MINISTRY OF PUBLIC WORKS (MPW)

DIRECTORATE GENERAL OF HUMAN SETTLEMENTS

MINISTRY OF PUBLIC WORKS

REPUBLIC OF INDONESIA

THE DETAILED DESIGN FOR URBAN DRAINAGE PROJECT IN THE CITY OF JAKARTA

FINAL REPORT

EXECUTIVE SUMMARY

NIPPON KOEI CO., LTD.
TOKYO, JAPAN

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DIRECTORATE GENERAL OF HUMAN SETTLEMENTS
MINISTRY OF PUBLIC WORKS
REPUBLIC OF INDONESIA

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FOR
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EXECUTIVE SUMMARY

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The cost estimate is based on the price level of June 1997 and the monthly mean exchange rates in June 1997. The monthly mean exchange rates in June 1997 are:

US$ 1.00 = ¥ 115.00 = Rp. 2,350

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct the Study on Detailed Design for Urban Drainage Project in the City of Jakarta and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team headed by Mr. Shigeo Ohnuma, Nippon Koei Co. Ltd., four times between September 1996 and November 1997.

The team held discussions with the officials concerned of the Government of Indonesia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the team.

December, 1997

Kimio Fujita
President
Japan International Cooperation Agency

December 1997

Mr. Kimio Fujita
President
Japan International Cooperation Agency

Dear Sir,

Letter of Transmittal

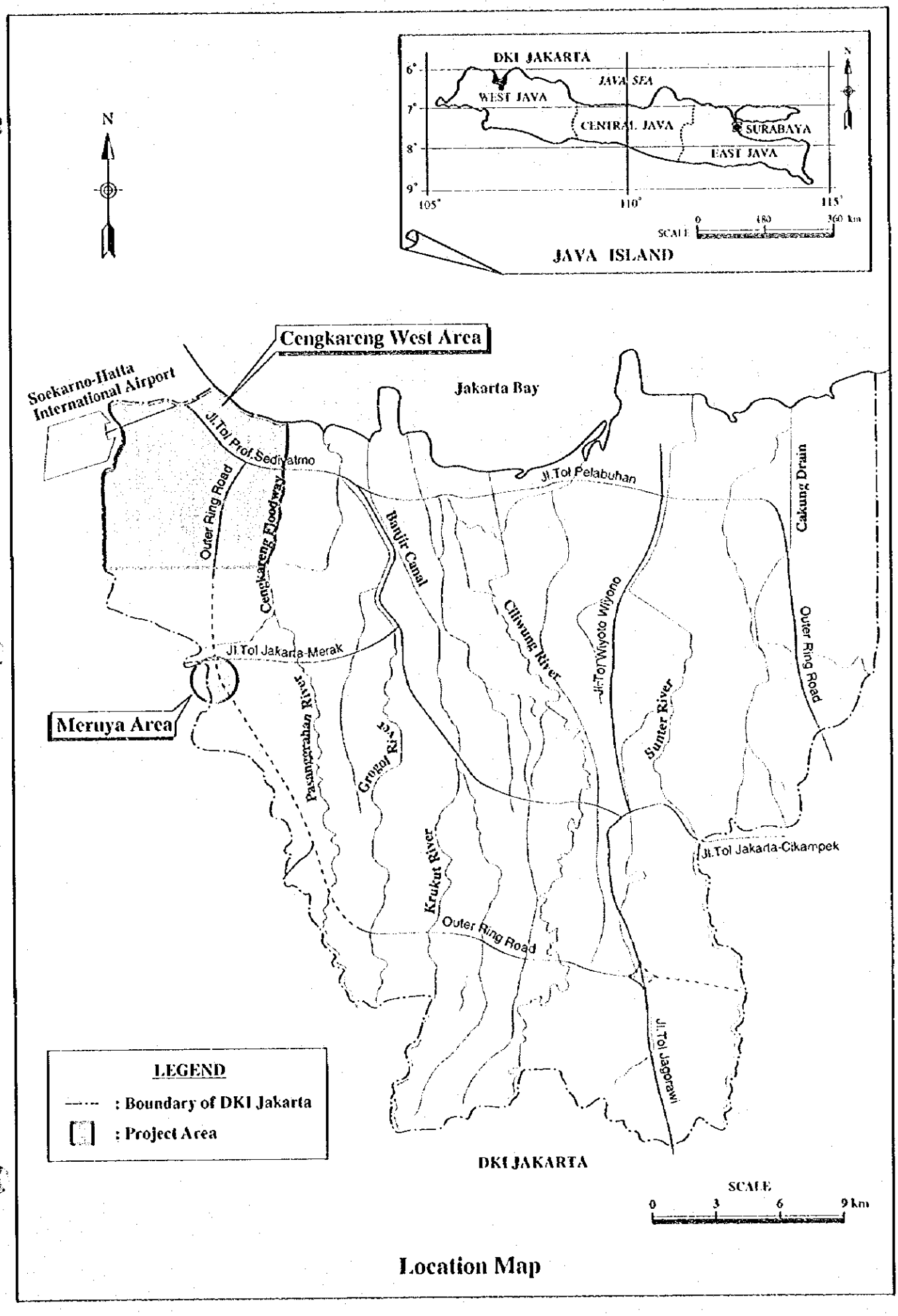
We are pleased to submit herewith the Final Report on the Detailed Design for Urban Drainage Project in the City of Jakarta. This Report deals with the formulation of the drainage plan in the project area including the Cengkareng west area and Meruya area and detailed design of the urban drainage works in the project area.

The Report consists of Design Reports and Tender Documents. The Design Report comprises Executive Summary, Volume I: Main Report, Volume II: Supporting Reports and Volume III: Design Drawings. Main outputs of this study are presented in the Executive Summary. The Main Report states a summary of the Supporting Reports and presents the results of technical study including basic concepts for urban drainage project, principles of design, design criteria, procedures of design, economic viability of the project, project implementation program, and environmental impact assessment and social impact management program. The Supporting Reports comprise four annexes and present details of the design including design calculation for the drainage structures, work quantity calculation, construction plan and schedule, cost estimate and breakdown of unit costs, and details of environmental impact assessment and social impact management program. The Tender Documents consist of a series of international tender documents and tender drawings.

We would like to express grateful acknowledgment to the personnel of your Agency, Advisory Committee, Ministry of Foreign Affairs, Ministry of Construction and Embassy of Japan in Indonesia, and also to officials and individuals of the Government of Indonesia for their assistance and advice extended to the Study Team. We sincerely hope that this study would contribute to the regional development of the Study Area.

Your sincerely,

Shigeo Ohnuma
Team Leader
The Detailed Design for Urban Drainage Project
in the City of Jakarta



Location Map

REPUBLIC OF INDONESIA

THE DETAILED DESIGN FOR URBAN DRAINAGE PROJECT IN THE CITY OF JAKARTA

SUMMARY

1. BASIC CONCEPT FOR DRAINAGE PLAN

1) Study Area: Cengkareng west area: 36.71 km^2 and Meruya area: 1.27 km^2
2) Design Flood: 10-year flood for the Cengkareng west area and 5-year flood for the Meruya area.
3) Target Year: 2010.
4) Drainage Method: Gravity flow
5) Category of Drainage Channel: Main drainage channel.
6) Special Consideration for Planning: Land subsidence and clean water management.

2. OUTLINE OF PROJECT

2.1 Features of Project

1) Drainage Works in the Cengkareng West Area

(i) Kamal drainage channel(drainage area: 20.89 km^2)

- Total channel length	7.2 km
- Design discharge	0.9 m^3/sec~48.1 m^3/sec
- Shape of channel	Trapezoidal and rectangular type
- Excavation	267,000 m^3
- Embankment	39,000 m,
- Concrete parapet	484 m
- Concrete ditch	452 m
- Revetment	6,675 m
- Bridge	28 nos.
- Gate	23 slide/flap gates

(ii) Tanjungan drainage channel(drainage area: 4.25 km^2)

- Total channel length	2.5 km
- Design discharge	9.6 m^3/sec~19.0 m^3/sec
- Shape of channel	Trapezoidal and rectangular type
- Excavation	51,000 m^3
- Embankment	52,000 m,
- Concrete wall	1,134 m
- Revetment	347 m
- Bridge	5 nos.
- Gate	7 slide/flap gates

(iii) PIK Junction drainage channel(drainage area: 2.7 km^2)

- Total channel length	0.8 km
- Design discharge	7.1m^3/sec~18.1 m^3/sec
- Shape of channel	Rectangular type
- Excavation	7,400 m^3
- Concrete ditch	765 m
- Bridge	4 nos.
- Gate	1 slide gate

(iv) Gede/Bor drainage channel(drainage area: 2.41km^2)

- Total channel length	1.2 km
- Design discharge	15.5 m^3/sec~16.9 m^3/sec
- Shape	Trapezoidal type
- Excavation	29,000 m^3
- Revetment	2,300 m,
- Bridge	10 nos.
- Gate	5 slide/flap gates

(v) Saluran Cengkareng drainage channel(drainage area: 3.08km^2)

- Total channel length	4.2 km
- Design discharge	5.8 m^3/sec~18.8 m^3/sec
- Shape of channel	Trapezoidal and rectangular type
- Excavation	83,000 m^3
- Embankment	41,000 m,
- Concrete parapet	1,285 m
- Concrete culvert	391 m
- Revetment	4,188 m
- Bridge	13 nos.
- Gate	15 slide/flap gates

2) Drainage Works in the Meruya Area

Meruya drainage channel(drainage area: 1.27km^2)

- Total channel length	2.3 km
- Design discharge	1.6 m^3/sec~9.4 m^3/sec
- Shape of channel	Rectangular type
- Excavation	15,000 m^3
- Concrete ditch and box culvert	2,798 m
- Bridge	16 nos.

2.2 Project Cost

Total project cost for the urban drainage project was estimated at US$ 88,973,000 comprising:

1) Foreign currency portion:	US$ 28,016,000
2) Local currency portion	US$ 60,957,000

2.3 Economic Evaluation

Economic Internal Rate of Return(EIRR) of the urban drainage project was estimated at 17.9 %. Relocation of the local residents, both legal residents and the squatters is the most significant and negative impacts induced by the project.

2.4 Social Impact Management Plan

1) Number of households and other building subject to relocation:

- Local residents with land certificate	211	households
- Squatters	1,442	households, and
- Factories, school, market, etc.	63	places
2) Cost of compensation for households	Rp. 17,443.9	million
3) Cost of land acquisition		
- Overall land area for project	321,489	m^2
- Cost of land acquisition	Rp. 53,045.7	million

4) Method of relocation operation

DPU DKI Jakarta is the organization responsible for conducting relocation operation and its method. Although there are a number of intricate government procedures to

follow when the resettlement operation was conducted, Department of housing, DKI Jakarta takes over the entire resettlement operation including treatment of low cost apartment.

2.5 Construction Plan and Implementation Schedule

1) An executing agency of the project will be the Directorate General of Human Settlements (CIPTA KARYA), Ministry of Public Works, which is responsible for the management of the project works including loan appraisal, loan agreement and overall management of the project works. The construction works will be entrusted and carried out by the Project Management Office, DPU DKI Jakarta.

2) The foreign currency portion of the project cost and a part of the local currency portion are expected to be financed by an international organization. Remaining local currency portion will be covered by the Indonesian national budget.

3) It has been proposed to execute the project works by dividing into three packages, namely,
   - Package-1: Kamal drainage channel
   - Package-2: Tanjungan and PIK Junction drainage channels
   - Package-3: Saluran Cengkareng, Gede/Bor and Meruya drainage channels

4) It is scheduled to implement the construction works from Package-1 in initial stage and Package-2 in second stage due to the reason that the drainage areas along the Prof. Sediyatmo toll road(highway) are quite populated and the highest economic development potential zones and early implementation of the drainage channels is required. The Package-3 is scheduled to be executed in final stage.

5) The construction works are scheduled to be executed in 6.5 years from May 2000. The pre-construction activities in 1997 to 2000 consist of financial arrangement, pre-qualification of tender, tendering and contract award. Besides those activities, land compensation and resettlement will be made timely in advance of commencement of the construction works at each site.

THE DETAILED DESIGN FOR URBAN DRAINAGE
PROJECT IN THE CITY OF JAKARTA

DESIGN REPORT

EXECUTIVE SUMMARY

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LIST OF FIGURES

ABBREVIATIONS

(1) Local Terms

BAKOSURTANAL	Badan Koordinasi Survei dan Penetaan Nasional	:National Mapping Agencies
BAPPENAS	Badan Perencanaan Pembangunan National	:National Planning and Development Board
BPS	Biro Pusat Statistic	:Central Bureau of Statistics
BINA MARGA		:Directorate General of Road Development
CIPTA KARYA		:Directorate General of Human Settlements
DGWRD		:Directorate General of Water Resources Development
DINAS TATA KOTA		:Department of City Planning, DKI Jakarta
DKI Jakarta	Daerah Khusus Ibukota Jakarta	:Special Region of Capital City Jakarta
DPMA	Direktorat Penyelidikan Masalah Air	:Directorate of Hydraulic Engineering
DPU	Departmen Pekerjaan Umum	:Ministry of Public Works
DPU DKI Jakarta	Dinas Pekerjaan Umum DKI Jakarta	:Department of Public Works, DKI Jakarta
DPUP	Dinas Pekerjaan Umum Propinsi	:Provincial Department Office of Public Works
JABOTABEK		:Jakarta-Bogor-Tangerang-Bekasi
JASA MARGA		:Indonesia Highway Corporation
Kabupaten		:Regency
Kecamatan		:Sub-district
Kelurahan		:District
Kotamadya		:Municipal City
PELITA	Pembangunan Lima Tahun	:Five-Year Development
PERUM PERUMNAS		:National Urban Development Corporation

PMG	Pusat Meteorogi dan Geofisika	:Meteorological and Geophysical Center
P.P.	Priok Pile	
P.T.	Perusahaan Terbatas	: Private Estate Enterprise (Company Ltd.)
PWSCC	Proyek Pengembangan Wilayah Sungai Ciliwung-Cisadene	: Ciliwung-Cisadane River Basin Development Project Office
RKL		:Environmental Management Program
RPL		:Environmental Monitoring Program
REPELITA	Rencana Pembangunan Lima Tahun	:Five-Year Development Plan
TTG.	Tanda Tinggi Geodesi	

(2)International or Foreign Organization

GOI	:Government of the Republic of Indonesia
GOJ	:Government of Japan
IBRD	:International Bank for Reconstruction and Development
JICA	:Japan International Cooperation Agency
OECF	:Overseas Economic Cooperation Fund

(3) Foreign Terms

EIRR	:Economic Internal Rate of Return
FIRR	:Financial Internal Rate of Return
GDP	:Gross Domestic Product
GNP	:Gross National Product
GRP	:Gross Regional Product
PMF	:Probable Maximum Flood
NPV	:Net Present Value
O&M	:Operation and Maintenance
IEI	:Initial Environmental Evaluation
B/Q	:Bill of Quantities
TOR	:Terms of Reference

B/C	:Box Culvert
CAD	:Computer-aided Design
EIA	:Environmental Impact Assessment
ICB	:International Competitive Bidding
LCB	:Local Competitive Bidding
JIS	:Japan Industrial Standards
ASTM	:American Society for Testing and Materials

(4) Numerical Units

Length

mm	millimeter
cm	centimeter
m	meter
km	kilometer

Area

mm^2	square millimeter
cm^2	square centimeter
m^2	square meter
km^2	square kilometer
ha	hectare

Volume

cm^3	cubic meter
m^3	cubic meter
Ltr	liter

Weight

gr	gram
kg	kilogram
ton	metric ton

Time

sec	second
min	minute
hr	hour
yr	year

Others

%	percent
℃	degree centigrade
10^3	thousand
10^6	million
10^9	billion

Money

Exchange Rate

Rp.	Indonesian Rupiah	Official rate as of June 1997
¥	Japanese yen	US$ 1= Rp 2,350 = ¥ 115
US$	US dollar	

1 Introduction

This is an Executive Summary on urban drainage project in the city of Jakarta, which was carried out from August 1996 to December 1997.

The report on the urban drainage project in the city of Jakarta comprises a design report including executive summary, main report, supporting report and design drawings and a series of tender documents including tender drawings. Main outputs of this study are presented in the executive summary. The main report states a summary of the supporting report and presents the results of technical study including basic concepts for the urban drainage project, principle of design, design criteria, procedures of design, economic viability of the project and project implementation program and study on the environmental management and monitoring programs and social impact management plan. The supporting reports present details of the design including design calculation for the drainage structures, work quantity calculation, construction plan and schedule, cost estimate and breakdown of unit costs, and details of the environmental management and monitoring programs and social impact management program. The tender documents comprise a series of international tender documents and tender drawings. The summary of the study and design of the urban drainage project in the city of Jakarta is stated hereinafter.

1.1 Background of Project

The feasibility study on the urban drainage project for four objective areas, namely, Cengkareng west area, Sepak area, Bojong area and Meruya area was carried out by JICA and completed in 1991, namely, 6 years ago. Since then, land utilization condition has largely changed due to mainly rapid urbanization represented by house development on the land created by land reclamation in the depression areas located in the project areas. The house development has rapidly progressing in many places, especially in the Cengkareng west area, Sepak area and Meruya area. In the Cengkareng west area, many depression areas and swampy areas are located and all of these areas have already acquired by private house developers or private enterprises. It is anticipated that these depression and swampy areas will be utilized as house development areas by creating the lands by means of land reclamation. In the Sepak and Meruya areas, a large scale house complex has completed and further extension is progressing at present. In the Bojong area, rehabilitation works of the existing drainage facilities have completed. In addition to the rapid urbanization in the objective areas,

interchange works for Jakarta ring road have been progressing at the northern part of the Cengkareng west area and eastern part of the Meruya area. Due to construction of these interchanges, present drainage networks were largely changed compared with the situation investigated in the feasibility study stage.

Discussion meeting on determination of alignment for the proposed drainage channels was carried out and it was determined that detailed design works for the Sepak and Bojong areas were canceled from the scope of works because objected drainage channels in the Sepak area had already constructed and being scheduled to be improved by private housing developers, and the drainage facilities in the Bojong area had recently rehabilitated and no further drainage works were needed. Due to change of the scope of works, basic study, definitive planning and detailed design for the urban drainage plan were carried out for the Cengkareng west and Meruya areas.

1.2 Objectives of Study

The objectives of the Study are:

(i) to formulate definitive plan of the urban drainage projects in the Cengkareng west area and Meruya area through review of the Study and execution of additional surveys and investigations.
(ii) to prepare detailed design documents and tender documents for the project, and
(iii) to transfer relevant planning and designing technologies to Indonesian counterpart in the course of the design works.

1.3 Scope of Study

The project area covers about 38 km^2 in total and composed of two sub-drainage areas, namely, Cengkareng west area and Meruya area. The Study covers preparation of definitive plan in Phase I stage and preparation of detailed design and tender documents in Phase II stage.

