3–6 PARKS AND OPEN SPACES

3-6-1 The Green Axis and the Green Belt

The Green Axis is a symbolic zone which provides for social activities by accommodating schools and football grounds as well as conserving the existing green. In contrast to the densely populated residential areas, it will be an area with a lot of greenery. Functionally, it not only divides the Planning Area into three sectors, but, at the same time, binds the divided area through its network of major footpaths which run along the wooded area and also run across them. Out of the two axis, the one to the north runs parallel with a river and includes the riverbank. The other to the south is a main axis which connects with both the town centre and the central park. In addition, both the axes connect onto the Green Belt to the east.

This Green Belt has been specified in the masterplan of Jakarta as a recreation zone, and is a part of a strip of land which runs from the hill land, in the west of Jakarta, to the coastal region. To put it in another way, the Green Axes are continuations of the recreation zone which protrude perpendicularly from the Green Belt. The width of the Green Belt, including the river which runs through it, is 100m, and it can also act as a control pond at times of flood.

EXISTING GREEN BELT

The Green Axis are presently inhabited by farmers, and some parts may be used as fields. It is also a condition of the project that these local inhabitants may be able to move into the new residential areas. It is for these reasons that the empty lots will be sold without restricting the trade and

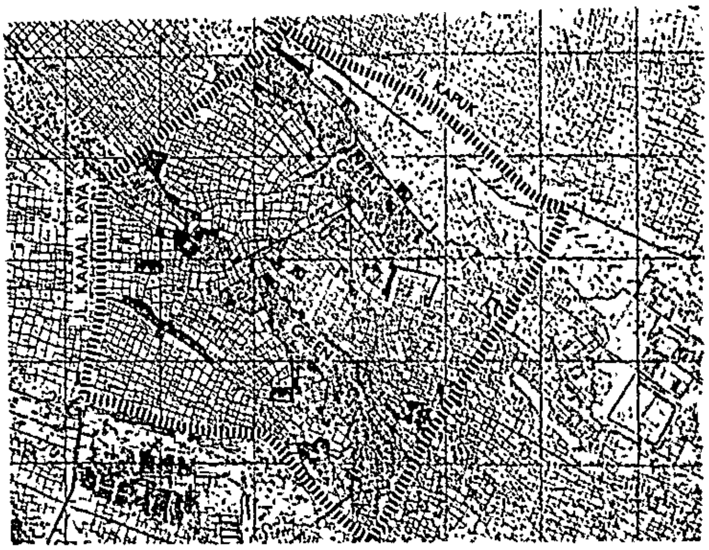


Fig. 3-22 EXISTING GREEN

domestic industry taking place on them. The Kampung Improvement Programme is one of the effective method for it. If the inhabitants do not readily move out of the present habitat, the structuring of the Green Axis will not be easy, and so it is vital that they receive the greatest assistance in securing new employment.

3-6-2 Waterside parks, central park

Along with the construction of the Cengkareng Floodway a drainage canal - collector drainage- is being planned for this area. The width of the canal is to be about 18 meters. As mentioned in the previous section on open areas, this waterway will not only be used for drainage of water but its banks will be used as waterside parks, functioning as a part of the surrounding facilities.

It is also hoped that the micro-drainages flowing into the collector drainage can be utilized as part of open space. Use of the water does not necessarily have to be solely for the park, but can also be a means of small scale transportation to the Java Sea.

In addition to these parks as regional parks, a central park will be established as part of the Town Centre. This park will have different urban characteristics and atmosphere compared to the others.

In addition to these, there will be one or more football grounds and play lots etc. to each or group of neighbourhood unit.

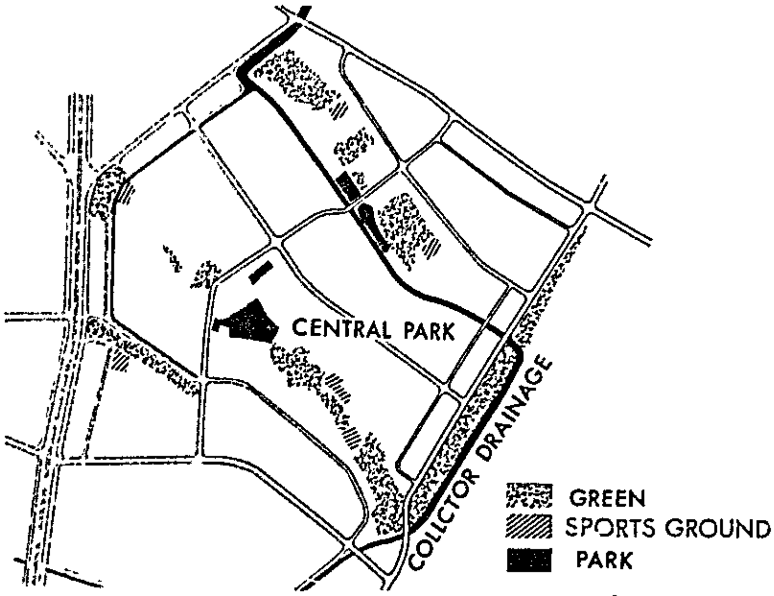


Fig. 3-23 PARK AND OPEN SPACE PLAN

3–7 PHASING

3-7-1 Assumed phasing methods

Out of the 370ha Planning Area, the land acquired so far is the 120ha shown in Fig. 3-24.

Most progress has been made in acquiring land in the paddy-field area between the two Green axis. The northern sector of the Planning Area and the wooded area still hold many inhabitants.

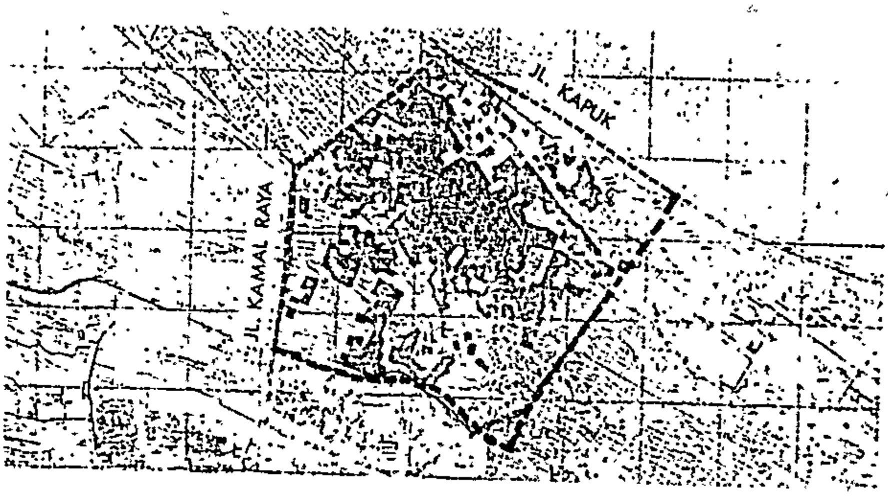


Fig. 3-24 AQUISITED LAND MAP

As a desirable form of phasing, the details of the project should be adapted to continue development of the area, taking into account the current situation as regards to acquisition and condition of roads and land.

The project plans to use the existing Kapuk Street as the main access road, so the natural course would be to expand northward into land which is close to Kapuk Street. However, acquisition in this area has not progressed, and with many existing villages, cannot be taken as a suitable starting place. Therefore, it will probably be more appropriate to commence from the middle of the Planning Area (the surrounding area of which acquisition has already progressed). This region mostly consists of paddy-fields, and if the connection of acquired land takes place smoothly, it will total 110ha within which only 20% is still not to be acquired. (Fig. 3-31) The shape of the land is almost rectangular, measuring 1.5km by 0.7km, which is a suitable size for a residential area. In addition, its location in the middle of the Planning Area will allow expansion into any direction and so has flexibility. Therefore this central region will be the area for phase 1 operations.

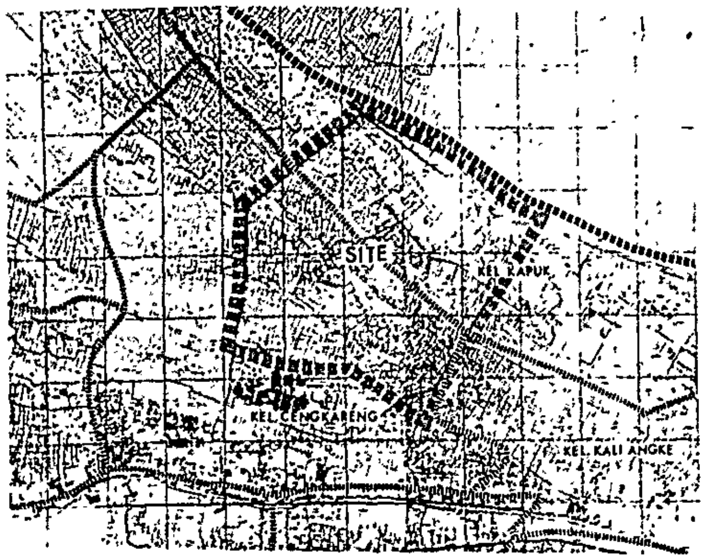


Fig. 3-25 THE PLANNING AREA AND THE ADMINISTRATIVE BOUNDARY

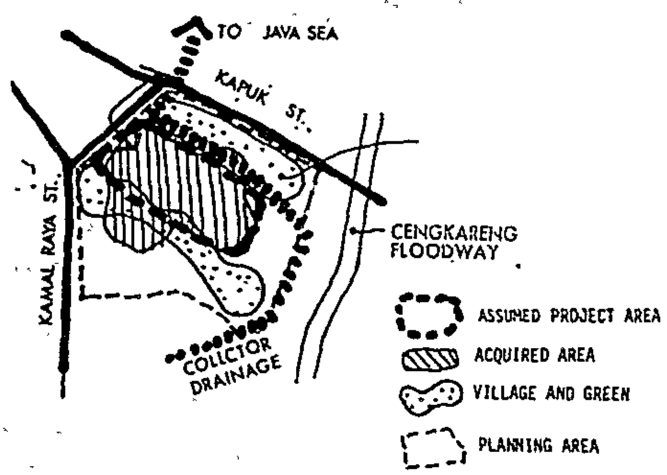


Fig. 3-26 FIRST DEVELOPMENT AREA

There are three alternatives for the direction of phase 2 operations (see Fig. 3-27). Area B locates to the direction of extending the main road of phase 1 and operations can continue on it as long as the acquisition progresses. Area C will be the most effected by the first stage project since it is closer than A to the location of the Town Centre. The current land use is also mostly for rice cultivation and, if its acquisition is successful, development should not be difficult. However, by using Kamal Street, the area can be developed privately, and with access to the various facilities developed in phase 1, acquisition will possibly be difficult. In any case, since these two areas will be developed faster and in larger scale because, compared to A, land acquisition in these two areas will be done easily.

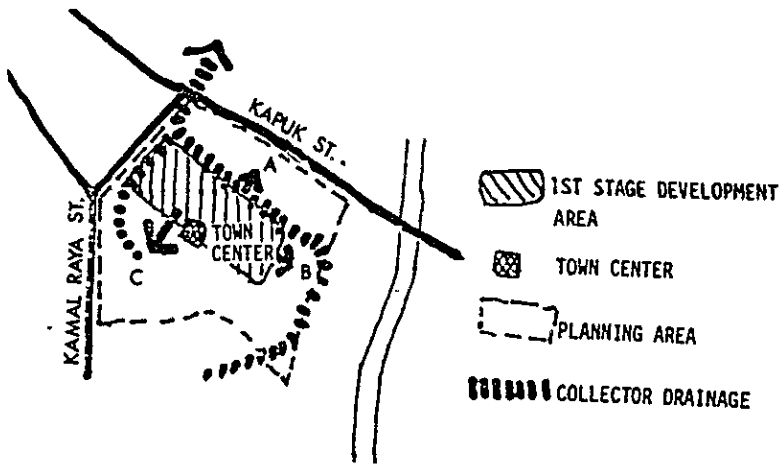


Fig. 3-27 SECOND DEVELOPMENT AREA

Area A has scattered villages where partly "sprawl" development is advanced. Being close to Kapuk Street, it may be considered that there is a strong need for its development, but it can also be said that acquisition is difficult. It is desirable that, based on the already acquired land, road school and other community facilities will be constructed inducing effectively private developments of the area and work should start as soon as possible, and confusion should be avoided in the area.

From the above mentioned points, it can be said that A is the area where the development is most urgent but B and C areas are suitable for second development area because their land-acquisition is easier compared to A. Taking into account that the main implementing body is PERUM PERUMNAS, who is concerned in developing housing areas, it can be concluded that the project should be carried out in the order of B, C, A.

3-7-2 Phasing plan

The development will be carried out in three stages.

Stage 1 will be in the central sector of the Planning Area which covers 110ha including a part of the Town Centre. It will produce several neighbourhood units along a primary road, to be constructed off Kamal Street. This will create a balanced residential area, despite it being the first stage, and the roads and facilities will be laid out in such a way that will not hinder future expansion. It will be assumed that the collector drainage system will be installed prior to this project. The sector in which this first stage will take place will be called as the "Project Area".

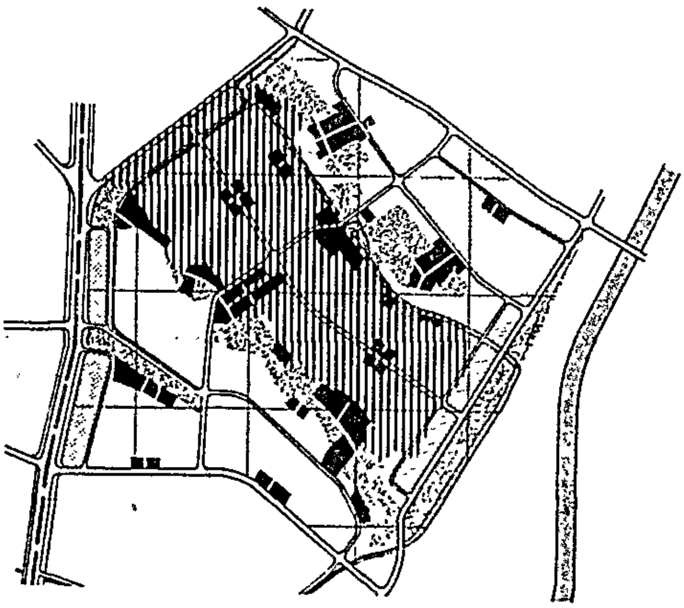


Fig. 3-28 FIRST PHASING- THE PROJECT AREA DEVELOPMENT

Stage 2 will develop a 20ha section(B) east of the Project Area and about 40ha section (part of C) which extends south wards from the Town Centre. The latter section is within the of the collector drainage for the west side of the Project Area. With this, all the areas along Kamal Street will have been developed. It is hoped that the inhabitants of the Green Axis between the Project Areas for stage one and two, will have moved, due to developments in stage 1.

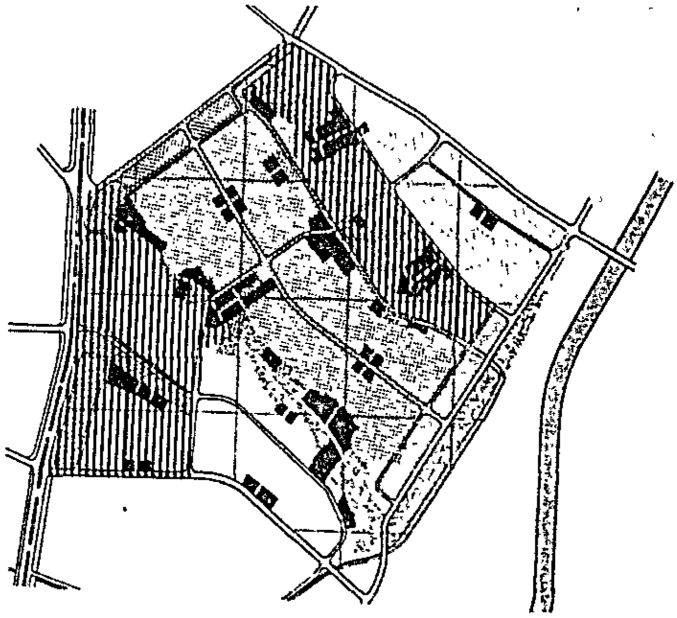


Fig. 3-29 SECOND PHASING

Stage 3 will take place parallel to the city road construction from Kamal street. The collector drainage system will also be completed in this stage.

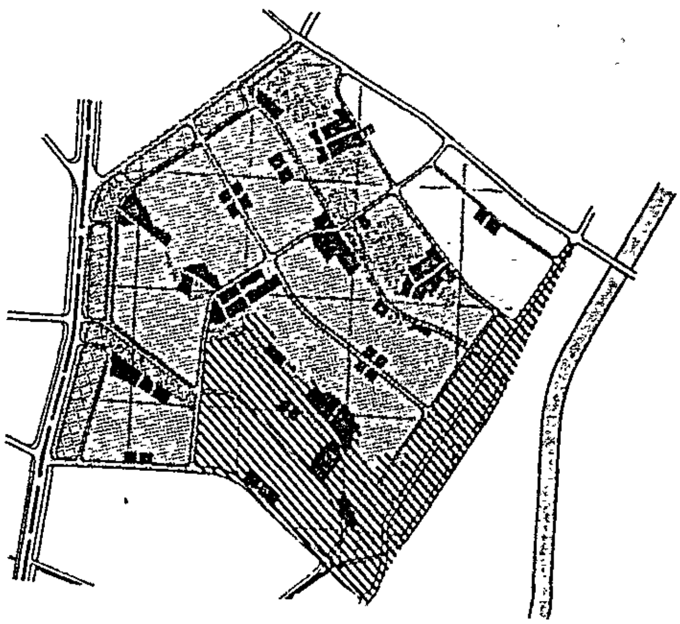


Fig. 3-30 THIRD PHASING

3-7-3 Setting of the Project Area

The Project Area is the section to be developed during stage 1, and will be the object of this technical, financial, and economic feasibility study.

The Project Area is set including the area already acquired and those area where the land acquisition is now in progress. At the Steering Committee held in Jakarta on Nov. 4, 1980, this setting of the Project Area was approved.

Fig. 3-31 shows the Project Area and its surrounds. The boundary of the area is based on the paddy-field block. The Project Area comes under the administrative control of Kelurahan Cengkareng and Kapuk.

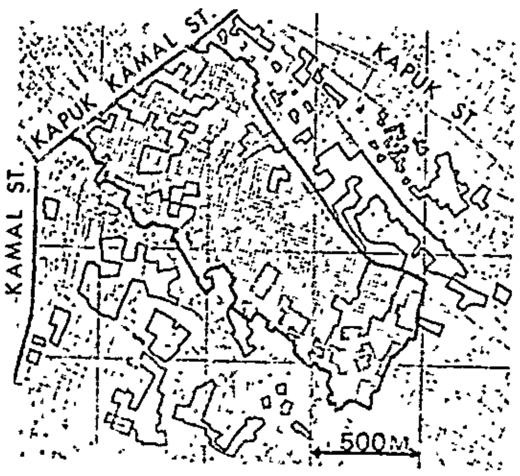


Fig. 3-31 THE PROJECT AREA

3-8 ENVIRONMENTAL IMPACT

Area programmes in the past, which were based on the latest technology, evolved around an approach viewed from the stand point of the development of housing sites and other methods. The consequence is that development endeavors were made, disregarding various aspects of the world of nature and the characteristics of land resources , and a wide variety of problems, such as floods, land subsidences, imbalances of the ecosystem and rises in the maintenance and control cost.

In view of this situation, the study team is going to study the effects of the aforementioned area programme on the natural environment, estimate in advance the conformity between the environment of the Planning Area and its vicinities and this programme, and generally plan the preparation of such infrastructures as housing sites, rain water drainage facilities, and sewage facilities. This study has covered a general survey on the main factors of natural environment but, in the detail design, one should make a detailed environmental assessment of the definite particulars involved.

3-8-1 Formulation of items of assessment

The influences which will be brought about on the environment by this development programme may be classified as follows, depending on the time an impact makes its appearance, and its cause.

i) Impacts which make their appearance in conjunction with construction work for the development -- Noise from construction work, outflow of earth and sand, dust and environmental disruption by vehicles used in construction work.

ii) Impact which will be at issue after the development

ii)-1 Impact caused by changes in landform -- Floods, damage to irrigation and the ground, influences on the ecosystem, micro-climate, scenery, cultural assets, etc.

ii)-2 Impact caused by human activities -- Pollution of river water by human waste, noise from traffic, air pollution.

These influences on the environment may be classified as follows, depending on the phenomenon caused.

i) Nature's disruption (landform, geology, flora and fuana, natural secenery)

ii) Air pollution

iii) Water pollution

iv) Noise

v) Vibration

vi) Offensive odour

vii) Soil pollution

viii) Land subsidence

These phenomena are known as environmental disruption at present. The characteristics of their appearance differs, depending on the type of development, so that there is a need to make a case-by-case study.

In an environmental assessment, a separate analysis and assessment is conducted, in general, according to the aforementioned classification of environmental disruption, and at the same time, an over-all assessment will be made.

For a housing development program, (i) disruption of nature, (iii) water pollution, (vii) soil pollution, and (viii) land subsidence, might be considered principal items of assessement. In the following, a study will be carried out item by item.

3-8-2 Study by items of assessment

a. Disrution of nature

Following are believed to be the main problems concerning this program:

<u>Preservation of the wooded</u> area

The slightly elevated land that crosses the present project area lengthwise, differs topographically and geologically from the paddy-fields and forms an important greenbelt in the area. Wooded area, such as this, are difficult to restore once they are destroyed. Further, trees planted in the reclaimed land included in the paddy-field zone, cannot be expected to grow as well as in the existing wooded area because of less fertile soil.

Moreover, since this slightly elevated land is now used by local inhabitants for housing and recreation, it is advantageous to retain as much of the wooded area as possible. As stated in 3-6, preservation of wooded area is regarded as of specific importance.

Flooding of inland waters due to change of drainage system

The Project Area, composed mostly of paddy-fields, may suffer from temporary inundation in heavy rainfall but, at the same time, it functions as a regulating reservoir, thereby preventing flooding of the local inland waters.

If this programme is executed, the paddy-fields will be turned into housing sites and the discharge of rain water will greatly exceed its present level. It is, therefore, necessary to plan rain water drainage so as to minimize the extent of the impact on the periphery of the Project Area. Further, the drastic rerouting of the drainage system may cause new, unforeseen problems, since the drainage system route is closely related to topography, geology, ecology, land use, etc. So, under this programme, the rerouting of the drainage system is held to a minimum. For details of the rain water drainage facility plan, see 5-1.

b. Water pollution

At present, although villages are located in some sections of the Planning Area, paddy-fields are distributed in most parts of it. For this reason, the sources of water pollution are significantly limited, and water pollution is not taken up as a big issue, although the facilities to deal with human waste are not adequate. Upon completion of the development, however, this area will become a major housing area, so that the pollution of water by human waste from the Planning Area cannot be ignored.

The rivers, not only in the periphery of the Planning Area but in the major urban areas of Indonesia as well, are significantly soiled. This is because the human waste and garbage treatment plants have yet to be developed to the full extent, but not so much progress has been made, although there have been strong calls. However, as it is expected that water pollution will be taken up as a primary type of environmental disruption in the future, no plans should be worked out on the basis of the prevailing degree of riparian turbidity.

Standards for an assessment of the water quality are formulated, not only for the protection of man's health but for the conservation of the living environment as well, and it is a general practice to determine criteria, depending upon the type of water area. In Indonesia, the criteria for water quality is on a trial basis at present and no criteria are available for application to this development programme. It is necessary to make propositions this time, but as the cost for the construction of human waste treatment plants is extremely high in general, it will be reasonable to come out with a cost value from the standpoint of the water quality, construction cost, maintenance, and control cost and future estimate.

c. Soil pollution

Soils are usually assessed from the view-point of the growth of organisms but, as far as this programme is concerned, they must be assessed in connection with civil engineering (preparation of housing sites, landscaping plan, etc.), instead. Therefore, we shall discuss here the problem of soil pollution, and the problem of turning paddy-fields into housing sites in conjunction with the circulatory system of water.

Mechanism for mixing of salinity with soil and underground water

This area is significantly close to the sea. Moreover, it is linked to the sea with a saline, swampy area situated in between. The migration of salinity into well water and the density of salinity in the soil are high. In no way are these phenomena suitable in respect to human compact. However, as for the wells and soil of the slightly high section, a number of mechanisms available in this area function for desalinization. As has been elucidated earlier, the permeability of rain water is significantly high and the dilution of the saline density is also high in the slightly high section, which is porous. The penetration of salinity into the slightly high section from the saline, swampy section, is percolated by sand, as fresh water flows down from the upper reaches to the seacoast at an inclination, resulting in a significant desalinization of the soil. A similar mechanism also works for well water. Should development be attempted in disregard of these factors, the salinity will rise, posing serious questions.

As stated already, this program proposes to preserve the slightly elevated land as Green Axis. So, it seems that there is little fear that the salinity will increase beyond its present level.

Effects of change of water conditions in paddy-field soils on the growth of plants

The growth of plants is affected by surface-layer soils, particularly soil micro-organisms. Normally, it takes at least four or five years for soils to change from a state unsuitable to the growth of plants, to a state that permits their growth.

Changes in the moisture conditions of the local paddy-field soil creakes varying anerobic bacteria which make it impossible to grow plants at present.

This programme proposes to cover the top of the paddy-field soil with earth brought from elsewhere. As stated in 5-2, earth from the proposed site of the Cengkareng Floodway may be used for this purpose, and it will be ncessary to conduct a geological survey on this earth hereafter, since we were unable to make this survey during our study.

d. Settlement of ground

It is considered that the settlement of ground is caused mainly by consolidation due to the load of earth fill and the drawing of large quantities of groundwater. The amount of earth fill is estimated, as stated in 1-3, to be small enough to avoid harmful consolidation settlement. As for settlement by the mass drawing of groundwater, this programme does not involve the use of any groundwater (see 5-4). It is therefore considered that no settlement of ground for which this programme is directly responsible, will occur.

3-8-3 Overall assessment

It can be considered that, as seen from the above, this programme generally agrees with the natural environment. However, new problems must be expected to arise at the stage of planning the details of individual methods. These problems must be studied while reviewing the programme.

4 PROJECT AREA

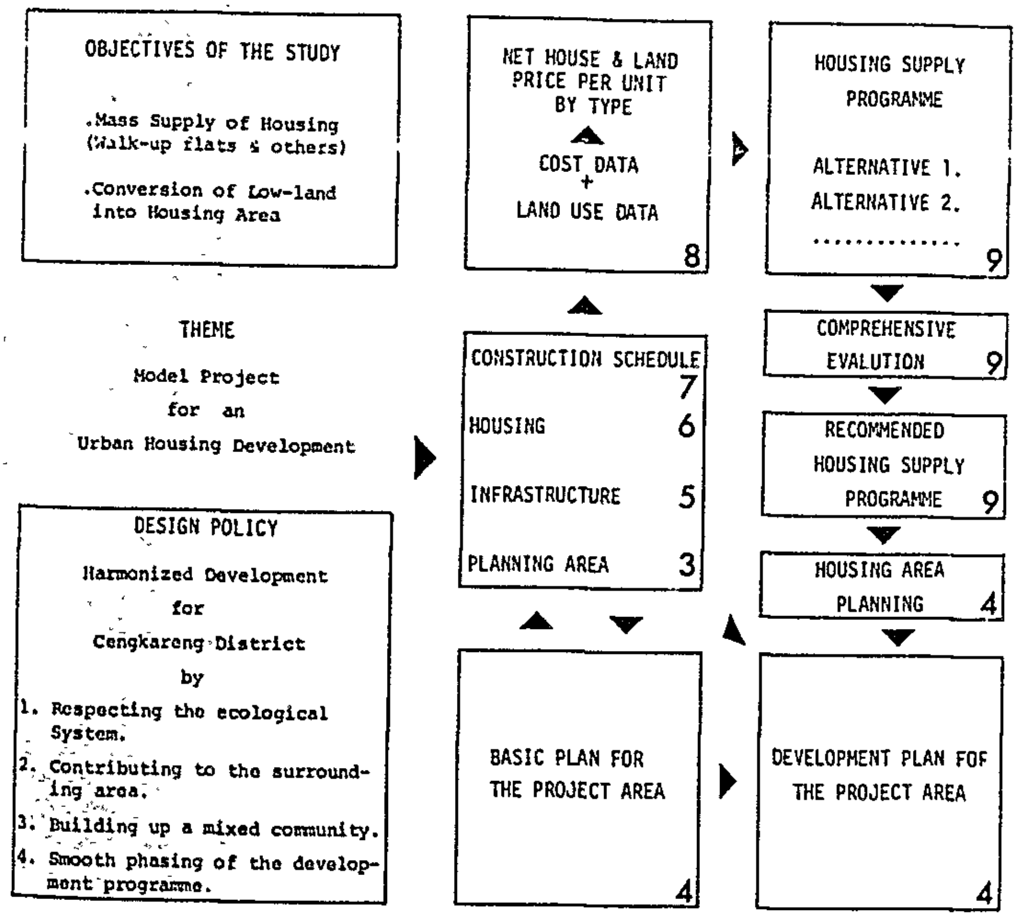
TABLE OF CONTENTS

4-1 WORK FRAME

The Project Area is the area on which the feasibility study is carried out. Infrastructure costs estimated for the basic plan and the land use data are to be used for determining the unit prices of housing types. (See Chapter 8).

In this study, alternative plans are studied, mainly centering around the housing supply programme. If the development plan of the Project Area is fixed on one plan, various alternatives could not be coped with. Therefore, a framework of the plan which can cope with alternatives, shall be introduced into the basic plan as a general solution, on which the neighbourhood unit plan corresponding to the housing supply programme in Chapter 9 shall be overlapped and studied. One actual case shall be referred to in the development plan as a case study.

The optimum solution to the alternative plan adopted is expected to be studied further at the detailed design stage based upon the basic plan.



