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No. 8

MALAYSIA

MASTER PLAN AND FEASIBILITY STUDY FOR SEWERAGE AND DRAINAGE SYSTEM PROJECT IN KELANG, PORT KELANG AND ITS ENVIRONS

VOLUME II SEWERAGE

MASTER PLAN

NOVEMBER 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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This Master Plan and Feasibility Study consists of eight volumes:

I	Sewerage Summary Report
II	Sewerage Master Plan
III	Sewerage Feasibility Study
IV	Sewerage Appendices
V	Drainage Summary Report
VI	Drainage Master Plan
VII	Drainage Feasibility Study
VIII	Drainage Appendices

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AC	Asbestos Cement
BOD	Biochemical Oxygen Demand
DID	Drainage and Irrigation Department, Ministry of Agriculture and Fisheries
F.C.	Foreign Currency
F.M.P.	Fourth Malaysia Plan
Fig.	Figure
GDP	Gross Domestic Product
ha	hectares
HDPE	High Density Polyethlene
hr	hours
Jalan	Road
JICA	Japan International Cooperation Agency
JKR	Public Works Department
Jln.	Jalan, Road
JT	Jambatan Telecom
Kg.	Kampung
km	kilometers
KTM	Malayan Railway
L.C.	Local Currency
LLN	National Electric Board
Lrg.	Lorong
m	meters
m^2	square meters
m^3	cubic meters

MPK	Kelang Municipality (Majlis Perbandaran Kelang)
M$	Malaysian Dollars
O & M	Operation and Maintenance
PVC	Polyvinyl Chloride
R.L.	Reduced Level
SEDC (PKNS)	State Economic Development Corporation
SS	Suspended Solids
TCP	Town and Country Planning
VC	Vitrified Clay
WWD	Waterworks Department

OUTLINE

OUTLINE

1. Present Condition of the Project Area

Located in the western coast of Selangor State in Peninsular Malaysia, the Project Area includes the entire Kelang Municipality area and its environs, and covers an area of 7,669 ha. Kelang represents the largest trading port and the fifth largest city in Malaysia. Present population of the Area is about 200,000 (1980).

The water quality of the rivers and drains in the Area is in very poor condition. One of the reasons for its deterioration is the lack of modern sewerage facilities to collect, treat and dispose of domestic sewage and trade waste. Furthermore, there still remain such non-hygienic human excreta disposal systems as the bucket system and pit privy. Taking these conditions into account, the urgent necessity of sewerage facilities is self-evident.

2. Planning Basis

In order to develop a sewerage system plan by the target year of 2000, the following premises are made by the Study Team:

1) Urbanized population in the Project Area by the year 2000 is forecasted to be 380,000.

2) Wastewater flow to be collected and disposed of by the year 2000 is estimated as shown in Table 1. by applying the unit flow rates, for both domestic and industrial water usage, projected in the water supply master plan. Also, BOD and SS load estimates are based on data obtained from field surveys conducted in the Area.

Table 1. Summary of Projected Wastewater and Waste Load in the Year 2000

Source	Wastewater (m^3/day)	BOD Load (t/day)	SS Load (t/day)
Domestic	132,000	26	26
Industrial	64,000	10	13
Infiltration	45,000	-	-
Total	241,000	36	39

3. Sewerage Master Plan

The separate system, which handles sewage and rainfall runoff separately, is recommended for the Project. In order to determine the optimal sewerage system, the Project Area is divided into several sewerage districts and a careful consideration given to comparison with the centralized sewerage system proposed in the previous study. As a result, a decentralized sewerage system, with ten (10) sewage treatment plants for the entire Project Area, is proposed. Sewerage facilities considered in the Master Plan are as follows:

1) System of sanitary trunk, branch and lateral sewers

2) Pumping stations

3) Sewage treatment facilities

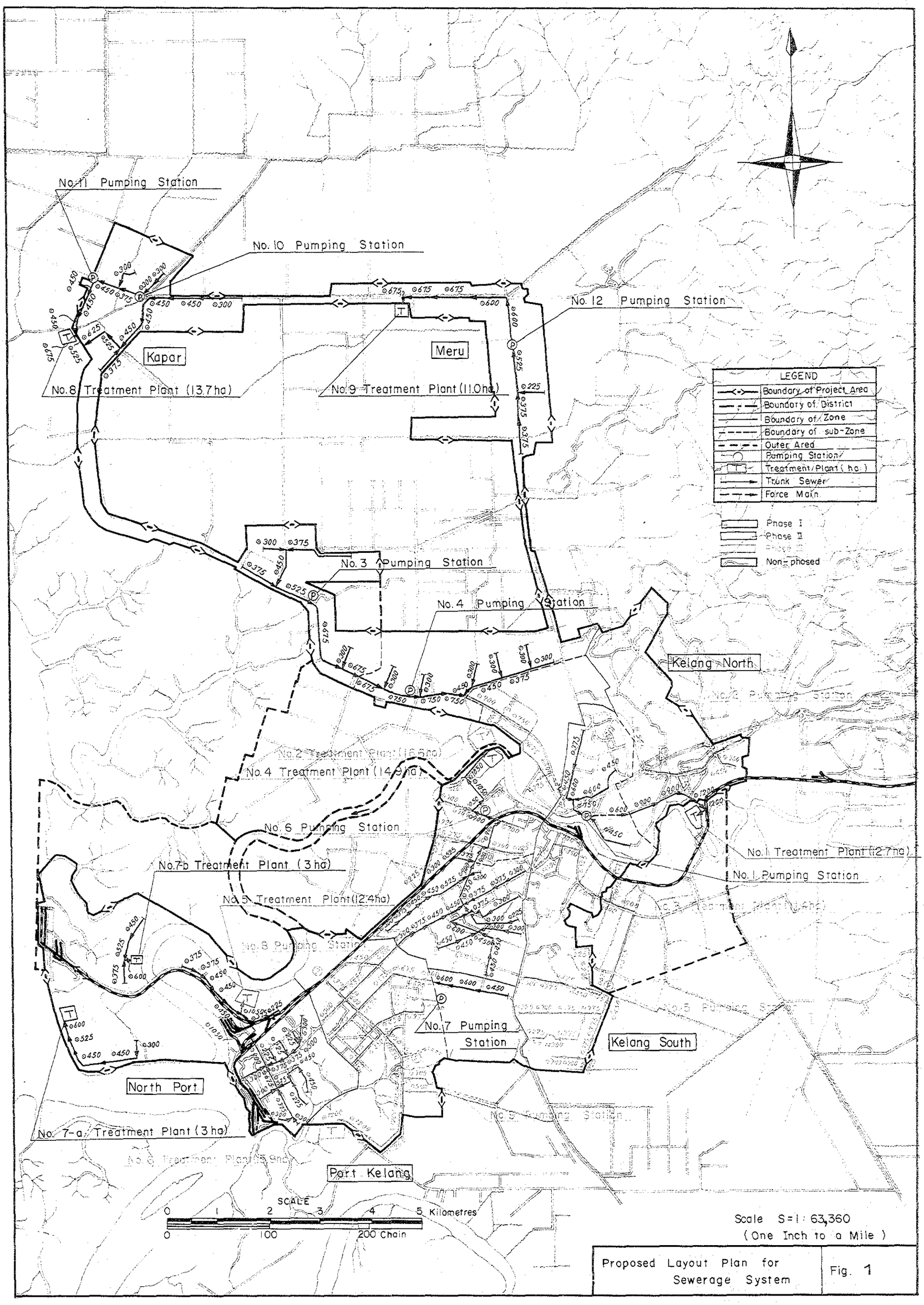
Concerning the sewage treatment facilities, cost comparison of three alternative processes was conducted. As a result, the aerated lagoon process is recommended for the six (6) sewage treatment plants with relatively large sewage flow, and stabilization pond process for the four (4) smaller plants.

Since large-scale industrial development is expected in the Project Area, consideration was also given to develop basic principles for handling industrial wastewater. The general rule is not to accept industrial discharge into the sewerage system from 1) factories with excess flow rate (more than 60 m^3/day) or BOD load (more than 6 kg/day), which are prescribed in the Environment Quality Regulations, and 2) factories which discharge excessive concentrations of hazardous materials.

Preliminary engineering design for necessary sewerage facilities was conducted. Fig. 1. shows the layout plan for the total Project Area.

As the sewerage project for the Area requires sizable amount of investment and considerable time, it is necessary to implement the Project according to the schedule established with due consideration of these factors. As shown in Fig. 1. and Table 2., an implementation program up to the year 2000, in three phases, is developed, taking into account the implementation priority for each sewerage zone and availability of fund for the Project. It should be noted that the sewerage zones, where full development is not expected and therefore not explored, and where sewerage facilities are planned to be constructed by the development authority, are excluded from the implementation program.

Construction, operation and maintenance costs are presented at 1981 price in Malaysia. Project cost includes engineering cost, land acquisition cost and contingency allowance. As shown in Table 2., approximately M$327 million is required for the completion of the Project by the year 2000.



Proposed Layout Plan for Sewerage System

Fig. 1

Table 2. Implementation Program

Phase	Sewerage District, Zone and Sub-zone	Area (ha)	Population in 2000	Construction Cost (M$ million)
Phase - I (∿ 1990)	Kelang North, Z-1, S-1	338	36,000	58.0
Phase - II (1995 ∿ 1995)	Kelang South, Z-2, S-2	512	57,800	
	Port Kelang, Z-1, S-2	410	20,500	
	Sub-total	922	78,300	77.8
Phase - III (1995 ∿ 2000)	Kelang North, Z-1, S-2	589	40,800	
	Kelang North, Z-2, S-1	401	32,000	
	Kelang South, Z-1, S-1	306	9,000	
	Kelang South, Z-1, S-2	353	28,000	
	Kelang South, Z-2, S-1	315	24,200	
	Port Kelng, Z-2, S-1	445	39,700	
	Port Kelng, Z-2, S-2	186	9,900	
	Sub-total	2,595	183,600	190.7
Total	10 Sub-zones	3,855	297,900	326.5

Note: Cost is presented at 1981 price level

4. Financial Plan

Sources for financing the sewerage project from the planning stage to the actual implementation stage are explored. Long-term loans from the Federal Government and multilateral and bilateral lending agencies and grants from the Federal and/or State Government are available to cover the construction cost. On the other hand, sewerage users' charge, property tax for the sewerage service and Kelang Municipality's general revenue are available for covering operation and maintenance costs.

The charging method for the sewerage users' charge proposes that the sewerage charge be calculated by multiplying a fixed rate by the metered amount of water consumption. The charging method for the property tax for the sewerage service is to impose the rate according to the current property tax rate applied to the entire Kelang Municipality area.

The following financial plan is recommended as the most viable plan, from a long-term viewpoint.

1) The foreign currency of the construction cost (M$92 million) is to be financed by loan from foreign lending agencies.

2) M$93 million of the local currency of the construction cost is to be financed by loan from the Federal Government.

3) The remaining cost (M$142 million) is to be given as a grant by the Federal and/or State Government.

However, the amounts of the grant are proposed to be increased, phase by phase, as follows:

First Phase -- Grant for acquisition of total land required up to 2000
Second Phase -- Grant for one-third of the construction cost
Third Phase --Grant for half of the construction cost

4) A 70 percent sewerage surcharge rate on the water bill and a 3 percent sewerage surcharge tax rate of the property assessment are to be imposed on the beneficiaries.

5) Kelang Municipality is to bear the financial burden of MS15 million up to the year 2005 for the proposed sewerage system.

5. Institutional Organization

5.1. Expansion of Engineering Department

Expansion of the Engineering Department is proposed, based on a review of the existing organization dealing with sewerage activities at each governmental level -- Federal, State, and Kelang Municipality.

The main features of the new organization are as follows:

1) In the existing Sewer and Drain Section, three units are newly set up: Design Unit, Construction Unit, and Operation and Maintenance Unit.

2) The existing Work Shop Unit of the Sewer and Drain Section becomes an independent section.

3) An accounting system, separated from the Municipalitys general revenues and expenditures, is to be incorporated in the new organization.

4) The required staff numbers 11 in the initial year of 1983 and 26 in 1990 at the end of the First Phase, and 28 in 1995, at completion of the Second Phase program and thereafter (excluding the labor pool).

5.2. Training

From the short range viewpoint, on-the-job training with foreign engineering consultants is recommended, while from the long range viewpoint, it is recommended that a training organization be set up in Malaysia as soon as possible under the supervision of the Ministry of Housing and Local Government.

6. Lows and Regulations

A review of the Acts related to sewerage activities and interviews with relevant governmental officials show that there are no legal problems in implementing the sewerage project under the existing laws and regulations.

7. Project Evaluation

Benefits to be derived from the sewerage activities are quantified in the following categories:

1) Reduction of BOD Load

Total estimated BOD load of about 36 t/day can be reduced to about 12 t/day (a reduction of 66 percent) by the year 2000.

2) Saving on Cost of Desludging Septic Tanks and Night Soil Collection and Disposal

Operating costs for desludging septic tanks and night soil collection and disposal of about M$2 million up to the year 2000 will be saved.

3) Unquantifiable Benefit

There would also be significant unquantifiable benefits, such as environmental improvement. Willingness-to-pay comprehensively representing these benefits was surveyed by the Study Team. The results of this survey show the residents' high level of willingness-to-pay compared with their ability-to-pay. This indicates the residents' strong desire for the sewerage system.

8. Interim Measures

Pending completion of the sewerage system in the Project Area, the following interim measures are proposed to improve sanitary and environmental conditions:

1) Intensification of compulsory desludging from septic tanks by MPK

2) Modification of night soil disposal facilities to a digestion tank system or joint treatment at a wastewater treatment facility

3) Installation of pour flush toilet system in rural areas

4) Installation of sedimentation tanks at public markets

5) Installation of oil separator tanks at gas stations

6) Installation of sedimentation tanks at poultry processing houses

7) Installation of sewerage system with temporary treatment facility in new housing developments

2.2. Sewerage Unit

In order to determine the implementation schedule, the Sewerage Feasibility Study Area is identified by sewerage units, according to topographic condition and existing and proposed road layout plans. The Federal Highway connecting Kuala Lumpur and Kelang through the east-west direction will divide the Area, for the purpose of sewerage unit consideration, because of heavy traffic conditions causing difficulty in installing sewer crossings.

The Area north of the Federal Highway is divided into three units (units 1 to 3 from east to west). Unit-1 consists of a residential area which is separated from Unit-2 by a narrow depression running along the high-tension power line. Unit-3 is located along Jalan Meru, separated from Unit-2 by a small rise.

The area south of the Federal Highway is divided into two units by Jalan Landasan, since sewers in the northern part (Unit-4) are naturally intercepted by this road, but sewers in the southern part (Unit-5) naturally flow toward Jalan Bukit Kuda.

These five units and their hectares are shown in the following Fig. 2.1.

LEGEND

Boundary of the Master Plan Area

Boundary of the Feasibility Study Area

Boundary of the Unit

UNIT 1 56ha

UNIT 2 59ha

UNIT 3 86ha

UNIT 4 56ha

UNIT 5 81ha

SEWAGE TREATMENT PLANT

N

SEWERAGE AND DRAINAGE SYSTEM PROJECT IN KELANG, PORT KELANG AND ITS ENVIRONS

Feasibility Study Area

SCALE 1:10,000

Fig.2.1.

CHAPTER 3

LAND USE PLAN AND POPULATION PROJECTION

CHAPTER 1 INTRODUCTION

1.1. Background

The economy of Malaysia has made remarkable progress in the past decade, which is apparent in its highly sustained GDP growth, its large investment share in GDP and its rapid, stable growth in the manufacturing sector.

The State of Selangor, which occupies only 2.5 percent of the total area of the country has about 18 percent of the total population and generates one-third of the total GDP in Malaysia including the Federal Territory.

Kelang Municipality is in the State of Selangor and is connected with the Federal capital of Kuala Lumpur at a distance of about 40 km by a direct highway route. The belt along this highway from Kuala Lumpur to Kelang Municipality called "Kelang Valley" is the most vital and economically advanced area in the State of Selangor and is expected to be continuously developed during the immediate future.

Kelang Municipality, located at the mouth of the Kelang River facing the Straits of Malacca is considered to be the gateway to this vital "Kelang Valley" belt. Port Kelang including North Port, the largest trading port in Malaysia, serves as a trigger for further continuous development of this vital belt, and is expected to increase its function even more. Furthermore, Kelang Municipality has rapidly been increasing various social and economic aspects of its activities to become a vital stronghold of the area due to its proximity and ease of commutation up to Kuala Lumpur.

The foregoing are factors which ensure the rapid future industrialization and urbanization of Kelang Municipality.

However, the sanitary conditions prevailing in Kelang Municipality can only be termed as being very poor. Its urban drains and streams,

which are presently used for both sewerage and drainage purposes, are badly polluted and their maintenance is not satisfactory, providing a possible source of health hazards through disease vectors, vermins and industrial waste. If appropriate sanitary control measures are not set up soon, future industrialization and urbanization of the Municipality are expected to further increase problems of sanitation and pollution. The conditions are obviously in need of improvement.