1.4 Features of the Construction Works

The features of the construction works of the project are as follows:

(1) Drainage works in the Cengkareng west area

(i) Kamal drainage channel(drainage area: 20.89km^2)

- Total channel length 7.2 km
- Design discharge 0.9 m^3/sec - 48.1 m^3/sec
- Shape of channel Trapezoidal and rectangular type
- Excavation 267,000 m^3
- Embankment 39,000 m^3
- Concrete parapet 484 m
- Concrete ditch 452 m
- Revetment 6,675 m
- Bridge 28 nos.
- Gate 23 slide/flap gates

(ii) Tanjungan drainage channel(drainage area: 4.25km^2)

- Total channel length 2.5km
- Design discharge 9.6 m^3/sec - 19.0 m^3/sec
- Shape of channel Trapezoidal and rectangular type
- Excavation 51,000 m^3
- Embankment 52,000 m^3
- Concrete wall 1,134 m
- Revetment 347 m
- Bridge 5 nos.
- Gate 7 slide/flap gates

(iii) PIK Junction drainage channel(drainage area: 2.70 km^2)

- Total channel length 0.8 km
- Design discharge 7.1 m^3/sec-18.1 m^3/sec
- Shape of channel Rectangular type
- Excavation 7,400 m^3
- Concrete ditch 765 m
- Bridge 4 nos.
- Gate 1 slide gate

(iv) Gede/Bor drainage channel(drainage area: 2.41 km^2)

- Total channel length 1.2 km
- Design discharge 15.5 m^3/sec-16.9 m^3/sec
- Shape of channel Trapezoidal type
- Excavation 29,000 m^3
- Revetment 2,300 m
- Bridge 10 nos.
- Gate 5 slide/flap gates

(v) Saluran Cengkareng drainage channel(drainage area: 3.08 km^2)

- Total channel length	4.2 km
- Design discharge	5.8 m^3/sec-18.8 m^3/sec
- Shape of channel	Trapezoidal and rectangular type
- Excavation	83,000 m^3
- Embankment	41,000 m^3
- Concrete parapet	1,285 m
- Concrete culvert	391 m
- Revetment	4,188 m
- Bridge	13 nos.
- Gate	15 slide/flap gates

(2) Drainage works in the Meruya area

Meruya drainage channel(drainage area: 1.27 km^2)

- Total channel length	2.3 km
- Design discharge	1.6 m^3/sec-9.4 m^3/sec
- Shape of channel	Rectangular type
- Excavation	15,000 m^3
- Concrete ditch and culvert	2,798 m
- Bridge	16 nos.

2 Natural Conditions of the Project Areas

2.1 Topography and Geology

(1) Topography

The Cengkareng west area is located in the north-western part of the city of Jakarta and bounded by the highway connecting the international airport and the city of Jakarta in west, Mookervaat canal in south, Cengkareng floodway in east and Jakarta bay in north. Drainage area of the Cengkareng west area is about 36.7 km^2. The Cengkareng west area is characterized by remarkably low land elevation in a range of EL 0 m to EL 5 m, existence of several large scale depression and swampy areas and rapid urbanization represented by house development on the land created by land reclamation for these depression and swampy areas. Due to these topographic characteristics, habitual inundation takes place in several low land areas. In the northern part of this area, the Jl. Tol Prof. Sediyatmo is located. In its northern part, a large fish pond is extending to the Jakarta bay. Five primary drainage channels are located in this area and majority of

drainage water is discharged to the Jakarta bay through the largest Kamal drainage channel and Tanjungan and PIK Junction drainage channels. The remaining two primary drainage channels are located to direction of southwards and eastwards.

The Meruya drainage area is located in the southern part of highway connecting Jakarta and Merak harbor and bounded by existing drainage in the west, higher elevated area in the south, and higher elevated street in the east. Drainage area of the Meruya drainage system is about 1.3 km^2 and all of this area has been utilized as residential area. This drainage area is located on the elevation of 8~9m, but ground elevation is complicatedly undulated. Center part of this area is elevated and low land areas are located in its both sides. Due to these topographic characteristics, habitual inundation occurs in these depression areas in every rainy season.

(2) Geology

The sub-surface of the Jakarta plain consists of 250 m thick, Quaternary soils. Clays represent more than 70% of the soil cover. Thin sand layers are intercalated but laterally they are not continuous. The sands are fine grained and silty. The ground water is distributed over several thin and discontinuous layers and a clear distinction of aquifers is difficult. In general, the ground water level lies 2 m below the ground surface The soils are softer in the coastal area and more consistent from highway to the south and in the Meruya area. Very soft and soft, clayey and silty soils, SPT-value 0 to 3 blows, occur in the lower Kamal and Tanjungan areas, till the level of the highway. Their thickness is 9 to 11 m. Underneath, the soils are more consistent, SPT-values gradually increase to 20 and 30 blows, for an investigation depth of 35 m. South of the highway, towards the Daan Mogot road, mixed or clayey soft soils, where the SPT-value is less than 10 blows, extend from the ground surface to 5 or 7 m of depth. Underneath, 1.5 to 7 m thick, cemented sands, SPT-value more than 50 blows, have been found. This bed is not continuous over the entire area. The sands are underlain by stiff to hard clays, SPT-values 15 to 30 blows.

The Meruya area is covered with red soils. These are mixed type of soils, containing equal amounts of clay, silt and sand, locally with gravel. Such soils are generally stiff to hard. From the sounding data, a hard layer, possibly cemented sands, underlies the soil cover, at an average depth of 5 m.

The project area and the entire Jakarta plain will be affected by subsidence, due to self-weight consolidation in the deeper soil beds (40-250 m). This process is triggered by

groundwater pumping from the deeper, confined aquifer and its impact on the sub-surface is far more important and the counter-measures imply long term decisions on regional scale. At present, groundwater has been extracted by more than 3,000 wells with about 300 m long deep for industrial purposes in the Cengkareng west area. It has been reported that the maximum land subsidence rate in the project area is about 8cm/year.

2.2 Meteorological Condition

(1) Air temperature

Annual average of air temperature at an international airport located at southern part of the project area is in the range of 26℃ and 27℃ throughout a year. Extremely maximum and extremely minimum are 35.2℃ and 17.4℃ respectively in November and August.

(2) Relative humidity

Monthly mean relative humidity at the international airport ranges from 75% to 89% throughout a year. Monthly maximum and monthly minimum occur in February and September respectively.

(3) Surface wind

Wind speed is generally calm to 10 knots from 1 a.m. to 10 a.m. The wind speed becomes higher, more than 10 knots at 11 a.m. to 3 p.m. After 3 p.m., the wind speed usually decreasing except in bad weather.

(4) Rainfall

Annual rainfall during the period from 1986 to 1995 at the international airport is around 1,700 mm. The monthly maximum rainfall is 644 mm in January and monthly minimum is 1 mm in October. The highest frequency and lowest frequency of rainy day occur in January and September respectively.

2.3 Flood and Inundation

On average, approximately 5% of the project area is affected by floods. The inundation tends to occur in lowland areas and the areas along the rivers and drainages. The areas in which the inundation is clustered are the area in Kamal, Tanjungan and the area along the Saluran Cengkareng drainage channel. The depth of the inundation

ranges from 15cm to 100cm depending on the location. The range of duration is 1 to 7 hours. In the Tegal Alur and Kamal along the Kamal river, the range of depth of inundation is 30cm to 100cm which is the deepest in the project area. In Meruya area, the depth of inundation sometimes reaches 75cm.

The data showing the relationship between acreage of the inundation area and flood damage are not available. Then, the flood damage was estimated assuming the assets in the inundation areas. The estimated annual flood damage is about US$ 7.7million for the Cengkareng west area and US$ 0.2million for the Meruya area.

3 Social Conditions in the Project Areas

3.1 Administrative Unit of the Project Area

The project area is located in northwest part of DKI Jakarta which covers 4 Kecamatans and 9 Kelurahans: Kec. Kembangan, Kec. Cengkareng, Kec. Kalideres in Jakarta Barat and Kec. Penjaringan in Jakarta Utara.

The project area is one of the fastest growing regions in DKI Jakarta. This growing trend is caused partly by the Jakarta Outer-Ring Road and the Jl. Tol Prof. Sediyatmo which cut through the project area. The outer-ring road, currently under construction, is going to be built along Kec.Cengkareng and Kec. Kembangan. The highway, which connects the central city and the international airport, is located in the north part of Kec. Cengkareng and Kec. Kalideres. Because of the existence and construction of the highways, many large scale housing developments are currently underway. In the near future, this area is expected to play an important role for economy in the city of Jakarta.

3.2 Population

The population of the project area in 1994 was 261,893 which is 3.5% of the population in DKI Jakarta(7,515,392). The area of kelurahan which covers the project area is 52.3km^2 which is about 8% of the area of DKI Jakarta(661.26km^2).

The average population increase in the project area from 1990 to 1994 was 4.03% which is relatively high compared with the rate in 1980's which shows 3.89% increase. The Kelurahan which shows a large population increase is

Pegadungan(10.57%) in Kec. Kalideres where there is a large scale housing development. Several housing developments are also currently underway in Kec.Cengkareng. In Kec. Kalideres, where is more space for housing development, more housing development can be expected, which will trigger a rapid population increase in the future.

Population density of the project area is 5,008 persons/km^2 which is low compared with the population density for DKI Jakarta(10,192 persons/km^2) at present, but, due to rapid housing development in the project area, high population density in the project area in near future is anticipated.

3.3 Present Land Use

Approximately 61.1% (22.4km^2) of the area has been utilized as a residential area, followed by agricultural area (15.1%, 5.6km^2), fish pond(9%, 3.3km^2), swampy/depression area (8.5%, 3.1km^2) and industrial area(6.3%, 2.3km^2). According to the field survey, most open space has already been acquired by private sector for housing development. Industrial area, commercial area, and office area occupy about 18% of the project area. Industrial area concentrates mainly in Kec. Kamal along the Jl. Tol Prof. Sediyatmo. The commercial area is scattered in all the project area.

3.4 Labor Force

People in the project area are employed in a variety of sectors. The sector with the largest employment is the industry sector which employs about 26% of employment, followed by a commerce sector (24%) and the government sector (13%). The recent trend of economic activities in this area is the decline of agricultural activities, which is caused by a rapid urbanization of the area. Agricultural activities can be seen only in a small area of Kec. Kalideres and Kec. Penjaringan. There is no agricultural activity in Kec. Cengkareng and Kec. Kembangan.

3.5 Social Infrastructure

(1) Water supply

The piped water supply by PAM(Water Supply Enterprise) is available only in the newly developed area. For the majority of households in the project area, the main source of water for domestic use is from wells, either pumped by machine or by hand,

and the main source of drinking water is distributed by PAM in large tanks placed in several places in Kelurahan. Even though the water from wells contains salt and not suited for drinking, there are people who use the water from wells for a drinking purpose. The piped water supply is still limited to small number of households, however, due to the housing development in the area and the effort by PAM, the water service by pipe is expanding and more people will have an access to the PAM service.

(2) Electricity and gas supplies

The electricity is available in most households in the project area. More than 90% of households have an access to electricity. About 6% of households use either lamp or oil, and only a small number of households(0.02%) cannot have any mean of electricity. Gas is utilized by propane tank for most households. Oil is also used for cooking in some area.

4 Existing Drainage System

4.1 Cengkareng West Area

Drainage water in the Cengkareng west area is discharged through five main drainage channels to Jakarta bay to northwards, the Cengkareng floodway to eastwards and the Mookervaat canal to southwards. Present condition of the respective drainage areas and drainage facilities are as follows:

(1) Kamal drainage area

The Kamal drainage area is located in the north-western part of the Cengkareng west area and it is bounded by the Jl. Tol Prof. Sediyatmo in the west, main irrigation channel in the south and Jakarta outer ring road in the east. Drainage area of the Kamal drainage system is about 20.9 km^2 which occupies about 57 % of the Cengkareng west area. About 75% of the drainage area is occupied by residential area. In center and southern parts of this area, one swampy area and four depression areas are located. These swampy and depression areas had been already acquired by private developers for housing development. A part of the depression area has been developed as housing complex on the land created by land reclamation.

The Kamal main drainage channels have about 11,900 m in total length comprising about 9,700 m long channel constructed and maintained by DKI and 2,200 m long channel constructed by private sectors. Lined channel with wet masonry is 9,700 m and

unlined channel is 2,200 m. The channel is about 15 m wide and 2.5~3 m deep at the highway crossing and 10 m wide and 1.5 m deep at the junction portion of the channel extending from eastern direction. The channel bed slope is about 1:3,200 in about 2.3 km from channel mouth and 1:1,800 in its upstream channel stretch.

No channel related structure such as gates and weirs has been provided along the drainage channels. Thirty one bridges and one culvert cross the drainage channels. Majority of the bridges are single span and about 3~8 m in length. Among the related structures, the culvert the Jl. Tol Prof. Sediyatmo is the largest structure with two lanes of 10.8m in total width.

(2) Tanjungan drainage area

The Tanjungan drainage area is located in the northern part of the Cengkareng west area and bounded by the Kamal drainage in the west and south and outer ring road and interchange of the outer ring road in the east. This drainage area comprises low land with elevation of about EL 0.5 m in the southern part of the highway and large scale depression/swampy areas. These depression /swampy areas have been already acquired by private sector for house development. The downstream part of the Jl. Tol Prof. Sediyatmo (the highway) forms fish pond. Industrial areas are located along the highway. Drainage area of the Tanjungan drainage system is about 4.3 km^2. About 40 % of this drainage area is occupied by residential and industrial areas. The Tanjungan drainage channel has about 1,700 m long lined channel with wet masonry and concrete and 200m long unlined channel. The drainage channel is about 5 m wide and 0.8 m deep at the highway crossing. The channel bed slope is so gentle as being about 1:5,000 in all channel stretch. Due to this gentle channel bed slope, drainage water is stagnating even in a dry season. A culvert with about 3.4 m wide and 1~2 m high has been provided under the highway. However, since the road surface elevation of the highway became almost the same as tidal level due to the subsidence of the highway, the culvert crossing the highway functions as siphon at present. Due to this situation, remarkably small drainage water is discharged to downstream through the culvert. The drainage water released through this culvert flows into fish pond in its downstream and poured to Jakarta bay through about 900 m long channel provided in the upstream of channel mouth. According to the information concerning subsidence of the highway, the subsidence of the highway has been progressing in the road stretch between the Kamal culvert portion and the Cengkareng floodway bridge in the Cengkareng west drainage area and its extent is the most serious near the Tanjungan culvert crossing portion. Due to inundation caused by subsidence of the highway, access to the international airport

has been sometimes disturbed in a rainy season.

No channel related structure has been provided along the drainage channel. Five bridges and one culvert cross the Tanjungan drainage channels.

(3) PIK Junction drainage area

This drainage area is located in the northeast part of the Cengkareng west area and surrounded by an interchange of the outer ring road in the west, existing street with slightly higher elevation in the south and the Cengkareng floodway in the east. The downstream of the Jl Tol Prof. Sediyatmo forms mainly fish pond and a golf yard. Drainage area of the new drainage system is about 2.7 km^2 and about 64 % of it is occupied by residential and industrial areas. The drainage system in this area was drastically changed by construction of the interchange roads of the Jakarta outer ring road and drainage of this area has been interrupted by the interchange road. In this drainage area, 5 culverts with 0.8m in diameter are provided crossing the highway. Length of the new drainage channel is 300m up to the highway. It is reported that these culverts are constructed mainly to stabilize the highway by balancing the water level at the both sides of the highway. The drainage water collected from the densely populated area in the left bank of the Cengkareng floodway is drained along the low elevated fringe of the Cengkareng highway, but due to obstruction of the interchange roads to the Cengkareng direction and the airport direction, the drainage water is drained through seven culverts with 0.8 m in diameter provided crossing the highway and one culvert with about 0.7m in diameter provided at the interchange road.

No related structure is located in this drainage area. Two bridges and two culverts are crossing the proposed drainage channel.

(4) Gede/Bor and Saluran Cengkareng drainage areas

This drainage area is located in the southern part of the Cengkareng west area and bounded by higher elevated area in the west, boundary area in the south, main irrigation cannel in the north and the Cengkareng floodway in the east. Drainage area of the Gede/Bor and Saluran Cengkareng drainage systems are about 2.41 km^2 and 3.08 km^2 respectively and all of these areas except for 6 % of the paddy field in the Gede/Bor drainage area have been utilized as residential area.

The Gede drainage channel comprises 1.5 km constructed by DKI and 1.9km constructed by a private sector. The drainage water discharged through 1.9km long

Gede channel which is located inside the newly constructed housing complex is drained to the Bor channel. The drainage water from the Bor channel is divided into the southern direction to the Mookervaat canal and eastern direction to the Saluran Cengkareng channel. The Bor drainage channel has about 1.5 km in length to the Mookervaat canal and channel bed slope is about 1:1,100. While, the Saluran Cengkareng drainage channel is about 4.2 km in total length to the Cengkareng floodway and channel bed slope is about 1:3,000. It is presumed that majority of the drainage water is discharged to the Mookervaat canal through the Bor drainage channel due to steeper river bed slope of the Bor drainage channel.

The Gede drainage channel which is provided inside the new housing complex is about 8 m wide and 2 m deep. All of these channels are lined channel. About 4 m wide and 2 m deep Citra Garden II channel which drains from the southwestern part of the area has been rehabilitated by private sector. In order to drain water from the Citra Garden II channel to the Mookervaat canal, the private sector already constructed a drainage channel to the Mookervaat canal in the right side of the existing Bor drainage channel.

The Saluran Cengkareng drainage channel which drain to the Cengkareng floodway has 4,200 m in total length comprising 3,400 m long lined channel and 800m long unlined channel. All of these channels were constructed by DKI. Several channel stretch portions of the Saluran Cengkareng channel were rehabilitated by DKI. Its dimension is 5~8 m wide and 1.5 m deep at upstream end and about 10m wide and 1.8 m deep at the confluence with the Cengkareng floodway. The drainage water collected through the Saluran Cengkareng channel flows down through remarkably densely populated area and drained to the Cengkareng floodway. A sluice facility with 2 units of 2.4m wide and 2.6 m high spindle type sluice gate has been provided at the outlet of the Saluran Cengkareng drainage channel to minimize inundation in locally low land area along the Saluran Cengkareng drainage channel due to back water of the Cengkareng floodway. Fourteen bridges cross the Saluran Cengkareng drainage channel.

(5) Pedongkelan drainage area

This drainage area is located in the eastern part of the Cengkareng west area and bounded by Jakarta outer ring road and main irrigation canal in the west, boundary of the PIK Junction drainage area in the north and the Cengkareng floodway in the east. Drainage area of the Pedongkelan drainage system is about 3.38 km^2 and all of this area has been utilized as residential area. Almost the whole central part of this drainage area is already occupied by the National Urban Development Corporation (PERUM

PERUMNAS) and a new drainage channel with poundage and a pump facility at its outlet is being constructed to drain the drainage water to the Cengkareng floodway. The new drainage is located surrounding the housing complex. The drainage channel comprises about 6,600 m long lined channel with wet masonry.