3~9: Chapters

Fig. 4-1 WORK FLOW

4–2 THE SITE

The Project Area shares border with:

Kapuk Kamal Street to the north-west,
Existing villages via a drainage to the north-east,
Existing villages to the south-west,
Paddy-field to the south-east.

The area is approximately 110 hectares.

The most of the area is, now, paddy-field.

The contour lines are shown in Fig. 1-6 in Chapter 1.

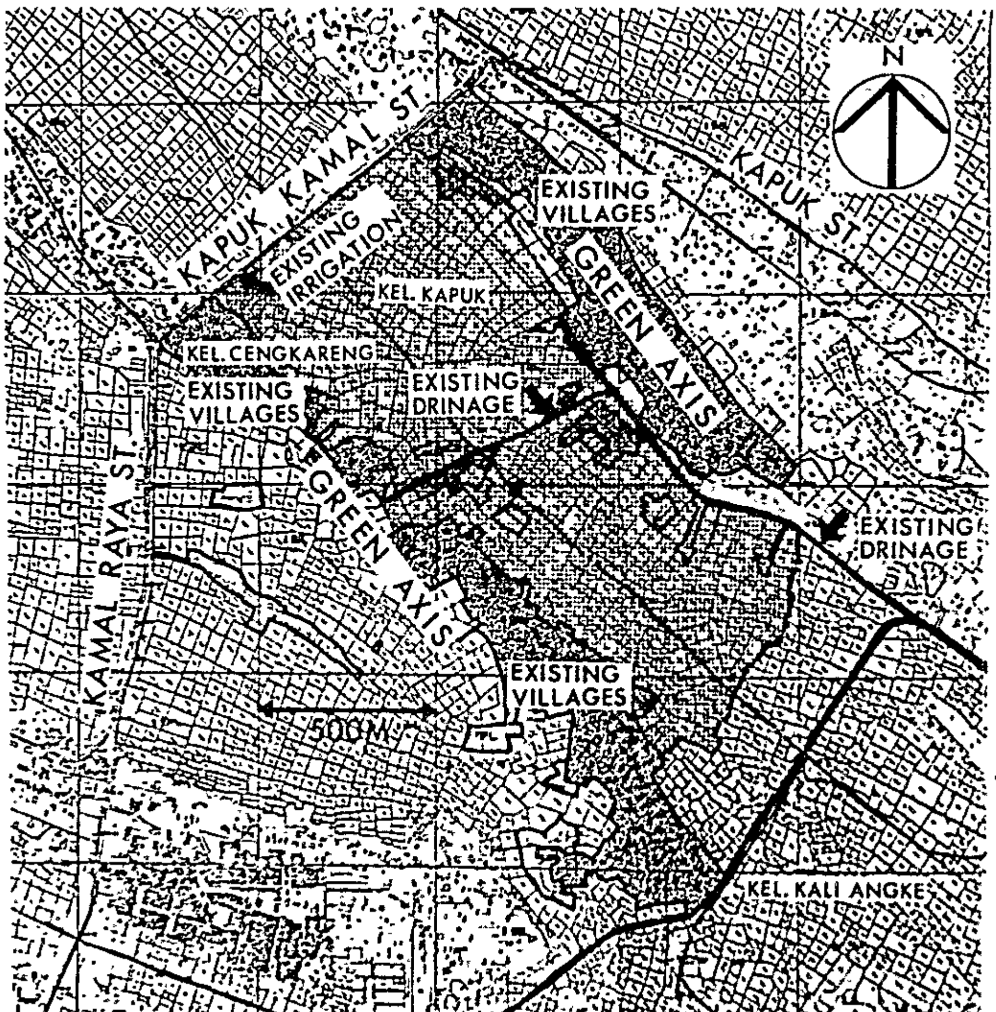
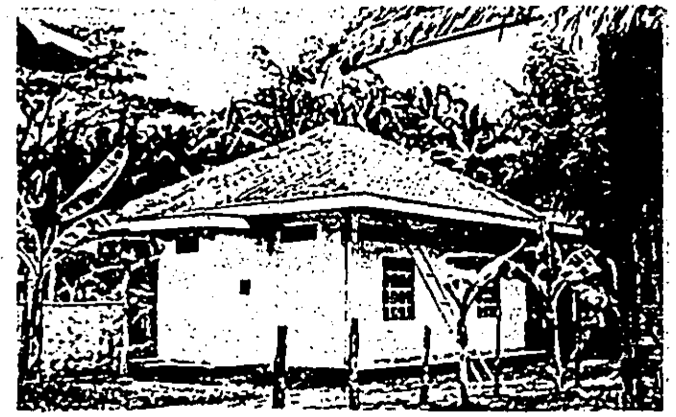


Fig. 4-2 THE SITE

HEALTH CENTRE ALONG KAPUK ST.

TWO ELEMENTARY SCHOOLS ON ONE SITE ALONG KAPUK ST.



SMALL MOSQUE IN THE SOUTH-WESTERN VILLAGE

KAPUK KAMAL ST. IRRIGATION (RAWA GABUS RIVER) PROJECT AREA SEEN FROM KAPUK KAMAL ST. KAPUK KAMAL ST.

DRAINAGE ALONG THE BORDER (KAPUK KAMAL RIVER)

GREEN AREA IN THE PROJECT AREA

DRAINAGE RUNNING ACROSS THE PROJECT AREA

4-3 POPULATION

4-3-1 Target density

The target density for the Project Area is 60 - 80 dwellings per hectare, because:

1. The higher density than 60 dwellings per hectare, the value shown in PERUM PERUMNAS Guidelines, should be achieved for an urban-type development.

2. According to the plan of DKI Jakarta, Cengkareng district belongs to a moderate density area of 201 - 500 persons per hectare, which is equivalent to 33 - 83 dwellings per hectare, assuming the average household size is 6 persons.

Figures of PERUM PERUMNAS Guidelines and those acquired in PERUM PERUMNAS housing complexes (including a planned one) are shown in Fig. 4-3. The density in existing housing complexes, excluding minor exceptions, are lower than those of the Guidelines. The highest density acquired among approximately 100 hectare housing complexes is 55 dwellings per hectare in Banyumanik, Semarang City (population: over 900,000), Central Jawa.

4-3-2 Population

The target population is 39,600 - 52,800, which is derived from the simple multiplication of the target density by the average household size of 6 persons and the area of 110 hectares.

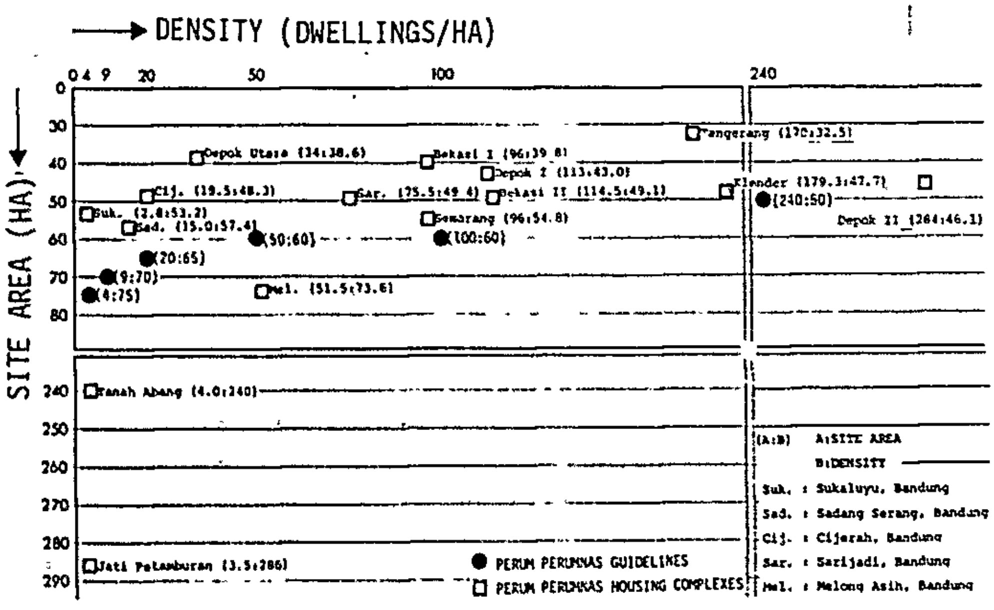


Fig. 4-3 DENSITY

4—4 TOWN STRUCTURE

4-4-1 Town structure

In planning the town structure of the Project Area, the design policy mentioned in the Feasibility Syudy Report, and the general plan for the Planning Area, together with the consideration of the community structure in Indonesia give a framework.

The layout of the commercial lot area along Kapuk Kamal Street, the Town Centre, the primary roads and 10 neighbourhood units is shown diagrammatically in Fig. 4-4.

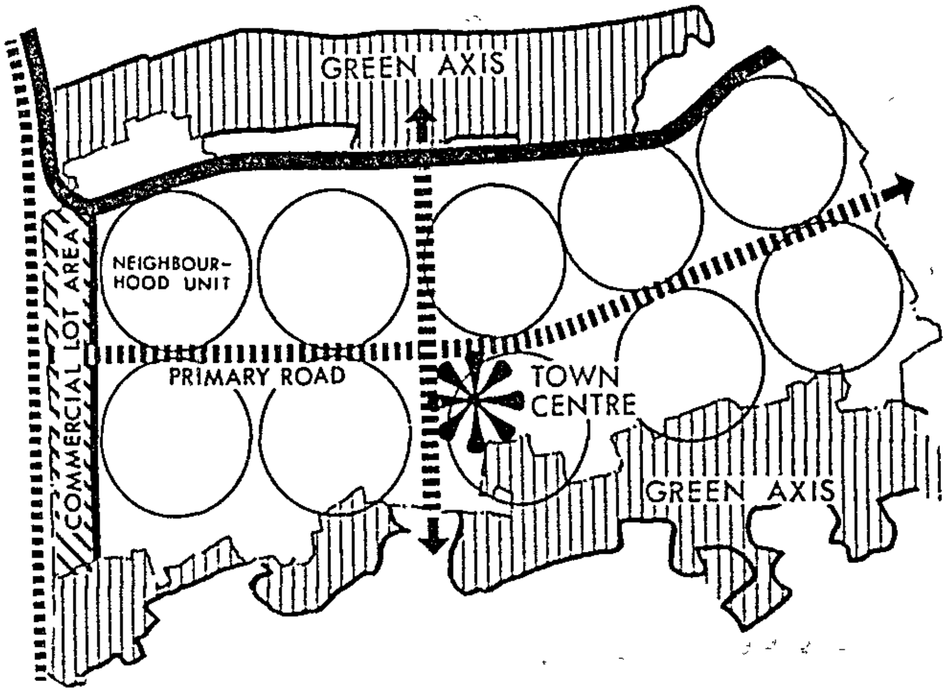


Fig. 4-4 FRAMEWORK OF TOWN STRUCTURE

4-4-2 Community structure

The composition of community structures in Indonesia and their application in this plan are shown in Table 4-1.

In this plan, the Project Area and a neighbourhood unit, each contains one Kelurahan and one RW, respectively.

The Project Area consists of 10 neighbourhood units. Their respective locations and names are shown in Fig. 4-5.

Table 4-1 COMMUNITY STRUCTURE

PERUM PERUMNAS Guidelines and DKI Jakarta Standards

PERUM PERUMNAS Guidelines		RK	RW	NEIGHBOURHOOD	SUB-DISTRICT	KELURAHAN	SUB-PROVINCE	
Population		(1,500)	(3,000-3,500)	(6,000-7,500)	(15,000)	(30,000)	(80,000)	
Households		300	600-700	1,200-1,500	3,000	6,000	12,000	
Area		4	9	20	50	100	240	

DKI Jakarta Standards	RT			RW 12RT		KELURAHAN 10RW		KECAMATAN	TOWN
Population	250	750		3,000		30,000		200,000	1 million
Households	(50)	(150)		(600)		(6,000)		(40,000)	(200,000)
Area	0.5-1.25	1.5-3.75		6-15		60-150		400-1,000	2,000-5,000

Cengkareng Project

Cengkareng Project		NEIGHBOURHOOD UNIT		PROJECT AREA	PLANNING AREA
Population		4,200		46,200	
Households		700		7,700	
Area		10		110	370

- RT(Rukun Tetangga), RK(Rukun Kanpung) and RW(Rukun Warga) are not administrative units but residents' organizations.
- Kelurahan and Kecamatan are administrative units.
- The values of DKI Jakarta Standards are for moderate dense districts. (Population: 201~500 per hectare).
- By assuming the average household size to be 5 persons, in case of PERUM PERUMNAS Guidelines, the population is estimated through the number of households, and in case of DKI Jakarta Standards, vice versa.
- As for the figures of the Cengkareng project, the population and the number of households are estimated under the condition of 70 dwellings per hectare with the average household size of 6 persons.

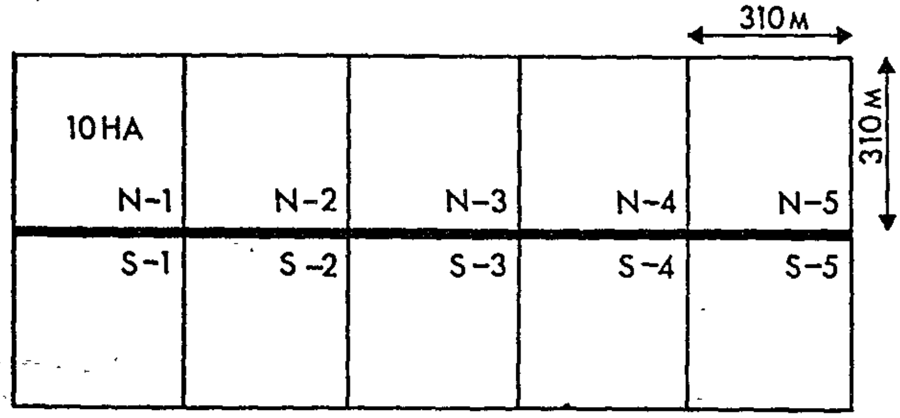


Fig. 4-5 DIAGRAMMATIC LAYOUT OF NEIGHBOURHOOD UNITS

4-4-3 Respect of the ecological system

To respect the existing ecological system, which is interpreted, in terms of the streams and the green areas shown in Fig. 4-2, the following are considered:

① A collector drainage canal follows the existing stream. (Planned by P.B.J.R.) See 5-1-2.

② A micro drainage canal follows the existing stream.

③ A network of major footpaths connecting the Green Axes is formed.

④ The green areas within the Project Area are utilized as educational and recreational facilities, even where existing trees cannot be preserved. In the Town Centre, a park is planned on the existing green area. (Cengkareng Plaza).

⑤ Educational and recreational facilities are laid out on the Green Axis side of the Project Area.

⑥ The reserved area for the extension of vehicle roads during the future development stage along the collector drainage is utilized as a park (Waterside Park). After the development, integrating both sides of the collector drainage, the Waterside Park is expected to become a recreational area for Cengkareng district.

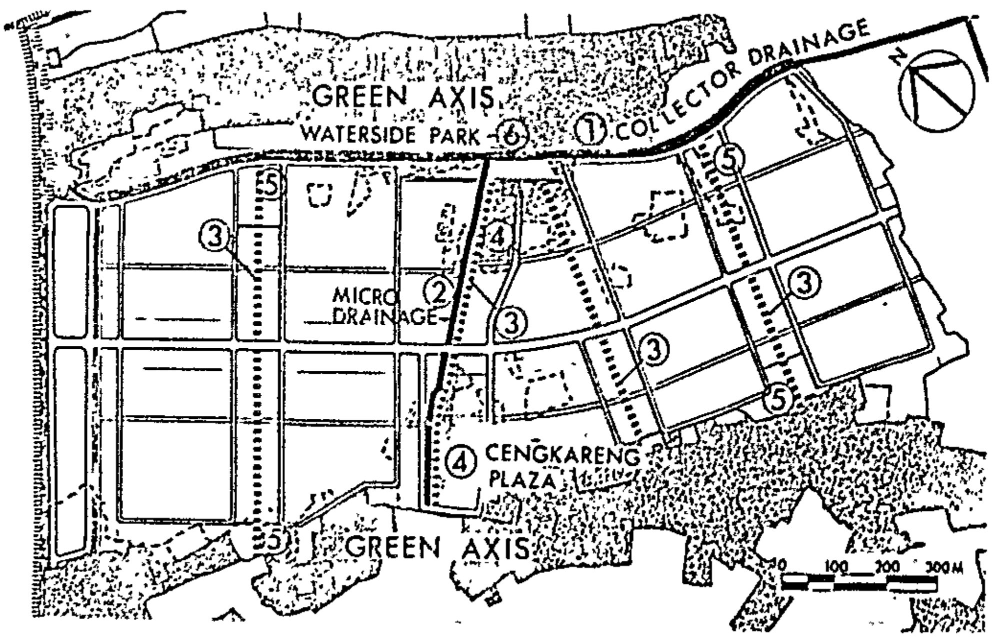


Fig. 4-6 RESPECT OF ECOLOGICAL SYSTEM

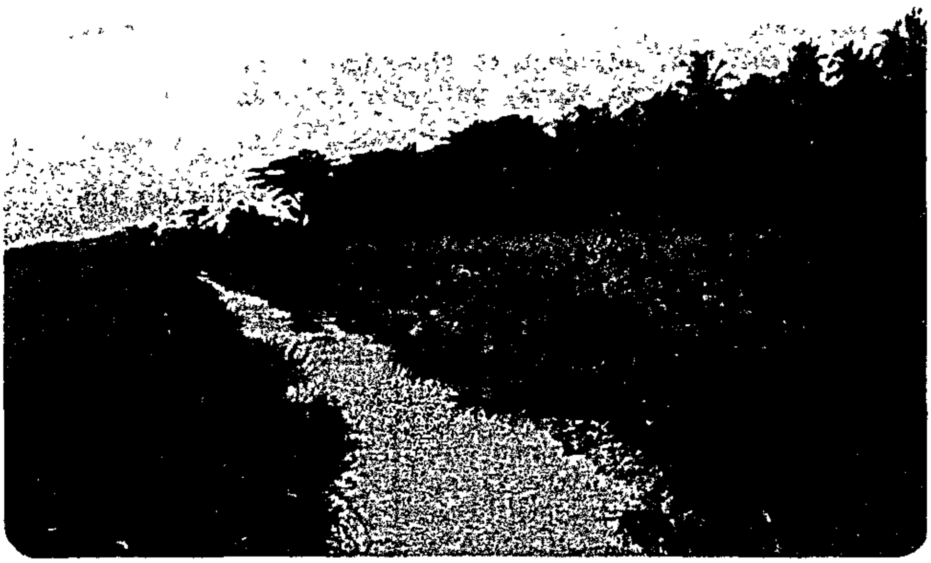


Fig. 4-7 THE SITE OF THE WATERSIDE PARK

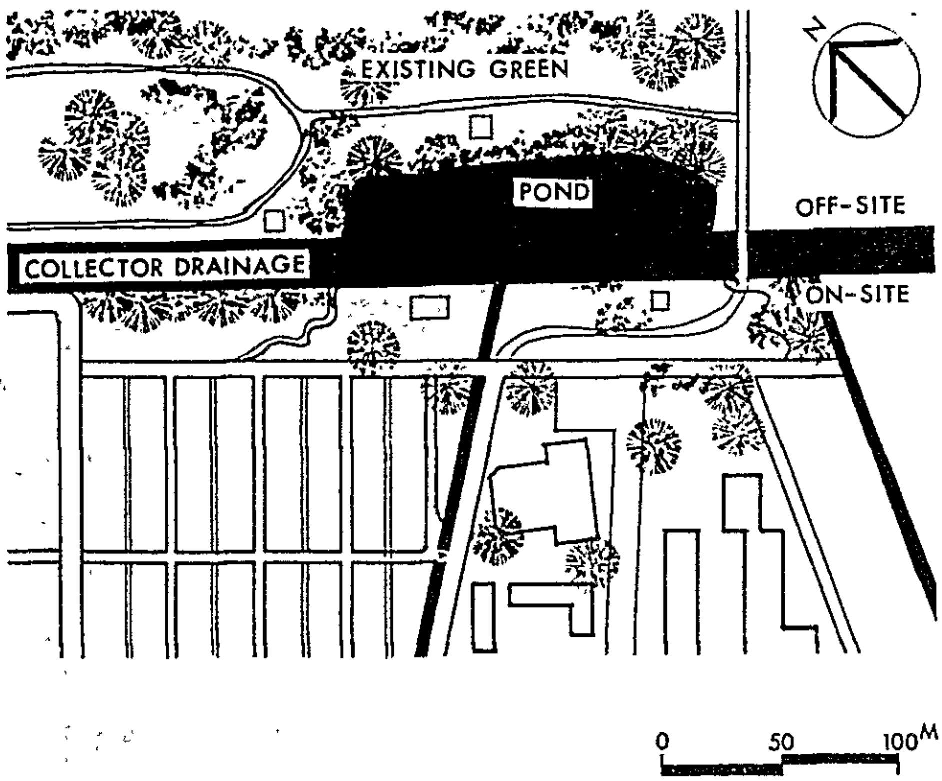


Fig. 4-8 WATERSIDE PARK

4-4-4 Smooth phasing of the development programme

For the smooth phasing of the development programme, the following are considered:

① The Town Centre is laid out around the centre of the Planning Area, adjacent to the site to be developed during the second stage, in order to enable the Town Centre itself to develop.

② The primary roads A,B,C will be extended during the future development stages, B and C by:

B. Starting at any point of the looped road

C. Starting at any point of the reserved area

③ The major footpaths, when extended, will integrate the communities of both the first stage development area and the next stages development areas.

④ Empty lots for housing and home industries along the trunk roads provide residences and job opportunities for those who live in the existing villages, which are to be developed during the future stages.

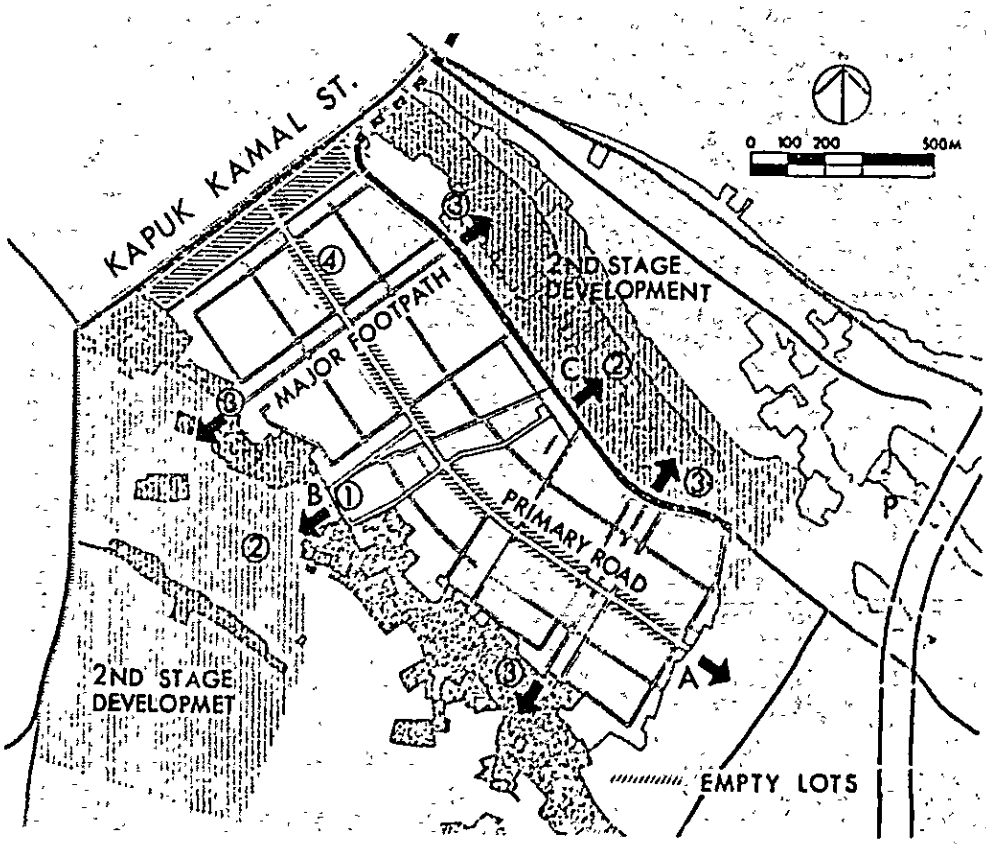


Fig. 4-9 FUTURE STAGE OF THE DEVELOPMENT

4-5 LAND USE

The high-density development requires more open space area and road and footpath area, compared to PERUM PERUMNAS Guidelines.

Table 4-2 TARGET LAND USE

	PERUM PERUMNAS Guidelines		Target land use in Cengkaren Project	
	ha	%	%	ha
Site Area	→	100	100	110
Road	→	* 20	23 [1]	25
Community Facilities	→	16	26	29
Open Space		4.7	12 [2]	13
Social Facilities		7.6	8	9
Commercial Facilities		3.7	6	7
Housing Area	→	64	51	56

* 20% is taken from the examples in PERUM PERUMNAS housing complexes.

1. Corresponds to the increase of transportation.

2. The lagoon (2.9ha), the collector drainage (4.4ha), two parks (1.0ha).

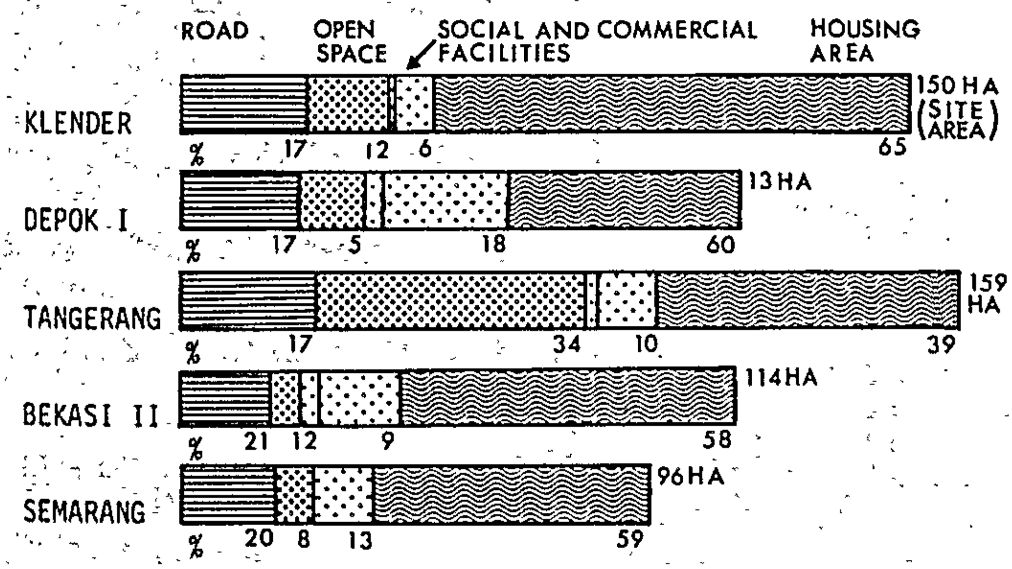


Fig. 4-10 LAND USE DATA IN PERUM PERUMNAS HOUSING COMPLEXES

4–6 CIRCULATION

4-6-1 Circulation system

The system of separating footpaths from vehicle roads as shown in Fig. 4-11 is adopted, following the experiences in existing PERUM PERUMNAS housing complexes.

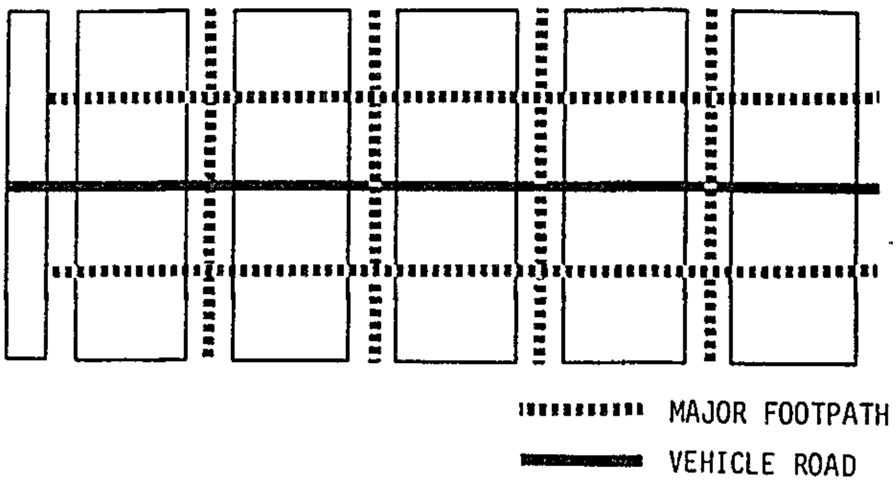


Fig. 4-11 DIAGRAMMATIC LAYOUT OF THE CIRCULATION SYSTEM

An interpretation of the diagramme is shown in Fig. 4-12. A maintenance road for the collector drainage canal and the necessary modifications to lower the road and footpath area are introduced.

