MASTER PLAN AND FEASIBILITY STUDY FOR SEWERAGE AND DRAINAGE SYSTEM PROJECT IN ALOR SETAR AND ITS URBAN ENVIRONS MALAYSIA

VOLUME VII

APPENDICES FOR SEWERAGE MASTER PLAN

MARCH 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

MASTER PLAN AND FEASIBIBITY STUDY

FOR

SEWERAGE AND DRAINAGE SYSTEM PROJECT

IN

ALOR SETAR AND ITS URBAN ENVIRONS

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ON
MASTER PLAN AND FEASIBILITY STUDY
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Guide to the Reports

The Reports consist of the following,

VOLUME I	:	SUMMARY
VOLUME II	:	SEWERAGE MASTER PLAN REPORT
VOLUME III	:	DRAINAGE MASTER PLAN REPORT
VOLUME IV	:	SEWERAGE FEASIBILITY STUDY REPORT
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LIST OF ABBREVIATIONS

ACP	- Asbestos cement pipe
ASTM	- American Society for Testing Materials
BOD	- Biochemical oxygen demand (3-day, 30 degrees C)
CRCP	- Centrifugally cast reinforced concrete pipe
DE	- Department of Environment, Ministry of Science, Technology and Environment
DID	- Drainage and Irrigation Department, Ministry of Agriculture and Fisheries
DO	- Dissolved oxygen
DWF	- Dry weather flow
EHEU	- Environmental Health and Engineering Unit, Ministry of Health
EPU	- Economic Planning Unit, Prime Minister's Office
ft	- feet
FTCP	- Federal Town and Country Planning
g/cap	- grammes per capita
g/day	- grammes per day
gal	- Imperial gallons
gal/cap	- gallons per capita
gal/day	- gallons per day
GDP	- Gross Domestic Product
GSD	- Federal Geological Survey Department
ha	- hectares
hr	- hours
IBRD	- International Bank for Reconstruction and Development
IMF	- International Monetary Fund
kg	- kilogrammes
km	- kilometres
l/day	- litres per day
l/day/cap	- litres per day per capita
l/sec	- litres per second
m	- metres
m^2	- square metres
m^3	- cubic metres

MADA	- Muda Agricultural Development Authority
mg/l	- milligrames per litre
mil	- miles
MLG	- Ministry of Local Government
mm	- millimetres
MPKS	- Majlis Perbandaran Kota Setar (Municipal Council Kota Setar)
MPN	- Most probable number
MS	- Meterological Station
MSWL	- Mean Sea Water Level
NEB (LLN)	- National Electricity Board (Lembaga Letrik Negara)
p/ha	- persons per hectare
pH	- Hydrogen iron potential
ppm	- parts per million
PVCP	- poly Vinyl chloride pipe
PWD (JKR)	- Public Works Department, Ministry of Works and Utilities (Jabatan Kerja Raya)
RCP	- Reinforced concrete pipe
SDID	- State Drainage and Irrigation Department
SEDC	- State Economic Development Corporation
SEPU	- State Economic Planning Unit
SLO	- State Land Office
SMHD	- State Medical and Health Services Department
SS	- Suspended solids
STCP	- State Town and Country Planning
VCP	- Vitrified clay pipe
WHO	- World Health Organization
yr	- years

CONVERSION FACTORS

Multiply imperial unit by figures in multiplier column to obtain metric (SI) equivalent; multiply metric (SI) unit by reciprocal to obtain imperial equivalent.

Imperial Unit	Multiplier	Metric unit	Reciprocal
acre	0.4047	hectare (ha)	2.471
ft	0.3048	m	3.281
ft/s	0.3048	m/s	3.281
ft^2	0.0929	m^2	10.76
ft^3	0.02832	m^3	35.31
ft^3/s (cusec)	0.02832	m^3/s (cumec)	35.31
gal	4.546	litre	0.220
gal	0.004546	m^3	220
hp	0.7457	kW	1.341
in	25.40	mm	0.03937
lb	0.4536	kg	2.205
lb/ft^2	4.881	kg/m^2	0.2049
lb/ft^3	16.03	kg/m^3	0.06243
mile	1.609	km	0.6214
$mile^2$	2.589	km^2	0.3862
ton	1.016	tonne	0.9842
yd	0.9144	m	1.094
yd^2	0.8361	m^2	1.196
yd^3	0.7646	m^3	1.308

APPENDIX A

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2. Socio Economic Background

2.1 General

Malaysia is composed of 13 states, 11 of which form Peninsular Malaysia - Johore, Melaka, Negri Sembilan, Pahang, Selangor, Trengganu, Kelantan, Perlis, Kedah, Perak and Penang. The other two states are Sarawak and Sabah on the island of Borneo.

Except for the alluvial plains along the west coast of the peninsular, most of the country's 332,943 square kilometers are covered by mountains. The climate is tropical with average daily temperature ranging from 70°F to 90°F.

The population of 12.6 million is made up of diverse ethnic origins - 55% Malays, 34% Chinese and the remainder mostly Indians.

The official language is Bahasa Malaysia but English and other languages are also widely used. Islam and Buddhism are the dominant religions.

Malaysia has a constitutional monarchy. The titular Head of State is the Yang Di-Pertuan Agong who is elected from the nine ruling sultans in Peninsular Malaysia Legistative powers are vested in the two houses of Parliament - the Dewan Rekayat (House of Representatives) and the Dewan Negara (House of Senate). The national executive power is vested in a Prime Minister and his cabinet.

2.2 Malaysia National Economy

Malaysia has an agriculturally-oriented economy which makes her the largest exporter of rubber, palm oil, tropical hardwood timber and

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Note: Money figures are expressed in Malaysian dollar unless otherwise indicated.

pepper. However, she is now diversifying into industry to concentrate on the manufacturing of finished products from her own natural resources. This is reflected by the increase in contribution to the GNP by the manufacturing sector from 9% in 1972 to 15% in 1978. The manufacturing sector accounts for more than one-fifth of Malaysia's total exports too. Exports of machinery, transport equipment, and petroleum products have been experiencing strong growth despite the slow external demand for the Malaysian manufactured goods.

The Government gives high priority to labour intensive, agro-based and export oriented industrial projects which use a high percentage of local raw materials. Steps have been taken to distribute industries to the less developed areas so as to balance geographical distribution of industries. Investors whose plans conform to the Government's policy are given attractive incentives.

In promoting industrialisation, the Government has followed a programme of developing industrial estates. To date there are 64 industrial estates and free trade zones and 32 planned industrial estates. In many cases, the expensive lands in the industrial estates are obtained on a long term lease basis.

The Malaysian economy is largely export orientated that 50% of the GNP arises from exports. In 1978, total exports amounted to US$6,486 million, an increase of 6.6% from the 1977 figures. The manufacturing sector accounted for more than 20% of the total exports. Rubber, which has been the most important exporting product for years, earned US$1,362 million or 21% of the total export value in 1978. Petroleum replaced tin as the second major export earner, grossing US$992 million or 15% of the total export value whereas tin earned US$742 million or 11%.

Total imports in 1978 increased by 17% to US$5,249 million. Investment goods accounted for one-third of the import value; consumption goods accounted for just over one-fourth. Japan continued to be the major supplier of Malaysia's imports (23%) followed by the European Common Market, the ASEAN countries and the U.S.

The Government welcomes foreign investors which contribute significantly both for improvement of income and employment conditions and for transfer of skills and technology. In addition, the foreign ownership provides widening access to international markets for the country's exports.

Malaysia has favourable balance of payments since 1969. The surplus for 1978 was US$118 million. The inflow of private long term capital comprising new foreign direct investment and retained earnings, has been relatively high and stable ever since the country's independence. This signifies the confidence for the foreign investors in the growth potential and stability of the country.

Malaysia's satisfactory balance of payments, together with her high foreign exchange reserves has enabled her to adopt Article VIII of the Agreements of the International Monetary Fund. This means that Malaysia may not, without prior approval of the IMF, impose restrictions on payments or transfers for current international transaction or engage in discriminately currency arrangements or multiple currency practices. It must also provide for the free convertibility of Malaysian currency held by foreigners.

2.3 Economic Development

The economic development in Malaysia has been based on the New Economic policy. The objectives of this policy are to reduce and eventually to eradicate poverty irrespective of races by rectifying the economic imbalances existing between races and regions. These objectives will be achieved by generating more employment opportunities and increasing productivity and income by the target year 1990.

Implementation of the new economic policy has necessitated a greater involvement of the government sector. This is done through the State Economic Development Corporation and Government sponsored public corporations such as the National Corporation (PERNAS) and the Development Bank of Malaysia.

The objectives of the New Economic policy were incorporated as the main target of the Second Malaysia Economic Plan (1971-1975). Development projects under Transport as well as Commerce and Industry were given more emphasis under this plan. Utilities, Health and Family Planning as well as Social and Community Services, which were given importance during the First Malaysia Plan, decreased in terms of expenditure allocation.

The achievements made under this plan were:

1. Average annual growth rate at current price - 12%
2. Average annual growth rate of real Gross National Income per capital (1970 prices) - 1.6%
3. Increase in new employment - 588,000
4. Average annual growth rate in employment - 3.3%

The current plan, namely the Third Malaysia Plan (1976-1980), aims to further intensify efforts to eradicate poverty and to continue effort to change social structure. In addition, the Plan aims to strengthen the national security too. The targets set out for the Plan are to achieve a growth rate of 8.5% p.a. at the target year of 1980 in terms of the Gross Domestic Product and to create 743,000 new jobs.

2.4 The Second Malaysia Plan 1971-1975

The main thrust of the Second Malaysia Plan (SMP) was to lay the foundations for the implementation of the New Economic Policy (NEP). The SMP itself was the first in a series within the perspective Plan, 1971-90 aimed at accelerating economic change designed to bring about a more equitable distribution of economic opportunity, income and wealth among the population.

2.4.1 Growth in Major Sectors

During 1971-75, the Gross Domestic Product (GDP) at factor cost, grew by 7.4% per annum in real terms as compared with the original SMP target of 6.8% and the revised target in the Mid-Term Review (MTR) of 7.8%. The shortfall with respect to the MTR target is largely attributable to the impact of worldwide recession on the Malaysian economy during 1974/75. The average annual rate of grwoth of GDP was 8.4% during 1971-74 as compared to 3.5% in 1975.

The fastest growing sectors were transport, manufacturing, public administration and other services with annual growth rates of 12.6%, 10.9% and 7.2%, respectively during the SMP period.

2.4.2 Sources of Growth

Economic development during the SMP was largely stimulated by public sector expenditures for investment and consumption. These expenditures constituted the main source of growth under the SMP. The rate of growth for public investment was 17.6% p.a. in real terms while the private investment registered sharp fluctuations during the SMP period. Negative rates of grwoth occurred in 1972 and 1975 in contrast with an increase of 22.3% between 1973 and 1974.

2.4.3 Exports

Exports provided the main thrust of economic growth during the years of 1973 and, to a lesser extent, 1974. International prices of raw materials were favourable and the prices of Malaysia's major primary commodities reflected this trend.

In 1970, more than 50% of total exports came from agricultrual sector with rubber contributing the largest portion, 34%, followed by timber 16.3% and palm oil 5.1%. The mining and the manufacturing sectors contributed 22.6% and 11.4% respectively. By 1975, however, manufactured exports amounted to 23.0% of total exports even though agriculture continued to predominate with 49.5%.

2.4.4 Imports

Imports of goods and non-factor services in constant prices amounted to over one-third of GNP. Among the major components of the import bill were electrical and industrial machinery which accounted for 24% of the total imports, followed by agricultrual items 17%, transport equipment 11% and industrial chemical and fertilizers 5%.

2.4.5 The External Economy 1971-1975

Despite fluctuations in the world economy, Malaysia continued to maintain a favourable basic balance in the exports and imports of goods and non-factor services. Cumulatively, the basic balance remained in Malaysia's favour amounting to $3,000 million for the five years between 1970 and 1975.

Malaysia's favourable trade balance and substantial inflow of funds both in public and private sectors enabled the country to accumulate some $1,900 million in external reserves over the last five years. This enhances Malaysia's financial strength giving the Ringgit a 164.9% in 1975.

2.4.6 Employment and Underemployment

In the five-year period of the SMP, the economy achieved a rate of 3.3% per annum in employment growth compared with 3.2% per annum in the growth of the labour force. This resulted in a net increase of 588,000 new jobs.

Four sectors of the economy accounted for almost 90% of the increase in new jobs. The sectors are services 24%, agriculture 26%, manufacturing 18% and wholesale and retail trade 20%.

2.4.7 Conclusion

In many respects, the SMP differed in substance and scope from previous plans. Its premises were the two prongs of NEP. Its paramount objective is to promote growth and development in a united and progressive nation within a generation. The SMP has demonstrated the acceptance of these objectives of the NEP and the political will and capacity to realize these objectives. These will be the foundations for the TMP.

2.5 The Third Malaysia Plan 1976-1980

The Third Malaysia Plan (TMP), 1976-80 constitutes the Second Phase in the implementation of the NEP, which will be based upon the significant economic and social progress obtained in the recent past, in particular the SMP.

The Plan aims to further intensify efforts to eradicate poverty and to continue efforts to restructure Society, with an additional aim to strengthen the National Security.

The Mid-Term Review of the TMP was released on March 20, 1979. It proposes an additional $13,500 million to pump up developments, raising the Government TMP to $32,100 million, an increase of 73% on original provision.

2.5.1 Exports and the Economy

The strong performance by exports provided the main thrusts to the economy in 1976-1978.

Exports registered an annual growth rate of 22% compared with the TMP target of 13.6%. Again rubber was the best-seller.

Beyond by the strong commodity prices, per capita real gross National Income in 1970 prices rose from $1,304 in 1975 to $1,644 in 1978 - an annual growth of 8%. This performance was well above the average of most developing countries. The GDP rose at an average annual rate of 8.5% during 1976-78.

The overall real growth rate of 8.7% achieved by the economy in 1976-78 exceeded the TMP target of 8.4% despite the continued slow growth of the world economy and the less than full recovery from the 1975 international recession by Malaysia's major trading partners.

Although all sectors contributed to the growth over the past few years, manufacturing grew by 14.3% per annum in 1976-78, raising its share in the GDP to about 19% from 16.4% in 1975. This rapid growth, exceeding the TMP target of 12% per annum, was achieved despite short falls in private investment in the first two years of the plan. This was due to the 18.5% growth in manufacturing production in 1976, following rising domestic demand and prices.

Rubber production grew by 3.3% (TMP 6%) during the same period followed by palm oil 12.5% (TMP 16.4%), saw logs 14.5% (TMP 6.7%) and construction 11.1% (TMP 8.9%). The rapid growth of the construction sector was mainly concentrated in private residental construction, particularly in medium and low-cost housing and government project.

2.5.2 Investments

Total investment in 1970 prices increased from $3,936 million in 1975 to $5,109 million in 1978 achieving an average growth rate of 9.1% per annum. The increase was partly related to the petroleum industry.

Public investment expanded strongly by 17.1% in current prices and 10% in real terms between 1976 and 1978. However, the private investment had a slow growth rate of 9.6% per annum. A substantial portion of this increase was due to investments in production facilities undertaken by the petroleum industry.

2.5.3 Imports

This grew at a rate of 12.5% per annum during 1976-78.

2.5.4 Balance of Payment

Malaysia's balance of payments position improved significantly in 1976-78 and its combined merchandise surplus amounted to $10,300 million,

exceeding the five year target of $4,000 million.

On the current account, a surplus of $3,200 million was recorded as against the projected deficit in the Plan. The traditional deficit of the services account continued to increase which was primarily the result of large payments overseas for freight and insurrance and investment income.

The net inflow of long-term capital, which in the TMP was projected at $9,500 million for the five-year period, amounted to $5,200 million during 1976-78. Of this total, official capital was $1,800 million while private capital amounted to $3,400 million.

The favourable position on the current account, together with the inflow of long-term capital, resulted in a substantial surplus in the basis balance which amounted to $8,300 million compared with a cumulative five-year target of $4,300 million.

2.5.5 Employment

For the 1976-78 period, the economy made substantial progress creating 474,100 jobs or about 64% of the 743,000 targeted in the plan. This had reduced the unemployment rate from 7% in 1975 to 6.2% in 1978. However, in view of the rapid increase in the labour force of 3.5% per annum, the unemployment rate for 1980 will remain at 6.1% as indicated in the plan. It was expected that the manufacturing, service and commerce sectors would provide most of the jobs. With a projected GDP growth of 7.7% per annum, 320,200 jobs would be generated in 1979-80.

2.5.6 Future Economic Outlook

The 1979 Budget has been prepared with the aims to sustain and promote Malaysia's steady economic growth and to improve the income distribution within the framework of stable prices. The details of the budget are as follows:

Budget totaling:	$12,709 million; 9% increase over 1978 budget of $11,700 million.
Appropriation for development:	$4,000 million
Operating expenditure:	$8,709 million; Increase of 8.1% over 1978 budget
Operating revenue:	$9,100 million; Increase of 11% over 1978 budget
GNP expected growth rate:	11.2%

Despite the pessimistic forecasts for world economic growth and the recent increase in international petroleum prices, the prospects for Malaysia's continued advance appear bright in 1979 and in 1980.

The MTR of the TMP envisaged that the industrial sectors - manufacturing, construction and mining would account for about 30% of the GDP by 1980. Contribution from the agricultural sector was expected to decline to 23.2% in 1980, comparing from 1976. Employments opportunities would be increased with the creation of 320,000 jobs in 1979 - 80.

With the extra allocation of funds for the TMP after the MTR, agriculture and rural development, including social development, will continue to receive the highest priority to accelerate further the implementation of anti-poverty programmes, especially for the less developed states.

2.6 Banking and Finance

The Malaysian financial system will be divided into two parts, the banking system and the system of non-bank financial intermediaries as shown in Figure A-6. The former includes the monetary institutions such as the Central Bank and the commercial banks, the merchant banks, discount houses, finance companies and the foreign exchange market. The non-financial intermediaries are comprised of the provident pension and insurance funds, the development finance institutions and the unit trusts.

Commercial banking is well developed in Malaysia. As from August 1978, there were 37 commercial banks, of which 20 were domestic banks with a total of 437 banking offices and 17 in foreign countries. The commercial banks are the largest group of financial institutions in the country and are the most important local sources of financing. At the end of 1977, total loans and advances of all commercial banks amounted to US$3,198 million and total assets of US$6,643 million, of which US$4,915 came from deposits.

The commercial banks are closely supervised by the central bank, Bank Negara, which is also the sole currency issuing authority and acts as banker to the Government and the commercial banks.

The second-largest group of deposit-taking institutions, after the commercial banks, are the finance companies licensed as borrowing companies under the Borrowing Companies Act 1969. This group competes actively with the commercial banks for savings and fixed deposits, while in their credit operations, they complement the credit operations of the banks by specialising mainly in hire-purchase and housing loan finance.