4.2 Meruya Area

The Meruya drainage area is located at the southern part of highway connecting Jakarta and Merak harbor and bounded by existing drainage in the west, higher elevated area in the south, and higher elevated street in the east. Drainage area of the Meruya drainage system is about 1.27 km^2 and all of this area has been utilized as residential area. The Meruya drainage channel to be studied is secondary level and comprises about 600 m long concrete ditch and 600 m long unlined ditch. The drainage ditch is about 1~2 m wide and 1 m deep in an average. Drainage water collected from southern watershed flows towards northern direction and divided into eastern and western directions due to high undulation in the center part of the drainage area. The drainage water flowed down to the eastern direction once stagnates in low land or depression area in the eastern part of the drainage area and a part of drainage water discharges to existing eastern drainage ditch provided in the recently constructed private house complex. The drainage water flowed down to the western direction stagnates in depression area in the western part of the drainage area and a part of drainage water discharges to the existing drainage ditch located at northern part of the objective drainage area through the existing cross drains provided under the highway. In the rainy season, habitual inundation with long duration takes place in the above mentioned depression areas due to undulation of the ground surface and inadequate drainage canal alignment. Since the capacity of the drainage ditch constructed in the private owned housing area in eastwards is limited, drainage water flows down in the eastern part of the drainage area will have to be shifted to the western direction. In the northeastern part of the drainage area, construction works of interchange (Kebon-Jeruk Junction) works are being executed. Due to the construction of the interchange facilities, drainage to the existing cross drains under the embankment of the highway will be disturbed and the only outlet of the drainage water in the western part of the drainage area will be limited to a tributary of the Angke river located at about 480m westwards of the drainage area. Along the existing drainage channel, five bridges and 3 culverts cross the existing drainage networks.

5 Detailed Design of Urban Drainage Project

5.1 Basic Principle for Urban Drainage Plan

The basic principle for the urban drainage plan for two objective areas, Cengkareng west area and Meruya area, was established considering rapid urbanization in the objective areas represented by housing development and drastic variation of the existing drainage networks due to (i) construction of interchange structures of Jakarta ring road and (ii) anticipating future land use condition. The established basic concept for the proposed urban drainage plan is as follows:

(1) The future land use plan for the objective areas was established referring to the land use plan set out by DKI Jakarta and anticipating future land use condition from present land use progressing situation, and target year for this drainage plan is set at 2010. Comparison of the land use in the present and the target year 2010 is as follows:

(Unit: km^2)

Category of Area	Present Land Use	Land Use in 2010
- Residential area	22.44	27.98
- Industrial area	2.31	3.48
- Paddy field	5.55	2.27
- Fish pond	3.28	2.98
- Swampy/depression area	3.13	0
Total	36.71	36.71

(2) The drainage channels are designed under protection level of 10-year flood for the Cengkareng west area and 5-year flood for the Meruya area.

(3) Drainage water is drained by gravity flow in principle to minimize operation and maintenance cost for the drainage facilities after construction of the project.

(4) Special consideration for land subsidence and clean water management was made for planning and designing the proposed urban drainage project. Concept for the land subsidence and clean water management is as follows:

(a) Land subsidence

Land subsidence is a serious problem in the Cengkareng west area. Extent of the land subsidence for 20 years since 1974 has been estimated at the rates of 6cm/year to 8cm/year by DKI Jakarta by means of leveling survey of existing bench marks in PP System. In due consideration of the extent of the land subsidence, basic concept

and criteria for design of this urban drainage project against land subsidence was set forth as follows:

(i) Drainage channels and related structures are designed so as to cope with land subsidence up to the target year 2010.

(ii) Drainage channels and related structures shall be designed under the condition that all of the riparian areas along the drainage channels are settled down at the subsidence rates above and tidal water level is unchanged. The drainage channels and related structures will be designed by gravity flow up to the target year under the above condition. In case of the Kamal, the Tanjungan and the Saluran Cengkareng drainage channels, pumping up facilities will have to be considered, if the design flood water level becomes higher than the ground in riparian areas along the channel due to land subsidence after the target year. To cope with such situation, locations and required capacities of regulation ponds are to be examined at a preliminary study level.

(iii)It has been presumed that subsidence takes place due to two parameters, namely settlement due to heavy burden in a shallow zone and self consolidation due to pumping up of ground water in a deep zone. In order to design such permanent structures as bridges and culverts to cope with settlement in the shallow zone, it was proposed to apply supporting or friction piles and to provide additional clearance to meet subsidence depth during the selected period above the freeboard of the design flood water level. However, since it is impossible to cope with self consolidation in a deep zone, type of bridge and culvert which can be technically heightened when land subsidence in a deep zone takes place was adopted. No allowance for land subsidence was provided for levee since the capacity and freeboard of the drainage channels can be ensured by additional heightening.

(b) Clean water management

Drainage water containing contaminated water in the existing drainage channels in the Cengkareng west area stagnates at many locations in a dry season, due mainly to (i) very gentle bed slope of the drainage channels and (ii) reduction of flow capacity caused by throwing dust and garbage into the drainage channels. In particular, this phenomenon is conspicuous in the outlet of the Saluran Cengkareng drainage channel. Consciousness of inhabitants for improvement to clean water in the drainage channels is remarkably low at present. In order to keep and maintain drainage channels in clean condition, following structural and non-structural measures will have to be adopted.

(i) Along the downstream part of the Saluran Cengkareng drainage channel, many houses are densely located and the drainage channel has been filled with dust and garbage. To prevent dust and garbage from flowing into the drainage channel and to keep clean water, a structural measure of 400m long culvert with mesh cover and inlet screen is to be introduced in this densely populated stretch. In addition, to prevent stagnation of drainage water, the drainage channel is to be designed with high water velocity as far as the topographic condition allows.

(ii) In order to flush out the contaminated water in the drainage channels in a dry season, a part of irrigation water from the main irrigation canal provided at the southern part of the Cengkareng west area should be utilized as maintenance flow of the proposed drainage channels. To meet this requirement, connection of the drainage channels and secondary irrigation canals should be contemplated for design works.

(iii)In order to facilitate the clean water management plan as a non structural measure, proposed operation and management plan including technical aspects such as routine operation and maintenance methods/works and necessary equipment, and institutional aspects such as proposed organization and system, annual budget to be disbursed and participation of inhabitants to operation and maintenance works will be needed.

(5) It has been strongly requested by the Director General of CIPTA KARYA that this drainage project should be carried out under private sector's participation to reduce budgetary burden to the governmental side. To meet this request, it is proposed that the drainage channels in private owned areas which are mainly depression and swampy areas at present should be constructed by themselves and the constructed drainage facilities will be handed over to DKI Jakarta for routine maintenance works. In a definitive plan, design criteria to be applied to the drainage channels for private sectors such as design discharges, design channel bed slopes and design channel bed elevations are to be clarified.

(6) Currently, the Jl. Tol. Prof. Sediyatmo is aligned in the swampy area in the northern part of the Cengkareng west area and it has repeatedly suffered from submergence in a rainy season. The cause of this road submergence is attributable mainly to lower elevation of the highway in an about 4 km long stretch in the Cengkareng west area. To cope with this submergence and also to cope with traffic volume increase in a future stage, it has been planned by JASA MARGA that the existing highway is widened to four lanes and heightened in the stretch between the Kamal drainage crossing site and Cengkareng flooway crossing site. It has been agreed among CIPTA KARYA, BINA MARGA, JASA MARGA, DKI Jakarta and JICA Study Team that bridges crossing the Kamal and Tanjungan drainage channels are to be

designed and constructed by JASA MARGA themselves. Thus, in this design, the bridges for the Kamal and Tanjungan drainage channels, which cross the highway are excluded.

(7) High tension electric lines and water supply pipe lines cross the existing drainage channels. Due to expansion of the drainage channels, treatment of these lines are needed. Besides, it is obliged to shift the existing telephone poles, concrete structure with gates for drainage facilities of highway, road signs, traffic signals, etc. due to expansion of the existing drainage channel. For the treatment, discussion is to be made with authorities concerned. It is proposed that planning, designing and construction of expansion/shifting works of these structures are to be made by authorities themselves under the condition that the cost necessary for expansion/shifting works is born by the project.

5.2 Detailed Design of Drainage Channels

The detailed design of the drainage channels was carried out based on the topographic maps with a scale of 1:1,000 and channel cross sections with an interval of 100m.

(1) Design conditions

The design criteria of the drainage structures including drainage channels, levees, revetments, bridges, culverts and gate facilities were established referring to standards applied in Public Works, DPU DKI Jakarta and standards applied in Japan.

(2) Proposed flood discharge distribution

The flood discharge distribution established in the feasibility study was reviewed by incorporating latest rainfall data of selected gauges where automatic rainfall data in a long period are available. The design flood discharges in the revised flood discharge distribution are the same as those of the feasibility study. The diagram of the established flood discharge distribution is shown in Figs 4.1 and 4.2.

(3) Alignment of drainage channels and proposed gate facilities

In accordance with the basic principle, the drainage channel alignment and basic drainage plan were determined as shown in Figs 4.3 and 4.4. Except the PIK Junction drainage channel in the Cengkareng west area, all of the proposed drainage channels were designed by widening the existing channels. In order to minimize compensation of lands and houses, it is needed to reduce the widths of the drainage channels as far as

possible. There are a lot of locally low land areas in the Cengkareng west and Meruya areas. Since it is impossible to drain water perfectly from the low land areas, it was contemplated to provide slide/flap gates in the proposed drainage channels along the low land areas under the condition that rain water is discharged at each gate site to the drainage channel when the water level in the drainage channel is lowered than that in the low land area. Low land extends in the southern part of the highway for the Tanjungan drainage channel. In order to drain water in this low land by gravity flow and to cope with land subsidence, it is necessary to heighten this low land up to EL 2 m. For drainage of the Saluran Cengkareng, the slide gates will be provided at the outlet of this channel to avoid influence of the flood from the Cengkareng floodway. In addition, the slide gates will be also provided at the upstream end of the Saluran Cengkareng drainage channel to release maintenance water, particularly in a dry season since the Saluran Cengkareng drainage channel is planned to be separated from the Bor drainage channel.

For the Meruya area, drainage ditches were aligned so as to discharge water in the drainage area to the western direction and to drain to the tributary of the Angke river, at about 480m westwards of the drainage area.

In the course of the study on alignment of the drainage channels, following alternative plans were proposed by the Indonesian side:

(i) In order to reduce compensation cost for land and houses along the Kamal drainage channel in its downstream part, a new drainage channel is aligned to the existing irrigation canal in the western side of the Cengkareng west area.
(ii) In order to alleviate Jl. Tol Prof. Sediyatmo from being submerged, a long storage plan along the toll road between the Kamal and Tanjungan drainage channels and parallel drain along the Kamal lower stretch or storage pump into the Kamal drain canal is contemplated.

The above two alternative plans were carefully examined from technical and economic viewpoints and it was finally concluded that:

(a) For alternative plan (i)
In order to discharge drainage water in the private owned areas to a newly proposed drainage channel which will be constructed by widening the existing irrigation canal and connected with the Kamal main drainage channel in the direction to Jakarta bay, the

channel slope of the existing drainage channel which is aligned in the private owned areas in the eastern direction must be changed reversibly in the western direction. At the junction of the drainage channel from the private owned areas and the new drainage channel, the channel bed of the drainage channel from the private owned area becomes lower than that of the new drainage channel. To drain water from the private owned areas to the new drainage channel, pump up facilities with regulation pond will have to be adopted at the junction portion. Besides, compensation cost for about 85 households and land of about 8 ha is additionally needed. Cost comparison between the present by proposed plan and alternative plan (i) clarifies that project cost for the alternative plan becomes higher than that of the presently proposed plan, and operation and maintenance cost for the pumping facilities is needed annually in case of the alternative plan. It is contemplated that promotion of the presently proposed plan which has smaller construction cost including compensation and operation and maintenance costs will be benefitable in a long term basis.

(b) For alternative plan (ii),

This alternative plan may be effective as an urgent action before widening and heightening works of the Jl Tol Prof. Sediyatmo by JASA MARGA, though this alternative will also need pumping facilities at the junction of the parallel storage canal and the Kamal drainage channel to drain water to Jakarta bay, and operation and maintenance cost is needed annually. However, after widening and heightening works of the toll road, this alternative plan will become unneccesary. Since the drainage plan presently proposed for the Kamal and Tanjungan drainage channels was formulated based on the heightening of the highway, this alternative plan is not considered as a competitive plan for the presently proposed plan.

(4) Longitudinal profile of drainage channels

1) Cengkareng west area

a) Drainage channels to be drained to Jakarta bay

Drainage water in the Kamal, the Tanjungan and the PIK Junction drainage channels is discharged to Jakarta bay. In order to drain as much discharge as possible with limitation in channel width, steeper channel bed slopes should be applied. If this method is applied, channel excavation is needed off shore and jetties will have to be provided to protect the excavated channel from scouring and sand depositing. However, design of a jetty including its direction and scale can not be made without any result of coastal

investigation. In addition, it is anticipated that the deepened channel bed alters to the original channel bed due to sea sand intrusion and upstream sand deposition. Considering above situation, design channel beds in the existing drainage channel portions are set nearly at their original ones for the Kamal and the Tanjungan drainage channels. The design channel beds for the depression and swampy area portions, which have been acquired by private sectors, are set respectively, referring to the design channel bed slopes of the existing channels downstream of the portions and assumed ground elevations of related land reclamation areas.

The design channel bed slope for the PIK Junction drainage channel is set considering the existing channel bed slope along Jl. Tol Prof. Sediyatmo and a ground elevation of the upstream drainage area. The determined channel bed slope is as follows:

- Kamal drainage channel: 1:3,200 and 1:1,800
- Tanjungan drainage channel: 1:5,000
- PIK Junction drainage channel: 1:600

b) Drainage channel to be drained to Cengkareng floodway

The Saluran Cengkareng drainage channel discharges to the Cengkareng floodway. The Saluran Cengkareng drainage channel is affected in its downstream portion by back-water from the Cengkareng floodway. Even if the channel bed at the outlet portion of the Saluran Cengkareng drainage channel is lowered, flood discharge to be drained is unchanged. Thus, the design channel bed is set nearly at the original channel bed elevation. The determined channel bed slope is 1:3,000.

c) Drainage channel to be drained to Mookervaat canal

The Gede/Bor drainage channel is discharged to the Mookervaat canal. Since the Gede/Bor drainage channel is not affected by water from the Mookervaat canal, the channel bed at the outlet portion is slightly lowered and a steeper channel bed slope than the original one is adopted to minimize the channel width. The determined channel bed slope is 1:1,600.

2) Meruya area

In order to drain rainfall water in the Meruya area by gravity flow to the tributary of the Angke river, following conditions were contemplated:

(i) All of the objective drainage area was already acquired by residents and provision of a new drainage channel in this acquired area is rather difficult because of compensation problem with residents. To avoid this compensation problem, the proposed drainage channel is to be aligned along the existing roads.

(ii) The proposed drainage channel is to have alignment crossing the city road along the west fringe of the drainage area, so as not to cross a pier portion of the road bridge across the Jl. Tol Jakarta-Merak.

(iii) Foundation of the existing houses located along the proposed drainage channel in the center part area has been heightened by 0.5~0.7 m to avoid inundation. Since the ground elevation of the center part area is about 2m lower than those of neighboring areas, the design water level corresponding to a 5-year flood becomes about 0.5m higher than the foundation of the existing houses. Under such drainage conditions, it was contemplated to proceed with the drainage works by two stages. In the initial stage, a drainage channel with the same design water level as the foundation of the existing houses is designed considering convenience of inhabitants, on condition that inundation is allowed at a part of the center part area against a 5-year probable flood. In the final stage when substantial land reclamation will be carried out, the drainage channel will be heightened to discharge a 5-year probable flood.

Comparative study on the relationship among channel widths to drain the design flood (5-year flood), ground elevations along the drainage channel and designed channel beds was made. Among several alternatives, drainage plan with the lowest design water level was selected. The selected design channel bed has slopes of 1:2,000, 1:260 and 1:700 from downstream to upstream direction.

The design longitudinal profiles determined in accordance with the above concepts are given in Fig 4.5.

(5) Cross sections of drainage channels

Single cross sections are applied for all of the proposed drainage channels, respectively. The cross sections were designed considering the following conditions:

a) The design water level should be lower than the ground elevation of the related drainage area, in principle.

b) In case of the Tanjungan drainage channel, it is necessary to heighten low lands in the southern part of the highway up to EL 2 m to drain water by gravity flow and to

cope with land subsidence.

c) Compensation of lands and houses due to widening the drainage channels should be minimized.

d) The freeboard as specified in the design criteria is applied.

Comparative study on relationship among channel bottom width, channel depth, design water level and ground elevation was made for respective drainage channels by means of non-uniform flow calculation. Among several alternatives, a cross section with a maximum channel depth to satisfy the above condition, except for locally low land area portion, and with a minimum width was selected as a design cross section for each channel portion. The designed cross sections thus selected are given in Fig 4.6.

5.3 Design of Drainage Structures

(1) Design conditions

1) Levee

Earth type levees of trapezoidal shapes having a common side slop of 1:2.0 and 3 m to 5 m wide crests were proposed to be applied. However, concrete parapet walls were adopted to the channel stretches where there is constraint in land acquisition in densely populated housing areas.

2) Revetment

Wet cobble masonry type revetments shall be constructed to stabilize side slopes of the drainage channels, except the channel stretches which will be provided with the earth type levees.

3) Inspection road

Existing roads along the proposed drainage channels can act as inspection roads not only for routine operation and maintenance works of such drainage facilities as drainage channels, levees, revetments and sluiceways but for periodical inspection of the facilities. In case that no existing road is available for the inspection road s along the proposed drainage channels, inspection roads at least 5 m wide will be provided on the crests of the newly constructed earth type levees or along the drainage channels.

(2) Design works

(a) Channel structures

1) Channel lined with wet masonry revetment

The channel lined with a wet masonry revetment was applied to all the channel stretches, excluding those for items 2), 3) and (b) below. The side slopes of the wet masonry revetments are 1:0.5 in common.

2) Open culvert with mesh cover and screen

An open culvert with mesh cover was applied to the 400m long channel stretch from the outlet of the Saluran Cengkareng drainage channel to prevent dust and garbage from being thrown into the drainage channel. The open culvert was divided into three lanes. Mesh cover supported by a L- type steel frame was provided at the top of the open culvert. To prevent dust and garbage from flowing into the culvert, 3 pieces of screens made of I- type section steel members were provided at the upstream end of the open culvert.

3) Open U- type concrete ditch

The open U- type concrete ditch was adopted to all the proposed stretches in the Meruya area except highly elevated portions in the center and western parts of the drainage area, to all the proposed stretches in the PIK Junction drainage channel and the up most stream stretch of a branch channel of the Kamal drainage channel.

