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THE GOVERNMENT OF THE REPUBLIC OF INDONESIA

THE STUDY ON URBAN DRAINAGE AND WASTEWATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

MASTER PLAN STUDY

SUPPORTING REPORT

VOL. II

MARCH 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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APPENDIX A SOCIO-ECONOMIC CONDITIONS

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ABBREVIATIONS

AIT	Asian Institute of Technology
B/C	Benifit Cost Ratio
BAPPENAS	National Planning and Development Board
BAPPEDA	Regional Planning and Development Board, DKI Jakarta
BPPT	Agency of Assessment and Application of Technology
BOD	Biochemical Oxygen Demand
CIPTA KARYA	Directorate General of Human Settlement
Cl^-	Chloride Ion
cm	Centimeters
COD	Chemical Oxygen Demand
Dept.	Department
DKI	Jakarta Metropolitan Government
DO	Dissolved Oxygen
EIRR	Economic Internal Rate of Return
ENSIC	Environmental Sanitation and Information Center of AIT
FC	Fecal Coliform Density
Fig.	Figure
gcd	Gram per Capita per Day
ha	Hectares (10,000 m^2)
hrs	Hours
HWL	High Water Level
JICA	Japan International Cooperation Agency
JFCP	Jakarta Flood Control Project
JSSP	Jakarta Sewerage and Sanitation Project
JUDP	Jakarta Urban Development Project
kg/d	Kilogram per Day
Kec.	Kecamatan
Kel.	Kelurahan
KIP	Kampung Improvement Project
KKC	Kokusai Kogyo Co., Ltd.
km	Kilometers
km^2	Square Kilometers
kw	Kilowatt
kwh	Kilowatt-hour
lcd	Litter per Capita per Day
m	Meters

m^2	Square Meters
m^3	Cubic Meters
m^3/s	Cubic Meters per Second
m^3/d	Cubic Meters per Day
mg/l	Milligram per Litter
mm	Millimeters
MPN	Most Probable Number
MSL	Mean Sea Level
MWL	Mean Water Level
NEDECO	Netherlands Engineering Consultants
NH_4-N	Ammonia Nitrogen
NK	Nippon Koei Co., Ltd.
NPV	Net Present Value
NWL	Normal Water Level
OECF	Overseas Economic Cooperation Fund (of Japan)
PCI	Pacific Consultants International
PEI	Project Economy Institute, Inc.
P4L	Cities and Environmental Research and Development Center, DKI Jakarta
p.p.	Priok Pile
ppm	Parts per Million
%	Percent
P3O	Center for Oceanological Research and Development
RBC	Rotating Biological contactor
R.C.	Reinforced Concrete
Rd.	Road
Rp.	Rupiah (Indonesian Currency) US$=approximately Rp.1850
SS	Suspended Solids
TEC	Tokyo Engineering Consultants
T-P	Total Phosphorus
TS	Total Solids
TVS	Total Volatile Solids
WHO	World Health Organization

APPENDIX G

URBAN DRAINAGE DEVELOPMENT PLAN

APPENDIX G URBAN DRAINAGE DEVELOPMENT PLAN

1. Design Flood Discharge

1.1 Design Flood Frequency

(1) The design flood frequency of the objective urban drainage channels will be determined, in principle, in accordance with the guidelines prepared by the Ministry of Public Works, the Government of Indonesia (Refer to National Strategic Plan for the Urban Drainage and Urban Flood Protection Sectors).

In these guidelines, the design flood frequency of urban drainage channel varies according to the magnitude of catchment area as shown below.

Catchment Area (ha)	Design Flood Frequency (Year)
less than 10	1 ~ 2
10 ≤ A < 100	2 ~ 5
100 ≤ A < 500	5 ~ 10
greater than 500	10 ~ 25

In this table, higher design flood frequency will be applied for more developed area.

(2) Population of the Study Area is concentrated on its central part and Tanjung Priok region at present and will continue to remain so in future. The western, southern and eastern fringes of the Project Area will have a relatively low population density even in future (See Fig.G.1).

However, a large portion of the existing agricultural land in the north eastern part of the Project Area will be developed for industrial use in future (See Fig.G.2).

While, the flood vulnerable areas are mostly located in the northern low-lying areas (See Fig.G.3).

(3) Based on the above facts, in general, higher design flood frequency will be applied for the drainage channels inside the existing Banjir Canal and proposed East Banjir Canal than for the channels outside both the Banjir Canals as shown below.

Catchment Area (ha)	Design Flood Frequency (Year)	
	Outside Area	Inside Area
less than 10	1	2
$10 \leq A < 100$	2	5
$100 \leq A < 500$	5	10
greater than 500	10	25

While, the design discharges of many main drainage channels in the Study Area have been already established by the Jakarta Flood Control Project, which are Group I and Group II channels (see APPENDIX E, Chapter.2). The design flood frequency of such drainage channels is 25-year. Pump drainage in the polders has also been designed to meet a 25-year floods.

The design discharge proposed by the Jakarta Flood Control Project will be adhered in this Study to maintain the consistency among the completed, on-going and future projects.

However, no design flood discharge has yet been fixed for the drainage channels in the polders. In this Study, a design flood frequency of 10-year will be applied for such drainage channels, considering the fact that each drainage channel in a polder drains a relatively small area even though the polder itself covers a large catchment.

(4) The design flood frequency applied for the urban drainage of the capital cities in the other South East Asian Countries are shown below for reference.

Country	Capital City	Design Flood Frequency (Year)[<1]
Bangladesh	Dacca	5
Thailand	Bangkok	5 (large channel) 2 (small channel)
Laos	Vientiane	2
Philippines	Manila	5 ~ 10

(5) Based on the above considerations, the design flood frequency of all the objective urban drainage channels are determined as shown in Fig.G.4.

1.2 Flood Run-off Calculation

1.2.1 Calculation Method

Flood peak run-offs of the objective urban drainage channels are calculated by using the following Rational Formula. This formula is widely used for rivers and drainages when flood retarding effect is not very significant.

$$Q_p = \frac{1}{3.6} \cdot f \cdot ra \cdot A$$

where,

Q_p = Flood peak run-off (m^3/s)

f = Run-off coefficient

r_a = Basin average rainfall intensity during flood concentration time (mm/hr)

A = Catchment area (km^2)

(1) Run-off Coefficient (f)

The flood run-off coefficient varies according to the land use patterns of the basin. It is assumed as given below.

Residential Area	:	f = 0.50
Commercial & Institutional Area	:	f = 0.70
Industrial Area	:	f = 0.60

[<1] : Those are refered from the JICA Study Reports.

Other Areas (farmland/open space) : f = 0.20

For reference, the adopted standard run-off coefficients for urban drainage basin in Japan and the United States are given below.

		Japan[<1]	U.S.A[<2]
Residential Area	:	0.3 ~ 0.5	0.4 ~ 0.6
Commercial & Institutional Area	:	0.7 ~ 0.9	0.5 ~ 0.7
Industrial Area	:	0.4 ~ 0.6	0.5 ~ 0.8
Other Areas (farmland/open space)	:	0.1 ~ 0.2	0.1 ~ 0.3

(2) Basin Average Rainfall Intensity

The existing available relationship between rainfall intensity and its duration in the Study Area was established by NEDECO as mentioned in APPENDIX B (Chapter 3. Rainfall Intensity) and it is expressed for various rainfall frequencies. These are shown below and also presented in Fig.G.5.

For 2-year frequency ;

$$r_p = \frac{10490}{t^{1/0.90} + 76.3} \quad \text{for } t \leq 180 \text{ min.}$$

$$r_p = \frac{12692}{t^{1/0.90} + 172.8} \quad \text{for } t > 180 \text{ min.}$$

For 5-year frequency ;

$$r_p = \frac{7946}{t^{1/1.00} + 48.8} \quad \text{for } t \leq 180 \text{ min.}$$

$$r_p = \frac{8756}{t^{1/1.00} + 93.5} \quad \text{for } t > 180 \text{ min.}$$

<1 : Those are refered from the River Technical Standards of Ministry of Construction in Japan.

<2 : Those are refered from the American Society of Civil Engineers.

For 10-year frequency ;

$$r_p = \frac{8571}{t^{1/1.02} + 50.1} \quad \text{for } t \leq 180 \text{ min.}$$

$$r_p = \frac{8973}{t^{1/1.02} + 68.0} \quad \text{for } t > 180 \text{ min.}$$

For 25-year frequency ;

$$r_p = \frac{6271}{t^{1/1.12} + 31.2} \quad \text{for } t \leq 180 \text{ min.}$$

$$r_p = \frac{6090}{t^{1/1.12} + 31.5} \quad \text{for } t > 180 \text{ min.}$$

where,

r_p = Point rainfall intensity (mm/hr)
t = Duration time (min.)

The basin average rainfall intensity (r_a) is obtained by multiplying the point rainfall intensity by the rainfall reduction factors. The rainfall reduction factor varies according to length of flood concentration time and size of basin area. It is given below.

Rainfall Reduction Factors

Concentration	Drainage Area (A, km^2)					
time (tc, hr)	0	5	10	30	50	70
1/6	1.00	0.94	0.91	0.81	0.74	0.69
1/2	1.00	0.95	0.92	0.83	0.77	0.73
1	1.00	0.96	0.93	0.86	0.81	0.76
2	1.00	0.96	0.94	0.88	0.82	0.79
3	1.00	0.96	0.94	0.88	0.83	0.79
4	1.00	0.96	0.94	0.88	0.83	0.79
5	1.00	0.97	0.94	0.88	0.84	0.80

12	1.00	0.98	0.97	0.92	0.89	0.87
24	1.00	0.99	0.98	0.96	0.94	0.93

(3) Concentration Time (tc)

Concentration time (t_c) of flood run-offs consists of overland time (t_1) and drain time (t_2).

$$t_c = t_1 + t_2 \quad \text{(min.)}$$

The overland time is a flood concentration time along the longest time route from the catchment boundary to the uppermost point of the objective urban drainage channel. The overland time is estimated by assuming that:

$$\text{Route Length} = \frac{\text{Catchment Area}}{\text{Length of Objective Urban Drainage Channel}}$$

Flow Velocity : 0.4 m/s .

The drain time is flood concentration time in the objective urban drainage channel. In the drain time calculation, flow velocity is assumed as follows.

Velocity	Channel Gradient
v = 2.0 m/s	1/200 < I
v = 1.5	1/500 < I ≤ 1/200
v = 1.0	1/1,000 < I ≤ 1/500
v = 0.5	I ≤ 1/1,000

1.2.2 Hydraulic Characteristics of Basin

The hydraulic characteristics of the basins drained by the objective channel sections of Group III (APPENDIX E Chapter 2) were established to calculate flood run-offs. The hydraulic characteristics include:

- Drainage basin covered by the objective section
- Channel length at upstream of the objective section

- Average channel gradient at upstream of the objective section
- Run-off coefficient of the basin covered by the objective section.

The established hydraulic characteristics of the channel sections of Group III are shown in Table G.1.

1.3 Design Flood Discharge

(1) The already established design discharges of the on-going channel sections (Group I) are applied for this Master Plan with no revision (See Table G.2).

(2) The design discharges already proposed by JFCP for the channel sections of Group II are applied for this Master Plan with no revision (See Table G.3).

(3) The design discharges for the channel sections of Group III are proposed as shown in Table G.4.

2. Shortage in Flow Capacity of Existing Channels

2.1 Channel Stretches

Shortage in flow capacity of the existing channels to meet the proposed design discharge was calculated for the sections of Group II and Group III as shown in Table G.5 and Table G.6.

The existing flow capacity is insufficient in 40 channel sections of Group II and Group III. The shortage rate in flow capacity of the 40 channel sections is 54 % on an average. Such sections with a total length of 87.4 km shall be improved. Their locations are shown in Fig.G.6.

2.2 Bridge Crossings

Shortage in flow capacity of the bridge crossings in Group II and Group III sections was also calculated as shown in Table G.7. The calculated results are checked by interview survey on site. Bridges which caused actual

floods are identified. Such bridges with a total number of 21 shall be improved. Their locations are shown in Fig.G.7.

3. Urban Drainage Development Plan

3.1 Division of Drainage Zone

The Study Area is comprised of many complicated urban drainage networks. Some of them are hydraulically independent, while others are mutually connected. The hydraulically connected channels shall be developed as a package to maintain the hydraulic consistency among them.

The Jakarta urban drainage project consists of many small unit projects which will meet their respective local drainage requirements. Such small unit projects are widely distributed over the whole Study Area.

Regional priority sequences shall be made clear to attain the optimum stagewise development of such unit projects.

Based on the above considerations, the Study Area is divided into six (6) drainage zones. The divided drainage zones are shown in Fig.G.8.

The main features of the respective drainage zones are described below.

(1) Zone 1

This zone covers the drainage basin of 10,017 ha encompassed by the DKI, Jakarta administration boundary to the west and south, the Pesanggrahan River and Cengkareng Floodway to the east and by the coast of Jakarta Bay to the north.

The included major rivers and channels are:

- Kamal, Maja, Mookervart, Angke, Kreo, Pesanggrahan, Cengkareng Floodway, etc.

The ground elevation of the zone ranges from 2 m in the northern coastal plain to 30 m in the southern hilly areas.

The existing total population of the zone is estimated at 0.57 million in 1988. It is expected to grow to 1.33 million in 2010.

At present, rural land use including agricultural land, swamp and other open spaces is prevailing. However, a large portion of this rural land will be converted into urban land in future. The urban land use ratio will increase from 61 % in 1988 to 81 % in 2010. The land use patterns in 1988 and 2010 are estimated as shown in Table G.8.

(2) Zone 2

This zone covers the drainage area of 11,023 ha located between the Pesanggrahan River - Cengkareng Floodway and Krukut River - Banjir Canal.

The zone is mainly drained by the rivers and channels of:

- Cengkareng Floodway, Pesanggrahan, Angke, Sekretaris, Grogol, Krukut, Banjir Canal, etc.

The total population of the zone is estimated at 1.65 million in 1988 and 2.53 million in 2010.

The ground elevation of the zone is in the range of 1 m in the northern coastal plain and 50 m in the southern hilly areas. The zone has been already highly urbanized. Urban land use including residential, commercial and institutional, and industrial uses occupy 90 % of the total land. The estimated land use patterns of the zone in 1988 and 2010 are shown in Table G.8.

(3) Zone 3

This zone covers an area of 8,356 ha. It is surrounded by the Krukut River to the west, by administrative boundary of DKI Jakarta to the south, by the Ciliwung River to the east and by Banjir Canal to the north.

The major included rivers and channels are:

- Krukut, Mampang, Cideng, Kali Baru Barat, Kali Bata, Ciliwung, etc.

The total population of the zone is estimated to be 1.29 million in 1988 and 1.73 million in 2010.

The zone is located in a hilly area with an elevation of 10 m to 60 m.

The land of the zone has also been developed for urban use with a large extent. Urban land use rate of the zone is estimated to be 82 % in 1988. Its rate will further increase to 89 % in 2010. The land use patterns of the zone in 1988 and 2010 are estimated as shown in Table G.8.

(4) Zone 4

This zone covers the most developed area of 5,125 ha in the Study Area. It is surrounded by Banjir Canal to the west and south, by the Lower Ciliwung River to the east and by the coast of Jakarta Bay to the north.

The zone is mainly drained by the following rivers and channels.

- Banjir Canal, Cideng, Lower Ciliwung, Besar, Karang, etc.

The zone is already densely populated. Future population of the zone is expected to remain in nearly same level of the existing one. The total population of the zone and its average population density are estimated to be 1.44 million and 281 person/ha respectively in 1988. They are also estimated at 1.65 million and 323 person /ha respectively in 2010.

The ground of the zone is flat and low-lying. Its elevation is in the range of 1 m and 10 m.

The land of the zone has been fully developed for urban use. Commercial and institutional uses are prevailing as well as residential use. The land use patterns of the zone in 1988 and 2010 are shown in Table G.8.

(5) Zone 5

This zone covers the southern east area of 11,119 ha surrounded by the Ciliwung River to the west, by the DKI Jakarta administrative boundary to the south, by the Sunter River to the east and by the proposed East Banjir Canal to the north.

The zone is mainly drained by the following rivers.

- Ciliwung, Sentiong, Kali Baru Timur, Cipinang, Sunter, etc.

The zone lies in the southern hilly area with an elevation of 10 to 60 m.

A considerable area of agricultural land and other open spaces still exist in the zone. The urban land use rate is 71% in 1988. No large urban development is expected in future. The estimated land use patterns of the zone in 1988 and 2010 are shown in Table G.8.

(6) Zone 6

This zone covers the drainage area of 19,510 ha encompassed by the Lower Ciliwung River to the west, by the East Banjir Canal to the south, by the DKI Jakarta administrative boundary to the east and the coast of Jakarta Bay to the north.

The included major rivers and channels are:

- Lower Sentiong, Lower Sunter, Lower Buaran, Cakung Drain, Sal.Bekasi Tenggah, etc.

The ground of the zone is flat and low-lying . Its elevation ranges from 2 m to 10 m.

Population increase of the zone in future is large. The total population of zone will increase form 2.74 million in 1988 to 3.90 million in 2010.

This zone have a rural land including agricultural land , swamp and other open spaces of 5,191 ha or 27 % of the total land at present. However, half of this existing rural land is expected to be converted into industrial land. The urban land use rate will increase from 73 % in 1988 to 87 % in 2010. The estimated land use patterns of the zone in 1988 and 2010 are shown in Table G.8.

3.2 Design Standard for Improvement Works

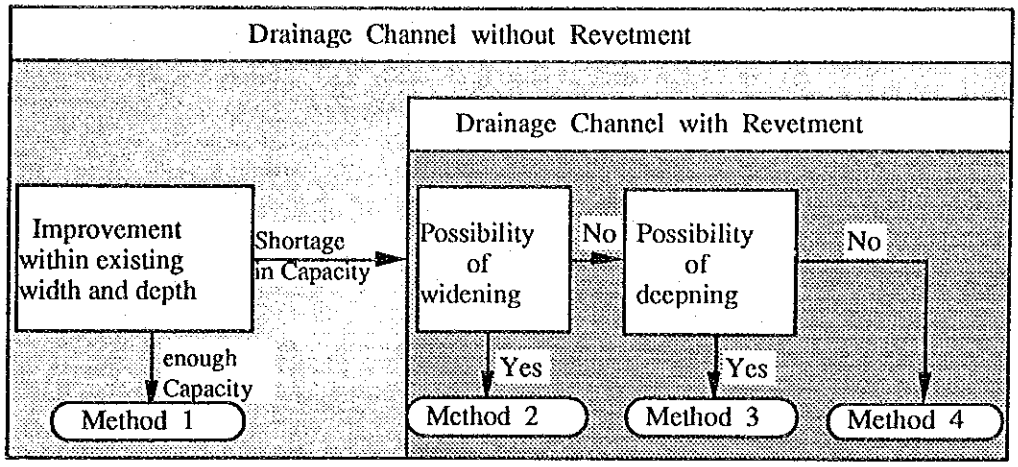
The following four (4) kinds of improvement works are proposable to meet the requirements of urban drainage improvement in the Study Area.