At the end of 1977, a total of 12 merchant banks operated in Malaysia. The main activities of this type of financial institutions include providing financial and management consultancy services, underwriting debts and equity issues, and acting as intermediary in arranging medium and long-term financing. For their own account, they also participate in money market operations and grant all loans as well a term loans for working capital on property acquisition.

The discount houses are secondary financial institutions which mobilise funds mainly from other financial intermediaries and large enterprises. These funds are usually in the form of short-term deposits, money at call, and deposits up to 3 months of maturity.

All financial institutions are required to allocate a fixed minimum proportion of the total increase in their loans and advances to priority areas like the expansion of indigenous ownership (through the Bumiputra community), the agricultural sector, and the building and construction sector, especially for house owners. For the commercial banks, at least 30% of the increase must go to the Bumiputra community, 10% to agricultural food production, 25% to manufacturing and 10% to housing for individuals.

Financial companies which are licensed as borrowing companies are required to provide a minimum of 20% of their total increase of loans to Bumiputra, 25% to housing, and a minimum to 30% to agriculture, forestry and fishery, manufacturing, building and construction.

2.6.1 Exchange Control

The Exchange Control Ordinance 1953 and the implementary regulations issued by the Controller of Foreign Exchange provide the rules on foreign exchange controls. The Central Bank administers these rules on behalf of the Government, the Governor of the Central Bank being the Controller of the Foreign Exchange.

In May 1973, Malaysia adopted a liberal and non-discriminatory system of exchange regulations. Previously, regulations provided for an exchange controls system for transactions with countries outside the Sterling Area, while transactions within the Sterling Area were not subject to controls. Payments for foods and services are generally permitted with a minimum of formality (except Rhodesia and South Africa). Payments not exceeding M$1,000 are allowed without seeking approval or completion of foreign forms. For amounts beyond M$1,000 up to M$1,000,000 exchange control forms have to be filled out but the approval can be obtained through any commercial banks in Malaysia. For amounts exceeding

M$1,000,000, direct applications to the Controller of Foreign Exchange should be made. No exchange control permission is required for portfolio and direct investment by non-residents of Malaysia.

Companies are allowed to open inter-company accounts with their foreign offices and settle balances in these accounts, provided that export and loan proceeds are entered into these accounts only with their permission of the Controller of Foreign Exchange. A company in Malaysia controlled by non-residents is permitted to borrow amounts up to M$500,000 from Malaysian Commercial banks, exchange control permissions is required for loans beyond this amount.

The Malaysian bank accounts of residents of other countries (except Rhodesia and South Africa) are designated as external accounts. Deposits are freely permitted but subject to the formalities applicable to foreign currency payments. There are no restrictions on withdrawals.

2.6.2 Stock Exchange

On December 27, 1976, the new Kuala Lumpur Stock Exchange, limited by guarantee and as governed by the Companies Act, 1965, officially took over from its predecessor, the Kuala Lumpur Stock Exchange, Berhad. This was in line with the Government's decision to establish a separate Malaysian Stock Exchange. Formerly, the country's capital market and that of Singapore with trading rooms where in Kuala Lumpur and Singapore.

Companies listed on the Stock Exchange are categorised under six sections; industrials, hotels, properties, palm oil, tin and rubber. Public companies which want to be listed on the Stock Exchange must obtain the approval of the Capital Issues Committee and the Stock Exchange Committee.

Table A-1 Balance of Payment[1]

$ million

Item	1977
I. GOODS[2]	
Exports (f.o.b)	14,865
Imports (f.o.b.)	11,113
Merchandise balance	+3,752
Non-monetary gold	-10
II. SERVICES[3]	
Freight and insurance	-890
Other transportation	+97
Travel	-190
Investment income[3]	-1,189
Government transaction, n.i.e.[4]	+27
Other services	-142
Balance on services	-2,287
BALANCE ON GOODS AND SERVICES	+1,455
III. TRANSFERS (Net)	
Private	-122
Government	+22
BALANCE ON GOODS, SERVICES AND TRANSFERS	+1,355
IV. LONG-TERM CAPITAL MOVEMENTS (net)	
Official long-term capital	+621
Government[5]	(+535)
Statutory authorities[5]	(+94)
Other[6]	(- 8)
Corporate investment	+1,183
Commercial credits[7]	-20
Balance on long-term capital	+1,784
BASIC BALANCE	+3,139

V.	PRIVATE FINANCIAL CAPITAL AND UNRECORDED TRANSACTIONS (net)	
	Commercial banks[8]	+197
	Other[9]	-1,477
	Error and omissions, including other short-term capital	-1,104
	OVERALL BALANCE (surplus +/deficit -)	-755
VI.	ALLOCATION OF SPECIAL DRAWING RIGHTS	-
VII.	IMF RESOURSES	-265
VIII.	NET CHANGE IN CENTRAL BANK RESERVES	
	(increase -/decrease +)	-490
	Special drawing rights	(+116)
	IMF reserve tranche position	(+ 9)
	Gold and foreign exchange[10]	(-615)

1. Data on services, transfers and private capital flows from 1974 may not be strictly consistent with those of earlier years as the basis for estimation has been revised.
2. Adjusted for valuation and coverage to a balance of payments basis. Imports include military goods and commercial ships and aircraft. Data from 1977 include also imports for offshore installations of the petroleum industry which are not included in trade data.
3. Include undistributed earnings of foreign direct investment companies. The counterpart of these earnings is shown as an inflow of direct reinvestment capital under "Corporate investment".
4. Include transactions of foreign military and diplomatic establishments.
5. Refer to receipts and repayments on market and project loans by the Governments and statutory authorities.
6. Refer to changes in overseas assets of the Government and statutory authorities and subscription to international institutions and international commodity agreements.
7. Refer to receipts and repayments of long-term credit extended to the national shipping and airline companies.
8. Refer to the change in net overseas assets.

9. Refer to the change in the net overseas assets of finance companies, merchant banks and other identified financial transactions.

10. With the termination of the legal tender status of the Malayan dollar in January 1969, Malaysia's estimated share of the residual assets of the Board of Commissioners of Currency, Malaya and British Borneo is reflected since that date in the accumulated assets of the Federal Government instead of the Central Bank's gold and foreign exchange holdings.

Source: Department of Statistics
Inter-Agency Planning Group

Table A-2 Balance of Payments[1]

$ million

Item	1961	1962	1963	1964	1965	1966	1967	1968	1969
I. GOODS[2]									
Exports(f.o.b.)	3,208	3,232	3,296	3,346	3,752	3,808	3,679	4,070	4,921
Imports(f.o.b.)	2,668	2,892	3,010	3,071	3,226	3,249	3,202	3,427	3,290
Merchandise balance	+540	+340	+286	+275	+526	+559	+477	+643	+1,631
Non-monetary gold	-29	-3	-3	-3	-5	-6	-2	-6	-18
II. SERVICES(net)									
Freight and insurance	-133	-145	-155	-154	-162	-165	-170	-186	-247
Other transportation	-8	-8	-9	-15	-16	-11	-9	-12	-14
Travel	-67	-70	-69	-74	-80	-78	-69	-73	-96
Investment income[3]	-231	-177	-195	-230	-255	-268	-144	-154	-334
Government transaction, n.i.e.[4]	+145	+131	+150	+197	+225	+189	+132	+125	+105
Other services	-40	-41	-43	-50	-53	-74	-91	-100	-116
Balance on services	-334	-310	-321	-326	-341	-407	-351	-400	-702
BALANCE ON GOODS AND SERVICES	+177	+27	-38	-54	+180	+146	+124	+237	+911
III. TRANSFERS(net)									
Private	-205	-207	-206	-201	-195	-196	-185	-180	-209
Government	+12	+13	+25	+127	+137	+90	+43	+37	+29
BALANCE ON GOODS, SERVICES AND TRANSFERS	-16	-167	-219	-128	+122	+40	-18	+94	+731
IV. LONG-TERM CAPITAL MOVEMENTS(net)									
Official long-term capital	-159	+87	+146	+229	+174	+218	+382	+161	+264
Government[5]	(+13)	(+22)	(+48)	(-7)	(+70)	(-9)	(+81)	(+63)	(+147)
Statutory authorities[6]	(+10)	(+28)	(+41)	(+27)	(+35)	(+60)	(+53)	(+50)	(+32)
Other[6]	(-182)	(+37)	(+57)	(+209)	(+69)	(+167)	(+248)	(+48)	(+85)
Corporate investment	+180	+235	+270	+165	+150	+170	+130	+93	+245
Commercial credits[7]	-	-	-	-	-	-	-	-	-5
Balance on long-term capital	+21	+322	+416	+394	+324	+388	+512	+254	+504
BASIC BALANCE	+5	+155	+197	+266	+446	+428	+494	+348	+1,235
V. PRIVATE FINANCIAL CAPITAL AND UNRECORDED TRANSACTIONS(net)									
Commercial banks[8]	+77	+23	+59	-	-102	+33	+8	+115	-126
Other[9]	-	-	-	-	-	-	-	-	-27
Error and omissions,including other short-term capital	-101	-95	-212	-204	-235	-396	-543	-286	-588
OVERALL BALANCE(surplus+/deficit-)	-19	+83	+44	+62	+109	+65	-41	+177	+494
VI. ALLOCATION OF SPECIAL DRAWING RIGHRS	-	-	-	-	-	-	-	-	-
VII. IMF RESOUTCES	-	-	-	-	-	-	-	-	-
VIII. NET CHANGE IN CENTRAL BANK RESERVES (increase-/decrease+)	+19	+83	+44	+62	-109	-65	+41	-177	-494
Special drawing rights	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
IMF reserve tranche position	(-2)	(-2)	(-12)	(-1)	(-20)	(-20)	(-35)	(-4)	(-8)
Gold and foreign exchange[10]	(+21)	(-81)	(-32)	(-61)	(-89)	(-45)	(+76)	(-173)	(-486)

1 Data on services, transfers and private capital flows from 1974 may not be strictly consistent with those of earlier years as the basis for estimation has been revised.

2 Adjusted for valuation and coverage to a balance of payments basis. Imports include militaty goods and commercial ships and aircraft Data from 1977 include also imports for offshore installations of the petroleum industry which are not included in trade data

3 Include undistributed earnings of foreign direct investment companies. The counterpart of these earningsis shown as an inflow of direct reinvestment capital under "Corporate investment".

4 Include transactions of foreign military and diplomatic establishments.

5 Refer to receipts and repayments on market and project loans by the Government and statutory authorities.

6,7,8,9,10 See footnotes on following page.

Source: Department of Statistics
Inter-Agency Planning Group

Table A-2 Balance of Payments (cont'd)[1]

$ million

Item	1970	1971	1972	1973	1974	1975	1976	1977
I. GOODS[2]								
Exports(f.o.b.)	5,020	4,884	4,736	7,263	10,022	9,057	13,329	14,865
Imports(f.o.b.)	3,942	4,179	4,356	5,664	9,345	8,330	9,556	11,113
Merchandise balance	+1,078	+705	+380	+1,599	+677	+727	+3773	+3,752
Non-monetary gold	-11	-19	-15	-5	-5	-3	-11	-10
II. SERVICES(net)								
Freight and insurance	-304	-322	-309	-420	-714	-621	-726	-890
Other transportation	-21	-34	-35	+49	+82	+98	+94	+97
Travel	-105	-106	-101	-94	-39	-105	-151	-190
Investment income[3]	-355	-363	-378	-659	-997	-726	-931	-1,189
Government transaction n.i.e.[4]	+68	+52	+25	+29	+43	+47	+36	+27
Other services	-145	-105	-108	-102	-94	-95	-129	-142
Balance on services	-862	-878	-906	-1,197	-1,719	-1,402	-1,807	-2,287
BALANCE ON GOODS AND SERVICES	+205	-192	-541	+397	-1,047	-678	+1,955	+1,455
III. TRANSFERS(net)								
Private	-199	-188	-176	-185	-125	-115	-121	-122
Government	+19	+51	+19	+34	+21	+36	+21	+22
BALANCE ON GOODS, SERVICES AND TRANSFERS	+25	-329	-698	+246	+1,151	-757	+1,855	+1,355
IV. LONG-TERM CAPITAL MOVEMENTS(net)								
Official long-term capital	+21	+398	+692	+120	+276	+872	+489	+621
Government[5]	(-4)	(+375)	(+346)	(+73)	(+227)	(+912)	(+369)	(+535)
Statutory authorities[6]	(+6)	(-7)	(+14)	(+1)	(+51)	(+24)	(+50)	(+94)
Other	(+19)	(+30)	(+332)	(+46)	(-2)	(-64)	(+70)	(-8)
Corporate investment	+287	+306	+320	+420	1,374	+862	+763	+1,183
Commercial credits[7]	+5	-15	+173	+46	-67	-18	+154	-20
Balamce on long-term capital	+313	+689	+1,185	+586	+1,583	+1,716	+1,406	+1,784
BASIC BALANCE	+338	+360	+487	+832	+432	+959	+3,261	+3,139
V. PRIVATE FINANCIAL CAPITAL AND UNRECORDED TRANSACTIONS(net)								
Commercial banks[8]	-16	+68	-15	+259	+65	-108	+66	+197
Other[9]	+6	+5	+9	-5	+36	+25	-241	-1,477
Error and omissions,including other short-term capital	-260	-230	-92	-510	-81	-705	-1,032	-1,104
OVERALL BALANCE(surplus+/deficit-)	+68	+203	+389	+576	+452	+171	+2,054	+755
VI. ALLOCATION OF SPECIAL DRAWING RIGHRS	+64	+61	+60	-	-	-	-	-
VII. IMF RESOUTCES	-	-	-	-	-	-	+265	-265
VIII. NET CHANGE IN CENTRAL BANK RESERVES (increase-/decrease+)	-132	-264	-449	-576	-452	-171	-2,319	-490
Special drawing rights	(-72)	(-61)	(-60)	(+8)	(+10)	(-11)	(-5)	(+116)
IMF reserve tranche position	(-47)	(+35)	(-)	(-22)	(+1)	(-21)	(+4)	(+9)
Gold and foreign exchange[10]	(-13)	(-238)	(-389)	(-562)	(-463)	(-139)	(-2,318)	(-615)

1,2,3,4,5 See footnotes in previous page

6 Refer to changes in overseas assets of the Government and statutory authorities and subscriptionsto international institutions and international commodity agreements.

7 Refer to receipts and repayments of long-term credits extended to the national shipping and airline companies.

8 Refer to the change in net overseas assets.

9 Refer to the change in the net overseas assets of finance companies, merchant banks and other identified financial transactions.

10 With the termination of the legal tender status of the Malayan dollar in January 1969, Malaysia's estimsted share of the residual assets of the Board of Commissioners of Currency, Malaya and British Borneo is reflected since that date in the accumulated assets of the Federal Government instead of the Central Bank's gold and foreign exchange holdings.

Source: Department of Statistics
Inter-Agincy Planning Group

Table A-3 External Reserves of Malaysia

($ million)

AT END OF PERIOD		GROSS EXTERNAL RESERVES OF MALAYSIA (MISSION RINGGIT)				OTHER OFFICIAL RESERVES	GROSS OFFICIAL RESERVES	NET OFFICIAL RESERVES	NET FOREIGN ASSETS OF COMMERCIAL BANKS	NET EXTERNAL RESERVES
		Total	Special Drawing Rights	IMF Gold tranche position	Gold and Foreign Exchange					
1976		6,273.3	191.8	158.4	5,922.1	110.1	6,382.4	6,359.3	-252.2	6,107.1
1977		6,770.5	76.3	149.2	6,545.0	103.7	6,874.2	6,842.7	-449.1	6,393.6
1978	Jan	6,759.8	76.3	149.3	6,534.2	104.5	6,864.3	6,830.3	-509.3	6,321.0
	Feb	6,765.9	76.3	149.3	6,540.3	104.0	6,869.9	6,838.1	-442.7	6,395.4

Table A-4

Peninsular Malaysia: Consumer Price Index

Period	Consumer Price Index (1967 = 100)									
	Total	Food	Beverages and tobauo	Clothing and footwear	Gross rent, fuel and power	Furniture, furnishing and household equipment	Medical care and health expenses	Transport and comminication	Recreation extertainment education and cultural services	Miscellaneous goods and services
	Weight									
	100.0	46.8	8.9	4.8	9.4	6.6	2.0	10.4	5.6	5.5
1968	99.8	98.5	100.4	100.5	100.3	100.3	100.5	101.2	103.9	101.3
1969	99.4	97.1	100.7	100.9	100.5	101.9	100.7	100.7	104.5	103.3
1970	101.3	99.1	102.8	102.3	101.1	105.5	101.8	102.8	106.3	103.5
1971	102.9	100.6	103.5	103.0	102.0	108.2	102.6	103.8	111.1	106.1
1972	106.2	103.8	107.2	105.8	102.8	114.0	103.4	106.5	115.5	112.8
1973	117.4	120.3	108.6	129.0	104.3	128.6	107.8	109.4	119.8	122.5
1974	137.8	151.7	110.7	144.1	111.5	150.5	116.4	119.7	126.9	140.4
1975	144.0	157.4	121.2	143.3	118.9	157.8	122.4	127.1	129.5	147.9
1976	147.8	160.5	122.8	146.9	125.6	161.7	135.2	133.3	130.3	151.3
1977	154.8	169.4	127.3	152.6	133.3	167.3	140.9	138.1	132.7	159.4
1978 Jan - Feb	161.5	176.6	133.7	157.3	139.4	173.5	145.0	145.6	135.0	168.4

1 Annual indices are simple averages of monthly indices.

Table A-5 Malaysia: Employment Growth By Sector, 1978-80

(1,000 persons)

Sector	1978		1980		Increase 1978-80	Share in job creation (%)
	Estimated employment	Share of total (%)	Estimated employment	Share of total (%)		
Agriculture, forestry, livestock and fishing	1,972.5	43.9	2,023.6	42.0	51.1	16.0
Mining and quarrying	90.2	2.0	91.7	1.9	1.5	0.5
Manufacturing	587.3	13.1	675.1	14.0	87.8	27.4
Construction	196.5	4.4	227.0	4.7	30.5	9.5
Utilities	27.7	0.6	30.8	0.6	3.1	1.0
Transport, storage and communications	207.9	4.6	227.6	4.7	19.7	6.1
Wholesale and retail trade	559.3	12.4	613.7	12.8	54.4	17.0
Finance and insurance	43.3	1.0	47.0	1.0	3.7	1.1
Producers of government services	621.8	13.8	673.2	14.0	51.4	16.1
Other services	187.1	4.2	204.1	4.3	17.0	5.3
TOTAL:	4,493.6	100.0	4,813.8	100.0	320.2	100.0

Source - TMP Mid-Term Review 1978

Table A-6 Malaysia: Exports, 1976-78

($ million)

Goods	1976	1977	1978	Average Annual Growth Rate (%)
Rubber	3,117	3,379	3,537	20.4
Tin	1,527	1,704	1,920	16.8
Palm Oil (crude and refined)	1,196	1,768	1,740	9.6
Crude Oil	1,550	1,908	2,413	49.2
Petroleums (partly refined and petroleum products)	353	203	110	-22.7
Sawlogs	1,471	1,519	1,562	32.7
Sawn Timber	854	790	747	24.0
Canned Pineapple	62	65	62	6.7
Pepper	137	143	145	11.0
Manufactures (excluding pineapple and petroleum products)	2,359	2,601	3,511	23.6
Others	816	891	1,005	-
Gross Exports	13,442	14,971	16,752	22.0

Source - TMP Mid-Term Review 1978

Table A-7 This Malaysia Plan Projection of Balance of Payments 1975-1980

($ million)

	1975	1980	Cumulative Total '76-80
Goods and services			
Receipts	10,165	19,029	80,443
Payments	10,386	20,840	85,154
Net position	-221	-1,811	-4,711
Transfer (Net)			
Private	-160	-110	-655
Government	+35	+45	+205
Balance on current account	-346	-1,876	-5,161
Long-term capital (net)			
Public	+827	+1,518	+5,800
Private	+525	+900	+3,650
Basic Balance	+1,006	+542	+4,289
Errors and amission including short-term capital	-835	-400	-2,450
Overall surplus (+) or deficit (-)	+171	+142	+1,839
Allocation of IMF Special Drawing Rights	-	-	-
Net change in external reserves (increase - decrease +)	-171	-142	-1,839

Table A-8 Annual Growth Rates of Gross Domestic Product (at Constant Prices)

Years	Malaya 1956-60[1] (1960=100)	Malaysia 1961-65 (1965=100)	Malaysia 5 year plans 1st 1966-70 (1965=100)	2nd 1971-75 (1970=100)	3rd 1976-80 (1975=100)
1	3.0%	1.4%	6.2%	6.5%	10.8%
2	2.5%	6.9%	1.0%	9.4%	7.8%
3	0.5%	5.5%	4.2%	11.7%	7.0%[2]
4	4.5%	5.8%	10.4%	8.3%	
5	9.9%	5.6%	5.0%	0.8%	
Average	4.1%	5.0%	5.4%	7.3%	8.5%

1. Peninsular Malaya
2. Estimates

Source: Bank Negara Malaysia, Economic Planning Unit and Department of Statistics.

