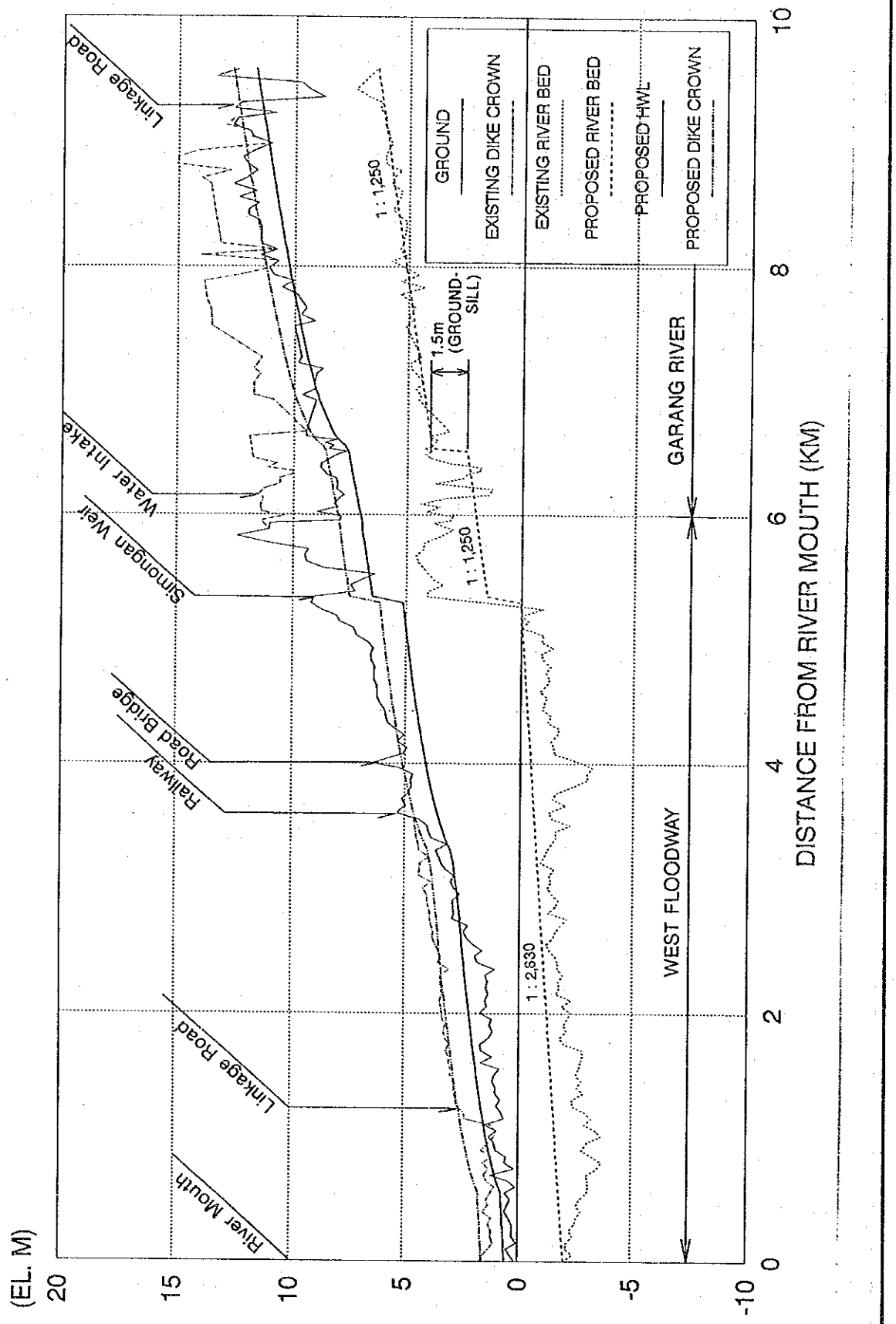
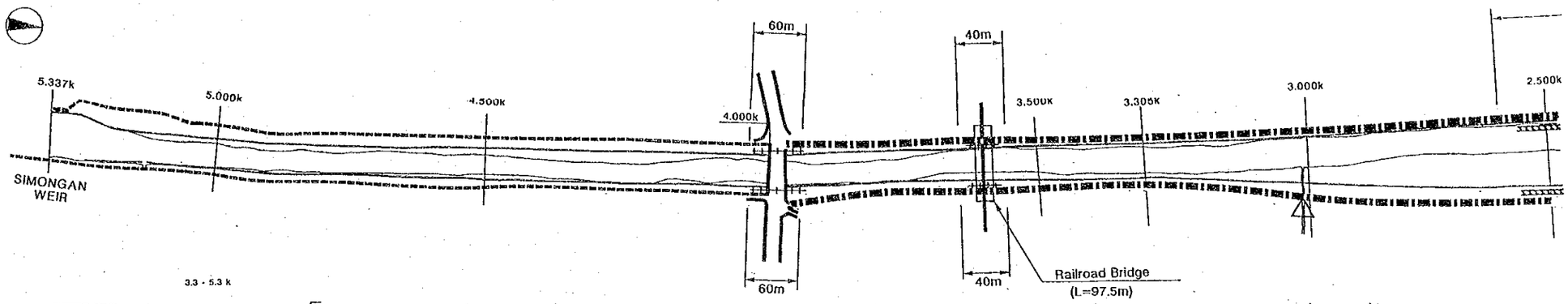
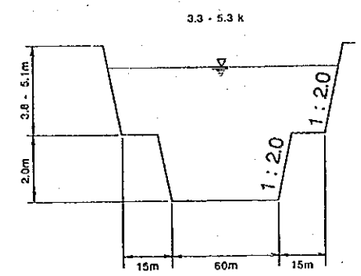


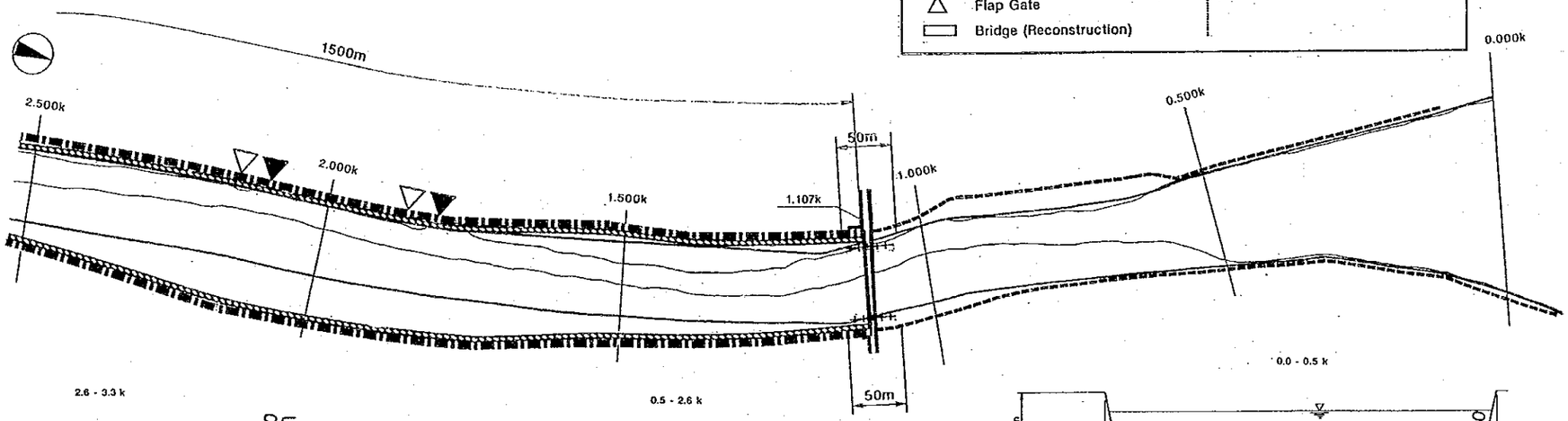

| | |
|---|---|
| MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS<br>JAPAN INTERNATIONAL COOPERATION AGENCY | Fig. V.5.6<br>LONGITUDINAL PROFILE PROPOSED FOR THE OPTIMUM RIVER IMPROVEMENT PLAN |

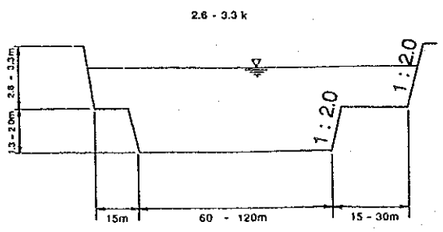


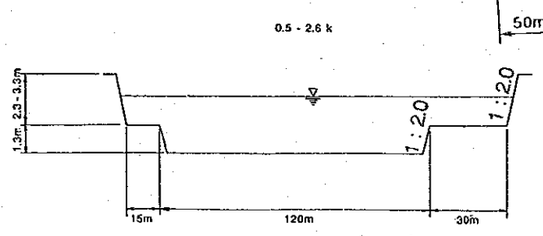



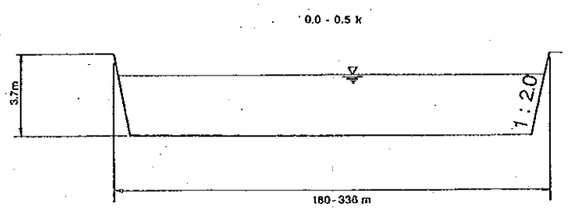

LEGEND

| Proposed | Existing |
|---|---|
| Low-Water Channel | Low-Water Channel |
| Embankment | Embankment |
| Revetment (Type-A) | Revetment (Type-A) |
| Revetment (Type-B) | Retaining Wall (Type-A) |
| Retaining Wall (Type-B) | Retaining Wall (Type-B) |
| Retaining Wall (Type-E) | Retaining Wall (Type-E) |
| Weir (Reconstruction) | Flap Gate |
| Ground Sill | Boundary of right-of-way |
| Intake Structure (Reconstruction) | |
| Flap Gate | |
| Bridge (Reconstruction) | |



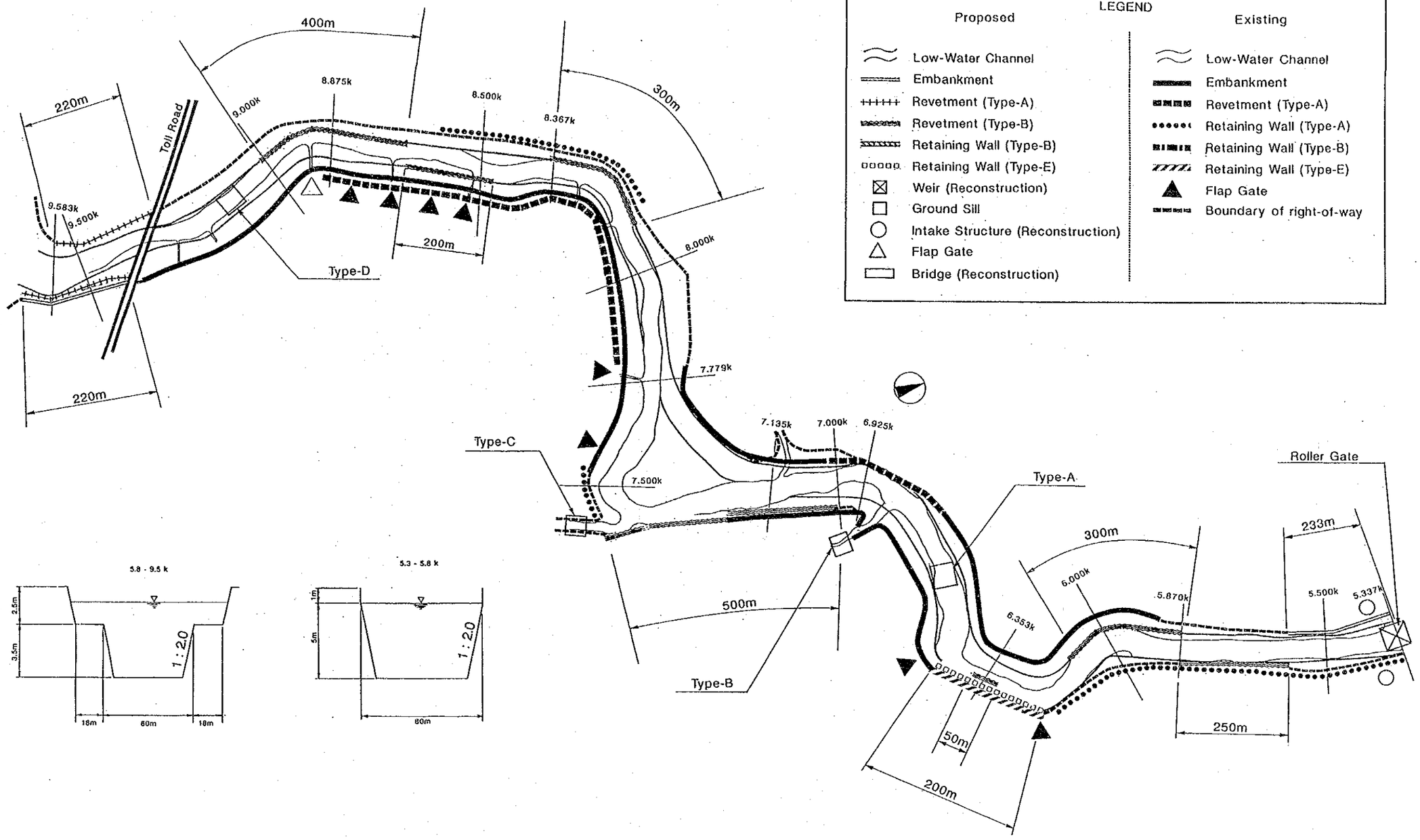




SCALE FOR PLAN
0 50 100 150 200 250 300m

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. V.5.7
STANDARD CROSS-SECTION AND ALIGNMENT PROPOSED FOR THE OPTIMUM RIVER IMPROVEMENT PLAN OF WEST FLOOD-WAY




MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. V.5.8

STANDARD CROSS-SECTION AND ALIGNMENT PROPOSED FOR THE OPTIMUM RIVER IMPROVEMENT PLAN OF GARANG RIVER

# V FLOOD CONTROL PLAN

# (ANNEX)

## ANNEX SUPPLEMENTARY STUDY ON URGENT PROJECT

### A.1 Supplementary Study Item

The study on the Urgent Project for flood control of West Floodway/Garang River was carried out in CHAPTER 5 of this SECTOR V. In the Study, the Urgent Project is proposed as a single package program on the premise that foreign financial assistance will be made in 1994. However, the Government of Indonesia had stated that it may not be easy to obtain foreign financial assistance in 1994. In accordance with this comment, a supplementary study was required to prepare alternatives of the phased implementation schedules, assuming various timing of financial assistance. The alternatives of the phased implementation schedule are divided into two (2) packages to be implemented before and after the foreign financial assistance. The supplementary study was also requested to clarify the appropriate work items to be implemented through the local annual budget while waiting for the approval of foreign financial assistance.

Due to the aforesaid circumstances, the supplementary study was carried out. The major supplementary study items are enumerated below:

(1) To clarify the appropriate work items that could be implemented solely by the available local budget while waiting for the approval of foreign financial assistance;

(2) To prepare the alternatives of the phased implementation schedule in due consideration of the available annual local budget and the timing of foreign financial assistance; and

(3) To carry out economic evaluation on the above alternative implementation schedule.

## A.2 Division of Package Project

The work items proposed for the optimum plan of the Urgent Project are divided into the following two packages:

(1) Package 1 to be immediately implemented by the available annual local budget as a continuation of the ongoing river improvement works; and

(2) Package 2 to be implemented on condition that foreign financial assistance is provided.

The work items of Package 1 should bring about the immediate flood control effect. At the same time, the work contents of Package 1 should be closely related to those of the ongoing river improvement works so that the ongoing works could be shifted to the proposed work items of Package 1 without difficulty. In due consideration of these conditions, the priority work items to be included in Package 1 are selected from all the items proposed in the Urgent Project Study as below:

| Priority | Construction Item | Work Volume |
|---|---|---|
| 1 | Retaining Wall (Garang River) | 200 m |
| 2 | Retaining Wall (West Floodway) | 3,000 m |
| 3 | Flap Gate | 16 pcs |
| 4 | Embankment | 10,200 $m^3$ |
| 5 | Excavation (West Floodway) | 663,000 $m^3$ |

## A.3 Alternatives of Phased Implementation Schedule

### A.3.1 Premises

The alternatives of the phased implementation schedule were prepared based on the following conditions:

(1) The work items for Package 1 will be implemented in the aforesaid priority order.

(2) The annual local budget of about 1.5 to 2.0 billion rupiah will be allocated to the Urgent Project. Then, the annual work volume for Package 1 are to be determined in accordance with the project cost to be disbursed within the limits of the available amount of annual local budget.

### A.3.2 Implementation Schedule

The four (4) alternatives of the phased implementation schedule mentioned below are conceived to evaluate the economic viability of the project influenced by the variable timing of the foreign financial assistance (refer to Figs. V.A.1 and V.A.2).

Alt. 1 : This alternative is originally proposed in the Urgent Project. In this alternative, foreign financial assistance is assumed to be made at the beginning of the Project. The project is implemented as a single-package program continuously from 1994 to 1999. The detailed design and tender works are carried out for the first three (3) years, and during this period, no construction work is to be carried out.

Alt. 2 : The foreign financial assistance is made at the beginning of the project for the entire implementation period from 1994 to 1999. Thus, this alternative has the same project implementation period and the same timing of foreign financial assistance as Alt. 1. In this alternative, however, the project is divided into two (2) packages. Package 1 is done solely under the local budget for the first three (3) years of the entire implementation period. Package 2 is subject to the foreign financial assistance and implemented throughout the entire project implementation period. In the implementation of Package 2, the detailed design and tender works are carried out for the first three (3) years, and immediately after the detailed design and tender works are completed, the related construction works are implemented.

Alt. 3 : The foreign financial assistance is made in 1997. In this alternative, the project is also divided into two (2) packages. Package 1 is implemented solely under the local budget for the period from 1994 to 2000, and the remaining Package 2 through the foreign financial assistance is implemented from 1997 to 2002.

Alt. 4 : The foreign financial assistance is made in 2000. In this alternative, the project is also divided into two (2) packages. Package 1 is implemented solely by the local budget for the period from 1994 to

2002, and the remaining Package 2 through the foreign financial assistance is implemented from 2000 to 2004.

### A.3.3 Annual Disbursement Schedule

The financial and economic investment costs for the Urgent Project are estimated as shown in Tables V.A.1 and V.A.2. In addition, the breakdown of the construction base cost for the Urgent Project is as shown in Tables V.A.3 and V.A.4. Details of the cost estimation are as described in SECTOR XII, PROJECT COST ESTIMATE.

To evaluate the economic viability of the aforesaid alternatives for the phased implementation, the annual disbursement schedules of the above investment cost for the Urgent Project are prepared for each alternative in accordance with its implementation schedule (refer to Tables V.A.5 and V.A.6).

## A.4 Economic Evaluation

The economic internal rate of return (EIRR) and the net present value (NPV) for the respective alternatives of the phased implementation schedule are estimated on the basis of the annual cost-benefit cash flow (refer to Table V.A.7). The economic viability of each alternative is figured out as follows:

| | | EIRR | NPV |
|---|---|---|---|
| (a) | Alt. 1 | 15.9% | 31,153 Mill. Rp. |
| (b) | Alt. 2 | 16.1% | 32,438 Mill. Rp. |
| (c) | Alt. 3 | 15.7% | 26,707 Mill. Rp. |
| (e) | Alt. 4 | 15.4% | 22,720 Mill. Rp. |

As estimated above, the highest economic viability is given to Alternative 2, but the dominant difference is not shown in the EIRR's and the NPVs of all alternatives. This estimation results may suggest that the economic advantage of the project will be given to the earlier implementation of Package 1 financed by the local budget as shown in the case of Alternative 2. At the same time, the delay of implementation of Package 2 associated with the foreign financial assistance may not cause serious disadvantage on the economical viability as compared between the EIRR/NPV of Alt. 2 and the EIRR's and NPVs of other alternatives.

## Table V.A.1 (1/4) SUMMARY OF URGENT PROJECT COST (ALTERNATIVE 1, FINANCIAL)

| Description | Amount F.C. (Mill.Rp.) | Amount L.C. (Mill.Rp.) | Amount Total (Mill.Rp.) | Total (1,000 US$) | Total (Mill.Yen) |
|---|---|---|---|---|---|
| I. Construction Base Cost | 34,700 | 24,646 | 59,346 | 29,191 | 3,663 |
| 1. Preparatory Works | 2,659 | 1,436 | 4,095 | 2,014 | 253 |
| 2. West Floodway Improvement Works | 3,904 | 1,687 | 5,591 | 2,750 | 345 |
| 3. Garang River Improvement Works | 3,940 | 2,474 | 6,414 | 3,155 | 396 |
| 4. Reconstruction of Simongan Weir | 11,330 | 6,681 | 18,011 | 8,859 | 1,112 |
| 5. Intake Structure | 1,465 | 869 | 2,334 | 1,148 | 144 |
| 6. Others | 3,536 | 1,344 | 4,880 | 2,400 | 301 |
| 7. Miscellaneous Works | 2,418 | 1,306 | 3,724 | 1,832 | 230 |
| Sub-total | 29,252 | 15,797 | 45,049 | 22,159 | 2,781 |
| 8. Price Contingency ; F.C.3% & L.C.8% | 5,448 | 8,849 | 14,297 | 7,032 | 883 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 4,924 | 4,924 | 2,422 | 304 |
| 1. Administration | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 2. Price Contingency ; F.C.3% & L.C.8% | 0 | 1,770 | 1,770 | 871 | 109 |
| IV. Engineering Service | 6,948 | 3,950 | 10,898 | 5,361 | 673 |
| 1. Detailed Design | 2,958 | 1,385 | 4,343 | 2,136 | 268 |
| 2. Construction Supervision | 3,172 | 1,454 | 4,626 | 2,275 | 286 |
| 3. Price Contingency ; F.C.3% & L.C.8% | 818 | 1,111 | 1,929 | 949 | 119 |
| V. Physical Contingency; 10% of I+II+IV | 4,165 | 2,860 | 7,025 | 3,455 | 434 |
| VI. Total (I+II+III+IV+V) | 45,813 | 36,380 | 82,193 | 40,429 | 5,074 |
| VII .Value Added Tax ; 10% of VI | 0 | 8,219 | 8,219 | 4,043 | 507 |
| VIII.Grand Total | 45,813 | 44,599 | 90,412 | 44,472 | 5,581 |
| Grand Total (1,000 US$) | 22,535 | 21,938 | 44,473 | | |
| Grand Total (Mill.Yen) | 2,828 | 2,753 | 5,581 | | |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

Table V.A.1 (2/4) SUMMARY OF URGENT PROJECT COST
(ALTERNATIVE 2, FINANCIAL)

| Description | Amount F.C. (Mill.Rp.) | Amount L.C. (Mill.Rp.) | Amount Total (Mill.Rp.) | Total (1,000 US$) | Total (Mill.Yen) |
|---|---|---|---|---|---|
| I. Construction Base Cost | 31,005 | 27,438 | 58,443 | 28,747 | 3,608 |
| 1. Preparatory Works | 2,383 | 1,712 | 4,095 | 2,014 | 253 |
| 2. West Floodway Improvement Works | 3,643 | 1,948 | 5,591 | 2,750 | 345 |
| 3. Garang River Improvement Works | 3,940 | 2,474 | 6,414 | 3,155 | 396 |
| 4. Reconstruction of Simongan Weir | 11,330 | 6,681 | 18,011 | 8,859 | 1,112 |
| 5. Intake Structure | 1,465 | 869 | 2,334 | 1,148 | 144 |
| 6. Others | 1,290 | 3,590 | 4,880 | 2,400 | 301 |
| 7. Miscellaneous Works | 2,168 | 1,556 | 3,724 | 1,832 | 230 |
| Sub-total | 26,219 | 18,830 | 45,049 | 22,159 | 2,781 |
| 8. Price Contingency ; F.C.3% & L.C.8% | 4,786 | 8,608 | 13,394 | 6,588 | 827 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 4,800 | 4,800 | 2,361 | 296 |
| 1. Administration | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 2. Price Contingency ; F.C.3% & L.C.8% | 0 | 1,646 | 1,646 | 810 | 102 |
| IV. Engineering Service | 6,229 | 4,663 | 10,892 | 5,358 | 672 |
| 1. Detailed Design | 2,656 | 1,687 | 4,343 | 2,136 | 268 |
| 2. Construction Supervision | 2,847 | 1,779 | 4,626 | 2,275 | 286 |
| 3. Price Contingency ; F.C.3% & L.C.8% | 726 | 1,197 | 1,923 | 946 | 119 |
| V. Physical Contingency; 10% of I+II+IV | 3,723 | 3,210 | 6,933 | 3,410 | 428 |
| VI. Total (I+II+III+IV+V) | 40,957 | 40,111 | 81,068 | 39,876 | 5,004 |
| VII .Value Added Tax ; 10% of VI | 0 | 8,107 | 8,107 | 3,988 | 500 |
| VIII.Grand Total | 40,957 | 48,218 | 89,175 | 43,864 | 5,505 |
| Grand Total (1,000 US$) | 20,146 | 23,718 | 43,864 | | |
| Grand Total (Mill.Yen) | 2,528 | 2,976 | 5,504 | | |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