(1) Improvement of the existing channels
(2) Improvement of bridge crossing
(3) Installation of pumping station
(4) Installation of new channel.

For these improvement works, the following design standards are applied to maximize economical efficiency of the project, securing its hydraulical and structural safety and maintaining consistency with other completed and on-going improvement works.

(1) Improvement of the existing channels

The urban drainage channel which has not enough capacity for the proposed design discharge shall be improved based on the following flow chart of channel improvement method.



The four (4) improvement methods in the above figure are explained as follows along with description of structural type of revetment.

Method 1: Existing natural drainage channel will be provided with revetment of wet masonry type to increase the flow capacity within the existing width and depth.

Method 2: Existing drainage channel will be widened to increase the flow capacity where land acquisition is not difficult. Even in this case, revetment of wet masonry type will be provided to minimize the required land area.

Method 3: Existing drainage channel bed will be deepened to increase the flow capacity by providing revetment of wet masonry type or concrete pile wall. Herein, the maximum allowable depth of deepening is assumed to be 1.5 m in consideration of survey errors or thickness of river bed sediment, since no longitudinal data is available for most of the proposed urban drainage channels.

Method 4: Existing drainage channel bank will be heightened to increase the flow capacity by providing parapet or earth embankment where it will not cause inland floods. Herein, the allowable maximum height of heightening is assumed to be 1.0 m.

The above four (4) methods are shown schematically in Fig.G.9, and structural types of revetment applied in these methods are presented in Fig.G.10.

Selection of improvement method for some specified drainage channels is made through the field survey.

While, the inspection road with side ditch shall be constructed basically at both sides of the drainage channel if there is no existing available road in the surroundings and land acquisition is not difficult. The typical sections of inspection road for dike and excavated channel are shown in Fig.G.11.

(2) Improvement of bridge crossing

Shortage in flow capacity of drainage channel at the existing bridge crossings was calculated in the previous Chapter. Some bridge crossings much interfere with free flood discharge. Such bridges shall be reconstructed to meet the design flood discharge.

Furthermore, some existing bridges shall be extended to meet the design discharge along with widening of the drainage channel.

The improvement method are decided through the field survey in consideration of surrounding conditions.

(3) Installation of pumping station

Inland flood in the Study Area mainly occurs behind levee of the flood control river where ground surface level is lower than high water level of the river. The inland floods behind the urban drainage channel is limited to quite a small area since almost all of the drainage channels are excavated ones. Then, only inland floods behind the flood control river is studied.

The inland flood area is at first identified based on the flood area map prepared in Appendix A, where floods exist in the vicinity of confluence of the urban drainage channel and flood control river though flow capacity of the existing drainage channel meets the design discharge.

Then, field survey was carried out for confirmation of the above selection.

Pumping station with a regulating pond is supplied for the inland flood area selected through the above procedure. The required volume for pump drainage is calculated based on the following design criterias.

(i) Design frequency of pump drainage is decided in the same way for the drainage channel, except the on-going pump stations by the Jakarta Flood Control Project.

(ii) The probable point rainfall mass curve established by NEDECO is utilized for preparation of the design hyetograph. They are presented in Table G.9 and Fig.G.12.

(iii) The design hydrograph of pump drainage is determined by using a unit hydrograph method. The calculated method of unit hydrograph is schematically given in Fig.G.13.

Then, the optimum combination of pumping station and retarding pond to meet the required drain volume is decided considering the topographic conditions and economic efficiency.

On the other hand, expansion of the existing pump station is also studied for the case that runoff volume has been increasing in accordance with the land development of its drain area.

(4) Installation of new urban drainage channel

In the eastern and western fringe areas of the Study Area, a large green land of agricultural, swamp and other uses is being developed for urban use, in accordance with the land use policy of the DKI Jakarta Structure Plan 2005. Such urban land developments will increase properties in the flood prone areas on one hand and on the other hand, will increase flood run-off peak of the drainage basin. It will result in creation of new flood problems.

New urban drainage channels shall be installed in advance of such urban developments to cope with expected new flood problems in the future.

The new urban drainage channel shall be prepared based on the following policies.

(i) One (1) major urban drainage shall not cover a too large drainage basin so that quick and easy secondary and tertiary drainage can be attained.

(ii) The route of new drainage channel shall be determined to use the existing channel such as irrigation water channel as much as possible so that land acquisition or earth work costs can be minimized.

(iii) The revetment of wet masonry type shall be applied for construction of new drainage channel. Also, the access road shall be attached at the side of the drainage channel for the maintenance and operation purpose.

3.3 Development Plan of Drainage Zone

The development plan proposed by this Study is composed of :

- improvement works for 32 existing channels with a total length of 76.1 km including 21 bridge crossings.
- installation works for two (2) pumping stations with a total capacity of 8.7 m^3/s.
- installation works for three (3) new channels with a total length of 11.4 km.

The location of these proposed projects are shown in Fig. G.14. The detailed location map and proposed cross sections of improvement for drainage channels and bridge crossings are shown in Fig. G.15 to Fig. G.18. The detailed location map, and typical plan and section for the pump stations are also shown in Fig. G.19 and Fig. G.20 respectively.

The main features of the proposed drainage channel improvement plans including design discharge, improvement length, improvement cross section and improvement works are shown in Table G.10.

On the other hand, 25 urban drainage projects are on-going. Their implementation stage, executing agency, funding agency and major work contents are also introduced in this Chapter. The projects are mostly executed by the government agencies of JFCP, DKI and JSSP. However, two (2) private sector agencies of Ex-Kemayoran Airport Authority and Sunter Development Authority are also implementing the drainage works related to their housing development projects. The major funding agencies of the on-going projects are OECF, IBRD and GOI. Location of the on-going project is shown in Fig. G.21.

3.3.1 Development Plan of Zone 1

(1) On-going Project

A. Sepak River Improvement Project:

- D/D completed by JFCP with OECF Fund in July 1987
- Major Works

(i) Channel Improvement : 3.3 km (Excavation, Embankment & Bank Protection)
(ii) Construction of Bridge : 2 places
(iii) Construction of Drainage Culvert : 2 places

(2) Proposed Project

No.1-1 Kamal River Improvement Project:

The No.1-1 River drains a catchment area of 1,640 ha directly into the Jakarta Bay. Housing developments are on-going in the upstream area of the basin. The existing main river courses of 7.4 km will be improved to carry the design discharge of 45 m^3/s. The major improvement works are excavation of river bank and bed, and construction of revetment.

No.1-2 Tanjungan River Improvement Project:

The No.1-2 River drains a catchment area of 780 ha directly into the Jakarta Bay. The upstream area of the basin is undergoing housing and industrial land developments. The existing river channel of 3.2 km will be improved to meet the future land development in the basin. The design discharge is 30 m^3/s. The major improvement works are excavation of river bank and bed, and construction of revetment.

No.2-1 Kali Gede / Kali Bor Channel Improvement:

No.2-1 drainage channel drains a catchment area of 560 ha into the Mookervart River. The existing channel of 4.8 km will be widened and deepened to carry the design discharge of 30 m^3/s. The major improvement works are excavation of river channel and construction of revetment.

No.2-2 Saluran Cengkareng Channel Improvement:

No.2-2 drainage channel covers a catchment area of 330 ha. Storm water is drained into the Cengkareng Floodway through the No.2-3 Padongkelan drainage channel. The existing channel of 4.5 km will be widened and deepened to meet the design discharge of 20 m^3/s. The major improvement works are excavation of river channel and construction of revetment.

No.2-3 Padongkelan Channel Improvement:

No.2-3 drainage channel drains a catchment area of 520 ha into the Cengkareng Floodway. The land of 340 ha of the basin is being developed for housing by PERUM PERUMNAS. The existing channel of 1.1 km will be widened and deepened to meet the design discharge of 25 m^3/s. The major improvement works are excavation of river channel and construction of revetment.

No.3 Semanan River Improvement Project:

The No. 3 River is affected by backwater of the Mookervart River. The river floods 0.5 km reaches of low bank elevation. Earth embankment and parapet will be constructed for the above 0.5 km reaches. The design discharge is 10 m^3/s.

No.4 Kreo River Improvement Project:

The upstream and downstream reaches of No. 4 River has already been improved along with the related housing developments. However, 0.9 km channel section located between these development areas has remained unimproved. This channel section of 0.9 km length will be improved to meet the design discharge of 35 m^3/s. The major works is construction of revetment.

No.5 Ulujami River Improvement Project:

No. 13 Bridge is located at midstream of the Ulujami River (No. 5 River). The downstream reaches of the bridge has already been improved for development of the new residential area. However, this bridge crossing interferes with free flood flow and inundates the upstream reaches. The river width at this bridge crossing will be widened by constructing an additional one (1) span of bridge. The design discharge is 25 m^3/s.

No.6 Sepak River Improvement Project:

The upstream section of the No. 6 River has already been improved for development of the new residential area. However, the downstream section of 0.6 km has remained unimproved. This section of 0.6 km length will be improved to meet the design discharge of 70 m^3/s. The major improvement works are excavation of bank and construction of revetment. This project is connected to the on-going No. A Sepak River Improvement Project at the downstream end.

No.7 Pesanggrahan Bawah River Improvement Project:

The existing river width is very narrow. The river width will be widened in the reaches of 1.1 km to cope with the increasing flood peaks due to housing developments in the basin. The design discharge is 20 m^3/s. The major improvement works are excavation of bank and construction of revetment.

3.3.2 Development Plan of Zone 2

(1) On-going Project

B. Lower Angke River Improvement Project:

- D/D completed by JFCP with OECF Fund in July 1987
- Major Works

(i) Channel Improvement : 4.5 km (Excavation/Dredging)
(ii) Construction of Bridge : 2 places
(iii) Construction of Drainage Culvert : 13 places
(iv) Construction of Pump Station : 1 place (8 m^3/s)

C. Grogol Sekretaris Interceptor Project (including Lower Grogol River Improvement):

- Under construction by JFCP with OECF Fund
- Major Works

(i) Construction of Interceptor Channel : 2.9 km (Excavation, Embankment & Bank Protection)
(ii) Channel Improvement : 4.5 km (Dredging of Grogol Drain)
(iii) Construction of Bridge : 8 places
(iv) Construction of Drainage Culvert : 22 places

D. Lower Sekretaris River Improvement Project:

- Under construction by DKI with GOI Finance in 1990
- Major Works

(i) Channel Improvement : 2.1 km

E. Upper Grogol River Improvement Project:

- D/D completed by JFCP with GOI Finance
- Major Works

(i) Channel Improvement : 5.7 km (Excavation, Embankment & Bank Protection)
(ii) Construction of Bridge : 4 places
(iii) Construction of Gate : 1 place

(2) Proposed Project

No.10 Kedaung River Improvement Project:

The No. 10 River drains a catchment area of 220 ha which is mostly swamps. The river reaches of 1.2 km will be improved to meet the future land development in the basin. The design discharge is 10 m^3/s. The major improvement works are excavation of bank and construction of revetment.

No.14 Cilawe River Improvement Project:

The No. 14 River flows along the Pertamina Hospital to the Grogol River. The river banks are densely occupied by residential and institutional buildings. The river capacity will be increased by deepening. The river length of improvement and design discharge are 0.9 km and 10 m^3/s respectively. The major improvement works are sheet piling and river bed excavation.

No.A Sekretaris River Improvement Project:

The downstream portion of the Sekretaris River is under construction by the Lower Sekretaris Improvement Project of DKI. However, the upstream portion of Jl. Jakarta - Merak has not been improved yet. This upstream reaches are subject to flooding at many locations. Widening of the river is possible to some extent although it runs through residential areas. The river length of improvement and design discharge are 6.0 km and 25 m^3/s respectively. The proposed major improvement works are excavation of river bank and bed, and construction of revetment.

Moreover, the existing 13 bridges (No. 16-21, No. 23-27, No. 29 and No. 30 bridges) in the upstream reaches of the No. A Sekretaris River

interfere with free flood flow, causing frequent flooding in the basin. These bridges will be improved along with the above river improvement works.

P-1 Kedaung Kali Angke Pump Station Construction :

The drainage basin of the Kedaung Kali Angke covers an area of 480 ha encompassed by the Jl. Kapuk Raya to the north, the Lower Angke River to the east, the Jl. Daan Mogot to the south and the Cengkareng Floodway to the west. The ground level becomes lower, from the west to the east, toward the Lower Angke River.

Inland flooding occurs in the low-lying areas due to backwater effects of the Lower Angke River. This inland flooding will become more severe in future. This is because the existing farm land of 180 ha located in the south-west part of the drainage basin is expected to be converted into residential or industrial land in future.

To cope with this inland flooding, a pump station of 2.5 m^3/s along with a regulation pond of 9.0 ha is proposed. The pump station will be installed at the outlet of the existing channel to the Lower Angke River. The regulation pond will be constructed at the eastern end of the existing green area. The pump station and regulation pond will be connected by the existing channel of 8 m width and 0.6 km in length. Dredging works of this existing channel is also necessary.

3.3.3 Development Plan of Zone 3

(1) On-going Project

F. Setia Budi Reservoir Rehabilitation Project:

- Under construction by JSSP with IBRD Fund in 1990
- Major Works

(i) Deepening of Reservoir

(ii) Lining of Side Wall of Reservoir

(2) Proposed Project

No.19 Mampang River Improvement Project:

The Mampang River with a relatively large drainage area of 2,600 ha flows through the residential areas to confluence with the Krukut River. Widening of the existing river is difficult because the river banks are densely occupied by residential buildings. A 6.0 km reaches of the river will be deepened to meet the design discharge of 60-90 m^3/s. The major improvement works are sheet piling and river bed dredging.

No.20 Cideng River Improvement Project:

Downstream reaches of the river (Jl. Palbatu Menteng Dalam - Setia Budi Pond) has already been improved. While, its upstream reaches has remained unimproved except for a short river distance where housing development is on-going.

A river reaches of 2.5 km will be improved to meet the design discharge of 25-45 m^3/s. The major improvement works are sheet piling, and excavation of river bed and bank.

No.27 Kali Bata River Improvement Project:

The No. 27 River divides into two (2) rivers : No. 28 River and No. 29 River. Flood water of the No. 27 River had been discharged into the No. 28 River in the past. However, it is being released to the No. 29 River since the No. 29 River was constructed to prevent the Manggarai Switchyard from flooding by JSSP. The downstream reaches of the No. 27 River has already been improved. The upstream reaches of 0.4 km will be improved to meet the design discharge of 55 m^3/s. The major improvement works are sheet piling and river bed excavation

P-2 Menteng Wadas Pump Station Construction Project:

The Kali Baru Barat River was constructed originally as a water supply channel. It drains only an area of 250 ha though it is 20 km long from the boundary of the Jakarta city to the Banjir Canal..

There are three (3) outlet gates at the confluence with the Banjir Canal. Two (2) of them are connected to the Banjir Canal but the other one to the Gresik Surabaya River by a syphon across the Banjir Canal. Under normal conditions, the former two (2) gates are kept open and the latter is closed, and vice versa in case of high flow in the Banjir Canal. Flooding occurs in the lowermost reaches of the Kali Baru Barat River when both the water levels of the Banjir Canal and the Gresik Surabaya River are high.

To cope with this flooding, a pump station of 6.2 m^3/s is proposed at just upstream of the existing gates. This pump station is provided with no regulation pond because land space for the pond is not available. Instead, the available storage capacity of 5,000 m3 between the high water level and top of bank in the existing channel is used for regulation of flood peaks.

3.3.4 Development Plan of Zone 4

(1) On-going Project

G. Sarinah Thamrin Project:

- Under construction by JFCP with OECF Fund
- Major Works

(i) Channel Improvement : 7.8 km (Siantar: 0.5 km, Krukut: 3.5 km,Cideng: 0.1 km, Cideng Thamrin: 3.7 km)

(ii) Construction of Pump Station : 2 places (40.3 m^3/s: Cideng:40 m^3/s & Melati: 0.3 m^3/s))

(iii) Construction of Bridge : 3 places

(iv) Construction of Reservoir : 4.2 ha (Melati Reservoir)

H. Ciliwung Kota Drain Project:

- D/D is completed by JFCP & DKI with OECF Fund in Sept. 1987

- Major Works

(i) Channel Improvement : 9.1 km (Ciliwung Kota: 5.2 km, Thamrin Sari: 2.0 km, Beton: 1.9 km)

(ii) Construction of Bridge : 13 places

I. Pluit Rehabilitation Project:

- D/D is on-going by JFCP with IBRD Fund
- Major Works

(i) Dredging of Reservoir

(ii) Rehabilitation of Pump Station

J. K. Besar & Duri Canal Improvement Project:

- D/D is on-going by JFCP with IBRD Fund
- Major Works

(i) Channel Improvement : 10.5 km (Excavation of K.Besar, Pakin Jelankeng and Duri Canals)

K. Ciliwung River Improvement Project:

- D/D is on-going by JFCP with IBRD Fund
- Major Works

(i) Channel Improvement : 14.0 km (Excavation of Ciliwung River)

(ii) Construction of Gate : 1 place (Pekapuran Tidal Gate)

(2) Proposed Project

There is no project proposed in Zone 4.

3.3.5 Development Plan of Zone 5

(1) On-going Project

There is no on-going project in Zone 5.

(2) Proposed Project

No.34 Sentiong River Improvement Project:

The river reaches of 1.2 km will be improved to meet the design discharge of 15 m^3/s. The major improvement works are excavation of bank and river bed, and construction of revetment.

