4 FORMULATION OF FLOOD CONTROL MASTER PLAN

4.1 Basic Concepts of Plan Formulation

4.1.1 Planning Conditions

(1) Target Year

Flood Control Master Plan is formulated for the target year of 2025

(2) Objective Rivers

The Flood Control Master Plan covers 8 river systems which consist of 23 main rivers in the Study Area. The objective rivers are listed in Table 2.9.

In DKI Jakarta area, objective rivers for the Flood Control Master Plan are limited to the rivers which are under the control of DGWRD.

(3) Design Scale

The design scales of the Flood Control Master Plan are proposed in consideration of the criteria on design scale in "Flood Control Manual, Volume II Guidelines for Planning and Survey (1993)", which was prepared by DGWRD. The design scales of the objective rivers proposed by the Study Team are shown in Table 2.9 and Figure 4.1.

(4) Target Flooding Type

In principle, the Flood Control Master Plan is formulated to mitigate the flooding from the rivers caused by the rainfall in upper mountainous or hilly areas. Drainage is treated as the related part of the said flood control.

4.1.2 Basic Planning

(1) Comprehensive Flood Control

The Study Area has been being urbanized very rapidly in recent years due to the rapid growth of the economy in the area. The situation is so serious in the view point of flood control that it no longer seems to be possible to expect the level of flood control to desired extent only by structural methods.

In order to keep the function of the said area as the mainstay of national socio-economy, it is necessary to introduce a new concept of flood control in the area, the comprehensive flood control, extending the view point to the whole watershed and introducing non-structural methods other than the structural methods. The concept of comprehensive flood control is schematically shown in Figure 4.2.

In the formulation of the Flood Control Master Plan, this concept of comprehensive flood control is applied as much as possible in due consideration of the area in the present and estimated future conditions.

(2) Zoning of Basin by Flood Control Function

Principally the Study Area is zoned by flood control function to 1) water retention zone, 2) retarding zone, and 3) low-lying zone as shown in Figure 4.3.

(3) Objective Area and Stretches of Master Plan

In principle, the target area which should be protected from the flooding is the low-lying coastal floodplain in the downstream area.

The valley plain of hilly area in the middle reaches is not treated as the target area of flood control in due consideration that the rivers flow in deeply dissected valley. From the view point of comprehensive flood control, it will be desired that the inundation in the narrow valley plain along the middle reaches should be left in the present situation as much as possible by flood plain zoning. The reasons are as follows:

- scale of river improvement in the lower reaches is mitigated by the storage function in the valley plain in hilly area as natural retarding basin ;
- the economic benefit of the river improvement in the valley plain area is limited because of its narrow flood plain.

The flood plain zoning area here is defined as the area where the river area is defined and the delineation is announced to the public. The area to be protected by structural measures and the area of flood plain zoning are shown in Figure 4.4.

(4) Basic Consideration by Areas

The Study Area is classified into 2 areas from the viewpoint of development progress as below:

- central river basins of such as the Cengkareng Floodway System, the Western Banjir Canal System and Proposed Eastern Banjir Canal System which flow through DKI Jakarta;
- western river basins of the Cidurian, Cirarab, Cimanceuri and Cisadane rivers, and eastern river basin of the CBL Floodway System.

The following consideration is given in the study on the Flood Control Master Plan of the above river basins respectively:

(a) Central River Basins

In this area, on account of the high urbanization, land acquisition has become so difficult that

it is considered that part of the "Master Plan for Drainage and Flood Control of Jakarta" (NEDECO, 1973) may not be implemented without modification. But many flood control and drainage projects are existing or on-going in accordance with the existing Master Plan. Yet these projects should be introduced as much as possible depending on the present new situation in the area. In the planning, as a matter of fact, consideration is given to the issue of people's relocation.

It is supposed that the comprehensive flood control including non-structural methods is effective for the relatively big, hilly rivers in DKI Jakarta such as the Angke and Pesanggrahan rivers. Those rivers have no mountainous area in the upper basins, originate in hilly area and have densely populated low-lying area along the lower reaches in coastal plain. The upper river basins, where the area should function as runoff retention area, will be completely urbanized in the near future. In such a case, it may be difficult to cope with only by structural methods, on account of the big increase of flood discharge caused by the loss of flood retention function in upper basins and the difficulties of land acquisition in the lower reaches.

In this area, however, structural methods are inevitably required in due consideration of the following issues, even though non-structural methods will be introduced:

- seriousness of flooding;
- largeness of flood damage due to the accumulation of property accompanied by rapid growth of the economy;
- remarkable progress of urbanization in recent years; and
- difficulties and uncertainness of land use regulation.

(b) Western and Eastern River Basins

Urbanization is intensively going on in the objective river basins, especially in the hilly middle reaches. Accordingly the mechanism of run-off in the basins has been changing. The Master Plan should be formulated in consideration of these changes in the basin and future program of rural development in the basin. Water retention function in the basin should be considered as is planned in the Situ-situ project in each river basin.

In the lower reaches on coastal floodplain, it is estimated that the area will be mainly utilized as agricultural land even in 2025, the target year of the Master Plan. The land acquisition for river improvement is not expected so difficult as compared with that in urban area. Therefore, structural methods as well as non-structural methods are introduced.

4.1.3 Basic Design Discharge

Based on the design rainfalls and flood runoff model developed, the probable flood runoff at the respective design control points which become inputs for the flooding model are given in Figure 4.5. The probable flood peak distributions at the design control point for the design scale of each river system and those specific discharge are summarized in Figure 4.6.

Basic design discharges in the 8 rivers systems in JABOTABEK area are estimated based on the estimated future land use and above-mentioned basic concepts. The basic design discharges adopted in the Study are shown in Figure 4.7.

4.2 Alternative Plans

4.2.1 General

Flood control alternatives here discussed are focused on structural measures. Non-structural measures will be discussed in Sub-section 4.5.

In due consideration of the topography, geology, zoning, peoples' relocation, and others in the basin, alternative structural flood control plans are prepared. For the river systems of the Cidurian, Cimanceuri, Cirarab, Cisadane, and CBL Floodway, conceivable alternative is only the .river improvement of the downstream reaches. For the river systems of Cengkareng Floodway, Western Banjir Canal and Eastern Banjir Canal, conceivable alternatives are more than one.

4.2.2 Cengkareng Floodway System

Following 4 alternatives are studied for flood control of this river system. These alternatives includes replacement or rehabilitation of existing barrages such as the Cengkareng barrage and the Koneng barrage.

- CKR-1 : River improvement
- CKR-2 : River improvement and construction of Limo Dam
- CKR-3 : River improvement and construction of Angke Floodway
- CKR-4 : River improvement, and construction of Limo Dam and Angke Floodway

Limo dam is for flood control of the Pesanggrahan river. Angke Floodway is to divert the flood of the Angke river to the Cisadane river. River improvement of the Grogol river is not considered to be necessary, since the present carrying capacity of the river is bigger than the design discharge.

4.2.3 Western Banjir Canal System

Following 3 alternatives are studied for flood control of this river system. These alternatives includes rehabilitation of existing barrages such as the Manggarai barrage and the Karet barrage.

- WBC-1 : River improvement
- WBC-2 : River improvement and construction of Ciawi Dam
- WBC-3 : River improvement and construction of Ciliwung Floodway

Ciawi dam is for flood control of the Ciliwung river in the upstream of Bogor city.

Ciliwung floodway is to divert the flood of the Ciliwung river to the Cisadane river in Bogor city.

The alternative of WBC-2 is, before proceeding to cost estimate, discarded by the result of hydrological study that the effect of the dam for flood control is so small.

4.2.4 Eastern Banjir Canal System (EBC system)

Following 4 alternatives are studied here for flood control of this river system:

- EBC-1-1 : Construction of EBC with open channel and box culvert
- EBC-1-2 : Construction of EBC with open channel with PC-sheet pile revetment
- EBC-1-3 : Construction of EBC with open channel with double cross-section
- EBC-2 : River Improvement of Existing Rivers without Construction of EBC

For all the alternatives, the concept of utilization of existing river as much as possible is considered. Accordingly for the alternatives of EBC-1-1, 1-2 and 1-3, the existing alignment which, after joining the Cakung river, flows straightforward to the north is modified in the present study by using the downstream reaches of Cakung drain and the Marunda drain as much as possible.

The following are the concepts of the above alternatives:

EBC-1-1 : This option aims to construct the Eastern Banjir Canal and to minimize the land acquisition cost.

EBC-1-2 : This option aims to construct the Eastern Banjir Canal and to minimize the total cost of construction and the land acquisition.

EBC-1-3 : This option aims to construct the Eastern Banjir Canal and to minimize the construction cost.

EBC-2 : This option aims to improve the existing rivers without construction of the Eastern Banjir Canal. This option needs the maximum volume of excavation and embankment, and maximum land acquisition area compared with the other alternatives, since the necessary river improvement length is about 48 km while the other alternative needs the length of about 23.4 km and existing channels to be incorporated for this option are small ones with the present river width of about 10 m or so. Accordingly the alternatives of EBC-1-1, 1-2, and 1-3 are taken up for the economic evaluation.

4.2.5 CBL System

River improvement of the following rivers is not considered to be necessary, since the present carrying capacity of those rivers are bigger than the design discharge.

(1) The Cikarang river

(2) The upstream reaches of CBL before joining of the Cisadang river
(3) The Cilemahabang river

The Cilemahabang river has been being improved by Jatiluhur project as one of the drainage channels of the overall irrigation system in this area.

4.3 Flood Damage

4.3.1 Flood Inundation Analysis

Flood inundation analysis is conducted by using a flooding model in order to hydraulically simulate the flood runoff in the inundation and flooding areas.

(1) Basin Model

The basin model for the computation is constructed based on the available topographic maps (scales, 1:25,000, 1:50,000) and the objective area is divided into mesh blocks as shown in Figure 4.8. Each mesh block has a size of 30 seconds of latitude × 30 seconds of longitude (approximately, 919 m × 919 m ≒ 84.4 ha). Average ground elevation of each mesh is also determined using contour lines and point elevations shown in 1:25,000 topographic map.

(2) Pond Model Method

In this analysis, Pond Model Method is applied as flooding model to simulate a wide-spreading flood in the areas extending in the downstream reaches of each river system in the Study Area. This model simulates the two dimensional flood flow propagation between divided mesh blocks by solving the movement and continuity equations.

(3) Input Data of The Model

The input for the objective area covered by the pond model consists of runoff hydrograph at flooding point calculated by the storage function method. Probable flooding point on each river system is assumed based on the past flood and inundation records and discharge carrying capacities of present river channel.

(4) Simulation Results

Using the developed pond model, simulation for probable flood runoff is carried out for each river system with following conditions:

River System	Design Scale (year)	Carrying Capacity (m^3/s)	Probable Flood Peak (m^3/s)											
			Return Period (Present Land Use)						Return Period (Future Land Use)					
			2	5	10	25	50	100	2	5	10	25	50	100
Cidurian	25	220	93	183	263	380	-	-	166	322	457	645	-	-
Cimanceuri	25	210	77	137	183	249	-	-	90	158	210	282	-	-
Cirarab	25	25	7	11	14	18	-	-	28	45	57	74	-	-
Cisadane	50	700	387	672	872	1157	1368	-	483	810	1036	1339	1571	-
Cengkareng F. W.	100	300	58	96	121	167	203	242	168	270	341	448	530	616
WBC	100	300	82	168	230	313	376	444	134	246	324	433	517	602
EBC (Cipinang)	100	10	10	15	20	25	30	34	24	39	51	67	78	90
EBC (Sunter)	100	19	8	13	17	22	25	30	33	54	70	91	107	124
EBC (Buaran)	100	14	5	8	10	13	15	17	12	20	26	33	39	45
EBC (Jatikramat)	100	2	4	7	9	12	14	16	12	18	24	31	37	42
EBC (Cakung)	100	9	5	9	11	15	17	20	23	37	48	62	73	84
CBL	50	210	117	215	298	421	521	-	194	340	459	637	774	-

Note) [ ] : indicates no flooding

Results of the simulation for probable flood runoff in condition of the design scale with future land use are shown in Figure 4.9.

4.3.2 Damage Assessment

(1) General

Flood damage is estimated as the direct damage, indirect damage, and other damage.

Direct flood damage is estimated based on the damage to the properties in the flood prone area on the following items

1) General assets
   - a) Residence and other buildings for office, factory, retail, warehouse and public services
   - b) Household effects, indoor moveable of buildings specified above

2) Agricultural properties : various kind of crops on farm land

3) Infrastructure such as roads, channel, canal and public utilities related to water and electricity supply

Indirect damage is estimated as the damage to economic activities due to its activities stagnation.

Other damage is estimated as the following:

- cost emergency measures made by central and rural government
- termination of public services such as transportation, communication, electricity, water and gas supply.
- loss due to interruption of traffic
- social, economical and political loss due to paralysis of their function
- inconvenience of citizens' life
- insanitary and danger of infectious diseases
- injury to human lives

Distribution of the properties in the Study Area is based on the statistic data on general assets and study results of land use which are presented in section 3.2.

The Study Area is divided into blocks about 0.85 sq. km wide for flood simulation analysis as discussed in the foregoing sub-section 4.3.1. These blocks are used as the units of damage assessment.

(2) Direct Damage

(a) General Assets

1) Residence

a) House

Generally types of residence are classified into three classes such as permanent type, semi-permanent type and non-permanent type according to statistic data.

Number of residence in the Study area is estimated based on the population projection. The population projection is conducted in consideration of that by JWRMS and future land use map presented in Figure 3.3, and on the assumption that family size and composition of house type until 2025 continues to be the same as that in 1993.

b) Household Effects

Type of household effects is estimated for each type of residence. The values of household effects are estimated from the market price depreciating by the assumed average lifetime and period of use.

2) Commercial Sector

a) Building for Commercial Sector

Unit values of buildings in commercial sector such as shops, restaurants, supermarkets,

department stores, hotels and banks are estimated by classifying them into two classes, i.e. large scale shop and medium/small scale shop. Markets (pasar) which consist of number of small shops are also included in the large scale building.

b) Facilities in Building for Commercial Sector

Buildings in commercial sector generally have such facilities as show cases, refrigerator, tables, chairs, cooking facilities, etc. inside. Values of those facilities for commercial sector are estimated from the market price depreciating by the assumed average lifetime and period of use.

c) Merchandise

Value of merchandise in a building for commercial sector is estimated based on the type of building by classifying into two types ; large scale or medium/small scale.

3) Office

a) Building for Office

Average size of building for office is estimated from average number of employees and necessary area for the employees. Type of building is assumed to be the same as that of the permanent residence. Unit value of building for office is estimated in consideration of the average floor area, unit construction cost, and depreciation rate of building.

Building for office is considered only for DKI Jakarta since data on number of office building are not available for the area outside DKI Jakarta.

b) Facilities in Building for Office

Such facilities as desk, chair, bookshelf, stationary, typewriter, telephone, drinking water server, personal computers, photocopy machine, facsimile machine, etc. are considered as the facilities in a building for office. Value of such facilities are estimated from the market price depreciating by the assumed average lifetime and period of use.