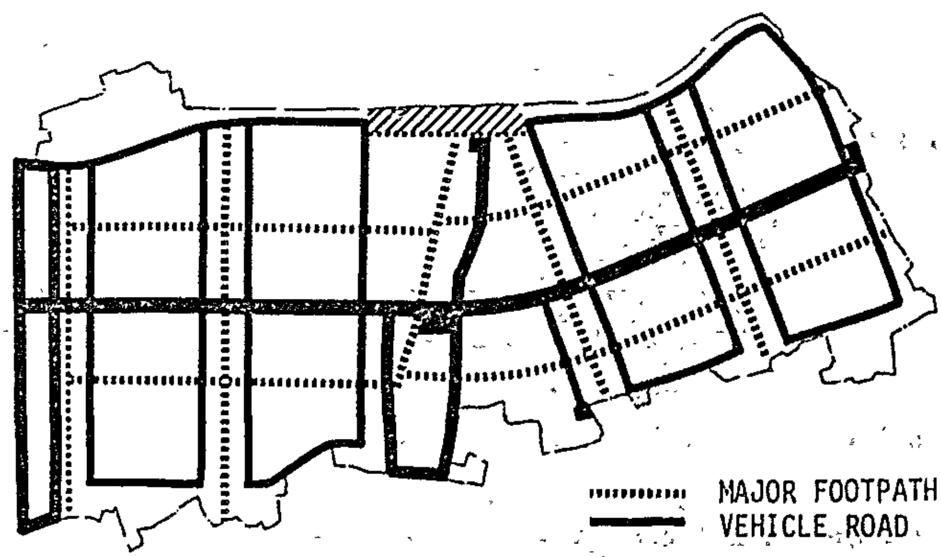


Fig. 4-12 INTERPRETATION OF THE DIAGRAMME

4-6-2 Vehicle road network

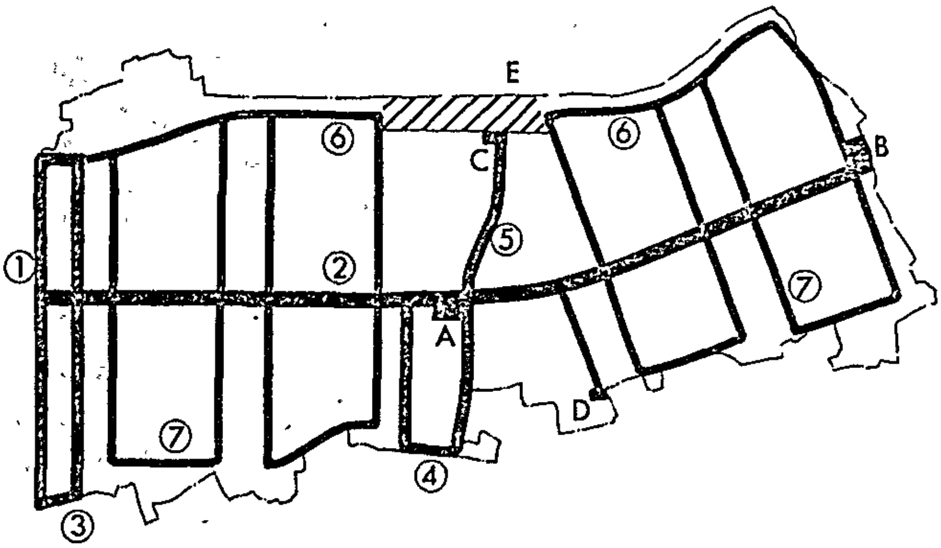


Fig. 4-13 VEHICLE ROAD NETWORK

	*ROW	Category	Function
①	12	Primary road B	Access road to the Project Area.
②	18	Primary road A	Spinal trunk road.
③	12	Primary road B	Trunk road to be extended during future development stages.
④	12	↑	Service roads for the commercial lot area and the Town Centre.
⑤	12	↑	Maintenance roads for the collector drainages.
⑥	8	Service road	Service roads for neighbourhood units.
⑦	8	↑	Emergency escape roads for the spinal trunk road.

*For cross sections of roads, see 5-3.

A Bus terminal

B Turn around

C Turn around

D Turn around

E Reserved area for the extension of the trunk road.

4-6-3 Bus service route

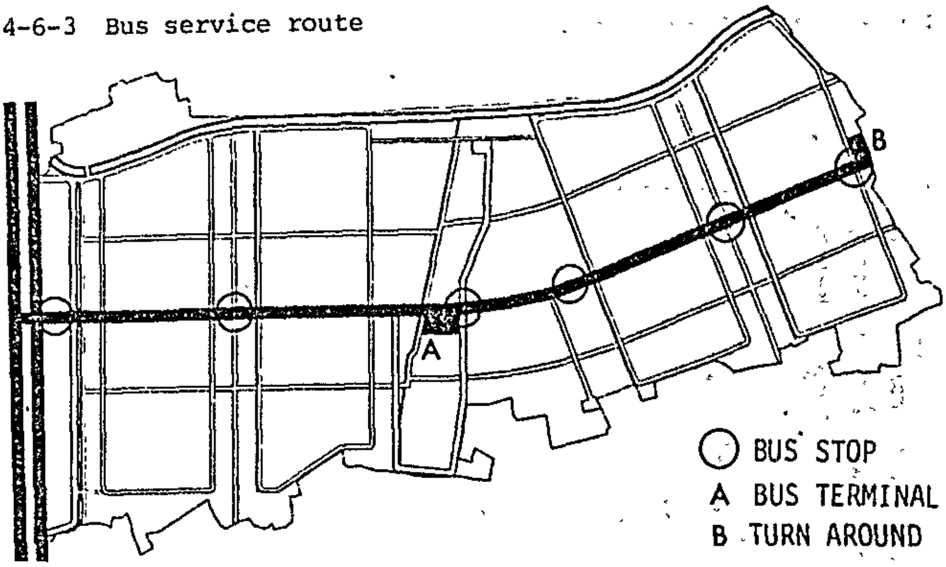


Fig. 4-14 BUS SERVICE ROUTE

4-6-4 Major footpath network

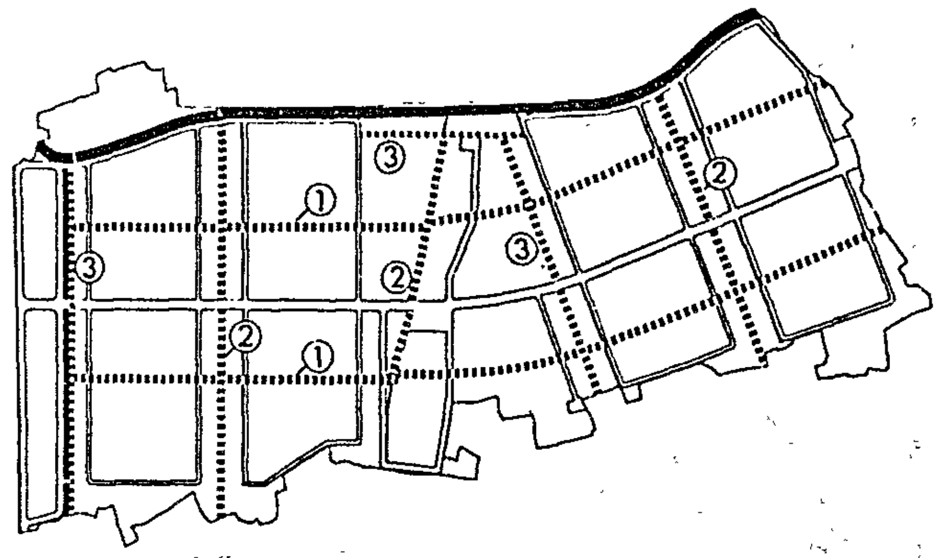


Fig. 4-15 MAJOR FOOTPATH NETWORK

	ROW	Function
①	8	Spinal major footpaths connecting neighbourhood units.
②	8	Major footpaths connecting the Green Axes.
③	6	Auxiliary major footpaths.

* Footpaths serve for pedestrians, bicycles, motor-bicycles, becaks and emergency vehicles.

4-6-5 Examples of footpath networks in a neighbourhood unit

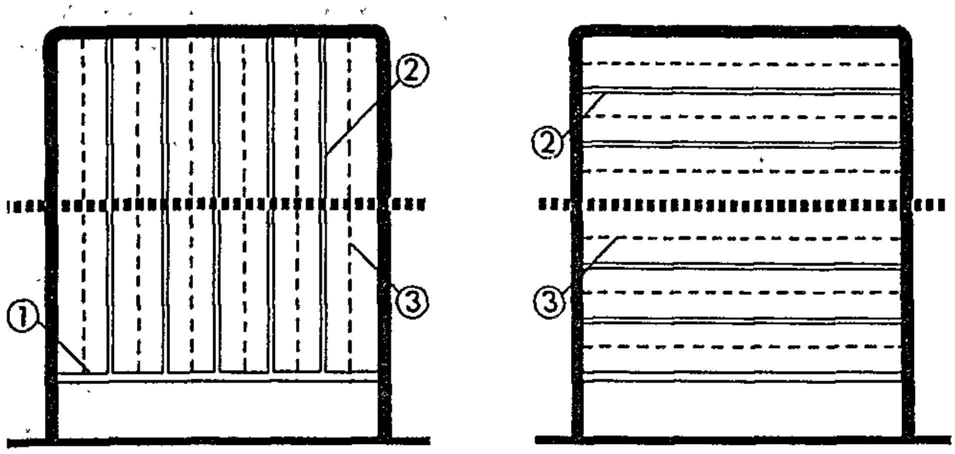


Fig. 4-16 DIAGRAMMATIC LAYOUT OF FOOTPATHS IN A NEIGHBOURHOOD UNIT (A)

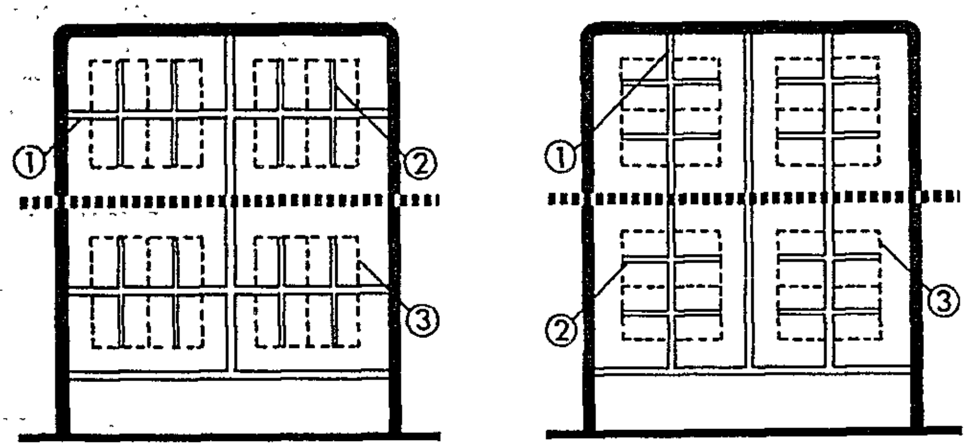


Fig. 4-17 DIAGRAMMATIC LAYOUT OF FOOTPATHS IN A NEIGHBOURHOOD UNIT (B)

ROW

① 6 ——— Footpaths

② 4 ——— Footpaths

③ 2 ——— Service alleys

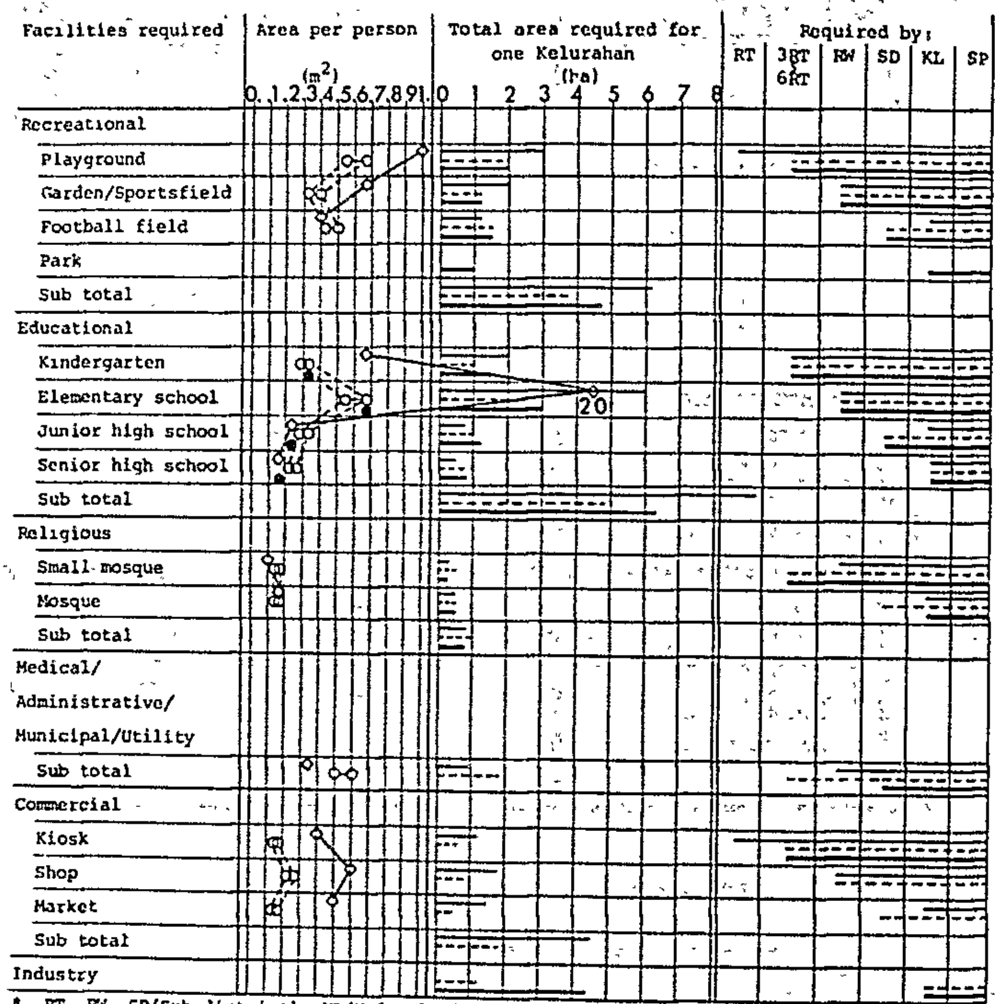
4–7 COMMUNITY FACILITIES

4-7-1 Facilities and the area required

Facilities and the area required are given in both:

1. Urban Planning Standards for DKI Jakarta, and
2. PERUM PERUMNAS Guidelines.

The figures in above Standards, Guidelines and those taken by the study team are shown in Fig. 4-18.



* RT, RW, SD(Sub-district), KL(Kelurahan), SP(Sub-province) : See 4-4-2.
* ◇ —— : DKI Jakarta Standards
* ○ ---- : PERUM PERUMNAS Guidelines
* ● —— : Cengkareng Project
* ○-○ : Household size 6 - Household size 5 (PERUM PERUMNAS Guidelines)
* Total area for DKI Standards is given through multiplying the area per person by 30,000 population.
* Areas per person for junior and senior high schools are the values for multi-storied buildings.
* The values of DKI Jakarta Standards are for the medium density area.

Fig. 4-18 COMMUNITY FACILITIES AND THE AREA REQUIRED

4-7-2 Population increase and community facility planning

The projected population in the Project Area is larger than the figure indicated for the 100 hectare development in PERUM PERUMNAS Guidelines for the following reasons:

1. The density is higher.

2. The average household size is assumed to be 6 persons instead of 5.

The required area for community facilities to meet the increased population is considered as follows:

1. As for recreational facilities, two parks, one in the Town Centre and the other along the collector drainage canal, are provided in addition, while other figures for the area required are not increased.

2. As for religious, medical, commercial, and administrative/municipal/utility facilities, the figures given in the Guidelines will not be insufficient even when the population increases, because the Project Area is not isolated, and flexible utilization can be expected.

   Walking distances to the following facilities will be more important. See 4-7-3.

3. As for educational facilities, the area should be increased than the figures given in PERUM PERUMNAS Guidelines. See 4-7-7.

4-7-3 Walking distance

The walking distances to the following facilities should be:

Playground Kindergarten Small mosque Kiosk	300m - 400m (5 minutes)
Elementary school	1,000m (15 minutes)

Walking distances are decided, based on consultation with PERUM PERUMNAS.

4-7-4 Layout

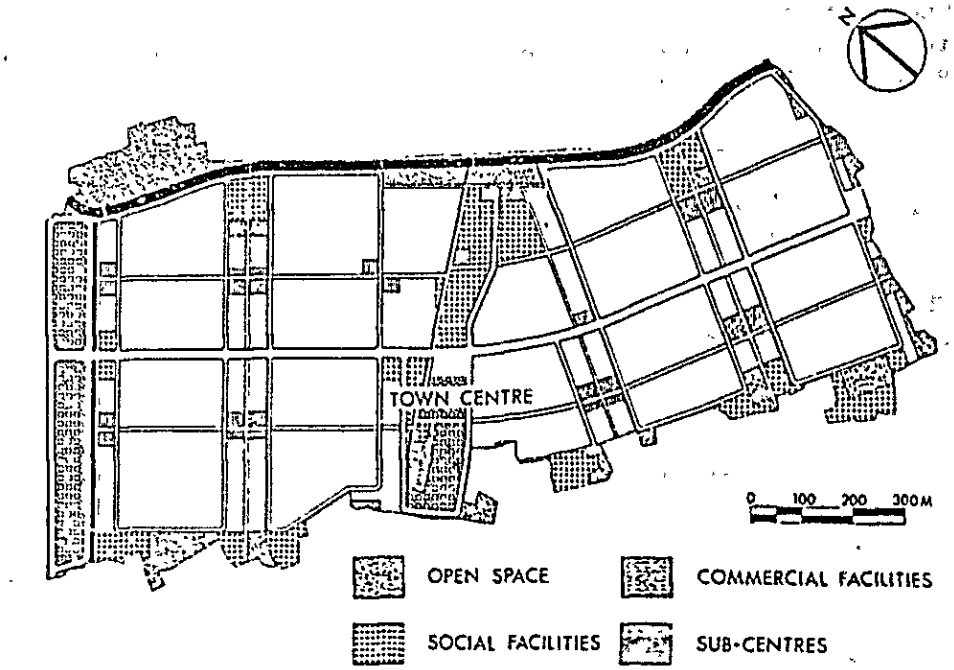
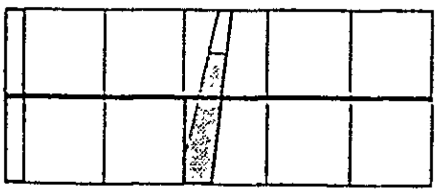
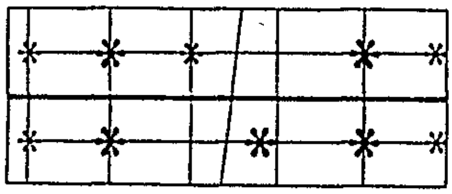


Fig. 4-19 LAYOUT OF COMMUNITY FACILITIES



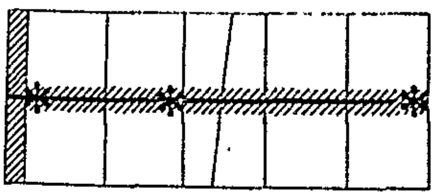
TOWN CENTRE



SUB-CENTRE

PLAYGROUND, KINDERGARTEN

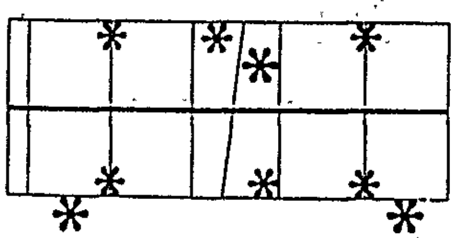
SMALL MOSQUE, KIOSK



ADMINISTRATIVE/MUNICIPAL
UTILITY FACILITIES

COMMERCIAL LOT AREA

EMPTY LOTS FOR HOUSING AND
HOME INDUSTRIES



EDUCATIONAL AND
RECREATIONAL FACILITIES

Fig. 4-20 LAYOUT PATTERNS OF COMMUNITY FACILITIES

4-7-5 The Town Centre

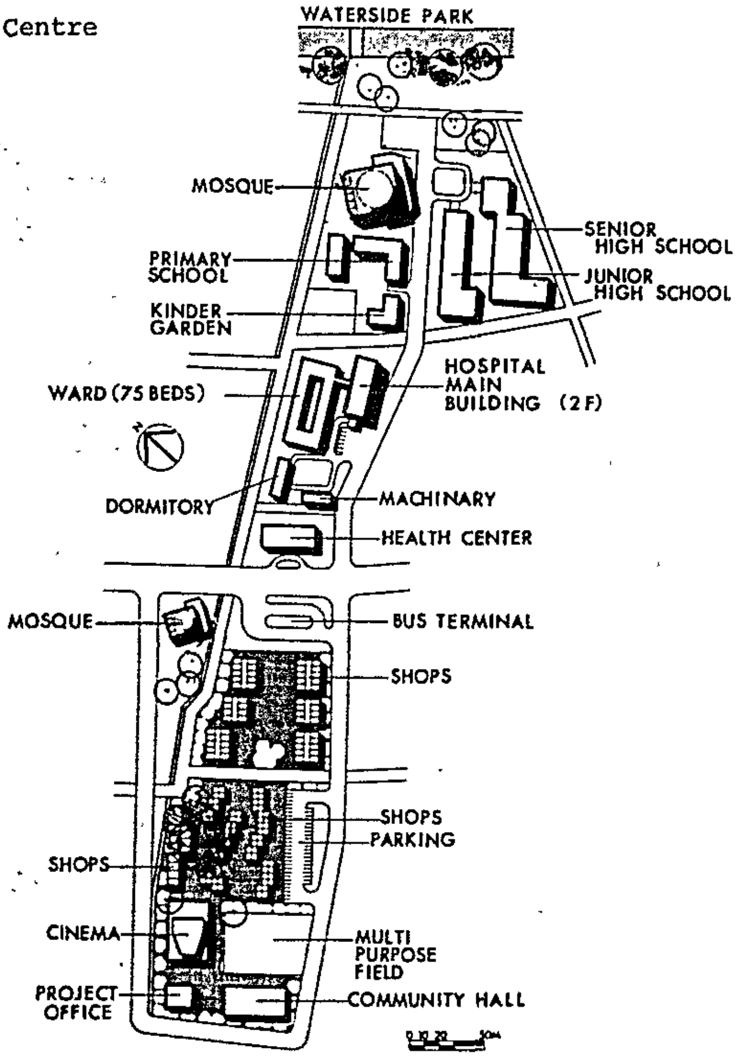


Fig. 4-21 THE TOWN CENTRE

Table 4-3 COMPOSITION OF THE TOWN CENTRE

		A (ha)	B (ha)	C (ha)
Bus terminal		0.3	0.3	0.3
Park: Central	0.35	1.0	1.0	0.35
Canal	0.65			
Health centre		0.2		0.2
Mosque: Central	0.25	0.5		0.25
Canal	0.25			
Commercial (Incl. parking area)	1.8	2.4	0.4	2.4
Hospital	0.6		0.6	
Community hall	0.1			0.1
Elementary schools Senior high school		1.8		
Total		6.2	2.3	3.6

A: All facilities in the central area.
B: In addition to the values given in PERUM PERUMNAS Guidelines.
C: Excluding the northern part of the central area.

4-7-6 Sub-centres

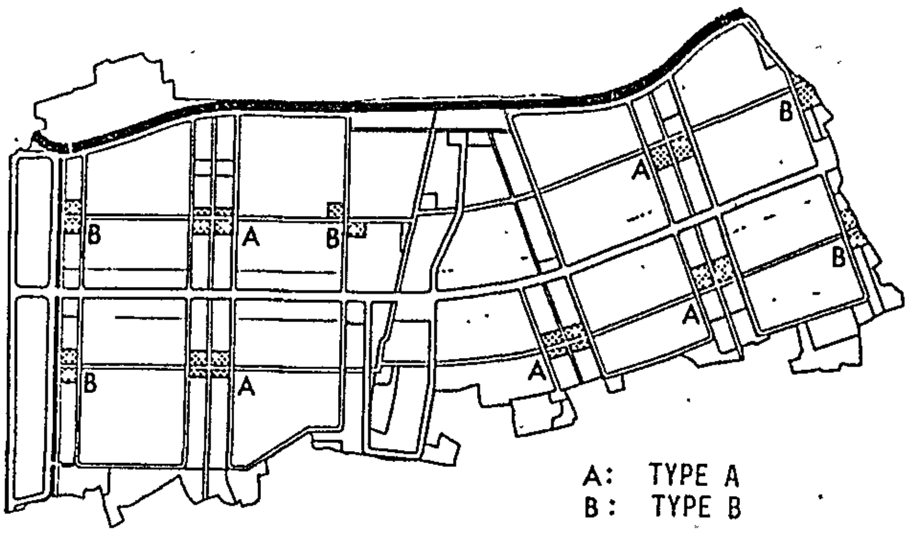
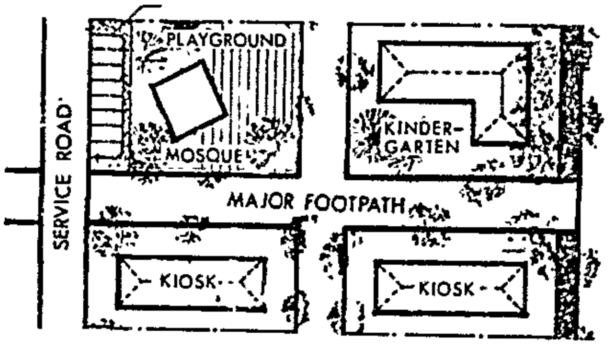


Fig. 4-22 SUB-CENTRES



TYPE A SUB-CENTRE

	(m^2)
Playground	500
Kindergarten	1,000
Small Mosque	250
Kiosk - Parking	1,250

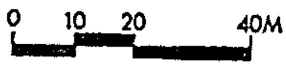
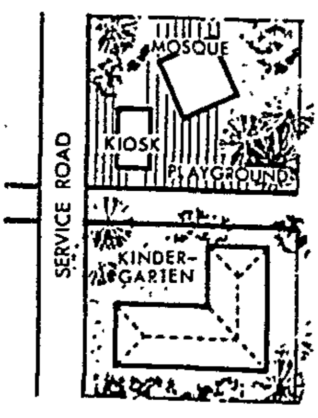


Fig. 4-23A TYPE A SUB-CENTRE



TYPE B SUB-CENTRE

	(m^2)
Playground	500
Kindergarten	1,000
Small Mosque	250
Kiosk	250

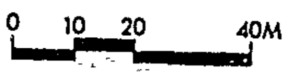


Fig. 4-23B TYPE B SUB-CENTRE

4-7-7 Educational facilities

Educational and recreational facilities are located in the areas along the boundary between the Project Area and the neighbouring villages where greens remain, in order to:

1. Avoid the over-all grading of the green area inevitable for the development of the housing area.

2. Utilize the irregularly shaped land around the site boundary.

3. Accept the likely transit demand from residents of the villages.

4. Achieve an outward flow of people to encourage the integration of communities inside and outside the Project Area.

In order to create greater flexibility and efficiency;

1. Elementary schools and sportsfield are located together as one set.

2. Elementary schools of adjacent neighbourhood units are located on both sides of the major footpaths.

3. Junior high schools and football fields are located together as one set.

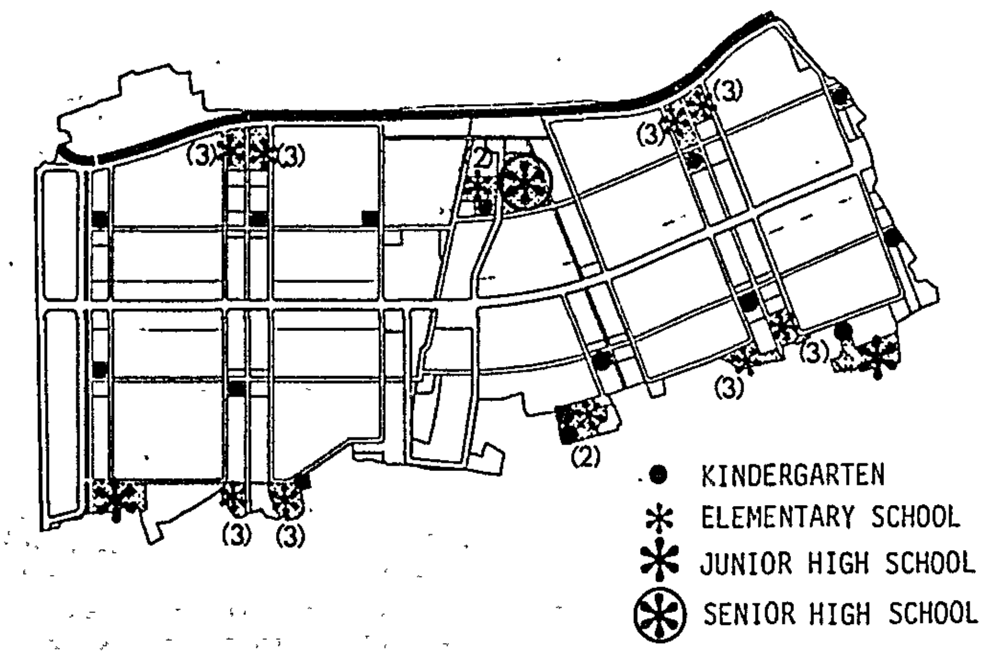


Fig. 4-24 EDUCATIONAL FACILITIES

To meet the increased population, the area required shall be assessed through multiplying the required area per person by the assumed population.

TABLE 4-4 REQUIRED AREA FOR EDUCATIONAL FACILITIES

	Area per person (m^2)	Total area required (ha)			
		S: 100	110		
		D: 60	60	70	80
		P:30,000	39,600	46,200	52,800
Kindergarten	0.33	(1.0)	1.3	1.5	1.8
Elementary school	0.67	(2.0)	2.6	3.0	3,5
Junior high school	0.24	(1.0)	0.9	1.1	1.3
Senior high school	0.16	(0.8)	0.6	0.7	0.7
Total	1.4	(4.8)	5.4	6.3	7.4

S: Site area
D: Dwellings per hectare
P: Population
( ): Values given by PERUM PERUMNAS Guidelines

In order to examine the above figures, the needed number of elementary schools shall be obtained by a different method.

Assuming:

1. Number of children going to elementary school is *1.75 per household,

2. The two-shift instruction system is introduced,

3. Number of pupils per class is 40,

4. Number of classes per school is 6,

When the density is 70 dwellings per hectare, the needed number of elementary school shall be:

70 dwellings/ha × 110ha ÷ 1.75 persons/dwelling
÷ 40 pupils/class ÷ 6 classes/school ÷ 2 shifts
= 28.1 schools

Since the total area of elementary schools is 3.0 hectares as shown in Fig. 4-18, joint use of facilities among schools and two-storied school building will be needed so that 28 schools can be constructed on lots of 3.0 hectares. If 28 schools are laid out in neighbourhood units according to the basic plan, it will be as the figures in parentheses in Fig. 4-22.