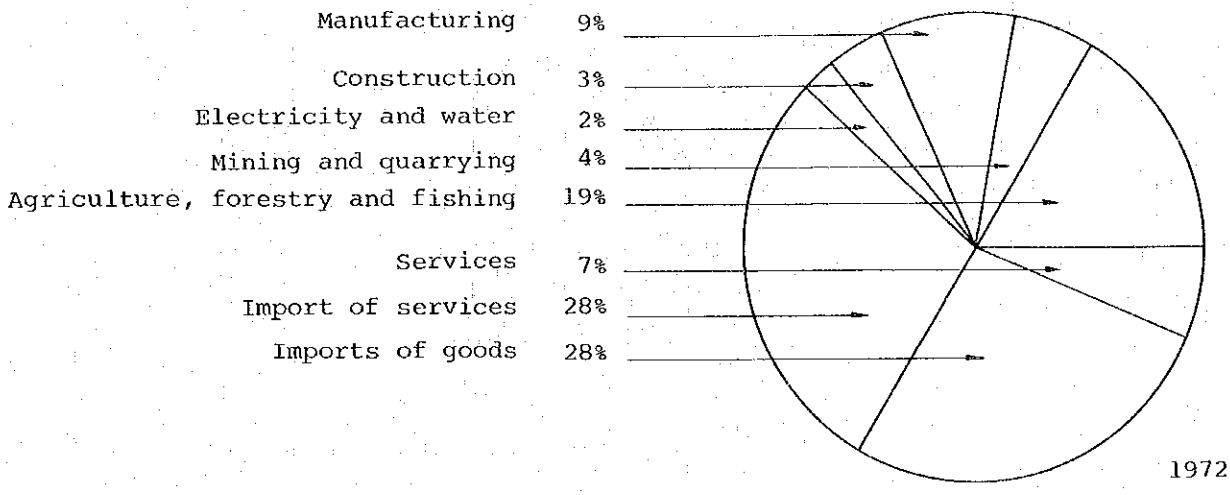
Table A-9 Composition of the Gross Domestic Product (GDP) by Industry of Origin

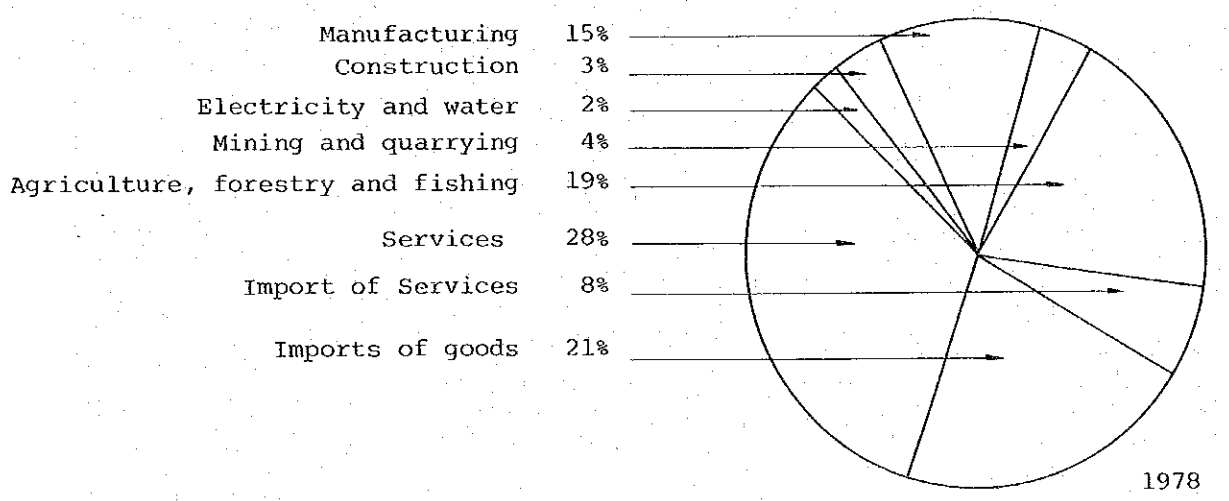
	1955[1] (1960=100)	1965[1] (1960=100)	1975 (1970=100)	1978 (1970=100)
	Per cent of GDP			
Agriculture, forestry and fishing (of which: rubber planting)	40.2 (26.0)	31.5 (21.2)	27.6 (10.0)	25 (9)
Mining and quarrying	6.3	9.0	4.6	5
Manufacturing	8.2	10.4	16.4	19
Construction	3.0	4.5	3.8	4
Services	42.3	44.6	47.6	47

1. Peninsular Malaysia only

Source: Economic Planning Unit and Department of Statistics.

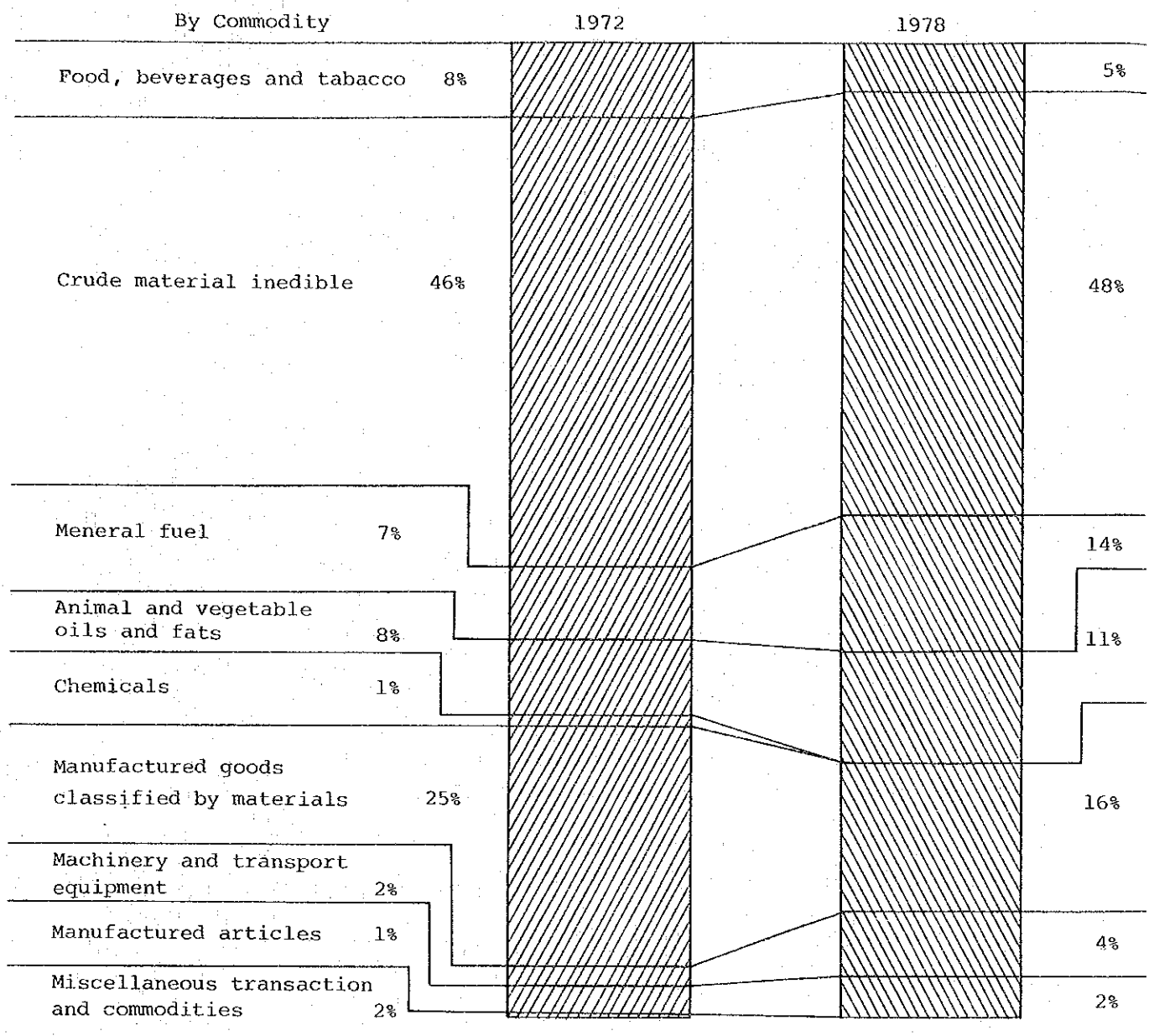
Figure A-1 Percentage Distribution of Gross National Product By Origin 1972 and 1978





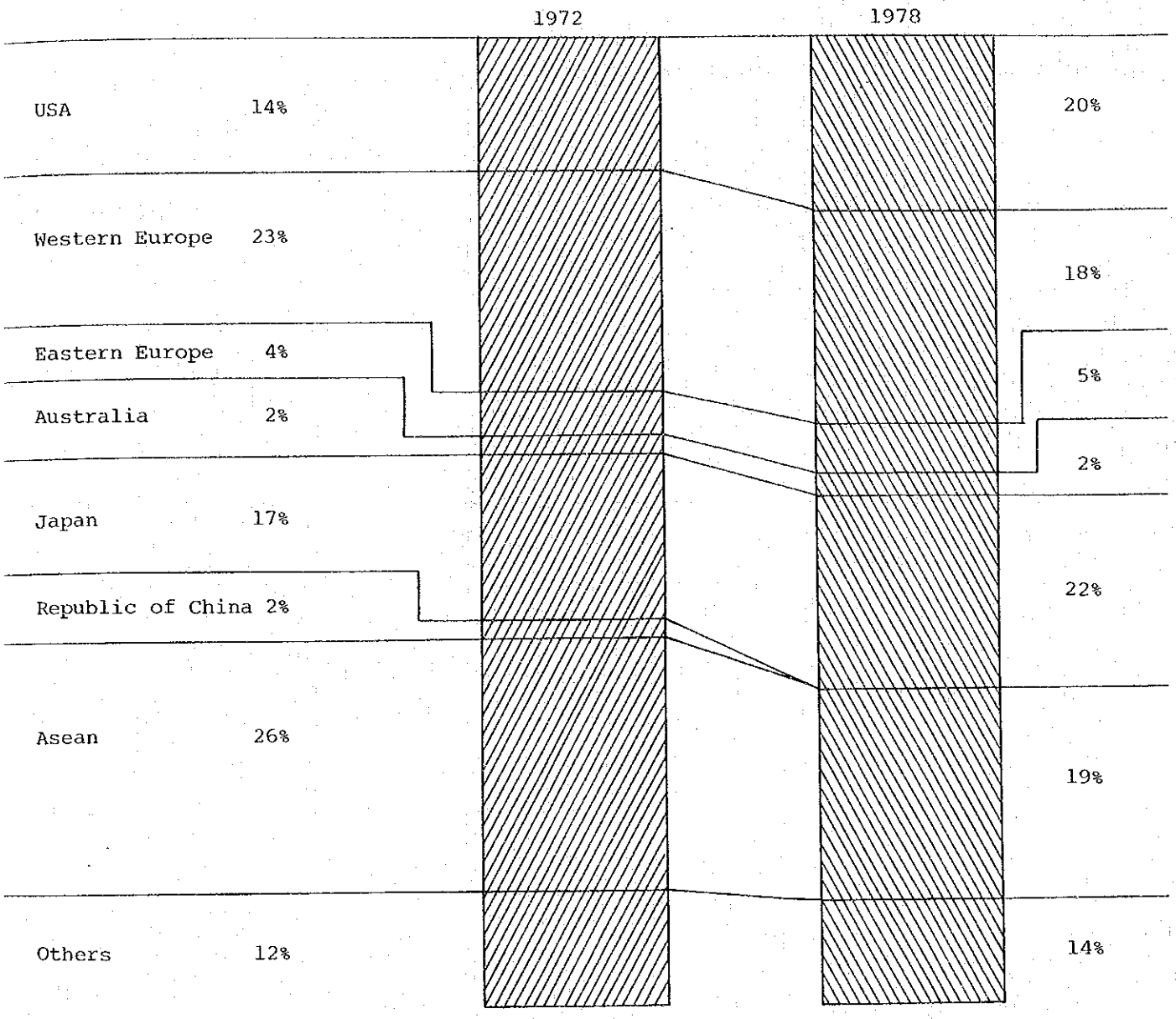
Source: Economic Report Ministry of Finance 1972/73 and 1978/79

Figure A-2 Distribution of Exports by Commodity 1972 and 1978



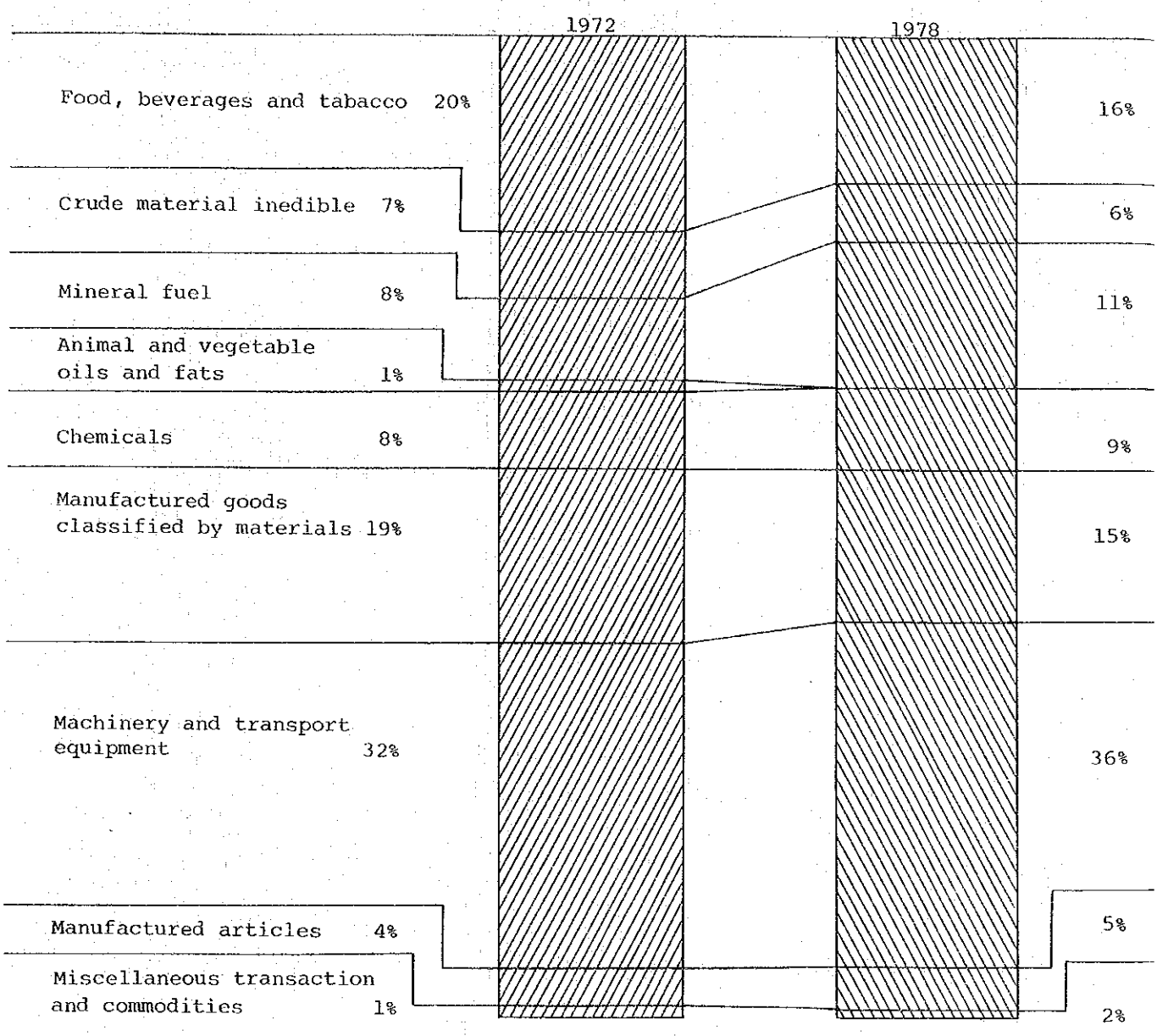
Source: Economic Reports Ministry of Finance 1972/73 and 1978/79