4) Factory

a) Building for Factory

Unit value of buildings for factory is estimated in consideration of type of building (large, medium and small), average floor area, unit construction cost, and depreciation rate.

b) Property in Factory Building

Property in factory building consists of stock of products, stock of raw materials and machines and equipment.

5) Warehouse

a) Building for Warehouse

Unit value of warehouse is estimated in consideration of average floor area, unit construction cost, and depreciation rate.

b) Stock in Warehouse

Value of stocks in warehouse is estimated based on the following consideration:

- warehouses located at Kecamatans Tanjung Priok, Cilincing, Pulo Gadung and Cakung in DKI Jakarta are classified into large scale warehouses and assumed to stock export and import goods.
- other warehouses in DKI Jakarta are classified into small scale warehouses and assumed to stock merchandise like textile in Tanah Abang area.
- warehouses located outside DKI Jakarta are classified into small scale warehouses and assumed to stock agricultural products , fertilizer and chemicals like gudang KUD.

6) Public Building

a) Building

Public buildings include such buildings as schools, mosques, church, medical facilities and government offices. Numbers of such buildings in the Study Area are estimated based on statistic data and data collected from Kabupaten offices. Unit value of building for office is estimated in consideration of average floor area, unit construction cost, and depreciation rate.

b) Properties in Public Building

Public buildings also have various kinds of properties inside. Value of such properties are also taken into consideration.

7) Future Value of General Assets

After estimation of value of assets in Kecamatans in the flood prone area, correlation between value of assets in Kecamatans and number of population has been examined. Its result is shown in Figure 4.10. From the figure it is able to say that assets in Kecamatan increase according to population growth. Therefore future value of general assets in the flood prone area is assumed to increase according to population growth for damage assessment.

(b) Agricultural Properties

According to Agricultural Census 1993 (Potensi Desa/Kelurahan) conducted by BPS, major agricultural activity in the flood prone area is production of paddy. Several kinds of upland

crops are also cultivated in the area but their cultivation area is far smaller than paddy cultivation area. They are generally situated on hilly areas and those areas are free from flood. Thus only damage to paddy cultivation is taken into account.

According to Government policy, it is assumed that rice production will not decrease much by intensive rice production in Botabek area.

(c) Infrastructure

Damage to infrastructure such as roads, railway, channel, and irrigation facilities is assumed to be at 30 % of damage to the general assets and agricultural crops based on data from the Public Works Department of DKI Jakarta on restoration cost of roads and channel damaged by flood.

(3) Indirect Damage

Indirect damage is assumed to be 6 % of flood damage to the general assets which is discussed above. The indirect flood damage is the net economic loss of goods and services to the nation due to interruption of economic activities in the Study Area.

(4) Other Damage

Other damage is assumed to be 20 % of total damages to general assets, agricultural crops, indirect damage and infrastructure.

(5) Flood Damages

Probable flood damages are estimated from the damageable properties in inundated area by multiplying the flood damage rate corresponding to inundation conditions under various magnitudes of flood events. All the inundation area and inundation conditions are derived from the flood inundation analysis in the foregoing sub-section 4.3.1.

Annual mean flood damages are estimated as accumulation of flood damage segments derived from various magnitude of probable flood damages multiplied by the corresponding probability of occurrence, from non-damageable flood up to design probable flood.

4.4 Project Evaluation

4.4.1 Economic Evaluation

Economic evaluation is conducted for the selected alternatives of flood control master plan. The costs and benefits are estimated at the price level of October 1995. Applied foreign exchange rates are as follows:

1 US$ = Rp. 2,281
1 Japanese Yen = Rp. 22.70

Main components entering into the economic analysis are:

Project benefits

(a) benefits of reduction of direct flood damage to property, crops, and infrastructure
(b) benefits of indirect damage as discussed in the foregoing sub-section 4.3.2
(c) benefits of other damage as discussed in the foregoing sub-section 4.3.2

Project costs

(a) construction cost
- direct construction cost
- cost of land acquisition / house compensation
- administration cost
- cost of engineering services
- physical contingency

(b) operation and maintenance cost
(c) replacement cost

(1) Estimation of Economic Benefits

Economic benefits expected from flood control project are mitigation of flood damage. In the estimate of economic benefits, only the reduction of flood damage is taken into account.

For the estimate of flood damage reduction, direct damage, indirect damage, and other damage are taken into account. The discussion on the direct damage, indirect damage and other damage are presented in the foregoing sub-section 4.3.2.

Project benefit as the reduction of flood damage is calculated as the difference of annual mean flood damages between with and without projects.

(2) Economic Project Cost

The economic costs of the project are the figures that reflect the true economic value of goods and services involved. These costs are used for the economic evaluation of the project. Transfer items such as taxes and duties imposed on construction materials and equipment, including government subsidy, are excluded from the elements of financial cost. It is assumed that 3 % of foreign currency portion and 8 % of local currency portion of direct construction cost are deemed as the transfer items.

Regarding the land acquisition and house compensation costs, the following are considered as economic cost from the economic point of view:

(a) farm land : productivity during the project life
(b) residential area: productivity during the project life + building cost of new house

(3) Economic Evaluation

Economic evaluation of projects are conducted from the economic viewpoint of viability (EIRR). The estimated economic benefits, costs, and EIRRs are as follows:

Alternatives	Economic Annual Mean Benefit (Rp. million)	Economic Cost (Rp. million)	EIRR (%)
1. Cidurian river	7,295	144,861	3.8
2. Cimanceuri river	931	54,042	<0
3. Cirarab river	2,098	15,772	12.1
4. Cisadane river	8,419	176,052	3.3
5. Cengkareng floodway system			
CKR-1	87,792	141,639	42.9
CKR-2	87,792	609,991	12.6
CKR-3	87,792	520,388	14.6
CKR-4	87,792	981,974	7.8
6. Western Banjir Canal			
WBC-1+CSD-1	85,815	285,007	22.5
WBC-3+CSD-1'	85,815	456,332	16.1
7. Eastern Banjir Canal			
EBC-1-1	228,798	2,415,578	8.4
EBC-1-2	228,798	916,747	20.6
EBC-1-3	228,798	513,591	30.5
8. CBL floodway	9,988	138,200	6.2

4.4.2 Evaluation of Alternatives

(1) Criteria

The view points for overall evaluation considered are the following:

1) financial project cost
2) land acquisition and house compensation cost
3) economic internal rate of return (EIRR)
4) technical evaluation
5) beneficial population
6) land use
7) environmental impact
8) project status(master plan, feasibility study, detailed design, construction)

(2) Overall Evaluation

In consideration of the above criteria, overall evaluation among the alternatives is conducted as shown in Table 4.1. For the river systems of Cidurian, Cimanceuri, Cirarab, and CBL

floodway, since the conceived alternative is just one, comparison of alternative is not conducted.

The master plan projects for the river systems of the Western Banjir Canal and the Cisadane river are evaluated to be economically highly feasible and socially strongly required, and are given the highest priority. Following those projects, the projects for the river systems of the proposed Eastern Banjir Canal and the Cengkareng floodway are evaluated to be high priority projects from the same viewpoint.

According to the result of initial environmental examination, negative impact to environment resulting from the implementation of the project might be limited. Those are the temporary ones such as noise, vibration, and the increase of suspended solid in river water due to river excavation and dredging during construction period.

It is evaluated that the implementation of each project will decrease the flooding and inundation in the objective area and contribute to the improvement of environment such as betterment of public welfare, enhancement of land use, etc. in addition to the direct protection of human life and properties.

4.4.3 Initial Environmental Examination

(1) Environmental Items

The major components of possible measures of flood control included in the alternative schemes are; 1) dyke system, 2) river channel improvement, 3) construction of flood control dam, 4) flood way. Thus, the environmental items for the IEE are principally selected from common items related to these measures based on the existing guidelines such as the Environmental Guidelines for Selected Agricultural and Natural Resources Development Projects of DAB (1987) and the Guidelines of the EIA for River and Sand Control Projects of JICA (1994). Consequently, the following items are selected for the IEE:

Social Environmental Issues	Nature Environmental Issues	Environmental Pollution Issues
- Resettlement	- Encroachment into precious	- Air pollution and noise
- Impairment of the	ecosystem	- Deterioration of water quality
transportation system	- Aesthetics & landscapes	
- Communities	- Change of river flow regime	
- Encroachment on historical	- Watershed erosion and	
Assets	sedimentation	
- Inundation of mineral resources		

(2) Initial Environmental Examination (IEE)

The alternative schemes are set up for the several river systems; the Cidurian, Cimanceuri, Cirarab, Cisadane, Cengkareng Floodway, Western Banjir Canal, Eastern Banjir Canal, and CBL Floodway systems, and these systems have several work components.

Various environmental items are to be evaluated for a whole project implementation period. However, specific items to be selected for a project would depend on the respective project feature, implementation stage, socio-economic conditions and nature conditions around project area. Moreover, during a selection of environmental items of the IEE, a priority project was not specifically determined yet, then the IEE items should have been major and general ones out of 11 items for each alternative scheme.

Significance for proceeding EIA among the IEE items has been classified in the respective alternative schemes by the following classes; (A) mostly significant, (B) significant, (C) significant but relatively minor, (D) No effect is expected. Its results are shown in Table 4.2.

- *Resettlement problem, Impairment of the transportation system and Communities*

  These items will be considered as a mostly significant problem in the case of providing dyke system, river channel improvement, provision of floodway in the densely populated urban area. Particularly in the Eastern Banjir Canal System, several rivers flow down through the densely populated urban area with population density of 10,000 to 20,000 persons/km^2. Therefore, resettlement, separation of community and impairment of transportation system are significant problems to be caused.

- *Encroachment on historical Assets*

  No effect can be expected through the field reconnaissance and taking account of present land use conditions, however no exact information about historical assets are available. Therefore it is necessary to investigate them in the proceeding EIA.

- *Inundation of mineral resources*

  No effect can be expected through the field reconnaissance and taking account of land use conditions.

- *Encroachment into precious ecosystem*

  Nature Reserve Mural Angle is located at the estuary of Western Banjir Canal, moreover, Gunning Geed National Park is located at the upstream of Ciawi dam, construction of which is included in a alternative scheme of Western Banjir Canal System. In the envisaged catchment area of the dam, forests still exist. Therefore, there is possibility that richer wildlife species might be found. It is necessary to investigate it when the Western Banjir Canal System will be proceeded.

  Mawuk and Taman Wisata Tanjung Pasir, which are proposed as nature conservation areas, are located at the estuary of the Cimanceuri and Cisadane river. Therefore, in the coastal areas along Java sea, there is possibility that richer wildlife species might be found, and it is necessary to investigate it when these river systems will be proceeded.

Pondok Tengah, which is protection forest, is located at the estuary of CBL Floodway, moreover, Muara Gembong, which is proposed as nature conservation area, is located at the estuary of the Citarum. Therefore, in the coastal areas along Java sea, there is possibility that richer wildlife species might be found, and it is necessary to investigate it when the CBL Floodway System will be proceeded.

- *Aesthetics and landscapes*

No effect can be expected through the field reconnaissance and taking account of present land use conditions. However, as for Ciawi dam, dam site is located in a valley and forests still exist in the envisaged catchment area of the dam. Thus, negative impacts might be caused by this work.

- *Change of river flow regime*

A gate rehabilitation of the existing Pasar Baru barrage, which is for an irrigation water intake for Cisadane-Prosida system, is a major work of Cisadane river System. It is suggested to maintain the present water supply during rehabilitation of the barrage.

Watershed erosion and sedimentation

Erosion source area is located in the watershed of the Ciliwung river, and it revels that this watershed has rather high erosion tendency mainly due to torrential rain during the rainy season. Thus the watershed erosion and sedimentation is to be an important factor for the construction of Ciawi dam.

- *Air pollution and noise*

During the construction period, the local people, living near the construction site and/or along the road to be used as access route to the construction site, might be annoyed by the deterioration of air quality, noise and vibration hazard caused by the operation of construction equipment and construction transportation.

- *Deterioration of water quality*

River dredging work will worsen river water quality with respect to increase suspended solids during the construction period.

4.5 Proposed Master Plan

As the flood control master plan in JABOTABEK area, for the target year of 2025, the features of proposed stretch of flood control master plan is shown in Table 4.3.

The design discharge distribution of the proposed flood control master plan is shown in Figure 4.11.

The proposed design discharge distribution is somewhat different from that of the existing one in some river systems because of the difference of the methodology of rainfall and run off analyses and the difference of the assumption of future land use condition.

4.5.1 Structural Measures

The incorporated structural measures in the flood control master plan for JABOTABEK area are also schematically shown together with the design discharge distribution in Figure 4.11.

The longitudinal profiles and the standard cross-sections of the objective reaches of the river improvement works of the objective rivers are shown in Figure 4.12.

Other than the conventional river channel improvement works, the following works are incorporated.

(1) Cengkareng Floodway System

Angke floodway : about 4 km long at around the boundary of Tangerang and Serpong.

(2) Western Banjir Canal System

Ciliwung floodway : about 900 m long on the upstream side of Bogor city.

4.5.2 Non-Structural Measures

(1) Watershed Management

Flood control can not be achieved only by the structural method. The basic point of non-structural method for flood control should be the watershed management.

The river consists of water and soil. Both are supplied from the watershed of the river. Countermeasures in only the downstream reaches, therefore, are not enough for flood control. If the watersheds are indiscriminately developed in different to the situation in the downstream area, then the flood peak will increase unexpectedly and the sediment supply to the river will increase so much and then the river-bed will be elevated so much. The both will surely result in a serious flooding in the downstream basin and then serious flood damage maybe including the loss of human lives.

Accordingly the preservation of the soil conservation and flood retention functions in upper watershed is the essential part of the non-structural flood control. Like in the medical field, prevention against becoming sick is much more important than curing after becoming sick.

The runoff analysis in the basin is conducted in the present study. Even the data utilized for the runoff analysis in the present study is very much limited, future runoff in the basin is

estimated to increase so much due to its urbanization in the upstream basins. For example, the basin of the Cengkareng Floodway system is estimated to have been urbanized by 28 % of the whole basin at present. But future urbanization in 2025 is estimated to be about 88 % of the whole basin. Accordingly the flood peak is estimated to increase from 240 m3/s from the present stage to 620 m^3/s in future stage due to its urbanization.

This includes the preservation of forest, paddy field, lake and pond, and then regulation of land development in the basin. All these will contribute to the preservation of the flood retention function in the basin and soil conservation.

As a matter of fact, sabo works as structural method in the basin is also an important aspect of watershed management from the view point of flood control.

(2) Flood Plain Management

Flood plain management here comprises that in the middle reaches and the low-lying area in the downstream basin.

(a) Middle Reaches

In the middle reaches, an important aspect is land regulation to preserve the flood retarding function in the basin. Not only the valley plain in middle hilly reaches of rivers in JABOTABEK area, but also the lakes and ponds scattered in the area play an important role for flood retarding function. This also contributes so much to suppress the increase of flood peak in the downstream reaches.