3.3.6 Development Plan of Zone 6

(1) On-going Project

L. Kemayoran Airport Drainage Project:

- D/D is on-going by Ex-Kemayoran Airport Authority
- Major Works

(i) Channel Improvement : 0.8 km
(ii) Construction of Pump Station : 1 place (4.0 m^3/s)
(iii) Construction of Reservoir : 15 ha

M. Pademangan Canal Improvement Project:

- D/D is on-going by JFCP with OECF Fund
- Major Works

(i) Channel Improvement : 5.5 km (Excavation & Lining)

N. Ancol Canal Improvement Project:

- D/D is on-going by JFCP with IBRD Fund
- Major Works

(i) Channel Improvement : 6.5 km (Excavation & Lining of Ancol Canal)
(ii) Construction of Gate : 2 places (Ancol Gravity)
(iii) Construction of Pump Station : 1 place (15.0 m^3/s)

O. Sentiong Cut-off Channel Project:

- D/D is on-going by JFCP with IBRD Fund
- Major Works

(i) Construction of Cut-off Channel (Sentiong Cut-off Channel)

P. Sunter West Polder Project:

- D/D completed by JFCP with OECF Fund in 1989
- Major Works

I) Private Sector Project with Sunter Development Authority Finance

(i) Construction of Pump Station : 1 place (10.0 m^3/s)

(ii) Construction of Reservoir : 40 ha

II) JFCP Project with IBRD Fund

(i) Construction of Gate : 1 place (Lagoa Tidal Gate)

(ii) Channel Improvement : 0.5 km (Papango Drain)

Q. Sunter River Improvement Project:

- D/D completed by JFCP & DKI with OECF Fund in 1990
- Major Works

(i) Channel Improvement : 19.3 km

(ii) Construction of Bridge : 8 places

(iii) Construction of Sluiceway : 90 places

R. Sunter East III Polder Project:

- D/D completed by JFCP & DKI with OECF Fund in 1990
- Major Works

(i) Construction of Pump Station : 1 place (15.5 m^3/s)

(ii) Construction of Reservoir : 8.1 ha

S. Buaran River Improvement Project:

- D/D completed by JFCP with OECF Fund in 1990
- Major Works

(i) Channel Improvement : 9.8 km

(ii) Construction of Bridge : 1 place

(iii) Slope Protection : 3.7 km

T. Cakung River Improvement Project:

- D/D is on-going by JFCP with OECF Fund
- Major Works

(i) Channel Improvement : 5.2 km

(ii) Construction of Bridge : 3 places

U. Petukangan Canal Project:

- Under construction by DKI with GOI Finance
- Major Works

(i) Channel Improvement : 0.8 km

(ii) Installation of Gate : 1 place

V. Cakung Floodway Improvement Project:

- D/D completed by JFCP with OECF Fund in 1990
- Major Works

(i) Channel Improvement : 5.9 km (Dredging)

W. Marunda Canal Project:

- D/D is on-going by JFCP with OECF Fund
- Major Works

(i) Construction of Drainage Channel : 3.4 km
(ii) Construction of Syphon : 1 place
(iii) Construction of Bridge : 6 places

X. Sunter East II Polder Project:

- D/D is on-going by JFCP & DKI with OECF Fund
- Major Works

(i) Construction of Gate : 1 place (Landak Gate)
(ii) Construction of Pump Station : 1 place (5.2 m^3/s)
(iii) Construction of Reservoir : 25 ha
(iv) Construction of Drain : 1.5 km

Y. Marunda Polder Project:

- D/D is on-going by JFCP & DKI with OECF Fund
- Major Works

(i) Construction of Gate : 1 place (Marunda Tidal Gate)

(2) Proposed Project

No.49 Kebon Bawang River Improvement Project:

The No. 49 River is affected by tide of the Jakarta Bay and the residential areas along the river suffer from flooding almost every day. However, this river will be encircled by the polder of the on-going Sunter West Polder Project along with the rivers of No. 47, 48, 50, 51, 52, 53 and 54. The river flow is lead to the Sunter West Pond planned at northern west side of the polder area and be pumped into the Jakarta Bay during high tide. However, it will be drained by

gravity through the tidal gate planned at northern east end of the polder during low tide.

Widening of this river is difficult due to the existing roads along both sides of river banks. The river reaches of 1.6 km will be improved to carry the design discharge of 15 m^3/s. The major improvement works are sheet piling and river bed excavation.

No.50, No.52 and No.54 Lagoa Tenggiri River Improvement Project:

These three (3) rivers will also be encompassed by the on-going polder works and drained in the same manner as No. 49 River. The No. 50 and 52 Rivers will be improved within the respective existing river widths, while the No. 54 River will be widened to some extent. The improvement distance and design discharge are 0.6 km, 30 m^3/s for the No. 50 River, 0.7 km, 35 m^3/s for the No. 52 River and 1.8 km, 40 m^3/s for the No. 54 River. The major improvement works are river bed excavation for the No. 50 River, sheet piling and river bed excavation for the No. 52 River, and excavation of bank and river bed for the No. 54 River.

No.58 Cipinang River Improvement Project:

The No. 58 River runs through the comparatively dense residential areas Widening of the existing river width is difficult. River reaches of 0.8 km will be improved by river bed excavation along with sheet piling. The design discharge is 5 m^3/s.

No.72 Tugu-Batu River Improvement Project:

Upstream reaches of this river have already been improved along with housing developments. While, 1.3 km of the downstream reaches still remain unimproved. Housing developments are also being undertaken along the downstream reaches by land reclamation. The river capacity will be increased to meet the design discharge of 45 m^3/s by embankment and excavation.

No.73 & 74 Rawa Badak River Improvement Project:

The residential areas along these two (2) rivers suffer from flooding due to tidal effects of the Jakarta Bay almost every day. The rivers will be encircled by the polder of the on-going Sunter East III Polder Project along with the No. 75 River. Widening of these rivers is difficult since roads run on the river banks at both sides. Both of these rivers will be improved within the existing river widths by river bed excavation with sheet piling. The improvement length and design discharge are 2.0 km, 20 m^3/s for the No. 73 River and 1.0 km, 20 m^3/s for the No. 74 River.

No.75 Pelumpang River Improvement Project:

The existing No. 75 River drains only a part of the No. 74 River. However, it shall drain the whole area of the Sunter East III Polder after completion of the polder project. River reaches of 0.9 km will be improved by construction of concrete pile wall, and excavation of bank and river bed. The design discharge is 30 m3/s.

No.76 Cakung Lama River Improvement Project:

The No. 76 (1) River is connected to the No. 78 River at present. However, the polder of the on-going Sunter East II Polder Project will intersect the existing river networks. The whole discharge of the No. 76 (1) River shall be lead to the No. 76 (2) River. Some reaches of the No. 76 (2) have already been improved. The whole reaches of 5.2 km in the No. 76 (1) River and the remaining 1.9 km in the No. 76 (2) River will be improved to carry the respective design discharges of 40 m^3/s and 50 m^3/s. The major improvement works are excavation of bank and river bed, and construction of revetment.

Moreover, No. 227 bridge across the No. 76 (2) River interferes with free flood flow. The bridge will be reconstructed along with the river improvement.

No.78 Cakung River Improvement Project:

The No. 78 River will be encircled by the polder of the on-going Sunter East II Polder Project along with the No. 79 River. The No. 78 River drains into the Cakung Drain through the existing flood gate at the confluence to the Cakung Drain at present. After completion of the Polder Project, this No. 78 River will discharge into the No. 79 river for pump drainage to the Cakung River during high flow of the Cakung River and gravity drainage during low flow of the Cakung River. The No. 78 River runs through rice field. The river reaches of 5.2 km will be widened to carry the design discharge of 20 m^3/s. The improvement works are excavation of bank and construction of revetment.

Moreover, No. 223 and No. 224 bridges that interfere with free flood flow will be reconstructed along with the river improvement works.

No.79 Jati Bening River Improvement Project:

The No. 79 River was originally constructed as a side drainage channel of the Cakung Drain. It is connected to the No. 78 River. However, after completion of the on-going Polder Project, this No. 79 River will convey floods of the No. 78 River to the Sunter East II Pond for pump drainage to the Cakung Drain. During low water of the Cakung Drain, it will function as present. The river length of 1.4 km will be improved to carry the design discharge of 20 m^3/s. The major improvement works is river bed excavation with sheet piling.

No.U Kali Item River Improvement Project:

The No. U River connects the Sunter and Sentiong Rivers. The river is provided with one (1) gate each at the confluences to the above two (2) rivers. During flood time, the gate at the Sunter River side is kept closed and the No. U River is drained to the Sentiong River. This river is affected by tide. The river banks of 0.6 km length will be heightened by parapet. The design discharge is 20 m3/s.

No.V Sentiong River Improvement Project:

The No. V River is affected by tide. Areas along both sides of this river are drained by the on-going Pademangan and Sunter West Polder Projects. The river banks of 1.4 km will be heightened by parapet and embankment to prevent spill-over of the river. The design discharge of the river is 60 m^3/s.

No.X Sentiong River Improvement Project:

This river section is located just upstream of the on-going Sentiong Cut-off Channel Project and is affected by tide. Areas along both sides of this river are drained by the on-going Pademangan and Sunter West Polder Projects. The river banks of 0.5 km will be hightened by parapet to prevent flooding of this river. The design discharge is 65 m^3/s.

N-1 Lower Marunda Channel Construction Project:

The N-1 new channel will be constructed to drain an area of 540 ha bounded by the Cakung Drain to the west, Marunda Drain to the south and Marunda Polder to the east, to the Bay of Jakarta. The drainage area is mostly covered by rice field or fish pond at present. However, these lands will be developed for industrial and residential uses in future. Construction of this new channel is required for such land developments. The channel will be excavated along the western side of the Marunda Polder. The channel length is 1.3 km. The design discharge is 15 m^3/s. The major improvement works are excavation of channel and construction of revetment.

N-2 and N-3 Upper Marunda Channel Construction Project:

The N-2 and N-3 new channels will be constructed to drain an area of 1,300 ha bounded by the Cakung Drain to the west, Marunda Drain to the north, East Banjir Canal to the east and Malang River to the south. This area will also be developed for industrial and residential uses in future.

The channels will be constructed by using the existing irrigation channels as much as possible to minimize the construction cost and land acquisition. The channel length and design discharge are 4.1 km, 20-40 m^3/s for the N-2 channel and 3.5 km, 20-30 m^3/s for the N-3 channel. The major works for both channels are channel excavation and construction of revetment.

4. Estimated Cost

The project cost is composed of (i) direct construction cost (ii) land acquisition and compensation costs (iii) engineering service cost (iv) government administration cost (v) physical contingency. The cost items of (iii) to (v) are estimated based on the items (i) and (ii). The calculation method is shown below.

(i) Direct construction cost	= work volume x unit price
(ii) Land acquisition and compensation cost	= work volume x unit price
(iii) Engineering service cost	= (i) x 7 %
(iv) Government administration cost	= sum of (i) and (ii) x 1.5 %
(v) Physical contingency cost	= sum of (i) x 10%

The proposed construction works are as follows.

(i)	Earth work	- excavation - embankment
(ii)	Revetment work	- wet masonry - concrete pile wall - sheet pile
(iii)	Side ditch	
(iv)	Road pavement	
(v)	Bridge improvement	
(vi)	Reconstruction of river crossing pipe	
(vii)	Parapet	
(viii)	Culvert	
(ix)	Pump station	

Direct construction cost is estimated for the above construction works. while, land acquisition and compensation costs are estimated for urbanized and green areas, respectively.

Then, the project cost for each proposed project is estimated. The total project costs for the proposed and on-going projects amount to Rp.133,661 million and Rp.543,038 million respectively. Work volumes and project cost for each proposed project and summarized project cost are shown in Table G.11 to Table G.13. Also, each and summarized project costs for the on-going projects are shown in Table G.14 and Table G.15.

These project costs are allocated to each drainage zone with some miscellaneous cost for the purpose of the prioritization study for urban drainage development. The project cost of each drainage zone in the proposed and on-going projects are shown in Table G.16 and Table G.17, and are summarized below.

(Unit : Million Rp.)

Zone No.	On-going Project	Proposed Project	Total
1	1,842	59,564	61,406
2	84,591	9,740	94,331
3	5,187	14,565	19,752
4	165,891	0	165,891
5	0	828	828
6	285,526	48,964	334,490
Total	543,036	133,661	676,697

5. Effect of Land Subsidence

Elevation of some bench marks located the coastal area of Central Jakarta was surveyed by JFCP in 1977, 1981 and 1988. Location of the surveyed bench marks are shown in Fig. 22. The survey results are shown in the Table given below.

It is evident from this Table that some land subsidence has occurred in the coastal area of Central Jakarta in recent years. This land subsidence may further aggravate the drainage conditions of the Study Area in future.

A series of detailed levelling survey of the existing bench marks shall be carried out over the Study Area to confirm the extent and progressive rate of the land subsidence.

Land subsidence in urban areas is caused by excessive pumping of groundwater. Groundwater recharge in combination with regulation of groundwater withdrawal is widely used as control measure of land subsidence.

Artificial infiltration of storm water is an effective means for both flood run-off control and groundwater recharge. Therefore, it is recommended to investigate on-site flood control method by means of artificial infiltration of storm water.

Levelling Survey of Bench Mark

	Elevation (m, P.P.)				Difference (m)	
Point of B.M	1977 by NEDECO	1981 by MURSIN	1988 by INDEMCO	1988 by NIKKEN	1977 -1981	1977 -1981
NWP.6	4.305	4.201	-	3.998	0.203	0.307
NWP.7	4.292	4.185	-	3.987	0.198	0.305
NWP.9	-	2.229	-	1.952	0.277	-
NWP.13	2.747	2.382	2.094	2.083	0.299	0.664
NWP.17	2.179	_	1.433	-	-	0.746
NWP.19	5.155	4.783	4.263	-	0.520	0.892
PB.384	2.130	1.877	1.536	-	0.341	0.594

Note : Reference Point : NWP.60 : 41.161 m P.P.

Source : Jakarta Flood Control Office

Table G.1 (1) Hydraulic Characteristics of the Channel Sections of Group III

River No.	River Name		Basin Area (km2)	River Length (km)	River Gradient	Runoff Coefficient
1-1	Kamal	(1)	7.1	2.3	1 : 1,600	0.397
	- do -	(2)	10.8	3.3	1 : 3,000	0.397
	- do -	(3)	16.4	7.4	1 : 3,000	0.397
1-2	Tanjungan		7.8	3.2	1 : 3,000	0.380
2-1	Kali Gede/Bor	(1)	3.3	3.4	1 : 2,000	0.500
	- do -	(2)	5.6	4.8	1 : 2,000	0.500
2-2	Saluran Cengkareng	(1)	1.4	1.7	1 : 2,000	0.500
	- do -	(2)	3.3	4.5	1 : 2,000	0.500
2-3	Padongkelan		5.2	1.1	1 : 2,000	0.500
3	Semanan		0.7	1.2	1 : 2,000	0.503
4	Kreo		7.8	4.8	1 : 1,920	0.504
5	Ulujami	(1)	1.0	1.0	1 : 830	0.510
	- do -	(2)	6.0	6.2	1 : 1,040	0.510
	- do -	(3)	8.4	8.7	1 : 830	0.510
6	Sepak		17.8	10.9	1 : 850	0.508
7	Pesanggrahan bawah		2.4	2.0	1 : 1,110	0.502
8	Kedaung		0.4	1.0	1 : 2,080	0.533
9	Kedaung		0.3	0.6	1 : 2,080	0.533
10	Kedaung		2.1	2.2	1 : 2,080	0.533
11	Mookervart		0.4	1.5	1 : 5,000	0.477
12	Mookervart		2.7	2.9	1 : 5,000	0.505
13	Kedoya		1.6	2.0	1 : 1,250	0.535
14	Cilawe	(1)	1.4	1.5	1 : 2,700	0.532
	- do -	(2)	2.2	2.3	1 : 200	0.532
15	Ciragil		6.4	3.1	1 : 420	0.494
16	Krukut		2.1	1.6	1 : 110	0.447
17	Mampang	(1)	1.5	1.9	1 : 380	0.445
	- do -	(2)	2.7	3.4	1 : 250	0.445
18	Mampang		2.5	1.4	1 : 280	0.444
19	Mampang	(1)	9.7	4.0	1 : 610	0.472
	- do -	(2)	13.4	5.5	1 : 300	0.472
	- do -	(3)	19.9	8.2	1 : 540	0.472
	- do -	(4)	25.5	10.5	1 : 810	0.472
20	Cideng Atas	(1)	1.7	1.3	1 : 350	0.536
	- do -	(2)	5.1	3.8	1 : 560	0.536
21	Warung		0.8	1.1	1 : 440	0.535
22	Cideng		8.1	5.8	1 : 580	0.532
23	K.Baru Barat/PS.Minggu	(1)	0.5	3.9	1 : 120	0.502
	- do -	(2)	0.7	5.4	1 : 150	0.502
	- do -	(3)	1.0	8.4	1 : 430	0.502
	- do -	(4)	1.4	11.7	1 : 660	0.502
	- do -	(5)	2.1	17.2	1 : 330	0.502
	- do -	(6)	2.4	19.6	1 : 270	0.502
24	Ciliwung		0.7	1.7	1 : 190	0.490
25	Rawa Bilai		1.2	2.5	1 : 380	0.544
26	K. Bata Timur	(1)	2.5	1.5	1 : 320	0.520
	- do -	(2)	5.2	3.1	1 : 550	0.520
27	K. Bata		7.0	3.8	1 : 550	0.526
28	K. Bata		0.3	1.0	1 : 550	0.446
29	Bali Matraman		7.8	5.3	1 : 380	0.536
30	Goseng		2.8	1.2	1 : 480	0.439
31	Cijantang		4.3	2.7	1 : 200	0.441
32	Ciliwung		7.5	3.6	1 : 180	0.417
33	K.Baru Timur	(1)	0.2	1.7	1 : 240	0.481
	- do -	(2)	0.4	3.2	1 : 330	0.481
	- do -	(3)	0.7	6.2	1 : 260	0.481
	- do -	(4)	1.0	8.2	1 : 400	0.481
	- do -	(5)	1.5	12.7	1 : 950	0.481

Table G.1 (2) Hydraulic Characteristics of the Channel Sections of Group III

River No.	River Name	Basin Area (km2)	River Length (km)	River Gradient	Runoff Coefficient
34	Sentiong	1.4	4.0	1 : 530	0.467
35	Kali Baru Timur (1)	6.4	17.0	1 : 860	0.511
	- do - (2)	7.9	18.9	1 : 1,530	0.517
36	Cipinang	1.9	1.2	1 : 240	0.539
37	Cipinang	1.3	2.0	1 : 300	0.526
38	Cipinang	4.5	3.5	1 : 250	0.522
39	Cipinang	2.2	1.7	1 : 240	0.388
40	Sunter	1.5	3.0	1 : 240	0.462
41	Sunter	6.4	3.4	1 : 200	0.459
42	Sunter (1)	9.0	5.4	1 : 320	0.455
	- do - (2)	9.9	7.2	1 : 200	0.451
43	Sunter	5.3	3.6	1 : 360	0.425
44	Salemba (1)	10.9	22.6	1 : 740	0.524
	- do - (2)	13.0	25.2	1 : 1,620	0.527
45	Kali Baru Senen	1.2	1.9	1 : 2,380	0.534
46	Mati	1.0	1.4	1 : 1,860	0.555
47	Lagoa	4.4	2.8	1 : 5,000	0.506
48	Koja	1.2	1.1	1 : 5,000	0.543
49	Kebon Bawang	1.8	2.0	1 : 5,000	0.587
50	Lagoat Timur	3.3	2.6	1 : 5,000	0.571
51	Lagoa	1.2	1.6	1 : 5,000	0.587
52	Lagoat Timur	4.9	3.3	1 : 5,000	0.571
53	Bambu	0.3	1.2	1 : 3,700	0.585
54	Lagoat Tenggiri	7.8	5.3	1 : 5,000	0.561
55	Utan Kayu (1)	2.7	2.0	1 : 650	0.528
	- do - (2)	8.2	6.0	1 : 4,000	0.528
56	Rawa Badak	1.4	1.5	1 : 1,300	0.538
57	Utan Kayu	9.8	6.9	1 : 630	0.529
58	Cipinang	0.7	1.5	1 : 600	0.531
59	Rawamangun	1.6	3.2	1 : 1,040	0.541
60	Kayu Putih Utara	1.9	1.8	1 : 1,200	0.535
61	Pulo Nangka	1.5	2.8	1 : 1,870	0.551
62	Kayu Putih Selatan	2.0	3.5	1 : 1,170	0.543
63	Pula Mas Barat	1.1	4.1	1 : 1,110	0.528
64	Pulo Gadung	5.5	4.5	1 : 2,250	0.526
65	Rawa Gate	0.3	0.5	1 : 5,000	0.503
66	Pulo Gadung	6.5	6.1	1 : 5,000	0.522
67	Sukapura	0.3	0.8	1 : 5,000	0.489
68	Tugu Batu	7.3	6.8	1 : 5,000	0.501
69	Rawa Gatel	1.2	0.9	1 : 5,000	0.518
70	Kelapa Gadiung	2.1	2.0	1 : 5,000	0.523
71	Kelapa Nias	3.6	3.0	1 : 5,000	0.521
72	Tugu Batu	12.2	8.7	1 : 5,000	0.495
73	Rawa Badak	2.2	1.4	1 : 5,000	0.513
74	Rawa Badak	2.0	1.2	1 : 5,000	0.513
75	Pelumpang	5.7	2.2	1 : 2,000	0.512
76	Cakung Lama (1)	5.1	5.2	1 : 1,890	0.522
	- do - (2)	11.7	7.9	1 : 5,000	0.522
77	Pandang	0.2	0.6	1 : 5,000	0.522
78	Cakung	3.8	5.2	1 : 5,000	0.516
79	Jati Bening	4.0	6.6	1 : 5,000	0.516
80	Jati Bening	0.9	1.1	1 : 5,000	0.514
81	Sal. Bekasi tengah	3.5	5.8	1 : 5,000	0.507