Figure A-3 Distribution of Exports by Destination 1972 and 1978



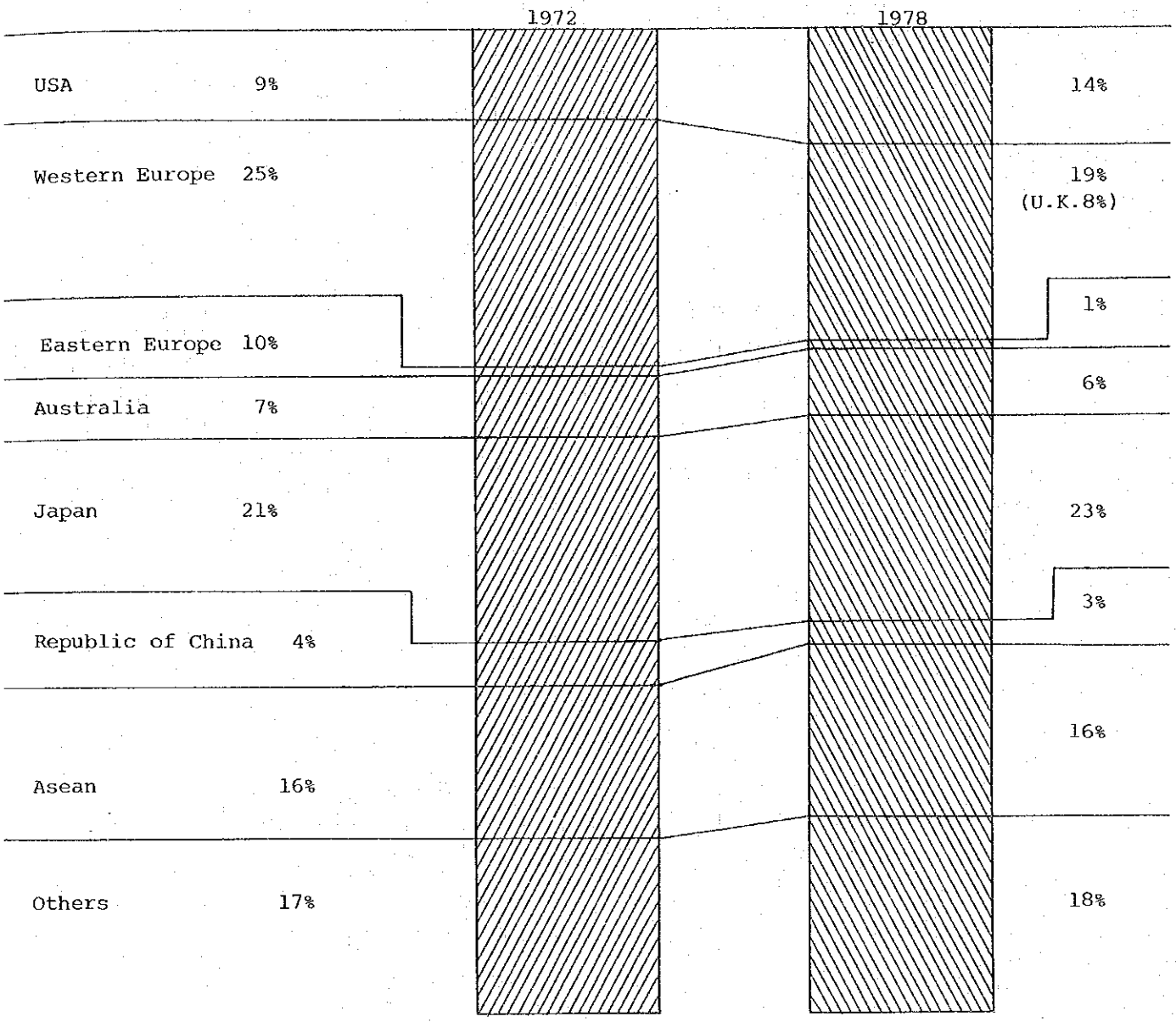
Sources: Economic Report Ministry of Finance 1978/79

Figure A-4 Distribution of Imports by Commodity 1972 and 1978



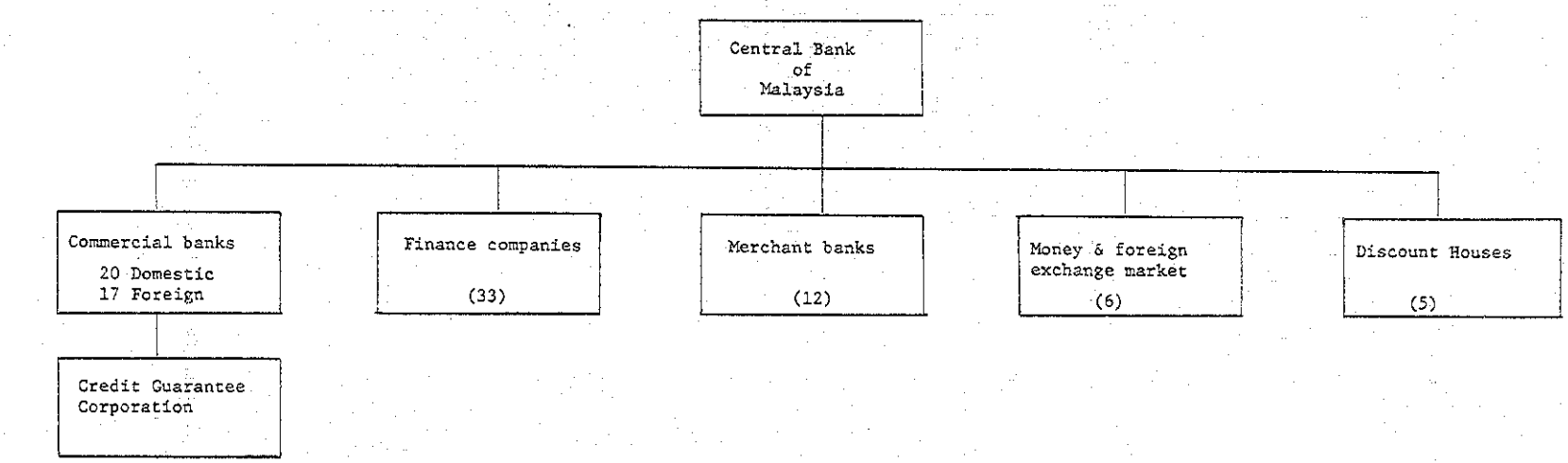
Source: Economic Reports Ministry of Finance 1977/78

Figure A-5 Distribution of Import by Origin 1972 and 1978



Source: Economic Report Ministry of Finance 1977/78

Figure A-6 The Financial System Structure as at Dec. 31, 1978 The Banking System



NON-BANK FINANCIAL INTERMEDIARIES

DEVELOPMENT FINANCE INSTITUTION	SAVINGS INSTITUTION	PROVIDENT AND PENSION FUNDS	INSURANCE COMPANIES	OTHER FINANCIAL INTERMEDIARIES	UNIT TRUSTS	STOCK EXCHANGES
1. Malaysian Industrial Development Finance 2. Agricultural Bank of Malaysia 3. Borneo Development Corporation 4. Sabah Credit Corporation 5. Development Bank Malaysia 6. Sabah Development Bank	1. National Savings Bank 2. Cooperative Societies: (a) Bank Rakyat (b) Cooperative Central Bank (c) Urban Credit Cooperative Society (d) Housing Cooperatives (e) Rural Cooperatives Societies	1. Employees Provident Fund 2. Teachers Provident Fund 3. Armed forces Fund 4. Social Security Organization 5. Other Statutory and private and pension funds	64 Insurance Companies	1. Housing Credit 2. Industries (a) Malaysia Building Society Berhad (b) Borneo Housing Mortgage Finance (c) Housing Loans Division Treasury (d) Bumiputra Investment Foundation (e) Pilgrims Management and Fund Board (f) Komplek Kewangan Malaysia Berhad	1. Unit Trust Companies 2. Unit Trust Funds	1. Kuala Lumpur Stock Exchange 2. Bumiputra Stock Exchange Division, Komplek Kewangan Malaysia Berhad

2.7 Kedah

2.7.1 General

Kedah is situated on the North Western part of Peninsular Malaysia, and forms part of the 237,000 acres of Muda Scheme. This makes her the leading rice producing state in Malaysia which gives her the name of "The Rice Bowl of Malaysia".

Rice cultivator in the state occupies 320,990 acres and rubber also plays an important role in the State economic activities, taking up 452,590 acres.

2.7.2 Climate

Kedah has a tropical-monsoon climate which is warm and humid. The temperature is 32°C (90°F) and the average minimum is 24°C(75°F). Relative humidity varies between 70% and 90%. The State experiences two periods of high rainfall and two periods of low rainfall. The maxima occur in April - May and October - November which are inter-monsoonal periods. The minima occur during the monsoons i.e. in January - February and in June. Annual precipitation approximates around 110 to 104 inches.

2.7.3 Population

The area of the State is approximately 3,600 square miles and the population is estimated to be about 955,000 with the Malays forming the majority (71%), followed by the Chinese (19%), Indians (8%) and others (2%). A major portion of the population is relatively young with 43% in the 1 - 14 years age group. This indicates a high dependency ratio. According to the 1970 Census, the working population is estimated at 660,000 with an annual growth rate of 2.4%. The unemployment rate is estimated at 4.3%. These features indicate a high demand for education, health and employment. As the expansion in the fields of agriculture and forestry as the solution to unemployment problem is rather limited, there will be a high demand on industrial growth. To meet this demand the Government encourages the establishment of labour intensive projects.

2.7.4 Economy

Kedah has been one of the less developed States in the Peninsular Malaysia, with per capita income of about $800 which is only 66% of the National Average per capital income (about $1,512 per capita). The total GDP of the State, in 1970, is estimated at $1.0 billion with the State's

expenditure being $63.4 million. The economy of the State is predominantly agricultural, with forestry, fishing and more recently, industrialisation being the main economic forms of activities.

2.7.5 Development

In line with the New Economic Policy, the Federal and the State Government have given high priority and attention to develop the depressed and the under-developed areas in the State. Various strategies, agricultural and industrial, have been proposed, adopted and implemented.

The agricultural strategy aims at:

1. Strengthen the State's rural economy through diversification and intensification.
2. Maintain and if possible, increase the number of people who earn their living from the land.
3. Increase household incomes especially amongst the poorer sections of the rural community.

The industrial strategy undertakes to accelerate and disperse industrial development in less developed areas. Extensive programmes of industrialisation for the State have been launched and implemented through the various public and quasi public agencies and statutory bodies such as the Kedah State Development Corporation, the State Economic Development Corporation, the State Economic Planning Unit and State Development Office.

The State officials have identified Alor Setar, Sungai Petani, Kulim and Baling as the potential growth centres in the next 10 years. Five industrial estates are presently being developed around the major towns to cater for the demand of the various investors and they are situated as follows:-

1. Tikam Batu (100 acres) - Light and heavy industries.
2. Bakar Arang (550 acres) -Light and heavy industries.
3. (a) Mergong I (86 acres) -Light and service industries.
   (b) Mergong II (82 acres) -Light and service industries.

4. Kuala Kedah (47 acres) - Marine-based industries.
5. Kulim (523 acres) - Light and heavy industries.

Total area of industrial sites - 1,390 acres.

The Federal Government has declared the whole state of Kedah, except for District of Kuala Muda, as locational incentive areas, which means that the investment incentives in other areas are more and the tax holidays are longer than those available for the Kuala Muda District. By doing so, the Federal Government hopes to disperse industries away from existing industrial concentration in urban areas. However,the Kuala Muda District can enjoy an additional year of tax relief period over urban areas.

The tax relief period up to a maximum of 10 years for all areas in Kedah except District of Kuala Muda are as tabulated:

Qualifying Fixed Capital Expenditure/Employment	Period of Tax Holidays (Years)	
	Kulim and other areas outside K. Muda District	Bakar Arang & Other areas within K. Muda District
For fixed capital expenditure/less than M$250,000/- or employment less than 101	**5	*3
For fixed capital expenditure not less than M$250,000/- or employment not less than 201	6	4
For fixed capital expenditures not less than M$560,000/- or employment not less than 201	7	5
For fixed capital expenditures not less than M$1,000,000/- or employment not less than 351	8	6
Priority Product	1	1
Malaysia Consent	1	1
Total no. of years of Tax Relief	10	8

Note: * One additional year over urban areas

** Three additional years over urban areas

2.7.6 Infrastructures

The State Government has improved the infrastructure facilities of the State to meet the demands of the industrial estates. The National Electricity Board (NEB) has provided an underground 11 kv lines alongside surfaced roads within the industrial sites. Different tariff are being charged against the medium and large size industries.

Adequate water supply has been assured of by JKR. With the increased capacity of Bukit Penang Reservoir in Alor Setar, the water capacity and pressure for Mergong and Kuala Kedah Site was adequate after September 1978. For the areas of Kulim, Tikam Batu and Bakar Arang, additional demand of water can be met by arrangements with Penang Water Authority through the PWD.

Telecommunication services like telephone and telex are readily available. Ample lines are reserved for all industrial estates.

Labour-rates in Kedah, in particular, favour the needs of labour intensive export-oriented industries. The rates are as follows:-

1. Daily-paid workers: (all rates are in Malaysian Ringgit)
   Unskilled (with at least 6 years of primary education)
   - $3.50 to $4.00 per day.
   Semi-skilled (with at least 3 years of secondary education)
   - $4.00 to $6.00 per day.
   Skilled (with 3 years of secondary education plus 2 years of industrial training)
   - $6.00 to $8.00 per day.

2. Monthly Salaried Workers: (all wages are in Malaysian Ringgit)
   Clerical group (with at least 5 years of secondary education)
   - $180 to $400 per month.
   Executive officers (with at least 2 years of pre-university of equivalent plus 3 years in colleges)
   - $400 to $1,000 per month
   Professional and Managerial Group (with college/university education plus experienced)
   - $800 to $2,000 per month

2.7.7 Banking

There are numerous banks and financial institutions to render service of the economy of the State. Among them are the various commercial banks, the Malaysian Industrial Development Finance Behad (MIDFB), the Credit Guarantee Corporation, Borrwoing Companies and the Merchant Bankers. The facilities offered are such as underwriting services, provision of loan, provision of credit facilities guarantee scheme and stock exchange activities.

2.7.8 Future Development Strategy

The recent Kedah - Perlis Development Study recommends the spot development in the State such as the Gunung Jerai, beaches of Pantai Merdeka and Langkawi. The study also recommends the establishment of more recreational facilities in Alor Setar and the Development of more links with tourist resorts in Thailand such as Phuket Islands and Bangkok. These developments will certainly promote tourism in Kedah.

2.8 Alor Setar

Alor Setar is the capital city of the State of Kedah and is also the residence of His Highness The Sultan of Kedah, being the major administrative centre in Kedah. Most of the Government departments and other public agencies in Kedah are based in Alor Setar.

Commercial activities have grown rapidly due to the adequate facilities provided by both the Government and the private agencies in servicing these activities. Numerous banks have been opened which offer the normal banking services including making loans and advances, discounting trade bills and provision of business investment advisory services.

In addition to the various services available, there is a good network of road, and railways and a domestic airport, those of which link Alor Setar with the surrounding areas. This has made Alor Setar into a busy centre where all the business and trading activities have focussed upon. The good communication between Alor Setar and Butter-

worth where shopping facilities are available has further enhanced the position of Alor Setar as a trading centre.

As a service centre, the city plays a dominant role for Perlis too because the State is too small to support the same order of activity.

The employment in Alor Setar are largely absorved by the Governmental agricultural and the commercial sector, mainly retaining. Industrial employment is high too compared to the other towns.

The Government has planned to undertake further development on industrial estate in Alor Setar thus diversifying the city's economy.

At present, an industrial estate has been established at Mergong which is 1.5 miles from central part of Alor Setar. The Phase I of the industrial estate occupying 86 acres has been completed while the Phase II is still undergoing development for 82 acres of area. Almost all the land has been taken up for light and service industries. This site has been gazetted as a locational incentive area under which a maximum tax relief period of 10 years can be granted.

There are tentative plans to establish another two industrial estates in Alor Setar under the 4th Malaysia Plan commencing in 1981 as follows:

1. Tandop, Sungai Korok -	Phase I	130 acres
	Phase II	100 acres
2. Barrage Site, Mergong		33 acres
Total		263 acres

State Budget

The following is the estimated Revenue and Expenditure for the year 1979.

	1979
REVENUE	
State Revenue	$31,211,175
Grant and Loan from Federal Government	12,919,697
	44,130,872
EXPENDITURE	
Salary	28,322,867
Other Annual Expenditure	19,611,517
Other Special Expenditure	
Office	2,530,433
Loan	5,334,535
Development and water supply funds	2,000,000
Allocated Expenditure	9,663,759
Total Expenditure	67,463,111
DEFICIT	$23,332,239
BUDGETED DEVELOPMENT EXPENDITURE FOR 1979	
State Funds	$12,362,687
Federal Govt. Grant	22,456,203
Loan	49,984,084
	$84,802,974
BUDGETED WATER SUPPLY EXPENDITURE FOR 1979	
State Funds	$8,731,466
Loan	1,848,678
	$10,589,144

3. Existing Excreta Disposal System

Distribution of the existing bucket (conservancy system) and communal septic tanks are obtained from MPKS as shown in Tables A-10, A-11 respectively and in Figure A-7.

Table A-10 Distribution of Bucket System

	Area	No. of Bucket
1.	Sungai Korok sampai Simpang Kuala	488
2.	Pengkalan kapal, Pekan China, Pekan Melayu, Penjara Lama Jalan Raja, Jalan Langgar dan Jalan Tunku Ibrahim	298
3.	Seberang Perak	125
4.	Kota Tanah	293
5.	Jalan Pegawai	98
6.	Limbong Kapal	151
7.	Jalan Langgar	280
8.	Jalan Putera	215
9.	Kampong Perak	100
10.	Jalan Kanchut	80
11.	Jalan Telok Wan Jah	155
12.	Alor Merah	42
13.	Tanjong Bendahara & Keretapi	50
14.	Simpang Tiga Derga	160
	Total	2,533

Table A-11 Distribution of Communal Septic Tanks

Ref. No. (Refer to Fig.A-7)	Area	No. of House	Served Population
1.	Taman Kuala Kedah	218	1199
2.	Rancangan Rumah Murah Jl. Sultanah	147	809
3.	Alor Malai Flats	180	960
4.	Kawasan Perumahan Jl. Shariff	272	1496
5.	Lorong Tiong	96	528
6.	Lorong Merpati	53	292
7.8.	Jl. Ghouse	77	424
9.	Market	-	-
10.	"	-	-
11.	"	170	938
12.	Rancangan Rumah Murah Tongkang Yard	59	325
13.	Jl. Bunga Raya	70	385
15.	Commercial Area	170	940
16.	Polis Quarters	54	297
17.	"	144	782
18.	Market	30	165
19.	"	30	165
20.	"	-	-
21.	General Hospital	-	-
	Total	1,770	9,705

4. Water Quality Standards

4.1 Present Activity on Water Quality Regulation in Malaysia

Surface water in Malaysia, has been polluted as a result of the rapid development of areas including agricultural, industrial, residential, etc. For the pollution control, the Environmental Quality Act was established in 1974 by the Federal Government of Malaysia. Following the Act, several regulations/guidelines of water quality are being prepared by the Federal Government to restore the waters to a tolerable level for beneficial uses by the people.