The area that is presently functioning as the retarding basin of rivers should not be developed as residential or commercial area. The authorities responsible to flood control should define the flood retarding area for each river and with the coordination with the local government, land use development should de regulated.

This management also includes the regulation of land filling in the basin. This land filling activity can be found everywhere in JABOTABEK area. This also gradually diminishes the retarding function in the basin.

(b) Low-lying Area

In the low-lying area, flood forecasting and flood proofing are the major non-structural method for flood control.

(3) Public Information and Education

Public information and education comprises the aspects of flood prevention and that of flood damage mitigation

(a) Flood Prevention

Activity of public information and education for people not to construct illegal facilities inside the river area, and not to dump garbage to the river area. This should be conducted by the following methods:

- to hold forum
- to hold ceremony or concert to love rivers
- to make campaign through mass-media especially by popular people like a film star or singers

(b) Flood Damage Mitigation

Activity of public information and education to mitigate the flood damage as much as possible since the flood of rivers as natural phenomena may sometimes exceeds the design discharge that is always limited to certain scale due to socio-economic situation of the area, and because the flood control facilities planned can not be constructed all at once due to the limitation of the government budget. Usually completion of the flood control facilities needs a long time.

This comprises the following:

- preparation of flood risk map
- establishment of flood warning board to show the past maximum inundation water level in the area

(4) Related Agencies

There are many related agencies to non-structural measures such as ministry of public works, ministry of forest, ministry of industry, ministry of agriculture, ministry of education and culture and ministry of people's welfare.

4.6 Selection of Priority Projects

4.6.1 Criteria

Criteria to select priority projects which are to be taken up for the feasibility study are as follows:

1) Financial project cost is within the moderate amount.
2) Land acquisition/house compensation cost is small.
3) Beneficiaries are many.
4) Land use in 2025 is important.
5) Economic internal rate of return (EIRR) is high.
6) Implementation of the project is easy with less technical issue.
7) Social beneficial impact is big.

8) Implementation of the project is easy with less environmental issue.

4.6.2 Overall Evaluation

The master plan projects for the river systems of the Western Banjir Canal and the Cisadane river are evaluated to be economically highly feasible and socially strongly required, and are given the highest priority as shown in Table 4.4. Accordingly, the following projects are selected as the priority projects for the feasibility study.

1. Improvement of the Western Banjir Canal (Estuary - Manggarai Barrage, l=17 km)
2. Improvement of the Cisadane River (Estuary - Pasar Baru Barrage, l=21 km)
3. Construction of the Ciliwung Floodway

The economic viability (EIRR) of the project is estimated to be 15.4 %. This value of EIRR is not the highest one among those of the other schemes of proposed flood control master plan in Jabotabek area. But the project area is located in the center of DKI Jakarta where the political and economic centers of Indonesia are located. The project benefits not counted in monetary term should be so high.

Besides this scheme is socially urgently needed since the flooding in January 6 to 8, 1996 brought about a serious flood damage to the central part of DKI Jakarta even though the flood embankment of the Western Banjir Canal did not totally collapsed.

Since this scheme includes the floodway from the Ciliwung to Cisadane rivers, the river improvement of the downstream reaches of the Cisadane river should be included.

This will be also highly beneficial to surroundings of the north-western area of the Soekarno-Hatta International Airport. Since the benefits counted in monetary term do not include the enhancement benefit due to the development of coastal area between the estuary of the Cisadane and the river-mouth of the Lower Angke by KAPUKNAGA Project.

Following the selected projects, the projects for the river systems of the proposed Eastern Banjir Canal and the Cengkareng floodway are evaluated to be high priority projects from the same viewpoint.

4.7 Proposed River Water Management Plan

4.7.1 Basic Principles of River Water Management

The functions of river are, not only the provision of safe flood route, provision of river water for the economic activities and human lives, but also the provision of amenity to the society by providing the open space and river water of proper water quality.

Terminology of river water management here is considered to be one of the aspects of river management. The basic objectives of river water management are, to alleviate flood damages effectively, to utilize the river water effectively, to keep the river water quality within certain

criteria, and to provide the good amenity to the society.

For those objectives, information management, high flow management, low flow management, water quality management, and facilities management are needed.

(1) Information Management

Necessary information on rainfall, water-level, discharge, tide, river facilities and etc. for the purpose of river water management should be transmitted to a center, be processed, and be stored in a proper manner. Those information and data then should be displayed in a proper manner and then be transmitted to agencies concerned. In such a manner, management of necessary information and data should be centralized.

(2) High Flow Management

Forecast of high flow should be conducted and the necessary instructions based on the result of forecast should be given to operation offices of related facilities. At the same time, related information and data should be supplied to agencies concerned. These information and data would also be utilized for flood fighting activities.

(3) Low Flow Management

Accumulation of low flow data will be contributive to planning formulation for appropriate water resources development. During a drought, forecast of low flow should be conducted and the necessary information and data should be supplied to related agencies and urgent countermeasure should be taken.

(4) Water Quality Management

Water quality has an important role not only for river water utilization but also for giving the amenity of river environment to the society along the river.

(5) Facilities Management

River area and related facilities should be properly maintained and operated to keep the function of rivers, river water, and the related facilities properly.

In the following sections, since this Study only focuses to the flood control aspect of river water management, low flow management and river water quality management are not included in the discussion.

4.7.2 Monitoring System

(1) Consideration to Existing Monitoring System

(a) Rainfall Gauging Station

Presently rainfall data observed are kept by respective agencies and there is no centralized data bank system in the area. And there is no data keeping system commonly established

The observation network is still not enough in number and distribution. Especially gauging stations in the upstream basins of the Cikarang and the Cimanceuri rives are not enough.

(b) Water-level Gauging Station

Water-level gauging stations are mainly located in DKI Jakarta area. It is desirable to establish more stations in western area in future. The datum level of staff gauge at each station is not always clear.

There is no centralized data bank system in the area. There is no data keeping system commonly established

(c) Discharge Observation Station

Discharge measurement has been conducted mainly during low flow. Data during high flow is rather insufficient. Cross-sectional profiles at discharge measurement sites are also insufficient.

(d) Monitoring System

SCADA System mentioned in the previous sub-section is now underway for establishment, but the coverage of the system is not enough for the whole JABOTABEK area.

(2) Monitoring System

Overall monitoring system in JABOTABEK area should consists of a overall center, district centers, observation stations, and facilities stations.

The overall center should be at the Ciliwung - Cisadane River Basin Development Project (PPWSCC). District centers should be the eastern district center at DPU Bekasi, the central district center at PPWSCC, and the western district center at DPU Tangerang. Information transmission to DKI Jakarta should be conducted by the overall center.

The proposed locations of observation and facilities stations are shown in Figure 4.13. The hierarchy of the system is shown in Figure 4.14. The functions of the centers and stations should be as follows:

(a) Overall Center (PPWSCC)

Functions

Collection of data of the whole JABOTABEK area, process of collected data, data banking, monitoring of the operation of facilities, forecast of high flow, information, data and warning transmission to district centers and agencies concerned, and display of the situation, etc.

Facilities

Data communication control facilities, data bank facilities, computers for data display (EWS), computers for high flow forecast, data display panel, graphic display panel. telephone and facsimile, and radio communication equipment.

(b) District Center (Bekasi, PPWSCC, Tangerang)

Functions

Monitoring of the information in the each area, data process, data banking, instructions to facilities, and instructions to flood fighting teams.

Facilities

Data communication control facilities, data bank facilities, computers for data display (EWS), telephone and facsimile, and radio communication equipment, and ITV monitor.

(c) Observation Station (rainfall, water-level)

Functions

Observation of rainfall and water-level, transmission of observed data to the district center

Facilities

Rainfall gauges, water-level gauges, and telemetering equipment

(d) Facilities Station

Functions

Operation of facilities, monitoring of facilities situation, and transmission of situation to district center.

Facilities

telephone and facsimile, radio communication equipment, and ITV monitor.

4.7.3 River Water Management Plan

For the comprehensive river water management, principles on river water management

should be established for the proper function of the river and river water for the society. The principles should be established not only for the river water itself, but also the principles for the river facilities should be established.

(1) Management Plan of River Facilities

The river facilities include dams, barrages, water gates, embankment, and others. For the high flow management, the following should be determined:

1) operation rule of facilities.
2) reporting, warning, and evacuation water-levels at the site.

(2) Management Plan of Construction and Temporary Occupation in River Area

The management of river area is an important aspect of proper management of river water. In the river area, constructions, green belt, park approved by the river management authorities, and other many kinds of constructions are found. These should not obstruct the smooth flow of high flow in the river.

Among others, the following should be paid special attention from the view point of flood control:

(a) Location and Dimensions of Bridge

Location and dimensions of bridge crossing the river have a close relation to the smooth flow of flood. Substantial principles on bridge construction should be established.

(b) Occupation of River Area

Occupation of river area should not obstruct the smooth flow of flood. Since one of the functions of river is the provision of open space to the society especially in urban area where dense land use is dominant. It is said that open space in densely populated area has an important role for the soundness of society. River management authorities should have clear criteria to approve the occupation of river area and should periodically inspect the situation so that the occupation would not hinder the normal function of the river.

(c) Sand Mining

Sand mining has an close relation not only with the low flow and river water quality, but also has an close relation to high flow since the river facilities may loose the foundation so easily depending the way and quantity of sand mining in the river. Accordingly the river management authorities should have criteria to approve the sand mining not only about the quantity but also the location, method and equipment, and about the duties for safe guard to local people.

(3) Flood Fighting Activities

Purpose of flood control could not be achieved only by structural measures such as construction of embankment, dam, floodway and others.

Flood fighting activity is one of the important aspects of flood control and accordingly one of the important aspects of river water management. The purpose of flood fighting activities is to mitigate the flood damage to the possible minimum level.

Major components of flood fighting activities consist of the following:

1) to the resident

- transmission of flood related information,
- establishment of readiness against flooding,
- acceleration of flood fighting activities
- instructions for evacuation
- rescue activities for the victims

2) to the river facilities

- instructions about proper operation of facilities
- inspection of facilities about function and damage
- necessary activities to protect the embankment and other facilities against over flow, water penetration and scouring

(4) Restriction of Land Use

Land to be restricted for use from the view point of flood control consists of the following:

- in the upstream basin,
- in the urban area,
- in the riverine area,
- in the land to be river area in the future,
- flood prone area

(a) Upstream Basin

The land use restriction in the upstream basin should be conducted from the view point to suppress the increase of runoff. The river improvement in the downstream reaches become more and more difficult due to the land use intensification.

(b) Urban Area

River area also plays an important role as disaster prevention area and urgent evacuation place. Accordingly the city planning should take into consideration of the role of the river

area in urban area. Appropriate land use restriction should be made depending on the role of river area in the urban area.

(c) Riverine Area

Land use restriction in riverine area should be conducted from the view point of above-mentioned role of river area and to keep the amenity role of the river area.

(d) Area to be River Area in the Future

Any kind of construction in the area to be river area in the future should be executed after obtaining the approval of the river management authority so that future river construction is assured.

(e) Flood Prone Area

Due to various circumstances, some flood control structures could not be constructed in due time and accordingly some area would remain as flood prone area. In such a case, land use restriction should be made to minimize the flood damage as much as possible.

4.8 Implementation Program

Implementation schedule of the proposed flood control master plan is prepared in consideration of the following:

(1) EIRR

Implementation of projects of higher economic internal rates of return (EIRR) should rather be laid much importance.

(2) Feasibility Study

Feasibility study should continue for about 1 year. The feasibility study of the flood control project of the Western Banjir Canal system should be conducted together with the flood control project of the Cisadane river in the downstream reaches. Because the flood control project of the Western Banjir Canal system includes the floodway from the Ciliwung to Cisadane.

(3) Detailed Design

It should take about 1 year to start the detailed design after the completion of feasibility study. Detailed design should continue for about 2 years. Some parts of the detailed design of the Western Banjir Canal system and the whole Eastern Banjir Canal system have been conducted once, accordingly some part includes the review of the past detailed design.

(4) Implementation

For estimate the construction period, the past record of annual financial disbursement for flood control project in Indonesia is taken into account.

For the Western Banjir Canal System, the river improvement works of the Cisadane river in the downstream reaches should be completed before the completion of the floodway from the Ciliwung to Cisadane.

Figure 4.15 shows the tentatively proposed implementation schedule of the flood control master plan in JABOTABEK area. The tentative implementation schedule proposed shows only by major river system basis.

5 RECOMMENDATIONS

5.1 Flood Control and Drainage

(1) Eastern Banjir Canal

In the present study on the flood control master plan in JABOTABEK area, construction of the Eastern Banjir Canal is proposed as the flood control measure for the eastern part of DKI Jakarta. But the plan needs huge amount of land acquisition cost even though the plan claims the least cost among other alternatives plans. Accordingly it seems that the preparation of such huge amount of land acquisition cost would be very difficult.

But according to the information on PANTURA DKI Jakarta (reclamation plan along the north coast of Jakarta), they are planning to utilize the Eastern Banjir Canal as the waterway and Roro harbor for the Marunda industrial area with the minimum width of 200m of the Eastern Banjir Canal for the downstream reaches.

If a joint planning and implementation with PANTURA DKI Jakarta is realized for construction of the Eastern Banjir Canal, land acquisition and implementation costs for its downstream reaches will be greatly decreased for the government. In this case, the construction of the Eastern Banjir Canal would be much more realistic.

Regarding the upstream reaches of the Eastern Banjir Canal, in order to reduce the land acquisition cost, it is conceivable to make a plan to utilize the space over the Eastern Banjir Canal as housing area or an objective area for city redevelopment project. This can be conducted by joint project with private sector.

Accordingly it is recommended that joint planning with PANTURA DKI Jakarta or other private sectors be conducted in early stage for construction of the Eastern Banjir Canal, since the flood control in the eastern part of DKI Jakarta is socially and urgently needed together with the flood control of the eastern part of DKI Jakarta.

(2) Operation Rule of Barrage

Pasar Baru barrage across the Cisadane river has 10 gates but due to its deterioration, some gates does not function properly. It is estimated that one reason of the deterioration is the rusting caused by biased usage of specific gates.

Accordingly, it is recommended that the operation rule be reconsidered so as to operate all the gate evenly. This recommendation might be applied to Bekasi and Cikarang barrages.

(3) Present River Area

The middle reaches of the rivers in JABOTABEK area are basically located in the deep valley. And accordingly the area is not included in the area to be protected from flooding in due consideration of the retarding effect to the downstream reaches and small beneficiary area due

to its topographical situation.

But in some rivers, many people are already living in the river area even though the area is not delineated as the river area officially.

Technically, the people in those area should be relocated after official delineation of the river area is announced to the public. But for the time being, it does not seem to be possible to relocate the people so soon. Accordingly the delineation of the river area should be implemented first. And then the public announcement should be made that the area is the river area. Then the possibility of flooding to certain elevation to certain amount of discharge of the river with the occurrence possibility should be announced to the public.

