CHAPTER 8 PROPOSED FLOOD CONTROL PLAN

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8. PROPOSED FLOOD CONTROL PLAN

8.1 General

As studied in the previous chapter, the flood control plan consisting of river channel improvement, construction of a new diversion channel and utilization of three retarding basins as controllable ones is selected as an optimum flood control method in the Widas river basin, within the foreseenable future social and economic frame works in the basin. This plan is referred to as "comprehensive plan" in this report.

Regarding to implementation of the comprehensive plan, possibility of stagewise development is examined; namely the first stage and the second stage. Based on examination, practical implementation is recommended.

8.2 Proposed Comprehensive Plan

8.2.1 River stretches for comprehensive plan

The comprehensive plan covers the Widas main stream and its major tributaries. Considering the flood prone area and carrying capacity of the existing river channel, the stretches of the rivers taken up for planning for the comprehensive flood control plan are determined. The upstream end of the stretches for channel improvement is determined as the location where the design high-water level is accommodated with the existing river bank elevation with the proposed allowance.

The total river length to be improved by comprehensive plan is 81.8 km and those stretches are as follows.

(a) Widas river : 32.8 km
from river mouth to Sect. 41.1

(b) Flood diversion channel and upper Ulo : 7.9 km
from new confluence with Widas to Tiripan dam

(c) Lower Ulo : 3.3 km
from the confluence with Widas to bridge at Sect. 5.5 + 350

(d) Kedungsoko river : 9.8 km
from the confluence with the Widas to Malangasari dam

(e) Kuncir river : 10.3 km
from the confluence with the Kedungsoko to left tributary at Sect. 11.0

(f) Major secondary tributaries : Total 17.7 km for 12 rivers.

8.2.2 Design discharge distribution

The design discharge distribution for the proposed comprehensive plan is given on Fig. 8.2. The details of the flood analysis and preliminary hydraulic calculation on retarding basin are shown in ANNEX-2 and ANNEX-4 respectively.

8.2.3 Guideline design

The following are the criteria applied to design of river channel improvement;

(a) A series of photographic maps of 1/5,000 and 1/10,000 is used for the design of channel, dike alignment and controllable retarding basin.

(b) The river cross-section surveyed by BRBDEO and Study Team are used for the design of river channel. The interval of the surveyed cross-section is 500 m in average.

(c) With regard to Manning's roughness coefficient "n", 0.03 low-water channel and 0.05 for high-water channel are adopted by considering the channel condition.

(d) The following are adopted for the design of dike section as standard. The standard section is shown on Fig. 7.5.

River	Free board (m)	Crown width (m)	Slope	
			w/o protection	w/protection
Kuncir	0.8	3	1 : 2	1 : 1.5
Others	1.0	4	1 : 2	1 : 1.5

(e) The water level of 37.59 m in SHVP currently designed for 50-yr probable flood by Brantas Middle Reach River Improvement Project is adopted for the water level at river mouth of the Widas.

(f) The river width is determined by considering present river width of the objective rivers, scales of catchment area and design discharge, and recommended river width in Japan. For the lower Widas, the river width is proposed so as to envelope the large meandering of the existing river course. However, some excessive meandering is smoothened by means of cut-off channel. For the flood diversion channel, upper Ulo and Kuncir, high-water channel with a minimum width of 5 m is considered for securing stability of enbankment.

8.2.4 Proposed plan

The concept of the proposed plan is given on Fig. 8.3. The proposed longitudinal profiles are given on Fig. 8.4. The details of the proposed river channel alignment, river cross-sections and related river structures are shown in ANNEX-4. The outline of the proposed plan is as follows.

(1) Widas river

The total channel length to be improved is about 32.8 km. The proposed improvement plan consists of (i) river channel improvement, (ii) construction of controllable retarding basins of Widas and Ulo, and (iii) construction/reconstruction of related river structures.

The existing Widas river channel is improved mainly by excavation of low-water channel and construction of flood dike. Some parts of the excessive meandering in the existing channel are smoothened by means of cut-off channel.

The lower Ulo and a new diversion channel are newly joined to the middle and upper reaches of the Widas river respectively.

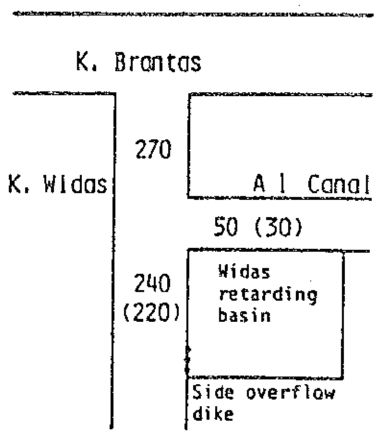
The existing natural retarding basins in the lower Widas and lower Ulo are converted into controllable one by construction of side overflow dike and drainage slice. The flood peak in the Widas is attenuated by the above controllable retarding basins. The layout of the Widas and Ulo controllable retarding basins and its related structures are given on Figs. 8.5 and 8.6.

As for designing the dimensions of the side overflow dike of the Widas retarding basin, the following are taken into consideration.

As one of the basic conditions of the improvement plan of the Widas river, the maximum outflow from the Widas river basin into the Main Brantas river is limited to 270 m^3/S against the 25-yr probable flood of the Widas river including the run-off of the Warujayeng irrigation area through Al canal.

According to the result of the run-off analysis, when the flood discharge of the Widas river is at its peak of about 410 m^3/S, the concurrent flood discharge of Al canal is about 30 m^3/S. By considering the limitation of outflow of 270 m^3/S to the Brantas river, the discharge of the Widas river of about 410 m^3/S should be reduced by the Widas retarding basin to 240 m^3/S. On the other hand, when the flood discharge of Al canal is at its peak of about 50 m^3/S, the flood discharge of the Widas river should be regulated (to about 220 m^3/S from) by the Widas retarding basin with the same reason.

The above discharge conditions are shematically shown below.



Note: Unit : m^3/s

(30) : Peak inflow from Al canal at design discharge of 240 m^3/s in the Widas

(220) : Peak inflow in the Widas at design discharge of 50 m^3/s in Al canal

The dimensions of the side overflow dike of the Widas retarding basin is determined by the above two conditions as well as the discharge limitation of about 220 m^3/S allowed for the Widas river. Because the length of the side overflow dike could be about 200 m against the discharge of 240 m^3/S for the downstream reach, but should be about 400 m against the discharge of about 220 m^3/S.

The proposed features of the controllable retarding basins are summarized below.

Features	Widas	Ulo
Retarding area (km^2)	13.2	6.3
Retarding capacity ($10^6 m^3$)	13.6	4.8
Design W.L (SHVP.m)	38.6	44.4
Control facility	Side overflow dike Drainage slice	Side overflow dike Drainage slice
Side overflow dike		
- Type	Fixed (non-gated)	Fixed (non-gated)
- Length	400 m for left bank 400 m for right bank	550 m for right bank of Widas
Drainage slice		
- Type	Open	Open
- Dimension (Width x Height)	3 m x 4 m x 2 spans for left bank 4 m x 4 m x 2 spans for right bank	4 m x 3.5 m x 2 spans for left bank of Kedungsoko

For lange tributaries, back-water levees are provided, for small tributaries, drainage culvert is constructed.

The Lengkong bridge is reconstructed due to the designed river wider width than the present one, as shown in ANNEX-4.

(2) Lower Ulo river

The total length to be improved is about 3.3 km. The Ulo river is separated from the Ulo retarding basin for effective use of the retarding basin. The lower Ulo river is diverted to the middle reaches of the Widas river by means of construction of cut-off channel with a total length of 1 km. The function of the lower Ulo is limited to that of local drainage in its residual basin. A syphon is constructed across under cut-off channel for irrigation use and a drop structure is constructed at the lowermost reach of the Ulo.

(3) Upper Ulo river and flood diversion channel

The total channel length to be improved is about 7.9 km. The proposed plan consists of (i) channel improvement of upper Ulo, (ii) construction of a new flood diversion channel with a length of 2.9 km and (iii) construction of related river structures.

The flood diversion channel is constructed to dirvert flood water coming from the upper Kuncir and Ulo rivers directly into the upper Widas river. No flood into the existing Kuncir and lower Ulo is allocated in this plan. The proposed route of the diversion channel is given on Fig. 8.7. The upper Ulo river is improved by excavation of low-water channel and construction of low dike. The lowermost of Second river a left tributary is improved by cut-off channel considering smooth joint and stability of the proposed diversion channel. The excessive meandering in the upper Ulo is also improved by means of cut-off channel.

The existing Kuncir diversion weir is reconstructed and its feasibility design is shown on Fig. 8.8.

The railway and highway bridges on the new diversion channel to be newly constructed are shown on Figs. 8.9 and 8.10. The Tiripan irrigation head works, and syphon-2 for irrigation use and a drop structure are newly constructed in the new diversion channel. Their feasibility designs are given in ANNEX-4.

(4) Kedungsoko river

The total channel length to be improved is about 9.8 km. The improvement plan consists of (i) channel improvement, (ii) construction of Kedungsoko controllable retarding basin, and (iii) construction of related river structures. The existing Kedungsoko river is improved by excavation of low-water channel and construction of flood dike involving construction of cut-off channel. The existing natural retarding basin of the Kedungsoko is improved as controllable one by means of construction of side overflow dike and drainage sluice. The flood peaks in the Kedungsoko river are attenuated by the above retarding basin. The layout of the Kedungsoko controllable retarding basin and its related structures are shown on Fig. 8.11. The proposed features of the controllable retarding basin are summarized below.

Features	Kedungsoko Retarding Basin
Retarding area (km^2)	6.5
Retarding capacity ($10^6 m^3$)	5.1
Design W.L (SHVP.m)	44.6
Control facility	Side overflow dike Drainage sluice
Side overflow dike	
- Type	Fixed (non-gated)
- Length	360 m for left bank 360 m for right bank
Drainage sluice	
- Type	Culvert
- Dimensions	2 m x 2 m x 2 spans for left bank 2.5 m x 2.5 m x 2 spans for right bank

The Malangsari dam is widened and strengthened by replacing the existing gates by a motor-driven gates. The Kedungsoko highway bridge is replaced by a motor-driven gate, and a new bridge and the Kedungsoko railway bridge is remained as it is. However, its piers in the low-water channel are protected. Such designs are presented in ANNEX-4.

(5) Kuncir river

The total channel length to be improved is about 10.3 km. The lower and middle Kuncir river is improved by means of excavation of low-water channel, construction of low dike, and cut-off channel. The flood coming from the upper Kuncir is diverted to the Widas river. The main purpose of the Kuncir river is local drainage in the residual basin. The stretch of downstream of the Kramat dam, which runs through the urban area is shifted by a cut-off channel to the outer area. The remained Kuncir river after construction of cut-off channel is utilized as an urban drainage channel.

A new syphon is constructed in the reach of the cut-off channel. The existing irrigation head works of Kapas and Kramat are improved by replacing the existing gate to motor-driven gate. Their feasibility designs are shown in ANNEX-4.

(6) Major secondary tributaries

Major secondary tributaries are improved in their backwater stretches by means of minor channel excavation and embankment. The total length to be improved is about 18 km and is shown below.

Tributary		Length to be improved (km)
Widas river		
Pohbuntu r	(Sect. 7.1)	0.9
Nglempoh r	(Sect. 12.3)	1.6
Jaan r	(Sect. 15.5 + 800)	1.3
Tributary	(Sect. 15.5 + 1300)	1.2
Tretes r	(Sect. 21.1 + 350)	1.5
Ngrembek r	(Sect. 31.1 + 200)	1.5
Tributary	(Sect. 33.1 - 700)	1.5
Pelangkeng r	(Sect. 33.1)	2.9
Wotrangkul r	(Sect. 38.6)	2.5
Upper Ulo river		
Secong r	(Sect. 15.5 + 250)	1.5
Winong r	(Sect. 18.0 + 250)	0.5
Kuncir river		
Gonggang - Malang r (Sect. 0.5)		0.8
Total		17.7

(7) Other related river structures

The other related river structures to be improved in this plan are revetment works, drop structures, drainage culverts, bridges, syphon for irrigation use, etc. Road bridges are planned to be reinforced concrete bridge in future, it may be possible to adopt P.C bridges on plate girder bridges, if they are cheaper and reliable. Inspection roads are planned on the top of the dikes, in order to secure good sight throughout the entire stretches. If public traffic is allowed on the inspection road, restriction of traffic may be required for protection of the dikes. The details of the proposed related river structures are presented in ANNEX-4.

8.2.5 Proposed flood control works and its quantities

The following are the major works proposed for the flood control project.

(1) Widas main stream including controllable retarding basins, major secondary tributaries and lower Ulo.

  (a) Excavation/dredging of channel and embankment of dike
  (b) Bank protection by means of wetmasonry/gabion
  (c) Reconstruction/construction of bridge
  (d) Construction of drop structure
  (e) Construction of drainage culvert and sluice
  (f) Construction of side overflow dike
  (g) Construction of syphon

(2) Flood diversion channel and upper Ulo river

  (a) Excavation of channel and embankment of dike
  (b) Bank protection by wetmasonry/gabion
  (c) Reconstruction/construction of bridge
  (d) Construction of drop structure, syphon, diversion weir irrigation head works
  (e) Construction of drainage culvert

(3) Kedungsoko river including controllable retarding basin

  (a) Excavation/dredging of channel and embankment of dike
  (b) Bank protection by wetmasonry/gabion
  (c) Reconstruction/construction of bridge
  (d) Construction of drainage culvert and sluice
  (e) Reimprovement of irrigation head works
  (f) construction of side overflow dike
  (g) Protection of railway bridge piers

(4) Kuncir river

  (a) Excavation of channel and embankment of dike
  (b) Bank protection by wetmasonry/gabion
  (c) Reconstruction/construction of bridge
  (d) Construction of syphon and drainage culvert
  (e) Reimprovement of irrigation head works

For the above works, the proposed work quantities and compensation are presented in Table 8.1 and summarized below.

River improvement works

Dredging	:	3,200,000 m^3
Excavation	:	4,200,000 m^3
Embankment	:	1,700,000 m^3
Bank protection		
Wetmasonry	:	108,000 m^2
Gabion	:	86,500 m^2
Reconstruction/construction of bridge including footpath	:	34 places
Pier protection of Kedungsoko railway bridge	:	1 place
Construction of drainage culverts and sluices	:	28 places
Reconstruction/reimprovement of irrigation head works	:	4 places
Reconstruction/construction of syhphns	:	4 places
Reconstruction of diversion weir	:	1 place
Construction of drop structures	:	2 places
Construction of side overflow dikes	:	5 places
Construction of drainage sluices in retarding basin	:	5 places

Land acquisition and building compensation

Land acquisition	:	7.016×10^6 m^2
Building compensation	:	440 nos

8.2.6 Direct construction cost

The direct construction cost is estimated on the basis of unit construction cost supported by unit prices of labor, construction materials and cost for operation of equipment assuming construction work by full-contract system.

The direct construction cost thus estimated for the comprehensive plan is $41,412.5 \times 10^6$Rp. The details of the construction plan and cost estimate are explained in Chapter 9 and ANNEX-8.

8.3 Stage-wise Development

8.3.1 General

The comprehensive flood control plan is formulated aiming at mitigating flood damage not only in the future basin condition but also in the present basin condition. As explained in the preceding chapter 5, the basin especially Nganjuk and its hinterland has been suffered from recurrent floodings. Therefore, urgent implementation of the flood control works for mitigating flood damage in the basin are strongly desirable from the viewpoint of social and economic espects.

However, current finance condition in Indonesia is being worsened due to depressing of oil export, drop of international market prince of oil, and other domestic constraints. In this regard, the Government of Indonesia requests a special consideration regarding to the allocation of counter Rupiah for project implementation.

Upon this request from the Government of Indonesia, stagewise development is examined below, to decrease annual counter Rupiah cost to be required for the project implementation.

The stagewise development is divided into 2 stages of first and second. The first stage plan is examined for 10-yr probable flood. The stage-wise development plan is described hereunder.

8.3.2 River stretches and extent

Since the prime objective of the flood control works is to protect the Nganjuk urban area which locates at the upstream end of the objective rivers of the comprehensive plan, all the stretches taken in the comprehensive plan shall also be considered in the first stage plan. Then the total length to be improved by the first stage plan is 81.8 km consisting of the following;

(a) Widas river : 32.8 km
from river mouth to Sect. 41.1

(b) Flood diversion channel and upper Ulo : 7.9 km
from new confluence with Widas to Tiripan dam

(c) Lower Ulo : 3.3 km
from the confluence with Widas to bridge at Sect. 5.5 + 350

(d) Kedungsoko river : 9.8 km
from the confluence with the Widas to Malangasari dam

(e) Kuncir river : 10.3 km
from the confluence with the Kedungsoko to left tributary at Sect. 11.0

(f) Major secondary tributaries : Total 17.7 km for 12 rivers.

8.3.3 Design discharge distribution

The target of the first stage development is set to protect the basin against the 10-yr probable flood. The design discharge distribution of 10-yr probable flood is given on Fig.8.12. The details of the flood analysis and the preliminary hydraulic study on the retarding basin are described in ANNEX-4.

8.3.4 Scope of the first stage development

In studying the scope of the first stage development, the following principles are taken into account;

(1) The project facilities shall be constructed so as to protect the basin against the 10-yr probable flood.

(2) The project facilities in the first stage shall be constructed so as to avoid and/or minimize future re-construction, re-widening and re-heightening.

In order to avoid re-widening of the total river width, the total river width in the first stage development is set as same as that in the comprehensive plan. Then, the total length of the bridges is the same as that in the comprehensive plan. In order to avoid re-heightening of the formation levels of the project facilities, the design high water levels in the first stage development are determined to be the same as those in the comprehensive plan. Then, the formation levels of dikes, bridges, etc. is the same as those in the comprehensive plan. In order to avoid re-construction, construction of side overflow dikes of the retarding basins, drainage sluices, irrigation headworks, diversion weir, drainage culrents, drops, etc. is based on work quantities established in the comprehensive plan.

Difference in the required discharge capacity of the river channel between the 10-yr and 25-yr probable floods is adjusted by the width of the low water channel. Then, in case the both banks of the low-water channel are to be protected by revetment works, semi-permanent method like wetmasonry type is employed to one bank and temporary method such as gabion is employed to another bank by considering its modification in future.

From the above arrangement, the scope of the first stage development is determined as follows;

(1) Widas main stream including controllable retarding basins, major secondary tributaries and lower Ulo.

- (a) Excavation/dredging of channel and embankment of dike
- (b) Bank protection by means of wetmasonry/gabion
- (c) Reconstruction/construction of bridge
- (d) Construction of drop structure
- (e) Construction of drainage culvert and sluice
- (f) Construction of side overflow dike
- (g) Construction of syphon

(2) Flood diversion channel and upper Ulo river

- (a) Excavation of channel and embankment of dike
- (b) Bank protection by wetmasonry/gabion
- (c) Reconstruction/construction of bridge
- (d) Construction of drop structure, syphon, diversion weir irrigation head works
- (e) Construction of drainage culvert

(3) Kedungsoko river including controllable retarding basin

- (a) Excavation/dredging of channel and embankment of dike
- (b) Bank protection by wetmasonry/gabion
- (c) Reconstruction/construction of bridge
- (d) Construction of drainage culvert and sluice
- (e) Reimprovement of irrigation head works
- (f) construction of side overflow dike
- (g) Protection of railway bridge piers

(4) Kuncir river

- (a) Excavation of channel and embankment of dike
- (b) Bank protection by wetmasonry/gabion
- (c) Reconstruction/construction of bridge
- (d) Construction of syphon and drainage culvert
- (e) Reimprovement of irrigation head works

For the above works, the proposed work quantities and compensation are presented in Table 8.2 and summarized below.

River improvement works		First Stage	Second Stage
Dredging	:	2,800,000 m^3	400,000 m^3
Excavation	:	3,600,000 m^3	600,000 m^3
Embankment	:	1,700,000 m^3	-
Bank protection			
Wetmasonry	:	54,000 m^2	54,000 m^2
Gabion	:	19,000 m^2	67,500 m^2
Reconstruction/construction of bridge including foot path	:	34 places	-
Pier protection of Kedungsoko railway bridge	:	1 place	-
Construction of drainage culvert and sluice	:	28 places	-
Reconstruction/reimprovement of irrigation head works	:	4 places	-
Reconstruction/construction of syphon	:	4 places	-
Reconstruction of diversion weir	:	1 place	-
Construction of drop structures	:	2 places	-
Construction of side overflow dikes	:	5 places	-
Construction of drainage sluices in retarding basin	:	5 places	-

Land acquisition and building compensation

Land acquisition	:	7.016 x $10^6 m^2$	-
Building compensation	:	440 nos	-

8.3.5 Direct construction cost

The direct construction costs for the stage-wise development are estimated as follows;

1st stage development	;	Rp	37,197 x 10^6 (89.8%)
2nd stage development	:	Rp	4,215.5 x 10^6 (10.2%)
Total			41,412.5 x 10^6

8.3.6 Remarks on stage-wise development

As shown in Sub-section 8.3.5, the construction cost of first stage development shares 90% of that of the comprehensive plan. Reasons for this large precentage share are as follows;

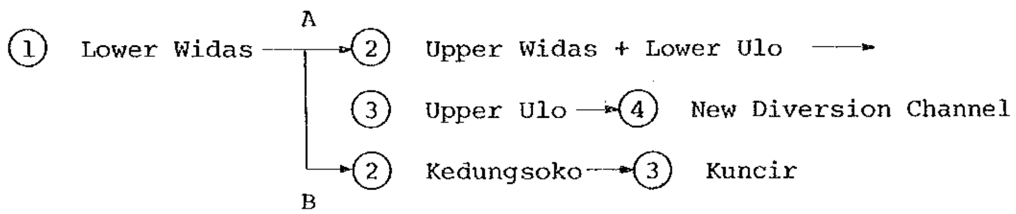
(1) Difference in the magunitudes of the design flood between the first stage development and the comprehensive plan is not large.

(2) Increase of the discharge is absorbed in the retarding basins.

(3) All the related river structures and bridges are to be constructed in the first stage development. Postpone of construction of some related river structures is not desirable from the view point of flood control. Postpone of bridge construction will cause social disturbance. Therefore, it is necessary to construct all the related structures and bridges in the first stage development.

Since the remaining works after the first stage development are very small, it is less meaningful to implement the flood control works in stages. Therefore, it is recommended to implement the flood control works in one stage.

In order to ease the financial burden, it may be possible to implement the flood control works in area-wise. The river improvement works shall be implemented from the downstream to the upstream, in principle. Then, the sequence of the river improvement in the Widas river basin will become as follows;



Then, following the improvement work, it may be possible to proceed to A alternative or B alternative.

Details of implementation shall be examined during future detailed design.

Table 8.1 REQUIRED CONSTRUCTION WORKS, LAND ACQUISITION AND BUILDING COMPENSATION FOR COMPREHENSIVE PLAN

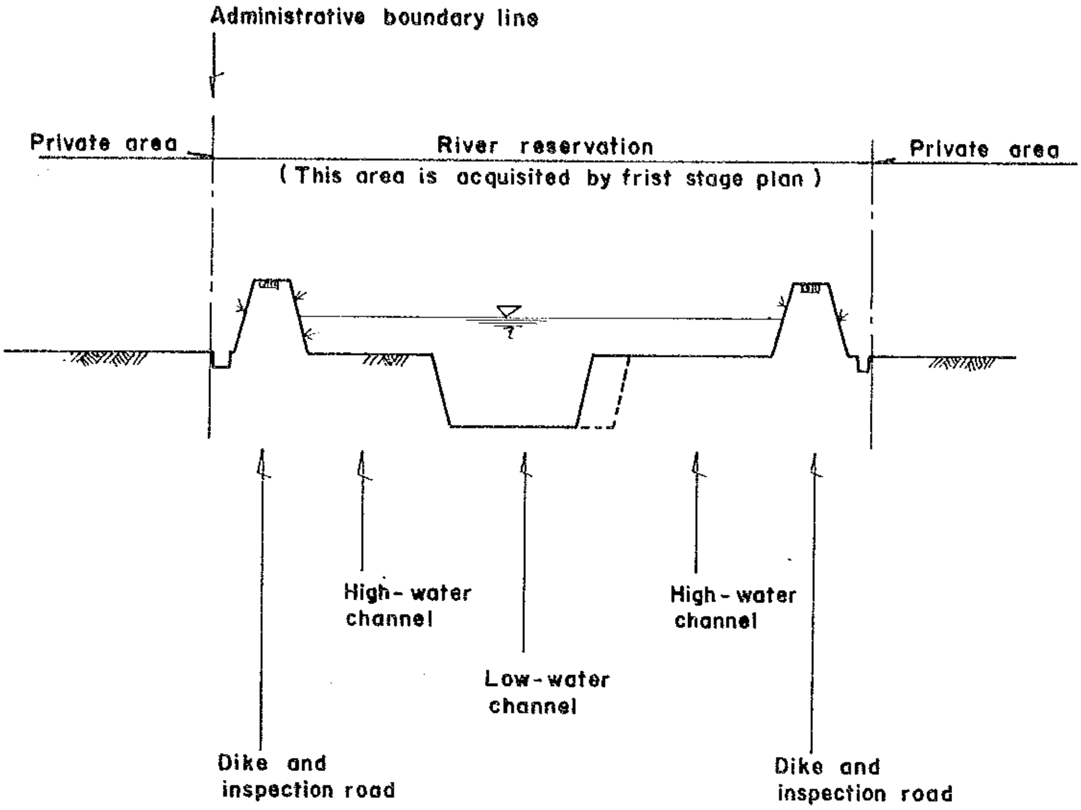
Works	Unit	Work Quantity						Total
		Lower Widas river	Upper Widas + lower Ulo	Diversion channel	Upper Ulo river	Kedungsoko river	Kuncir river	
I. Channel Improvement								
Dredging	(10^3m^3)	1,390	963	-	-	813	-	3,166
Excavation	(")	2,223	815	276	300	376	228	4,218
Embankment								
New embankment	(")	557	239	19	112	105	208	1,240
Heightening	(")	70	-	-	4	109	-	183
Back water levee	(")	89	100	-	34	-	26	249
Disposal of excess excavated materials								
Backfill of old channel	(")	1,176	370	-	51	130	-	1,727
Reclamation	(")	1,721	1,069	257	99	845	-6 /1	3,985
Bank protection								
Wetmasonry	(m^2)	42,700	9,900	26,000	15,400	6,100	7,900	108,000
Gabion	(m^2)	42,700	9,900	4,500	15,400	6,100	7,900	86,500
Bridge								
Road								
National	(nos)	-	-	1	-	1	-	2
Provincial	(")	1	-	-	2	-	3	6
Rural	(")	2	8	4	2	2	3	21
Foot path	(")	3	-	-	-	-	1	4
Railway								
New	(")	-	-	1	-	-	-	1
Pier protection	(")	-	-	-	-	1	-	1
Drainage culvert								
Type I	(nos)	4	2	4	-	-	5	15
Type II	(")	3	2	-	-	3	1	9
Type III	(")	-	-	-	-	-	1	1
Sluice (intake)	(")	-	1	-	1	-	1	3
Diversion weir	(")	-	-	-	1	-	-	1
Irrigation head works								
Reconstruction	(nos)	-	-	-	1	-	-	1
Repair	(")	-	-	-	-	1	2	3
Drop structure	(")	-	1	1	-	-	-	2
Syphon	(")	-	1	2	-	-	1	4
Side overflow dike	(m)	800	550	-	-	720	-	2,070
Drainage sluice	(nos)	2	-	-	-	2 + 1	-	5
Drainage in retarding basin	(10^3m^3)	154	6	-	-	24	-	194
Al Canal levee	(10^3m^3)	184	-	-	-	-	-	184
II. Land Acquisition and Compensation								
Land acquisition	(10^3m^2)	4,357	1,126	192	226	727	388	7,016
Building : Ave = 40 m^2	(nos)	150	120	15	60	45	50	440

Note : /1 Excavated materials in the other rivers are utilized for embankment of Kuncir river.