* Between 1.5 and 2.0 is given by PERUM PERUMNAS.

4-7-8 Recreational facilities

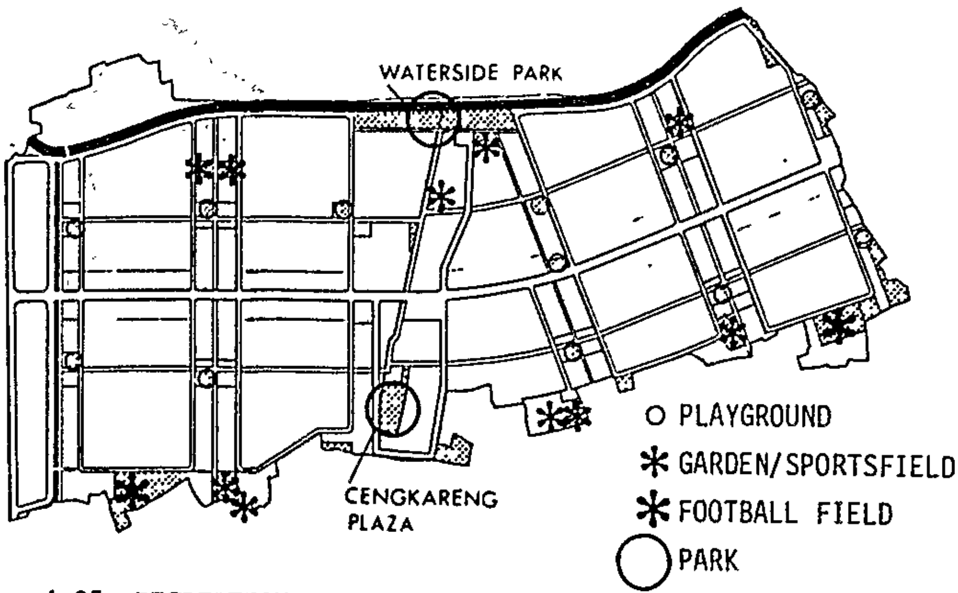


Fig. 4-25 RECREATIONAL FACILITIES

4-7-9 Religious facilities

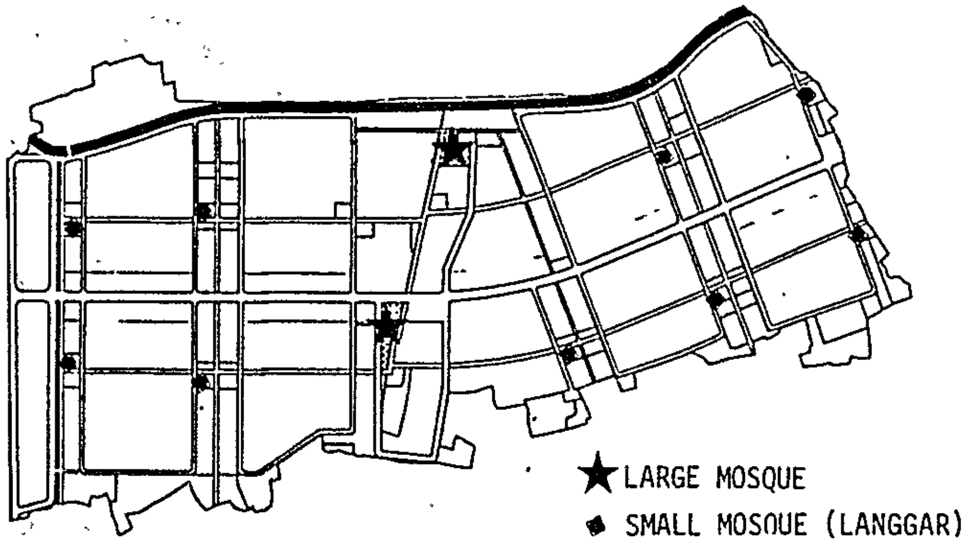


Fig. 4-26 RELIGIOUS FACILITIES

4-7-10 Medical facilities

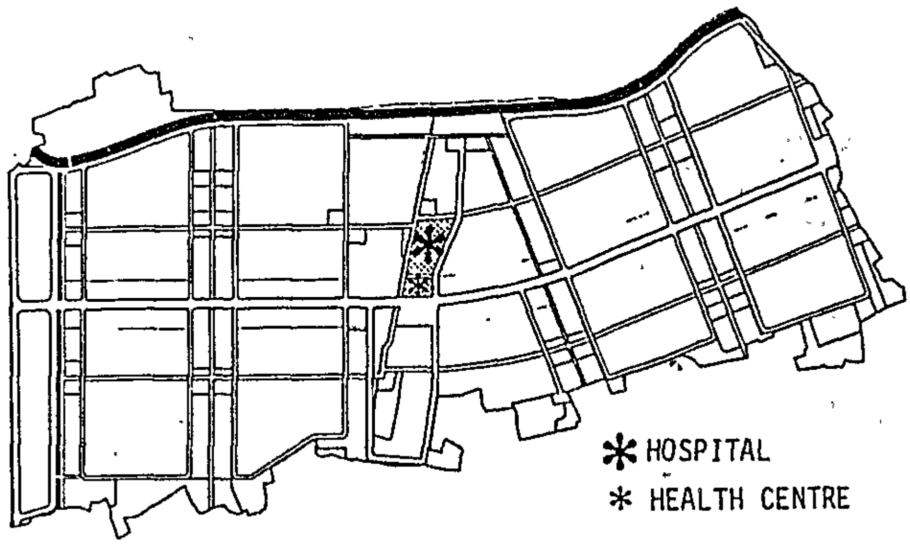


Fig. 4-27 MEDICAL FACILITIES

One policlinic to each neighbourhood unit is not to be provided, which is decided based on consultation with PERUM PERUMNAS.

4-7-11 Administrative/Municipal/Utility facilities

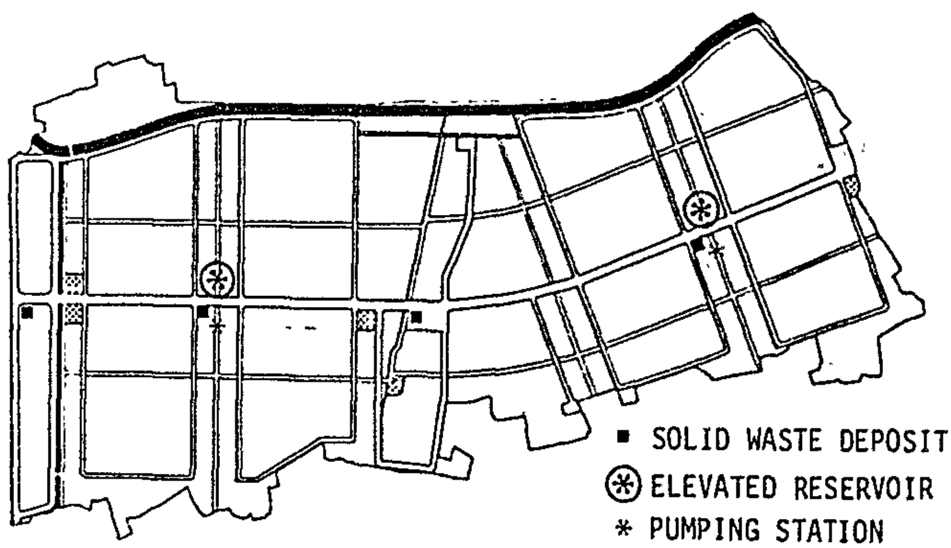


Fig. 4-28 ADMINISTRATIVE/MUNICIPAL/UTILITY FACILITIES

4-7-12 Commercial facilities

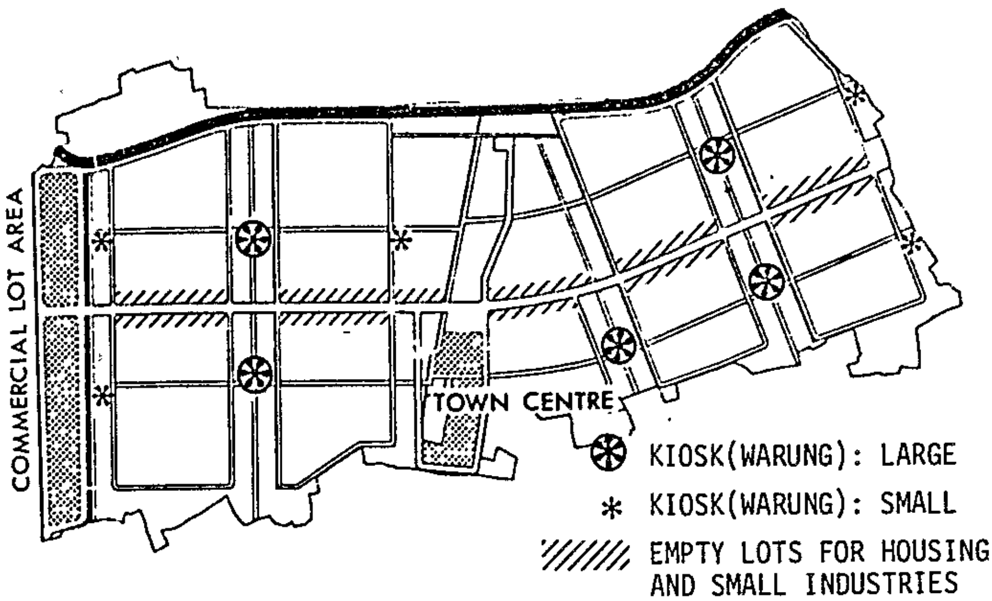


Fig. 4-29 COMMERCIAL FACILITIES

4–8 HOUSING AREA

4-8-1 General

In housing area planning, the following are considered:

1. The flexible allocation corresponding to the housing supply programme should be achieved.

2. Various types of housing are to be distributed to each neighbourhood unit to build-up a mixed community.

3. Each dwelling unit should be within approximately 100m of vehicle road access.

4-8-2 Layout of walk-up flats

When the number of walk-up flats is between 0 and approximately 1,500 units, the walk-up flats are to be laid out in two groups on both sides of major footpaths in order to:

1. Avoid any exessive concentration of population in any one area

2. Give variation to the monotonous aspect usually associated with new towns

3. Build-up a mixed community

4. Allocate elevated water reservoir effectively

5. Correspond to the two stages of the construction schedule.

6. Integrate the communal space of the walk-up :flats to the major footpath.

4-8-3 Layout of empty lots for housing and home industries

Empty lots for housing and home industries are laid out along the primary and secondary roads.

In case more empty lots are required, lots along service roads will be sold as empty lots.

These empty lots are expected to be utilized for commercial facilities, home industrial sites, as well as for ordinary housing lots.

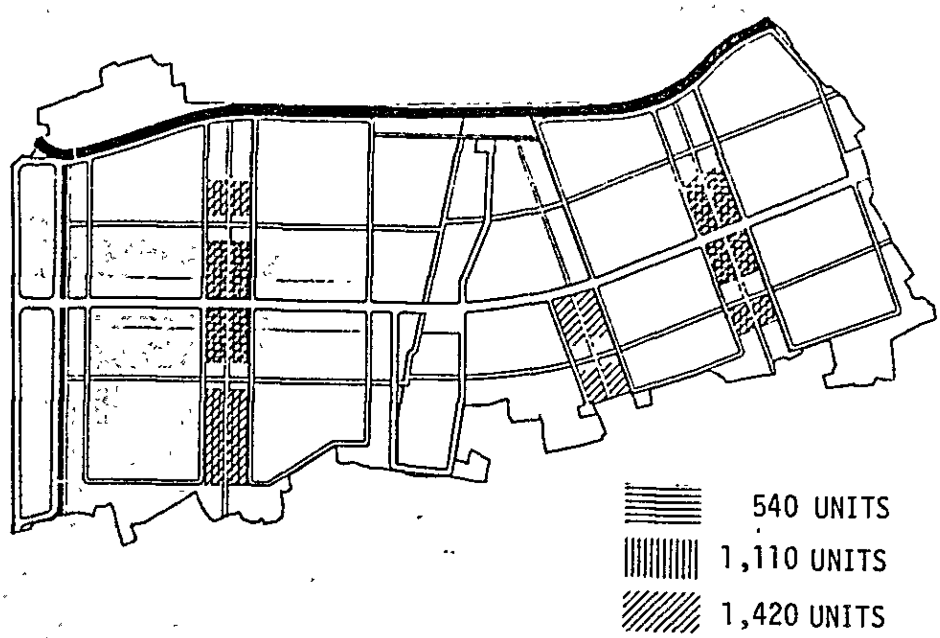
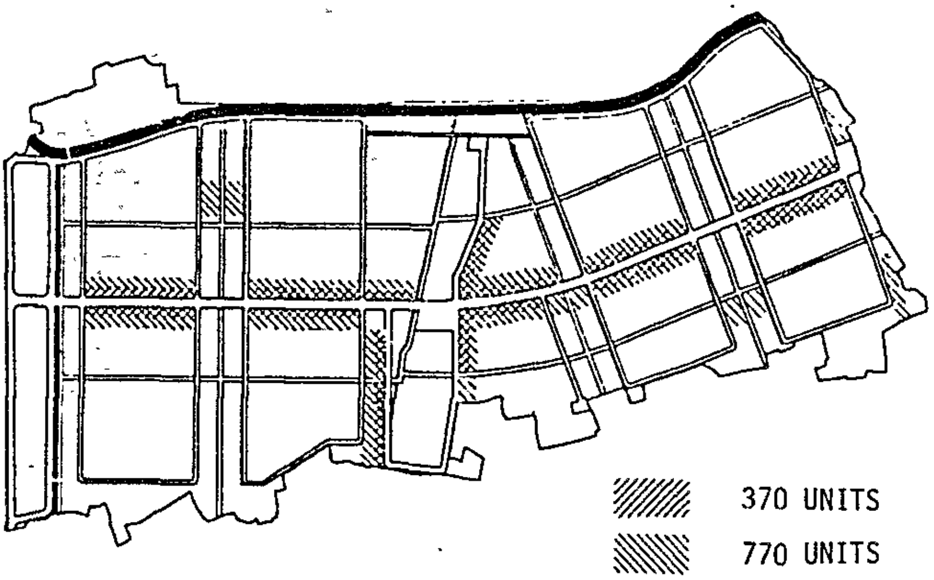


Fig. 4-30 LAYOUT OF WALK-UP FLAT



LAYOUT OF EMPTY LOTS FOR HOUSING
AND SMALL INDUSTRIES

Fig. 4-31 HOUSING AREA

4—9 NEIGHBOURHOOD UNIT

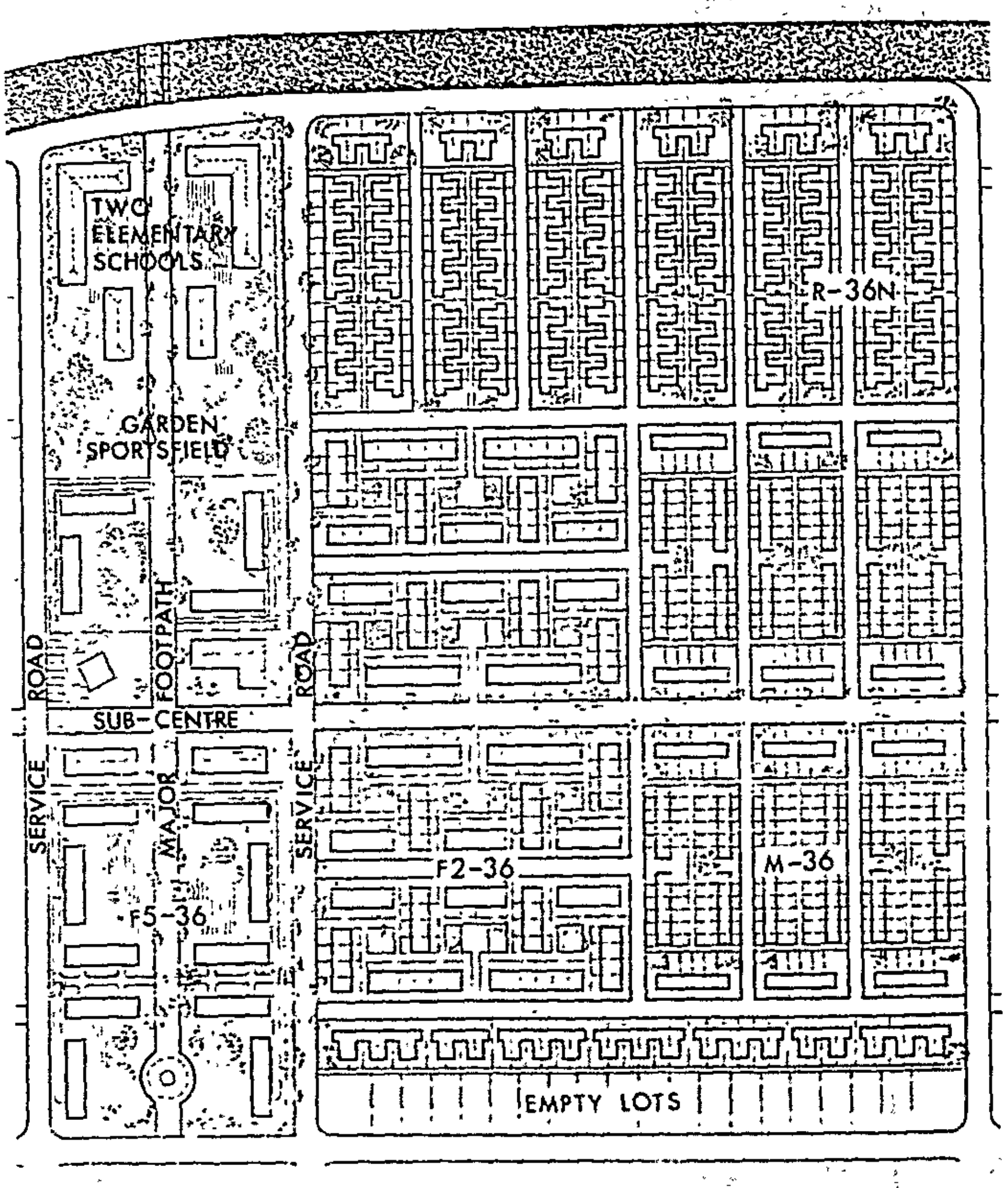


Fig. 4-32 NEIGHBOURHOOD UNIT PLAN (EXAMPLE)

4—10 DEVELOPMENT PLAN FOR THE RECOMMENDED ALTERNATIVE PLAN

Table 4-5 LAND USE DATA

			(ha)	(%)
Roads and footpaths			25	23
Open space			13	12
Lagoon	2.9	7.3		
Collector drainage				
Micro drainage	4.4			
Recreational facilities				
Playground	2.0	5.7		
Garden/Sportsfield	1.2			
Football field	1.5			
Park	1.0			
Social facilities			9	8
Educational facilities				
Kindergarten	1.5	6.3		
Elementary school	3.0			
Junior high school	1.1			
Senior high school	0.7			
Religious facilities				
Small mosque	0.25	0.75		
Mosque	0.5			
Medical facilities				
Health centre	0.2	0.8		
Hospital	0.6			
Administrative/Municipal Utility facilities		0.9		
Commercial facilities			7	6
Empty lots along Kapuk Kamal St.	4.4	7.0		
In the Town Centre	1.8			
In sub-centres	0.8			
Housing area			56	51