The strategy for the pollution control by the Government comprises a double-sided approach by: (1) setting-up surface water quality standards for various water uses, and (2) controlling effluent water quality for conservation or restoration of the quality by setting up standards for each type of beneficial use of receiving water. However, the enactments have not been sufficiently enforced, and most of them are still considered only as a guideline.

The Ministry of Health has proposed a guideline for surface water quality, in which Malaysian waterways are classified into nine categories of beneficial uses, and 10 parameters of water quality are described for each beneficial use. The description of the parameters are, however, not clear except coliforms, pH, and dissolved oxygen.

As a reference, the surface water quality criteria applied in several countries are shown in Table A-12.

The Ministry of Science, Technology and Environment is preparing the effluent quality criteria for sewage and industrial wastewater. The effluent is classified into three types according to their sources:

(1) Primary palm oil mill wastes,

(2) Rubber factory wastes, and

(3) Other factory, commercial and domestic wastes

The effluent quality of palm oil and rubber factories, which discharge wastes containing high BOD (some have thousands milligram per liter) will be regulated gradually following the special yearly plan to be established by the Government. For primary palm oil mill wastes, the effluent standards and yearly plan have been established in 1977.

The effluent quality criteria for the other factories will be regulated by both setting up the objectives for water quality of receiving water and establishing the permissible concentration of pollution parameters in the effluent. This is still under drafting stage. The Ministry of Health, Federal Industrial Development Authority, and others are intimately involved in these draft preparation.

4.2 Tentative Effluent Quality Criteria

The effluent from the proposed treatment facilities would be discharged into water bodies which have many different beneficial uses such as agriculture, fisheries, recreation, and other possible uses in future. Therefore, the effluent from the treatment facilities must be controlled for these uses.

The parameters of water quality to be measured are classified into two categories by the objectives for:

(1) Operation and surveillance of the treatment plant: water temperature, pH value, dissolved oxygen, BOD, suspended solids, and coliforms.

(2) Special purpose: heavy metals (mercury, cadmium, lead, chromium, etc.), arsenic, and other harmful chemicals.

Taking into consideration the draft water quality regulations of Malaysia as mentioned in the previous section, especially the environmental quality regulations for sewerage and industrial effluent currently being drafted, tentative effluent quality criteria are proposed as shown in Table A-13. These criteria are used in designing the proposed treatment facilities.

BOD, and coliforms are the most important parameters to check the treatment efficiency. The values for the parameters prepared here should be applied as the tentative effluent criteria. Data accumulated during long term operation should be used for improvement of treatment facilities operation and future design.

Coliforms themselves are not harmful to human health, but commonly used as an index parameter of potential contamination by human excreta and, consequently, by enteric disease bacteria. According to the effluent quality criteria from treatment plant prepared by the Ministry of Health as a guideline, for the same beneficial uses, as those of the receiving water of the proposed sewage treatment facilities effluent, coliforms of the effluent are regulated to be a maximum of 20 N/ml. This value may be too conservative because coliforms must be highly diluted and majority portion die off. As a tentative criterion, therefore, 1,000 N/ml are proposed as shown in Table A-13.

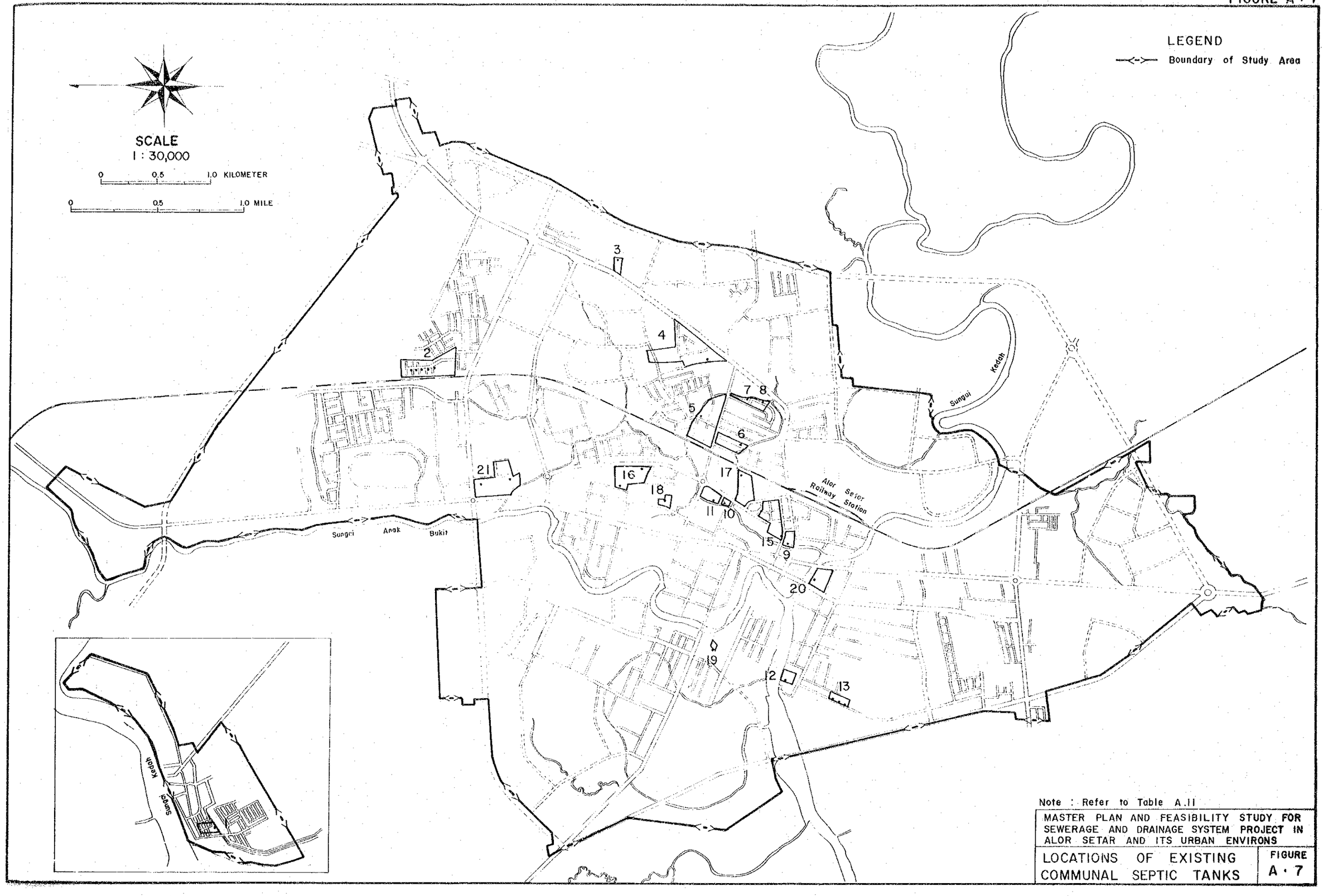
Table A-12 Receiving Water Quality Criteria Being Applied in Various Countries

	Coliforms (N/ml)	BOD (mg/l)	SS (mg/l)	pH	DO (mg/l)
Malaysia	10/20(*)	-	-	6 - 9	3
Japan	10/50(*)	3/5/10(*)	5/25(*)	6.5 - 8.5	7.5/5(*)
Philippines	10	-	10	6.5 - 8.5	5
Great Britain	-	20	30	-	10%-40%
Netherland	20/50	3/5	25/80	6.5 - 8.5	50%-120%
USA	10/20/50/100	-	-	-	-
Brazil	100	-	-	-	-
Uruguai	40	-	-	-	-
Ghana	10	-	-	-	-
WHO	0.5/2	-	-	5.9	-

Note: (*) value varies according to type of water uses

Table A-13 Tentatively Recommended Effluent Quality Criteria from Sewage treatment Facility

Parameter	Unit	Value	Remarks
BOD	mg/l	50	3 days at 30°C
Coliforms	N/ml	1,000	



Note : Refer to Table A.11

MASTER PLAN AND FEASIBILITY STUDY FOR SEWERAGE AND DRAINAGE SYSTEM PROJECT IN ALOR SETAR AND ITS URBAN ENVIRONS

LOCATIONS OF EXISTING COMMUNAL SEPTIC TANKS

FIGURE A · 7

APPENDIX B

WATER QUALITY STUDY

1. Water Pollution Study

1.1 General

Rivers and roadside drains located in the two districts, Alor Setar and Kuala Kedah are covered in this study. The river includes both mainstream and its tributaries. Since stream pollution varies according to season, field survey was carried out in both wet and dry seasons during the year of 1979. For pollution analysis, water was sampled at selected points along the Sg. Kedah and Sg. Anak Bukit, at the junctions of the mainstreams and their tributaries, and also at the inflow points of the roadside drains to the streams. There are a total of 31 sampling points along the various streams and roadside drains.

Twelve kilometers upstream from the river mouth of the Sg. Kedah, there locates a tidal gate. Usually the upstream of the gate has little flow due to the gate, however, flow occurs when the gate is opened during the period of low tide.

Water hyacinths are seen growing in the Sg. Kedah and Sg. Anak Bukit as well as in their tributaries regardless pollution and especially are seen thriving in rainy season. Among the streams surveyed, the most polluted is the Sg. Raja, whereas the least polluted stream is the Sg. Kedah.

1.2 Survey on River Pollution

1.2.1 Method of Survey

The streams subject to pollution survey are the Sg. Kedah and Sg. Anak Bukit as well as their tributaries. Sixteen sampling stations are established on the two main rivers and 15 stations on the tributaries. The survey was conducted in the wet months during June and July of 1979, and in the dry month of December of the same year separately. The distribution of sampling stations is shown in Figure B.1.

For water quality analysis, samples were taken from water surface, and field analysis was made as to temperature, pH, conductivity, and DO, whereas remaining parameters such as BOD_3, SS, chlorine ion, and coliform group, laboratory experiment was conducted. The survey was also extended to some physical characteristics such as flow velocity and geographic features of the streams.

To suit local situation, the following water quality parameters were analyzed as indicated below deviating from the standard method on common practice.

BOD_3	:	30°C for 3 days
SS	:	glass fiber filtration method
Chlorine ion	:	mercuric sulfate method
Coliform group	:	desoxycholate agar method

During the dry season, a visual observation of the water quality was also performed for the Sg. Raja at the station established under the bridge close to the MPKS. This station, being located half-way to the river mouth, obviously is able to bring about an average feature for entire reach of the stream.

1.2.2 Result and Discussion

1) Water Quality of the Mainstreams and Their Tributaries

The results of water quality analysis for the mainstreams and their tributaries are shown in Table B-1. The water quality together with the quantity varies according to season. The variation between the two seasons is distinctive, as discussed in detail in terms of each parameter as follows:

a) Discharge and Flow Velocity

Due to both lack of adequate slope and presence of the barrage, the upstream flow becomes stagnant especially when the weather is dry. However, at the time of rainfall or low tide, the gate is intermittently opened to discharge the river water to the sea, thus resulting to lower the river stage.

b) Water Temperature

Water temperature in the mainstreams is higher in the rainy season than the dry season. During the rainy season, the temperature rises at around 30.5°C, but decreases to a rather constant value of about 28°C in the dry season. There is no difference of water temperature between upstreams and downstreams. However, the temperature does vary from tributaries to their mainstream. As compared to the mainstream, the tributary has slightly lower temperature during the rainy season, about 1.5°C less than that of the mainstream. In dry season, however, no temperature variations have been observed between tributaries and mainstreams.

c) pH

Throughout the year, pH of the mainstream stayed in a rather narrow range between 6.0 and 6.5. No distinctive difference in pH was observed between dry and rainy seasons. As for the tributaries, the pH was all the time around 7.0, being higher than that found in the mainstreams in the same period. However, during the dry season, no difference in pH was observed between tributaries and mainstreams.

Table B-1 Results of Water Quality Analysis of Mainstreams and Tributaries

Station	Season rainy or dry	Date '79	Time	Flow Rate (m^3/sec)	Velocity (m/sec)	Temp. (°C)	Trans. (cm)	pH	Elc. Cond. (μv/cm)	DO (mg/l)	DO Satu. (%)	BOD3 (mg/l)	SS (mg/l)	Cl^- (mg/l)	Coliform (C/ml)
1.	rainy	17/6	9:50	0	0	30.5		6.6	650	2.17	29	3.6	49.5	152	1,740
	dry	12/12	12:00			30.1	65	6.4	3,200	2.1	30	2.3	53.0	828	31
2.	rainy	17/6	9:50	0	0	30.9		6.6	132	1.23	17	3.8	37.0	22.6	1,320
	dry	11/12	9:00			28.6	16	6.2		1.9	25	2.9	35.2		424
	dry	16/12	8:40	0		27.5	22	6.4	2,630	0.4	5	4.2		530	106
3.	dry	11/12	9:07			28.6	14	6.2		1.4	18	1.6	36.1	168	
	dry	26/12	8:50	0		27.9	23 <	6.2	2,150	0.6	8	2.9		510	134
4.	dry	11/12	9:35			28.6	14	6.4		1.6	21	2.7	33.8	360	
	dry	26/12	9:20	0		27.7	23 <	6.2	340	0.8	10	3.1		39	410
5.	rainy	17/6	8:35	23.2	0.161	30.6		6.4	135	0.81	11	7.0	35.5	24.6	80
	dry	11/12	9:50			28.4	15	6.4		3.4	44	2.5	31.7		312
	dry	26/12	9:35	0		27.9	22.2	6.2	96	1.9	24	4.0		14	157
6.	dry	11/12	10:05			28.4	15	6.2		3.1	40	2.5	37.2		284
	dry	26/12	9:50	0		28.0	15.5	6.2	63	1.5	19	3.8		12	81
7.	dry	11/12	10:40			29.0	16	6.2		3.5	46	2.5	29.3		232
	dry	26/12	10:25	0		28.1	13.8	6.2	56	2.5	32	2.9		11	69
8.	dry	11/12	10:50			29.5	16	6.2		4.3	57	2.5	30.5		120
9.	dry	18/6	11:40	13.6	0.08	30.6		6.0	97	1.56	22	3.6	35.5	22.6	20
10.	rainy	18/6	11:29			30.6		6.0	94	1.62	22	2.1	38.5	18.5	15
	dry	12/12	9:15			28.7	16	6.2	112	1.2	16	2.5	39.8	15	637
	dry	27/12	9:15	0		27.8	21.5	6.2		2.3	30	4.4			628
11.	rainy	18/6	9:45			30.3		6.2	95	1.98	26	2.3	460	36.9	35
	dry	12/12	9:35			28.9	14	6.2	53	2.7	35	3.7	43.5	11	213
	dry	27/12	9:30	0		27.3	18.5	6.2	158	1.0	13	1.3		20	145
12.	dry	12/12	9:55			29.0	14	6.2	45	3.7	48	4.3	25.5	9	14
	dry	27/12	9:45	0		27.8	18.5	6.4	72	1.9	24			14	29

- to be continued -

Table B-1 Results of Water Quality Analysis of Mainstreams and Tributaries

Station	Season rainy or dry	Date '79	Time	Flow Rate (m^3/sec)	Velocity (m/sec)	Temp. (°C)	Trans. (cm)	pH	Elc. Cond. (μv/cm)	DO (mg/l)	DO Satu. (%)	BOD3 (mg/l)	SS (mg/l)	Cl^- (mg/l)	Coliform (C/ml)
13.	dry	12/12	10:05			30.1	14	6.2	46	3.9	52	2.7	30.1	10	6
	dry	27/12	10:05	0		28.0	19	6.2	82	2.3	30	1.3		15	0
14.	dry	12/12	10:30			28.7	14	6.2	42	3.1	40	2.1	21.7	8	16
15.	dry	12/12	10:35			28.9	14	6.2	47	3.1	41	1.9		9	6
16.	dry	12/12	10:45			28.9	15	6.2	50	3.1	41	1.7	22.8	10	14
101.	rainy	17/6	9:40	0	0	29.1		6.4	910	1.98	26	7.7	59.0	222	530
102.	rainy	17/6	9:27	0.880	0.152	28.3		6.3	650	0.99	13	5.3	120	156	1,900
103.	rainy	16/6	10:42	0.089	0.066	30.2		7.5	450	0		18.0	19.5	34.9	36,300
104.	rainy	16/6	10:55	0.037	0.049	29.2		7.3	360	1.38	18	5.9	24.7	32.8	26,100
105.	rainy	18/6	10:50	0	0	28.5		6.9	405	0		19.8	35.0	53.3	70,700
	dry	12/12	9:25					6.2	110	1.6		4.5		16	382
	dry	27/12	9:25			27.8	19	6.2	1,730	2.3	30	2.7		330	532
106.	rainy	18/6	11:06	1.35	0.18	28.0		7.2	411	0		17.5	42.0	49.2	33,600
107.	rainy	18/6	11:57	1.75	0.20	28.5		7.3	421	0.89	12	12.0	30.0	61.5	31,900
108.	rainy	18/6	9:16	0.072	0.015	28.1		7.1	471	0.69	9	14.4	23.5	66.7	24,400
109.	rainy	18/6	9:31	0.078	0.105	29.2		7.3	388	1.23	16	13.4	32.0	48.4	12,200
110.	rainy	16/6	11:43	0	0	30.3		7.3	480	0		34.8	21.3	54.4	11,600
111.	rainy	16/6	11:52	0	0	29.7		7.4	650	0		8.6	18.7	65.5	29,000
112.	rainy	16/6	12:02	0	0	29.0		7.3	700	0		14.4	12.0	62.6	50,800
113.	rainy	16/6	12:16	0	0	29.3		6.7	210	0.87	11	3.1	40.0	23.6	10,200
114.	rainy	17/6	10:50	0	0	30.2		6.2	160	0.59	8	6.6	26.7	22.6	88,000
	dry	12/12	9:45			29.0	13	6.2	56	3.5	46	2.7		11	33
115.	rainy	12/12	10:10			28.1		6.2	87	3.1	40			12	124
	dry	27/12	10:00			27.3	17.8	6.4	88	1.5	19	1.2		15	25

d) Conductivity and Chlorine Ion

During the rainy season, only the part of mainstream downstream the barrage is affected by seawater intrusion. In dry days, however, the influence of seawater extends up to the point of junction of the Sg. Anak Bukit and Sg. Kedah. No seawater influence was observed beyond this point. An experiment was conducted separately in March 1979 and July 1979 for vertical distribution of conductivity when the dry weather days were continuing. From the results shown in Figure B-2, it is seen that the seawater intrusion has a greater effect in dry season than in wet season. In contrast to the mainstream, the tributaries have no intrusion effect for both wet and dry seasons.

e) DO and Its Saturation Percentage

Throughout the year there was little dissolved oxygen present in the mainstreams, being below 2 mg/l most of the year. However, an experiment conducted on the day of December 11, 1979, early stage of dry season, showed a rather high DO values, 3-4 mg/l, in the upper reaches of the mainstreams. In terms of percentage saturation, this range is equivalent to 40-50%. For other parts of the streams, the figure is around 30%, being close to the threshold for survival of aquatic lives in the tropic climate.