Table G.2 Design Flood Discharge of Group I

River No.	River Name	Basin Area (km2)	River Length (km)	Design Frequency (Year)	Design Discharge (m3/s)	Specific Discharge (m3/s/km2)
a	Sepak	5.1	3.0	25	95	18.6
b	Secretaris	13.1	2.0	25	50	3.8
c	Grogol	-	4.0	25	35	-
d	Grogol	15.1	10.1	25	80	5.3
e	Grogol-Secretaris	15.6	1.0	25	80	5.1
f	Grogol-Secretaris	20.0	1.9	25	130	6.5
g	Lower Angke	35.2	2.0	25	140	4.0
h	Lower Angke	40.5	2.5	25	140	3.5
i	Grogol	7.3	5.9	25	30	4.1
j	Grogol	7.4	6.8	25	40	5.4
k	Gresik	-	-	25	20	-
l	Cideng	-	1.8	25	25	-
m	Cideng	-	1.5	25	49	-
n	Sianter	-	0.5	25	43	-
o	Duri	2.1	5.6	25	30	14.3
p	Krukut	3.5	3.5	25	40	11.3
q	Jelakang	-	0.8	25	55	-
r	Ciliwung	-	8.5	25	75	-
s	Ciliwung	-	2.5	25	75	-
t	Ciliwung	-	1.2	25	75	-
u	Ciliwung	-	2.0	25	75	-
v	Ciliwung Kota	0.7	1.4	25	10	15.4
w	Taman Sari	1.2	2.0	25	15	12.2
x	Ciliwung Kota	-	0.3	25	25	-
y	Beton	2.0	2.3	25	20	10.1
z	Ciliwung Kota	4.2	0.6	25	45	10.8
aa	Ciliwung Kota	5.8	1.0	25	75	12.9
ab	Pakin	6.5	0.5	25	75	11.6
ac	Opak	18.8	0.5	25	130	6.9
ad	Pademagan Barat	8.7	1.3	25	15	1.7
ae	Pademagan Barat	8.7	1.9	25	35	4.0
af	Pademangan Timur	8.7	3.2	25	5	0.6
ag	Cipinang	3.0	2.2	25	20	6.7
ah	Cipinang	1.6	1.5	25	30	18.8
ai	Sunter	4.6	2.4	25	20	4.3
aj	Sunter	11.9	1.4	25	50	4.2
ak	Sunter	-	4.0	25	80	-
al	Sunter	17.1	2.4	25	85	5.0
am	Sunter	-	0.6	25	90	-
an	Sunter	32.0	3.1	25	120	3.8
ao	Sunter	47.7	1.5	25	140	2.9
ap	Sunter	53.7	2.6	25	160	3.0
aq	Buarang	8.3	5.0	25	50	6.0
ar	Cakung	11.9	6.1	25	60	5.0
as	Petukangan	-	-	25	60	-
at	Cakung	34.3	-	25	130	3.8
au	Cakung	50.1	3.9	25	150	3.0
av	Marunda	9.2	6.4	25	65	7.1
aw	Cakung	71.5	5.9	25	180	2.5
ax	Cakung	-	-	25	200	-

Table G.3 Design Flood Discharge of Group II

River No.	River Name	Basin Area (km2)	River Length (km)	Design Frequency (Year)	Design Discharge (m3/s)	Specific Discharge (m3/s/km2)
A	Kali Sekretaris (1)	-	2.0	25	10	-
	- do - (2)	-	4.5	25	35	-
	- do - (3)	13.1	1.9	25	40	3.1
B	Jatipulo Tomang	-	2.1	25	4	-
	Kyai Tapa	5.8	1.7	25	13	2.2
C	Angke	-	1.3	25	12	-
D	Gresik Surabaya	1.7	4.3	25	25	15.0
E	Cideng	0.7	1.4	25	10	15.4
F	Krukut	1.0	2.0	25	15	14.7
G	Cideng	-	1.4	25	10	-
H	Cideng	-	3.3	25	50	-
I	Jelangkeng	-	0.5	25	45	-
J	Cibubur	0.1	1.2	25	10	83.3
K	Angke	1.1	1.5	25	3	2.8
L	Angke	1.2	0.2	25	10	8.3
M	Jelangkeng	-	0.7	25	45	-
N	Jenbatan Dua	0.2	0.6	25	3	15.0
O	Bandengan	0.9	1.5	25	5	5.7
P	Pluit	2.0	1.5	25	20	10.2
Q	Cideng	-	1.8	25	20	-
R	Ciliwung	-	4.3	25	10	-
S	Muara Karang	14.7	4.0	25	55	3.7
T	Sentiong	17.5	1.5	25	45	2.6
U	K. Item	-	2.5	25	20	-
V	Sentiong	-	1.7	25	60	-
W	Sunter C	-	3.9	25	20	-
X	Sentiong	-	2.0	25	65	-

Table G.4 (1) Design Flood Discharge of Group III

River No.	River Name		Basin Area (km2)	Design Q Frequency (Year)	Rainfall Intensity (mm/hour)	Design Discharge (m3/sec)	Specific Discharge (m3/s/km2)
1-1	Kamal	(1)	7.1	10	34	30	4.2
	- do -	(2)	10.8	10	29	35	3.2
	- do -	(3)	16.4	10	23	45	2.7
1-2	Tanjungan		7.8	10	34	30	3.9
2-1	Kali Gede/Bor	(1)	3.3	10	45	25	7.5
	- do -	(2)	5.6	10	34	30	5.3
2-2	Saluran Cengkareng	(1)	1.4	10	65	15	10.8
	- do -	(2)	3.3	10	39	20	6.0
2-3	Padongkelan		5.2	10	30	25	4.9
3	Semanan		0.7	2	59	5	7.1
4	Kreo		7.8	10	33	35	4.5
5	Ulujami	(1)	1.0	10	83	15	15.5
	- do -	(2)	6.0	10	31	25	4.2
	- do -	(3)	8.4	10	38	45	5.4
6	Sepak		17.8	10	31	70	3.9
7	Pasanggrahan bawah		2.4	5	48	20	8.3
8	Kedaung		0.4	2	68	5	12.5
9	Kedaung		0.3	2	76	5	16.7
10	Kedaung		2.1	5	49	15	7.1
11	Mookervart		0.4	2	61	5	12.5
12	Mookervart		2.7	5	43	20	7.4
13	Kedoya		1.6	5	53	15	9.4
14	Cilawe	(1)	1.4	5	57	15	10.5
	- do -	(2)	2.2	5	63	20	9.1
15	Ciragil		6.4	10	54	45	7.0
16	Krukut		2.1	5	68	20	9.5
17	Mampang	(1)	1.5	5	77	15	9.9
	- do -	(2)	2.7	5	66	25	9.3
18	Mampang		2.5	5	57	20	8.0
19	Mampang	(1)	9.7	10	42	55	5.7
	- do -	(2)	13.4	10	44	70	5.2
	- do -	(3)	19.9	10	32	75	3.8
	- do -	(4)	25.5	10	28	85	3.3
20	Cideng Atas	(1)	1.7	10	75	20	11.5
	- do -	(2)	5.1	10	61	45	8.8
21	Warung		0.8	2	74	5	6.3
22	Cideng		8.1	10	45	55	6.8
23	K.Baru Barat/PS.Minggu	(1)	0.5	5	92	10	21.0
	- do -	(2)	0.7	5	80	10	15.1
	- do -	(3)	1.0	5	64	10	9.7
	- do -	(4)	1.4	5	43	10	7.0
	- do -	(5)	2.1	5	30	10	4.7
	- do -	(6)	2.4	5	28	10	4.2
24	Ciliwung		0.7	2	86	5	7.1
25	Rawa Bilai		1.2	5	82	15	12.5
26	K. Bata Timur	(1)	2.5	10	66	25	9.9
	- do -	(2)	5.2	10	59	45	8.7
27	K. Bata		7.0	10	54	55	7.9
28	K. Bata		0.3	2	88	5	16.7
29	Bali Matraman		7.8	10	54	60	7.7
30	Goseng		2.8	5	50	20	7.1
31	Cijantang		4.3	5	55	30	7.0
32	Ciliwung		7.5	10	55	45	6.0
33	K.Baru Timur	(1)	0.2	5	109	5	25.0
	- do -	(2)	0.4	5	89	5	13.3
	- do -	(3)	0.7	5	65	10	13.7
	- do -	(4)	1.0	5	55	10	10.4
	- do -	(5)	1.5	5	41	10	6.7

Table G.4 (2) Design Flood Discharge of Group III

River No.	River Name		Basin Area (km2)	Design Q Frequency (Year)	Rainfall Intensity (mm/hour)	Design Discharge (m3/sec)	Specific Discharge (m3/s/km2)
34	Sentiong		1.4	5	61	15	10.7
35	Kali Baru Timur	(1)	6.4	10	36	35	5.5
	- do -	(2)	7.9	10	33	40	5.1
36	Cipinang		1.9	5	62	20	10.5
37	Cipinang		1.3	5	81	15	11.5
38	Cipinang		4.5	5	56	40	8.9
39	Cipinang		2.2	5	65	15	6.8
40	Sunter		1.5	5	77	15	10.0
41	Sunter		6.4	10	55	45	7.0
42	Sunter	(1)	9.0	10	51	55	6.1
	- do -	(2)	9.9	10	49	60	6.1
43	Sunter		5.3	10	60	40	7.5
44	Salemba	(1)	10.9	25	25	40	3.7
	- do -	(2)	13.0	25	23	45	3.5
45	Kali Baru Senen		1.2	10	65	15	12.5
46	Mati		1.0	10	71	15	15.0
47	Lagoa		4.4	10	44	30	6.8
48	Koja		1.2	10	68	15	12.5
49	Kebon Bawang		1.8	10	59	20	11.1
50	Lagoat Timur		3.3	10	48	25	7.6
51	Lagoa		1.2	10	67	15	12.5
52	Lagoat Timur		4.9	10	42	35	7.1
53	Bambu		0.3	10	89	5	16.7
54	Lagoat Tenggiri		7.8	10	32	40	5.1
55	Utan Kayu	(1)	2.7	25	72	30	11.0
	- do -	(2)	8.2	25	35	40	4.9
56	Rawa Badak		1.4	10	65	15	10.7
57	Utan Kayu		9.8	25	32	45	4.6
58	Cipinang		0.7	5	85	10	14.3
59	Rawamangun		1.6	10	52	15	9.4
60	Kayu Putih Utara		1.9	10	59	20	10.5
61	Pulo Nangka		1.5	10	55	15	10.0
62	Kayu Putih Selatan		2.0	10	48	15	7.5
63	Pula Mas Barat		1.1	10	47	10	9.1
64	Pulo Gadung		5.5	25	42	35	6.4
65	Rawa Gate		0.3	5	88	5	16.7
66	Pulo Gadung		6.5	25	36	35	5.4
67	Sukapura		0.3	5	87	5	16.7
68	Tugu Batu		7.3	25	34	35	4.8
69	Rawa Gatel		1.2	10	67	15	12.5
70	Kelapa Gadiung		2.1	10	57	20	9.5
71	Kelapa Nias		3.6	10	46	25	6.9
72	Tugu Batu		12.2	25	28	45	3.7
73	Rawa Badak		2.2	10	56	20	9.1
74	Rawa Badak		2.0	10	57	20	10.0
75	Pelumpang		5.7	10	39	30	5.3
76	Cakung Lama	(1)	5.1	25	40	30	5.9
	- do -	(2)	11.7	25	30	50	4.3
77	Pandang		0.2	5	96	5	25.0
78	Cakung		3.8	10	36	20	5.3
79	Jati Bening		4.0	10	31	20	5.0
80	Jati Bening		0.9	5	66	10	11.1
81	Sal.Bekasi tengah		3.5	10	34	20	5.7

Table G.5 Shortage of River Capacity of Group II

River No.	River Name	River Length (km)	River Capacity (m3/s)	Design Discharge (m3/s)	Shortage of Capacity (%)
A	Kali Sekretaris (1)	2.0	24	10	0
	- do - (2)	4.5	4	35	88
	- do - (3)	1.9	12	40	70
B	Jatipulo Tomang	2.1	5	4	0
	Kyai Tapa	1.7	14	13	0
C	Angke	1.3	61	12	0
D	Gresik Surabaya	4.3	35	25	0
E	Cideng	1.4	47	10	0
F	Krukut	2.0	94	15	0
G	Cideng	1.4	52	10	0
H	Cideng	3.3	71	50	0
I	Jelangkeng	0.5	51	45	0
J	Cibubur	1.2	15	10	0
K	Angke	1.5	23	3	0
L	Angke	0.2	10	10	0
M	Jelangkeng	0.7	90	45	0
N	Jenbatan Dua	0.6	17	3	0
O	Bandengan	1.5	16	5	0
P	Pluit	1.5	22	20	0
Q	Cideng	1.8	24	20	0
R	Ciliwung	4.3	45	10	0
S	Muara Karang	4.0	82	55	0
T	Sentiong	1.5	107	45	0
U	K. Item	2.5	12	20	42
V	Sentiong	1.7	48	60	20
W	Sunter C	3.9	21	20	0
X	Sentiong	2.0	41	65	38

Table G.6 (1) Shortage of River Capacity of Group III

River No.	River Name		River Length (km)	River Capacity (m3/s)	Design Discharge (m3/s)	Shortage of Capacity (%)
1-1	Kamal	(1)	2.3	3	30	90
	- do -	(2)	1.0	9	35	74
	- do -	(3)	4.1	20	45	56
1-2	Tanjungan		3.2	4	30	87
2-1	Kali Gede/Bor	(1)	3.4	2	25	92
	- do -	(2)	1.3	3	30	90
2-2	Saluran Cengkareng	(1)	1.7	3	15	80
	- do -	(2)	2.9	7	20	65
2-3	Padongkelan		1.1	2	25	92
3	Semanan		1.2	4	5	18
4	Kreo		4.8	30	35	15
5	Ulujami	(1)	1.0	22	15	0
	- do -	(2)	5.2	27	25	0
	- do -	(3)	2.5	51	45	0
6	Sepak		2.2	49	70	30
7	Pesanggrahan bawah		2.0	2	20	91
8	Kedaung		1.0	9	5	0
9	Kedaung		0.6	46	5	0
10	Kedaung		1.2	9	15	41
11	Mookervart		1.5	147	5	0
12	Mookervart		0.7	147	20	0
13	Kedoya		2.0	47	15	0
14	Cilawe	(1)	1.5	32	15	0
	- do -	(2)	0.8	16	20	20
15	Ciragil		3.1	46	45	0
16	Krukut		1.6	21	20	0
17	Mampang	(1)	1.9	53	15	0
	- do -	(2)	1.5	26	25	0
18	Mampang		1.4	23	20	0
19	Mampang	(1)	4.0	88	55	0
	- do -	(2)	1.5	43	70	39
	- do -	(3)	2.7	66	75	12
	- do -	(4)	2.3	80	85	5
20	Cideng Atas	(1)	1.3	14	20	30
	- do -	(2)	2.5	21	45	53
21	Warung		1.1	16	5	0
22	Cideng		2.0	78	55	0
23	K. Baru Barat/PS.Minggu	(1)	3.9	10	10	0
	- do -	(2)	1.5	10	10	0
	- do -	(3)	3.0	75	10	0
	- do -	(4)	3.3	55	10	0
	- do -	(5)	5.5	58	10	0
	- do -	(6)	2.4	58	10	0
24	Ciliwung		1.7	18	5	0
25	Rawa Bilai		2.5	28	15	0
26	K. Bata Timur	(1)	1.5	28	25	0
	- do -	(2)	1.6	71	45	0
27	K. Bata		0.7	40	55	28
28	K. Bata		1.0	100	5	0
29	Bali Matraman		1.5	74	60	0
30	Goseng		1.2	84	20	0
31	Cijantang		2.7	40	30	0
32	Ciliwung		0.9	67	45	0
33	K.Baru Timur	(1)	1.7	10	5	0
	- do -	(2)	1.5	9	5	0
	- do -	(3)	3.0	14	10	0
	- do -	(4)	2.0	63	10	0
	- do -	(5)	4.5	36	10	0