(b) Levee

1) Earth type levee

An earth type levee of a trapezoidal shape was adopted for the channel stretches along locally low areas and sparsely populated areas in the Kamal and the Saluran Cengkareng drainage channels. The levee was provided with bituminous pavement 4m wide on its crest in case of the stretch which has no existing road available for an inspection road.

2) Concrete parapet wall

The concrete parapet walls having 1m to 2m in height were provided in the channel stretches along the densely populated areas in the Kamal, the Tanjungan and the Saluran Cengkareng drainage channels.

(c) Gate and related structures

1) Kind of gate and location to be adopted

Two types of gate; namely, slide gate and flap gate types are adopted in this design. Each type of gate was applied to the following locations:

Gate Type	Locations
Slide gate	- at inlet and outlet sluiceways of the Saluran Cengkareng drainage channel - at sluiceways having design discharges of more than 0.2 m^3/s
Flap gate	- at sluiceways having design discharges of equal to or less than 0.2 m^3/s

2) Design of gate and related structures

Steel-made slide gates of twelve sizes from 2.3 m to 0.5 m squares and steel-made flap gates with a common size 0.4 m square were designed considering the magnitude of the sluiceway design discharges.

3) Standard to be applied

The design and fabrication of the gates, in principle, conform to the applicable provisions of the Technical Standards for Gates and Penstocks published by the Hydraulic Gate and Penstock Association of Japan. The Japanese Industrial Standards (JIS) and the American Society for Testing and Materials (ASTM) are adopted mainly for the materials to be used and workmanship of the gate works. In addition, the Indonesian National Standards are applied as much as possible.

4) Slide gates

Type of gate shall be determined from view points of required purpose, functions, frequency of operation, safety, convenience of operation and maintenance, installed locations and circumstances, civil structures, etc., and also from an economical view point. A slide gate or a roller (fixed wheel) gate is generally adopted to the inlet or outlet gates of vertical lift type. Out of them, a lift slide gate was adopted from the viewpoint of simple manufacturing procedures, easy maintenance and operation load conditions.

The power source will not be supplied for the gate operation in principle. Accordingly, gate operation should be executed by man power within limited operation force.

5) Flap gates

Four (4) flap gates are provided at the outlets of the sluiceways of which the conduit sizes are 0.4 m wide and 0.4 m high in common. The flap gates can be operated automatically by water head difference between their upstream and downstream faces. The square type flap gate having rubber seal was applied from the viewpoints of perfect water tightness and high durability.

6) Stoplog

To maintain gate leaves, guide slots and piers, timber stoplogs are installed at the upstream and/or downstream sides of the sluiceways.

7) Screen

In case of the open culvert provided in the 400 m downstream stretch of the Saluran Cengkareng drainage channel, 3 pieces of fixed type screens are installed at the upstream end of the open culvert to avoid garbage flowing which shall obstruct the smooth flow in the channel.

8) Mesh cover

The mesh cover is provided at the top of the open culvert of the Saluran Cengkareng drainage channel to prevent garbage from being thrown away into the channel. The mesh size is determined to be 50 mm square so that the relatively large garbage can not be dumped. The frame size of the mesh cover is determined to be 2 m wide and 3.5 m long for easy handling.

(d) Shifting of related structures

High tension electric lines, water supply pipe lines and telephone lines crossing the existing drainage channels and other structures such as concrete structures with gates, road signs, signals, etc. are planned to be shifted due to expansion of the existing drainage channels. In this design only cost necessary for the shifting works was estimated under the condition that the shifting works including planning, designing and land/house compensation are performed by the authorities concerned.

5.4 Design of Bridge

(1) Design conditions

Due to the expansion of the existing drainage channels, 76 existing bridges and culverts was planned to be reconstructed. Design of these bridges was made in accordance with Indonesian Codes and Standards. For the design criteria which have not been covered

by these Codes and Standard, Japan Standard or AASHTO for highway bridges were applied.

(a) Type of superstructure

Based on the study on the relationship among bridge span, girder height and kind of superstructures, two types of bridges, namely, normal sized bridges with pre-tension girders and in-situ slab type were applied. Type of bridges is illustrated in Fig 4.7. Breakdown of the bridge types is as follows and their locations are shown in Fig 4.8.

Drainage Channel	Girder Bridge	Slab Bridge	Total
-Kamal(main)	9	-	9
-Kamal(branch)	17	2	19
-Tanjungan	5	-	5
- PIK Junction	-	4	4
-Gede/Bor	10	-	10
-S.Cengkareng	13	-	13
-Meruya	-	16	16
Total	54	22	76

In order to standardize the type of bridges and culverts, these 76 existing bridges and culverts were classified by bridge width and girder length and following standardized type of bridges were selected:

Type of Bridge	Number of Standardized Type
- Girder type bridge	31
- In-situ slab type bridge	6
Total	37

Breakdown of bridge length and unit span for 31 standardized girder type bridges is as follows:

No of Bridge	Bridge Dimension(m)			No of Bridge	Bridge Dimension(m)		
	Length	Width	Unit span length		Length	Width	Unit span length
BKM 1	44.79	4.6	14.9	BKE 8	16.86	2.5	8.4
BKM 3	40.14	9.6	13.35	BKE 10	14.66	6.6	7.3
BKM 4	39.96	2.5	13.1	BKE 11,18	14.66	4.6	7.3
BKM 5	56.72	9.6	14.15	BKE 13	14.66	8.2	7.3
BKM 6,7	36.54	2.5	12.15	BKE 14,15	14.66	3	7.3
BKM 8	38.79	4.6	12.9	BKE 16,17	14.66	2.5	7.3
BKM 10,11	35.79	9.6	11.9	BTM 1	40.59	6.6	13.5
BKE 1	16.86	3	8.4	BTM 3	23.86	10.6	11.9
BKE 2,6,9	16.86	4.6	8.4	BTM 4,5	19.26	12.2	9.6
BKE 3,4,5,7	16.86	6.6	8.4	BTM 6	18.46	2.5	9.2

No of Bridge	Bridge Dimension(m)			No of Bridge	Bridge Dimension(m)		
	Length	Width	Unit span length		Length	Width	Unit span length
BGM 1,2	15.83	9.6	15.8	BCM 4	14.63	2.5	14.6
BGM 3	15.83	2.5	15.8	BCM 5	15.83	6.6	15.8
BGM 4,8,9	15.83	6.6	15.8	BCM 6	14.13	6.6	14.1
BCM 5,6,7	15.83	4.6	15.8	BCM 8,9	12.63	2.5	12.6
BGM 10	15.83	3.5	15.8	BCM 11,12	13.53	12.2	13.5
BCM 2	15.83	9.6	15.8	BCM 13	11.33	8.2	11.3
BCM 3	15.83	4.6	15.8	BCM 14	10.53	9.6	10.5
BCM 7	15.83	2.5	15.8	BKE 19,20	2.33	4.6	2.3
BCM10	14.93	6.6	14.9				

In this design work, 37 type bridges were designed and designed structural sections were applied to the remaining 39 proposed bridges.

In order to cope with land subsidence, lifting measure was introduced for re-positioning of the bridge girder on the heightened abutments and piers under the condition that the access road is additionally heightened and road surface is re-paved.

(b) Type of foundation

Foundation of the bridge structures consists of clay layer, silt sand/clay and clay/silt with N value of about 16-30 at depth of more than 9m. Considering the geological conditions of the bridge substructures, namely, expecting both resistance of pile at tip and skin, pile type was selected as foundation.

(c) Type of pier

Pile trestle type was selected considering relatively small vertical reaction from superstructure, horizontal reaction due to load, height of pier and economical view points according to Indonesian standard drawings.

(d) Type of abutment

Spill-through pile trestle abutment was selected considering foundation condition of the abutment site and height of the abutment provided on the existing ground.

(e) Elevation of bridge

Elevation of the girder bottom of the proposed bridges shall be set above the vertical clearance restricted by the freeboard and allowance of land subsidence. The elevation of bridge surface shall be calculated as:

Bridge surface elevation = H.W.L+ Freeboard +Land subsidence +Girder height + Pavement depth +Cross- fall.

(2) Design works of bridges and related structures

(a) Superstructure

The girder type bridge was designed as an uniform rectangular section. The relation between the stress by service load and allowable stress at girder center was calculated to determine the dimension of the girder section.

(b) Substructure

Geological data including core drilling data at 6 points and geological profiles of Dutch cone sounding along the channels which have been obtained through the geo-technical investigation was used to estimate bearing layer penetrated with pile tips. The layers with more than 15 blows of N value have been read on the profile as a bearing stratum for clay. Based on the results of the geo-technical investigation, the pile length at the bridge structures for each drainage channel was assessed as follows:

Name of d, channels	Pile length(m)
-Kamal(main)	10-16.0
-Kamal(branch)	7-19.0
-Tanjungan	9-17.0
-PIK Junction	8-11.0
-Gede/Bor	9-10.0
-S.Cengkareng	5-9.0

(c) Access road

The elevation gap between the bridge surface and existing ground surface shall be smoothly connected by access road with transition curve. Applied maximum gradient of the access road ranges between 5% and 9%. For stares for pedestrian bridges, 10 % was applied. Based on this criteria, length of the access road was determined as follows:

	Road Length(one side)(m)	
Name of D,Channel	Carriageway	Pedestrian
-Kamal(Main)	30.5-60.5	15.7-21.3
-Kamal(Branch)	31.2-50.1	18.7-21.6
-Tanjungan	49.2-68.8	-
-Gede/Bor	43.9-79	19.1
-S.Cengkareng	27.6-57	13.8-26

6 Cost Estimate

6.1 Condition of Cost Estimate

The construction cost of the project was estimated under the following conditions and assumptions:

(i) Exchange rate of currencies is US$ 1.0 = Rp. 2,350 = ¥ 115.
(ii) The construction cost was estimated based on the price level of June, 1997.
(iii) The physical contingency is assumed to be 10 % of the total cost.
(iv) The price escalation rate is assumed to be 2 % per annum.
(v) Income tax of 10 % is included in the project cost.
(vi) The government administrative cost is assumed to be 5 % of the direct construction cost.
(vii) Engineering service cost is estimated on actual cost basis.
(viii) Compensation cost for land and house is estimated adopting the unit price in similar project in west Jakarta.

6.2 Financial Cost and Annual Disbursement Schedule

The project cost estimated based on the above conditions and assumptions is US$ 88,973,000. Based on the construction time schedule, the cost to be disbursed during each construction year was estimated as follows:

Year	Amount(1,000US$)	Year	Amount(1,000US$)
1997	1,030	2002	15,803
1998	854	2003	12,487
1999	3,297	2004	14,802
2000	8,152	2005	10,856
2001	14,245	2006	7,447
Total	27,578		61,395

7 Economic Evaluation of the Project

Economic viability of the project was examined based on the economic cost and benefit to be obtained by reduction of decrease in flood damage. The conditions and assumptions adopted for the economic evaluation are as follows:

(i) The economic cost was estimated by deducting tax related to the works and by adopting shadow price. The estimated economic cost is US $ 51.42 million.

(ii) Since design flood of 10-year recurrence for the Cengkareng west area and 5-year recurrence for the Meruya area was applied, the flood damage less than the flood damages with respective flood probability was regarded as the flood control benefit. The estimated annual benefit is US $ 7.6 million for the Cengkareng west area and US$ 0.2 million for the Meruya area.

(iii) Economic viability of the project was examined by means of economic internal rate of return (EIRR) under the following conditions:

(a) Economic project life time is 50 years after completion of the project works.

(b) The economic cost and benefit were estimated on price level at September 1996.

(c) Operation and maintenance cost was estimated as 0.5 %of the direct construction cost of the project.

(d) Due to the land subsidence, pumping facilities may be needed at outlet portion of the Tanjungan, Kamal, Saluran Cengkareng and Gede/Bor drainage channels in years, 2016, 2018, 2018 and 2024 respectively if design water becomes higher than the ground elevation along the drainage channel. Economic cost for the pumping up facilities was estimated at US$ 3,065 million in total.

EIRR estimated based on the above conditions is 17.9 %. In addition, sensitivity analysis was made under the following three cases:

(i) In case that the construction cost increases by 15 %.

(ii) In case that the economic benefit decreases by 15 %.

(iii) In case that the above two cases take place at the same time.

Results of the sensitivity analysis for the above three cases are as follows:

(Unit: %)

Case	EIRR
Case 1	14.8
Case 2	14.2
Case 3	11.7

8 Environmental Impact Assessment

(1) Present environmental conditions significantly related to the project

(a) Socio-economic environment

1) Legal residents

There are 211 households with land certificate, generally termed as legal residents, directly affected by the project and that they are subject to relocation. Their level of income is relatively low.

Based on the experiences of the Department of Housing, DKI Jakarta, approximately 75 % of the local residents would move into the low cost apartment. In the case of the project, 162 households would move into the low cost apartment constructed by the Department of Housing, DKI Jakarta. This is approximately 77 % of the total number of local households subject to relocation as high income families, shop and factory owners would not move into the low cost apartment.

2) Squatters

The squatters directly affected by the project are 1,442 households. They are subject to evacuation with nominal amount of payment before the riverside areas are cleared for engineering works. Existing squatters have been causing environmental impacts to the socio-economy of the surrounding areas as well as to the physical conditions of the drainage channels. Removing them from the riverside areas would be generally considered as a way to improve present environmental conditions.

(b) Biological environment

1) Mangrove growth area

The Tanjungan drainage channel is constructed through mangrove plantation area where planting scheme is currently undertaken by the Department of Forestry of DKI Jakarta. The area is designated as "Protected Forest of Angke - Kapuk". Next to the protection forest is a wide area of fishpond. The Tanjungan drainage channel is also constructed through these areas.

(c) Physico-chemical environment

1) Air quality, noise level and dust

Air quality in the project area is generally low. In the area where the traffic and industrial establishment are concentrating is the worst area. Jl. Kamal Muara that crosses over PIK Junction, Tanjungan, and Kamal drainage channel is the road with significant pollution load coupled with the industries established along the road. Other areas along the major roads are generally considered as significantly polluted in terms of air quality. Residential areas without any economic activities do not suffer air

pollution of the project area.

2) Water quality

The result of water quality analysis for the drainage channels within the project area shows significant substandard of water quality as compared to the Standard of Water Quality for DKI Jakarta. This is also exemplified in the biological analysis.

There are a number of reasons being considered. Among them are the disposal of solid waste as well as the domestic waste water and some industrial discharge of small and medium sized factories disposed to the drainage channels in the project area.

(2) Significant environmental impacts induced by project

(a) Relocation of local residents

1) Legal residents

Relocation of the local residents is the most significant and negative impacts induced by the project. Thus relocation plan is conducted within the framework of the project as a means to minimize the impact on the socio-economic environment. As the relocation plan is conducted, details of which is dealt with in the "Social Impact Management Plan", most of the significant impacts are minimized although some individuals would remain unsatisfied as they have to rearrange their economic activities in the resettlement area. Those who work for companies will have to change their commuting route to work, or to school in the case of their children, and the general living conditions of the resettlement area. To some extent, local residents would have to rearrange their occupation too.

Those who keep shops in the areas, especially the Kamal drainage channel that are not subject to relocation will lose a large number of local residents who have been living in the area as customers. To some extent, small and medium factories would suffer from the loss of inexpensive labor as the local residents with land certificate, or even squatters, are relocated.

2) Squatters

Removing the squatters from the present living areas would mean to cause further congestion to the riverside areas elsewhere in DKI Jakarta as they move out from the riverside areas on the drainage channels within the project area. This will cause two significant impacts as follows:

- They might move out to other drainage channels within the project area for extra payment, or the payment is made inadvertently for the second time, or even for the third; and
- Making nominal payment to the squatters would not solve chronicle problem of urban settlement within DKI Jakarta.

Thus, preparation of land areas for the squatters to move into and resettle in the prepared land area as they pay rent for their plot is suggested. Details of the suggestion to prepare resettlement areas for the squatters are described in the "Social Impact Management Plan". With the implementation of the suggested resettlement plan for the squatters, the above two significant impacts are greatly reduced.

(b) Mangrove growth area

Construction works taking place within the mangrove plantation area is considered to induce some negative and significant impacts to the mangrove protection area. As monitoring works and present planting activities are conducted, mitigation measures to avoid excessive turbidity in the water of the mangrove growth area could be implemented during the construction period.

(c) Air quality, noise level and dust

Air quality, noise level and dust including general degradation of air quality and vibration during the construction period is considered as negative but not significant impact. Monitoring works conducted as a part of general requirement for construction works would be generally considered as a part of environmental management plan to solve the problem.

(d) Traffic congestion

Bridge reconstruction works associated with the drainage construction works would induce negative and significant impacts as it causes significant traffic congestion. The most significant traffic congestion that might occur during the reconstruction of bridges in the project area would occur in the area as follows:

- Jl. Kamal Muara on Tanjungan drainage channel;
- Jl. Kamal Muara on Kamal drainage channel (Main); and
- Jakarta Outer Ring Road on Saluran Cengkareng Drainage Channel.

These bridges would require wide area for traffic diversion during the reconstruction

period. Further, the construction works would probably cause negative impacts to the general economic activities in and around the project area.

(3) Environmental management plan

(a) Relocation of local residents, factories and others

Relocation plan, generally termed as "Social Impact Management Plan", is a kind of environmental management plan for the project. Number of households, factories and other buildings subject to relocation have been estimated at 1,716.

Of the total local residents with land certificate, 162 households are expected to move into the low cost apartment. Other households, factories and other buildings including several schools, mosque buildings and market places will have to find individual resettlement areas upon payment of compensation. Assessment of the value of compensation has been done based on the rate of compensation determined by the Land Procurement Committee of the Kotamadya of West Jakarta for the similar nature of project conducted in 1995. Cost of compensation was estimated at Rp.17,443.9 million.

Squatters are likely to spread over different riverside areas within DKI Jakarta upon nominal payment made for evacuation of the present living areas. They might move into yet constructed drainage areas within the project area for double payment. Thus establishment of their resettlement areas, bare land for rent, has been suggested.

With these measures, social environmental impact associated with the relocation plan would have to be managed to a large extent. Details of the relocation plan are dealt with in the "Social Impact Management Plan".

(b) Precautionary measures during the construction period

General precautionary measures of the construction works is considered as one of the environmental management plans for the project that are necessary to conduct during the construction implementation period. In many cases, these precautionary measures will take effect.

In the case of the general ambient air quality, noise level, dust, and vibration exceeding maximum allowable level, any mitigation measures based on the monitoring work will have to be conducted according to the guideline of the standard of air quality of DKI Jakarta. Up suggestions made to conduct mitigation measures, the person-in-charge of the project and the Engineer will instruct responsible contractor to reduce emission of

exhaust gas from the construction equipment, noise, etc. during the construction period as a matter of general procedure.

(c) Traffic congestion

During the construction period for reconstruction of the bridges crossing over the drainage channels, heavy traffic congestion is expected depending on the locations. Traffic diversion arrangement according to the construction plan would be carefully conducted while precautionary measures to consult with the Traffic Police of the Jakarta Police Department and the Transportation and Traffic Department of DKI Jakarta is conducted. Heads of Kecamatan, Kelurahan, Rukun Tattanga and Rukun Warga will also be informed for cooperation.

