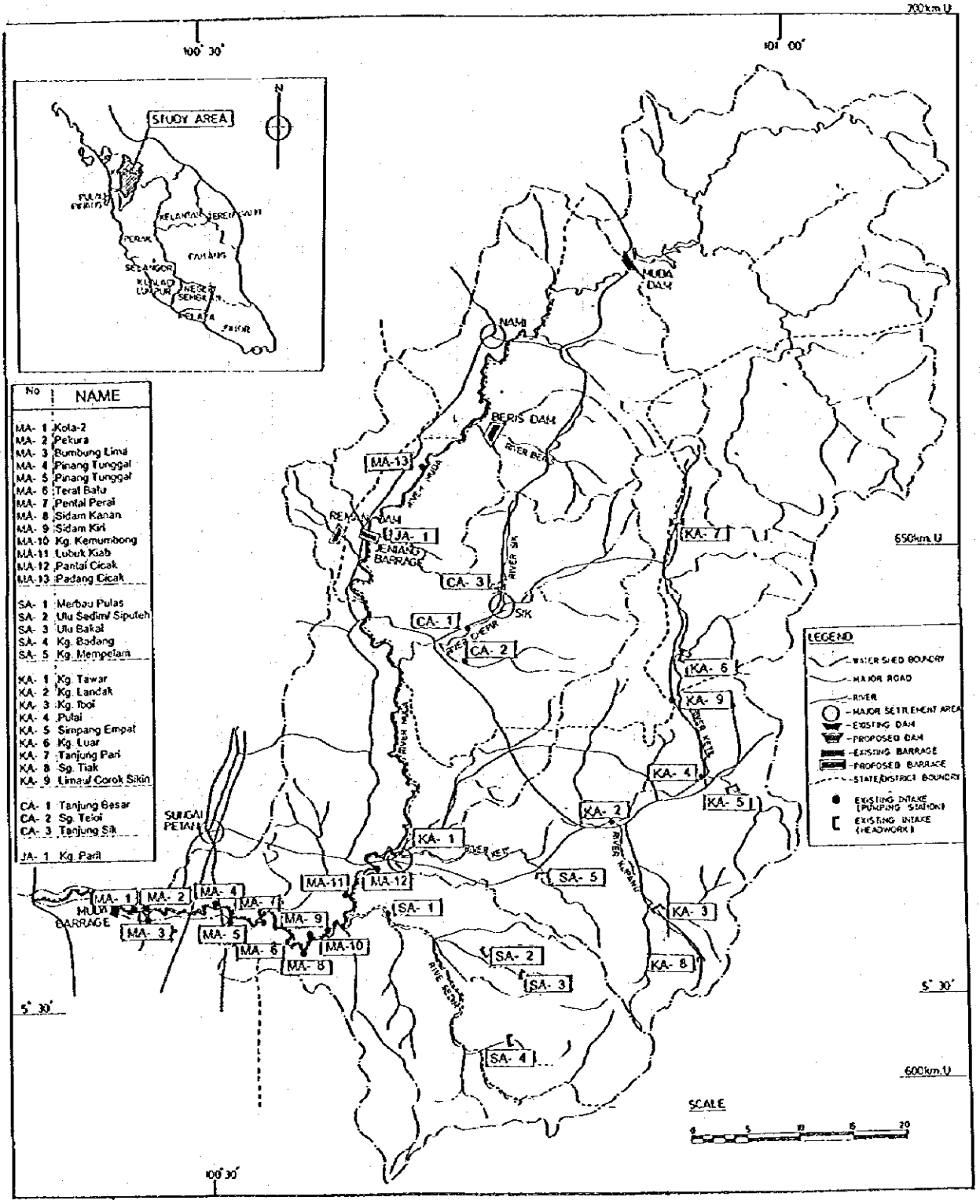
COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN JAPAN INTERNATIONAL COOPERATION AGENCY	FIG.III. 2.1.3 ACTUAL INTAKE DISCHARGE FROM MUDA RIVER SYSTEM



COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

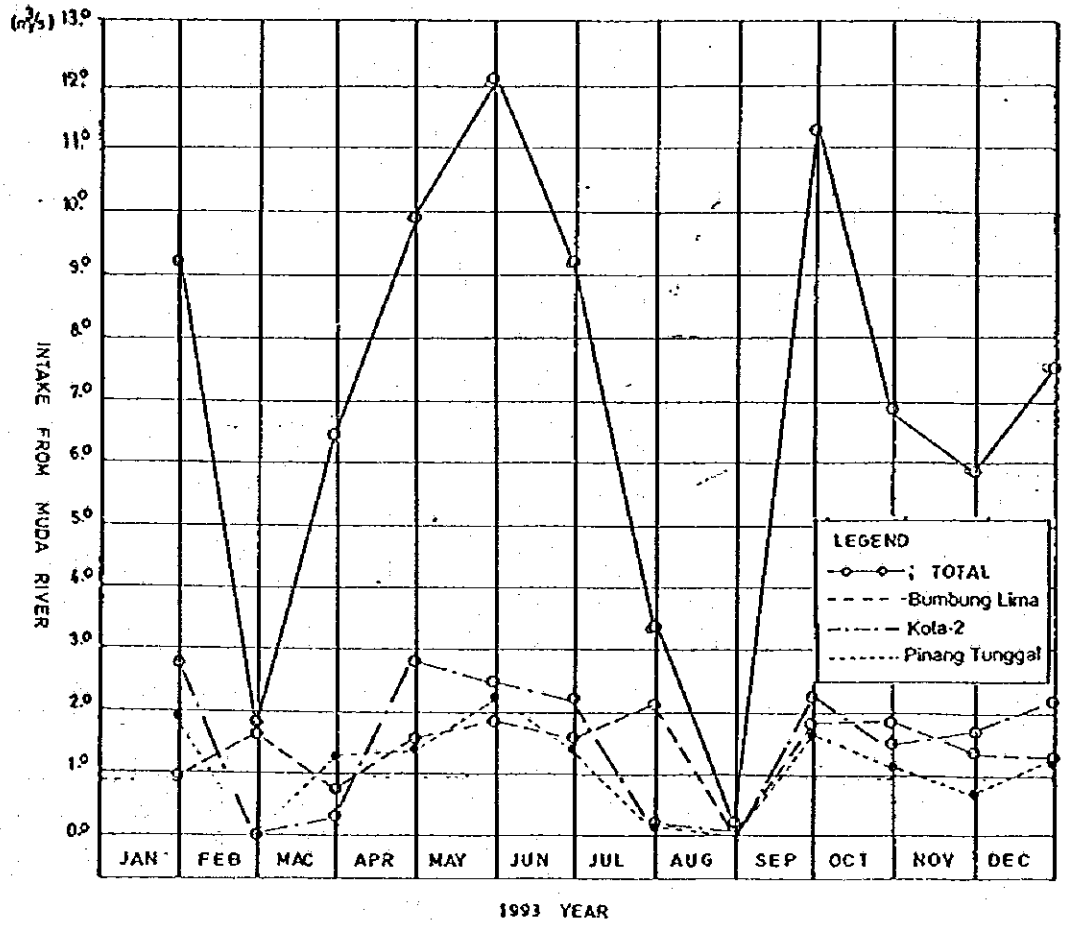
FIG.III. 2.2.1 LOCATION OF EXISTING IRRIGATION SCHEME



COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

FIG.III. 2.2.2 LOCATION MAP OF INTAKE FACILITIES FOR IRRIGATION WATER



COMPREHENSIVE MANAGEMENT PLAN OF MUDA RIVER BASIN	FIG.III. 2.2.3 ACTUAL INTAKE DISCHARGE FROM MUDA RIVER SYSTEM
JAPAN INTERNATIONAL COOPERATION AGENCY	