Table G.6 (2) Shortage of River Capacity of Group III

River No.	River Name		River Length (km)	River Capacity (m3/s)	Design Discharge (m3/s)	Shortage of Capacity (%)
34	Sentiong		4.0	3	15	83
35	Kali Baru Timur	(1)	4.3	41	35	0
	- do -	(2)	1.9	79	40	0
36	Cipinang		1.2	21	20	0
37	Cipinang		2.0	21	15	0
38	Cipinang		1.5	70	40	0
39	Cipinang		1.7	41	15	0
40	Sunter		3.0	132	15	0
41	Sunter		3.4	212	45	0
42	Sunter	(1)	2.0	101	55	0
	- do -	(2)	1.8	96	60	0
43	Sunter		3.6	41	40	0
44	Salemba	(1)	3.7	124	40	0
	- do -	(2)	2.6	132	45	0
45	Kali Baru Senen		1.9	18	15	0
46	Mati		1.4	17	15	0
47	Lagoa		2.8	32	30	0
48	Koja		1.1	20	15	0
49	Kebon Bawang		2.0	9	20	56
50	Lagoa Tenggiri		0.6	20	25	18
51	Lagoa		1.6	156	15	0
52	Lagoa Tenggiri		0.7	21	35	40
53	Bambu		1.2	5	5	0
54	Lagoa Tenggiri		2.0	13	40	68
55	Utan Kayu	(1)	2.0	94	30	0
	- do -	(2)	4.0	48	40	0
56	Rawa Badak		1.5	15	15	0
57	Utan Kayu		0.9	171	45	0
58	Cipinang		1.5	8	10	23
59	Rawamangun		3.2	21	15	0
60	Kayu Putih Utara		1.8	61	20	0
61	Pulo Nangka		2.8	26	15	0
62	Kayu Putih Selatan		3.5	27	15	0
63	Pula Mas Barat		4.1	10	10	0
64	Pulo Gadung		4.5	56	35	0
65	Rawa Gate		0.5	63	5	0
66	Pulo Gadung		1.6	63	35	0
67	Sukapura		0.8	32	5	0
68	Tugu Batu		0.7	63	35	0
69	Rawa Gatel		0.9	63	15	0
70	Kelapa Gadiung		2.0	63	20	0
71	Kelapa Nias		1.0	63	25	0
72	Tugu Batu		1.9	12	45	73
73	Rawa Badak		1.4	11	20	46
74	Rawa Badak		1.2	11	20	43
75	Pelumpang		0.8	9	30	70
76	Cakung Lama	(1)	5.2	6	30	79
	- do -	(2)	2.7	6	50	87
77	Pandang		0.6	10	5	0
78	Cakung		5.2	4	20	79
79	Jati Bening		1.4	11	20	46
80	Jati Bening		1.1	10	10	0
81	Sal.Bekasi tengah		5.8	27	20	0

Table G.7 (1) Shortage of Flow Capacity of Bridge

Bridge No.	River Name	Bridge Capacity (m3/s)	Design Discharge (m3/s)	Shortage of Capacity (%)	Result of Survey at Site
1	KAMAL	47	25	0	No Flood
2	KEMBANGAN	426	20	0	No Flood
3	KEMBANGAN	59	20	0	No Flood
4	SEPAK	173	70	0	No Flood
5	SEPAK	183	70	0	No Flood
6	SEPAK	197	70	0	No Flood
7	KREO	92	35	0	No Flood
8	KREO	105	35	0	No Flood
9	KREO	105	35	0	No Flood
10	KREO	103	35	0	No Flood
11	KREO	44	35	0	No Flood
12	DAAN MOGOT	15	15	0	No Flood
13	DAAN MOGOT	53	25	0	No Flood
14	DAAN MOGOT	59	45	0	No Flood
15	DAAN MOGOT	49	45	0	No Flood
16	SEKRETARIS	195	40	0	No Flood
17	SEKRETARIS	24	40	40	No Flood
18	SEKRETARIS	97	35	0	No Flood
19	SEKRETARIS	11	35	69	Flood
20	SEKRETARIS	20	35	43	Flood
21	SEKRETARIS	28	35	20	Flood
22	SEKRETARIS	25	35	29	No Flood
23	SEKRETARIS	32	35	9	No Flood
24	SEKRETARIS	22	35	37	Flood
25	SEKRETARIS	28	35	20	Flood
26	SEKRETARIS	29	35	17	Flood
27	SEKRETARIS	16	35	54	Flood
28	SEKRETARIS	14	35	60	No Flood
29	SEKRETARIS	20	35	43	Flood
30	SEKRETARIS	22	35	37	Flood
31	SEKRETARIS	11	10	0	No Flood
32	SEKRETARIS	10	10	0	No Flood
33	SEKRETARIS	93	10	0	No Flood
34	SEKRETARIS	362	10	0	No Flood
35	MUARAKARANG	113	55	0	No Flood
36	MUARAKARANG	92	55	0	No Flood
37	MUARAKARANG	47	55	15	No Flood
38	CILAWE	13	15	13	No Flood
39	CILAWE	51	20	0	No Flood
40	CILAWE	60	20	0	No Flood
41	CILAWE	58	20	0	No Flood
42	CILAWE	102	20	0	No Flood
43	PLUIT	87	20	0	No Flood
44	PLUIT	477	20	0	No Flood
45	ANGKE	17	12	0	No Flood
46	ANGKE	50	12	0	No Flood
47	CIDENG	82	15	0	No Flood
48	CIDENG	80	15	0	No Flood
49	CIDENG	78	15	0	No Flood
50	CIDENG	97	15	0	No Flood
51	CIDENG	22	15	0	No Flood
52	CIDENG	82	15	0	No Flood
53	CIDENG	54	15	0	No Flood
54	CIDENG	73	15	0	No Flood
55	CIDENG	80	15	0	No Flood
56	CIDENG	53	20	0	No Flood
57	CIDENG	116	20	0	No Flood
58	CIDENG	29	20	0	No Flood
59	CIDENG	37	20	0	No Flood
60	CIDENG	101	20	0	No Flood

Table G.7 (2) Shortage of Flow Capacity of Bridge

Bridge No.	River Name	Bridge Capacity (m3/s)	Design Discharge (m3/s)	Shortage of Capacity (%)	Result of Survey at Site
61	CIDENG	157	20	0	No Flood
62	CIDENG	93	20	0	No Flood
63	CIDENG	99	20	0	No Flood
64	CIDENG	89	20	0	No Flood
65	CILIWUNG	41	10	0	No Flood
66	CILIWUNG	71	10	0	No Flood
67	CILIWUNG GAJAHMADA	47	10	0	No Flood
68	CILIWUNG GAJAHMADA	31	10	0	No Flood
69	CILIWUNG GAJAHMADA	35	10	0	No Flood
70	KRUKUT	74	15	0	No Flood
71	KRUKUT	625	15	0	No Flood
72	CIRAGIL	58	45	0	No Flood
73	CIRAGIL	47	45	0	No Flood
74	CIRAGIL	45	45	0	No Flood
75	CIRAGIL	49	45	0	No Flood
76	CIRAGIL	44	45	2	No Flood
77	MAMPANG	79	85	7	No Flood
78	MAMPANG	49	75	35	Flood
79	MAMPANG	24	75	68	Flood
80	MAMPANG	73	75	3	Flood
81	MAMPANG	58	70	17	No Flood
82	MAMPANG	35	55	36	Flood
83	MAMPANG	19	25	24	No Flood
84	CIDENG	161	55	0	No Flood
85	CIDENG	190	55	0	No Flood
86	CIDENG	58	55	0	No Flood
87	CIDENG ATAS	17	45	62	No Flood
88	CIDENG ATAS	9	45	80	No Flood
89	KALIBARU BARAT/PS.MINGGU	29	10	0	No Flood
90	KALIBARU BARAT/PS.MINGGU	64	10	0	No Flood
91	KALIBARU BARAT/PS.MINGGU	41	10	0	No Flood
92	KALIBARU BARAT/PS.MINGGU	35	10	0	No Flood
93	KALIBARU BARAT/PS.MINGGU	18	10	0	No Flood
94	KALIBARU BARAT/PS.MINGGU	32	10	0	No Flood
95	KALIBARU BARAT/PS.MINGGU	21	10	0	No Flood
96	KALIBARU BARAT/PS.MINGGU	25	10	0	No Flood
97	KALIBARU BARAT/PS.MINGGU	66	10	0	No Flood
98	KALIBARU BARAT/PS.MINGGU	27	10	0	No Flood
99	KALIBARU BARAT/PS.MINGGU	66	10	0	No Flood
100	KALIBARU BARAT/PS.MINGGU	15	10	0	No Flood
101	KALIBARU BARAT/PS.MINGGU	22	10	0	No Flood
102	KALIBARU BARAT/PS.MINGGU	86	10	0	No Flood
103	KALIBARU BARAT/PS.MINGGU	47	10	0	No Flood
104	KALIBARU BARAT/PS.MINGGU	45	10	0	No Flood
105	KALIBARU BARAT/PS.MINGGU	34	10	0	No Flood
106	KALIBARU BARAT/PS.MINGGU	63	10	0	No Flood
107	KALIBARU BARAT/PS.MINGGU	95	10	0	No Flood
108	KALIBARU BARAT/PS.MINGGU	25	10	0	No Flood
109	KALIBARU BARAT/PS.MINGGU	31	10	0	No Flood
110	KALIBARU BARAT/PS.MINGGU	31	10	0	No Flood
111	KALIBARU BARAT/PS.MINGGU	44	10	0	No Flood
112	KALIBARU BARAT/PS.MINGGU	31	10	0	No Flood
113	KALIBATA TIMUR	23	25	8	No Flood
114	KALIBATA TIMUR	47	25	0	No Flood
115	KALIBATA TIMUR	35	25	0	No Flood
116	KALIBATA TIMUR	41	25	0	No Flood
117	KALIBATA TIMUR	41	25	0	No Flood
118	KALIBATA TIMUR	45	25	0	No Flood
119	KALIBATA TIMUR	55	25	0	No Flood
120	KALIBATA TIMUR	36	25	0	No Flood

Table G.7 (3) Shortage of Flow Capacity of Bridge

Bridge No.	River Name	Bridge Capacity (m3/s)	Design Discharge (m3/s)	Shortage of Capacity (%)	Result of Survey at Site
121	KALIBATA TIMUR	33	25	0	No Flood
122	KALIBATA TIMUR	30	25	0	No Flood
123	KALIBATA TIMUR	23	25	8	No Flood
124	CIJANTUNG	164	30	0	No Flood
125	GOSENG	58	20	0	No Flood
126	SALEMBA	21	65	68	No Flood
127	SALEMBA	106	45	0	Flood
128	SALEMBA	48	45	0	Flood
129	SALEMBA	11	40	73	Flood
130	SALEMBA	47	40	0	No Flood
131	SALEMBA	37	40	8	No Flood
132	SALEMBA	98	40	0	No Flood
133	SALEMBA	51	40	0	No Flood
134	SALEMBA	75	40	0	No Flood
135	SALEMBA	28	35	20	No Flood
136	SALEMBA	29	35	17	No Flood
137	SALEMBA	32	35	9	No Flood
138	SALEMBA	76	35	0	No Flood
139	SALEMBA	17	35	51	No Flood
140	SALEMBA	23	35	34	No Flood
141	SALEMBA	61	35	0	No Flood
142	SALEMBA	56	35	0	No Flood
143	SALEMBA	36	35	0	No Flood
144	SALEMBA	31	35	11	No Flood
145	KALIBARU TIMUR	47	35	0	No Flood
146	KALIBARU TIMUR	17	35	51	No Flood
147	KALIBARU TIMUR	34	35	3	No Flood
148	KALIBARU TIMUR	42	35	0	No Flood
149	KALIBARU TIMUR	31	35	11	No Flood
150	KALIBARU TIMUR	78	35	0	No Flood
151	KALIBARU TIMUR	26	35	26	No Flood
152	KALIBARU TIMUR	40	35	0	No Flood
153	KALIBARU TIMUR	47	35	0	No Flood
154	KALIBARU TIMUR	37	35	0	No Flood
155	KALIBARU TIMUR	43	35	0	No Flood
156	KALIBARU TIMUR	39	35	0	No Flood
157	KALIBARU TIMUR	34	35	3	No Flood
158	KALIBARU TIMUR	36	35	0	No Flood
159	KALI BARU	9	15	40	No Flood
160	KALIBARU TIMUR	5	15	67	No Flood
161	KALIBARU TIMUR	5	15	67	No Flood
162	CIPINANG	254	20	0	No Flood
163	CIPINANG	206	20	0	No Flood
164	CIPINANG	125	20	0	No Flood
165	CIPINANG	190	15	0	No Flood
166	CIPINANG	17	15	0	No Flood
167	CIPINANG	27	15	0	No Flood
168	RAWA KERBAU	19	15	0	No Flood
169	RAWA KERBAU	16	15	0	No Flood
170	RAWA KERBAU	22	15	0	No Flood
171	UTAN KAYU	150	30	0	No Flood
172	UTAN KAYU	78	30	0	No Flood
173	UTAN KAYU	34	30	0	No Flood
174	UTAN KAYU	23	30	23	No Flood
175	UTAN KAYU	31	30	0	No Flood
176	UTAN KAYU	34	30	0	No Flood
177	LAGOA	3	30	90	Flood
178	LAGOA	13	30	57	Flood
179	ITEM	20	20	0	No Flood
180	ITEM	20	20	0	No Flood

Table G.7 (4) Shortage of Flow Capacity of Bridge

Bridge No.	River Name	Bridge Capacity (m3/s)	Design Discharge (m3/s)	Shortage of Capacity (%)	Result of Survey at Site
181	KEBON BAWANG	43	20	0	Flood
182	KEBON BAWANG	27	20	0	Flood
183	KEBON BAWANG	10	20	50	Flood
184	KEBON BAWANG	8	20	60	Flood
185	KEBON BAWANG	6	20	70	Flood
186	KEBON BAWANG	6	20	70	Flood
187	KEBON BAWANG	6	20	70	Flood
188	KEBON BAWANG	7	20	65	Flood
189	KEBON BAWANG	6	20	70	Flood
190	KEBON BAWANG	5	20	75	Flood
191	KEBON BAWANG	5	20	75	Flood
192	KEBON BAWANG	5	20	75	Flood
193	KEBON BAWANG	5	20	75	Flood
194	KEBON BAWANG	5	20	75	Flood
195	RAWA BADAK	5	20	75	Flood
196	RAWA BADAK	5	20	75	Flood
197	ARTON IJOM	120	15	0	No Flood
198	ARTON IJOM	41	15	0	No Flood
199	LAWAMANGUN	47	15	0	No Flood
200	LAWAMANGUN	51	15	0	No Flood
201	LAWAMANGUN	7	15	53	No Flood
202	LAWAMANGUN	5	15	67	No Flood
203	LAWAMANGUN	44	25	0	No Flood
204	LAWAMANGUN	35	25	0	No Flood
205	KELAPA NIAS	24	25	4	No Flood
206	KELAPA NIAS	17	35	51	No Flood
207	KELAPA NIAS	12	35	66	No Flood
208	PULO GADUNG	12	35	66	No Flood
209	PULO GADUNG	9	35	74	No Flood
210	PULO GADUNG	8	35	77	No Flood
211	PULO GADUNG	5	15	67	No Flood
212	PULO GADUNG	8	15	47	No Flood
213	KAYU PUTIH SELATAN	23	15	0	No Flood
214	KAYU PUTIH SELATAN	23	15	0	No Flood
215	KAYU PUTIH SELATAN	28	15	0	No Flood
216	KAYU PUTIH SELATAN	81	15	0	No Flood
217	KAYU PUTIH UTARA	53	15	0	No Flood
218	KAYU PUTIH UTARA	56	15	0	No Flood
219	KAYU PUTIH UTARA	60	15	0	No Flood
220	KAYU PUTIH UTARA	6	15	60	No Flood
221	KAYU PUTIH UTARA	23	15	0	No Flood
222	CAKUNG	28	20	0	No Flood
223	CAKUNG	12	20	40	No Flood
224	CAKUNG	20	20	0	No Flood
225	CAKUNG	20	20	0	No Flood
226	CAKUNG LAMA	9	5	0	No Flood
227	CAKUNG LAMA	15	5	0	No Flood
228	MALANG	12	20	40	No Flood
229	MALANG	5	20	75	No Flood
230	MALANG	8	20	60	No Flood
231	MALANG	1	20	95	No Flood
232	MALANG	4	20	80	No Flood
233	MALANG	2	20	90	No Flood
234	MALANG	3	20	85	No Flood
235	MALANG	11	20	45	No Flood
236	SUNTER	35	40	13	No Flood
237	SUNTER	145	45	0	No Flood
238	PETUKANGAN	38	30	0	No Flood
239	SUNTER	94	15	0	No Flood

Table G.8 Existing and Future Population and Land Use Pattern

Drainage Zone No.		Population	Population Density (Capita/ha)	Residential Area (ha)	Commercial/ Institutianal (ha)	Industrial Area (ha)	Other Area (ha)	Total Area (ha)
1	in 1998	569,227	57	4,466	1,174	454	3,924	10,017
	in 2010	1,331,860	133	5,467	1,777	870	1,903	10,017
2	in 1998	1,651,215	150	7,372	2,010	523	1,118	11,023
	in 2010	2,531,337	230	7,481	2,304	401	838	11,023
3	in 1998	1,290,052	154	5,171	1,632	82	1,470	8,356
	in 2010	1,726,188	207	5,533	1,845	33	945	8,356
4	in 1998	1,441,595	281	3,152	1,298	314	360	5,125
	in 2010	1,657,589	323	2,743	1,768	372	242	5,125
5	in 1998	1,098,039	99	6,555	1,010	276	3,278	11,119
	in 2010	1,651,187	149	6,503	1,473	346	2,797	11,119
6	in 1998	2,735,889	140	11,190	2,168	961	5,191	19,510
	in 2010	3,901,839	200	10,504	2,075	4,362	2,569	19,510
Total	in 1998	8,786,016	135	37,906	9,292	2,610	15,340	65,149
	in 2010	12,800,000	196	38,232	11,241	6,383	9,293	65,149

Table G.9 Point Rainfall Masscurves

(Unit : mm)

Time (hr)	2 Year	5 Year	10 Year	20 Year	25 Year	30 Year	50 Year	100 Year
1	63.0	73.0	81.0	88.0	92.0	96.0	100.0	106.0
2	73.0	90.0	103.0	109.0	117.0	121.0	126.0	148.0
3	79.0	100.0	114.0	126.0	134.0	139.0	144.0	167.0
4	83.0	107.0	122.0	138.0	147.0	152.0	158.0	179.0
5	87.0	113.0	129.0	148.0	156.0	162.0	169.0	188.0
6	90.0	118.0	135.0	156.0	163.0	170.0	178.0	196.0
7	92.0	121.0	141.0	161.0	169.0	176.0	184.0	203.0
8	94.0	124.0	145.0	165.0	174.0	181.0	190.0	210.0
9	96.0	126.0	148.5	169.0	178.0	186.0	196.0	216.0
10	98.0	128.0	151.5	172.0	182.0	190.0	200.0	221.0
11	99.0	130.0	154.5	175.0	185.0	194.0	204.0	226.0
12	100.0	132.0	157.0	178.0	188.0	197.0	207.5	230.0
13	101.0	133.5	159.5	181.0	191.0	200.0	210.5	233.0
14	102.0	135.0	161.5	183.5	193.5	202.0	213.0	237.0
15	103.0	137.0	163.5	186.0	195.5	205.0	216.0	240.0
16	104.0	138.5	165.5	188.0	197.5	207.0	218.5	243.0
17	105.0	140.0	167.5	190.5	200.0	209.0	220.5	246.0
18	106.0	142.0	169.0	193.0	202.0	211.0	222.5	248.0
19	107.0	143.5	171.0	195.0	204.0	213.0	225.0	251.0
20	108.0	145.0	173.0	197.0	206.0	216.0	227.5	253.0
21	108.5	147.0	175.0	199.0	208.0	218.0	230.0	256.0
22	109.0	149.0	177.0	201.0	210.0	220.0	232.5	258.0
23	110.0	150.5	178.5	203.0	212.0	222.0	235.0	261.0
24	111.0	152.5	180.0	205.0	213.5	224.0	237.0	263.0
26	113.0	156.0	183.0	207.0	217.0	228.0	241.0	267.0
28	115.0	159.0	186.0	209.0	220.0	232.0	245.0	271.0
30	117.0	162.0	189.0	212.0	223.0	235.0	249.0	275.0
32	119.0	164.0	191.0	215.0	225.0	238.0	253.0	279.0
34	121.0	166.0	193.0	218.0	227.0	241.0	256.0	283.0
36	123.0	168.0	195.0	222.0	229.0	244.0	259.0	286.0
38	125.0	171.0	199.0	226.0	233.0	248.0	263.0	290.0
40	126.0	174.0	202.0	230.0	237.0	252.0	267.0	294.0
42	127.0	176.0	205.0	234.0	241.0	255.0	271.0	298.0
44	128.0	178.0	208.0	238.0	244.0	258.0	275.0	302.0
46	129.0	180.0	211.0	241.0	247.0	261.0	278.0	306.0
48	130.0	182.0	214.0	244.0	250.0	264.0	281.0	309.0