(d) Mangrove growth area

Mangrove growth area that Tanjungan drainage channel goes through is suggested to designate the area of which sensitive biological management is necessary during the construction implementation period within the framework of the project. This is a way to call for precautions among the personnel concerned with the project . Therefore, intensive care by the contractor would be taken during the construction implementation period with the assistance of the Department of Forestry, DKI Jakarta i.e. monitoring work on the water quality is conducted by the contractor or entrusted to the Department of Forestry.. The means of mitigation measures and biological management works should be also carried out by assistance of the Department of Forestry, DKI Jakarta.

Intensive effort of plating mangrove species could be conducted during and upon completion of the construction works of the Tanjungan drainage channel as the result of environmental monitoring works so indicates.

(4) Environmental monitoring plan

(a) Air quality, noise level, dust and vibration

Throughout the project area and the construction implementation period, general air quality, noise level, dust and vibration should be monitored. This is a prerequisite of the construction works that the contractor has to abide the contractual requirement during the construction implementation period. The obtained date is analyzed with the data obtained during the EIA Study in conjunction the standard of water quality of DKI Jakarta.

(b) Mangrove growth area

Mangrove plantation area should be constantly monitored during the construction period of the Tanjungan drainage channel in order to conduct any necessary mitigation measures to protect the growth of mangrove.

(c) Socio-economic survey of the resettlement areas

Socio-economic survey on the resettlement area should be conducted 6 months after the resettlement operation is completed. Thereby conditions of the resettlement area are analyzed objectively and evaluated for any further recommendations to take effect. General living conditions of the resettled residents should be surveyed by using questionnaire, which is subject to elaboration. The same survey should also be conducted for the squatters who are subject to resettlement in the designated rented land areas with in the project area as the suggested plan is implemented.

9 Social Impact Management Program

(1) Number of households subject to compensation

Number of households and other buildings subject to relocation have been identified as follows:

a.	Local residents with land certificate	211	households;
b.	Squatters	1,442	households; and
c.	Factories, schools, market place, etc.	63	places.

(2) Cost of compensation

Cost of compensation is summarized as follows:

a.	Local Residents with Land Certificate;			
	Rp. 42.01 million /household	x	211 households	Rp. 8,864.2 million
b.	Squatters;			
	Type A - Rp. 200,000 /household	x	534 households	Rp. 106.8 million
	Type B - Rp. 50,000 /household	x	908 households	Rp. 45.4 million
c.	Factories and others;			Rp. 8,427.5 million
	Total			Rp. 17,443.9 million

There are two different kinds of squatters within the project area. Type A is the squatters who have been in the present area for considerably long period of time. They have established themselves as members of the local neighborhood associations, termed

as Rukun Warga and Rukun Tattange. Being members of the local neighborhood association, they own RW/RT numbers, or address identified for residential registration. Payment they receive upon order of evacuation made by the government agency varies. Depending on negotiation, it can go up to several million Rupiahs. However, prevailing average amount within DKI Jakarta is Rp. 200,000.

Those who have not established themselves as members of the local neighborhood association would be termed as "Illegal Residents". Payment they receive upon order of evacuation made by the government agency varies. Some goes up to several hundred thousand Rupiahs. However, prevailing average amount within DKI Jakarta is Rp.50,000.

(3) Cost of land acquisition

There are open spaces such as the areas being unused in the low lying areas, agricultural land, and fish pond as well as the protection forest within the project area that are subject to acquisition for drainage channel construction works as follows:

- Overall land area for the project 321,489.0 m^2
- Total cost of land acquisition (Rp. 165,000/m^2) Rp.53,045.7 million.

(4) Relocation operation

1) Budget plan

Disbursement plan has been elaborated in order to distribute large sum of budget for compensation of relocation and land acquisition as evenly as possible. Thus, as the land acquisition in the area to the north of Jl. Tol. Prof. Sediyatmo for the Kamal drainage channel is conducted in 1997, the following disbursement plan could be a possible option:

(Unit : million Rp.)

Year 1997	2,000.0	(2.8 %)
Year 1998	1,474.4	(2.1 %)
Year 1999	5,446.2	(7.7 %)
Year 2000	7,909.5	(11.2 %)
Year 2001	17,668.9	(25.1 %)
Year 2002	19,135.5	(27.2 %)
Year 2003	9,127.9	(12.9 %)
Year 2004	4,822.8	(6.8 %)
Year 2005	2,904.5	(4.2 %)
Total	70,489.4	(100 %)

With the above arrangement, DPU DKI Jakarta could relatively evenly divide the budget for the cost of compensation for relocation and land acquisition with the peak year 2002.

2) Method of relocation operation

Actual relocation operation is conducted by the Department of Housing, DKI Jakarta, when government development project is conducted by DKI Jakarta within the boundaries of DKI Jakarta. Thus, DPU DKI Jakarta is to make a formal request to conduct relocation operation for the project to the Department of Housing, DKI Jakarta. The request is made when approval on implementation of the project is issued by the Government of Indonesia. A series of formal procedure required to observe as the standard procedure of DKI Jakarta is summarized as follows:

(a) Land procurement committee

Kotamadya Jakarta Barat and Jakarta Utara will establish their own Land Procurement Committee for assessment of the rate of compensation for the area within their administrative areas. In the case of the project area, a portion of the Kamal, Tanjungan and PIK Junction drainage channels to the northeast of Jl. Kamal Muara are inside of Jakarta Utara. Thus, Land Procurement Committee of Jakarta Utara will make decision on the rate of compensation. The rest is in the jurisdiction of Jakarta Barat.

(b) Establishment of the drainage area

As soon as the project implementation is determined, parallel to the formation of Land Procurement Committee, the person-in-charge of the project should establish geographical area of drainage channel prior to negotiation with individual households, factories and others owning building and land within the boundaries of drainage channel.

Upon consultation with the Department of Urban Planning, DKI Jakarta, for demarcation of each drainage channel area and its area for right-of-way according to the Local Government Act of the West Jakarta No.2/1985 regarding Demarcation for Urban Drainage, each drainage channel area is finally established.

(c) Negotiation and evaluation

A formal request is made to the Head of Jakarta Barat and Jakarta Utara for negotiation of relocation. Each Kotamadya then undertakes to form a team of negotiators. It is

termed as Assisting Team for Execution of Procurement of Land. This team is usually the staff of the Department of Housing, DKI Jakarta. The Assisting Team will begin negotiation with each household and other land/building owners. They are witnessed with a representative of Kecamatan, Kelurahan, as well as the heads of Rukun Tattange and Rukun Warga during the negotiation. Contents of the negotiation and evaluation will include number of families, age, income, type of the current occupation, area of plot and floor space, number and area of improvement subject to compensation and their monetary values, available resettlement area/housing/industrial estate, their selection of resettlement areas, and clarification of the arrangement of payment for compensation.

When agreement is made and amount of compensation is paid, each plot is cleared based on the procedure set out in the Minister of Home Affairs, Regulation No.2 of the Year 1985 and the President Decree No.55 of the Year 1993. The person-in-charge of the project will notify the right of land utilization of the acquired plot to Jakarta Utara or Jakarta Barat depending on the location of the acquired plot. The notification should contain the sum of compensation paid, type of land ownership, complete record of the negotiation procedure including dispute if any.

In case of the area where there is no resettlement operation is involved, the person-in-charge of the project negotiate with land owners of the agricultural areas, fishpond and mangrove growth area. In the case of mangrove growth area, negotiation should be held with the Department of Forestry, DKI Jakarta, to open up the mangrove growth area for drainage channel.

(d) Payment procedure

As both parties of the person-in-charge of the project and the households reach an agreement of relocation, the agreed amount of compensation is paid in cash in person with witnesses from the Kelurahan and Kecamatan. The resettlement plan is financed by the Regional Budget of APBD TK II allocated to each Kotamadya.

Upon payment, land certificate is exchanged. This concludes the negotiation and formal hand over of the land is completed. If certificate was not exchanged for the reasons that it is used for bank/loan guarantee, etc. the relevant third party with original certificate should be present at the time of payment. Depending on the contents of agreement, type of disbursement for relocation will be subdivided.

(e) Registration of the drainage area

Upon payment, land clearing is conducted by the Assisting Team for Execution of Procurement of Land. Construction equipment for demolition of the houses and others is provided by the team. Parallel to the clearing operation, invitation and consultation with the Regional Office of National Land Administration in Jakarta Barat and Jakarta Utara for the survey result of acquired land is conducted. Thereby the Regional Office of National Land Administration in Jakarta Barat and Jakarta Utara will declare the acquired land as state land, specifically to make use of the land for drainage channels, in the name of the Head of Land Registration. The procedure is further approved by the Head of National Land Administration.

(f) Resettlement arrangement

Whether the local residents resettle in the low cost apartment or individual resettlement areas, the person-in-charge of the project will coordinate with the Department of Housing for preparation of the low cost apartment for allocation of unit to those entitled to moving into the low cost apartment. Same consultation is conducted for those resettling in their own resettlement areas. Actual moving operation is conducted by the Department of Housing, DKI Jakarta.

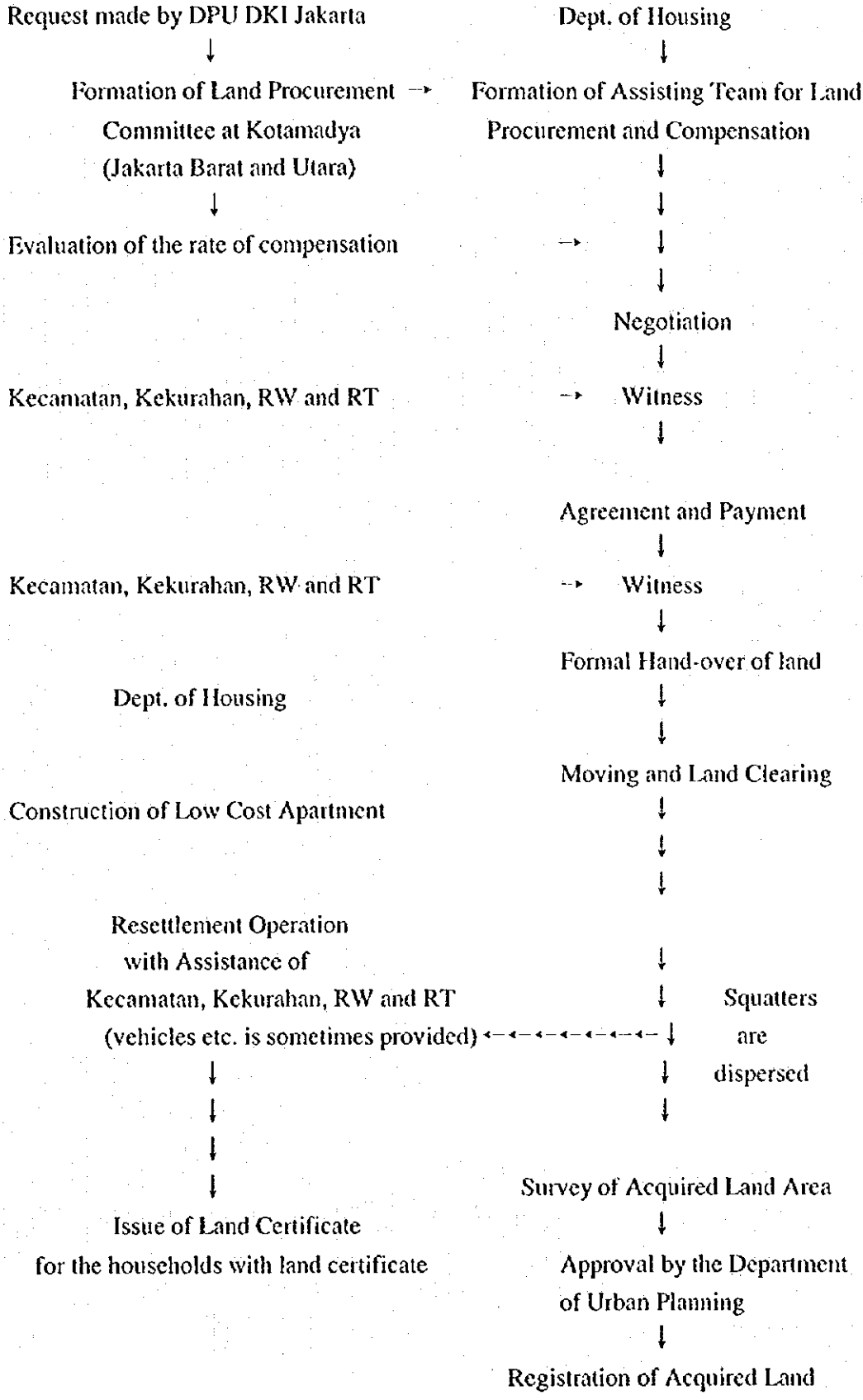
Upon completion of resettlement operation, arrangement for issuing of official certificate of resettlement for those subject to resettlement should be conducted with the Regional Office of Land Administration in Jakarta Barat and Jakarta Utara.

Dissemination of information on the result of land acquisition and relocation operation to those related to the project should be done to close the resettlement operation. This includes the heads of Rukun Warga and Rukun Tattanga.

(g) Organizations concerned with the resettlement program

As described above, large number of organizations are required to be informed of the progress of the resettlement program and its timing as well as the closing. The person-in-charge of the project is responsible to notify, request assistance and clarification, and disseminate information on the project to all the organizations concerned with the relocation operation of the project.

A simplified flow chart of relocation operation for the households with land certificate and the squatters is as follows:


Request made by DPU DKI Jakarta
Dept. of Housing
Formation of Land Procurement Committee at Kotamadya (Jakarta Barat and Utara)
Formation of Assisting Team for Land Procurement and Compensation
Evaluation of the rate of compensation
Negotiation
Kecamatan, Kekurahan, RW and RT
Witness
Agreement and Payment
Kecamatan, Kekurahan, RW and RT
Witness
Formal Hand-over of land
Dept. of Housing
Moving and Land Clearing
Construction of Low Cost Apartment
Resettlement Operation with Assistance of Kecamatan, Kekurahan, RW and RT (vehicles etc. is sometimes provided)
Squatters are dispersed
Survey of Acquired Land Area
Issue of Land Certificate for the households with land certificate
Approval by the Department of Urban Planning
Registration of Acquired Land

at Regional Office of Land Administration

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Implementation of the Construction Works

10 Construction Plan and Implementation Schedule

(1) The proposed organization for implementation of the project is shown in Fig. 10.1. An executing agency of the project will be Directorate General of Human Settlements (CIPTA KARYA), Ministry of Public Works, the Republic of Indonesia, which is responsible for management of the project works including loan appraisal, loan agreement and overall management of the project works. The construction works will be entrusted and carried out by Project Management Office, DPU DKI Jakarta.

(2) The foreign currency portion and a part of the locale currency portion of the construction cost are expected to be financed by an international organization with its soft loan. The remaining local currency portion will be covered by the Indonesian national budget.

(3) Study on the contract packaging and project implementation plan was made from three aspects, namely, (i) prospect of compensation of households and land, (ii) investment effect of the project cost, and (iii) technical priority. Based on these results, the contract package was determined in consideration of the following aspects:

(i) Sequence of implementation for drainage channel works studied so far
(ii) Harmonization of implementation works to avoid social inequality and administrative imbalance as pointed out by vice governor
(iii) Early implementation of drainage channel with less compensation area
(iv) Combination of drainage channels works in consideration of topographic conditions for construction works and of avoiding traffic jamming due to different contract packaged works
(v) Amount of contract package in consideration of international tendering

In consideration of the above situations, it has been proposed to proceed with the construction works of the drainage channels by dividing into the following three packages:

Package-1 : Kamal drainage channel

Package-2 : Tanjungan drainage channel and PIK Junction drainage channel
Package-3 : Gede/Bor drainage channel, Saluran Cengkareng drainage channel and Meruya drainage channel

For formulation of the project implementation plan, the following matters were contemplated:

(i) Early implementation of drainage channel with less compensation area
(ii) Loan validity by an international financing agency, and
(iii) Balanced compensation cost to be disbursed annually

At the explanation of the final draft report, it was requested by DKI Jakarta that the first priority should be given to package-1 and next priority is package-2, due to the reason that drainage areas along Jl. Tol Prof. Sediyatmo are quite densely populated and the highest economic development potential zones, and early implementation of the drainage channels for the packages-1 and 2 was required.

In consideration of the above requested comments and items (ii) and (iii), it was proposed to proceed with the construction works of the drainage channels in accordance with the implementation schedule as shown in Fig 10.2.

(4) Construction time schedule was formulated considering the following conditions:

- Drainage channel works shall be executed from downstream part in principle.
- Construction priority is given to the section having fewest number of households.
- Bridge construction in each section shall be made from downstream part in order to follow river structure construction.
- The construction periods of neighboring bridges shall not be overlapped.

The proposed construction time schedule is illustrated in Fig 10.2. The construction works are scheduled to be executed in 6.5 years from May 2000. The pre-construction activities in 1997 to 2000 consist of detailed design, financial arrangement, pre-qualification of tender, tendering, tender evaluation and contract award. Besides those activities, land compensation and resettlement will be made timely in advance of commencement of construction works at each site.