Table V.A.1 (3/4) SUMMARY OF URGENT PROJECT COST
(ALTERNATIVE 3, FINANCIAL)

| Description | Amount F.C. (Mill.Rp.) | Amount L.C. (Mill.Rp.) | Amount Total (Mill.Rp.) | Total (1,000 US$) | Total (Mill.Yen) |
|---|---|---|---|---|---|
| I. Construction Base Cost | 28,740 | 34,415 | 63,155 | 31,065 | 3,898 |
| 1. Preparatory Works | 2,092 | 2,003 | 4,095 | 2,014 | 253 |
| 2. West Floodway Improvement Works | 1,053 | 4,538 | 5,591 | 2,750 | 345 |
| 3. Garang River Improvement Works | 3,881 | 2,533 | 6,414 | 3,155 | 396 |
| 4. Reconstruction of Simongan Weir | 11,330 | 6,681 | 18,011 | 8,859 | 1,112 |
| 5. Intake Structure | 1,465 | 869 | 2,334 | 1,148 | 144 |
| 6. Others | 1,290 | 3,590 | 4,880 | 2,400 | 301 |
| 7. Miscellaneous Works | 1,902 | 1,822 | 3,724 | 1,832 | 230 |
| Sub-total | 23,013 | 22,036 | 45,049 | 22,159 | 2,781 |
| 8. Price Contingency ; F.C.3% & L.C.8% | 5,727 | 12,379 | 18,106 | 8,906 | 1,118 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 5,774 | 5,774 | 2,840 | 356 |
| 1. Administration | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 2. Price Contingency ; F.C.3% & L.C.8% | 0 | 2,620 | 2,620 | 1,289 | 162 |
| IV. Engineering Service | 6,105 | 6,348 | 12,453 | 6,125 | 769 |
| 1. Detailed Design | 2,388 | 1,955 | 4,343 | 2,136 | 268 |
| 2. Construction Supervision | 2,561 | 2,065 | 4,626 | 2,275 | 286 |
| 3. Price Contingency ; F.C.3% & L.C.8% | 1,156 | 2,328 | 3,484 | 1,714 | 215 |
| V. Physical Contingency; 10% of I+II+IV | 3,484 | 4,077 | 7,561 | 3,719 | 467 |
| VI. Total (I+II+III+IV+V) | 38,329 | 50,614 | 88,943 | 43,750 | 5,490 |
| VII .Value Added Tax ; 10% of VI | 0 | 8,893 | 8,893 | 4,374 | 549 |
| VIII.Grand Total | 38,329 | 59,507 | 97,836 | 48,124 | 6,039 |
| Grand Total (1,000 US$) | 18,853 | 29,271 | 48,124 | | |
| Grand Total (Mill.Yen) | 2,366 | 3,673 | 6,039 | | |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

## Table V.A.1 (4/4) SUMMARY OF URGENT PROJECT COST (ALTERNATIVE 4, FINANCIAL)

| Description | Amount F.C. (Mill.Rp.) | Amount L.C. (Mill.Rp.) | Amount Total (Mill.Rp.) | Total (1,000 US$) | Total (Mill.Yen) |
|---|---|---|---|---|---|
| I. Construction Base Cost | 25,219 | 38,383 | 63,602 | 31,285 | 3,926 |
| 1. Preparatory Works | 1,834 | 2,261 | 4,095 | 2,014 | 253 |
| 2. West Floodway Improvement Works | 0 | 5,591 | 5,591 | 2,750 | 345 |
| 3. Garang River Improvement Works | 3,881 | 2,533 | 6,414 | 3,155 | 396 |
| 4. Reconstruction of Simongan Weir | 11,330 | 6,681 | 18,011 | 8,859 | 1,112 |
| 5. Intake Structure | 1,465 | 869 | 2,334 | 1,148 | 144 |
| 6. Others | 0 | 4,880 | 4,880 | 2,400 | 301 |
| 7. Miscellaneous Works | 1,668 | 2,056 | 3,724 | 1,832 | 230 |
| Sub-total | 20,178 | 24,871 | 45,049 | 22,159 | 2,781 |
| 8. Price Contingency ; F.C.3% & L.C.8% | 5,041 | 13,512 | 18,553 | 9,126 | 1,145 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 6,932 | 6,932 | 3,410 | 428 |
| 1. Administration | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 2. Price Contingency ; F.C.3% & L.C.8% | 0 | 3,778 | 3,778 | 1,858 | 233 |
| IV. Engineering Service | 5,926 | 8,377 | 14,303 | 7,035 | 883 |
| 1. Detailed Design | 2,120 | 2,223 | 4,343 | 2,136 | 268 |
| 2. Construction Supervision | 2,274 | 2,352 | 4,626 | 2,275 | 286 |
| 3. Price Contingency ; F.C.3% & L.C.8% | 1,532 | 3,802 | 5,334 | 2,624 | 329 |
| V. Physical Contingency; 10% of I+II+IV | 3,114 | 4,676 | 7,790 | 3,832 | 481 |
| VI. Total (I+II+III+IV+V) | 34,259 | 58,368 | 92,627 | 45,562 | 5,718 |
| VII .Value Added Tax ; 10% of VI | 0 | 9,263 | 9,263 | 4,556 | 572 |
| VIII.Grand Total | 34,259 | 67,631 | 101,890 | 50,118 | 6,290 |
| Grand Total (1,000 US$) | 16,851 | 33,267 | 50,118 | | |
| Grand Total (Mill.Yen) | 2,115 | 4,175 | 6,290 | | |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

## Table V.A.2 (1/4) SUMMARY OF URGENT PROJECT COST (ALTERNATIVE 1, ECONOMIC)

| Description | Amount F.C. (Mill.Rp.) | Amount L.C. (Mill.Rp.) | Amount Total (Mill.Rp.) | Total (1,000 US$) | Total (Mill.Yen) |
|---|---|---|---|---|---|
| I. Construction Base Cost | 26,583 | 14,263 | 40,846 | 20,091 | 2,521 |
| 1. Preparatory Works | 2,417 | 1,297 | 3,714 | 1,827 | 229 |
| 2. West Floodway Improvement Works | 3,548 | 1,534 | 5,082 | 2,500 | 314 |
| 3. Garang River Improvement Works | 3,580 | 2,230 | 5,810 | 2,858 | 359 |
| 4. Reconstruction of Simongan Weir | 10,293 | 6,018 | 16,311 | 8,023 | 1,007 |
| 5. Intake Structure | 1,327 | 784 | 2,111 | 1,038 | 130 |
| 6. Others | 3,221 | 1,221 | 4,442 | 2,185 | 274 |
| 7. Miscellaneous Works | 2,197 | 1,179 | 3,376 | 1,661 | 208 |
| Sub-total | 26,583 | 14,263 | 40,846 | 20,091 | 2,521 |
| 8. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 1. Administration | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 2. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| IV. Engineering Service | 6,130 | 2,839 | 8,969 | 4,412 | 554 |
| 1. Detailed Design | 2,958 | 1,385 | 4,343 | 2,136 | 268 |
| 2. Construction Supervision | 3,172 | 1,454 | 4,626 | 2,275 | 286 |
| 3. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| V. Physical Contingency; 10% of I+II+IV | 3,274 | 1,709 | 4,983 | 2,451 | 308 |
| VI. Total (I+II+III+IV+V) | 35,987 | 21,965 | 57,952 | 28,506 | 3,577 |
| VII .Value Added Tax ; 0% of VI | 0 | 0 | 0 | 0 | 0 |
| VIII.Grand Total | 35,987 | 21,965 | 57,952 | 28,506 | 3,577 |
| Grand Total (1,000 US$) | 17,701 | 10,804 | 28,505 | | |
| Grand Total (Mill.Yen) | 2,221 | 1,356 | 3,577 | | |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

## Table V.A.2 (2/4) SUMMARY OF URGENT PROJECT COST (ALTERNATIVE 2, ECONOMIC)

| Description | Amount F.C. (Mill.Rp.) | Amount L.C. (Mill.Rp.) | Amount Total (Mill.Rp.) | Total (1,000 US$) | Total (Mill.Yen) |
|---|---|---|---|---|---|
| I. Construction Base Cost | 23,822 | 17,024 | 40,846 | 20,091 | 2,521 |
| 1. Preparatory Works | 2,165 | 1,549 | 3,714 | 1,827 | 229 |
| 2. West Floodway Improvement Works | 3,310 | 1,772 | 5,082 | 2,500 | 314 |
| 3. Garang River Improvement Works | 3,580 | 2,230 | 5,810 | 2,858 | 359 |
| 4. Reconstruction of Simongan Weir | 10,293 | 6,018 | 16,311 | 8,023 | 1,007 |
| 5. Intake Structure | 1,327 | 784 | 2,111 | 1,038 | 130 |
| 6. Others | 1,176 | 3,266 | 4,442 | 2,185 | 274 |
| 7. Miscellaneous Works | 1,971 | 1,405 | 3,376 | 1,661 | 208 |
| Sub-total | 23,822 | 17,024 | 40,846 | 20,091 | 2,521 |
| 8. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 1. Administration | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 2. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| IV. Engineering Service | 5,503 | 3,466 | 8,969 | 4,412 | 554 |
| 1. Detailed Design | 2,656 | 1,687 | 4,343 | 2,136 | 268 |
| 2. Construction Supervision | 2,847 | 1,779 | 4,626 | 2,275 | 286 |
| 3. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| V. Physical Contingency; 10% of I+II+IV | 2,934 | 2,049 | 4,983 | 2,451 | 308 |
| VI. Total (I+II+III+IV+V) | 32,259 | 25,693 | 57,952 | 28,506 | 3,577 |
| VII .Value Added Tax ; 0% of VI | 0 | 0 | 0 | 0 | 0 |
| VIII.Grand Total | 32,259 | 25,693 | 57,952 | 28,506 | 3,577 |
| Grand Total (1,000 US$) | 15,868 | 12,638 | 28,506 | | |
| Grand Total (Mill.Yen) | 1,991 | 1,586 | 3,577 | | |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

## Table V.A.2 (3/4) SUMMARY OF URGENT PROJECT COST (ALTERNATIVE 3, ECONOMIC)

| Description | Amount F.C. (Mill.Rp.) | Amount L.C. (Mill.Rp.) | Amount Total (Mill.Rp.) | Total (1,000 US$) | Total (Mill.Yen) |
|---|---|---|---|---|---|
| I. Construction Base Cost | 20,910 | 19,936 | 40,846 | 20,091 | 2,521 |
| 1. Preparatory Works | 1,901 | 1,813 | 3,714 | 1,827 | 229 |
| 2. West Floodway Improvement Works | 954 | 4,128 | 5,082 | 2,500 | 314 |
| 3. Garang River Improvement Works | 3,529 | 2,281 | 5,810 | 2,858 | 359 |
| 4. Reconstruction of Simongan Weir | 10,293 | 6,018 | 16,311 | 8,023 | 1,007 |
| 5. Intake Structure | 1,327 | 784 | 2,111 | 1,038 | 130 |
| 6. Others | 1,176 | 3,266 | 4,442 | 2,185 | 274 |
| 7. Miscellaneous Works | 1,730 | 1,646 | 3,376 | 1,661 | 208 |
| Sub-total | 20,910 | 19,936 | 40,846 | 20,091 | 2,521 |
| 8. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 1. Administration | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 2. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| IV. Engineering Service | 4,866 | 4,103 | 8,969 | 4,412 | 554 |
| 1. Detailed Design | 2,348 | 1,995 | 4,343 | 2,136 | 268 |
| 2. Construction Supervision | 2,518 | 2,108 | 4,626 | 2,275 | 286 |
| 3. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| V. Physical Contingency; 10% of I+II+IV | 2,577 | 2,406 | 4,983 | 2,451 | 308 |
| VI. Total (I+II+III+IV+V) | 28,353 | 29,599 | 57,952 | 28,506 | 3,577 |
| VII .Value Added Tax ; 0% of VI | 0 | 0 | 0 | 0 | 0 |
| VIII.Grand Total | 28,353 | 29,599 | 57,952 | 28,506 | 3,577 |
| Grand Total (1,000 US$) | 13,946 | 14,559 | 28,505 | | |
| Grand Total (Mill.Yen) | 1,750 | 1,827 | 3,577 | | |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

## Table V.A.2 (4/4) SUMMARY OF URGENT PROJECT COST (ALTERNATIVE 4, ECONOMIC)

| Description | Amount F.C. (Mill.Rp.) | Amount L.C. (Mill.Rp.) | Amount Total (Mill.Rp.) | Total (1,000 US$) | Total (Mill.Yen) |
|---|---|---|---|---|---|
| I. Construction Base Cost | 18,331 | 22,515 | 40,846 | 20,091 | 2,521 |
| 1. Preparatory Works | 1,666 | 2,048 | 3,714 | 1,827 | 229 |
| 2. West Floodway Improvement Works | 0 | 5,082 | 5,082 | 2,500 | 314 |
| 3. Garang River Improvement Works | 3,529 | 2,281 | 5,810 | 2,858 | 359 |
| 4. Reconstruction of Simongan Weir | 10,293 | 6,018 | 16,311 | 8,023 | 1,007 |
| 5. Intake Structure | 1,327 | 784 | 2,111 | 1,038 | 130 |
| 6. Others | 0 | 4,442 | 4,442 | 2,185 | 274 |
| 7. Miscellaneous Works | 1,516 | 1,860 | 3,376 | 1,661 | 208 |
| Sub-total | 18,331 | 22,515 | 40,846 | 20,091 | 2,521 |
| 8. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 1. Administration | 0 | 3,154 | 3,154 | 1,551 | 195 |
| 2. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| IV. Engineering Service | 4,227 | 4,742 | 8,969 | 4,412 | 554 |
| 1. Detailed Design | 2,040 | 2,303 | 4,343 | 2,136 | 268 |
| 2. Construction Supervision | 2,187 | 2,439 | 4,626 | 2,275 | 286 |
| 3. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 |
| V. Physical Contingency; 10% of I+II+IV | 2,257 | 2,726 | 4,983 | 2,451 | 308 |
| VI. Total (I+II+III+IV+V) | 24,815 | 33,137 | 57,952 | 28,506 | 3,577 |
| VII .Value Added Tax ; 0% of VI | 0 | 0 | 0 | 0 | 0 |
| VIII.Grand Total | 24,815 | 33,137 | 57,952 | 28,506 | 3,577 |
| Grand Total (1,000 US$) | 12,206 | 16,300 | 28,506 | | |
| Grand Total (Mill.Yen) | 1,532 | 2,045 | 3,577 | | |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

Table V.A.3 BREAKDOWN OF CONSTRUCTION BASE COST FOR URGENT PROJECT (FINANCIAL)

| Item | | Quantity | | Unit Price F.C. (1,000Rp.) | Unit Price L.C. (1,000Rp.) | Amount F.C. (Mill.Rp.) | Amount L.C. (Mill.Rp.) | Amount Total (Mill.Rp.) |
|---|---|---|---|---|---|---|---|---|
| 1.Preparatory Works | | | | | | 2,659 | 1,436 | 4,095 |
| 2.West Floodway Improvement Works | | | | | | 3,904 | 1,687 | 5,591 |
| (1) Excavation; | Common 1-F | 339,000 | m3 | 4.6 | 1.2 | 1,559 | 407 | 1,966 |
| | Common 2-F | 226,000 | m3 | 5.3 | 1.4 | 1,198 | 316 | 1,514 |
| | River Mouth | 98,000 | m3 | 6.4 | 1.9 | 627 | 186 | 813 |
| (2) Retaining Wall; | Type B | 3,000 | m | 87.0 | 144.0 | 261 | 432 | 693 |
| (3) Revetment; | Type A | 6,580 | m2 | 26.4 | 35.9 | 174 | 236 | 410 |
| | Type B | 3,020 | m2 | 28.0 | 36.4 | 85 | 110 | 195 |
| 3.Garang River Improvement Works | | | | | | 3,940 | 2,474 | 6,414 |
| (1) Excavation; | Common 1-G | 276,800 | m3 | 6.7 | 1.8 | 1,855 | 498 | 2,353 |
| | Common 1-EM | 10,200 | m3 | 3.8 | 1.0 | 39 | 10 | 49 |
| | Common 2-G | 72,000 | m3 | 7.4 | 2.0 | 533 | 144 | 677 |
| (2) Embankment | | 10,200 | m3 | 2.0 | 0.6 | 20 | 6 | 26 |
| (3) Revetment; | Type A | 2,110 | m2 | 26.4 | 35.9 | 56 | 76 | 132 |
| | Type B | 32,200 | m2 | 28.0 | 36.4 | 902 | 1,172 | 2,074 |
| (4) Sodding | | 3,880 | m2 | 0.1 | 1.0 | 0 | 4 | 4 |
| (5) Groundsill; | Type A | 1,040 | m3 | 335.0 | 344.0 | 348 | 358 | 706 |
| | Type B | 110 | m3 | 352.0 | 388.0 | 39 | 43 | 82 |
| | Type C | 30 | m3 | 352.0 | 388.0 | 11 | 12 | 23 |
| | Type D | 390 | m3 | 352.0 | 388.0 | 137 | 151 | 288 |
| 4.Reconstruction of Simongan Weir | | | | | | 11,330 | 6,681 | 18,011 |
| (1) Diversion Works & Dewatering | | 1 | LS | 166,000.0 | 158,000.0 | 166 | 158 | 324 |
| (2) Demolition | | 12,000 | m3 | 19.5 | 7.1 | 234 | 85 | 319 |
| (3) Excavation; | Common 2-G | 6,710 | m3 | 7.4 | 2.0 | 50 | 13 | 63 |
| (4) Revetment; | Type C | 1,110 | m2 | 41.3 | 58.8 | 46 | 65 | 111 |
| (5) Sodding | | 570 | m2 | 0.1 | 1.0 | 0 | 1 | 1 |
| (6) Reinforced Concrete | | 6,790 | m3 | 254.0 | 254.0 | 1,725 | 1,725 | 3,450 |
| (7) Foundation Pile; | D=500mm,L=12m | 216 | pc | 810.0 | 700.0 | 175 | 151 | 326 |
| | D=400mm,L=12m | 135 | pc | 565.0 | 465.0 | 76 | 63 | 139 |
| | D=350mm,L=12m | 480 | pc | 466.0 | 376.0 | 224 | 180 | 404 |
| (8) Sheet Pile; | t=0.2m | 1,380 | m2 | 109.0 | 92.0 | 150 | 127 | 277 |
| (9) Main Gate 1 | | 236 | m2 | 25,200.0 | 10,800.0 | 5,947 | 2,549 | 8,496 |
| (10)Main Gate 2 | | 54 | m2 | 26,600.0 | 11,400.0 | 1,436 | 616 | 2,052 |
| (11)Retaining Wall; | Type C | 80 | m | 3,800.0 | 2,970.0 | 304 | 238 | 542 |
| (12)Concrete Block; | t=0.5m | 2,830 | m2 | 24.7 | 52.5 | 70 | 149 | 219 |
| (13)Gabion Mattress; | t=0.5m | 2,020 | m2 | 12.8 | 17.8 | 26 | 36 | 62 |
| (14)Bridge | | 1,040 | m2 | 210.0 | 210.0 | 218 | 218 | 436 |
| (15)Control House & Gate House | | 1 | LS | 28,000.0 | 112,000.0 | 28 | 112 | 140 |
| (16)Steel Stop Log | | 1 | LS | 455,000.0 | 195,000.0 | 455 | 195 | 650 |
| 5.Intake Structure | | | | | | 1,465 | 869 | 2,334 |
| (1) Demolition | | 350 | m3 | 19.5 | 7.1 | 7 | 2 | 9 |
| (2) Excavation; | Common 2 | 150 | m3 | 7.4 | 2.0 | 1 | 0 | 1 |
| (3) Reinforced Concrete | | 510 | m3 | 254.0 | 254.0 | 130 | 130 | 260 |
| (4) Foundation Pile; | D=350mm,L=12m | 60 | pc | 466.0 | 376.0 | 28 | 23 | 51 |
| (5) Sheet Pile; | t=0.2m | 240 | m2 | 109.0 | 92.0 | 26 | 22 | 48 |
| (6) Gate | | 30 | m2 | 29,400.0 | 12,600.0 | 882 | 378 | 1,260 |
| (7) Retaining Wall; | Type C | 55 | m | 3,800.0 | 2,970.0 | 209 | 163 | 372 |
| | Type D | 80 | m | 2,270.0 | 1,890.0 | 182 | 151 | 333 |
| 6.Others | | | | | | 3,536 | 1,344 | 4,880 |
| (1) Railroad Bridge | | 1 | LS | 1,290,000.0 | 477,000.0 | 1,290 | 477 | 1,767 |
| (2) Retaining Wall for PDAM; | Type E | 200 | m | 3,230.0 | 3,020.0 | 646 | 604 | 1,250 |
| (3) Flap Gate; | 1.0m x 1.0m | 2 | pc | 24,300.0 | 7,000.0 | 49 | 14 | 63 |
| | 1.5m x 1.5m | 0 | pc | 64,600.0 | 8,900.0 | 0 | 0 | 0 |
| | 2.0m x 2.0m | 14 | pc | 110,800.0 | 17,800.0 | 1,551 | 249 | 1,800 |
| 7.Miscellaneous Works | | | | | | 2,418 | 1,306 | 3,724 |
| Total | | | | | | 29,252 | 15,797 | 45,049 |