Table G.10 (1) Main Features of River Improvement

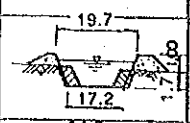
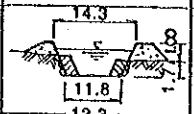
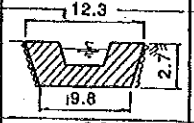
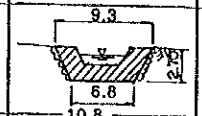
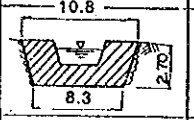
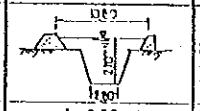
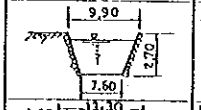
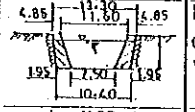
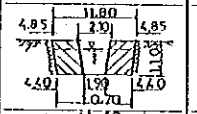
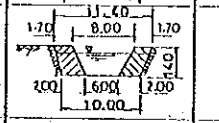
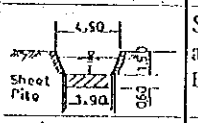
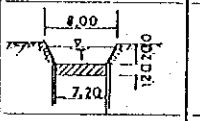
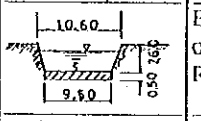
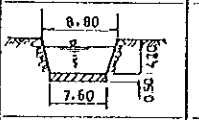
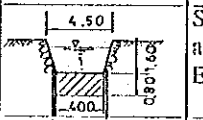
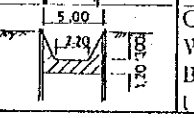
River No.	River Name	Design Discharge (m3/sec)	Improvement Section	Improvement Works	Improvement Length (km)
1 - (1)	Kanal	47		Excavation of Banks, and Embankement, and Wet Masonry	8.10
1 - (2)	Tanjungan	24		-do-	7.20
2 - (1)	Kali Gede Kali Bor	27		Excavation of Banks of Riverbed, and Wet Masonry	4.80
2 - (2)	Saluran Cengkareng	18		-do-	4.50
2 - (3)	Padongkelan	30		-do-	2.90
3	Semanan	10		Embankment and Parapet	0.50
4	Kreo	35		Wet Masonry	0.90
6	Sepak	70		Excavation of Banks, and Wet Masonry	0.60
7	Pesanggrahan bawah	20		- do -	1.10
10	Kedaung	10		- do -	1.20
14 - (2)	Cilawe	10		Sheet Pile, and Riverbed, Excavation	0.90
19 - (2)	Mampang	60		- do -	1.00
19 - (3)	Mampang	80		Excavation of Riverbed	2.70
19 - (4)	Mampang	90		- do -	2.30
20 - (1)	Cideng Atas	25		Sheet Pile, and Riverbed Excavation	1.50
20 - (2)	Cideng Atas	45		Concrete Pile Wall, and Banks Excavation	1.00

Table G.10 (2) Main Features of River Improvement

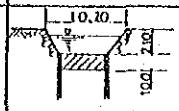
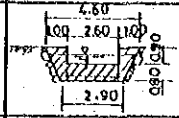
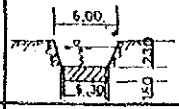
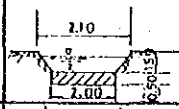
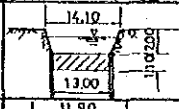
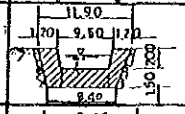
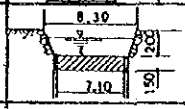
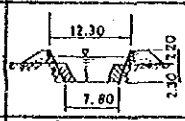
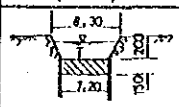
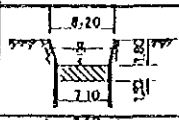
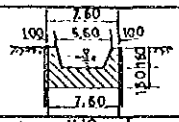
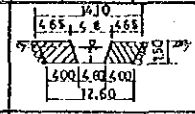
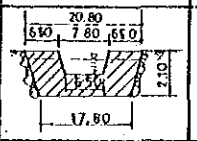
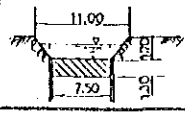
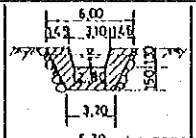
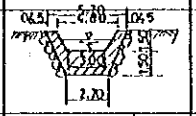
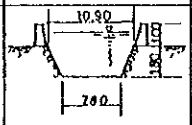
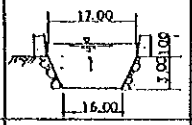
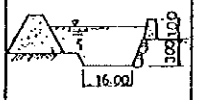
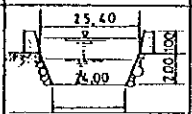
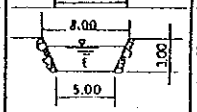
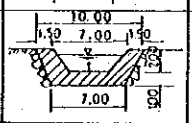
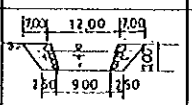
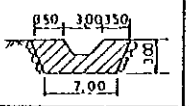
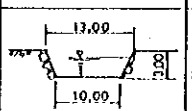
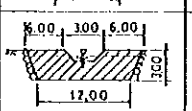
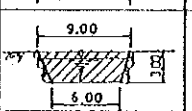
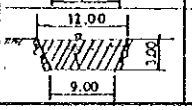
River No.	River Name	Design Discharge (m3/sec)	Improvement Section	Improvement Works	Improvement Length (km)
27	K. Bata	55		Sheet Pile, and Riverbed Excavation	0.40
34	Sentiong	15		Excavation of Banks and Riverbed, Wet Masonry	1.20
49	Kebon Bawang	15		Sheet Pile, and Riverbed Excavation	1.60
50	Lagoa Tenggiri	30		Riverbed Exacavation	0.60
52	Lagoa Tenggiri	35		Sheet Pile, and Riverbed Excavation	0.70
54	Lagoa Tenggiri	40		Excavation of Banks & Riverbed	1.80
58	Cipinang	5		Sheet Pile, and Riverbed Excavation	0.70
72	Tugu Batu	45		Excavation of Banks, and Embankment, and Wet Masonry	1.30
73	Rawa Badak	20		Sheet Pile, and Riverbed Excavation	2.00
74	Rawa Badak	20		- do -	1.00
75	Pelumpang	30		Concrete Pile Wall, and Banks & Riverbed Excavation	0.90
76 - (1)	Cakung Lama	40		Excavation of Banks, and Wet Masonry	5.20
76 - (2)	Cakung Lama	50		Excavation of Banks of River-bed, and Wet Masonry	1.90
78	Cakung	20		Excavation of Banks, and Wet Masonry	5.20
79	Jati Bening	20		Sheet Pile, and Riverbed Excavation	1.40

Table G.10 (3) Main Features of River Improvement

River No.	River Name	Design Discharge (m3/sec)	Improvement Section	Improvement Works	Improvement Length (km)
A - (2)	Sekretaris (1)	25		Excavation of Banks and Riverbed, and Wet Masonry	1.90
A - (3)	Sekretaris (2)	25		- do -	4.10
U	K. Item	20		Parapet	0.60
V - (1)	Sentiong	60		- do -	1.40
V - (2)	Sentiong	60		Parapet and Embankment	0.50
X	Sentiong	65		Parapet	0.50
N - I(1)	Lower Marunda	15		Excavation, and Wet Masonry	1.30
N - I(2)	- do -	25		Excavation of Banks & Riverbed, and Wet Masonry	0.90
N - I(3)	- do -	30		Embankment, and Wet Masonry	1.60
N - 2(1)	Upper Marunda	20		Excavation, and Wet Masonry	1.40
N - 2(2)	- do -	30		Excavation, and Wet Masonry	0.90
N - 2(3)	- do -	40		- do -	1.80
N - 3(1)	- do -	20		- do -	1.60
N - 3(2)	- do -	30		- do -	1.90

Total 87.50km

Table G.11 (1) Work Volume for Each Proposed Project

Item	Unit	1-1(1)	1-1(2)	1-1(3)	1-2	2-1(1)	2-1(2)	2-2(1)	2-2(2)	2-3	3	4	5	6	7	10	14(2)	19(2)	19(3)
I. Direct Construction																			
1. Earth Work																			
a. Excavation	m3	47,438	24,125	92,913	87,617	72,322	31,634	21,062	36,187	21,908	0	800	0	4,500	11,200	6,200	1,900	8,500	7,700
b. Embankment	m3	12,656	5,503	22,341	36,000	0	0	0	0	0	4100	0	0	0	0	0	0	0	0
2. Revetment Work																			
a. Wet Masonry	m2	21,511	9,353	37,971	29,460	32,079	12,439	15,432	26,935	9,820	1700	2,400	0	36,200	26,600	3,800	0	0	0
b. Concrete Pile Wall	m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
c. Sheet Pile	m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,100	2,400	0
3. Side Ditch	m	778	338	1,373	2,435	0	0	0	0	0	0	0	0	0	1,100	1,200	0	0	0
4. Road Pavement	m2	21,799	9,478	38,481	68,242	0	0	0	0	0	0	0	0	0	3,300	0	0	0	0
5. Bridge Improvement	m2	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	68
6. Reconstruction of River Crossings	m	0	0	100	110	0	0	150	0	0	0	0	0	0	0	120	0	0	15
7. Parapet	m	0	0	0	0	0	0	0	0	0	500	0	0	0	0	0	0	0	0
8. Culvert	m3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9. Pump Station																			
a. Newly Constructed	m3/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b. Capacity to be increased	m3/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II. Land Acquisition and Compensation																			
1. Land Acquisition																			
a. Green Area	m2	12,358	5,373	21,814	16,925	0	0	0	0	0	0	0	0	0	6,500	3,400	0	0	0
b. Housing Area	m2	0	0	0	0	67,436	26,149	32,440	56,623	20,644	5,700	0	0	1,200	0	0	0	0	0
2 Compensation																			
a. Green Area	m2	12,358	5,373	21,814	16,925	0	0	0	0	0	0	0	0	0	6,500	3,400	0	0	0
b. Housing Area	m2	0	0	0	0	67,436	26,149	32,440	56,623	20,644	5,700	0	0	1,200	0	0	0	0	0

Table G.11 (2) Work Volume for Each Proposed Project

Item	Unit	19(4)	20(1)	20(2)	27	34	49	50	52	54	58	72	73	74	75	76(1)	76(2)	78	79
I. Direct Construction																			
1. Earth Work																			
a. Excavation	m3	8,800	4,800	10,200	2,800	5,000	12,700	4,600	10,000	31,500	1,600	5,200	20,800	10,100	14,500	67,500	58,400	74,900	15,700
b. Embankment	m3	0	0	0	0	0	0	0	0	0	0	30,700	0	0	0	0	0	0	0
2. Revetment Work																			
a. Wet Masonry	m2	0	0	0	0	4,600	0	0	0	14,100	0	13,400	0	0	0	17,500	8,900	17,500	0
b. Concrete Pile Wall	m2	0	0	8,400	0	0	0	0	0	0	0	0	0	0	6,100	0	0	0	0
c. Sheet Pile	m2	0	2,400	0	800	0	4,800	0	1,500	0	800	0	5,900	2,800	0	0	0	0	3,900
3. Side Ditch	m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,200	1,900	5,200	0
4. Road Pavement	m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15,600	5,700	15,600	0
5. Bridge Improvement	m2	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	320	250	0
6. Reconstruction of River Crossings	m	5	0	0	0	0	0	0	0	170	0	130	0	0	55	560	310	610	0
7. Parapet	m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8. Culvert	m3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9. Pump Station																			
a. Newly Constructed	m3/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b. Capacity to be increased	m3/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II. Land Acquisition and Compensation																			
1. Land Acquisition																			
a. Green Area	m2	0	0	0	0	0	0	0	0	4,100	0	28,700	0	0	0	0	0	0	0
b. Housing Area	m2	0	0	0	0	2,900	0	0	0	0	0	0	0	0	2,000	29,900	28,900	31,200	0
2 Compensation																			
a. Green Area	m2	0	0	0	0	0	0	0	0	4,100	0	18,600	0	0	0	0	0	0	0
b. Housing Area	m2	0	0	0	0	2,900	0	0	0	0	0	0	0	0	2,000	29,900	28,900	31,200	0

Table G.11 (3) Work Volume for Each Proposed Project

Item	Unit	A(2)	A(3)	U	V(1)	V(2)	X	N-1(1)	N-1(2)	N-1(3)	N-2(1)	N-2(2)	N-2(3)	N-3(1)	N-3(2)	P-1	P-2
I. Direct Construction																	
1. Earth Work																	
a. Excavation	m3	17,200	27,700	0	0	0	0	25,400	14,000	0	33,000	31,100	69,300	31,200	59,900	0	0
b. Embankment	m3	0	0	0	0	5,700	0	0	0	45,600	0	0	0	0	0	0	0
2. Revetment Work																	
a. Wet Masonry	m2	11,900	27,500	0	0	0	0	8,700	6,000	10,700	9,400	6,000	12,100	10,700	12,700	0	0
b. Concrete Pile Wall	m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
c. Sheet Pile	m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Side Ditch	m	1,900	0	0	0	350	0	1,300	900	1,600	1,400	900	1,800	1,600	1,900	0	0
4. Road Pavement	m2	0	0	0	0	0	0	3,900	2,700	4,800	4,200	2,700	5,400	4,800	5,700	0	0
5. Bridge Improvement	m2	150	170	0	0	0	0	50	55	0	60	75	170	110	140	0	0
6. Reconstruction of River Crossings	m	15	30	0	0	0	0	0	80	0	120	90	235	135	0	0	0
7. Parapet	m	0	0	1,200	2,000	350	300	0	0	0	0	0	0	0	0	0	0
8. Culvert	m3	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9. Pump Station																	
a. Newly Constructed	m3/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	6.2
b. Capacity to be increased	m3/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II. Land Acquisition and Compensation																	
1. Land Acquisition																	
a. Green Area	m2	4,800	6,400	0	0	4,600	0	19,500	2,300	13,000	6,400	18,000	13,000	5,800	36,100	91,200	0
b. Housing Area	m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Compensation																	
a. Green Area	m2	4,800	6,400	0	0	4,600	0	19,500	2,300	13,000	6,400	18,000	13,000	5,800	36,100	91,200	0
b. Housing Area	m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table G.12 (1) Project Cost for Each Proposed Project

(Unit : Million Rp.)

Item	Unit Price		1-1(1)	1-1(2)	1-1(3)	1-2	2-1(1)	2-1(2)	2-2(1)	2-2(2)	2-3	3	4	5	6	7	10	14(2)	19(2)	19(3)
I. Direct Construction Cost																				
1. Earth Work			226	111	433	474	260	114	76	130	79	18	3	0	16	40	22	7	31	28
a. Excavation	3,600	Rp./m3	171	87	334	315	260	114	76	130	79	0	3	0	16	40	22	7	31	28
b. Embankment	4,400	Rp./m3	56	24	98	158	0	0	0	0	0	18	0	0	0	0	0	0	0	0
2. Revetment Work			1,594	693	2,814	2,183	2,377	922	1,143	1,996	728	126	178	0	2,682	1,971	282	52	114	0
a. Wet Masonry	74,100	Rp./m2	1,594	693	2,814	2,183	2,377	922	1,143	1,996	728	126	178	0	2,682	1,971	282	0	0	0
b. Concrete Pile Wall	675,000	Rp./m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
c. Sheet Pile	47,600	Rp./m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	114	0
3. Side Ditch	241,200	Rp./m	188	82	331	587	0	0	0	0	0	0	0	0	0	265	289	0	0	0
4. Road Pavement	15,400	Rp./m2	336	146	593	1,051	0	0	0	0	0	0	0	0	0	51	0	0	0	0
5. Bridge Improvement	881,800	Rp./m2	0	0	0	0	0	0	0	0	0	0	0	31	0	0	0	0	0	60
6. Reconstruction of River Crossin	595,300	Rp./m	0	0	60	65	0	0	89	0	0	0	0	0	0	0	71	0	0	9
7. Parapet	217,200	Rp./m	0	0	0	0	0	0	0	0	0	109	0	0	0	0	0	0	0	0
8. Culvert	649,400	Rp./m3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9. Pump Station			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
a. Newly Constructed	785,800,000	Rp./m3/s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b. Capacity to be increased	566,500,000	Rp./m3/s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total			2,344	1,032	4,230	4,361	2,637	1,036	1,309	2,126	807	253	181	31	2,699	2,328	665	59	145	97
II. Land Acquisition and Compensation Cost																				
1. Land Acquisition			79	34	140	108	5,220	2,024	2,511	4,383	1,598	441	0	0	93	42	22	0	0	0
a. Green Area	6,400	Rp./m2	79	34	140	108	0	0	0	0	0	0	0	0	0	42	22	0	0	0
b. Housing Area	77,400	Rp./m2	0	0	0	0	5,220	2,024	2,511	4,383	1,598	441	0	0	93	0	0	0	0	0
2. Compensation			9	4	15	12	3,486	1,352	1,677	2,927	1,067	295	0	0	62	5	2	0	0	0
a. Green Area	700	Rp./m2	9	4	15	12	0	0	0	0	0	0	0	0	0	5	2	0	0	0
b. Housing Area	51,700	Rp./m2	0	0	0	0	3,486	1,352	1,677	2,927	1,067	295	0	0	62	0	0	0	0	0
Sub-total			88	38	155	120	8,706	3,376	4,188	7,310	2,665	736	0	0	155	46	24	0	0	0
III. Engineering Service			164	72	296	305	185	73	92	149	57	18	13	2	189	163	47	4	10	7
IV. Government Administration			37	16	66	67	170	66	82	142	52	15	3	1	43	36	10	1	2	1
V. Physical Contingency			234	103	423	436	264	104	131	213	81	25	18	3	270	233	67	6	15	10
VI. Project Cost			2,867	1,261	5,170	5,289	11,962	4,654	5,802	9,939	3,661	1,046	214	37	3,355	2,805	812	70	172	115

Table G.12 (2) Project Cost for Each Proposed Project

(Unit : Million Rp.)