Figures

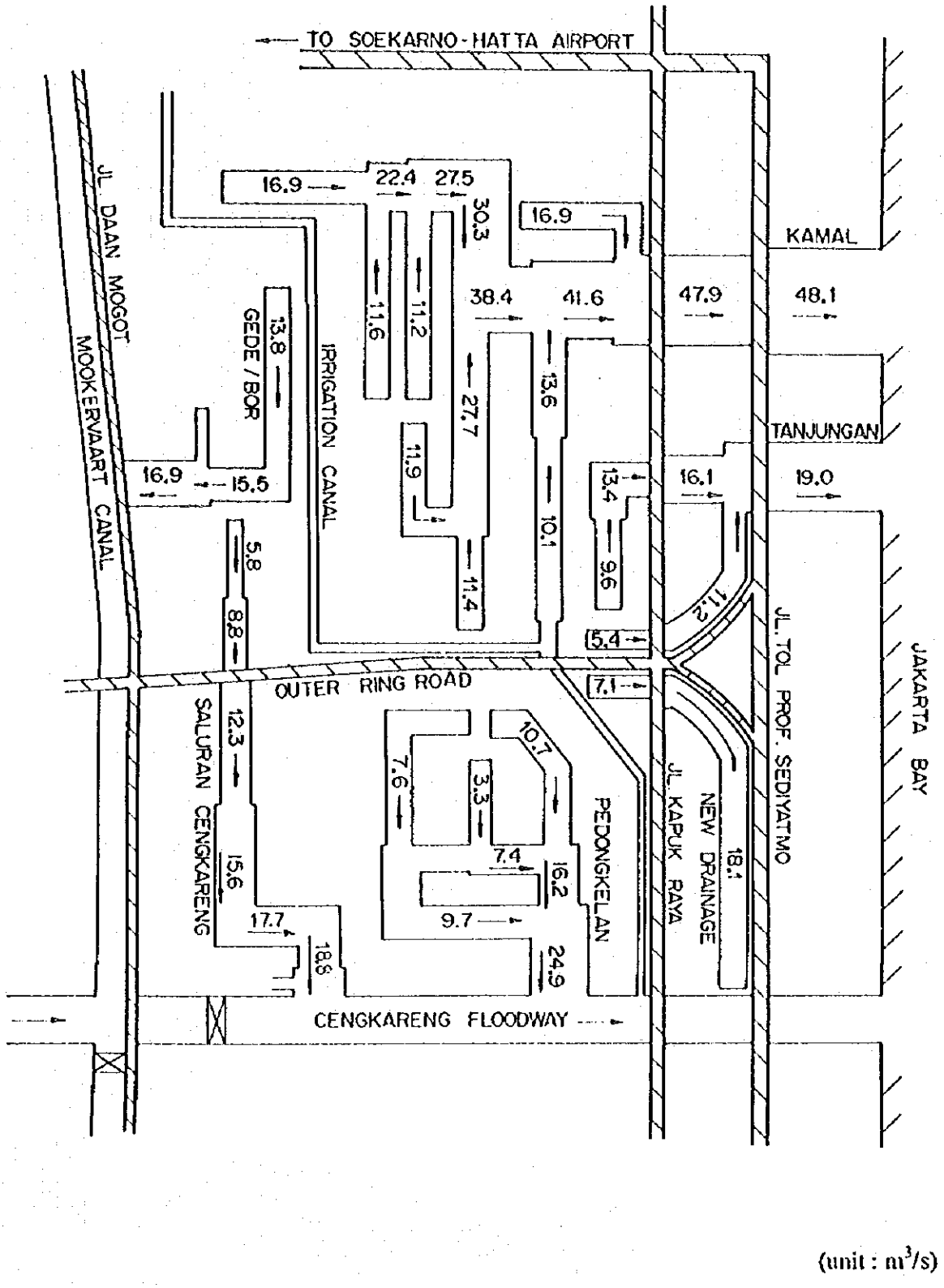
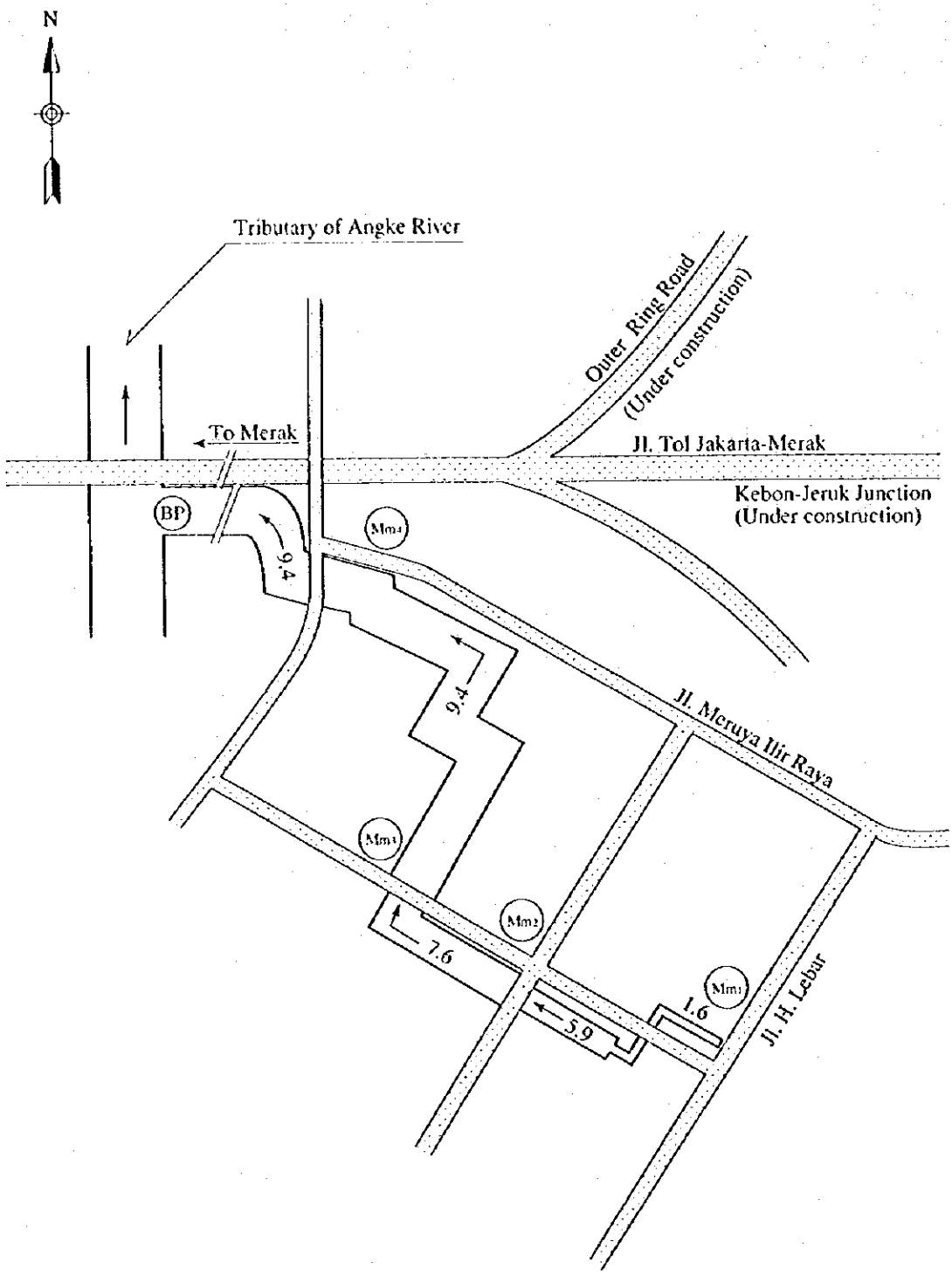


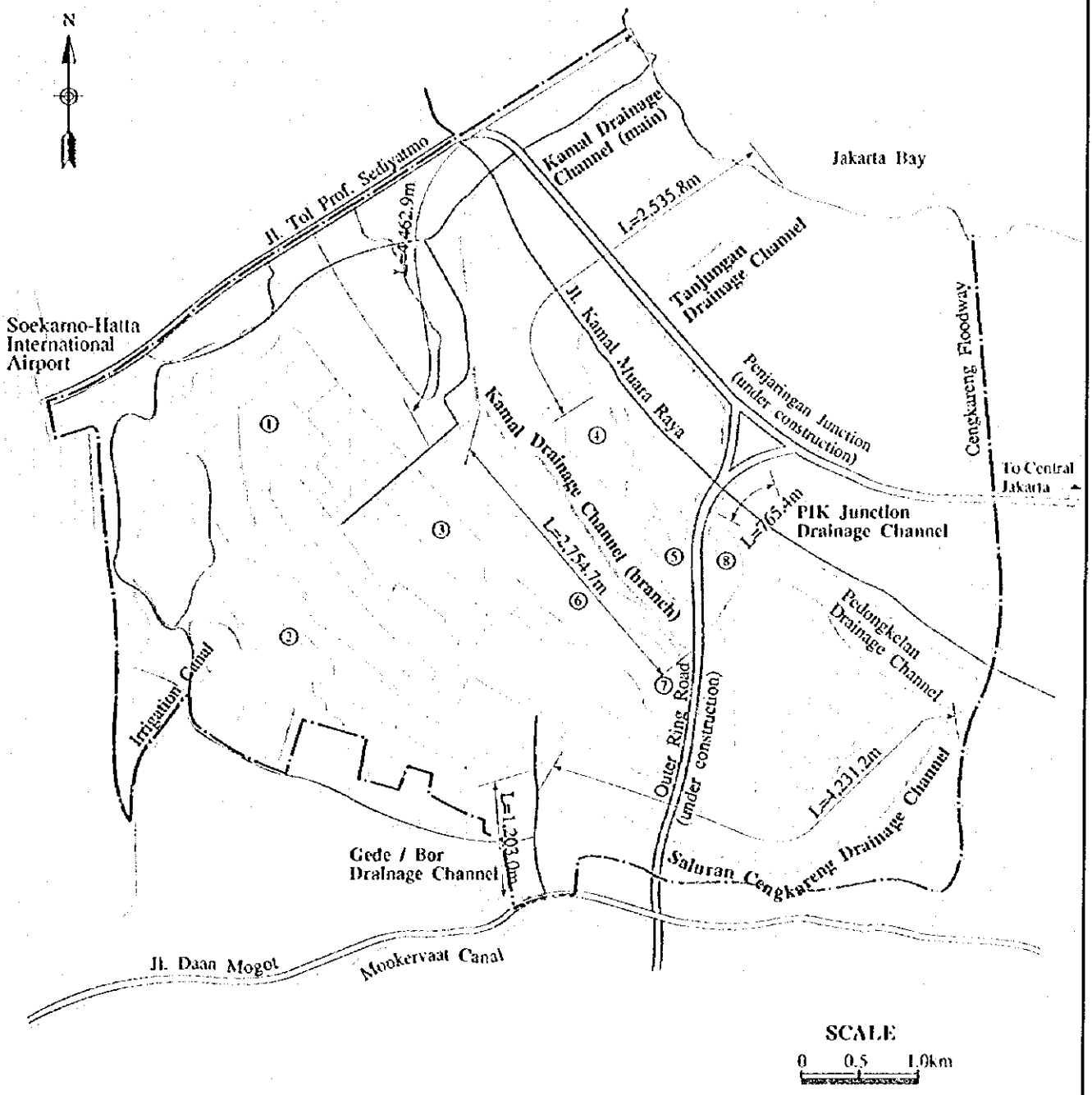
Fig. 4.1 Proposed Flood Discharge Distribution in Cengkareng West Area



Note: Value : Design Discharge (m^3/s)

(Mm) : Code No.

Fig. 4.2 Proposed Flood Discharge Distribution in Meruya Area



LEGEND

- : Project boundary
- : Drainage channel/design stretch in the project
- : Drainage channel/already constructed
- : Drainage channel/to be constructed by private sector
- : Area already aquired by private sector
- : Swamp/depression area already aquired by private sector
- : Paddy field

Reclamation Level for swamp/depression area

1	EL. 3 - 4 m
2	EL. 4 - 5 m
3	EL. 3 - 4 m
4	EL. 1 - 2 m
5	EL. 1 - 2 m
6	EL. 2 - 3 m
7	EL. 2 - 3 m
8	EL. 1 - 2 m

Fig. 4.3 Proposed Drainage Channel Alignment in Cengkareng West Area

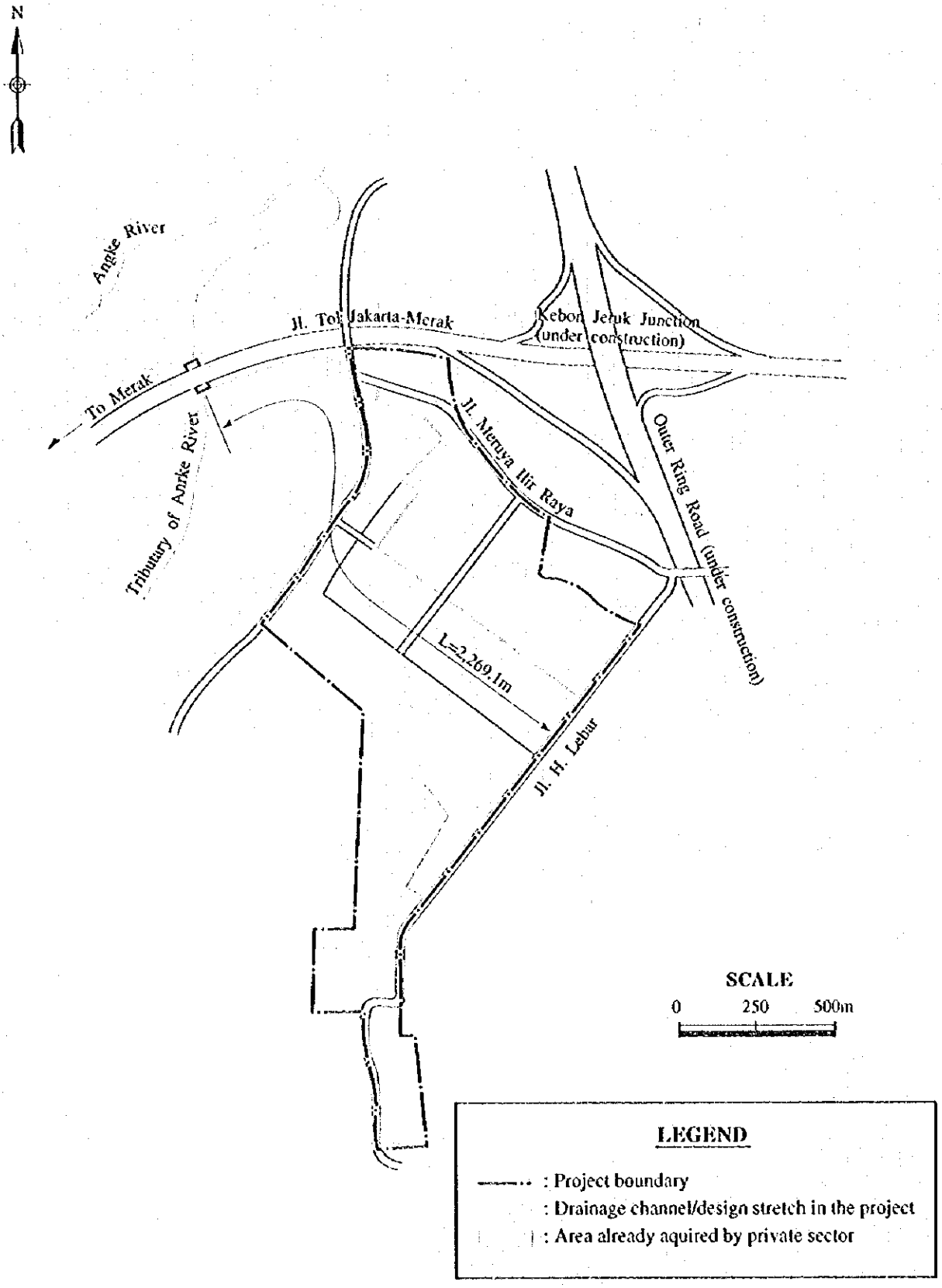


Fig. 4.4 Proposed Drainage Channel Alignment in Meruya Area

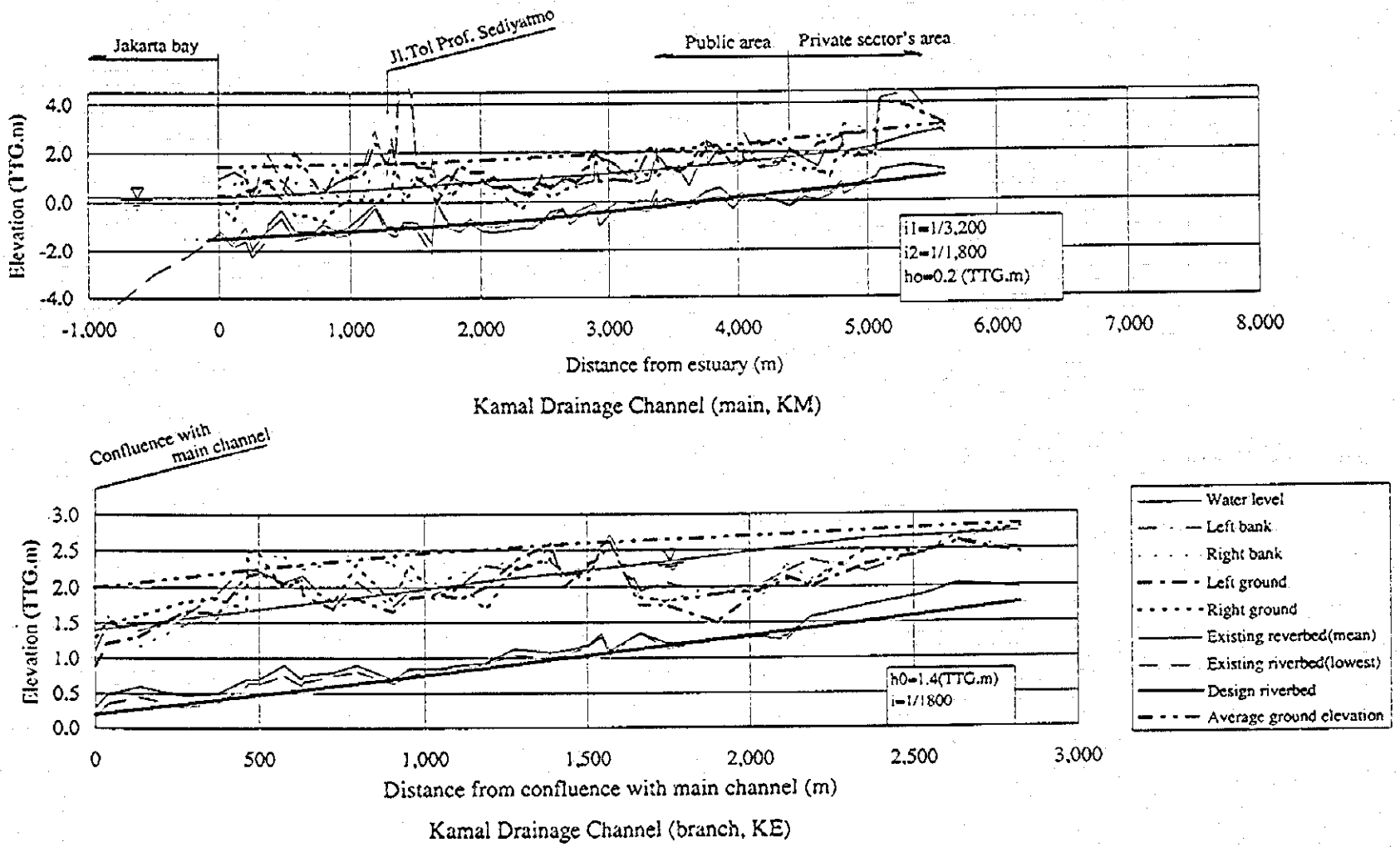


Fig. 4.5 Longitudinal Profile of Proposed Drainage Channels (1/4)