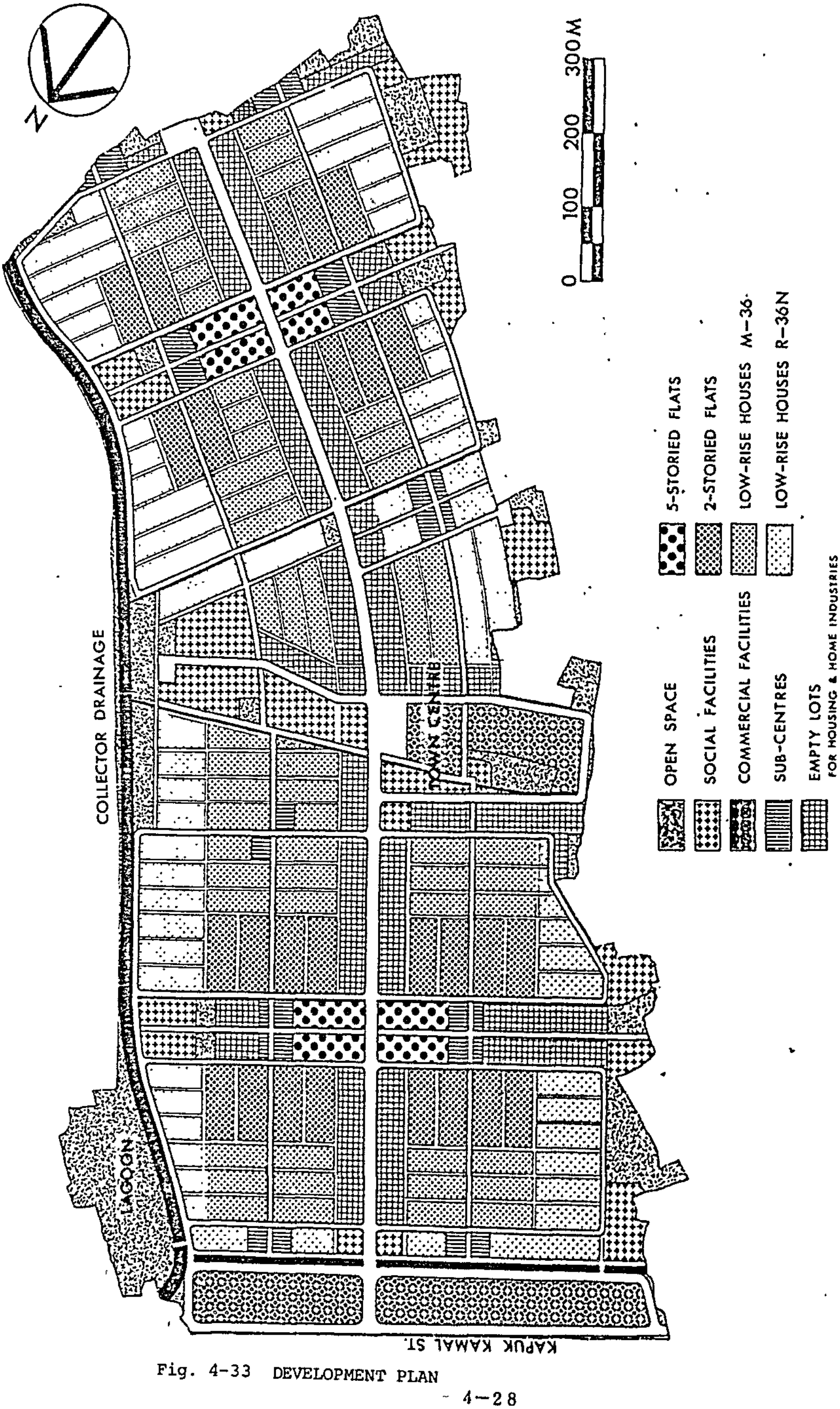


Fig. 4-33 DEVELOPMENT PLAN

APPENDICES

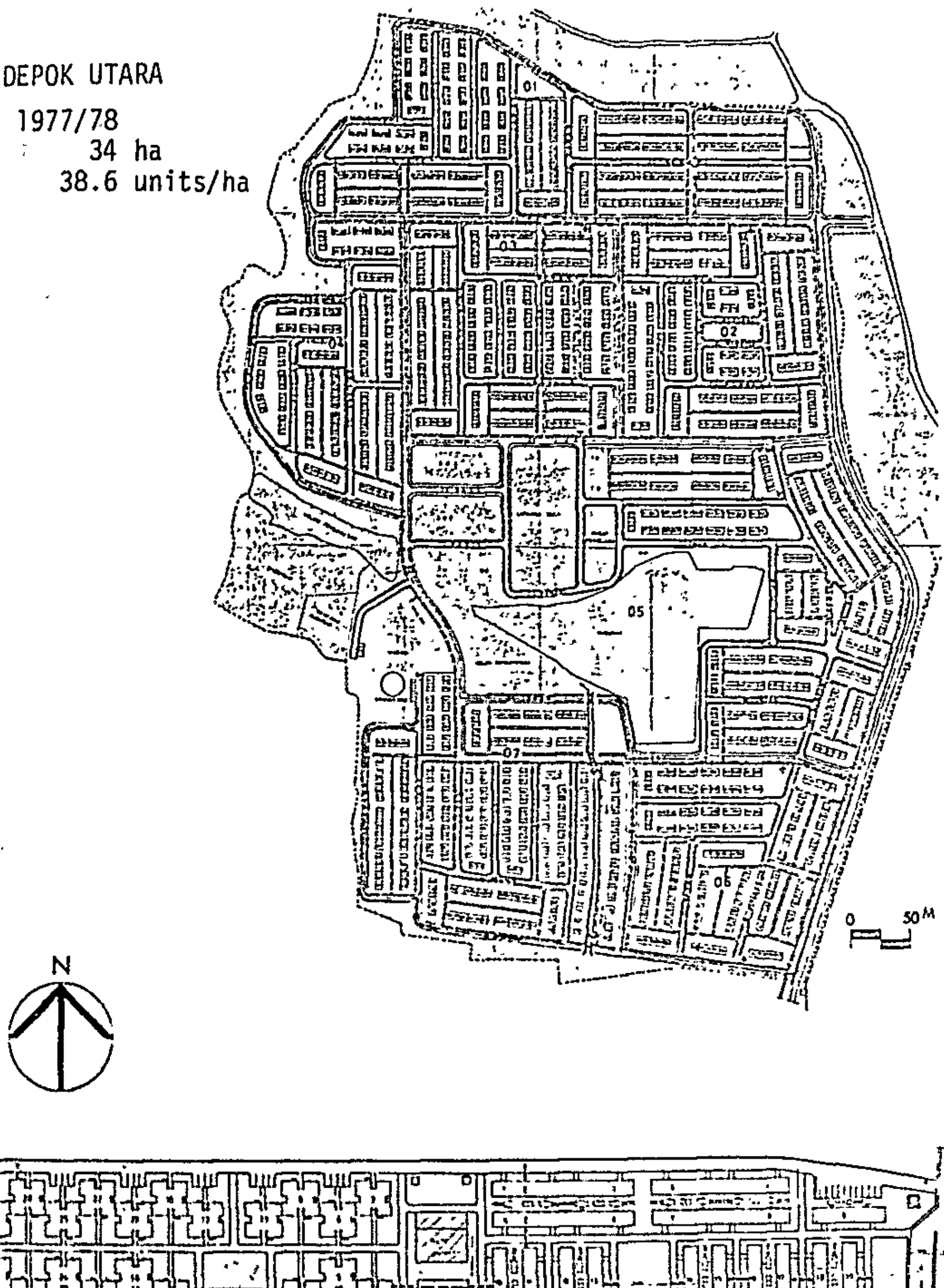
A EXAMPLES OF THE SITE PLANS OF PERUM PERUMNAS HOUSING COMPLEXES

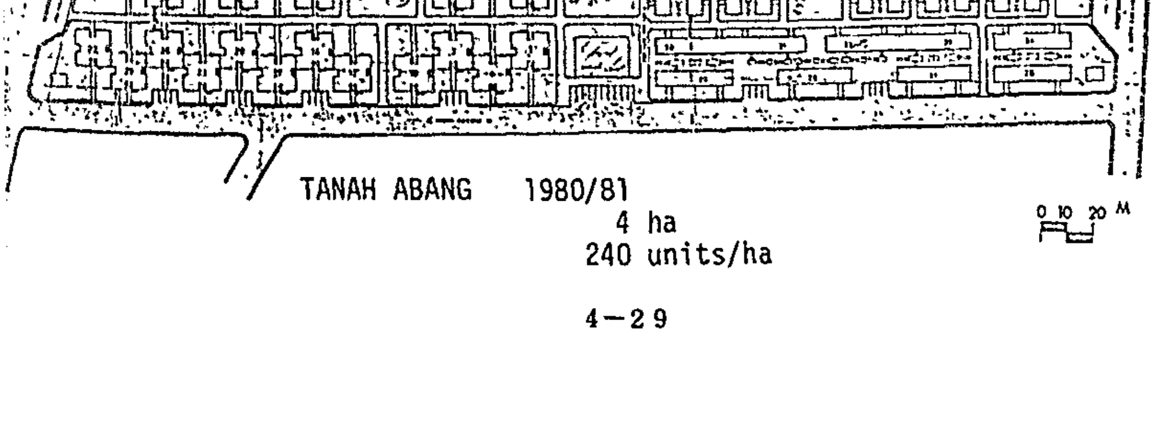
DEPOK UTARA

1977/78

34 ha

38.6 units/ha

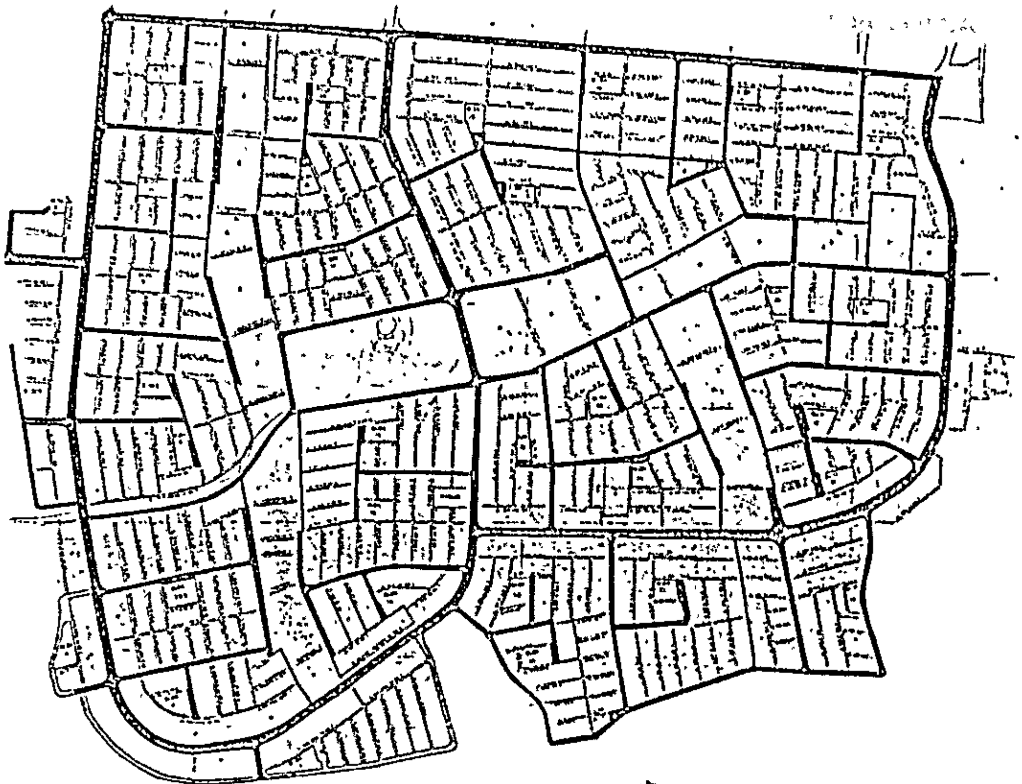




TANAH ABANG 1980/81

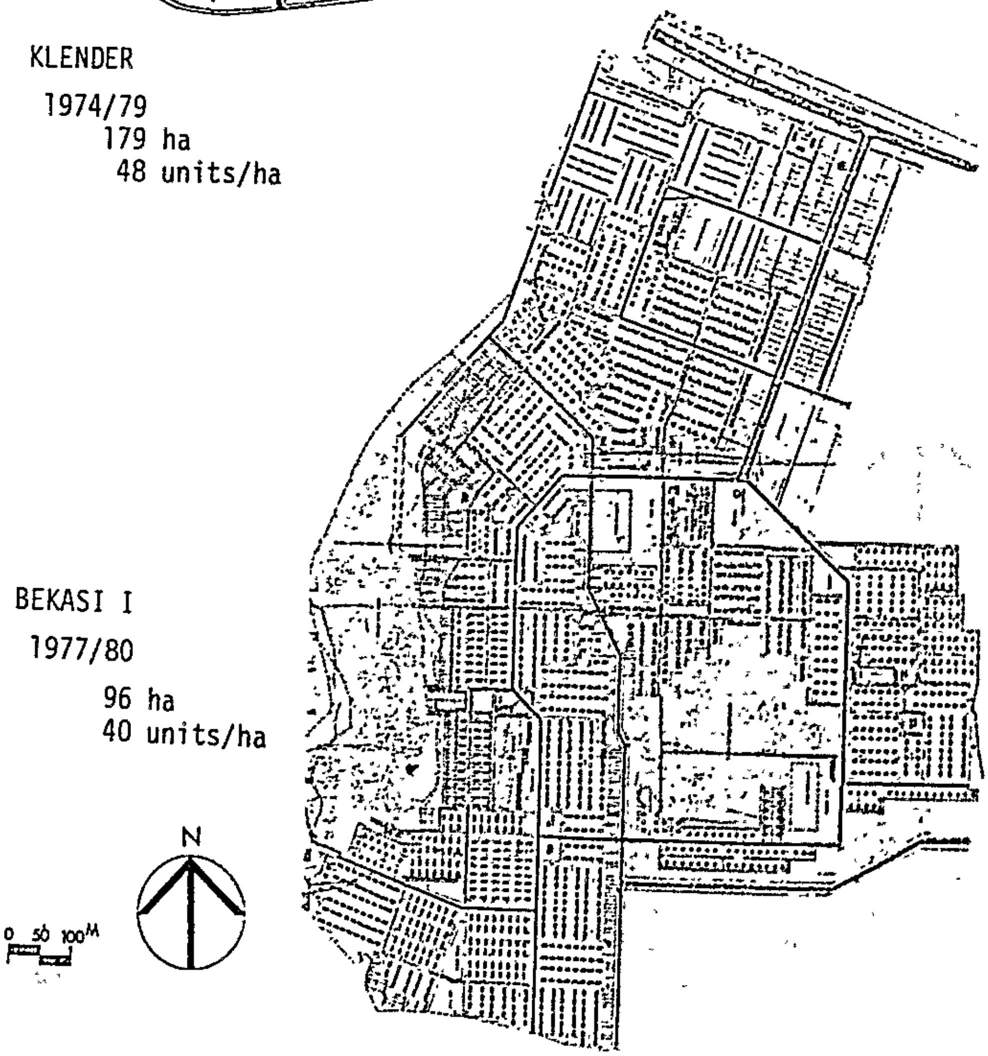
4 ha

240 units/ha



KLENDER

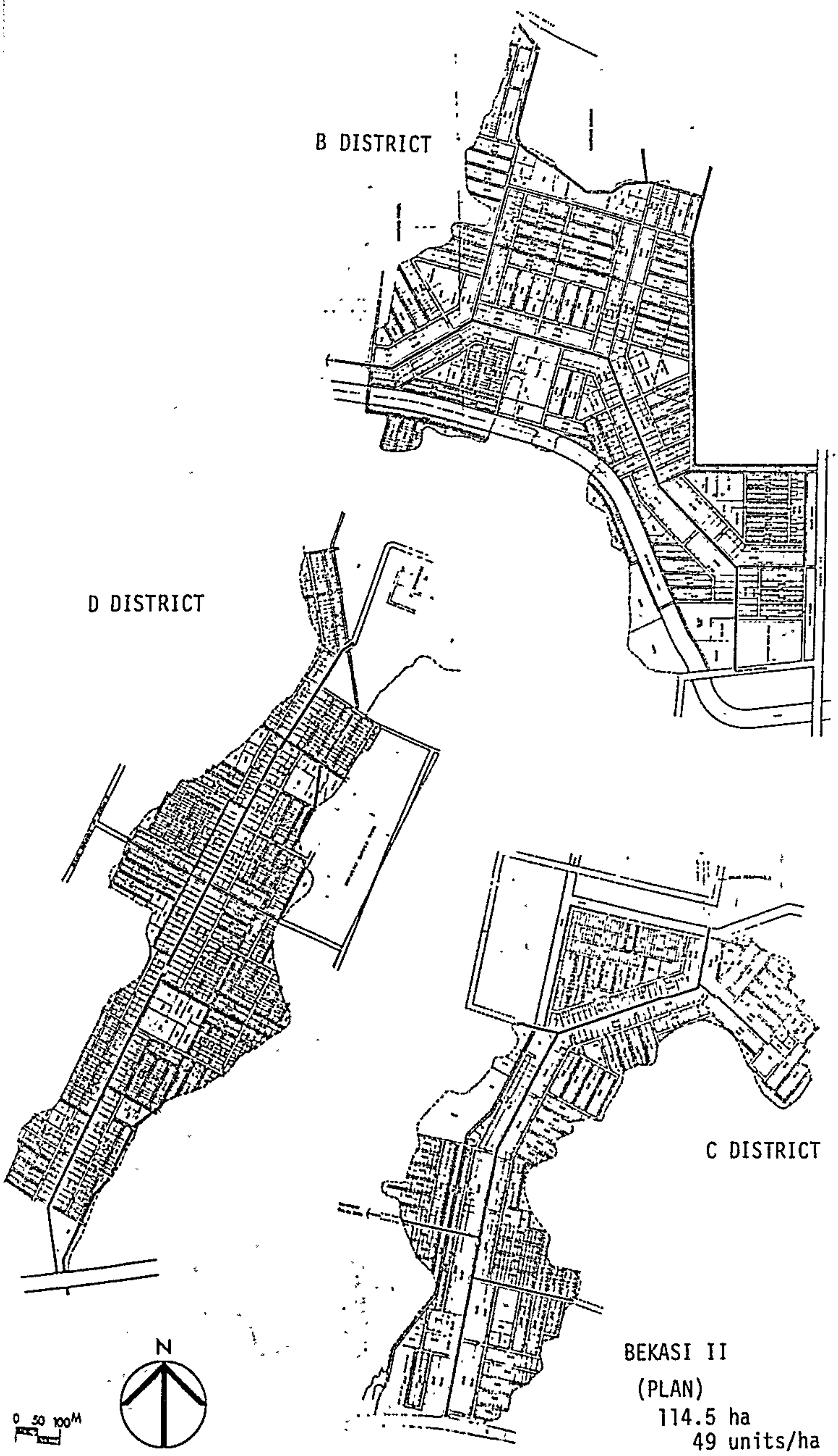
1974/79
179 ha
48 units/ha

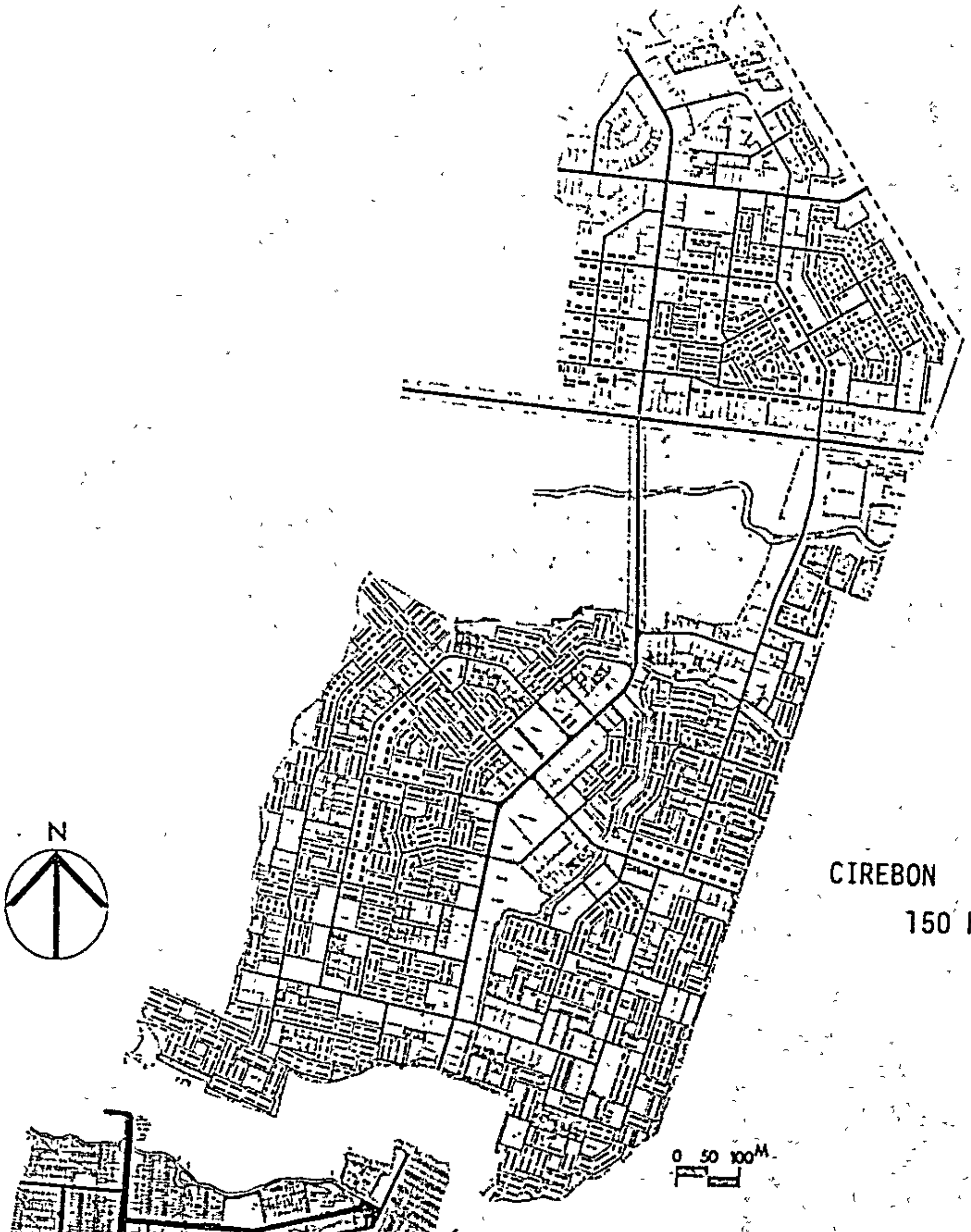


BEKASI I

1977/80

96 ha
40 units/ha

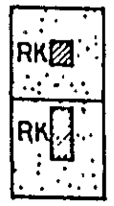
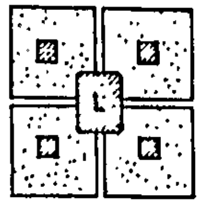
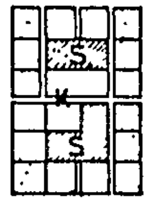
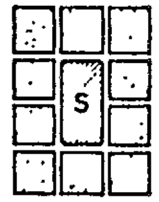
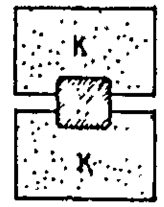
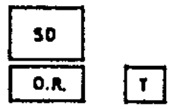
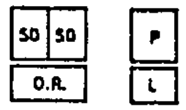
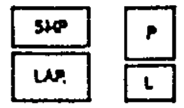
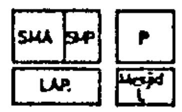

B DISTRICT
D DISTRICT
C DISTRICT
N
0 50 100M
BEKASI II
(PLAN)
114.5 ha
49 units/ha



CIREBON
150 ha

SEMARANG
96 ha
55 units/ha

B PERUM PERUMNAS GUIDELINES

COMMUNITY STRUCTURE AND FACILITIES	RUKUN KAMPUNG (RK)		RUKUN WARGA (RW)		LINKUNGAN (L)		SUB-DISTRICT (SD)		KELURAHAN (K)		SUB-PROVINCE (SP)	
NEIGHBOURHOOD STRUCTURE											SUB WILAYAH 	
LOT SIZE	60 / 90		60 / 90		90 / 120		90/120/160/200		90/120/200		90/120/200/300	
OPEN SPACE AND FACILITIES												
CENTRE			 Pusat R.W.		 Pusat Lingkungan		 Pusat Subdistrict		 Pusat District		 Pusat Kota	
FACILITIES	NO.	AREA (HA)	NO.	AREA (HA)	NO.	AREA (HA)	NO.	AREA (HA)	NO.	AREA (HA)	NO.	AREA (HA)
1. PLAYGROUND (Tempat bermain)	(1)	0.1	(2)	.2	(4)	.4	(8-10)	1.0	(20)	2.0	(40)	4.0
2. KIOSK/SMALL MOSQUE (Warung/Langgar)	(1)	0.05	(2)	.1	(4)	.2	(8-10)	.5	(20)	1.0	(40)	2.0
3. KINDERGARTEN/POLICLINIC (STK/Poliklinik)	(1)	0.1	(2)	.1	(4)	.2	(8-10)	1.0	(20)	2.0	(40)	4.0
4. ELEMENTARY SCHOOL (Sekolah Dasar)			(1)	.3	(2)	.5	(4-5)	1.0	(8-10)	2.0	(20)	4.0
5. GARDEN/SPORTSFIELD (Taman/Olah raga)			(1)	.2	(1)	.3	(2-3)	.6	(4-5)	1.2	(8-10)	2.4
6. SHOPS/MARKET (Toko-toko/Pasar)			(1)	.1	(1)	.2	(2-3)	.4	(4-5)	.8	(8-10)	1.6
7. MISCELLANEOUS FACILITIES (Fasilitas lainnya)					-	.2	(2-3)	.4	(4-5)	.8	(8-10)	1.6
8. JUNIOR HIGH SCHOOL (SMP)							(1)	.5	(2)	1.0	(4)	2.0
9. SOCCERFIELD (Lap. sepak bola)							(1)	.8	(2)	1.5	(4)	3.0
10. MARKET/LARGE SHOP (Pasar/Pertokoan)							(1)	.5	(2)	1.2	(4)	2.0
11. MOSQUE/MISCELLANEOUS FACILITIES (Mesjid/Fas.lainnya)							(1)	.3	(2)	.5	(5)	2.0
12. SENIOR HIGH SCHOOL (SMA)									(1)	.8	(2)	2.0
13. INDUSTRY/INSTITUTE (Industri/Inst.)									(1)	1.2	(1)	7.4
14. TOWN CENTRE (Pusat kota)											(1)	4.0
TOTAL AREA FOR FACILITIES (HA)	.25		.9		2.0		7.0		16.0		42.0	
SIZE OF THE COMMUNITY AREA (HA) / NO. OF UNITS	4 / 300		9 / 6-700		20 / 12-1500		50 / 3000		100 / 6000		240 / 12000	
PERCENTAGE OF THE AREA FOR FACILITIES	6 %		10 %		10 %		14 %		16 %		16 %	
DENSITY (UNITS/HA)	75		70		65		60		60		50	

5 INFRASTRUCTURES

TABLE OF CONTENTS

5-1 DRAINAGE SYSTEM

5-1-1 Present situation and Problems

a. Drainage system in DKI Jakarta

The drainage and flood control systems have developed together with the growth of DKI Jakarta, but the systems have not developed to the extent which the city requires. In addition, the river bed has become shallow due to sedimentary accumulation, abandoned refuse, and lack of necessary repair-work. For these reasons the maintenance and expansion of drainage and flood control systems should be reconsidered in order to keep pace with the rapid progress of DKI Jakarta. The current points concerning DKI Jakarta's drainage and flood prevention are:

1) Completion of drainage systems in the metropolitan area,
2) Prevention of flooding in the metropolitan area caused by run-off from the southern hill area,
3) Prevention of stagnation in the city's open sewers during the dry season.

<u>The origin of Proyek Banjir Jakarta Raya (PBJR)</u>

During February 1965 the Department of Public Works and Electric Power was in the process of producing a policy for a future development plan covering the years 1985 to 2000. To help to solve inherent problems in the program, a committee, henceforth known as "Proyek Banjir Jakarta Raya", was commissioned by a Presidential decree.

<u>Masterplan for drainage and flood control of Jakarta</u>

In November 1972, a tentative masterplan was fashioned with the help of the Netherland Engineering Consultants, NEDECO, including various alternatives to the criteria involved in drainage and flood control system.

On April 27th 1973, a conference was held by the concerned governmental body to discuss the various alternatives, and the principal foundations of the project were approved by the governor of DKI Jakarta. The drainage and flood control project was then introduced into the city's development program over the next few months, and detailed plans were made. As a compendium, a final report titled "Masterplan for Drainage and Flood Control of Jakarta" was presented by PBJR and NEDECO, in December 1973.

b. Western Banjir Canal

Present situation of the Western Banjir Canal

As a vital flood control system to Jakarta, the Western Banjir Canal was constructed in 1920. (see Fig. 5-1)

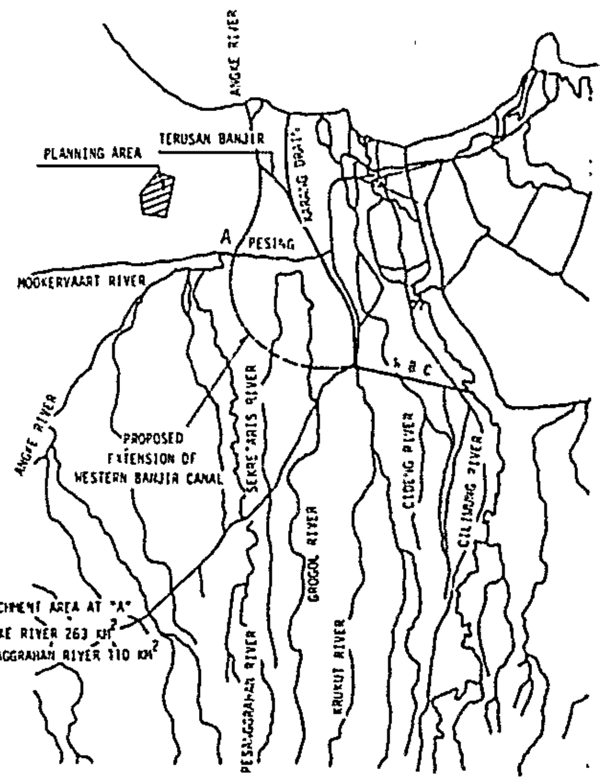


Fig. 5-1 EXISTING RIVERS AND CANALS IN WESTERN JAKARTA

Plans for the Western Banjir Canal

As proposed in the Masterplan presented in December 1973, the Western Banjir Canal was to be extended westwards from the point where the canal changes course to the north, and, on its circuit route around the low lying city, it was to collect the run-off from the up-land areas. It was determined possible that the proposed route would take the Western Banjir Canal from its dividing point with the existing canal, to join the Angke river at Pesing near the Jakarta-Tangerang railroad, and detailed research on the shortest possible route had been carried out by the city planning agency. (see Fig. 5-2(2))

Revised plans for the Western Banjir Canal

The distance from the existing Western Banjir Canal to the Pesing is approximately 8km, and from there it is another 6km to the Java Sea.

The original plan called for the Angke river to be widened, straightened, and both sides embanked.

Since 1973 efforts have been made to acquire land in the populated areas along the Angke River but, due to the difficulties involved in expropiation and the high cost of purchasing the lots abutting the river, the governor of DKI Jakarta decided to alter the location of the outlet to the Western·Banjir Canal. The canal was now to take a new route to the west of the Angke River.

c. Cengkareng Floodway

The current situation of the Cengkareng Floodway Project

When the study team visited PBJR in October 1979, they put forward two new alternatives to the extention of the Western Banjir Canal.

1) Rerouting the Western Banjir Canal away from the Angke River. (see Fig. 5-2(3))

2) Dividing the Western Banjir Canal into two. That is to say, running the drainage from the Ciliwung, Cideng, Krukut, Grogol and Sekretaris Rivers (56% of the total catchment area) into the existing Angke River, while the drainage from the Pesanggrahan and Angke Rivers (44% of the total water surface area) is disposed into the Java Sea through a new canal, namely "the Cengkarang Drain". (see Fig. 5-2(4), (5)) When the study team revisited PBJR in August 1980, this "Cengkarang Drain" had been renamed the "Cengkarang Floodway".

The latter scheme "Cengkareng Drain" is briefed in a publication "PENJELASAN SINGKAT PENANGGULANGAN MASALAH BANJIR"* (in Indonesian) by the Ministry of Public Works in 1979.

* ... "Brief Explanation on Measures of the Flood Control and Drainage in DKI Jakarta" in English.

Hydraulic data included in the Masterplan

River	Catchment Area (sq.km)	(%)	- do - (sq.km)	Accumulated (%)	Design flood Q2	Q25	Q100 (cu.m/s)
Ciliwung	347	41	347	41			
Cideng	8	1	355	42			
Krukut	98	11	453	53			
Grogol	13	2	466	55			
Secretaris	8	1	474	56	150	270	370
Pesanggrahan	110	13	584	69			
Angke	263	31	847	100	190	400	525
Total	847	100					

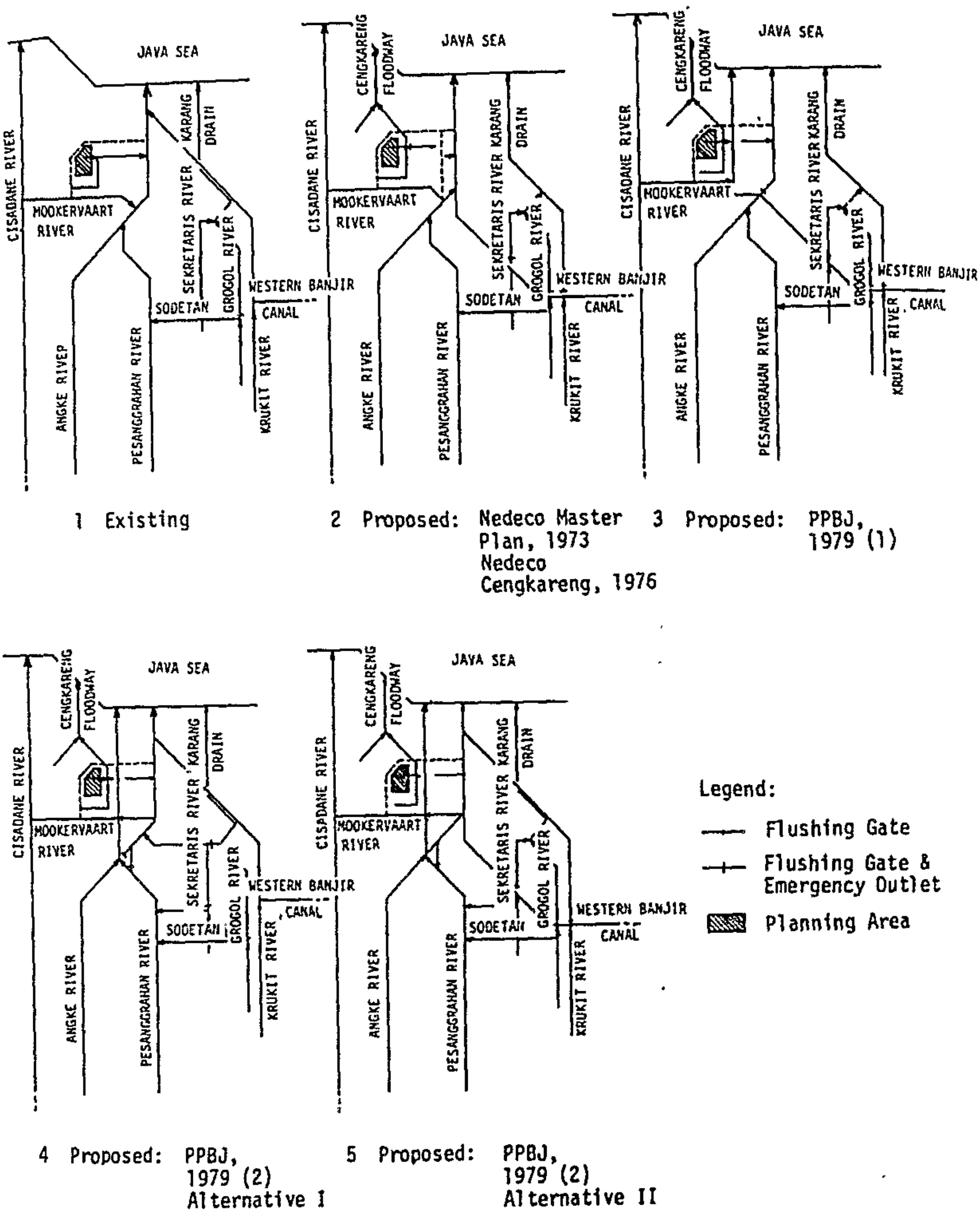


Fig. 5-2 FLOOD CONTROL AND DRAINAGE SYSTEM IN WESTERN JAKARTA

Proposed plans for the Cengkareng Floodway

To date (October 1980), the project has been following the plan as shown in Fig. 5-2(4).

This project is a vast metropolitan drainage system which simultaneously aims at achieving flood control of the up-stream urban areas. The entire project is scheduled to take three years from 1980 to its planned completion in March 1983.

The earth moving and the bridge construction works are to be carried out under separate tenders, the earth moving operation being divided into three stages. Stage 1 covers the 3.6km from the Java Sea to Kapuk Street, Stage 2 covers 2.35km from Kapuk Street to Mookervaart River and Stage 3 covers a distance of about 4.0km upstream along the Mookervaart River. (see Fig. 5-3)

The first stage was initiated at the end of 1980 and the excavation is to take from 9 to 12 months. The excess earth produced during this period will be used for the foundation work on the cemetery area planned for the north side of Kapuk Street. This whole operation is to be funded by the Indonesian Government.

The excavation work on 1/3 of the northern section of Stage 2 will involved dredging, due to damp conditions, but 1/5 of the southern section is dry. The type of operation to be used for the remaining 7/15 of stage 2 is yet to be determined. This operation, which is to be carried out between August 1981 and October 1982, is to be financed with economic assistance from Holland.

Prior to excavation, the volume of earth in the Stage 2 zone is 550,000 - 600,000m^3, and from this, 375,000 - 400,000m^3 is considered to be the residual volume since some of the earth will be used for the embankment.

Since Stage 2 involves this embankment being built, the existing drainage channel (Kapuk Muara River) will be cut off, and an outlet gate is planned to be constructed in the bank to relieve the contained water.

The construction during Stage 3 will be carried out through the Dutch Economic Aid Program.

The cross-section of the Cengkareng Floodway is designed for a return period of 100 years and without a bank protection. The flow is V = 1.5 - 1.7 m/sec (as opposed to the figure for a 25 year return period). A sketch of the cross section is shown in Fig. 5-4.

The effect of the Cengkareng Floodway on the areas within and surrounding the operational zone

The extensive Cengkareng Floodway project aims at constructing a system which will function both for drainage and flood control, but this planned drainage channel does not cater for the 590ha catchment areas surrounding the project zone.