Item	Unit Price		19(4)	20(1)	20(2)	27	34	49	50	52	54	58	72	73	74	75	76(1)	76(2)	78
I. Direct Construction Cost																			
1. Earth Work			32	17	37	10	18	46	17	36	113	6	154	75	36	52	243	210	270
a. Excavation	3,600	Rp./m3	32	17	37	10	18	46	17	36	113	6	19	75	36	52	243	210	270
b. Embankment	4,400	Rp./m3	0	0	0	0	0	0	0	0	0	0	135	0	0	0	0	0	0
2. Revetment Work			0	114	5,670	38	341	229	0	71	1,045	38	993	281	133	4,118	1,297	660	1,297
a. Wet Masonry	74,100	Rp./m2	0	0	0	0	341	0	0	0	1,045	0	993	0	0	0	1,297	660	1,297
b. Concrete Pile Wall	675,000	Rp./m2	0	0	5,670	0	0	0	0	0	0	0	0	0	0	4,118	0	0	0
c. Sheet Pile	47,600	Rp./m2	0	114	0	38	0	229	0	71	0	38	0	281	133	0	0	0	0
3. Side Ditch	241,200	Rp./m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,254	458	1,254
4. Road Pavement	15,400	Rp./m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	240	88	240
5. Bridge Improvement	881,800	Rp./m2	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	282	221
6. Reconstruction of River Crossin	595,300	Rp./m	3	0	0	0	0	0	0	0	101	0	77	0	0	33	333	185	363
7. Parapet	217,200	Rp./m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8. Culvert	649,400	Rp./m3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9. Pump Station			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
a. Newly Constructed	785,800,000	Rp./m3/s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b. Capacity to be increased	566,500,000	Rp./m3/s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total			55	132	5,707	48	359	274	17	107	1,259	44	1,224	356	170	4,202	3,368	1,883	3,644
II. Land Acquisition and Compensation Cost																			
1. Land Acquisition			0	0	0	0	225	0	0	0	26	0	184	0	0	155	2,314	2,237	2,415
a. Green Area	6,400	Rp./m2	0	0	0	0	0	0	0	0	26	0	184	0	0	0	0	0	0
b. Housing Area	77,400	Rp./m2	0	0	0	0	225	0	0	0	0	0	0	0	0	155	2,314	2,237	2,415
2. Compensation			0	0	0	0	150	0	0	0	3	0	13	0	0	103	1,546	1,494	1,613
a. Green Area	700	Rp./m2	0	0	0	0	0	0	0	0	3	0	13	0	0	0	0	0	0
b. Housing Area	51,700	Rp./m2	0	0	0	0	150	0	0	0	0	0	0	0	0	103	1,546	1,494	1,613
Sub-total			0	0	0	0	375	0	0	0	29	0	197	0	0	258	3,860	3,731	4,028
III. Engineering Service			4	9	400	3	25	19	1	8	88	3	86	25	12	294	236	132	255
IV. Government Administration			1	2	86	1	11	4	0	2	19	1	21	5	3	67	108	84	115
V. Physical Contingency			6	13	571	5	36	27	2	11	126	4	122	36	17	420	337	188	364
VI. Project Cost			65	156	6,763	57	805	325	20	127	1,522	52	1,650	422	201	5,242	7,909	6,018	8,407

Table G.12 (3) Project Cost for Each Proposed Project

(Unit : Million Rp.)

Item	Unit Price		79	A(2)	A(3)	U	V(1)	V(2)	X	N-1(1)	N-1(2)	N-1(3)	N-2(1)	N-2(2)	N-2(3)	N-3(1)	N-3(2)	P-1	P-2
I. Direct Construction Cost																			
1. Earth Work			57	62	100	0	0	25	0	91	50	201	119	112	250	112	216	0	0
a. Excavation	3,600	Rp./m3	57	62	100	0	0	0	0	91	50	0	119	112	250	112	216	0	0
b. Embankment	4,400	Rp./m3	0	0	0	0	0	25	0	0	0	201	0	0	0	0	0	0	0
2. Revetment Work			186	882	2,038	0	0	0	0	645	445	793	697	445	897	793	941	0	0
a. Wet Masonry	74,100	Rp./m2	0	882	2,038	0	0	0	0	645	445	793	697	445	897	793	941	0	0
b. Concrete Pile Wall	675,000	Rp./m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
c. Sheet Pile	47,600	Rp./m2	186	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Side Ditch	241,200	Rp./m	0	458	0	0	0	84	0	314	217	386	338	217	434	386	458	0	0
4. Road Pavement	15,400	Rp./m2	0	0	0	0	0	0	0	60	42	74	65	42	83	74	88	0	0
5. Bridge Improvement	881,800	Rp./m2	0	132	150	0	0	0	0	44	49	0	53	66	150	97	124	0	0
6. Reconstruction of River Crossing	595,300	Rp./m	0	9	18	0	0	0	0	0	48	0	71	54	140	80	0	0	0
7. Parapet	217,200	Rp./m	0	0	0	261	434	76	65	0	0	0	0	0	0	0	0	0	0
8. Culvert	649,400	Rp./m3	0	104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9. Pump Station			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,965	4,872
a. Newly Constructed	785,800,000	Rp./m3/s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,965	4,872
b. Capacity to be increased	566,500,000	Rp./m3/s	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total			242	1,647	2,305	261	434	186	65	1,154	850	1,453	1,342	935	1,953	1,542	1,826	1,965	4,872
II. Land Acquisition and Compensation Cost																			
1. Land Acquisition			0	31	41	0	0	29	0	125	15	83	41	115	83	37	231	584	0
a. Green Area	6,400	Rp./m2	0	31	41	0	0	29	0	125	15	83	41	115	83	37	231	584	0
b. Housing Area	77,400	Rp./m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Compensation			0	3	5	0	0	3	0	14	2	9	5	13	9	4	25	64	0
a. Green Area	700	Rp./m2	0	3	5	0	0	3	0	14	2	9	5	13	9	4	25	64	0
b. Housing Area	51,700	Rp./m2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total			0	34	46	0	0	33	0	139	16	92	46	128	92	41	256	648	0
III. Engineering Service			17	115	161	18	30	13	5	81	60	102	94	66	137	108	128	138	341
IV. Government Administration			4	25	35	4	7	3	1	19	13	23	21	16	31	24	31	39	73
V. Physical Contingency			24	165	231	26	43	19	7	115	85	145	134	94	195	154	183	197	487
VI. Project Cost			287	1,986	2,778	309	515	253	77	1,508	1,024	1,816	1,636	1,238	2,408	1,870	2,424	2,985	5,773

Table G.13 Summary of Proposed Project Cost

(Unit : Million Rp.)

Item	Estimated Cost
I. Direct Construction Cost	
1. Earth Work	4,833
a. Excavation	(4,118)
b. Embankment	(715)
2. Revetment Work	44,938
a. Wet Masonry	(33,894)
b. Concrete Pile Wall	(9,788)
c. Sheet Pile	(1,257)
3. Side Ditch	8,002
4. Road Pavement	3,271
5. Bridge Improvement	1,478
6. Reconstruction of River Crossings	1,810
7. Parapet	945
8. Culvert	104
9. Pump Station	6,837
a. Newly Constructed	(6,837)
b. Capacity to be increased	(0)
Sub-total	72,217
II. Land Acquisition and Compensation Cost	
1. Land Acquisition	25,664
a. Green Area	(2,050)
b. Housing Area	(23,614)
2. Compensation	15,991
a. Green Area	(217)
b. Housing Area	(15,773)
Sub-total	41,655
III. Engineering Service	5,055
IV. Government Administration	1,708
V. Physical Contingency	7,222
VI. Project Cost	127,856

Table G.14 (1) Project Cost for Each On-going Project

(Unit : Million Rp.)

Item	A	B	C	D	E	F	G	H	I	J	K	L	M
I. Direct Construction Cost	1,158	17,643	25,793	900	10,234	4,377	63,331	23,189	12,155	948	8,793	5,142	1,552
II. Land Acquisition and Compensation Cost													
1. Land Acquisition	278	4,235	3,227	219	3,497	0	600	14,012	0	0	0	8,107	0
a. Green Area	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
b. Housing Area	(278)	(4,235)	(3,227)	(219)	(3,497)	(0)	(600)	(14,012)	(0)	(0)	(0)	(8,107)	(0)
2. Compensation	185	2,823	2,152	146	2,332	0	400	9,342	0	0	0	5,404	0
a. Green Area	0	0	0	0	0	0	0	0	0	0	0	0	0
b. Housing Area	185	2,823	2,152	146	2,332	0	400	9,342	0	0	0	5,404	0
Sub-total	463	7,058	5,379	365	5,829	0	1,000	23,354	0	0	0	13,511	0
III. Engineering Service	81	1,235	1,806	63	716	306	4,433	1,623	851	66	616	360	109
IV. Government Administration	24	371	468	19	241	66	965	698	182	14	132	280	23
V. Physical Contingency	116	1,764	2,579	90	1,023	438	6,333	2,319	1,216	95	879	514	155
VI. Project Cost	1,842	28,071	36,025	1,437	18,043	5,187	76,062	51,183	14,404	1,123	10,420	19,807	1,839

Table G.14 (2) Project Cost for Each On-going Project

(Unit : Million Rp.)

Item	N	O	P(1)	P(2)	Q	R	S	T	U	V	W	X
I. Direct Construction Cost	15,253	4,310	30,679	2,586	60,431	25,515	8,491	8,000	57	18,000	7,500	10,000
II. Land Acquisition and Compensation Cost												
1. Land Acquisition	0	300	1,661	0	0	0	0	1,200	362	0	8,400	15,000
a. Green Area	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
b. Housing Area	(0)	(300)	(1,661)	(0)	(0)	(0)	(0)	(1,200)	(362)	(0)	(8,400)	(15,000)
2. Compensation	0	200	1,107	0	0	0	0	800	241	0	5,600	10,000
a. Green Area	0	0	0	0	0	0	0	0	0	0	0	0
b. Housing Area	0	200	1,107	0	0	0	0	800	241	0	5,600	10,000
Sub-total	0	500	2,768	0	0	0	0	2,000	603	0	14,000	25,000
III. Engineering Service	1,068	302	2,148	181	4,230	1,786	594	560	4	1,260	525	700
IV. Government Administration	229	72	502	39	906	383	127	150	10	270	323	525
V. Physical Contingency	1,525	431	3,068	259	6,043	2,552	849	800	6	1,800	750	1,000
VI. Project Cost	18,075	5,615	39,165	3,065	71,610	30,236	10,061	11,510	680	21,330	23,098	37,225

Table G.15 Summary of On-going Project Cost

(Unit : Million Rp.)

Item	Estimated Cost
I. Direct Construction Cost	371,037
II. Land Acquisition and Compensation Cost	
1. Land Acquisition	61,098
a. Green Area	(0)
b. Housing Area	(61,098)
2. Compensation	40,732
a. Green Area	(0)
b. Housing Area	(40,732)
Sub-total	101,830
III. Engineering Service	25,973
IV. Government Administration	7,094
V. Physical Contingency	37,104
VI. Project Cost	543,038

Table G.16 Proposed Project Cost by Drainage Zone

(Unit : Million Rp.)

Item	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Total
I. Direct Construction Cost							
1. Civil Work	25,371	4,676	6,183	0	359	28,792	65,381
2. Pump	0	1,965	4,872	0	0	0	6,837
3. Miscellaneous	1,269	935	1,237	0	18	1,440	4,898
Sub-total	26,639	7,576	12,291	0	377	30,231	77,115
II. Land Acquisition and Compensation Cost							
1. Land Acquisition	16,672	677	0	0	225	8,090	25,664
a. Green Area	(403)	(677)	(0)	(0)	(0)	(970)	(2,050)
b. Housing Area	(16,269)	(0)	(0)	(0)	(225)	(7,121)	(23,614)
2. Compensation	10,911	74	0	0	150	4,855	15,991
a. Green Area	(44)	(74)	(0)	(0)	(0)	(99)	(217)
b. Housing Area	(10,867)	(0)	(0)	(0)	(150)	(4,756)	(15,773)
Sub-total	27,583	751	0	0	375	12,946	41,655
III. Engineering Service	1,865	530	860	0	26	2,116	5,398
IV. Government Administration	813	125	184	0	11	648	1,781
V. Physical Contingency	2,664	758	1,229	0	38	3,023	7,712
VI. Project Cost	59,564	9,740	14,565	0	828	48,964	133,661

Table G.17 Financial On-going Project Cost by Drainage Zone

(Unit : million Rp.)

Item	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Total
I. Direct Construction Cost	1,158	54,570	4,377	108,416	0	202,516	371,037
II. Land Acquisition and Compensation Cost							
1. Land Acquisition	278	11,779	0	22,119	0	26,923	61,099
a. Green Area	(0)	(0)	(0)	(0)	(0)	(0)	(0)
b. Housing Area	(278)	(11,779)	(0)	(22,119)	(0)	(26,923)	(61,099)
2. Compensation	185	7,852	0	14,746	0	17,948	40,731
a. Green Area	(0)	(0)	(0)	(0)	(0)	(0)	(0)
b. Housing Area	(185)	(7,852)	(0)	(14,746)	(0)	(17,948)	(40,731)
Sub-total	463	19,631	0	36,865	0	44,871	101,830
III. Engineering Service (7% of I.)	81	3,820	306	7,589	0	14,176	25,973
IV. Government Administration (1.5% of (I.+II.	24	1,113	66	2,179	0	3,711	7,093
V. Physical Contingency (10% of I.)	116	5,457	438	10,842	0	20,252	37,104
VI. Project Cost	1,842	84,591	5,187	165,891	0	285,526	543,036

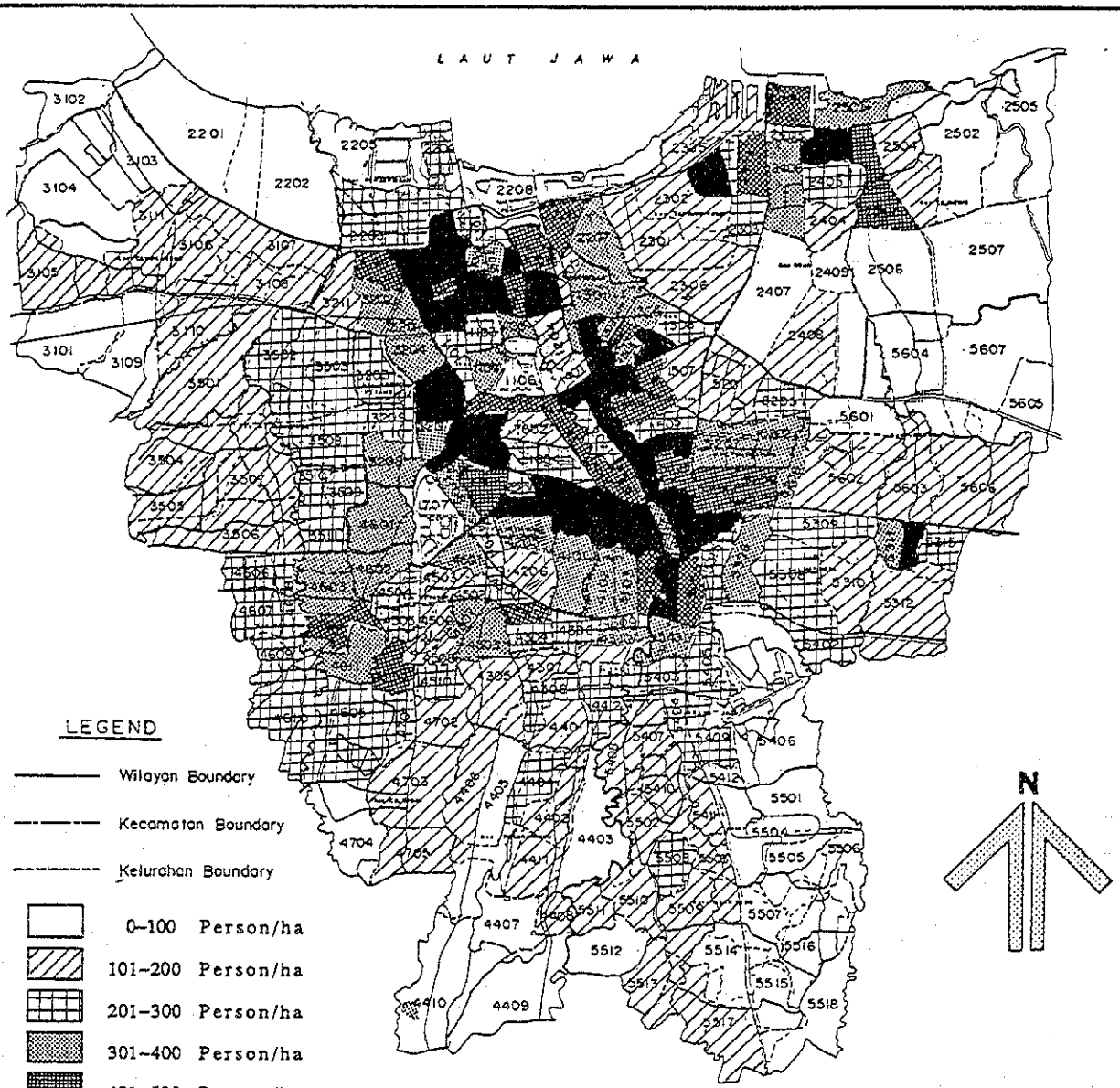


FIG. G.1 POPULATION DENSITY IN THE YEAR 2010 BY KELURAHAN

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

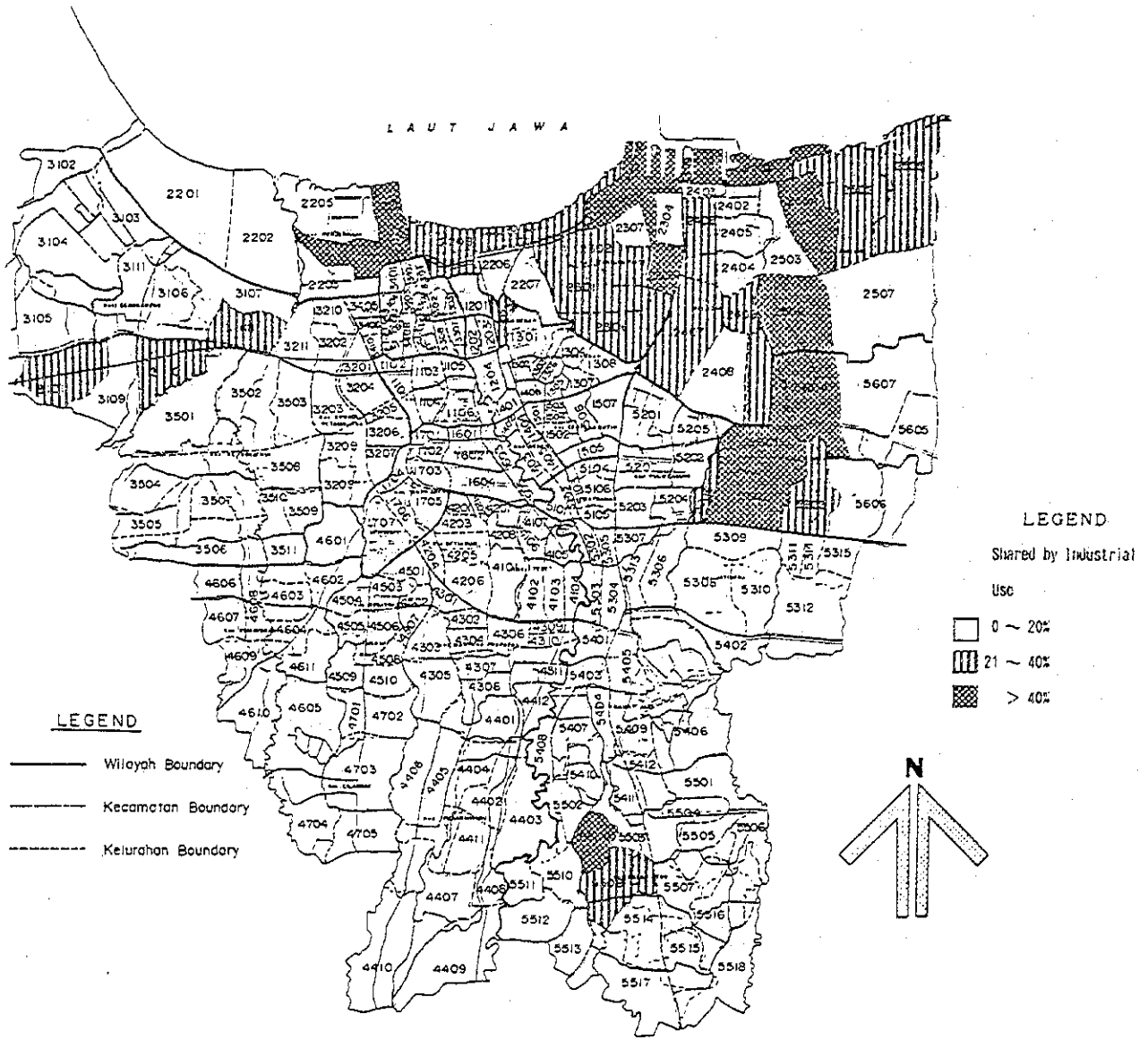


FIG. G.2 LAND USE PATTERN IN 2010 (INDUSTRIAL USE)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