At the same time, the effective flood forecasting and warning system should be established so that people can evacuate safely with their properties in the houses. Flood warning should be made by using plural measures including TV.

(4) Future River Area

After the finalization of flood control master plan in JABOTABEK area by the authorized agencies, the area to be the river area in future in accordance with the master plan flood control, should be delineated and certain land use regulation should be conducted so that land acquisition in future should not hinder the implementation of the project.

(5) Bridge

Past flooding on January 6 to 8 in 1996 revealed that some bridges form a bottle neck to flood flow and some bridge do not seem to have enough freeboard. The girder level of bridge or that of aqueduct do no seem to have enough high elevation. This situation should be examined soon and proper action should be taken.

(6) Garbage Issue

Garbage issue of rivers in JABOTABEK area especially in DKI Jakarta has already reached to the level not to be overlooked anymore. Garbage dumped to the river flow causes so bad smell and deteriorates the amenity of rivers so much.

Garbage dumped to the river is, not only the problem of environment, but also the problem of flood control, as already clearly shown in the recent flood on January 6 to 8, 1996, being serious obstacle to flood flow. But construction of garbage screen in the midst of rivers at certain place to protect the downstream reaches may become a serious problem to riverine area around the screen site.

Periodical removal of garbage in rivers during low flow should be conducted. This activity would contribute to elimination of garbage problem during flood.

(7) Preservation of Situ-Situ

Lakes and ponds in the JABOTABEK area so called situ-situ in the local dialect, as discussed in the sub-section 2.4.2, play an important role for flood retention. Situ-situ have, not only the function of flood retention, but also the function of water resources conservation as infiltration place in the basin. Besides the situ-situ also plays an role of giving amenity to the society as recreation place and an role to preserve the fauna and flora in the basin. This has an important significance from the viewpoint of environment.

(8) Regulation of Land Development

So many and wide areas in JABOTABEK area are recently intensively developed as industrial, commercial, resort, and residential area, without appropriate facilities to prevent the increase of flood flow due to the development. The development, not only increases the flood peak flow, but also reduces the basin storage of water resources causing deficit of water resources in the basin or salt water intrusion in groundwater in the area close to the sea.

To avoid these situation, certain legislation should be enacted so that land development should accompany the construction of appropriate flood retention facilities such as flood retention pond, and rainfall infiltration facilities such as infiltration pavement and the like.

(9) Small Scale Improvement of Flooding

(a) I.K.P.N. Complex Along Pesanggrahan River

Floods have been caused by river water flown into the area over the existing concrete wall along the left bank of the Pesanggrahan river as well as local rainwater on the area. It can be suggested that the following measures be taken for improvement of the present situation:

(i) Improvement and extension of the existing concrete wall(left bank only),
(ii) Improvement of local drainage channel in the area and replacement of the existing drainage pump.

The location of the area is indicated as *S7* in Figure 2.25.

(b) Tangerang City Area Between Cisadane and Sabi Rivers

Improvement of a local urban drainage system over this area has been on-going. Besides such improvement works, measures to lower the water level of the Sabi river during flooding of the Cisadane river is necessary to be studied in order to improve a drain condition of the area. Due to no data availability of the Sabi river, specific measure is hard to propose at present, however a preliminary hydrological observation and investigation is recommended to conduct for the Sabi river. For an improvement of the present situation of the Perumahan Benua Indah area which locations is shown as *L1* in Figure 2.26, a replacement of the existing small drainage pump is also necessary.

(c) Ciledug Area Along Angke River

According to the preliminary investigation undertaken for the Ciledug Indah Complex area, indicated as ***R4*** in Figure 2.26, inundation have been caused by flood water of Angke river, not due to drainage problem of local rainfall. No overtopping of flood water has been observed according to inhabitants in this area. However, deteriorated structures such as concrete wall and sluice conduit allowed water intrusion during high water level of the Angke river. Not only local river improvement works, but also removal of garbage deposit and trees in the river course may be effective means for improvement of the present situation of the area.

(d) Rehabilitation of the Cidurian and the Cimanceuri Rivers

The river improvement of the Cidurian and the Cimanceuri rivers are situated in rather low priority since the economic internal rate of returns are small. But the present situation of the rivers are that flooding in downstream areas occurs almost every year because some portion of the present flood embankment of the rivers in the downstream reaches are breached and flood water easily overtops there and inundates in the hinterland.

5.2 Organization and Institutions

5.2.1 Basic Consideration on Present Situation

Various agencies are to be involved in dealing with flood control works, in particular those which are related to land matters and crossing of flood control infrastructures with other structures. To cope with problems which may arise, it is important to make efforts which accommodate institutional approach from the planning, designing, construction, and operation and maintenance stages. All must be based on the prevailing legislation and in order that the implementation of each management aspect is able to run institutionally, the said legislation is necessary to be developed accordingly.

In addition, it is now necessary to consider not only structural method but also non-structural method for flood control in JABOTABEK area especially in DKI Jakarta, Tangerang and Bekasi areas since those areas are now densely populated and urbanized very much. Accordingly new concepts for flood control is now needed to be introduced and the corresponding regulations and institutions are needed to be prepared and enacted for comprehensive flood control in the area.

Furthermore, flood control is closely related to other various development aspects. In order to meet their needs, several agencies have carried out individual/sectional planning and development studies in their respective fields. It is anticipated that within certain period of time, conflict of interest may occur. But due to lack of an integrated planning, the conflict of interest that may occur will be solved in each case by conducting coordination and cooperation among the agencies concerned.

5.2.2 Recommendations

In consideration of the above, the following are recommended for the comprehensive flood control in JABOTABEK area:

1) To carry out the tasks and function of development and management, it is necessary to establish a Unit/Body which is able to perform such tasks and functions.

In national level, the Directorate General of Water Resources Development, within the Ministry of Public Works has the tasks and functions to implement the management and development of water and water source.

In provincial level, water resources unit is established under the provincial regional government, which at present as follows:

In the province of DKI Jakarta, there is a Sub-Dinas of water management (Sub Dinas Tata Air) of Dinas PU and in level of city area (Wilaya Kota), there is Suku Dinas PU which has water division. (Bagian Pengairan)

In the province of West Java, there is a provincial water service (Dinas PU Pengairan) and its Cabang Dinas Pengairan and Ranting Dinas Pengairan.

In the district level, there is a public works district unit (Unit PU Kabupaten) and there is no particular unit which deals with water.

In order to meet the requirements as stated in the prevailing legislation, the above organization structure and its scope of works need to be reviewed soon to match the realistic conditions and being able to anticipate the coming progress of development in JABOTABEK area in which all development sectors are progressing rapidly.

2) An overall and integrated water resources development master plan has to be prepared through the legalized coordination between the agencies concerned.

3) Then the institutional study for the development of the necessary institutions for the said overall and integrated water resources development master plan should be conducted.

4) As intermediate step before getting the conclusion from the said institutional study, the Ciliwung - Cisadane River Basin Development Project should be entrusted to function as head of technical implementation unit which is established based on the Ministerial Decree of State Agencies Management No. 106/1994 (for water resources public services, water resources preservation and conservation agency).

5) If the said institutional study resulted that a state corporation type is feasible and viable, the establishment of such corporation which has the authority and responsibility as stipulated in the Governmental Regulation No. 35/1991 on Rivers, should be proposed. The establishment of the corporation should be made by issuance of the government regulation.

Then it may be preferable to enlarge the scope of work of Jasa Tirta State Corporation (establishment by Government Regulation No. 5/1990) by issuing a Presidential Decree especially related to Art. 8 sect.(2) of Government Regulation No. 5.1990.

6) The steps should be as follows:

- MPW should deliver a proposal to the President to readjust and enlarge the number of rivers which becomes under the management of Jasa Tirta State Corporation to simplify the system of management for rivers and take into consideration the system which is adopted by Ministerial Decrees of MPW No. 39/PRT/1989 and No. 48/PRT/1990.

- In the proposal, sub units or branches should be included which has the authority and responsibility of the management of water resources in the basin.

5.3 Water Resources and River Water Quality

(1) Preservation of Natural Pond, "Situ-Situ"

There are many natural ponds with a total area of about 2,200 ha which have a multiple functions for water use, groundwater recharge, flood retention, recreation, stabilization of flow situation, and so on. In these years, the ponds have been decreased for industrialization and housing development and its total volume have been reduced by sedimentation. Besides, water quality in natural ponds have been deteriorated due to intrusion of waste water.

Furthermore, the river water quality in DKI Jakarta and Bogor areas is being significantly deteriorated but it becomes difficult to provide flushing water for improving worsened situation since construction of dam and reservoir for providing it is rather hard and expensive job as stated by the JWRMS. Taking into account these situation, preservation of the natural ponds "Situ-Situ" contributing to stabilization of river water during the drought season is one of urgent works in managing river water in JABOTABEK area.

From the aspects of river water management, it is recommended to provide rehabilitation works for the existing "Situ-Situ" area for preservation of important functions of them.

(2) Strict Management of Groundwater Use and Provision of Piped Water Supply System and Water Resources Development

It has been identified by the previous studies that the northern part of DKI Jakarta is subsided due to intensive groundwater uses for municipal and industrial water supply. The Government of Indonesia has made efforts to manage the groundwater uses. However, the land subsidence is still progressed and several areas are facing drainage problems which will become more serious if the land subsidence situation is further worsened.

Strict management of the groundwater uses is indispensable to mitigate the land subsidence in

the northern part of DKI Jakarta, including clarification of safe yield of groundwater based on detailed data on the existing wells and geographical information, and improvement of licensing and registration of water users.

Although the ground water use regulation as mentioned in sub-section 2.6.3 is issued, it is necessary to analyze and clarify the relationship between the extent of land subsidence and the mentioned regulation through more detailed simulation study based on detailed geotechnical and geological investigations and groundwater records to be monitored.

As a measure against land subsidence, provision of piped water supply system in JABOTABEK area is recommended to be urgently undertaken by the PAM Jaya in order to replace the water amount taken from ground water source thereby and to develop the surface water resources as soon as possible, as proposed by the JWRMS. Also, other possible measures for groundwater recharge enhancement and groundwater tariff are proposed to be implemented together with the mentioned works.

(3) Separation of Polluted Rivers from West Tarum Canal (WTC)

The West Tarum Canal currently conveys the river water in the Bekasi, Cikarang and Cibeet rivers for drinking water supply in Kabupaten Bekasi and DKI Jakarta. However, the river water quality in these rivers are being worsened by the intrusion of polluted water in the upstream areas. In order to reduce the health risks and operation and maintenance cost in the water treatment plants, especially purification cost, it is recommended to separate these rivers by provision of syphon structure or pipeline conveyance at joining points with these rivers.

While, the intake weirs along the WTC are currently operated mainly for conveying water to DKI Jakarta. Therefore, the gates of these weirs are not effectively operated for smoothly passing flood water in these rivers in order to keep water level at the weir sites and to take water in, and this is one of causes for flooding in the upstream of weir sites.

From the above, the proposed improvement works will be effective not only for water uses management but also flood control.

(4) Establishment of Solid Waste Collection System

Solid waste is deposited at many places or trapped by the river structures along the river course and drainage canal, and it worsens river water quality and river view. Besides, the waste causes reduction of flow capacity of river channels and drainage canals.

To mitigate the mentioned situation, appropriate solid waste collection system is required to be established by DKI Jakarta.

(5) Water Data Center for Managing Water Resources

The Cisadane Water Data Center was established as a part of the Water Quality Management

and Pollution Control Project and is scheduled to be upgraded to the JABOTABEK Water Data Center by the project.

The related data to water quantity and quality are currently managed by many agencies. However, in order to timely and effectively manage the water resources and its quality, data observation network, collection and analysis system are strongly required under close relation and coordination between the agencies concerned.

To earlier realization of the JABOTABEK Water Data Center, the phases III and IV, scheduled to be carried out in 1992 to 1995, are expected to be proceeded in the current phase of the Water Quality Management and Pollution Control Project.

Tables

Table 2.1 GROSS DOMESTIC PRODUCT

Year	At Current Price				At 1983 Constant Price			
	GDP		GDP Per Capita		GDP		GDP Per Capita	
	Amount (Rp. Billion)	Growth Rate	Amount (Rp.)	Growth Rate	Amount (Rp. Billion)	Growth Rate	Amount (Rp.)	Growth Rate
1984	89,885	-	-	-	83,037	-	-	-
1985	96,997	7.9%	581,469	-	85,082	2.5%	491,836	-
1986	102,683	5.9%	576,005	-0.9%	90,081	5.9%	500,837	1.8%
1987	124,817	21.6%	734,866	27.6%	94,518	4.9%	556,478	11.1%
1988	142,020	13.8%	818,962	11.4%	99,936	5.7%	576,282	3.6%
1989	167,185	17.7%	956,817	16.8%	107,437	7.5%	614,872	6.7%
1990	195,597	17.0%	1,097,812	14.7%	115,217	7.2%	646,671	5.2%
1991	227,450	16.3%	1,253,971	14.2%	123,225	7.0%	679,361	5.1%
1992	259,885	14.3%	1,408,657	12.3%	131,185	6.5%	711,063	4.7%
1993	302,018	16.2%	1,609,997	14.3%	139,707	6.5%	744,751	4.7%

Source: Pendapatan National Indonesia 1988 - 1993, Biro Pusat Statistik
Statistik Indonesia 1988, 1990 and 1991

Note: Figures in 1992 and 1993 are preliminary.