At the movement, this area drains into the Kapuk Muara River, which is a tributary to the Angke River, but in constructing embankments for the Cengkareng Floodway, the Kapuk Muara River will be checked and the catchment area will lose this outlet. (The outlet gate to be installed is to operate when the surrounding water level exceeds that of the water level in the floodway, thus causing a difference in pressure, and therefore, it will lose this effect when the level of water within the channel rises excessively during the rainy season. Furthermore, we cannot rely on its ability to cope with the amount of run-off after construction, making it unfeasible to rely on the gate alone for the discharge.) Consequently, the drains from this area will accumulate rain water and will probably swamp much of the land, making necessary some other counteractive mechanism. As a solution to this problem, PBJR are currently investigating the possible adoption of the Macro- and Collector drainage systems. (see Fig. 5-3,4)

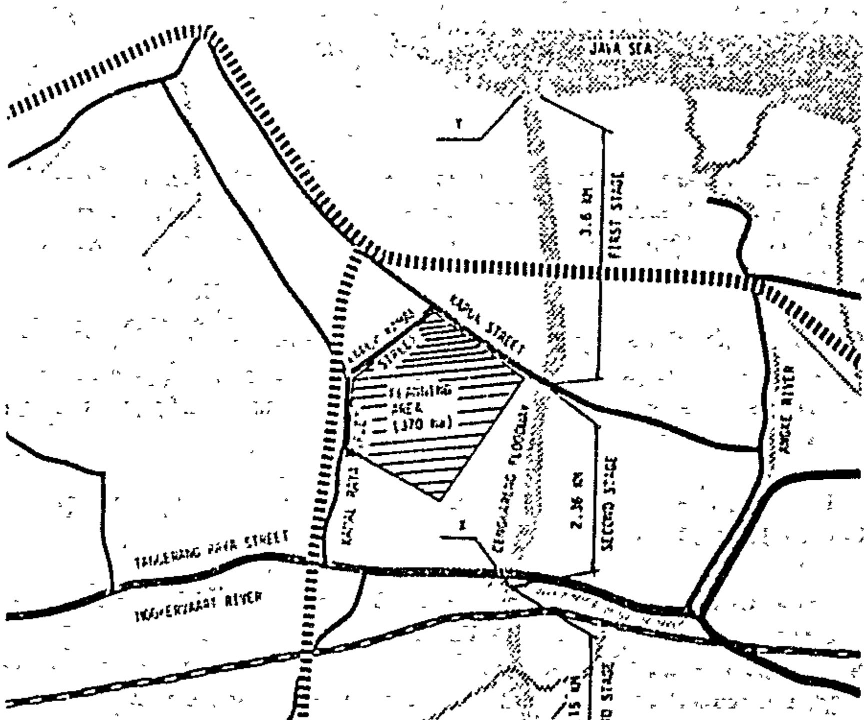


Fig. 5-3 CENGKARENG FLOODWAY

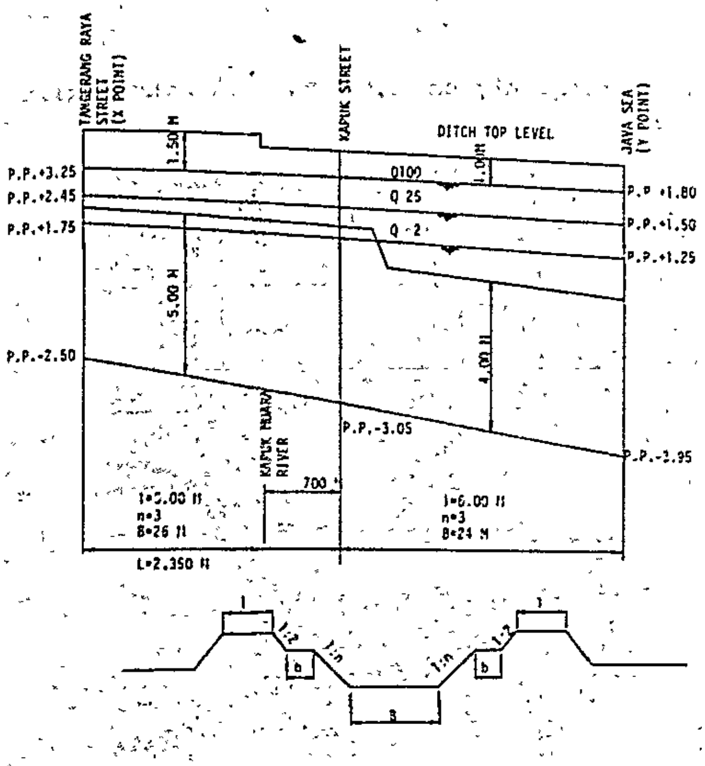


Fig. 5-4 CROSS SECTION OF CENGKARENG FLOODWAY

d. Present situation of the surrounding areas

<u>Outline of present situation</u>

The proposed waterway lies within the 590ha catchment area in receiving the Angke River's tributary, Kapuk Kamal River. The discharge of surplus water from the surrounding paddy-fields into the Kapuk Kamal and Kapuk Muara Rivers has such a significant effect on the amount of flow that their capacity in receiving drainage from the catchment area is small. At the moment, the burden on the river is temporarily relieved by controlling the flow through the paddy-fields, but on completion of the project, their ability to accept the influx of drained rain water from the catchment area will be highly insufficient.

The Kapuk Kamal River is 3m wide and 1.3m deep, with hardly any hydraulic gradient, while the Kapuk Muara River is 5 - 6m wide, 1.5 - 2.0m deep, with a hydraulic gradient of 1/2450. The rivers follow a route through the low lying valley and altitude at the place of origin is 2.5 - 3.0m. Consequently, both rivers are affected by torrential downpours and tides to the extent that flow becomes static or, in some cases, reverses upstream. The water for the paddy-fields originates from the Cisadane through the Raw Gabus (irrigation) Rivers (width of 7.0m). As to the condition of the river banks, a 500m upstream section on the Kapuk Muara River is lined with concrete, but it is otherwise banked with earth and is in a bad state of repair. The

Rawa Gabus River is currently having stonework banks built along it. (see Fig. 5-5)

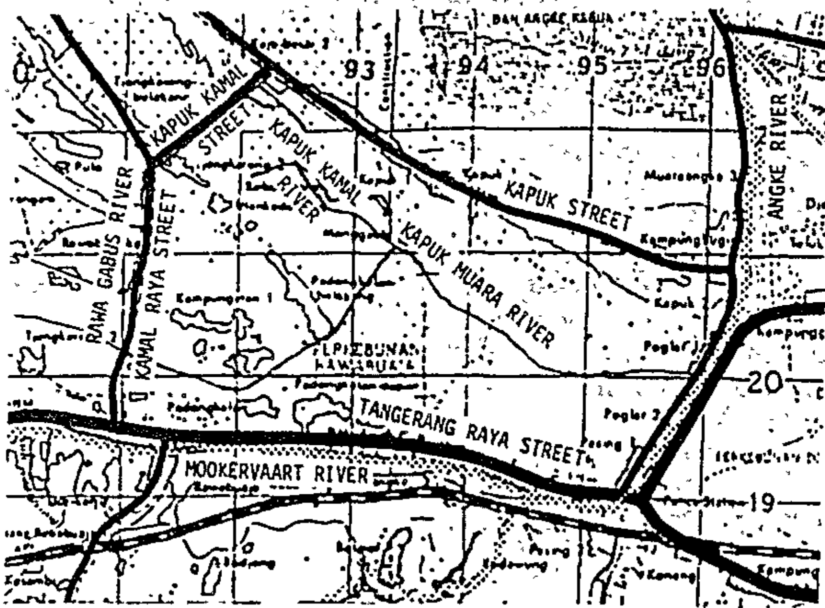


Fig. 5-5 EXISTING DRAINAGE SYSTEM AND ROADS AROUND PLANNING AREA

<u>Evidence of flooding</u>

During August 1980, the study team carried out a search for any evidence of floods in the surrounding area, and as a result, evidence of a large scale flood in recent years was discovered near the conflux point of the Kapuk Muara and Angke Rivers. (see Fig. 5-6) Traces were found on a stone post in a village by Angke River, and on brief measurement from a bridge furthest down river on the Kapuk Muara River, the flood level was found to be p.p. +3.087m. The exact year of the flood could not be determined from information given by the inhabitants, and so the team examined the rainfall data recorded at the Cengkareng Meteorological Station. (see Table 5-1) The information for the thirteen years prior to 1978 revealed that the heaviest rainfalls have been concentrated in recent years, and that there were four occasions when the daily fall exceeded 120mm. Since flooding in the area is also related to the tides, the heaviest rainfall does not necessarily cause the greatest flood, but the fact that the flood occured in recent years and that there had been heavy falls in 1973, 1974, 1976 and 1977, indicates that the flood occured in one of these 4 years.

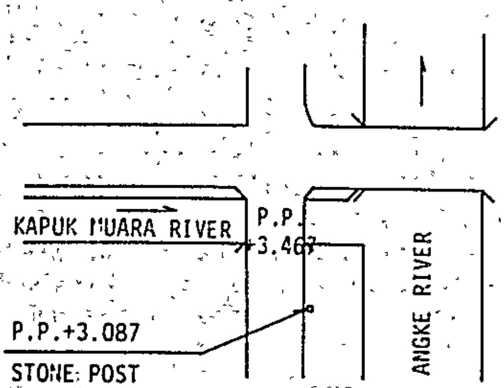
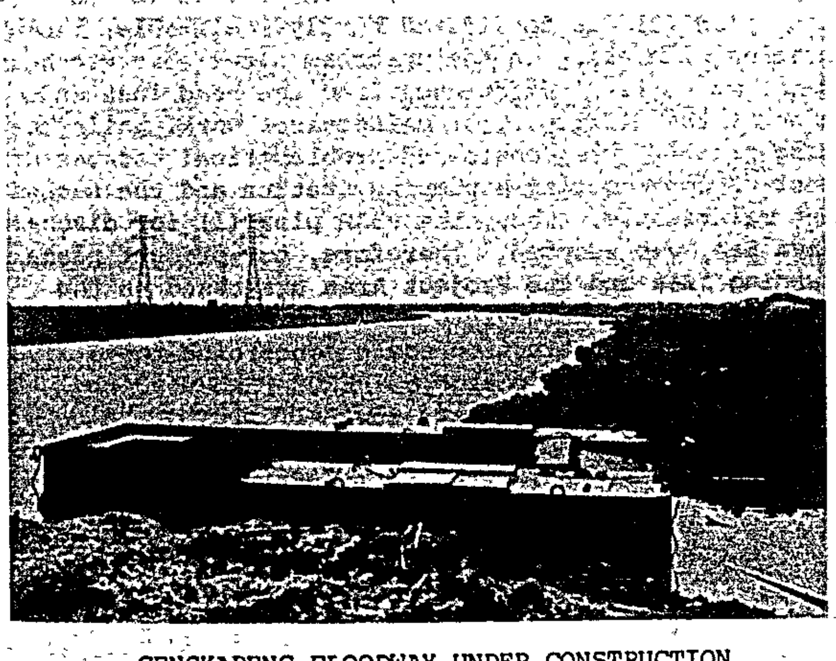


Fig. 5-6 TRACE OF FLOOD IN CENGKARENG DRAINAGE

Table 5-1 DAILY RAINFALL DATA IN CENGKARENG

Year	Month	Day	Rainfall/day (mm)
1973	January	27	152
1974	January	9	130
1976	March	5	151
1977	January	19	123



CENGKARENG FLOODWAY UNDER CONSTRUCTION
(MARCH, 1981)

5-1-2 Drainage system for the Planning Area and vicinity (Macro and collector drainage systems)

a. How plan was formed

Survey results in 1979 showed that a drainage plan for areas including this Planning Area has been drafted in the February 1976 report of the PBJR and the NEDECO entitled: "Explanatory Notes on the Design of the Cengkareng Drainage System - Annex VIII to Final Report Phase II, Jakarta Drainage and Flood Control Project". This drainage system was designed to discharge rain water from the drainage basin of the Planning Area and its vicinity directly into the Java Sea.

By the time of the later surveys in August and October 1980, the drainage routes in that previous draft plan had been studied further.

The terminal drainage system in the drainage basin including the Planning Area, is most important for the preparation of this Project Area and its drainage plan, and if a system of discharging rain water directly into the Java Sea was not realized, another terminal drainage system would naturally becomes necessary. So, alternative plans werr formed during our survey of October and November 1980 and three plans were submitted to the Work Control Committee Meeting in Jakarta for deliberation. They were (1) the above-mentioned plan for direct discharge into the Java Sea (PBJR plan), (2) a plan for pump discharge into the Cengkareng Floodway (Study Team's plan) and (3) a plan to cross the Cengkareng Floodway by a syphon, for discharge into the existing canal (Kapuk Muara River), which we regarded as the terminal canal (Study Team's plan). The result was that the syphoning plan (3) was considered hardly realizable, because large quantities of banking on the upstream sites were necessary, to keep up the water level difference from the head loss and also, because of the difficulty of maintenance work, while the pump draining plan (2) was considered problematical because of the high cost of constructing a pumping station and the necessity of permanent maintenance. Thus, the PBJR plan (1) for discharge into the Java Sea, was adopted. Therefore, our present plans for the Planning Area and the Project Area are based on the PBJR plan for direct discharge into the Java Sea as the terminal drainage system. All construction costs concerning these alternative plans are outside the charge of PERUM PERUMNAS.

The position of drainage canals in the Project Areas, as proposed in the PBJR plan, is partially amended as follows: The collector drainage canal on the west side be moved to the east side for reasons of land use, while the collector drainage canal on the north side be amended according to natural topography. (see Fig. 5-7)

b. Principles of macro- and collector drainage system

Discharge load evaluation

Return period	25 years (2 years)
Run-off coefficient (α)	0.7 (medium density residential area)
Discharge formula	Retaional method
Drainage gradient (s)	0.3 - 0.5%
Retention factor (δ)	2 (Cengkareng low lying area)
Manning's roughness coefficient (K.M)	37 (earth channel)

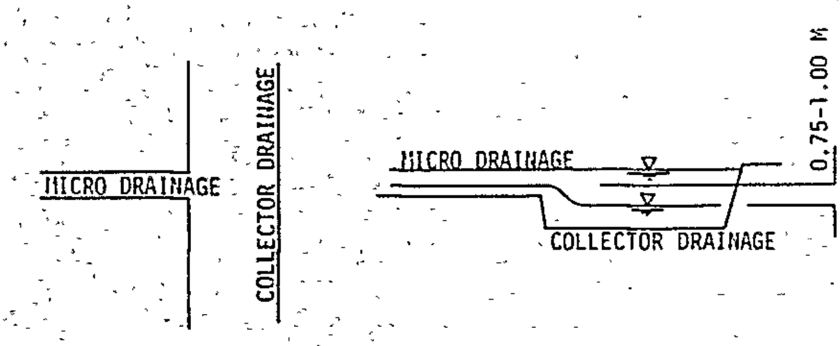
Evaluation of channel cross-section

Manning's formula: $Q = A \times V$ $V = K \times I^{1/2} \times R^{2/3}$

A = Cross-sectional area of flow
V = Velocity of flow
K = Manning's roughness coefficient
I = Drainage gradient
P = Wetted perimeter

Water levels in collector and micro-drainage channels

The "Master Plan for Drainage and Flood Control of Jakarta" water levels recommended for the collector and micro-drainage channels are as shown below:



Flushing

Flushing of open channels is carried out during the dry season, or during time when the channel is dry, and it is an effective means of clearing the mud and waste accumulating within the channel.
It is planned to use the Collector Drainage System in the 590ha area around the Planning Area, but the Flushing gate will be included as a necessary component of the system.

c. Details of the alternative systems

C-1 Direct discharge system

Outline

Proposed during the 1980 study session by PBJR as a possible macro- and collector drainage system, it is based on handling the concerned area's rain water drainage separately from the Cengkareng Floodway Project, and discharging through a new route into the Java Sea. The proposal, therefore, does not only cater for the 590ha catchment area in the planned zone, but also caters for all the surrounding low lying areas. However, here we shall only deal with the relevant 590ha catchment surface area and its related outlet channels. Also, the term macro- drain shall here signify the primary drainage system (between Kapuk Street and the Java Sea) and collector drain shall signify the Secondary Drainage system. (see Fig. 5-7)

* Macro drainage and collector drainage

  These are drainage canals designed so as to have sufficient capacities for a 25-year return period, and will be constructed by the Ministry of Public works.

  Macro drainage canals are main calans in this drainage system, while collector drainage canals are quasi-main canals in the system.

C-2 Pumping system

This was put forward by the study team as one of the alternative methods of drainage disposal. It involves the installation of a regulating reservoir and a pump-house to discharge into the Cengkareng Floodway. As to the discharge, since the planned catchment area does not include the downstream section of the Mookervaart River, utmost care must be taken in order to avoid excessive loading. For this reason, about 5% of the estimated capacity of the floodway (Q_{25}: 200 - 230 m^3/s) will be taken as the permissible discharge load. For the regulating reservoir, structural analysis based on the 25 year return period as used for the macro- and collector drains will be favourable, but due to its small amount of discharge relative to the return period, the burden on the reservoir will become excessive. Therefore, the reservoir will be designed based on a 2 year return period, and for the excess return, it must be assumed that the reservoir will at times be full.

The assessment for this pumping system must take into account the 590ha around the Planning Area and the 150ha triangular area enclosed by the Kapuk Street, the Harbour Road (currently being planned by DKI Jakarta) and the floodway. This system uses two separate reservoirs and pumping stations, making the construction costs far higher than with the Direct Discharge Plan (into the Java Sea). In addition, since it is not a free flowing discharge system, the maintenance costs will also be high, and for such reasons this system must be considered economically more disadvantageous than the direct discharge system. The planned project area lies at an altitude of p.p + 2.7 - 3.5m and a free flowing discharge should be possible, but if lot acquisition or other obstacles prevent the construction of a direct discharge channel to the Java Sea, then the Pumping System will become necessary. (see Fig. 5-9,10)

(1) Structural analysis of the reservoir

<u>Rainfall intensity of 2 year return period</u>

$$i = \frac{16,286}{t_2 + 51.43} \text{ (l/sec/ha)} \rightarrow i = \frac{5,863}{t_2 + 51.43} \text{ (mm/hr)}$$

run-off coefficient (c) 0.7

<u>Capacity of reservoir</u>

<u>Reservoir A</u> (Total catchment area A = 590ha)

Permissible discharge flow Q_C = 10m^3/s (Discharged through pumps)
Rainfall intensity corresponding to permissible discharge flow i_C

$$i_C = \frac{360 \times Q_C}{C \times A} = \frac{360 \times 10.0}{0.7 \times 590} = 8.72 \text{ mm/hr}$$

Maximum capacity of the reservoir V, is given by,

$$V = \left(\frac{5,863}{t + 51.43} - i_c\right) \times 60 \times t \times c \times A \times \frac{1}{360}$$

Differentiating from the former equation, at point of maximum V, $\frac{dV}{dt} = 0$, we obtain the maximum capacity of the reservoir, $V = 211,200m^3$ at time, t = 134 minutes.

Reservoir B (Total catchment area A = 150ha)

Permissible discharge flow, $Q_C = 2.0m^3/s$ (Discharged through pumps)
Rainfall intensity corresponding to permissible discharge flow, i_C,

$$i_C = \frac{360 \times Q_C}{C \times A} = \frac{360 \times 2.0}{0.7 \times 150} = 6.86 \text{ mm/hr}$$

Substituting i_C in the equation given previously, we obtain the maximum capacity of reservoir, $V = 58,400m^3$ at time, t = 58 minutes.

(2) Pumping station

Pumping station A

i. Pump

Discharge flow $Q = 10.0 \text{ m}^3/\text{s} \longrightarrow 600 \text{ m}^3/\text{min}$
Diameter of inlet to pump,

$$D = 146 \sqrt{\frac{Q}{V}}$$

D = Diameter of inlet to pump (mm)
Q = Discharge flow (m^3/min)
V = Velocity of fluid at inlet

If 5 pumps are used, discharge for each pump $q = 120 \text{ m}^3/\text{min}$. Setting the velocity of fluid at V = 2.0 m/s (standard values are V = 1.5 - 3.0 m/s), we obtain from the above equation $D = 146\sqrt{\frac{120}{2.0}} = 1,131\text{mm} \doteqdot 1,150\text{mm}$.

Therefore, 5 horizontal axis pumps with $\phi = 1,150$mm are required.

ii. Motor

$$P_S = \frac{0.163 \gamma Q H}{\eta}$$

P_S = axial power of pump (Kw)
Q = Discharge flows (m^3/min)
H = Total head (m)

γ = Density of fluid (Kg/ℓ)
η = Efficiency of pump

$$P_S = \frac{0.163 \times 1 \times 120 \times 7}{0.82} \fallingdotseq 167 \fallingdotseq 160\text{Kw (each pump)}$$

Q = 120 m^3/min
H = 7.0m
γ = 1.0 (density of water)
η = 0.82

From this, 5 motors with $P_S \fallingdotseq$ 160Kw are required.

iii. Emergency generator

A necessary safeguard in case of power failure is the installation of an internal combustion diesel generator.

Emergency generator (Diesel internal combusion)

$$P_E \geqq \frac{1.36\ Pr}{\eta_G}$$

P_E = Generator output (PS)
Pr = Power required at station (Kw)
η_G = Efficiency of generator (0.85 - 0.90)

$$\therefore P_E = \frac{1.36 \times 1{,}000}{0.85} = 1{,}600\text{PS}$$

The following are required as necessary components of the generator system:-

(1) Fuel tank
(2) Operating device
(3) Colling device
(4) Over head crane

iv. Electrical fittings

Power supply and transmission cables.

v. Pump house and water tank

Pump house 40m × 30m
Water tank 20m × 20m × 3m

Pumping station B

i. Pump

Discharge flow = Q = 2.0 m^3/s → 120 m^3/min
Diameter of inlet to pump,

Assuming that 3 pumps will be used, then the discharge from each pump $q = 40m^3/min$, and taking the velocity of fluid to be, $V = 2.0$ m/s,

$$D = 146 \sqrt{\frac{40}{2.0}} = 653mm \doteqdot 650mm$$

Thus 3 horizontal axis pumps of ϕ = 650mm are required.

ii. Motor

$$P_S = \frac{0.163 \times 1 \times 40 \times 7}{0.82} = 55.7 \doteqdot 55Kw$$

Therefore 3 motors of P_S = 55Kw are required.

iii. Emergency generator

Generator output (Diesel internal combustion)

$$P_E = \frac{1.36 \times 300}{0.85} = 480 \doteqdot 500 \text{ PS}$$

Other necessary components:-

(1) Fuel tank
(2) Operation area
(3) Cooling system
(4) Overhead crane

iv. Electrical fittings

Power supply and transmission cables.

v. Pump house and water tanks

Pump house	30m × 25m
Water tank	10m × 10m × 3m

C-3 Syphone system

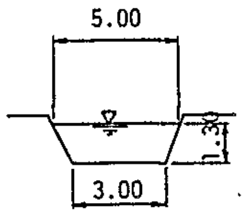
Outline

The drainage from the rain water in the 590ha catchment area surrounding the Planning Area, is discharged via the Kapuk Muara River, into the Angke River. This system plans to increase the load on the existing waterway (Kapuk Muara River) by adding to it the drainage from the Planned Area through syphons below the Cengkareng Floodway.

With a 80cm difference in water level between each end of the syphons, the system is physically possible. The planned water level at the outlet is approximately P.P. + 2.6m, and so, in order to satisfy the requirements, the area around the inlet must be at least P.P + 3.60m high. The amount of earth filler required for this would be about $1.08 \times 10^6 m^3$ making the cost of earth moving alone over 3 billion rupias. This figure is much higher than the other alternatives, and with the need of a complex maintenance facility, the possibility of this system being adopted is very low. (see Fig. 5-10)

Hydraulic analysis of the syphon

EXISTING DRAINAGE CROSS SECTION



Cross sectional area of flow $A = 1/2(5.00 + 3.00) \times 1.3$
$= 5.2m^2$

Wetted perimeter $p = 6.28m$
Hydraulic mean radius $R = A/p = 0.828m$
Drainage gradient $I = 0.46$ 0/00
Roughness coefficient $k = 37$

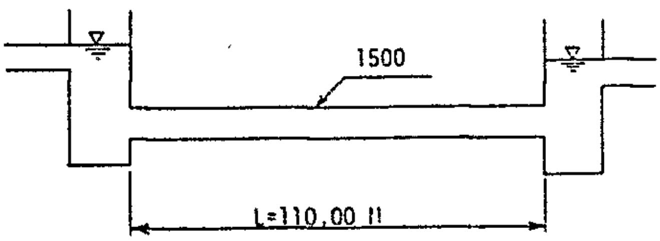
Using Manning's formula, the velocity of flow, V, is given by,

$$V = k \times I^{1/2} \times R^{2/3} = 37 \times 0.00046^{1/2} \times 0.828^{2/3} = 0.700 \text{ m/s}$$

The amount of discharge Q, is given by,

$$Q = A \times V = 5.2 \times 0.700 = 3.64 \text{ m}^3/\text{s}$$

Calculation of head loss in syphon



$$H = i \times l + 1.5 \frac{v^2}{2g} + \alpha$$

H: Head loss in syphon (m)
i: Hydraulic gradient corresponding to the velocity of flow in the syphon
l: length of syphon (m)
v: Velocity of flow in syphon (m/s)

g: Acceleration due to gravity (9.8 m/sec^2)
α: Allowance for sedimentation 5cm

Calculated discharge, $Q = 3.64\ m^3/s$.

Taking φ1500mm for the syphon, the velocity of flow in the syphon, V, is given by,

$$V = Q/A = \frac{3.64}{1.5^2 \times 3.14 \times 1/4} = 2.061\ m/s$$

According to Manning's formula, the hydraulic gradient i, is given by, $i = (\frac{V}{k \times R^{2/3}})^2 = (\frac{2.061}{67 \times 0.375^{2/3}})^2 = 0.0035$

k = 67 (reinforced concrete pipe)
$R = \pi r^2/2\pi r = 0.375m$

Therefore, the head loss across the syphon is given by

$$H = 0.0035 \times 110.0 + 1.5 \times \frac{2.061^2}{2 \times 9.8} + 0.05 = 0.76m$$

<u>Capacity of reservoir</u>

Catchment area A = 590ha
Permissible discharge flow $Q_C = 3.64\ m^3/s$
Run-off coefficient C = 0.7
Rainfall intensity of 2 year return period i

$$i = \frac{5{,}863}{t_2 + 51.43}\ mm/hr$$

Rainfall intensity corresponding to permissible discharge flow i_C

$$i_C = \frac{360 \times Q_C}{C \times A} = \frac{360 \times 3.64}{0.7 \times 590} = 3.17\ mm/hr$$

Maximum capacity of reservoir V

$$V = (\frac{5{,}863}{t + 51.43} - \frac{i_C}{2}) \times 60 \times t \times c \times A \times \frac{1}{360}$$

Differentiating from the former equation, at point of maximum V, $\frac{dV}{dt} = 0$, we obtain the maximum capacity of the reservoir,

$V = 313{,}970m^3$ (t = 385 minutes)

Assuming 2 meters depth, the area of the reservoir is $S = 157{,}000m^2$.