# Table V.A.4 BREAKDOWN OF CONSTRUCTION BASE COST FOR URGENT PROJECT (ECONOMIC)

| Item | | Quantity | | Unit Price F.C. (1,000Rp.) | Unit Price L.C. (1,000Rp.) | Amount F.C. (Mill.Rp.) | Amount L.C. (Mill.Rp.) | Amount Total (Mill.Rp.) |
|---|---|---|---|---|---|---|---|---|
| 1.Preparatory Works | | | | | | 2,417 | 1,297 | 3,714 |
| 2.West Floodway Improvement Works | | | | | | 3,548 | 1,534 | 5,082 |
| (1) Excavation; | Common 1-F | 339,000 | m3 | 4.2 | 1.1 | 1,424 | 373 | 1,797 |
| | Common 2-F | 226,000 | m3 | 4.8 | 1.3 | 1,085 | 294 | 1,379 |
| | River Mouth | 98,000 | m3 | 5.8 | 1.7 | 568 | 167 | 735 |
| (2) Retaining Wall; | Type B | 3,000 | m | 79.0 | 130.0 | 237 | 390 | 627 |
| (3) Revetment; | Type A | 6,580 | m2 | 23.9 | 32.2 | 157 | 212 | 369 |
| | Type B | 3,020 | m2 | 25.5 | 32.5 | 77 | 98 | 175 |
| 3.Garang River Improvement Works | | | | | | 3,580 | 2,230 | 5,810 |
| (1) Excavation; | Common 1-G | 276,800 | m3 | 6.1 | 1.7 | 1,688 | 471 | 2,159 |
| | Common 1-EM | 10,200 | m3 | 3.5 | 0.9 | 36 | 9 | 45 |
| | Common 2-G | 72,000 | m3 | 6.7 | 1.8 | 482 | 130 | 612 |
| (2) Embankment | | 10,200 | m3 | 1.8 | 0.5 | 18 | 5 | 23 |
| (3) Revetment; | Type A | 2,110 | m2 | 23.9 | 32.2 | 50 | 68 | 118 |
| | Type B | 32,200 | m2 | 25.5 | 32.5 | 821 | 1,047 | 1,868 |
| (4) Sodding | | 3,880 | m2 | 0.1 | 0.8 | 0 | 3 | 3 |
| (5) Groundsill; | Type A | 1,040 | m3 | 304.0 | 306.0 | 316 | 318 | 634 |
| | Type B | 110 | m3 | 319.0 | 338.0 | 35 | 37 | 72 |
| | Type C | 30 | m3 | 319.0 | 338.0 | 10 | 10 | 20 |
| | Type D | 390 | m3 | 319.0 | 338.0 | 124 | 132 | 256 |
| 4.Reconstruction of Simongan Weir | | | | | | 10,293 | 6,018 | 16,311 |
| (1) Diversion Works & Dewatering | | 1 | LS | 151,000.0 | 141,000.0 | 151 | 141 | 292 |
| (2) Demolition | | 12,000 | m3 | 17.8 | 6.3 | 214 | 76 | 290 |
| (3) Excavation; | Common 2-G | 6,710 | m3 | 6.7 | 1.8 | 45 | 12 | 57 |
| (4) Revetment; | Type C | 1,110 | m2 | 37.5 | 53.0 | 42 | 59 | 101 |
| (5) Sodding | | 570 | m2 | 0.1 | 0.8 | 0 | 0 | 0 |
| (6) Reinforced Concrete | | 6,790 | m3 | 230.0 | 225.0 | 1,562 | 1,528 | 3,090 |
| (7) Foundation Pile; | D=500mm,L=12m | 216 | pc | 740.0 | 640.0 | 160 | 138 | 298 |
| | D=400mm,L=12m | 135 | pc | 511.0 | 420.0 | 69 | 57 | 126 |
| | D=350mm,L=12m | 480 | pc | 423.0 | 340.0 | 203 | 163 | 366 |
| (8) Sheet Pile; | t=0.2m | 1,380 | m2 | 99.0 | 84.0 | 137 | 116 | 253 |
| (9) Main Gate 1 | | 236 | m2 | 22,900.0 | 9,800.0 | 5,404 | 2,313 | 7,717 |
| (10)Main Gate 2 | | 54 | m2 | 24,200.0 | 10,400.0 | 1,307 | 562 | 1,869 |
| (11)Retaining Wall; | Type C | 80 | m | 3,430.0 | 2,660.0 | 274 | 213 | 487 |
| (12)Concrete Block; | t=0.5m | 2,830 | m2 | 22.7 | 46.7 | 64 | 132 | 196 |
| (13)Gabion Mattress; | t=0.5m | 2,020 | m2 | 11.6 | 15.2 | 23 | 31 | 54 |
| (14)Bridge | | 1,040 | m2 | 190.0 | 190.0 | 198 | 198 | 396 |
| (15)Control House & Gate House | | 1 | LS | 25,500.0 | 101,800.0 | 26 | 102 | 128 |
| (16)Steel Stop Log | | 1 | LS | 414,000.0 | 177,000.0 | 414 | 177 | 591 |
| 5.Intake Structure | | | | | | 1,327 | 784 | 2,111 |
| (1) Demolition | | 350 | m3 | 17.8 | 6.3 | 6 | 2 | 8 |
| (2) Excavation; | Common 2 | 150 | m3 | 6.7 | 1.8 | 1 | 0 | 1 |
| (3) Reinforced Concrete | | 510 | m3 | 230.0 | 225.0 | 117 | 115 | 232 |
| (4) Foundation Pile; | D=350mm,L=12m | 60 | pc | 423.0 | 340.0 | 25 | 20 | 45 |
| (5) Sheet Pile; | t=0.2m | 240 | m2 | 99.0 | 84.0 | 24 | 20 | 44 |
| (6) Gate | | 30 | m2 | 26,700.0 | 11,500.0 | 801 | 345 | 1,146 |
| (7) Retaining Wall; | Type C | 55 | m | 3,430.0 | 2,660.0 | 189 | 146 | 335 |
| | Type D | 80 | m | 2,050.0 | 1,700.0 | 164 | 136 | 300 |
| 6.Others | | | | | | 3,221 | 1,221 | 4,442 |
| (1) Railroad Bridge | | 1 | LS | 1,176,000.0 | 434,000.0 | 1,176 | 434 | 1,610 |
| (2) Retaining Wall for PDAM; | Type E | 200 | m | 2,920.0 | 2,740.0 | 584 | 548 | 1,132 |
| (3) Flap Gate; | 1.0m x 1.0m | 2 | pc | 22,100.0 | 6,200.0 | 44 | 12 | 56 |
| | 1.5m x 1.5m | 0 | pc | 58,700.0 | 8,000.0 | 0 | 0 | 0 |
| | 2.0m x 2.0m | 14 | pc | 101,200.0 | 16,200.0 | 1,417 | 227 | 1,644 |
| 7.Miscellaneous Works | | | | | | 2,197 | 1,179 | 3,376 |
| Total | | | | | | 26,583 | 14,263 | 40,846 |

# Table V.A.5 (1/4) ANNUAL DISBURSEMENT SCHEDULE (ALTERNATIVE 1, FINANCIAL)

Unit: Million Rp.

| Description | Amount | | | 1994/1995 | | 1995/1996 | | 1996/1997 | | 1997/1998 | | 1998/1999 | | 1999/2000 | | 2000/2001 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F.C. | L.C. | Total | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. |
| I. Construction Base Cost | 34,700 | 24,646 | 59,346 | 0 | 0 | 0 | 0 | 0 | 0 | 14,011 | 9,457 | 14,075 | 10,680 | 6,614 | 4,509 | 0 | 0 |
| 1. Preparatory Works | 2,659 | 1,436 | 4,095 | 0 | 0 | 0 | 0 | 0 | 0 | 1,330 | 718 | 1,329 | 718 | 0 | 0 | 0 | 0 |
| 2. West Floodway Improvement Works | 3,904 | 1,687 | 5,591 | 0 | 0 | 0 | 0 | 0 | 0 | 2,787 | 1,180 | 1,117 | 507 | 0 | 0 | 0 | 0 |
| 3. Garang River Improvement Works | 3,940 | 2,474 | 6,414 | 0 | 0 | 0 | 0 | 0 | 0 | 797 | 359 | 2,689 | 1,784 | 454 | 331 | 0 | 0 |
| 4. Reconstruction of Simongan Weir | 11,330 | 6,681 | 18,011 | 0 | 0 | 0 | 0 | 0 | 0 | 4,898 | 2,849 | 5,500 | 3,147 | 932 | 685 | 0 | 0 |
| 5. Intake Structure | 1,465 | 869 | 2,334 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 1,424 | 830 | 0 | 0 |
| 6. Others | 3,536 | 1,344 | 4,880 | 0 | 0 | 0 | 0 | 0 | 0 | 1,549 | 938 | 387 | 143 | 1,600 | 263 | 0 | 0 |
| 7. Miscellaneous Works | 2,418 | 1,306 | 3,724 | 0 | 0 | 0 | 0 | 0 | 0 | 725 | 392 | 725 | 392 | 968 | 522 | 0 | 0 |
| Sub-total | 29,252 | 15,797 | 45,049 | 0 | 0 | 0 | 0 | 0 | 0 | 12,086 | 6,436 | 11,788 | 6,730 | 5,378 | 2,631 | 0 | 0 |
| 8. Price Contingency ; F.C.3% & L.C.8% | 5,448 | 8,849 | 14,297 | 0 | 0 | 0 | 0 | 0 | 0 | 1,925 | 3,021 | 2,287 | 3,950 | 1,236 | 1,878 | 0 | 0 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 4,924 | 4,924 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,906 | 0 | 2,057 | 0 | 961 | 0 | 0 |
| 1. Administration | 0 | 3,154 | 3,154 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,297 | 0 | 1,296 | 0 | 561 | 0 | 0 |
| 2. Price Contingency ; F.C.3% & L.C.8% | 0 | 1,770 | 1,770 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 609 | 0 | 761 | 0 | 400 | 0 | 0 |
| IV. Engineering Service | 6,948 | 3,950 | 10,898 | 1,569 | 807 | 1,616 | 873 | 0 | 0 | 1,512 | 879 | 1,557 | 949 | 694 | 442 | 0 | 0 |
| 1. Detailed Design | 2,958 | 1,385 | 4,343 | 1,479 | 692 | 1,479 | 693 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Construction Supervision | 3,172 | 1,454 | 4,626 | 0 | 0 | 0 | 0 | 0 | 0 | 1,304 | 598 | 1,304 | 598 | 564 | 258 | 0 | 0 |
| 3. Price Contingency ; F.C.3% & L.C.8% | 818 | 1,111 | 1,929 | 90 | 115 | 137 | 180 | 0 | 0 | 208 | 281 | 253 | 351 | 130 | 184 | 0 | 0 |
| V. Physical Contingency ; 10% of I+II+IV | 4,165 | 2,860 | 7,025 | 157 | 81 | 162 | 87 | 0 | 0 | 1,552 | 1,034 | 1,563 | 1,163 | 731 | 495 | 0 | 0 |
| VI. Total (I+II+III+IV+V) | 45,813 | 36,380 | 82,193 | 1,726 | 888 | 1,778 | 960 | 0 | 0 | 17,075 | 13,276 | 17,195 | 14,849 | 8,039 | 6,407 | 0 | 0 |
| VII .Value Added Tax ; 10% of VI | 0 | 8,219 | 8,219 | 0 | 261 | 0 | 274 | 0 | 0 | 0 | 3,035 | 0 | 3,204 | 0 | 1,445 | 0 | 0 |
| VIII.Grand Total | 45,813 | 44,599 | 90,412 | 1,726 | 1,149 | 1,778 | 1,234 | 0 | 0 | 17,075 | 16,311 | 17,195 | 18,053 | 8,039 | 7,852 | 0 | 0 |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

# Table V.A.5 (2/4) ANNUAL DISBURSEMENT SCHEDULE (ALTERNATIVE 2, FINANCIAL)

Unit: Million Rp.

| Description | Amount | | | 1994/1995 | | 1995/1996 | | 1996/1997 | | 1997/1998 | | 1998/1999 | | 1999/2000 | | 2000/2001 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F.C. | L.C. | Total | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. |
| I. Construction Base Cost | 31,005 | 27,438 | 58,443 | 0 | 1,681 | 0 | 1,737 | 0 | 1,877 | 13,584 | 8,499 | 13,795 | 10,264 | 3,626 | 3,380 | 0 | 0 |
| 1. Preparatory Works | 2,383 | 1,712 | 4,095 | 0 | 137 | 0 | 142 | 0 | 140 | 1,192 | 646 | 1,191 | 647 | 0 | 0 | 0 | 0 |
| 2. West Floodway Improvement Works | 3,643 | 1,948 | 5,591 | 0 | 0 | 0 | 0 | 0 | 693 | 2,613 | 892 | 1,030 | 363 | 0 | 0 | 0 | 0 |
| 3. Garang River Improvement Works | 3,940 | 2,474 | 6,414 | 0 | 0 | 0 | 0 | 0 | 0 | 1,010 | 416 | 2,699 | 1,785 | 231 | 273 | 0 | 0 |
| 4. Reconstruction of Simongan Weir | 11,330 | 6,681 | 18,011 | 0 | 0 | 0 | 0 | 0 | 0 | 5,350 | 3,143 | 5,261 | 3,012 | 719 | 525 | 0 | 0 |
| 5. Intake Structure | 1,465 | 869 | 2,334 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 335 | 165 | 1,130 | 704 | 0 | 0 |
| 6. Others | 1,290 | 3,590 | 4,880 | 0 | 1,250 | 0 | 1,286 | 0 | 577 | 903 | 334 | 387 | 143 | 0 | 0 | 0 | 0 |
| 7. Miscellaneous Works | 2,168 | 1,556 | 3,724 | 0 | 125 | 0 | 129 | 0 | 127 | 650 | 353 | 650 | 353 | 868 | 469 | 0 | 0 |
| Sub-total | 26,219 | 18,830 | 45,049 | 0 | 1,512 | 0 | 1,557 | 0 | 1,537 | 11,718 | 5,784 | 11,553 | 6,468 | 2,948 | 1,972 | 0 | 0 |
| 8. Price Contingency ; F.C.3% & L.C.8% | 4,786 | 8,608 | 13,394 | 0 | 169 | 0 | 180 | 0 | 340 | 1,866 | 2,715 | 2,242 | 3,796 | 678 | 1,408 | 0 | 0 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 4,800 | 4,800 | 0 | 124 | 0 | 137 | 0 | 147 | 0 | 1,801 | 0 | 2,001 | 0 | 590 | 0 | 0 |
| 1. Administration | 0 | 3,154 | 3,154 | 0 | 106 | 0 | 109 | 0 | 108 | 0 | 1,226 | 0 | 1,261 | 0 | 344 | 0 | 0 |
| 2. Price Contingency ; F.C.3% & L.C.8% | 0 | 1,646 | 1,646 | 0 | 18 | 0 | 28 | 0 | 39 | 0 | 575 | 0 | 740 | 0 | 246 | 0 | 0 |
| IV. Engineering Service | 6,229 | 4,663 | 10,892 | 1,409 | 1,250 | 1,451 | 1,172 | 0 | 215 | 1,428 | 830 | 1,515 | 924 | 426 | 272 | 0 | 0 |
| 1. Detailed Design | 2,656 | 1,687 | 4,343 | 1328 | 917 | 1,328 | 770 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Construction Supervision | 2,847 | 1,779 | 4,626 | 0 | 155 | 0 | 160 | 0 | 158 | 1,232 | 565 | 1,269 | 582 | 346 | 159 | 0 | 0 |
| 3. Price Contingency ; F.C.3% & L.C.8% | 726 | 1,197 | 1,923 | 81 | 178 | 123 | 242 | 0 | 57 | 196 | 265 | 246 | 342 | 80 | 113 | 0 | 0 |
| V. Physical Contingency ; 10% of I+II+IV | 3,723 | 3,210 | 6,933 | 141 | 293 | 145 | 291 | 0 | 209 | 1,501 | 933 | 1,531 | 1,119 | 405 | 365 | 0 | 0 |
| VI. Total (I+II+III+IV+V) | 40,957 | 40,111 | 81,068 | 1,550 | 3,348 | 1,596 | 3,337 | 0 | 2,448 | 16,513 | 12,063 | 16,841 | 14,308 | 4,457 | 4,607 | 0 | 0 |
| VII .Value Added Tax ; 10% of VI | 0 | 8,107 | 8,107 | 0 | 490 | 0 | 493 | 0 | 245 | 0 | 2,858 | 0 | 3,115 | 0 | 906 | 0 | 0 |
| VIII.Grand Total | 40,957 | 48,218 | 89,175 | 1,550 | 3,838 | 1,596 | 3,830 | 0 | 2,693 | 16,513 | 14,921 | 16,841 | 17,423 | 4,457 | 5,513 | 0 | 0 |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

# Table V.A.5 (3/4) ANNUAL DISBURSEMENT SCHEDULE (ALTERNATIVE 3, FINANCIAL)

Unit: Million Rp.

| Description | Amount | | | 1994/1995 | | 1995/1996 | | 1996/1997 | | 1997/1998 | | 1998/1999 | | 1999/2000 | | 2000/2001 | | 2001/2002 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F.C. | L.C. | Total | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. |
| I. Construction Base Cost | 28,740 | 34,415 | 63,155 | 0 | 1,681 | 0 | 1,737 | 0 | 1,877 | 0 | 1,829 | 0 | 1,244 | 0 | 2,137 | 13,741 | 10,256 | 14,999 | 13,654 |
| 1. Preparatory Works | 2,092 | 2,003 | 4,095 | 0 | 137 | 0 | 142 | 0 | 140 | 0 | 136 | 0 | 88 | 0 | 145 | 1,255 | 729 | 837 | 486 |
| 2. West Floodway Improvement Works | 1,053 | 4,538 | 5,591 | 0 | 0 | 0 | 0 | 0 | 693 | 0 | 1,160 | 0 | 806 | 0 | 1,322 | 756 | 388 | 297 | 169 |
| 3. Garang River Improvement Works | 3,881 | 2,533 | 6,414 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 75 | 0 | 0 | 0 | 0 | 1,253 | 581 | 2,628 | 1,877 |
| 4. Reconstruction of Simongan Weir | 11,330 | 6,681 | 18,011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,761 | 3,275 | 5,569 | 3,406 |
| 5. Intake Structure | 1,465 | 869 | 2,334 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 294 | 126 | 1,171 | 743 |
| 6. Others | 1,290 | 3,590 | 4,880 | 0 | 1,250 | 0 | 1,286 | 0 | 577 | 0 | 0 | 0 | 0 | 0 | 0 | 903 | 334 | 387 | 143 |
| 7. Miscellaneous Works | 1,902 | 1,822 | 3,724 | 0 | 125 | 0 | 129 | 0 | 127 | 0 | 124 | 0 | 81 | 0 | 132 | 951 | 551 | 951 | 553 |
| Sub-total | 23,013 | 22,036 | 45,049 | 0 | 1,512 | 0 | 1,557 | 0 | 1,537 | 0 | 1,495 | 0 | 975 | 0 | 1,599 | 11,173 | 5,984 | 11,840 | 7,377 |
| 8. Price Contingency ; F.C.3% & L.C.8% | 5,727 | 12,379 | 18,106 | 0 | 169 | 0 | 180 | 0 | 340 | 0 | 334 | 0 | 269 | 0 | 538 | 2,568 | 4,272 | 3,159 | 6,277 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 5,774 | 5,774 | 0 | 124 | 0 | 137 | 0 | 147 | 0 | 154 | 0 | 108 | 0 | 192 | 0 | 2,223 | 0 | 2,689 |
| 1. Administration | 0 | 3,154 | 3,154 | 0 | 106 | 0 | 109 | 0 | 108 | 0 | 105 | 0 | 68 | 0 | 112 | 0 | 1,201 | 0 | 1,345 |
| 2. Price Contingency ; F.C.3% & L.C.8% | 0 | 2,620 | 2,620 | 0 | 18 | 0 | 28 | 0 | 39 | 0 | 49 | 0 | 40 | 0 | 80 | 0 | 1,022 | 0 | 1,344 |
| IV. Engineering Service | 6,105 | 6,348 | 12,453 | 0 | 525 | 0 | 388 | 0 | 411 | 1,384 | 1,187 | 1,426 | 1,290 | 0 | 283 | 1,530 | 1,025 | 1,765 | 1,239 |
| 1. Detailed Design | 2,388 | 1,955 | 4,343 | 0 | 295 | 0 | 148 | 0 | 144 | 1,194 | 655 | 1,194 | 713 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Construction Supervision | 2,561 | 2,065 | 4,626 | 0 | 155 | 0 | 160 | 0 | 158 | 0 | 153 | 0 | 100 | 0 | 165 | 1,208 | 554 | 1,353 | 620 |
| 3. Price Contingency ; F.C.3% & L.C.8% | 1,156 | 2,328 | 3,484 | 0 | 75 | 0 | 80 | 0 | 109 | 190 | 379 | 232 | 477 | 0 | 118 | 322 | 471 | 412 | 619 |
| V. Physical Contingency ; 10% of I+II+IV | 3,484 | 4,077 | 7,561 | 0 | 221 | 0 | 213 | 0 | 229 | 138 | 302 | 143 | 253 | 0 | 242 | 1,527 | 1,128 | 1,676 | 1,489 |
| VI. Total (I+II+III+IV+V) | 38,329 | 50,614 | 88,943 | 0 | 2,551 | 0 | 2,475 | 0 | 2,664 | 1,522 | 3,472 | 1,569 | 2,895 | 0 | 2,854 | 16,798 | 14,632 | 18,440 | 19,071 |
| VII .Value Added Tax ; 10% of VI | 0 | 8,893 | 8,893 | 0 | 255 | 0 | 248 | 0 | 266 | 0 | 499 | 0 | 445 | 0 | 285 | 0 | 3,143 | 0 | 3,751 |
| VIII.Grand Total | 38,329 | 59,507 | 97,836 | 0 | 2,806 | 0 | 2,723 | 0 | 2,930 | 1,522 | 3,971 | 1,569 | 3,341 | 0 | 3,139 | 16,798 | 17,775 | 18,440 | 22,822 |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

# Table V.A.5 (4/4) ANNUAL DISBURSEMENT SCHEDULE (ALTERNATIVE 4, FINANCIAL)

Unit: Million Rp.

| Description | Amount | | | 1994/1995 | | 1995/1996 | | 1996/1997 | | 1997/1998 | | 1998/1999 | | 1999/2000 | | 2000/2001 | | 2001/2002 | | 2002/2003 | | 2003/2004 | | 2004/2005 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F.C. | L.C. | Total | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. |
| I. Construction Base Cost | 25,219 | 38,383 | 63,602 | 0 | 1,681 | 0 | 1,737 | 0 | 1,877 | 0 | 1,829 | 0 | 1,244 | 0 | 2,137 | 0 | 2,223 | 0 | 2,366 | 0 | 1,585 | 11,356 | 8,812 | 13,853 | 12,892 |
| 1. Preparatory Works | 1,834 | 2,261 | 4,095 | 0 | 137 | 0 | 142 | 0 | 140 | 0 | 136 | 0 | 88 | 0 | 145 | 0 | 140 | 0 | 144 | 0 | 89 | 1,100 | 661 | 734 | 439 |
| 2. West Floodway Improvement Works | 0 | 5,591 | 5,591 | 0 | 0 | 0 | 0 | 0 | 693 | 0 | 1,160 | 0 | 806 | 0 | 1,322 | 0 | 564 | 0 | 241 | 0 | 805 | 0 | 0 | 0 | 0 |
| 3. Garang River Improvement Works | 3,881 | 2,533 | 6,414 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,253 | 581 | 2,628 | 1,877 |
| 4. Reconstruction of Simongan Weir | 11,330 | 6,681 | 18,011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,761 | 3,275 | 5,569 | 3,406 |
| 5. Intake Structure | 1,465 | 869 | 2,334 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 294 | 126 | 1,171 | 743 |
| 6. Others | 0 | 4,880 | 4,880 | 0 | 1,250 | 0 | 1,286 | 0 | 577 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 707 | 0 | 1,060 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7. Miscellaneous Works | 1,668 | 2,056 | 3,724 | 0 | 125 | 0 | 129 | 0 | 127 | 0 | 124 | 0 | 81 | 0 | 132 | 0 | 128 | 0 | 130 | 0 | 81 | 834 | 499 | 834 | 500 |
| Sub-total | 20,178 | 24,871 | 45,049 | 0 | 1,512 | 0 | 1,557 | 0 | 1,537 | 0 | 1,495 | 0 | 975 | 0 | 1,599 | 0 | 1,539 | 0 | 1,575 | 0 | 975 | 9,242 | 5,142 | 10,936 | 6,965 |
| 8. Price Contingency | 5,041 | 13,512 | 18,553 | 0 | 169 | 0 | 180 | 0 | 340 | 0 | 334 | 0 | 269 | 0 | 538 | 0 | 664 | 0 | 791 | 0 | 610 | 2,124 | 3,670 | 2,917 | 5,927 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 6,932 | 6,932 | 0 | 124 | 0 | 137 | 0 | 147 | 0 | 154 | 0 | 108 | 0 | 192 | 0 | 200 | 0 | 220 | 0 | 147 | 0 | 2,348 | 0 | 3,155 |
| 1. Administration | 0 | 3,154 | 3,154 | 0 | 106 | 0 | 109 | 0 | 108 | 0 | 105 | 0 | 68 | 0 | 112 | 0 | 108 | 0 | 110 | 0 | 68 | 0 | 1,007 | 0 | 1,253 |
| 2. Price Contingency | 0 | 3,778 | 3,778 | 0 | 18 | 0 | 28 | 0 | 39 | 0 | 49 | 0 | 40 | 0 | 80 | 0 | 92 | 0 | 110 | 0 | 79 | 0 | 1,341 | 0 | 1,902 |
| IV. Engineering Service | 5,926 | 8,377 | 14,303 | 0 | 525 | 0 | 388 | 0 | 411 | 0 | 363 | 0 | 403 | 0 | 536 | 1,343 | 1,490 | 1,383 | 1,507 | 0 | 216 | 1,402 | 1,082 | 1,798 | 1,456 |
| 1. Detailed Design | 2,120 | 2,223 | 4,343 | 0 | 295 | 0 | 148 | 0 | 144 | 0 | 94 | 0 | 154 | 0 | 148 | 1,060 | 647 | 1,060 | 593 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Construction Supervision | 2,274 | 2,352 | 4,626 | 0 | 155 | 0 | 160 | 0 | 158 | 0 | 153 | 0 | 100 | 0 | 165 | 0 | 158 | 0 | 161 | 0 | 100 | 1,013 | 464 | 1,261 | 578 |
| 3. Price Contingency | 1,532 | 3,802 | 5,334 | 0 | 75 | 0 | 80 | 0 | 109 | 0 | 116 | 0 | 149 | 0 | 223 | 283 | 685 | 323 | 753 | 0 | 116 | 389 | 618 | 537 | 878 |
| V. Physical Contingency | 3,114 | 4,676 | 7,790 | 0 | 221 | 0 | 213 | 0 | 229 | 0 | 219 | 0 | 165 | 0 | 267 | 134 | 371 | 138 | 387 | 0 | 180 | 1,277 | 989 | 1,565 | 1,435 |
| VI. Total (I+II+III+IV+V) | 34,259 | 58,368 | 92,627 | 0 | 2,551 | 0 | 2,475 | 0 | 2,664 | 0 | 2,565 | 0 | 1,920 | 0 | 3,132 | 1,477 | 4,284 | 1,521 | 4,480 | 0 | 2,128 | 14,045 | 13,231 | 17,216 | 18,938 |
| VII .Value Added Tax | 0 | 9,263 | 9,263 | 0 | 255 | 0 | 248 | 0 | 266 | 0 | 257 | 0 | 192 | 0 | 313 | 0 | 576 | 0 | 600 | 0 | 213 | 0 | 2,728 | 0 | 3,615 |
| VIII.Grand Total | 34,259 | 67,631 | 101,890 | 0 | 2,806 | 0 | 2,723 | 0 | 2,930 | 0 | 2,822 | 0 | 2,112 | 0 | 3,445 | 1,477 | 4,860 | 1,521 | 5,080 | 0 | 2,341 | 14,045 | 15,959 | 17,216 | 22,553 |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