As compared to the mainstreams, DO levels of the tributaries is even worse. During the rainy season, dissolved oxygen can be completely depleted. Especially in the Sg. Raja, there have experienced a great many days without the presence of DO. DO less than 20% of its saturation value is also experienced in dry season. Although such low levels of oxygen concentrations, which are usually considered unable to sustain the aquatic lives, some fish were still found in the water. The decrease in DO is probably due to lack of reaeration of stream rather than inflow of pollutional load. This viewpoint can be further strengthened by the low value of BOD measured in the stream. More discussions in this aspect will be given over to the following section.

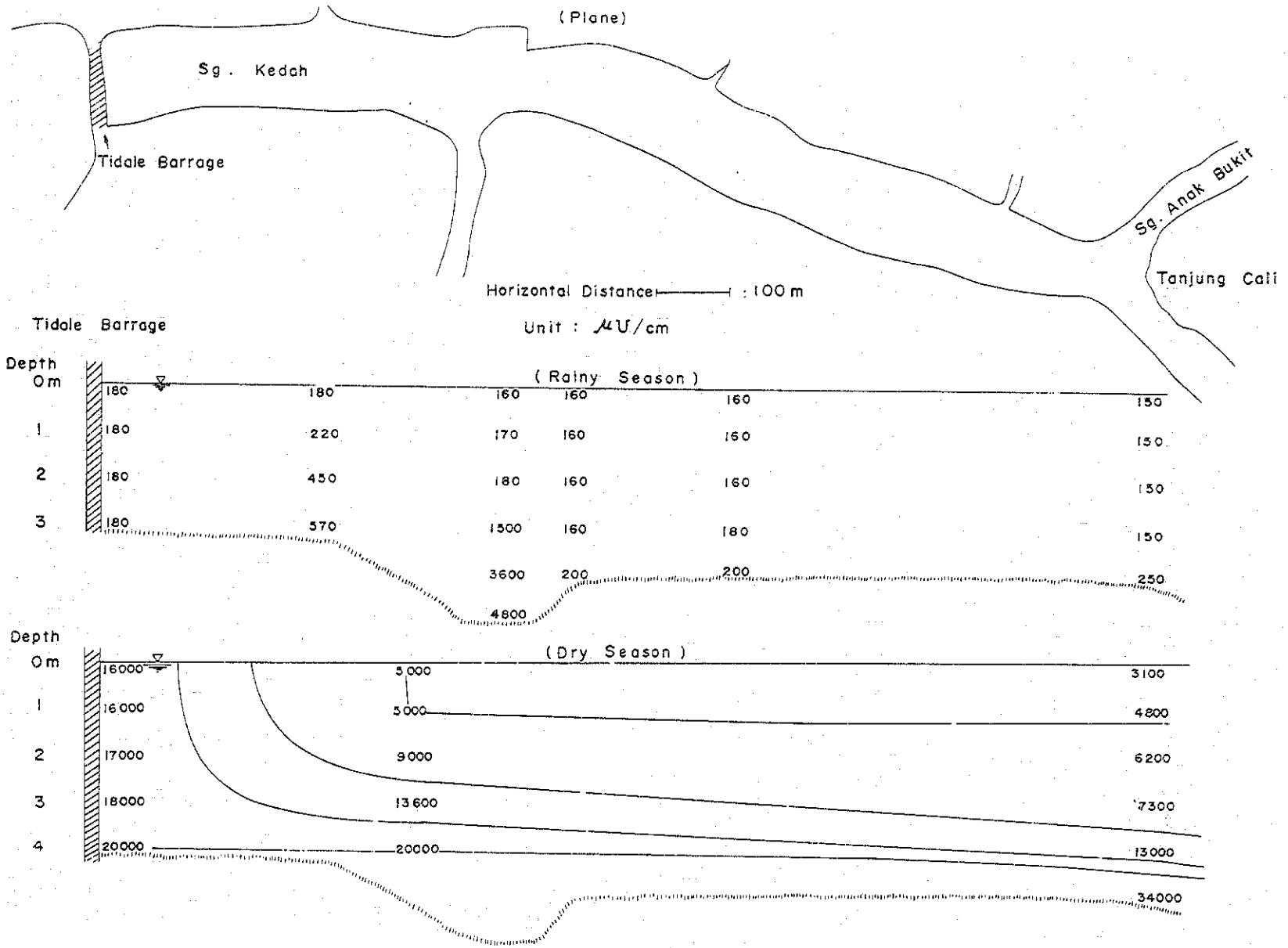


FIGURE B·2 ELECTRIC CONDUCTIVITY OF THE UPSTREAM OF SG. KEDAH

f) BOD_3

Irrespective of sampling point and season, BOD of the mainstream was usually close to the level of 3 mg/l.

Figure B-3 shows BOD levels of the streams. From the figure it is obvious to note that the Sg. Raja is most polluted.

g) SS

In either mainstream or tributary, SS concentration is always high irrespective of season, lying in the range of 20-50 mg/l. The high SS concentration appears to be contributed by erosion of the particular of the region.

h) Coliform Group

In dry season, the bacteria density was in an order of 10^2/ml both in mainstreams and tributaries. On the contrary, it varied greatly during rainy season, from 10 to 10^3/ml in the mainstreams, whereas 10^5/ml in the tributaries. Obviously it can be concluded that high coliform density is associated with rainy season.

i) Nitrogen and Phosphorus

For survey of phosphorus and nitrogen, samples are taken from selected points of the area and also from the source of the Alor Setar water supply. The samples were then shipped to *Penang for analysis. The results are shown in Table B-2. The K-N values as shown in the table seems unreasonablly very high, judging from the surrounding environmental conditions and the stream itself. For reexamination, additional samples were brought back to Japan for follow-up experiment. The results are shown in Table B-3. A comparison between the two tables reveals that there is a general agreement in the values of phosphorus but not in nitrogen. The discussion, which follows, is made based on the data given in Table B-3. Phosphorus in the Sg. Raja is as high as 1.28 mg/l; whereas other streams give concentration as low as 0.09-0.21 mg/l. Similarly for nitrogen,

the Sg. Raja gives 12.4 mg/l of T-N, but only 0.22-1.39 mg/l in other streams. Since both concentrations of nitrogen and phosphorus are high in the Sg. Raja it is obvious that pollution is advancing in the Sg. Raja.

Note: * The samples were analyzed by Rahman Hydraulic Tin Berhad.

Table B-2 Concentration of Nitrogen and Phosphorus
(Analized by Rahman Hydraulic Tin Berhad)

Unit: mg/l

Point	T-P	K-N	NO_3-N
1. Biak (Agricultural use)	0.22	84	0.52
2. Kedah	0.15	108.5	0.9
3. Kedah, Upstream (St. 16)	0.09	73.5	0.62
4. Anak Bukit (St. 5)	0.04	164.5	0.9
5. Anak Bukit, Upstream	0.08	94.5	1.48
6. Water Source	0.22	70	0.50
7. Raja Water (blackish)	1.06	91	0.4
8. Raja Water (blackish)	1.08	59.5	0.5

Table B-3 Concentration of Nitrogen and Phosphorus
(Analized by NSC)

Unit: mg/l

Point	T-P	PO_4-P	T-N	NH_4-N	NO_3-N	NO_2-N	K-N
Water Source	0.09	0.01	0.22	0.1	< 0.01	0.01	0.1
Anak Bukit (Sts. 5, 6)	0.21	0.07	1.39	0.1	0.79	0.002	0.5
Kedah, Upstream (St. 16)	0.17	0.06	1.10	0.1	0.30	0.001	0.7
Raja (Blackish)	1.28	0.83	12.4	2.9	0.05	0.18	9.3

2) Water Quality of the Sg. Raja

A survey on water quality of the Sg. Raja, the most polluted stream in the Area, was conducted over the period of December 12-31, 1979. The results are shown in Table B-5.

Ordinarily, the flow is stagnant, but considerable flow velocity was observed when the barrage gate was opened. The water stage varied greatly depending on the gate opening or closing operations. There was no variation in pH of the water, standing at around 6.6. As for dissolved oxygen, the concentration was always below 1 mg/l. Over half period of the survey, no dissolved oxygen was detected. In the previous survey conducted spearately on a sunny day (July 17, 1979) and a rainy day (July 21, 1979) when the flow turned blackish, a vertical distribution of DO was investigated. The results are shown in Table B-4. In the July 17th (1979) experiment, although it appeared that the water on the surface was saturated with oxygen, the oxygen diminished as the depth reached 40 cm below water surface. In the second experiment as conducted on a rainy day, no oxygen is detected through the entire depth of the stream. At the time even when dissolved oxygen is not detected (separately in July and December, 1979), some fishes were observed in the water.

Table B-4 Vertical DO Distribution Near MPKS Bridge

17/7				21/7			
Water Depth(m)	Temp. (°C)	E.C. (μ℧/cm)	DO (mg/l)	Water Depth(m)	Temp. (°C)	E.C. (μ℧/cm)	DO (mg/l)
0	33.0	470	13.6	0	28.3	450	0
0.2	30.4	470	-	0.2	28.3	470	0
0.4	30.4	470	0.9	0.4	26.8	449	0
0.6	29.8	465	-	0.6	26.7	465	0
0.8	29.6	465	-	0.8	26.7	468	0
1.1	29.4	465	0	1.0	26.8	450	0
				1.5	26.7	459	0

Table B-5 Observation Results of the Sg. Raja

Date (Dec.'79)	Time	Water Level (cm)	Velocity (cm/sec)	Temp. (°C)	Trans. (cm)	pH	DO (mg/l)	Colour	Oil (%)	Green Floc *	Wind
	8:30	0	(11)		12.2		0		100	0	Low
	10:30	3.0	(9.7)		11.3		0		80	0	Low
12	12:30	4.8	(13)		8.5		0.4		0	3-4	High
	14:30	7.0	(12)		7.1		0.6		0	7-8	High
	16:30	8.5	6(11)		10.3				0	3-4	High
	8:00	24.5					0	Black	100	0	
	10:00	25.0					0	Black	100	0	
15	12:00	25.5					0	Black	100	0	
	14:00	26.0					0	Black	100	0	
	16:30	26.5					0	Black	100	0	
17	2:00			30.5		6.4	0.2				
	8:00	-20.5	0.7(7)	27.0			0	Black	100	0	0
	12:00	-19.5	3.6(13)	30.0			0	Greenish Black	80	0	High
18	15:00	-19.3	6.0(9)	32.1			0	Greenish Black	100	3-4	Low
	8:00	-18.2	1.6(6)	26.9		6.6	0	Greenish Black	60	0	Low
19	12:00	-17.8	8.0(10)	29.8		6.6	0.8	Dark Green	10	5	High
	15:00	-17.6	7.9(13)	31.8		6.6	0.3	Brownish Green	100	0	0
	8:00	-16.4	3.2(4)	26.4		6.6	0.2	Browinish Green	60	0	0
20	12:00	-16.4	2.5(13)	31.4		6.4	0.4	Greenish Black	10	3-4	0
21	12:00	-14.3	3.6(13)	30.0		6.4	0	Greenish Black	10	0	Low
22	12:00	-12.4	3.2(10)	29.8		6.6	0.4	Greenish Black	100	0	0
23	8:30	-8.6	1.8(6)	26.8		6.4	0	Black	50	0	Low
	8:00	-8.3	1.6(3)	26.8		6.6	0	Dark Green	10	2	0
24	12:00	-8.3		28.8		6.6		Green	0	2-3	High
	15:00	-8.2		30.0	7.1	6.6		Green	0	0	0
27	9:00		1.8(4.0)	25.5	7.3	6.6	0	Black	100	0	0
	12:00		3.5(7.5)	28.8	8.2	6.6	0	Black	10	0	Low
30	12:00		5.1(14)	29.7	6.1	6.6	0	Black	20	0	High
	15:00		- (6)	29.2	6.9	6.6	0	Black	10	0	0
31	9:00		- (11)	27.2	8.8	6.6	0	Black	50	0	0
	12:00		18(33)	28.0	7.3	6.6	0	Black	10	0	High

Note: * No. of floc within a range of 5 m upstream of the observation points and the river width.

For further laboratory experiment for dissolved oxygen as to water depth, water was sampled respectively from the Sg. Raja and Sg. Kedah and stored in container respectively one was 10 cm deep and the other, 30 cm deep. A comparison of DO between the waters in the two types of containers after 3 days indicated that the water with depth of 10 cm contained DO at the level of few mg/l, whereas the water with depth of 30 cm contained very little oxygen, being less than 1 mg/l. When the water was quiescent without stirring, little oxygen was transferred from air and dissolved into the water. The water taken from the Sg. Raja turned black after a few days. However, no offensive odor could be smelt.

As was presumed that the black water has great connection with the bottom mud deposit, a survey on the bottom deposit was conducted during the month of December 1979. For sampling of the deposit, a 20-mm iron pipe was driven into the river bed. Then, gas came out in such a great amount that it seemed to bring up the 10-20 cm layer of water mass upward. In the meantime the gas turned the surrounding water into black color. The following figure shows a schematic diagram for such phenomenon.

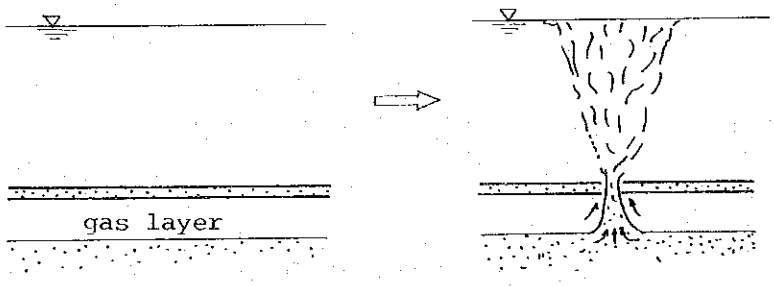


Figure Schematic Drawing of River Bed

Mud was sampled from the places as shown in Figure B-4 and then put on test for both moisture and volatile solid contents. The results are shown in Table B-6. The sample was red in color, and this was presumably due to the presence of iron element.

The blackish color of the water may not be necessarily resulted from human activity. According to local people, such blackish water is also found in some streams which have not been affected by pollution.

Table B-6 Moisture Contents and Volatile Solid Contents of the Sampled Mud out of River Bottom

Sampling Point		Moisture Contents (%)	Volatile (%)
F		50.1	23.6
Right bank of Sg. Raja		34.6	25.5
1	Upper layer	46.9	41.5
	Lower layer	29.8	25.7
2	Upper layer	51.1	12.5
	Lower layer	46.4	36.5

Note: Figures in parentheses refer to mean value.

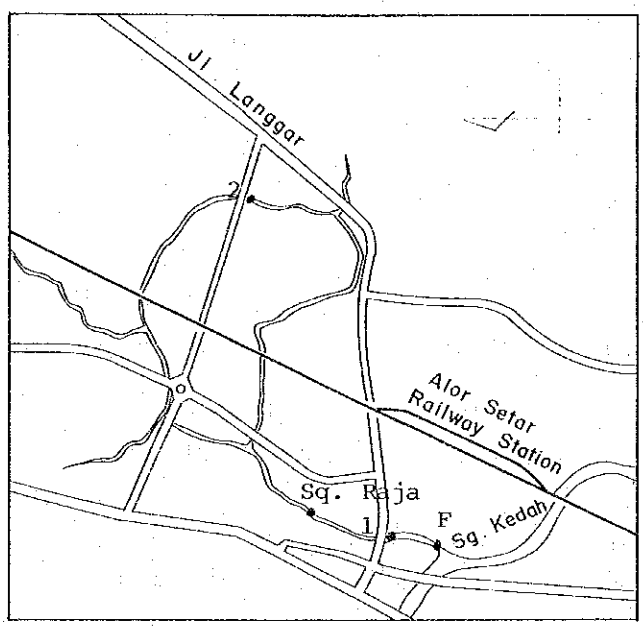


Figure B-4 Sampling Points

1.3 Pollution Survey on Roadside Drain

1.3.1 Method of Survey

Locations of sampling points for the roadside drains are shown in Figure B-5. There are a total of 32 points located in the Alor Setar area, and in the area of Kuala Kedah, including the one sampling point for the seafood processing wastewater. The survey was conducted in the months of June and July, 1979. For water quality analysis, methods previously used for the stream pollution analysis were employed.

1.3.2 Result and Discussion

The results are shown in Table B-7. Except one location which gives pH value of 5.3, the pH is generally in the range of 6.2-7.7. As for DO, the concentration ranges widely from 0 to 6.2 mg/l, which correspond to 0-82% in terms of percentage saturation.

As an indicator of organic pollution, BOD of the areawide water was measured as resulted in Figure B-6. From the figure it is reasonable to see that the roadside drains, which flow around the highly populated area, have high BOD concentration.

The extent of pollution is also measured in terms of DO. Contrary to the distinctive areal variation in BOD, the variation in SS is insignificant. Except a couple of locations, SS was generally in the order of 10 mg/l.

In addition to physicochemical analysis the water samples are also tested for coliform bacteria. The result indicates that there is a relation between bacteria density and BOD. High BOD water gave high coliform density, ranging from 10,000 to 100,000 cells/ml.