Table 2.2 PRICE INDEX AND INFLATION RATE

Year	Consumer Price Index (DKI Jakarta)					Wholesale Price Index	Inflation Rate (DKI Jakarta)	
	General	Foodstuffs	Housing	Clothing	Miscella-neous	Construction Materials General	Calender Year	Fiscal Year
Price Index								
1985	232.28	207.77	272.79	194.85	242.28	113.00	3.94%	5.44% (85/86)
1986	239.92	222.20	275.97	195.91	246.28	119.00	8.18%	6.24% (86/87)
1987	263.50	242.31	292.61	225.29	281.28	132.00	9.02%	8.08% (87/88)
1988	263.70	283.10	309.80	230.10	289.80	145.00	4.44%	5.99% (88/89)
1989	301.02	300.94	324.20	239.91	299.63	160.00	5.56%	4.97% (89/90)
	(100)	(100)	(100)	(100)	(100)			
1990	112.31	109.18	115.06	113.96	111.90	174.00	11.26%	10.29% (90/91)
1991	123.79	118.63	127.87	119.98	126.49	190.00	10.38%	10.75% (91/92)
1992	134.30	129.45	137.65	130.32	137.55	200.00	5.46%	11.50% (92/93)
1993	148.29	139.60	156.67	147.10	149.03	213.00	10.28%	7.29% (93/94)
1994	162.35	156.67	175.66	159.38	155.11	224.00	10.56%	9.47% (94/95)
1995	179.03	178.29	195.32	169.85	165.69	246.00	9.54%	10.30% (95/96)
Average annual increasing ratio								
1985 - 1995 (10 years)	8.8%	10.0%	8.8%	7.7%	7.4%	8.1%	8.5%	8.5%
1990 - 1995 (latest 5 years)	9.8%	10.3%	11.2%	8.3%	8.2%	7.2%	9.2%	9.9%

Sources :
Statistik Indonesia 1988, 1991, 1994, Biro Pusat Statistik
Indikator Ekonomi, January 1993, January 1994, January to December 1995
Indikator Ekonomi DKI Jakarta 1995, BPS DKI Jakarta

Note :
1. Consumer price index before 1990: April 1977 - March 1978 = 100
2. Consumer price index since 1990: April 1988 - March 1989 = 100
3. Wholesale price index: 1983 = 100

Table 2.3 INTERNATIONAL BALANCE OF PAYMENT

(Unit : US$ million)

Items	Fiscal Year						
	1988/ 1989	1989/ 1990	1990/ 1991	1991/ 1992	1992/ 1993	1993/ 1994	1994/ 1995
A) Current Account	-1,859	-1,599	-3,741	-4,352	-2,561	-2,940	-3,488
1) Merchandise	5,513	6,456	5,115	4,911	7,986	7,377	8,039
a) Export (F.O.B)	19,824	23,830	28,143	29,714	35,303	36,504	42,161
Non-oil and non-gas	12,184	14,493	15,380	19,008	24,823	27,170	31,716
Oil and gas	7,640	9,337	12,763	10,706	10,480	9,334	10,445
- Oil	5,007	6,288	8,053	6,869	6,363	5,512	6,312
- LNG	2,508	2,801	4,304	3,510	3,764	3,507	3,746
- LPG	125	248	406	327	353	315	387
b) Import (F.O.B)	-14,311	-17,374	-23,028	-24,803	-27,317	-29,127	-34,122
Non-oil and non-gas	-12,239	-14,845	-19,448	-21,660	-23,751	-25,311	-30,476
Oil and gas	-2,072	-2,529	-3,580	-3,143	-3,566	-3,816	-3,646
- Oil	-1,912	-2,342	-3,388	-2,915	-3,314	-3,555	-3,383
- LNG	-160	-187	-192	-228	-252	-261	-263
2) Services (net)	-7,372	-8,055	-8,856	-9,263	-10,547	-10,317	-11,527
a) Non-oil and non-gas	-4,864	-5,158	-5,683	-6,262	-7,148	-7,333	-8,515
b) Oil and gas	-2,508	-2,897	-3,173	-3,001	-3,399	-2,984	-3,012
- Oil	-1,560	-1,635	-1,783	-1,796	-1,722	-1,638	-1,557
- LNG	-948	-1,262	-1,390	-1,205	-1,677	-1,346	-1,455
B) Capital Account	2,614	2,405	6,780	5,551	5,199	5,711	4,750
1) Official capital (net)	2,825	1,830	924	1,418	915	1,063	105
a) *Inflows*	6,588	5,516	5,006	5,600	5,755	6,195	5,651
IGGI	5,468	4,668	4,897	5,250	5,527	5,778	5,510
non-IGGI	1,120	848	109	350	228	417	141
b) Debt repayment	-3,763	-3,686	-4,082	-4,182	-4,840	-5,132	-5,546
2) Private capital	-211	575	5,856	4,133	4,284	4,648	4,645
a) *Direct investment*	585	722	1,424	1,531	1,705	1,971	2,566
b) Others	-796	-147	4,432	2,602	2,579	2,677	2,079
C) Total (A through B)	755	806	3,039	1,199	2,638	2,771	1,262
D) Errors and Omissions (net)	-1,432	-558	263	-218	-1,199	-2,044	646
E) Reserves	677	-248	-3,302	-981	-1,439	-727	-616
1) Foreign assets	677	-248	-3,302	-981	-1,439	-727	-616
2) Foreign liabilities	0	0	0	0	0	0	0

Sources : Indikator Ekonomi January 1993 and September 1996, Biro Pusat Statistik.

Table 2.4 MAIN IMPORT AND EXPORT COMMODITIES OF INDONESIA

Commodity Group	1981		1985		1990		1995	
	Value (US$ million)	Rate(*)	Value (US$ million)	Rate(*)	Value (US$ million)	Rate(*)	Value (US$ million)	Rate(*)
(A) Import								
a) Foodstuff and livestock	1,356	10.2%	556	5.4%	852	3.9%	3,023	7.4%
b) Beverages and tobacco	45	0.3%	21	0.2%	54	0.2%	178	0.4%
c) Raw materials (inedible)	565	4.3%	729	7.1%	1,885	8.6%	3,643	9.0%
d) Fuel, lubricants and related materials	1,727	13.0%	1,288	12.6%	1,937	8.9%	3,007	7.4%
e) Animal & vegetable oils & fats	29	0.2%	36	0.4%	25	0.1%	105	0.3%
f) Chemical materials	1,754	13.2%	1,917	18.7%	3,394	15.5%	6,251	15.4%
g) Manufactured goods classified chiefly by materials	2,518	19.0%	1,718	16.7%	3,553	16.3%	6,669	16.4%
h) Machinery and vehicles	4,619	34.8%	3,618	35.3%	9,328	42.7%	16,290	40.1%
i) Miscellaneous manufactured articles	325	2.4%	331	3.2%	797	3.6%	1,426	3.5%
j) Commodities & transactions not classified above	334	2.5%	46	0.4%	12	0.1%	37	0.1%
Total	13,272	100.0%	10,260	100.0%	21,837	100.0%	40,629	100.0%
(B) Export								
(1) Petroleum & Gas	20,663	82.1%	12,718	68.4%	11,071	43.1%	10,465	23.0%
a) Crude petroleum	16,954	67.4%	8,251	44.4%	6,220	24.2%	5,146	11.3%
b) Petroleum and related products	1,211	4.8%	832	4.5%	1,184	4.6%	1,297	2.9%
c) Gas	2,499	9.9%	3,635	19.6%	3,667	14.3%	4,022	8.9%
(2) Agricultural Products	1,570	6.2%	1,388	7.5%	2,083	8.1%	2,889	6.4%
a) Rubber	42	0.2%	35	0.2%	40	0.2%	42	0.1%
b) Coffee	346	1.4%	556	3.0%	369	1.4%	596	1.3%
c) Legs	662	2.6%	9	0.0%	-	0.0%	-	0.0%
d) Shrimps	163	0.6%	202	1.1%	671	2.6%	1,032	2.3%
e) Tea	101	0.4%	149	0.8%	181	0.7%	85	0.2%
f) Spices	73	0.3%	126	0.7%	152	0.6%	214	0.5%
g) Tobacco	51	0.2%	43	0.2%	59	0.2%	49	0.1%
h) Cocoa beans	15	0.1%	59	0.3%	99	0.4%	225	0.5%
i) Cassava	33	0.1%	46	0.2%	71	0.3%	-	0.0%
j) Fish	37	0.1%	22	0.1%	205	0.8%	372	0.8%
k) Vegetables	5	0.0%	7	0.0%	22	0.1%	43	0.1%
l) Fruits	4	0.0%	16	0.1%	21	0.1%	30	0.1%
m) Other agricultural products	39	0.2%	118	0.6%	192	0.7%	201	0.4%
(3) Industrial Products	2,667	10.6%	4,246	22.8%	11,879	46.3%	29,328	64.6%
a) Plywood	161	0.6%	825	4.4%	2,726	10.6%	3,462	7.6%
b) Sawn wood	220	0.9%	307	1.7%	110	0.4%	454	1.0%
c) Other processed wood	36	0.1%	53	0.3%	491	1.9%	1,075	2.4%
d) Tin	452	1.8%	241	1.3%	173	0.7%	239	0.5%
e) Aluminium	1	0.0%	246	1.3%	262	1.0%	475	1.0%
f) Nickel	151	0.6%	117	0.6%	188	0.7%	284	0.6%
g) Garments	95	0.4%	340	1.8%	1,670	6.5%	3,388	7.5%
h) Other textile	31	0.1%	220	1.2%	1,260	4.9%	2,816	6.2%
i) Processed rubber	812	3.2%	683	3.7%	851	3.3%	2,191	4.8%
j) Cattle fodder	88	0.4%	68	0.4%	163	0.6%	142	0.3%
k) Palm oil	107	0.4%	166	0.9%	204	0.8%	747	1.6%
l) Fatty acids	11	0.0%	59	0.3%	80	0.3%	327	0.7%
m) Electrical apparatus	86	0.3%	144	0.8%	286	1.1%	922	2.0%
n) Processed food	64	0.3%	57	0.3%	293	1.1%	819	1.8%
o) Cement	19	0.1%	22	0.1%	97	0.4%	8	0.0%
p) Chemicals	30	0.1%	57	0.3%	113	0.4%	519	1.1%
q) Fertilizer	4	0.0%	80	0.4%	194	0.8%	277	0.6%
r) Paper & paper goods	1	0.0%	21	0.1%	156	0.6%	1,011	2.2%
s) Other industrial products	296	1.2%	542	2.9%	2,561	10.0%	10,172	22.4%
(4) Mining Products	203	0.8%	196	1.1%	636	2.5%	2,691	5.9%
a) Copper ore	128	0.5%	115	0.6%	375	1.5%	1,537	3.4%
b) Coal	5	0.0%	35	0.2%	168	0.7%	1,033	2.3%
c) Other mining products	69	0.3%	47	0.3%	94	0.4%	121	0.3%
(5) Other Products	62	0.2%	39	0.2%	6	0.0%	46	0.1%
Total	25,165	100.0%	18,587	100.0%	25,675	100.0%	45,418	100.0%

Source : Indikator Ekonomi, September 1996, Biro Pusat Statistik

Note : Symbol of (*) indicates percentage distribution in value within major import and export commodities.

Table 2.5 TRADING SITUATION OF TANJUNG PRIOK PORT IN JAKARTA

Port of Import and/or Export	1987		1988		1989		1990		1991		1992		1993		1994	
	Volume	Value	Volume	Value	Volume	Value	Volume	Value	Volume	Value	Volume	Value	Volume	Value	Volume	Value
(A) *Import*																
Tanjung Priok	6,199	5,895	6,197	6,527	7,238	8,395	9,245	12,008	10,054	14,248	11,218	14,116	12,578	15,340	14,907	18,340
Contribution (%)		47.7%		49.3%		51.3%		55.0%		55.1%		51.7%		54.2%		59.2%
Indonesia	23,081	12,370	21,518	13,249	26,082	16,380	30,280	21,837	34,215	25,869	36,016	27,280	37,961	28,328	41,960	30,954
Contribution (%)		100.0%		100.0%		100.0%		100.0%		100.0%		100.0%		100.0%		100.0%
(B) *Export*																
Tanjung Priok	7,547	2,013	8,144	2,795	9,759	3,891	8,176	5,123	8,671	6,885	11,950	9,731	10,463	10,903	10,689	11,411
Contribution (%)		11.7%		14.5%		17.6%		20.0%		23.6%		28.6%		29.6%		28.7%
Indonesia	134,249	17,136	115,381	19,219	102,263	22,159	107,566	25,675	115,461	29,142	151,535	33,967	177,471	36,823	214,714	39,708
Contribution (%)		100.0%		100.0%		100.0%		100.0%		100.0%		100.0%		100.0%		100.0%

Sources: Statistik Indonesia 1991 and 1994 Biro Pusat Statistik

Note:

1. Unit: Volume in 1,000 ton
   Value in US$ million
2. Figures in 1994 are estimated figures by Biro Pusat Statistik

Table 2.6 FOREIGN CURRENCY EXCHANGE RATE
(Middle Rate)

(Unit: Rupiah)

Month	1989		1990		1991		1992		1993		1994		1995		1996	
	US$	JP¥	US$	JP¥	US$	JP¥	US$	JP¥	US$	JP¥	US$	JP¥	US$	JP¥	US$	JP¥
January	1,735.38	13.56	1,803.75	12.35	1,907.40	14.13	1,997.60	15.79	2,064.78	16.55	2,126.25	18.99	2,217.25	22.14	2,303.25	22.65
February	1,741.50	13.50	1,810.95	12.33	1,915.00	14.56	2,006.75	15.60	2,066.63	17.12	2,133.75	20.06	2,232.00	22.69	2,315.40	21.66
March	1,750.80	13.33	1,819.00	11.85	1,928.25	13.97	2,014.80	15.07	2,069.13	17.70	2,161.60	20.53	2,236.80	24.48	2,341.75	22.13
April	1,755.00	13.19	1,825.75	11.41	1,935.20	13.95	2,028.80	14.98	2,070.76	18.45	2,170.25	20.93	2,244.00	26.70	2,346.20	21.91
May	1,765.00	12.66	1,830.80	11.78	1,943.00	13.93	2,024.50	15.36	2,076.67	18.88	2,173.25	20.67	2,245.00	26.52	2,344.80	22.12
June	1,770.90	12.21	1,840.00	11.92	1,951.50	13.80	2,030.60	15.89	2,083.83	19.48	2,169.25	21.35	2,242.50	26.54	2,346.00	21.64
July	1,772.50	12.47	1,845.80	12.28	1,957.00	14.03	2,033.60	16.06	2,093.00	19.47	2,163.00	21.89	2,239.25	25.86	2,348.40	21.53
August	1,779.30	12.51	1,853.55	12.48	1,961.10	14.19	2,034.50	15.97	2,097.38	20.25	2,177.25	21.84	2,258.60	24.17	2,356.00	21.90
September	1,786.25	12.21	1,859.57	13.28	1,966.00	14.49	2,037.70	16.51	2,115.00	20.01	2,186.40	22.07	2,284.00	22.73	2,345.71	21.41
October	1,787.03	12.48	1,865.00	14.29	1,973.80	14.97	2,043.80	16.80	2,133.50	19.46	2,186.00	22.19	2,281.00	22.68	2,346.05	20.94
November	1,793.15	12.38	1,874.60	14.44	1,980.75	15.16	2,053.00	16.49	2,115.00	19.38	2,185.60	22.32	2,291.20	22.50		
December	1,794.19	12.39	1,888.91	13.93	1,988.38	15.34	2,057.90	16.47	2,118.00	18.96	2,195.80	22.02	2,302.50	22.65		
Average	1,769.25	12.74	1,843.14	12.70	1,950.62	14.38	2,030.30	15.92	2,091.97	18.81	2,169.03	21.24	2,256.18	24.14	2,339.36	21.79

Source : Study on Ciujung - Cidurian Integrated Water Resources in Indonesia, JICA.
Indikator Ekonomi January 1992, January 1993, January 1994, May 1994, January 1995, May 1995, August 1995, October 1995, January 1996, April 1996 and August 1996, Biro Pusat Statistik.
Written information from Bank Indonesia for September and October 1996.