# Table V.A.6 (1/4) ANNUAL DISBURSEMENT SCHEDULE (ALTERNATIVE 1, ECONOMIC)

Unit: Million Rp.

| Description | Amount | | | 1994/1995 | | 1995/1996 | | 1996/1997 | | 1997/1998 | | 1998/1999 | | 1999/2000 | | 2000/2001 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F.C. | L.C. | Total | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. |
| I. Construction Base Cost | 26,583 | 14,263 | 40,846 | 0 | 0 | 0 | 0 | 0 | 0 | 10,982 | 5,824 | 10,712 | 6,066 | 4,889 | 2,373 | 0 | 0 |
| 1. Preparatory Works | 2,417 | 1,297 | 3,714 | 0 | 0 | 0 | 0 | 0 | 0 | 1,209 | 648 | 1,208 | 649 | 0 | 0 | 0 | 0 |
| 2. West Floodway Improvement Works | 3,548 | 1,534 | 5,082 | 0 | 0 | 0 | 0 | 0 | 0 | 2,534 | 1,072 | 1,014 | 462 | 0 | 0 | 0 | 0 |
| 3. Garang River Improvement Works | 3,580 | 2,230 | 5,810 | 0 | 0 | 0 | 0 | 0 | 0 | 723 | 328 | 2,446 | 1,604 | 411 | 298 | 0 | 0 |
| 4. Reconstruction of Simongan Weir | 10,293 | 6,018 | 16,311 | 0 | 0 | 0 | 0 | 0 | 0 | 4,450 | 2,570 | 4,994 | 2,832 | 849 | 616 | 0 | 0 |
| 5. Intake Structure | 1,327 | 784 | 2,111 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 35 | 1,289 | 749 | 0 | 0 |
| 6. Others | 3,221 | 1,221 | 4,442 | 0 | 0 | 0 | 0 | 0 | 0 | 1,407 | 852 | 353 | 130 | 1,461 | 239 | 0 | 0 |
| 7. Miscellaneous Works | 2,197 | 1,179 | 3,376 | 0 | 0 | 0 | 0 | 0 | 0 | 659 | 354 | 659 | 354 | 879 | 471 | 0 | 0 |
| Sub-total | 26,583 | 14,263 | 40,846 | 0 | 0 | 0 | 0 | 0 | 0 | 10,982 | 5,824 | 10,712 | 6,066 | 4,889 | 2,373 | 0 | 0 |
| 8. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 3,154 | 3,154 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,297 | 0 | 1,296 | 0 | 561 | 0 | 0 |
| 1. Administration | 0 | 3,154 | 3,154 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,297 | 0 | 1,296 | 0 | 561 | 0 | 0 |
| 2. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| IV. Engineering Service | 6,130 | 2,839 | 8,969 | 1,479 | 692 | 1,479 | 693 | 0 | 0 | 1,304 | 598 | 1,304 | 598 | 564 | 258 | 0 | 0 |
| 1. Detailed Design | 2,958 | 1,385 | 4,343 | 1,479 | 692 | 1,479 | 693 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Construction Supervision | 3,172 | 1,454 | 4,626 | 0 | 0 | 0 | 0 | 0 | 0 | 1,304 | 598 | 1,304 | 598 | 564 | 258 | 0 | 0 |
| 3. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| V. Physical Contingency ; 10% of I+II+IV | 3,274 | 1,709 | 4,983 | 148 | 69 | 148 | 69 | 0 | 0 | 1,230 | 642 | 1,203 | 666 | 545 | 263 | 0 | 0 |
| VI. Total (I+II+III+IV+V) | 35,987 | 21,965 | 57,952 | 1,627 | 761 | 1,627 | 762 | 0 | 0 | 13,516 | 8,361 | 13,219 | 8,626 | 5,998 | 3,455 | 0 | 0 |
| VII .Value Added Tax ; 0% of VI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VIII.Grand Total | 35,987 | 21,965 | 57,952 | 1,627 | 761 | 1,627 | 762 | 0 | 0 | 13,516 | 8,361 | 13,219 | 8,626 | 5,998 | 3,455 | 0 | 0 |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

# Table V.A.6 (2/4) ANNUAL DISBURSEMENT SCHEDULE (ALTERNATIVE 2, ECONOMIC)

Unit: Million Rp.

| Description | Amount | | | 1994/1995 | | 1995/1996 | | 1996/1997 | | 1997/1998 | | 1998/1999 | | 1999/2000 | | 2000/2001 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F.C. | L.C. | Total | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. |
| I. Construction Base Cost | 23,822 | 17,024 | 40,846 | 0 | 1,369 | 0 | 1,420 | 0 | 1,396 | 10,652 | 5,233 | 10,495 | 5,834 | 2,675 | 1,772 | 0 | 0 |
| 1. Preparatory Works | 2,165 | 1,549 | 3,714 | 0 | 124 | 0 | 129 | 0 | 127 | 1,083 | 585 | 1,082 | 584 | 0 | 0 | 0 | 0 |
| 2. West Floodway Improvement Works | 3,310 | 1,772 | 5,082 | 0 | 0 | 0 | 0 | 0 | 627 | 2,375 | 812 | 935 | 333 | 0 | 0 | 0 | 0 |
| 3. Garang River Improvement Works | 3,580 | 2,230 | 5,810 | 0 | 0 | 0 | 0 | 0 | 0 | 920 | 382 | 2,451 | 1,606 | 209 | 242 | 0 | 0 |
| 4. Reconstruction of Simongan Weir | 10,293 | 6,018 | 16,311 | 0 | 0 | 0 | 0 | 0 | 0 | 4,860 | 2,832 | 4,778 | 2,713 | 655 | 473 | 0 | 0 |
| 5. Intake Structure | 1,327 | 784 | 2,111 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 305 | 150 | 1,022 | 634 | 0 | 0 |
| 6. Others | 1,176 | 3,266 | 4,442 | 0 | 1,132 | 0 | 1,174 | 0 | 526 | 823 | 304 | 353 | 130 | 0 | 0 | 0 | 0 |
| 7. Miscellaneous Works | 1,971 | 1,405 | 3,376 | 0 | 113 | 0 | 117 | 0 | 116 | 591 | 318 | 591 | 318 | 789 | 423 | 0 | 0 |
| Sub-total | 23,822 | 17,024 | 40,846 | 0 | 1,369 | 0 | 1,420 | 0 | 1,396 | 10,652 | 5,233 | 10,495 | 5,834 | 2,675 | 1,772 | 0 | 0 |
| 8. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 3,154 | 3,154 | 0 | 106 | 0 | 109 | 0 | 108 | 0 | 1,226 | 0 | 1,261 | 0 | 344 | 0 | 0 |
| 1. Administration | 0 | 3,154 | 3,154 | 0 | 106 | 0 | 109 | 0 | 108 | 0 | 1,226 | 0 | 1,261 | 0 | 344 | 0 | 0 |
| 2. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| IV. Engineering Service | 5,503 | 3,466 | 8,969 | 1,328 | 1,072 | 1,328 | 930 | 0 | 158 | 1,232 | 565 | 1,269 | 582 | 346 | 159 | 0 | 0 |
| 1. Detailed Design | 2,656 | 1,687 | 4,343 | 1,328 | 917 | 1,328 | 770 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Construction Supervision | 2,847 | 1,779 | 4,626 | 0 | 155 | 0 | 160 | 0 | 158 | 1,232 | 565 | 1,269 | 582 | 346 | 159 | 0 | 0 |
| 3. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| V. Physical Contingency ; 10% of I+II+IV | 2,934 | 2,049 | 4,983 | 133 | 244 | 133 | 235 | 0 | 155 | 1,189 | 580 | 1,177 | 642 | 302 | 193 | 0 | 0 |
| VI. Total (I+II+III+IV+V) | 32,259 | 25,693 | 57,952 | 1,461 | 2,791 | 1,461 | 2,694 | 0 | 1,817 | 13,073 | 7,604 | 12,941 | 8,319 | 3,323 | 2,468 | 0 | 0 |
| VII .Value Added Tax ; 0% of VI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VIII.Grand Total | 32,259 | 25,693 | 57,952 | 1,461 | 2,791 | 1,461 | 2,694 | 0 | 1,817 | 13,073 | 7,604 | 12,941 | 8,319 | 3,323 | 2,468 | 0 | 0 |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

# Table V.A.6 (3/4) ANNUAL DISBURSEMENT SCHEDULE (ALTERNATIVE 3, ECONOMIC)

Unit: Million Rp.

| Description | Amount | | | 1994/1995 | | 1995/1996 | | 1996/1997 | | 1997/1998 | | 1998/1999 | | 1999/2000 | | 2000/2001 | | 2001/2002 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F.C. | L.C. | Total | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. |
| I. Construction Base Cost | 20,910 | 19,936 | 40,846 | 0 | 1,369 | 0 | 1,420 | 0 | 1,396 | 0 | 1,364 | 0 | 891 | 0 | 1,451 | 10,156 | 5,407 | 10,754 | 6,638 |
| 1. Preparatory Works | 1,901 | 1,813 | 3,714 | 0 | 124 | 0 | 129 | 0 | 127 | 0 | 124 | 0 | 81 | 0 | 132 | 1,141 | 658 | 760 | 438 |
| 2. West Floodway Improvement Works | 954 | 4,128 | 5,082 | 0 | 0 | 0 | 0 | 0 | 627 | 0 | 1,060 | 0 | 737 | 0 | 1,199 | 685 | 351 | 269 | 154 |
| 3. Garang River Improvement Works | 3,529 | 2,281 | 5,810 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 68 | 0 | 0 | 0 | 0 | 1,141 | 529 | 2,388 | 1,684 |
| 4. Reconstruction of Simongan Weir | 10,293 | 6,018 | 16,311 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,234 | 2,953 | 5,059 | 3,065 |
| 5. Intake Structure | 1,327 | 784 | 2,111 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 267 | 115 | 1,060 | 669 |
| 6. Others | 1,176 | 3,266 | 4,442 | 0 | 1,132 | 0 | 1,174 | 0 | 526 | 0 | 0 | 0 | 0 | 0 | 0 | 823 | 304 | 353 | 130 |
| 7. Miscellaneous Works | 1,730 | 1,646 | 3,376 | 0 | 113 | 0 | 117 | 0 | 116 | 0 | 112 | 0 | 73 | 0 | 120 | 865 | 497 | 865 | 498 |
| Sub-total | 20,910 | 19,936 | 40,846 | 0 | 1,369 | 0 | 1,420 | 0 | 1,396 | 0 | 1,364 | 0 | 891 | 0 | 1,451 | 10,156 | 5,407 | 10,754 | 6,638 |
| 8. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 3,154 | 3,154 | 0 | 106 | 0 | 109 | 0 | 108 | 0 | 105 | 0 | 112 | 0 | 112 | 0 | 1,179 | 0 | 1,323 |
| 1. Administration | 0 | 3,154 | 3,154 | 0 | 106 | 0 | 109 | 0 | 108 | 0 | 105 | 0 | 112 | 0 | 112 | 0 | 1,179 | 0 | 1,323 |
| 2. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| IV. Engineering Service | 4,866 | 4,103 | 8,969 | 0 | 450 | 0 | 308 | 0 | 302 | 1,174 | 857 | 1,174 | 867 | 0 | 165 | 1,186 | 544 | 1,332 | 610 |
| 1. Detailed Design | 2,348 | 1,995 | 4,343 | 0 | 295 | 0 | 148 | 0 | 144 | 1,174 | 704 | 1,174 | 704 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Construction Supervision | 2,518 | 2,108 | 4,626 | 0 | 155 | 0 | 160 | 0 | 158 | 0 | 153 | 0 | 163 | 0 | 165 | 1,186 | 544 | 1,332 | 610 |
| 3. Price Contingency ; F.C.0% & L.C.0% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| V. Physical Contingency ; 10% of I+II+IV | 2,577 | 2,406 | 4,983 | 0 | 182 | 0 | 173 | 0 | 170 | 117 | 222 | 117 | 176 | 0 | 162 | 1,134 | 595 | 1,209 | 726 |
| VI. Total (I+II+III+IV+V) | 28,353 | 29,599 | 57,952 | 0 | 2,107 | 0 | 2,010 | 0 | 1,976 | 1,291 | 2,548 | 1,291 | 2,046 | 0 | 1,890 | 12,476 | 7,725 | 13,295 | 9,297 |
| VII .Value Added Tax ; 0% of VI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VIII.Grand Total | 28,353 | 29,599 | 57,952 | 0 | 2,107 | 0 | 2,010 | 0 | 1,976 | 1,291 | 2,548 | 1,291 | 2,046 | 0 | 1,890 | 12,476 | 7,725 | 13,295 | 9,297 |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

# Table V.A.6 (4/4) ANNUAL DISBURSEMENT SCHEDULE (ALTERNATIVE 4, ECONOMIC)

Unit: Million Rp.

| Description | Amount | | | 1994/1995 | | 1995/1996 | | 1996/1997 | | 1997/1998 | | 1998/1999 | | 1999/2000 | | 2000/2001 | | 2001/2002 | | 2002/2003 | | 2003/2004 | | 2004/2005 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F.C. | L.C. | Total | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. |
| I. Construction Base Cost | 18,331 | 22,515 | 40,846 | 0 | 1,369 | 0 | 1,420 | 0 | 1,396 | 0 | 1,364 | 0 | 891 | 0 | 1,451 | 0 | 1,393 | 0 | 1,436 | 0 | 885 | 8,400 | 4,644 | 9,931 | 6,266 |
| 1. Preparatory Works | 1,666 | 2,048 | 3,714 | 0 | 124 | 0 | 129 | 0 | 127 | 0 | 124 | 0 | 81 | 0 | 132 | 0 | 126 | 0 | 131 | 0 | 81 | 1,000 | 597 | 666 | 396 |
| 2. West Floodway Improvement Works | 0 | 5,082 | 5,082 | 0 | 0 | 0 | 0 | 0 | 627 | 0 | 1,060 | 0 | 737 | 0 | 1,199 | 0 | 508 | 0 | 220 | 0 | 731 | 0 | 0 | 0 | 0 |
| 3. Garang River Improvement Works | 3,529 | 2,281 | 5,810 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,141 | 529 | 2,388 | 1,684 |
| 4. Reconstruction of Simongan Weir | 10,293 | 6,018 | 16,311 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,234 | 2,953 | 5,059 | 3,065 |
| 5. Intake Structure | 1,327 | 784 | 2,111 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 267 | 115 | 1,060 | 669 |
| 6. Others | 0 | 4,442 | 4,442 | 0 | 1,132 | 0 | 1,174 | 0 | 526 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 644 | 0 | 966 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7. Miscellaneous Works | 1,516 | 1,860 | 3,376 | 0 | 113 | 0 | 117 | 0 | 116 | 0 | 112 | 0 | 73 | 0 | 120 | 0 | 115 | 0 | 119 | 0 | 73 | 758 | 450 | 758 | 452 |
| Sub-total | 18,331 | 22,515 | 40,846 | 0 | 1,369 | 0 | 1,420 | 0 | 1,396 | 0 | 1,364 | 0 | 891 | 0 | 1,451 | 0 | 1,393 | 0 | 1,436 | 0 | 885 | 8,400 | 4,644 | 9,931 | 6,266 |
| 8. Price Contingency | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| II. Compensation Cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| III. Administration Cost | 0 | 3,154 | 3,154 | 0 | 106 | 0 | 109 | 0 | 108 | 0 | 105 | 0 | 112 | 0 | 112 | 0 | 108 | 0 | 110 | 0 | 111 | 0 | 963 | 0 | 1,210 |
| 1. Administration | 0 | 3,154 | 3,154 | 0 | 106 | 0 | 109 | 0 | 108 | 0 | 105 | 0 | 112 | 0 | 112 | 0 | 108 | 0 | 110 | 0 | 111 | 0 | 963 | 0 | 1,210 |
| 2. Price Contingency | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| IV. Engineering Service | 4,227 | 4,742 | 8,969 | 0 | 450 | 0 | 308 | 0 | 302 | 0 | 307 | 0 | 317 | 0 | 313 | 1,020 | 786 | 1,020 | 794 | 0 | 163 | 969 | 444 | 1,218 | 558 |
| 1. Detailed Design | 2,040 | 2,303 | 4,343 | 0 | 295 | 0 | 148 | 0 | 144 | 0 | 154 | 0 | 154 | 0 | 148 | 1,020 | 628 | 1,020 | 632 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Construction Supervision | 2,187 | 2,439 | 4,626 | 0 | 155 | 0 | 160 | 0 | 158 | 0 | 153 | 0 | 163 | 0 | 165 | 0 | 158 | 0 | 162 | 0 | 163 | 969 | 444 | 1,218 | 558 |
| 3. Price Contingency | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| V. Physical Contingency | 2,257 | 2,726 | 4,983 | 0 | 182 | 0 | 173 | 0 | 170 | 0 | 167 | 0 | 121 | 0 | 176 | 102 | 218 | 102 | 223 | 0 | 105 | 938 | 509 | 1,115 | 682 |
| VI. Total (I+II+III+IV+V) | 24,815 | 33,137 | 57,952 | 0 | 2,107 | 0 | 2,010 | 0 | 1,976 | 0 | 1,943 | 0 | 1,441 | 0 | 2,052 | 1,122 | 2,505 | 1,122 | 2,563 | 0 | 1,264 | 10,307 | 6,560 | 12,264 | 8,716 |
| VII .Value Added Tax | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VIII.Grand Total | 24,815 | 33,137 | 57,952 | 0 | 2,107 | 0 | 2,010 | 0 | 1,976 | 0 | 1,943 | 0 | 1,441 | 0 | 2,052 | 1,122 | 2,505 | 1,122 | 2,563 | 0 | 1,264 | 10,307 | 6,560 | 12,264 | 8,716 |

Notes : *1 Price Level in July,1992
*2 Conversion Rate US$ 1.00 = Rp.2,033, 1 Yen = Rp.16.20

Table V.A.7 (1/4) ANNUAL COST AND BENEFIT FLOW OF URGENT PROJECT (ALT.1)

(Unit : Million Rp.)

| Year | Economic Cost | | | Benefit | Balance |
|---|---|---|---|---|---|
| | Const. | OMR | Total | | |
| 1994 | 2,388 | 0 | 2,388 | 0 | (2,388) |
| 1995 | 2,388 | 0 | 2,388 | 0 | (2,388) |
| 1996 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 21,877 | 0 | 21,877 | 0 | (21,877) |
| 1998 | 21,845 | 0 | 21,845 | 2,753 | (19,092) |
| 1999 | 9,453 | 0 | 9,453 | 5,808 | (3,645) |
| 2000 | 0 | 220 | 220 | 7,473 | 7,253 |
| 2001 | 0 | 220 | 220 | 7,884 | 7,664 |
| 2002 | 0 | 220 | 220 | 8,317 | 8,097 |
| 2003 | 0 | 220 | 220 | 8,775 | 8,555 |
| 2004 | 0 | 220 | 220 | 9,258 | 9,038 |
| 2005 | 0 | 220 | 220 | 9,767 | 9,547 |
| 2006 | 0 | 220 | 220 | 10,304 | 10,084 |
| 2007 | 0 | 220 | 220 | 10,871 | 10,651 |
| 2008 | 0 | 220 | 220 | 11,469 | 11,249 |
| 2009 | 0 | 220 | 220 | 12,099 | 11,879 |
| 2010 | 0 | 220 | 220 | 12,765 | 12,545 |
| 2011 | 0 | 220 | 220 | 13,467 | 13,247 |
| 2012 | 0 | 220 | 220 | 14,207 | 13,987 |
| 2013 | 0 | 220 | 220 | 14,989 | 14,769 |
| 2014 | 0 | 220 | 220 | 15,813 | 15,593 |
| 2015 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2016 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2017 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2018 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2019 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2020 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2021 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2022 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2023 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2024 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2025 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2026 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2027 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2028 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2029 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2030 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2031 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2032 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2033 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2034 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2035 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2036 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2037 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2038 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2039 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2040 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2041 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2042 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2043 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2044 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2045 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2046 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2047 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2048 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2049 | 0 | 220 | 220 | 16,683 | 16,463 |
| Total | 57,951 | 11,000 | 68,951 | 753,860 | 690,972 |
| | | | | EIRR= | 15.9% |

(Discount Rate 10 %)

NPV = 31,153

Table V.A.7 (2/4) ANNUAL COST AND BENEFIT FLOW OF URGENT PROJECT (ALT.2)

(Unit : Million Rp.)

| Year | Economic Cost | | | Benefit | Balance |
|---|---|---|---|---|---|
| | Const. | OMR | Total | | |
| 1994 | 4,252 | 0 | 4,252 | 0 | (4,252) |
| 1995 | 4,155 | 7 | 4,162 | 420 | (3,742) |
| 1996 | 1,817 | 15 | 1,832 | 876 | (956) |
| 1997 | 20,677 | 23 | 20,700 | 1,125 | (19,575) |
| 1998 | 21,260 | 23 | 21,283 | 3,585 | (17,698) |
| 1999 | 5,791 | 23 | 5,814 | 6,384 | 570 |
| 2000 | 0 | 220 | 220 | 7,473 | 7,253 |
| 2001 | 0 | 220 | 220 | 7,884 | 7,664 |
| 2002 | 0 | 220 | 220 | 8,317 | 8,097 |
| 2003 | 0 | 220 | 220 | 8,775 | 8,555 |
| 2004 | 0 | 220 | 220 | 9,258 | 9,038 |
| 2005 | 0 | 220 | 220 | 9,767 | 9,547 |
| 2006 | 0 | 220 | 220 | 10,304 | 10,084 |
| 2007 | 0 | 220 | 220 | 10,871 | 10,651 |
| 2008 | 0 | 220 | 220 | 11,469 | 11,249 |
| 2009 | 0 | 220 | 220 | 12,099 | 11,879 |
| 2010 | 0 | 220 | 220 | 12,765 | 12,545 |
| 2011 | 0 | 220 | 220 | 13,467 | 13,247 |
| 2012 | 0 | 220 | 220 | 14,207 | 13,987 |
| 2013 | 0 | 220 | 220 | 14,989 | 14,769 |
| 2014 | 0 | 220 | 220 | 15,813 | 15,593 |
| 2015 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2016 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2017 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2018 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2019 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2020 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2021 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2022 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2023 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2024 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2025 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2026 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2027 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2028 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2029 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2030 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2031 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2032 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2033 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2034 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2035 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2036 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2037 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2038 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2039 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2040 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2041 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2042 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2043 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2044 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2045 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2046 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2047 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2048 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2049 | 0 | 220 | 220 | 16,683 | 16,463 |
| Total | 57,951 | 11,000 | 68,951 | 753,860 | 694,708 |
| | | | | EIRR= | 16.1% |

(Discount Rate 10 %)

NPV = 32,438

Table V.A.7 (3/4) ANNUAL COST AND BENEFIT FLOW OF URGENT PROJECT (ALT.3)

(Unit : Million Rp.)