Table 8.2 REQUIRED CONSTRUCTION WORKS, LAND ACQUISITION AND BUILDING COMPENSATION FOR FIRST STAGE PLAN

Works	Unit	Work Quantity						Total
		Lower Widas river	Upper Widas + lower Ulo	Diversion channel	Upper Ulo river	Kedungsoko river	Kuncir river	
I. Channel Improvement								
Dredging	(10^3m^3)	1,208	877	-	-	708	-	2,793
Excavation	(")	1,932	724	250	248	328	164	3,646
Embankment								
New embankment	(")	557	239	19	112	105	208	1,240
Heightening	(")	70	-	-	4	109	-	183
Back water levee	(")	89	100	-	34	-	26	249
Disposal of excess excavated materials								
Backfill of old channel	(")	1,176	370	-	51	130	-	1,727
Reclamation	(")	1,248	892	231	47	692	-70 /1	3,040
Bank protection								
Wet masonry	(m^2)	8,600	2,000	26,000	14,500	1,200	1,600	53,900
Gabion	(m^2)	8,600	2,000	1,800	3,600	1,200	1,600	18,800
Bridge								
Road								
National	(nos)	-	-	1	-	1	-	2
Provincial	(")	1	-	-	2	-	3	6
Rural	(")	2	8	4	2	2	3	21
Foot path	(")	3	-	-	-	-	1	4
Railway								
New	(")	-	-	1	-	-	-	1
Pier protection	(")	-	-	-	-	1	-	1
Drainage culvert								
Type I	(nos)	4	2	4	-	-	5	15
Type II	(nos)	3	2	-	-	3	1	9
Type III	(nos)	-	-	-	-	-	1	1
Sluice (intake)	(")	-	1	-	1	-	1	3
Diversion weir	(")	-	-	-	1	-	-	1
Irrigation head works								
Reconstruction	(")	-	-	-	1	-	-	1
Repair	(")	-	-	-	-	1	2	3
Drop structure	(")	-	1	1	-	-	-	2
Syphon	(")	-	1	2	-	-	1	4
Side overflow dike	(m)	800	550	-	-	720	-	2,070
Drainage sluice	(nos)	2	-	-	-	2 + 1	-	5
Drainage in retarding basin	(10^3m^3)	154	6	-	-	24	-	194
A1 Canal levee	(10^3m^3)	184	-	-	-	-	-	184
II. Land acquisition and Compensation								
Land acquisition	(10^3m^2)	4,357	1,126	192	226	727	388	7,016
Building : Ave = 40 m^2	(nos)	150	120	15	60	45	50	440

Note : /1 Excavated materials in the other rivers are utilized for embankment of Kuncir river.



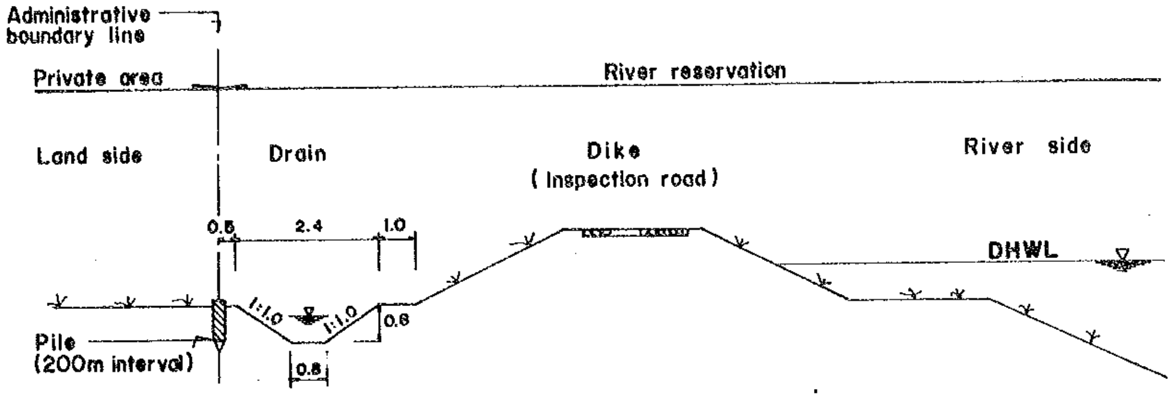
Legends

——— : River cross-section to be constructed by frist stage plan.

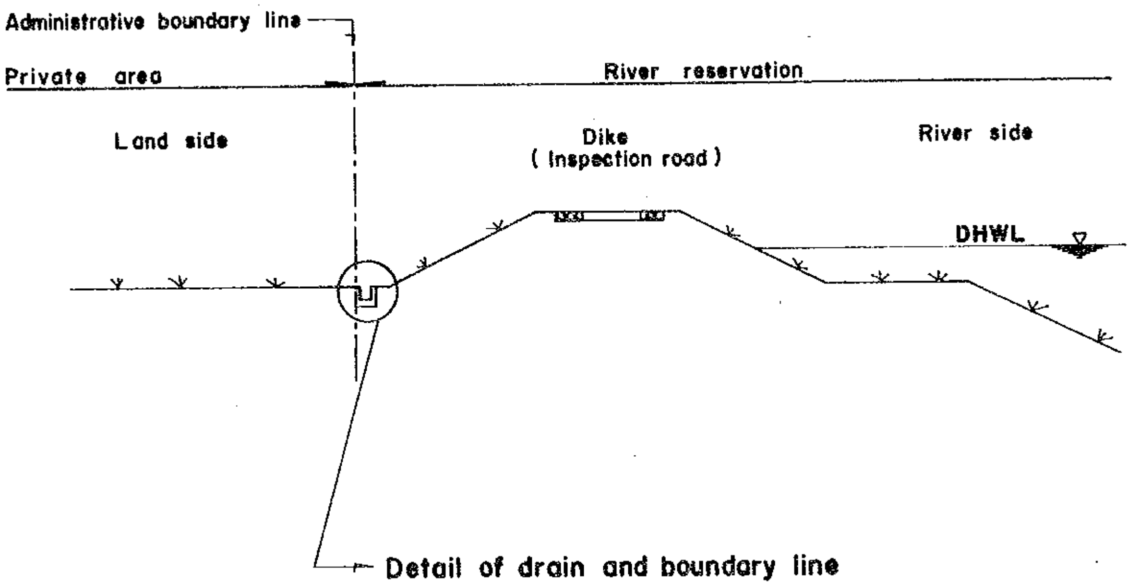
----- : River cross-section to be widened by comprehensive plan.

Fig. 8.1 ADMINISTRATIVE BOUNDARY LINE OF RIVER RESERVATION (1/2)

For stretches of lower Widas (left bank)



For other stretches



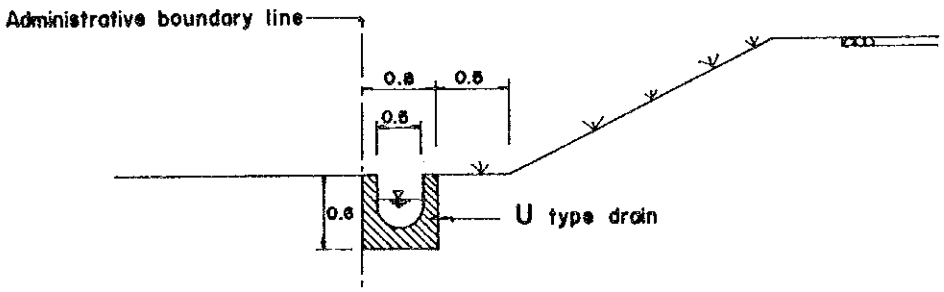
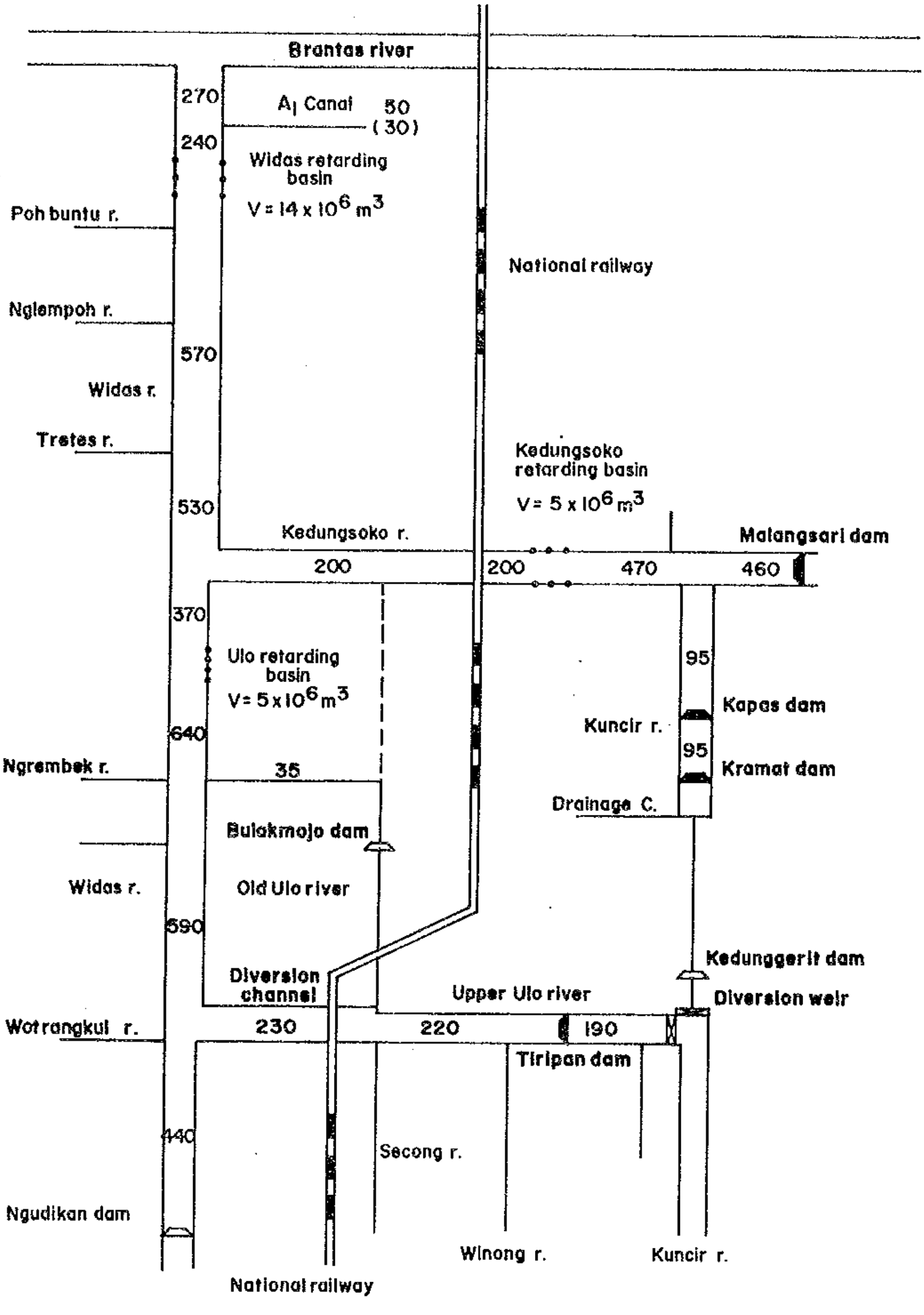


Fig. 8.1 ADMINISTRATIVE BOUNDARY LINE OF RIVER RESERVATION (2/2)



Note : Unit m^3/s
(30) Inflow at peak stage in the Widas
Irrigation head works to be repaired
Side overflow dike

Fig. 8.2 DESIGN DISCHARGE DISTRIBUTION OF PROPOSED COMPREHENSIVE PLAN

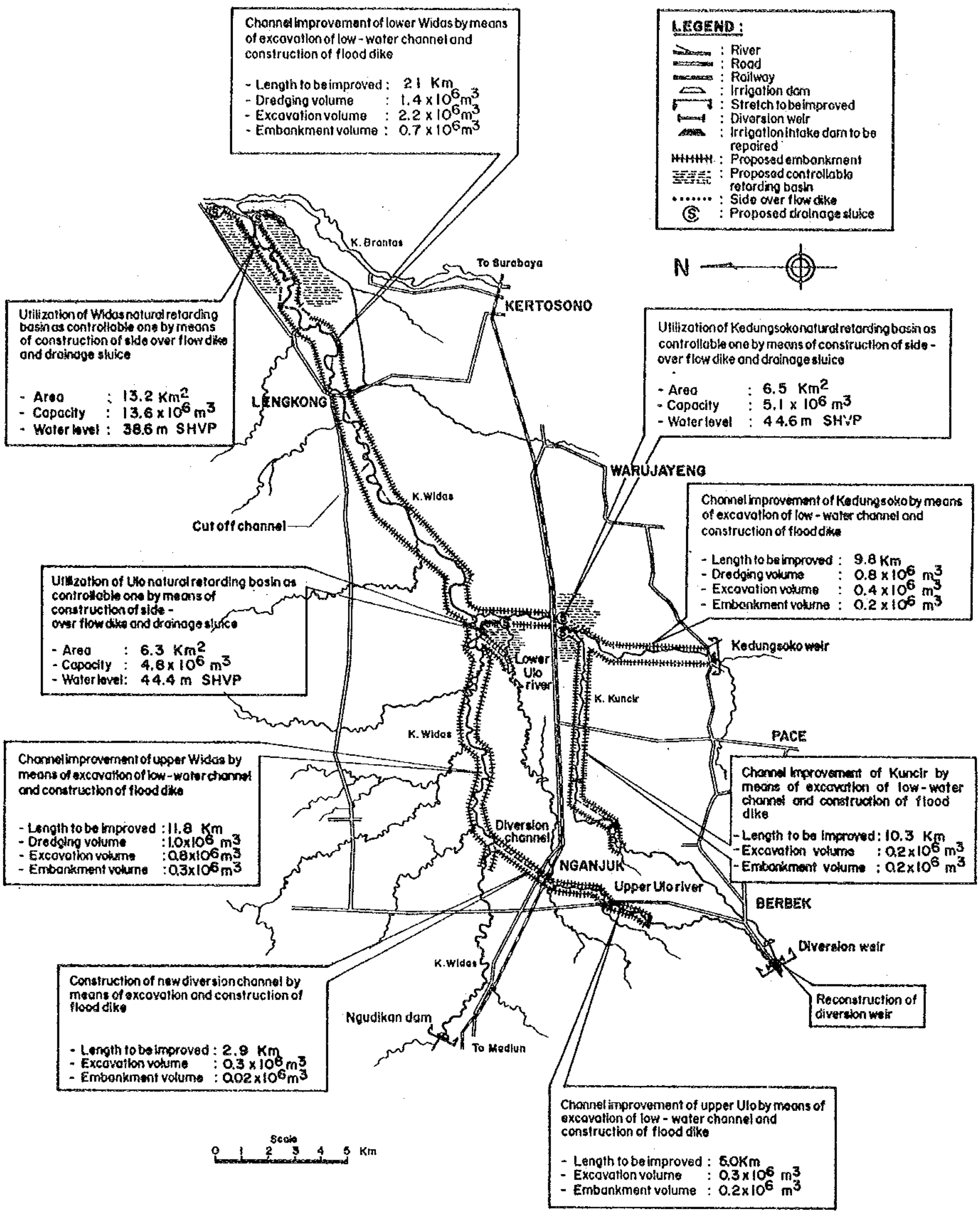


Fig. 8.3 OUTLINE OF COMPREHENSIVE PLAN (1/3)

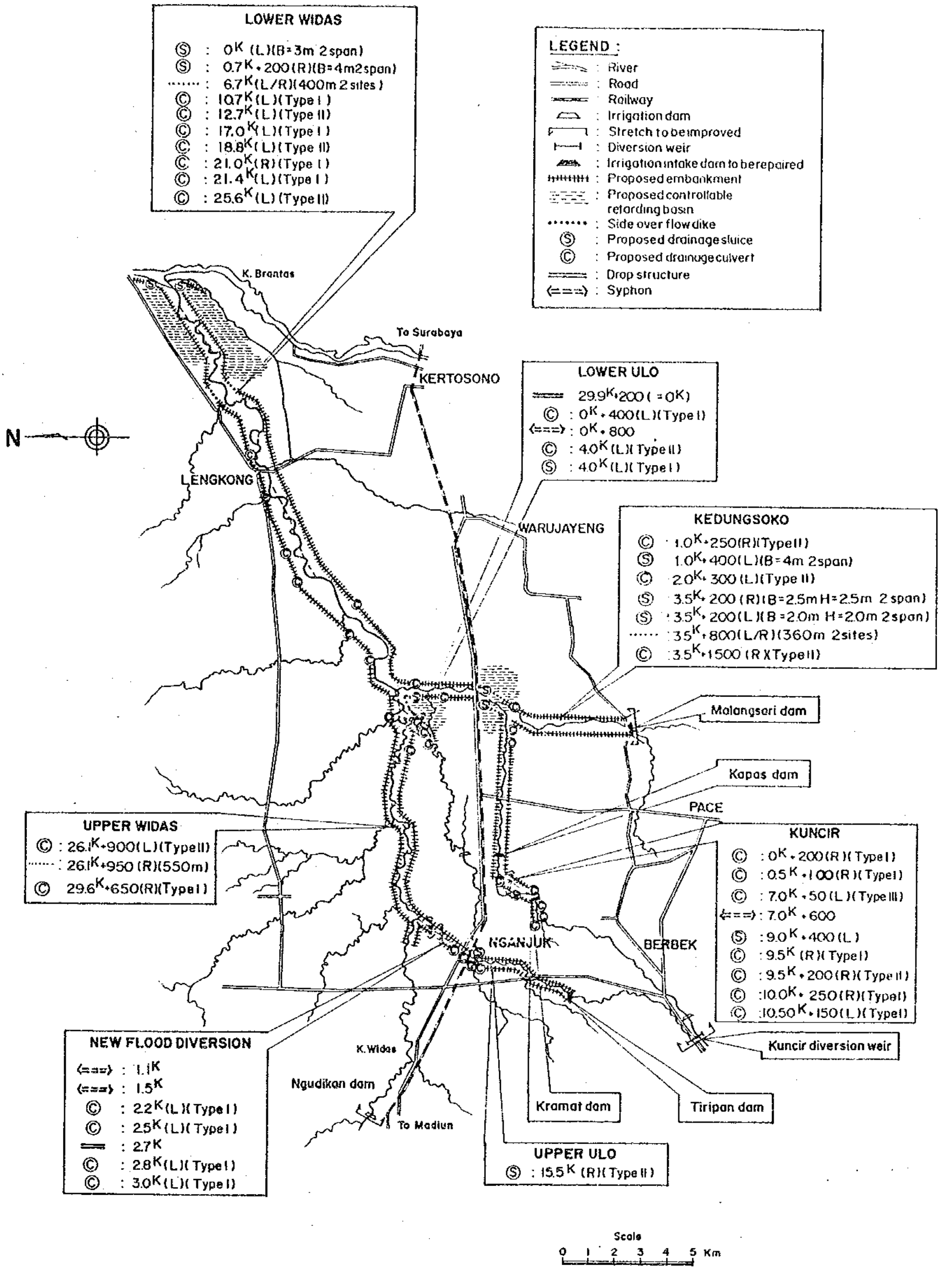


Fig. 8.3 OUTLINE OF PROPOSED STRUCTURES OF COMPREHENSIVE PLAN (2/3)

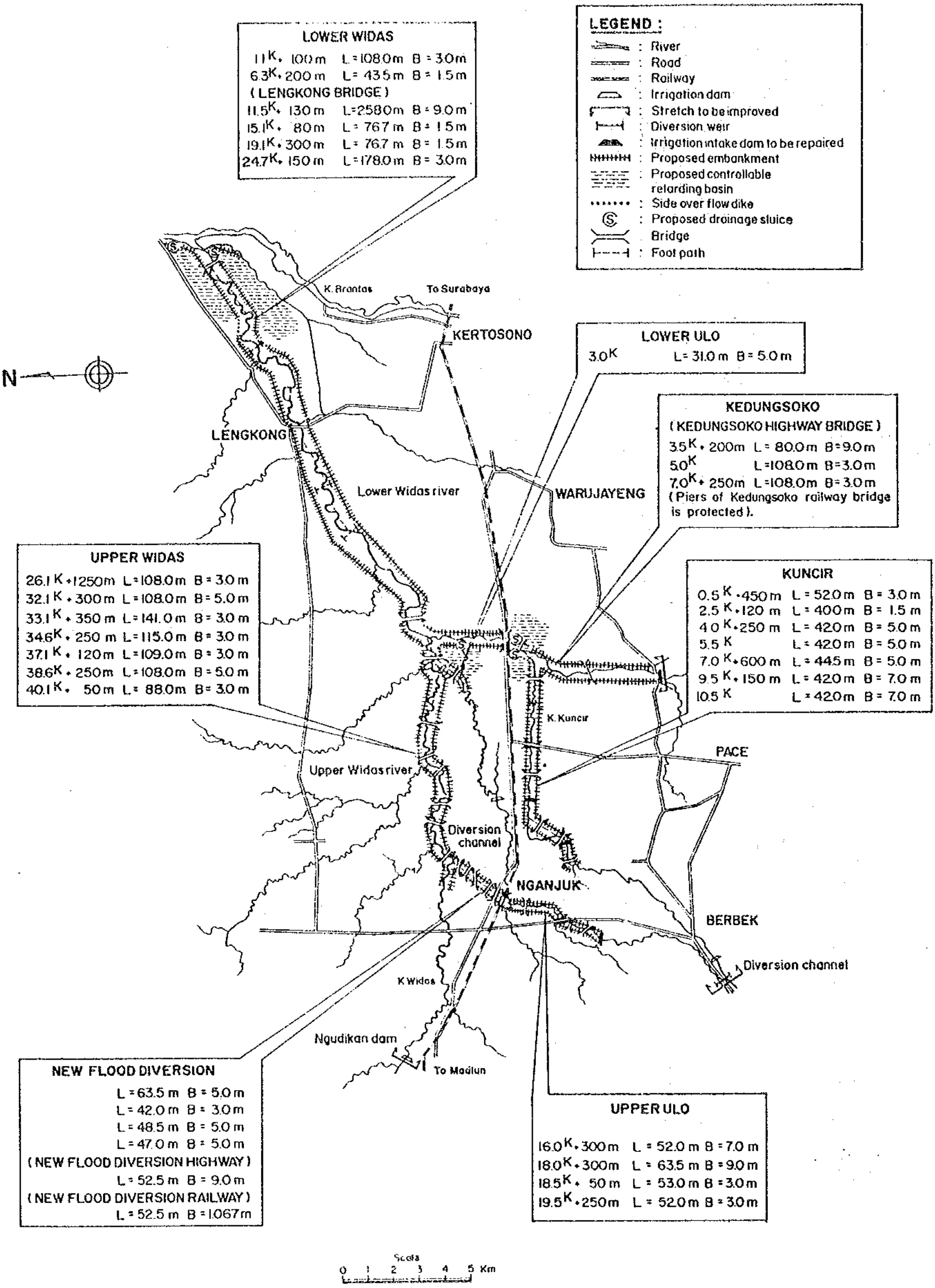


Fig. 8.3 OUTLINE OF PROPOSED BRIDGES OF COMPREHENSIVE PLAN (3/3)