Table 2.7 REGIONAL GROSS DOMESTIC PRODUCT IN 1983 CONSTANT PRICE LEVEL IN STUDY AREA

Industry Origin	Indonesia		West Java		DKI Jakarta		Kab Bogor		Kodya Bogor		Kab. Tangerang		Kodya Tangerang		Kab. Bekasi		Kab. Serang	
Year:	1993		1993		1994		1992		1991		1992		1993		1992		1991	
	(Rp. Billion)	(%)	(Rp. Million)	(%)	(Rp. Million)	(%)	(Rp. Million)	(%)	(Rp. Million)	(%)	(Rp. Million)	(%)	(Rp. Million)	(%)	(Rp. Million)	(%)	(Rp. Million)	(%)
Regional Gross Domestic Products																		
1) Agriculture	24,569	17.6%	3,870,047	17.6%	84,497	0.4%	250,667	15.6%	2,499	1.3%	169,038	12.0%	19,122	2.3%	145,718	13.8%	126,777	11.0%
2) Mining & quarrying	19,370	13.9%	2,512,203	11.4%	0	0.0%	10,992	0.7%	0	0.0%	507	0.0%	0	0.0%	3,527	0.3%	5,964	0.5%
3) Manufacturing industries	29,484	21.1%	5,008,020	22.8%	4,986,474	26.5%	484,956	30.2%	14,585	7.6%	402,670	28.6%	274,123	33.3%	456,578	43.3%	696,231	60.3%
4) Electricity, gas & water supply	1,022	0.7%	471,850	2.1%	828,245	4.4%	44,245	2.8%	9,692	5.1%	33,180	2.4%	16,053	1.9%	23,178	2.2%	5,781	0.5%
5) Construction	9,223	6.6%	1,453,758	6.6%	1,950,023	10.4%	158,732	9.9%	29,426	15.4%	105,917	7.5%	64,523	7.8%	96,126	9.1%	84,675	7.3%
6) Trade, restaurant and hotel	22,850	16.4%	4,582,276	20.9%	3,763,679	20.0%	389,934	24.3%	41,249	21.6%	290,749	20.6%	160,055	19.4%	177,312	16.8%	127,416	11.0%
7) Transportation & communication	8,302	5.9%	1,241,942	5.7%	2,124,181	11.3%	89,225	5.6%	42,323	22.2%	288,946	20.5%	248,160	30.1%	58,588	5.6%	33,495	2.9%
8) Banking and Financing	7,070	5.1%	525,667	2.4%	3,195,861	17.0%	2,485	0.2%	9,800	5.1%	9,235	0.7%	3,012	0.4%	2,305	0.2%	7,068	0.6%
9) Ownership of dwelling	3,411	2.4%	318,952	1.5%		0.0%	22,756	1.4%	1,875	1.0%	14,261	1.0%	4,731	0.6%	10,885	1.0%	8,461	0.7%
10) Public services and defence	9,509	6.8%	1,224,079	5.6%	598,631	3.2%	67,615	4.2%	31,529	16.5%	61,213	4.3%	22,087	2.7%	41,961	4.0%	39,145	3.4%
11) Services	4,897	3.5%	746,774	3.4%	1,258,918	6.7%	82,482	5.1%	8,061	4.2%	34,032	2.4%	12,478	1.5%	37,781	3.6%	19,780	1.7%
Total :	139,707	100.0%	21,955,568	100.0%	18,790,509	100.0%	1,604,089	100.0%	191,039	100.0%	1,409,748	100.0%	824,344	100.0%	1,053,959	100.0%	1,154,793	100.0%
		Growth Rate		*Growth Rate*		*Growth Rate*		*Growth Rate*		*Growth Rate*		*Growth Rate*		*Growth Rate*		*Growth Rate*		*Growth Rate*
1993	139,707	6.5%	21,955,568	6.9%	17,350,315	8.4%	-	-	-	-	-	-	824,344	10.1%	-	-	-	-
1992	131,185	6.5%	20,540,754	7.0%	16,001,557	8.6%	1,604,089	8.0%	-	-	1,409,748	10.9%	748,589	8.1%	1,053,959	15.8%	-	-
1991	123,225	7.0%	19,195,892	6.9%	14,730,349	7.8%	1,485,688	9.1%	191,039	8.3%	1,270,671	7.7%	692,571	-	909,889	12.5%	1,154,793	8.7%
1990	115,217	7.2%	17,959,098	9.4%	13,664,719	8.6%	1,361,966	9.2%	176,324	6.9%	1,179,445	8.1%	-	-	808,810	13.4%	1,062,366	-
1989	107,437	7.5%	16,409,083	8.2%	12,586,088	9.7%	1,247,098	7.4%	164,967	6.3%	1,091,071	7.4%	-	-	713,047	8.3%	-	-
1988	99,981	5.8%	15,167,864	8.3%	11,469,201	6.6%	1,161,429	11.2%	155,216	9.2%	1,016,116	9.1%	-	-	658,099	12.1%	923,631	6.9%
1987	94,518	4.9%	14,007,974	3.7%	10,757,764	5.8%	1,044,163	19.9%	142,159	4.2%	931,525	7.6%	-	-	587,162	4.0%	864,301	4.6%
1986	90,081	5.9%	13,504,535	6.6%	10,163,638	5.0%	870,977	8.6%	136,365	5.0%	865,648	8.1%	-	-	564,490	5.2%	826,148	22.8%
1985	85,082	2.5%	12,671,165	6.1%	9,678,677	5.1%	802,242	5.7%	129,905	11.8%	800,459	26.9%	-	-	536,730	8.7%	673,020	21.3%
1984	83,037	-	11,940,200	-	9,204,771	-	758,896	-	116,182	-	630,948	-	-	-	493,755	-	554,855	-

Sources : 1. Pendapatan National Indonesia 1988 - 1993, Biro Pusat Statistik

2. Pendapatan Regional Bruto Propinsi-Propinsi di Indonesia Menurut Lapangan Usaha 1988 - 1993, Biro Pusat Statistik

3. Jakarta Dalam Angka 1994, 1995, Kab. Bogor Dalam Angka 1992, Kab. Tangerang Dalam Angka 1993, Kodya Tangerang Dalam Angka 1993, Kab. Bekasi Dalam Angka 1993

4. Produk Domestik Regional Bruto Kabupaten/Kotamadya di Jawa Barat 1986 - 1990, Kantor Statistik Propinsi Jawa Barat

5. Study on Ciujung - Cidurian Integrated Water Resources in Indonesia, JICA

Table 2.8 CATCHMENT AREA OF RIVERS

No.	River Systems	Principal Point on Main Rivers/Related Rivers	Area (km2)
1	Cidurian (803 km²)	Cidurian (estuary)	803
		Cidurian (Parigi)	596
		Cidurian (before confluence with Cibeureum)	378
		Cibeureum	218
2	Cimanceuri (570 km²)	Cimanceuri (estuary)	570
		Cimanceuri (confluence with Cipaseun <Balaraja>)	415
		Cimanceuri (confluence with Cimatuk)	233
		Cipaseun	116
		Cimanceuri (confluence with Cimatuk)	102
		Cimatuk	131
3	Cirarab (161 km2)	Cirarab (estuary)	161
4	Cisadane (1,411 km²)	Cisadane (estuary)	1,411
		Cisadane (Pasar Baru weir)	1,248
		Cisadane (after confluence with Cianten)	846
		Cisadane (before confluence with Cianten)	433
		Cianten	413
5	Cengkareng Floodway (459 km²)	Cengkareng Floodway (Cengkareng weir)	459
		Cengkareng Floodway (confluence with Angke)	392
		Mookervaart canal	67
		Angke <including Sepak>	255
		Angke (proposed Angke floodway site)	107
		Pesanggrahan <including Grogol>	137
		Pesanggrahan (confluence with Sodetan)	94
		Pesanggrahan river (Proposed Cinere Dam site)	72
		Grogol river (upstream of Sodetan)	30
6	Western Banjir Canal (421 km²)	Western Banjir Canal (Karet weir)	421
		Krukut	84
		Ciliwung (Manggarai)	337
		Ciliwung (Proposed Depok Dam site)	251
		Ciliwung (Proposed Ciliwung Floodway site)	152
		Ciliwung (Proposed Ciawi Dam site)	88
7	Proposed Eastern Banjir Canal (207 km²)	Proposed Eastern Banjir Canal (Estuary)	207.0
		Cipinang (upstream of EBC)	50.5
		Sunter (upstream of EBC)	73.1
		Buaran (upstream of EBC)	13.0
		Jatikramat (upstream of EBC)	16.5
		Cakung (upstream of EBC)	34.5
		Residual basins	19.4
8	CBL Floodway (1,135 km²)	CBL Floodway (Estuary)	915
		Bekasi (upstream of CBL Floodway)	403
		Bekasi (Bekasi weir)	389
		Bekasi river (confluence of Cikeas and Cileungsi)	371
		Cikeas	110
		Cileungsi	261
		Cisadang (upstream of CBL Floodway)	135
		Cikarang (upstream of CBL Floodway)	230
		Cilemahabang (Estuary)	220
		Residual basins	147
9	Other residual basins including urban drainage area in DKI Jakarta		903
Total JABOTABEK area			6,070

Table 2.9 DIMENSIONS OF RIVERS

No.	River systems	No.	Related rivers	Dimensions of basins					Characteristics of basins	
				Length (km)	Elevation (m) max.	Elevation (m) min.	Average slope	Area (km2)	Topography	Present land use in flood plain
1	Cidurian	1	Cidurian	129.3	1700.0	0.0	1/80	803	Mountainous	Rural
2	Cimanceuri	2	Cimanceuri	101.3	600.0	0.0	1/170	570	Mountainous	Rural
3	Cirarab	3	Cirarab	49.0	62.5	0.0	1/780	161	Hilly	Rural
4	Cisadane	4	Cisadane	137.8	2100.0	0.0	1/70	1411	Mountainous	Urban + Rural
5	Cengkareng Floodway (459 km^2)	5	Cengkareng Floodway	7.9	3.0	0.0	1/2630	459	Plain	Urban
		6	Mookervaart Canal	13.0	14.0	3.0	1/1180	67	Plain	Urban
		7	Angke	81.8	225.0	2.0	1/370	255	Hilly	Urban
		8	Pesanggrahan	65.5	175.0	3.0	1/380	107	Hilly	Urban
		9	Grogol (upstream of Sodetan)	21.0	100.0	21.0	1/270	30	Hilly	Urban
6	Western Banjir Canal (421 km^2)	10	Western Banjir Canal	17.3	6.3	0.0	1/2750	421	Plain	Urban
		11	Krukut	33.5	100.0	3.0	1/350	84	Hilly	Urban
		12	Ciliwung (upstream of Manggarai)	109.0	1500.0	6.3	1/70	337	Mountainous	Urban
7	Eastern Banjir Canal <proposed> (207 km^2)	13	Proposed Eastern Banjir Canal	23.7	12.5	0.0	1/1900	207.0	Plain	Urban
		14	Cipinang (upstream of EBC)	36.0	115.0	12.5	1/350	50.5	Hilly	Urban
		15	Sunter (upstream of EBC)	37.0	120.0	11.5	1/340	73.1	Hilly	Urban
		16	Buaran (upstream of EBC)	9.0	32.0	10.0	1/410	13.0	Hilly	Urban
		17	Jatikramat (upstream of EBC)	13.5	41.0	9.5	1/430	16.5	Hilly	Urban
		18	Cakung (upstream of EBC)	30.5	103.0	6.5	1/320	34.5	Hilly	Urban
8	C.B.L. Floodway (1,135 km^2)	19	C.B.L. Floodway	28.8	10.0	0.0	1/2880	1326	Plain	Rural
		20	Bekasi (upstream of CBL)	115.1	1500.0	4.3	1/80	403	Mountainous	Urban + Rural
		21	Cisadang (upstream of CBL)	36.5	87.5	8.0	1/460	135	Hilly	Rural
		22	Cikarang (upstream of CBL)	65.3	300.0	10.0	1/230	230	Hilly	Rural
		23	Cilemahabang	62.8	52.0	3.0	1/1280	220	Plain	Rural

Table 2.10 CARRYING CAPACITIES OF CHANNELS

River Systems and Rivers	Bankful (m^3/s)	Freeboard (m^3/s)
1 *Cidurian River System*		
- Cidurian	200 - 850	100 - 650
2 *Cimanceuri River System*		
- Cimanceuri	175 - 750	100 - 625
3 *Cirarab River System*		
- Cirarab	25 - 175	20 - 100
4 *Cisadane River System*		
- Cisadane	300 - 3200	200 - 2800
5 *Cengkareng Floodway System*		
- Cengkareng Floodway	75 - 500	50 - 300
- Mookervaart Canal	30 - 470	25 - 380
- Angke	30 - 300	25 - 225
- Pesanggrahan	30 - 250	20 - 180
- Grogol	150 - 400	100 - 300
6 *Western Banjir Canal System*		
- Western Banjir Canal	100 - 800	75 - 625
- Krukut	25 - 120	20 - 175
- Ciliwung	200 - 1700	175 - 1450
7 *Proposed Eastern Banjir Canal System*		
- Eastern Banjir Canal	-	-
- Cipinang	13 - 23	7 - 12
- Sunter	11 - 28	5 - 20
- Buaran	7 - 29	1 - 14
- Jatikramat	2 - 8	0 - 0
- Cakung	4 - 12	1 - 6
8 *CBL Floodway System*		
- CBL Floodway	200 - 1000	100 - 950
- Bekasi	100 - 2000	80 - 1600
- Cisadang	30 - 200	20 - 150
- Cikarang	350 - 950	250 - 750
- Cilemahabang	100 - 275	75 - 200

Table 2.11 PUMP STATION FOR DRAINAGE SYSTEM IN DKI JAKARTA

Pump Station No.	Name	Drain. Area(ha)	Capacity Unit Capacity (m^3/s)	(Nos.)	Total (m^3/s)	Related Reservoir / Rivers
EXISTING						
P01	Pluit Barat	3,430	4.0	4	16.0	Pluit Reservoir
P02	Pluit Timur		3.2	4	12.8	Pluit Reservoir
P03	Muara Angke	53	1.3	2	2.6	K.Angke, Banjir Canal
P04	Melati	185	0.5	6	3.0	Banjir Canal
P05	Setiabudi Barat	232	1.0	5	5.0	K.Cideng, Banjir Canal
P06	Setiabudi Timur		1.0	3	3.0	K.Cideng, Banjir Canal
P07	Grogol	60	0.5	2	1.0	K.Grogol, K.Jelambar
			0.7	1	0.7	
P08	Tomang Barat	170	1.0	4	4.0	K.Sekretaris
P09	Pulo Mas	25	2.5	3	7.5	K.Sunter
P10	Rawa Kepa	253	2.0	4	8.0	Western Banjir Canal
P11	Teluk Gong (Lower Angke)	-	0.5	4	2.0	Lower K.Angke
P12	Sunter Barat Utara	1,250	3.3	3	9.9	K.Lagoa Tenggiri K.Ancol
P13	Hankam Slipi	-	0.06	3	0.18	K.Grogol
P14	Cideng	750	6.7	6	40.0	Western Banjir Canal
P15	Pondok Bandung	90	1.3	2	2.6	Western Banjir Canal
P16	Istana	50	0.25	3	0.75	K.Ciliwung
P17	JKPN	-	0.06	3	0.18	K.Pesanggrahan
P18	Mangga Dua Utara	77	1.3	2	2.6	K.Ciliwung
UNDER CONSTRUCTION/PLAN						
P19	Ancol	630	-	-	15.0	K.Sunter
P20	Sunter Timur I	390	-	-	5.2	K.Sunter
P21	Sunter Timur III	570	-	-	15.5	K.Sunter
P22	Kemayoran Airport Re-development	380	-	-	4.0	

Source : (1) The Studu on Urban Drainage and Wastewater Disposal Project in the City of Jakarta, Master Plan Study, Main Report /Supporting Report Vol.I, JICA, 1991
(2) DPU DKI Jakarta
(3) Review Report of East Jakarta Flood Control Project, Aug.,1988

Table 2.12 RESERVOIR FOR DRAINAGE SYSTEM IN DKI JAKARTA

Reservoir			Drain	Related Structure				Related Rivers
				Pump Station		Gate	Syp'n	
No.	Name	Area (ha)	Area (ha)	No.	Name	Nos.	Nos.	
EXISTING								
R01	Wk. Pluit	80	3,430	P01	Pluit Barat	1	12	K.Jelakeng
				P02	Pluit Timur			K.Pakin
								K.Jl.Pluit Selatan
R02	Muara Angke	0.5	53	P03	Muara Angke	1	-	K.Angke
								Banjir Canal
R03	Wk. Melati	3.5	185	P04	Melati			Banjir Canal
R04	Wk. Setibudi	4	232	P05	Setiabudi Barat	1	1	Banjir Canal
	(East and West)			P06	Setiabudi Timur			K.Cideng
R05	Wk. Grogol	3	60	P07	Grogol	1	-	K.Grogol
								K.Jelambar
R06	Tomang Barat	6.8	170	P08	Tomang Barat	-	-	K.Sekretaris
R07	Pulo Mas	5.3	25	P09	Pulo Mas	1	-	K.Sunter
	(to be extended)	9						
R08	Wk.Rawa Kepa	0.5	253	P10	Rawa Kepa	-	-	Banjir Canal
R09	Wk.Teluk Gong	2.5	95	P11	Teluk Gong	1	-	K.Angke(Lower)
R10	Sunter Barat	30	1,250	P12	Sunter Utara	1	-	K.Lagra Tenggiri,
	(Utara/Selatan)				/Barat			K.Ancol
R11	Wk.Hankam Slipi	-	-	P13	Hankam Slipi	-	-	K.Grogol
UNDER CONSTRUCTION/PLAN								
R12	Sunter Timur I	15	390	P20	Sunter Timur I	1	-	K.Sunter
R13	Sunter Timur III	8	570	P21	Sunter Timur III	1	-	K.Sunter
R14	Wk.Sunter II	-	214		-	-	-	Cakung Drain
R15	Wk.Marunda	-	990		-	-	-	(Eastern
								Banjir Canal)

Source : (1) The Study on Urban Drainage and Wastewater Disposal Project in the City of Jakarta, Master Plan Study, Main Report/Supporting Report Vol.I, JICA,1991
(2) PU DKI Jakarta
(3) Review Report of East Jakarta Flood Control Project, Aug.,1988

Table 2.13 GATED WEIR IN DKI JAKARTA

Gated Weir No.	Name	Related River/Channel	Function	Management
EXISTING				
G01	Cengkareng	Cengkareng Floodway	Flood	PWSCC
G02	Manggarai I	Ciliwung	Drainage	DPU
G03	Karet	Banjir Canal	Flood	DPU
G03a	Karet II	Banjir Canal	Flushing	DPU
G05	Pondok Pinang	Grogol	Drainage	DPU
G06	Sunter Hulu	Sunter	Drainage	DPU
G07	Polar	Angke	Irrigation Drainage	DPU
G08	Koneng	Pesanggrahan	- do -	DPU
G10	Tarum Barat to Saluran	Tarum Barat Canal	Water Supply /Irrigation	DPU
G11	Pulo Gadung	Sunter	Flood	DPU
G12	Sunter	Sunter	Flood	DPU
G13	Cakung	Cakung	Flood	DPU
G14	Pasar Ikan	Besal/Pakin/Ciliwung	Drainage	PU DKI
G15	Saringan Sampah Teluk Gong	Angke		PU DKI
G16	Syphon Pluit	Waduk Pluit	Flood	PU DKI
G17	Bendungan Jago(I,II)	Item	Flood	PU DKI
G18	Manggarai I	Ciliwung	Flood/Flushing	PU DKI
G18a	Manggarai III	Surabaya Canal	Flushing	PU DKI
G19	Tarum Barat II	Tarum Barat Canal	Flushing	PU DKI
G20	Capitol(Istiqlal)	Ciliwung	Flushing	PU DKI
G21	Tangki	Ciliwung	Flushing	PU DKI
G22	Kali Duri	Duri	Flood	PU DKI
G23	Kampung Gusti	Angke	Drainage	PU DKI
G24	Jembatan Dua	Grogol	Drainage	PU DKI
G25	Jembatan Merah	Gunung Sahari	Drainage	PU DKI
G26	Pekapuran	Gunung Sahari	Flood	PU DKI
G27	Cideng	Cideng	Flood	PU DKI
G28	Kyai Tapa	Ciliwung	Flood	PWSCC
G29	Syphon Cideng	Cideng	Flood	PU DKI
G30	Syphon Teluk Gong	Angke	Flood	PU DKI
G31	Saringan Sampah Gunung Sahari	Gunung Sahari		PU DKI

Source : (1) The Study on Urban Drainage and Wastewater Disposal Project in the City of Jakarta, Master Plan Study, Main Report/Supporting Report Vol.I, JICA, 1991
(2) PU DKI Jakarta

Table 2.14 RECENT DRAINAGE PROJECT IN DKI JAKARTA (1/3)

NO.	Project Name	Project Feature: General	Drain Area (ha)	Imprv /Const Length(km)	Design Disch. (m3/s)	Related Facility / Structure	Project Status: As of Prev. JICA Study (1991)	Present Construction
Zone - I								
A	Sepak River .	imprv	-	3.3	-	Brg(2), Cvt(2)	D/D(1987)	Finish(part)
1	Kamal River .	imprv	1,640	7.4	45	Rvt	Proposed	
2	Tanjungan River	imprv	780	3.2	30	Rvt	Proposed	
3	Kali Gede/Kali Bor Channel .	imprv	560	-	-	Rvt	Proposed	
4	Sal.Cengkareng Channel	imprv	330	4.5	20	Rvt	Proposed	
5	Pondongkelan Channel	imprv	520	1.1	25	Rvt	Proposed	
6	Semanan River	imprv	-	0.5	10	Emb, Prp	Proposed	Completed
7	Kreo River	imprv	-	0.9	35	Rvt	Proposed	
8	Ulujami River	imprv	-	-	35	Brg(1)	Proposed	
9	Sepak River	imprv	-	0.6	70	Rvt	Proposed	Finish(part)
10	Lower Pesanggrahan River	imprv	-	1.1	20	Rvt	Proposed	
Zone - II								
B	Lower Angke Rive	imprv /const	-	4.5	-	Brg(2), Cvt(13) Pump(8 m³/s)	D/D(1987)	
C	Grogol Sekretaris Intercept	imprv /const	-	4.5 2.9	- -	Brg(8), Cvt(22) Channel	Under Const	Completed
D	Lower Sekretaris Riv.	imprv	-	2.1	-		Under Const	Completed
E	Upper Grogol River	imprv	-	5.7	-	Brg(4), Gate(1)	D/D	
11	Kedaung River	imprv	220	1.2	10	Rvt	Proposed	
12	Jelawe River	imprv	-	0.9	10	SP	Proposed	
13	Sekretaris River	imprv	-	6.0	25	Rvt, Brg	Proposed	
14	Kedaung Kali Angke Pump Station /exist. canal	const imprv	480	0.6	-	Pump(2.5 m³/s) Reg.Pond(9 ha)	Proposed	
a	Sekretaris	const	-	0.58	-	Rvt	-	on-going
Zone - III								
F	Setia Budi Reservoir	rehab	-	-	-	Deepning/Lining	Under Const	Completed
15	Mampang River	imprv	2,600	6.0	60 - 90	SP	Proposed	
16	Cideng Atas River	imprv	-	2.5	25 - 45	SP, Bank	Proposed	Finish(part)
17	Kali Bata River	imprv	-	0.4	55	SP	Proposed	
18	Menteng Wadas Pump Station	const	250	-	-	Pump(6.2 m³/s)	Proposed	
b	Sal.Situ Babakan	rehab/imprv (irrigation)		2.0	-		-	On-going
c	Sal.Karang Tengah	rehab/imprv (irrigation)		0.66	-		-	On-going

Note : (1) imprv ; Improvement const ; Construction rehab ; Rehabilitation
Brg ; Bridge Rvt ; Revetment Cvt ; Culvert Prp ; Parapet
Emb ; Embankment SP ; Sheet Pile CP ; Concrete Pile
(2) (Part) ; Partially
(3) On-going ; under construction and to be completed by March 1996

Table 2.14 RECENT DRAINAGE PROJECT IN DKI JAKARTA (2/3)

NO.	Project Name	Project Feature: General	Drain Area (ha)	Imprv /Const Length(km)	Design Disch. (m3/s)	Related Facility / Structure	Project Status: As of Prev. JICA Study (1991)	Present Construction
Zone - IV								
G	Sarinah Thamrin	imprv /const	-	7.8	-	Cideng P.S.(40 m³/s) Melati P.S.(0.3 m³/s) Melati Resvr(4.2 ha).	Under Const	Completed
H	Ciliwung Kota Drain	imprv	-	9.1	-	Brg(13)	D/D(1987)	Finish(part)/On-going
I	Waduk Pluit	rehab	-	-	-	Dredging. of Reservoir Rehab. of Pump	D/D(on-going)	On-going
J	K.Besar and Duri Canal	imprv	-	10.5	-		D/D(on-going)	Completed
K	Ciliwung River.	imprv	-	18.2	-	Tidal gate(1)	D/D(on-going)	
d	Turap K.Ciliwung Utr	const	-	0.4	-	Prp	-	On-going
e	Turap K.Jelakung	const	-	0.58	-	CP	-	On-going
Zone - V								
19	Sention River	imprv	-	1.2	15	Rvt	Proposed	
f	Sal.Situ Dongkelan	rehab/imprv (irrigation)		0.2	-	Rvt	-	On-going
g	PA Sunter Hulu	rehab (irrigation)		0.1	-	Rvt	-	On-going
h	Sal.Kramat Jati	const		0.38	-	Rvt	-	On-going
i	Sal.Condet Batu Ampar	const		0.46	-	Rvt	-	On-going
j	Sal.Cililitan	const		0.64	-	Rvt	-	On-going
k	Sal.Cipinang Squadran	const		0.15	-	Prp	-	On-going
l	K.Cipinang (I.G.Ngurah Rai)	rehab		0.14	-	Rvt	-	On-going
m	Sal.K.Baru Cawang	const		0.65	-	Rvt	-	On-going
Zone - VI								
L	Kemayoran Airport Drainage	imprv /const	-	0.8	-	Pump(4.0 m³/s) Reservoir(15 ha)	D/D(on-going)	Completed
M	Pademangang Canal	imprv	-	5.5	-		D/D(on-going)	Finish(part)/On-going
N	Ancol Canal	imprv /const	630	6.5	-	Pump(15 m³/s) Gate(2)	D/D(on-going)	On-going
O	Sentiong Cutoff Channel	const	191.5	40.0 (m)	-	Cvt(40 m), Rvt	D/D(on-going)	On-going
P	Sunter West Polder	const	-			Pump (10 m³/s) Reservoir, Gate(1)		
		" /imprv		0.5	-	Panango Drain	D/D(1989)	Completed
Q	Sunter River Imp.	imprv	-	19.3		Brg(8),SW(90)	D/D(1990)	Finish(part)/On-going
R	Sunter East III Polder	const	570	-	-	Pump (15.5 m³/s) Reservoir(8.1 ha)	D/D(1990)	On-going
S	Buaran River	imprv	-	9.8	-	Brg(1)	D/D(1990)	
T	Cakung River	imprv	-	5.2	-	Brg(3)	D/D(on-going)	
U	Petukangan River	imprv	-	0.8	-	Gate	Under Const	
V	Cakung Drain	imprv	-	5.9	-		D/D(1990)	

Note : (1) imprv ; Improvement const ; Construction rehab ; Rehabilitation
Brg ; Bridge Rvt ; Revetment Cvt ; Culvert Prp ; Parapet
Emb ; Embankment SP ; Sheet Pile CP ; Concrete Pile
(2) (Part) ; Partially
(3) On-going ; under construction and to be completed by March 1996

Table 2.14 RECENT DRAINAGE PROJECT IN DKI JAKARTA (3/3)

NO.	Project Name	Project Feature: Gene-ral	Drain Area (ha)	Imprv /Const Length(km)	Design Disch. (m3/s)	Related Facility / Structure	Project Status: As of Prev. JICA Study (1991)	Present Construction
(Zone - VI)								
W	Marunda Canal	const	-	3.4	-	Brg(1), Syp(1)	D/D(on-going)	
X	Sunter East II Polder	const	-	-	-	Pump(5.2 m³/s) Resrvoir(25 ha) Drain(1.5 km), Gate(1)	D/D(on-going)	
Y	Marunda Polder	const.	-	-	-	Tidal Gate(1)	D/D(on-going)	
20	Kebon Bawang Riv.	imprv	-	1.6	15	SP	Proposed	
21	Lagoa Tenggiri Riv.	imprv	-	0.6/0.7/1.8	30/35/40	SP	Proposed	Finish(part)
22	Cipinang River	imprv	-	0.8	5		Proposed	
23	Tugu Batu River	imprv	-	1.3	45	Emb	Proposed	
24	Rawa Badak River	imprv	-	2.0/1.0	20/20		Proposed	Finish(part)
25	Pelumpang River	imprv	-	0.9	30	CP	Proposed	
26	Cakung Lama River	imprv	-	5.2/1.9	40/50	Rvt, Brg(1)	Proposed	
27	Cakung River	imprv	-	5.2	20	Rvt, Brg(2)	Proposed	
28	Jati Bening River	imprv	-	1.4	20	SP	Proposed	
29	Kali Item River	imprv	-	0.6	20	Prp	Proposed	Finish
30	Sentiong River	imprv	-	1.4/0.5	60/65	Prp, Emb	Proposed	On-going(paet)
31	Lower Marunda Channel	const	540	1.3	15	Rvt	Proposed	
32	Upper Marunda Channel	const	1,300	4.1 3.5	20 - 40 20 - 30	Rvt Rvt	Proposed	
n	Sal.Induk Cabang Tmr	rehab/imprv (irrigation)	-	0.2	-	Rvt	-	On-going
o	Sal.Induk Bekasi Tgh	rehab/imprv (irrigation)	-	2.0	-		-	On-going
p	Sal.Kayu Tinggi	rehab/imprv (irrigation)	-	3.0	-		-	On-going
q	Sal.Sentra Primer Tmr	const	-	0.14	-		-	On-going
r	Sal.Sedap Malam	const	-	0.27	-	Rvt	-	On-going
s	Sal Sentiong Salemba	const	-	0.43	-	Rvt	-	On-going
t	Sal.Valker	const	-	0.65	-	Rvt	-	On-going
u	Turap K.Lagoa Tengiri	const		0.42	-	Rvt	-	On-going
v	Sunter East I	const	390	-	-	Pump(5.2 m³/s), Rvt	-	On-going
w	Cipinang Sunter	const	520	-	-		-	On-going