| Year | Economic Cost | | | Benefit | Balance |
|---|---|---|---|---|---|
| | Const. | OMR | Total | | |
| 1994 | 2,107 | 0 | 2,107 | 0 | (2,107) |
| 1995 | 2,010 | 7 | 2,017 | 62 | (1,955) |
| 1996 | 1,976 | 15 | 1,991 | 129 | (1,862) |
| 1997 | 3,839 | 23 | 3,862 | 201 | (3,661) |
| 1998 | 3,962 | 30 | 3,992 | 345 | (3,647) |
| 1999 | 1,890 | 38 | 1,928 | 509 | (1,419) |
| 2000 | 19,883 | 46 | 19,929 | 611 | (19,318) |
| 2001 | 22,285 | 46 | 22,331 | 1,456 | (20,875) |
| 2002 | 0 | 220 | 220 | 8,317 | 8,097 |
| 2003 | 0 | 220 | 220 | 8,775 | 8,555 |
| 2004 | 0 | 220 | 220 | 9,258 | 9,038 |
| 2005 | 0 | 220 | 220 | 9,767 | 9,547 |
| 2006 | 0 | 220 | 220 | 10,304 | 10,084 |
| 2007 | 0 | 220 | 220 | 10,871 | 10,651 |
| 2008 | 0 | 220 | 220 | 11,469 | 11,249 |
| 2009 | 0 | 220 | 220 | 12,099 | 11,879 |
| 2010 | 0 | 220 | 220 | 12,765 | 12,545 |
| 2011 | 0 | 220 | 220 | 13,467 | 13,247 |
| 2012 | 0 | 220 | 220 | 14,207 | 13,987 |
| 2013 | 0 | 220 | 220 | 14,989 | 14,769 |
| 2014 | 0 | 220 | 220 | 15,813 | 15,593 |
| 2015 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2016 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2017 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2018 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2019 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2020 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2021 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2022 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2023 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2024 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2025 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2026 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2027 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2028 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2029 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2030 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2031 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2032 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2033 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2034 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2035 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2036 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2037 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2038 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2039 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2040 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2041 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2042 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2043 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2044 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2045 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2046 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2047 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2048 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2049 | 0 | 220 | 220 | 16,683 | 16,463 |
| Total | 57,951 | 11,000 | 68,951 | 753,860 | 670,601 |
| | | | | EIRR= | 15.7% |

(Discount Rate 10 %)

NPV = 26,707

Table V.A.7 (4/4) ANNUAL COST AND BENEFIT FLOW OF URGENT PROJECT (ALT.4)

(Unit : Million Rp.)

| Year | Economic Cost | | | Benefit | Balance |
|---|---|---|---|---|---|
| | Const. | OMR | Total | | |
| 1994 | 2,107 | 0 | 2,107 | 0 | (2,107) |
| 1995 | 2,010 | 7 | 2,017 | 62 | (1,955) |
| 1996 | 1,976 | 15 | 1,991 | 129 | (1,862) |
| 1997 | 1,943 | 23 | 1,966 | 201 | (1,765) |
| 1998 | 2,066 | 30 | 2,096 | 279 | (1,817) |
| 1999 | 2,052 | 38 | 2,090 | 370 | (1,720) |
| 2000 | 3,627 | 46 | 3,673 | 470 | (3,203) |
| 2001 | 3,685 | 53 | 3,738 | 644 | (3,094) |
| 2002 | 1,886 | 61 | 1,947 | 838 | (1,109) |
| 2003 | 16,231 | 69 | 16,300 | 970 | (15,330) |
| 2004 | 20,369 | 69 | 20,438 | 1,801 | (18,637) |
| 2005 | 0 | 220 | 220 | 9,767 | 9,547 |
| 2006 | 0 | 220 | 220 | 10,304 | 10,084 |
| 2007 | 0 | 220 | 220 | 10,871 | 10,651 |
| 2008 | 0 | 220 | 220 | 11,469 | 11,249 |
| 2009 | 0 | 220 | 220 | 12,099 | 11,879 |
| 2010 | 0 | 220 | 220 | 12,765 | 12,545 |
| 2011 | 0 | 220 | 220 | 13,467 | 13,247 |
| 2012 | 0 | 220 | 220 | 14,207 | 13,987 |
| 2013 | 0 | 220 | 220 | 14,989 | 14,769 |
| 2014 | 0 | 220 | 220 | 15,813 | 15,593 |
| 2015 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2016 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2017 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2018 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2019 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2020 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2021 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2022 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2023 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2024 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2025 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2026 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2027 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2028 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2029 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2030 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2031 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2032 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2033 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2034 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2035 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2036 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2037 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2038 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2039 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2040 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2041 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2042 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2043 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2044 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2045 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2046 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2047 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2048 | 0 | 220 | 220 | 16,683 | 16,463 |
| 2049 | 0 | 220 | 220 | 16,683 | 16,463 |
| Total | 57,951 | 11,000 | 68,951 | 753,860 | 647,157 |
| | | | | EIRR= | 15.4% |

(Discount Rate 10 %)

NPV = 22,720

## *Alternative 1*

| Item | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Detailed Design | | | | | | | | | | | |
| P/Q and Tendering | | | | | | | | | | | |
| Construction | | | | | | | | | | | |

Package 1 : Subject to Foreign Financial Assistance

## *Alternative 2*

| Item | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Detailed Design | | | | | | | | | | | |
| P/Q and Tendering | | | | | | | | | | | |
| Construction | | | | | | | | | | | |

Package 1 : Financed by Local Budget
Package 2 : Subject to Foreign Financial Assistance

## *Alternative 3*

| Item | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Detailed Design | | | | | | | | | | | |
| P/Q and Tendering | | | | | | | | | | | |
| Construction | | | | | | | | | | | |

Package 1 : Financed by Local Budget
Package 2 : Subject to Foreign Financial Assistance

## *Alternative 4*

| Item | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Detailed Design | | | | | | | | | | | |
| P/Q and Tendering | | | | | | | | | | | |
| Construction | | | | | | | | | | | |

Package 1 : Financed by Local Budget
Package 2 : Subject to Foreign Financial Assistance

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. V.A.1

IMPLEMENTATION SCHEDULE FOR URGENT PROJECT

| Item | | | Quantity | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Preparatory Works | | | | | | | | | | |
| 2. W-Floodway Improvement Works | | | | | | | | | | |
| (1) | Excavation | Common 1-F | 339,000 m3 | | | | | | | |
| | | Common 2-F | 226,000 m3 | | | | | | | |
| | | River Mouth | 98,000 m3 | | | | | | | |
| (2) | Retaining Wall | Type B | 3,000 m | | | | | | | |
| (3) | Revetment | Type A | 6,580 m2 | | | | | | | |
| | | Type B | 3,020 m2 | | | | | | | |
| 3. Garang R. Improvement Works | | | | | | | | | | |
| (1) | Excavation | Common 1-G | 276,800 m3 | | | | | | | |
| | | Common 1-EM | 10,200 m3 | | | | | | | |
| | | Common 2-G | 72,000 m3 | | | | | | | |
| (2) | Embankment | | 10,200 m3 | | | | | | | |
| (3) | Revetment | Type A | 2,110 m2 | | | | | | | |
| | | Type B | 32,200 m2 | | | | | | | |
| (4) | Sodding | | 3,880 m2 | | | | | | | |
| (5) | Groundsill | Type A | 1 LS | | | | | | | |
| | | Type B | 1 LS | | | | | | | |
| | | Type C | 1 LS | | | | | | | |
| | | Type D | 1 LS | | | | | | | |
| 4. Reconstruction of Simongan Weir | | | | | | | | | | |
| (1) | Diversion Works & Dewatering | | 1 LS | | | | | | | |
| (2) | Demolition | | 12,000 m3 | | | | | | | |
| (3) | Excavation | Common 2-G | 6,710 m3 | | | | | | | |
| (4) | Revetment | Type C | 1,110 m2 | | | | | | | |
| (5) | Sodding | | 570 m2 | | | | | | | |
| (6) | Reinforced Concrete | | 6,790 m3 | | | | | | | |
| (7) | Foundation Pile | D=500mm,L=12m | 216 pc | | | | | | | |
| | | D=400mm,L=12m | 135 pc | | | | | | | |
| | | D=350mm,L=12m | 480 pc | | | | | | | |
| (8) | Sheet Pile | t=0.2m | 1,380 m2 | | | | | | | |
| (9) | Main Gate 1 | | 236 m2 | | | | | | | |
| (10) | Main Gate 2 | | 54 m2 | | | | | | | |
| (11) | Retaining Wall | Type C | 80 m | | | | | | | |
| (12) | Concrete Block | t=0.5m | 2,830 m2 | | | | | | | |
| (13) | Gabion Mattress | t=0.5m | 2,020 m2 | | | | | | | |
| (14) | Bridge | | 1,040 m2 | | | | | | | |
| (15) | Control House & Gate House | | 1 LS | | | | | | | |
| 5. Intake Structure | | | | | | | | | | |
| (1) | Demolition | | 350 m3 | | | | | | | |
| (2) | Excavation | Common 2-G | 150 m3 | | | | | | | |
| (3) | Reinforced Concrete | | 510 m3 | | | | | | | |
| (4) | Foundation Pile | D=350mm,L=12m | 60 pc | | | | | | | |
| (5) | Sheet Pile | t=0.2m | 240 m2 | | | | | | | |
| (6) | Gate | | 30 m2 | | | | | | | |
| (7) | Retaining Wall | Type C | 55 m | | | | | | | |
| | | Type D | 80 m | | | | | | | |
| 6. Others | | | | | | | | | | |
| (1) | Railroad Bridge | | 1 LS | | | | | | | |
| (2) | Retaining Wall for PDAM | | 200 m | | | | | | | |
| (3) | Flap Gate | 1.0m x 1.0m | 2 pc | | | | | | | |
| | | 1.5m x 1.5m | 0 pc | | | | | | | |
| | | 2.0m x 2.0m | 14 pc | | | | | | | |
| 7. Miscellaneous Works | | | | | | | | | | |

Package 1 : Subject to Foreign Financial Assistance

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. V.A.2 (1/4)
CONSTRUCTION SCHEDULE FOR URGENT PROJECT
(ALTERNATIVE 1)

| Item | | | Quantity | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Preparatory Works | | | | | | | | | | |
| 2. W-Floodway Improvement Works | | | | | | | | | | |
| (1) | Excavation | Common 1-F | 339,000 m3 | | | | | | | |
| | | Common 2-F | 226,000 m3 | | | | | | | |
| | | River Mouth | 98,000 m3 | | | | | | | |
| (2) | Retaining Wall | Type B | 3,000 m | | | | | | | |
| (3) | Revetment | Type A | 6,580 m2 | | | | | | | |
| | | Type B | 3,020 m2 | | | | | | | |
| 3. Garang R. Improvement Works | | | | | | | | | | |
| (1) | Excavation | Common 1-G | 276,800 m3 | | | | | | | |
| | | Common 1-EM | 10,200 m3 | | | | | | | |
| | | Common 2-G | 72,000 m3 | | | | | | | |
| (2) | Embankment | | 10,200 m3 | | | | | | | |
| (3) | Revetment | Type A | 2,110 m2 | | | | | | | |
| | | Type B | 32,200 m2 | | | | | | | |
| (4) | Sodding | | 3,880 m2 | | | | | | | |
| (5) | Groundsill | Type A | 1 LS | | | | | | | |
| | | Type B | 1 LS | | | | | | | |
| | | Type C | 1 LS | | | | | | | |
| | | Type D | 1 LS | | | | | | | |
| 4. Reconstruction of Simongan Weir | | | | | | | | | | |
| (1) | Diversion Works & Dewatering | | 1 LS | | | | | | | |
| (2) | Demolition | | 12,000 m3 | | | | | | | |
| (3) | Excavation | Common 2-G | 6,710 m3 | | | | | | | |
| (4) | Revetment | Type C | 1,110 m2 | | | | | | | |
| (5) | Sodding | | 570 m2 | | | | | | | |
| (6) | Reinforced Concrete | | 6,790 m3 | | | | | | | |
| (7) | Foundation Pile | D=500mm,L=12m | 216 pc | | | | | | | |
| | | D=400mm,L=12m | 135 pc | | | | | | | |
| | | D=350mm,L=12m | 480 pc | | | | | | | |
| (8) | Sheet Pile | t=0.2m | 1,380 m2 | | | | | | | |
| (9) | Main Gate 1 | | 236 m2 | | | | | | | |
| (10) | Main Gate 2 | | 54 m2 | | | | | | | |
| (11) | Retaining Wall | Type C | 80 m | | | | | | | |
| (12) | Concrete Block | t=0.5m | 2,830 m2 | | | | | | | |
| (13) | Gablon Mattress | t=0.5m | 2,020 m2 | | | | | | | |
| (14) | Bridge | | 1,040 m2 | | | | | | | |
| (15) | Control House & Gate House | | 1 LS | | | | | | | |
| 5. Intake Structure | | | | | | | | | | |
| (1) | Demolition | | 350 m3 | | | | | | | |
| (2) | Excavation | Common 2-G | 150 m3 | | | | | | | |
| (3) | Reinforced Concrete | | 510 m3 | | | | | | | |
| (4) | Foundation Pile | D=350mm,L=12m | 60 pc | | | | | | | |
| (5) | Sheet Pile | t=0.2m | 240 m2 | | | | | | | |
| (6) | Gate | | 30 m2 | | | | | | | |
| (7) | Retaining Wall | Type C | 55 m | | | | | | | |
| | | Type D | 80 m | | | | | | | |
| 6. Others | | | | | | | | | | |
| (1) | Railroad Bridge | | 1 LS | | | | | | | |
| (2) | Retaining Wall for PDAM | | 200 m | | | | | | | |
| (3) | Flap Gate | 1.0m x 1.0m | 2 pc | | | | | | | |
| | | 1.5m x 1.5m | 0 pc | | | | | | | |
| | | 2.0m x 2.0m | 14 pc | | | | | | | |
| 7. Miscellaneous Works | | | | | | | | | | |

Package 1 : Financed by Local Budget

Package 2 : Subject to Foreign Financial Assistance

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. V.A.2 (2/4)
CONSTRUCTION SCHEDULE FOR URGENT PROJECT
(ALTERNATIVE 2)

| Item | | | Quantity | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Preparatory Works | | | | | | | | | | | |
| 2. W-Floodway Improvement Works | | | | | | | | | | | |
| (1) | Excavation | Common 1-F | 339,000 m3 | | | | | | | | |
| | | Common 2-F | 226,000 m3 | | | | | | | | |
| | | River Mouth | 98,000 m3 | | | | | | | | |
| (2) | Retaining Wall | Type B | 3,000 m | | | | | | | | |
| (3) | Revetment | Type A | 6,580 m2 | | | | | | | | |
| | | Type B | 3,020 m2 | | | | | | | | |
| 3. Garang R. Improvement Works | | | | | | | | | | | |
| (1) | Excavation | Common 1-G | 276,800 m3 | | | | | | | | |
| | | Common 1-EM | 10,200 m3 | | | | | | | | |
| | | Common 2-G | 72,000 m3 | | | | | | | | |
| (2) | Embankment | | 10,200 m3 | | | | | | | | |
| (3) | Revetment | Type A | 2,110 m2 | | | | | | | | |
| | | Type B | 32,200 m2 | | | | | | | | |
| (4) | Sodding | | 3,880 m2 | | | | | | | | |
| (5) | Groundsill | Type A | 1 LS | | | | | | | | |
| | | Type B | 1 LS | | | | | | | | |
| | | Type C | 1 LS | | | | | | | | |
| | | Type D | 1 LS | | | | | | | | |
| 4. Reconstruction of Simongan Weir | | | | | | | | | | | |
| (1) | Diversion Works & Dewatering | | 1 LS | | | | | | | | |
| (2) | Demolition | | 12,000 m3 | | | | | | | | |
| (3) | Excavation | Common 2-G | 6,710 m3 | | | | | | | | |
| (4) | Revetment | Type C | 1,110 m2 | | | | | | | | |
| (5) | Sodding | | 570 m2 | | | | | | | | |
| (6) | Reinforced Concrete | | 6,790 m3 | | | | | | | | |
| (7) | Foundation Pile | D=500mm,L=12m | 216 pc | | | | | | | | |
| | | D=400mm,L=12m | 135 pc | | | | | | | | |
| | | D=350mm,L=12m | 480 pc | | | | | | | | |
| (8) | Sheet Pile | t=0.2m | 1,380 m2 | | | | | | | | |
| (9) | Main Gate 1 | | 236 m2 | | | | | | | | |
| (10) | Main Gate 2 | | 54 m2 | | | | | | | | |
| (11) | Retaining Wall | Type C | 80 m | | | | | | | | |
| (12) | Concrete Block | t=0.5m | 2,830 m2 | | | | | | | | |
| (13) | Gabion Mattress | t=0.5m | 2,020 m2 | | | | | | | | |
| (14) | Bridge | | 1,040 m2 | | | | | | | | |
| (15) | Control House & Gate House | | 1 LS | | | | | | | | |
| 5. Intake Structure | | | | | | | | | | | |
| (1) | Demolition | | 350 m3 | | | | | | | | |
| (2) | Excavation | Common 2-G | 150 m3 | | | | | | | | |
| (3) | Reinforced Concrete | | 510 m3 | | | | | | | | |
| (4) | Foundation Pile | D=350mm,L=12m | 60 pc | | | | | | | | |
| (5) | Sheet Pile | t=0.2m | 240 m2 | | | | | | | | |
| (6) | Gate | | 30 m2 | | | | | | | | |
| (7) | Retaining Wall | Type C | 55 m | | | | | | | | |
| | | Type D | 80 m | | | | | | | | |
| 6. Others | | | | | | | | | | | |
| (1) | Railroad Bridge | | 1 LS | | | | | | | | |
| (2) | Retaining Wall for PDAM | | 200 m | | | | | | | | |
| (3) | Flap Gate | 1.0m x 1.0m | 2 pc | | | | | | | | |
| | | 1.5m x 1.5m | 0 pc | | | | | | | | |
| | | 2.0m x 2.0m | 14 pc | | | | | | | | |
| 7. Miscellaneous Works | | | | | | | | | | | |

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Package 2 : Subject to Foreign Financial Assistance

MASTER PLAN ON WATER RESOURCES DEVELOPMENT AND FEASIBILITY STUDY FOR URGENT FLOOD CONTROL AND URBAN DRAINAGE IN SEMARANG CITY AND SUBURBS

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Fig. V.A.2 (3/4)

CONSTRUCTION SCHEDULE FOR URGENT PROJECT (ALTERNATIVE 3)

| Item | Quantity | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Preparatory Works | | | | | | | | | | | | |
| 2. W-Floodway Improvement Works | | | | | | | | | | | | |
| (1) Excavation Common 1-F | 339,000 m3 | | | | | | | | | | | |
| Common 2-F | 226,000 m3 | | | | | | | | | | | |
| River Mouth | 98,000 m3 | | | | | | | | | | | |
| (2) Retaining Wall Type B | 3,000 m | | | | | | | | | | | |
| (3) Revetment Type A | 6,580 m2 | | | | | | | | | | | |
| Type B | 3,020 m2 | | | | | | | | | | | |
| 3. Garang R. Improvement Works | | | | | | | | | | | | |
| (1) Excavation Common 1-G | 276,800 m3 | | | | | | | | | | | |
| Common 1-EM | 10,200 m3 | | | | | | | | | | | |
| Common 2-G | 72,000 m3 | | | | | | | | | | | |
| (2) Embankment | 10,200 m3 | | | | | | | | | | | |
| (3) Revetment Type A | 2,110 m2 | | | | | | | | | | | |
| Type B | 32,200 m2 | | | | | | | | | | | |
| (4) Sodding | 3,880 m2 | | | | | | | | | | | |
| (5) Groundsill Type A | 1 LS | | | | | | | | | | | |
| Type B | 1 LS | | | | | | | | | | | |
| Type C | 1 LS | | | | | | | | | | | |
| Type D | 1 LS | | | | | | | | | | | |
| 4. Reconstruction of Simongan Weir | | | | | | | | | | | | |
| (1) Diversion Works & Dewatering | 1 LS | | | | | | | | | | | |
| (2) Demolition | 12,000 m3 | | | | | | | | | | | |
| (3) Excavation Common 2-G | 6,710 m3 | | | | | | | | | | | |
| (4) Revetment Type C | 1,110 m2 | | | | | | | | | | | |
| (5) Sodding | 570 m2 | | | | | | | | | | | |
| (6) Reinforced Concrete | 6,790 m3 | | | | | | | | | | | |
| (7) Foundation Pile D=500mm,L=12m | 216 pc | | | | | | | | | | | |
| D=400mm,L=12m | 135 pc | | | | | | | | | | | |
| D=350mm,L=12m | 480 pc | | | | | | | | | | | |
| (8) Sheet Pile t=0.2m | 1,380 m2 | | | | | | | | | | | |
| (9) Main Gate 1 | 236 m2 | | | | | | | | | | | |
| (10) Main Gate 2 | 54 m2 | | | | | | | | | | | |
| (11) Retaining Wall Type C | 80 m | | | | | | | | | | | |
| (12) Concrete Block t=0.5m | 2,830 m2 | | | | | | | | | | | |
| (13) Gabion Mattress t=0.5m | 2,020 m2 | | | | | | | | | | | |
| (14) Bridge | 1,040 m2 | | | | | | | | | | | |
| (15) Control House & Gate House | 1 LS | | | | | | | | | | | |
| 5. Intake Structure | | | | | | | | | | | | |
| (1) Demolition | 350 m3 | | | | | | | | | | | |
| (2) Excavation Common 2-G | 150 m3 | | | | | | | | | | | |
| (3) Reinforced Concrete | 510 m3 | | | | | | | | | | | |
| (4) Foundation Pile D=350mm,L=12m | 60 pc | | | | | | | | | | | |
| (5) Sheet Pile t=0.2m | 240 m2 | | | | | | | | | | | |
| (6) Gate | 30 m2 | | | | | | | | | | | |
| (7) Retaining Wall Type C | 55 m | | | | | | | | | | | |
| Type D | 80 m | | | | | | | | | | | |
| 6. Others | | | | | | | | | | | | |
| (1) Railroad Bridge | 1 LS | | | | | | | | | | | |
| (2) Retaining Wall for PDAM | 200 m | | | | | | | | | | | |
| (3) Flap Gate 1.0m x 1.0m | 2 pc | | | | | | | | | | | |
| 1.5m x 1.5m | 0 pc | | | | | | | | | | | |
| 2.0m x 2.0m | 14 pc | | | | | | | | | | | |
| 7. Miscellaneous Works | | | | | | | | | | | | |

Package 1 : Financed by Local Budget

Package 2 : Subject to Foreign Financial Assistance

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JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. V.A.2 (4/4)

CONSTRUCTION SCHEDULE FOR URGENT PROJECT (ALTERNATIVE 4)

# VI URBAN DRAINAGE PLAN

# VI URBAN DRAINAGE PLAN

## TABLE OF CONTENTS

LIST OF TABLES

## LIST OF FIGURES

# CHAPTER 1 INTRODUCTION

Semarang City of approximately 374 $km^2$ is located on the plains situated between the hilly land to the south and the Jawa Sea to the north. Due to the topographic conditions, high rainfall intensity and insufficient drainage facilities, low-lying built-up areas of Semarang City suffer from habitual inundation during the rainy season.

Based on the internal flood survey, it is found that a total area of 2,605 ha corresponding to almost 7% of Semarang City is affected every year. The flooding situation will likely worsen yearly and become a serious constraint to social and economic development.