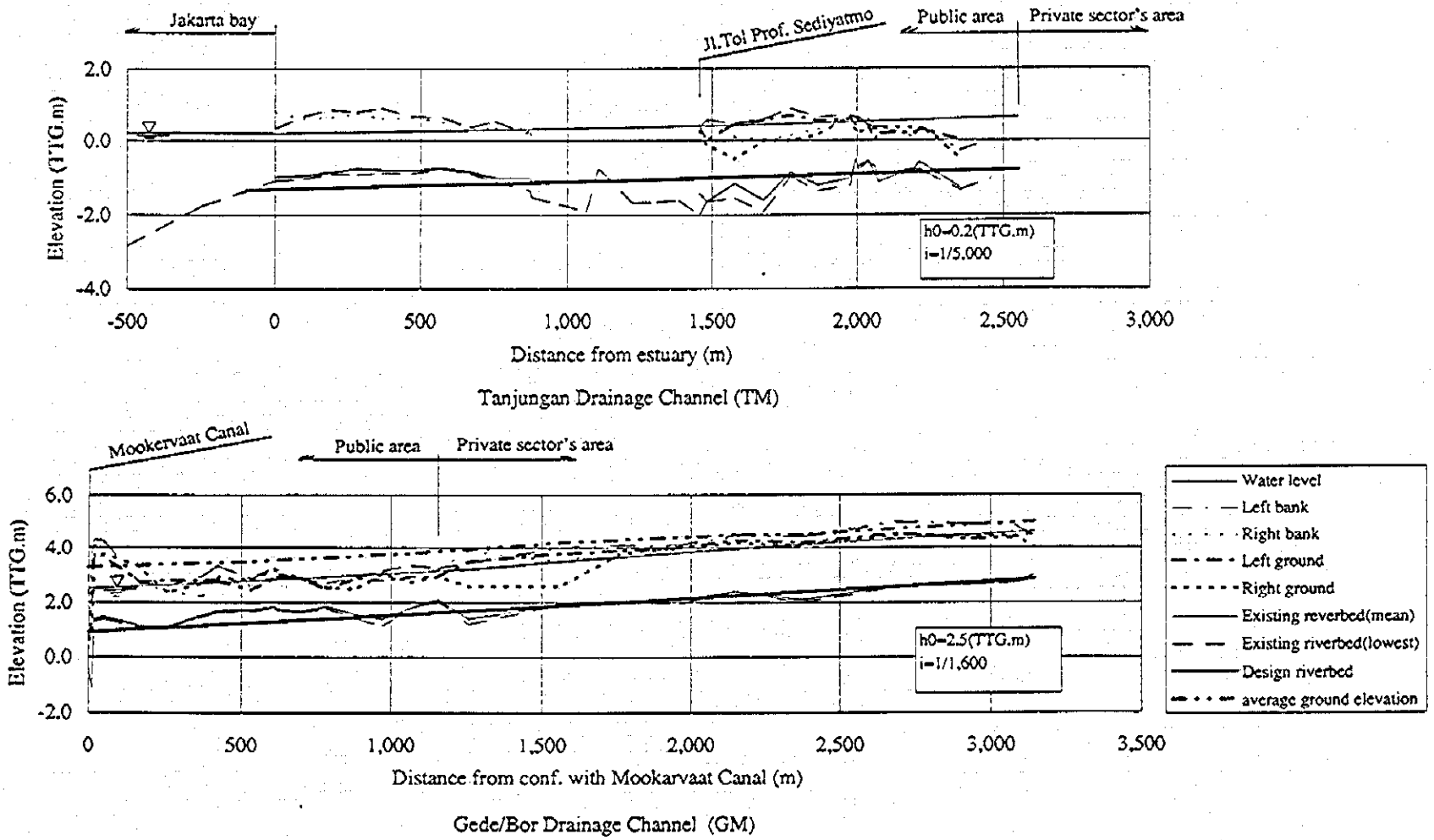


Fig. 4.5 Longitudinal Profile of Proposed Drainage Channels (2/4)

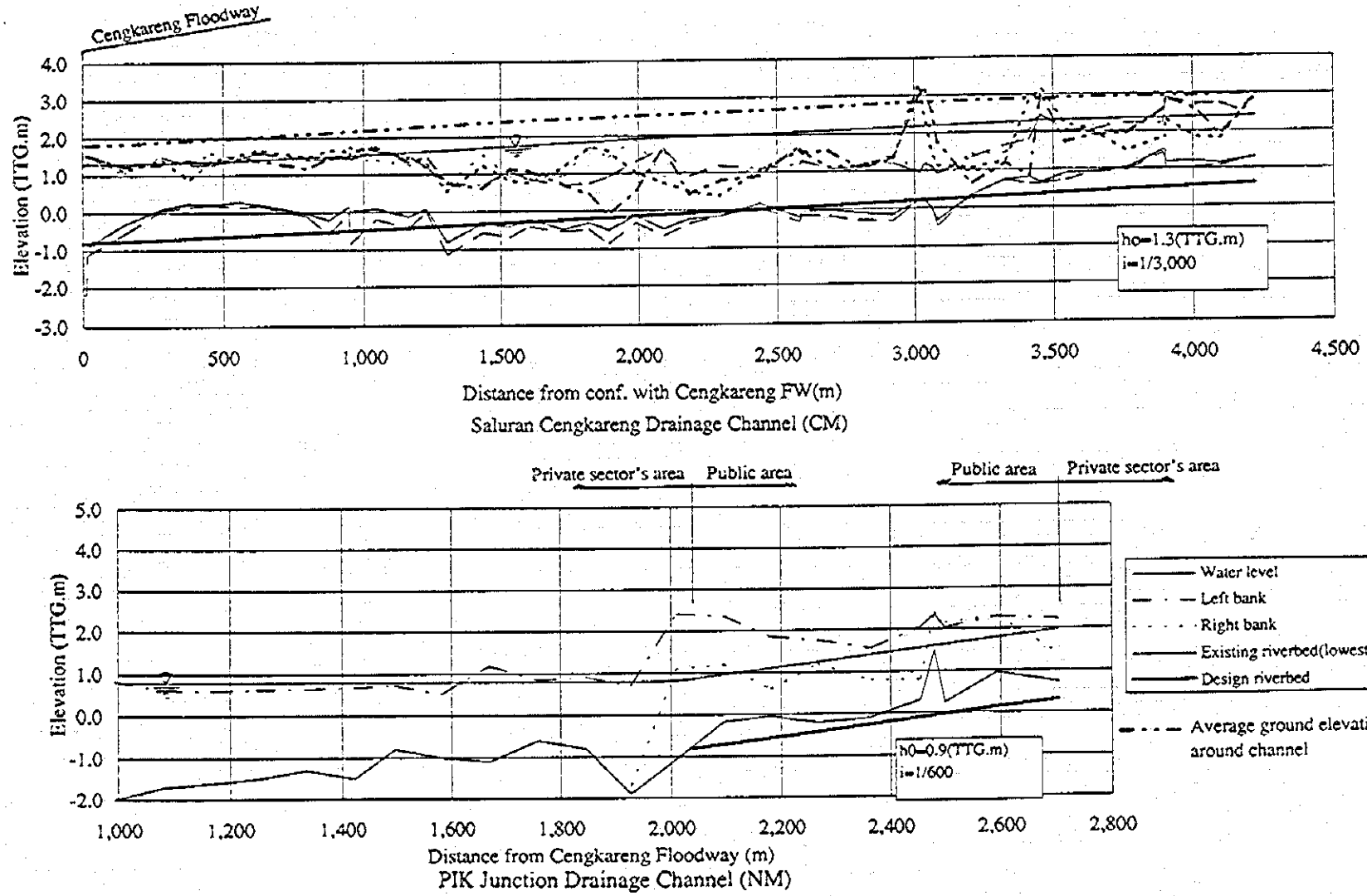
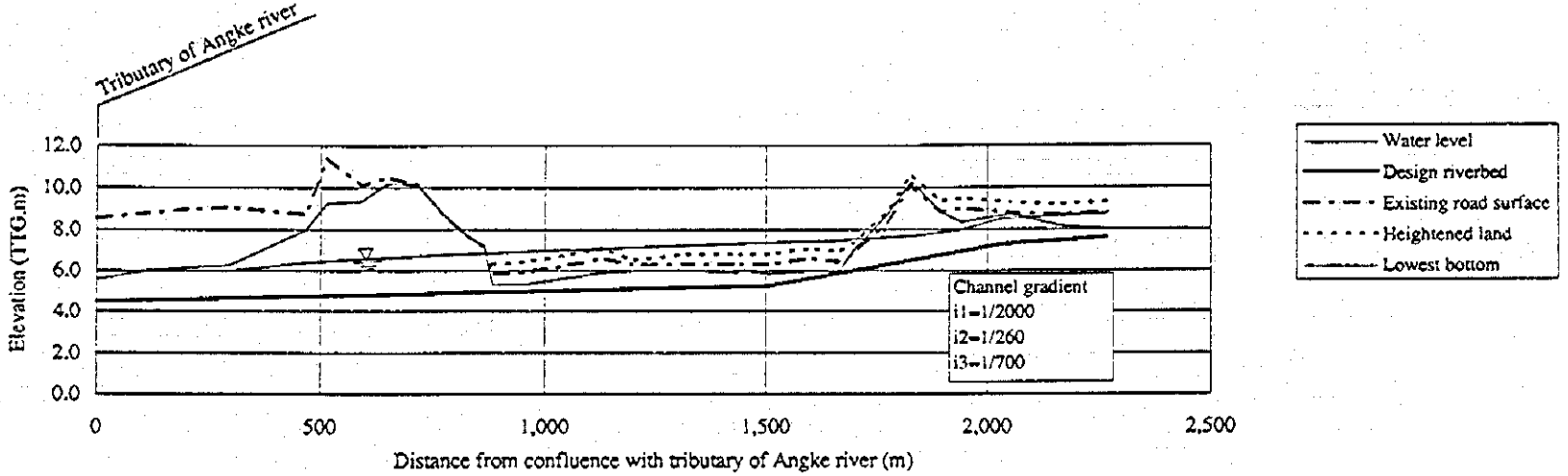
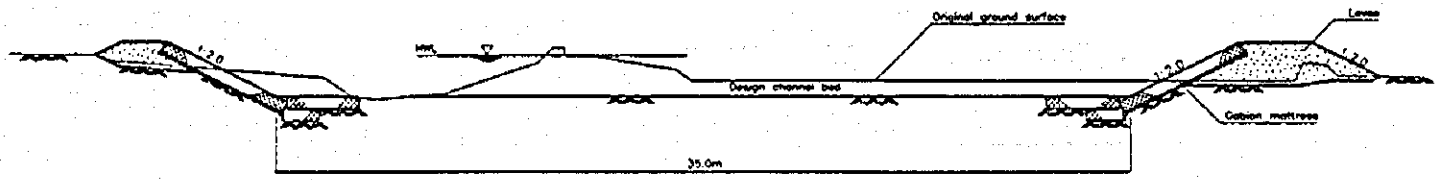


Fig. 4.5 Longitudinal Profile of Proposed Drainage Channels (3/4)

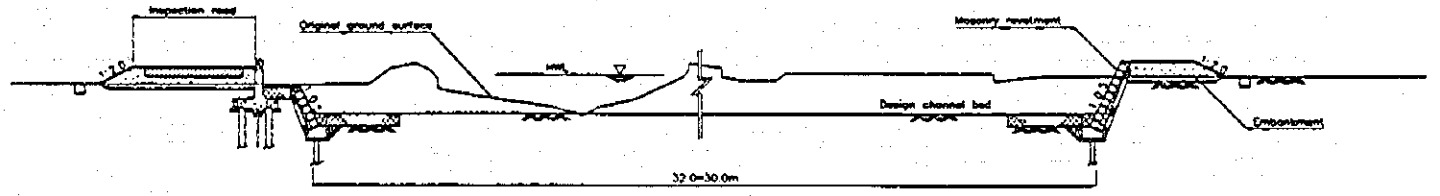


Meruya Area (MM)

Fig. 4.5 Longitudinal Profile of Proposed Drainage Channels (4/4)

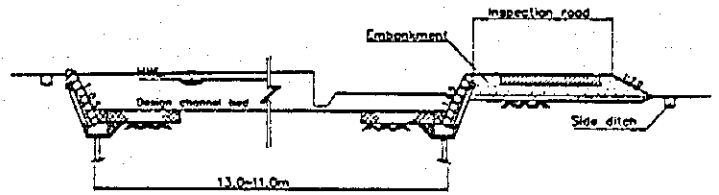


(a) Downstream of Jl. Tol Prof. Sedyatmo

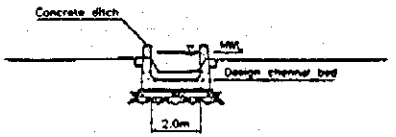


(b) Upstream of Jl. Tol Prof. Sedyatmo

(1) Kamal Drainage Channel (Main)



(a) Downstream Stretch



(b) Upstream Stretch

(2) Kamal Drainage Channel (Branch)

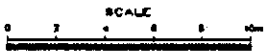
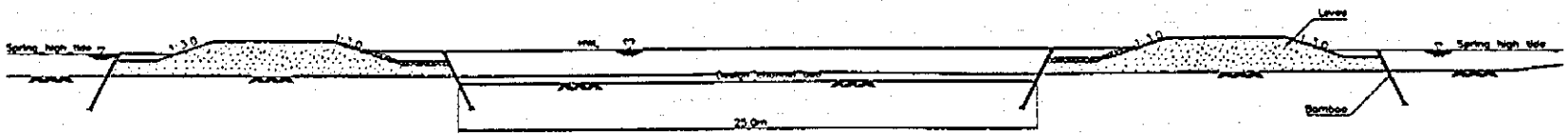
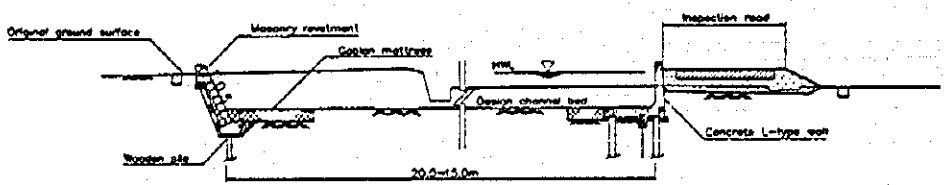


Fig. 4.6 Typical Cross Sections (1/3)

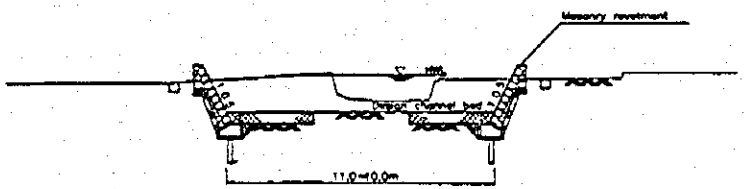


(a) Downstream of Jl. Tol Prof Sedyatmo

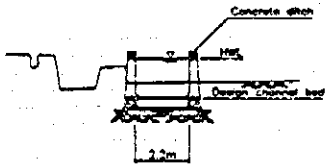


(b) Downstream of Jl. Tol Prof. Sedyatmo

(3) Tanjungan Drainage Channel



(4) Gede/Bar Drainage Channel



(5) PIK Junction Drainage Channel

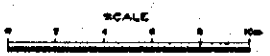
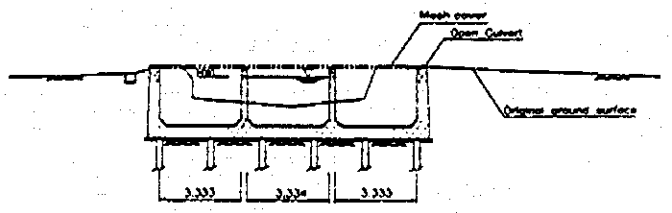
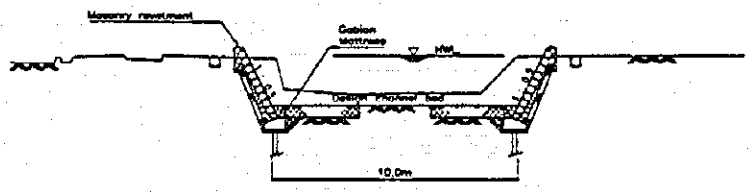


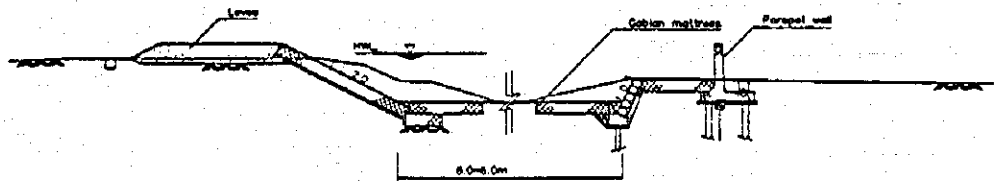
Fig. 4.6 Typical Cross Sections (2/3)



(a) Open Culvert

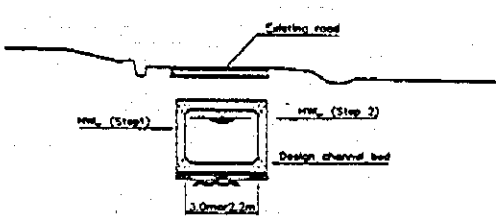


(b) Upstream of Open Culvert

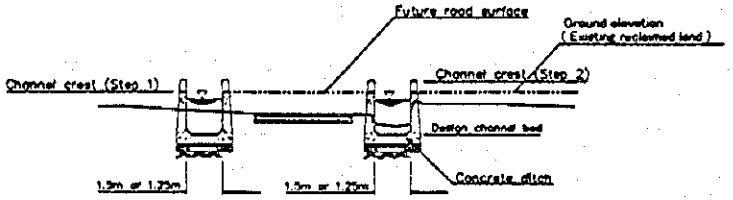


(c) Upstream Stretch

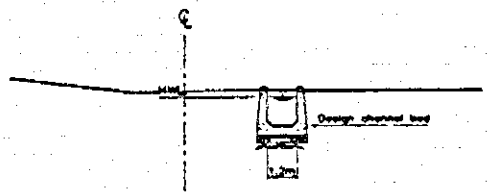
(6) Salaran Cengkareng Drainage Channel



(a) Box Culvert



(b) Open Culvert (Both Side Drain, Stepwise Construction)



(c) Open Culvert (One Side Ditch, Upstream Strech

(7) Meruyo Area

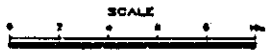
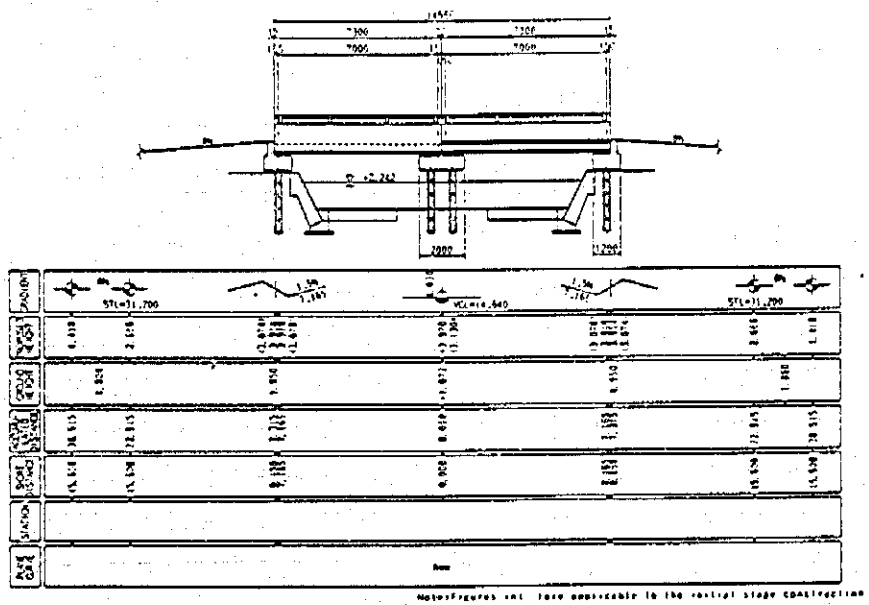
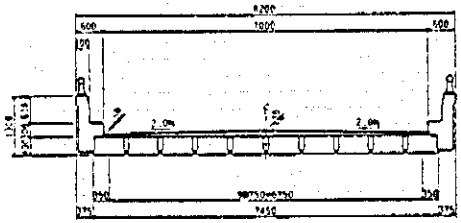