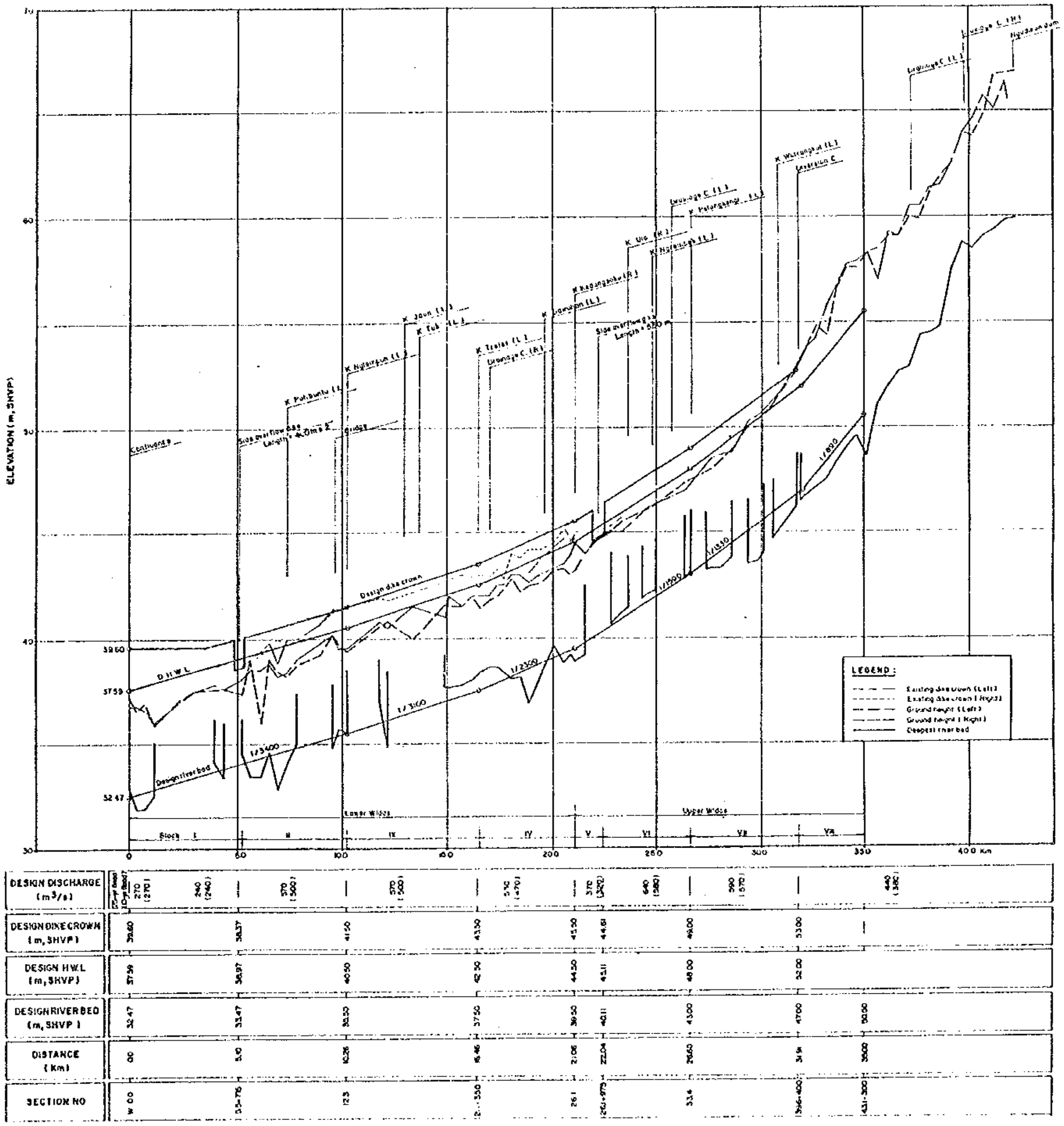
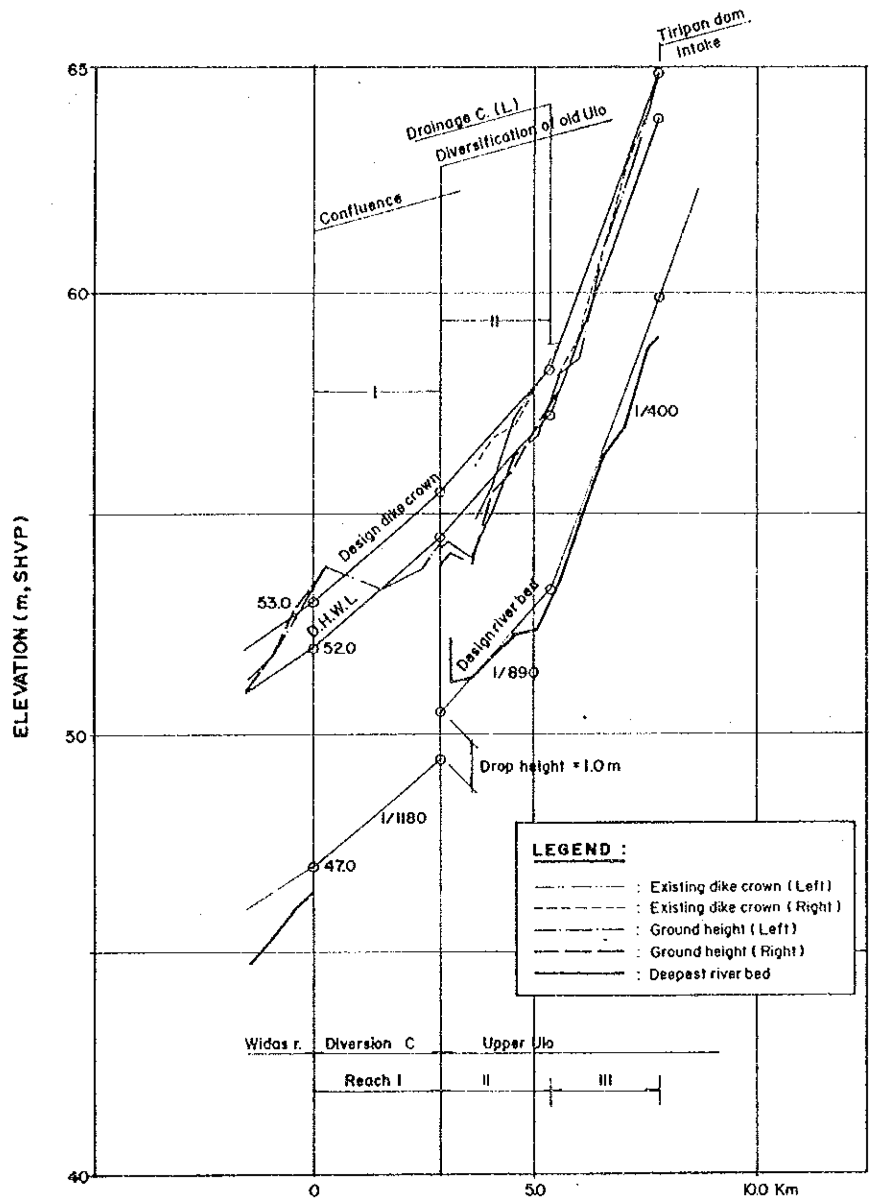
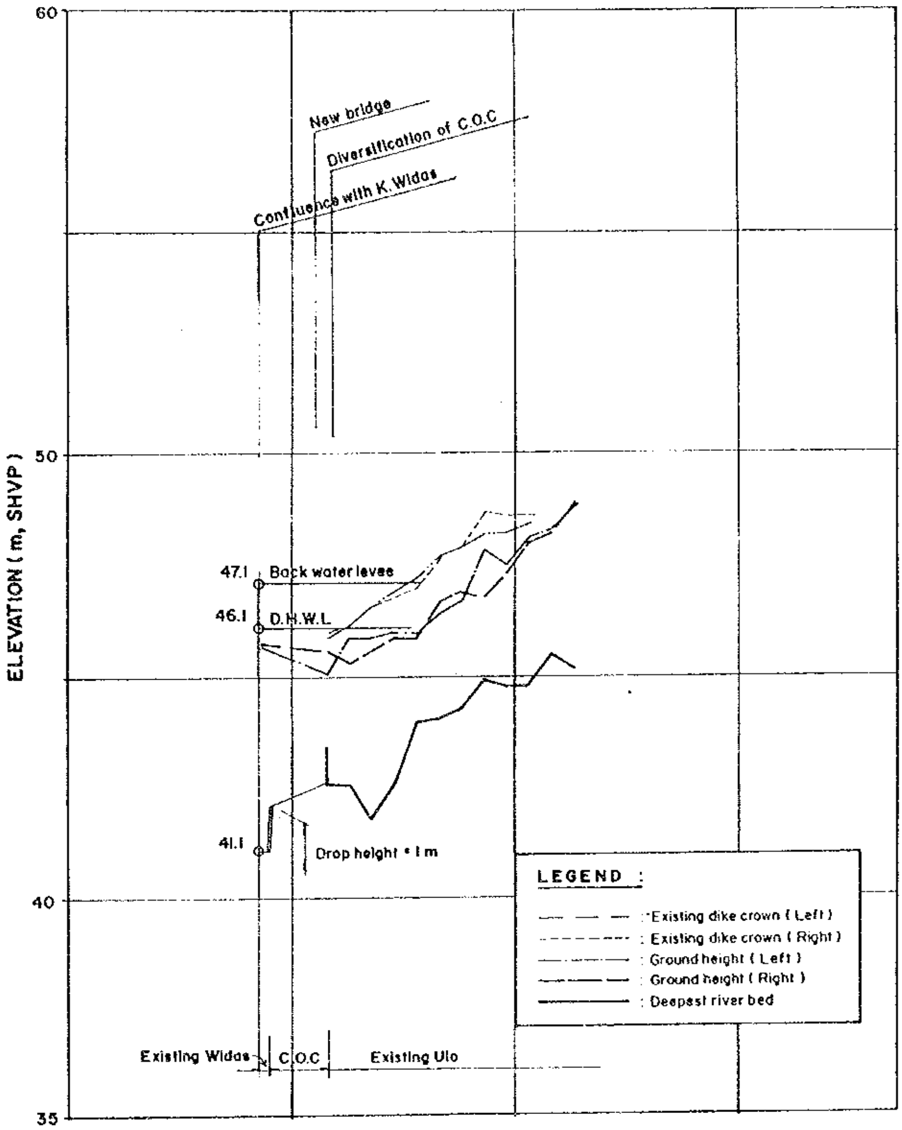


Fig. 8.4 DESIGN LONGITUDINAL PROFILE OF WIDAS RIVER (1/5)



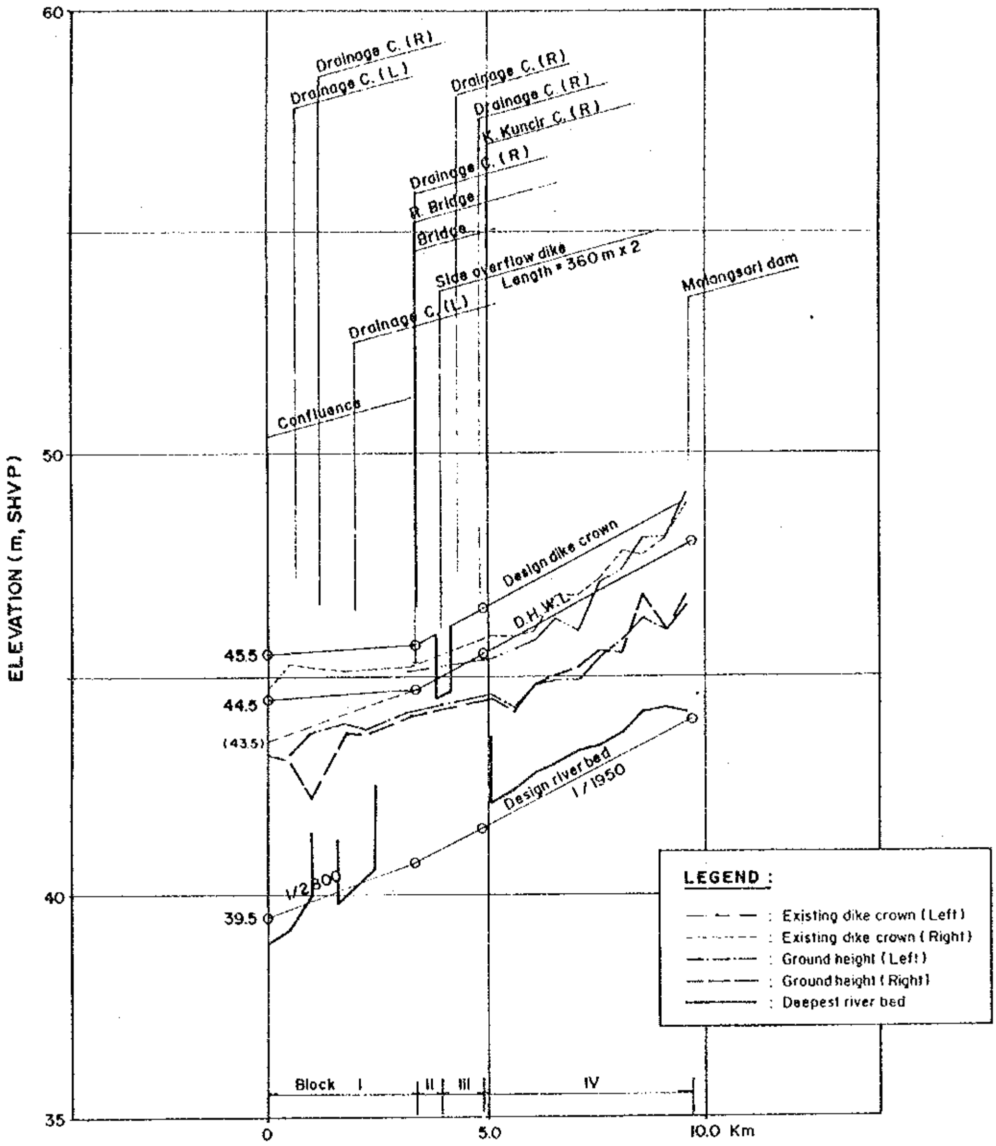
DESIGN DISCHARGE (m^3/s)	25-yr flood (10-yr flood)		230 (190)		220 (180)		190 (170)	
DESIGN DIKE CROWN (m, SHVP)		53.00		55.50		58.30		64.90
DESIGN H.W.L (m, SHVP)		52.00		54.50		57.30		63.90
DESIGN RIVER BED (m, SHVP)		47.00		49.50 (50.50)		53.30		59.90
DISTANCE (Km)		0.0		2.90		5.45		7.85
SECTION NO		39.6+400		15.5+250		18.0+300		20.5+200

Fig. 8.4 DESIGN LONGITUDINAL PROFILE OF DIVERSION CHANNEL AND UPPER ULO RIVER (2/5)



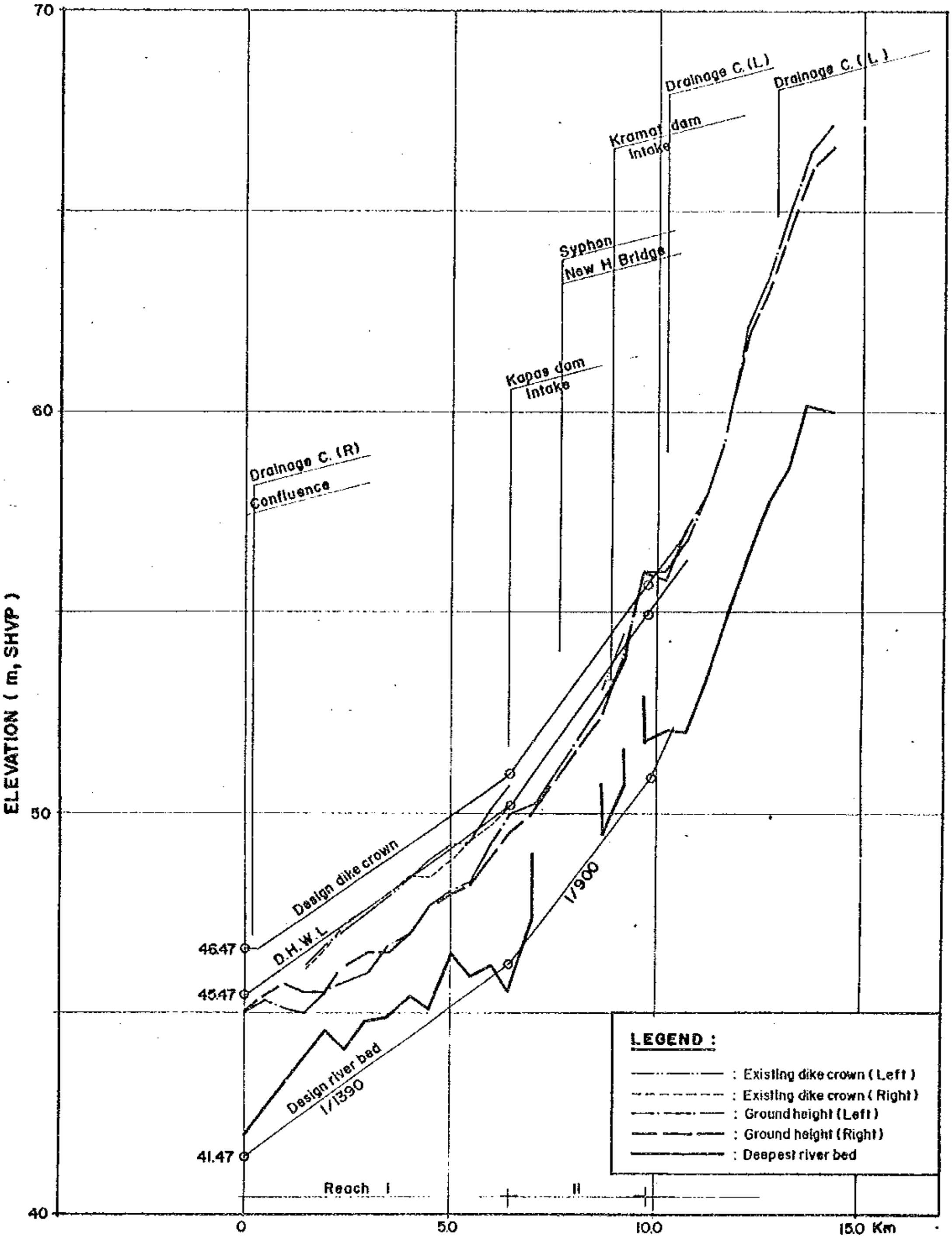
DESIGN DISCHARGE (m³/s)	25-yr flood (10-yr flood)		35 (30)	
DESIGN DIKE CROWN (m, SHVP)	47.1	47.1	47.1	47.1
DESIGN H.W.L (m, SHVP)	46.1	46.1	46.1	46.1
DESIGN RIVER BED (m, SHVP)	41.1	41.2 (42.2)	42.6	43.4
DISTANCE (Km)	0	200	1450	3300
SECTION NO	29.9+200	30.1	4.0	5.5+350

Fig. 8.4 DESIGN LONGITUDINAL PROFILE OF LOWER ULO RIVER(3/5)



DESIGN DISCHARGE (m^3/s)	25-yr flood (10-yr flood)	200 (180)		470 (410)		460 (400)	
DESIGN DIKE CROWN (m, SHVP)	45.50		45.70	44.56	46.47		49.00
DESIGN H.W.L (m, SHVP)	44.50		44.70	45.06	45.47		48.00
DESIGN RIVER BED (m, SHVP)	39.50		40.70	41.06	41.47		44.00
DISTANCE (Km)	0.0		3.35	4.05	4.85		9.75
SECTION NO	W 261		35-200	35-900	5-250		10-150

Fig. 8.4 DESIGN LONGITUDINAL PROFILE OF KEDUNGSOKO RIVER (4/5)



DESIGN DISCHARGH (m^3/s)	20-yr flood (10-yr flood)	95 (80)		
DESIGN DIKE CROWN (m, SHVP)	46.47	51.00	55.70	56.47
DESIGN H.W.L (m, SHVP)	45.47	50.20	54.90	55.67
DESIGN RIVER BED (m, SHVP)	41.47	46.20	50.90	52.01
DISTANCE (Km)	0.0	6.50	9.75	10.25
SECTION NO	KC 0.0	6.5	10.5	11.0

Fig. 8. 4 DESIGN LONGITUDINAL PROFILE OF KUNCIR RIVER (5/5)

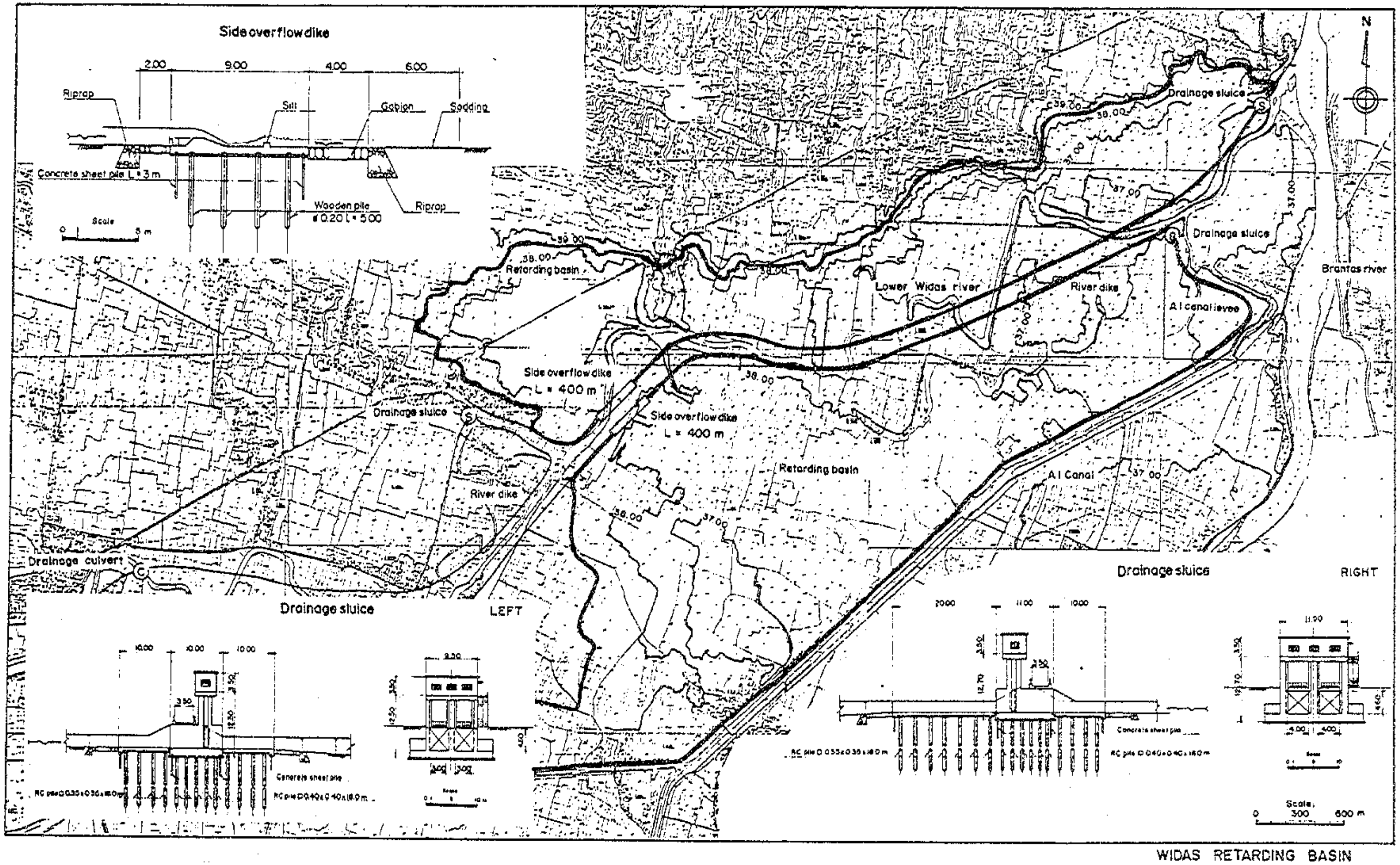


Fig. 8.5 LAYOUT OF WIDAS RETARDING BASIN FACILITIES (1/4)

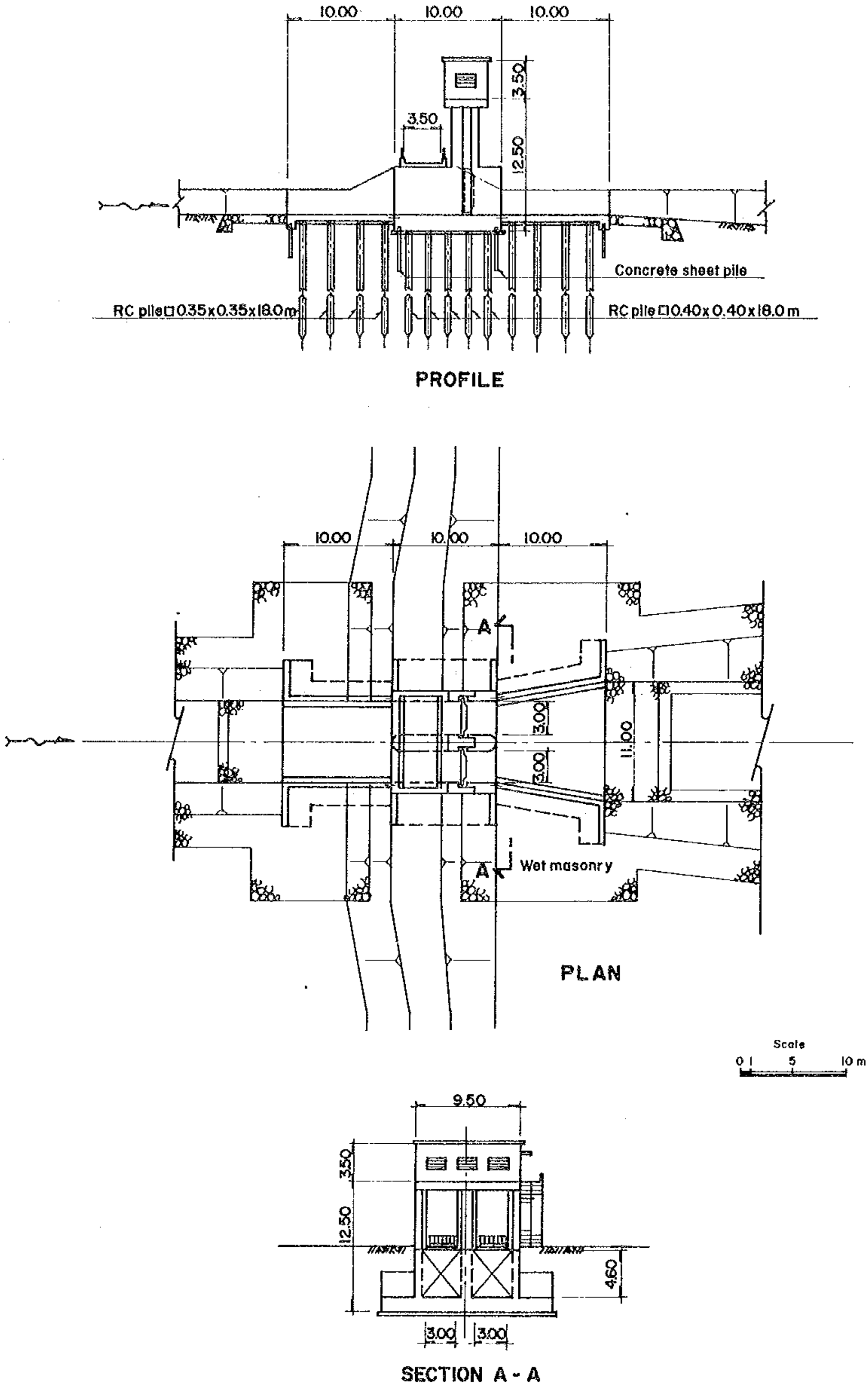
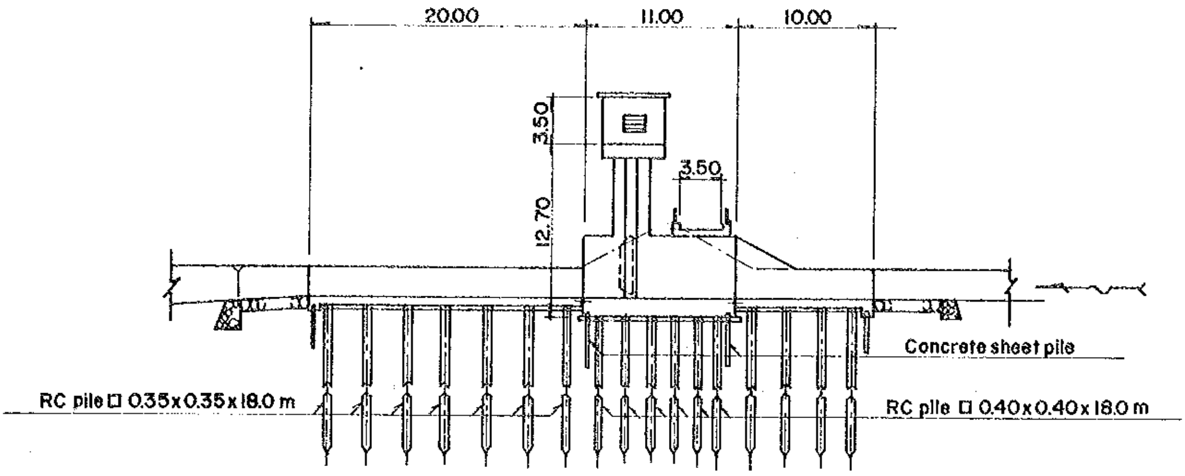
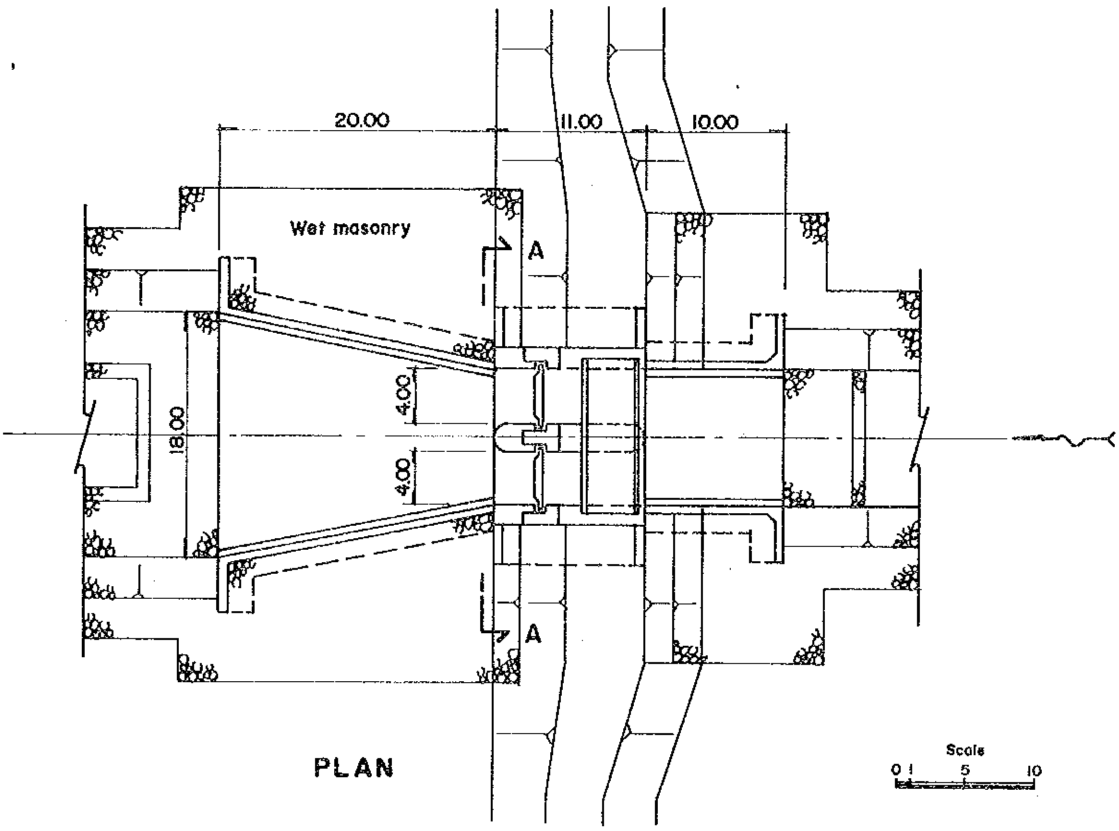


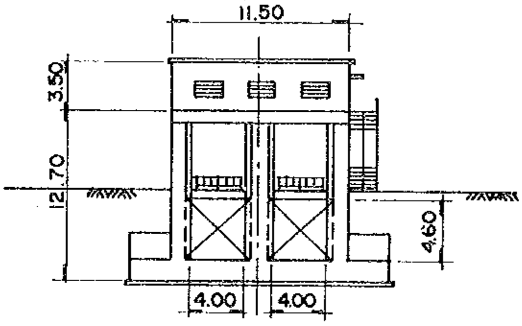
Fig. 8.5 PROPOSED DRAINAGE SLUICE IN WIDAS RETARDING BASIN (LEFT SIDE) (2/4)



PROFILE

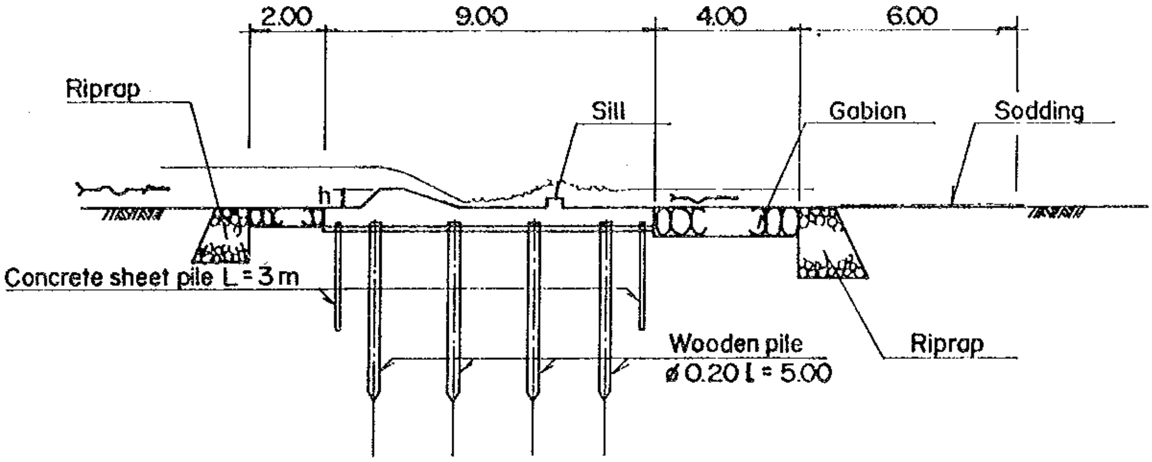


PLAN

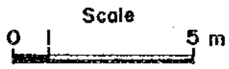


SECTION A - A

Fig. 8.5 PROPOSED DRAINAGE SLUICE IN WIDAS RETARDING BASIN (RIGHT SIDE) (3/4)



PROFILE



Retarding basin	Height of side overflow dike, h	Overflow depth
Widas	0.5 m	0.5 m
Ulo	0.2 m	0.5 m
Kedungsoko	0.4 m	0.5 m

Fig. 8.5 STANDARD DESIGN OF SIDE OVERFLOW DIKE (4/4)

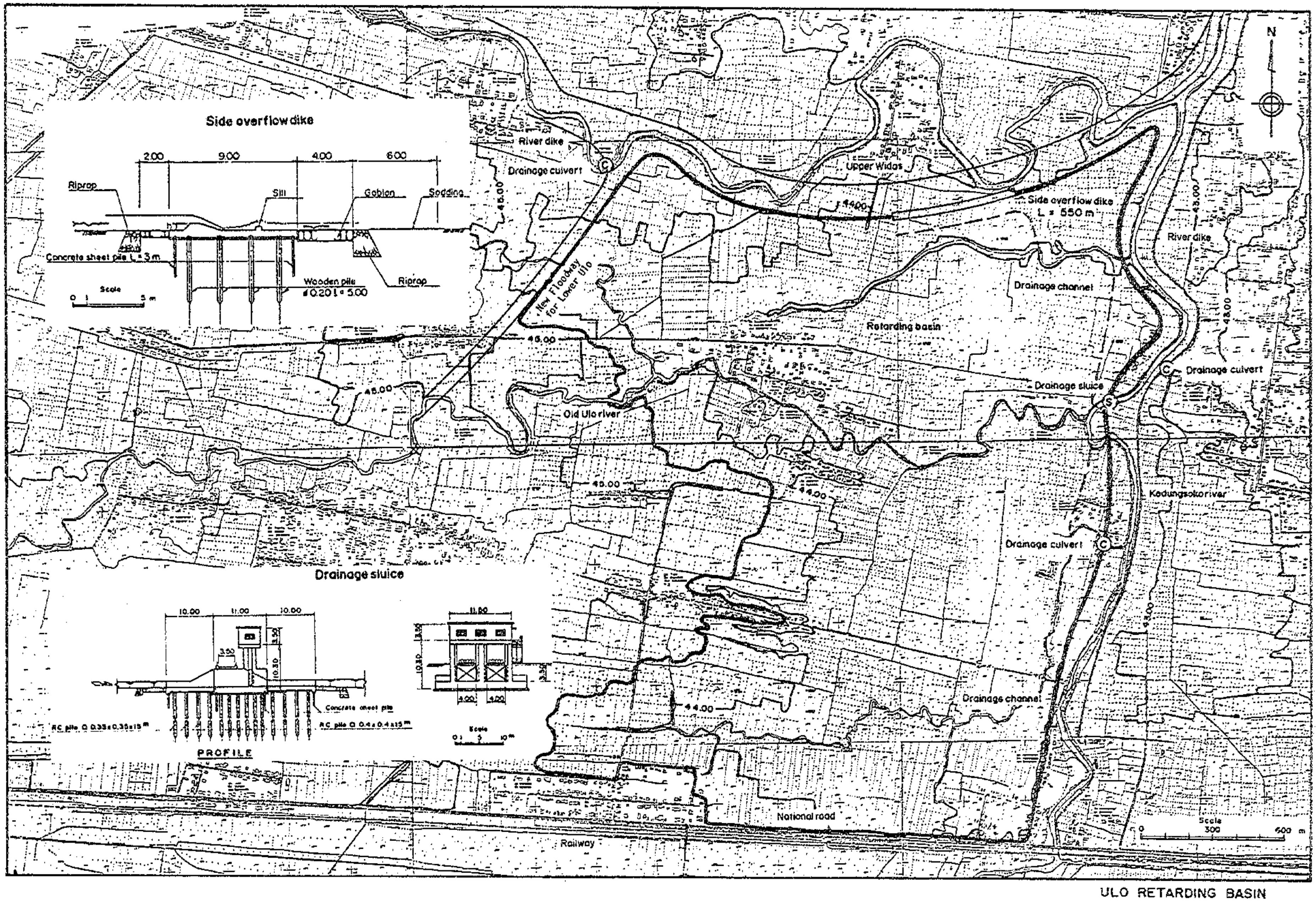
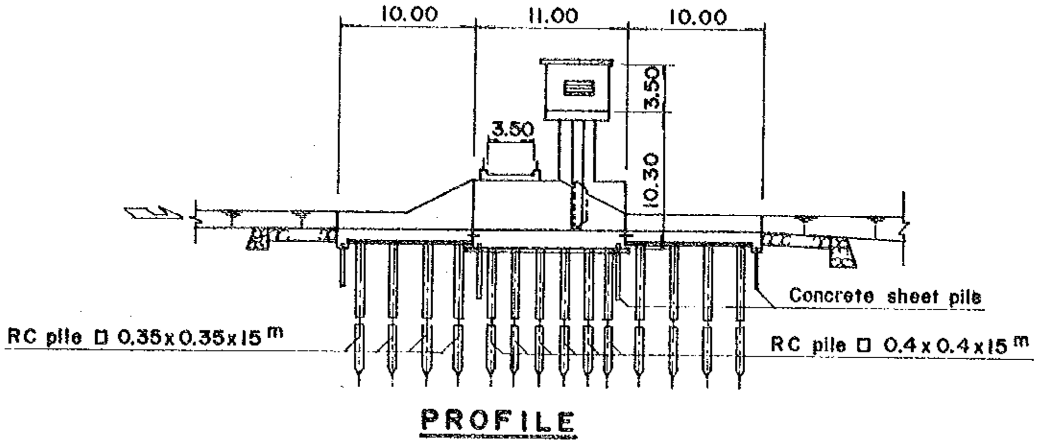
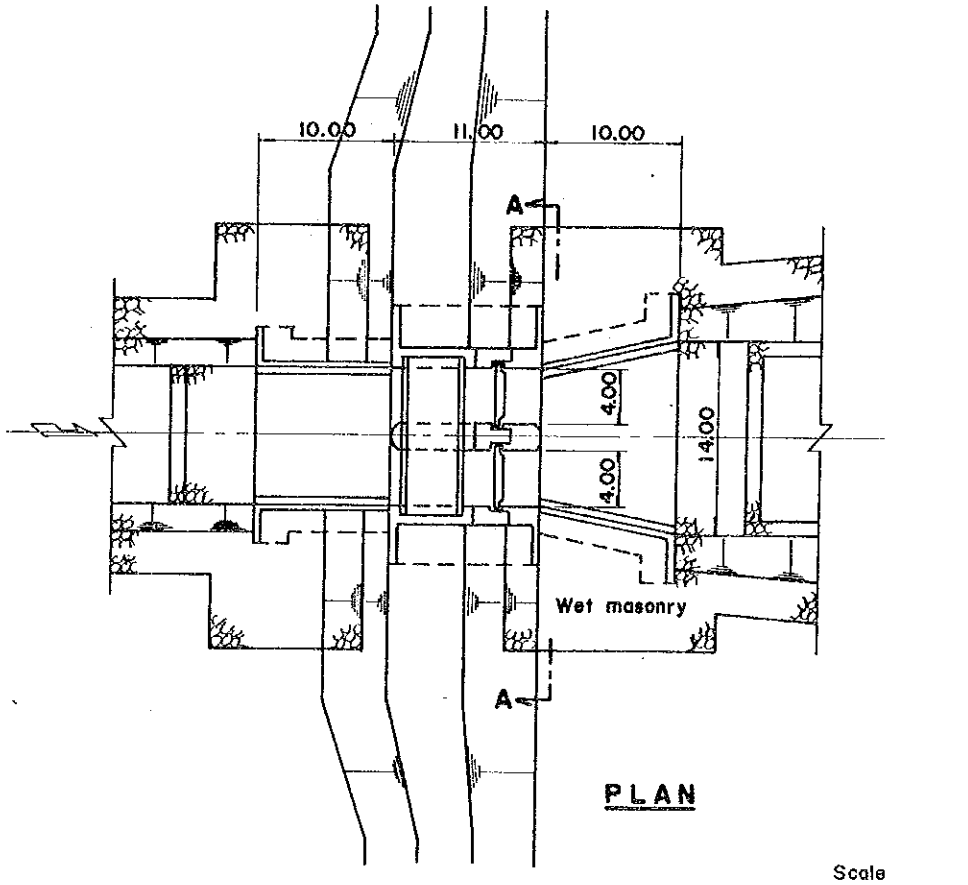


Fig. 8.6 LAYOUT OF ULO RETARDING BASIN FACILITIES (1/2)





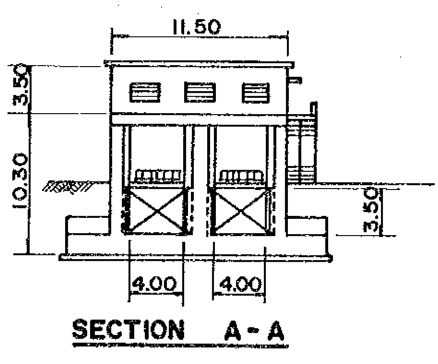


Fig. 8.6 PROPOSED DRAINAGE SLUICE IN ULO RETARDING BASIN (2/2)

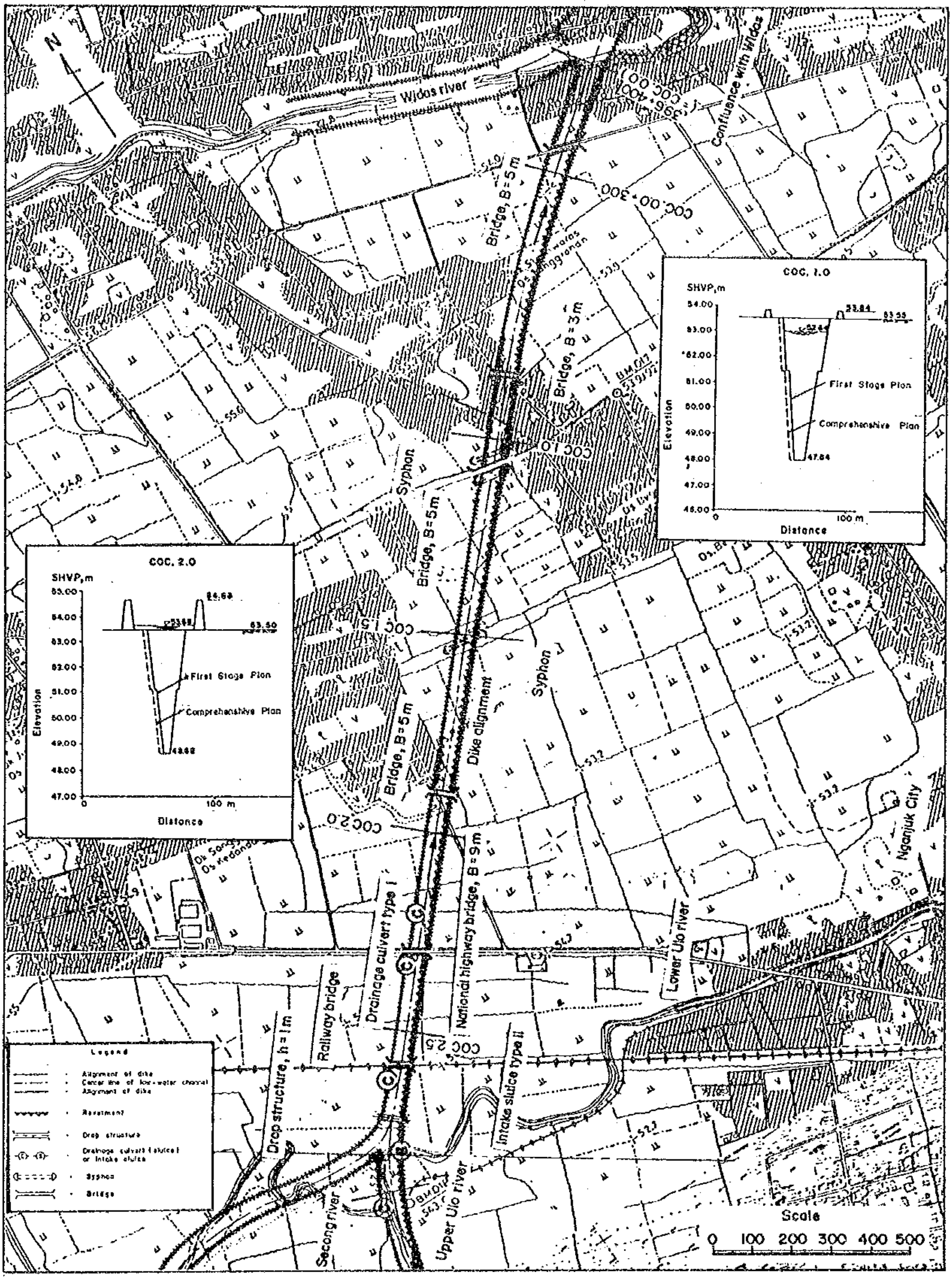


Fig. 8.7 PROPOSED ROUTE OF FLOOD DIVERSION CHANNEL FOR UPPER ULO

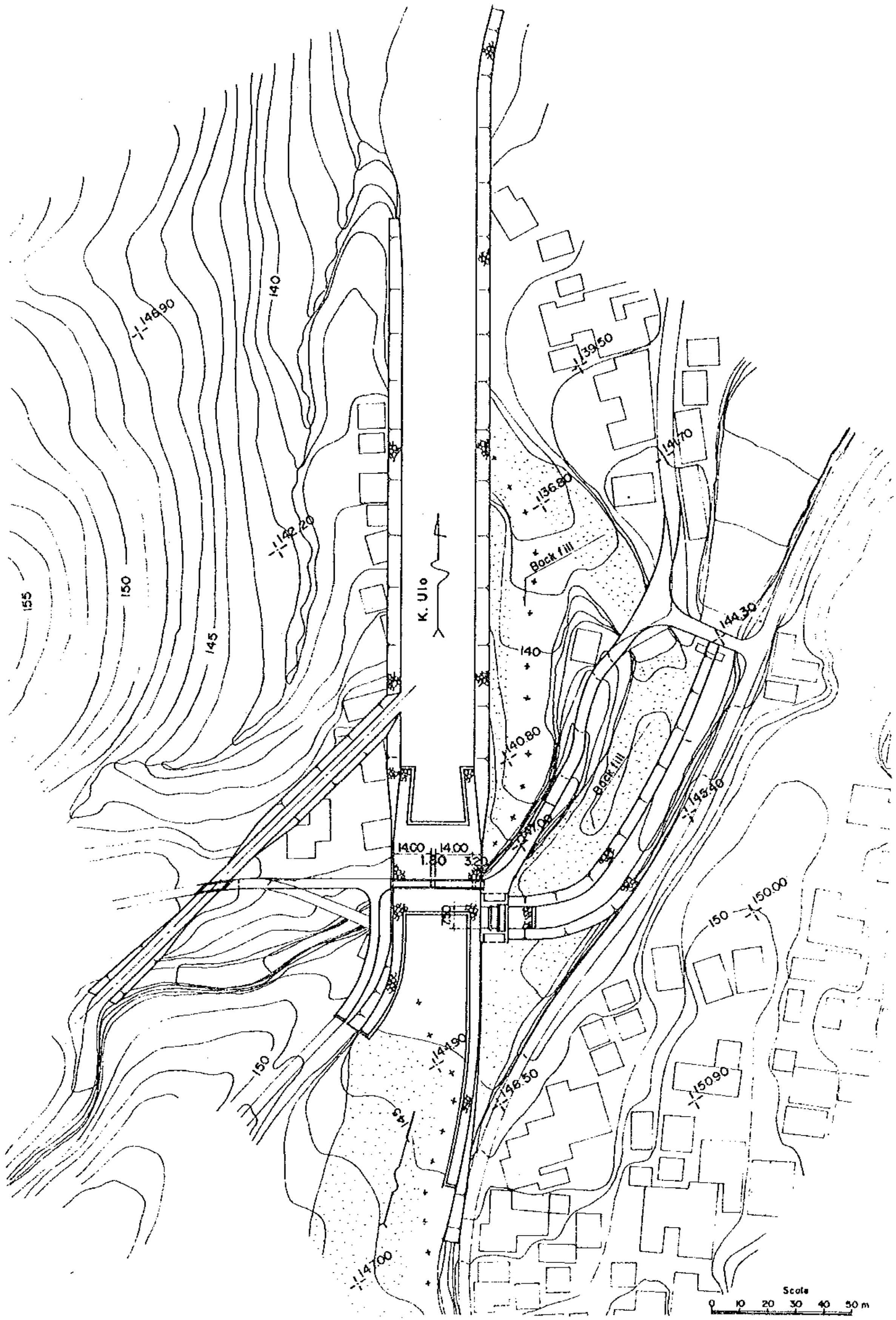


Fig. 8.8 PROPOSED KUNCIR DIVERSION WEIR AT UPPER ULO (1/2)

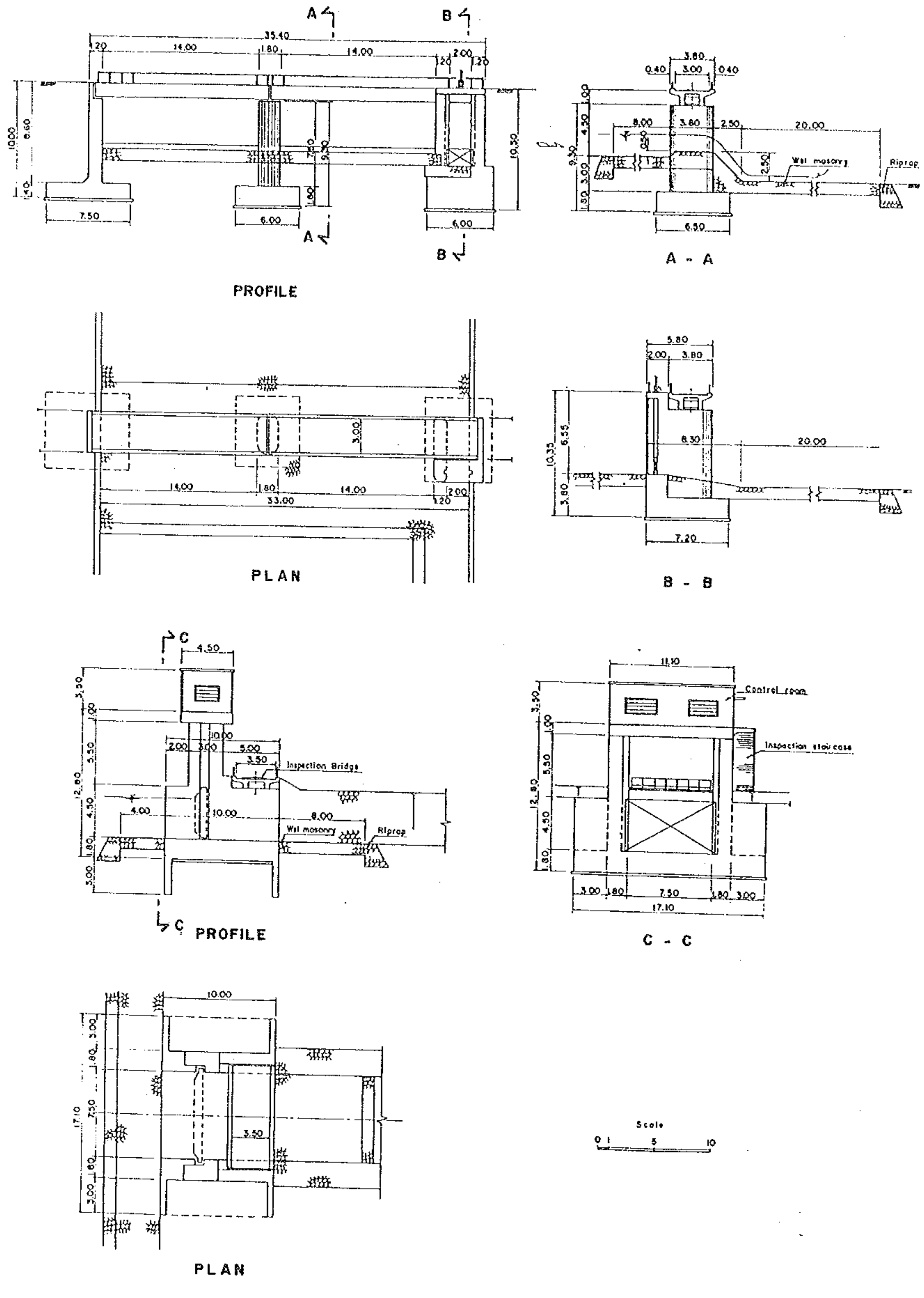


Fig. 8.8 PROPOSED KUNCIR DIVERSION WEIR AT UPPER ULO (2/2)

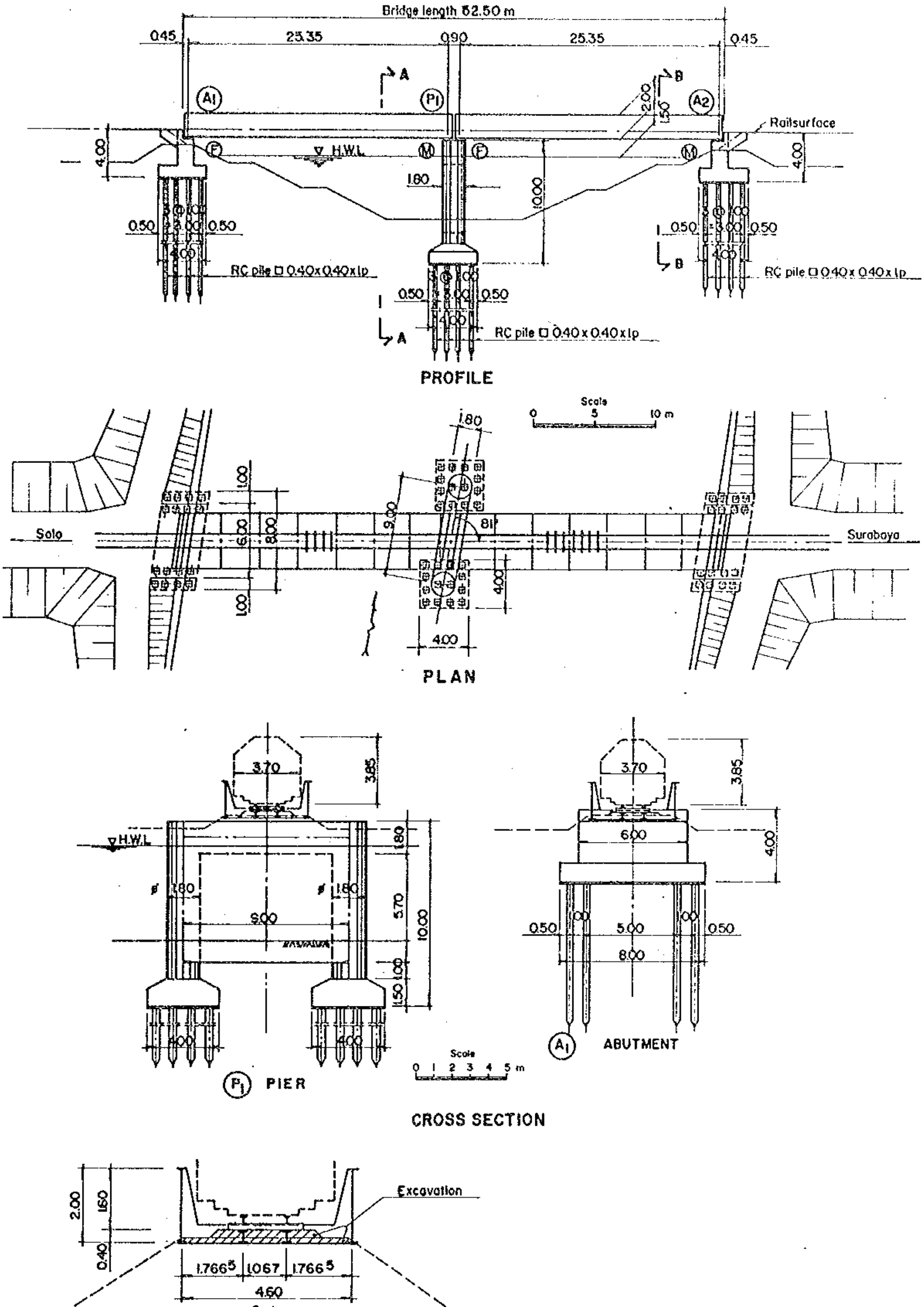


Fig. 8.9 PROPOSED RAILWAY BRIDGE AT DIVERSION CHANNEL

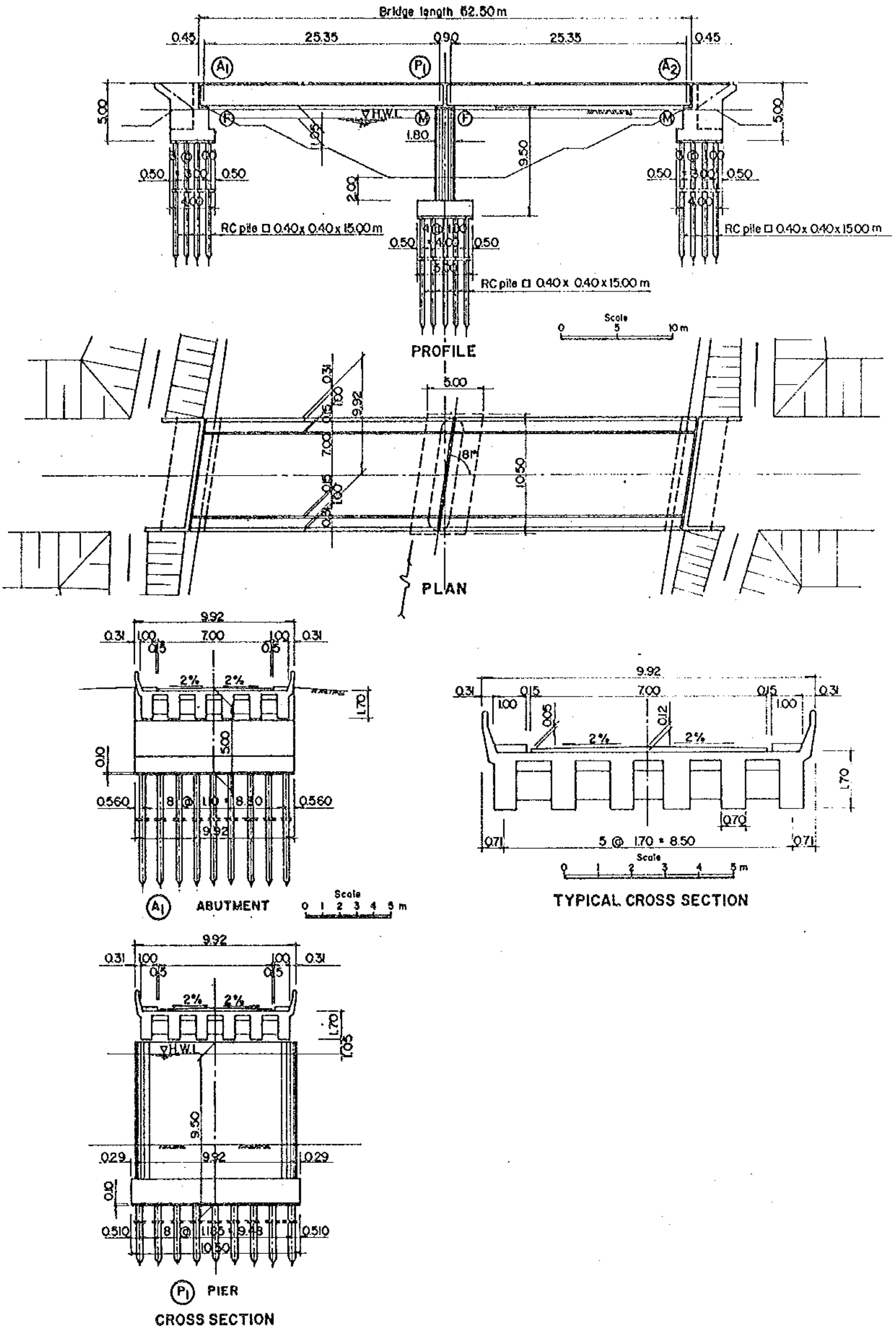
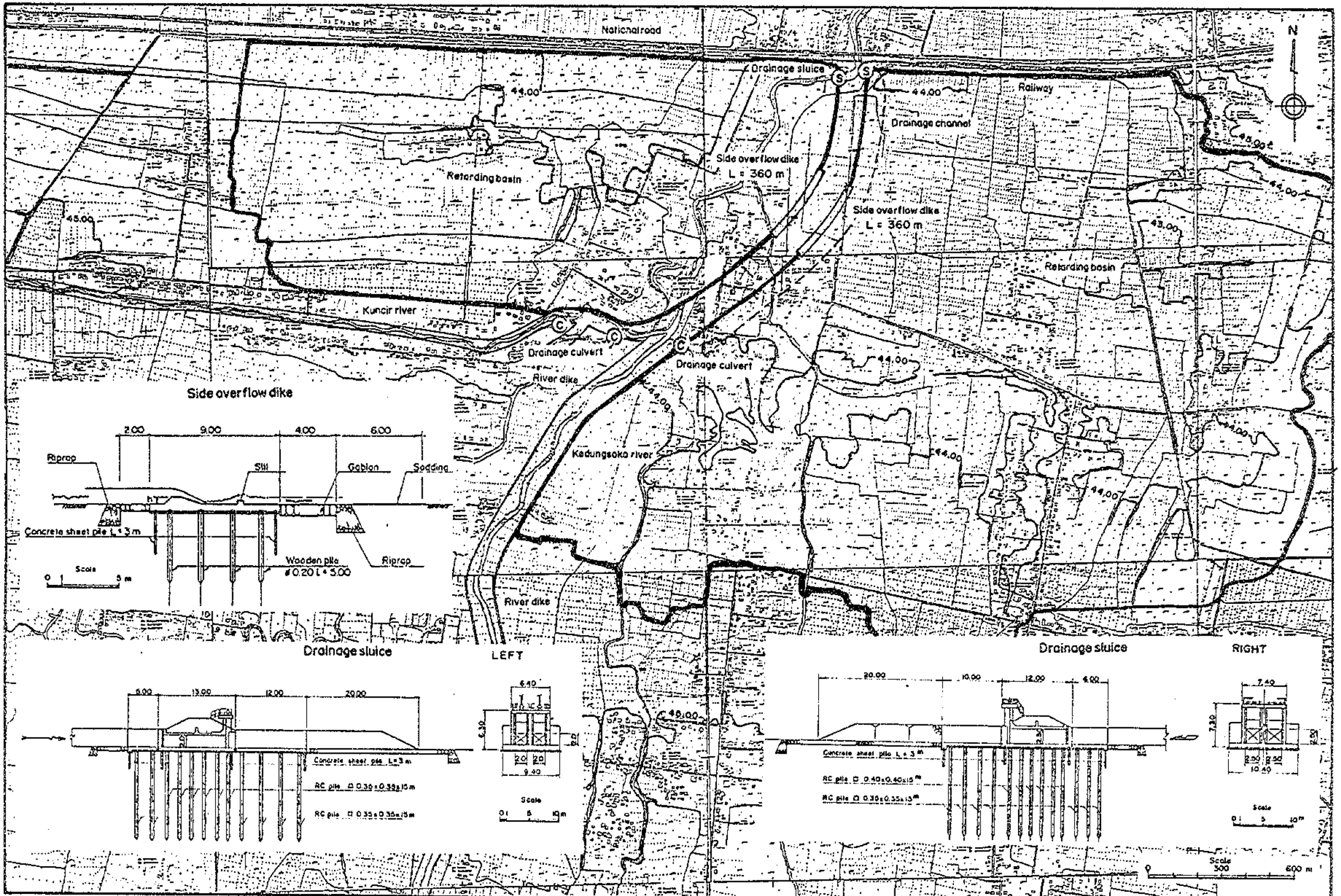
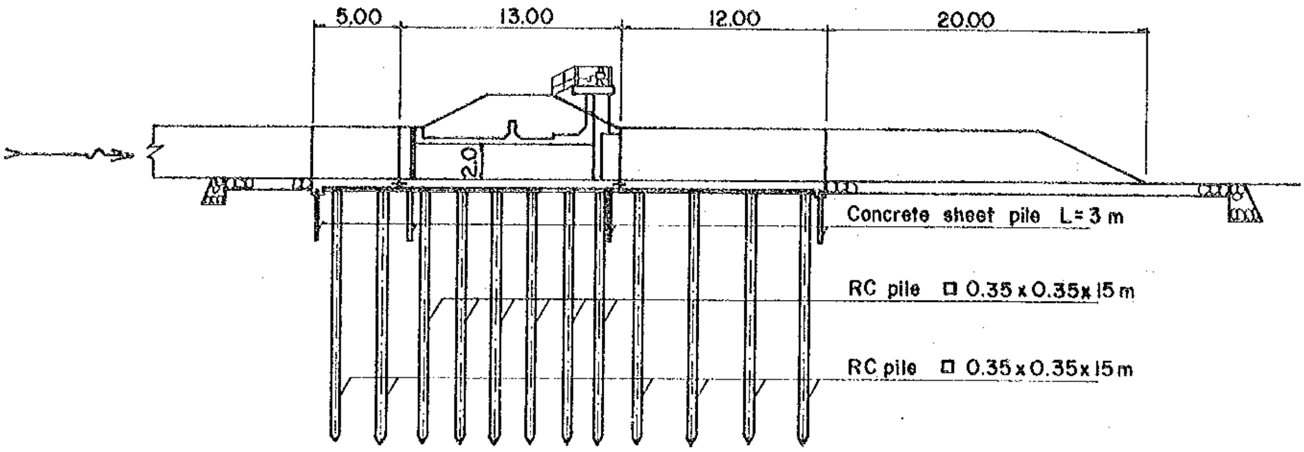


Fig. 8.10 PROPOSED HIGHWAY BRIDGE AT DIVERSION CHANNEL

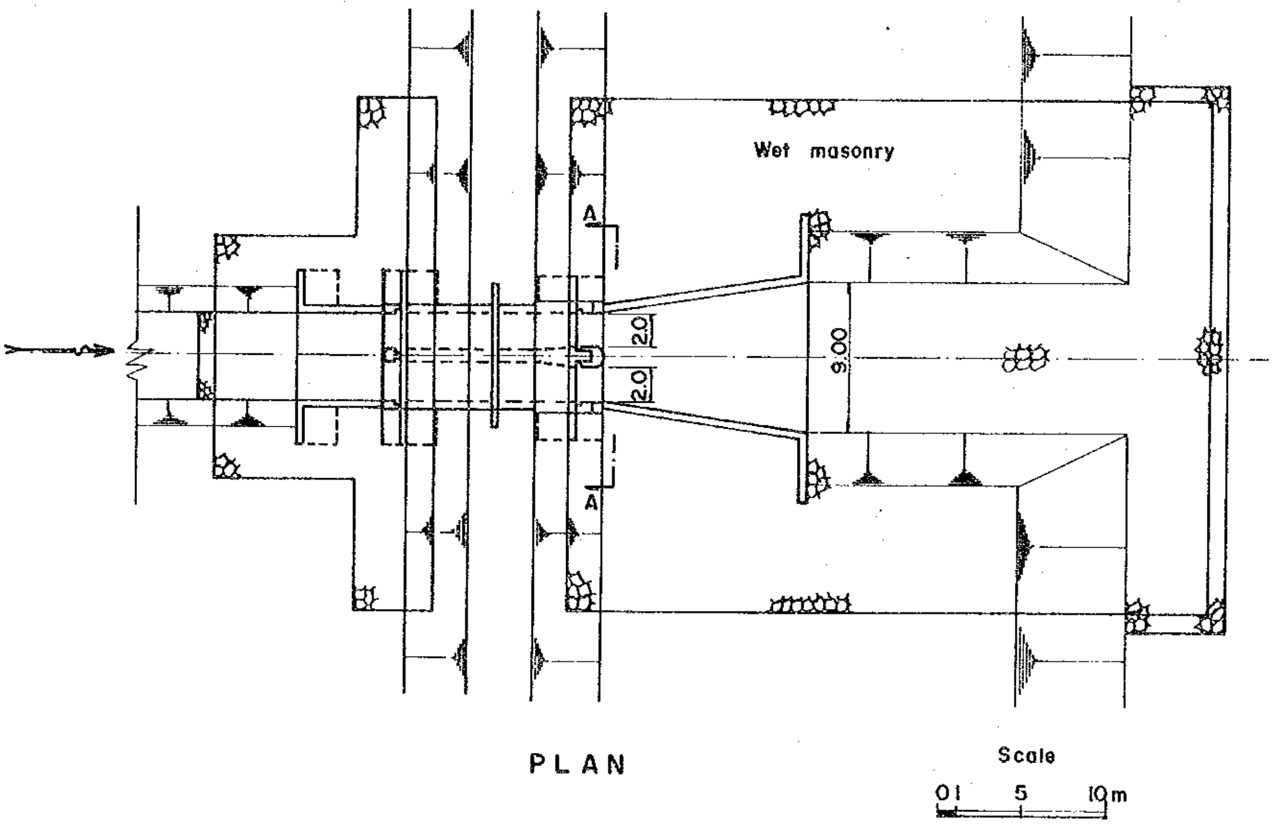


KEDUNGSOKO RETARDING BASIN

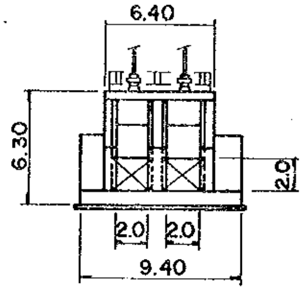
Fig. 8.11 LAYOUT OF KEDUNGSOKO RETARDING BASIN FACILITIES (1/3)



PROFILE

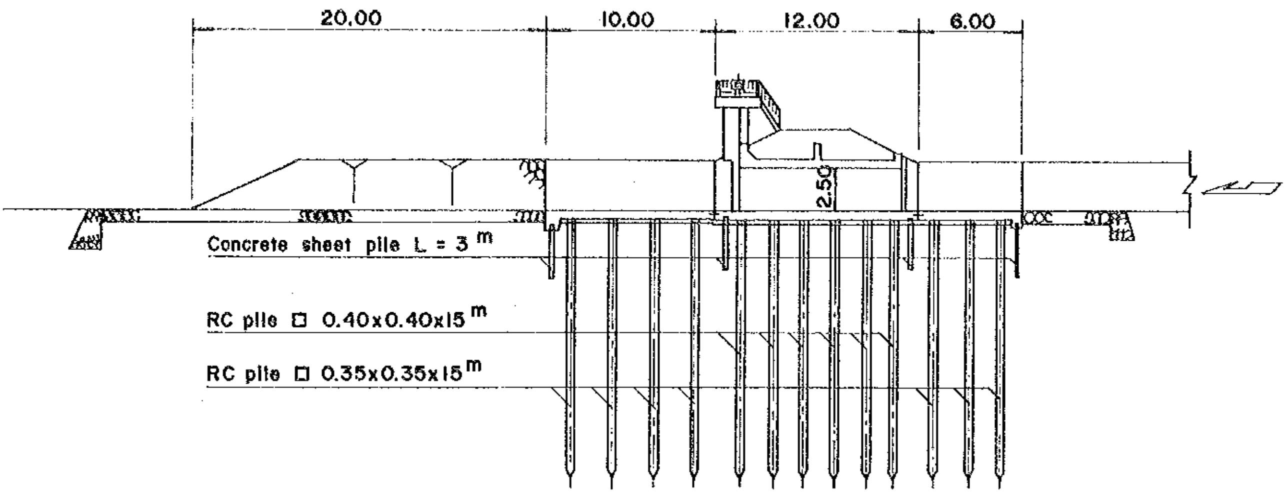


PLAN

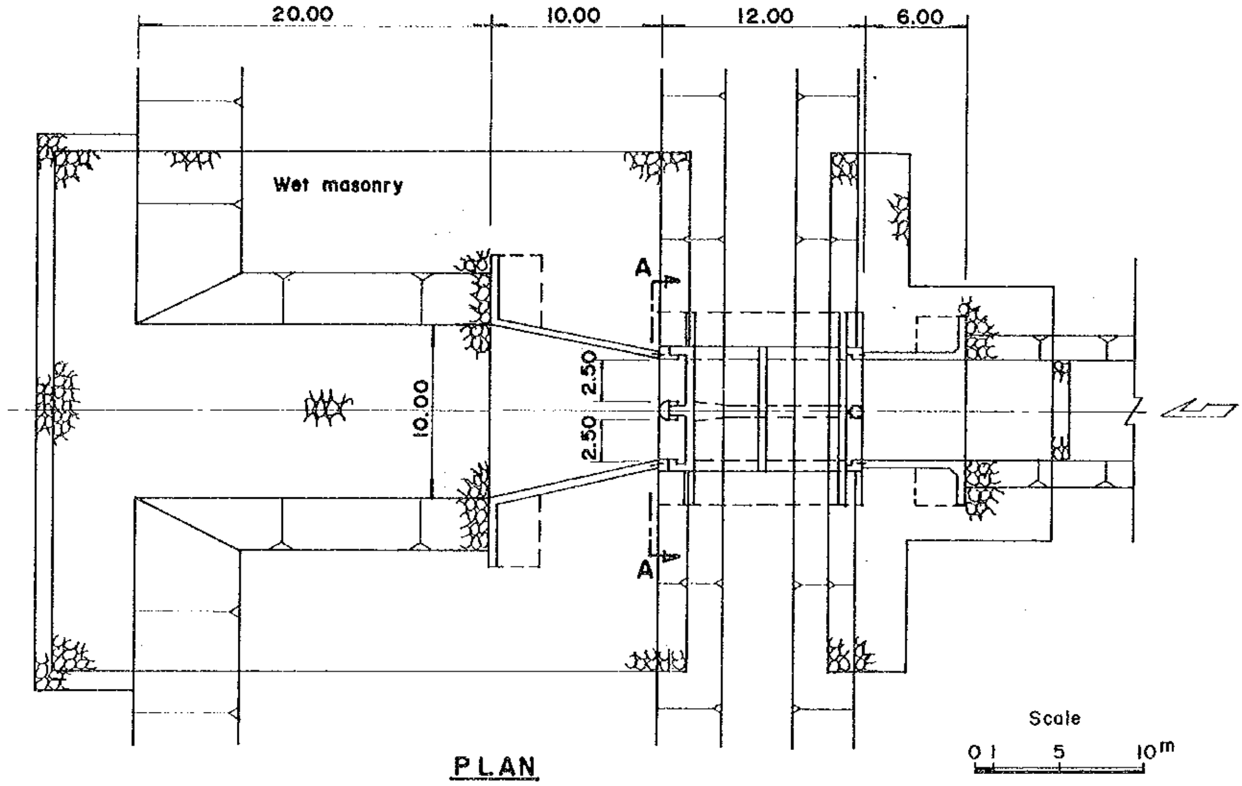


SEC. A — A

Fig. 8.11 PROPOSED DRAINAGE SLUICE IN KEDUNGSOKO RETARDING BASIN (LEFT SIDE) (2/3)



PROFILE



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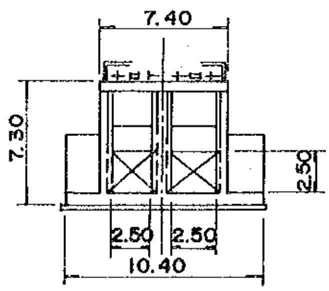
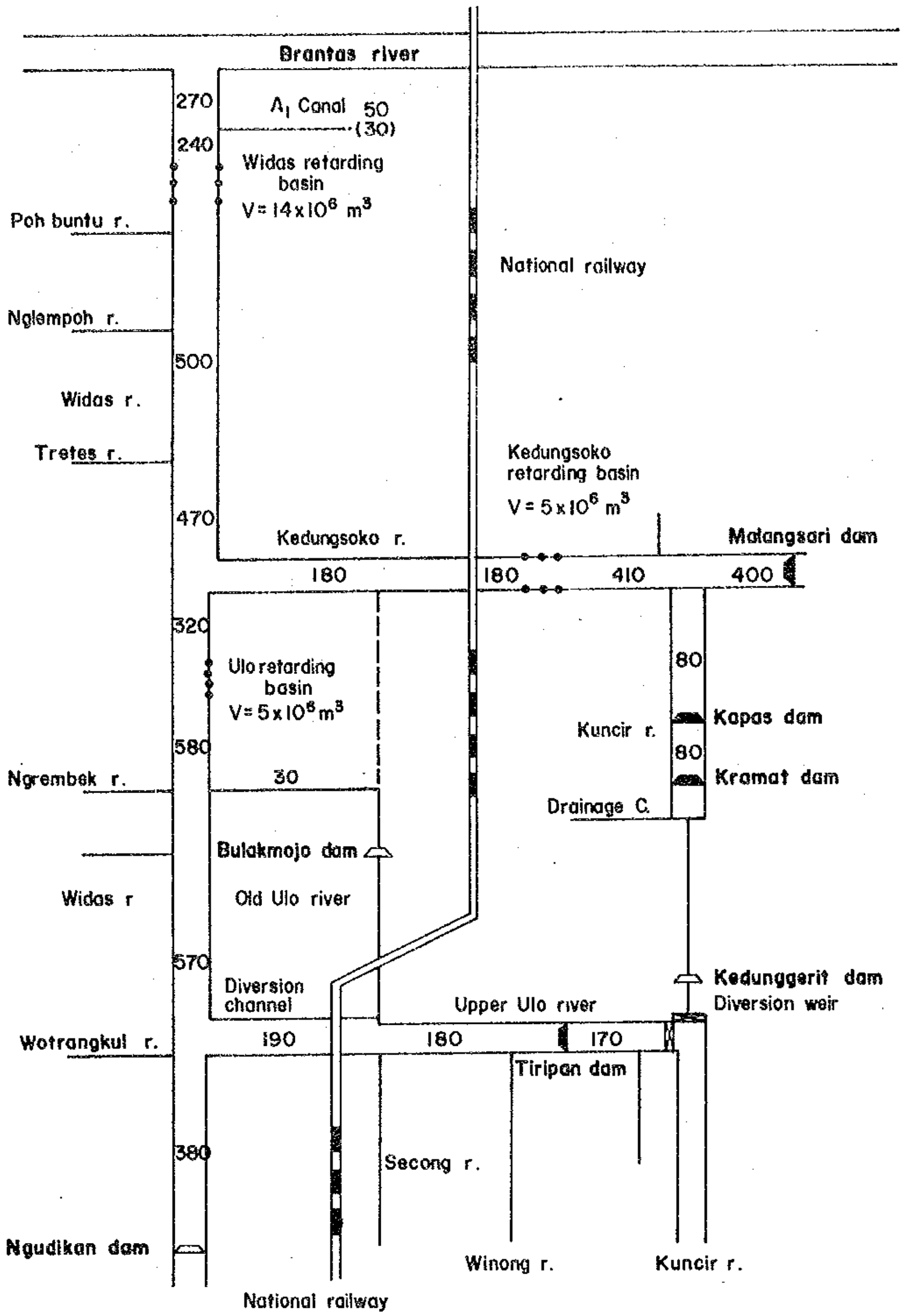


SEC. A - A

Fig. 8.11 PROPOSED DRAINAGE SLUICE IN KEDUNGSOKO RETARDING BASIN (RIGHT SIDE) (3/3)



Note : Unit m^3/s

Irrigation headworks to be repaired

(30) Inflow at peak stage in the Widas

Side overflow dike

Fig. 8.12 DESIGN DISCHARGE DISTRIBUTION OF PROPOSED FIRST STAGE PLAN

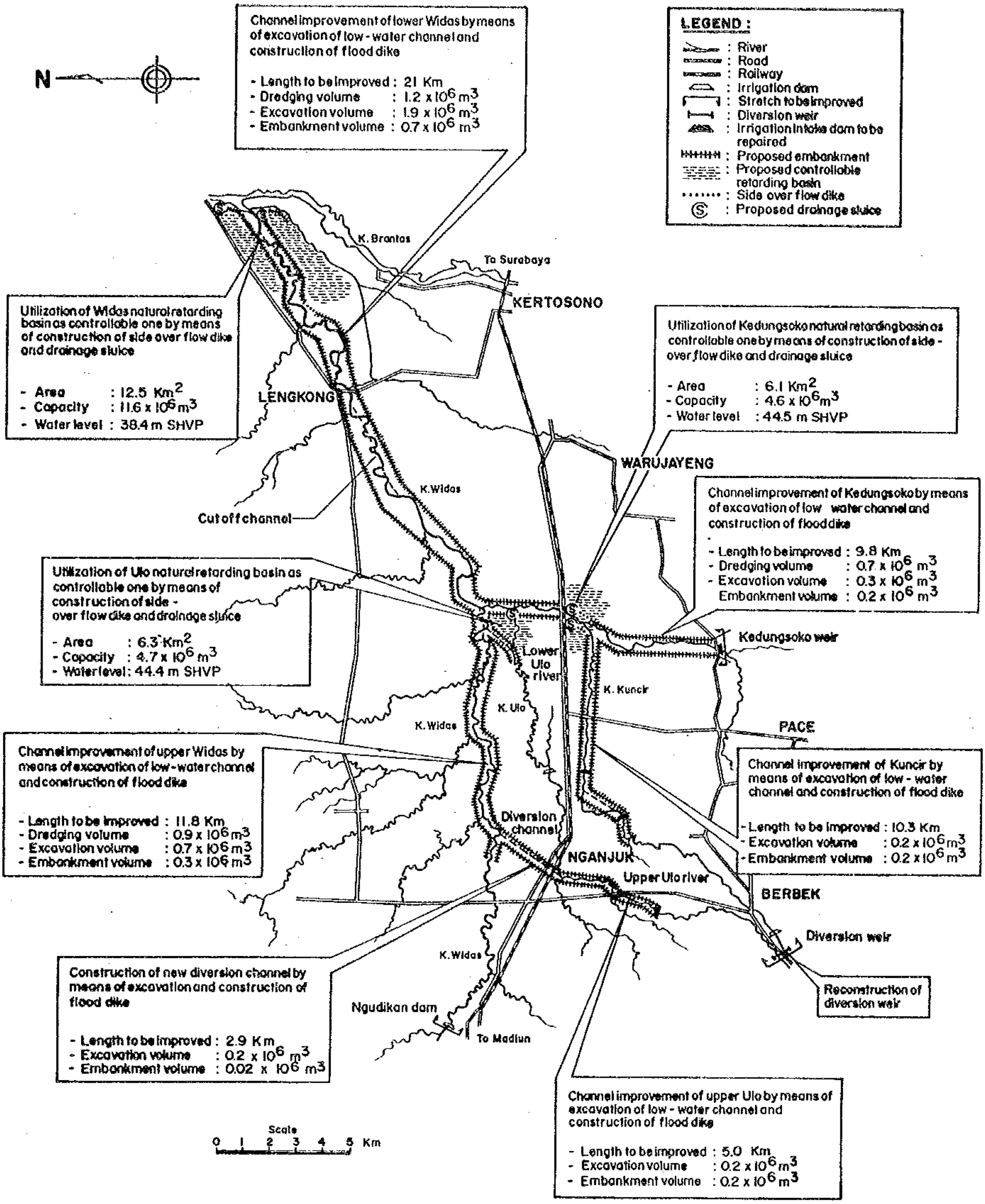


Fig. 8.13 OUTLINE OF FIRST STAGE PLAN

CHAPTER 9 CONSTRUCTION PLAN AND COST ESTIMATE

LIST OF TABLES

LIST OF FIGURES

CHAPTER 9 CONSTRUCTION PLAN AND COST ESTIMATE

9.1 Construction Plan

9.1.1 General

A construction plan and time schedule are described in this chapter conforming to the proposed comprehensive development plan of the flood control scheme in the basin.

It is a basic concept that the river improvement works be Implemented at once as recommended in Chapter 8.

The construction plan and schedule proposed herein are explained briefly on the following major components of the proposed plan.

(1) Channel improvement works for K. Widas, K. Kedungsoko, K. Ulo and K. Kuncir.

(2) Construction of structures related to the above four (4) rivers.

(3) Construction of new flood diversion channel connecting with K. Ulo and K. Widas.

The following conditions in the basin are also considered for preparation of this plan.

- Meteorology
- Topography
- Geology and soil condition
- River profile
- Local availability of construction materials and equipment
- Labour sources
- Other basic conditions such as workable days, men and equipment production rate and swell factors of earth material.

9.1.2 Mode of construction

The construction works of the Widas flood control and drainage project is assumed to be performed by the price contract system by selected contractor/s through international and/or local tender divided into the following five (5) construction packages.

Package - I	:	Lower Widas and Widas retarding basin
Package - II	:	Upper Widas, Ulo retarding basin and lower Ulo
Package - III	:	Upper Ulo and Ulo diversion channel
Package - IV	:	Kedungsoko and Kedungsoko retarding basin
Package - V	:	Kuncir

The fund required for the execution of construction works is assumed to be allocated from the governmental national budget and loan from bilateral and/or international financing agency.

At the implementation stage of construction works, the project will be administrated by DOR of DGWRD, and be supervised by BRBDEO in Malang in association with the Consultant.

9.1.3 Construction method

9.1.3.1 Work items and quantity

Major work items on the flood control and drainage project are given as follows.

(a) Channel improvement works

- Low water channel excavation; Widas and Kedungsoko
- High water channel excavation; Widas, Kedungsoko, Ulo and Kuncir
- Cut-off channel: Widas
- Levee embankment: Widas, Kedungsoko, Ulo and Kuncir
- Revetment

(b) Construction of related structures

- Highway and railway bridges
- Kuncir diversion weir
- Retarding basins at Widas, Kedungsoko and Ulo
- Irrigation headworks

(c) Construction of new flood diversion channel

- Channel excavation and embankment
- Construction of highway and railway bridge and other related structures

Bill of quantity by work items are presented in Table 8.2 and 8.3 of ANNEX 8.

9.1.3.2 Channel improvement works

The stretch of the rivers to be improved is as follows.

- Lower Widas	:	21.0 km
- Upper Widas & Lower Ulo	:	15.1 km
- Upper Ulo & New D. Channel	:	7.9 km
- Kedungsoko	:	9.8 km
- Kuncir	:	10.3 km
- Secondary Tributary	:	17.7 km
Total	:	81.8 km

The improvement methods of the existing river channel are river bed dredging, excavation of high water channel, cut-off channel, reinforcing and new levee embankment and revetment works by masonry and gabion.

(1) Low Water Channel Excavation by Dredger

Objective river is Widas and Kedungsoko. Excavation volume is estimated at about 3.2 million m^3 in total, 75% of which is in the Widas river. Dredged soil will not be suitable for the embankment material for the levee owing to the sandy quality. These soil are planned to be used for land reclamation in the low land of left and right side of the rivers excluding the areas of the proposed retarding basins.

Regional map shows the lower Widas area consisting of alluvial clay deposits with thickness of 10 - 50 m, which are easily excavated by cutter-suction dredger. The excavation of low water channel will be carried out mainly by 500 PS class suction dredger driven by diesel engine. The dredging works proceed from the downstream to the upstream. Discharge pipeline is planned to be one (1) km at maximum including floating pipeline. The annual operation hour of the dredger is limited due to the draft which will require one (1) meter at minimum and limited discharge of objective rivers in the dry season.

Amphibious excavator with dragline and swamp type long arm backhoe are planned to be used as supporting equipment considering river profile and limited workable days of dredger. These equipment are operated mainly at the Upper Widas and Kedungsoko for the low water channel excavation. Combination equipment with these supporting equipment is tractor shovel and dump truck.

Two (2) shift operation will be applied for dredger.

Drainage system is to be provided at the reclamation areas where the dredged materials are disposed.

The sequence of dredging and extent of river stretch to be dredged annually are determined as follows.

Sequence of dredging

Widas

Reach	Cons.year
I (22,000m^3)	1st year by dredger
II (450,000m^3)	"
III (390,000m^3)	2nd year, by dredger
IV (540,000m^3)	3rd & 4th year by dredger
V (-)	-
VI (260,000m^3)	3rd & 4th year by dredger
VII (580,00m^3)	4th & 5th year by dredger & amphibious excavator
VIII(120,000m^3)	"
Total (2,400,000m^3) approx.)	

Kedungsoko

Reach	Cons.year
I (110,000m^3)	1st year by long arm backhoe
II (-)	-
III (20,000m^3)	1st year by long arm backhoe
IV (680,000m^3)	2nd to 5th year by long arm backhoe
Total (800,000m^3 approx.)	

(2) High Water Channel Excavation

Objective rivers are Widas, Kedungsoko, Ulo and Kuncir.

Excavation volume in high water channel is roughly estimated at 1.43 million m^3 in total including 0.28 million m^3 of excavation at flood diversion channel. The breakdown is as follows.

River	Volume excavation approx.
Widas	420,000 m^3
Kedungsoko	160,000 m^3
Ulo	330,000 m^3
Kuncir	230,000 m^3
Flood diversion channel	280,000 m^3
Total	1,420,000 m^3

The soil properties in high water channel indicate the adequacy as the levee embankment material according to the survey results. It is planned that whole materials excavated at high water channel are to be used for the levee embankment materials.

The excavation works will be carried out by equipment in combination with swamp type bulldozer and backhoe, tractor shovel and dump truck. The hauling distance is planned in five (5) km at maximum. The works will be proceeded in parallel way for the low water channel works at several places provided with the grouping of equipment and crews with one (1) shift and seven (7) hours operation.

(3) Cut-off Channel

The cut-off channel works are planned at five (5) places at Widas and three (3) places at Kedungsoko. Total volume to be excavated is estimated at about 2.8 million m^3. Excavated soil distribution is planned as follows, approximately.

Levee embankment	:	560,000 m^3
Backfill of old channel	:	1,730,000 m^3
Land reclamation	:	510,000 m^3
Total	:	2,800,000 m^3

Same kind of equipment and construction method to the high water channel works will be applied for this works.

(4) Levee Embankment

The work comprises the construction of new levee and backwater levee, and reinforcing the existing levee. Embankment volume is estimated at about 1.7 million m^3 for both existing and new ones. The material sources are in high water channel and cut-off channel. The existing levee are generally thin and their slopes fairly steep. In order to secure the stability, most of them are planned to be reinforced with additional embankment. As for reinforcing the existing levee, the priority is to be given to the stretch where the crest elevation is lower than design crest elevation.

The embankment volume of 1.7 million m^3 is further classified as follows.

	Newly embank. (m^3)	Backwater levee (m^3)	Heightening (m^3)
Widas	760,000	200,000	70,000
Kedungsoko	110,000	-	120,000
Ulo	160,000	40,000	-
Kuncir	210,000	30,000	-
(Sub-Total)	1,240,000 m^3	270,000 m^3	190,000 m^3
Total		1,700,000 m^3	

A combination work by bulldozer, backhoe, tractor shovel, dump truck and vibration roller will be applied for this work. Compaction work is planned to use bulldozer, vibration roller and water tanker for control of moisture contents. The embankment works are carried out in the same schedule for high water channel excavation divided into several construction groups with one (1) shift operation.

(5) Revetment

To protect the river banks from erosion due to the flow, revetment which cover the river bank directly are principally planned at concave river bank and up and downstream end of structures where the flow would hit violently. Wet masonry and gabion matters and cylinder gabion revetment are designed considering easiness of construction and economical procurement of materials. Revetment works are to be carried out mainly by man power excluding the materials transportation. Sand bags with wooden piles are planned for the coffering works for wet masonry works in the low water channel. The piles are driven by man power.

(6) Flood Diversion Channel

A new flood diversion channel is about 3 km in length and of trapezoidal cross section. The following major facilities are constructed newly as the related structures of the channel.

Railway bridge	:	1 set
National highway bridge	:	1 set
Rural bridge	:	4 sets
Syphon	:	2 sets

The method of bridge & syphon construction is briefly explained in the later part of this chapter. The quantity of earthwork is 280,000 m^3 of excavation and 20,000 m^3 for embankment. Same kind of equipment and method to the high water channel works will be applied for this works. Excessive soils are utilized for land reclamation at surrounding low land.

9.1.3.3 Related structures to the rivers

(1) Bridges

It is planned that 34 bridges in total number will be constructed in the basin including replacement of existing bridges. The conditions of basic design is as follows.

Class		Newly Construction	Replacement	Type
Railway bridge		1	(1)/1	Steel trough
Highway bridge,	national road	1	1	T-beam
	Provincial road	1	5	"
	rural road	11	10	"
	foot path	3	1	Wooden
		17	17	

/1 : Only pier protection by riprap

The construction period is scheduled to be completed within 7 years for all bridges mentioned above. The priority of construction will be given according to the crowded condition. Construction period for one (1) bridge is planned in two (2) years at maximum.

The bridge construction will be carried out in two (2) stages by partial coffering method. Combination work by manpower and equipment will be applied for construction of bridges.

Temporary bridge and road are to be provided during the construction stage. The electric power supply is planned by diesel generator.

A new and steel trough type railway bridge having 52.5 m in length with two (2) spans is planned to be constructed crossing in the flood diversion channel. This railway is the trunk line between Surabaya and Jakarta. This railway bridge construction should be carried out in advance the excavation of channel. The PJKA's standards are to be applied. Further consultation with PJKA Madiun, Surabaya and Bandung is required at the detailed design stage.

(2) Diversion weir

Existing diversion weir located at Kuncir village is planned to be replaced just at upstream the existing one including channel excavation in about 350 m in length. The new fixed type weir to be constructed is equipped with a set of intake sluice gate of 7.5 m in width at the right side of the weir and a bridge of 3.5 m in width.

Construction period is scheduled at two (2) years.

No foundation treatment is required for the new weir. A combination work by manpower and equipment are applied for the construction of the weir and intake facilities, and channel excavation and other earthwork are carried out by equipment.

The weir construction and channel excavation are proceeded simultaneously. Construction equipment for this work those of bulldozer with ripper, dozer shovel, dump truck, backhoe, truck crane and portable concrete mixer for concreting.

Existing weir will be demolished using breakers. Temporary road and bridge should be provided during construction works. The required power is supplied by diesel generators.

(3) Irrigation Headworks, Replacement

Existing Tiripan intake dam of about 10 m in width is replaced with new one having 40 m in width equipped with two (2) sets of lifting gate of each 9 m in width operated by electric power.

Irrigation water should be supplied by pump-up system or other method during the construction period. The amount to be supplied is as follows.

Right side	:	0.2 m^3/sec
"	:	0.2 "
Left side	:	0.05 "

Construction period is scheduled at two (2) years. The construction will be done by partial coffering method divided into two (2) stages. Foundation is treated by reinforced concrete piles.

Manpower and equipment combination are required for this work. Major equipment will be vibro and pile hammer, bulldozer, dump truck and crane. Temporary road with bridge is to be provided during the work period. Required power is supplied by diesel generator.

(4) Irrigation Headworks, Improvement

The following 3 intake dams are planned to be improved for widening and reinforcement.

Malangsari dam in Kedungsoko
Kramat dam in Kuncir
Kapas dam in Kuncir

Irrigation water should be supplied during the improvement works by pump-up or other systems. The required discharge is as follows.

Malangsari,	left side	:	0.8 m^3/s
Kramat	, right side	:	0.3 "
Kapas	, left side	:	0.2 "
"	, right side	:	0.25 "

Construction period is scheduled at two (2) years for each, and the works will be carried out in two (2) stages by partial coffering method principally. Foundation is strengthened by reinforced concrete piles. Manpower and equipment combination works are also applied. Major equipment for this work will be vibro and pile hammer, bulldozer, dozer shovel, backhoe, dump truck and crane. Electric driven gates will be installed to each dam. Diesel generators will be used for power supply for the construction works.

(5) Other Structures

The following related structures to the rivers are also constructed.

Drainage culvert	:	24 nos
Sluice (intake)	:	3 "
Syphon	:	3 "
Drop structure	:	2 "
Side overflow dike	:	2,070 m
Drainage sluice in retarding basin	:	5 nos
Drainage channel in retarding basin	:	15,500 m
Al canal levee in retarding basin	:	184,000 m^3

These structures are constructed by equipment for earthworks and pile driving, and manual power for concrete works and others. The construction period is scheduled at five (5) years, and the construction priority on those structures will be decided at the detailed design stage. Major construction equipment required for construction works of the scheme are estimated and tabulated in Table 8.4 of ANNEX 8.

9.1.4 Preparatory works

Major item of preparatory works of temporary facilities is access and construction roads, offices and quarters both for the Owner with consultant and contractor and communication system. Since the Project lies in urban area, there are many public utilities. Those are existing roads, electricity supply, water supply, etc.

Access and Construction Roads

The principal road in the area runs East-West and connect Nganjuk, Kertosono, Jombang and Mojokerto to the Provincial Capital of Surabaya which is the main sea-port in Jawa. Distance from Surabaya to Nganjuk are 130 km approximately. This trunk road is maintained well by the Government. Provincial and rural roads branch away to North-South from this trunk road, and these roads are to be improved partially including bridges. The Surabaya wharf is big enough in its capacity to allow ships to reach there and for unloading facilities. Fig. 9.1 shows access to the site.

Offices and Quarters

The offices and quarters will be provided at Nganjuk for the Owners and Consultant's supervisory staffs having the following areas.

Offices	:	500 m^2
Quarters	:	1,000 m^2

The Contractor's site office will be provided at the nearest town of the construction sites having 1,000 m^2 approximately. Other contractor's temporary buildings will be as follows.

- Laboratoreis	:	100 m^2
- Warehouses	:	1,000 m^2
- Repair shop	:	300 m^2
- Motor pool	:	2,000 m^2
- Small control building at each job sites	:	500 m^2

Communication system

Direct dial - in telephone system is available between Malang - Kediri only within the Project's region at present. Indirect telephone system through the station operator is usable between Malang, Nganjuk, Kertosono and Lengkong. Telecommunication system within the Project area will be provided connecting the Owner's main office at Nganjuk and each job sites in addition to the internal telephone system in the office which will have to be about 50 circuits.

Power supply system

Required electric power for construction of related structures is planned to be supplied by diesel generators. According to the PLN's distribution program, 20 KV lines and 380/220 V system will be available from 1987/1988 in the Project area.

Air supply system

Portable type air compressor will be provided for supply of compressed air for demolishing works and others.

Fuel supply system

Fuel tanker will be utilized for supply of fuel to the each job site.

Construction Plant

Stationally type aggregate and batching plant is not considered since there are many job sites but small work quantities in each site. Required aggregates will be procured from local market or produced by portable crushing plant.

Portable type concrete mixers are planned to be used for concrete production.

Clinics & First Aid Facility

Public utilities in the region would be utilized for the purpose of safety.

9.1.5 Construction time schedule

In preparing the construction plan and time schedule, the following basic conditions were taken into account.

(a) Workable days and hours

Yearly workable days and hours are estimated as follows based on the rainfall records in last ten (10) years at Temperan and Sawahan gauging station in Nganjuk, discharge data of the four (4) rivers and Indonesian labour regulations.

	Dredging	Other works
Equipment	200 days, 2,000 hrs (2 - shift)	215 days, 1,500 hrs (1 - shift)
Labour force	- -	215 days, 1,500 hrs

(b) Hourly production rate of equipment

Hourly production of major equipment is estimated by conventional method for each equipment.

(c) Equipment

Based on the contract system in execution of the project, no consideration is taken for utilization of equipment owned by the Brantas Project.

The proposed construction time schedule is shown in Fig. 9.2. The summary is given as follows.

1985 - 1988 : Pre-construction

- Feasibility study
- Survey, investigation & hydraulic model test
- Detailed design
- Financial arrangement

1989 - 1991 : Tender & award of contract. Package I to V

1989 - 1994 : 1st stage construction

- Lower Widas & retarding basin
- Upper Widas, lower Ulo and retarding basin
- Upper Ulo & new diversion channel
- Kedungsoko & retarding basin
- Kuncir
- Related river structures to the above

The sequence for construction works on the Widas river flood control scheme is given below.

1st : Channel improvement works for lower Widas with retarding basin and related structures.

2nd : Construction of channel improvement of Upper Widas and lower Ulo with retarding basin and related structures.

3rd : Channel improvement of Kedungsoko with retarding basin and related structures.

4th : Channel improvement of Upper Ulo and construction of new diversion channel.

5th : Channel improvement of Kuncir with related structures.

Proposed time schedule is prepared taking into account the sequence of the works mentioned above. Construction is scheduled to be completed in five (5) and starting from 1989. Channel improvement works will be proceeded with the working groups of (i) low water channel improvement, (ii) high water channel improvement, (iii) levee embankment and (iv) related structures. The three (3) retarding basins should be completed within one (1) year after the commencement of construction works of each package.

9.2 construction Cost Estimate

9.2.1 Conditions of cost estimate

The followings are basic conditions and assumptions for the financial cost estimation on the Schemes.

Items		Conditions or Assumptions
1. Implementation method	:	Contracting system
2. Construction period	:	1st stage : 5 years 2nd stage : 3 years
3. Price level	:	November, 1985
4. Exchange rate	:	1 US$ = Rp. 1.100 = Yen 210
5. Composition of Construction cost	:	1) Cost for general items 2) Cost for main civil works - Direct cost - Indirect cost 3) Land & building compensation cost 4) Government administration cost 5) Engineering services 6) Physical contingency
6. Method of estimation		
1) cost for general items	:	Lump sum basis
2) Cost for main civil works	:	Unit cost basis
3) Land & building compensation cost	:	Unit price basis
4) Government adminis-tration cost	:	Lump sum basis
5) Engineering services	:	"
6) Physical contingency	:	"

Items	Conditions or Assumptions
7. Unit cost	: Unit cost is to be supported by unit prices of the followings; - Labour wage - Material price - Equipment cost - Miscellaneous
8. Unit price	
1) Labour wage	: Daily wages of labourer are established using collected datas with one (1) shift and seven (7) hour working conditions, principally. (Table 8.5 of ANNEX-8)
2) Material price	: Material unit prices are provided based on the collected datas at site delivery basis. (Table 8.6 of ANNEX-8)
3) Equipment	: Hourly cost of equipment is estimated comprising the following cost. - Depreciation cost - Maintenance and repair cost - Management cost
4) Miscellaneous cost	: Lump sum
9. Direct cost	: Direct construction cost multiplied by the Unit cost.
10. Indirect cost	: As for contractors overhead, profile and site expenses, 25% of direct cost is estimated.
11. Currency component	: Three (3) components : - Foreign portion, F.C (US$) - Indirect foreign portion, I.F.C (US$) - Domestic portion, D.C (Rp.)

Items	Conditions or Assumptions
12. Cost items in F.C, I.F.C & D.C	
1) Foreign currency portion (US$) :	1) Direct cost - 100 % of depreciation cost of equipment - 85% of maintenance & repair cost of equipment (same as BTS Middle Reach Project). 2) Engineering services cost - Remuneration & direct cost of foreign consultants. 6.4% of total direct & indirect cost (8% x 70% of foreign portion) 3) Physical contingency
2) Indirect foreign :	1) Imported plant and materials - Cost of imported plant, licences raw and intermediate materials to produce domestically available materials. Rates are referred to other projects. (Wonorejo, T'agung, Tes-1 & Padang) datas as shown in Table 8.7 of ANNEX-8.
3) Domestic currency portion (Rp.) :	1) Cost for general items, 100% 2) Direct cost - 100% of labour cost - Material cost (by ratio as stipulated above) - 100% of equipments management cost - 15% of maintenance & repair cost of equipment - 100% of miscellaneous cost 3) Indirect cost - 100% of indirect cost (Contractor's overhead, profit & site expenses)

4) Land & building compensation cost 100%

5) Government administration cost 100%

6) Engineering services
- Remuneration and direct cost for domestic consultant & direct cost of foreign consultant. 2.4% of total direct & indirect cost (8% x 30% of domestic portion)

7) Physical contingency

13)	Cost of Government administration	:	5% of total cost for direct & indirect cost
14)	Engineering services	:	8% of total cost for direct & indirect cost
15)	Physical contingency	:	15% of base cost
16)	Price contingency	:	Foreign 3% per annum Domestic 5% per annum

9.2.2 Construction cost

Based on the conditions and assumptions outlined above, the construction cost was estimated as totalized below.

Comprehensive plan

Foreign currency	:	US$	$26,989.6 \times 10^3$
Domestic "	:	Rp.	$32,903.8 \times 10^6$
Total Rp. Equivalent	:	Rp.	$62,592.4 \times 10^6$

Table 9.1 shows construction cost of each work item and Table 9.2 shows the summary of construction cost. The detailed results of them are shown in ANNEX-8.

Bill of quantities and its unit cost for direct cost is shown in Table 8.8 of ANNEX-8.

9.2.3 Disbursement schedule

The construction period is scheduled to be five (5) years from 1988 to 1993. The annual disbursement schedule for funds required for this project, excluding interest during construction period, was assumed and shown in Table 9.3.

Table 9.1 DIRECT CONSTRUCTION COST OF FIRST STAGE (1/2)

Unit: 10^6 Rp

Work Item	Lower Widas	U. Widas L. Ulo	F.D. Channel	Upper Ulo	Kedungsoko Soko	Kuncir	Total
1. Dredging of lowwater channel	2,657.8	1,929.6	-	-	1,663.2	-	6,250.6
2. Excavation of highwater channel, etc.	1,845.3	691.5	283.8	236.9	313.3	156.6	3,527.4
3. Levee embankment	1,708.2	802.9	46.4	356.8	495.6	564.7	3,974.6
4. Disposal of excess soil	1,907.1	450.9	282.9	138.2	225.0	76.0	3,080.1
5. Bank protection	262.0	73.0	372.8	269.7	43.7	58.4	1,079.6
6. Bridge	1,960.3	2,225.8	1,475.2	779.3	905.1	840.5	8,186.2
7. Drainage culvert	391.4	235.9	150.3	-	241.1	382.4	1,401.1
8. Intake sluice	-	41.5	-	41.5	-	41.5	124.5
9. Syphon	-	171.8	226.4	-	-	200.3	598.5
10. Drop structure	-	34.1	34.0	-	-	-	68.1
11. Drainage sluice in retarding basin	683.0	-	-	-	632.4	-	1,315.4
12. Side overflow dike	968.6	665.9	-	-	871.7	-	2,506.2
13. Flood diversion weir	-	-	-	415.8	-	-	415.8
14. Irrigation headworks	-	-	-	866.2	1,238.3	987.0	3,091.5
15. Drainage in retarding basin	404.1	37.6	-	-	56.4	-	498.1
16. A-1 canal embankment	404.1	-	-	-	-	-	404.1
Total	13,149.9	7,512.5	2,826.8	3,104.4	6,686.0	3,317.4	36,596.0

Table 9.1 DIRECT CONSTRUCTION COST OF COMPLEHENSIVE PLAN (2/2)

Unit: 10^6 Rp

Work Item	Lower Widas	U. Widas L. Ulo	F.D. Channel	Upper Ulo	Kedungsoko Soko	Kuncir	Total
1. Dredging of lowwater channel	3,058.3	2,118.8	-	-	1,909.9	-	7,087.0
2. Excavation of highwater channel, etc.	2,123.2	778.4	263.6	286.5	359.1	217.8	4,028.6
3. Levee embankment	1,708.5	793.9	46.4	356.8	495.6	564.7	3,965.9
4. Diesposal of excess soil	2,263.6	684.9	314.7	201.8	244.6	64.5	3,774.1
5. Bank protection	1,557.7	361.2	437.0	561.8	222.5	288.2	3,428.4
6. Bridge	1,908.5	2,225.8	1,474.9	779.4	905.1	840.5	8,134.2
7. Drainage culvert	353.8	235.9	150.3	-	241.1	382.4	1,363.5
8. Intake sluice	-	41.5	-	41.5	-	41.5	124.5
9. Syphon	-	171.8	219.1	-	-	200.3	591.2
10. Drop structure	-	34.1	34.1	-	-	-	68.2
11. Drainage sluice in retarding basin	683.0	-	-	-	632.4	-	1,315.4
12. Side overflow dike	968.6	665.9	-	-	871.7	-	2,506.2
13. Flood diversion weir	-	-	-	415.8	-	-	415.8
14. Irrigation headworks	-	-	-	866.2	1,238.3	987.0	3,691.5
15. Drainage in retarding basin	361.8	37.6	-	-	56.4	-	455.8
16. A-1 canal embankment	404.1	-	-	-	-	-	404.1
Total	15,391.1	8,188.3	2,947.7	3,509.9	7,176.9	3,586.9	40,800.8

Table 9.2 FLOOD CONTROL SCHEME
SUMMARY OF CONSTRUCTION COST (1/2)

COMPREHENSIVE PLAN

	Item	Foreign Currency (10^3 US$)	Domestic Currency (10^6 Rp)	Total Equipvalent (10^6 Rp)
1.	General item	-	610	610
2.	Direct cost			
	Lower Widas	8,238.8	6,328.4	15,391.1
	U. Wides + L. Ulo	4,089.1	3,690.3	8,188.3
	F.D. Channel	1,541.6	1,252.0	2,947.7
	Upper Ulo	1,824.9	1,502.5	3,509.9
	Kedungsoko	3,647.4	3,164.7	7,176.9
	Kuncir	1,717.9	1,698.8	3,588.6
3.	Sub Total (1 & 2)	21,059.8	18,246.8	41,412.5
4.	Land acquisition	-	7,632.0	7,632.0
5.	Government Administration	-	2,070.6	2,070.6
6.	Engineering Services	2,409.5	662.6	3,313.0
7.	Base Cost	23,469.2	28,612.0	54,428.2
8.	Physical Contingency	3,520.4	4,291.8	8,164.2
9.	Base Cost + Physical Contingency	26,989.6	32,903.8	62,592.4
10.	Price Contingency	6,050.5	11,775.4	18,430.9
	Total Cost	33,040.1	44,679.2	81,023.3

Table 9.2 FLOOD CONTROL SCHEME
SUMMARY OF CONSTRUCTION COST (2/2)

FIRST STAGE

	Item	Foreign Currency (10^3 US$)	Domestic Currency (10^6 Rp)	Total Equivalent (10^6 Rp)
1.	General item	-	610	610
2.	Direct cost			
	Lower Widas	7,288.5	5,132.6	13,149.9
	U. Wides + L. Ulo	3,774.2	3,360.9	7,512.5
	F.D. Channel	1,486.4	1,191.8	2,826.8
	Upper Ulo	1,667.6	1,270.0	3,104.4
	Kedungsoko	3,411.0	2,933.9	6,686.0
	Kuncir	1,631.6	1,522.4	3,317.2
3.	Sub Total (1 & 2)	19,259.3	16,021.6	37,206.8
4.	Land acquisition	-	7,632.0	7,632.0
5.	Government Administration	-	2,070.6	2,070.6
6.	Engineering Service	2,164.7	595.3	2,976.5
7.	Base Cost	21,424.0	26,319.5	49,885.9
8.	Physical Contingency	3,213.6	3,947.9	7,482.9
9.	Base Cost + Physical Contingency	24,637.6	30,267.4	57,368.8
10.	Price Contingency	5,523.2	10,831.9	16,907.4
	Total Cost	30,160.8	41,099.3	74,276.2

Table 9.3 DISBURSEMENT SCHEDULE OF FLOOD CONTROL PLAN (1/3)

Unit: FC 10^3 US$
DC 10^6 Rp

Work Item	Total			1988			1989		
	FC	DC	T	FC	DC	T	FC	DC	T
1. General Item		610.0	610.0					122.0	122.0
2. Direct Construction Cost									
(1) Lower Widas	8,238.8	6,328.4	15,391.1				1,647.8	1,265.7	3,078.2
(2) Upper Widas & Lower Ulo	4,089.1	3,690.3	8,188.3						
(3) Flood Diversion Channel	1,541.6	1,252.0	2,947.7						
(4) Upper Ulo	1,824.9	1,502.5	3,509.9						
(5) Kedungsoko	3,647.4	3,164.7	7,176.9						
(6) Kuncir	1,717.9	1,698.8	3,588.6						
3. Land Acquisition		7,632.0	7,632.0		2,289.6	2,289.6		3,052.8	3,052.8
4. Administrative Expenses		2,070.6	2,070.6					207.1	207.1
5. Engineering Services	2,409.5	662.6	3,313.0				240.9	66.3	331.3
Base Cost	23,469.2	28,612.0	54,428.2		2,289.6	2,289.6	1,888.7	4,713.8	6,781.4
6. Physical Contingency	3,520.4	4,291.8	8,164.2		343.4	343.4	283.3	707.1	1,018.7
Base Cost & Physical Contingency	26,989.6	32,903.8	62,592.4		2,633.0	2,633.0	2,172.0	5,420.9	7,810.1
7. Price Contingency	6,050.5	11,775.4	18,430.9		490.3	490.3	309.0	1,331.0	1,670.9
Total Cost	33,040.1	44,679.2	81,023.3		3,123.3	3,123.3	2,481.0	6,751.8	9,481.0

Table 9.3 DISBURSEMENT SCHEDULE OF FLOOD CONTROL PLAN (2/3)

Unit: FC 10^3 US$
DC 10^6 Rp

Work Item	1990			1991			1992		
	FC	DC	T	FC	DC	T	FC	DC	T
1. General Item		244.0	244.0		244.0	244.0			
2. Direct Construction Cost									
(1) Lower Widas	2,471.6	1,898.5	4,617.3	2,471.6	1,898.5	4,617.3	1,647.8	1,265.7	3,078.2
(2) Upper Widas & Lower Ulo	817.8	738.1	1,637.7	1,226.7	1,107.1	2,456.5	1,226.7	1,107.1	2,456.5
(3) Flood Diversion Channel							385.4	313.0	736.9
(4) Upper Ulo				456.2	375.6	877.5	912.5	751.2	1,755.0
(5) Kendungsoko	911.9	791.2	1,794.2	1,823.7	1,582.4	3,588.4	911.9	791.2	1,794.2
(6) Kuncir							429.5	424.7	897.1
3. Land Acquisition		2,289.6	2,289.6						
4. Administrative Expenses		414.1	414.1		414.1	414.1		414.1	414.1
5. Engineering Services	481.9	132.5	662.6	481.9	132.5	662.6	481.9	132.5	662.6
Base Cost	4,683.2	6,508.0	11,659.6	6,460.2	5,754.3	12,860.5	5,995.6	5,199.6	11,794.7
6. Physical Contingency	702.5	976.2	1,748.9	969.0	863.1	1,929.1	899.3	779.9	1,769.2
Base Cost & Physical Contingency	5,385.7	7,484.2	13,408.5	7,429.2	6,617.4	14,789.6	6,894.9	5,979.5	13,563.9
7. Price Contingency	950.8	2,303.6	3,349.5	1,573.7	2,469.5	4,200.7	1,711.2	2,642.0	4,524.4
Total Cost	6,336.4	9,787.9	16,758.0	9,003.0	9,087.0	18,990.2	8,606.1	8,621.5	18,088.3

Table 9.3 DISBURSEMENT SCHEDULE OF FLOOD CONTROL PLAN (3/3)

Unit: FC 10^3 US$
DC 10^6 Rp

Work Item	1993			1994		
	FC	DC	T	FC	DC	T
1. General Item						
2. Direct Construction Cost						
(1) Lower Widas						
(2) Upper Widas & Lower Ulo	817.8	738.1	1,637.7			
(3) Flood Diversion Channel	770.8	626.0	1,473.9	385.4	313.0	736.9
(4) Upper Ulo	456.2	375.6	877.5			
(5) Kendungsoko						
(6) Kuncir	859.0	849.4	1,794.3	429.5	424.7	897.1
3. Land Acquisition						
4. Administrative Expenses		414.1	414.1		207.1	207.1
5. Engineering Services	481.9	132.5	662.6	240.9	66.3	331.3
Base Cost	3,385.7	3,135.7	6,860.0	1,055.8	1,011.0	2,172.4
6. Physical Contingency	507.9	470.4	1,029.0	158.4	151.7	325.9
Base Cost & Physical Contingency	3,893.6	3,606.1	7,889.0	1,214.2	1,162.7	2,498.3
7. Price Contingency	1,112.1	1,853.3	3,076.7	393.6	685.6	1,118.6
Total Cost	5,005.7	5,459.4	10,965.7	1,607.8	1,848.2	3,616.9

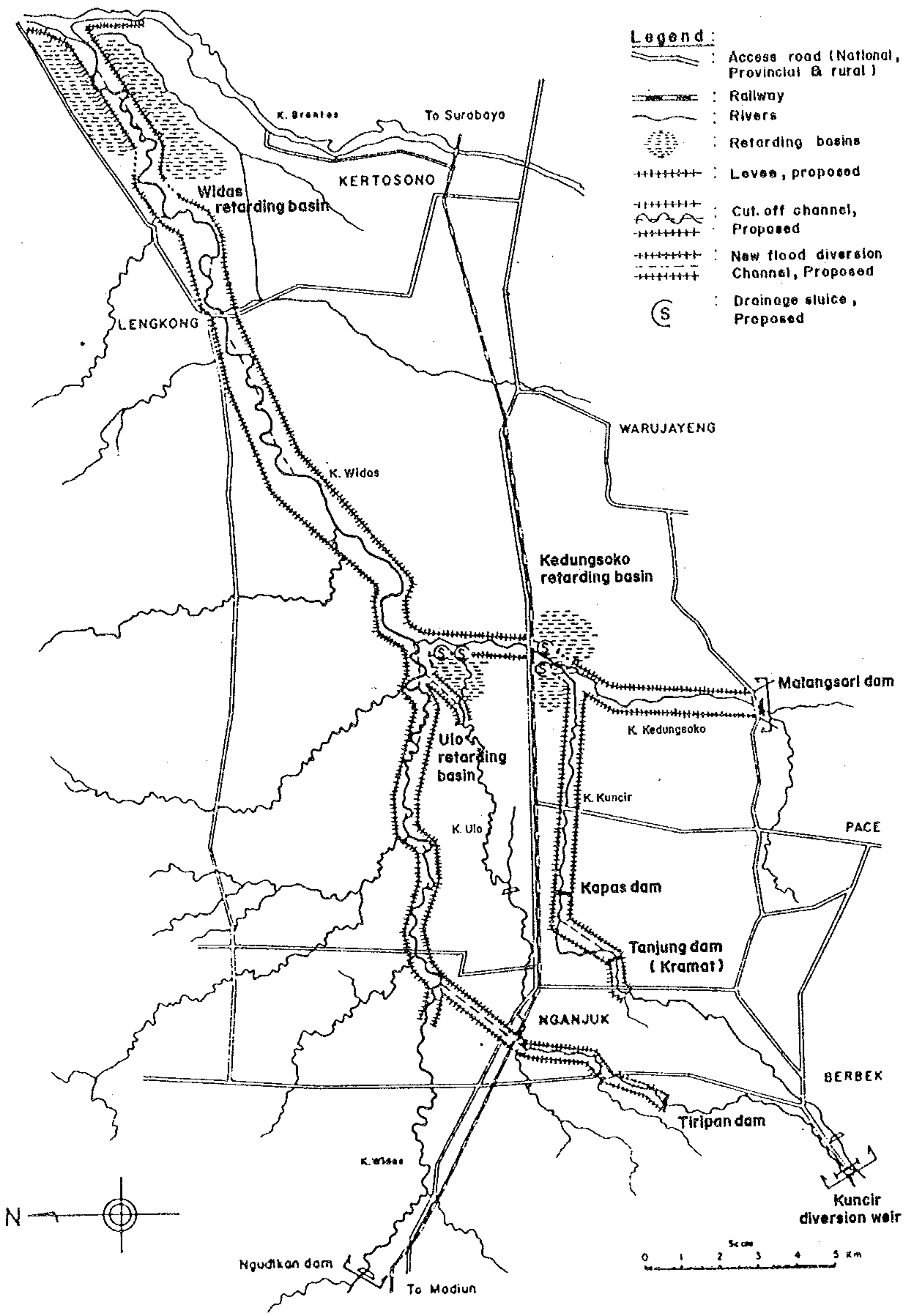
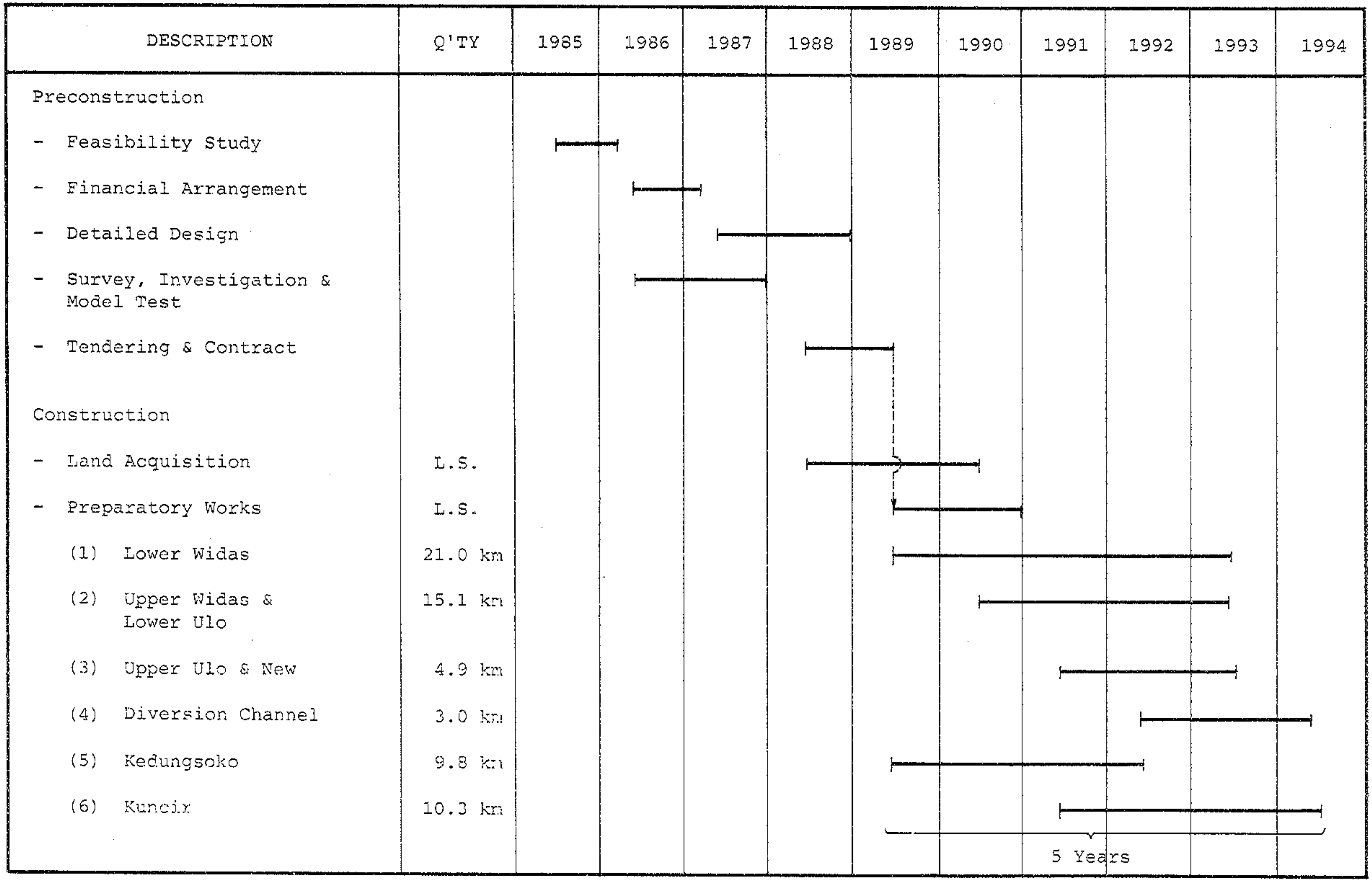


Fig. 9.1 ACCESS TO SITE, WIDAS PROJECT

Fig. 9.2 CONSTRUCTION TIME SCHEDULE FOR FLOOD CONTROL SCHEME



CHAPTER 10 EVALUATION OF THE PROPOSED PLAN

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10. EVALUATION OF THE PROPOSED PLAN

10.1 Introduction

The flood control and drainage improvement plan in the Widas river basin which has been presented in the previous chapters is evaluated from the economic and environmental viewpoints. Firstly, the economic cost of the Project and the anticipated benefits are estimated. Then the cost and benefit are compared.

Since the majority of the benefits will arise from the flood control benefit which is measured as reduced amount of flood damage, probable flood damages are estimated, by means of a Mesh method. In the Mesh method the flood plain is divided into 500 m square meshes and the property values in each mesh are estimated. The flood damage is calculated as the property value multiplied by the damage rate. The flood plain is delineated referring to the 1979 flood as shown on Fig. 10.1. For each mesh, the ground surface elevation and land use (paddy field, upland field, residential area, etc.) are given based on 1 to 2,500 scale topographic maps. Fig. 10.2 shows the general procedure for flood damage analysis.

10.2 Economic cost

The construction cost estimated in chapter 9 involves some transfer of payments within the national economy, nominally over-valued prices, etc. In order to find out economic costs of the Project, the following adjustments are made.

Firstly, transfer of payments are classified into 2 items; import duty tax and sales tax.
The average tax rates of above items are shown as below:

- Import duty tax 10%
- Sales tax 10% (the average sales tax of both equipment and raw materials is 10%)

Secondarily, economic cost of unskilled labour is estimated at 50% of financial labour cost.

Construction cost of this Project is broadly classified into 3 components namely foreign, and domestic cost. As far as foreign portion of construction cost are concerned, import duty and sales tax are subtracted from financial cost because most of cost items are related to import or knockdown equipments. Since domestic portion of cost items covers domestic materials and skilled and unskilled labour, sales tax of domestic materials and over-valued unskilled labour cost (50% of nominal wage rate) are subtracted from financial cost. After the proportions of domestics material and unskilled labour cost are counted by each work item of flood control plans, the conversion rate from financial cost to economic cost is calculated by each work item.

Lands to be acquired by this Project are mostly paddy field. By referring the average cropping pattern of the Project area, economic cost of such lands is regarded as production foregone of agricultural crops during the life time of the Project. Economic cost of compensation is taken up as an annual value of house.

Further, adjustment is made to the costs for replacement of the existing bridges and dams. Since almost all the existing structures are superannuated, it will become necessary to replace them within a decade or so, even if the flood control project is not implemented. It is considered that such replacement costs be inevitable to the national economy. Therefore, the amounts needed to replace the existing structures in the existing scale are deducted from the cost of the flood control project. Instead of this adjustment, benefit from grading up of the existing structures such as widening of carrage way is not counted.

As a result, the former cost portion of bridges intake weirs, etc. mentioned above is taken up as economic cost of them. The detailed results concerning economic costs are shown in Table 10.1.

10.3 Damageable Property Values

10.3.1 General

Damage appraisal for project evaluation involves a comparison of the damage that can be expected without the project and that which will occur after the project is implemented. Proper appraisal requires a projection of physical and economic conditions during the life time of the project. The present conditions are merely convenient benchmarks from which to estimate future conditions without and with the project. /

Since the economic growth in real term is expected to continue in the Widas basin and the basin population growth is also expected in the coming decade although the growth rate will become gradually low, it is considered that the damageable property values in the basin will increase year by year. Therefore, the damageable property values are estimated for 1985 as a benchmark and for future covering the life time of the Project. The increase of the damageable value is assessed by increase in the unit property value and increase in number of the damageable property items.

/ U.S.D.A. Soil conservation service (ECONOMICS GUIDE FOR WATERSHED PROTECTION AND FLOOD PREVENTION", Mar. 1964.)

10.3.2 Kinds of properties in the flood plain

Kinds of properties in the flood plain are summarized in the following:

- various kinds of crops on the farm land
- buildings for households (urban and rural), restaurant, store, public and private building, and manufacturing establishments
- indoor movables by the type of buildings specified above
- infrastructures such as roads, bridges, levees, canals
- cars and motor cycles

10.3.3 Assessment of damageable property value at present and in the future

For assessment of the property value, the following items are selected as representative ones.

- crops .... paddy, maize, soybean
- buildings .... households (urban and rural), restaurant, store, manufacturing establishments, private & public buildings.
- indoor movables ... corresponding to the classification of buildings
- cars and motorcycles

Since data on the economic value of the above item covering flood plain are not available, present economic unit value and yield (density of each item) is estimated analytically. Details of estimation of economic unit value of each item in 1985 are given in ANNEX-5 and results are summarized below.

(1) Unit value of crops per ha

The procedures taken in the calculation of crop damages are shown in ANNEX-5. Since agricultural conditions are different by areas within the Widas river basin, the damageable value is estimated by areas shown below.

- Ulo, Widas and Kedungsoko retarding basin
- Widas North, Widas South, Warujayeng and Widas Extension Area

Based on the area classification, unit value of crops is estimated with the following parameters.

- crop yield by areas specified above
- cropping pattern by areas
- planted area by areas (based on cropping intensity)
- seasonal frequency of floods
- Economic price of crops (based on Primary Price Prospects of Commodities issued by the World Bank)
- Production cost

Economic prices of crops are shown in ANNEX-6. Breakdown of production costs by crops based on average farm inputs of Kab. Nganjuk are shown in ANNEX-6. Accumulation cost is calculated by farm inputs based on stage of farming practices.

Crop damage is defined as the difference in the net income of corps and accumulated production cost between in with-flood condition and in without - flood condition. Since unit value of crops is estimated by areas based on agricultural conditions, an arrangement is required to calculate the average unit value of crops by block area of the flood plain classified in 10.4 because each block area crossed over a few area classified on the basis of agricultural condition. Unit value of crops by block areas is shown in Table 10.2.

(2) Unit value of buildings and their property

(A) Unit value of buildings

Present unit value per each type of building is estimated based on building cost per m^2 and its salvage value, and standard size of building. The detailed data on unit cost of buildings are shown in Table 10.3.

(B) Value of indoor movables per building

Value of indoor movables per each type of building is estimated based on various kinds of economic or social indicators, such as GRDP, population and so on. Value of indoor movables per each type of building is estimated as stock value. The basic data on household effect are collected through survey which covers 5 desas (one urban desa + four rural desas). Value of indoor movables is estimated as an average of market and salvage value. The detailed data on value of indoor movables are shown in Table 10.4.

(3) Unit value of cars and motorcycles

Unit value of above property is estimated as an average of market and second-hand price.

Since the economic development in the basin will continue in future, variations in unit value of crops, buildings and indoor movables related to the buildings are also projected. Future unit value of items mentioned above is forecast up to 2050, taking into account economic life of flood control facilities. Future unit value of items are shown at 1985 constant price.

(4) Future unit value of crops per ha.

An increase rate of unit yield is assumed to be 1% p.a. which is taken up as natural increase rate. Maximum future unit yield is assumed to be 130% of the present unit yield.