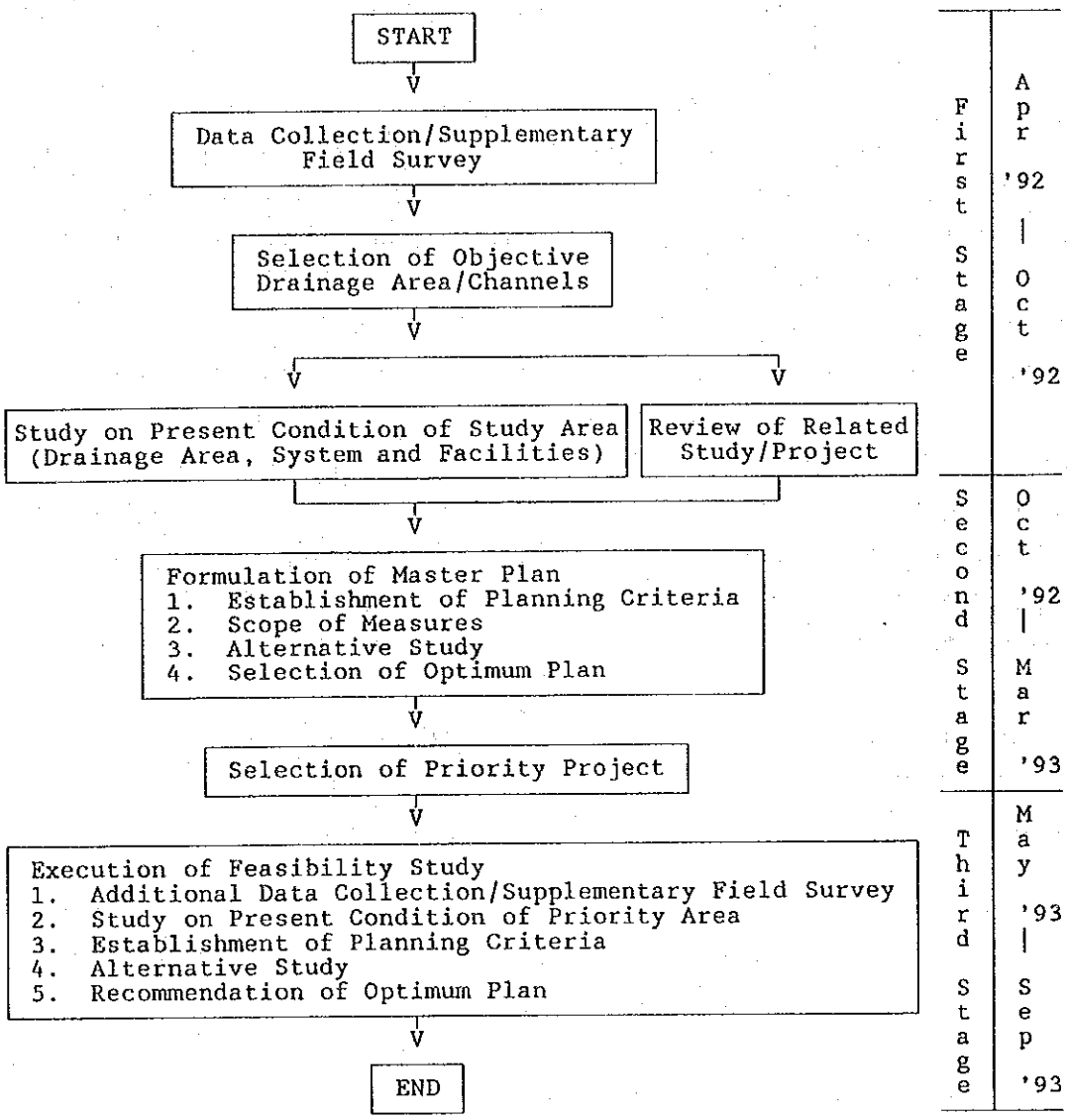
To find out an effective solution for such internal flood problem, studies have made in the following three (3) study stages:

First Stage : April 1992 to October 1992, Study on Present Condition of Study Area and Review of Related Projects

Second Stage : October 1992 to March 1993, Formulation of Master Plan and Selection of Priority Project

Third Stage : May 1993 to September 1993, Execution of Feasibility Study on Priority Project

The studies have been carried out in accordance with the following flow chart:


START
Data Collection/Supplementary Field Survey
Selection of Objective Drainage Area/Channels
Study on Present Condition of Study Area (Drainage Area, System and Facilities)
Review of Related Study/Project
Formulation of Master Plan
1. Establishment of Planning Criteria
2. Scope of Measures
3. Alternative Study
4. Selection of Optimum Plan
Selection of Priority Project
Execution of Feasibility Study
1. Additional Data Collection/Supplementary Field Survey
2. Study on Present Condition of Priority Area
3. Establishment of Planning Criteria
4. Alternative Study
5. Recommendation of Optimum Plan
END
First Stage
Apr '92 | Oct '92
Second Stage
Oct '92 | Mar '93
Third Stage
May '93 | Sep '93

## CHAPTER 2 COLLECTED DATA AND THEIR AVAILABILITY

Collected data and information related to the urban drainage study, which are attached in the form of DATA BOOK, have been compiled into the following five (5) categories:

Category I : topography

Category II : population and land-use

Category III : flood and flood damage

Category IV : existing drainage system and facilities

Category V : related study and on-going project

Collected topographic maps with scales of 1:50,000, 1:20,000 and 1:10,000 are rather old and partially lack information on drainage networks. These are required to be partially up-dated. During the Master Plan Study, a new topographic map with a scale of 1:10,000 was prepared by the Study Team based on the current aerial photograph and supplementary topographic survey.

For the population and land-use of Semarang City, present (1990) and future (2000) forecasting data were obtained. Future population and land-use in the target year 2015 were forecasted by trending of these data (refer to CHAPTER 1 of SECTOR III).

Current internal flood and flood damage data were collected from Semarang City; however, these are rather insufficient. Supplementary interview survey was conducted by the Study Team to enhance the data reliability for the economic and social evaluation of the proposed project.

For the central area of Semarang City, the existing drainage network and as-built drawings of the Semarang River and

Banger River improvement project were obtained. On the former drawings, however, no main hydraulic or structural features of the channels are mentioned. Investigation of the existing drainage system and facilities by field survey was required.

Several reports, documents and drawings concerning the previous studies and on-going projects were collected from the related agencies. These studies and on-going projects were reviewed in the Master Plan Study.

# CHAPTER 3 IDENTIFICATION OF OBJECTIVE DRAINAGE AREA AND CHANNELS

Semarang City, consisting of nine (9) districts (kecamatan), is the capital of Central Jawa Province and covers an area of approx. 374 km2. This area is topographically divided into the following two (2) land features as shown in Fig. VI.3.1:

(1) The northern coastal flood plain of approx. 123 $km^2$ lying between the coastline and the 25 m contour line; and

(2) The southern hilly land of approx. 251 $km^2$ lying above 25 m contour line.

Almost 65% of the present population of 1.25 million and 50% of the total built-up area of 186.3 $km^2$ are concentrated in the northern coastal area. It is projected that these percentages in the target year 2015 will increase to approx. 70% and 60%, respectively, because of the high potential for urban development (refer to Table VI.3.1, and Figs. VI.3.2 and VI.3.3). Moreover, 95% of all the frequently flooded area of approx. 2,600 ha is located in the northern coastal area, where much personal and social assets are concentrated and has always had a high flood damage risk (refer to Table VI.3.2 and Fig. VI.3.4).

Taking the above into consideration, the northern coastal area consisting of four (4) drainage areas, namely, Eastern Semarang, Central Semarang, Western Semarang, and Kec. Tugu, has been selected as a master plan area for urban drainage (refer to Fig. VI.3.1).

Objective primary channels in the master plan area, which are directly connected to either the Jawa Sea or the major flood control rivers flowing through Semarang City as

defined in the Scope of Work of this study, were identified as follows:

| Name of Drainage Area | Objective Primary Channel | | |
|---|---|---|---|
| | Number | Total Catchment Area ($km^2$) | Total Channel Length (km) |
| Eastern Semarang | 2 | 42.764 | 18.42 |
| Central Semarang | 4 | 18.269 | 16.61 |
| Western Semarang | 4 | 7.362 | 7.98 |
| Kec. Tugu | 9 | 35.376 | 30.10 |
| Total | 19 | 103.771 | 73.11 |

Details and location of the objective primary channels are shown in Table VI.3.3 and Fig. VI.3.5.

# CHAPTER 4 PRESENT DRAINAGE CONDITION OF MASTER PLAN AREA

## 4.1 Present Condition of Drainage Area and System

The master plan area is divided into four (4) drainage areas; Eastern Semarang, Central Semarang, Western Semarang and Kec. Tugu. Their present conditions are described below.

### 4.1.1 Eastern Semarang Area

The eastern Semarang area of 47.8 $km^2$ is surrounded by the coastline to the north, East Floodway to the west and south, and Babon River to the east. The area is mainly divided into two (2) drainage zones; the Siringin river basin of 14.104 $km^2$ and the Tenggang river basin of 28.660 $km^2$. The remaining area of about 5.0 $km^2$ is included in the Babon river basin. Most of the area has been developed as an agricultural land; however, it is currently being developed as both industrial and residential area.

Changes in land use have deteriorated flooding conditions due to increase of peak run-off. The areas which experienced flooding in almost every year show a flood area of 9.76 $km^2$, flood depth of 0.3 to 1.2 m, and flood duration of 8 to 21 hours.

Stormwater collected by tertiary open ditches are drained into Jawa Sea through several secondary drains and the primary channels of Siringin and Tenggang rivers, as shown in Fig. VI.4.1.

This area has never had an urban drainage master plan; however, improvement of two (2) primary channels is proposed to be implemented as a mid-term

plan in SIUIDP (Semarang Integrated Urban Infrastructure Development Program) with financial assistance from IBRD (refer to Section 5.1).

### 4.1.2 Central Semarang Area

The central Semarang area of 27.2 $km^2$ is situated between East and West Floodway, and covers the central area of Semarang City which is fully urbanized. The area is mainly divided into three (3) drainage areas, the Semarang river basin of 11.225 $km^2$ including the Asin river basin of 4.252 $km^2$, the Banger river basin of 6.466 $km^2$, and the Bulu river basin of 0.578 $km^2$. The remaining area of about 8.93 $km^2$ consists of several small independent drainage areas along the northern coastline and West Floodway.

After completion of the Semarang River Drainage Improvement Project (Urban V) which was undertaken from 1985 to 1990, an area of 5.98 $km^2$ is still flooded at a depth of 0.2 to 0.7 m and a duration of 1 to 8 hours. The flooding conditions of the Banger river basin are more serious with a flood area of 2.73 $km^2$, flood depth of 0.2 to 0.75 m, and duration of 1 to 48 hours, because of incomplete river improvement works.

The area has basically adopted a surface drainage system consisting of tertiary open ditches, open or covered type secondary drains, and primary open channels such as the Semarang, Banger, Asin and Bulu rivers, as shown in Fig. VI.4.1.

Construction of a tidal gate with a pumping station at the mouth of Semarang River and improvement of Banger River were poposed in SIUIDP. Feasibility of this proposal were reviewed in the Master Plan Study.

### 4.1.3 Western Semarang Area

The western Semarang area of 12.4 $km^2$ situated between Silandak Floodway and West Floodway covers the newly developed area (PRPP and Marina Recreation Center) and Achmad Yani Airport. The area is divided into three drainage zones; the Karangayu-Ronggolawe river basin of 4.533 $km^2$, the Tawan river basin of 1.403 $km^2$ and the Silandak drainage basin of 1.426 $km^2$. The remaining area of about 5.0 $km^2$ includes Achmad Yani Airport and the fishpond along seashore.

Stormwater collected by open ditches is drained into West Floodway and Silandak River by gravity flow through the primary channels of Karangawe, Ronggolawe and other channels, as shown in Fig. VI.4.1.

Improvement of five (5) bottlenecks at the above channel crossings with the national railway and Jl. Siliwangi, which are the main causes of floods (flood area of 0.5 ha, flood depth of 0.2 m, and duration of almost 3 hours), was also proposed in SIUIDP as the urgent improvement work.

### 4.1.4 Kecamatan Tugu Area

The Kecamatan Tugu area of 35.4 $km^2$ is situated between the west boundary of Semarang City and Silandak Floodway. The area is in the early stage of development. Built-up area is situated along Jl. Siliwangi and the national railway. The predominant land use is paddy field and fishpond which are expected to be developed in the future as industrial area. This area includes nine (9) primary drainage channels which drain directly into Jawa Sea, and no master plan has ever been formulated for these channels.

## 4.2 Present Condition of Objective Primary Channels

### 4.2.1 Current Channel Improvement Works

Out of 19 objective primary channels, only Semarang River has had a full scale drainage improvement project proposed in the previous Master Plan prepared in 1976. The project consists of channel improvement works of approx. 51.4 km including secondary and tertiary channel improvement, 13 bridge construction, rehabilitation of Kartini pumping station and procurement of seven (7) O/M equipment. The project was executed from 1985 to 1990 as Semarang River Drainage Improvement Project (Urban V) (refer to Section 5.3).

Banger River has been improved at only three (3) sections of about 3.5 km out of a total channel length of 6.7 km, because of land acquisition problem and budgetary constraint.

Three (3) primary channels except Silandak channel in Western Semarang area have been improved in the land development project of PRPP without any authorized drainage master plan.

No channel improvement works have been implemented for other primary channels situated in Eastern Semarang and Kec. Tugu areas.

### 4.2.2 Sectional Channel Characteristics

Sectional channel characteristics of 10 primary drainage channels located between Silandak River and Babon River were investigated based on the channel survey by the JICA study team. The main features of these channels are summarized in the following table.

| Name of Channel | Length (km) | Width (m) | Depth (m) | Bed Slope |
|---|---|---|---|---|
| Siringin R. | 8.6 | 1.8-45.5 | 0.7-2.7 | 0.00036-0.0011 |
| Tenggang R. | 9.5 | 3.5-49.5 | 0.8-2.4 | 0.00014-0.0016 |
| Semarang R. | 8.2 | 2.2-66.0 | 0.7-2.2 | 0.00021-0.00076 |
| Banger R. | 6.5 | 3.5-53.5 | 0.8-1.6 | 0.00017-0.00063 |
| Asin R. | 3.4 | 1.3-35.0 | 0.7-2.1 | 0.00055-0.0013 |
| Bulu R. | 1.8 | 1.8- 4.7 | 0.6-1.9 | 0.00083-0.0038 |
| Kalangayu R. | 2.9 | 3.4- 9.8 | 0.7-9.8 | 0.00027-0.0046 |
| Ronggolawe R. | 4.6 | 3.3-22.5 | 1.0-2.6 | 0.00031-0.0014 |
| Tawang R. | 1.2 | 3.6-11.5 | 1.3-2.1 | 0.00067 |
| Silandak C. | 0.8 | 5.5- 7.2 | 0.9-1.9 | 0.0021 |

Table VI.4.1 and Fig. VI.4.2 show the hydraulic features of the objective primary channels.

Supplementary cross sectional surveys for 31 bottlenecks of the primary channels have been conducted at the road or railway crossing in order to calculate their present flow capacities and to supply data for evaluation of the necessity of their improvement. Location and cross section of the bottlenecks are shown in Figs. VI.4.3 and VI.4.4.

### 4.2.3 Discharge Capacity

The existing discharge capacity for 133 channel sections and 31 bottlenecks at railway or road crossings of 10 objective primary channels was estimated by the uniform flow model of Manning's Formula as shown below.

$$Q = 1/n \cdot A \cdot i^{1/2} \cdot R^{2/3}$$

*where,*

*Q* : *Rate of discharge ($m^3/s$)*
*n* : *Manning's roughness coefficient*
- *unlined channel; n = 0.031*
- *lined channel (both banks); n = 0.024*
- *lined channel (bed and both bank); n = 0.020*

*A* : *flow area considering freeboard ($m^2$)*
*i* : *channel bed slope*
*R* : *Hydraulic radius (m)*

The estimated discharge capacities are summarized in the table below.

| Name of Channel | Typical Section ($m^3/s$) | Bottleneck (place) | Bottleneck ($m^3/s$) |
|---|---|---|---|
| Siringin R. | 0.8-48.7 | 2 | 3.7- 4.5 |
| Tenggang R. | 2.2-19.5 | 5 | 1.6-11.8 |
| Semarang R. | 2.9-31.6 | 8 | 2.2-35.01 |
| Banger R. | 1.6-17.8 | 6 | 0.8- 7.7 |
| Asin R. | 0.1-39.4 | 3 | 0.4- 7.1 |
| Bulu R. | 0.6-16.2 | - | - |
| Kalangayu R. | 1.5-38.0 | 4 | 1.5- 4.8 |
| Ronggolawe R. | 0.8-14.4 | 4 | 2.9-23.65 |
| Tawang R. | 2.8-25.7 | - | - |
| Silandak C. | 4.7- 8.0 | - | - |

Tables VI.4.1 and VI.4.2 and Fig. VI.4.2 show the existing discharge capacity of the objective primary channels including their bottlenecks.

### 4.2.4 Sedimentation

Through the field investigation of the primary channels, the following findings have been confirmed:

(1) The existing urban drainage systems have been used for multiple purposes such as storm drainage, open sewer for sanitary and industrial waste-water, and disposal site for solid waste and other trash;

(2) Most primary channels in the Central Semarang Area have thick layers of sedimentation consisting of silt, solid waste and organic material, the main causes of internal flood; and

(3) Operation and maintenance work for channel sedimentation has not been done sufficiently.

Although some dredging and dumping equipment for the removal of sediment were procured in Urban V during the period from 1985 to 1990, sedimentation problems have not been solved yet due to insufficient funds for O/M activities.

For example, the channel cross section of Semarang River has been reduced by heavy sedimentation after completion of channel improvement in 1990. The required dredging volume of Semarang River from the river mouth to Jl. Pandanaran is estimated to be approx. 87,300 $m^3$ based on the channel survey results as shown in Table VI.4.3 and Fig. VI.4.5.

# CHAPTER 5 REVIEW ON RELATED STUDIES AND PROJECTS

## 5.1 Stormwater Drainage Master Plan for the City of Semarang

This was the first master plan of urban storm drainage for Semarang City with a total area of approx. 374 $km^2$. The study was conducted between 1975 and 1976 by a joint venture of foreign consultants, Burns & McDonnell and Trans-Asia Engineering Associates, Inc., as one of the four concurrent environmental master plan studies; municipal water supply, wastewater, storm drainage, and solid waste management.

The study had included the collection of historical data and information, investigation and evaluation of present drainage system and facilities, forecasts of future population and land use in the target year 2000, study on alternative drainage system, and determination of improvements to be required during the planning period for the urbanized area of approx. 27 $km^2$ between the East and West Floodway.

The conclusions of the study are summarized below.

(1) Basic rainfall and runoff data necessary to accurately design the storm drainage systems are not available. A system for the monitoring and recording of required hydrological data should be established immediately.

(2) Most existing storm drainage systems are undersized and dirty. Silt and waste should be removed from the channels. Some sections have to be widened and lined to increase flow capacity.

(3) The practice of "flushing" consumes part of the channel maintenance flow and should be minimized. The proposed channel lining will permit effective flushing with a limited amount of water.

(4) All solid wastes, trash and sanitary sewage should be kept out of the drainage systems. The storm drainage system should be used for the single purpose of removal of surface storm runoff.

(5) Land use practices in upstream catchment areas should be changed in order to develop new ground cover and promote reforestation to prevent continued erosion of the soil. Soil erosion has caused a major problem of siltation in existing city drainage systems.

Identified storm drainage programs were recommended to be implemented in the following three phases correlating with the future city growth.

(1) Phase I (up to 1980): To establish the organization for implementing the program and improve the existing drainage system (Fig. VI.5.1).

This involves the establishment of a governmental organization which shall be responsible for all operation and maintenance (O/M) of the existing drainage systems and the execution of proposed improvement programs. It includes the establishment of a system for monitoring and recording of hydrological and hydraulic data in the organization. Improvement of the existing drainage channels

and construction of new channels and other drainage facilities are to be executed as follows:

| | | |
|---|---|---|
| Cleaning of Existing Channels | : | V = 178,000 $m^3$ |
| Rehabilitation of Existing Channels | : | l = 47 km |
| Improvement of Semarang R. | : | l = 3.6 km |
| Construction of New Channels | : | l = 6.2 km |
| Construction of Tidal Gate | : | 1 unit |
| Construction of Side Outlet Weir | : | 1 unit |

Total project cost is estimated to be about US$6.3 million at 1976 prices.

(2) Phase II (up to 1990): Design and construction of drainage facilities to relieve the flooding problem of Simpang Lima area and to provide adequate road drainage (Fig. VI.5.2).

Phase II will cover improvement of the Simpang Lima Drainage System, as follows:

| | | |
|---|---|---|
| Construction of Storage Well | : | l = 2,000 m |
| Construction of Pump Station | : | Q = 6 $m^3/s$ |
| Provision of Drainage Ditch along the Roadway | : | 1 unit |

Total project cost was estimated to be about US$1.5 million at 1976 price.

(3) Phase III (up to 2000): Design and construction of drainage facilities for the developing city area.

This phase will cover the following:

(a) Provision of adequate ditches along new roads;

(b) Establishment of flood plain management; and

(c) Construction of recommended drainage canals; namely, the construction of drains running in cross section from 3 $m^2$ to 60 $m^2$ of about 100 km.

Total project cost is estimated to be about US$12.0 million at 1976 prices.

## 5.2 Semarang Drainage Project

In succession to the aforesaid master plan study, a detailed technical study on a drainage improvement project for Semarang River and Banger River was conducted in 1982 by a local consultant, Deserco Development Services. The study included the following:

(1) Establishment of design criteria;

(2) Run-off analysis and determination of design discharges;

(3) Planning of river alignment and forming of typical cross sections and profiles of the rivers;

(4) Preliminary design of bank protection, bridge, and related structures, including O/M equipment; and

(5) Project phasing and cost estimate.

The study results are summarized below.

### 5.2.1 Hydrological and Hydraulic Criteria

Design Tide Level

Design tide levels applied at the mouth of both rivers are as follows:

| Design Water Level | BPP M1 | MSL at JKT |
|---|---|---|
| Highest High Water Level (HHWL) | +1.30 | +0.79 |
| Mean High Water Level (HWL) | +0.93 | +0.42 |
| Mean Sea Level (MSL) | +0.63 | +0.12 |
| Mean Low Water Level (MLWL) | +0.33 | -0.18 |

Note: MSL at Jakarta = BPP M1 - 0.506 m

Design Rainfall

The rainfall intensity-duration with a 5-year return period was employed for the design of the river improvement. For secondary channels, a 2-year return period rainfall intensity was applied. Design rainfall is shown below:

| Duration (min) | Rainfall Intensity (mm/hr) | |
|---|---|---|
| | 2-year return period | 5-year return period |
| 20 | 104 | 145 |
| 40 | 72 | 99 |
| 60 | 55 | 79 |
| 120 | 34 | 55 |
| 180 | 24 | 40 |
| 240 | 18 | 30 |
| 360 | 15 | 23 |

Run-off Model

The run-off model for the estimation of design discharges of drainage channels applied the following Modified Rational Formula.

$$Q = c \cdot C_S \cdot i \cdot A$$

*where,*

| | | |
|---|---|---|
| $Q$ | : | *Peak discharge ($m^3/s$)* |
| $c$ | : | *Runoff coefficient* |
| $C_S$ | : | *Storage factor coefficient (0.8)* |
| $i$ | : | *Average rainfall intensity during time of concentration (mm/hr)* |
| $A$ | : | *Drainage area ($km^2$)* |

Runoff coefficient

Applied runoff coefficients by land use are shown below.

| Land Use | Runoff Coefficient |
|---|---|
| Business Area | 0.95 |
| Area around Business Area | 0.70 |
| Residential Area | |
| - High Density | 0.75 |
| - Middle Density | 0.65 |
| - Low Density | 0.50 |

5.2.2 Design Discharge and Forming of Profile and Cross Section

Design discharges of both rivers were estimated by the Modified Rational Formula mentioned before.

According to the calculation results shown in Figs. VI.5.3 and VI.5.4, the specific design discharges of both rivers range as follows:

Semarang River : 5.8 - 18.4 $m^3/s/km^2$
($A = 0.2 - 10.3\ km^2$)

Banger River : 5.7 - 14.4 $m^3/s/km^2$
($A = 0.4 - 6.5\ km^2$)

Profiles and cross sections of the channels are formed to obtain the effective velocity for sedimentation in design flood run-off. Designed profiles and typical cross sections of Semarang and Banger Rivers are given as follows:

| Item | Semarang River | Banger River |
|---|---|---|
| Riverbed Slope | 0.000209-0.000761 | 0.000174-0.000634 |
| Cross Section | | |
| - Downstream | trapezoidal shape with 1:2 slope | trapezoidal shape with 1:2 slope |
| - Middle Stream | rectangular type paved by retaining wall | trapezoidal shape with 1:0.5 slope paved by retaining wall |
| - Upstream | - do - | - do - |

Proposed typical cross sections of channel improvement are presented in Fig. VI.5.5.

### 5.2.3 Project Cost

Total project cost was estimated to be Rp. 11,331.9 million (US$17.4 million) at 1976 prices, based on the preliminary design of retaining

wall for bank protection, bridge, culvert outlet, and other related structures. The breakdown of the project cost are shown below:

(Unit: million Rp.)

| Item | Semarang River | Banger River | Total |
|---|---|---|---|
| Construction Cost | 3,403.9 | 3,364.8 | 6,768.7 |
| House Compensation | 1,798.6 | 1,207.3 | 3,005.9 |
| Rehabilitation of Bridge | 187.9 | 944.4 | 1,132.3 |
| O/M Equipment | 425.0 | - | 425.0 |
| Total | 5,815.4 | 5,516.5 | 11,331.9 |

The project is recommended to be implemented in three (3) phases.

## 5.3 Implementation of Semarang River Drainage Improvement Project (Urban V)

This is a drainage improvement project consisting of channel improvement of Semarang River, secondary and tertiary drains, construction of related structures, and procurement of O/M equipment. The plans were prepared based on the Master Plan prepared in 1976 and the detailed structural study in 1982 mentioned before. As a link to the Urban V program, the project was implemented from 1985 to 1990 with financial assistance from the World Bank (IBRD). Fig. VI.5.6 shows the location of each project package.

The number of project packages and their total cost by fiscal year are as follows (refer to Table VI.5.1):

| Fiscal Year | No. of Packages | Project Cost (million Rp.) |
|---|---|---|
| 1984/1985 | 10 | 1,094.0 |
| 1985/1986 | 16 | 2,392.0 |
| 1986/1987 | 8 | 725.5 |
| 1987/1988 | 11 | 2,520.0 |
| 1988/1989 | 18 | 2,592.1 |
| 1989/1990 | 10 | 3,428.9 |
| Total | 73 | 12,752.5 |

The project components are given below.

(1) Channel Improvement

| | | |
|---|---|---|
| Primary Channel | : | approx. 7.85 km |
| Secondary Channel | : | approx. 35.11 km |
| Tertiary Channel | : | approx. 8.46 km |
| Total | : | 51.42 km |

(2) Bridge Construction : 13 units

(3) Mechanical and Electrical
Pump Rehabilitation : 2 places

(4) Procurement of O/M
Equipment : 7 units

(5) Land Acquisition/House
Evacuation : 2,128 families

Breakdown of channel improvement length, project cost and the financial source by fiscal year are shown in Tables VI.5.1 to VI.5.3.

A tidal gate with pump station and storage basin, which was proposed to be installed near the river mouth of Semarang River in the master plan, was excluded in this project. Hence, tidal floods occurring along the downstream stretches of Semarang River were not solved and the problems have become more serious for the inhabitants, aggravated by land subsidence due to private groundwater use.

## 5.4 Semarang Surakarta Urban Development Project (SSUDP)

### 5.4.1 Technical Memorandum of SSUDP

The SSUDP is an on-going project of the Directorate General of Cipta Karya and the Directorate of Bina Program, Ministry of Public Works, as a medium term investment program (PJM) for drainage improvement in Semarang City and Surakarta City. The technical study was carried out from 1990 to 1991 by Sinotech Engineering Consultants, Inc., in association with two foreign and one local consultants. The objective of this program is to mitigate the frequent floods experienced in the coastal flood plain by improving the major drainage systems between Silandak River and Babon River.

The design scale of the program followed the urban drainage guideline of the Integrated Urban Infrastructure Development Program (IUIDP), i.e., a 2-year return period for housing area, and a 5-year return period for commercial and industrial areas,as well as major channels in large areas.

The proposed works consist of channel improvement including railway bridge improvement, construction of tidal gate with pumping station, rehabilitation of secondary and tertiary drains, O/M support, and

technical assistance for the revision of the urban drainage master plan. The cost is summarized as follows:

| Area | Proposed Works | Cost (million Rp. at 1991 price) |
|---|---|---|
| Western Semarang | Channel improvement including railway bridge (l = 4,692 m) | 2,933.3 |
| West Floodway | Railway bridge, channel improvement of Ronggolawe River and Karangayu River, channel improvement of Bulu River (l = 2,040 m) | 2,446.0 |
| Central Semarang | Tidal gate of Semarang River and channel improvement of Banger River (l = 3,141 m) | 13,002.7 |
| Eastern Semarang | Channel improvement of Tenggang River and Siringin River (l = 10,520 m) | 21,620.2 |
| | - Rehabilitation of secondary and tertiary drains including Tumpang channel (l = 810 m) | 1,484.9 |
| | - O/M support | 3,626.7 |
| | - Technical assistance for master plan revision | 719.4 |
| | - Administration cost | 2,725.9 |
| | - Engineering cost | 4,342.8 |
| | - Tax | 4,053.2 |
| Total | | 56,955.1 |

Note: The above cost includes physical contingency at 10% of base cost, but excludes price contingency.

It was proposed that the above project components will be implemented between fiscal year 1991/1992 and 1995/1996 as shown in Table VI.5.4. Fig. VI.5.7 shows the location of the proposed projects.

Directorate General of Cipta Karya and Directorate of Bina Program have already requested the World Bank financial assistance for the smooth implementation of this project. According to the discussion with Cipta Karya of Central Jawa Province, a consultant from the Netherlands, DHV, started the review study of the project feasibility in June 1992. Hence, it is necessary to correlate the studies made by JICA and the World Bank in further studies.

### 5.4.2 Review Study of SSUDP

Stage IV of Semarang Surakarta Urban Development Project (SSUDP), which is a medium term infrastructure development project for the year 2000, started in June 1992 and is scheduled to be completed in June 1993. The objectives of Stage IV are to finalize the study process by assisting the local governments of Semarang and Surakarta for the IBRD appraisal, to provide support during the appraisal process, to prepare loan documentations and to assist in the preparation for implementation.

According to the Position Paper Semarang of SSUDP prepared in April 1993, the proposal for urban drainage in Semarang City covers the following:

(1) To increase the flow capacity of rivers, drainage channels and pumping stations in the densely populated central city area where these improvements will have the greatest economic and social benefit;

(2) Rehabilitation of secondary and tertiary drainage channels; and

(3) Provision of assistance to improve the operation and maintenance of the drainage system.

The proposed program, which consists of the 16 components proposed in Stage IV and nine (9) components additionally proposed, is summarized below.

(1) Improvement of 28.3 km primary channels;
(2) Improvement of 34.8 km secondary channels;
(3) Improvement of 91.5 km tertiary drains;
(4) Construction of a tidal gate in Semarang River;
(5) Procurement of equipment; and
(6) Periodic maintenance.

Total cost of the proposed program is estimated to be Rp. 50.7 billion.

Location of each proposed project component and their implementation schedule are shown in Fig. VI.5.8 and Table VI.5.5, respectively.

# CHAPTER 6 FORMULATION OF MASTER PLAN

## 6.1 Planning Criteria

### 6.1.1 Target Year

The target completion year of the Urban Drainage Master Plan is set at 2015 on the premise that the project implementation period is 20 years. Accordingly, plans are to be prepared to meet the population and land use in the target year 2015. Present and projected future population and built-up area of the urban drainage study area are shown in Table VI.3.1.

### 6.1.2 Scope of Measures

The proposed measures will consist of structural and non-structural measures to minimize project cost and to facilitate the smooth implementation of the project in correlation with the urban development plans for the rapidly urbanizing areas.

Structural measures to be proposed for the present and future built-up areas are:

(1) improvement of primary channels having poor flow capacity for the future requirement including improvement of bottlenecks such as bridges, box culverts and pipe culverts;

(2) construction of tidal protection facilities such as raising of existing embankment or revetment, and construction of tidal gate; and

(3) construction of pump station with retarding basin for low-lying area to economize on pump drainage cost by reducing the pump requirements.

On the other hand, non-structural measures to be mainly proposed for development areas in the future are:

(1) proper land use arrangement or regulation to preserve the area requirement for the proposed structural measures mentioned above; and

(2) recommendation of the lowest ground elevation by filling up in the future land development for low-lying areas (fishpond or paddy field) along the seashore.

### 6.1.3 Design Scale

Design scale of the Urban Drainage Master Plan is proposed to meet the guideline on the level of services for urban drainage systems proposed in IUIDP (Integrated Urban Infrastructure Development Program). The proposed design scale is as follows:

| Catchment Area ($km^2$) | Design Flood (year return period) |
|---|---|
| less than 0.1 | 1 |
| 0.1 to 1.0 | 2 |
| 1.0 to 5.0 | 5 |
| more than 5.0 | 10 |

In accordance with the above design scale, out of 19 objective primary channels, seven (7) channels should

be planned for a 10-year return period flood. These are:

| | | |
|---|---|---|
| Eastern Semarang Area | : | Siringin R. and Tenggang R. |
| Central Semarang Area | : | Semarang R. and Banger R. |
| Western Semarang Area | : | None |
| Kec. Tugu Area | : | Boom Karanganyar R., Randugarut R. and Mangkang Kulon R. |

Other 12 primary channels should be planned for a 5-year return period flood.

### 6.1.4 Design Flood Level

According to the Technical Study on the Drainage Improvement of Semarang and Banger Rivers, the design flood levels at the mouth of Semarang River and Banger River adopted the tidal levels at Semarang Harbor shown in the table below, the bench mark of which used BPP MI, +1.225 m above low water spring in Semarang Harbor.

| Item | BPP MI System | Jakarta System |
|---|---|---|
| Highest High Water Level | +1.30 | +0.79 |
| High Water Level | +0.93 | +0.42 |
| Mean Water Level | +0.63 | +0.12 |
| Low Water Level | +0.33 | -0.18 |
| Lowest Low Water Level | +0.00 | -0.51 |

Note: Datum line of BPP MI System is 0.51 meter below datum line of Jakarta System (Mean Sea Level in Jakarta Harbor)

Design flood levels in this Master Plan are proposed by applying the tidal levels at Semarang Harbor revised based on the latest available tidal records from January 1989 to September 1992. The proposed design flood levels are as follows:

| Item | BPP MI System | Jakarta System |
|---|---|---|
| Highest High Water Level | +1.31 | +0.80 |
| Mean High Water Level | +1.11 | +0.60 |
| Mean Water Level | +0.60 | +0.09 |
| Mean Low Water Level | +0.11 | -0.37 |
| Lowest Low Water Level | -0.07 | -0.58 |

The revised high water level of +0.6m above MSL in Jakarta Harbor is analyzed to be almost 0.20 m higher than the previous one. Fig. VI.6.1 shows the tidal levels at Semarang Harbor. The Mean High Water Level (MHWL) of +0.6 m above MSL at Semarang Harbor is used as the starting water level for the calculation of the design high water level of the objective drainage channels.

Fig. VI.6.2 illustrates the typical tidal variations at HHWL and MHWL, which give effective information for the demarcation of gravity or pump drainage systems.

### 6.1.5 Design Rainfall

Two (2) design rainfalls have been developed for the primary channel improvement plan and the pump drainage plan.

(1) For Primary Channel Improvement Plan

The rainfall intensity-duration with 5-year and 10-year return periods are employed for the design of channel improvement.

*5-year Return Period*

$$I = 1{,}000/(T + 4.49)^{0.60} \quad : \quad t \leq 2 \text{ hr}$$
$$I = 2{,}050/(T + 2.95)^{0.76} \quad : \quad 2 \text{ hr} < t \leq 12 \text{ hr}$$

*10-year Return Period*

$$I = 967/(T + 2.93)^{0.57} \quad : \quad t \leq 2 \text{ hr}$$
$$I = 2{,}600/(T + 7.20)^{0.78} \quad : \quad 2 \text{ hr} < t \leq 12 \text{ hr}$$

*where, I: Point rainfall intensity (mm/hr)*
*T: Duration time (min.)*

Applied rainfall intensity and duration curves are shown in Fig. VI.6.3.

The above design rainfalls are made based on the point rainfall data. For the calculation of the design discharge, the area reduction factor is to be considered to convert a basin average rainfall intensity. The areal reduction factor curves are presented in Fig. VI.6.4.

(2) For Pump Drainage Plan

Twelve (12) hours of consecutive rainfall with a 5-year return period is applied as the design rainfall for the pump drainage plan. The rainfall depth and its hourly distribution are shown in Fig. VI.6.4. This design rainfall is made based on the rainfall intensity-duration

formula with a 5-year return period as a central concentration type hyetograph.

### 6.1.6 Run-off Formula

The Modified Rational Formula is applied for the calculation of design discharges for channel improvement considering the topographic and land use conditions of the catchment areas.

$$Q = 0.2778 * Cs * C * I * A$$

*where,* $Q$ : *peak discharge* ($m^3/s$)
$I$ : *average intensity of rainfall (mm/hr)*
$A$ : *catchment area* ($km^2$)
$C$ : *run-off coefficient*
$Cs$ : *storage coefficient (0.8)*

The proposed run-off coefficients (c) by land use are shown in the table below.

| Land Use | Run-off Coefficient (c) |
|---|---|
| Business and Surrounding Area | 0.8 |
| Residential Area | |
| - High density | 0.7 |
| - Medium density | 0.6 |
| - Low density | 0.5 |
| Industrial and Harbor Area | 0.8 |
| Green Zone and Others | 0.3 |

### 6.1.7 Drainage Criteria

Since the design rainfall intensity in short duration is very high, it is proposed that short duration internal flooding with low flood damage will be allowed for some low-lying areas, considering that

the investment for project implementation is reasonable. Duration of pump drainage for design rainfall is proposed to be within 24 hours.

### 6.1.8 Demarcation Criteria of Gravity or Pump Drainage System

The demarcation criteria for adoption of gravity or pump drainage system is as follows:

*GE ≥ DWL + hl : Gravity Drainage System*
*GE < DWL + hl : Pump Drainage System*

*where, GE : ground elevation of low-lying area (EL. m)*

*DWL : design flood water level at outlet of drainage channel (EL. m)*

*hl : hydraulic head loss of open drainage channel (0.3 to 0.5 m)*

Taking the above into consideration, some downstream areas along Semarang River and Banger River are to adopt the pump drainage system as shown in Fig. VI.6.5.

### 6.1.9 Freeboard and Roughness Coefficient

Freeboard and Manning's roughness coefficient for channel improvement plan are applied as follows:

| Channel Type | Freeboard (m) | Manning's Roughness Coefficient |
|---|---|---|
| Unlined Channel (embankment) | 0.60 | 0.031 |
| Lined Channel (both banks) | 0.40 | 0.024 |
| Lined Channel (bed and both banks) | 0.40 | 0.015 |

6.1.10 Specific Pump Capacity and Storage Requirement

Specific pump capacity and storage requirement by channel, retarding basin and temporary inundation area are estimated to be 1.34 $m^3/s/km^2$ and 69.19 x $10^3 m^3/km^2$, respectively, by Mass Curve method as shown in Fig. VI.6.6.

## 6.2 Alternative Plan

Alternative plans composed of some possible measures were prepared for the following drainage channels, considering the features of channel courses and catchment areas:

(1) Tenggang River in Eastern Semarang Area
(2) Semarang River in Central Semarang Area
(3) Banger River in Central Semarang Area
(4) Bulu River in Central Semarang Area

No alternative plan is prepared for Western Semarang and Kec. Tugu areas because of the very simple drainage system.

### 6.2.1 Tenggang River

Tenggang River has the biggest catchment area of 28.66 $km^2$. No channel improvement work has been implemented except the middle-stream stretches of 1.7 km. In due consideration of the present poor flow capacity, a large scale channel improvement by widening and deepening will be necessary. Two (2) cases of diversion alternatives by new channel construction are prepared as shown in Fig. VI.6.7(2/7).

Alternative 1-A : Large scale channel improvement of Tenggang River under the present drainage system

Alternative 1-B : Channel improvement of Tenggang River and construction of a new 2.25 km diversion channel for the industrial area of 6.4 $km^2$ between Jl. Raden Patah and the national railway.

Alternative 1-C : Partial channel improvement of Tenggang River and construction of a new 4.50 km diversion channel for the eastern side of the area of about 18.2 $km^2$.

Construction costs of the above alternatives are given in the following table:

(Unit: million Rp.)

| Item | Alt.1-A | Alt.1-B | Alt.1-C |
|---|---|---|---|
| Channel Improvement | 10,583 | 10,663 | 10,883 |
| Related Structure | 2,025 | 2,125 | 1,772 |
| Land Acquisition | 5,060 | 6,520 | 6,860 |
| House Evacuation | 1,736 | 1,498 | 1,008 |
| | (248) | (214) | (144) |
| Total | 19,404 | 20,806 | 20,523 |

Note: 1. Figures in parentheses show the number of houses to be evacuated.
2. Details of construction cost are shown in Table VI.6.1(1/4).

Although Alternative 1-A is recommendable considering the lowest construction cost, Alternative 1-C is recommended in due consideration of the following:

(1) Construction cost of Alternative 1-C is not too different from Alternative 1-A;

(2) The number of house evacuation for Alternative 1-C is the lowest; and

(3) It is recommendable to construct one diversion channel between Tenggang River and Siringin River to reduce the design discharge of the downstream stretch to less than 100 m3/s and to minimize the risk of flood damage downstream of Tenggang River.

### 6.2.2 Semarang River

In the previous master plan (refer to Section 5.1) and SSUDP (refer to Section 5.4), construction of a tidal gate and a pumping station with a retarding basin was proposed at the mouth of Semarang River. These structures are for the prevention of tidal backflow and stormwater drainage of some low-lying

areas at high tide. Since their capital and O/M costs seem to be higher, the following tidal protection and pump drainage alternatives are prepared as shown in Fig. VI.6.7(3/7).

Alternative 2-A : Proposal in the previous Master Plan and SSUDP.

Alternative 2-B : Raising the embankment of Semarang River between the North Ring Road and the national railway for tidal protection, and construction of two (2) small pumping stations with gates and retarding ponds at the mouth of Asin River and one pumping station for the low-lying area of Bandar Harjo West, where a triangular zone is formed surrounded by Semarang River, the ring road, and Baru and Semarang rivers.

Construction costs of the above alternatives are given as follows.

(Unit: million Rp.)

| Item | Alt. 2-A | Alt. 2-B |
|---|---|---|
| Channel Improvement | 2,072 | 2,093 |
| Pumping Station with Gate | 20,738 | 12,919 |
| Related Structure | 551 | 551 |
| Land Acquisition | 352 | 250 |
| House Evacuation | 0 | 1,050 |
| | (0) | (150) |
| Total | 23,713 | 16,863 |

Note: 1. Figures in parentheses show the number of houses to be evacuated.

2. Details of construction cost are shown in Table VI.6.1(2/4).

Although about 150 houses are to be removed, Alternative 2-B is recommended because of the more economical tidal protection measure and the pump drainage system for the Semarang river basin.

### 6.2.3 Banger River

In the previous Master Plan, Karangturi River was proposed to be connected with Banger River through three (3) covered channels to be newly constructed along Jl. Brigjend Katamso, Jl. Kartini and Jl. Bugangan. However, only the channel along Jl. Brigjend Katamso has been constructed. Therefore, two (2) channel improvement alternatives are prepared as shown in Fig. VI.6.7(4/7).

Alternative 3-A : Construction of two (2) connection channels (box culvert) with a total length of 0.9 km along Jl. Kartini and Jl. Bugangan.

Alternative 3-B : Karangturi river channel improvement of 2.58 km by widening and deeping.

Construction costs of the above alternatives are given as follows.

(Unit: million Rp.)

| Item | Alt. 3-A | Alt. 3-B |
|---|---|---|
| Channel Improvement | 3,337 | 4,045 |
| Related Structure | 50 | 82 |
| Land Acquisition | 310 | 596 |
| House Evacuation | 910 | 1,505 |
| | (130) | (215) |
| Total | 4,607 | 6,228 |

Note: 1. Figures in parentheses show the number of houses to be evacuated.
2. Details of construction cost are shown in Table VI.6.1(3/4).

Alternative 3-A is recommended because of lower construction cost and fewer house evacuation than Alternative 3-B.

### 6.2.4 Bulu River

Bulu River improvement is proposed to be implemented in SIUIDP under the original catchment area of 0.41 $km^2$. As shown in Fig. VI.6.7(5/7), if stormwater of the uppermost area (about 0.17 $km^2$) of the Asin river basin can be drained into Bulu River by constructing a new covered connection channel of 200 m along Jl. Indraprasta, it will be possible to delete the requirement for pump station at the mouth of Asin River. So, the following alternatives are prepared.

Alternative 4-A : Bulu River improvement in original drainage system

Alternative 4-B : Bulu River improvement and construction of a new covered connection channel of 200 m along Jl. Indraprasta.

Construction costs of these alternatives are given as follows:

(Unit: million Rp.)

| Item | Alt. 4-A | Alt. 4-B |
|---|---|---|
| Channel Improvement | 224 | 400 |
| Related Structure (Pump Station and Inspection Road) | 429 | 9 |
| Land Acquisition | 99 | 66 |
| House Evacuation | 252 | 210 |
| | (36) | (30) |
| Total | 1,004 | 685 |

Note: 1. Figures in parentheses show the number of houses to be evacuated.
2. Details of construction cost are shown in Table VI.6.1(4/4).

Alternative 4-B is recommended because of lower construction cost and less number of house evacuation in comparison with Alternative 4-A.

## 6.3 Optimum Plan

### 6.3.1 Proposed Channel Improvement Plan

Design Discharge

Each objective drainage area is divided into several sub-drainage areas based on the existing topographic conditions, roads and channel networks as shown in Fig. VI.6.7(1/7) to VI.6.7(7/7). The design discharges for channel improvement are estimated by the Modified Rational Formula according to the short duration design rainfall of 5-year or 10-year return periods and the projected land use in 2015.

The proposed design discharges for each channel improvement are shown in Table VI.6.2 and Fig. VI.6.8.

Proposed Channel Improvement

The objective primary channels require channel improvement by widening and dredging in order to increase their conveyance capacity.

Planning concepts for longitudinal and cross sections of the channels to be improved are as follows:

(1) Bed elevation at the river mouth at Jawa Sea is planned to be the same or higher than -2.0 m above MSL in Jakarta Harbor in order to maintain the riverbed;

(2) Channel bed slope is planned to be nearly the same as the existing one or the ground slope; and

(3) The following six (6) types of channel cross sections are proposed:

Type A : Trapezoidal shape channel with 1:2 slope lined by sodding

Type B : Trapezoidal shape channel with 1:1.5 slope lined by cobblestone pitching

Type C : Trapezoidal shape channel with 1:0.33 slope lined by stone masonry

Type D : Rectangular channel lined by stone masonry

Type E : Type C provided with concrete sheet pile for foot protection

Type F : Type D provided with concrete sheet pile for foot protection

Types A and B are applied for channel sections in the existing fishpond area or agricultural land where land acquisition is likely easy. Types C to F are proposed for those in the existing built-up areas where land acquisition is to be difficult.

(4) Operation and maintenance roads with a minimum width of 5.0 m including shoulder is planned along both sides of river channels.

The proposed longitudinal and cross sections of the primary channels are shown in Table VI.6.3 and Fig. VI.6.9.

As related structures, road and railway bridges are planned to be reconstructed at channels crossed by roads and railways.

The proposed channel improvement works are shown in Table VI.6.4. Since Kec. Tugu Area does not have any urban development plan, only the width of the right-of-way and the area to be acquired for the objective rivers are presented for future urban development plan (refer to Table VI.6.5).

### 6.3.2 Proposed Pump Drainage Plan

Pump Drainage Area

As mentioned in Subsection 6.1.8, Demarcation Criteria of Gravity or Pump Drainage System, low-lying areas of the Semarang river basin between the North Ring Road and the national railway are to adopt the pump drainage system. The low-lying areas are divided into the following three (3) pump drainage areas (refer to Fig. VI.6.10).

| Name of Pump Drainage Area | Area ($km^2$) |
|---|---|
| Bandar Harjo (Bh) | 0.580 |
| Asin River Basin (As) | 4.252 |
| Baru River Right Bank (Ba) | 1.088 |
| Total | 5.920 |

On the other hand, the low-lying area at the right bank of Banger River containing the undeveloped national railway property, is proposed to be filled up to 1.1 m above MSL in Jakarta Harbor before land development, to avoid the costly pump drainage system.

Requirement of Pumping Station and Retarding Basin

To economize on total pump drainage cost by reducing the required pump capacity, each pump station is proposed to be provided with a retarding basin. The required pump capacity and retarding basin volume can be estimated by the specific pump capacity and storage requirement mentioned in Subsection 6.1.10. The calculation results are as follows:

| Item | Pump Drainage Area | | |
|---|---|---|---|
| | Bh | As | Ba |
| Drainage Area ($km^2$) | 0.580 | 4.252 | 1.088 |
| Specific Pump Capacity ($m^3/s/km^2$) | 1.34 | 1.34 | 1.34 |
| Specific Storage Requirement ($x10^3m^3/km^2$) | 69.2 | 69.2 | 69.2 |
| Required Pump Capacity ($m^3/s$) | 0.8 | 5.7 | 1.5 |
| Required Total Storage Volume ($x10^3m^3$) | 40.1 | 294.2 | 75.3 |
| (1) Storage Volume by Channels ($x10^3m^3$) | 6.0 | 44.1 | 11.3 |
| (2) Storage Volume by Temporary Inundation in the area ($x10^3m^3$) | 17.4 | 127.6 | 32.6 |
| (3) Storage Volume by Retarding Basin ($x10^3m^3$) | 16.7 | 122.5 | 31.4 |

Note: 1. Storage volume by channel is assumed to be almost 15% of the required total storage volume.
2. Almost 15% of pump drainage area is allowed for temporary inundation at depths lower than 0.20 m under non-flood damage condition.

Proposed Location of Pumping Station with Retarding Basin

The location of three (3) pumping stations with retarding basin is proposed as follows:

P1: Bandar Harjo P.S.: low-lying right bank of Semarang River crossing with North Ring Road

P2: Asin P.S. : confluence of Asin and Semarang River

P3: Baru P.S. : right bank of Baru River crossing with North Ring Road

Proposed location is shown in Fig. VI.6.10.

6.3.3 Proposed Non-structural Measures

Necessity of Non-structural Measures

Eastern Semarang area is being rapidly urbanized from paddy field to residential and industrial areas and Kec. Tugu area is expected to develop in the near future as an industrial area. Thus, both of the areas are projected to be fully urbanized by the target year 2015. Change of land use from paddy fields or fishponds in low-lying areas to industrial or residential areas by filling up will increase not only the total amount of flood run-off but also the peak discharge. Hence, the proposed structural measures shall be implemented to meet the expansion of urbanization, although, it will take much time and investment for their completion.

On the other hand, non-structural measures consisting of land use regulations or arrangements as soft measures do not require much investment for execution. Although difficulty is found for the execution of land use regulations due to insufficient local government organization and lack of laws for land use control, non-structural measures are recommended to sustain the full functioning of proposed structural measures and to prepare a guideline for future development from the viewpoint of stormwater drainage.

Preservation of Low-lying Area

Essentially, low-lying areas have the potential for storage of stormwater and the function to decrease the peak discharge of storm run-off. Filling up of low-lying areas for land development will instantly deteriorate the drainage condition of surrounding areas and bring the necessity of much investment for drainage improvement by structural measures.

Accordingly, it is proposed that the local government shall preserve the low-lying areas for land development as much as possible under the guidance of appropriate land use regulations.

Preservation of Future Land Requirement of Channel Improvement

The objective primary channels in Eastern Semarang and Kec. Tugu areas will require a large scale channel improvement by widening and dredging. Since land acquisition will require much investment, the future land requirement of channel improvement shall be preserved for the present. Any reduction of the proposed minimum channel width including O/M road shall be strictly controlled by the local government.

The total area to be preserved in both areas is estimated at 1,774.5 x $10^3 m^2$. Table VI.6.5 shows the preserved area by objective primary channel.

Required Ground Elevation of Future Development

Most low-lying areas in Eastern Semarang and Kec. Tugu are expected to be developed by filling up. The ground elevation of future low-lying development is to be the following one required for adoption of the gravity drainage system because the pump drainage is more costly.

$$GE > DWL + hl$$

*where, GE : required ground elevation by filling up (EL. m)*

*DWL : design flood water level at outlet of drainage channel (EL. m)*

*hl : hydraulic head loss (0.3-0.5 m)*

Low-lying areas along the coastline shall be filled up to 1.1 m above MSL, at least, for land development. Moreover, extra-filling for not only settlement due to consolidation but also land subsidence due to groundwater development shall be considered.

## 6.4 Selection of Priority Project

The results of the economic evaluation on the Urban Drainage Master Plan are as follows:

| | EIRR (%) |
|---|---|
| Western Semarang Area | 10.8 |
| Central Semarang Area | 15.1 |
| Eastern Semarang Area | 9.5 |

Considering the above results of economic evaluation and social impact, the priority sequence of drainage areas is given as follows:

First Priority Area : Central Semarang Area of 27.2 $km^2$

Second Priority Area : Western Semarang Area of 12.4 $km^2$

Third Priority Area : Eastern Semarang Area of 47.8 $km^2$

To facilitate the selection of a priority project for the feasibility study, already planned and/or ongoing projects by concerned agencies and deferrable work will be deleted from the projects proposed in the first priority area, Central Semarang of 27.2 $km^2$. The ongoing and deferrable projects are given as follows:

(1) Channel improvement of Bulu River in SSUDP with financial assistance from IBRD (L = 2,040 m).

(2) Channel improvement of Banger River proposed in the above project (L = 3,141 m).

(3) Construction of tidal gate and pumping station of Semarang River proposed in the above project. This construction work is revised by this Master Plan.

Table VI.5.5 shows the implementation schedule of the above works in SSUDP. Accordingly, the following pump drainage projects for low-lying areas in the Semarang river basin are given as the priority projects for the Feasibility Study.

(1) Pump drainage project for Bandarharjo West Area of 0.58 $km^2$;

(2) Pump drainage project for the Asin river basin of 4.252 $km^2$;

(3) Pump drainage project for the right bank of Baru River (hereinafter revised to Bandarharjo East Area) of 1.088 $km^2$;

(4) Raising of earth dike of Semarang River from the river mouth to the national railway crossing (L = 2.9 km);

(5) Reconstruction of gate structure in Baru River; and

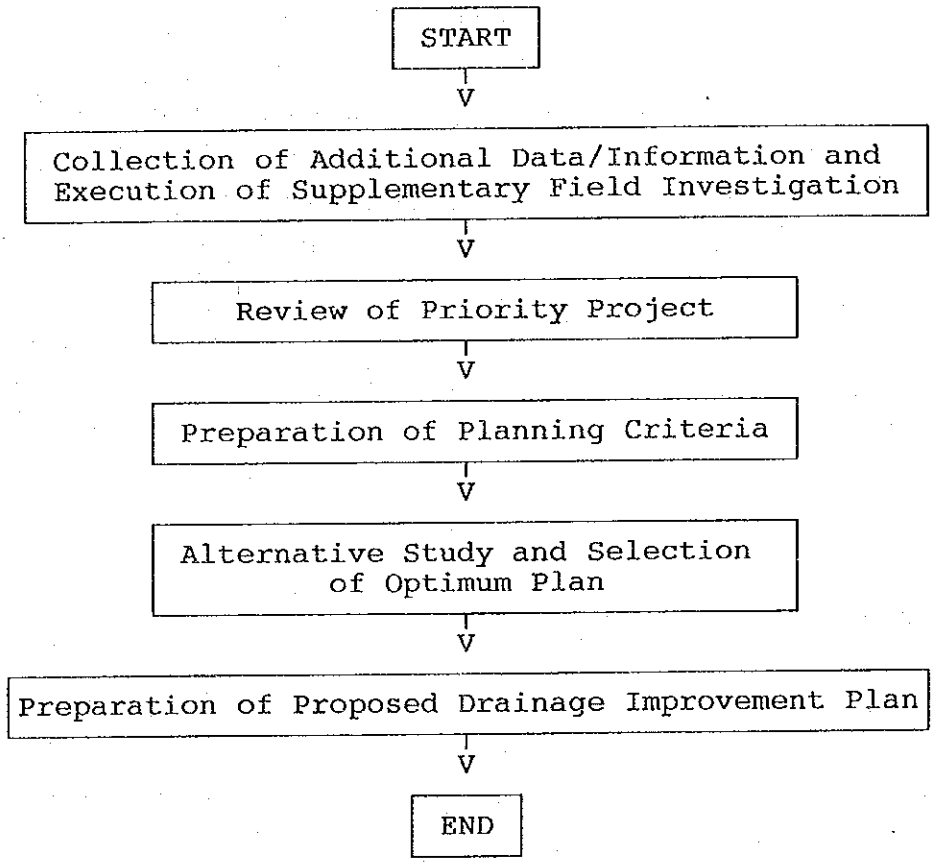
(6) Dredging of Semarang River from the river mouth to Jl. Pandanaran crossing (L = 6.9 km).

Fig. VI.6.10 shows the location of the above priority projects.

# CHAPTER 7 FEASIBILITY STUDY ON PRIORITY PROJECT

## 7.1 General

As described in the previous chapter, six (6) priority projects consisting of three (3) pump drainage projects, one (1) gate construction project and two (2) channel improvement projects of Semarang River were identified as the priority projects for the Feasibility Study. The study has been carried out in accordance with the following flow chart.




## 7.2 Present Condition of Priority Project Area

### 7.2.1 Bandarharjo West Area (refer to Fig. VI.7.1)

The Bandarharjo West drainage area of 0.58 $km^2$ is triangular shape surrounded by the Ring Road to the

north, Semarang River to the southwest, and Baru River to the east. The southern part of almost 65% of the drainage area has been developed as a low income residential area (50%) and the Marabunta warehouse (15%) along the left bank of Baru River. The northern part of remaining 35% of the area is low-lying and still undeveloped as a swamp, or unfunctional fishpond; however, it is expected to be developed in the future as an industrial area, according to the land development program prepared by Tanjung Emas State Port Corporation.

As no systematic secondary and tertiary drainage network is prepared in the residential area, inundation problems are very serious. During daily high tide, some low-lying areas have been inundated by 0.1 to 0.2 m deep without any rainstorm, due to the backwater of high tide of Semarang River. It is strictly required that secondary channels of the covered type shall be constructed under the main inner roads of the residential area to drain rainstorm to the proposed pumping station located to the north.

### 7.2.2 Asin Drainage Area (refer to Fig. VI.7.2)

Asin drainage area covers the Asin river basin of 4.252 $km^2$, which is mostly fully urbanized mainly as residential area (80% of the area). Areas along Imam Bonjol/Hasanuddin streets, especially the Tanah Mas and Pondok Hasanuddin estates, are for middle and high class housing. Low income residential areas are situated at the left bank of Semarang River south of Tanah Mas Estate, at the west and east areas from Pondok Hasanuddin Estate, and along both sides of the national railway including the northern area of Poncol Railway Station. Institutional and

business/commercial areas are along the both sides of Pemuda Street.

The Asin drainage area is provided mostly with systematic secondary and tertiary drainage networks . Five (5) main secondary channels located at the southern part of the area drain stormwater into the uppermost stream of Asin River. These channels are:

Channel A : Drainage for Bima, Poncowolo, Plombokan, and Ksatria areas.

Channel B : Drainage for Abimanyu, Pondok Hasanuddin estate, and Ksatria areas.

Channel C : Drainage for Imam Bonjol (south) and Hasanuddin areas.

Channel D : Drainage for Imam Bonjol (center), Purwosari, and Purwogondo areas.

Channel E : Drainage for Boomlama and Peres areas.

Stormwater collected by tertiary drains in Tanah Mas Estate drain directly into Asin River through six (6) secondary channels. The drainage area along the left bank of Semarang River drains into Semarang River; however, during high tide, it cannot drain out due to its low ground elevation.

During the rainy season, many areas in the northern part from the national railway have been flooded several times a year. The most serious areas are situated along the left bank of Semarang River and both banks of Asin River, where some low-lying areas have been inundated daily at high tide even in the dry season.

### 7.2.3 Bandarharjo East Area (refer to Fig. VI.7.3)

As mentioned later, the name and area are revised respectively from the right bank of Baru River to Bandarharjo East and from 1.088 $km^2$ to 1.49 $km^2$ by adding the southern part of Tawang Street.

The area is surrounded by Baru River to the west, Usman Janatin Street to the north, Ronggowarsito Street to the east, and the small inner road to the south. The area is divided into two sub-drainage areas, the northern part of approx. 1.0 $km^2$ and the southern part of approx. 0.49 $km^2$.

The present land use of the northern sub-drainage area is warehouse/factory in the western part and low income residential area in the eastern part. The main secondary drain is open channel along Usman Janatin, Mpu Tantular and Ronggowarsito streets, and its outlet is at the crossing with the Ring Road and Baru River. Flood damage in western low-lying areas is very serious. During high tide in the dry season, these areas have always been flooded.

The southern sub-drainage area is used mainly as business/commercial area. The main secondary drain is the open channel along Merak, Ronggowarsito streets. The old city area between Merak and Suprapto streets has a high flood damage risk due to its low ground elevation.

## 7.3 Review on the Priority Project

Based on the collected additional data and supplementary field investigation, the priority project identified in the master plan has been reviewed and revised, as follows:

(1) The name of Bandar Harjo drainage area is revised to Bandarharjo West drainage area.

(2) Name and area of the Right Bank of Baru River are revised to Bandarharjo East drainage area and 1.49 km, respectively. Based on the supplementary field survey, it was found that the southern part of approx. 0.49 $km^2$ from Tawang Street drains into Baru River through the secondary channel along Merk and Ronggowarsito streets.

(3) Based on the above, the requirements of pump capacity of Bandarharjo East is revised as follows:

$$Q = 1.34\ m^3/s/km^2 \times 1.49\ km^2 = 2.0\ m^3/s$$

(4) Considering the difficulty of land acquisition for the proposed retarding pond in Asin River and Bandarharjo East area, it is proposed that the percentage of temporary inundation area is revised from 15% to 20% of the total drainage area, so that storage requirements are calculated as follows:

| Item | Asin River | Bandarharjo East |
|---|---|---|
| Required Total Storage Volume ($x10^3 m^3$) | 294.2 | 103.1 |
| (a) Storage Volume by Channel ($x10^3 m^3$) | 44.1 | 15.5 |
| (b) Storage Volume by Temporary Inundation in the Area ($x10^3 m^3$) | 170.1 | 59.6 |
| (c) Storage Volume by Retarding Pond ($x10^3 m^3$) | 80.0 | 28.0 |

(5) Type and length of tidal protection facility for Semarang River by raising of earth dike (L = 2.9 km) are revised to raising of earth dike (Type B, L = 2.36 km) and retaining wall (Type C, L = 0.54 km).

(6) For tidal protection of the Baru river basin, raising of retaining wall (Type C, L = 600 m) from Ring Road crossing to the uppermost junction with Semarang River shall be undertaken as an additional priority project.

The revised priority project (refer to Fig. VI.7.4) is given below:

(1) Pump drainage works for Bandarharjo West area of 0.58 $km^2$;

(2) Pump drainage works for the Asin river basin of 4.252 $km^2$;

(3) Pump drainage works for Bandarharjo East area of 1.49 $km^2$;

(4) Raising of earth dike (Type B, L = 2.36 km) and retaining wall (Type C, L = 0.54 km) of Semarang River from the river mouth to the national railway crossing;

(5) Reconstruction of gate structure in Baru River;

(6) Raising of retaining wall (Type D, L = 800 m) of Baru River from Ring Road crossing to junction with Semarang River; and

(7) Dredging of Semarang River (approx. V = 87,000 $m^3$) from the river mouth to Jl. Pandanaran crossing (L = 6.9 km).

## 7.4 Planning Criteria for Feasibility Study

### 7.4.1 Target Year

The target completion year of the priority project for the Feasibility Study is set at 2005 on the premise that the project implementation period is 10 years.

The proposed pumping stations with retarding ponds are, however, to be planned and designed to meet the population and land use in the same target year 2015 as that of the Master Plan, considering the following:

(1) The proposed facilities serve urban drainage for the central area of Semarang City, which is already fully and highly urbanized and will not be a higher density area in the future.

(2) Three (3) pumping stations proposed in the Master Plan, with various capacities ranging from approx. 0.8 to 5.7 m3/s based on a 5-year return period flood, are not so big in scale and also not so high in their investment cost. Since their economic efficiency is expected to be high, the proposed pumping stations shall be constructed at a time in full scale.

(3) Considering the difficulty of future land acquisition in the central area of Semarang City, it is recommended that land acquisition for the proposed pumping stations and retarding ponds shall be carried out as soon as possible.

### 7.4.2 Design Scale of Semarang River Improvement

In the master plan of Semarang River improvement, a 10-year frequency flood is applied as the design flood of the long term plan for the target year 2015 in accordance with the IUIDP (Integrated Urban Infrastructure Development Program) guideline prepared by Cipta Karya, Ministry of Public Works.

For the identified priority project of Semarang River improvement, which consists of the dredging work of 6.9 km and the raising of embankment or retaining wall of 2.9 km, a 5-year return period flood is proposed for the design flood due to the following considerations:

(1) The target completion year of the priority project is set at 2005 as a middle term drainage improvement program.

(2) The channel improvement work shall be executed step by step and its flood mitigation function shall be gradually upgraded considering its economic efficiency.

(3) The priority project shall be implemented to coincide with the related ongoing SSUDP (Semarang Surakarta Urban Development Project) assisted by the World Bank, where the design scale for the primary channel is also a 5-year return period as a middle term plan.

### 7.4.3 Other Criteria

Other criteria such as design flood level, design rainfall, freeboard, etc., follow those of the Master Plan.

## 7.5 Alternative Plan

Pump drainage alternative study has been carried out for two (2) drainage areas, Asin River basin and Bandarharjo East. Since it may be anticipated that land acquisition for the proposed pump station and retarding ponds will be difficult in due consideration that their proposed sites are in almost fully urbanized areas. No alternatives to the pump drainage plan are prepared for Bandarharjo West area.

### 7.5.1 Asin River Basin

The proposed site of the Asin pumping station ($Q = 5.7\ m^3/s$) with retarding pond ($V = 80,000\ m^3$) is near the confluence with Asin and Semarang Rivers, of which upstream area has developed as low and middle class residential area. Even if some open spaces are found out in the Tanah Mas estate at near the proposed site, these have already been scheduled to construct an apartment building in the near future. Considering the above difficult situation of land acquisition and house evacuation for the construction of the proposed facilities, the following three (3) pump drainage alternatives are prepared:

(1) Alternative A-1 [refer to Fig. VI.7.5(1/2)]

Pumping station ($Q=5.7\ m^3/s$) with retarding pond ($V=80,000\ m^3$) is planned to be constructed at the confluence with Asin and Semarang rivers with much land acquisition and house evacuation.

(2) Alternative A-2 [refer to Fig. VI.7.5(2/2)]

Pumping station (Q=5.7 $m^3/s$) with retarding pond (V=40,000 $m^3$; 50% of Alternative A-1) and the remaining retarding pond (V=40,000 $m^3$) with a daily dewatering pumping station (Q=0.5 $m^3/s$) are planned to be constructed at the confluence of Asin and Semarang rivers and open space at the uppermost reaches of Asin River, respectively.

(3) Alternative A-3 [refer to Fig. VI.7.5(1/2)]

This is basically the same as Alternative A-1, however, additional channel improvement works for Semarang River (shift of river channel) shall be considered for less land acquisition and house evacuation.

Construction costs of the above alternatives are given below.

(Unit: million Rp.)

| Item | | Alt.A-1 | Alt.A-2 | Alt.A-3 |
|---|---|---|---|---|
| A: | Construction Base Cost | 10,513 | 12,703 | 10,951 |
| (1) | Preparatory Works | 956 | 1,155 | 996 |
| (2) | Pumping Station | 5,976 | 7,476 | 5,976 |
| (3) | Gate Structure | 899 | 899 | 899 |
| (4) | Retarding Pond | 1,444 | 1,754 | 1,337 |
| (5) | Channel Improvement | 369 | 369 | 838 |
| (6) | Miscellaneous Works | 869 | 1,050 | 905 |
| B: | Compensation Cost | 1,687 (94) | 1,212 (94) | 751 (52) |
| | Total | 12,200 | 13,915 | 11,702 |

Note: 1. Figures in parentheses show the number of houses to be evacuated.

2. Details of the above cost are shown in Table VI.7.1.

Although construction base cost of Alternative A-3 is higher than that of Alternative A-1, Alternative A-3 is recommended because of its lowest total construction and house evacuation costs. The houses to be removed are the illegal ones constructed by fishermen.

### 7.5.2 Bandarharjo East Area

The pumping station with a capacity of 2.0 $m^3/s$ combined with the retarding pond with a storage volume of 28,000 $m^3$ are proposed to be constructed at the right bank of Baru River upstream of the Ring Road bridge, which has fully developed as a warehouse or industrial area. Considering the above site condition, the following two (2) pump drainage system alternatives are prepared.

(1) Alternative B-1 (refer to Fig. VI.7.6)

Pumping station (Q=2.0 $m^3/s$) with retarding pond (V=28,000 $m^3$) including connection channel (L=600 m) between the existing secondary channel and the retarding pond are planned to be constructed at the right bank of Baru River neighboring with the Navy office.

(2) Alternative B-2 (refer to Fig. VI.7.6)

Baru River has been serving two (2) functions, as port facility for loading/unloading and as diversion channel of Semarang River. At present, however, it serves only as a diversion channel (Q=6.0 $m^3/s$). Therefore, Baru River is divided into two (2) cross sections by constructing a concrete retaining wall of about 600 m long between the Ring Road bridge and the

uppermost reaches of Baru River. Almost 30% of Baru River's cross section is planned for use as diversion channel (Q=6.0 $m^3/s$, L=600 m). The remaining 70% of the cross section is used for the proposed pumping station (Q=2.0 $m^3/s$) and retarding pond (V=28,000 $m^3$). Construction of the connection channel is almost the same as that of Alternative B-1.

Construction costs of the above alternatives are given below.

(Unit: million Rp.)

| | Item | Alt. B-1 | Alt. B-2 |
|---|---|---|---|
| A: | Construction Base Cost | 6,046 | 7,401 |
| | (1) Preparatory Works | 550 | 673 |
| | (2) Pumping Station | 3,442 | 3,442 |
| | (3) Gate Structure | 242 | 242 |
| | (4) Retarding Pond | 531 | 802 |
| | (5) Channel Improvement | 781 | 1,630 |
| | (6) Miscellaneous Works | 500 | 612 |
| B: | Land Acquisition/House Evacuation | 1,156 (4) | 84 (0) |
| | Total | 7,202 | 7,485 |

Note: 1. Figures in parentheses show the number of houses to be evacuated.
2. Details of the above cost are shown in Table VI.7.2.

Although the total cost of Alternative B-2 is only 4% higher than Alternative B-1, Alternative B-2 is recommended in due consideration of the difficulty of land acquisition and house evacuation.

## 7.6 Optimum Plan

### 7.6.1 Proposed Pump Drainage Plan

The optimum pump drainage plan covers the following three (3) pump drainage areas:

Bandarharjo West Area : A = 0.580 $km^2$
Asin River Basin : A = 4.252 $km^2$
Bandarharjo East Area : A = 1.490 $km^2$

Proposed Pumping Station and Retarding Pond

The application of retarding pond in urban storm drainage system economizes on the total pump drainage cost by reducing the required pump capacity. The required pump capacity and storage volume of the retarding pond are calculated by Mass Curve method as mentioned in Section 6.1.10. The calculation results are given in the following table.

| Item | Pump Drainage Area | | |
|---|---|---|---|
| | Bandarharjo West | Asin River | Bandarharjo East |
| Drainage Area ($km^2$) | 0.58 | 4.252 | 1.49 |
| Specific Pump Capacity ($m^3/s/km^2$) | 1.34 | 1.34 | 1.34 |
| Specific Storage Requirement ($x10^3$ $m^3/km^2$) | 69.2 | 69.2 | 69.2 |
| Required Pump Capacity ($m^3/s$) | 0.8 | 5.7 | 2.0 |
| Required Total Storage Volume ($x10^3$ $m^3$) | 40.1 | 294.2 | 103.1 |
| (1) Storage Volume by Channels ($x10^3$ $m^3$) | 6.0 | 44.1 | 15.5 |

| | | | |
|---|---|---|---|
| (2) Storage Volume by Temporary Inundation in the Area ($x10^3$ $m^3$) | 17.4 | 170.1 | 59.6 |
| (3) Storage Volume by Retarding Pond ($x10^3$ $m^3$) | 16.7 | 80.0 | 28.0 |

Note: 1. Storage volume by channel is assumed to be almost 15% of the required total storage volume.

2. Temporary inundation is considered to be allowed, of which area and depth are almost 15% for Bandarharjo West, 20% for Asin River and Bandarharjo East, and about 20 cm with non-flood damage, respectively.

Proposed Pumping Station

Based on the existing drainage system and drain network, construction sites of the three (3) pumping stations are proposed as follows:

Bandarharjo West P.S. : Right bank of Semarang River upstream from the North Ring Road crossing

Asin River P.S. : At the confluence with Asin and Semarang Rivers

Bandarharjo East P.S. : Baru River upstream from the North Ring Road crossing

Regarding the design water level of these pumping stations, the high water level (HWL) at Semarang Harbor of 0.60 m above MSL in Jakarta Harbor is basically applied as the design outlet water level. However, the design of the pump equipment shall also consider operation during the highest high water level (HHWL) of 0.8 m above MSL in Jakarta Harbor, which is the design water level for the embankment or