Table B-7 Results of Water Quality Analysis of the Drains and Diches
(Rainy Season)

Station No.	Date	Time	Flow Rate (m3/sec)	Flow (m/sec)	Temp. (°C)	pH	Elec. Cond. (μΩ/cm)	DO (mg/l)	DO Satu. (%)	BOD3 (mg/l)	SS (mg/l)	Cl^- (mg/l)	Coliform (c/ml)
1	8/7	10:40	0.009	0.12	29.0	7.7	870	0		60.8	72.0	66.0	1,900
2	18/6	10:35	0.052	0.263	27.0	7.5	342	2.27	29	178	444	39.0	23,200
3	18/6	11:05	0.006	0.103	28.0	7.1	363	2.17	28	260	252	35.5	47,600
4	18/6	11:58	0.005	0.40	28.3	7.6	252	2.54	33	22.8	135	25.6	1,340
5	27/6	24 hr	0.007	0.19	30.4	7.3	-			94.7	25.3	59.1	-
6	17/6	8:35	0	0	28.3	7.4	850	0.59	8	24.1	27.0	114	66,700
7	16/6	11:35	0	0	32.7	7.2	880	0		27.2	34.7	125	13,000
8	16/6	11:27	0	0	31.8	7.3	410	3.79	52	5.5	9.5	36.9	8,700
9	16/6	10:30	0.005	0.038	30.1	7.0	620	0		169	42.0	52.3	21,800
10	16/6	10:18	0.002	0.046	30.5	7.7	380	1.19	16	32.2	22.8	18.5	21,800
11	16/6	9:55	0.006	0.092	30.0	7.5	310	2.96	39	39.4	17.0	16.4	16,000
12	13/6	12:15	0	0	28.5	6.6	451	0		9.3	37.0	49.8	1,800
13	16/6	10:05	0	0	29.5	5.3	78	1.98	26	5.0	50.0	12.3	15,950
14	16/6	9:25	0.04	0.15	30.7	7.3	580	0.61	8	137	67.0	36.9	17,400
15	13/6	11:30	1.01	0.190	29.0	6.4	57	3.34	44	3.1	55.8	8.2	840
16	14/6	9:20	0.592	0.197	29.2	6.2	55	3.46	45	2.6	38.7	14.4	800
17	16/6	9:37	0	0	28.9	6.7	610	1.42	19	12.5	17.3	28.4	14,500
18	14/6	9:00	0.266	0.085	28.2	6.2	67	3.75	49	2.2	61.3	9.2	370
19	13/6	11:00	0.028	0.111	30.3	6.1	83	6.15	82	3.5	78.0	18.5	30
20	13/6	11:55	0.013	0.106	29.8	6.6	119	2.15	28	6.5	35.0	48.7	35
21	30/6	24 hr	0.0005	0.008	30.0	7.3	-	-		171	54.8	51.8	
22	17/6	11:20	0	0	29.1	7.3	1,080	0		18.3	44.0	248	29,000
23	17/6	10:12	0.036	0.015	29.0	6.8	220	0.99	13	7.8	37.0	26.7	3,900
24	17/6	10:25	0	0	29.3	6.2	1,160	0		231	26.7	153	76,000
25	17/6	10:34	0.218	0.390	29.0	6.6	120	3.34	44	3.3	20.0	24.6	1,400
26	17/6	9:00	0.017	0.021	29.1	7.3	290	0.79	10	19.9	31.5	26.7	96,700
27	17/6	9:15	0.233	0.062	28.0	6.6	1,050	2.17	28	4.3	58.0	260	3,400
K-1	25/8	8:50	0.481	0.037	28.7	7.1	320	1.17		3.9	18.0	70.8	40
K-2	25/6	8:32	0.006	0.077	27.5	7.6	2,400	0		125	344	461	28,400
K-3	25/6	9:27	0	0	29.1	6.7	1,300	0.8		6.9	33.0	343	900
K-4	25/6	9:50	0.655	0.116	29.5	7.2	19,000	2.0		5.1	61.0	7,200	1,560
K-5*	25/6	10:25	0.008	0.3	32.3	7.4	8,100	0		2,350	324	1,840	12,200

(1) * wastewater from se food precessing plant in Kuala Kedah. (2) K refers to Kuala Kedah.

1.4 Survey on Septic Tank Operation

1.4.1 Method of Survey

There are numerous septic tanks distributed in the town of Alor Setar. However, only a few of them could be traced back as to the starting date of operation and the construction. Among the identical septic tanks, four septic tanks were selected for study as shown in Table B-8.

Table B-8. Septic Tanks Surveyed

No.	Place	Kind of Waste	Period Used (yr)	Treatment Method	No. of person Using
1	Taman Pumpong	Excreta from one household	0.5	3-stage anaerobic tank	Ad: 4 Ch: 3
2	Akademi Utama	Excreta from one school	0.5	1-stage anaerobic tank	St: 499 Te: 20
3	Alor Malai Flats	Excreta from flats	1.5	1-stage anaerobic tank	po: 960
4	Taman Muhibbah	Excreta from one household	5.0	2-stage anaerobic tank	Ad: 2 Ch: 2

The investigation was carried out in July 1979. In order to know the performance efficiency, water is sampled at the tank outlet and then analyzed to determine its temperature, pH, BOD, SS, Cl^-, and coliform bacteria.

Since the fouth group of septic tank located in Taman Muhibbah has the longest history of operation of 5 years, further investigation was carried out as to sludge accumulation in the tank.

1.4.2 Result and Discussion

1) Effluent Quality Survey

Effluent qualities of septic tanks of various locations were investigated and the results are shown in Table B-9. The septic tank located in the school campus of Akademi Utama is presumed receiving mainly urine portion of human wastes, reflecting in their effluent quality as shown in Table B-9. The effluent shows no existence of coliform bacteria, but is characterized by high pH (about 11), presumably due to the presence of abundant quantity of ammonia, a product decomposed from urine, in the wastewater. In the case of the Taman Pumpong septic tank, probably due to its shorter duration of operation (6 months), the BOD removal retains a high efficiency giving low BOD effluent (16.3 mg/l). The effluent BOD values for the remaining two septic tanks in the table show 70.6 and 36.5 mg/l respectively, which are considered to be in a acceptable range.

Table B-9 Results of Water Quality Analysis of Septic Tanks Surveyed

No.	Place	Survey date	Temp. (°C)	pH	BOD3 (mg/l)	SS (mg/l)	Cl^- (mg/l)	Coliform (C/ml)
1	Taman Pumpong	15/7	(31.0)	(7.6)	(36.6)	(18.0)	(38.0)	(4,600)
			30.7	7.8	16.3	10.0	24.0	10
2	Akademi Utama	15/7	29.0	11.0	9.6	24.4	400	1
3.	Alor Malai	11/7			(115)	(155)	(100)	(6,800)
			30.0	8.1	70.6	117	68	2,600
4.	Taman Muhibbah	16/7	(29.4)	(7.8)	(90.3)	(110)	(67.0)	(90,000)
			28.8	7.6	36.5	34	49.0	7,300

Note: Figures in ( ) indicate the values of effluents from first stage anaerobic tank.

2) Survey on Sludge Accumulation

As the Taman Muhibbah septic tank in Table B-9 has the longest history of operation (5 years) a further survey was carried out for sludge accumulation. The field survey reveals that the first of the two chambers in series has a sludge accumulation of 60 cm (tank depth 1.4 m) whereas the second chamber no sludge deposit at all, as illustrated in Figure B-7. The sludge contains about 3% solids and appears to have been highly digested.

Over a period of 5 years the quantity of sludge generated in the first chamber is 0.3 m^3 (9 kg), being equal to 40% of the tank capacity. The septic tank has been owned by a family of 2 adults and 2 children. Assuming that wastes generated by the two children, respectively 3 and 6 years old now, are negligible amount, then the per capita generation rate is estimated to be 30 liters/capita.year (90 g/capita.year).

According to the MPKS standard, each septic tank, which consists of two chambers, has a total volume of 1.61 m^3. Assuming that it is owned by an average family of 5.5 persons, or five adults in equivalent, and then applying the previously estimated sludge accumulation rate of 30 liters/capita.year, a period of 11 years is required for the two chambers to become full. This evaluation, being in good agreement with that obtained from the local family interview, is therefore justifiable.

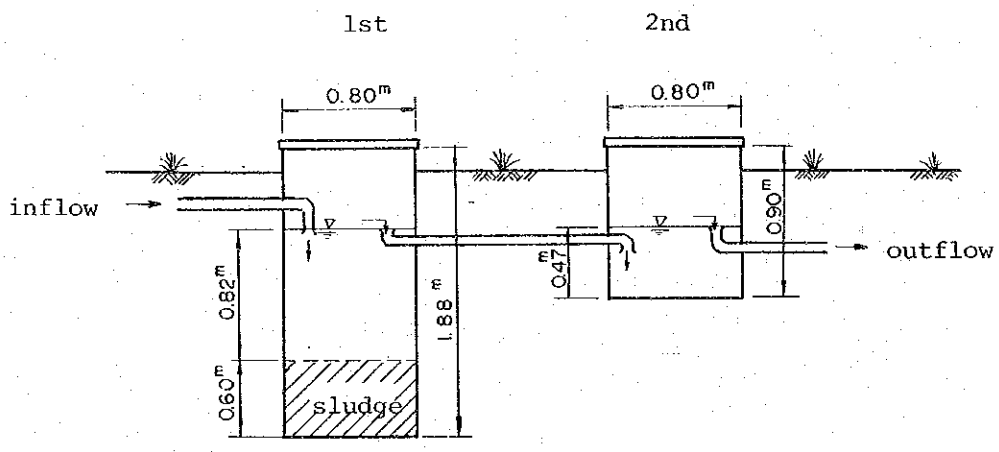


Figure B-7 Schematic Drawing of Two Staged Septic Tank

1.5 Survey on Distribution of Water Hyacinths

In the Alor Setar area there is an abundant growth of water hyacinths, which, especially during the rainy season, covers the entire surface of the water upstream of the tidal gate. Distribution survey of the water hyacinths isdifficult in the rainy season because the hyacinths are drifted down by the increased flow and mix with those grown in the survey area. Dry season, instead, provides a good opportunity to carry out such survey due to low flow, thus the month of December (1979) was selected for the survey. A visual observation of the growth was made over a boat as resulted in Figure B-9.

As shown in the Figure B-9, water hyacinths grow all over the water surface surveyed. It is seen that even in the non-polluted area, there is a growth of water hyacinths, inferring that in the future even when the sewerage system is completed, i.e., when the water pollution is brought under control, water hyacinths, may still be present.

In order to investigate the growth in various water environments a laboratory experiment was conducted. The results are shown in Figure B-8, revealing that for a period of 10 days, the hyacinths multiplied 1.5-3.7 times by weight, being two times in average. Note that the growth experiment was conducted in vessels of a bucket type each having a capacity of only 120 liters, which might not provide an optimum condition, thus implies that a more rapid growth would have been attained in a natural environment.

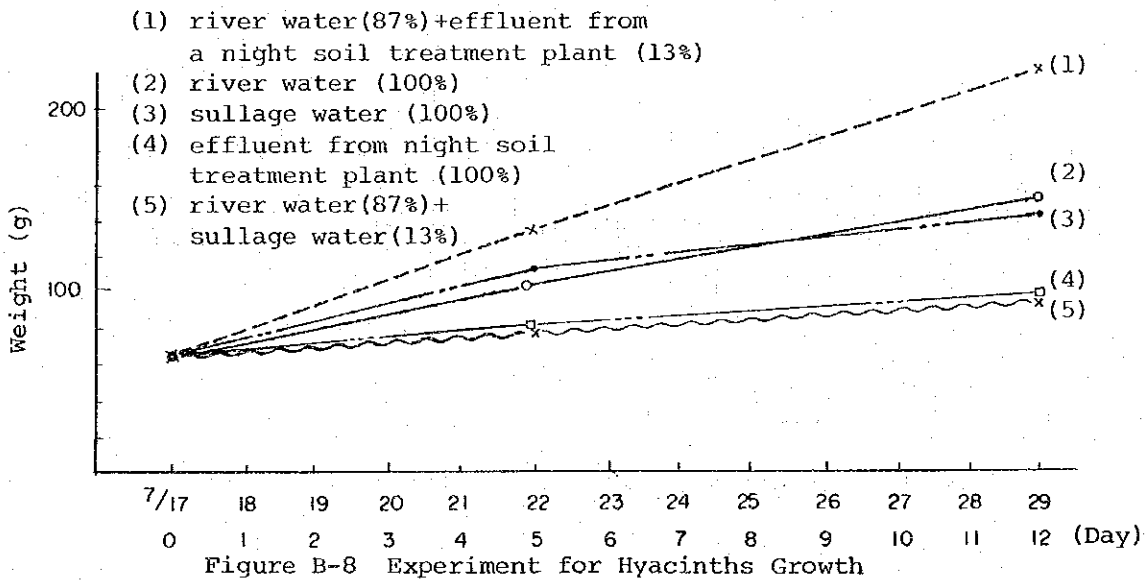


Figure B-8 Experiment for Hyacinths Growth

2. Characteristics of Wastewater

In order to obtain the per capita per day pollutional load respectively for the domestic, commercial and industrial wastewater, on-site investigation together with relevant data collection was carried out. Data obtained from various sources were then used for evaluating the per capita per day pollutional load surveyed.

2.1 Survey on Wastewater from Residential Area

The domestic sewage consists of two components: excreta and sullage wastes originated by cooking, bathing, and washing. To determine the per capita per day pollutional load, a field investigation is conducted for the portion of sullage water, whereas the pollutional load (BOD) required for the portion of human body waste is assumed to be 13 g/cap.day, being equal to the figure used in our previous projects in Indonesia and Malaysia.

2.1.1 Method of Survey

Based on the results of field reconnaissance, a survey of domestic sewage was conducted for two selected residential areas: the one is encompassed with 5-story housing complexes, and the other with semi-detached houses. Population and some other required data are given in Table B-10. The survey was conducted for a duration of 24 hours, falling on the two days of June 30 and July 1, 1979. During this period, both flow measurement and water sampling were carried out at intervals of 2 hours. The samples are transported to the laboratory for water quality analysis. The analytical methods employed were as follows:

BOD: 30°C for 3 days
SS : glass fiber filtration
Cl^-: mercuric sulfate method

Table B-10 Discription of Housing Areas Surveyed

Name of Housing Area	Served Area(ha)	No. of House Served	Population	House Type
Taman Malaysia	1.56	24	125	Semi-detached, including excreta
Alor Malai Flats (B)	0.32	48	305	5-story housing complex, not including excreta

2.1.2 Result and Discussion

1) Housing Complex [Alor Malai Flats (B)]

Characteristics of the domestic wastewater, in which no human body waste is included, are studied and the results are shown in Table B-10 and Figure B-10. The table and figure reveal that BOD varies with time, that is, high values appear during the hours between 6 a.m. and 12 noon, whereas the low values between 2 p.m. and 10 p.m. As for other indicators such as SS, and Cl^-, little variations were observed. The concentration of SS is rather small, presumably due to the settling down of large particulate matters during the course of their transportation from their points originated to the points of measurement. However, the settlement may not affect for the variation of BOD values.

The daily wastewater discharge at the time of the survey was measured 39.3 m^3, giving a total BOD load of 6.5 kg. Since the total population is 305 persons, the per capita flow and BOD load are:

flow: $(39.3\ m^3/day) \times \left(\frac{1}{305\ persons}\right) = 130$ liters/cap.day

BOD load: $(6.5\ kg/day) \times \left(\frac{1}{305\ persons}\right) = 21$ g/cap.day

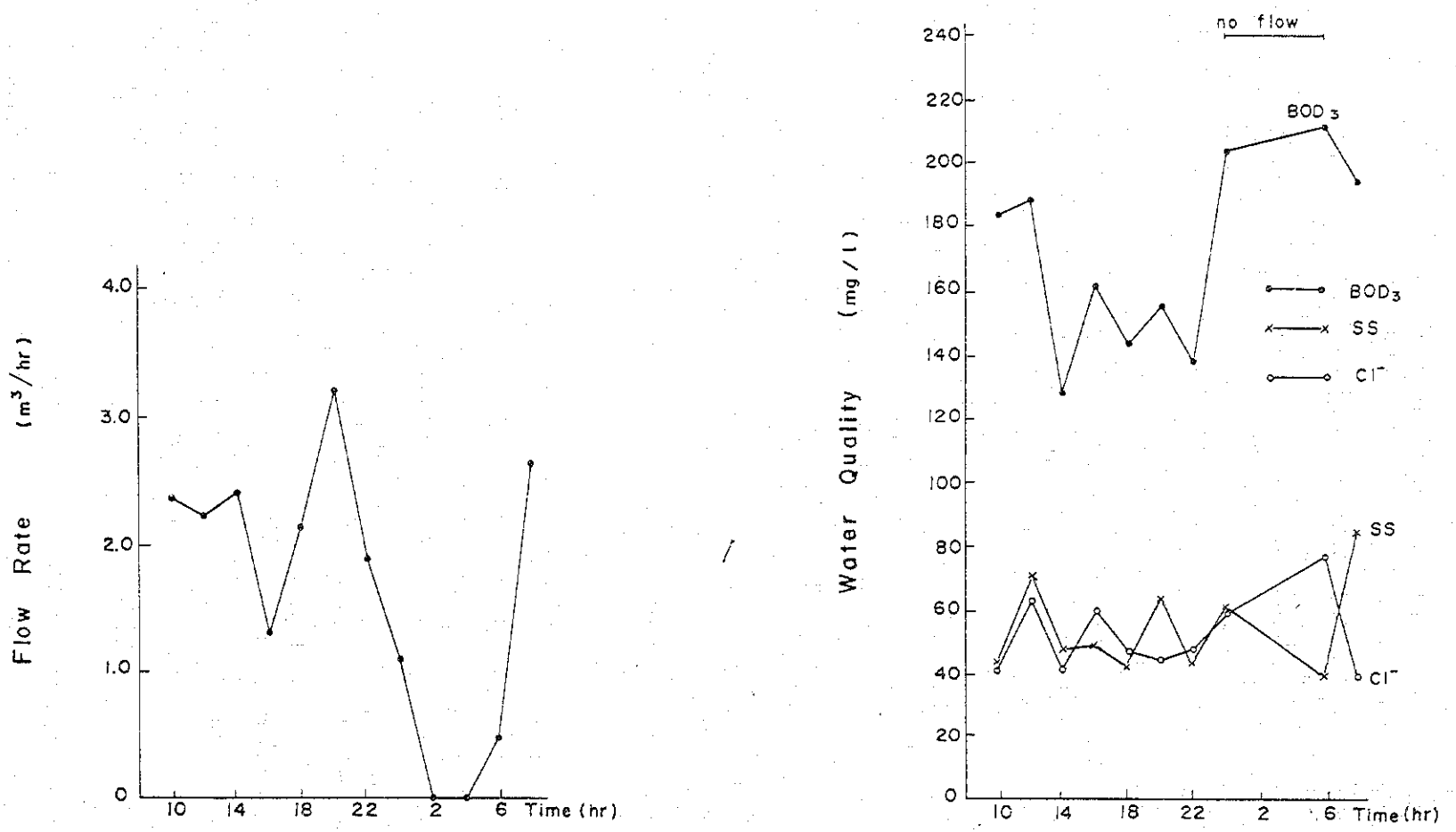


FIGURE B-10 SURVEY RESULTS FOR ALOR MALAI HOUSING COMPLEX

Table B-11 Survey Results of Alor Malai Flat (B)

Item	Flow	Temp.	pH	BOD	SS	Cl^-
Time	m^3/hr	°C		mg/l	mg/l	mg/l
30/6 10	2.36	31.0	7.6	183	43.5	41.0
12	2.23	31.2	7.2	188	71.0	62.0
14	2.40	33.5	7.1	129	48.0	41.0
16	1.31	31.2	6.8	162	49.0	60.5
18	2.13	30.3	7.2	144	42.5	47.2
20	3.22	30.0	7.1	156	64.0	43.1
22	1.79	29.0	7.5	139	44.0	47.2
24	1.10	28.2	7.2	204	61.0	59.3
1/7 2	0	-	-	-	-	-
4	0	-	-	-	-	-
6	0.47	27.8	7.5	212	39.0	76.9
8	2.65	28.0	7.7	194	85.0	39.0
Ave.	1.64	30.0	7.3	171	54.8	51.8

2) Semi-detached Housing Area (Taman Malaysia)

Sewage sampled from the drain consists of a mixture of septic tank effluent and sullage water from the area. Both quantity and quality of the sewage are studied and the results are shown in Table B-12 and Figure B-11. As compared to the wastewater of the housing complex, BOD of the sewage from this area is less concentrated, probably due to the fact the analyzed wastewater is composed of treated septic tank effluent as one reason and also the wastewater generated is greater in amount as another reason. The BOD concentration does not vary greatly with time. The variations for other parameters such as SS and Cl^- are not significant as shown in Table B-12.

The flow is usually large in volume during the daytime between 10 a.m. and 8 p.m., but decreases to a minimum in the early morning between 2 to 6 o'clock.

The total flow for a 24-hour duration at the time of survey amounts to 32.9 m^3.hr, giving a total BOD load of 3.3 kg. Since a total population of 125 persons in this area, the per capita flow rate and BOD load are:

flow: $\frac{32.9\ m^3/day}{125\ persons} = 263$ liters/capita.day

BOD load: $\frac{3.3\ kg/day}{125\ persons} = 26$ g/capita. day

Table B-12 Survey Results for Taman Malaysia

Item		Flow	Temp.	pH	BOD	SS	Cl^-
Time		m3/hr	°C		mg/l	mg/l	mg/l
30/6	10	2.02	29.0	7.8	137	69.0	45.1
	12	1.91	30.5	7.7	112	43.0	34.9
	14	2.31	32.0	7.3	124	62.0	45.1
	16	1.89	32.1	7.4	112	37.3	28.7
	18	1.48	30.5	7.5	86	31.3	31.0
	20	2.26	29.8	7.3	55	21.5	29.0
	22	0.86	29.5	7.3	134	34.7	51.3
	24	0.84	28.9	7.6	90.2	32.0	52.3
1/7	2	0.34	-	-	86.4	42.0	46.2
	4	0.34	27.8	6.9	86.4	42.0	46.2
	6	0.34	27.5	7.6	89.4	31.3	57.4
	8	1.86	28.0	7.6	79.2	28.0	39.0
Ave.		1.37	29.6	7.5	100	39.3	41.9

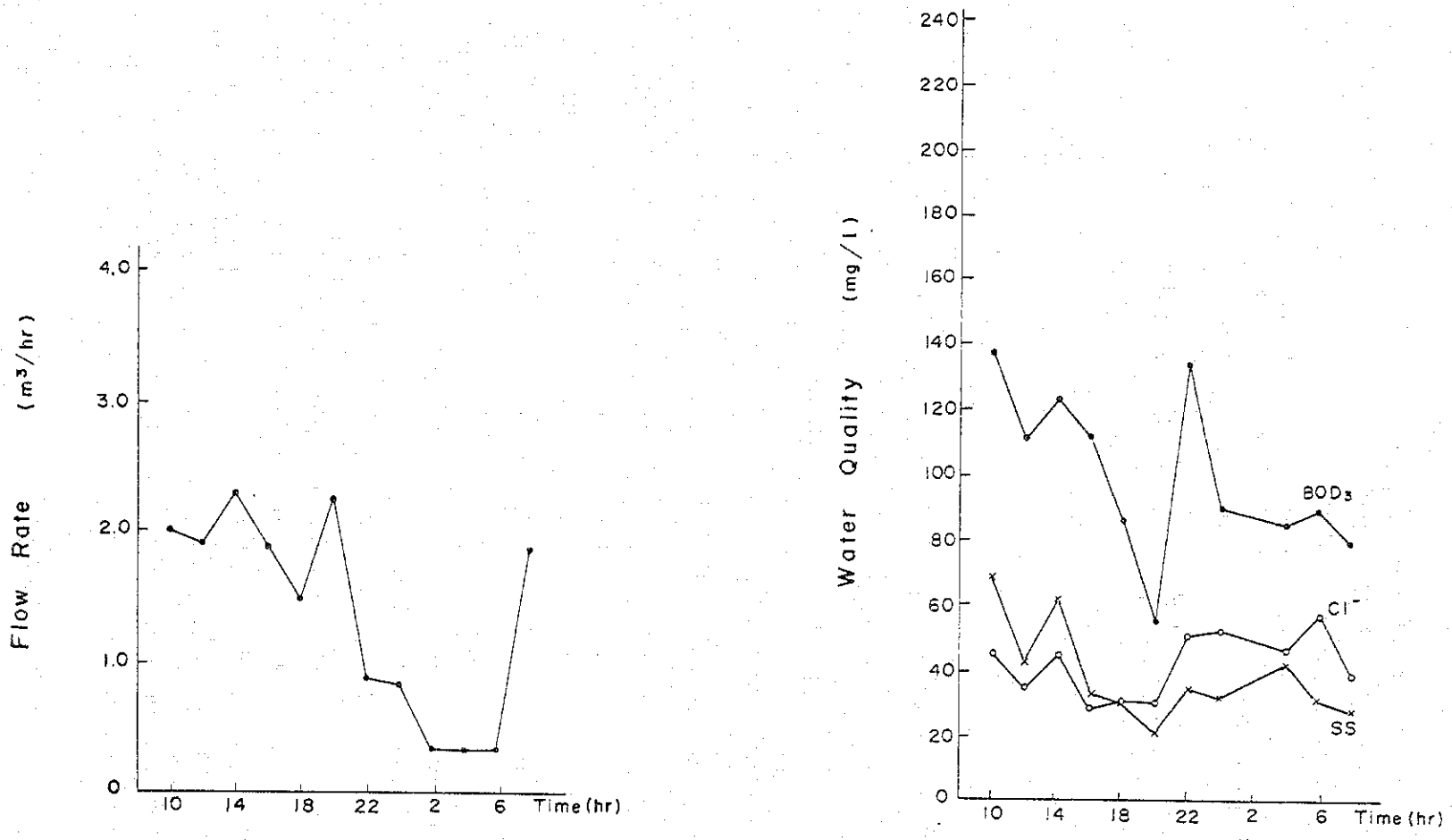


FIGURE B-11 SURVEY RESULTS FOR THE TAMAN
MALAYSIA

3) Summary

According to the results of survey and in-depth study of the two types of the residential areas, it is estimated that use of the data of Alor Malai Flats(B) would be more justifiable, whereas the data of Taman Malaysia may not represent the average condition of the study area because of high standard of living. In addition, there is an agreement between the sewage amount generated and water consumed in case of Alor Malai Flats (B). This provides additional basis for considering the data of Alor Malai Flats (B) as representative values. Therefore, the per capita flow and BOD loading of the domestic sewage applied as design are shown in Table B-13.

Table B-13 Per Capita Flow and BOD Loading

Item	Water Volume (l/c.day)	BOD Loading (g/c.day)
Excreta	40	13
Sullage Water	130	21
Total	170	34

2.2 Survey on Wastewater from Commercial Area

In order to estimate the per capita generation rate of the commercial wastewater, a survey was conducted for both water consumption and sewage generation. The per capita water consumption was estimated at 340 liters/cap.day by the water consumption record as described in detail in Appendix D. The survey was also extended to waste loading, and this constitutes the main part of the study.

2.2.1 Method of Survey

In the downtown of Alor Setar, a distinct unit area of a drainage basin was selected for study. The flow of the waterway was measured while the sampled water was analyzed in the laboratory. Since the water-

way was started with a covered channel for a long extension, the sampling point becomes 20 m upstream from the Sg. Raja. The sample was taken every 3 hours during the 24-hour period on the days of 27/28 of June, 1979.

The surveyed area surrounded by the streets of Jl. Sultan Badlishah, Jl. Tunku Ibrahim, and Lorong Padi, has a total area of 4.7 ha and a total population of 940 persons. The area is composed of various types of buildings and businesses such as stores, offices, restaurants, hotels, and apartments. The sewege consists of sullage waste, not including human excreta. The human excreta are separately treated by a communal septic tank and the effluent is discharged directly to the Sg. Raja.

2.2.2 Result and Discussion

Quantity and quality of commercial wastewater, in which no night soil is included, are studied and results are shown in Table B-14.

The daily wastewater discharge at the time of the survey was measured 321.6 m^3, giving a total BOD load of 54.8 kg. Since the total population is 940 persons, the per capita flow and BOD loading are:

$$\text{Flow: } \frac{321.6\ m^3/day}{940\ persons} = 342 \fallingdotseq 340\ liters/cap.day$$

$$\text{BOD load: } \frac{54.8\ kg/day}{940\ persons} = 58.3 \fallingdotseq 59\ g/cap.day$$

Since the results of the samples taken out of the terminal open channel of a representative commercial block, seemed to carry over residual run-off due to the rain of the previous day, approximately 10% of the flow quantity is justified to reduce as 340 liters/cap.day. Accordingly, the per capita flow and BOD loading of the commercial wastewater applied as design are resulted in Table B-15.

Table B-14 Survey Results for Commercial Area

Time		Flow (m^3/hr)	Temp. (°C)	pH	BOD_3 (mg/l)
27/7	9	26.6	29.1	7.2	125.6
	12	21.4	31.5	7.2	174.3
	15	13.5	31.2	7.1	215.0
	18	15.9	31.5	7.5	223.0
	21	11.2	30.0	7.4	238.0
28/7	2	2.3	29.2	7.1	43.6
	6	13.1	29.0	7.1	98.6
Average		13.4	-	-	170.4

Table B-15 Per Capita Flow and BOD Loading

Item	Water Volume (l/c.day)	BOD loading (g/c.day)
Excreta	40	13
Sullage Water	300	59
Total	340	72

2.3 Survey on Wastewater from Industrial Area

According to the list of existing industries and industries to be developed in the Study Area furnished by MPKS, the industries are classified into 11 categories. This classification is applicable to both the existing and future industries. In order to obtain information about the quantity and quality of the wastewater discharged from each category of industries, a questionnaire-visiting survey and field investigation of the wastewater quality were conducted.

2.3.1 Method of Survey

1) Questionnaire and Firm Visit

A questionnaire covering the items such as type of industry, land area, number of employees, water consumption, product output and others, has been sent to 205 firms, of which 52 have replied, corresponding to be 25% recovery rate. Some replied were neither complete or sufficient information. Consequently, a total of 80 selected firms were visited to fill the gap and/or to view.

2) Survey on Wastewater Quantity

Sampling method was varied according site condition; some wastewater were sampled at the outlet of the discharge, while some others, whose flows were too small to be taken directly from the wastewater outlet, were sampled at the near-by downstream roadside drains. Some grown wastewaters from various plants of similar characteristics are sampled at an appropriate downstream roadside drains. Sampling Stations are established as shown in Table B-16 taking into consideration that the wastewater quality of each category of industry can be characterized. The outlet from the market area was included as one of the sampling stations.

Table B-16 Sampling Locations and Point Sources of Industrial Wastes

Industrial Area	Category	No. of Plants Surveyed	Sampling Point
K. Kedah	Marine Products Processing	One	Outlet
Mergong	Food	One	Outlet
	Rubber and Plastics	One each	Roadside ditch
	Metal Plate Working, Electric Goods	One each	Roadside ditch
	Car Repair Workshop with washing process	one	Roadside ditch
	without washing process	one	Roadside ditch
Pasar Besar	Public market	One	Outlet

The effluent quality for each category of industries was investigated during the months of June and July, 1979. The water quality parameters employed were temperature, pH, DO, BOD, SS, and Cl^-. Right after each sampling, pH, temperature, and DO were determined at site; while the remaining testing items were determined at the laboratory.

2.3.2 Result and Discussion

1) Questionnaire and Firm Visit

The results of questionnaire and firm visit are combined and summarized in Table B-17, in which, some firms do not have data on water consumption. Therefore, per unit floor area water consumption is obtained only for those firms with such data available. The unit area water consumption rates of the similar firms are then put together to get an average data as resulteded in Table B-18.

Table B-17 Results of Questionnaire and Firm Visit

Location	Code	Product	Area (m^2)	Employee	Water Comsuption (m3/d)	Turn Out
Alor Setar	01	Rice	1.024	12		80,000 case/yr
		Rice	1.018	39	4	-
		Feed	1.377	8		-
		Feed	-	4		36 ton/yr
		Coffee	280	8	0.5	180 kg/d
		Coffee	680	14	0.7	2.4 ton/yr
		Noodle	736	7		0.7 ton/d
	03	Plastics Cussion	735	4	3.5	M$80,000/yr
		Repair		7	3.6	120 pieces
		Footwear	11,000	750	55.0	-
	04		126	5		-
				5	1.4	-
			1.150	5		-
				20	1.5	-
	05	Refrigi-lator	418	126		-
		Electric parts	2,280	110	3.6	1,500,000 pcs/yr
	07	Furniture		10	4.4	-
	10		604	5	2.5	-
				20	7.3	-
			1,011	4	1.8	-
				2	0.1	-
			1,300	4	2.4	-
			1,014	1		-
			1,002			-
			111	7	2.3	-
				14		-
Kuala Kedah	01	Frozen Marine Products	2,023 (6,075)*	60	55	218 ton/yr
		Fish Meal	6,079 (4,050)*	47	68	200,000 ton/yr
		Fish Powder	(5,040)*	45	50	2,850 ton/yr

Note: (1) No reply for future expansion plan for factories surveyed.

(2) * refers to SEDC's data.

Table B-18 Water Consumption Rates by Industry/Product

Category No.	Kind of Industry or Product	No. Sample	Land Area (ha)	Wastewater Generated (m3/day)	Wastewater Generated (m3/day/ha)
01	Foodstuffs	3	0.2398	5.1	21.7
03	Plastic and Rubber	3	1.0536	62.1	58.9
04	Metal Works	2	0.1392	2.9	20.8
05	Electrical Works	1	0.2880	3.6	12.5
06	Others	1	0.0723	4.4	60.9
10	Car Repair	6	0.6742	16.4	24.3
01	Fish processing	1	0.6075	55	90.5
	Fish meal	1	0.4050	68	167.9
	Fish powder	1	0.5400	50	92.6

2) Wastewater Quality

As shown in Table B-19 the seafood processing industry in the Kuala Kedah area generates wastewater with highest BOD concentration, being equal to 2,350 mg/l. Next is the food industry, which has a BOD concentration of 74.5 mg/l. The remaining categorical industries with BOD generation in decending order are car repairing business (14.8 mg/l), gum and plastics industries (12.1 mg/l), and metal processing and appliance industries (11.2 mg/l).

Table B-19 Results of Industrial Wastewater Quality Survey

Area	Category	Date	Time	Temp. (°C)	pH	DO (mg/l)	BOD (mg/l)	SS (mg/l)	Cl^- (mg/l)
Kuala Kedah	01 Marine Products Processing	25/6	10:25	32.3	7.4	0	2,350	324	1,840
Alor Setar (Mergong)	01 Food	8/7	10:00	28.4	6.3	0	74.5	57.0	53.3
	03 Rubber and Plastics	8/7	10:11	29.0	7.5	8.6	12.1	24.0	151
	04 Metal Plate working	8.7	9:30	27.6	7.7	0.7	11.2	14.0	67.0
	05 Electric Goods								
	10 Car Repair Workshop with washing process	8/7	9:30	27.9	7.1	0	14.8 (480)	30.0	72.0
	without washing process	8/7	9:50	29.9	7.2	0	458 (4,960)	4,230	45.0
	Public Market	9/7	8:11	-	-	0	5,140	520	-
			15:00	30.0	6.8	0	624	855	-

As observed in the wastewater quality survey, the sample was taken either after the wastewater passed through a pit and removed some fraction of the solid contents or from the roadside drain where the flow velocity was very low. Therefore, the samples taken became less concentrated than the original wastewater. In case the seafood processing wastewater, since the samples were taken at the time when the effluent happened to be highly concentrated, it is preferable to adjust the value to represent average condition of the day. Taking into account of these factors, the values of the two wastewater quality parameters, BOD and SS, to be used in the sewerage system planning, are thus determined as shown in Table B-20.

Table B-20 BOD and SS Values Used for Planning

	Category	BOD (mg/l)	SS (mg/l)
01	Marine Products Processing	2,000	324
01	Food	150	150
03	Rubber and Plastics	30	50
04	Metal Plate Working	30	50
05	Electric Goods	30	50
10	Car Repair Workshop	30	50

3. Preliminary Experiments on Water Quality Improvement

3.1 General

Based on the various studies and site investigations, a conclusion is made to employ stabilization pond screened among other treatment methods as discussed in the main report (Vol.II). Experiment was made to monitor the growth of the photoplankton and the trend of coliform bacteria decay over a variety of wastewater samples of eight different characteristics.

3.2 Method of Experiment

As shown in Table B-21, 8 kinds of wastewaters were tested by the experiment. Each wastewater, 20 - 40 liters in a bucket, was seeded with the Penang stabilization pond wastewater in which photoplankton had already abounded. The seeding ratio was about 200 ml per 30 liters of test liquid. The change in water quality according to time was studied. The experiment for each test wastewater was conducted both indoors and outdoors for a period of 10 days starting from December 23, 1979.

Table B-21 Characteristics of Sampled Water

Sampled Water	Characteristics of Sampled Water
(1)	Added 1/300 portion of 1-stage unaerobic tank effluent of night soil septic tank to one portion of Alor Malay Flat's sullage water
(2)	- ditto -
(3)	Water from the Sg. Raja upstream where hyacinths heavily inhibited
(4)	Blackish water from the Sg. Derga
(5)	Added 1/300 portion of 1-stage unaerobic tank effluent of night soil septic tank to one portion of water of the Sg. Derga
(6)	Water from the Sg. Kedah (sampled infront of the covering point with the Sg. Raja)
(7)	Water from the Sg. Raja near MPKS
(8)	Added 1/300 portion of 1-stage unaerobic tank effluent of night soil septic tank to (7)
(9)	Water from the quasi-stabilization pond (see Table B-22)