Note : (1) imprv ; Improvement const ; Construction rehab ; Rehabilitation
Brg ; Bridge Rvt ; Revetment Cvt ; Culvert Prp ; Parapet
Emb ; Embankment SP ; Sheet Pile CP ; Concrete Pile
(2) (Part) ; Partially
(3) On-going ; under construction and to be completed by March 1996

Source : (1) The Study on Urban Drainage and Wastewater Disposal Project in the City of Jakarta, Master Plan Study, Main Report/Supporting Report Vol.I, JICA, March 1991
(2) DPU DKI

Table 2.15 SEWERAGE DEVELOPMENT SYSTEM
IN THE PREVIOUS MASTER PLAN (JICA, 1991)

Zone	Central	North West	South West	North East	South East	Tanjung Priok	Total
Service Area(ha)	6,107	2,016	2,170	3,566	1,243	1,502	16,604
(Conventional Area)	3,422	530	938	1,610	307	700	7,507
(Interceptor Area)	2,595	1,332	1,232	1,886	936	802	8,783
(No Sewerage Area)	90	154	0	70	0	0	314
Population Served in 2010 (x1,000)	2,466	642	674	1,383	523	663	6,351
(Conventional Area)	1,149	185	244	527	137	337	2,579
(Interceptor Area)	1,317	457	430	856	386	326	3,772
Lift Pump Station(location)	1	3	5	0	0	1	10
Treatment Plant							
System	A.L/F.P	A.L	A.L	A.S	A.L	A.L/F.P	
Capacity(1,000m³/day)	529	124	117	261	101	120	1,252
Bay / River to be Discharged	Jakarta B.	Cengkar.	Pesanggr	Sunter	Sunter	Cakung	

Note : A.L ; Aerated lagoon
A.L/F.P ; Aerated lagoon and falcultative pond
A.S ; Conventional activated sludge

Table 2.16 OVERVIEW OF CHARACTERISTICS OF BASIC SCENARIOS

Item/Variable	Scenario A (high growth)	Scenario B (low growth)	Scenario C (managed growth)
I. General Conditions			
a) Economic growth rate	high (>6.5%)	low (<6.5%)	high (=6.5%)
b) Unemployment	low	high	low or medium
c) Focus of government policy	high economic growth	high economic growth	equity and environment
d) Government budget	medium	low	high
e) Attitude to subsidies	no	no (can not)	yes
f) Government investments	medium	low	high
g) Income distribution	skewed	skewed	more equal
II. Population			
a) Effect of urban planning	no	no	yes
b) General trend *)	JMDPR - 2nd	JMDPR - 2nd	JMDPR - 3rd
c) Growth of DKI	low	high	medium
d) Growth Botabek	around DKI Jakarta	low	west-east corridor
e) Outside Jabotabek	high	low	high
III. Domestic Water Demands			
a) Cost recovery of PWS	full	full	subsidized
b) Price development	high	high	low
c) Willingness to connect	medium	low	high
IV. Industry			
a) Industry development	high	low	medium or high
b) Per unit water demand	as present	as present	increase of 25 %
c) Industrial pollution loads	high	medium	low
V. Agriculture			
a) Area	<< present	= present	<< present
b) Consumption pattern	other / paddy	present	change
c) Government policy	present	present	diversified
d) Production	paddy and vegetables	paddy	intensified and vegetables
e) Water demand	< present	present	<< present
VI. Water Quality			
a) Government policy	present	present	intensified
b) Sewerage / treatment	no	no	yes
c) Discharges	high	medium	low

Note : *) Trend of spatial development according to analyses of Jabotabek Metropolitan Development Plan and Review, Second and Third Planning Report

Source : Jabotabek Water Resources Management Study in 1994

Table 4.1 EVALUATION OF FLOOD CONTROL ALTERNATIVES

No.	1				2		3		
River System	Cengkareng Floodway				Western Banjir Canal		Eastern Banjir		
Alternative	CKR-1	CKR-2	CKR-3	CKR-3	WBC-1+CSD-1	WBC-3+CSD-1'	EBC-1-1	EBC-1-2	EBC-1-3
Outline of Plan	River Imp.	River Imp. & Limo Dan	River Imp. & Angke Fldw.	River Imp. & Angke Fldw. & Limo Dam	River Imp.	River Imp. & Ciliwung Fldw.	Box culvert	PC-sheet Pile	Double-cross-section
Financial Project Cost (Rp.billion)	585	1,317	858	1,647	757	767	3,416	1,931	1,666
Point	2	1	2	0	2	2	0	0	0
Financial land acquisition/house compensation cost (Rp.billion)	406	621	295	571	466	305	878	943	1,088
Point	6	4	8	6	6	8	2	2	0
EIRR (%)	42.9	12.6	14.6	7.8	22.5	16.1	8.4	20.6	30.5
Point	6	6	6	2	6	6	2	6	6
Technical Evaluation	Ordinary	Complicated	Complicated	Complicated	Ordinary	Complicated	Ordinary	Ordomary	Ordinary
Point	2	1	1	1	2	1	2	2	2
Environmental Impact	might affect	might affect	might affect	might affect	not affect	not affect	might affect	might affect	might affect
Point	0	0	0	0	2	2	0	0	0
Overall Point	16	12	17	9	18	19	6	10	8
Selection for Optimum			*			*		*	

Evaluation Criteria	Financial Cost	Land Acquisition etc.	EIRR	Technical Evaluation	Environmental Impact
	0 : 1,500<X 1 : 1,000<X<1,500 2 : 500<X<1,000 3 : X<500	0 : 1,000<X 2 : 800<X<1,000 4 : 600<X< 800 6 : 400<X< 600 8 : 200<X< 400 10: X< 200	0 : X< 5 2 : 5<X<10 4 : 10<X<12 6 : 12<X	1 : Complicated 2 : Ordinary	0 : might affect 2 : not affect

*1) River Imp. : River Improvement

*2) EIRR : Economic Internal Rate of Return

Table 4.2 RESULT OF IEE (SIGINIFICANT ITEMS FOR ALTERNATIVES)

Alternative schems	Construction Works										
	Social Environmental Items					Nature Environmental Items				Pollution	
	Resettlement	Impairment of the transportation system	Communities	Encroachment on historical Assets	Inundation of mineral resources	Encroachment into precious ecosystem	Aesthetic&Landscape	Change of river flow regime	Watershed erosion and sedimentation	Air pollution and noise	Deterioration of water quality
Cidurian River System	B	D	C	B	D	D	D	D	D	C	A
Cimanceuri River System	B	D	C	B	D	D	D	D	D	C	A
Cirarab River Sytem	B	D	C	B	D	D	D	D	D	C	A
Cisadane River System	B	D	C	B	D	D	D	B	D	B	A
1) Cengkareng Floodway System	A	A	C	B	D	D	D	D	D	A	A
2) with Limo dam	A	A	C	B	D	B	D	D	C	A	A
3) with Floodway	A	A	C	B	D	D	D	D	D	A	B
3) with Limo dam & Floodway	B	A	C	B	D	B	D	D	C	A	A
1) Western banjir Canal System	A	A	C	B	D	A	D	D	D	A	A
2) with Ciawi dam	A	A	C	B	C	A	B	D	A	A	A
3) with Floodway	A	A	C	B	D	A	D	D	D	A	B
Eastern Banjir Canal System	A	A	A	B	D	D	D	D	D	A	A
CBL Floodway System	B	D	C	B	D	D	D	D	D	B	A

Note : A ; Mostly siginificant item B ; Siginificant item C ; Siginificant but relatively minor item D ; No effect is expecte

Table 4.3 OUTLINE OF PROPOSED FLOOD CONTROL MASTER PLAN

No.	River Systems and Objective Rivers	Optimum Alternative Schemes	Design Control Points	Design Scales (year)	Catchment Area (km^2)	Design Discharges (m^3/s)	Principal Countermeasures					Objective stretches (km)	
							River improvement	Floodway	Flood control dam	Flood plain zoning	Other non-structural	River Improvement (structural)	Flood Plain Zoning (non-structural)
1	*Cidurian River System*	CDR-1	Jl. Serang Raya (Parigi)	25	596	650	X	-	-	X	X	31.9	16.0
2	*Cimanceuri River System*	CMC-1	Jl. Serang Raya (Balaraja)	25	415	290	X	-	-	X	X	22.2	42.0
3	*Cirarab River System*	CRB-1	Irrigation canal from Cisadane (CRR-9)	25	147	75	X	-	-	X	X	16.8	13.8
4	*Cisadane River System*	CSD-1+WBC-3	Pasar Baru barrage	50	1248	1900	X	-	-	X	X	21.0	14.6
5	*Cengkareng Floodway System*	CKR-3					X	X	-	X	X		
	- Cengkareng Floodway		Estuary	100	459	510	X	-	-	-	X	8.1	0.0
	- Mookervaart Canal		Junc. with Cengkareng	25	67	125	X	-	-	-	X	6.0	0.0
	- Angke		Junc. with Cengkareng	100	224	160	X	X	-	X	X	5.0	11.7
	- Pesanggrahan		Junc. with Cengkareng	100	137	290	X	-	-	X	X	3.2	16.3
	- Grogol*		Pondok Pinang barrage	25	30	85	-	-	-	-	-	-	-
6	*Western Banjir Canal System*	WBC-3					X	X	-	X	X		
	- Western Banjir Canal		Karet barrage	100	421	450	X	-	-	-	X	17.4	0.0
	- Ciliwung		(Manggarai barrage)	100	337	410	-	X	-	X	X	0.0	21.3
	- Krukut		Junc. with WBC	25	84	135	-	-	-	X	X	0.0	8.8
7	*Proposed Eastern Banjir Canal System*	EBC-1-2					X	X	-	-	X		
	- Eastern Banjir Canal		Estuary	100	207	370	-	X	-	-	X	23.6	0.0
	- Cipinang		Cipinang inlet	25	50.5	85	X	-	-	-	X	8.5	0.0
	- Sunter		Sunter inlet	25	73.1	105	X	-	-	-	X	7.2	0.0
	- Buaran		Buaran inlet	25	13.0	50	X	-	-	-	X	3.4	0.0
	- Jatikramat		Junc. with EBC	25	16.5	45	X	-	-	-	X	3.2	0.0
	- Cakung		Junc. with EBC	25	34.5	60	X	-	-	-	X	11.5	0.0
8	*CBL Floodway System*	CBL-1					X	-	-	X	X		
	- CBL Floodway		Junc. with Bekasi	50	877	780	X	-	-	-	X	22.1	0.0
	- Bekasi		Bekasi barrage	50	389	590	X	-	-	X	X	20.0	11.2
	- Cisadang		Junc. with CBL	25	135	130	X	-	-	-	X	7.6	0.0
	- Cikarang*		Cikarang barrage	25	216	210	-	-	-	-	-	-	-
	- Cilemahabang*		Bridge near CLA-27	25	121	55	-	-	-	-	-	-	-
				Total								239	156

* : Present carrying capacity > Design discharge

Table 4.4 OVERALL EVALUATION OF MASTER PLAN

River System	1 Cidurian	2 Cimanceun	3 Cisarab	4 Cengkareng Floodway	5 Western Banjir Canal + Cisadane	6 Eastern Banjir Canal	7 CBL Floodway	8 Non-structural Measures
Outline of Plan (Improvement Length)	River Improvement 32km	River Improvement 22km	River Improvement 12km	River Improvement and Angke floodway 22km	River Improvement and Ciliwung floodway 38km	River Improvement and Eastern Banjir Canal 57km	River Improvement 50km	Flood forecasting and warning system,
Implementation Program (year)	2018-2023	2022-2025	2013-2016	2013-2025	1997-2008/2008-2011	2005-2017	2014-2019	flood risk map,
Beneficial Population in 2025 (1000 nos) point	495 1	605 3	144 1	2,505 5	1,865 5	4,119 7	1,607 5	institutions,
Beneficial Area(km^2)	180	240	70	120	230	210	570	flood fighting system,
Land Use in 2025 point	Agriculture 1	Agriculture 1	Agriculture 1	Residential Area 5	Gov. Ind. & Comm. 9	Res. & Industrial 7	Agri. & Residential 3	public education,
Return Period of Design Flood(year)	25	25	25	100	100 and 50	100	50	
Financial Project Cost (Rp. billion) point	227 3	108 3	27 3	858 2	767 2	1,931 0	220 3	school education,
Financial Land/House Cost (Rp. billion) point	87 10	59 10	12 10	295 8	305 8	943 2	88 10	etc.
EIRR (%) point	3.8 0	- 0	12.1 6	14.6 6	16.1 6	20.6 6	6.2 2	
Technical Evaluation point	Ordinary 2	Ordinary 2	Ordinary 2	Complicated 1	Complicated 1	Ordinary 2	Ordinary 2	
Social Beneficial Impact point	small 1	small 1	small 1	big 5	very big 7	big 5	middle 3	
Environmental Impact point	not affect 2	might affect 0	not affect 2	not affect 2	not affect 2	not affect 2	might affect 0	
Project Status	F/S: not available	F/S: not available	F/S: not available	D/D: partly available	D/D: partly available	Partly implemented	F/S: not available	
Overall Point	20	20	26	34	40	31	28	
Priority Projects for F/S					◎			

Evaluation Criteria

Land Use	Financial Project Cost	Land & house cost	EIRR	Beneficial Population	Technical Evaluation	Social Beneficial Impact	Environmental Impact
1: Agriculture	0: 1,500<X	0: 1,000<X	0: X< 5	1: X<500	1: Complicated	1: small	0: might affect
3: Agri. & residential	1: 1,000<X<1,500	2: 800<X<1,000	2: 5<X<10	3: 500<X<1000	2: Ordinary	3: medium	2: not affect
5: Residential	2: 500<X<1,000	4: 600<X<800	4: 10<X<12	5: 1000<X<3000		5: big	
7: Resid. & Industrial	3: X<500	6: 400<X<600	6: 12<X	7: 3000<X		7: very big	
9: Gov.,Ind.& Comm.		8: 200<X<400					
		10: X<200					

*1) I/P: Implementation Program, Gov. : Governmental Office Area, Comm.: Commercial Area, Ind : Industrial Area, Agri.: Agricultural Area, Land/house Cost: Land acquisition/house compensation cost

*2) The project costs here are all those estimated on the master plan level.