In addition to the above sanitary conditions, Kelang Municipality has been suffering from problem of flooding due to its topographic conditions. Most of the areas lies on very flat and low land, compared with the water level of the Kelang River which flows through Kelang Municipality into the Straits of Malacca. During heavy rainfalls and high sea tides, flooding occurs in the lower parts of the Municipality. Since future development within and around the Municipality is expected to increase the rate of rainfall runoff, it is evident that the flooding areas will be expanded with consequent problems and/or damage to industry, commerce and human daily life. These conditions may in turn serve as bottlenecks for future industrialization and urbanization of Kelang Municipality.

Taking the above-mentioned conditions into account, the necessity and urgency of establishing an effective plan of implementing both sewerage and drainage systems for Kelang Municipality was recognized, and the Government of Malaysia requested the assistance in the form of technical cooperation by the Government of Japan to conduct a study for a long range Master Plan to be followed by a Feasibility Study on priority areas according to urgency of the needs.

In response to the above request, the Government of Japan agreed to offer the services of a Japanese team of experts for the study and transfer of knowledge to counterpart personnel appointed by the Government of Malaysia, in accordance with laws and regulations in force in Japan. The Japan International Cooperation Agency (JICA), the official agency responsible for implementation of technical cooperation programs sponsored by the Government of Japan, is in charge of this study.

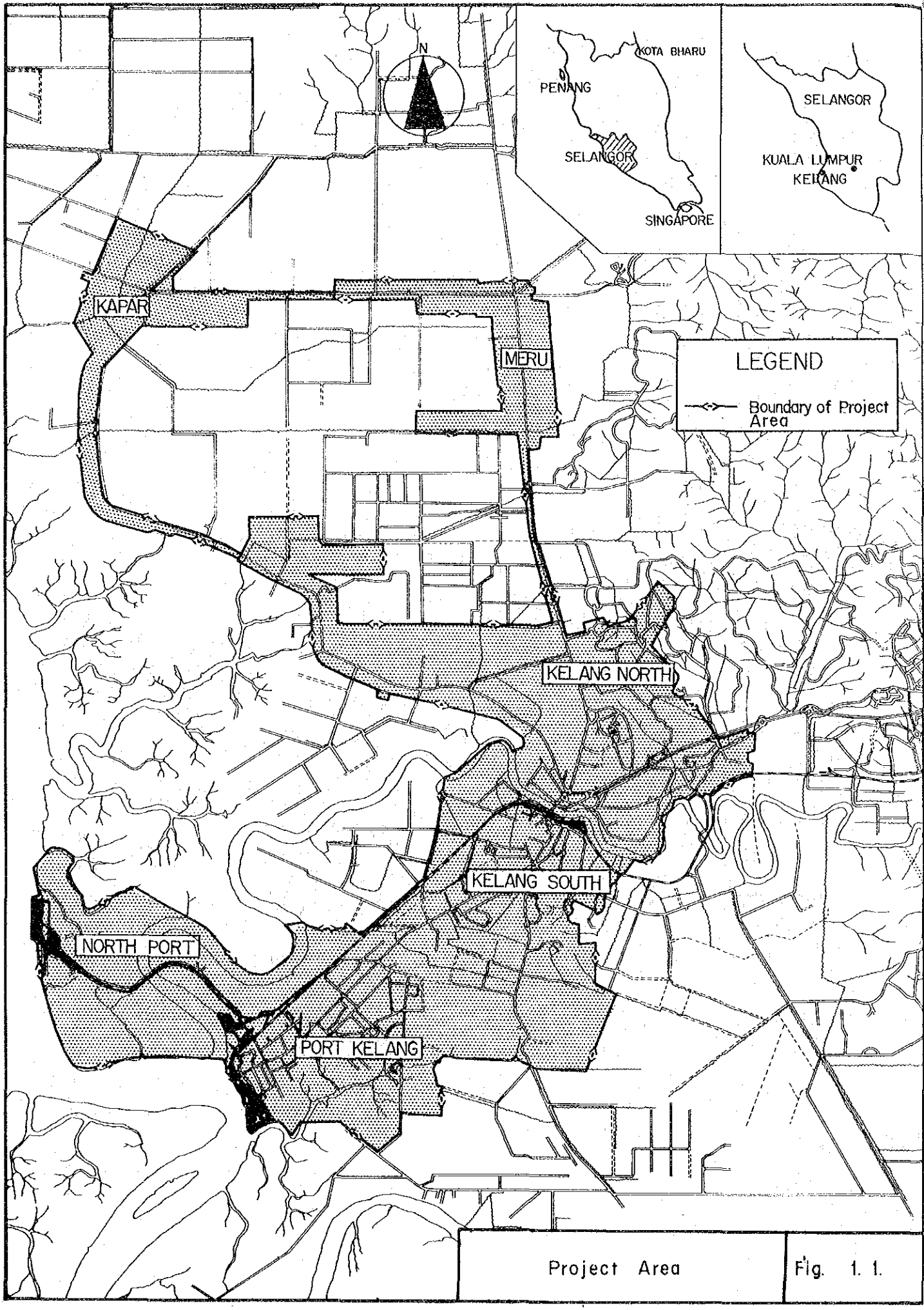
For the above purpose, a Japanese Supervisory Committee was set up in Tokyo in March 1981 and the joint firms of Tokyo Engineering Consultants Co., Ltd. and Central Consultant Inc. were retained by JICA to form the Study Team under the supervision of the Japanese Supervisory Committee. Technical and Steering Committees of the Government of Malaysia were also set up in Kuala Lumpur in order to deal with the progress of its studies and substance of its reports.

1.2. Definition of the Project

Before commencing the Study, the Scope of Work for the Project was officially agreed by both the Governments of Malaysia and of Japan. The Project consists of preparing a Master Plan up to the year 2000 for both sewerage and drainage systems including all aspects of engineering and managerial matters normally required for a comprehensive long-range plan, and a Feasibility Study on the first priority area with sufficient details on engineering plan, cost estimates and financing consideration.

The area for the Project was determined based on the above agreement. Total area of the Project Area is 7,669 ha. as shown in Fig. 1.1. For the purpose of planning, total Project Area is expected to be divided into smaller areas to identify urgency of the work, based on which phasing schedule for implementation will be established with the first phase program for Feasibility Study.

It is expected that following completion of the Master Plan, plans for sewerage and drainage systems covering the Project Area with necessary facilities up to the year 2000 will be established, with approximate cost estimates for implementation which however, will require reviewing and modifying at a later stage, according to succeeding developments. On the other hand, the Feasibility Study, completed in the first phase program for the highest priority area will enable the authorities concerned to proceed detailed design of civil work and procurement of materials and equipment according to the required standard procedure, provided sufficient fund for implementation is committed.



Project Area | Fig. 1. 1.

CHAPTER 2

BACKGROUND INFORMATION FOR THE STUDY

CHAPTER 2 BACKGROUND INFORMATION FOR THE STUDY

2.1. Physical Characteristics of the Project Area

2.1.1. Location

Malaysia consists of West Malaysia (Peninsular Malaysia) and East Malaysia (Sabah and Sarawak), and has thirteen states including Sabah, Sarawak and the Federal Territory. Malaysia's total area is about 330,400 km^2.

West Malaysia is surrounded by the Straits of Malacca to the west, the South China Sea to the east, and the contiguous boundaries of Thailand and Singapore. It lies entirely within the tropics, extending from latitude 1° to 7° north and from longitude 100° to 104° east.

The State of Selangor is located in the western part of West Malaysia and lies from latitude 2.5° to 4.0° north and from longtitude 100.7° to 102.0° east. Its area is about 8,200 km^2, including the Federal Territory, which occupies 2.5 percent of the whole area of Malaysia.

The Project Area of the Master Plan is situated in the western part of the State of Selangor and covers the whole area of the Kelang Municipality and its various environs. The Kelang Municipality is located about 40 km west of the Federal capital of Kuala Lumpur and has a population of 196,209 (1980), which makes Kelang Municipality the fifth largest city in Malaysia.

The Project Area is comprised of Kelang, Port Kelang, Kapar and Meru. From north to south, the Area is about 17 km (10.5 miles) and from east to west about 14 km (8.7 miles), with a total of 7,669 ha. (about 19,000 acres).

In the Project Area, the watercourses are the Kelang River, the Aur River, and the coastal watercourses of the Kapar Besar and Puloh rivers, etc. The Kelang River runs through and around the center of the Project Area and into the Straits of Malacca. The Aur River flows across the southern edge of the Project Area.

2.1.2. Topography and Geology

1) Topography

The Project Area can be divided topographically into two parts, Port Kelang and other areas comprised of Kelang, Kapar and Meru.

Port Kelang has flat terrain, and the elevation is below 3.05 m (10 ft.). Even in residential areas, there are some low lying locations where tide-effected flooding occurs.

Although the other areas are mildly hilly, the terrain is mostly flat with higher elevation compared to the Kelang River. There is a hilly ridge beyond the Project boundary at Meru running from northwest to southeast. This ridge is a watershed for runoff which originates outside the Project Area. At present, some hills in this area are being developed into residential estates. This tendency is expected to continue towards the future, due to the urbanization program in Kelang Municipality. By the year 2000, the target year of the Master Plan, condition of land use in this terrain is expected to be greatly changed.

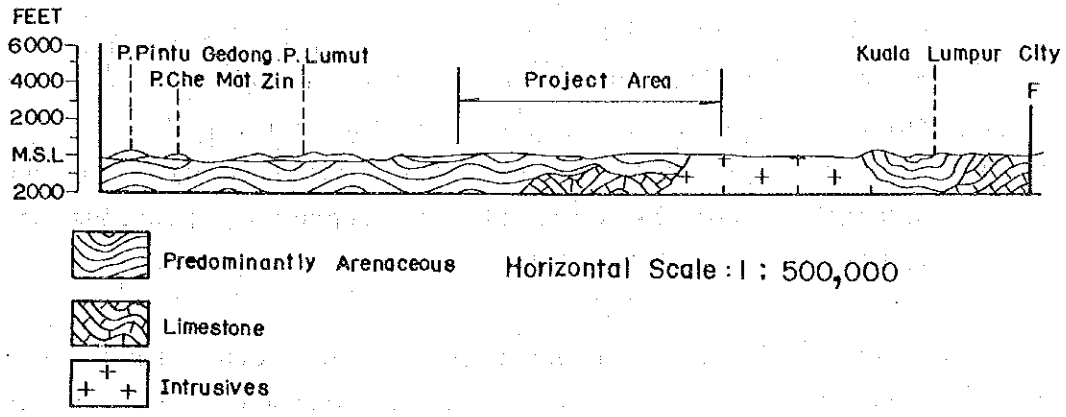
The populated areas are located in Port Kelang, Kelang South and Kelang North. Suburbs are almost totally covered by palm groves.

2) Geology

The geological nature of the western part of the Project Area divided by Jalan Langat, is alluvium of the Quaternary Period and that of the east is quartzite and phyllite of the Permian Carboniferous, or Triassic Period.

The hilly ridge running from north to south at the east side of Jalan Langat is overlain by medium stiff clay with some gravel and is of the quartzite, sandstone, schist and shale groups.

Fig. 2.1. Diagrammatic Section of Geology



Source: Hydrogeological Map of Peninsular Malaysia

The relatively shallow underground in the Project Area seems to be formed by two typical soil layers. The upper layer is silty clay and the lower layer is silty sand, according to boring data from the Aur River and terrain of the Project Area. The elevation of the lower layer, which is considered to be a supporting ground base, seems to gradually rise to the surface eastward toward the Project Area.

According to the "Kelang Sewerage Study" report in 1968, conducted by Proctor & Redfern International Ltd., twenty-one (21) boring tests were carried out up to a depth of 7.6 m (25 ft.), by means of an auger and shell in Port Kelang, Kelang South and North, with the following results:

a) Typically, the soils are soft to very soft clay with ground water level less than 1.5 m (5 ft.) below the surface.

b) The coefficient of cohesion C of clay soils is less than 0.18 kg.cm^2 (375 p.s.f.) by the unconfined compression strength test and these are classified as "very soft."

c) Values by the permeability test show around 3.0×10^{-6} cm per second. This value is a very low permeability consistent with the expected range between a clay and a silty clay.

d) A sulphate content is shown in a range of 98 to 108 ppm. Values of pH vary from 4.5 to 8.5.

e) By the Atterberg Limit test, the natural moisture of six samples out of eight samples is higher than the liquid limit.

f) Compaction testing indicates that substantially improved soil strengths could be obtained by compaction, provided moisture reduction is possible.

Location of the 21 boreholes where the boring tests were conducted are shown in Fig. 2.2. Out of the 21 boreholes, eight points were selected for ground water testing and low pH values were recorded at three points where ground elevation is high. Location of ground water sampling points and those of low pH values, are also shown in Fig. 2.2.

2.1.3. Climate

The climate in the Project Area is typically tropical; in short, hot and humid throughout the year with frequent squalls. No meteorological station exists in the Project Area; however, meteorological data is available at Subang Station (Kuala Lumpur International Airport), located 15 km east of the Area. Data obtained there for the 1968-1980 period are summarized as follows:

24 hrs. mean temp:	26.3°C
Mean daily maximum temp:	32.1°C
Mean daily minimum temp:	22.6°C
Highest maximum temp:	36.0°C
Lowest minimum temp:	18.1°C
24 hrs. mean humidity:	84.0%
Annual average rainfall:	2,300.8 mm/year

Mean number of rainy days: 193 days/year

Winds of strong force (Force 8 or more) are extremely rare.

Rainfall and temperature data are shown in Table 2.1 for reference.

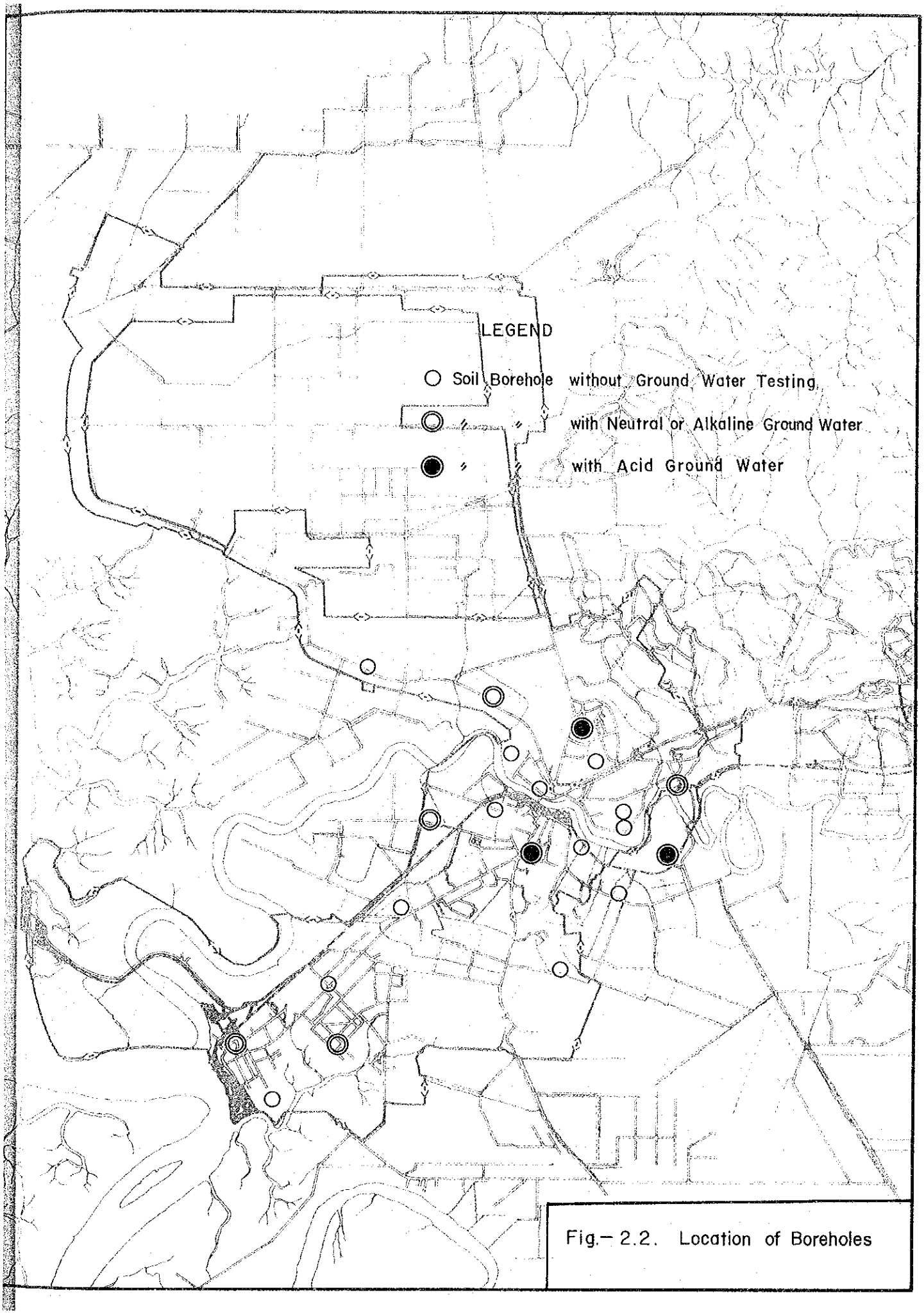


Fig.– 2.2. Location of Boreholes

Table 2.1. Record of Mean, Highest and Lowest of Monthly and Annual Rainfall, Raindays and Temperature

	Period	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Rainfall (mm)														
Mean	1966-1980	177.8	140.8	208.6	297.3	176.0	135.6	114.2	138.4	162.8	269.2	248.5	231.6	2300.8
Highest	1966-1980	370.3	255.5	336.8	469.4	405.6	253.5	242.4	312.2	281.9	496.3	374.7	536.7	2906.7
Year of Highest		1971	1966	1976	1966	1973	1972	1979	1969	1979	1968	1972	1971	1973
Lowest	1966-1980	70.9	87.1	89.4	144.4	49.3	25.7	49.5	36.6	98.8	58.7	91.2	100.3	1800.8
Year of Lowest		1974	1976	1972	1977	1979	1978	1976	1972	1976	1974	1971	1977	1974
Number of Raindays														
Mean	1966-1980	13	13	16	20	15	13	12	14	15	21	21	19	193
Highest	1966-1980	22	18	24	26	23	17	19	21	22	26	26	23	210
Year of Highest		1967	1966	1978	1973 1980	Sev.	1976 1977	1980	1969 1971	1975	1968	1972	Sev.	1980
Lowest	1966-1980	5	6	6	10	7	6	7	8	11	17	18	13	177
Year of Lowest		1972	1968	1972	1977	1976	1970 1978	1967	1974	1969	Sev.	1968 1973	1977	1972
Temperature (°C)														
24 Hr. Mean	1968-1980	25.9	26.3	26.6	26.8	27.0	26.7	26.4	26.4	26.2	26.2	25.9	25.8	26.3
Mean Daily Max.	1968-1980	31.9	32.8	33.0	32.8	32.7	32.3	31.9	32.0	31.8	31.7	31.2	31.2	32.1
Mean Daily Min.	1968-1980	21.8	21,9	22.4	23.1	23.3	22.9	22.5	22.5	22.6	22.7	22.8	22.3	22.6
Highest Max.	1968-1980	34.7	35.5	36.0	35.6	35.1	35.0	34.5	35.0	34.8	34.6	34.0	33.8	36.0
Year of Highest Max.		1979	1970	1970	1969	1979	1978	1976	1972	1969 1979	1979	1979	1977	1970
Lowest Min.	1968-1980	18.6	18.1	18.7	21.2	21.0	20.0	20.0	20.0	20.5	20.2	20.6	20.0	18.1
Year of Lowest Min.		1979	1968 1977	1968	1971	1976	1976	1976	1976	1976	1978	Sev.	1975	1968 1977

Notes: Station: Kuala Lumpur International Airport (Subang)
Latitude: 03°07'N
Longitude: 101°33'E
Ht. above M.S.L.: 16.5 m

2.2 Socio-Economic Conditions

2.2.1. Population and Urbanization

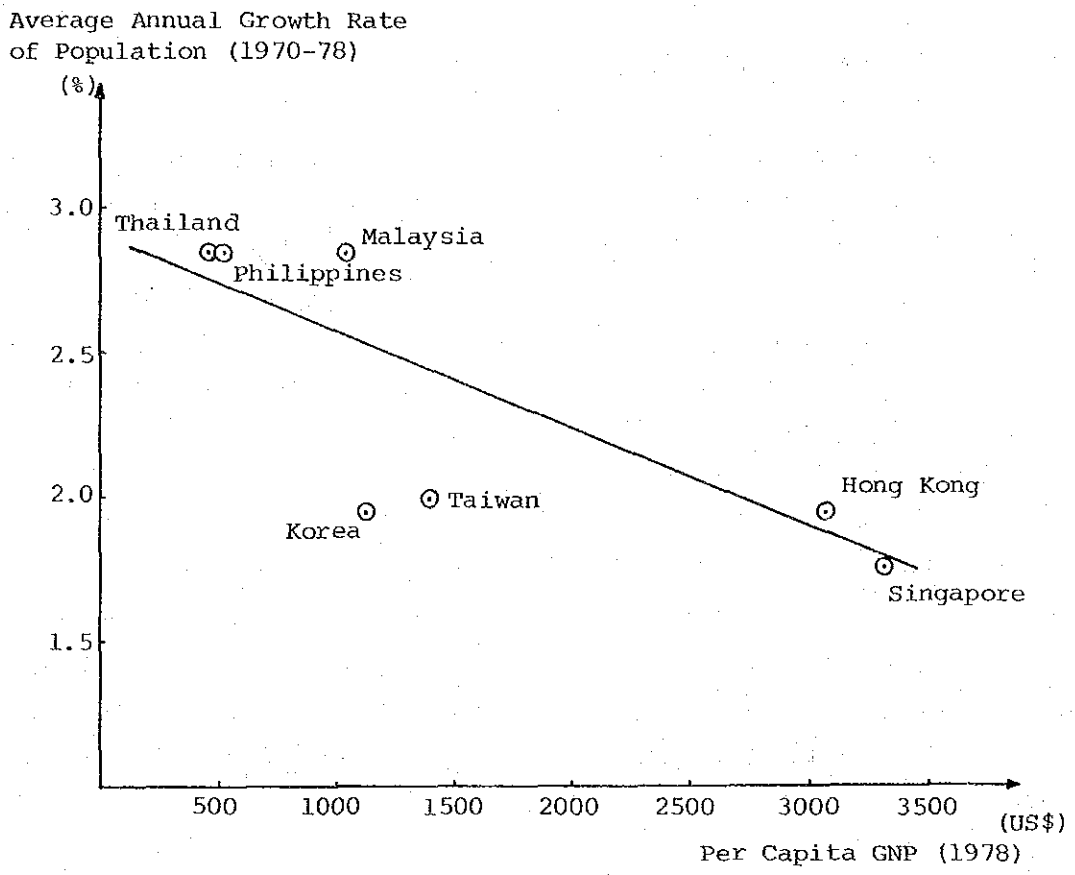
According to the Fourth Malaysia Plan (FMP), the total 10.8 million population of Malaysia in 1970 increased to an estimated 14.3 million in 1980, with an average annual growth rate of 2.8 percent. This growth rate is almost the same as that of middle-income countries in Asia, such as Thailand (2.7 percent) and the Philippines (2.7 percent).

As seen in the following Fig. 2.3, the population growth rate is, in general, related to the per capita income level. It can be empirically said that the more industrialized a nation, the less its growth rate. Therefore, the population growth rate in Malaysia is expected to decrease in the future as increased participation by the industrial sector in the economy is clearly foreseen.

According to the same source of information, the population of the country is estimated to increase from 14.3 million in 1980 to about 16.2 million by 1985, growing at an average annual rate of 2.6 percent. The population of Peninsular Malaysia is expected to increase at an average rate of 2.4 percent per annum, which is lower than the growth rate of 3.2 percent per annum estimated for Sabah and Sarawak.

The urban population growth rate in the last decade was 4.6 percent per annum. In absolute terms, urban population increased from 2.6 million in 1970 to about 4.1 million in 1980 in Peninsular Malaysia. This means that about 29 percent of the total population lived in urban areas in 1970, compared to 35 percent in 1980.

Fig. 2.3. Population Growth Rate and Per Capita Income Level



Source: World Development Report, W.B., 1980.

For reference, the urban population growth in Japan from 1950 to 1960 was 6.7 percent per annum while the growth rate of the real per capita GNP during the same period recorded 8 percent per annum. As the economy of Malaysia is expected to sustain its remarkable progress, its urban population growth rate will remain high throughout the 1980s. The FMP predicts the growth of the urban population in Peninsular Malaysia at an average rate of 4.1 percent per annum from 4.1 million in 1980 to an estimated 5.1 million by 1985. As a result, the proportion of urban population is expected to increase from 35 percent to 38 percent during the FMP period. The predicted high rate of urbanization is attributable to Malaysia's expected economic growth, particularly in the industrial sectors

and rural-urban migration, bringing the real per capita GNP to increase accordingly.

2.2.2. The Economy of Malaysia

In the past decade of the Second and Third Malaysia Plan periods (1970-80), the economy of the country achieved remarkable progress. It was indeed a period of high economic growth, which brought a great structural change the Malaysian economy had never experienced before. The per capita gross domestic product(GDP) in real terms during this decade increased by 4.9 percent per annum (about 60 percent increase in 10 years). The per capita gross national product (GNP) at the current price in 1980 reached approximately M$3,630.

The share of GDP in the agriculture, forestry and fishery sectors decreased from 30.8 percent in 1970 to 22.2 percent in 1980, while that of the manufacturing sector increased from 13.4 percent to 20.5 percent in the same period. The growth in total investment of the economy in the past decade was so vital that the share in GDP increased from 17.8 percent in 1970 to 26.5 percent in 1980, among which private investment was double that of public investment.

Active progress in the manufacturing sector, supported by (a) availability of domestic and foreign capital, (b) abundant labor force, (c) stable growth in the primary sector and (d) well-established managerial ability, proved to be sufficiently strong during the "Energy crises" period from 1973 onwards, which had serious ill effects on both developed and developing countries.

The above-mentioned three indicators; i.e., sustained growth in GDP, in large investment share in GDP and stable and rapid growth in the manufacturing sector, prove that the Malaysian economy has already entered the stage of modern economic growth which the Japanese economy experienced in the 1960s.

The New Economic Policy (NEP) launched at the inauguration of the Second Malaysia Plan in 1970 had as its fundamental goals the eradication of poverty by raising income levels and increasing opportunities for all Malaysians, and re-ordering of society to correct economic imbalance so as to reduce and eventually eliminate the identification of any particular group with economic activities.

Concerning income growth, the NEP provided satisfactory results in the past decade. However, equitable distribution of the achievement seems to be of concern to the Government. Poverty in urban areas still remain in the shadow of skyscrapers, and the gap in productivity between urban and rural areas is increasing.

The NEP's goals remain to be pursued during the current FMP (1981-85). Particularly, it seems to place major concern on equitable distribution of income among peoples as well as regions.

It is natural that the striking performance in the 1970s and further availability of resources in the Malaysian economy make FMP challenging. The FMP advocates the increase of the GDP in real terms to 7.9 percent per annum which is 0.1 percent higher than the rate achieved in the 1970s. (Ref.: Table 2.3.)

The position of balance of payments continued to be favorable during the 1970s. Particularly the trade balance recorded a remarkable surplus of M$21,954 million during 1976-80 compared to a surplus of M$4,088 million during 1971-75. The strong growth in trade surplus resulted from, in particular, an increase in the export value of crude petroleum and manufactured goods. A better position in trade balance and a substantial inflow of official and private capitals enabled the country to accumulate about M$6,702 million during 1976-80. Thus, the external reserves of the national bank reached an estimated M$10,304 million at the end of 1980. This level of external reserves is equivalent to 5.5 months of imports at the 1980 level. The debt service ratios to GNP and exports of goods/services were 4.6 percent and 8.8 percent respectively in 1978, compared to 1.7 percent and 3.6 percent in 1970. These figures indicate that although the position in debt service ratios was greater during the past decade, it is not at a critical level.

Table 2.2. Balance of Payments, Malaysia (1971-80)

(Unit: M$ million)

		Cumulative		
		1971-75 (Actual)	1976-80 (Estimate)	1971-80 (Estimate)
	Export of goods	35,962	97,282	133,244
-	Import of goods	31,874	75,328	107,202
=	Trade balance	+4,088	+21,954	+26,042
+	Balance on services	-6,457	-16,632	-23,089
+	Net transfers	-628	-487	-1,115
=	Balance on current account	-2,997	+4,835	+1,838
+	Official long-term capital	+2,327	+2,789	+5,113
+	Corporate investment	+3,282	+6,911	+10,193
+	Commercial credit	+119	-158	-39
+	Private financial capital	+339	-2,285	-1,946
+	Errors and omissions	-1,279	-5,537	-6,816
=	Overall balance	+1,791	+6,552	+8,343
+	SDR allocation	+121	+150	+271
=	Net change in external reserves (increase-/decrease+)	-1,912	-6,702	-8,614

Source: FMP

2.2.3. The Economy of the State of Selangor

The economy of Selangor, excluding the Federal Territory, has attained an overall high level, especially in its manufacturing and tertiary sectors during the past decade. Its rapid economic progress, as shown in the table below, has made it the richest state in Malaysia, with a per capita GDP nearly double the national average. Its GDP represents approximately one-third of the total national GDP.

Year	Per Capita GDP	GDP
1971	M$2,153	M$3,826 million
1980	M$2,655	M$4,144 million

One-third of its GDP comes from the manufacturing sector, while only 8 percent comes from agriculture. A substantial output of this manufacturing sector accrues from industries located in the Kelang Valley, and accounts for 37 percent of the nation's total output. Thus, this belt along the Kelang River from Port Kelang to Kuala Lumpur has become the most economically vital zone in the country.

The future economic growth of Selangor is expected to continue experiencing high levels of GDP and per capita GDP throughout the next decade. The GDP of the state is projected to grow at 7.4 percent per annum from 1980 to 1985 and at 9.0 percent per annum from 1985 to 1990, leading to M$5,934 million GDP and M$9,148 million GDP respectively (all figures are presented at 1970 price level). On the other hand, the per capita GDP is projected to reach M$3,100 in 1985 and M$3,972 in 1990, which are approximately 1.33 times higher for 1985 and 1.27 times higher for 1990 than the projected national average.

Particularly, the future growth of the economy of Selangor is expected to stem from the increasing establishment of high-technology industries, such as the production of medical, electrical and telecommunications equipment, as well as the expansion of service activities related to programs aimed at strengthening the role of Selangor as the growth center for Peninsular Malaysia.

The following Table 2.3 gives the economic condition of Selangor State, compared with those of the country as a whole.

Table 2.3. Economy of Selangor State: GDP of Sector Origin

(The Selangor State excludes the Federal Territory) (Unit: M$ million at 1970 price level)

Sector	State of Selangor (including F.G.)								Malaysia							
	1971		1980		1985		1990		1971		1980		1985		1990	
	Value	(%)	Value	(%)	Value	(%)	Value	(%)	Value	(%)	Value	(%)	Value	(%)	Value	(%)
Agriculture	419	(11.3)	611	(7.7)	636	(6.1)	682	(4.5)	3,852	(30.5)	5,809	(22.9)	6,720	(18.3)	8,193	(14.9)
Mining & Quarrying	198	(5.3)	153	(1.9)	146	(1.4)	115	(0.8)	834	(6.6)	1,214	(4.8)	1,607	(4.4)	1,863	(3.4)
Manufacturing	940	(25.3)	2,462	(31.2)	3,563	(34.0)	5,559	(37.0)	1,858	(14.7)	5,374	(21.2)	9,040	(24.6)	15,121	(27.6)
Construction	242	(6.5)	492	(6.2)	646	(6.2)	947	(6.3)	541	(4.3)	1,186	(4.7)	1,824	(5.0)	2,938	(5.4)
Utilities	76	(2.0)	219	(2.8)	284	(2.7)	396	(2.6)	238	(1.9)	592	(2.3)	953	(2.6)	1,500	(2.7)
Transport, Storage & Communication	196	(5.3)	722	(9.1)	905	(8.6)	1,263	(8.4)	632	(5.0)	1,696	(6.7)	2,492	(6.8)	3,834	(7.0)
Wholesale, Retail, Trade, Hotel & Restaurant	715	(19.2)	1,261	(16.0)	1,725	(16.5)	2,464	(16.4)	1,717	(13.6)	3,295	(13.0)	4,841	(13.2)	7,279	(13.3)
Finance, Insurance, Estate & Business Services	299	(8.0)	662	(8.4)	835	(8.0)	1,150	(7.7)	1,126	(8.9)	2,155	(8.5)	3,079	(8.4)	4,629	(8.4)
Gov't Service	509	(13.7)	1,033	(13.1)	1,373	(13.1)	1,920	(12.8)	1,466	(11.6)	3,398	(13.4)	5,228	(14.2)	8,044	(14.7)
Others	128	(3.4)	279	(3.5)	365	(3.5)	527	(3.5)	354	(2.8)	657	(2.6)	948	(2.6)	1,459	(2.7)
Total	3,722	(100.0)	7,894	(100.0)	10,478	(100.0)	15,023	(100.0)	12,618	(100.0)	25,376	(100.0)	36,732	(100.0)	54,860	(100.0)
Share of Selangor (%)	29.5		31.1		28.5		27.4									
Area (km^2)	8,196	(2.5% of the total area)							330,434							
Population (1,000)	1,777	(16.0)	2,559*	(17.9)	3,087	(19.1)	3,656	(20.0)	11,104		14,261		16,180		18,261	
Population Density(person/km^2)	216		312		377		446		33.6		43.2		50.0		55.3	
GDP at Purchasers' Value	3,826		4,144		5,934		9,148		13,016		26,188		37,824		56,760	
Per Capita GDP	2,153		2,655		3,100		3,972		1,172		1,836		2,338		3,129	
Ratio to Malaysia	1.84		1.45		1.33		1.27		1.0		1.0		1.0		1.0	

Source: Fourth Malaysia Plan

Note: * This figure is revised to be 2,405, according to the latest source, the 1980 Census.

2.3. Population and Land Use

2.3.1. Population

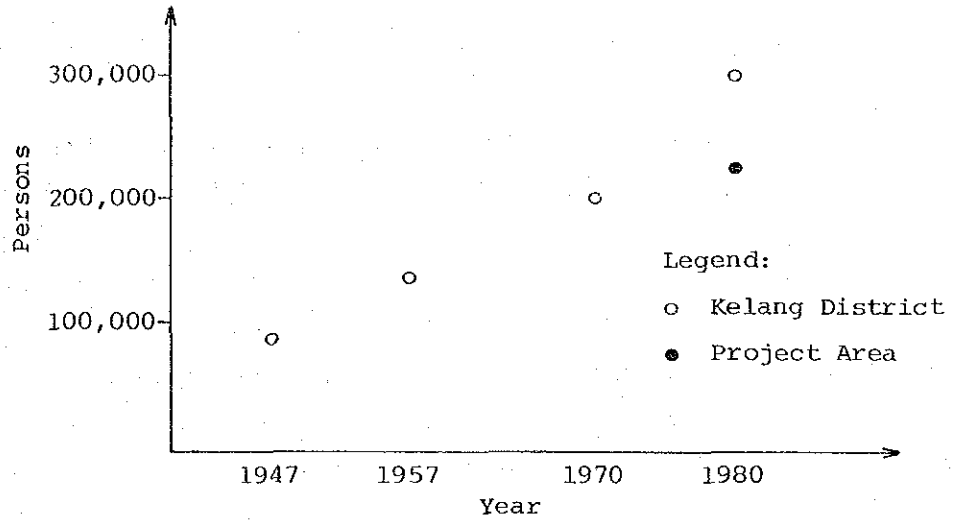
1) Population Trend

Population trend in the Project Area can be observed through results of four censues conducted in 1947, 1957, 1970 and 1980 in Malaysia.

Since various small suburbs are included in the Project Area, in additon to the entire Municipality area, the Project Area does not geographically coincide either with the State adminstrative area of Kelang District, which is larger than the Project Area, or with the Kelang Municipality area. Thus the Project Area population for the census years, 1947, 1957 and 1970 could not be obtained. However, population in the Kelang District for all of the census years and that in the Porject Area in the 1980 census were available to provide, as shown in Fig. 2.4, a graphic view of the population trend.

Since the Kelang Municipality area is the only urban area and the remaining areas consist of *Kampung* and agricultural areas, population increase in the Kelang District during the 33-year period from 1947 to 1980 is considered to have occurred in the Municipality area. Preliminary field count summaries of the 1980 census revealed the population in the Kelang District (which was 89,000 in 1947) and in the Project Area to be 284,941 and 205,630 respectively. The annual population growth rate of the years between 1970 and 1980 was 3.7 persent, which is larger than the annual growth rate of 2.4 percent for Peninsular Malaysia and samller than the rate of 4.0 percent for the State of Selangor.

Fig. 2.4. Population Trend



2) Population Distribution in 1980

The population figure of each *Kawasan* for the year 1980, taken from the preliminary field count summaries, is shown in Fig. 2.5 below. The figure illustrates that the population is concentrated in Port Kelang, Kelang North and Kelang South.

3) Population Density in 1980

The population density of each *kawasan* in 1980 is shown in the following Fig. 2.6, which shows that Port Kelang is the most densely populated area with *kawasan* #13 having the highest density of 100 persons/ha, including the squatter population. On the other hand, Kapar and Meru are observed to be among the least densely populated areas, with population density of approximately 10 persons/ha. The contrast in the various population densities with the average population density of the Project Area of approximately 30 persons/ha should be noted.

Fig. 2.5. Project Area Population Distribution in 1980

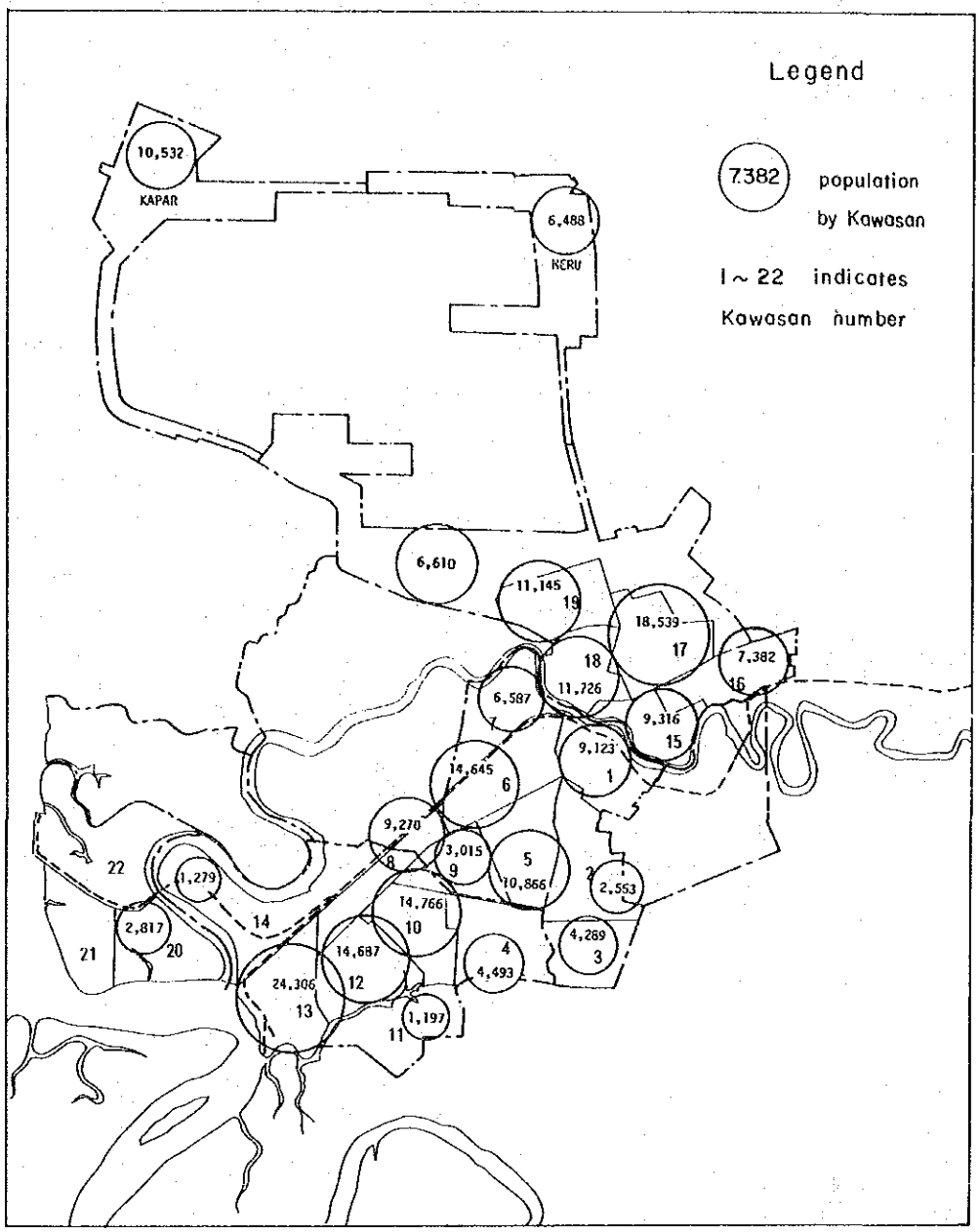
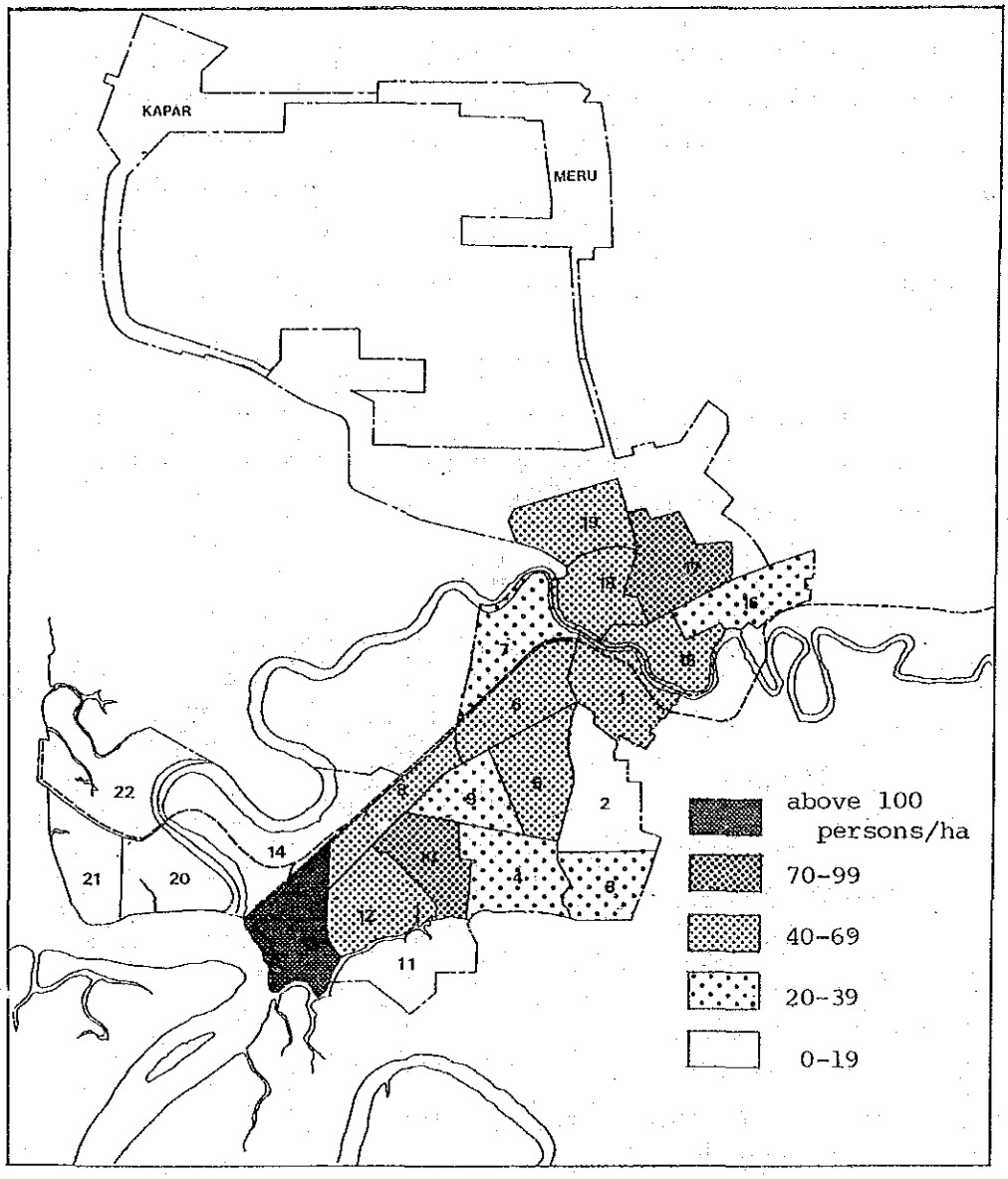


Fig. 2.6. Population Density in 1980



2.3.2. Land Use

1) Existing Land Use

The present situation regarding land use of the Project Area is that the area surrounding the commercial centers of Kelang North, Kelang South and Port Kelang are allotted for residential purpose. The major industrial area is allocated in the North Port area, with some industrial areas also included in Kelang North and Port Kelang. The agricultural areas, chiefly palms oil estates, cover the area between North Port and Kelang South.

The existing land use situation of the Project Area is shown in Fig. 2.7, while details of the areas earmarked for various categories of land use are given in Table 2.4.

Table 2.4. Existing Land Use (1980)

Land Use	Area (Hectare)	(Percentage)
Residential	1,600	20.9
Commercial	60	0.8
Industrial	700	9.1
Port Area	160	2.1
Institutional/Government	230	3.0
Open Space/Agriculture/ Vacant Land	4,919	64.1
Total	7,669	100.0

Source: Interim Development Control Planning Study, 1981, Selangor State.

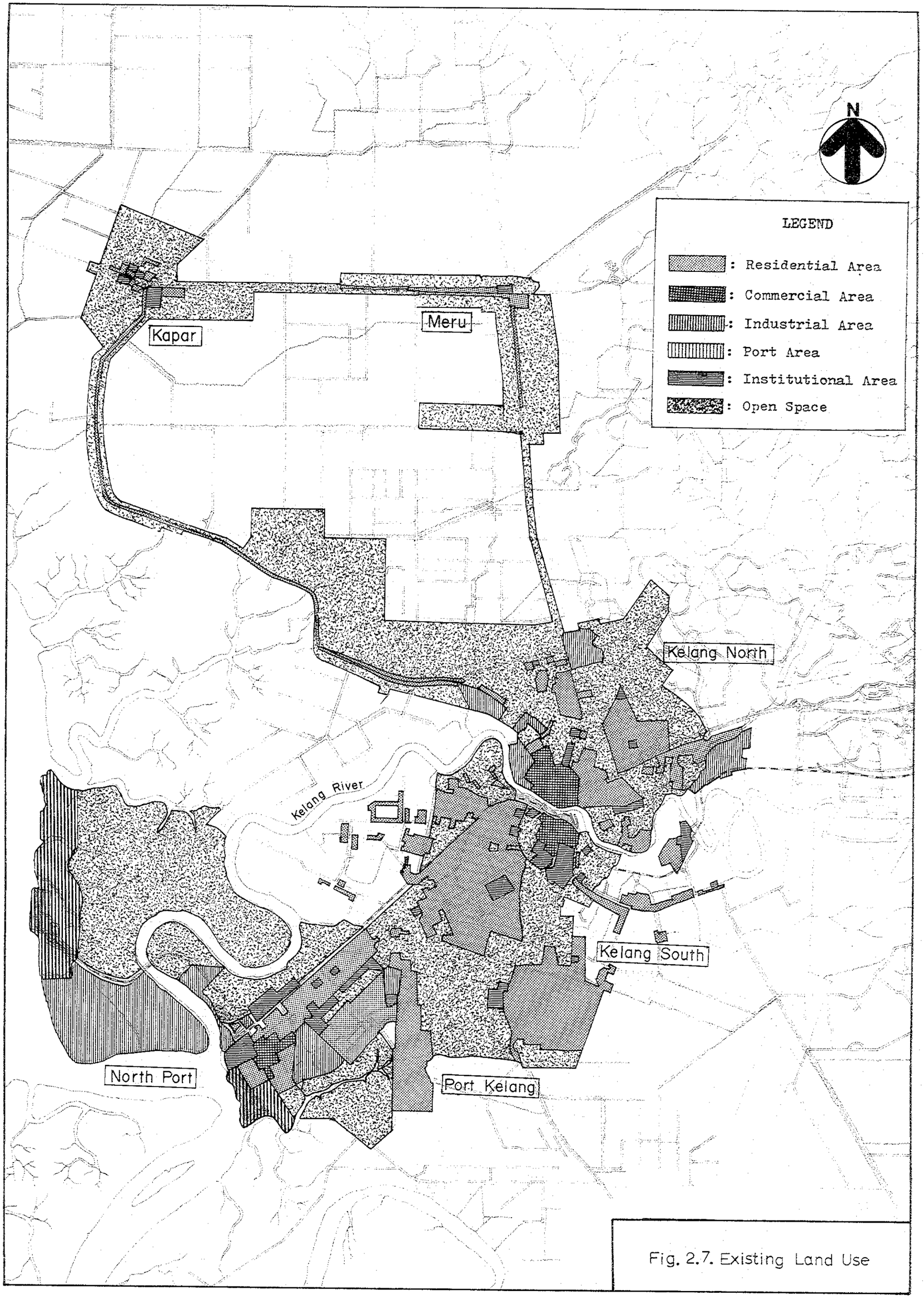


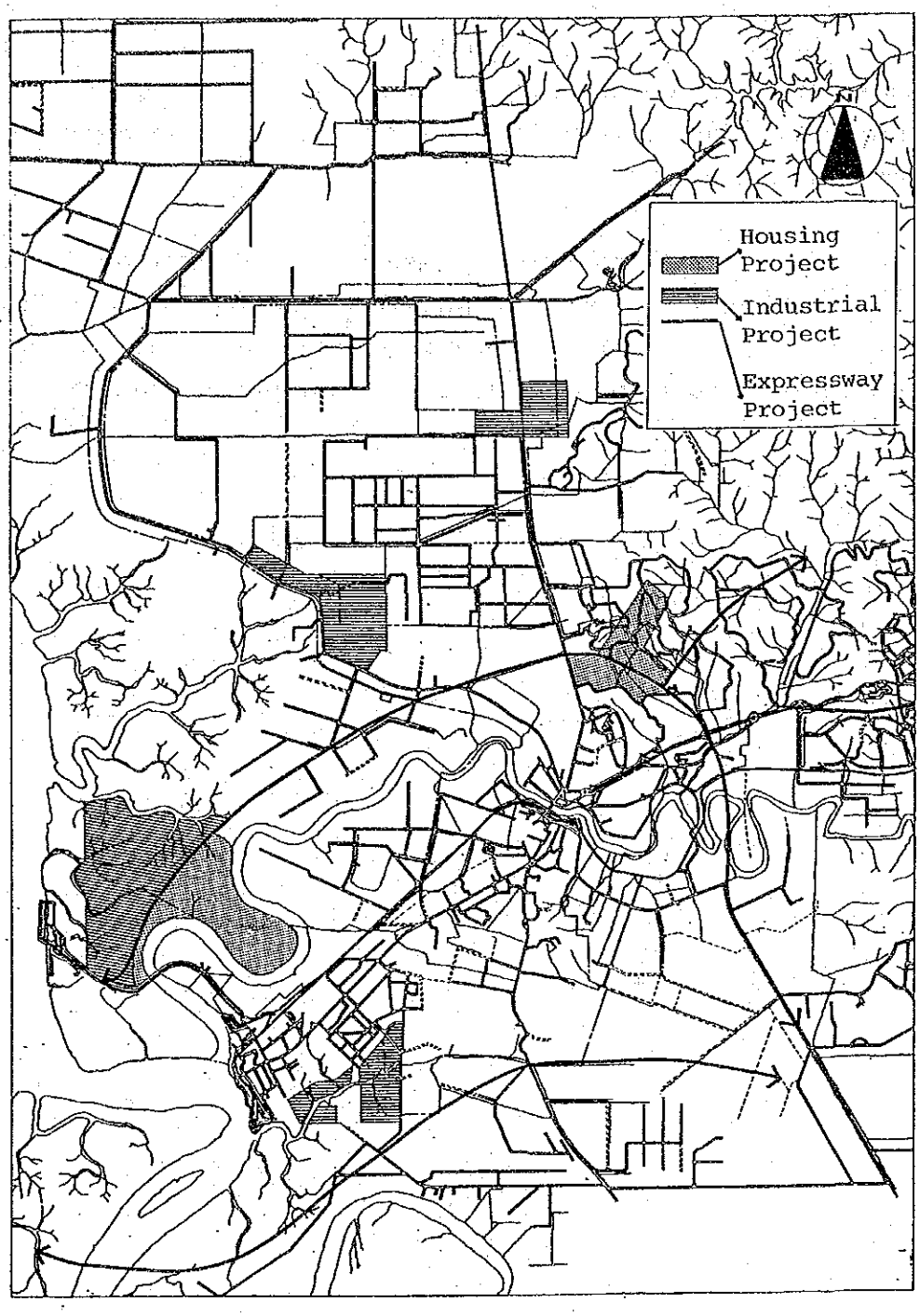
Fig. 2.7. Existing Land Use

2) Development Projects

The sites for the planned industrial, housing and road projects are shown in the following Fig. 2.8. According to this figure, the industrial projects are concentrated in North Port and the main housing projects are located in Kelang North.

As for road construction projects in the Project Area, the North Expressway is currently under construction, and the proposed South Expressway will connect Federal Highway and the New Port, which will be constructed at Pulau Lumut. These expressway projects are shown in Fig. 2.8.

Fig. 2.8. Main Development Projects



2.4. Public Health Condition

The condition of public health in the Project Area is generally good. According to data obtained from the Health Department of the Kelang Municipality, incidents of water-borne communicable diseases are insignificant. The number of such patients for the past eleven years are shown in Table 2.5. Despite the fact that the figures represent only those reported and that therefore the actual total might be higher, it can be said that the Project Area has not suffered from serious epidemics.

Table 2.5. Number of Patients of Water-Borne Communicable Diseases

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Cholera	-	-	-	-	-	-	-	-	1	-	-
Typhoid	-	-	-	-	-	-	16	8	10	7	3
A. Dysentery	1	1	-	-	-	2	2	4	5	2	13
B. Dysentery	-	-	-	1	-	4	-	7	3	-	1
Poliomyelitis	-	7	14	-	-	-	-	3	-	-	-
Leptospirosis	-	-	-	-	-	-	-	-	-	-	-
Amoebiasis	-	-	-	-	-	-	-	-	-	-	-
Infectious Hepatitis	-	5	-	-	1	3	14	22	27	6	29

2.5. Water Supply

2.5.1. Water Supply Condition

The water supply system in the State of Selangor is operated by the Water Works Department (WWD) of the State Government. Water supply system in the Study Area is under the control of Kelang District Office of the Department. The area covered by the District Office includes the state capital of Shah Alam and surrounding rural areas in addition to the Project Area.

According to the 1979 annual report, total expanse of Kelang District (in terms of water supply) is estimated to be 108,000 ha., in which estimated population was 280,000. The population served by the water supply system was estimated to be 260,000 which means that 93 percent of the total district population was being provided with piped water.

In the Project Area, the proportion of served population is considered to be higher than that of the District. Figures concerning water supply from the most recent population and housing census in 1980 are not available. However, according to the 1970 census, the proportion of the served population in the Project Area was estimated at 92 percent compared with 77 percent in Kelang District. Details of the water supply in living quarters are shown in Table 2.6. Taking into account present conditions where piped water is supplied even in some squatter areas by means of stand pipes, the served population in the Project Area can be considered to be almost the entire population.

Table 2.6. Water Supply in Living Quarters

(Unit: Number of households)

	Piped Water			Well or Pump	River	Parit, Drain, Canal	Other	Total
	Inside Living Quarters	Outside Living Quarters	Total					
Kelang Town Council	11,612	2,555	14,167	460	22	32	232	14,913
Kapar Local Council	494	362	856	218	2	1	275	1,352
Meru Local Council	312	453	765	125	4	1	94	989
Sub-Total*	12,418 (72.0%)	3,370 (19.5%)	15,788 (91.5%)	803 (4.7%)	28 (0.2%)	34 (0.2%)	601 (3.5%)	17,254 (100%)
Rest of the District	6,918	3,692	10,610	3,378	63	135	2,870	17,056
Total Kelang	19,336 (56.4%)	7,062 (20.6%)	26,398 (76.9%)	4,181 (12.2%)	91 (0.3%)	169 (0.5%)	3,471 (10.1%)	34,310 (100%)

Source: 1970 Population and Housing Census

* equal to Study Area.

2.5.2 Water Consumption

Current water consumption in the Project Area according to WWD data is as follows.

Table 2.7. Water Consumption in the Project Area in 1980

(Unit: m^3/day)

Area	Domestic	Trade	Total
Kelang North	13,200	4,100	17,300
Kelang South	14,400	1,200	15,600
Port Kelang	10,600	3,900	14,500
Kapar	5,600	1,500	7,100
Meru	1,100	40	1,140
Total	44,900	10,740	55,640

These figures are measurements taken from consumers' meters and represent actual consumption, excluding leakage, etc. Based on the present population in the Project Area, daily average water consumption per capita is calculated to be 271 ℓ/cap./day for overall consumption and 218 ℓ/cap./day for domestic consumption.

For water supply planning purpose, present per capita consumption is estimated to be 230 ℓ/cap./day for urban population and 140 ℓ/cap./day for rural population. This estimation is considered to be reasonable, taking into account the above-mentioned per capita water consumption in the Project Area.

The trade category shown in Table 2.7 includes both commercial and industrial use. Based on the data obtained from questionnaries collected from existing factories, total industrial water consumption supplied by WWD is estimated to be 4,570 m^3/day. The remaining 6,170 m^3/day is considered to be commercial consumption.

Employed population in the Project Area, excluding industrial area, is estimated to be 28,300 persons in 1980. Assuming that commercial consumption represents this employed population, estimated per capita consumption for employed population is 218 ℓ/cap./day.

2.5.3 Water Supply Master Plan

The Water Supply Master Plan was up-dated in 1979 modifying the former forecasts, based on data which became available after completion of the previous plan in 1973. The study area of the Master Plan comprises the Kuala Lumpur district, the Kelang district and part of the Ulu Langat district, including Kuala Lumpur, Petaling Jaya, Shah Alam and the town of Kelang. The entire Project Area is included in the study area.

The target year of the Master Plan is 1995. Water demand, both for domestic and industrial use, up to 1995 is forecasted. Demand of the domestic water supply is calculated based on the estimated population and per capita water consumption. Per capita consumption in 1995 is projected to be 273 ℓ/cap./day for the urban area and 227 ℓ/cap./day for the rural area. Industrial water in industrial estates is forecasted based on the area and basic rates of demand. Two basic rates are adopted, according to the expected condition of the industrial estates. The rate of 34 m^3/day/ha is adopted for the industrial estates in general, and a higher rate of 56 m^3/day/ha is adopted for the North Kelang Straits reclamation area (North Port district, according to the sewerage plan). It is expected that North Port industrial estate will attract heavier types of industries.

2.6. Sanitary Conditions

2.6.1. Sewerage

In the Project Area, there is no sanitary sewerage system which collects and disposes of domestic sewage together with trade wastewater. Sullage from residences, effluents from septic tanks and industrial wastes are discharged into the existing open drains, which are serving as a crude sewerage system.

2.6.2. Excreta Disposal Systems

Existing excreta disposal systems in the Project Area are classified into the three categories; namely, flush toilets with septic tanks, the bucket system and pit privies. There are two types of septic tank sytems, individual and communal. Based on the information from the Cleansing Department of the Municipal Council, the number of houses classified according to excreta disposal systems are summarized in Table 2.8. Also, data from the 1970 population and housing census are summarized in Table 2.9.

Comparing these two tables, an increasing preference for flush toilets is noted while buckets and pits are decreasing. Restrictions on the installation of bucket systems and pit privies in the permanent houses are largely responsible.

However, approximately 1,700 households still employ bucket systems (1980). These houses are scattered within the Project Area. Night soil from these houses is collected daily by Kelang Municipal council's tanker and is brought to disposal sites. Two disposal sites are currently in operation, one in Jalan Harper, Kelang North and the other in Jalan Tanki, Port Kelang. At the disposal sites, night soil is dumped into concrete tank where it is mixed with river water which flows in during high tide and the mixture is flushed into the rivers, the Kelang River and the Aur River, during low tide. No treatment is conducted at both sites.

In addition to the bucket system, houses with pit privies still remain. Most of these houses are located in *Kampung* areas and the number of houses are estimated to be 1,000.

These two types of toilet facilities are by no means adequate for modern living standards. Furthermore, difficulty in maintaining the bucket system by the local authority is foreseen because of the distasteful nature of the work. To improve living standards, as well as to improve the environmental conditions, these types of toilet facilities should be eliminated as soon as possible.

Table 2.8. Excreta Disposal Systems in Kelang Municipal Council (1980)

(Unit: number of household)

Flush Toilet with Individual Septic Tank	Flush Toilet with Communal Septic Tank	Bucket	Pit	Total
30,000 (76.5%)	6,500 (16.6%)	1,700 (4.3%)	1,000 (2.6%)	39,200 (100%)

Source: Kelang Municipal Council.

Table 2.9. Toilet Facilities in Kelang Municipal Council (1970)

(Unit: number of households)

	Flush	Bucket	Pit	Over River or Sea	No Facility	Total
Kelang Town Council	6,542	4,858	2,604	319	590	14,913
Kapar Local Council	111	80	888	3	270	1,352
Meru Local Council	40	61	724	17	147	989
Sub Total	6,693 (38.8%)	4,999 (29.0%)	4,216 (24.4%)	339 (2.0%)	1,007 (5.8%)	17,254 (100%)
Rest of the District	5,139	801	9,677	410	1,029	17,056
Total Kelang	11,832 (34.5%)	5,800 (16.9%)	13,893 (40.5%)	749 (2.2%)	2,036 (5.9%)	34,310 (100%)

Source: Population and Housing Census 1970.

In the new housing schemes, each house has an individual septic tank. Desludging of these septic tanks is carried out by the Municipal Council at the request of home owners. The average desludging period is calculated at about 30 years (based on the existing number of septic tanks and annual records of desludging obtained from the Cleansing Department).

As mentioned before, effluent from these septic tanks is discharged into open drains. According to the actual experience, the effect of septic tanks, especially small ones, is not satisfactory for reducing pollutants. Therefore, although flush toilets with septic tank system improve living conditions, this system is considered insufficient from the viewpoint of environmental control.

2.6.3. Refuse Collection and Drain Cleansing

Within the Munucipal Council Area, approximately 160,000 residents; i.e., 80 percent of the total population are served by refuse collection which is done by the Cleansing Department. Collection and transportation are carried out systematically and satisfactorily. However, illegal dumping of refuse into open drains or along roadsides has been witnessed in certain parts of the Project Area.

Collected refuse is disposed of at the Kelang South dumping site near the Kelang River as a means of sanitary land filling. This disposal site is now almost filled up, and the Cleansing Department has obtained a new disposal site near the Aur River, in the southern part of the Project Area for disposal of refuse from the Port Kelang area.

In addition to the collection and disposal of refuse, cleansing of the open drains is performed by the Cleansing Department. The total length of open drains in which cleansing work is conducted reaches 410 km. Some M$1.1 million, or about one-fourth of the total expenditure of this Department, was spent on this work in 1980.

Because of the low and flat nature of the land, open drain flow is slow and often stagnated, sometime with oil and grease from gasoline sta-

tions and general flotsam. These conditions, including the fact that the dry-weather flow in the drains is wastewater itself, constitute not only a sanitary hazard but also an aesthetic defect.

2.7. River and Drainage System

2.7.1. River System

In the Project Area there is one big river; namely, the Kelang River. The River starts from the mountainous border of the State of Pahang, and flows westward through Kuala Lumpur and Petaling Jaya to the sea. Its route through the Project Area goes through the center of Kelang, then to the north of Port Kelang. The River is affected by tidal waves throughout the Project Area and to a considerable distance upstream to the Puchong Weir. Most of the drains in the Project Area empty into the River.

1) Kelang River Flow

The DID maintains flow records at a few gauging stations upstream from the Puchong Weir where tides are not expected to have any effect on the River. The flood discharge at the town of Kelang was estimated as follows by using specific flood discharges based on results of the National Water Resources Study.

Flood Discharge (m^3/sec)	Return Period (year)
690	100
610	50
360	5
260	2

2) Kelang River Water Level

The Kelang River water level in the Project Area is highly affected by tidal waves. Therefore, the water level of the Kelang River is the same as that of the sea.

The tidal level which affects the water level of the Kelang River is shown below:

Tidal Level at Port Kelang

Lowest Astronomical Tide	R.L. -2.84 m
Mean Low Water Springs	R.L. -2.04 m
Mean Low Water Neaps	R.L. -0.44 m
Mean Sea Level	R.L. +0.16 m
Mean High Water Neaps	R.L. +0.86 m
Mean High Water Springs	R.L. +2.06 m

Source: Tide Tables, Malaysia and Singapore, 1981.

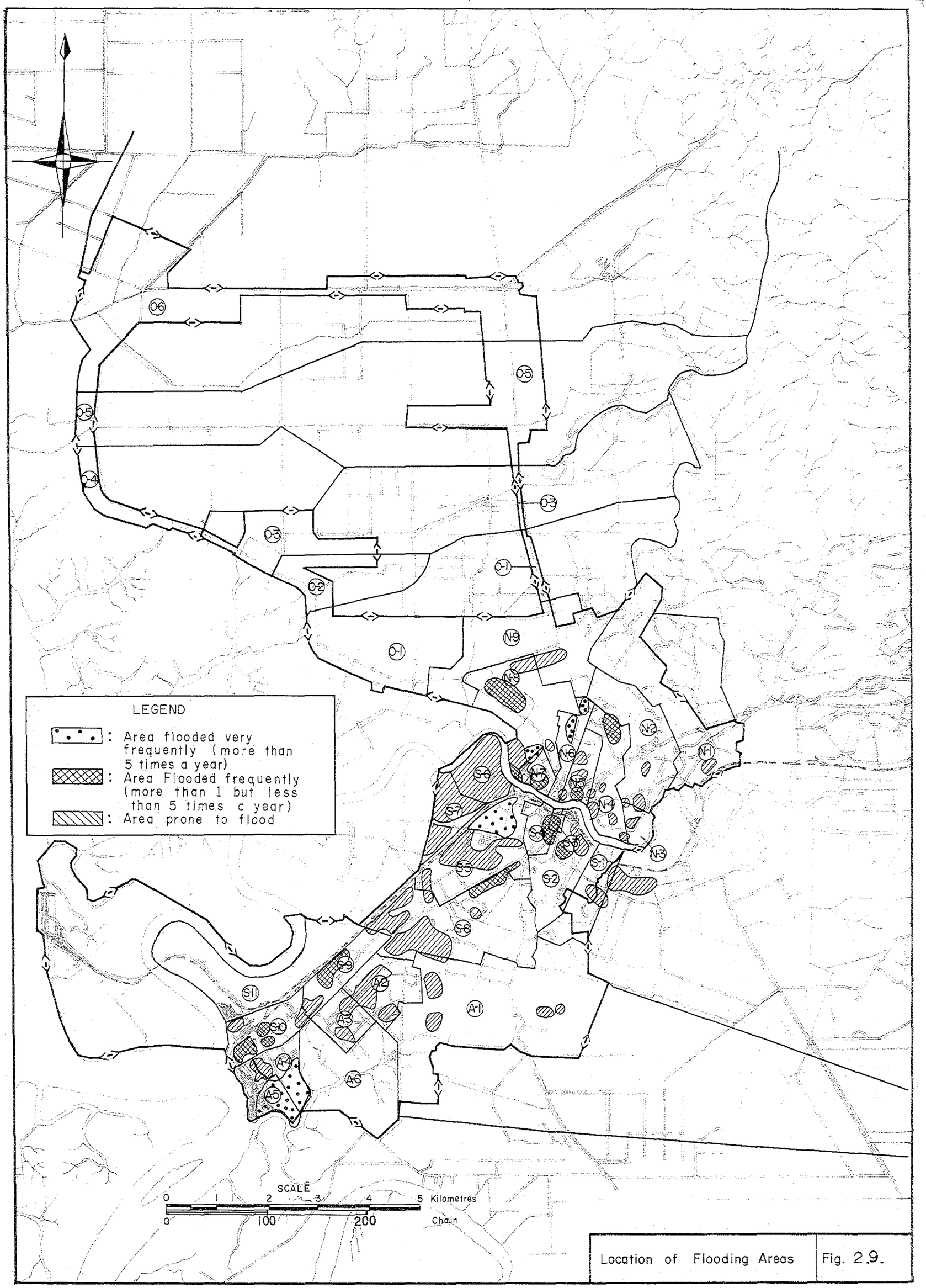
2.7.2. Drainage System

Since the construction some 30 to 40 years ago of the Kelang drainage system, consisting of bunds along both banks and a few tidal gates, the only changes which were made are the addition of several tidal gates.

However, when this system was constructed, limited allowances for further development, probably up to 10 years from the year of design and construction, were made in the planning and design. Also flow from the surrounding land, mainly agricultural, was only considered. It is assumed that the town area then considered might have been only about 5 or 6 km^2 the remaining being *Kampung* and agricultural land which is too limited compared to the present condition.

2.7.3. Flooding in the Project Area

As shown in Fig. 2.9, flood areas spread throughout the Area. Flooding in Kelang is presumably due to back-up of existing major drains, resulted from reduction in flow capacity caused by heavy silt of drains and high water levels of the River.



Location of Flooding Areas | Fig. 2.9.

2.8. Pollution in Watercourses

2.8.1. Pollution in Kelang River

The water quality of the Kelang River throughout the Project Area has deteriorated badly. Lack of facilities to provide sufficient removal of pollutants in the Project Area is considered to be one of the causes of this deterioration. In addition to the deteriorated stream quality, the significant amount of floating and deposited garbage and debris spoil the aesthetic pleasure that should normally be provided by the river.

However, a significant portion of the pollutants in the Kelang River undoubtedly originates in the cluster of such urbanized areas as Kuala Lumpur, Petaling Jaya and Shah Alam, located upstream of the Kelang River. Moreover, tidal effects in the Kelang River would also cause high pollutant concentration.

It might generally be said that the practical use of the Kelang River is minimal, including only a small amount of barge traffic to one or two industries along the river, the industrial water supply in a few factories, and the abstraction of water for cooling purpose by the Kelang Power Station outside the municipality at Connaught Bridge. Furthermore, due to the tidal effect and urban pollution, the river does not provide the public any aesthetic pleasure and the improvement of pollution in the Kelang River is considered to be one of the most important undertakings to be implemented.

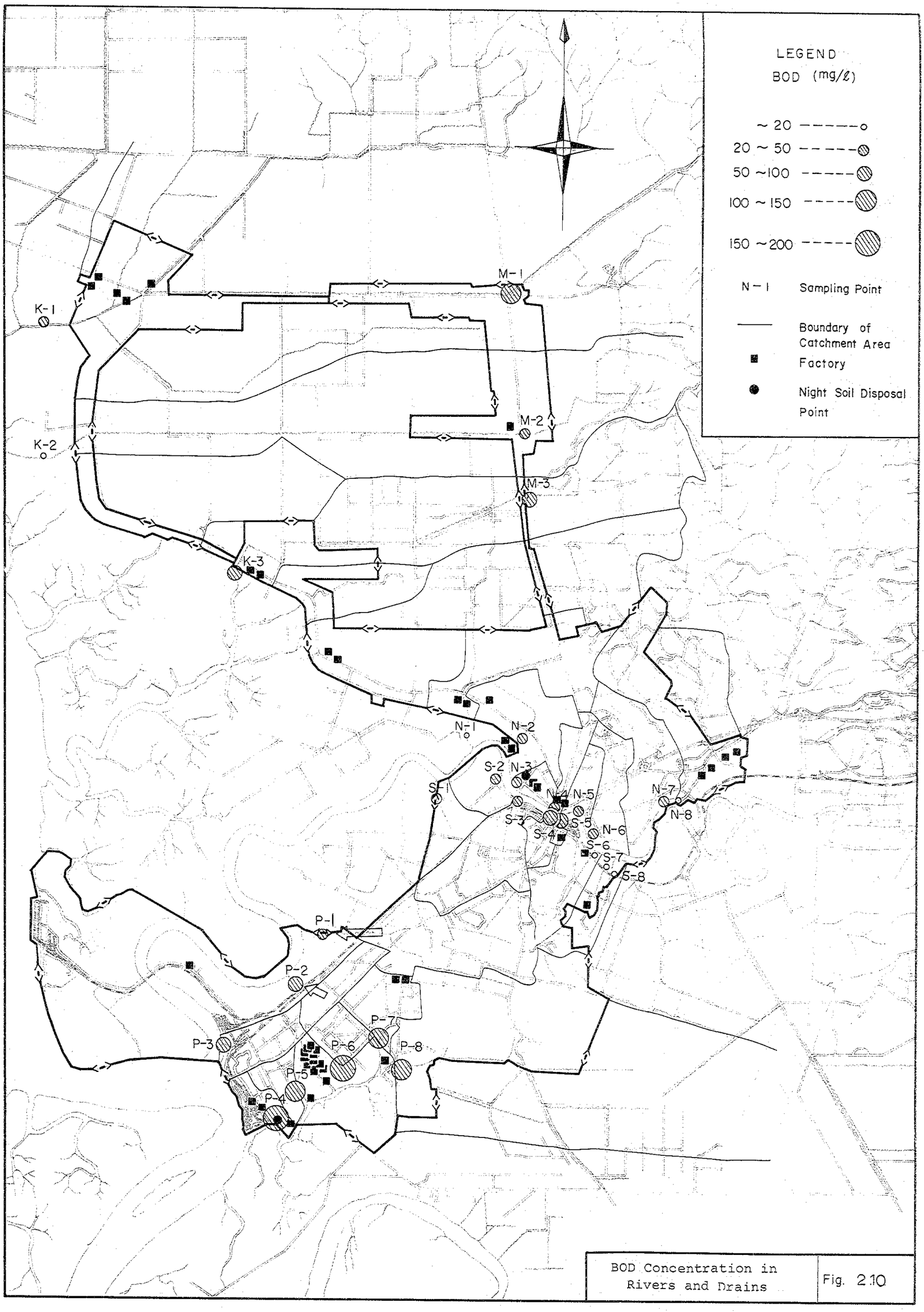
2.8.2. Pollution in Other Rivers and Drains

Since no data is available in the Project Area on water quality in the watercourses except for the Kelang River, sampling and analysis were carried out by the Study Team during the period of field surveys. Thirty sampling points were selected to evaluate water pollution conditions in the Project Area.

Sampling was carried out at ebb tide during water flow downstream in order to avoid any effect of sea water or Kelang River water. The results are summarized in Table 2.12 and Fig. 2.10.

High BOD and COD concentration were recorded at every sampling point, indicating that the watercourses in the Project Area are receiving high organic pollutants in general. The fact that the high BOD or COD concentration were obtained at points where outlet or discharge points for wastewaters from congested areas, are flowing into, indicates that these organic pollutants are of domestic and/or industrial origin. Location of factories listed in the Kelang Municipality records and night soil disposal points are also shown in Fig. 2.10. These facilities, as well as densely populated residential and commercial areas, are considered to be possible sources of organic pollutants.

In general, BOD concentration in excess of 10 mg/ℓ (which is obtained at each sampling point), indicates anaerobic condition of the water body, resulting in production of foul smell and even poisonous vapors. The lack of appropriate facilities to reduce pollutants before discharge of wastewater into the watercourses is considered to be the major cause of the deteriorated condition.



BOD Concentration in Rivers and Drains

Fig. 2.10

Table 2.10. Summary of Water Quality Investigation

Items \ District		Kelang North	Kelang South	Port Kelang	North Port	Kapar	Meru	Total
Number of Sampling Points		8	8	8	-	3	3	30
BOD (mg/ℓ)	Maximum	38	95	390	-	55	120	
	Medium	25	33	130	-	23	65	
	Minimum	15	13	35	-	15	30	
Number of Sampling Points with BOD in Excess of 50 mg/ℓ		0	2	7	-	1	2	12
COD (mg/ℓ)	Maximum	100	285	1,010	-	150	330	
	Medium	70	75	285	-	45	160	
	Minimum	35	30	90	-	35	95	
Number of Sampling Points with COD in Excess of 100 mg/ℓ		1	2	7	-	1	2	13

2.9. Review of Previous Study and Report

An outline of the major relevant report reviewed for this study is described below:

Kelang Sewerage Study (Prepared for the Government of Canada External Aid Office and the Government of Malaysia under the Auspices of the Colombo Plan, Prepared by Proctor & Redfern International Limited Consulting Engineers, October 1968)

The Town Council area of 2,914 ha at the time of study was covered in this study. Ultimate plans for the whole area were established to accommodate a future population of 324,000. Out of the whole study area, an area of 989 ha was designated as the "Phase I Scheme" for immediate implementation. Area, population and cost of the Phase I Scheme and the Ultimate Scheme are summarized in Table 2.11.

Table 2.11. Summary of Previous Study

Item	Phase I	Ultimate
Residential land served (ha)	-	3,955
Other urban land served (ha)*	-	2,510
Total urban area served (ha)	-	6,465
Population served	39,620	324,000
Capital cost trunk works (M$1,000)	14,618	35,970
Capital cost local sewers (")	6,746	55,450
Total capital cost (")	21,364	91,420
Annual O & M cost (M$1,000/year)	189	1,081
Annual allocation for repair services (" ")	59	275
Total annual cost (M$1,000/year)	248	1,356

Note: * e.g., commercial, industrial, public buildings, port reserve, etc.
All costs are at 1968 price levels.

A centralized sewerage system which covers the entire Project Area is recommended in this report. Sewage from all areas is collected by branch sewers and lifted by pumping stations to be transferred to trunk sewers then conveyed to a disposal point. A number of pumping stations, small and large, are required because of the flat terrain of the area. There are a total of 66 small pumping stations and six large ones.

Marine disposal to Kelang Strait without treatment is recommended. Proposed disposal site is located south of North Port. Sewage collected for a major pumping station in Port Kelang is conveyed by 4 km length force main and discharged by outfall pipe of 900 mm diameter and 900 m length, laid on the bottom of the Kelang Strait.

Proposed sewerage facilities, such as trunk sewers, force mains, pumping stations and an outfall, for Phase I and Ultimate stages are summarized in Table 2.12.

Table 2.12. Sewerage Facilities Proposed in the Previous Study

Item	Phase I	Ultimate
Total Length of Trunk Sewers, Diameter 300-1,650 mm, (m)	21,400	70,300
Total Length of Force Main, Diameter 150-900 mm, Excluding Outfall, (m)	8,700	34,600
Outfall - Land Section (m)	4,000	4,000
- Marine Section (m)	900	900
Number of Pumping Stations		
- Large (capacity greater than 0.2 m^3/sec)	3	6
- Small	6	66

The scheme proposed for the system in this study is considered as one of the alternatives for the Master Plan, and is presented in Chapter 5 of the current report.

CHAPTER 3

POPULATION PROJECTION AND LAND USE PLAN

CHAPTER 3 POPULATION PROJECTION AND LAND USE PLAN

3.1. Population Projection

3.1.1. Kelang District

In order to project the future population in the Project Area up to the year 2000, population in the Kelang District is first estimated. Data from the 1947, 1957, 1970 and 1980 Population Census are used, for which population in West Malaysia, Selangor State and Kelang District are available. However, population in the Project Area requires to be identified from the above data and forecasted because of the difference between Kelang District and the Municipal Council area.

The following four methods (detailed descriptions for each method are presented in Appendix A, Vol. IV) are adopted to estimate future population:

a) Projection based on annual growth rate
b) Projection based on regression curve
c) Projection based on ratio to West Malaysia population
d) Projection based on ratio to Selangor State population

Results of these projections are summarized in Table 3.1., showing variations in projected population from 560,000 to 590,000 in the year 2000. Taking into account this small deviation in the projections, it is considered reasonable to adopt the median of the four projected figures; i.e., 580,000, as the projected population for the Project.

Table 3.1. Population Projection for the Kelang District

Year	Methods			
	(a)	(b)	(c)	(d)
1980	284,941	284,941	284,941	284,941
1990	410,000	400,000	400,000	410,000
2000	590,000	570,000	560,000	590,000

3.1.2. Urban Area in the Kelang District

Population in the Project Area in 1980 is obtained from preliminary field count summaries of the 1980 Census of the Statistic Department as 205,630, while population of the Kelang District is 284,941, according to the 1980 Census report. This would mean that 79,311 population is distributed outside the Project Area, which is considered to be rural area where population growth is likely to be very slow even in the future. Therefore, it is assumed that there will be no significant change in the rural population of about 80,000 up to the year 2000. Consequently, by subtracting 80,000 out of the projected 580,000 for Kelang District, the rest of the population in the area, which might be termed as Urban Area inclusive of the Project Area, against the above referred rural area is calculated as 330,000 and 500,000 for the years 1990 and 2000 respectively.

Population projection based on the above-mentioned procedure is shown in Table 3.2. up to the year 2000.

Table 3.2. Population Projection in the Urban Area

Unit: persons

Year	Kelang District	Urban Area	Rural Area
1980	284,941	205,630	79,300
1990	410,000	330,000	80,000
2000	580,000	500,000	80,000

It should be noted that a projected urban population figure of 350,000 in 1990 is used in other studies, such as the Kelang Valley Review (Kelang District population is estimated as 344,600 in 1980 and as 511,700 in 1990) and the State FMP, and that this was brought up and discussed with the Government officers concerned. However, the projection shown in Table 3.2. is considered to be more realistic for the purpose of Project planning for the following reasons:

i) Data from 1980 Census was not available for the other studies, and over-estimation of population in the Kelang District is obvious.

ii) Target year of the Master Plan is the year 2000, and the planning of the sewerage and drainage facilities will be based on a projected population of 500,000. Therefore, the discrepancy in the projected figure of 20,000 in 1990 is considered to be insignificant from the planning point of view.

3.1.3. Project Area

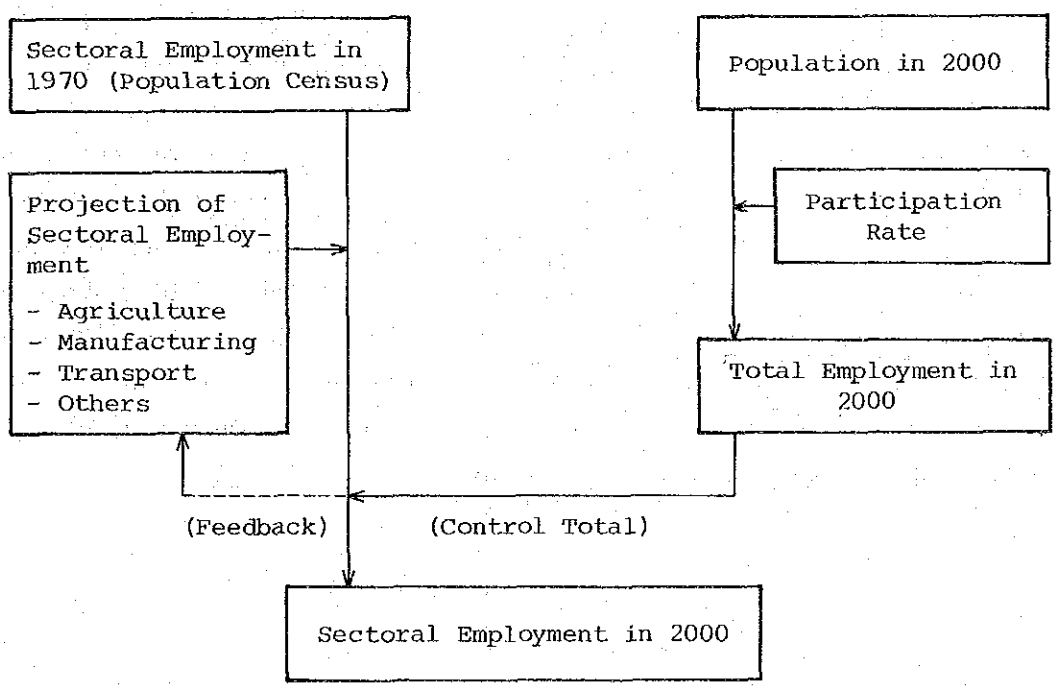
From the analysis stated above, it is obvious that the population of the Urban Area in Kelang District coincides with that of the Project Area in 1980. However, as the urbanization progresses and the population increases accordingly as estimated in the future, the Urban projected population figures are expected to exceed that of the Project Area, which is limited to an aera of 7,669 ha. Therefore, land use plan, which can accommodate the entire projected urban population of 500,000, is to be developed to cover not only the Project Area but also surrounding areas. This is to form the basis for estimating the Project Area population. Result of the projection is shown under Section 3.4. "Population Distribution" of the present Chapter based on the land use plan.

3.2. Employment Projection

3.2.1. Urban Area

Based on the Population Census conducted in 1970 together with the projected population presented in the last section, the sector-wise employment projection in the Urban Area in 2000 is considered to provide basis for future land use planning. Firstly, employment population in each sector is estimated independently by using various related factors, including land use and productivity projected in such other plans as Kelang Valley Review and State FMP. On the other hand, total employment population in the year 2000 is separately estimated as control total, based on the projected population and participation rate. The independently estimated sectoral employment total is then adjusted to the control total to arrive at the final employment population in each sector. The projection method outline is presented in the following chart.

Fig. 3.1. Sectoral Employment Projection Method in the Urban Area



The details on "Participation Rate," "Total Employment in 2000," and "Projection of Sectoral Employment" in the above chart are tabulated in Appendix A, Vol. IV: Population Projection and Land Use. Sectoral employment for the Kelang District and the Urban Area in 2000 is summarized in the following Table 3.3.

Table 3.3. Sectoral Employment in the Year 2000

Sector	Kelang District				Urban Area	
	1970		2000		2000	
	No. of Employees	Percentage	No. of Employees	Percentage	No. of Employees	Percentage
Agriculture, Forestry and Fishing	13,361	22.7	11,000	4.9	1,000	0.5
Mining and Quarrying	36	0.0	-	0	-	0
Manufacturing	14,432	24.5	89,000	39.4	81,000	41.5
Construction	1,964	3.4	8,000	3.5	7,000	3.6
Electricity, Gas and Water	841	1.4	3,000	1.4	3,000	1.5
Transport, Storage and Communications	9,796	16.6	43,000	18.9	38,000	19.5
Wholesale and Retail Trade	7,900	13.4	31,000	13.7	28,000	14.4
Services	10,567	18.0	41,000	18.2	37,000	19.0
Total	58,897	100.0	226,000	100.0	195,000	100.0

Source: 1970 Population Census

3.2.2. Project Area

For the same reason as described in the Section 3.1.3., "Population Projection," the employment projection for the Project Area is presented under Section 3.4. "Population Distribution."

3.3. Land Use Plan

3.3.1. Demand for Space in the Year 2000

1) Calculation of Land Use by Category

Demand for space of each land use category is worked out based on the following procedures.

a) Residential

To calculate the space for residential area, total projected population of 500,000 in 2000 is fully taken into account. Average population density in typical new housing schemes is estimated as 120 persons/ha. Taking into account the variation of population densities existing in the Project Area, population density of 100 persons/ha is considered to be a realistic estimate for calculating generally future space demand.

b) Industrial, Commercial and Institutional

To calculate required land space for industrial, commercial and institutional use, the number of sectoral employment as well as total population are used.

2) Summary

Additional land requirement is estimated based on the existing land use and future demand for space. Detailed calculations are tabulated in Appendix A: Population Projection and Land Use, and summarized in Table 3.4.

Table 3.4. Demand for Space in the Year 2000

Land Use Category	Requirement in 2000	Additional Requirement (1980 - 2000)
Residential Area	5,000 ha	3,400 ha
Industrial Area	2,000 ha	1,300 ha
Commercial Area	280 ha	190 ha
Institutional Area	600 ha	370 ha

3.3.2. Conceptual Development Pattern

Three alternative patterns are developed to identify desirable future development policy in order to cope with the space demand in 2000. These are (1) concentric pattern, (2) polycentric pattern and (3) linear pattern, as shown in Fig. 3.2. to Fig. 3.4. Relevant development projects (such as industrial, commercial and housing development and expressway, which are described in Section 2.3.2.), as well as present land use, are taken into account to develop these three alternative plans. Descriptions of these patterns are as follows:

1) Pattern A: Concentric Pattern

This Pattern will accelerate the concentration of urban facilities to Kelang North and Kelang South. Port Kelang, Kapar and Meru will remain as independent urban centers. The disadvantage of this Pattern is that it may create traffic congestions, particularly in the center of the Kelang town area because of the Kelang River flowing across the area. (Ref.: Fig. 3.2. Pattern A.)

2) Pattern B: Polycentric Pattern

This Pattern has the advantage of accelerating the growth rate of the less-developed districts; i.e., Kapar and Meru. However, as the Pattern calls for a development program for four different areas, which will cause problems concerning investment efficiency, it is therefore not advis-

able to be applied for Project planning at present. However, this pattern should be considered on a long-range basis in the future after certain development of urban functions in the Project Area. (Ref.: Fig. 3.3. Pattern B.)

3) Pattern C: Linear Pattern

This Pattern will accelerate the functional composition of the Project Area based on three axes; i.e., 'Industrial Axis', 'Urban Axis' and 'Reserve Axis'. Linear pattern in general is considered to promote rapid urbanization, thus favorable for the area where rapid development is anticipated. Taking into account the size of the urban area and its population and the rapid development progress taking place in the Project Area, pattern C is considered to be the most suitable for determining land use plan. (Ref.: Fig. 3.4. Pattern C.)

Fig. 3.2.

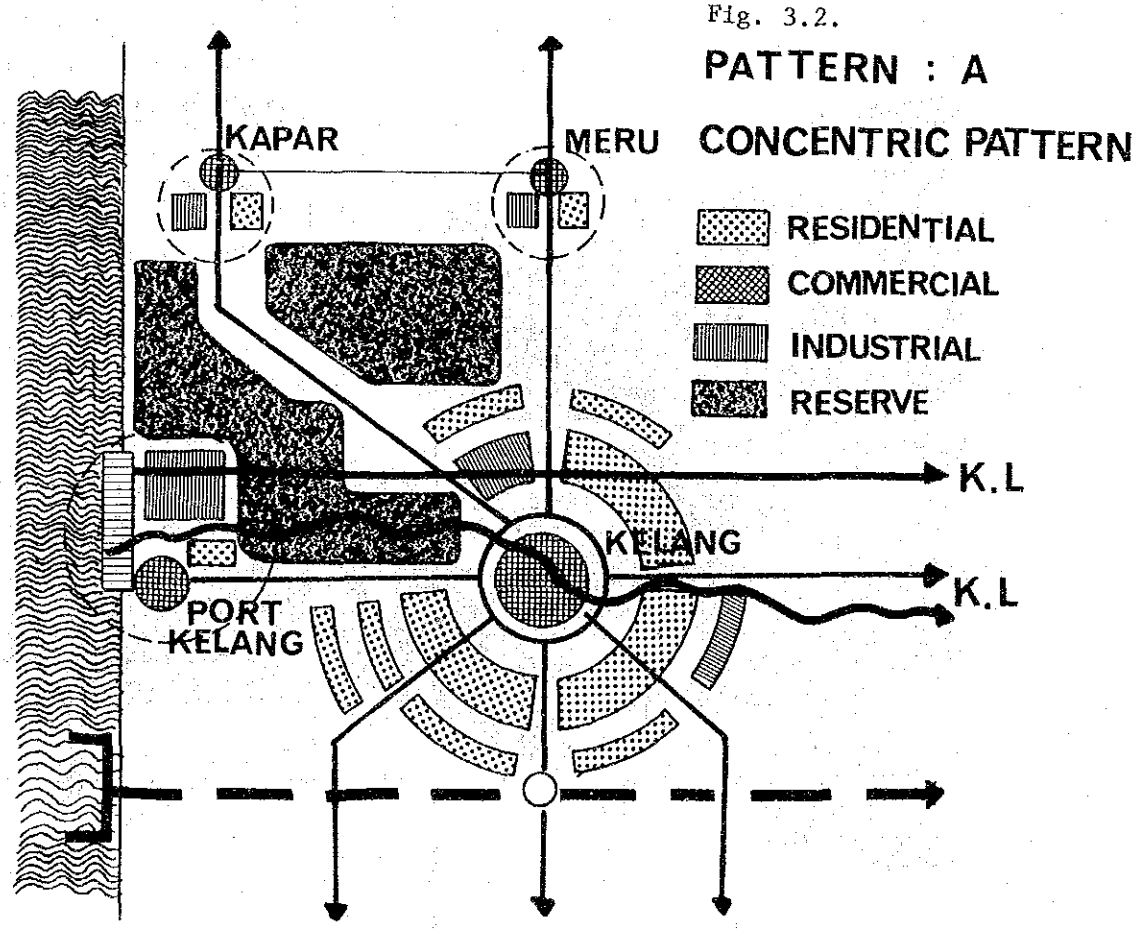


Fig. 3.3.

PATTERN : B

POLYCENTRIC PATTERN

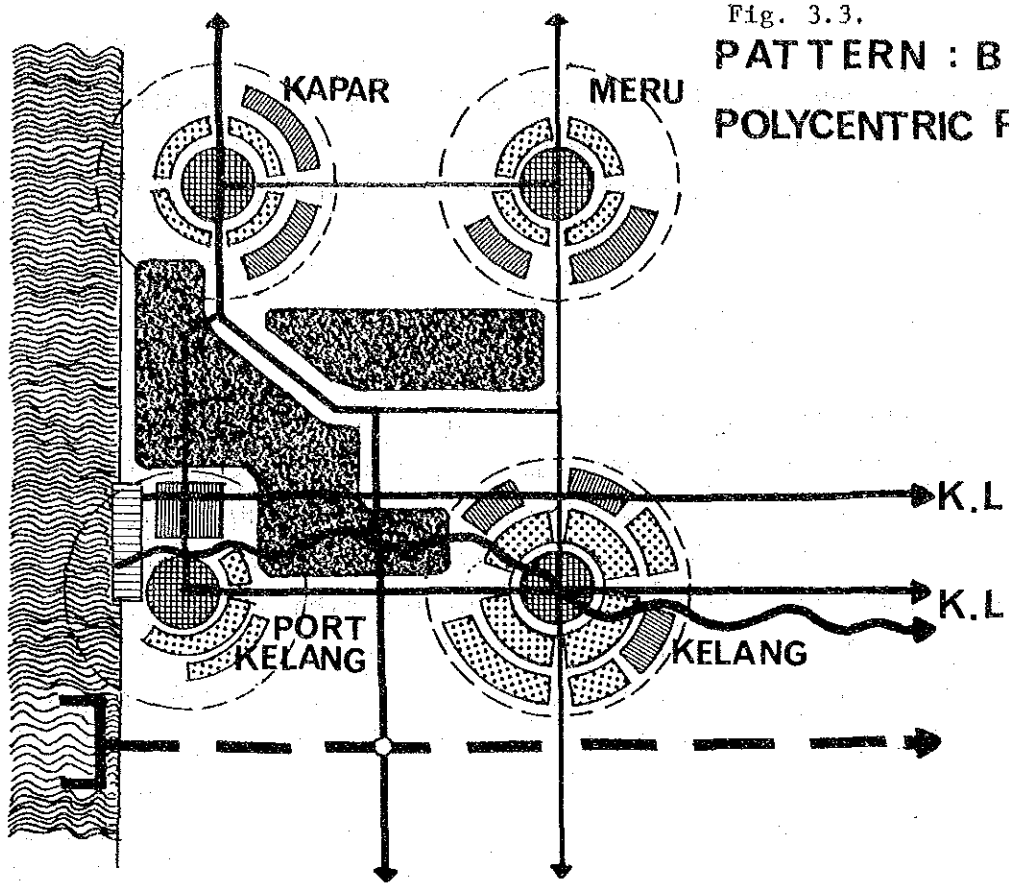
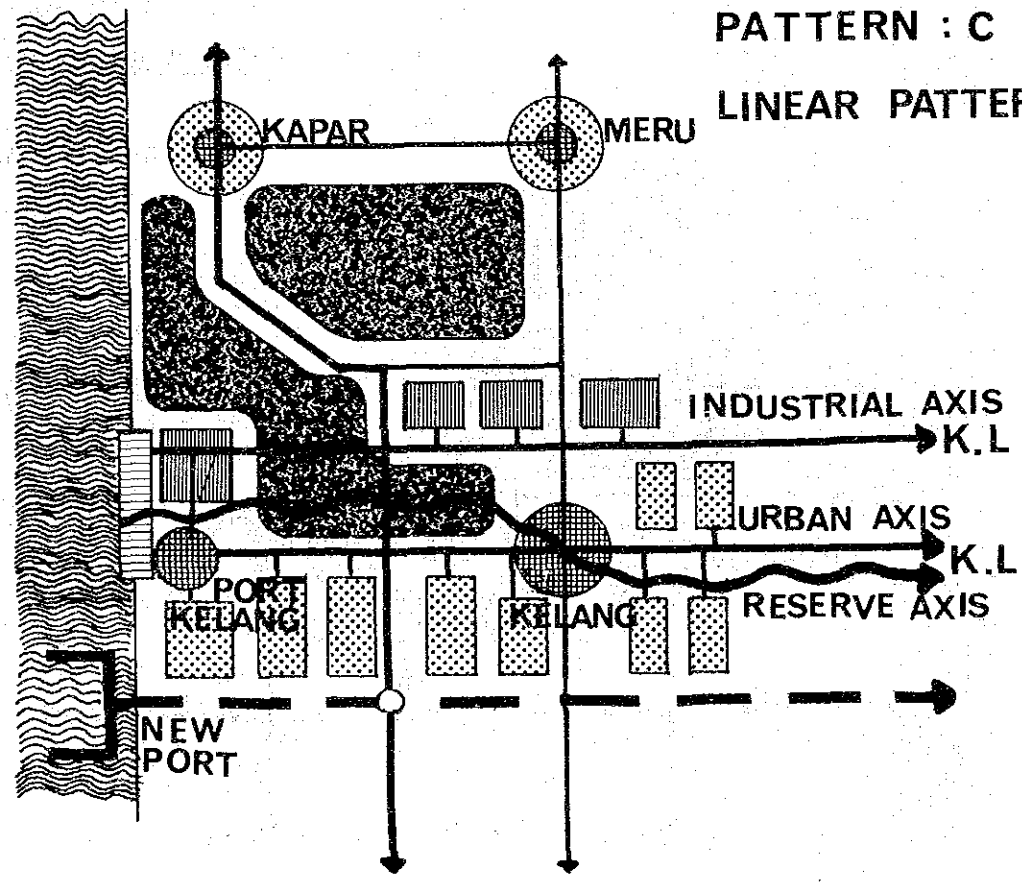


Fig. 3.4.

PATTERN : C

LINEAR PATTERN



3.3.3. Land Use Plan in the Year 2000

1) Allocation of Space

Taking into account the Conceptual Development Pattern C and the land requirement in the year 2000, the future land use plan is shown in the following Fig. 3.5.

a) Basic Policy

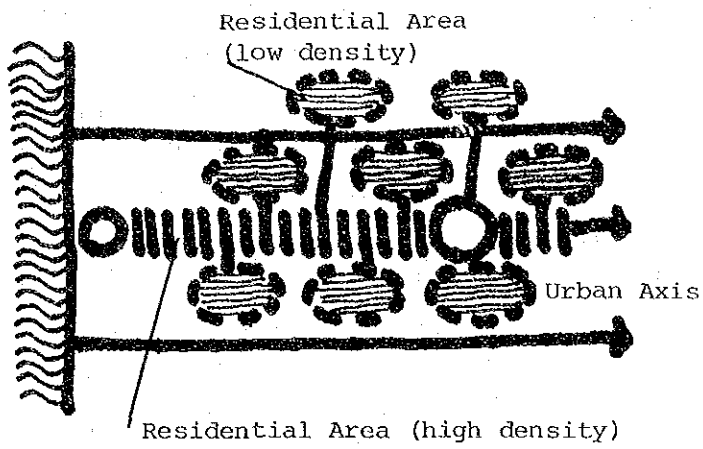
On the basis of the above consideration, the demand for space, including desirable open space and vacant land in the urban area, is estimated at about 10,000 ha in the year 2000, which exceeds the Project Area of 7,669 ha by nearly 3,000 ha. This figure is allocated for the Project Area on the basis of Conceptual Pattern C and taking into account the current trend of urbanization. Accordingly, present urbanization is expected to extend to the Malay Reserve adjoining the Project Area, and future urbanization to take place between the North and South expressways under this pattern.

On the other hand, the Project Area which was determined on the basis of agreement between the Malaysian Government and the Japanese Government excludes somes small parts of the present developing area but includes the rural areas surrounding Kapar and Meru. However, urbanization is not expected to take place in either Kapar or Meru, being located above the North Expressway, which forms the upper boundary of the future urbanization area.

Therefore, it is considered reasonable that the northern part of the Project Area should be allocated for open space or for agricultural land but not for urban area. Instead, the Malay Reserve adjoining the Project Area is recommended to be allocated for the urban area.

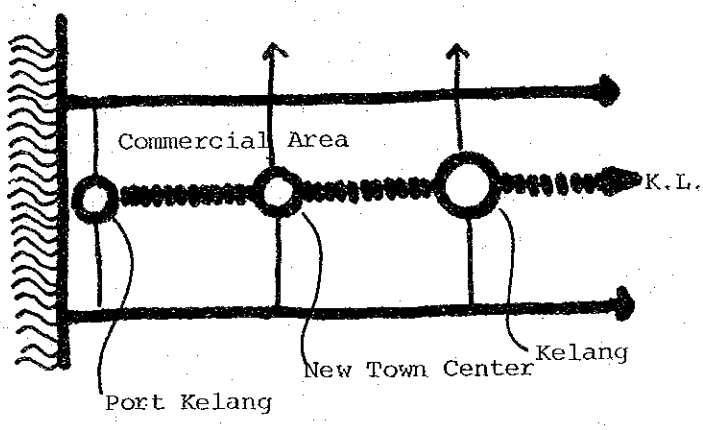
i) Residential Area

The residential areas are allocated in connection with the Urban Axis; i.e., federal Route II.



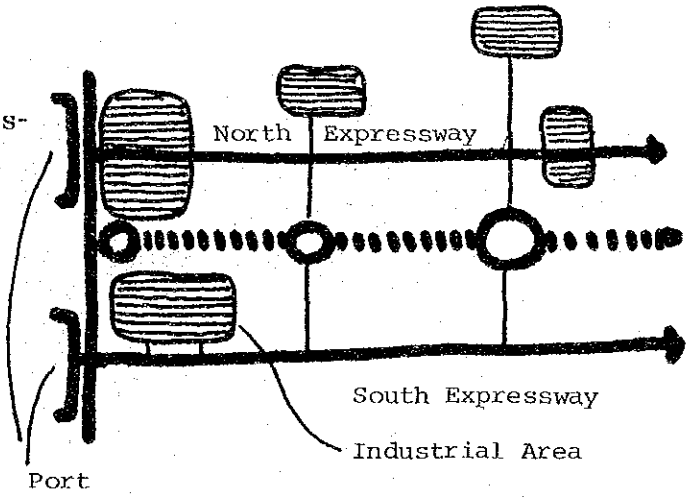
ii) Commercial Area

The commercial areas are allocated along the Urban Axis, especially the new town center which is planned between Kelang and Port Kelang.



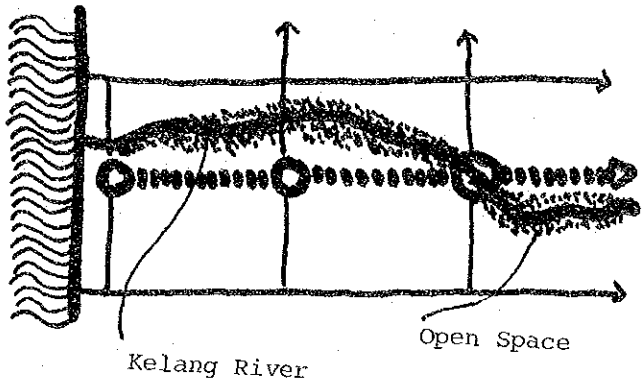
iii) Industrial Area

The industrial areas are allocated in connection with North Kelang Straits Expressway and South Expressway.



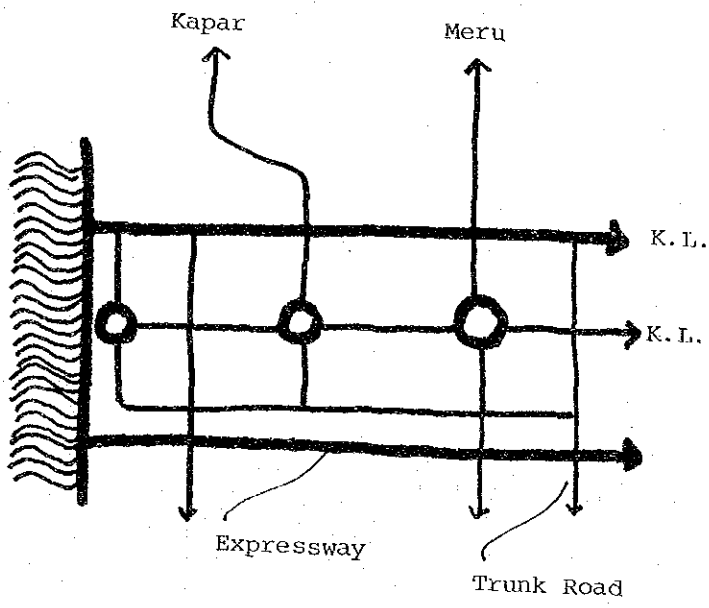
iv) Open Space

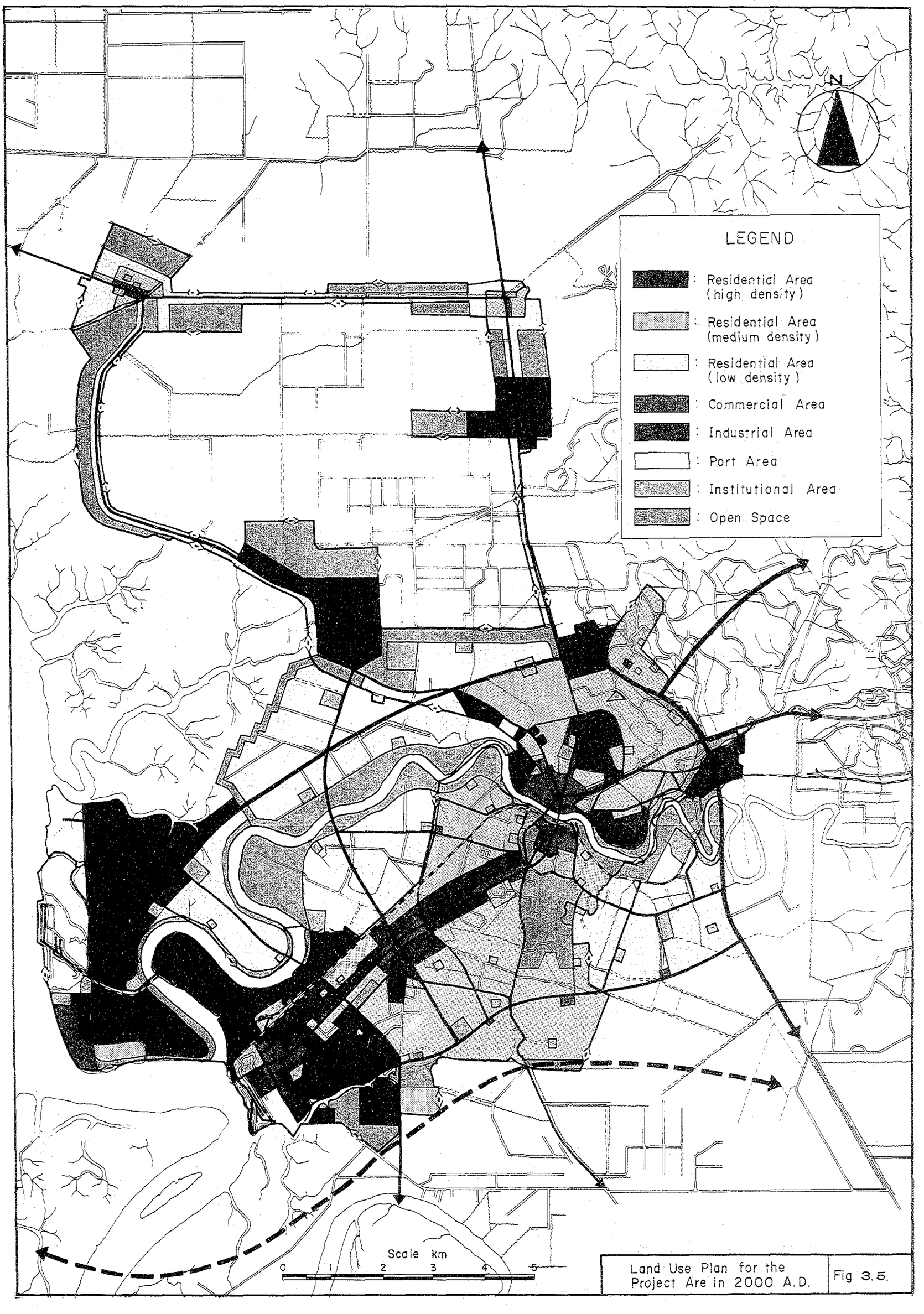
The open spaces are allocated along the Kelang River.



v) Road Network

The road network of the Project Area is composed of the grid pattern.





Land Use Plan for the Project Are in 2000 A.D.

Fig 3.5.

2) Future Land Use

On the basis of the land use plan shown in Fig. 3.5., details of the areas to be allotted for various land use purposes are tabulated in Table 3.5, followed by further details on population distribution.

Table 3.5. Future Land Use

	Urban Area	Project Area	Outer Area
Residential	5,000 ha	3,200 ha	1,800 ha
Commercial	280	275	5
Industrial	2,000	1,530	470
Port Area	400	280	120
Institutional/ Government	600	450	150
Open Space/ Agriculture/ Vacant Land	2,520	1,934	586
Total	10,800	7,669	3,131

(Note: Urban covers total projected population of 500,000 in 2000 for different land use purposes as indicated. Project Area shows allocation of the same purposes in the Project Area and the rest under Outer Area.)

3.4. Population Distribution

3.4.1. Population Distribution

The projected future population of the Urban Area is distributed over the Project Area on the basis of the land use plan. The method of distribution is based on the following criteria of population density:

Residential area (low density):	60 persons/ha
Residential area (medium density):	100 persons/ha
Residential area (high density):	150 persons/ha
Commercial area:	120 persons/ha

The present population density of corresponding areas in the Project Area is used to determine the above figures.

The average population density of the residential area is 120 persons/ha, including the squatter residents and about 100 persons/ha, excluding the same. The population density for the residential area of medium density is therefore determined to be 100 persons/ha.

The present population densities of central areas in Kelang North, Kelang South and Port Kelang range from 130 persons/ha to 180 persons/ha Accordingly, the figure for the residential area of high density is set at 150 persons/ha.

From the present population densities of Kelang environs, which range from 30 to 80 persons/ha, the population density for the residential area of low density is determined to be 60 persons/ha.

The present population density of the commercial area is approximately 150 persons/ha. Since the tendency to separate the residence from the workplace is expected to accelerate in the future, the figure for the commercial area is fixed at 120 persons/ha.

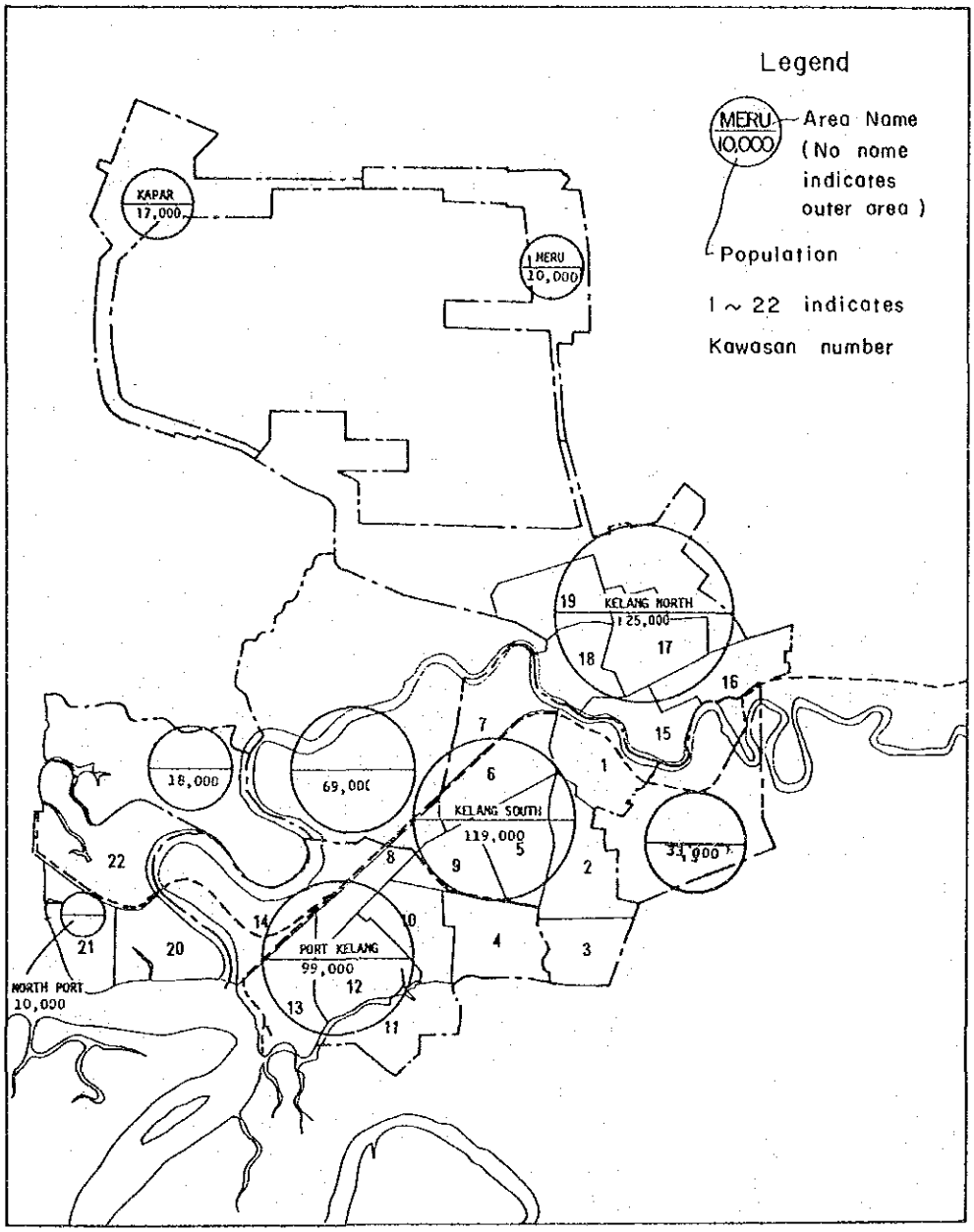
Since few resident is expected in such areas as industrial, port area, institutional and open space, population density in these area is considered to be negligible.

On the basis of the above-mentioned figures, the following are calculated for population distribution projection of the Project Area in the year 2000. (Ref.: Table 3.6. and Fig. 3.6.)

Table 3.6. Population Projection for the Project Area in the year 2000

Area	Population in 2000
Project Area	380,000 persons
Outer Area	120,000 persons
Urban Area	500,000 persons

Fig. 3.6. Project Area Population Distribution in the Year 2000



3.4.2. Employed Population at Place of Work

1) Projection for the Year 2000

The projected number of employed population in the industrial sector is distributed over the corresponding areas in the Project Area, based on the land use plan.

a) Agricultural Sector

The number of employed population in the agricultural sector is 1,000 workers in the Urban Area. This figure is distributed over the agricultural area of the Project Area. Accordingly, the agricultural population in the Project Area is calculated to be 700.

b) Manufacturing Sector

The number of employed population in the manufacturing sector is 81,000 in the Urban Area. This figure is distributed over the industrial area in the Project Area. Through the projection process the manufacturing population in the Project Area is calculated to be 60,500.

c) Construction Sector

The number of employed population in the construction sector is 7,000 in the Urban Area. This figure is distributed over the commercial areas in the Project Area. Through the projection process, the number of construction workers is calculated to be 6,900.

d) Electricity, Gas and Water Sector

The number of employed population in the electricity, gas and water business is 3,000. This figure is distributed over the institutional areas in the Project Area. Through the projection process the number of workers in this sector is calculated to be 2,200.

e) Transport, Storage and Communications Sector

The number of employed population in the transport, storage and communications sectors is 38,000. This figure is distributed over the commercial areas and the port areas in the Project Area. Based on this process, the projected employed population in this sector is calculated to be 33,000.

f) Wholesale and Retail Trade Sector

The number of employed population in the wholesale and retail trade sector is 28,000 in the Urban Area. This figure is distributed over the commercial areas in the Project Area. Through the projection process, the number of workers in this sector is calculated as 27,400.

g) Services Sector

The number of employed population in the Urban Area in this sector which is 37,000, is divided into those employed in private services and those in public services, with the former distributed over the commercial areas and the latter distributed over the institutional areas. The number of workers in this sector is therefore calculated to be 34,400 for the Project Area.

2) Summary

On the basis of the above-mentioned distribution of the sector-wise employed population, the projected number of employed population of the Project Area as a whole is calculated to be as follows:

Table 3.7. Employed Population in the Year 2000

Area	Employed Population in 2000
Project Area	165,000 workers
Outer Area	30,000 workers
Urban Area	195,000 workers

Distribution of employed population in the Urban Area is shown in Fig. 3.7.

Fig. 3.7. Distribution of Employed Population in the Urban Area