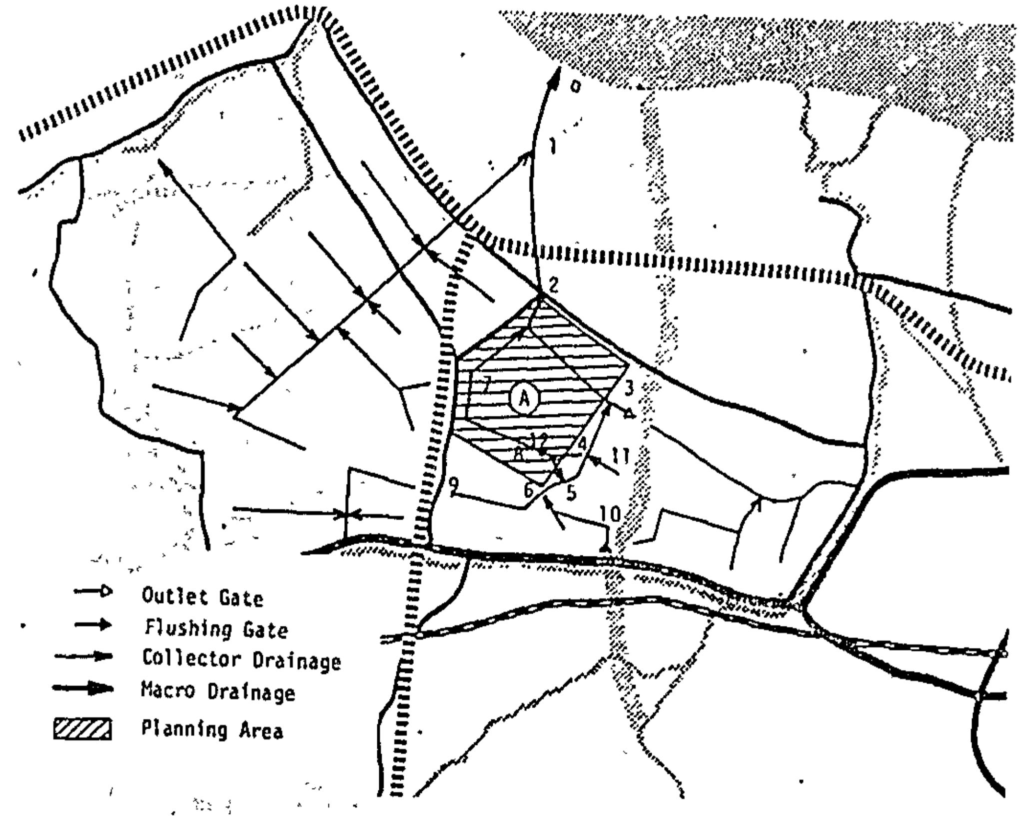


Fig. 5-7 MACRO AND COLLECTOR DRAINAGE SYSTEM PROPOSED BY PBJR, 1980

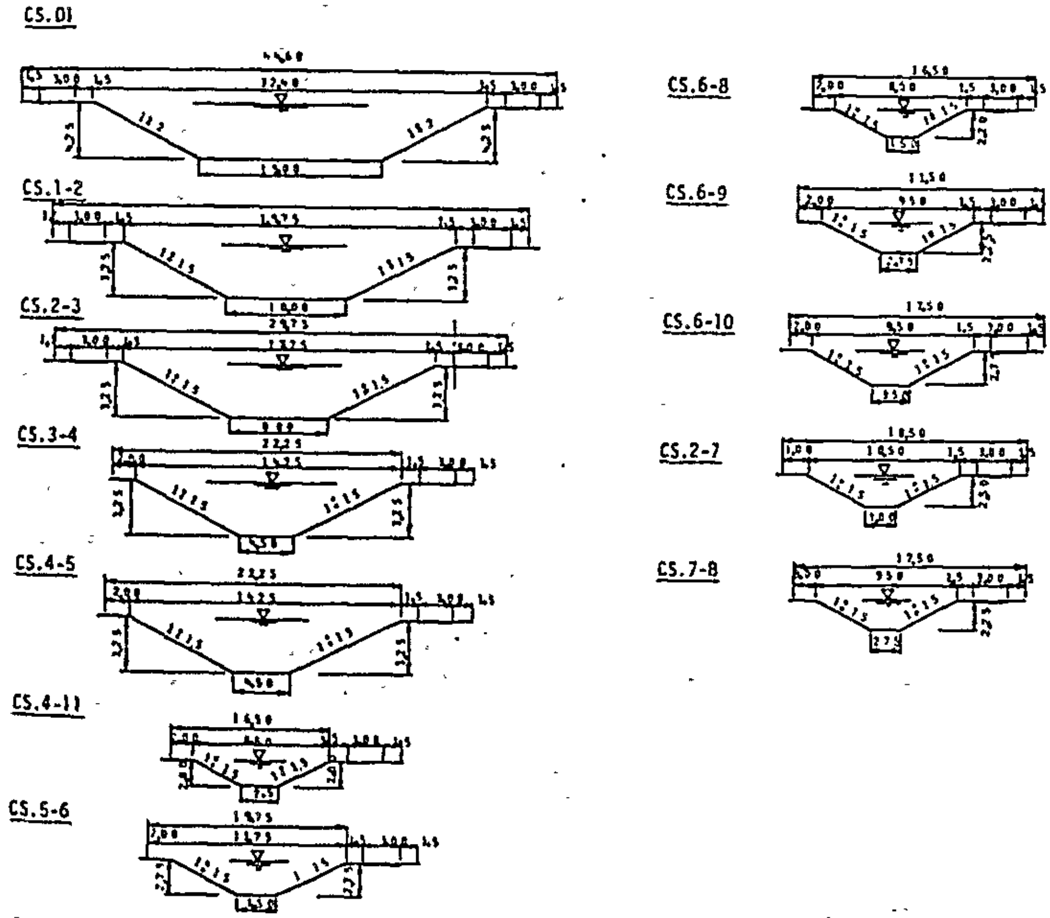


Fig. 5-8 TYPICAL CROSS SECTION OF MACRO AND COLLECTOR DRAINAGE PROPOSED BY PBJR, 1980

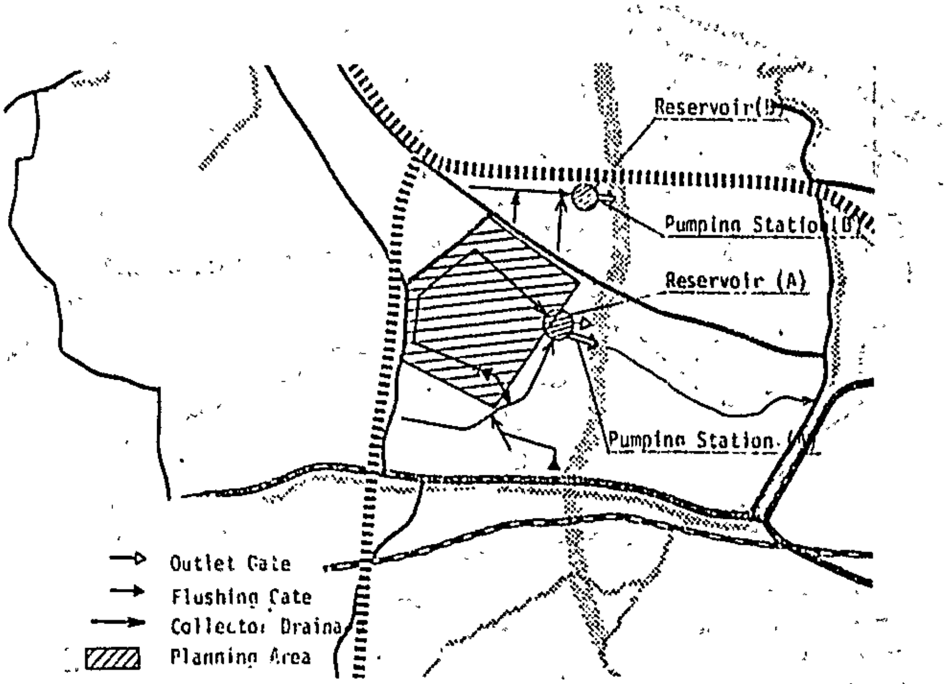


Fig. 5-9 PUMPING SYSTEM

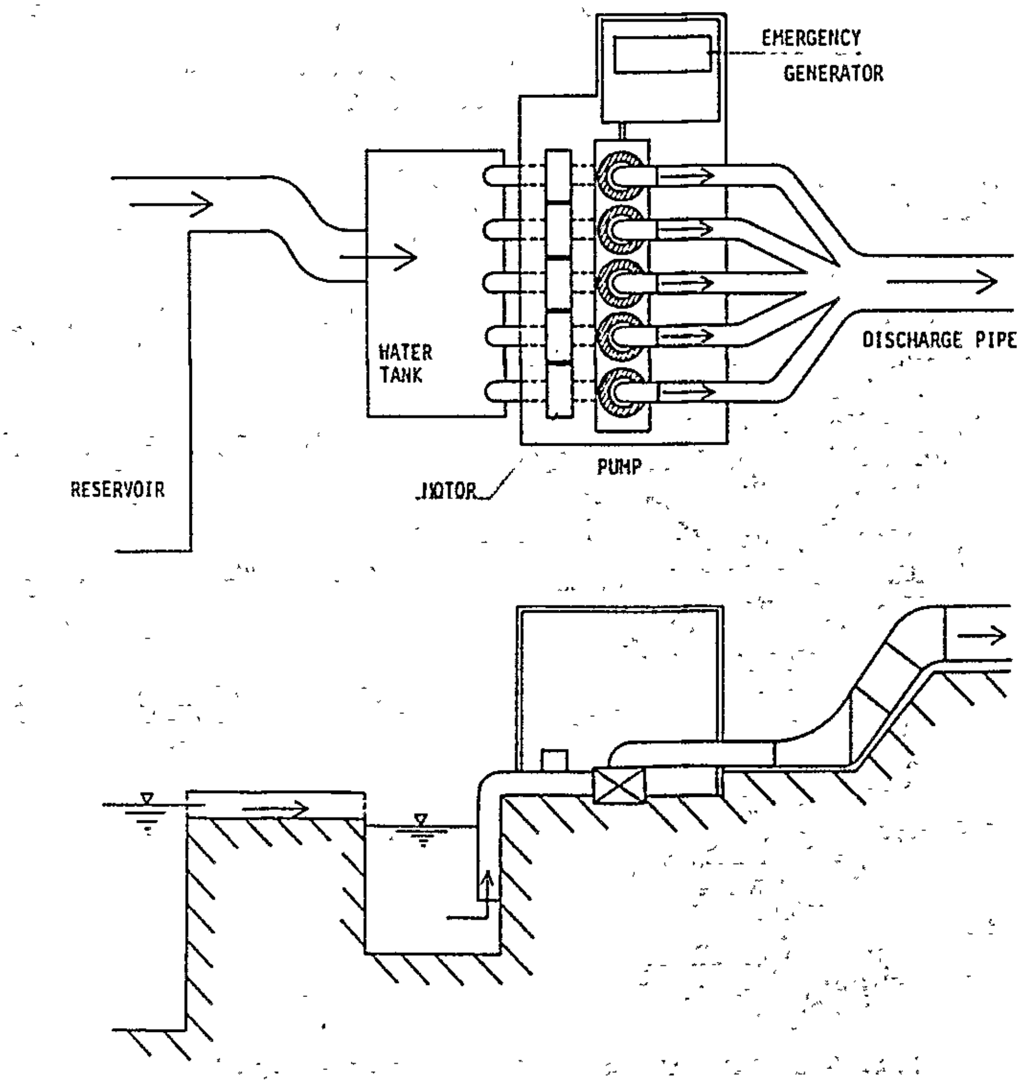


Fig. 5-10 PUMPING STATION

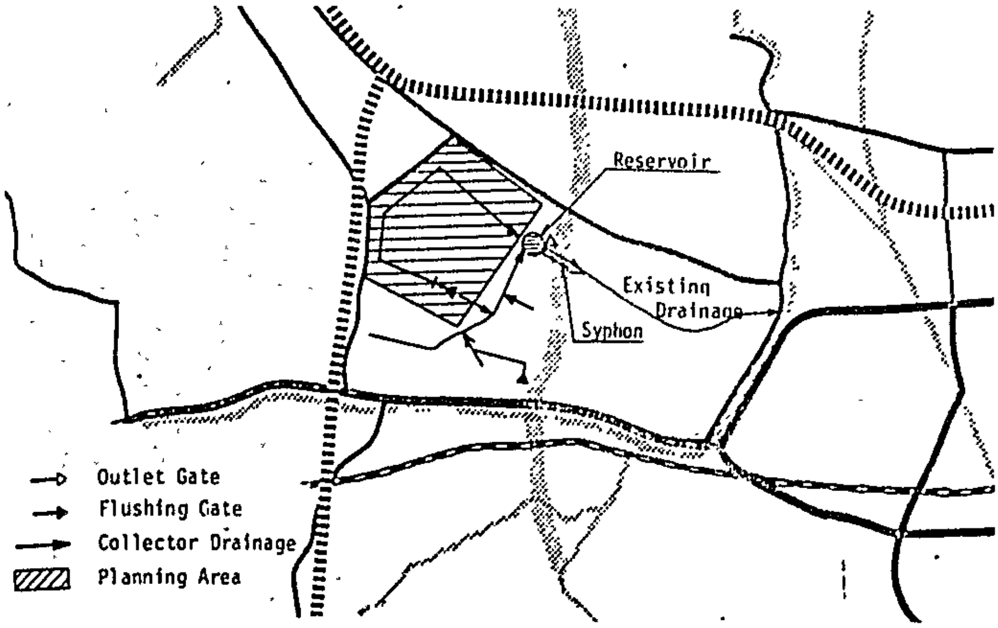


Fig. 5-11 SYPHON SYSTEM

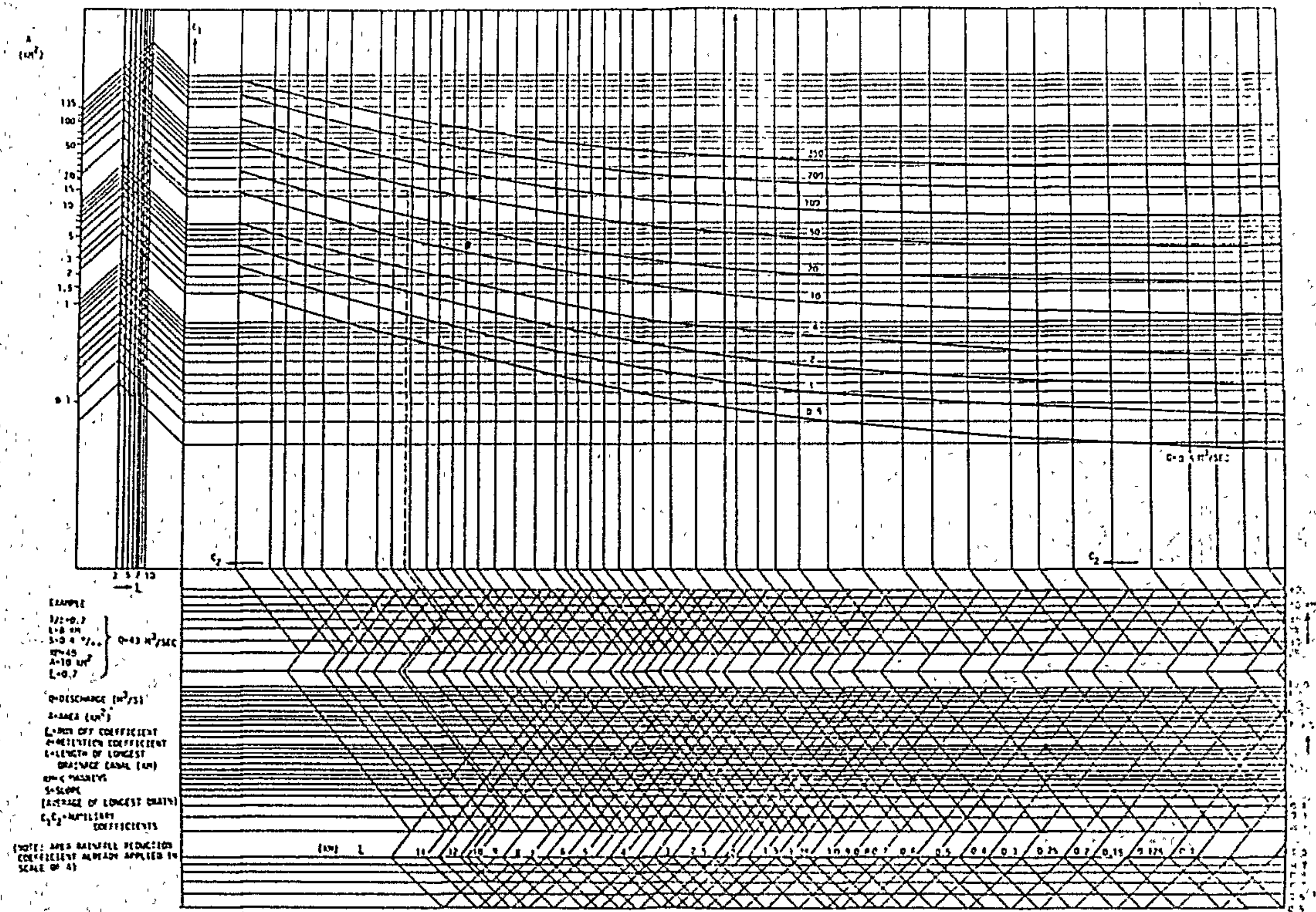
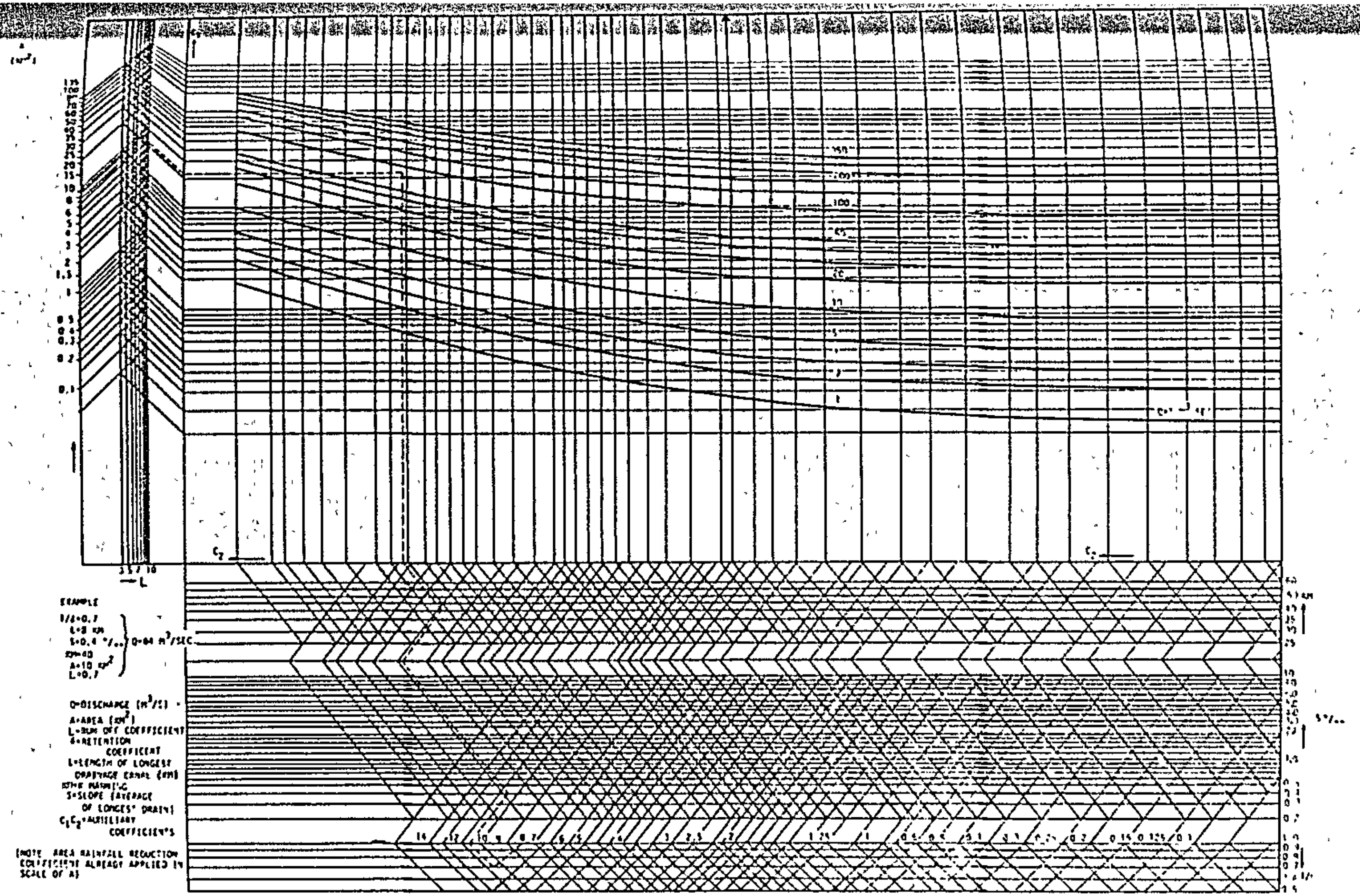


Fig. 5-12 NOMOGRAM FOR THE CALCULATION OF MAXIMUM DISCHARGES IN JAKARTA
(A) 2 YEAR RETURN PERIOD



NOMOGRAM FOR THE CALCULATION OF
MAXIMUM DISCHARGES IN JAKARTA
(B) 25 YEAR RETURN PERIOD

d. Costs of macro- and collector drainage system (based on figures of June 1980)

d-1 Direct discharge system

	Item	Volume	Construction costs: Unit price	Construction costs: Costs mill.Rp	Land acquisition costs: Unit price Rp/m²	Land acquisition costs: Costs mill.Rp	Operation/maintenance costs mill.Rp
Off-site	Macro* drainage	ℓ=3,200m, V=212,300m³ S₁=106,000m², S₂=10,000m²	Rp/m³ 630	133.75	1,000 5,000	106.0 50.0	-
	Collector* drainage	ℓ=7,800m, V=146,100m³ S=139,300m²	Rp/m³ 630	92.04	3,000	417.9	-
	Bridge	W=20m, ℓ=32m W=10m, ℓ=32m	Rp/m² 700,000	672.0	-	-	-
	Outlet gate	1 unit	Rp/unit 15×10⁶	15.0	-	-	-
	Flushing gate	2 units	Rp/unit 5×10⁶	10.0	-	-	-
	Temporary road	44,000m²	Rp/m² 4,990	219,56	-	-	-
	Sub-total			1,142.35		573.9	-
On-site	Collector* drainage	ℓ=2,150m, V=72,500m³	Rp/m³ 630	45.68	-	-	-
Total (net)				1,188.03		573.9	
Overhead				118.77		-	
Taxes (PPN)				32.70		-	
Total				1,339.5		573.9	

* Costs indicate macro- and collector-drainages of the point No. 0 through 11 shown in Fig. 5-7.

d-2 Pumping system

	Item	Volume	Construction costs: Unit price	Construction costs: Costs mill.Rp	Land acquisition costs: Unit price Rp/m²	Land acquisition costs: Costs mill.Rp	Operation/maintenance costs mill.Rp
Off-site	Collector drainage	ℓ=11,800m, V=309,100m³ S_1=800,000m², S_2=139,300m²	Rp/m³ 630	194.73	1,000 3,000	80.0 417.9	-
	Reservoir (A)	V=211,200m³ S=84,500m²	Rp/m³ 630	133.06	3,000	253.5	Dredging 35,400m³/Yr×400Rp/m³ =14.16
	Reservoir (B)	V=58,400m³ S=23,400m²	Rp/m³ 630	36.79	1,000	23.4	Dreading 9,000m³/Yr×400Rp/m³ =3.60
	Pumping station (A)			1,072.68	3,000	3.6	53.63
	Pumping station (B)			268.40	1,000	0.6	13.42
	Outlet gate	1 unit	Rp/unit 15×10⁶	15.0	-	-	-
	Flushing gate	2 units	Rp/unit 5×10⁶	10.0	-	-	-
	Temporary road	S=48,700m²	Rp/m² 4,990	243.02	-	-	-
	Sub-total			1,973.68		779.0	
On-site	Collector drainage	ℓ=2,150m, V=72,500m³	Rp/m³ 630	45.68	-	-	-
Total (net)				2,019.36		779.0	84.81
Overhead				201.94		-	-
Taxes (PPN)				55.50		-	-
Total				2,276.8		779.0	84.81

* Costs indicate all pumping system facilities shown in Fig. 5-9.

d-3 Syphon system

Item		Volume	Construction costs		Land acquisition costs		Operation/maintenance costs
			Unit price	Costs mill.Rp	Unit price Rp/m^2	Costs mill.Rp	mill.Rp
Off-site	Syphon			105.66	-	-	1.0
	Collector drainage	ℓ=7,800m, V=146,100m^3 S=139,300m^2	Rp/m^3 630	92.04	3,000	417.9	-
	Reservoir	V=313,970m^3, S=157,000m^2	Rp/m^3 630	197.80	3,000	471.0	Dredging 35,400m^3/Yr×400Rp/m^3 =14.16
	Land fill	V=1,080,000m^3	Rp/m^3 3,000	3,240.0	-	-	-
	Outlet gate	1 unit	Rp/unit 15×10^6	15.0	-	-	-
	Flush gate	2 units	Rp/unit 5×10^6	10.0	-	-	-
	Temporary road	25,300m^2	Rp/m^2 4,990	126.25	-	-	-
	Sub-total			3,786.75		888.9	15.16
On-site	Collector drainage	ℓ=2,150m, V=72,500m^3	Rp/m^3 630	45.68	-	-	-
Total (net)				3,832.43		888.9	15.16
Overhead				383.27		-	-
Taxes (PPN)				105.40		-	-
Total				4,321.1		888.9	15.16

* Costs indicate all syphon system facilities shown in Fig. 5-11.

5-1-3 Drainage system for the Project Area *(Micro drainage system)

a. Outline of plan

The "Masterplan for Drainage and Flood Control, 1973" proposed the designing of micro drainage facilities with capacities sufficient for a one-year return period, or a two-year return period. Accordingly, the present plan proposes design of micro drainage facilities for a two-year return period.

As to the siting of a catchment basin, the catchment area outside the Project Area is small because the land is to be prepared by banking. So, the 110-ha Project Area is conceived as the target catchment area, and drainage is to be divided into several drainage systems, each connected by a collector drainage canal.

As forms of rain water drainage, there are the open channel and the underdrain, but this plan proposes to drain rain water in the Project Area via the open channel, because the housing sites in the Project Area are level, and an underdrain would be so deep at its end that it could not be easily connected to a collector drainage canal. Further, underdrainage is undesirable for the reasons of difficulty of construction, construction cost, and maintenance.

Drainage for the Planning Area (370 ha) is of similar planning to that for drainage in the Project Area.

* Micro drainage

  A micro drain canal is a rain water drainage canal designed to have sufficient capacity for one-year return period, or a two-year return period. Micro drainage canals comprise drainage canals in residential areas, road gutters and ditches and drain water into macro drainage canals or collector drainage canals. Micro drainage canals in this Project Area will be constructed entirely at PERUM PERUMNAS expense.

b. Design criteria

Calculation of discharge flow

- Return period ..... 2 years

- Rainfall intensity formula (i) ... The Jakarta rainfall intensity formula is used.

$$i = \frac{16,286}{t + 51.43} \ (\ell/sec/ha) = \frac{5,863}{t + 51.43} \ (mm/hr)$$

$t = t_1 + t_2$

t : Time of concentration
t_1: Time of inlet, 5 - 10 minutes
t_2: Time of flow, $\frac{L}{60V}$
L: Length of drainage (m)
V: Average velocity, V = 0.8 m/s

- Discharge flow (Q) ..... The rational formula is used.

$$Q = \frac{1}{360} \times \alpha \times i \times A$$

α: Run-off coefficient, $\alpha = 0.7$
A: Catchment area (ha)

Calculation of drainage cross section

- Manning's formula is used.

$Q = A \times V \ (m^3/sec)$ $V = K \times I^{1/2} \times R^{2/3}$

A: Cross sectional area of flow
K: Roughness coefficient
Batukali 40
I: Hydraulic gradient (I = 0.001)
R: Hydraulic mean radius (m)

* These formulae are produced with reference to "Jakarta Drainage and Flood Control Project Phase II" and its "Final Report Annex VIII".

* Batukali: River stone

c. Preliminary engineering

Open drainage are normally constructed by using Batu Kali or Bataco Blocks, or by an arrangement of both. Structurally, those made from Batu Kali are stronger than those of Bataco Block composition, so those drainages which are relatively large are usually made of Batu Kali, and Bataco blocks are used for smaller structures. For this project, the drainages will be constructed from Batu Kali, with a cross sectional design based on the Bekasi II. (see Table 5-3)

As a margin of safety, the drainage is designed with a drainage depth of 75% of the total, and with a gradient of 1:02. In addition, a weep hole at one point every $3m^2$ is being considered to avoid damage to the drainage walls in case of reverse water pressure.

At intersections with roads (reinforced concrete), box culverts designed for 10 tons traffic loads, will be used. (see Fig. 5-13)

Table 5-2 AMOUNT OF DISCHARGE (m^3/sec/ha)

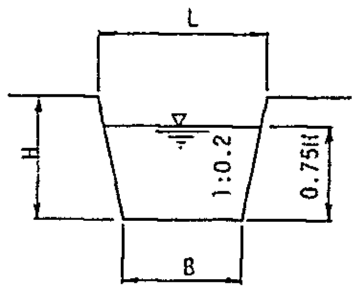
Concentration time (min)	Length of drainage (m)	Run-off coefficient	Rainfall intensity (mm/hr)	Discharge flow* Q (m^3/sec/ha)
7	0 - 48	0.7	100.3	0.195
8	49 - 96	"	98.7	0.192
9	97 - 144	"	97.0	0.189
10	145 - 192	"	95.4	0.185
11	193 - 240	"	93.9	0.183
12	241 - 288	"	92.4	0.180
13	289 - 336	"	91.0	0.177
14	337 - 384	"	89.6	0.174
15	385 - 432	"	88.3	0.172
16	433 - 480	"	86.9	0.169
17	481 - 528	"	85.7	0.167
18	529 - 576	"	84.4	0.164
19	577 - 624	"	83.2	0.162
20	625 - 672	"	82.1	0.160
21	673 - 720	"	80.9	0.157
22	721 - 768	"	79.8	0.155
23	769 - 816	"	78.8	0.153
24	817 - 864	"	77.7	0.151
25	865 - 912	"	76.7	0.149
26	913 - 960	"	75.7	0.147

* $Q = \frac{1}{360} \times 0.7 \times i$

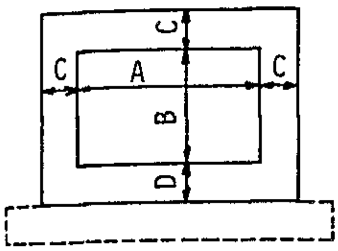
* Bataco block: Truss lime block or truss cement block

Table 5-3 CROSS SECTION OF MICRO DRAINAGE

Lm	Bm	Hm	I	Vm/s	Qm^3/s
0.42	0.30	0.30	0.001	0.277	0.0215
0.56	0.40	0.40	0.001	0.335	0.046
0.84	0.60	0.60	0.001	0.439	0.136
0.98	0.70	0.70	0.001	0.487	0.206
1.12	0.80	0.80	0.001	0.532	0.294
1.40	1.00	1.00	0.001	0.617	0.532
1.68	1.20	1.20	0.001	0.697	0.866
2.80	2.00	2.00	0.001	0.980	3.381



MANNING'S ROUGHNESS COEFFICIENT (K)
K=40 (BATU KALI)
(DATA BY OPEN CHANNEL HYDRAULICS)



Type	A (mm)	B (mm)	C (mm)	D (mm)
1000x1000	1,000	1,000	250	300
1250x1000	1,250	1,000	250	300
1500x1250	1,500	1,250	250	300
2500x1750	2,500	1,750	300	350

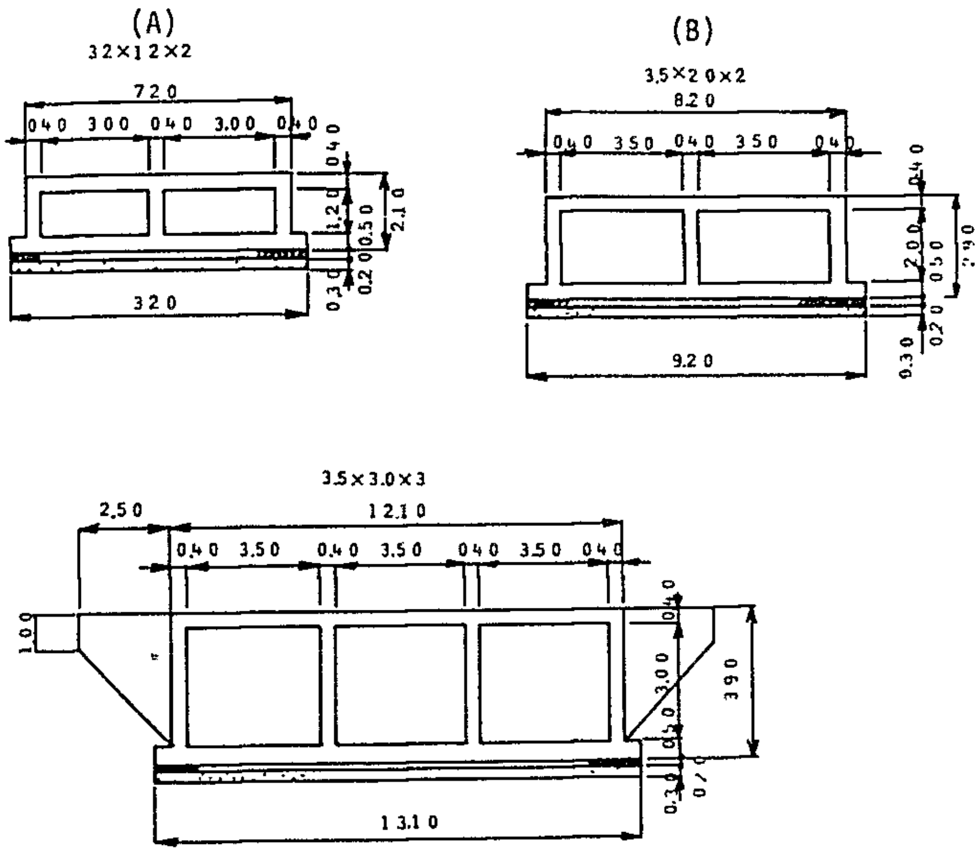


Fig. 5-13 CROSS SECTION OF BOX CULVERTS

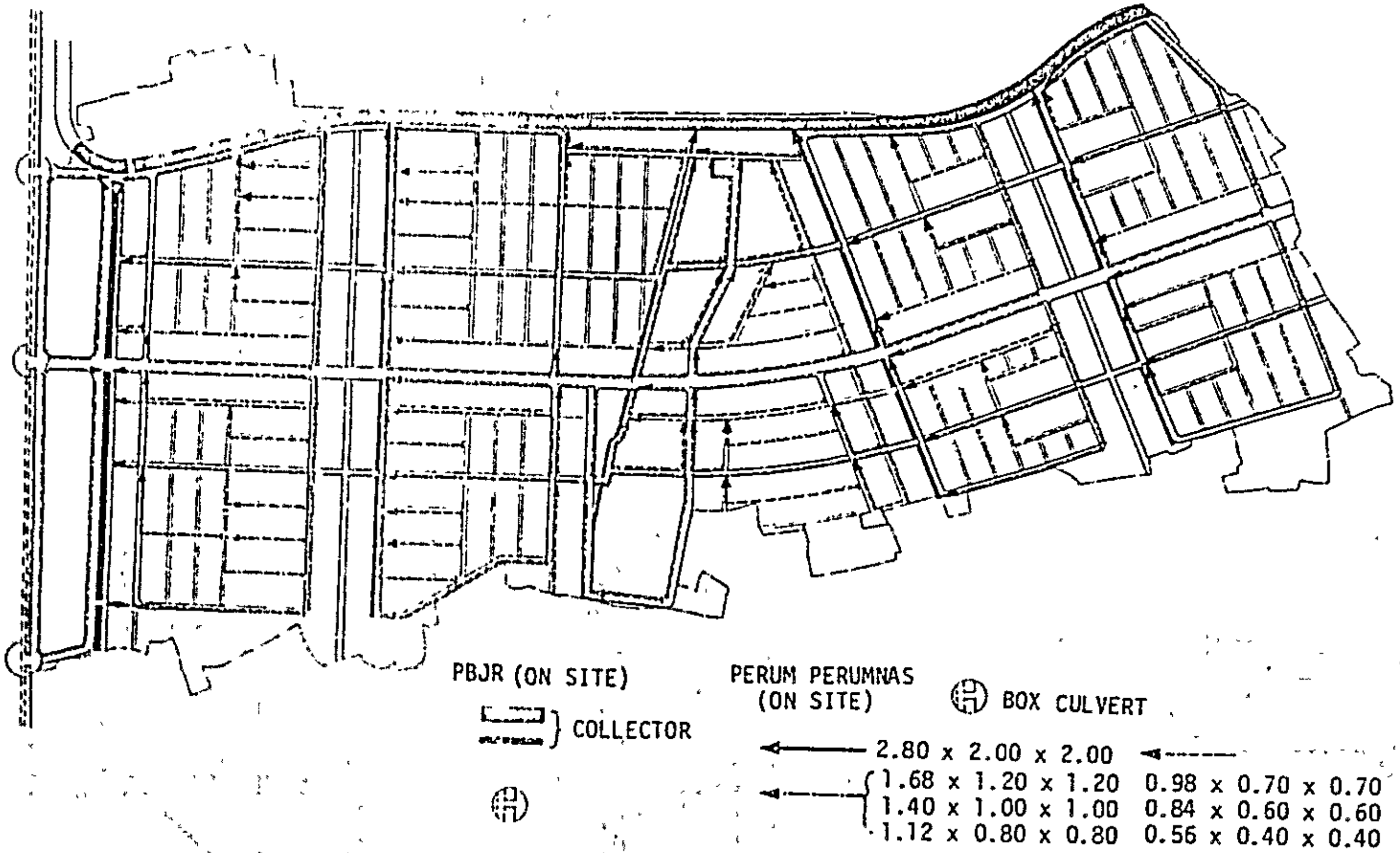


Fig. 5-14 MICRO DRAINAGE SYSTEM

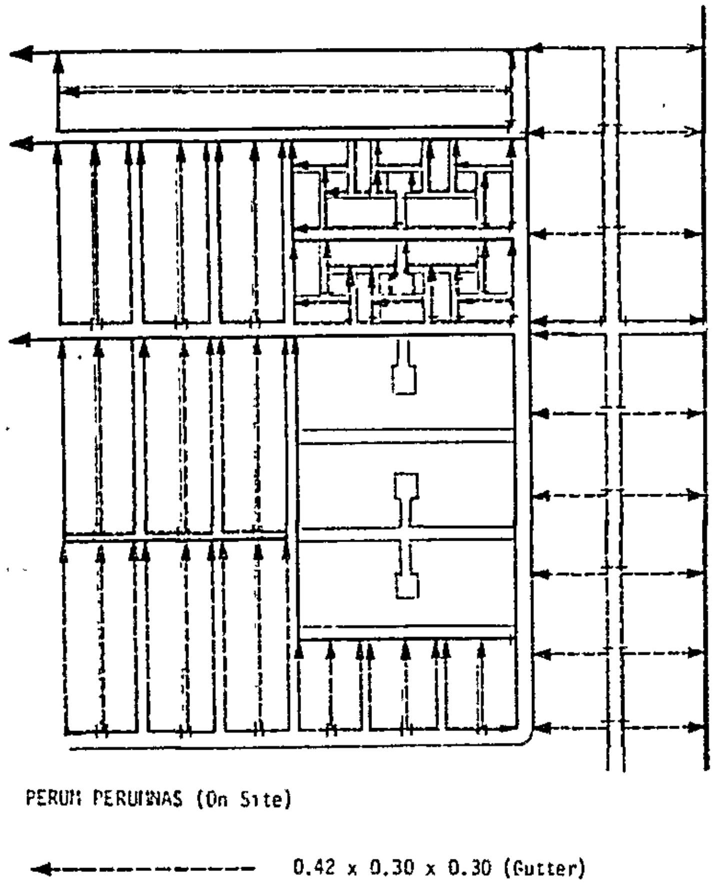


Fig. 5-15 TYPICAL PLAN OF OPEN GUTTERS

d. Construction costs of micro-drainage system
(based on figures of June 1980)

I. On-site

	million Rp
1. Drainage	462.5

Dimension (m) / Length (m)

Upper width		Bottom width		Depth		Length
0.42	×	0.3	×	0.3	×	35,000
0.56	×	0.4	×	0.4	×	9,030
0.84	×	0.6	×	0.6	×	4,060
0.98	×	0.7	×	0.7	×	1,470
1.12	×	0.8	×	0.8	×	5,860
1.40	×	1.0	×	1.0	×	4,370
1.68	×	1.2	×	1.2	×	4,540
2.80	×	2.0	×	2.0	×	2,390

2. Box culvert 219.5

Width		Height				Length
1.0	×	1.0			×	50
1.25	×	1.0			×	168
1.5	×	1.0			×	506
2.5	×	1.75			×	192
3.5	×	2.0	×	2	×	38
3.5	×	3.0	×	3	×	6

3. Total (net)	682.0
4. Overhead (3) × 0.1	68.2
5. Taxes (PPN) ((3) + (4)) × 0.025	18.8
6. Total On-site	million Rp 769.0

II. Off-site

1. Box culvert 34.2

Width		Height				Length
3.0	×	1.2	×	2	×	48

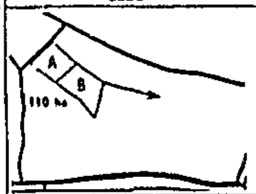
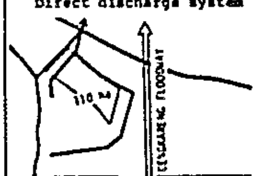
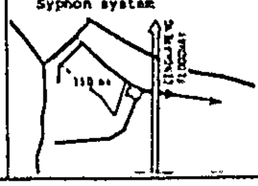
2. Overhead (1) × 0.1	3.4
3. Taxes (PPN) ((1) + (2)) × 0.025	0.9
Total Off-site	million Rp 38.5

5-2 LAND DEVELOPMENT

a. General conditions of the plan

The present conditions of work areas are mostly water farms or wet land, and flat areas (pp + 2.60m - pp + 3.40m above sea level). The development plan in this area is varies with conditions at the end of the drainage line. The cases for making the present waterway end the drainage line, and completing of with an end drainage system are shown in the following tables:

Table 5-4 ALTERNATIVES OF LAND DEVELOPMENT METHOD

Drainage sytem		Case	Method of development	Problems	Considerations
Present system Capacity of waterway $Q=1.64m^3/s$	(1)		"A" area is developed by banking with the soil excavated in "B" area, and "B" area will be a regulating reservior.	The housing area is decreased and it is unfavorable for utilization.	Not recommended because it is unfavorable for utilization
	(2)		The whole work area will be filled with the soil obtained in other areas, and developed to a height above p.p + 3.8m. The regulating pond will be constructed out of the "B" area.	It is best for housing area, but it is necessary to bring soil, and to provide for a regulating pond out of this area.	Not recommended because the construction cost will be high.
Completion with an end drainage system	(3)	Direct discharge system 	After the dry-up the development will be done by banking with the soil obtained in and out of the area.	The construction cost may be reasonable but it is necessary to complete macro and collector drainage lines.	This drainage system is highest in reality, and the construction cost is lowest, therefore, we recommend this plan.
	(4)	Pump-up system 		The construction cost is same as (3), but we are afraid that the area might be flooded in case of unexpectedly hard rain fall because the regulating pond is designed for two year's probable rain fall.	Not recommended because there is a possibility of flooding due to the rain fall rate over the two years.
	(5)	Syphon system 	The area will be developed to a height of p.p + 1.6m by the filling with the soil obtained in other areas.	Approx. $90 \cdot 10{,}000m^3$ of soil brought as necessary, so the construction cost will be high.	Not recommended due to the high construction cost.

→ Macro drainage   → Present waterway

⇒ Cengkareng Floodway   ▨ Regulated pond

We recommend case (3), but the completion of macro collector drainage line is provided, and we do not consider the development in substance with the soil obtained out of the area. However, according to the fact that the difference of the water level between the collector drainage line as a condition of the above mentioned draining and the micro drainage line is 0.75m to 1.00m for 2 year's probable rain fall, and in consideration of the slope developed for micro drainage line, approx. 320,000m^3 of soil obtained out of the area for banking after study. On the other hand, approx. 170,000m^3 of filling materials will be obtained from the structures in the work area and the excavation of the collector drainage line, and 150,000m^3 shortage will occur. We submitted a suggestion to the Work Management Committee in October, 1980 that we would use 150,000m^3 among the excavated soil from Cengkareng Floodway.

As a result, PBJR will investigate the carrying in of 150,000m^3 of soil to the work area under the Committee in November, 1980. With this background, we proceed on the development plan based on case of (3). Therefore, if a change occurs due to the outside problems, a change of plan on the preliminary or final design may be necessary. We have explained the general conditions of the development plan in the work area now, but we have basically the same idea for the planning area.

b. Planning standard

Gradient of land fill slope shall be stable and therefore it shall be less than angle of internal friction of soil. But for the land fill level less than 1m high, slight easing can be considered.

C. Rough design

C-1 Soil improvement

We recommend the following methods for soil improvement

Table 5-5 ALTERNATIVES OF SOIL IMPROVEMENT

Classification	Purpose	Method	Consideration	Appraisal
Replacement method	Making a foundation by replacement with good soil	Replacement with good soil	Expensive	×
Compaction method	Raising up the density and increasing the bearing strength of ground	Compaction by roller, rammer or soil impactor	Compaction by sheepsfoot roller is effective in the weak ground	o
Dehydrate compression method	To take out the moisture in soil particles, to raise up the density and to increase the bearing strength of ground	Wellpoint method	Expensive	×
		Sand drain method	"	Δ
		Electrical permeation method	"	×
Drying method	To increase the bearing strength of surface soil and the first upper layer	Dry-up by mostly natural drying	It is effective for the drying of surface soil, is not costly and is used on whole areas	o
Congeal method	To increase the bearing strength of ground due to the hardening of weak ground with a mixture of cement, lime, chemicals, etc.	Cement or liquid injection method	Expensive	×
		Lime treatment	Relatively reasonable cost, and useful for wet land areas	o
Piling method	Counter plan for inequal subsidence or heaving with a large number of piles	Wooden or bamboo piling	General method in Indonesia, but relatively expensive	Δ

It is understand that the first layer of ground in this work area will obtain $q=5.0t/m^2$ if it is compacted to decrease 10% of the moisture content by the soil test. And also the surface soil is unknown under present conditions, but we expect it is of the same soil as the first layer. Therefore, if it is sufficiently compacted to a 10 to 20% moisture content, $5.0t/m^2$ bearing strength will be obtained. Then, we recommend the drying of surface and filling materials, compaction by rolling and lime treatment for wet land areas as a method for ground improvement in this area, and we will proceed on the ground improvement plan with a combination of the above methods.

o Dry-up

The dry-up is effective if it is done during the dry season. Then, as the results of analysis based on the observation data from 1972 to 1978 (13 years except for non-obervation years) by Cengkareng Weather Bureau, we understand that there is very little rainfall for the three months of July, August, and September. The data are shown in the following table:

Table 5-6 CLIMATE DATA

Cengkareng Weather Bureau 1972 - 1978

	Jan.	Feb.	Mar.	Apr.	May	Jue.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average amount of rainfall a month (mm)	378	304	224	69	86	73	52	37	41	77	82	134
Average days of rainfall a month (days)	17.4	16.9	11.1	5.0	5.5	5.2	2.5	1.9	2.7	5.5	5.7	8.4
Average days with over 30mm of daily rainfall (days)	4.5	3.8	2.2	0.5	0.8	0.6	0.5	0.4	0.5	0.5	0.6	1.5

Considering the above data, there is only one day having over 30mm of daily rainfall for the 3 months during July, August and September. And the days of other rainfall are less than two for one month, and the amount of rainfall is not more than 10mm. Thus, supposing there is 30mm rainfall in the catchment area of this work zone, it is necessary to investigate the possibility for Dry-up under the capacity of the present waterway. The amount of out-flow in 110ha of this catchment area for 30mm of rainfall is V=23,100m^3. If we drain it with 5 d-200 pumps to the present waterway, the hours required for whole work are 21 because the capacity of discharge by one pump is 3.75 m^3/min, thus be 18.75 m^3/min by total pumps, and so 7 hours for approx. 10mm rainfall. On the other hand, the flow capacity of the present waterway is Q=3.64 m^3/min and the hours required to discharge 123,900m^3 of out-flow amounting from a 590ha catchment area is 9.5 hours, there is no trouble for drainage from the work area.

Though it is necessary to avoid the stagnation of the 23,100m^3 out-flow in the area, the length of collector to be provided on the north side of the area is 1,450m. And if 10.00m×5.00m×2.50m waterway is provided as a temporary main drainage line in this waterway, the volume will be 27,200m^3 and we can use it as a regulated pond. From the above facts, we would like to use the dry-up plan in this area utilizing the present waterway. The following shows the methods and system.

After cutting irrigation water, a temporary drainage line by open cut will be provided as shown in the following. The surface water is collected in a temporary main drainage line to the collector drainage line, and it flows out to the present waterway by temporary pumps. It is more effective to make the spacing between branch lines closer, but we have to study the preliminary and final designs further because are some problems in installation.

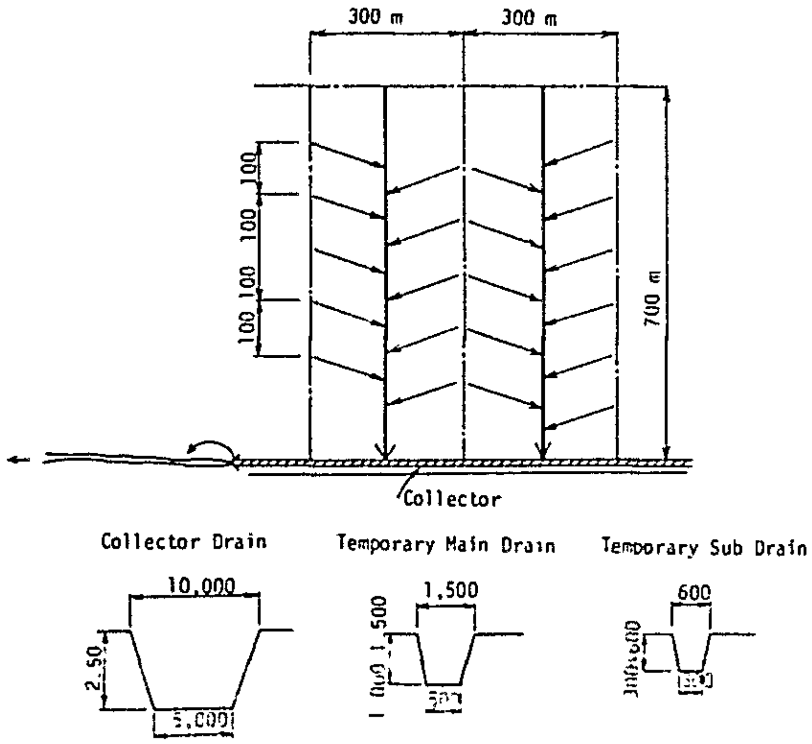


Fig. 5-16 TEMPORARY DRAINAGE

The Dry-up method as mentioned before is the best under the present situation, we think, but we have never carried out a pump test at the site or a permeability test of the soils. Therefore, the time required for Dry-up is not clear. To obtain a sufficient bearing strength, it is necessary to investigate a setting up based on the results of these tests under the preliminary and final design.

o Rolling for compaction

Sufficient compaction will be produced by sheepsfoot roller from the area completed with Dry-up of the present ground. For land filled soil also sufficient compaction should be done for each layer as the maximum thickness of one layer is 30cm.

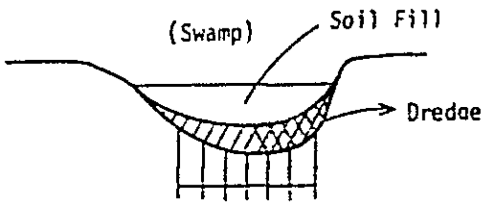
o Carry-in and drying of land fill soil

The soil carried in for filling will be used after the proper drying of soil at the temporary stockyard. If the soil carried in is not dried, the hours required for drying will be affected in construction. The details should be studied under the preliminary and final design.

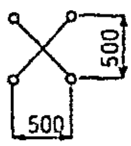
o Liming

In the pond and extremely marshy areas it is necessary to carry out ground improvement measures. The bamboo pile grouping method, shown in the figure below, is a commonly used method in Indonesia, but this report recommends liming the top 30cms of soil. This process entails the mixing of 20kgs of lime into each 1.0m^3 and allowing it to settle. Results from cost comparison studies of the two methods indicate that the use of liming is cheaper, and this method is to be adopted.

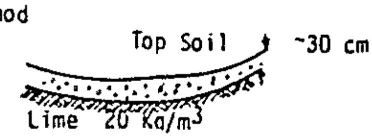
Bamboo Pile Method



Bamboo Pile



Lime Stability Method

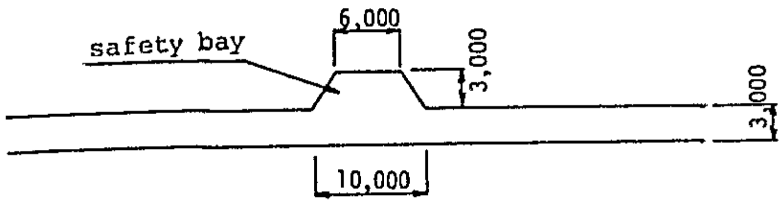


C-2 Land development

o Removal of grass and roots

Grass and roots must be removed from the whole Project Area.

o Temporary roads



Ideally, all temporary roads should be later developed as permanent roads, but there is a need for some extra temporary roads in certain places. In the first stage work area, ℓ=400m, and in the second stage work area ℓ=250m. Also, continuous paving of the temporary road W=3.0m, and every 100m, a safety bay should be provided, as indicated in the above figure. Cost for the temporary roads excludes the cost of developing them into permanent roads, i.e. the costs are calculated only for the temporary roads. At a point about 300m from the junction of the primary road the ground is particulary bad, requireing ground improvement by building up with laterite (average depth 30cms).

o Surface grading

Surface grading is required to remove rises and hollows, and will encourage easier settlement of the soil used for building-up.

o Land filling

The site of the Project Area stretches for about 1,700m in an east-west direction, and about 650m south-north. In relation to drainage, the grading should provide a higher elevation in the south-east, running to a lower elevation in the north-west. The gradient of the south-north dip should be 1/1000 - 1/1500, and the gradient of the east-west dip should be 1/3000 - 1/5000. The lowest part of the planning site should be over P.P. + 2.70m.

The establishment of the precise elevation will be determined by the water level of the micro drainage. Q2, which must be 0.7 - 1.0m higher than the macro drainage.

The preparation of the Project Area is divided into two stages (see Chapter 7). The first stage covers about 55ha and the second, about the same area. The amount of land fill soil is estimated about 230,000m^3, 90,000m^3 respectively (see Fig. 5-17)

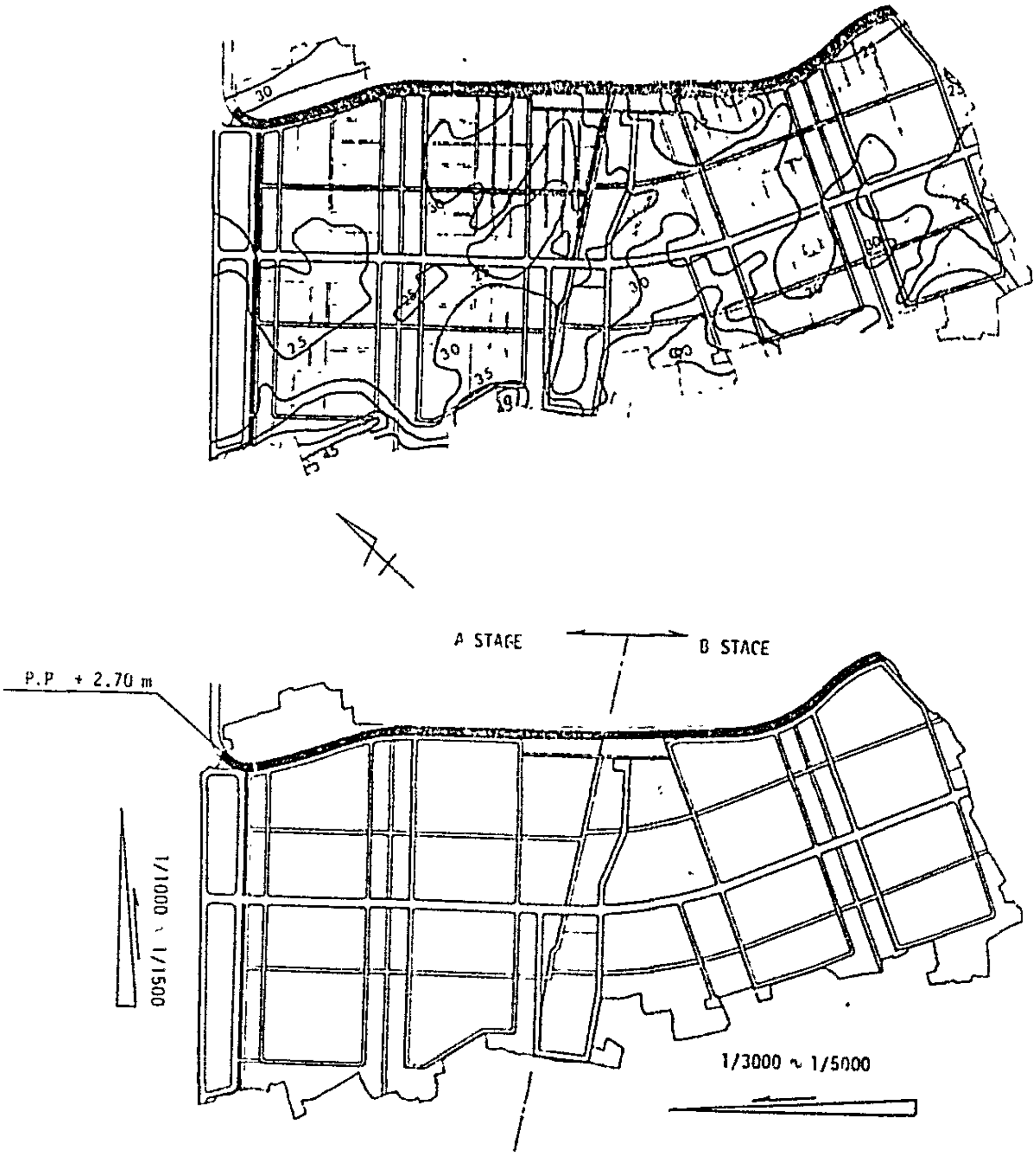


Fig. 5-17 GRADING PLAN

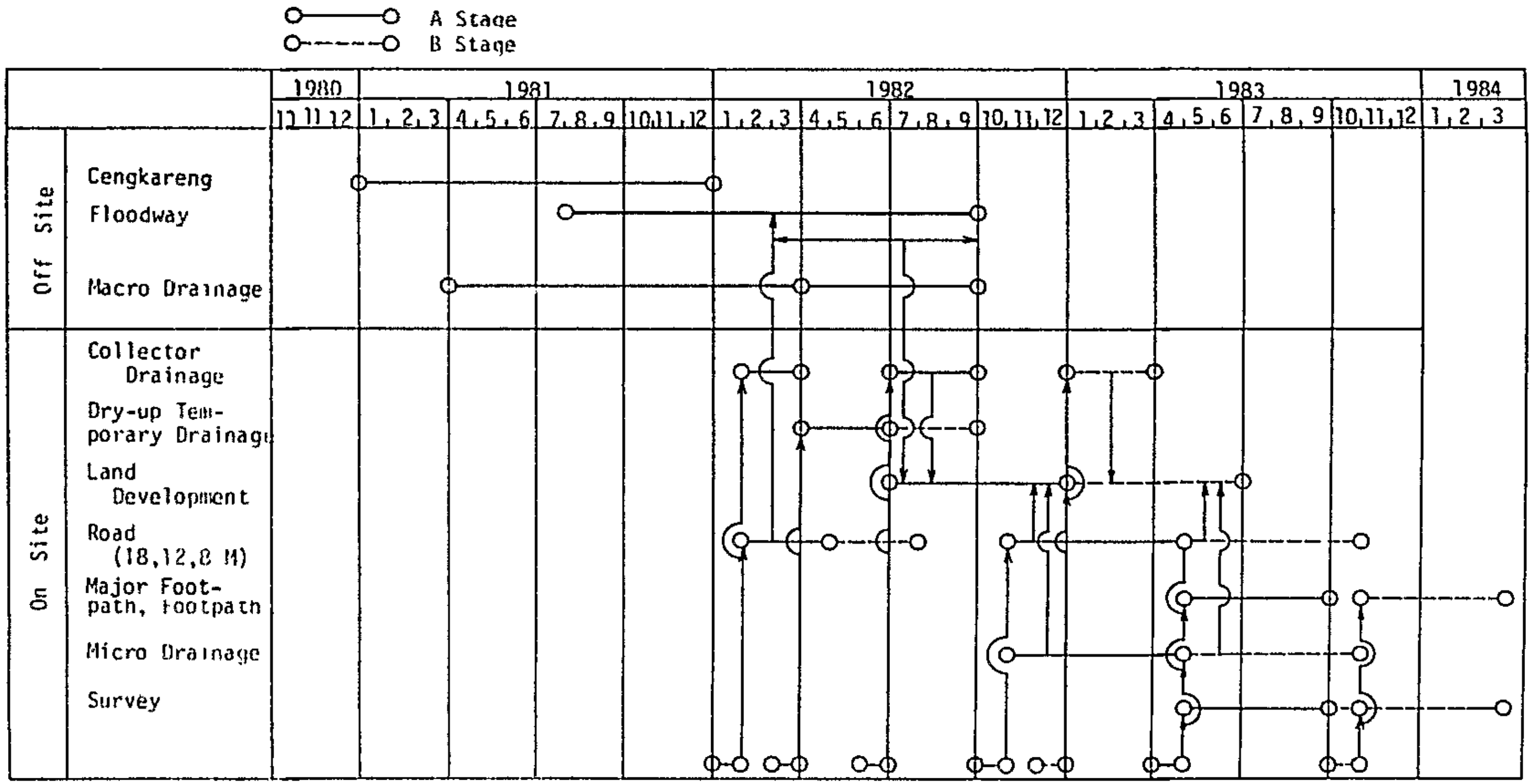


Fig. 5-18 WORK SCHEDULE OF DRAINAGE, ROADS AND LAND DEVELOPMENT

C-3 Construction costs of land development

(based on figures of June 1980)

		Volume	
1.	Grading		242.4 million Rp
	Clearing, grubbing & surface grading	110,000m^2	
	Temporary road		
	Transportation of soil	110,000m^3	
	Land filling	320,000m^3	
	Compaction	320,000m^3	
2.	Soil improvement		
	Soil improvement	30,000m^3	57.5
	Temporary drainage	40,200m^3	
	Pumps (ϕ200)	5 pumps	
3.	Total (net)		299.9
4.	Overhead (3)×0.1		30.0
5.	Taxes (PPN) ((3)+(4))×0.025		8.2
6.	Total		338.1 million Rp