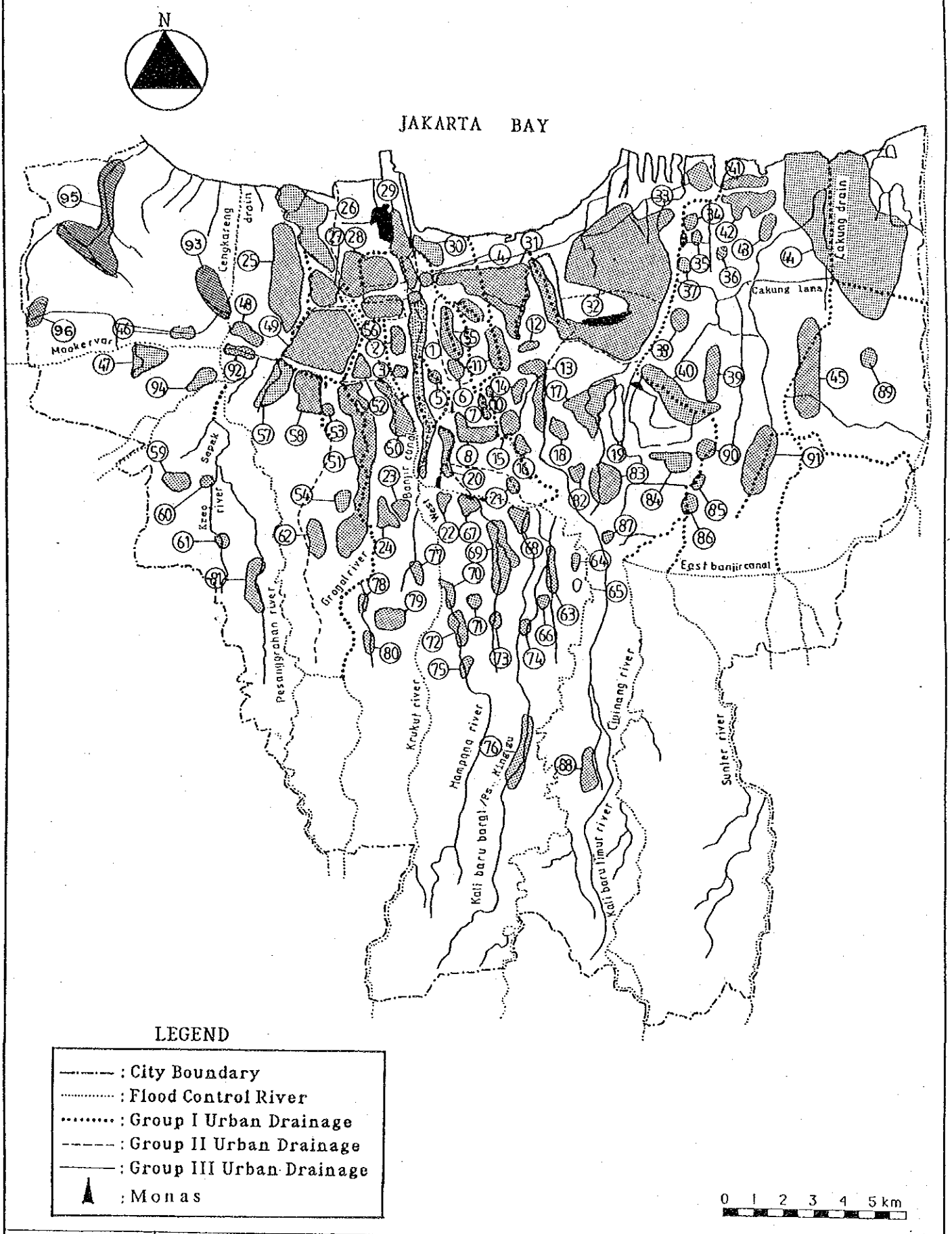


FIG. G.3 POTENTIAL FLOOD AREA

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

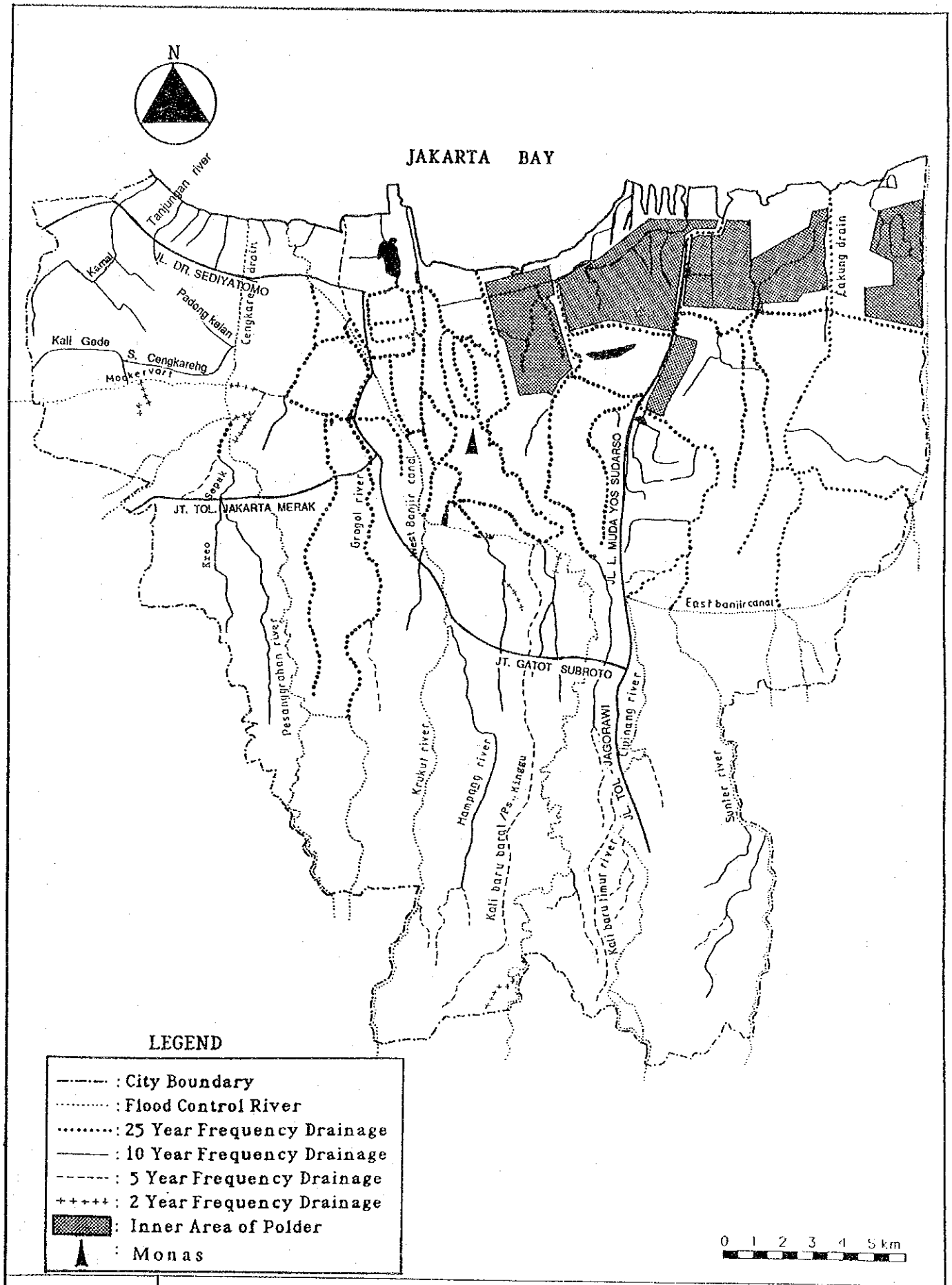
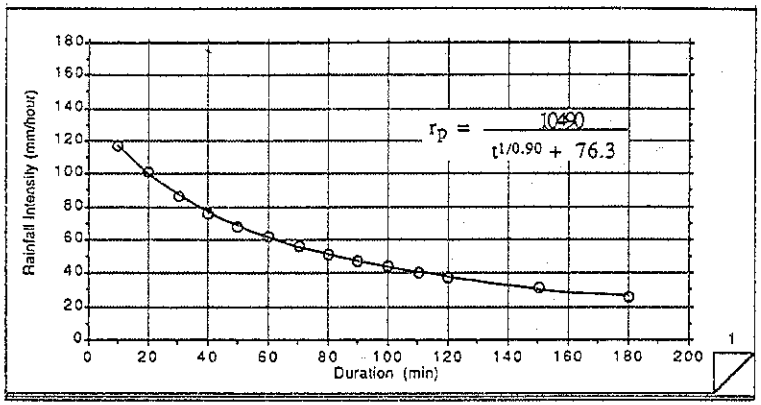
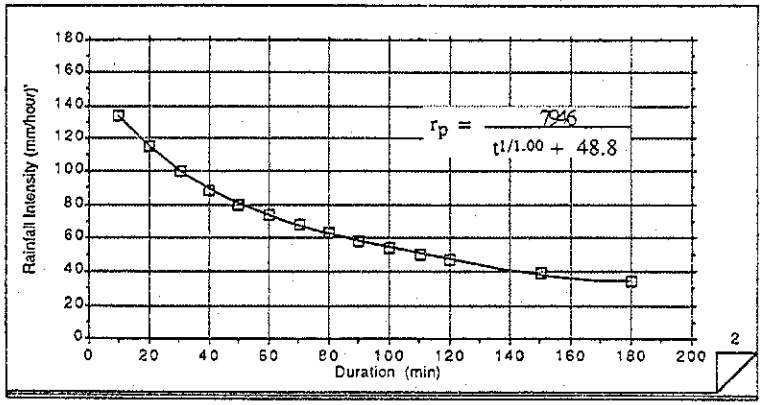


FIG. G.4 DESIGN FLOOD FREQUENCY OF THE URBAN DRAINAGE CHANNELS

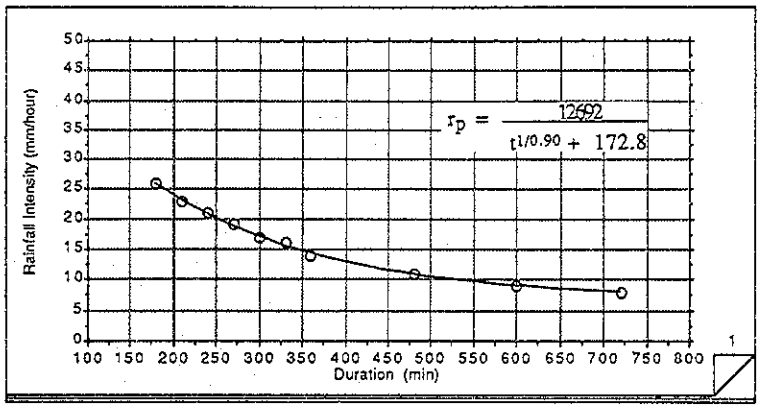
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



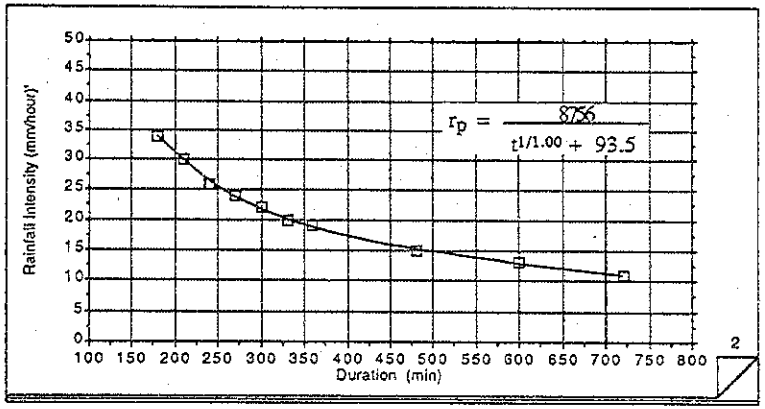
2 Year Return Period (Duration ≤ 180 min)



5 Year Return Period (Duration ≤ 180 min)



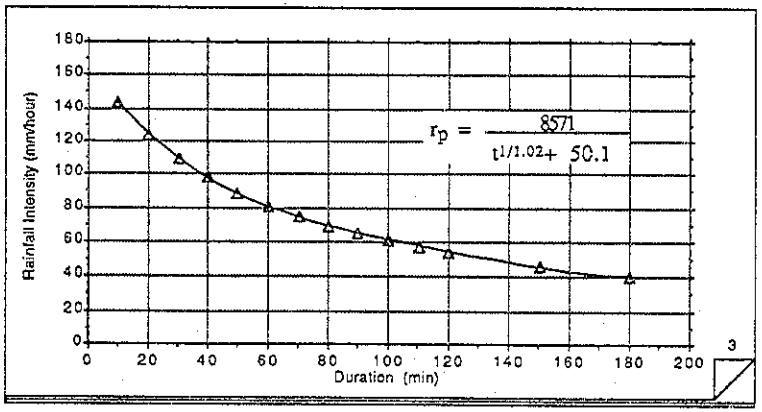
2 Year Return Period (Duration > 180 min)



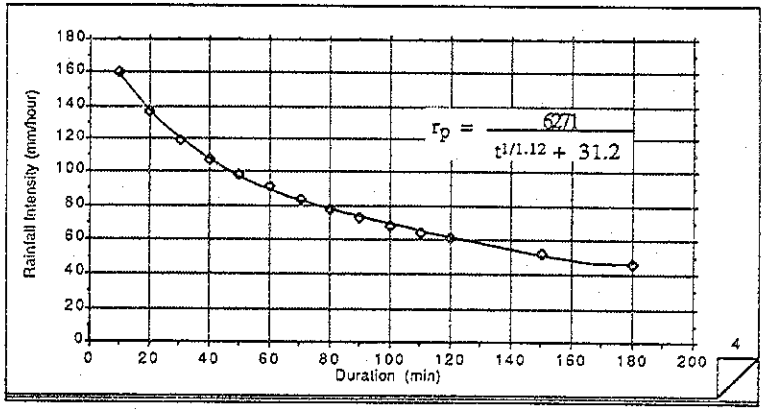
5 Year Return Period (Duration > 180 min)

FIG. G.5(1)	RAINFALL INTENSITY - DURATION CURVE

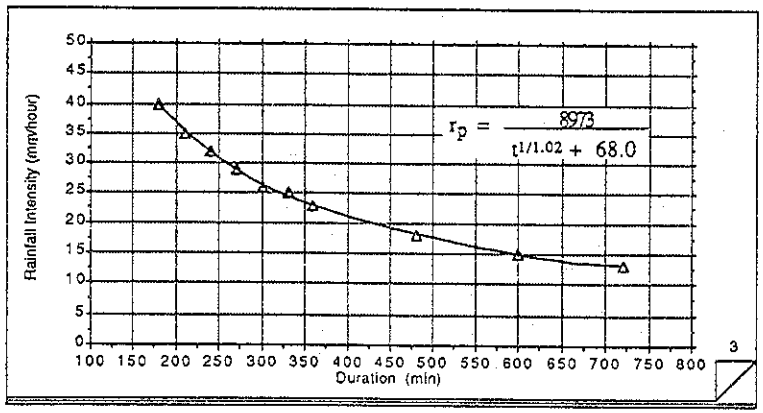
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



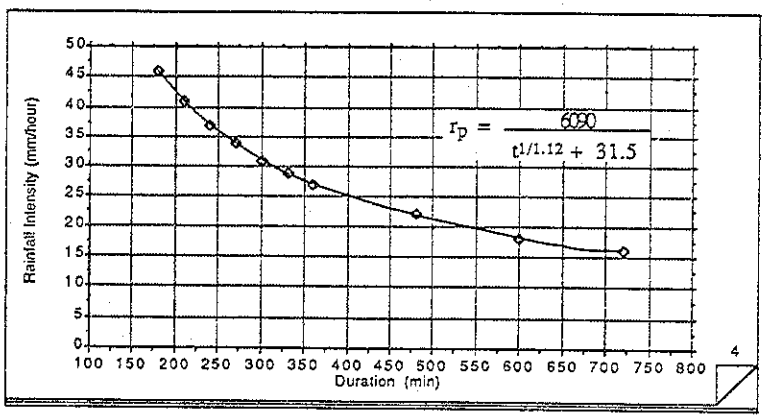
10 Year Return Period (Duration ≤ 180 min)



25 Year Return Period (Duration ≤ 180 min)



10 Year Return Period (Duration > 180 min)



25 Year Return Period (Duration > 180 min)

FIG. G.5(2)	RAINFALL INTENSITY - DURATION CURVE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA