5 FEASIBILITY STUDY

5.1 Priority Projects Sites

Through the overall evaluation including economic and technical evaluation, priority projects consisting of the following works have been selected for the Feasibility Study (refer to Figure 5.1).

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 (l=1 km)

Present conditions of the objective reaches of the WBC and the Cisadane river are described hereunder. The condition of the Ciliwung Floodway is described in ANNEX 8 (Design and Cost Estimate).

5.1.1 Western Banjir Canal

(1) General Situation

The Ciliwung river has a mountainous basin in the upstream of Bogor city. The middle stream basin of the Ciliwung river is already densely populated. The upstream and middle reaches of the river do not have flood embankment but have rather big carrying capacities, since the river flows through in deep valley. The Ciliwung river bifurcates to the WBC and the Ciliwung Drain at Manggarai Barrage in the midst of DKI Jakarta. The WBC flows through the western part of DKI Jakarta and flows into the Java Sea; the Cideng drain, the Krukut river and the Angke drain join the WBC.

The objective reaches of river improvement for the priority projects are the reaches of approximately 17 km from the estuary up to the Manggarai Barrage; the catchment areas at the Manggarai and Karet barrages are 337 km^2 and 421 km^2 respectively.

(2) River

(a) Estuary - Confluence of Angke Drain

(i) Short-cut Work at Kapuk Muara in 1995

The WBC near the estuary so-called Muara Angke has rather meandering river course, because the river course is the former Angke river course itself.

The recent biggest change of the WBC river course is the completion of short-cut work at extremely meandering part in Kelurahan Kapuk Muara (0.8 k - 1.1 k) as shown in Figure 5.2; the work was executed by Ciliwung-Cisadane River Basin Development Project Office (PPWSCC) by using local budget in 1995/1996 fiscal year.

The length of the short-cut is about 200 m and consequently the WBC river course was shortened by about 450 m. The former meandering river course still remains but the water surface is covered completely by vegetation now.

(ii) Nature Reserve Muara Angke

Nature Reserve Muara Angke with mangrove forest is located on the left bank of the WBC near the estuary. The area is now strictly preserved from the environmental aspects. Newly constructed gentle slope embankment, with sodding, planted trees and with the elevation of about PP 3.5 m (approximately TTG 2.9 m), forms clear boundary between the Nature Reserve and the residential area of Pantai Indah Kapuk as shown in Figure 5.2. The design of the embankment was conducted by PPWSCC and the construction work was executed by the developer.

The elevation of the embankment is higher than the design embankment elevation of the WBC (refer to Section 5.3). The embankment can practically function as a left side embankment of the WBC; Nature Reserve Muara Angke can greatly lower the flood water level of the WBC by its function as a natural retarding basin.

(iii) Squatters in River Area

Downstream of Mandara Permai bridge (1.9 k), squatters are located along the right bank of the WBC.

(iv) Angke Drain

The Angke Drain (Lower Angke river), the biggest drain along the WBC joins the WBC with gravity drainage. The detailed design by the West Jakarta Flood Control System Project has once been conducted including the design of the WBC from the Estuary to the Teluk Gong siphon and the Angke Drain.

(b) Confluence of Angke Drain - Karet Barrage

(i) Parapet Wall

The water level of January and February 1996 floods reached up to the top of embankment of the WBC, besides overflow occurred at several places. In order to cope with the serious situation of the 1996 floods, construction of parapet walls on the embankment has been conducted immediately after the floods by using local budget.

The construction work extends from the bridge on Jl. Pangeran Tubagus Angke (5.6 k) southward to the Karet Barrage (12.4 k) as shown in Figure 5.3. The height of the parapet walls ranges from 50 cm to 80 cm.

(ii) Rehabilitation of Embankment near Cideng Pumping Station in 1996

In February 1996 flood, the right embankment downstream of Cideng pumping station (9.2 k) was damaged by overflowing flood water, fortunately the embankment did not collapse completely though. The damaged portion of the embankment was rehabilitated by revetment immediately after the flood.

(iii) Utilization of High Water Channel

The high water channel has been utilized mainly as sport grounds and cultivated land. The high water channel is generally protected by bamboo revetment. The WBC has relatively wide (around 60 m) and flat high water channel from Aipda K. S. Tubun bridge (11.3 k) up to the Karet Barrage (12.3 k).

(iv) Squatters in River Area

From the confluence of the Angke Drain (2.9 k) up to near the Teluk Gong siphon (4.7 k), many squatters are located without break on both sides of high water channel and embankment: the practical flow area is only within the low water channel.

From the Teluk Gong siphon (4.7 k) up to Pangeran Tubagus Angke bridge (5.6 k), many squatters are also located on the right side high water channel and embankment.

(c) Karet Barrage - Manggarai Barrage

(i) Channel Condition

The WBC flows in this reaches crossing the boundary between the terrace and the low-lying plain; the WBC generally flows in parallel with a railway on the right bank and the roadway on the left bank. There is almost no embankment on the left bank throughout these reaches: the ground elevation on the left bank is generally higher than that of the right bank.

From the K. H. Mas Mansyur bridge (13.1 k) up to the M. H. Thamrin bridge (13.9 k), the crown of the right embankment is quite wide. As the elevation of the railway along the right bank is the same as that of the embankment, the railway becomes a part of the embankment; the embankment is practically almost like super-levee. High water channel exists only on the right bank in these reaches.

The right embankment is terminated at Madiun bridge (15.2 k). Upstream reaches of this point have no embankment with no high water channel up to the Manggarai Barrage.

Some reaches has rather steep sideslopes of approximately 1:1 (vertical to horizontal) with no revetment excluding near bridges; the sideslopes are covered by grass and there are trees in places.

The sideslope of this reaches seems to be rather stable without any revetment, some portion was eroded by the big floods in 1996 though. The reason why the sideslope seems to be stable is estimated that the reaches were excavated through the diluvial terrace and the material of sideslope seems to be compacted silt or clay of diluvial origin.

(ii) Park on Right Embankment

From the M. H. Thamrin bridge (13.9 k) up to the Sukabumi bridge (16.0 k), DKI Jakarta has put the right bank of the WBC in beautiful condition as a riverside park with promenade, benches, trees and streetlights on the embankment crown. This right bank stretch functions as one of the valuable place of recreation and relaxation for the citizens.

(iii) Cideng Drain

The Cideng Drain joins the WBC from the left bank at 14.5 k with gravity drainage. In January 1996 flood, the flood water of the WBC flowed backward to the Cideng Drain and flowed into the Setiabudi regulation ponds through the lower portion of the embankment.

(3) Related Structures

(a) Embankment

The of the WBC exists as follows:

- Confluence of the Angke drain (2.9 k) - Aipda K. S. Tubun bridge (11.3 k) : on both banks
- Aipda K. S. Tubun bridge (11.3 k) - Karet barrage (12.4 k) : on left bank only
- K. H. Mas Mansyur bridge (13.1 k) - Halimun bridge (15.2 k) : on right bank only

The slope of the existing embankment is generally 1:1.5. The present minimum crown width is 3 m. The embankment from 2.9 k to 12.4 k is covered by wet masonry revetment and asphalt pavement.

(b) Barrage

(i) Karet Barrage

The Karet Barrage is located crossing the WBC just downstream of the confluence with the Krukut river (12.4 k); the barrage has four slide gates and is integrated with a railway bridge. The functions of the barrage are as follows:

- to supply flushing water to the Krukut Drain from the gate located on the right bank near the barrage; and
- to supply raw water for the PAM Jaya treatment plant at Pejompongan, the confluence of the Krukut river with the WBC.

The barrage usually dams up the stream by about 2 m in the height. According to PAM Jaya, the main source of raw water at the plant will be the Kali Malang after completion of pipe construction from Cawang to the Pejompongan site.

(ii) Manggarai Barrage

The Manggarai Barrage is located at the upstream end of the WBC (16.9 k); the barrage on the WBC has two slide gates (Manggarai I gate) and is integrated with a railway bridge and a roadway bridge.

The functions of the barrage are as follows:

- to supply flushing water to the Ciliwung Drain from the Manggarai II gate located on the right bank; and
- to regulate the flood discharge distribution from the Ciliwung river to the WBC and the Ciliwung Drain.

It is said that the barrage dammed up the flow by about 3 m in height in January 1996 flood, because the gate is quite narrow. The necessity of the improvement of the barrage is discussed in Section 5.3.

(c) Bridge

There are 18 roadway bridges and three railway bridges crossing the WBC. Some bridges such as Prof. Dr. Latumeten and Kyai Tapa bridges have extremely low girders hanging down from the river bank. The treatment of these bridges is discussed in Section 5.1.

(d) Siphon

Three siphons as follows go under the WBC.

- Teluk Gong siphon of the Grogol drain (4.7 k)
- Siphon of Cideng drain (14.5 k)
- Siphon of Kali Baru (16.6 k)

(4) Present Carrying Capacity

Present carrying capacity of the WBC is estimated by using non-uniform flow formula based on the river survey results of feasibility study level conducted by the Study Team in 1996. The conditions for the calculation are shown below.

Calculation method

The same method described in Section 3.9 is adopted.

Tide level

Spring tide of PP 1.15 m (approximately TTG 0.55 m) is adopted for the lower-end water level.

Manning's roughness coefficient

n=0.025 : low water channel
n=0.040 : high water channel

The results are shown in Figure 5.4. The bankfull capacity and the freeboard (minimum 0.8 m) capacity are around 350 m^3/s and 250 m^3/s in average respectively.

In the middle reaches, the carrying capacity has increased by about 70 m^3/s in average by the new parapet wall constructed in 1996.

5.1.2 Cisadane River

(1) General Situation

The river basin has a mountainous area in the upstream reaches. In the middle stream reaches, Tangerang city, now developing as a satellite city of Jakarta, is located. The present land use along the embanked reaches downstream of Tangerang city is agricultural land and Soekarno-Hatta International airport.

The objective reaches of the river improvement for the priority projects are the reaches from the estuary to the Pasar Baru barrage (22.3 k); the catchment area at the Pasar Baru barrage is 1,411 km^2. The high water channel is generally covered with rich riverside forest or has been utilized as cultivated land.

(2) River

(a) Condition near the Estuary

According to the topographic map with a scale of 1:25,000 issued in 1989 that was the only available map in the previous stage, no shoal exists at the estuary. However, the actual situation is quite different from that on the map: there exists a big shoal almost like small island of about 9 ha on the left side of the estuary. The detailed topographic maps along the Cisadane river including the estuary with a scale of 1:5,000 were prepared in this feasibility study stage.

In downstream reaches from Desa Cirumpakabeting which is located about 2.5 km from the estuary, the natural levee and the embankment of the Cisadane river almost disappear and the ground becomes almost flat. The small villages near the estuary are generally located on the concave bank of the meandering portion, since sheer cliffs at the portion are convenient for the water-borne traffic. Many fish ponds are scattered around the estuary. The river bed material still consists of sand even at the estuary.

(b) Natural Levee and Former River Course *(i) Teluknaga on the right bank*

A remarkably developed natural levee, extending from 8.8 k on the right bank, exists along the former Cisadane river course. The city area of Teluknaga and other villages are located on the natural levee, since the ground elevation of the levee is higher than that of surrounding area and accordingly the area on the natural levee is precious safe place against the flood.

The former river course exists along the center of the natural levee; the former river course itself has been almost filled up and is utilized as a part of irrigation canal originated from the Pasar Baru Barrage. The width of the irrigation canal is about 7 m and the canal flows through the densely populated area of Teluknaga.

(ii) Left Bank between 9.2 k and 9.9 k

There exists a big oxbow lake of the former Cisadane river course with vast water area of around 9 ha on the left bank between 9.2 k and 9.9 k: there is no description of this lake on the topographic map with a scale of 1:25,000 issued in 1989. The lake is surrounded by relatively high former embankment of the Cisadane river. The relative height of the embankment from the water surface is estimated around 3 m, there is no survey result of this dike though.

(iii) Right bank at 13.1 k

There exists a distinct former river course with a circle shape on the right bank at 13.1 k near the north west edge of Cengkareng airport. The former river course forms deep sunken place. Some houses are located surrounded by this former river course.

(c) Bed Rock around 17.4 k

Tufaceous bed rock with gravel is exposed on the river bed from 17.4 k to 18.0 k. The bed slope forms stepwise shape in the reaches.

(d) Riverside Park in Tangerang

The right bank of the Cisadane river in the city area of Tangerang had been densely built-up area with no roadway. In April 1996, the area of about 1.3 km on the right bank was redeveloped as a riverside park with new roadway; the number of evacuated houses was 474 according to the local newspaper.

(3) Related Structures

(a) Embankment

The embanked reaches of the Cisadane river are located from 2.9 k up to around 17 k from the estuary. The reaches from 17 k up to Pasar Baru barrage form deeply dissected valley and has no embankment.

The artificial embankment is located on slightly high natural levee and accordingly the height of the artificial embankment is not so high.

(b) Bridge and Barrage

Pasar Baru barrage is located at the upper end of the objective reaches of the Master Plan (21.3 k). Kali Baru bridge at 6.4 k is the only bridge crossing the Cisadane river.

(4) Present Carrying Capacity

Present carrying capacity of the Cisadane river is estimated by using non-uniform flow formula based on the river survey results of feasibility study level conducted by the Study Team in 1996. The conditions for the calculation are shown below.

Calculation method

The same method described in Section 3.9 is adopted.

Tide level

Spring tide of PP 1.15 m (approximately TTG 0.55 m) is adopted for the lower-end water level.

Manning's roughness coefficient

0.0 k - 12.7 k	12.7 k - 21.3 k
n=0.030 : low water channel	n=0.035 : low water channel
n=0.050 : high water channel	n=0.050 : high water channel

The results are roughly summarized as follows (refer to Figure 5.5).

Reaches	Bankfull (m^3/s)	1.0 m freeboard (m^3/s)
0.0 k - 3.5 k	600	200
3.5 k - 12.7 k	1,500	1,200
12.7 k -	1,800	1,500

5.1.3 On-going Flood Control Plan

In order to cope with the serious damage caused by the big floods in January and February 1996, the Government of Indonesia has promoted the program to execute urgent and short-term flood control works. These flood control programs will be executed in line with this present Study.

The work items related to the present Study are listed as follows:

1. Channel excavation including disposal of excavated material of the Western Banjir Canal : 8 km
2. Embankment improvement of the Western Banjir Canal : 18 km
3. Drainage improvement of the Ciliwung Drain (Manggarai Barrage - Kapitol) : 8.4 km
4. Rehabilitation of slide gates of the Pasar Baru Barrage on the Cisadane river: 7 units

As already mentioned in Section 3.6, seven slide gates of the Pasar Baru Barrage on the Cisadane river do not function properly due to the deterioration. Accordingly, rehabilitation work of the gates will be implemented by this project.

5.2 Optimum Scale for Urgent Flood Control Project (1st Stage Project)

5.2.1 General

The flood control of the Western Banjir Canal and the Cisadane systems have been selected as priority projects.

But implementation of the priority projects on the Master Plan level at once needs huge project costs. Accordingly, effective stepwise implementation of the priority projects is required.

On the other hand, in January and February 1996, DKI Jakarta was hit by the worst floods of the Ciliwung river and the Western Banjir Canal (WBC) since World War II. Accordingly prompt action of flood control in DKI Jakarta is absolutely needed.

In consideration of these above, urgent flood control project to be implemented immediately as 1st stage project should be formulated. The optimum scale of the urgent flood control project is discussed hereunder. In the discussion, cost and benefit are those in the master plan level in 1995. The subsequent feasibility study is conducted for the formulated optimum scale.

5.2.2 Alternative Schemes

(1) Basic Considerations

First of all, it is considered that the urgent flood control project (1st stage project) of the WBC should be a project which can cope with the flood of the same scale as that of big floods in 1996 in consideration of social aspects; it is said that the floods in 1996 were the biggest for the past 25 - 50 years.

The following four design scale alternative schemes have been examined for optimum scale of the urgent flood control project. The alternative schemes are shown in Table 5.1 and Figure 5.6.

Alternatives	WBC	Ciliwung Floodway	Cisadane
Alt. 1	M/P scale (1/100)	2 tunnels (300 m^3/s x 2 units), discharge volume: 600 m^3/s	1/50 (1,900 m^3/s)
Alt. 2	M/P scale (1/100)	1 tunnel (300 m^3/s x 1 unit), discharge volume: 300 m^3/s	1/25 (1,500 m^3/s)
Alt. 2'	M/P scale (1/100)	2 tunnels (300 m^3/s x 2 units), discharge volume: 300 m^3/s	1/25 (1,500 m^3/s)
Alt. 3	1/50	1 tunnel (300 m^3/s x 1 unit), discharge volume: 300 m^3/s	1/10 (1,200 m^3/s)

In Alt.2', only 300 m^3/s is planned to be discharged to the floodway as the 1st stage: full scale discharge of 600 m^3/s should be discharged after the completion of the river improvement of the Cisadane river, in the reaches downstream of the Pasar Baru Barrage, with the Master Plan level.

Concerning the WBC, the objective discharges for the river improvement of the Alt.2 and Alt.3 are also the same as that of the Alt.1 of which the safety level is once in 100 years. But the safety level of the Alt.2 and Alt.3 will be less than once in 50 years because only half of design discharge of the Ciliwung Floodway will be diverted to the Cisadane river.

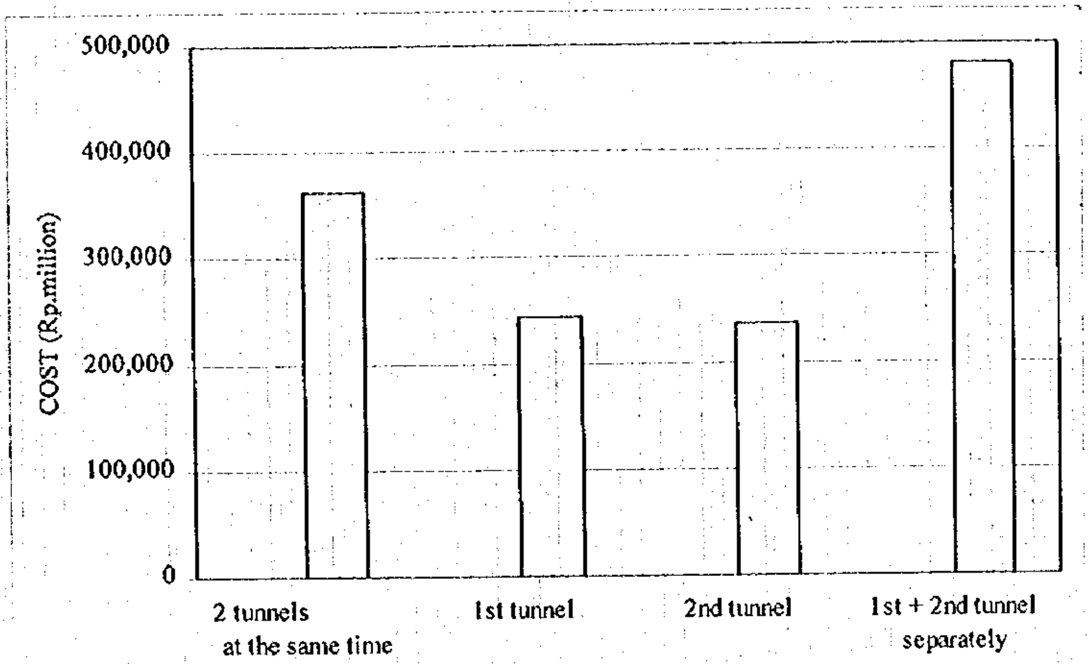
(2) Alternatives of Cisadane River

Each alternative has its own design scale of the Cisadane river from 10-year to 50-year. Here it is necessary to estimate work quantity of the Cisadane river improvement for the following economic evaluation. Preliminary design of the Cisadane river is roughly conducted based on the following considerations:

- river improvement work of each alternative forms a part of the master plan;
- river improvement reaches of each alternative will be different according to each design discharge and present carrying capacity; and
- land aquisition in the 1st stage should be carried out according to the right of way of the master plan stage;

5.2.3 Comparison of Construction Cost of Ciliwung Floodway

The comparison of construction cost of the Ciliwung Floodway is studied as shown in the figure below. To construct two tunnels at the same time is cheaper than to construct 1st tunnel in the urgent flood control project and construct 2nd tunnel later in the master plan stage separately.



5.2.4 Evaluation and Conclusion

(1) Economic Evaluation

Economic evaluation is conducted for the alternatives as one aspect of project evaluation. Flood damage reduction benefits and financial project costs are estimated based on the method described in the Main Report for the Master Plan. The estimated EIRR and B/C are as follows:

Alternatives	Flood reduction benefit (Million Rp)	Economic project cost (Million Rp)	EIRR (%)	B/C (discount rate : 12%)
Alt. 1	85,815	456,332	16.1	1.37
Alt. 2	79,196	365,553	18.0	1.57
Alt. 2'	79,196	405,686	16.4	1.41
Alt. 3	68,800	323,684	17.8	1.54

(2) Overall Evaluation

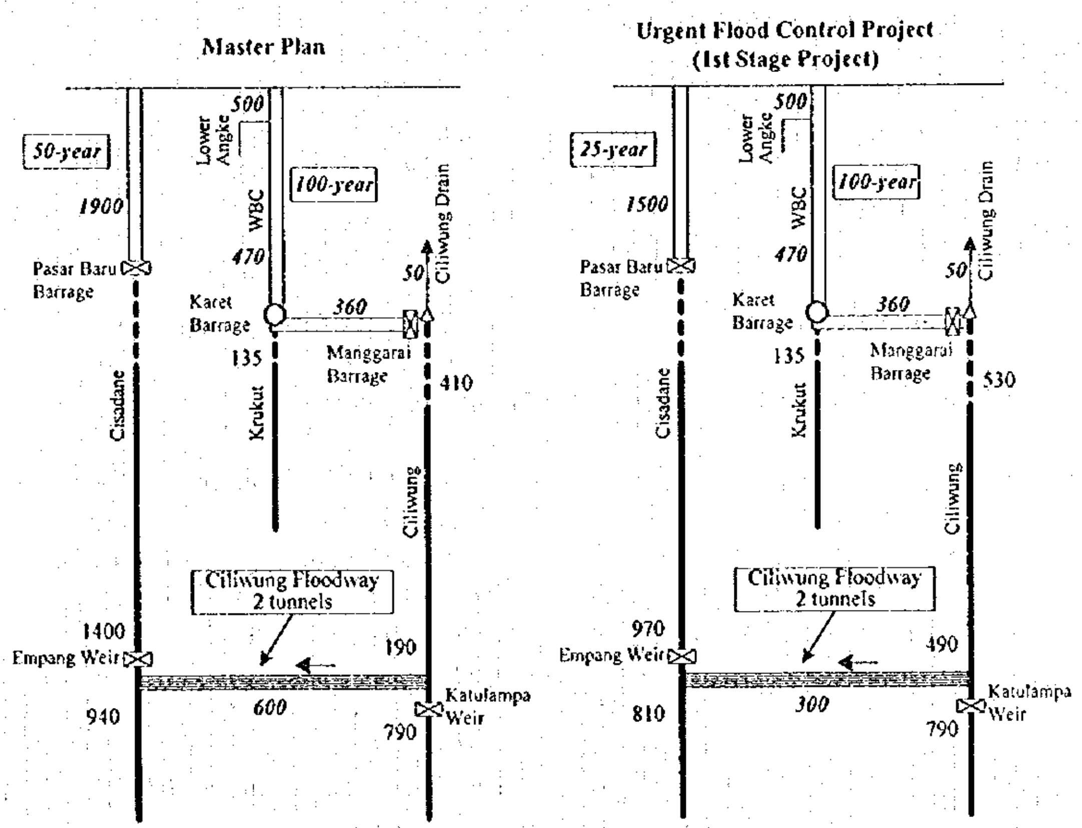
The Alt.2 has the highest EIRR and B/C. However, judging from technical viewpoint on construction of the tunnel, the Alt.2' has higher advantage than the Alt.2. The Alt.2' has still higher EIRR and B/C than that of the Alt.1 i.e. the Master Plan stage and has same design discharge distribution with Alt.2.

As for the construction of the Ciliwung floodway, the two tunnels proposed in the master plan are to be constructed in advance during the stage of the urgent flood control project. The design discharge to the two tunnels is proposed temporarily to be 300 m^3/s in accordance with the river improvement of the Cisadane river in downstream reaches with 25-year design scale.

The construction of 2 tunnels in advance is proposed with the consideration to the demerits such as various procedures, increase of the cost, negative impact of giving inconvenience to the surrounding residents and the others to be accompanied by future additional works.

Accordingly, the Alt.2' is selected as the optimum scale for the priority project to be implemented as an urgent flood control project (1st stage project).

The design discharge distribution thus proposed is as follows:



5.3 Preliminary Design of Western Banjir Canal for Urgent Flood Control Project

Preliminary design of the Western Banjir Canal is conducted for the urgent flood control project (1st stage project).

5.3.1 Design Criteria

In principle, the design is conducted in accordance with the criteria in "Flood Control Manual in Indonesia" (hereinafter referred to as the Manual), which was prepared by DGWRD in collaboration with Canadian International Development Agency in 1993. The criteria in the Manual concerning the river improvement such as embankment, bridge clearance and others are shown in Table 5.2.

The following criteria in Japan are also referred to:

- Manual for River Works in Japan
- Cabinet Order concerning Structural Standards for River Management Facilities
- Latest Guideline for River Improvement in Japan published in 1996

According to the latest river improvement criteria in Japan (Guideline for River Improvement in Japan, 1996), it is desired to decrease construction and maintenance costs and to preserve environment as much as possible. However the latest guideline is applied for the WBC limitedly because of the following reasons:

- the WBC is an artificial floodway;
- it is necessary to increase the carrying capacity within the present right of way to avoid land acquisition in the densely populated area; and
- it is necessary no to raise the design high water level as much as possible to decrease the number of bridges to be reconstructed.

5.3.2 Treatment of Existing Flood Control Plans

(1) Master Plan for Drainage and Flood Control of Jakarta (1973)

The design of the WBC for 100-year flood was once prepared along the proposed extension of the WBC in "Master Plan for Drainage and Flood Control of Jakarta" formulated by NEDECO in 1973. However, the proposed extension was abandoned mainly because of the land acquisition problem. Accordingly, the existing WBC had no consistent design high water level until the following project determined the partial high water level in lower reaches in 1987. As the adopted elevation datum was PP, it is necessary to pay attention to use the data by PP datum with the data based on TTG datum in this Study.

The proposed alignment and longitudinal profile at that time are shown in Figures 5.7 and 5.8 respectively.

(2) West Jakarta Flood Control System Project III (1987)

The detailed design for the improvement of the WBC from the estuary up to the Teluk Gong siphon and the Angke Drain (Lower Angke river) was prepared in "West Jakarta Flood Control System Project III" (hereinafter referred to as the Detailed Design) in 1987. The

Angke Drain was planned to join the WBC with gravity drainage. As the adopted elevation datum was PP, it is necessary to pay attention to use the data by PP datum with the data based on TTG datum in this Study.

The outline of the Detailed Design of the WBC is as follows:

- estuary - confluence of Angke drain : channel excavation and embankment works
- confluence of Angke drain - Teluk Gong siphon : embankment works

In principle, it is desired that the existing plan be introduced into this feasibility study as much as possible. However, it is necessary to modify the Detail Design near the estuary especially the embankment alignment because of the following changes of the situation since 1987:

- short-cut works of the WBC near the estuary were completed in 1995, which was executed by using local budget and was not included in the Detailed Design;
- a big scale residential development project is now already going on within the proposed embankment alignment by the Detailed Design near the Permai bridge; and
- the condition at the estuary will be changed by reclamation project in future.

The proposed alignment, longitudinal profile and standard cross section are shown in Figures 5.9, 5.10 and 5.11 respectively.

5.3.3 River Improvement

(1) Basic Improvement Items

The basic improvement items are summarized as follows (refer to Figure 5.12):

Estuary (0.0 k) - Confluence of Angke Drain (2.9 k)
- new embankment or raising of present embankment with sodding
- no parapet wall is included
- widening and excavation of low water channel
- no revetment for standard slope of 1:2.0
- low water channel revetment for some water colliding fronts

Confluence of Angke Drain (2.9 k) - Karet Barrage (12.4 k)
- raising of present embankment as occasion demands
- no parapet wall is included
- widening and excavation of low water channel as occasion demands
- revetment works and asphalt pavement for embankment (both banks; 2.9 k - 11.3 k, only left bank; 11.3 k - 12.4)
- no low water channel revetment for standard slope of 1:1.5
- low water channel revetment for some steep slope portions of 1:1.0

Karet Barrage (12.4 k) - Halimun Bridge (15.2 k)

- no raising of present embankment
- no embankment on left bank
- sodding on right embankment as occasion demands
- widening and excavation of low water channel as occasion demands
- no low water channel revetment for standard slope of 1:1.5
- low water channel revetment for some steep slope portions of 1:1.0

Halimun Bridge (15.2 k) - Manggarai Barrage (16.9 k)
- no embankment
- channel excavation as occasion demands*

* :
The WBC has no banquette in this reaches and the relative height from the ground to the design river bed is around 10 m in places. According to the information from PPWSCC, it is possible to excavate up to 12 m by the backhoe shovel equipped with attachment; the total arm length is 15 m.

(2) Design Discharge

As already discussed in Section 5.2, the design discharge distribution for the urgent flood control project (1st stage project) is the same with the master plan scale of 100-year.

- Estuary (0.0 k) - Angke Drain (2.9 k) : 500 m^3/s
- Angke Drain (2.9 k) - Krukut River (12.4 k) : 470 m^3/s
- Krukut River (12.4 k) - Manggarai Barrage (16.9 k) : 360 m^3/s

These are revised value in the feasibility study stage as already discussed in section 4.6.

(3) Objective Reaches

The objective reaches of the river improvement for the urgent flood control project (1st stage project) are approximately 17 km from the estuary up to the Manggarai Barrage.

(4) Right of Way

According to the present legislation, the authorities should acquire and control overall land to a distance of 5 meters beyond the outside toe of embankments as a right of way of river. However, this right of way of 5 m is not included as an objective area for land acquisition in consideration of present densely urbanized land use situation and difficulties of land acquisition along the WBC.

(5) Alignment

In principle, proposed alignment of the WBC is on the existing one except near the estuary to avoid any land acquisition.

Near the estuary, newly constructed embankment of PP. 3.5 m between the forest reservation area and the new residential development of Pantai Indah Kapuk is utilized as the left embankment of the WBC. The area between the WBC and the new embankment can function as a natural retarding basin effectively and can make the flood water level lower.

The proposed design alignment is shown in Figure 5.13.

(6) Water Level at Estuary

The water level of TTG 0.85 m (approximately PP 1.45 m) is adopted at the present estuary. This is the same figure adopted in the present Detailed Design. The channel to be prepared in the future reclaimed area by PANTURA as the continuation of the WBC should be designed not to give any raise of design high water level proposed by this WBC improvement plan. The condition required is already discussed in Section 4.7.

(7) Longitudinal Profile

In general, it is desirable to consider the followings to determine the design longitudinal profile:

- the high water level should be designed to be slightly lower than (at least approximately equal to) the both side's ground elevations; and
- the design river bed should be designed to have similar gradient of the present average river bed.

However, as the WBC flows through in densely populated area and has many related structures such as drainage facilities, pumping stations, bridges, siphons, barrages and so on, the following considerations are also introduced in the plan:

- It is absolutely necessary to cope with the new increased design discharge within the present right of way to avoid the serious social impact concerning the land acquisition: the design high water level will become higher than that of the ground elevation in the reaches downstream of the Karet Barrage;
- On the other hand, from the viewpoint of the clearance of the bridges on the WBC, it is desirable to make the design high water level lower to avoid reconstruction of the bridges as much as possible;
- It is necessary not to change the high water level drastically from that in existing WBC improvement plan especially at the confluence of the Angke Drain; and
- It is necessary to pay attention to the elevation of three siphons which go under the WBC to determine the design river bed elevation.

The design longitudinal profile is shown in Table 5.3 and Figure 5.14.

The sand bar at the estuary is estimated to be flushed in flooding time, detail study might be needed in the detail design stage though.

The design high water level is proved to be appropriate by non-uniform flow calculation as shown in Figure 5.15 based on the actual design cross sections of Figure 5.18. The backwater effect by the bridge piers is evaluated by using the D'Aubuisson's formula in this non-uniform flow calculation.

(8) Cross Sectional Profile

The proposed criteria for minimum condition of embankment of the WBC is shown in Table 5.4.

The design river width and low water channel width are determined based on that of the present as shown in Figure 5.16.

In the Master Plan stage, the sideslopes of the standard cross sections from the confluence of the Angke Drain up to the Manggarai Barrage were determined in accordance with the minimum embankment sideslopes of 1:2 in the Manual.

However, it is necessary to decrease land aquisition as much as possible to avoid the serious social impact. Accordingly, it is necessary to adopt steeper sideslopes of 1:1.5 to cope with the increased design discharge within the present right of way. Sideslopes of 1:1.0 is adopted in some critical portions with narrow channel width.

If the present river width is wider than that of the standard cross section, the present river width is preserved as it is. If the present river bed is deeper than that of the design river bed, the present river bed is preserved as it is, too.

The standard cross sections are prepared as shown in Table 5.5 and Figure 5.17. The actual design cross sections are shown in Figure 5.18.

(9) Manning's Roughness Coefficient

The following Manning's roughness coefficients (n) are adopted:

- 0.025 : low-water channel
- 0.040 : high-water channel

These are the same figures as that of the plan in the proposed Eastern Banjir Canal.

(10) Freeboard

According to the Manual, the minimum required freeboard corresponding to the design discharge is 0.8 m. However, the freeboard of 1.0 m is adopted taking into account the importance of the to-be protected area and the margin for future envisaged land subsidence.

This freeboard of 1.0 m was also adopted in detailed design of lower reaches of the WBC by "West Jakarta Flood Control System Project III (1987)". The freeboard of 1.5 m had been adopted in NEDECO's mater plan in 1973.

Freeboard of 0.6 m is adopted where the design high water level is lower than the ground elevation.

(11) Inspection Road

Inspection road with minimum 3 m width is provided on both embankments where there is no road available along the WBC at present.

Special attention will be needed to the riverside park on the right bank from the M. H. Thamrin bridge up to the Sukabumi bridge to harmonize the function of flood control and promenade.

(12) Revetment

Embankment

Revetment of wet masonry on the side slopes of the embankment and asphalt pavement on the crown are provided in the following reaches in the same way as the present.

- Confluence of the Angke drain (2.9 k) - Aipda K. S. Tubun bridge (11.3 k) : both banks
- Aipda K. S. Tubun bridge (11.3 k) - Karet barrage (12.4 k) : left bank only

The reasons why the embankment revetment is requited are as follows:

- the proposed embankment dimension is required minimum;
- flood continuation time is quite long as already proved by 1996 big floods; and
- the revetment is useful as a measure for excess flood.

River channel

Low and high water channel revetments are provided in the following portions:

- confluence of tributaries (Angke drain, Krukut river, Cideng drain)
- near structures such as bridges, barrages and pumping stations

Low water channel revetment is provided in the following portions:

- water colliding front along the meandering reaches of Muara Angke
- steeper slope portions than 1:1.0

In upstream reaches from K. H. Mas Mansyur bridge (13.1 k), it is desirable to pay attention in revetment works not to spoil the view along the WBC as a riverside park.

5.3.4 Bridge

(1) Freeboard

(a) Design Criteria

Here, there are following design criteria for bridges freeboard:

1) Bina Marga

According to the Manual, Bina Marga requires minimum freeboard of 1.5 m above bankfull flood.

However, if this criteria is adopted, more than half of present bridges crossing the WBC do not satisfy the criteria. It is practically impossible to adopt this criteria judging from the serious social impact caused by the interruption of heavy traffic of those bridges.

2) Cabinet Order concerning Structural Standards for River Management Facilities, etc. in Japan

"Cabinet Order concerning Structural Standards for River Management Facilities, etc. in Japan" requires the same freeboard as the embankment freeboard; the minimum freeboard of 0.8 m is required in the WBC from the design discharge of under 500 m^3/s excluding no embankment reaches of 0.6 m freeboard in the upstream end. The soffit elevation of bridge girder and required freeboard line are shown in Figure 5.19.

(b) Considerations

Bridges lower than proposed HWL

The following two bridges have extremely low girders and the girder soffit elevations become lower than that of the proposed HWL. Those bridges are required to be reconstructed.

- Prof. Dr. Latumeten bridge (6.9 k)
- Kyai Tapa bridge (8.4 k)

Bridges lower than freeboard line

According to the above criteria *2)*, the girder soffit elevation of following five bridges are higher than HWL but still lower than minimum freeboard line. Those bridges are fundamentally necessarily to be reconstructed.

- Teluk Gong Raya bridge (5.0 k)
- Railway bridge (future) (7.9 k)
- Railway bridge on Karet barrage (12.4 k)
- K. H. Mas Mansyur bridge (13.1 k)

- Roadway bridge on Manggarai barrage (16.9 k)

The reconstruction of those five bridges will be an obstacle and seems to be practically difficult judging from the present extremely heavy traffic situation in the central DKI Jakarta. However, the project cost is estimated by the reconstruction of seven bridges including above five bridges in accordance with the criteria in this feasibility study stage. Further consideration concerning the treatment of those five bridges will be needed in the succeeding detailed design stage.

(2) Protection of Pier

Some protection works for the following eight bridge piers will be needed resulting from the channel widening and excavation works.

- Mandara Permai bridge (1.9 k)
- Tol Airport Cengkareng bridge (2.7 k)
- Access bridge to Tol Airport Cengkareng (2.9 k)
- Tol Road bridge (4.7 k)
- Pangeran Tubagus Angke bridge (5.6 k)
- Tomang flyover (9.4 k)
- New flyover near TN. Abang Station (10.7 k)
- Aipda K. S. Tubun bridge (11.3 k)

5.3.5 Barrages

(1) Karet Barrage

The Karet Barrage will remain for flushing of the Krukut Drain in future. The flood water levels at the barrage are roughly estimated by using non-uniform flow calculation in order to know the carrying capacity and backwater as shown in Figure 5.20. The backwater caused by the barrage is estimated within 50 cm even by the new design discharge of 470 m^3/s. It is concluded that the barrage has enough carrying capacity and the improvement of the barrage is basically not necessary.

(2) Manggarai Barrage

It is said that the Manggarai barrage dammed up the flow by about 3 m in height in January 1996 flood, because the flow width was quite narrow. The estimated flood water levels at the barrage by non-uniform flow calculation in Figure 5.20 coincide well with the actual situation.

Improvement of the barrage is necessary because the carrying capacity of the barrage is not enough for the design discharge of 360 m^3/s and the improvement can also make lower the flood water level of upper side of the barrage.

In view of the present condition, installation of a new opening on the right bank is proposed.

The effects of a new opening with several width are roughly estimated by non-uniform flow calculation as shown in Figure 5.21. The opening width is enough if the width of 5.5 m (same as the present gate width) is adopted. The facility aspects is discussed in ANNEX 8.

5.3.6 Treatment of Tributaries

(1) Krukut River

The Krukut river is treated as flood plain zoning area in the Master Plan to preserve flood retarding function; the Krukut river is not objective reaches for river improvement.

(2) Drainage Channels

The following two urban drainage channels which join the WBC with gravity drainage are now treated as an urban drainage channel under the control of DKI Jakarta.

Angke Drain

The HWL and design river bed of the WBC is determined TTG 1.68 m and -3.92 m (approximately PP 2.28 m and -3.32 m) respectively at the confluence of the Angke Drain (2.9 k). On the other hand, according to the detailed design of "West Jakarta Flood Control System Project III (1987)", the HWL and design river bed of the lower end of the Angke Drain have been PP 2.30 m and -3.00 m respectively. Therefore, there is little influence for the present detailed design of the Angke Drain.

Cideng Drain

In January 1996 flood, the flood water of the WBC flowed backward to the Cideng Drain and flowed into the Setiabudi regulation ponds through the lower portion of the embankment of the drain. The embankment of the drain in the reaches near the WBC was already heightened after the floods.

The flood water of the Cideng drain is also drained to the WBC through the Cideng pumping station. The HWL of the WBC is determined TTG 3.98 m (approximately PP 4.58 m) at the pumping station (9.5 k). On the other hand, according to the detailed design of "West Jakarta Flood Control System Project (1986)", the HWL of the WBC have been partly assumed to be PP 5.00 m. Therefore, there is no bad influence for the present pumping station.

5.3.7 Proposed Project Works

The major required project works in the urgent flood control project (1st stage project) for the priority projects are as follows (in detail refer to ANNEX 8):

Work Item	Unit	Quantity
1. Land Aquisition and Compensation		
Land aquisition	ha	0.0
House	nos.	0
2. Channel Improvement (L=16.9 km)		
Preparatory	ls	1
Excavation and dredging	m^3	1,354,000
Embankment	m^3	110,000
Low and high water channel revetments (around tributaries and related structures)	m^2	17,100
Low water channel revetment (water colliding front, steep slope)	m^2	24,700
Embankment protection		
-Wet masonry	m^2	72,300
-Sod facing	m^2	42,900
Asphalt pavement of embankment crown	m^2	25,100
Drop structure	nos.	0
Construction of new drainage structure	nos.	4
Improvement of existing drainage structure	nos.	3
Reconstruction of existing bridges	nos.	7
Construction of New Opening at Manggarai Barrage	nos.	1

5.4 *Preliminary Design of Cisadane River for Urgent Flood Control Project*

Preliminary design of the Cisadane river is conducted for the urgent flood control project (1st stage project) here.

5.4.1 Design Criteria

In principle, the design of the Cisadane river is conducted in accordance with the same criteria as adopted in the design of the WBC.

The following considerations based on the latest river improvement criteria in Japan (Guideline for River Improvement in Japan, 1996) are also introduced positively to determine the design:

- same design high water level is adopted in the urgent flood control project (1500 m^3/s) and Master Plan stage (1900 m^3/s);

- widening and excavation of low water channel should be limited as much as possible in order to maintain the natural stability of present channel, to decrease the construction and maintenance costs, and to preserve the present environment;
- if the present embankment is located extremely close to the water colliding front, setting back of embankment is adopted to avoid failure of embankment due to scoring;
- revetment works should be limited as much as possible;
- former river course and oxbow lake should be treated as a part of river and included within the embankment alignment to preserve it's natural retarding effect and environment: no need to maintain uniform river width; and
- ground clearing of high water channel should be limited as much as possible to preserve riverside forest and environment, since the flood discharge on high water channel is limited and river side forest can decrease the hydraulic energy force against embankment.

5.4.2 River Improvement

(1) Basic Improvement Items

The basic improvement items for the urgent flood control project (1st stage project) are summarized as follows (refer to Figure 5.22):

0.0 k - 1.8 k
- no river improvement

1.8 k - 3.5 k
- new embankment

3.5 k - 7.7 k
- raising of present embankment as occasion demands
- setting back of embankment as occasion demands
- low water channel revetment for some water colliding fronts

7.7 k - 11.8 k
- raising of present embankment as occasion demands
- setting back of embankment as occasion demands
- widening and excavation of low water channel as occasion demands
- low water channel revetment for some water colliding fronts

11.8 k - 16.8 k
- raising of present embankment as occasion demands
- setting back of embankment as occasion demands

16.8 k - 21.3 k (Pasar Baru Barrage)
- no river improvement

(2) Design Discharge

As already discussed in Section 5.2, the design discharge for the urgent flood control project (1st stage project) is 1,500 m^3/s; the design scale is 25-year.

(3) Objective Reaches

The objective reaches of the improvement are determined from 1.8 k up to 16.8 k of the upper end of embanked reaches based on the present carrying capacity (refer to Section 5.1). There is no need of river improvement from the estuary to 1.8 k because of the following reasons:

- It is necessary to keep the water of fish pond brackish;
- There will be not so many property to be protected even in future; and
- The geological condition near the estuary will not be suitable for the embankment.

The upstream reaches from 16.8 k to the Pasar Baru barrage are not objective reaches for the urgent flood control project (1st stage project), present roadways along the both river banks should be preserved as inspection road though.

(4) Right of Way

In principle, overall lands to a distance of 5 meters beyond the outside toe of embankments is treated as right of way of river in accordance with the Manual.

(5) Alignment

The proposed embankment alignment is shown in Figure 5.23.

(6) Water Level at Estuary

The proposed high water level of the Cisadane river is rather high and the mangrove forest around the estuary will be kept as it is by the reclamation plan by KAPUKNAGA.

However, the channel to be prepared in the future reclaimed area by KAPUKNAGA as the continuation of the Cisadane river should be designed not to give any raise of design high water level proposed by this Cisadane improvement plan. The condition required is already discussed in Section 4.7.

(7) Longitudinal Profile

The design longitudinal profile is shown in Table 5.6 and Figure 5.24.

According to the sounding survey result around the estuary conducted by the Study Team in 1996, the sea-bed is relatively shallow. However, the sand bar at the estuary is estimated to be flushed in flooding time and the proposed design high water level is high enough, no matter how the sand bar will be flushed. Detail study might be needed in the detail design stage about this matter.

The slope of the river bed and ground clearly change around 12.7 k. It should be avoided to determine the design river bed elevation too low: bed rock is exposed on some river bed especially around 17.5 k as already mentioned in Section 5.1.

The design high water level is proved to be appropriate by non-uniform flow calculation as shown in Figure 5.25 based on the actual design cross sections of Figure 5.27. The spring tide of TTG 0.55 m (approximately PP 1.15 m) is adopted at the present estuary for the non-uniform flow calculation.

(8) Cross Sectional Profile

The design river width and low water channel width are determined based on that of the present as shown in Figure 5.26.

If the present river width is wider than that of the standard cross section, the present river width is preserved as it is. If the present river bed is deeper than that of the design river bed, the present river bed is preserved as it is, too.

The standard cross sections are prepared as shown in Table 5.7 and Figure 5.27. The actual design cross sections are shown in Figure 5.28.

(9) Manning's Roughness Coefficient

The following Manning's roughness coefficients (n) are adopted:

1.8 k - 12.7 k	12.7 k - 16.8 k
n=0.030 : low water channel	n=0.035 : low water channel
n=0.050 : high water channel	n=0.050 : high water channel

(10) Freeboard

The freeboard of 1.0 m corresponding to the design discharge of 1,500 m^3/s is adopted in accordance with the Manual.

(11) Inspection Road

Inspection road of 5 m width is provided on both embankments.

(12) Revetment

Some low water channel revetment works are required in water colliding fronts.

5.4.3 Related Structures

(1) Bridge

Kali Baru bridge (6.4 k) is the only bridge along the objective reaches. The girder elevation of TTG 7.0 m has enough clearance against the design high water level. There is no need to reconstruct this bridge.

It is not necessary to consider the protection of the bridge piers, since there is no excavation works there.

(2) Pasar Baru Barrage

As already mentioned in Section 5.1, the rehabilitation work of the Pasar Baru barrage will be implemented by the Project Type Sector Loan of OECF as a part of short-term flood control program. Accordingly the rehabilitation works of the barrage is not included in the objective of the Study.

5.4.4 Proposed Project Works

The major required project works in the urgent flood control project (1st stage project) for the priority projects are as follows (in detail refer to ANNEX 8):

Work Item	Unit	Quantity
1. Land Aquisition and Compensation		
Land aquisition	ha	45.3
House	nos.	460
2. Channel Improvement (L=15.0 km)		
Preparatory	ls	1
Excavation and dredging	m^3	825,000
Embankment	m^3	913,000
Low water channel revetment	m^2	8,400
Drop structure	nos.	0
Construction of new drainage structure	nos.	3
Improvement of existing drainage structure	nos.	2
Reconstruction of bridge	nos.	0

The number of houses to be expropriated were counted by using the topographic maps with a scale of 1:5,000 prepared by the Study Team in 1996. The number might include not only human habitation but also warehouse, livestock house and so on, since it is impossible to distinguish the type of house by the maps. Accordingly, it is necessary to investigate and classify those houses in the proceeding detailed design stage.

5.5 Preliminary Study on Ciliwung Floodway Route

5.5.1 Introduction

The location of Ciliwung Floodway was once proposed in the master plan based on the topographic map with the scale of 1:25,000 that was the only available map in that stage. The map was the one issued in 1989 based on the aerial photographs taken in 1981/1982.

Since the information of the map was rather old, and the information on the map was not much detailed, alternative study on the location of Ciliwung Floodway in this feasibility study stage has been conducted based on the above-mentioned topographic map and aerial photographs with a scale of 1:5,000 taken in May, 1996.

The alternative study has been conducted with two stages: an alternative study on the general location of Ciliwung Floodway and a study on the rather detailed location of the inlet and outlet facilities.

Detailed route study is conducted in succeeding section 4.4 based on the results of the topographic survey of the floodway area that has been conducted in this feasibility study stage.

5.5.2 Alternative Study on General Location

(1) Conceivable Route

As a general rule, it is desirable that the Ciliwung Floodway be an open channel floodway which connects the Ciliwung and the Cisadane rivers with the shortest route. However, it is inevitable that the Ciliwung floodway becomes a tunnel floodway to avoid the serious land acquisition problem in the densely populated area of Bogor city. The southern part of the Bogor city is the only area to satisfy the conditions for construction of floodway tunnel such as:

- enough overburden depth; and
- short distance between the Ciliwung and the Cisadane rivers.

Conceivable alternative routes of the proposed Ciliwung Floodway are shown in Figure 5.29. Alt.1 is the shortest route from the Ciliwung to the Cisadane rivers. Alt.2 connects the Ciliwung and Cisadane rivers through the Cipaku river, small right tributary of the Cisadane river.

In downstream reaches of the Alt.1, the floodway must be constructed by open channel because of shortage of relative height between the elevation of the Ciliwung river bed and the terrace on which the city area of Bogor is located. Construction of the floodway with open channel may cause not only serious land aquisition problem but also interruption problem of north-south traffic and canals in the center of city area. Accordingly construction of the floodway with open channel in this stretch is considered practically impossible.

Towards the upstream reaches of the Alt.2, the distance between the Ciliwung and Cisadane rivers increases. Besides the improvement length of the Cipaku river increases. Accordingly the upstream area of the Alt.2 is not considered for the conceivable route of the floodway.

(2) Comparative Study

(a) Land Use

According to the aerial photographs with a scale of 1:5,000 taken in May 1996, the area along alternative routes has already been urbanized mainly as residential area with one and/or two stories houses. The extent of urbanization is almost the same between the areas along two alternative floodway routes.

The land use condition in the topographic map with a scale of 1:25,000 is quite different from that of the present, since the map was prepared based on the aerial photographs taken in 1981/1982. The land use condition in some Bogor city map on the market is also different from that of present.

(b) General Longitudinal Profile

General longitudinal profiles along the two alternative routes are prepared as shown in Figure 5.30, by using 12.5 m pitch contour line on the topographic map with a scale of 1:25,000.

The overburden depth along the Alt.1 is around 30 m, even though relatively low elevation portion near a small river exists in the middle of the route. On the other hand, the overburden depth along the Alt.2 is around 20 m. The average gradient of both alternatives from the Ciliwung to Cisadane rivers is approximately i=1/100.

(c) Selection of Optimum Route

In consideration of the following aspects, the Alt.1 is adopted as the optimum floodway route:

Alt.1

- total floodway length is short (approximately 1 km);
- no serious land acquisition problem may be caused because of its short open channel stretch; and
- this route has smooth bifurcation alignment from the Ciliwung river and has smooth confluence alignment with the Cisadane river.

Alt.2

- total floodway length is long (approximately 1.5 km);
- the Cipaku river which forms downstream reaches of the floodway is a very small river, with the basin area of only about 6 km^2, and accordingly overall widening and straightening of the river are required;
- the river-bed of the Cipaku river consists of rock at location and accordingly there will be difficulties in excavation work even for open channel; and
- land aquisition problem may be caused because many houses are existing along the Cipaku river.

5.5.3 Study on Location of Inlet and Outlet Facilities

Here the discussion on the locations of inlet and outlet facilities are presented hereunder. The details are discussed in ANNEX 8 (Design and Cost Estimate).

(1) Location of Inlet Facilities

For selection of inlet facilities location, the following criteria have been considered:

1. the location of fixed weir to keep the water-level of the Ciliwung river at certain level before diversion of flood should be considered,
2. accordingly the longitudinal sloe of the river-bed of the Ciliwung river should be rather gentle one. Too much steep slope causes much more height of fixed weir,
3. location of temporary diversion channel of the Ciliwung river during the construction work, should be taken into consideration to avoid human resettlement as much as possible,
4. the land on the left side of the Ciliwung river should be as high as possible to have enough overburden depth above the tunnel, and to avoid human resettlement as much as possible,
5. the location of access road for tunnel construction works should be taken into consideration to avoid human resettlement as much as possible,
6. the alignment of the Ciliwung river to the tunnel should be a smooth one to lead much part of flood discharge of the Ciliwung river to the Cisadane river,
7. the river width should be as uniform as possible around the inlet.

The river-bed of the Ciliwung river has a rather sharp natural drop just downstream of the proposed site. Accordingly the inlet facilities should be located upstream of the drop.

In the reaches upstream of the bridge over the Ciliwung river, the left side land has rather gentle side slope to the low water channel and may houses are located on the slope close to the low water channel. Accordingly the inlet facilities should be located downstream of the bridge site.

Temporary diversion channel of the Ciliwung river should be constructed on the right side of the river in due consideration of the present situation. Accordingly the location of the inlet facilities should be the place where the houses are not many on the right side of the river. The presently proposed site is the better place than other sites to satisfy the condition.

The presently proposed site is better than the other locations to satisfy the conditions for an access road for construction works.

(2) Location of Outlet Facilities

For selection of outlet facilities location, the following criteria have been considered:

1. the Ciliwung Floodway should join the Cisadane river with a smooth alignment,
2. human resettlement for the construction of floodway should be as less as possible,
3. the location of access road for floodway construction works should be taken into consideration to avoid human resettlement as much as possible,
4. the river width of the Cisadane river should be as uniform as possible for smooth flow of sediment in.

The presently proposed site is the only place for the Ciliwung Floodway to join the Cisadane river with a smooth alignment.

Some houses are located rather close to the low water channel in the reaches downstream of presently proposed site.

Grave yard and military facilities are located on the right side of the river in further downstream reaches, and Ciliwung Floodway should avoid to pass underneath these facilities.

The river width of the Ciliwung river has rather uniform river width near the presently proposed site for the outlet.

5.6 Non-structural Measures

5.6.1 General

(1) Flood Risk Map

Low-lying area of DKI Jakarta has been suffering from habitual inundation for many decades. In order to cope with this, the Ministry of Public Works has been implementing various flood control and drainage projects in the area.

But the implementation of the flood control and drainage master plan in the area still needs much fund and time to be completed. And since the area is fundamentally located in the flood plain, even after completion of those flood control and drainage projects in line with the master plan, the area will be still subject to flooding. The causes may be failure of facilities, failure of operation of facilities, limitation of design scale, human activities against flood control and drainage facilities such as garbage dumping to river area or illegal structure construction in river area and others, abnormal high tide, other abnormal natural phenomena, etc.

Due to these reasons, non-structural measures for flood damage mitigation is inevitable in addition to structural measures. Flood risk map in low-lying area of DKI Jakarta is thus prepared as one of such non-structural measures.

(2) Flood Warning System

Since the flood of the Ciliwung river is to be diverted to the Cisadane river, it is necessary to improve the Cisadane river in its downstream reaches where the carrying capacity is not enough for the design discharge. But in addition to the river improvement of the Cisadane river, establishment of flood warning system for the Cisadane river is also required. As observed in the flood in January 1996, the river flow of the Cisadane river in Bogor city was just in a normal situation on the day when the big flood of the Ciliwung river attacked Bogor city and DKI Jakarta. Accordingly a flood warning system for the Cisadane river is indispensable for the projects.

5.6.2 Flood Risk Map

(1) General

Flood risk map is prepared to the condition that inundation would occur when failure of dike happens and the failure of dike may occur at any place in the objective reaches of the river during a flood of design discharge hydrograph

(2) Objective Area

The objective area of flood risk map covers the area of downstream basin of the Cengkareng Floodway, the Ciliwung, the Western Banjir Canal, the Cipinang, the Sunter, the Jatikramat, the Buaran, and the Cakung rivers. The area is about 500 km^2 wide.

(3) Flood Risk Map

The prepared flood risk map is shown in the MAIN REPORT (Feasibility Study).

5.6.3 Flood Warning System

(1) Present Situation of River Use

The present situation of river use of the Cisadane river in the reaches downstream of the outlet site of the Ciliwung floodway is as follows:

(a) Just downstream site

The area is in the city of Bogor and the river is used for washing, playing and fishing. In the reaches just upstream of Empang barrage, river is used for inland fishery, sand mining, and water intake by Empang barrage.

(b) In the middle reaches

The area is outside of Bogor city and the Cisadane river forms a very deep valley. The river is used for sand mining at places and partly for upland cropping.

In the reaches just upstream of Pasar Baru Barrage, the area is located in Tangerang city. The river water level is kept high by the Pasar Baru Barrage and the urban area is just close to the river water surface.

(c) In the downstream reaches (to the river-mouth)

In the reaches just downstream of Pasar Baru barrage, river water in dry season is very little since the river water is taken for irrigation purpose by the barrage. Since there exists only one bridge in the reaches, many ferry facilities are found. In the reaches near the estuary, water transportation and sand mining are found.

(2) Flood Propagation

From the outlet site of the Ciliwung floodway to the site of Pasar Baru barrage, the river length is about 85 km. Accordingly the propagation time of flood from the outlet of the Ciliwung floodway to the Pasar Baru barrage site is estimated to be about 8 hours. The Cisadane river in the reaches forms a very deep valley and the flood peak in the upstream reaches decreases so much.

Accordingly, by the diversion of flood of the Ciliwung river to the Cisadane river, the river water level of the Cisadane river will rise rapidly in the reaches just downstream of the outlet site, but it will not rise so rapidly in the middle and downstream reaches of the Cisadane river.

In the middle reaches of the Cisadane river, many tributaries join the Cisadane river. Accordingly for the proper operation of the Pasar Baru barrage, the information on flood not only about the flood from the Ciliwung floodway, but also about floods from the many tributaries are needed.

(3) Basic Concept of Flood Warning System

Basic concept of flood warning system for the Cisadane river is that information on flood diversion from the Ciliwung river to the Cisadane river should be conveyed to the society of the riverine area along the Cisadane river before the flood reaches the objective area. And the monitoring system for flood of the Ciliwung and Cisadane rivers should be established for that purpose.

(4) Flood Warning System

(a) Monitoring Site

The following should be the monitoring sites for flood warning:

1) inlet site of the Ciliwung floodway (Katulampa barrage as supplementary site)
2) outlet site of the Ciliwung floodway
3) Empang barrage
4) Serpong water-level gauging station
5) Pasar Baru barrage
6) Depok
7) Manggarai

(b) Facilities and Functions

1) Inlet site	: radio communication for downstream sites
2) Outlet site	: radio communication for upstream and downstream sites warning to the riverine area by sirens
3) Empang barrage	: radio communication for upstream and downstream sites warning to the riverine area by sirens
4) Serpong site	: telemetering for downstream sites
5) Pasar Baru barrage	: radio communication with upstream sites warning to the riverine area by siren car

(c) Network System

The proposed network system for flood warning and reporting is shown in Figure 5.31.

5.7 Preliminary Design of Cisadane River for 2nd Stage Project

(1) General

The preliminary design of the Cisadane river for the urgent flood control project (as 1st stage project) is already presented with a design scale of 25-year (Q=1,500 m^3/s) as shown in section 5.4.

Here, the preliminary design of the Cisadane river is presented for the succeeding works for the Master Plan with a design scale of 50-year (Q=1,900 m^3/s) (as 2nd stage project). The objective reaches are from 1.8 km to 20.1 km. Judging from the present carrying capacity, river improvement works is not required in the reaches from 20.1 km to Pasar Baru Barrage (21.3 km).

(2) River Improvement

The design criteria to be applied is basically the same with that for the urgent flood control (1st stage project). Accordingly, there is no change of the design river width and the design high water level in the objective reaches of the urgent flood control project (1.8 km - 16.8

km). The major additional work items for upgrading from 25-year to 50-year are as follows:

- widening of low water channel in the reaches from 4.3 km to 10.8 km; and
- new embankment along new objective reaches from 16.8 km to 20.1 km

The proposed alignment, the design longitudinal profile, the design cross sections and the related tables are compiled in VOLUME VI (SUPPLEMENTAL STUDY).

(3) Proposed Project Works

The major required project works for the Master Plan are as follows:

Additional Works from 25-year to 50-year Design Scale

Work Item	Unit	Quantity
1. Land Aquisition and Compensation		
Land aquisition	ha	3.4
House	nos.	60
2. Channel Improvement (L=18.3 km)		
Preparatory	ls	1
Excavation and dredging	m^3	1,271,000
Embankment	m^3	98,000
Low water channel revetment	m^2	0
Drop structure	nos.	0
Construction of new drainage structure	nos.	0
Improvement of existing drainage structure	nos.	0
Reconstruction of bridge	nos.	0

Project Works from Present Condition to 50-year Design Scale

Work Item	Unit	Quantity
1. Land Aquisition and Compensation		
Land aquisition	ha	48.7
House	nos.	520
2. Channel Improvement		
Preparatory	ls	1
Excavation and dredging	m^3	2,096,000
Embankment	m^3	1,011,000
Low water channel revetment	m^2	8,400
Drop structure	nos.	0
Construction of new drainage structure	nos.	3
Improvement of existing drainage structure	nos.	2
Reconstruction of bridge	nos.	0

6 RECOMMENDATIONS

In view of the serious direct and indirect damages and confusion due to the big flooding in January and February 1996 in DKI Jakarta, it is proposed that the urgent flood control project be implemented very soon as an urgent scheme.

The following recommendations on the flood control master plan and the feasibility study are also proposed.

6.1 Master Plan

(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. This barrage was constructed for irrigation purpose 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. And 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 the upstream reaches.

Periodical removal of garbage in rivers during low flow season 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 4.4.2, 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.

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 the rainfall infiltration facilities such as infiltration pavement and the like.

(9) Small Scale Improvement of 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:

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

The location of the area is indicated as in Figure 3.6.

(10) 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.

6.2 Feasibility Study

(1) Restriction of Development along the Western Banjir Canal

River improvement of the Western Banjir Canal has been proved to be indispensable for flood control of DKI Jakarta through the floods in 1996. And it has been also proved that the downstream reaches improvement has an important role for the river improvement of the whole reaches.

However, as can be seen along the downstream reaches of the WBC, it is practically impossible to implement the present Detailed Design of the WBC conducted in 1987 by "West Jakarta Flood Control System Project (III)" as it is because of the on-going big scale residential development projects within the proposed alignment.

Accordingly, it is absolutely necessary to regulate the development strictly within the proposed alignment of present feasibility study not to repeat this kind of situation again.

(2) Coordination with KAPUKNAGA

Reclamation of the north coast of the JABOTABEK area including the area near the estuary of the Cisadane river is planned by KAPUKNAGA project. Even though the estuary area is not included for reclamation by the project, downstream reaches of the Cisadane river has a close relationship with the project, since the development of the coastal area is included in the project.

As urgent flood control project, the project includes a plan to construct the embankment along the downstream reaches of the Cisadane river. But the downstream end of the embankment is planned not in consideration of the reclamation plan since the detailed design of the development is not available yet. Accordingly the coordination with KAPUKNAGA project for this aspect will be needed for further step of the project.

(3) Construction of Embankment

For construction of embankment of the Western Banjir Canal, even though the embankment is planned to be provided with revetment works or pavement on the crown in order that the embankment would not collapse totally even overtopping occurs for floods over the design scale, it is still important to pay attention so that no foreign body would not be included in the embankment during the construction stage.

Table 2.1 PREVIOUS STUDIES CONCERNING FLOOD CONTROL (1/7)

No.	Data Name	Date of Issue		Publishing Body
1	Djakarta Flood Control Preliminary Survey and Recommendations	1970	6	NEDECO, DGWRD
2	Jakarta Drainage and Flood Control Project, First Progress Report	1972	10	NEDECO, DGWRD
3	Jakarta Drainage and Flood Control Project, Second Progress Report	1973	2	NEDECO, DGWRD
4	Jakarta Drainage and Flood Control Project, Third Progress Report	1973	8	NEDECO, DGWRD
5	Jakarta Drainage and Flood Control Project, Fourth Progress Report	1973	12	NEDECO, DGWRD
6	Master Plan for Drainage and Flood Control of Jakarta, Main Report	1973	12	NEDECO, DGWRD
7	Jakarta Drainage and Flood Control Project, Fifth Progress Report	1974	4	NEDECO, DGWRD
8	Jakarta Drainage and Flood Control Project, Explanatory Note on the Design of the Eastern Banjir Canal (Annex II to Sixth Progress Report)	1974	8	NEDECO, DGWRD
9	Jakarta Drainage and Flood Control Project Phase II, First Progress Report	1974	12	NEDECO, DGWRD
10	Jakarta Drainage and Flood Control Project Phase II, Second Progress Report	1975	4	NEDECO, DGWRD
11	Jakarta Drainage and Flood Control Project, Annex XIV, Final Report Phase II, Hydrometric Program 1975-1980	1975	6	NEDECO, DGWRD
12	Jakarta Drainage and Flood Control Project Phase II, Third Progress Report	1975	8	NEDECO, DGWRD
13	Jakarta Drainage and Flood Control Project, Annex IV, Final Report Phase II, Explanatory Note on the Design of the Rehabilitation Works for the Ciliwung Drain and Gunung Sahari Drain	1975	11	NEDECO, DGWRD
14	Design Flood for the T.B.S Flood Diversion Canal in Bekasi	1976	1	Perum Otorita Jatiluhur Direktorat Pengairan Proyek Irigasi Jatiluhur
15	Jakarta Drainage and Flood Control Project Phase II, Forth Progress Report	1976	3	NEDECO, DGWRD
16	Jakarta Drainage and Flood Control Project, Advisory Note on Spoil Disposal including Maintenance Scheme	1976	10	NEDECO, DGWRD
17	Jakarta Drainage and Flood Control Project, Annex XI, Final Report Phase II, Explanatory Note on the Design of the Cipinang, Sunter and Buaran Rivers	1976	11	NEDECO, DGWRD
18	Jakarta Drainage and Flood Control Project Phase II, Supplement to Final Report of Phase II and Fifth Progress Report	1977	6	NEDECO, DGWRD

Table 2.1 PREVIOUS STUDIES CONCERNING FLOOD CONTROL (2/7)

No.	Data Name	Date of Issue		Publishing Body
19	Jatiluhur Irrigation Extension Project, Construction Drawings	1978	3	Perum Otorita Jatiluhur, Directorate of Irrigation
20	Prosida, Design Drainage Project Up-dated Feasibility Report, Volume 7, Cisadane Sub-Project	1978	6	Sir William Halcrow & Partners Consulting Engineers, DGWRD
21	Cisadane-Jakarta-Cibeet Water Resources Development Plan, Main Report	1979	1	Coyne et Bellier, Consulting Engineers, DGWRD
22	Cengkareng Drain System Study, Final Report, Annex 1A,1B,1C,1D	1980	7	NEDECO, DGWRD
23	Cisadane-Jakarta-Cibeet Water Resources Development Plan Complementary Report, Annex-D Flood Control of Rivers Crossing Jakarta, Damping Reservoir	1980	10	Coyne et Bellier, Consulting Engineers, DGWRD
24	Cengkareng Drain System Study, Final Report	1981	4	NEDECO, DGWRD
25	Technical Note on Final Design, Angke River Located Upstream of its Confluence with the Cengkareng Floodway	1981	11	NEDECO, DGWRD
26	Technical Note on Final Design, Pesanggrahan River Upstream of its Confluence with the Cengkareng Floodway	1981	11	NEDECO, DGWRD
27	Technical Note on Final Design, Angke Drain and Banjir Canal	1981	12	NEDECO, DGWRD
28	Project Proposal for West Jakarta Flood Control System	1982	2	NEDECO, DGWRD
29	Technical Note on Final Design, Cengkareng Weir	1982	3	NEDECO, DGWRD
30	Technical Note on Final Designs of Three Traffic Bridges across the Cengkareng Floodway	1982	4	NEDECO, DGWRD
31	Preparation of the Project Aid Proposal of West Jakarta Flood Control System (Japanese)	1982		International Engineering Consultants Association (IECA)
32	Study dan Perencanaan, Teknis Pengaturan Sungai Wilayah Ciliwung Hulu, Final Report	1983	8	Tricon Jaya P.T., DGWRD
33	Standing Operation Procedure Musim Hujan 1983-1984	1984		DGWRD
34	Pekerjaan Perencanaan Detail Design Pekerjaan Sipil Dan Mekanik Pintu Air Waduk Depok, Design Report	1985	7	Persero P.T. Indra Karya Consulting Engineers, DGWRD
35	Cisadane River Basin Development Feasibility Study Stage 1 : Prefeasibility Volume 4, Dams	1985	11	Indec & Associaters Ltd. Lavalin International Inc. Nippon Koei Co. Ltd., DGWRD

Table 2.1 PREVIOUS STUDIES CONCERNING FLOOD CONTROL (3/7)

No.	Data Name	Date of Issue		Publishing Body
36	Study Report on East Jakarta Flood Control Project	1985		International Engineering Consultants Association (IECA)
37	Standing Operation Procedure Musim Hujan 1984-1985	1985		DGWRD
38	Laporan Singkat, Permasalahan Banjir/Genangan DI DKI: Jakarta Tgl.26-27 Jan. Dan 29	1986	1	Proyek Pengendalian Banjir Jakarta Raya
39	Pekerjaan Detail Design Waduk Depok Tahap II Volume 1, Laporan Utama	1986	2	Persero P.T. Indra Karya Consulting Engineers, DGWRD
40	West Jakarta Flood Control System Project, Design Report, Vol. I, Summary/Service Report for D/D Stage	1986	6	Nikken Consultants, INC. and others, DGWRD
41	Cisadane River Basin Development Feasibility Study, Vol. 2 : Hydrology, Final Prefeasibility Report	1986	8	Indec & Associaters Ltd. Lavalin International Inc. Nippon Koei Co. Ltd., DGWRD
42	Design Criteria for Review of Detailed Engineering Design for Grogol Sekretaris Interceptor on West Jakarta Flood Control System Project	1986	12	Nikken Consultants, INC. i.a.w. Nippon Koei Co., Ltd and others, DGWRD
43	Field Reconnaissance Survey for Preliminary Study on Jabotabek Area Flood Control Plan and Jakarta Sewerage, Sanitation and Drainage Project (Japanese)	1986		International Engineering Consultants Association (IECA)
44	Preliminary Study on East Jakarta Flood Control System (Japanese)	1986		Ministry of Construction and International Engineering Consultants Association (IECA)
45	Field Reconnaissance Survey for Preliminary Study on Jabotabek Area Flood Control Plan	1986		International Engineering Consultants Association (IECA)
46	Standing Operation Procedure Musim Hujan 1985-1986	1986		DGWRD
47	West Jakarta Flood Control System Project (Grogol Sekretaris Interceptor Works) Design Report Vol. 1, Summary Service Report for Review of Detailed Engineering Design	1987	2	Nikken Consultants, INC. and others, DGWRD
48	Cisadane River Basin Development Feasibility Study Volume 1, Main Report, Final Feasibility Report	1987	9	Indec & Associaters Ltd. Lavalin International Inc. Nippon Koei Co. Ltd., DGWRD

Table 2.1 PREVIOUS STUDIES CONCERNING FLOOD CONTROL (4/7)

No.	Data Name	Date of Issue		Publishing Body
49	Standing Operation Procedure Musim Hujan 1986-1987	1987		DGWRD
50	Identifikasi Banjir dan Genangan di Wilayah Jabotabek	1988	4	DGWRD
51	East Jakarta Flood Control Project Review Report, Vol. 1, Summary	1988	8	Nikken Consultants, INC. and others, DGWRD
52	East Jakarta Flood Control Project, Design Report I, volume I, Main	1989	2	Nikken Consultants, INC. and others, DGWRD
53	Pengukuran dan Detail Design Improvement Kali Cidurian, Kali Cimanceuri, Kali Cisadane, Kali Cikepuh dan Kali Ciasin, Final Report	1989	3	PT. Jaya CM Manggla Pratama Consulting Engineers, DGWRD
54	East Jakarta Flood Control Project, Design Report II, Volume II, Main	1989	6	Nikken Consultants, INC. and others, DGWRD
55	Urban Sector Drainage and Flood Protection Study, Final Report, "Vol.1, Main Report	1989	11	Haskoning and Rayakonsult, DGWRD
56	Urban Sector Drainage and Flood Protection Study, Final Report, "Vol.2, Appendices	1989	11	Haskoning and Rayakonsult, DGWRD
57	Urban Sector Drainage and Flood Protection Study, Final	1989	11	Haskoning and Rayakonsult, DGWRD
58	Pengukuran dan Basic Design Upper K. Angke, K. Pesanggrahan, K. Krukut, K. Ciliwung, K. Cipinang, K. Sunter, K. Buaran, K. Cakung dan K. Jatikramat	1989		P.T. Yodya Karya, DGWRD
59	East Jakarta Flood Control Project, Design Report III, Volume I, Main	1990	6	Nikken Consultants, INC. and others, DGWRD
60	Review of Detailed Design and Economic Study for West Jakarta Flood Control System Project (III)	1990	10	Nikken Consultants, INC. and others, DGWRD
61	Laporan Penyelidikan Model untuk Banjir Kanal Jembatan Tol Grogol-Pluit Jakarta	1990	12	Balai Penyelidikan Sungai, Pusat Penelitian dan Pengembangan Pengairan
62	The Study on Urban Drainage and Waste Water Disposal Project in the City of Jakarta, Summary Report (Japanese)	1991	3	Japan International Cooperation Agency (JICA), DGWRD
63	The Study on Urban Drainage and Wastewater Disposal Project in the City of Jakarta, Master Plan Study, Main Report	1991	3	Japan International Cooperation Agency (JICA), DGWRD
64	West Jakarta Flood Control System Project (Sarinah Thamrin Drainage Pump), Completion Report, Volume I, Main Report	1991	4	Nikken Consultants, INC. and others, DGWRD
65	Major Drainage Works Component In JUDP-II, Design Report	1991	6	Nikken Consultants, INC. and others, DGWRD
66	Water Quality Control Management in Jabotabek, A Water Data Center for Jabotabek	1991	10	Beture Setame, PT Bina Karya, DGWRD

Table 2.1 PREVIOUS STUDIES CONCERNING FLOOD CONTROL (5/7)

No.	Data Name	Date of Issue		Publishing Body
67	Outline of West Jakarta Flood Control and Drainage Project	1991	12	DGWRD
68	Perencanaan Sarana Drainase Kota Study Detail Design Kali Krukut, Final Report, Volume I	1992	3	Prakarsa Mandiri Utama, DGWRD
69	West Jakarta Flood Control System Project (Grogol Sekretaris Interceptor), Completion Report Vol. I, Main Report	1992	4	Nikken Consultants, INC. and others, DGWRD
70	Studi Lanjutan Untuk Sungai-sungai Bagian Hulu Yang Berkaitan Dengan West Jakarta II Project, Laporan Akhir	1992	4	PT. Barunadri Engineering Consultant, DGWRD
71	Studi Kelayakan Teknik *Pendayagunaan* Saluran Cikarang-Bekasi-Laut Sebagai Alar Navigasi Darat, Laporan Akhir (No. PD. 1615-HA)	1992	12	Pusat Penelitian dan Pengembangan Pengairan, Bandung
72	Upper Citarum Basin Urgent Flood Control Project, Flood Plain Management Plan	1993	2	Pacific Consultants International in Association and others, DGWRD
73	Preliminary Study Report on Comprehensive River Water Management Plan of Cisadane, Ciliwung and Other Rivers	1993	3	International Engineering Consultants Association (IECA)
74	Preliminary Study Report on Comprehensive River Water Management Plan of Cisadane, Ciliwung and Other Rivers (Japanese)	1993	3	International Engineering Consultants Association (IECA)
75	Evaluation for Flood Control Project (West Jakarta Flood Control System Project)	1993	3	Ministry of Construction and International Engineering Consultants Association (IECA)
76	Pekerjaan Konsolidasi Design Ciliwung-Cisadane, Laporan Akhir, Volume-II, Laporan Utama	1993	3	PT Trikarsa Sarana Teknindo, DGWRD
77	Pekerjaan Konsolidasi Design Ciliwung-Cisadane, Laporan Akhir, "Volume-II Laporan Penunjang	1993	3	PT Trikarsa Sarana Teknindo, DGWRD
78	Guidelines and Criteria for Planning and Design of River Flood Control, Volume I	1993	6	Canadian International Development Agency, DGWRD
79	Guidelines and Criteria for Planning and Design of River Flood Control, Volume II	1993	6	Canadian International Development Agency, DGWRD
80	Guidelines and Criteria for Planning and Design of River Flood Control, Volume III	1993	6	Canadian International Development Agency, DGWRD

Table 2.1 PREVIOUS STUDIES CONCERNING FLOOD CONTROL (6/7)

No.	Data Name	Date of Issue		Publishing Body
81	East Jakarta Flood Control Project Stage I, The Rehabilitation of Irrigation Schemes and Flood Alleviation Works Project, Review Report Volume I, Review Study	1993	12	Nikken Consultants, INC. and others, DGWRD
82	Perencanaan Detail Rehabilitasi dan Pengembangan Situ-Situ di Wilayah Jabotabek, Final Report (Vol.1)	1994	1	CV. Imaya Consulting Engineers, DGWRD
83	Jabotabek Water Resources Management Study, Final Report, Executive Summary	1994	2	DGWRD
84	Pengukuran dan Perencanaan Perbaikan Sungai Kali Pesanggrahan di Hulu Jalan Toll	1994	2	P.T. Adhikara Mitra Cipta, DGWRD
85	Jabotabek Water Resources Management Study, Final Report Volume I, Main Report	1994	2	Iwaco, DHV Consultants, Deleft Hydrulics, DGWRD
86	Project Aid Proposal for Conservation Works of Situ-situ in the Jabotabek Area	1994	8	DGWRD
87	Data Pendukung Kesepakatan Bersama antara Direktorat Jenderal Pengairan Departen Pekerjaan Umum dan Pemerintah DKI Jakarta	1994	10	DGWRD
88	Kesepakatan Bersama antara Direktorat Jenderal Pengairan Departemen Pekerjaan Umum dan Pemerintah Daerah Khusus Ibukota Jakarta tentang Pengendalian Banjir dan Drainase di Wilayah Daerah Khusus Ibukota Jakarta	1994		DGWRD, DKI Jakarta
89	Prosedur Operasi Lapangan Musim Hujan 1994-1995	1994		DGWRD
90	Studi Penataan Lingkungan Kali Mookervaart, Final Report	1995	1	PT Agusta Primakarsa, DGWRD
91	Pengembangan Pantai Utara Jakarta	1995	2	PT Puncak Wawasan Indah, PT Puri Fadjar Mandiri, DKI Jakarta
92	Perencanaan Rehabilitasi Situ Cipondoh	1995	2	CV Teguh Utama Consultant, DGWRD
93	The Study on Ciujung-Cidurian Integrated Water Resources, Volume I, Executive Summary	1995	2	Japan International Cooperation Agency (JICA), DGWRD
94	The Study on Ciujung-Cidurian Integrated Water Resources, Volume II, Main Report	1995	2	Japan International Cooperation Agency (JICA), DGWRD
95	The Study on Ciujung-Cidurian Integrated Water Resources, Volume III, Supporting Report	1995	2	Japan International Cooperation Agency (JICA), DGWRD
96	The Study on Ciujung-Cidurian Integrated Water Resources, Volume IV, Data Book	1995	2	Japan International Cooperation Agency (JICA), DGWRD

Table 2.1 PREVIOUS STUDIES CONCERNING FLOOD CONTROL (7/7)

No.	Data Name	Date of Issue		Publishing Body
97	Inventory of Watershed in Ciliwung-Cisadane River Basin Development Project Indonesia	1995	3	DGWRD
98	Interim Report bagi Persiapan Studi Makro Aspek-aspek Reklamasi dan Hidrolik Proyek Pengembangan Wilayah Pantai Utara Jakarta	1995	7	PT. Puri Fadjar Mandiri, DKI Jakarta
99	Outline of West Jakarta Flood Control Project and East Jakarta Flood Control Project	1995	11	Nikken Consultants, INC.
100	Ring Kanal untuk Mengatasi Masalah Banjir di DKI Jakarta	1995		DGWRD
101	Debiet : Pencana & Maximum Tahunan Bendung Beet-Cikarang-Bekasi dari Th. 1977 S/D Th. 1994	1995		Divisi Pengairan Barat, Perum Otorita Jatiluhur
102	Buku Pedoman Pelaksanaan Pengendalian Banjir (P3B) Priode 1995/1996	1995		DKI Jakarta
103	Prosedur Operasi Lapangan Musim Hujan 1995-1996	1995		DGWRD
104	Penjelasan Singkat Proyek Pengendalian Banjir Jakarta Raya			Proyek Pengendalian Banjir Jakarta Raya
105	Penjelasan Masalah Banjir DI DKI Jakarta			Proyek Pengendalian Banjir Jakarta Raya
106	Program Eksploitasi & Pemeliharaan Saluran Induk Tarum-Barat			Perum Otorita Jatiluhur
107	Pola Induk Tata Pengairan Daerah Chusus Ibukota Djakarta Raya			DKI Jakarta

Table 3.1 CATCHMENT AREA OF RIVERS

No.	River Systems	Principal Point on Main Rivers/Related Rivers	Area (km^2)
1	Cidurian	Cidurian (estuary)	803
	(803 km^2)	Cidurian (Parigi)	596
		Cidurian (before confluence with Cibeureum)	378
		Cibeureum	218
2	Cimanceuri	Cimanceuri (estuary)	570
	(570 km^2)	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	Cisadane (estuary)	1,411
	(1,411 km^2)	Cisadane (Pasar Baru weir)	1,248
		Cisadane (after confluence with Cianten)	846
		Cisadane (before confluence with Cianten)	433
		Cianten	413
5	Cengkareng Floodway	Cengkareng Floodway (Cengkareng weir)	459
	(459 km^2)	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	Western Banjir Canal (Karet weir)	421
	(421 km^2)	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	Proposed Eastern Banjir Canal (Estuary)	207.0
	Banjir Canal	Cipinang (upstream of EBC)	50.5
	(207 km^2)	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	CBL Floodway (Estuary)	915
	(1,135 km^2)	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 3.2 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<including Sepak>	81.8	225.0	2.0	1/370	255	Hilly	Urban
		8	Pesanggrahan<including Grogol>	65.5	175.0	3.0	1/380	137	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	Proposed Eastern Banjir Canal (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	CBL Floodway (1,135 km^2)	19	CBL Floodway	28.8	10.0	0.0	1/2880	915	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 3.3 PRESENT CARRYING CAPACITIES OF CHANNELS

unit : m^3/s

River Systems and Rivers	Bankful	Freeboard
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 4.1 CRITERIA ON FLOOD CONTROL DESIGN SCALE IN INDONESIA

Conveyance System	Project Type (for River Flood Control Project) and Total Population (for Drainage System)	Initial Phase	Final Phase
River	Emergency Project	5	10
	New Project	10	25
	Updating Project		
	- for rural and/or urban with P < 2.000,000	25	50
	- for urban with P > 2,000,000	25	100
Primary Drainage System (Catchment area > 500 ha)	Rural	2	5
	Urban P < 500,000	5	10
	Urban 500,000 < P < 2,000,000	5	15
	Urban P > 2,000,000	10	25
Secondary Drainage System (Catchment area < 500 ha)	Rural	1	2
	Urban P < 500,000	2	5
	Urban 500,000 < P < 2,000,000	2	5
	Urban P > 2,000,000	5	10
Secondary Drainage System (Catchment area < 500 ha)	Rural and Urban	1	2

Notes:

1) Higher design flood standard should be applied if an economic analysis indicates that it is desirable, or if flooding is a significant risk to human life.

2) P = Total Urban Population

3) Emergency Project : Emergency Projects are developed without preliminary engineering and economic feasibility studies at sites where flooding is excessive and flooding problems present a significant risk to human life.

4) New Project : New Projects include flood control projects where no previous flood control projects have been developed or where Emergency Projects have been developed.

5) Updating Project : Updating Projects include rehabilitation projects and improvements to existing projects. Most River Basin Development Projects are considered to be updating projects.

Source : "Recommended Minimum Return Period of Design Flood" in Flood Control Manual, Volume II, Guidelines for Planning and Survey (DGWRD, Jun. 1993)

Table 4.2 OBJECTIVE RIVERS AND DESIGN SCALES FOR FLOOD CONTROL MASTER PLAN

Target Year = 2025

No.	River systems	No.	Related rivers	Dimensions of basins					Characteristics of basins			Design scale (year)		
				Length	Elevation (m)		Average	Area	Topography	Condition of flood plain in 2025		Existing overall	This study	
				(km)	max.	min.	slope	(km2)		Population(P)	Land use	flood control plan		project type
1	Cidurian	1	Cidurian	129.3	1700.0	0.0	1/80	803	Mountainous	P<2,000,000	Urban + Rural	Not available	25	New
2	Cimanceuri	2	Cimanceuri	101.3	600.0	0.0	1/170	570	Mountainous	P<2,000,000	Urban + Rural	Not available	25	New
3	Cirarab	3	Cirarab	49.0	62.5	0.0	1/780	161	Hilly	P<2,000,000	Urban + Rural	Not available	25	New
4	Cisadane	4	Cisadane	137.8	2100.0	0.0	1/70	1411	Mountainous	P<2,000,000	Urban + Rural	Not available	50	New
5	Cengkareng Floodway (459 km^2)	5	Cengkareng Floodway	7.9	3.0	0.0	1/2630	459	Plain	P<2,000,000	Urban	100	100	Updating
		6	Mookervaart Canal	13.0	14.0	3.0	1/1180	67	Plain	P<2,000,000	Urban	25	25	New
		7	Angke<including Sepak>	81.8	225.0	2.0	1/370	255	Hilly	P<2,000,000	Urban	100	100	Updating
		8	Pesanggrahan<including Grogol>	65.5	175.0	3.0	1/380	137	Hilly	P<2,000,000	Urban	100	100	Updating
		9	Grogol (upstream of Sodetan)	21.0	100.0	21.0	1/270	30	Hilly	P<2,000,000	Urban	25	25	New
6	Western Banjir Canal (421 km^2)	10	Western Banjir Canal	17.3	6.3	0.0	1/2750	421	Plain	P>2,000,000	Urban	100	100	Updating
		11	Krukut	33.5	100.0	3.0	1/350	84	Hilly	P<2,000,000	Urban	25	25	Updating
		12	Ciliwung (upstream of Manggarai)	109.0	1500.0	6.3	1/70	337	Mountainous	P<2,000,000	Urban	100	100	Updating
7	Proposed Eastern Banjir Canal (207 km^2)	13	Proposed Eastern Banjir Canal	23.7	12.5	0.0	1/1900	207.0	Plain	P>2,000,000	Urban	100	100	Updating
		14	Cipinang (upstream of EBC)	36.0	115.0	12.5	1/350	50.5	Hilly	P<2,000,000	Urban	25	25	Updating
		15	Sunter (upstream of EBC)	37.0	120.0	11.5	1/340	73.1	Hilly	P<2,000,000	Urban	25	25	Updating
		16	Buaran (upstream of EBC)	9.0	32.0	10.0	1/410	13.0	Hilly	P<2,000,000	Urban	25	25	Updating
		17	Jatikramat (upstream of EBC)	13.5	41.0	9.5	1/430	16.5	Hilly	P<2,000,000	Urban	25	25	Updating
		18	Cakung (upstream of EBC)	30.5	103.0	6.5	1/320	34.5	Hilly	P<2,000,000	Urban	25	25	Updating
8	CBL Floodway (1,135 km^2)	19	CBL Floodway	28.8	10.0	0.0	1/2880	915	Plain	P<2,000,000	Urban + Rural	50	50	Updating
		20	Bekasi (upstream of CBL)	115.1	1500.0	4.3	1/80	403	Mountainous	P<2,000,000	Urban + Rural	Not available	50	New
		21	Cisadang (upstream of CBL)	36.5	87.5	8.0	1/460	135	Hilly	P<2,000,000	Urban + Rural	Not available	25	New
		22	Cikarang (upstream of CBL)	65.3	300.0	10.0	1/230	230	Hilly	P<2,000,000	Urban + Rural	Not available	25	New
		23	Cilemahabang	62.8	52.0	3.0	1/1280	220	Plain	P<2,000,000	Urban + Rural	Not available	25	New

Note ; Design scale of each river is proposed according to the criteria in "Flood Control Manual Volume II (Jun, 1993, DGWRD)"

Additional judgment is proposed by the Study Team as follows;

1 Updating project (P<2,000,000) ; A>100km2 : 50-year, A<100km2 : 25-year

2 Design scale of 50-year is proposed for the new projects of Cisadane and Bekasi rivers taking into account the existence of Tangerang and Bekasi city areas in the flood plains respectively.

3 Design scale should be equal or greater than that of existing plan (Angke, Pesanggrahan rivers and Cengkareng floodway).

Project type	Discharge distribution	Design	Improvement works
New	X	-	-
Updating	X	X	-
Updating	X	X	X

X : available

\- : not available

Table 4.3 DESIGN SCALE AND DISCHARGE OF RIVERS IN INDONESIA

No.	Name of River	Province	Catchment Area (km^2)	Design Flood (m^3/s)	Specific Discharge ($m^3/s/km^2$)	Return Period (year)	Remarks
1	Cimanuk	West Java	3,006	1,440	0.48	25	
2	Serang	Central Java	937	900	0.96	25	
3	Citanduy	West Java	3,680	1,900	0.52	25	
4	Ular	North Sumatra	1,080	800	0.74	25	
5	Pemali	Central Java	1,228	1,300	1.06	25	
6	Cipanas	West Java	220	385	1.75	25	
7	Solo	Central/East Java	3,400	1,500	0.44	10	*1
	-do-	-do-	3,400	2,000	0.59	40	*2
8	Madiun	East Java	2,400	1,100	0.46	10	*1
	-do-	-do-	2,400	2,300	0.96	40	*2
9	Wampu	North Sumatra	3,840	1,320	0.34	20	
10	Arakundo	Ache	5,495	1,800	0.33	20	
11	Kring Ache	Ache	1,775	1,300	0.73	20	
12	Brantas	East Java	10,000	1,350	0.14	10	*1
	-do-	-do-	10,000	1,500	0.15	50	*2
13	Bah Bolon	North Sumatra	2,776	1,220	0.44	20	
14	Walanae	South Sulawesi	3,190	2,900	0.91	20	
15	Biba	South Sulawesi	1,368	1,900	1.39	20	
16	Jenebarang	South Sulawesi	729	3,700	5.08	50	
17	Ciujung	North Banten	1,850	1,100	0.59	10	*1
	-do-	-do-	1,850	1,600	0.86	50	*2
18	Kuranji	West Sumatra	213	870	4.08	25	*1
	-do-	-do-	213	1,000	4.69	50	*2
19	Air Dingin	West Sumatra	131	600	4.58	25	*1
	-do-	-do-	131	700	5.34	50	*2
20	Marmoyo	East Java	290	230	0.79	20	
21	Surabaya	East Java	631	370	0.59	50	

Note *1 : 1st stage and/or urgent plan
*2 : 2nd stage and/or overall plan

Table 4.4 OBJECTIVE STRETCHES OF FLOOD CONTROL MASTER PLAN

Target Year = 2025

No.	River Systems and Objective Rivers	Design Control Points	Design Scales (year)	Stretches of River Improvement (Structural measures) Total (km)	Lower End	Upper End	Stretches of Flood Plain Zoning (Non-structural measures) Total (km)	Lower End	Upper End
1	*Cidurian River System*	Jl. Serang Raya (Parigi)	25	31.9	Estuary	Jl. Serang Raya	16.0	Jl. Serang Raya	Bridge near CDR-50
2	*Cimanceuri River System*	Jl. Serang Raya (Balaraja)	25	22.2	Estuary	Jl. Serang Raya	42.0	Jl. Serang Raya	Bridge on CMR-49 (Cimanceuri) Bridge near CPS-15 (Cipaseun)
3	*Cirarab River System*	Irrigation canal from Cisadane (CRR-9)	25	16.8	Estuary	Irrigation canal (CRR-18)	13.8	Irrigation canal (CRR-18)	Jl. Serang Raya
4	*Cisadane River System*	Pasar Baru weir	50	21.0	Estuary	Pasar Baru weir	14.6	Pasar Baru weir	Outlet of Angke Floodway
5	*Cengkareng Floodway System*								
	- Cengkareng Floodway	Estuary	100	8.1	Estuary	Junc. with Pesanggrahan	0.0	-	-
	- Mookervaart Canal	Junc. with Cengkareng	25	6.0	Junc. with Cengkareng	Boundary of DKI and Tangerang	0.0	-	-
	- Angke	Junc. with Cengkareng	100	5.0	Junc. with Cengkareng	Polor weir	11.7	Polor weir	Inlet of Angke Floodway
	- Pesanggrahan	Junc. with Cengkareng	100	3.2	Junc. with Cengkareng	Jl. Toll Jakarta - Merak	16.3	Jl. Toll Jakarta - Merak	Outer Ringroad
	- Grogol	Pondok Pinang weir	25	0.0	(Present carrying capacity > Design discharge)		0.0	-	-
6	*Western Banjir Canal System*								
	- Western Banjir Canal	Karet weir	100	17.4	Estuary	Manggarai weir	0.0	-	-
	- Ciliwung	(Karet weir)	100	0.0	-	-	21.3	Manggarai weir	Outer Ringroad
	- Krukut	Junc. with WBC	25	0.0	-	-	8.8	Junc. with WBC	Jl. Kemang
7	*Proposed Eastern Banjir Canal System*								
	- Eastern Banjir Canal	Estuary	100	23.6	Estuary	Cipinang inlet	0.0	-	-
	- Cipinang	Cipinang inlet	25	8.5	Cipinang inlet	Jl. Raya Pondok Gede	0.0	-	-
	- Sunter	Sunter inlet	25	7.2	Sunter inlet	Jl. Raya Pondok Gede	0.0	-	-
	- Buaran	Buaran inlet	25	3.4	Buaran inlet	Jl. Toll Jakarta - Cikampek	0.0	-	-
	- Jatikramat	Junc. with EBC	25	3.2	Junc. with EBC	Jl. Toll Jakarta - Cikampek	0.0	-	-
	- Cakung	Junc. with EBC	25	11.5	Junc. with EBC	Jl. Raya Pondok Gede	0.0	-	-
8	*CBL Floodway System*								
	- CBL Floodway	Junc. with Bekasi	50	22.1	Estuary	Junc. with Cisadang river	0.0	-	-
	- Bekasi	Bekasi weir	50	20.0	Junc. with CBL	Bekasi weir	11.2	Bekasi weir	Junc. with Cikeas and Cileungsi
	- Cisadang	Junc. with CBL	25	7.6	Junc. with CBL	Jl. Jakarta - Cikarang	0.0	-	-
	- Cikarang	Cikarang weir	25	0.0	(Present carrying capacity > Design discharge)		0.0	-	-
	- Cilemahabang	Bridge near CLA-27	25	0.0	(Present carrying capacity > Design discharge)		0.0	-	-
			Total	238.7			155.7		

Table 4.5 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
utline 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	1317	858	1647	757	767	3416	1931	1666
Point	2	1	2	0	2	2	0	0	0
Land acquisition/house compensation cost (Rp.billion)	406	621	295	571	466	305	878	943	1088
Point	6	4	8	6	6	8	2	2	0
EIRR (%)	42.9	11.4	13.7	7.4	22.5	15.4	7.9	18.6	27.4
Point	6	4	6	2	6	6	2	6	6
Technical Evaluation	Ordinary	Complicated	Complicated	Complicated	Ordinary	Complicated	Ordinary	Ordinary	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	10	17	9	18	19	6	10	8
Selection for Optimum			*			*		*	

Evaluation Criteria	Financial Cost	Land Acquisition etc.	EIRR	Technical Evaluation	Environmental Impact
	0 : 1500<X 1 : 1000<X<1500 2 : 500<X<1000 3 : X<500	0 : 1000<X 2 : 800<X<1000 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 : not affect 2: might affect

*1) River Imp. : River Improvement

*2) EIRR : Economic Internal Rate of Return

Table 4.6 OUTLINE OF PROPOSED FLOOD CONTROL MASTER PLAN

No.	River Systems and Objective Rivers	Optimum Alternative Schemes	Design Control Points	Design Scales (year)	Catchment Area (km²)	Design Discharges (m³/s)	Principal Countermeasures: River improvement	Floodway	Flood control dam	Flood plain zoning	Other non-structural	Objective stretches (km): 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 4.7 DIMENSION OF LONGITUDINAL PROFILES (1/10)

CIDURIAN RIVER

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
CDR01	0.000	0.000	-1.70	0.03	-0.61	0.00	1.26	-4.50	0.00	2.30	3.30
CDR02	0.950	0.950	-3.03	-0.76	-0.67	1.12	2.29	-4.20	0.30	2.60	3.60
CDR03	1.000	1.950	-3.05	-0.57	0.05	2.71	4.27	-3.88	0.62	2.92	3.92
CDR04	1.000	2.950	-2.44	1.96	2.10	4.77	5.64	-3.57	0.93	3.23	4.23
CDR05	0.950	3.900	-2.71	1.96	1.12	5.24	3.84	-3.27	1.23	3.53	4.53
CDR06	1.050	4.950	-2.22	1.92	2.13	5.01	5.97	-2.93	1.57	3.87	4.87
CDR07	0.950	5.900	-3.57	2.65	1.76	4.42	5.09	-2.63	1.87	4.17	5.17
CDR08	1.000	6.900	-2.26	2.10	2.82	5.53	6.63	-2.32	2.18	4.48	5.48
CDR09	1.000	7.900	-2.59	2.19	2.77	5.27	5.98	-2.00	2.50	4.80	5.80
CDR10	1.000	8.900	-3.04	3.89	3.23	6.60	5.48	-1.68	2.82	5.12	6.12
CDR11	1.000	9.900	-3.20	3.27	3.39	6.67	6.37	-1.37	3.13	5.43	6.43
CDR12	1.000	10.900	-2.19	3.02	4.12	6.92	8.29	-1.05	3.45	5.75	6.75
CDR13	0.950	11.850	-0.08	6.45	6.13	7.47	8.30	-0.75	3.75	6.05	7.05
CDR14	1.000	12.850	-1.42	6.01	4.60	7.91	8.85	-0.43	4.07	6.37	7.37
CDR15	1.050	13.900	-0.44	7.24	6.05	8.83	8.26	-0.10	4.40	6.70	7.70
CDR16	1.000	14.900	0.01	4.74	5.08	7.85	9.10	0.22	4.72	7.02	8.02
CDR17	1.000	15.900	0.10	6.17	5.74	9.08	8.96	0.53	5.03	7.33	8.33
CDR18	0.950	16.850	-0.05	6.34	6.07	9.25	8.89	0.83	5.33	7.63	8.63
CDR19	1.000	17.850	-0.25	8.10	7.47	10.24	9.65	1.15	5.65	7.95	8.95
CDR20	1.050	18.900	1.08	7.73	7.76	10.55	10.77	1.48	5.98	8.28	9.28
CDR21	1.100	20.000	1.29	8.11	7.62	9.33	10.03	1.83	6.33	8.63	9.63
CDR22	1.050	21.050	1.79	8.50	7.55			2.16	6.66	8.96	9.96
CDR23	1.000	22.050	2.84	9.30	8.43			2.48	6.98	9.28	10.28
CDR24	1.050	23.100	1.87	9.89	9.96			2.81	7.31	9.61	10.61
CDR25	1.000	24.100	2.86	7.21	8.31	8.51		3.13	7.63	9.93	10.93
CDR26	1.050	25.150	1.99	10.39	12.30	12.75		3.46	7.96	10.26	11.26
CDR27	1.050	26.200	2.58	10.29	9.25			3.79	8.29	10.59	11.59
CDR28	1.000	27.200	3.80	11.14	11.48			4.11	8.61	10.91	11.91
CDR29	1.000	28.200	4.27	11.95	10.76			4.42	8.92	11.22	12.22
CDR30	0.750	28.950	3.26	13.24	12.60			4.66	9.16	11.46	12.46
CDR31	1.000	29.950	4.42	12.05	11.92			4.98	9.48	11.78	12.78
CDR32	1.000	30.950	4.48	11.75	14.05			5.29	9.79	12.09	13.09
CDR33(Jl. Raya Serang)	0.950	31.900	5.23	14.93	14.87			5.59	10.09	12.39	13.39

Table 4.7 DIMENSION OF LONGITUDINAL PROFILES (2/10)

CIMANCEURI RIVER

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
CMR01	0.000	0.000	-4.00	0.87	0.96			-4.00	-0.50	1.80	2.60
CMR02	1.000	1.000	-4.00	0.96	-0.14			-3.65	-0.15	2.15	2.95
CMR03	1.000	2.000	-3.72	-0.04	-0.02	2.11	3.37	-3.30	0.20	2.50	3.30
CMR04	0.800	2.800	-2.83	0.94	0.35	2.65	4.33	-3.02	0.48	2.78	3.58
CMR05	1.450	4.250	-2.10	3.62	2.20	4.61	3.87	-2.51	0.99	3.29	4.09
CMR06	0.500	4.750	-3.50	1.66	1.38	4.86	4.02	-2.34	1.16	3.46	4.26
CMR07	0.950	5.700	-0.86	2.50	7.77	6.09		-2.01	1.49	3.79	4.59
CMR08	1.050	6.750	-2.42	1.86	1.93	6.11	5.23	-1.64	1.86	4.16	4.96
CMR09	1.000	7.750	-3.07	2.46	2.85	5.86	4.85	-1.29	2.21	4.51	5.31
CMR10	1.000	8.750	-1.29	5.80	6.37			-0.94	2.56	4.86	5.66
CMR11	1.050	9.800	-1.02	3.89	4.42	6.10		-0.57	2.93	5.23	6.03
CMR12	1.000	10.800	-0.37	7.45	11.02			-0.22	3.28	5.58	6.38
CMR13	1.000	11.800	-0.97	5.36	5.06	7.32	5.88	0.13	3.63	5.93	6.73
CMR14	0.950	12.750	-0.60	5.90	5.64	7.12	7.83	0.46	3.96	6.26	7.06
CMR15	0.950	13.700	-0.48	6.24	7.35	7.43		0.79	4.29	6.59	7.39
CMR16	0.550	14.250	-0.58	7.12	7.22			0.98	4.48	6.78	7.58
CMR17	0.900	15.150	-0.05	6.77	8.91			1.30	4.80	7.10	7.90
CMR18	0.950	16.100	1.31	12.58	7.79			1.63	5.13	7.43	8.23
CMR19	1.000	17.100	1.16	7.67	7.26	9.47		1.98	5.48	7.78	8.58
CMR20	0.800	17.900	1.86	8.49	8.78			2.26	5.76	8.06	8.86
CMR21	0.650	18.550	1.53	7.84	7.89			2.49	5.99	8.29	9.09
CMR22	0.800	19.350	0.95	10.05	8.51			2.77	6.27	8.57	9.37
CMR23	1.050	20.400	1.97	9.13	9.35			3.13	6.63	8.93	9.73
CMR24	0.800	21.200	1.98	9.13	9.35			3.41	6.91	9.21	10.01
CMR25(Jl. Raya Serang)	1.000	22.200	3.83	13.36	13.08			3.76	7.26	9.56	10.36

Table 4.7 DIMENSION OF LONGITUDINAL PROFILES (3/10)

CIRARAB RIVER

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
CRR01	0.000	0.000	-1.92	0.44	0.44			-3.00	-1.00	0.00	0.60
CRR02	1.000	1.000	-2.86	1.61	0.89	2.04	1.68	-2.51	-0.51	0.49	1.09
CRR03	1.000	2.000	-2.87	1.71	1.15	2.72	3.03	-2.03	-0.03	0.97	1.57
CRR04	1.000	3.000	-2.12	1.88	1.46	2.89	2.83	-1.54	0.46	1.46	2.06
CRR05	0.900	3.900	-2.42	2.53	2.91	3.75	3.60	-1.11	0.89	1.89	2.49
CRR06	0.800	4.700	-1.36	2.14	2.38	3.80	3.98	-0.72	1.28	2.28	2.88
CRR07	1.100	5.800	-0.94	3.11	2.83	4.48	5.00	-0.18	1.82	2.82	3.42
CRR08	1.200	7.000	-0.97	3.21	2.96	5.06	4.83	0.40	2.40	3.40	4.00
CRR09(Irrigation canal)	1.100	8.100	0.88	5.88	5.88			0.93	2.93	3.93	4.53
CRR10	0.600	8.700	0.97	4.36	4.63	5.97	6.02	1.22	3.22	4.22	4.82
CRR11	1.200	9.900	0.05	3.57	4.71	4.97	5.91	1.81	3.81	4.81	5.41
CRR12	0.900	10.800	0.85	4.72	4.48	6.78	5.53	2.24	4.24	5.24	5.84
CRR13	1.050	11.850	2.16	5.85	5.11	7.14	6.51	2.75	4.75	5.75	6.35
CRR14	1.050	12.900	3.36	6.04	5.20	5.89	6.04	3.26	5.26	6.26	6.86
CRR15	0.975	13.875	2.98	7.26	5.56	7.27	6.54	3.74	5.74	6.74	7.34
CRR16	1.050	14.925	3.99	5.78	6.88		6.98	4.25	6.25	7.25	7.85
CRR17	0.850	15.775	4.04	6.32	7.78			4.66	6.66	7.66	8.26
CRR18(Irrigation canal)	1.000	16.775	4.89	9.86	7.90			5.14	7.14	8.14	8.74

Table 4.7 DIMENSION OF LONGITUDINAL PROFILES (4/10)

CISADANE RIVER

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
CSD01	0.000	0.000	-2.76	0.31	0.31	0.95	1.53	-6.00	1.00	3.50	4.50
CSD02	0.973	0.973	-6.30	-0.37	0.53	0.89	1.73	-5.68	1.32	3.82	4.82
CSD03	0.925	1.898	-6.12	0.40	1.53	2.23		-5.37	1.63	4.13	5.13
CSD04	0.900	2.798	-3.11	1.11	0.90	3.61	2.32	-5.07	1.93	4.43	5.43
CSD05	0.950	3.748	-6.17	1.60	2.05	3.90	4.04	-4.75	2.25	4.75	5.75
CSD06	1.088	4.835	-5.71	2.36	2.28	4.53	4.92	-4.39	2.61	5.11	6.11
CSD07	1.188	6.023	-4.96	2.15	2.15	4.46	5.17	-3.99	3.01	5.51	6.51
CSD08	1.150	7.173	-10.72	5.95	6.27	5.95	6.27	-3.61	3.39	5.89	6.89
CSD09	0.950	8.123	-6.24	5.21	5.16	5.21	6.68	-3.29	3.71	6.21	7.21
CSD10	0.900	9.023	-5.96	5.51	5.31	5.51	8.55	-2.99	4.01	6.51	7.51
CSD11	1.050	10.073	-3.59	4.73	4.64	7.27	7.56	-2.64	4.36	6.86	7.86
CSD12	1.050	11.123	-5.97	5.14	4.95	5.14	9.10	-2.29	4.71	7.21	8.21
CSD13	1.125	12.248	-1.59	7.51	7.28	8.21	9.13	-1.92	5.08	7.58	8.58
CSD14	0.887	13.135	-2.56	7.22	8.80	9.01	8.80	-1.62	5.38	7.88	8.88
CSD15	1.075	14.210	-2.16	8.30	9.10	9.86	9.94	-1.26	5.74	8.24	9.24
CSD16	0.775	14.985	-6.19	8.31	8.03	8.70	10.60	-1.01	6.00	8.50	9.50
CSD17	1.150	16.135	-1.33	8.77	8.77	9.98	10.41	-0.62	6.38	8.88	9.88
CSD18	1.150	17.285	-0.36	11.09	10.72	12.10	12.22	-0.24	6.76	9.26	10.26
CSD19	0.875	18.160	-2.59	10.44	9.76	10.95	10.92	0.05	7.05	9.55	10.55
CSD20	1.200	19.360	-0.76	11.63	11.63	12.55	11.66	0.45	7.45	9.95	10.95
CSD21	0.950	20.310	-0.17	9.82	11.88	12.09	11.92	0.77	7.77	10.27	11.27
CSD22(Pasar Baru weir)	0.725	21.035	0.45	14.41	13.72	14.41	14.10	1.00	8.00	10.50	11.50

Table 4.7 DIMENSION OF LONGITUDINAL PROFILES (5/10)

CENGKARENG FLOODWAY

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
CEN01	0.000	0.000	-4.57	-0.41	0.01	0.27	0.46	-4.55	-0.55	1.20	2.20
CEN02	0.444	0.444	-4.21	0.06	0.25		1.32	-4.44	-0.44	1.31	2.31
CEN03	0.544	0.989	-3.87	-1.22	0.48	1.21	1.54	-4.30	-0.30	1.45	2.45
CEN04	0.495	1.483	-3.93	-0.16	0.96	2.01	1.84	-4.18	-0.18	1.57	2.57
CEN05	0.544	2.028	-4.74	-0.18	0.66	1.64	1.69	-4.04	-0.04	1.71	2.71
CEN06	0.492	2.520	-4.70	0.37	2.23	2.66	2.88	-3.92	0.08	1.83	2.83
CEN07	0.482	3.001	-4.34	0.43	0.13	2.10	1.87	-3.80	0.20	1.95	2.95
CEN08	0.497	3.498	-3.94	1.29	1.07	2.21	2.32	-3.68	0.32	2.07	3.07
CEN09	0.507	4.005	-6.18	1.21	1.59	2.76	3.30	-3.55	0.45	2.20	3.20
CEN10	0.507	4.512	-6.37	1.53	0.58	2.81	2.25	-3.42	0.58	2.33	3.33
CEN11	0.522	5.034	-5.29	1.34	1.74	2.42	2.15	-3.29	0.71	2.46	3.46
CEN12	0.406	5.440	-4.86	1.22	0.78	2.38	2.11	-3.19	0.81	2.56	3.56
CEN13	0.380	5.820	-5.38	0.86	0.55	2.76	2.99	-3.10	0.91	2.66	3.66
Cengkareng Barrage	0.000	5.820	-5.38	0.86	0.55	2.76	2.99	-2.60	1.40	2.95	3.95
Conf. with Mookervaart Canal	0.175	5.995	-4.21	0.75	0.57	2.79	2.91	-2.54	1.46	3.01	4.01
CEN14	0.495	6.490	-3.04	0.63	0.59	2.81	2.83	-2.39	1.61	3.16	4.16
Drop Strucutre	0.527	7.017	-3.71	1.19	0.93	3.16	3.18	-2.22	1.78	3.33	4.33
	0.000	7.017	-3.71	1.19	0.93	3.16	3.18	-1.18	2.82	3.33	4.33
Conf. with Angke	0.236	7.253	-4.05	1.47	1.09	3.33	3.36	-1.08	2.92	3.43	4.43
CEN15	0.200	7.453	-4.38	1.75	1.26	3.50	3.53	-1.00	3.00	3.52	4.52
D7	0.693	8.146	-0.94	4.85	2.98			-0.71	3.29	3.81	4.81

Table 4.7 DIMENSION OF LONGITUDINAL PROFILES (6/10)

MOOKERVAART CANAL

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
Conf. with Cengkareng	0.000	0.000						-2.60		3.01	3.61
MKV13	0.570	0.570	-3.65	2.74	2.07			-2.35		3.01	3.61
MKV12	0.900	1.470	-2.10	3.47	2.54			-1.95		3.01	3.61
MKV11	1.000	2.470	-3.24	3.95	4.10			-1.51		3.01	3.61
MKV10	0.975	3.445	-3.34	3.97	3.02			-1.08		3.01	3.61
MKV09	0.815	4.260	-3.07	5.07	3.47			-0.72		3.28	3.88
MKV08	0.800	5.060	-3.40	5.51	4.84			-0.36		3.64	4.24
MKV07	0.975	6.035	-0.33	5.79	5.62			0.07		4.07	4.67

ANGKE RIVER

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
A 0	0.000	0.000	-2.88	2.10	1.80			-1.70	2.63	3.43	4.23
A11	1.020	1.020	-1.10	2.70	2.40			-1.19	2.63	3.43	4.23
A25	0.970	1.990	-1.09	3.00	4.30			-0.71	2.80	3.60	4.40
A31	1.085	3.075	-0.76	4.60	3.80			-0.16	3.34	4.14	4.94
A37	0.945	4.020	0.43	4.80	4.20			0.31	3.81	4.61	5.41
A44	0.635	4.655	1.76	6.00	5.40			0.63	4.13	4.93	5.73
Polor Weir	0.315	4.970	3.00	5.90	7.52			0.79	4.29	5.09	5.89

PESANGGRAHAN RIVER

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
DTK274	0.000	0.000						-0.75	3.05	4.50	5.30
D6	0.080	0.080	-1.59	2.18	2.22		3.60	-0.69	3.11	4.56	5.36
P35	0.852	0.932	1.74	3.34	4.65	4.90		0.00	3.80	5.25	6.05
P44	1.006	1.938	0.61	4.41	4.40			0.80	4.60	6.05	6.85
PSG01	0.854	2.792	-0.17	5.14	5.31			1.48	5.28	6.73	7.53
Toll Road	0.310	3.102	1.58	5.01	5.04			1.73	5.53	6.98	7.78

Table 4.7 DIMENSION OF LONGITUDINAL PROFILES (7/10)

WESTERN BANJIR CANAL

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
WBC01	0.000	0.000	-2.56	-0.18	-0.15			-4.95	-0.95	0.85	1.85
WBC02	0.625	0.625	-4.36	-0.97	-0.41	-0.50	0.05	-4.74	-0.74	1.06	2.06
WBC03	0.485	1.110	-5.38	0.09	-0.42	0.47	0.29	-4.58	-0.58	1.22	2.22
WBC04	0.525	1.635	-6.89	1.90	0.05	1.52	0.73	-4.41	-0.41	1.40	2.40
WBC05	0.638	2.273	-3.68	-0.23	-0.12	0.97	0.81	-4.19	-0.19	1.61	2.61
WBC06	0.437	2.710	-4.26	-0.23	0.09	0.11		-4.05	-0.05	1.75	2.75
WBC07	0.638	3.348	-4.55	-0.08	0.61	1.74		-3.83	0.17	1.97	2.97
WBC08	0.512	3.860	-5.11	-0.17	1.24	2.09		-3.66	0.34	2.14	3.14
WBC09	0.488	4.348	-4.05	0.14	1.54	2.34		-3.50	0.50	2.30	3.30
WBC10	0.537	4.885	-3.92	0.48	0.48	3.12	2.66	-3.32	0.68	2.48	3.48
WBC11	0.500	5.385	-2.25	2.60	2.47	3.54	3.40	-3.16	0.85	2.65	3.65
WBC12	0.512	5.897	-3.87	0.30	0.30	2.54	2.85	-2.98	1.02	2.82	3.82
WBC13	0.476	6.373	-3.06	1.31	1.31	3.42	2.99	-2.83	1.17	2.97	3.97
WBC14	0.512	6.885	-2.97	0.32	0.95	3.54	3.55	-2.66	1.35	3.15	4.15
WBC15	0.475	7.360	-4.41	2.09	1.55	3.88	3.62	-2.50	1.50	3.30	4.30
WBC16	0.463	7.823	-3.63	3.86	0.94	3.93	4.02	-2.34	1.66	3.46	4.46
WBC17	0.400	8.223	-4.54	2.93	1.97	3.39	3.48	-2.21	1.79	3.59	4.59
WBC18	0.537	8.760	-3.81	1.70	1.78	3.76	4.09	-2.03	1.97	3.77	4.77
WBC19	0.513	9.273	-1.68	1.87	3.12	4.07	6.12	-1.86	2.14	3.94	4.94
WBC20	0.425	9.698	-1.75	3.25	5.08	4.50	5.16	-1.72	2.28	4.08	5.08
WBC21	0.462	10.160	-2.18	3.02	2.32	4.25	4.71	-1.56	2.44	4.24	5.24
WBC22	0.425	10.585	-2.53	2.55	3.60	4.65	4.63	-1.42	2.58	4.38	5.38
WBC23	0.463	11.048	-4.58	4.68	3.19	4.69	4.17	-1.27	2.73	4.53	5.53
WBC24	0.475	11.523	-1.91	4.55	2.83	5.18	3.26	-1.11	2.89	4.69	5.69
WBC25	0.475	11.998	-0.58	3.12	5.06	4.38		-0.95	3.05	4.85	5.85
Karet Barrage	0.381	12.379	-0.30					-0.82	3.18	4.98	5.98
	0.000	12.379	-0.30					-0.30	3.70	5.50	6.50
WBC26	0.100	12.479	-2.26	4.80	5.52	6.65	6.59	-0.27	3.73	5.53	6.53
WBC27	0.544	13.023	-0.99	6.47	6.71	7.17	7.48	-0.09	3.91	5.71	6.71
WBC28	0.456	13.479	0.37	7.42	7.42	8.02	7.73	0.07	4.07	5.87	6.87
WBC29	0.388	13.867	0.90	9.40	9.17	9.76		0.20	4.20	6.00	7.00
WBC30	0.512	14.379	0.99	4.25	3.30	7.10	7.09	0.37	4.37	6.17	7.17
WBC31	0.463	14.842	0.68	5.60	6.40	7.49	7.95	0.52	4.52	6.32	7.32
WBC32	0.468	15.310	0.59	11.03	10.80			0.68	4.68	6.48	7.48
WBC33	0.525	15.835	-1.20	8.35	7.32			0.85	4.85	6.65	7.65
WBC34	0.475	16.310	1.21	8.33	8.59			1.01	5.01	6.81	7.81
WBC35	0.563	16.873	-2.41	9.40	13.56			1.20	5.20	7.00	8.00
Manggarai Barrage	0.100	16.973	0.36					1.23	5.23	7.03	8.03

Table. 4.7 DIMENSION OF LONGITUDINAL PROFILE S (8/10-1)

Eastern Banjir Canal

Section No.		Distance (km)	Existing Ground (Centre)	Existing Ground (Left) (m.PP)	Existing Ground (Right) (m.PP)	Design River Bed (m.PP)	Design HWL (m.PP)	Design Dike (m.PP)
NEBC	0.00	0	1.43	1.43	1.43	-2.00	3.20	4.20
NEBC	1.00	1,000	1.73	1.73		-1.78	3.42	4.42
NEBC	2.00	2,000	2.23	2.23	2.23	-1.56	3.64	4.64
NEBC	2.50	2,500	2.43	2.43	2.43	-1.44	3.76	4.76
NEBC	3.00	3,000	2.23	2.23	2.23	-1.33	3.87	4.87
NEBC	3.50	3,500	2.23	2.23	2.23	-1.22	3.98	4.98
NEBC	4.00	4,000	2.33	2.33	2.33	-1.11	4.09	5.09
NEBC	4.50	4,500	2.63	2.63	2.63	-1.00	4.20	5.20
NEBC	5.00	5,000	2.63	2.63	2.63	-0.89	4.31	5.31
NEBC	5.50	5,500	2.53	2.53	2.53	-0.78	4.42	5.42
NEBC	6.00	6,000	2.53	2.53	2.53	-0.67	4.53	5.53
NEBC	6.50	6,500	2.53	2.53	2.53	-0.56	4.64	5.64
NEBC	6.60	6,600	2.83	2.83	2.83	-0.53	4.67	5.67
NEBC	6.70	6,700	2.93	2.93	2.93	-0.51	4.69	5.69
NEBC	7.00	7,000	3.53	3.53	3.53	-0.44	4.76	5.76
NEBC	7.50	7,500	3.53	3.53	3.53	-0.33	4.87	5.87
NEBC	8.00	8,000	3.53	3.53	3.53	-0.22	4.98	5.98
NEBC	8.50	8,500	4.03	4.03	4.03	-0.11	5.09	6.09
NEBC	9.00	9,000	3.53	3.53	3.53	0.00	5.20	6.20
NEBC	9.50	9,500	6.53	6.53	6.53	0.11	5.31	6.31
NEBC	10.00	10,000	6.53	6.53	6.53	0.28	5.28	6.28
NEBC	10.50	10,500	5.53	5.53	5.53	0.44	5.44	6.44
NEBC	11.00	11,000	6.53	6.53	6.53	0.61	5.61	6.61
NEBC	11.35	11,350	4.03	4.03	4.03	0.73	5.73	6.73
NEBC	11.50	11,500	4.53	4.53	4.53	0.78	5.78	6.78
NEBC	12.00	12,000	4.53	4.53	4.53	0.94	5.94	6.94
NEBC	12.50	12,500	3.23	3.23	3.23	1.11	6.11	7.11
NEBC	13.00	13,000	3.53	3.53	3.53	1.28	6.28	7.28
NEBC	13.50	13,500	3.53	3.53	3.53	1.44	6.44	7.44
NEBC	14.00	14,000	6.03	6.03	6.03	1.61	6.61	7.61
NEBC	14.50	14,500	4.13	4.13	4.13	1.78	6.78	7.78
NEBC	15.00	15,000	4.23	4.23	4.23	1.94	6.94	7.94
NEBC	15.50	15,500	5.53	5.53	5.53	2.11	7.11	8.11
NEBC	16.00	16,000	4.83	4.83	4.83	2.28	7.28	8.28
NEBC	16.50	16,500	5.03	5.03	5.03	2.44	7.44	8.44
NEBC	17.00	17,000	9.53	9.53	9.53	2.61	7.61	8.61
NEBC	17.00	17,000	9.53	9.53	9.53	3.27	8.27	9.27
NEBC	17.95	17,947	12.59	13.68	10.15	3.59	8.59	9.59
BKT	250	18,068	8.50	8.35	8.66	4.63	9.63	10.63
BKT	252	18,204	12.23	8.50	15.00	4.68	9.68	10.68
BKT	254	18,305	8.96	8.51	8.80	4.71	9.71	10.71
BKT	255	18,355	8.61	8.36	8.76	4.73	9.73	10.73
BKT	256	18,413	8.50	8.63	9.36	4.75	9.75	10.75
BKT	258	18,577	8.23	8.22	8.25	4.82	9.82	10.82
BKT	260	18,680	10.34	13.70	8.40	4.86	9.86	10.86
BKT	262	18,782	13.60	14.99	10.50	4.90	9.90	10.90
BKT	264	18,882	15.54	15.18	15.44	4.94	9.94	10.94
BKT	266	18,991	15.18	15.10	15.48	4.98	9.98	10.98
BKT	268	19,081	15.23	10.51	15.62	5.02	10.02	11.02
BKT	270	19,172	11.06	11.71	13.45	5.06	10.06	11.06
BKT	272	19,282	10.47	11.35	10.84	5.10	10.10	11.10
BKT	274	19,388	17.40	17.24	16.89	5.14	10.14	11.14
BKT	276	19,487	16.69	16.26	16.09	5.18	10.18	11.18
BKT	278	19,584	17.26	17.78	17.63	5.22	10.22	11.22

Table. 4.7 DIMENSION OF LONGITUDINAL PROFILE S (8/10-2)

Eastern Banjir Canal

Section No.		Distance (km)	Existing Ground (Centre)	(Left) (m.PP)	(Right) (m.PP)	Design River Bed (m.PP)	HWL (m.PP)	Dike (m.PP)
BKT	280	19,680	16.87	18.36	15.30	5.26	10.26	11.26
BKT	282	19,773	14.50	13.21	14.43	5.30	10.30	11.30
BKT	283	19,823	11.45	12.71	11.18	5.32	10.32	11.32
BKT	284	19,872	11.83	12.80	11.07	5.34	10.34	11.34
BKT	286	19,957	10.27	11.12	11.90	5.37	10.37	11.37
BKT	288	20,073	10.07	10.24	10.44	5.42	10.42	11.42
BKT	290	20,174	9.56	10.88	10.62	5.46	10.46	11.46
BKT	292	20,273	10.06	10.79	9.98	5.50	10.50	11.50
BKT	294	20,365	10.64	11.00	12.60	5.53	10.53	11.53
BKT	296	20,441	12.59	11.58	14.32	5.56	10.56	11.56
BKT	298	20,552	15.12	13.81	15.97	5.61	10.61	11.61
BKT	300	20,659	17.24	15.26	16.82	5.65	10.65	11.65
BKT	302	20,748	14.95	13.94	14.60	5.69	10.69	11.69
BKT	304	20,900	13.04	13.70	12.51	5.75	10.75	11.75
BKT	306	21,010	11.45	12.50	11.30	5.79	10.79	11.79
BKT	308	21,112	12.56	11.93	12.21	5.83	10.83	11.83
BKT	310	21,225	12.48	13.50	12.67	5.88	10.88	11.88
BKT	312	21,304	15.12	14.56	15.10	5.91	10.91	11.91
BKT	314	21,395	16.90	15.39	16.46	5.95	10.95	11.95
BKT	316	21,513	16.12	12.87	16.12	5.99	10.99	11.99
BKT	318	21,612	15.07	14.01	16.12	6.03	11.03	12.03
BKT	320	21,731	15.80	14.98	16.15	6.08	11.08	12.08
BKT	322	21,847	9.92	10.14	10.48	6.13	11.13	12.13
BKT	324	21,950	10.20	10.58	10.76	6.17	11.17	12.17
BKT	326	22,084	9.67	9.72	9.80	6.22	11.22	12.22
BKT	328	22,148	9.10	9.41	9.10	7.25	11.25	12.25
BKT	330	22,252	15.42	16.85	15.20	7.29	11.29	12.29
BKT	332	22,335	18.88	19.46	16.82	7.33	11.33	12.33
BKT	334	22,443	15.26	17.56	15.40	7.38	11.38	12.38
BKT	336	22,527	17.74	15.66	17.85	7.43	11.43	12.43
BKT	338	22,633	14.69	13.97	16.18	7.48	11.48	12.48
BKT	340	22,720	15.88	15.22	15.87	7.52	11.52	12.52
BKT	342	22,814	12.03	12.76	12.51	7.57	11.57	12.57
BKT	344	22,927	12.94	12.25	11.19	7.63	11.63	12.63
BKT	346	23,030	11.62	12.23	12.06	7.68	11.68	12.68
BKT	348	23,133	17.51	16.96	14.30	7.73	11.73	12.73
BKT	349	23,183	17.75	17.72	17.17	8.95	12.95	13.95
BKT	350	23,233	17.86	16.92	17.00	8.98	12.98	13.98
BKT	352	23,341	18.26	18.12	18.53	9.03	13.03	14.03
BKT	354	23,442	14.26	16.63	16.04	9.08	13.08	14.08
CP.	1	23,610	10.30	14.30	14.53	9.21	13.21	14.21

Table 4.7 DIMENSION OF LONGITUDINAL PROFILES (9/10)

CBL FLOODWAY

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
CBL01	0.000	0.000	-2.41	0.25	0.57			-5.40	-2.40	-0.20	0.80
CBL02	1.038	1.038	-2.46	0.85	0.85			-5.23	-2.23	-0.03	0.97
CBL03	1.087	2.125	-2.38	0.37	1.49	0.71		-5.05	-2.05	0.15	1.15
CBL04	1.088	3.213	-2.49	0.46	0.95		1.30	-4.86	-1.86	0.34	1.34
CBL05	0.925	4.138	-2.16	0.39	2.13	0.94	2.54	-4.71	-1.71	0.49	1.49
CBL06	1.037	5.175	-1.58	1.22	1.22	1.30	2.51	-4.54	-1.54	0.66	1.66
CBL07	0.950	6.125	-2.65	0.48	0.86		2.33	-4.38	-1.38	0.82	1.82
CBL08	1.025	7.150	-2.19	0.55	0.55	1.68	3.36	-4.21	-1.21	0.99	1.99
CBL09	1.100	8.250	-2.02	1.35	1.35	2.10	4.52	-4.03	-1.03	1.18	2.18
CBL10	0.975	9.225	-1.90	1.18	1.18	2.35	5.07	-3.86	-0.86	1.34	2.34
CBL11	1.000	10.225	-1.71	1.38	1.38	1.82	3.98	-3.70	-0.70	1.50	2.50
Conf. with Bekasi River	0.525	10.750	-2.46	2.04	2.55	2.46	4.09	-3.61	-0.61	1.59	2.59
CBL12	0.525	11.275	-3.21	2.70	3.71	3.09	4.20	-3.35	-0.35	1.85	2.65
CBL13	0.900	12.175	-3.16	0.60	2.44	3.01	3.38	-2.90	0.10	2.30	3.10
CBL14	0.988	13.163	-2.94	2.21	2.21	2.74	4.40	-2.40	0.60	2.80	3.60
CBL15	1.037	14.200	-1.81	0.94	3.87	2.41	5.49	-1.88	1.12	3.32	4.12
CBL16	1.025	15.225	-2.54	3.08	3.08	4.08	5.52	-1.37	1.63	3.83	4.63
CBL17	1.050	16.275	-1.97	3.60	3.34		4.52	-0.85	2.15	4.35	5.15
CBL18	1.025	17.300	-1.38	7.12	4.25		5.11	-0.33	2.67	4.87	5.67
CBL19	1.000	18.300	-0.93	6.48	4.99		6.26	0.17	3.17	5.37	6.17
CBL20	1.013	19.313	0.10	8.63	5.56		6.36	0.67	3.67	5.87	6.67
CBL21	1.000	20.313	-0.56	10.76	7.31		7.36	1.17	4.17	6.37	7.17
CBL22	0.925	21.238	0.90	10.97	8.09		9.31	1.64	4.64	6.84	7.64
CBL23(Conf. with Cisadang)	0.887	22.125	1.50	10.80	8.87		9.85	2.08	5.08	7.28	8.08

Table 4.7 DIMENSION OF LONGITUDINAL PROFILES (10/10)

BEKASI RIVER

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
BKS01(Conf. with CBL)	0.000	0.000	-3.58	5.15	0.34		1.38	-3.61	0.39	2.39	3.39
BKS02	1.050	1.050	-6.04	1.00	2.81	3.81		-2.94	1.06	3.06	4.06
BKS03	1.000	2.050	-3.58	2.94	2.94	4.99	4.52	-2.30	1.70	3.70	4.70
BKS04	1.000	3.050	-4.69	3.65	3.75	5.20	5.46	-1.67	2.33	4.33	5.33
BKS05	0.900	3.950	-2.05	3.93	4.56	5.91	5.65	-1.09	2.91	4.91	5.91
BKS06	1.000	4.950	-2.83	6.34	4.70		5.86	-0.46	3.54	5.54	6.54
BKS07	1.000	5.950	-3.98	6.51	6.34			0.18	4.18	6.18	7.18
BKS08	1.300	7.250	-0.27	6.92	7.01			1.01	5.01	7.01	8.01
BKS09	0.750	8.000	-0.46	8.99	7.49			1.49	5.49	7.49	8.49
BKS10	1.000	9.000	-0.68	8.99	9.35			2.12	6.12	8.12	9.12
BKS11	0.900	9.900	0.23	7.58	10.14			2.70	6.70	8.70	9.70
BKS12	0.900	10.800	1.19	8.66	10.33			3.27	7.27	9.27	10.27
BKS13	1.125	11.925	0.57	9.74	8.07			3.99	7.99	9.99	10.99
BKS14	0.800	12.725	1.45	12.31	8.64			4.50	8.50	10.50	11.50
BKS15	1.075	13.800	1.65	13.19	13.28			5.18	9.18	11.18	12.18
BKS16	1.050	14.850	3.97	14.07	14.00			5.85	9.85	11.85	12.85
BKS17	0.875	15.725	4.38	9.97	9.12		12.43	6.41	10.41	12.41	13.41
BKS18	0.800	16.525	3.64	14.87	15.37			6.92	10.92	12.92	13.92
BKS19	1.000	17.525	6.72	17.07	15.73			7.55	11.55	13.55	14.55
BKS20	1.000	18.525	6.91	18.42	17.83			8.19	12.19	14.19	15.19
BKS21(Bekasi weir)	1.500	20.025	7.43	19.38	18.96			9.15	13.15	15.15	16.15

CISADANG RIVER

Section No.	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Design River Bed (m, TTG)	Design H.W.C. (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
CSG01(Conf. with CBL)	0.000	0.000	3.66	6.72	8.97			3.90		7.40	8.00
CSG02	0.875	0.875	4.20	9.53	9.29			4.84		8.34	8.94
CSG03	0.950	1.825	6.54	10.09	10.39			5.86		9.36	9.96
CSG04	0.838	2.663	8.21	10.94	12.34			6.76		10.26	10.86
CSG05	0.825	3.488	7.85	11.08	11.14			7.65		11.15	11.75
CSG06	0.800	4.288	8.32	11.75	11.57			8.51		12.01	12.61
CSG07	1.087	5.375	9.87	13.93	13.47			9.68		13.18	13.78
CSG08	0.900	6.275	10.37	13.25	13.15			10.65		14.15	14.75
CSG09(Jl. Jakarta-Cikarang)	1.325	7.600	12.06	16.41	17.10			12.07		15.57	16.17

Table 4.8 DIMENSION OF STANDARD CROSS SECTIONS (1/5)

CIDURIAN RIVER (Estuary - Jl Serang Raya <Parigi>) Q=650m3/s (25-year)

			Gradient	1/3160		
			Water level	6.80		Q(ql+2qh,m^3/s)
Low Water Channel	Width(top,m)	51.0	Total water depth(m)	6.80		656.9
	Width(bottom,m)	33.0	Water depth(m)	4.50		Free board(m)
	Depth	4.50	Width(m)	51.0		1.0
	I	2.0	A(m^2)	306.3		Crown width(m)
	n	0.030	S(m)	53.12		5.0
	Bed height(m)	0.0	R(m)	5.766	V(m/s)	1.91
			ql(m^3/s)	584.0		
High Water Channel	Width(one side)	25.0	Water depth	2.30	S(m)	30.1
	Slope gradient	2.0	Width(m)	29.6	R(m)	2.083
	n	0.050	A(m^2)	62.8	qh(m^3/s)	36.4
			V(m/s)	0.58	2qh(m^3/s)	72.9

CIMANCEURI RIVER (Estuary - Jl. Serang Raya <Balaraja>) Q=290m3/s(25-year)

			Gradient	1/2860		
			Water level	5.80		Q(ql+2qh,m^3/s)
Low Water Channel	Width(top,m)	28.0	Total water depth(m)	5.80		292.3
	Width(bottom,m)	14.0	Water depth(m)	3.50		Free board(m)
	Depth	3.50	Width(m)	28.0		0.8
	I	2.0	A(m^2)	137.9		Crown width(m)
	n	0.030	S(m)	29.65		5.0
	Bed height(m)	0.0	R(m)	4.651	V(m/s)	1.74
			ql(m^3/s)	239.5		
High Water Channel	Width(one side)	17.0	Water depth	2.30	S(m)	22.1
	Slope gradient	2.0	Width(m)	21.6	R(m)	2.005
	n	0.050	A(m^2)	44.4	qh(m^3/s)	26.4
			V(m/s)	0.59	2qh(m^3/s)	52.8

CIRARAB RIVER (Estuary - Irrigation canal(CRR-9)) Q=75m3/s(25-year)

			Gradient	1/2060		
			Water level	3.00		Q(ql+2qh,m^3/s)
Low Water Channel	Width(top,m)	19.0	Total water depth(m)	3.00		76.3
	Width(bottom,m)	11.0	Water depth(m)	2.00		Free board(m)
	Depth	2.00	Width(m)	19.0		0.6
	I	2.0	A(m^2)	49.0		Crown width(m)
	n	0.030	S(m)	19.94		5.0
	Bed height(m)	0.0	R(m)	2.457	V(m/s)	1.34
			ql(m^3/s)	65.5		
High Water Channel	Width(one side)	12.0	Water depth	1.00	S(m)	14.2
	Slope gradient	2.0	Width(m)	14.0	R(m)	0.913
	n	0.050	A(m^2)	13.0	qh(m^3/s)	5.4
			V(m/s)	0.41	2qh(m^3/s)	10.8

CIRARAB RIVER Q=55m3/s(25-year)
(Irrigation canal(CRR-9) - Irrigation canal(CRR-18))

			Gradient	1/2060		
			Water level	3.00		Q(ql+2qh,m^3/s)
Low Water Channel	Width(top,m)	15.0	Total water depth(m)	3.00		55.8
	Width(bottom,m)	7.0	Water depth(m)	2.00		Free board(m)
	Depth	2.00	Width(m)	15.0		0.6
	I	2.0	A(m^2)	37.0		Crown width(m)
	n	0.030	S(m)	15.94		5.0
	Bed height(m)	0.0	R(m)	2.321	V(m/s)	1.29
			ql(m^3/s)	47.6		
High Water Channel	Width(one side)	9.0	Water depth	1.00	S(m)	11.2
	Slope gradient	2.0	Width(m)	11.0	R(m)	0.890
	n	0.050	A(m^2)	10.0	qh(m^3/s)	4.1
			V(m/s)	0.41	2qh(m^3/s)	8.2

CISADANE RIVER (Estuary - Pasar Baru weir) Q=1600m3/s(50-year) <CSD-1>

			Gradient	1/3000		
			Water level	9.50		Q(ql+2qh,m^3/s)
Low Water Channel	Width(top,m)	76.0	Total water depth(m)	9.50		1605.2
	Width(bottom,m)	48.0	Water depth(m)	7.00		Free board(m)
	Depth	7.00	Width(m)	76.0		1.0
	I	2.0	A(m^2)	624.0		Crown width(m)
	n	0.030	S(m)	79.30		5.0
	Bed height(m)	0.0	R(m)	7.668	V(m/s)	2.41
			ql(m^3/s)	1502.3		
High Water Channel	Width(one side)	30.0	Water depth	2.50	S(m)	35.6
	Slope gradient	2.0	Width(m)	35.0	R(m)	2.283
	n	0.050	A(m^2)	81.3	qh(m^3/s)	51.4
			V(m/s)	0.63	2qh(m^3/s)	102.9

Table 4.8 DIMENSION OF STANDARD CROSS SECTIONS (2/5)

CENGKARENG FLOODWAY (Estuary - JCF-9) Q=510m3/s(100-year) <CKR-3>

			Gradient	1/4000		
			Water level	5.75		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	57.0	Total water depth(m)	5.75		515.7
Channel	Width(bottom,m)	33.0	Water depth(m)	4.00		Free board(m)
	Depth	4.00	Width(m)	57.0		1.0
	I	3.0	A(m^2)	279.8		Crown width(m)
	n	0.025	S(m)	58.30		5.0
	Bed height(m)	0.0	R(m)	4.799	V(m/s)	1.80
			ql(m^3/s)	503.4		
High Water	Width(one side)	5.0	Water depth	1.75	S(m)	10.5
Channel	Slope gradient	3.0	Width(m)	10.3	R(m)	1.267
	n	0.040	A(m^2)	13.3	qh(m^3/s)	6.2
			V(m/s)	0.46	2qh(m^3/s)	12.4

CENGKARENG FLOODWAY (JCF-9 - Cengkareng weir) Q=510m3/s(100-year) <CKR-3>

			Gradient	1/4000		
			Water level	5.75		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	53.0	Total water depth(m)	5.75		513.6
Channel	Width(bottom,m)	37.0	Water depth(m)	4.00		Free board(m)
	Depth	4.00	Width(m)	53.0		1.0
	I	2.0	A(m^2)	272.8		Crown width(m)
	n	0.025	S(m)	54.89		5.0
	Bed height(m)	0.0	R(m)	4.969	V(m/s)	1.84
			ql(m^3/s)	502.3		
High Water	Width(one side)	5.0	Water depth	1.75	S(m)	8.9
Channel	Slope gradient	2.0	Width(m)	8.5	R(m)	1.325
	n	0.040	A(m^2)	11.8	qh(m^3/s)	5.6
			V(m/s)	0.48	2qh(m^3/s)	11.3

CENGKARENG FLOODWAY (Cengkareng weir - Mookervaart canal) Q=510m3/s(100-year) <CKR-3>

			Gradient	1/3125		
			Water level	5.55		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	51.0	Total water depth(m)	5.55		517.6
Channel	Width(bottom,m)	35.0	Water depth(m)	4.00		Free board(m)
	Depth	4.00	Width(m)	51.0		1.0
	I	2.0	A(m^2)	251.1		Crown width(m)
	n	0.025	S(m)	52.89		5.0
	Bed height(m)	0.0	R(m)	4.747	V(m/s)	2.02
			ql(m^3/s)	507.4		
High Water	Width(one side)	5.0	Water depth	1.55	S(m)	8.5
Channel	Slope gradient	2.0	Width(m)	8.1	R(m)	1.199
	n	0.040	A(m^2)	10.2	qh(m^3/s)	5.1
			V(m/s)	0.50	2qh(m^3/s)	10.2

CENGKARENG FLOODWAY (Mookervaart canal - Angke river) Q=420m3/s(100-year) <CKR-3>

			Gradient	1/3125		
			Water level	5.55		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	44.0	Total water depth(m)	5.55		431.7
Channel	Width(bottom,m)	28.0	Water depth(m)	4.00		Free board(m)
	Depth	4.00	Width(m)	44.0		1.0
	I	2.0	A(m^2)	212.2		Crown width(m)
	n	0.025	S(m)	45.89		5.0
	Bed height(m)	0.0	R(m)	4.624	V(m/s)	1.99
			ql(m^3/s)	421.4		
High Water	Width(one side)	5.0	Water depth	1.55	S(m)	8.5
Channel	Slope gradient	2.0	Width(m)	8.1	R(m)	1.199
	n	0.040	A(m^2)	10.2	qh(m^3/s)	5.1
			V(m/s)	0.50	2qh(m^3/s)	10.2

CENGKARENG FLOODWAY (Angke river - upper end) Q=290m3/s(100-year) <CKR-1&3>

			Gradient	1/2380		
			Water level	4.50		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	41.0	Total water depth(m)	4.50		292.9
Channel	Width(bottom,m)	25.0	Water depth(m)	4.00		Free board(m)
	Depth	4.00	Width(m)	41.0		1.0
	I	2.0	A(m^2)	152.5		Crown width(m)
	n	0.025	S(m)	42.89		5.0
	Bed height(m)	0.0	R(m)	3.556	V(m/s)	1.91
			ql(m^3/s)	291.3		
High Water	Width(one side)	5.0	Water depth	0.50	S(m)	6.1
Channel	Slope gradient	2.0	Width(m)	6.0	R(m)	0.449
	n	0.040	A(m^2)	2.8	qh(m^3/s)	0.8
			V(m/s)	0.30	2qh(m^3/s)	1.7

Table 4.8 DIMENSION OF STANDARD CROSS SECTIONS (3/5)

MOOKERVAART CANAL Q=125m3/s(25-year)

(Cengkareng Floodway - Boundary of DKI and Tangerang)

			Gradient	1/2260		
			Water level	4.00		Q(ql+2qh,m³/s)
Low Water Channel	Width(top,m)	30.0	Total water depth(m)	4.00		121.4
	Width(bottom,m)	14.0	Water depth(m)	4.00		Free board(m)
	Depth	4.00	Width(m)	30.0		0.6
	I	2.0	A(m²)	88.0		Crown width(m)
	n	0.030	S(m)	31.89		5.0
	Bed height(m)	0.0	R(m)	2.760	V(m/s)	1.38
			ql(m³/s)	121.4		
High Water Channel	Width(one side)	0.0	Water depth	0.00	S(m)	0.0
	Slope gradient	2.0	Width(m)	0.0	R(m)	0.000
	n	0.050	A(m²)	0.0	qh(m³/s)	0.0
			V(m/s)	0.00	2qh(m³/s)	0.0

ANGKE RIVER (Conf. with Cengkareng Floodway - Polor weir) Q=160m3/s(100-year)

<CKR-3&4>

			Gradient	1/2000		
			Water level	4.30		Q(ql+2qh,m³/s)
Low Water Channel	Width(top,m)	26.5	Total water depth(m)	4.30		161.1
	Width(bottom,m)	16.0	Water depth(m)	3.50		Free board(m)
	Depth	3.50	Width(m)	26.5		0.8
	I	1.5	A(m²)	95.6		Crown width(m)
	n	0.030	S(m)	28.62		5.0
	Bed height(m)	0.0	R(m)	3.340	V(m/s)	1.67
			ql(m³/s)	159.2		
High Water Channel	Width(one side)	3.0	Water depth	0.80	S(m)	4.4
	Slope gradient	1.5	Width(m)	4.2	R(m)	0.648
	n	0.050	A(m²)	2.9	qh(m³/s)	1.0
			V(m/s)	0.33	2qh(m³/s)	1.9

PESANGGRAHAN RIVER Q=290m3/s(100-year)

(Conf. with Cengkareng Floodway - Toll Jakarta-Merak) <CKR-1&3>

			Gradient	1/1250		
			Water level	5.25		Q(ql+2qh,m³/s)
Low Water Channel	Width(top,m)	26.4	Total water depth(m)	5.25		292.3
	Width(bottom,m)	15.0	Water depth(m)	3.80		Free board(m)
	Depth	3.80	Width(m)	26.4		0.8
	I	1.5	A(m²)	116.9		Crown width(m)
	n	0.030	S(m)	28.70		5.0
	Bed height(m)	0.0	R(m)	4.074	V(m/s)	2.41
			ql(m³/s)	281.3		
High Water Channel	Width(one side)	5.0	Water depth	1.45	S(m)	7.6
	Slope gradient	1.5	Width(m)	7.2	R(m)	1.159
	n	0.050	A(m²)	8.8	qh(m³/s)	5.5
			V(m/s)	0.62	2qh(m³/s)	11.0

Table 4.8 DIMENSION OF STANDARD CROSS SECTIONS (4/5)

WESTERN BANJIR CANAL (Estuary - Angke drain) Q=480m3/s(100-year)

<WBC-3>

			Gradient	1/3000		
			Water level	5.80		Q(ql+2qh,m³/s)
Low Water Channel	Width(top,m)	48.0	Total water depth(m)	5.80		485.4
	Width(bottom,m)	24.0	Water depth(m)	4.00		Free board(m)
	Depth	4.00	Width(m)	48.0		1.0
	I	3.0	A(m²)	230.4		Crown width(m)
	n	0.025	S(m)	49.30		5.0
	Bed height(m)	0.0	R(m)	4.674	V(m/s)	2.04
			ql(m³/s)	470.3		
High Water Channel	Width(one side)	5.0	Water depth	1.80	S(m)	10.7
	Slope gradient	3.0	Width(m)	10.4	R(m)	1.296
	n	0.040	A(m²)	13.9	qh(m³/s)	7.5
			V(m/s)	0.54	2qh(m³/s)	15.0

WESTERN BANJIR CANAL (Angke drain - Karet weir) Q=450m3/s(100-year)

<WBC-3>

			Gradient	1/3000		
			Water level	5.80		Q(ql+2qh,m³/s)
Low Water Channel	Width(top,m)	42.0	Total water depth(m)	5.80		452.4
	Width(bottom,m)	26.0	Water depth(m)	4.00		Free board(m)
	Depth	4.00	Width(m)	42.0		1.0
	I	2.0	A(m²)	211.6		Crown width(m)
	n	0.025	S(m)	43.89		5.0
	Bed height(m)	0.0	R(m)	4.821	V(m/s)	2.08
			ql(m³/s)	441.0		
High Water Channel	Width(one side)	4.0	Water depth	1.80	S(m)	8.0
	Slope gradient	2.0	Width(m)	7.6	R(m)	1.301
	n	0.040	A(m²)	10.4	qh(m³/s)	5.7
			V(m/s)	0.54	2qh(m³/s)	11.4

WESTERN BANJIR CANAL (Karet weir - Manggarai weir) Q=340m3/s(100-year)

<WBC-3>

			Gradient	1/3000		
			Water level	5.80		Q(ql+2qh,m³/s)
Low Water Channel	Width(top,m)	34.0	Total water depth(m)	5.80		345.2
	Width(bottom,m)	18.0	Water depth(m)	4.00		Free board(m)
	Depth	4.00	Width(m)	34.0		1.0
	I	2.0	A(m²)	165.2		Crown width(m)
	n	0.025	S(m)	35.89		5.0
	Bed height(m)	0.0	R(m)	4.603	V(m/s)	2.02
			ql(m³/s)	333.8		
High Water Channel	Width(one side)	4.0	Water depth	1.80	S(m)	8.0
	Slope gradient	2.0	Width(m)	7.6	R(m)	1.301
	n	0.040	A(m²)	10.4	qh(m³/s)	5.7
			V(m/s)	0.54	2qh(m³/s)	11.4

Table 4.8 DIMENSION OF STANDARD CROSS SECTIONS (5/5)

CBL FLOODWAY (Estuary - Bekasi river) — Q=780m3/s(50-year) <CBL-1>

			Gradient	1/6000		
			Water level	5.20		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	122.0	Total water depth(m)	5.20		782.6
Channel	Width(bottom,m)	110.0	Water depth(m)	3.00		Free board(m)
	Depth	3.00	Width(m)	122.0		1.0
	I	2.0	A(m^2)	616.4		Crown width(m)
	n	0.030	S(m)	123.42		5.0
	Bed height(m)	0.0	R(m)	4.994	V(m/s)	1.26
			ql(m^3/s)	775.0		
High Water	Width(one side)	3.0	Water depth	2.20	S(m)	7.9
Channel	Slope gradient	2.0	Width(m)	7.4	R(m)	1.445
	n	0.050	A(m^2)	11.4	qh(m^3/s)	3.8
			V(m/s)	0.33	2qh(m^3/s)	7.5

CBL FLOODWAY (Bekasi river - Cijambe) — Q=330m3/s(50-year) <CBL-1>

			Gradient	1/2000		
			Water level	5.20		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	32.0	Total water depth(m)	5.20		331.1
Channel	Width(bottom,m)	20.0	Water depth(m)	3.00		Free board(m)
	Depth	3.00	Width(m)	32.0		0.8
	I	2.0	A(m^2)	148.4		Crown width(m)
	n	0.030	S(m)	33.42		5.0
	Bed height(m)	0.0	R(m)	4.441	V(m/s)	2.01
			ql(m^3/s)	298.8		
High Water	Width(one side)	9.0	Water depth	2.20	S(m)	13.9
Channel	Slope gradient	2.0	Width(m)	13.4	R(m)	1.770
	n	0.050	A(m^2)	24.6	qh(m^3/s)	16.1
			V(m/s)	0.65	2qh(m^3/s)	32.3

CBL FLOODWAY (Cijambe - Cisadang) — Q=300m3/s(50-year) <CBL-1>

			Gradient	1/2000		
			Water level	5.20		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	26.0	Total water depth(m)	5.20		301.8
Channel	Width(bottom,m)	14.0	Water depth(m)	3.00		Free board(m)
	Depth	3.00	Width(m)	26.0		0.8
	I	2.0	A(m^2)	117.2		Crown width(m)
	n	0.030	S(m)	27.42		5.0
	Bed height(m)	0.0	R(m)	4.275	V(m/s)	1.96
			ql(m^3/s)	230.1		
High Water	Width(one side)	21.0	Water depth	2.20	S(m)	25.9
Channel	Slope gradient	2.0	Width(m)	25.4	R(m)	1.969
	n	0.050	A(m^2)	51.0	qh(m^3/s)	35.9
			V(m/s)	0.70	2qh(m^3/s)	71.7

BEKASI RIVER (Conf. with CBL - Bekasi weir) — Q=590m3/s(50-year) <CBL-1>

			Gradient	1/1570		
			Water level	6.00		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	44.0	Total water depth(m)	6.00		593.3
Channel	Width(bottom,m)	28.0	Water depth(m)	4.00		Free board(m)
	Depth	4.00	Width(m)	44.0		1.0
	I	2.0	A(m^2)	232.0		Crown width(m)
	n	0.030	S(m)	45.89		5.0
	Bed height(m)	0.0	R(m)	5.056	V(m/s)	2.48
			ql(m^3/s)	574.9		
High Water	Width(one side)	5.0	Water depth	2.00	S(m)	9.5
Channel	Slope gradient	2.0	Width(m)	9.0	R(m)	1.478
	n	0.050	A(m^2)	14.0	qh(m^3/s)	9.2
			V(m/s)	0.65	2qh(m^3/s)	18.3

CISADANO RIVER (Conf. with CBL - Jl. Jakarta-Cikarang) — Q=130m3/s(25-year) <CBL-1>

			Gradient	1/930		
			Water level	3.50		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	26.0	Total water depth(m)	3.50		130.5
Channel	Width(bottom,m)	12.0	Water depth(m)	3.50		Free board(m)
	Depth	3.50	Width(m)	26.0		0.6
	I	2.0	A(m^2)	66.5		Crown width(m)
	n	0.030	S(m)	27.65		5.0
	Bed height(m)	0.0	R(m)	2.405	V(m/s)	1.96
			ql(m^3/s)	130.5		
High Water	Width(one side)	0.0	Water depth	0.00	S(m)	0.0
Channel	Slope gradient	2.0	Width(m)	0.0	R(m)	0.000
	n	0.050	A(m^2)	0.0	qh(m^3/s)	0.0
			V(m/s)	0.00	2qh(m^3/s)	0.0

Table 4.9 OVERALL EVALUATION OF MASTER PLAN

River System	1 Cidunan	2 Cimanceuri	3 Cirarab	4 Cengkareng Floodway	5 Western Banjir Canal + Cisadane	6 Eastern Banjir Canal	7 CBL Floodway	x Non-structural Measures
Outline of Plan (Improvement Length)	River Improvement 32km	River Improvement 22km	River Improvement 17km	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)	495	605	144	2,505	1,865	4,119	1,607	institutions,
point	1	3	1	5	5	7	5	
Beneficial Area(km²)	180	240	70	120	230	210	570	flood fighting system,
Land Use in 2025	Agriculture	Agriculture	Agriculture	Residential Area	Gov. Ind. & Comm.	Res. & Industrial	Agri. & Residential	public education,
point	1	1	1	5	9	7	3	
Return Period of Design Flood(year)	25	25	25	100	100 and 50	100	50	
Financial Project Cost (Rp. billion)	227	108	27	858	767	1,931	220	school education,
point	3	3	3	2	2	0	3	etc.
Financial Land/House Cost (Rp. billion)	87	59	12	295	305	943	88	
point	10	10	10	8	8	2	10	
EIRR (%)	3.8	-	12.1	14.6	16.1	20.6	6.2	
point	0	0	6	6	6	6	2	
Technical Evaluation	Ordinary	Ordinary	Ordinary	Complicated	Complicated	Ordinary	Ordinary	
point	2	2	2	1	1	2	2	
Social Beneficial Impact	small	small	small	big	very big	big	middle	
point	1	1	1	5	7	5	3	
Environmental Impact	not affect	might affect	not affect	not affect	not affect	not affect	might affect	
point	2	0	2	2	2	2	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.

Table 4.10 CONCEPT OF DESIGN DISCHARGE DISTRIBUTION AT MANGGARAI

NEW MASTER PLAN (by JICA Study Team)

unit : m3/s

Return Period (year)	-	-	-	-	-	100
Ciliwung River	Q<360	370	380	390	400	410
Western Banjir Canal	Q<360	360	360	360	360	360
Ciliwung-Gunung Sahari Drain	0	10	20	30	40	50

PRESENT MASTER PLAN (by NEDECO)

unit : m3/s

Return Period (year)	2	5	10	25	50	100
Ciliwung River	100	170	218	280	325	370
Western Banjir Canal	100	170	180	205	250	295
Ciliwung-Gunung Sahari Drain	0	0	38	75	75	75

Source :
Explanatory note on the design of the rehabilitation works for
the Ciliwung Drain and Gunung Sahari Drain (Nov. 1975, NEDECO)

Table 5.1 ALTERNATIVE SCHEMES FOR OPTIMUM SCALE OF PROJECTS

	Alt. 1	Alt. 2	Alt. 2'	Alt. 3
Design Scale	WBC: 100-year, Cisadane: 50-year	WBC: 100-year, Cisadane: 25-year	WBC: 100-year, Cisadane: 25-year	WBC: 50-year, Cisadane: 10-year
Floodway tunnel (unit	2	1	2	1
Financial Project Cost (Rp. billion)	767 1	672 2	714 2	595 3
EIRR	16.1% 1	18.0% 3	16.4% 2	17.8% 3
Technical Evaluation	(1) Investigation of ground water once, (2) no restriction to existing tunnel and channel, (3) access easy by existing road, (4) inlet weir construction once, (5) temporary works once 3	(1) Investigation of ground water twice, (2)restriction to existing tunnel and channel, (3) access difficult after construction of one tunnel, (4) inlet weir reconstruction needed, (5) temporary works 1	(1) Investigation of ground water once, (2) no restriction to existing tunnel and channel, (3) access easy by existing road, (4) inlet weir construction once, (5) temporary works once 3	(1) Investigation of ground water once, (2) no restriction to existing tunnel and channel, (3) access easy by existing road, (4) inlet weir construction once, (5) temporary works once 1
Environmental Impact	(1) Temporary land use once, (2) affect to ground water once, (3) river water disturbance once, (4) possible impact to historical assets once 3	(1) Temporary land use twice, (2) affect to ground water twice, (3) river water disturbance twice, (4) possible impact to historical assets 1	(1) Temporary land use once, (2) affect to ground water once, (3) river water disturbance once, (4) possible impact to historical assets once 3	(1) Temporary land use twice, (2) affect to ground water twice, (3) river water disturbance twice, (4) possible impact to historical assets 1
Social Impact	(1) Land acquisition once, (2) transportation of heavy equipment once, (3) affect to groundwater once, (4) noise, vibration, resettlement once, (5) benefit big 3	(1) Land acquisition later more difficult, (2) transportation of heavy equipment twice, (3) affect to groundwater twice, (4) noise, vibration, resettlement twice, (5) benefit middle 1	(1) Land acquisition once, (2) transportation of heavy equipment once, (3) affect to groundwater once, (4) noise, vibration, resettlement once, (5) benefit middle 3	(1) Land acquisition later more difficult, (2) transportation of heavy equipment twice, (3) affect to groundwater twice, (4) noise, vibration, resettlement twice, (5) benefit middle 1
Overall Score	11	8	13	9
			Optimum	

Note: Estimated financial project cost is on the Master Plan level.

Table 5.2 DESIGN CRITERIA IN INDONESIA (1/2)

Design Criteria for Dykes and Floodwalls

TYPE	CRITERIA
Design Flood	The dyke height should be selected to convey the discharge of the Design Flood Standard without over-topping. Sideslope erosion protection should accomodate the 50 year flood without damage.
Right-of-Way and Land Use	In accordance with existing law the government acquires and has control over all lands to a distance of 5 metres beyond the outside toe of dykes. Permanent residential or industrial type structures should not be allowed within the regulatory floodplain. High crops (e.g. banana plantations) and crops which leave soil exposed to potential erosion (e.g. vegetable crops) should not be permitted. Certain types of agriculture are allowable within the regulatory floodplain. Livestock pasture or low height crops which provide erosion protection for underlying soils are recommended. Land-use within the regularotry floodplain should have a negligible impact on flood water levels.
Construction Materials and Geotechnical	Utilize locally available construction materials including silts, sands and clays where workable. Dykes built of silts and sands should be capped with a 0.3 metre thickness of clay for protection against rapid failure in the event of overtopping. Dykes should be compacted to a minimum 90 percent of Standard Procter Density, or greater depending on specific site requirements.
Cross Section Details	Minimum Top of Dyke Width Q≤500 m^3/s use 3 metres 500 m^3/s <Q< 2000 m^3/s use 4 metres Q ≥ 2000 m^3/s use 5 metres Greater width may be required for local traffic, inspection vehicles or maintenance equipment Minimum Dyke/Floodwall Freeboard Q<200 m^3/s use 0.5 metres 200 m^3/s <Q<500 m^3/s use 0.8 metres 500 m^3/s <Q< 2000 m^3/s use 1.0 metres Q ≥ 2000 m^3/s use 1.2 metres In all cases freeboard should be greater then wave setup and runup resulting from the 1:10 year wind event. Minimum Dyke Sideslopes should be 1:2 (vertical to horizontal). Flatter slopes or berms may be required based on the results of stability calculations. Dyke slopes should be protected against erosion by vegetation, planting of shrubs or use of armor (e.g. rock riprap) depending on site and soil conditions.
Special Considerations	Additional safeguards should be provided where dykes and floodwalls are located in critical areas where the risk to life or property in the event of dyke failure is high (see Figure 4.2), or where dykes are of significant height (e.g. > 3.5 metres). These safeguards should include: • an additional 0.3 metres freeboard along such such critical reaches • armouring of the inside sideslopes where dykes are built from relatively erosive materials (e.g. silts and sands) • an impervious core and downstream filter where dyke embankment or foundation seepage is a concern • minimum embankment compaction of 95 percent of Standard Procter Density.

source : Flood Control Manual (CIDA, 1993)

Table 5.2 DESIGN CRITERIA IN INDONESIA (2/2)

Design Criteria for Bridges and River Crossings

TYPE	CRITERIA
Design Floods	At least equal to project flood standard. Any backwater effect during the design flood should not exceed 0.3 m. Higher standards for specific sites may be required by the Departemen Perhubungan or Bina Marga.
Freeboard	Bina Marga requires minimum freeboard of 1.5 m above bankfull flood. Department of Public Works "Guideline for Bridge & Highway Loading" requires at least 1.0 metre freeboard between the 50 year flood level and bottom of bridge girder. Bina Marga requires that for navigable waterways freeboard should be at least 12 metres above the 50 year flood level. The top of road crossing should be at least 0.5 metres above top of dyke/floodwall level.
River Engineering	Bridge crossing location and design layout should be selected to suit the river engineering and geomorphological characteristics of the stream.
Bridge Spans	Total bridge span should not be less than the natural width of the river channel and should be designed to safely pass the design flood.
Bridge Piers	Bridge piers should be located and spaced to insure passage of debris during the flood. Bridge piers should be designed to accommodate potential scour and channel degradation. Sand mining should be prohibited in the vicinity of bridge piers.

Design Criteria for Weirs

TYPE	CRITERIA
Design Floods	At least equal to project Design Flood Standard. Ministry of Public Works Standard SNI 03-2415-1991 requires that weirs be designed for a flood return period between 50 and 100 years. Weirs which are located upstream of major population densities should be designed such that catastrophic consequences do not occur in the event of overtopping or operator error.
River Engineering	Structure should be able to safely pass the design floods without interception of sediment and debris loads. River works should be designed to withstand river bed scour and degradation during design flood event and lateral erosion during project life.
Foundation & Abutments	The foundation and abutments must be stable and should not undergo excessive deformation under any loading condition. Seepage through the foundation and abutments must be controlled to prevent uplift, piping, instability, sloughing, erosion, etc.
Freeboard	Top of structure and wingwalls should be at least 0.5 metres higher than adjacent dykes.

source : Flood Control Manual (CIDA, 1993)

Table 5.3 PROPOSED LONGITUDINAL PROFILE OF WBC (1/2)

Section No.	Distance	Accumulative Distance	Existing River Bed	Existing Ground Left	Existing Ground Right	Existing Dike Left	Existing Dike Right	Existing Parapet Left	Existing Parapet Right	Bottom of Bridge Girder Bridge	Bottom of Bridge Girder Truss	Bottom of Bridge Girder Name	Design River Bed	Design H.W.L.	Design Dike
	(km)	(km)	(m, TTG)	(m. TTG)	(m. TTG)	(m. TTG)	(m, TTG)	(m, TTG)	(m, TTG)	(m, TTG)	(m, TTG)	Name	(m, TTG)	(m, TTG)	(m, TTG)
0.0	0.000	0.000	-2.37	0.98	0.82								-4.75	0.85	1.85
0.3	0.320	0.320	-3.37	1.00	0.79	2.90							-4.66	0.94	1.94
0.5	0.190	0.510	-5.27	0.96	0.71	2.90	1.20						-4.61	0.99	1.99
0.8	0.305	0.815	-4.28	0.73	0.63	2.90	1.41						-4.52	1.08	2.08
1.1	0.290	1.105	-4.54	0.80	0.91	2.90	2.40						-4.44	1.16	2.16
1.4	0.350	1.455	-4.82	0.41	0.87	2.90							-4.35	1.25	2.25
1.9	0.480	1.935	-5.16	1.29	1.29	2.90	1.65			2.64		Mandara Permai	-4.21	1.39	2.39
2.3	0.360	2.295	-3.01	1.30	1.67	2.35	2.19						-4.11	1.49	2.49
2.4	0.150	2.445	-5.53	0.65	1.03	2.40	1.80						-4.07	1.53	2.53
2.7	0.280	2.725	-3.77	0.79	0.83	2.22	3.71			3.53		Tol Airport Cengkareng	-3.99	1.61	2.61
2.9	0.250	2.975	-3.07	0.92	0.63	0.99	0.96						-3.92	1.68	2.68
3.2	0.290	3.265	-4.79	0.49	0.37	1.45	1.80						-3.82	1.78	2.78
3.4	0.220	3.485	-4.65	0.37	1.31	2.00	1.50						-3.74	1.86	2.86
3.7	0.298	3.783	-3.00	2.01	1.70	3.81	2.41						-3.64	1.96	2.96
4.0	0.305	4.088	-4.21	1.30	1.02	3.84	2.85						-3.53	2.07	3.07
4.3	0.265	4.353	-2.94	1.91	2.01	3.95	2.28						-3.43	2.17	3.17
4.6	0.285	4.638	-4.10	0.59	0.23	3.01	1.92						-3.33	2.27	3.27
4.8	0.215	4.853	-3.72	0.46	1.10	3.21	2.92						-3.25	2.35	3.35
5.0	0.145	4.998	-3.67	0.84	0.70	3.24	2.76			2.63		Teluk Gong Raya	-3.20	2.40	3.40
5.1	0.135	5.133	-3.68	1.22	0.29	3.27	2.59						-3.15	2.45	3.45
5.4	0.280	5.413	-4.05	0.62	1.13	3.04	3.09						-3.05	2.55	3.55
5.6	0.227	5.640	-3.00	1.90	1.35	3.73	3.80			3.60		Pangeran Tubagus Angke	-2.97	2.63	3.63
5.7	0.110	5.750	-3.58	3.12	0.84		3.30		3.80				-2.93	2.67	3.67
5.8	0.110	5.860	-3.55	2.68	1.01	4.01	3.25		3.75				-2.89	2.71	3.71
6.1	0.240	6.100	-3.64	3.43	1.29	3.37	3.29		3.70				-2.81	2.79	3.79
6.2	0.125	6.225	-3.22	3.22	1.98	3.30	4.00	3.60	4.30				-2.76	2.84	3.84
6.4	0.235	6.460	-2.90	3.76	1.92	3.45	3.68	4.00	4.20				-2.68	2.92	3.92
6.7	0.235	6.695	-2.89	0.92	1.37	3.42	3.76	3.80	4.28				-2.60	3.00	4.00
6.9	0.280	6.975	-2.81	1.86	1.37	4.26	4.19	4.30	4.80	2.14		Prof. Dr. Latumeten	-2.50	3.10	4.10
7.1	0.175	7.150	-2.19	3.68	1.11	3.87	3.33	4.00	4.00				-2.43	3.17	4.17
7.4	0.295	7.445	-2.11	0.96	1.70	4.19	4.21	4.40	4.60				-2.33	3.27	4.27
7.7	0.225	7.670	-2.13	1.36	1.89	4.15	4.00	4.50	4.50				-2.25	3.35	4.35
7.9	0.205	7.875	-2.20	2.54	2.02	4.23	4.20	4.48	5.00	3.42		Railway (Future)	-2.17	3.43	4.43
8.1	0.240	8.115	-5.37	1.65	1.17	3.85	3.82	4.10	4.30				-2.09	3.51	4.51
8.4	0.305	8.420	-0.70	2.53	2.03	3.78	4.17	4.30	4.60	2.51		Kyai Tapa	-1.98	3.62	4.62
8.6	0.205	8.625	-2.06	1.28	1.82	3.86	4.10	4.30	4.60				-1.91	3.69	4.69
8.9	0.253	8.878	-1.81	2.50	1.92	4.39	4.37	5.00	5.10				-1.82	3.78	4.78
9.2	0.300	9.178	-1.54	2.41	1.98	4.07	3.97	4.70	4.70				-1.71	3.89	4.89
9.4	0.258	9.436	-0.38	2.53	2.75	4.34	4.93	4.90	5.20	9.05		Tomang	-1.62	3.98	4.98
9.7	0.310	9.746	-1.95	1.57	3.52	4.36	5.16	4.70	5.30				-1.51	4.09	5.09
10.0	0.215	9.961	-4.58	3.05	2.81	4.84	4.68	5.30					-1.43	4.17	5.17

Table 5.3 PROPOSED LONGITUDINAL PROFILE OF WBC (2/2)

Section No.	Distance	Accumulative Distance	Existing River Bed	Existing Ground Left	Existing Ground Right	Existing Dike Left	Existing Dike Right	Existing Parapet Left	Existing Parapet Right	Bottom of Bridge Girder Bridge	Bottom of Bridge Girder Truss	Bottom of Bridge Girder Name	Design River Bed	Design H.W.L.	Design Dike
	(km)	(km)	(m, TTG)	(m, TTG)	(m, TTG)	(m, TTG)	(m, TTG)	(m, TTG)	(m, TTG)	(m, TTG)	(m, TTG)		(m, TTG)	(m, TTG)	(m, TTG)
10.3	0.360	10.321	-1.48	3.29	3.31	4.78	5.49	5.20					-1.30	4.30	5.30
10.6	0.240	10.561	-3.73	3.68	3.33	4.51	5.97	5.20					-1.21	4.39	5.39
10.7	0.135	10.696	-3.84	1.52	3.89	4.62	6.04	5.00					-1.17	4.43	5.43
10.8	0.120	10.816	-1.89	3.44	3.20	4.95	4.63	5.00					-1.12	4.48	5.48
11.0	0.175	10.991	-0.54	3.34	2.73	4.91	5.04	5.30					-1.06	4.54	5.54
11.1	0.140	11.131	-0.78	3.56	2.90	4.90	5.00	5.20					-1.01	4.59	5.59
11.3	0.158	11.289	-0.87	5.16	3.95		4.40	5.20		8.13		Aipda KS Tubun	-0.95	4.65	5.65
11.5	0.170	11.459	-0.50	4.71	5.37	5.34	5.84	5.10					-0.89	4.71	5.71
11.7	0.220	11.679	-0.74	4.31	4.39	4.91	5.14	5.10					-0.82	4.78	5.78
11.9	0.270	11.949	-0.49	3.71	5.09	5.08	5.90	5.27					-0.72	4.88	5.88
12.1	0.175	12.124	-0.44	4.90	4.35	5.30	5.77	5.60					-0.66	4.94	5.94
12.3	0.170	12.294	-0.29	3.64	4.13	4.22	6.21	5.00					-0.60	5.00	6.00
12.4	0.122	12.416	-6.76	6.89	6.60								-0.55	5.05	6.05
12.41	0.015	12.431	-1.39	6.66	6.71					5.26		Karet Barrage	-0.55	5.05	6.05
12.42	0.020	12.451	0.59	7.02	6.16	8.20	8.11						-0.54	5.06	6.06
12.6	0.110	12.561	0.59	7.93	5.15		7.06						-0.50	5.10	6.10
Krukut River	0.100	12.661	0.59	7.93	5.15		7.06						-0.46	5.14	6.14
12.9	0.210	12.871	1.38	7.18	7.25	8.18	8.25						-0.33	5.21	6.21
13.1	0.200	13.071	-1.35	7.73	7.98					5.27		KH Mas Mansyur	-0.21	5.28	6.28
13.2	0.180	13.251	-0.53	5.49	5.95	7.57	7.38						-0.10	5.35	6.35
13.4	0.190	13.441	0.68	7.82	5.54	8.46	6.89						0.02	5.42	6.42
13.7	0.220	13.661	0.68	7.35	5.25		7.10						0.16	5.56	6.56
13.9	0.242	13.903	1.53	7.35	5.25		7.18			9.34		MH Thamrin	0.31	5.71	6.71
14.2	0.265	14.168	1.48	4.67	4.24	6.70	7.25						0.48	5.88	6.88
14.4	0.268	14.436	1.62	7.41	5.37		7.47						0.65	6.05	7.05
14.8	0.325	14.761	0.73	6.60	7.57		7.01						0.85	6.25	7.25
14.9	0.185	14.946	0.89	7.40	8.04	7.85	8.26						0.96	6.36	7.36
15.2	0.280	15.226	1.64	9.15	9.70					7.16		Halimun	1.14	6.54	7.14
15.4	0.255	15.481	1.60	10.40	12.51								1.30	6.70	7.30
15.7	0.240	15.721	3.31	11.89	11.57					11.06	7.35	Guntur	1.45	6.85	7.45
16.0	0.280	16.001	1.52	11.06	11.62					11.20	8.17	Latuharhari	1.62	7.02	7.62
16.3	0.275	16.276	2.24	9.21	7.58		8.26						1.80	7.20	7.80
16.6	0.275	16.551	1.99	8.73	8.59								1.97	7.37	7.97
16.8	0.170	16.721	3.27	9.75	11.06								2.07	7.47	8.07
16.9	0.120	16.841	0.02	10.58	11.01								2.15	7.55	8.15
16.91	0.045	16.886	1.08	8.89	9.03								2.18	7.58	8.18
16.92	0.015	16.901	1.48	8.73	8.73					7.57		Manggarai Barrage	2.19	7.59	8.19
16.93	0.010	16.911	1.36	8.85	9.11										
16.94	0.022	16.933	1.90	12.25	9.45										
17.0	0.030	16.963	2.04	10.08	9.38										

Table 5.4 DESIGN CRITERIA FOR CROSS SECTIONS OF WBC

Estuary - Angke Drain

Project Name	Design Discharge (m3/s)	Crown Width (m)	Free-board (m)	Slope Gradient	Roughness Coefficient L. W. C.	Roughness Coefficient H. W. C.
New Master Plan (JICA)	500	4	1.0	1:2.0	0.025	0.040
Flood Control Manual (1993)	Q>500	4	1.0	1:2.0	-	-
Master Plan by NEDECO	*525	4	1.5	1:2.0	-	-
West Jakarta Flood Control Project	400	4	1.0	1:3.0	0.030	0.030

* ; This value includes the discharge of the Upper Angke river

Angke Drain - Krukut River

Project Name	Design Discharge (m3/s)	Crown Width (m)	Free-board (m)	Slope Gradient	Roughness Coefficient L. W. C.	Roughness Coefficient H. W. C.
New Master Plan (JICA)	470	3	1.0	1:1.5	0.025	0.040
Flood Control Manual (1993)	Q<500	3	0.8	1:2.0	-	-
Master Plan by NEDECO *1	370	-	-	-	-	-
West Jakarta Flood Control Project *2	370	3	1.0	1:2.0	0.030	0.030

*1 ; proposed extention was alternated by the Cengkareng Floodway
*2 ; raising of levee up to Teluk Gong Syphon

Krukut River - Manggarai Barrage

Project Name	Design Discharge (m3/s)	Crown Width (m)	Free-board (m)	Slope Gradient	Roughness Coefficient L. W. C.	Roughness Coefficient H. W. C.
New Master Plan (JICA)	360	3	1.0	1:1.5	0.025	0.040
Flood Control Manual (1993)	Q<500	3	0.8	1:2.0	-	-
Master Plan by NEDECO	290	4	1.5	1:1.5	-	-
West Jakarta Flood Control Project	-	-	-	-	-	-

Table 5.5 PROPOSED STANDARD CROSS SECTION OF WBC

0.0 k (Estuary) - 2.9 k (Angke Drain) **100-year, 500 m3/s**

			Gradient	1/3600		
			Water level	5.60		Q(ql+2qh,m^3/s)
Low Water Channel	Width(top,m)	53.0	Total water depth(m)	5.60		501.1
	Width(bottom,m)	36.2	Water depth(m)	4.20		Free board(m)
	Depth	4.20	Width(m)	53.0		1.0
	Slope gradient	2.0	A(m^2)	261.5		Crown width(m)
	n	0.025	S(m)	54.98		4.0
	Bed height(m)	0.0	R(m)	4.756	V(m/s)	1.89
			ql(m^3/s)	493.1		
High Water Channel	Width(one side)	5.0	Water depth	1.40	S(m)	8.1
	Slope gradient	2.0	Width(m)	7.8	R(m)	1.102
	n	0.040	A(m^2)	9.0	qh(m^3/s)	4.0
			V(m/s)	0.44	2qh(m^3/s)	8.0

2.9 k (Angke Drain) - 12.7 k (Krukut River) **100-year, 470m3/s**

			Gradient	1/2800		
			Water level	5.60		Q(ql+2qh,m^3/s)
Low Water Channel	Width(top,m)	44.0	Total water depth(m)	5.60		473.6
	Width(bottom,m)	31.4	Water depth(m)	4.20		Free board(m)
	Depth	4.20	Width(m)	44.0		1.0
	Slope gradient	1.5	A(m^2)	219.9		Crown width(m)
	n	0.025	S(m)	46.54		3.0
	Bed height(m)	0.0	R(m)	4.725	V(m/s)	2.13
			ql(m^3/s)	468.2		
High Water Channel	Width(one side)	3.0	Water depth	1.40	S(m)	5.5
	Slope gradient	1.5	Width(m)	5.1	R(m)	1.026
	n	0.040	A(m^2)	5.7	qh(m^3/s)	2.7
			V(m/s)	0.48	2qh(m^3/s)	5.5

12.7 k (Krukut River) - 15.2 k (Halimun Bridge) **100-year, 360m3/s**

			Gradient	1/1600		
			Water level	5.40		Q(ql+2qh,m^3/s)
Low Water Channel	Width(top,m)	31.0	Total water depth(m)	5.40		374.1
	Width(bottom,m)	18.4	Water depth(m)	4.20		Free board(m)
	Depth	4.20	Width(m)	31.0		1.0
	Slope gradient	1.5	A(m^2)	140.9		Crown width(m)
	n	0.025	S(m)	33.54		3.0
	Bed height(m)	0.0	R(m)	4.202	V(m/s)	2.60
			ql(m^3/s)	367.0		
High Water Channel	Width(one side)	4.0	Water depth	1.20	S(m)	6.2
	Slope gradient	1.5	Width(m)	5.8	R(m)	0.954
	n	0.040	A(m^2)	5.9	qh(m^3/s)	3.6
			V(m/s)	0.61	2qh(m^3/s)	7.1

15.2 k (Halimun Bridge) - 16.9 k (Manggarai Barrage) **100-year, 360m3/s**

			Gradient	1/1600		
			Water level	5.40		Q(ql+2qh,m^3/s)
Low Water Channel	Width(top,m)	36.0	Total water depth(m)	5.40		369.2
	Width(bottom,m)	19.8	Water depth(m)	5.40		Free board(m)
	Depth	5.40	Width(m)	36.0		0.6
	Slope gradient	1.5	A(m^2)	150.7		Crown width(m)
	n	0.025	S(m)	39.27		3.0
	Bed height(m)	0.0	R(m)	3.837	V(m/s)	2.45
			ql(m^3/s)	369.2		
High Water Channel	Width(one side)	0.0	Water depth	0.00	S(m)	0.0
	Slope gradient	1.5	Width(m)	0.0	R(m)	0.000
	n	0.040	A(m^2)	0.0	qh(m^3/s)	0.0
			V(m/s)	0.00	2qh(m^3/s)	0.0

Table 5.6 PROPOSED LONGITUDINAL PROFILE OF CISADANE RIVER

Section No	Distance (km)	Accumulative Distance (km)	Existing River Bed (m, TTG)	Existing Ground Left (m, TTG)	Existing Ground Right (m, TTG)	Existing Dike Left (m, TTG)	Existing Dike Right (m, TTG)	Observed Water Level in Dry Season (m, TTG)	Bottom of Bridge Girder (m, TTG)	Design River Bed (m, TTG)	Design H.W.L. (m, TTG)	Design Dike (m, TTG)
0.0	0.000	0.000	-1.07	0.67	0.67			0.40				
0.4	0.400	0.400	-3.79	0.74	1.25			0.42				
0.9	0.465	0.865	-4.10	1.23	1.70			0.70				
1.4	0.545	1.410	-7.22	1.23	1.63			0.50				
1.8	0.417	1.827	-4.48	2.00	1.51			0.50		-4.93	3.71	4.71
2.2	0.400	2.227	-4.73	1.57	1.87			0.50		-4.80	4.04	5.04
2.9	0.650	2.877	-3.97	1.67	2.14			0.20		-4.60	4.58	5.58
3.5	0.610	3.487	-5.50	2.15	3.11	4.94	3.30	0.30		-4.41	5.09	6.09
3.9	0.412	3.899	-4.39	1.78	1.24	4.26	4.10	0.60		-4.28	5.22	6.22
4.3	0.357	4.256	-5.59	2.12	4.06	4.37	4.70	0.10		-4.17	5.33	6.33
4.7	0.397	4.653	-4.13	2.30	2.11	5.30	4.70	0.50		-4.05	5.45	6.45
5.3	0.598	5.251	-5.50	3.26	2.92	3.62	4.77	0.40		-3.86	5.64	6.64
5.9	0.605	5.856	-3.84	3.41	4.69	4.42	5.79	0.42		-3.67	5.83	6.83
6.4	0.505	6.361	-5.87	4.65	4.00	5.64	6.50	0.41	7.00	-3.51	5.99	6.99
6.8	0.415	6.776	-4.34	3.70	3.20	6.77	6.53	0.40		-3.38	6.12	7.12
7.1	0.350	7.126	-8.10	3.70	2.78	6.50	6.10	0.60		-3.27	6.23	7.23
7.7	0.540	7.666	-3.51	4.51	3.53	6.89	5.94	0.50		-3.10	6.40	7.40
8.2	0.498	8.164	-3.53	4.96	4.87	6.65	6.45	0.50		-2.95	6.55	7.55
8.8	0.650	8.814	-5.95	4.89	4.22	7.20	7.60	0.50		-2.75	6.75	7.75
9.2	0.364	9.178	-3.45	5.32	4.86	7.70	7.90	0.80		-2.63	6.87	7.87
9.9	0.726	9.904	-3.61	5.69	4.27	6.70	6.05	0.40		-2.41	7.10	8.10
10.3	0.423	10.327	-3.33	5.66	5.22	8.20	7.95	0.80		-2.27	7.23	8.23
10.8	0.510	10.837	-5.04	4.13	5.89	8.30	8.90	0.80		-2.11	7.39	8.39
11.3	0.492	11.329	-6.16	7.33	5.37		7.80	0.90		-1.96	7.54	8.54
11.8	0.475	11.804	-7.42	5.57	6.75	8.60	9.30	0.90		-1.81	7.85	8.85
12.3	0.505	12.309	-5.74	6.33	5.68	7.82	6.96	0.90		-1.65	8.19	9.19
12.7	0.440	12.749	-1.51	8.14	8.17	8.84	9.07	1.00		-1.52	8.48	9.48
13.1	0.360	13.109	-3.51	8.34	9.23	9.60	9.40	1.20		-1.27	8.73	9.73
13.5	0.350	13.459	-1.08	8.19	8.72	9.57	9.90	0.80		-1.04	8.96	9.96
13.9	0.438	13.897	-1.37	9.20	8.31	10.23	9.96	1.70		-0.75	9.25	10.25
14.4	0.495	14.392	-2.20	9.08	10.22	9.75	11.55	1.70		-0.41	9.59	10.59
14.8	0.446	14.838	-0.09	9.08	8.05	9.75	9.25	2.70		-0.11	9.89	10.89
15.1	0.255	15.093	-2.20	8.37	9.34	10.35	10.30	2.90		0.06	10.06	11.06
15.6	0.520	15.613	-2.90	7.82	9.35	10.51	11.10	2.90		0.41	10.41	11.41
16.2	0.561	16.174	-1.45	9.55	9.45	10.62	11.40	2.90		0.78	10.78	11.78
16.8	0.668	16.842	-0.74	10.79	10.07	11.08	12.49	3.00		1.23	11.23	12.23
17.4	0.570	17.412	-0.08	10.63	13.75	11.64	14.70	4.40				
18.0	0.610	18.022	2.05	11.59	12.32			5.10				
18.5	0.465	18.487	-0.77	11.52	11.89	11.87	12.50	5.20				
19.1	0.582	19.069	1.36	12.30	12.45		12.95	5.30				
19.5	0.435	19.504	-0.13	12.46	11.44		12.04	6.90				
20.1	0.570	20.074	3.62	14.46	14.86			7.70				
20.7	0.662	20.736	5.59	14.49	15.60			7.40				
21.3	0.550	21.286	5.92	17.30	16.34			8.30				
21.32	0.030	21.316	7.30	17.39	16.76			13.20				
21.35	0.030	21.346	6.99	16.55	16.13			13.20				
21.5	0.200	21.546	7.97	15.11	15.29			13.20				
21.8	0.255	21.801	9.49	15.93	15.29			13.20				
22.1	0.329	22.130	8.06	15.31	15.62			13.50				

Table 5.7 PROPOSED STANDARD CROSS SECTION OF CISADANE RIVER

Optimum Scale Project (25-year, 1500m3/s)

1.8 k - 12.7 k

			Gradient	1/3200		
			Water level	9.50		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	77.0	Total water depth(m)	9.50		1501.2
Channel	Width(bottom,m)	47.0	Water depth(m)	7.50		Free board(m)
	Depth	7.50	Width(m)	77.0		1.0
	I	2.0	A(m^2)	619.0		Crown width(m)
	n	0.030	S(m)	80.54		5.0
	Bed height(m)	0.0	R(m)	7.686	V(m/s)	2.29
			ql(m^3/s)	1420.5		
High Water	Width(one side)	35.5	Water depth	2.00	S(m)	40.0
Channel	Slope gradient	2.0	Width(m)	39.5	R(m)	1.876
	n	0.050	A(m^2)	75.0	qh(m^3/s)	40.3
			V(m/s)	0.54	2qh(m^3/s)	80.7

12.7 k - 16.8 k

			Gradient	1/1490		
			Water level	10.00		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	63.0	Total water depth(m)	10.00		1508.1
Channel	Width(bottom,m)	31.0	Water depth(m)	8.00		Free board(m)
	Depth	8.00	Width(m)	63.0		1.0
	I	2.0	A(m^2)	502.0		Crown width(m)
	n	0.035	S(m)	66.78		5.0
	Bed height(m)	0.0	R(m)	7.518	V(m/s)	2.84
			ql(m^3/s)	1425.9		
High Water	Width(one side)	24.5	Water depth	2.00	S(m)	29.0
Channel	Slope gradient	2.0	Width(m)	28.5	R(m)	1.829
	n	0.050	A(m^2)	53.0	qh(m^3/s)	41.1
			V(m/s)	0.77	2qh(m^3/s)	82.1

Master Plan (50-year, 1900m3/s)

1.8 k - 12.7 k

			Gradient	1/3200		
			Water level	9.50		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	94.0	Total water depth(m)	9.50		1901.6
Channel	Width(bottom,m)	64.0	Water depth(m)	7.50		Free board(m)
	Depth	7.50	Width(m)	94.0		1.0
	I	2.0	A(m^2)	780.5		Crown width(m)
	n	0.030	S(m)	97.54		5.0
	Bed height(m)	0.0	R(m)	8.002	V(m/s)	2.36
			ql(m^3/s)	1839.9		
High Water	Width(one side)	27.0	Water depth	2.00	S(m)	31.5
Channel	Slope gradient	2.0	Width(m)	31.0	R(m)	1.843
	n	0.050	A(m^2)	58.0	qh(m^3/s)	30.8
			V(m/s)	0.53	2qh(m^3/s)	61.6

12.7 k - 20.1 k

			Gradient	1/1490		
			Water level	10.00		Q(ql+2qh,m^3/s)
Low Water	Width(top,m)	76.0	Total water depth(m)	10.00		1919.9
Channel	Width(bottom,m)	44.0	Water depth(m)	8.00		Free board(m)
	Depth	8.00	Width(m)	76.0		1.0
	I	2.0	A(m^2)	632.0		Crown width(m)
	n	0.035	S(m)	79.78		5.0
	Bed height(m)	0.0	R(m)	7.922	V(m/s)	2.94
			ql(m^3/s)	1859.0		
High Water	Width(one side)	18.0	Water depth	2.00	S(m)	22.5
Channel	Slope gradient	2.0	Width(m)	22.0	R(m)	1.780
	n	0.050	A(m^2)	40.0	qh(m^3/s)	30.4
			V(m/s)	0.76	2qh(m^3/s)	60.9