Fig. 4.6 Typical Cross Sections (3/3)

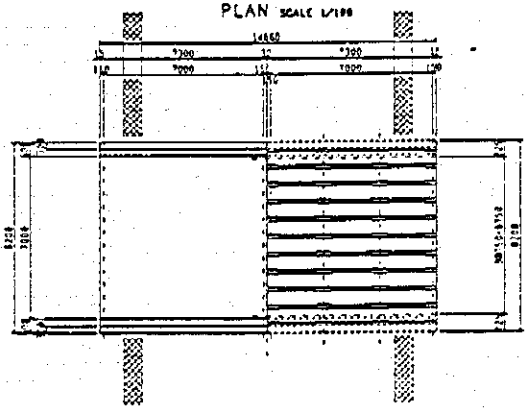
SIDE VIEW SCALE 1/100



CROSS SECTION SCALE 1/50



PLAN SCALE 1/100



DESIGN CONDITION

BRIDGE NAME	BRE13(BE15-2)
LIVE LOAD	5M TD
GIRDER LENGTH	9.30 m
SPAN LENGTH	9.00 m
WIDTH	8.20 m
BRIDGE ANGLE	90°

REACTION

	ABUTMENT(kN)	PIER(kN)
DEAD LOAD	82.2	84.2
LIVE LOAD	40.0	40.0
TOTAL	82.2	124.2

MATERIAL TABLE

KIND OF MATERIAL			UNIT	VOLUME	DESCRIPTION
MAIN GIRDER		NUMBER	NO	20	BRTB-01
FORMING	CONCRETE	DESIGN STRENGTH	N/mm²	5.7	
	FORM		m²	11.2	
MISCELLANEOUS	ROADWAY	PAVEMENT	m²	102.2	
	SIDE WALK	PAVEMENT	m²	—	
		SUBCONCRETE	m²	—	
		SIDE PLOCK	m	—	
		FILLING MORTAR	m³	—	
	GUARD RAIL	CONCRETE	m³	12.6	
		FORM	m²	75.4	
		RE-BAR	t	0.596	
		STEEL+RAILING	m	29.2	
	DRAINAGE	NUMBER		6	
	EXPANSION		m	24.6	
CROSS GIRDER	PC-TENDON	NUMBER		24	
		LENGTH	m	1,310	
		TOTAL LENGTH	m	175,920	
		TOTAL WEIGHT	t	0.281	
	SHEATH		m	43.2	
	GROUT		m	175.9	

Fig. 4.7 Type of Bridge (1/2)

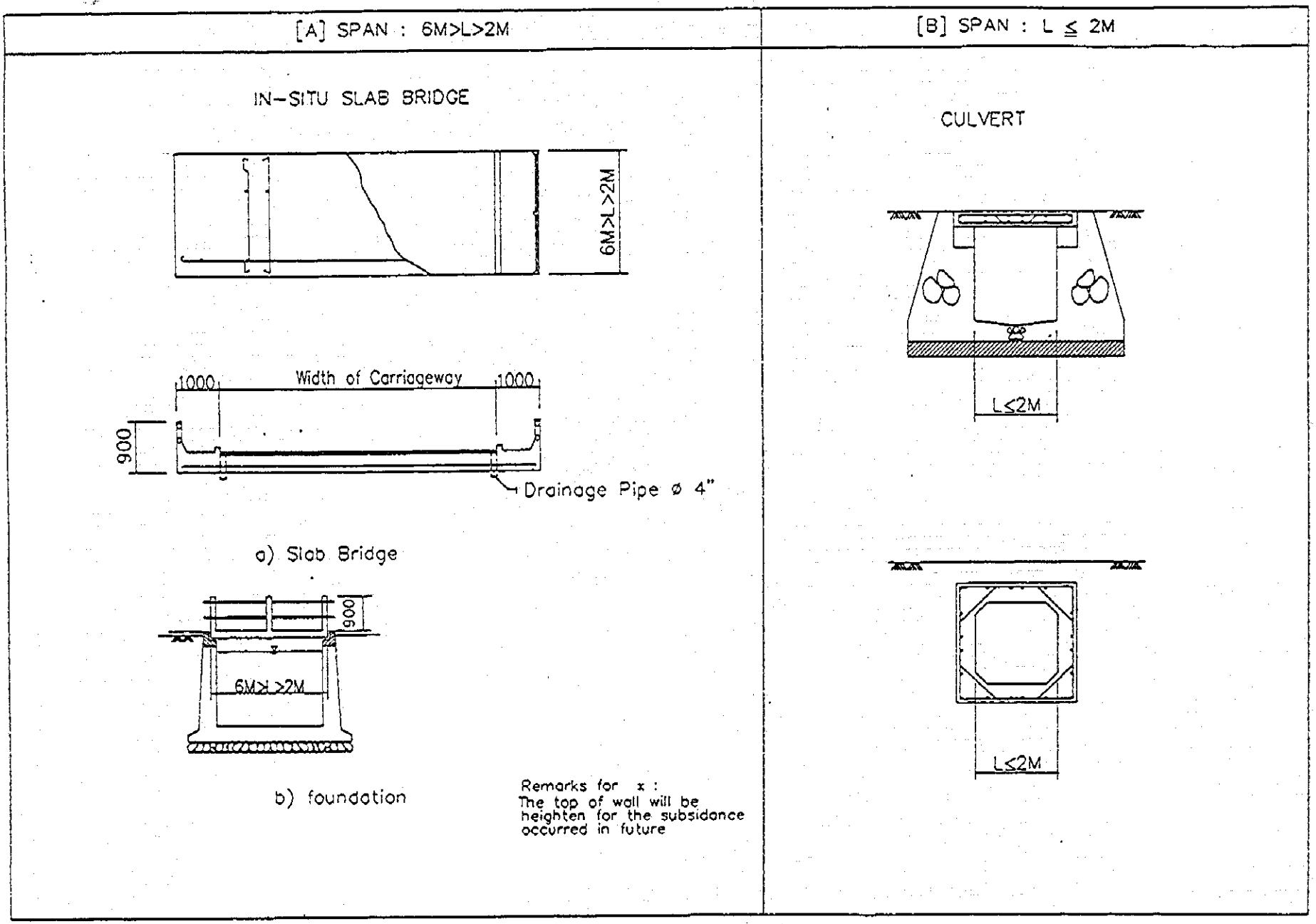


Fig. 4.7 Type of Bridge (2/2)

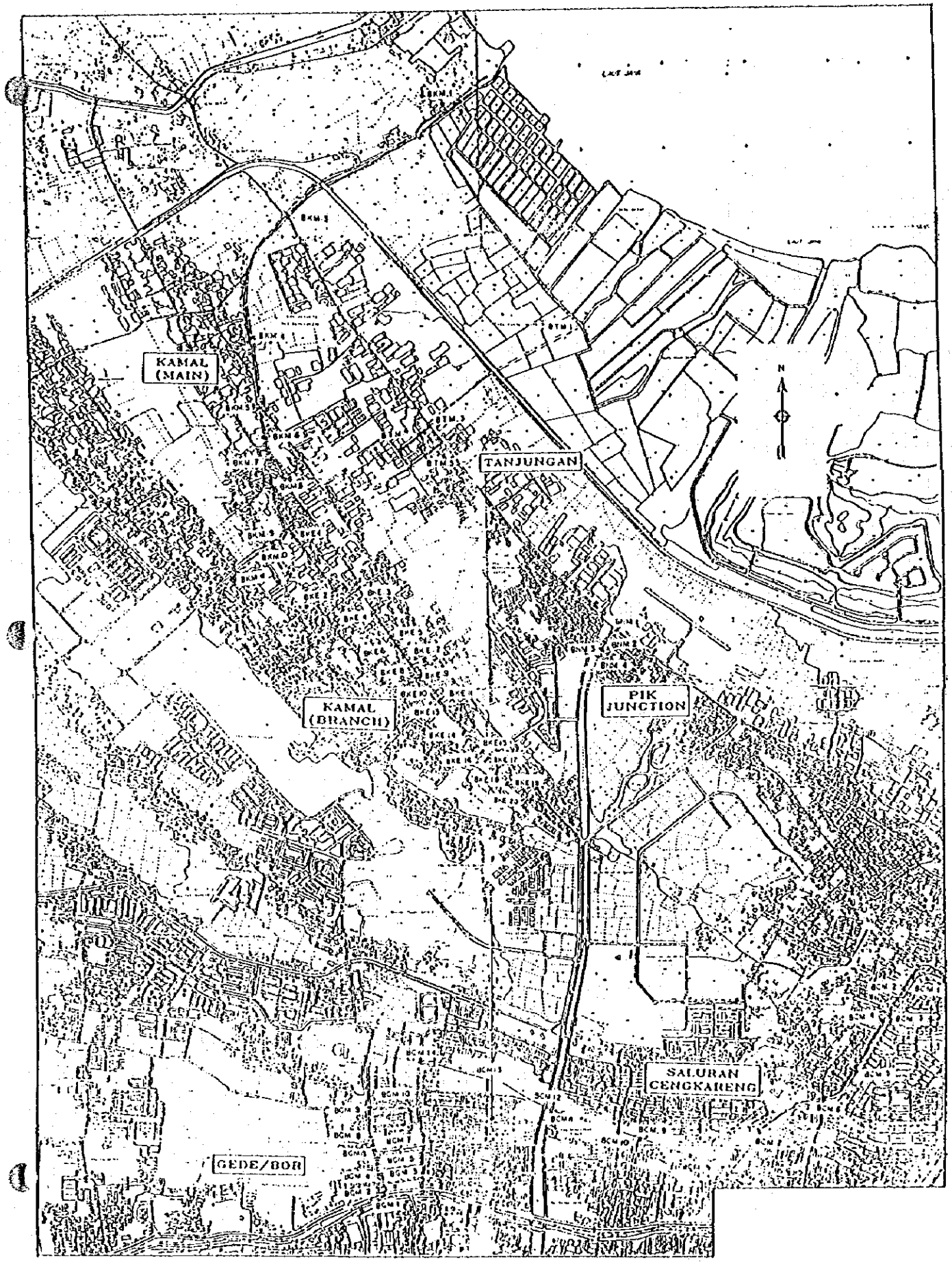


Fig. 4.8 Location Map of Bridges and Culverts (1/2)
(Cengkareng West Area)

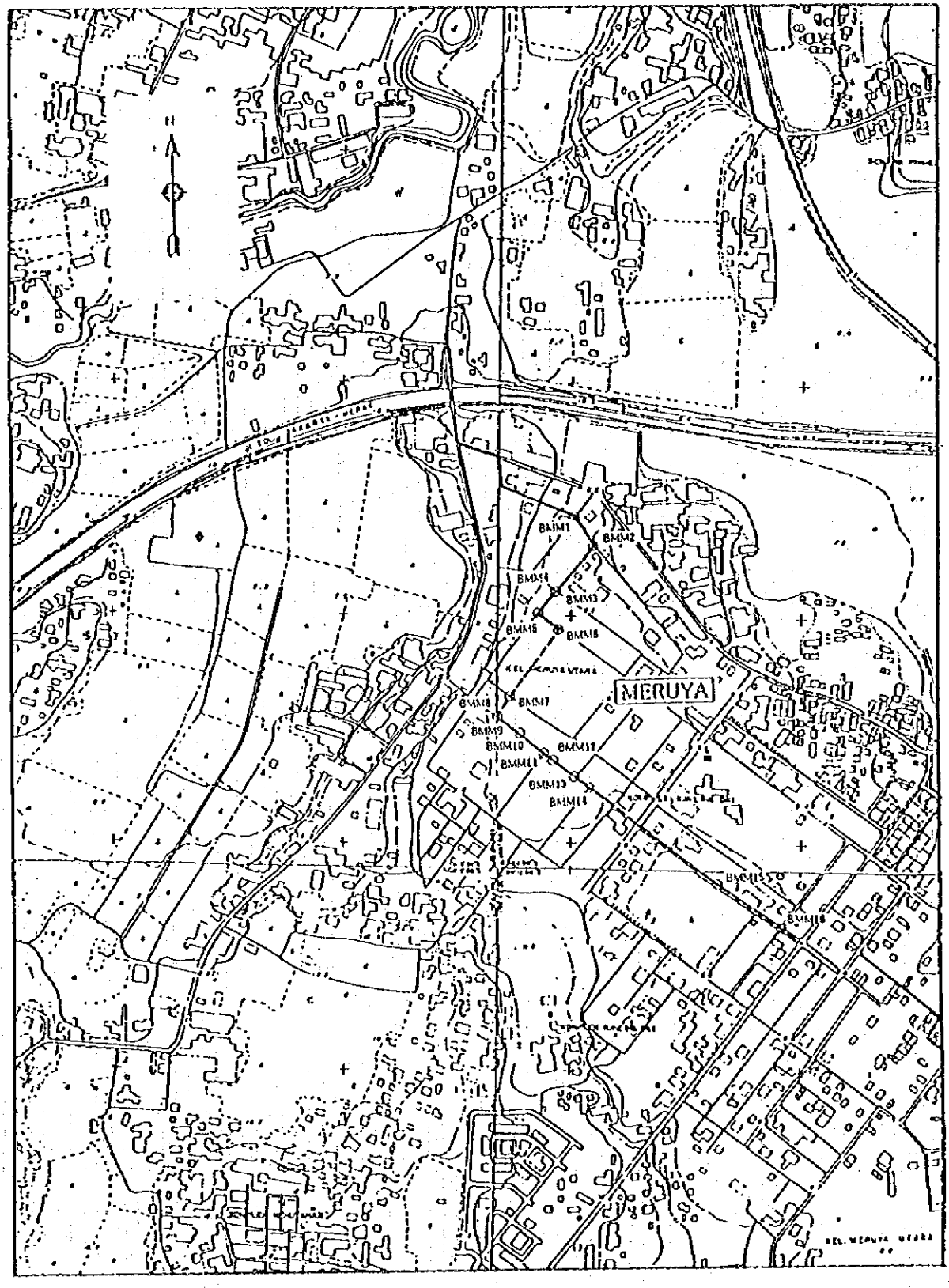


Fig. 4.8 Location Map of Bridges and Culvers (2/2)
(Meruya Area)

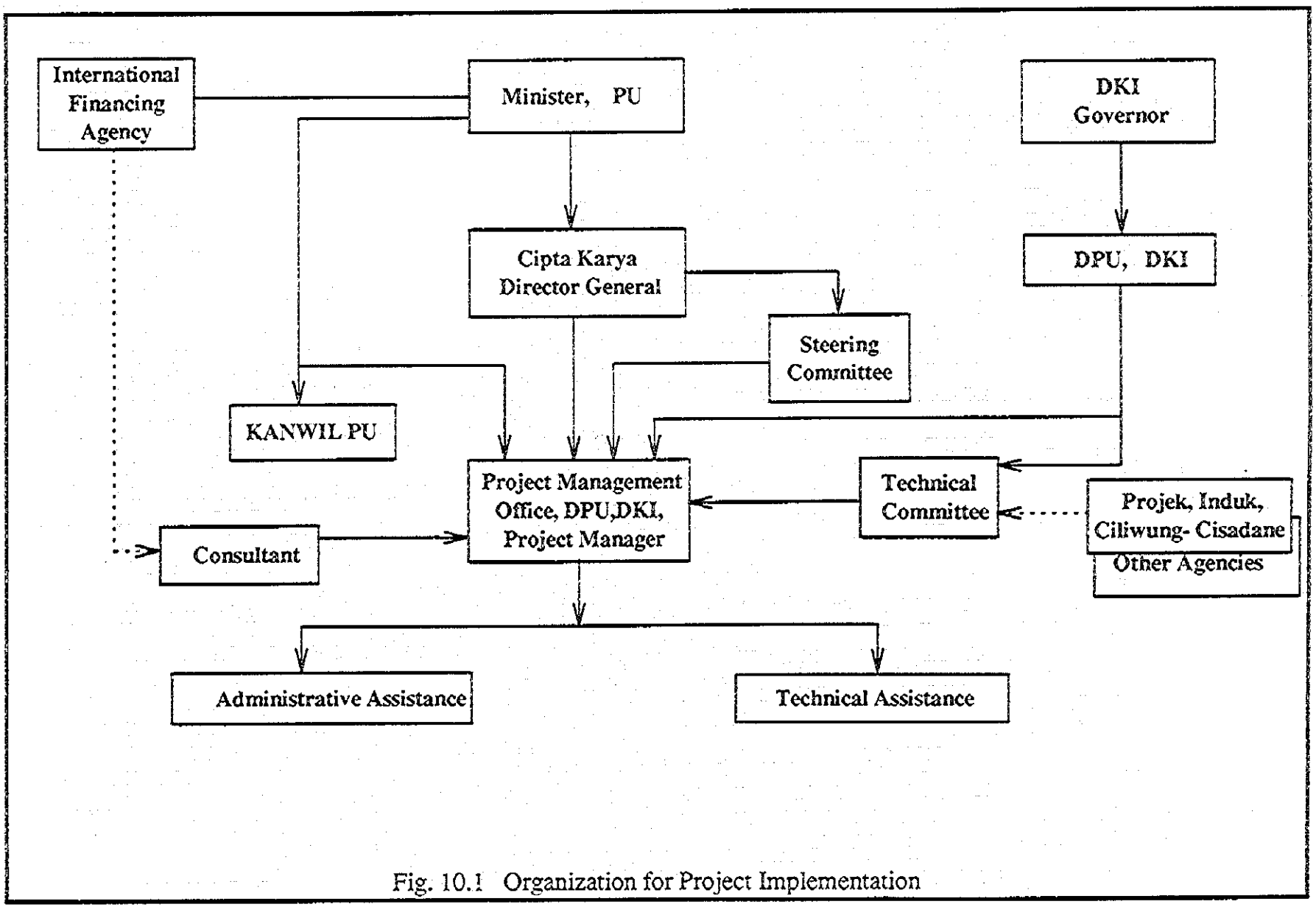


Fig. 10.1 Organization for Project Implementation

Fig. 10.2 Overall Implementation Schedule