However, farm land is expected to be reduced by an augment of buildings. In this respect, the maximum building density of the present urban desa is taken up as an upper limitation of building density for urban desa, while minimum one of present urban desa is taken up as upper limitation of building density for rural desa. Beyond that point, it is expected that farm land will be reduced. Future unit value of crops per ha is estimated by considering the reduction of farm land, which is shown in table 10.5.

(5) Future unit value of building and their properties

(A) Future unit value of buildings

Future unit value of buildings is estimated by referring to future increase of mortgage rate for estimating current value of houses, and increase rate of price index related to construction materials for houses as deflator.

(B) Future value of indoor movables per building

Future value of indoor movables per each type of building is estimated based on forecast of economic or social indicators, part of which is derived from Repelita IV of kab. Nganjuk. The detailed data in unit cost and indoor movables are in Table 10.6.

(6) Future value of cars or motorcycle

Future value of vehicles is assumed to be the same as present value of those.

10.3.4 Distribution of properties

Distribution of properties is assessed by two processes, namely, mesh survey and average density of properties derived from economic data.

The flood plain is divided by meshed having mesh intervals of 500 m. In each mesh, the elevation of the ground surface and land use condition (paddy, upland, building area) are read out using 1 to 50,000 scale maps. The total numbers of meshes is 843. Distributions of meshes and land use by area classified in 10.4 is shown in Table 10.7.

The number of houses, factories, stores, restaurants, private and public building and cars & motorcycles are estimated by using data on average building or vehicle density per 25 ha by desa belonging flood plain. The classification of desa into urban and rural ones is based on the definition of Statistical Office, which is discussed in 2.4.2. Table 10.8 shows average building or vehicle density per mesh by area and Table 10.9 shows total number of buildings or vehicles. Table 10.10 shows the present value of property per mesh by area.

10.3.5 Future increase of buildings and vehicles

Annual increase rate of each type of buildings is shown in Table 10.11. The number of vehicles is expected to increase in proportion to increase rate of houses, which is shown in table 10.12.

10.4 Probable Flood Damage

10.4.1 Inundation blocks

The flood plain is divided into 8 blocks from the viewpoints of inundation condition and topographic condition, as shown on Fig. 10.3.

Block A-1	;	Widas retarding basin
A-2	;	Between Lengkong and the confluence with the Kedungsoko river
B	;	Widas river upstream of the confluence with the Kedungsoko river
C	;	Ulo retarding basin
D	;	Upstream of the Ulo river
E	;	Kedungsoko retarding basin
F	;	Upstream of the Kuncir river
G	;	Upstream of the Kedungsoko river

10.4.2 Probable flood flows

The probable flood flows under the present river conditions are estimated for each block by the same method explained in Chapter 6, placing the single base point at the river mouth. The flood flows used for the flood damage analysis are presented in ANNEX-5.

Since the discharge capacities of the rivers in the Widas are so small that rainfalls occuring twice or three times a year cause flood damages. The above is checked by comparison of the probable rainfalls estimated from the non-annual exceedance series data with the probable rainfalls estimated from the annual maximum series data, as shown on Fig. 10.4. From this figure, the following can be said;

Return Period in year	
Big Annual Max. Series	By Non-annual Exceedance Series
1.05 - year flood ----------------------	0.3 - year flood
2 - year flood ----------------------	1.4 - year flood

10.4.3 Area - depth - duration analysis

Area - Depth - Duration of inundation is analized using the estimated probable floods and based on topographic maps and river cross-sections surveyed by BRBDEO.

The flooding condition is divided into two; one is the retarding type flooding and the other is the overland flow type flooding.

In case of the retarding type flooding, the Area - Depth - Duration of inundation is determined by the rating curve at the downstream end of the retarding basin, as shown in Table 10.13. The retarding type flooding is applied to Block A-1, C and E.

In case of the overland flow flooding, the following is referred to;

> "Peak discharge and flood stage have little meaning in overland floods. When the flood water emerges from the confined section on to the alluvial fan or plain the flood peak quickly flactens. As a result, the area flooded is not a direct function of the peak discharge except as it may overtop dikes built to direct its course away from a portion of the flood plan. More often, the area flooded is directly related to the flood volume. The greater the volume, the greater is the area flooded".
> (U.S.D.A. Soil conservation Service, "Economics GUIDE FOR WATERSHED PROTECTION AND FLOOD PREVENTION", Mar. 1964).

From the past inundation records, the above is considered applicable to the Widas basin. The overland flow is assumed to spread out in the plain and forming the water surface inclination same as the ground surface slope. The marginal discharge of the present river channel is estimated as follows:

Block	A-2	130 m^3/s
	B	100 m^3/s
	D	20 m^3/s
	F	10 m^3/s
	G	70 m^3/s

The results of Area - Depth - Duration analysis area as shown in Table 10.14 and those of each block area presented in ANNEX-5.

10.4.4 Damage rates

The damage rates of the direct damage are assumed as follows;

- Crops, buildings and in-door movables
  Standard rates developed by Ministry of Construction, Japan, as shown in Table 10.15

- Infrastructure
  30% of the total damage to crops, building and indoor movables. This 30% is taken referring to the damage rates obtained in Malaysia, since the actual data are not available in the basin.

The damage rate of indirect flood damage is assumed at 10% of the direct damage.

10.4.5 Average annual flood damage under present river conditions

The average annual flood damage under the present river conditions is estimated Rp. 7,560 million at the 1985 price level as shown in Table 10.16. The average annual flood damage in each block is presented in ANNEX-5.

Table 10.17 shows average annual flood damage in the year 2000 with future social and economic development.

10.4.6 Anticipated Flood Control Benefit

Flood Control Benefit

The proposed flood control plan diminish the flood damages upto the 25-year flood.

Since the economy in the Widas basin is expected to grow continuously at an assumed rate, 5% p.a., the anticipated flood control benefit with future development is required to be evaluated. In this case, 2000 development level is introduced as the development level of selective year. The anticipated flood control benefits at the 1985 price level at the 1985 and 2000 development levels are estimated as follows;

1985 development level	2000 development level
Rp.7,169.8 million/year	10,314.7

Land Enhancement Benefit

Land enhancement benefit is regarded as an increase of productivity of the land to be protected from habitual inundation. Land enhancement benefit is expected to accure in the parameter areas of three retarding basin (Ulo, Widas and Kedungsoko) which are not included in the controllable retarding basin. Although what kind of land use be made in such area is unknown, the increase of productivity of the land is assessed by the increase of agricultural productions value between with and without project. The following procedures are taken in order to estimate land enhancement benefit.

- Unit yield of crop is assumed to increase up to the average level of unit yield in Kecamatans relating to respective retarding basin. Therefore, an incremental unit yield is derived from the difference between present unit yield in the retarding basin, and the average unit yield in Kecamatans.

- Cropping pattern is taken into account in respective retarding basin.

- Economic prices of crops are expressed at 1985 price level.

- Area freed from habitual inundation by this Project in the present retarding basin is estimated as balance between the present and future inundated areas by 5-year probable flood. By taking into an account the practices in Indonesia that irrigation and drainage plan is established on the basis of 5-yer probability, the inundation frequency less than once in five years is considered sufficient for increase of productivity.

Based on the above procedure, total land enhancement benefit is estimated at 122.4 x 10^6 Rp. per year. The detailed results of land enhancement is given in Table 10.18. Inundation volume, area and water level are shown in table 10.19.

Total Benefit

Adding anticipated flood control benefit to land enhancement benefit total benefit is summarized below:

Unit 10^6 Rp.

1985 development level	2000 development level
7,292,2	10,437.1

10.5 Evaluation

The proposed flood control plan is evaluated at both 1985 and future development level, based on economic cost and benefit discussed so far. The disbursement schedule expressed by economic cost at 1985 price level is shown in Table 10.20. Table 10.21 shows cash flow of both present and future development level. In the benefit stream of cash flow, negative benefit (economic cost of land acquisition) is subtracted from total benefit.

The results of Economic Internal Rate of Return (EIRR) are shown as follows;

1985 development level	9.8%
Future development level	14.1%

Sensitivity analysis of EIRR is made based on the following conditions:

	Cost up 10%	Cost up 20%	Benefit down 10%	Benefit down 20%	Cost up 10% Benefit down 10%
1985 development level	9.03	8.38	8.95	8.08	8.23
Future level	13.32	12.45	13.13	12.11	12.3

As far as future development level is concerned, it is clear that EIRR is more than 12% in each condition of sensitivity analysis.

10.6 Environmental Assessment of Flood control Works

The Enabling Law of the Environment, Public Law No. 4 enforced in 1982, states that any project which is anticipated to have an "important" effect upon the environment must be accompanied by an analysis of the environmental impact of the project. Due to the above Enabling Law of the Environment, this study should be carried out as a part of the feasibility study, and presents the estimation and evaluation of the effects upon the environment caused by the implementation of the projects which are proposed in each development and gives recommendations to the projects at the stage of the feasibility study. Thus this study is to provide information useful for a further environmental impact analysis.

10.6.1 Methodology and procedure

1. Methodology

The environmental study conforms itself to the Phased Environmental Impact Analysis methodology, which generally consists of (1) Preliminary Environmental Information (PEI), (2) Preliminary Environmental Impact Analysis (PEIA), and (3) Environmental Impact Analysis (EIA), and the depth of analysis for the environmental assesment at any stage in the project life cycle is based upon the depth of analysis required for the project planning at that stage and upon available information. The RRM (Risk Resultant Matrix) method is applied to proceed environmental impact analysis.

The matrix has sectors of the environment as rows, time periods as columns and predicted impacts as entries in the various cells. At the stage of Preliminary Environmental Information, entries in the cells of matrix are simple yes-no alternatives, to indicate which sectors of environment will have probable experience/not experience impact from the given project. At the stage of Preliminary Environmental Impact Analysis, the entries in the cells represent the "expected value" of the impact. This "expected value" is a product of the absolute value of the impact multiplied by the risk of the impact's occuring.

The PEIA is used as the basis for the decision as to whether the predicted impact will be "important", by criteria listed in the Enabling Law on the Environment. If the predicted impact is classified as "not important", then the PEIA just recommends any measures necessary to be taken to preserve the environment and any other recommendations felt to be necessary. If the predicted impact is classified as "important", then the PEIA is followed by the Environmental Impact Analysis. The PEIA will concentrate its attention on those sectors of the environment which are predicted to have a large expected value, thus achieving the objective of efficient use of resources in environmental impact analysis. Since the Study aims to prepare the feasibility study for flood control works, the Preliminary Environmental Impact Analysis is to be adopted and it is examined within data to be obtained.

2. Procedure

The environmental study was proceeded in accordance with following steps.

(1) Data collection and field reconnaissance

(2) To grasp the summary of the projects and the present environmental conditions.

(3) To divide the project areas into eco-system regions and grasp the relation between the environmental factors of the projects and the present conditions in each eco-system region.

(4) To estimate and evaluate the environmental impacts by the projects in each eco-system region

(5) To give conclusions and recommendations to the proposed project from the environmental stand point

10.6.2 Division into eco-system region

The first step in analyzing data for the PEIA is to divide the projects into eco-system regions. The use of several eco-system regions for each project is necessary because different regions will experience different types of impact from the project works. In its Preliminary Environmental Impact Analysis work, it is defined three types of areas which will experience qualitatively different types of impact from the construction and operation of the project.

Area of physical works	:	area(s) that will experience impacts directly from the project physical works
Benefit area	:	area(s) that will experience direct benefit from the existence or operation of the project
Surrounding area	:	area(s) which will experience indirect impact from the existence and operation of the project.

Areas of the flood control works are divided into the following eco-system regions

	Physical works area	Benefited area	Surrounding area
River improvement of the existing river including river structures	K.Widas, K.Ulo, K.Kuncir, K.Kedungsoko (dredging area, embankment, cut-off)	inundated area (around Nganjuk and Lengkong)	-
Flood diversion channel	flood diversion channel (excavation, embankment)	inundated area (around Nganjuk)	-
Controlable retarding basin	K.Widas, K.Ulo, K.Kedungsoko (embankment, drainage sluice)	retarding basin	-

10.6.3 Estimation and evaluation

1. General

Estimation and evaluation of this study was made qualitatively for the effects upon the condition in each eco-system area which was described 10.6.2 (Division into Eco-system Region), caused by the impact of the proposed projects. The explanation and justification for various cell entries of RRM used for estimating and evaluating are presented below:

In the application of the RRM, the cell entries are in a qualitative coding form. Thus each of the components of impact, which are value, intensity and risk, are divided into categories and are represented by marks as follows;

Value

- O : no effect
- + : positive (beneficial)
- - : negative (harmful)
- ± : neutral

Intensity

- S : small
- M : medium
- L : large

Risk Probability

- A : certain to occur
- B : highly probable
- C : moderately probable
- D : highly improbable
- E : certain not to occur

The elevation of the "importance" of the environmental impact is made based upon the seven criteria listed in the Explanation to Law No. 4/1982:

- total number of people affected;
- total area affected;
- duration involved;
- intensity of impact;
- number of components of environment involved;
- cumulative effect;
- reversible or irreversible.

2. Future Condition without the Projects

The flood control works are planned to be commenced in the year of 1990 and to be completed in about five years. Therefore it is supposed that the future condition means the one about a decade later. Compared the future condition without the projects with the present condition, it is considered that natural environmental conditions involving geology, mineral resources, topography, soil, sedimentation, climate, archaeology and historical remains, air, water, forest, native flora and fauna will not change. As regards social conditions, in recent years Nganjuk and Lengkong have been developing with the progress of urbanization, population is increasing and the economic activities are prospering. Further there are and will be projects which develop the areas in the Widas river basin, for example irrigation project and river improvement project, then food production and other agricultural production will increase. However other social conditions involving land use patterns, public works facilities, demography, land tenure relations, health, social infrastructure, anthropology and culture may not change.

Judging from the above mentioned, this study was examined under the supposition that the present conditions be mostly applicable to the future condition.

The RRM has four environmental sectors which are A. Non-renewable Resources, B. Renewable Resources, C. Technology, and D. Human Environment, and each sector has also some environmental elements. The estimation and evaluation for the impacts of the projects is carried out in accordance with above criteria both for the stages during construction and during operation.

10.6.4 Evaluation

in this section, the environmental impacts are estimated and evaluated in accordance with the RRM (Risk Resultant Matrix) for each eco-system region.

1. River Improvement

(1) Eco-system Area : Area of Physical Works
(RRM : Refer to ANNEX-9)

(A) Non-Renewable Resources

There will be no effect upon geological features and there are no mineral resources in the area of physical works.

Topography will be changed by construction of river structures, and the existing meandering course of rivers will be straightened by construction of cut-off channel. However, these changes are evaluated neutral effect because they will not affect eco-system.

The excavated soil materials are planned to be used for embankment and reclamation, and degraged materials will be settled in temporary spoil banks. Then there will be effect upon soil along the river courses during construction. Necessary protection shall be taken for excess soil materials.

There are bank erosion problems in the present river channels, which cause sedimentation. The cut surface shall be treated properly not to cause bank erosion.

River improvement works will not effect the climate and there are no archaeology and historical remains in the area of physical works.

(B) Renewable Resources

There may be some dust released into the air from the embankement areas and areas along access roads during construction, however, it will be limited to the dry season and will be very small effect because of the small scale of works. The dust sprinkled by dump trucks for transportation of materials may affects human and plants along the areas to some extent. it is hoped to provide pertinent countermeasures for dust control.

During construction dredging in the river will affect water quality, water from the dredging site will be turbid. However, this effect will not be serious because it will be limited to construction and water in the river is already relatively turbid. Against return flow from temporary spoil bank, necessary countermeasures shall be taken not to carry back soil materials with it.

Water quantity and distribution through time will not change and there will not be aquatic weeds in the area of physical works.

Channel improvement including river structures will change land use patterns, however such change is evaluated neutral effect.

There are neither forest nor native flora and fauna in the area of physical works.

Accompanied by construction of dike and cut off channel, approximately thirty bridges and roads in the project area are planned. Therefore there will be great beneficial effect upon the public works facilities.

(C) Technology

The Project will use well-established technology during construction and will be implemented with safe care. Therefore, the Project will not involve any direct development of new technology or technological spinoff to any other sectors.

And during construction, channel improvement including river structures will be implemented with pertinent counterplans not to affect existing traffic and transportation, by means of temporary bridge, etc.

(D) Human Environment

Implementation of the project will bring forth job opportunities to many labours during construction.

There will be no effect upon demography because workers and staff will not accompany their families and the construction period will be relatively short.

Among economic activities, only small-scale trade and services in the area of physical works will be stimulated and will receive benefits to fill the needs of workers and staff during construction, however it will be temporary and will be limited to the construction period.

People of approximately 425 households living in the areas to be acquired will be removed. However, they will be compensated with due care by Project Executing Agency. Those households will have opportunity to build better houses. And also people whose land will be acquired for the project, including farmers whose farm land will be acquired for temporary spoil bank, shall be compensated.

Food crop production will decrease to some extent by conversion of farm land of about 680 ha to the river area. However this decrease will be well compensated by reduction of flood damages to crops in the benefit area.

The inspection roads along the rivers will improve the local transportation conditions.

There will be no effect upon health, other social infrastructure, anthropology and culture by he Project.

(2) Eco-system Area : Benefited Area inundated area (around Nganjuk and lengkong).

By improvement of drainage condition, soils in the inundation areas will be improved from water logging conditions.

By making the land free from risk of inundation, higher farming technology may be applicable.

Flood damages to crops, buildings and properties in the inundation areas will be much reduced. Further the conditions free from inundation will give firm basis for future socio-economic development. The health condition will be improved.

2. New Flood Diversion Channel

(1) Eco-system Area : Area of Physical Works (RRM: Refer ANNEX-9)

(A) Non-renewable Resources

There will be no effect upon geological features and there are no mineral resources in the area of physical works.

The construction of new diversion channel of about 3 km long and about 70 m width means a change of topography and landscape. However, such size of change is evaluated to be neutral effect from the view point of eco-system.

The excavated soil materials is planned to be used for embankment and reclamation of the gutter along the railway. Excess excavated soil materials will be put along the embankment temporarily and will be used for reclamation in the urban area in future. So there will be small change in soil.

There are no archaeology and historical remains in the area of physical works.

(B) Renewable Resources

As for air, the arguments are the same as what discussed in Area of Physical Works : Make reference to 1-(1) with respect to River improvement and it is hoped to consider pertinent counterplan to control dust to be released into the air from physical works area and to be sprinkled by dump trucks for transportation of materials.

Construction of new diversion channel may have possibility to cut the shallow ground water flow and might affect the use of water for daily-life and farm land. This matter shall be looked into during construction.

There will be no effect upon water, and there are no forests, native flora and fauna in the area of physical works.

By construction of new diversion channel, farm land, residence area, roads and so on within the physical works area will disappear and the farm land along the channel will be used for temporary spoil bank.

Then farmers of such farm land shall be compensated by the Project Executing Agency, and after construction the temporary spoil banks will be readjusted and prepared for farm land.

(C) Technology

Construction of the railway bridge over the new diversion channel will have to be made under no stop of railway traffic. Due care will be needed during construction.

(D) Human Environment

Implementation of the project will bring forth job opportunities to many labours during construction.

As regards demography and economic activities, the arguments are the same as those discussed in River Improvement; Area of Physical Works will be applicable.

Fifteen households in the physical works area of the new diversion channel will be removed. They shall be compensated with due care by the Project Executing Agency, and farmers whose land will be used for temporary storage of excavaged materials will be also compensated.

The decrease in food production by converting the farm land to the river area will be compensated by reduction of food damages to crops in the benefit area.

There will be no effect upon health, anthropology and culture.

New diversion channel will divide the area around physical works into two areas and will affect social infrastructure, communication, movement and transportation and so on from one side to the other. However, six new bridges to be built over the channel will minimize such effects.

Urbanization of the Nganjuk town to the west may be affected to some extent. However, six new bridges will minimize such effects.

(2) Eco-system Area : Benefited Area (Flood diversion channel)
(RRM : Refer to ANNEX-9)
inundated area (around Nganjuk)

The arguments are the same as those discussed in River Improvement; Benefited Area may be applicable.

3. Controllable Retarding Basin

(1) Eco-system Area : Area of Physical Works; side overflow dike,
drainage sluice (RRM : Refer to ANNEX-9)

(A) Non-renewable Resources

Construction of side overflow dike will change topography and soil in the physical works area, however such change is evaluated neutral effect. There will be no effect upon the other non-renewable resources.

(B) Renewable Resources

Physical works for controllable retarding basin will change land use. However, such change is evaluated neutral effect. There will be beneficial effects upon public facilities because existing roads and bridges will be improved. There will be no effect upon the other sectors of renewable resources.

(C) Technology

The controllable retarding basin is featured by hydrological and hydraulic complexity, such complexity shall be confirmed by hydraulic model tests and others. Flood control including large controllable retarding basins is the first case in Indonesia. Know-hows will be applicable for other cases.

(D) Human Environment

Modification of the natural retarding basin into the controllable retarding basin may have some social, administrative and operational issues such as restriction of land use. Such issues shall be solved by the time of completion of the Project.

Farmers whose farm land will be acquired for the project shall be compensated with due care. Since inundation frequency and duration will be decreased, food crop production will received benefit.

There will be no effect upon the other sectors of human environments.

(2) Eco-system Area : Benefited Area (RRM : Refer to ANNEX-9)

There will be no effect upon non-renewable resources, renewable resources and technology.

As a result of controllable retarding, agriculture, food production and health will receive great benefit.

There are no industry and other agriculture production, and there will be no effect upon other social infrastructure and anthropology and culture.

10.6.5 Evaluation of the "Importance" of the Impact

The evaluation of the "importance" of the environmental impact will be made based upon the seven criteria listed in the Explanation to Law No. 4/1982:

a. total number of people affected;
b. total area affected;
c. duration involved;
d. intensity of impact;
e. number of components of environment involved;
f. cumulative effect;
g. reversible or irreversible.

The evaluation of the "Importance" of the impact are shown in ANNEX-9.

The main purpose of Environmental Impact Analysis is to identify potential negative impacts, as an aid to project planning and decision-making. The number of people to be negatively affected is difficult to count. The total area to be affected is relatively small. Most of the negative effects will occur during the construction period and then will disappear. All intensities of negative impacts will be relatively small and they will not be cumulative. Therefore, it may be concluded that the project will not have a significant negative effect upon the environment.

As for the neutral and possitive effects of the Project, the analysis shows that most of the people and areas directly identifiable to be affected by the project will experience neutral changes. The people whose land is acquired for project works are considered to be affected neutrally because they will be compensated for their land and houses.

Thus it may be concluded that the project will have some effects upon the environment, but that negative effects will not be significant. Positive impacts, especially upon human environments in the benefited areas, will be more intense and cumulative than neutral or negative impacts.

Table 10.1 BREAKDOWN OF ECONOMIC COST

Unit : 10^6 Rp

No.	Scheme	Financial Cost	Economic Cost	Conversion rate of Financial to economic (%)
I.	Direct Cost (Domestic Portion)			
1.	Lower Widas	6,328	5,275	83
2.	Upper Widas and Lower Ulo	3,690	3,048	83
3.	Flood Diversion Channel	1,252	1,011	81
4.	Upper Ulo	1,502	1,224	81
5.	Kedungsoko	3,165	2,575	81
6.	Kuncir	1,699	1,385	82
7.	Sub Total	17,635	14,518	82
II.	Direct Cost (Foreign Portion) :	23,166	19,145	83
	Total	40,801	33,663	82.5

Note :

I. The calculation of economic value of house in rural area :

Unit cost per m^2	: 0.019×10^6 Rp
Standard size of building	: 70 m^2
Unit cost of house	: 1.33×10^6 Rp
Life time	: 15 years
Annual value	: 88.5×10^3 Rp./house

II The calculation of economic value of paddy :

Average unit yield of clean dry paddy	: 4.6 ton/ha (average yield of Kabupaten Nganjuk)
Economic price of paddy	: 143.140 Rp./ton
Gross income of paddy	: 658,400 Rp.

III The calculation of economic value of Polowijo :

Average unit yield of maize	: 3.1 ton/ha
Economic price of maize	: 185,660 Rp.
Gross income of maize	: 575,546 Rp.
Average unit yield of soybean	: 0.8 ton/ha
Economic price of soybean	: 338,560
Gross income of soybean	: 270,848 Rp.
Average of gross income of polowijo Polowijo	: 423,200 Rp.

IV. Cropping pattern : Paady - polowijo - polowijo
Total gross income of paddy and polowijo crops : 658,400 Rp. + (423,200 Rp.) x 2 = 1,504,800 Rp./ha.

Table 10.2 PRESENT UNIT VALUE OF CROPS PER HA BY FLOOD PLAIN AREA

Unit : 10^6 Rp.

	A1	A2	B	C	D	E	F	G
Paddy	0.24	0.28	0.31	0.25	0.30	0.28	0.29	0.30
Polowijo	0.005	0.004	0.007	0.006	0.006	0.006	0.004	0.005

Remarks : Block area ranging from A to G belongs flood plain area
Unit value of polowijo is the average value of maize and soybean per ha.

Table 10.3 PRESENT UNIT COST PER EACH TYPE OF BUILDING

	House		Industry	Store	Restaurant	Public & Private
	Urban	Rural				
Unit Cost per m2 /2 (10^6 Rp)	0.077	0.019	0.021	0.077	0.077	0.157
Standard size of building (m2)	100/1	70/1	100	100	200	1090/3
Unit cost per building (10^6 Rp)	7.70	1.33	2.10	7.70	15.40	171.13

Remarks : /1 Dalam Angka of East Java

/2 Unit cost per m^2 is the average value between market price and its salvage value

/3 Directorate General of Cipta Karya

Table 10.4 PRESENT UNIT VALUE OF INDOOR MOVABLES PER BUILDING

Unit : 10^6 Rp.

	House		Industry	Store	Restaurant	Public & Private
	Urban	Rural				
Unit value of indoor movables per building	0.84	0.42	0.83	3.8	2.4	9.0

Table 10.5 FUTURE UNIT VALUE OF PADDY PER HA BY BLOCK AREA

Unit : 10^6Rp

	1985	1990	2010	2025	2050
Area of Block					
A1	0.24	0.25	0.30	----------------	0.30
A2	0.28	0.29	0.37	----------------	0.37
B	0.31	0.33	0.40	----------------	0.40
C	0.25	0.26	0.32	----------------	0.32
D	0.30	0.32	0.38	---- 0.38 -----	0.17
E	0.28	0.29	0.37	----------------	0.37
F	0.29	0.30	0.37	---- 0.37 ----	0.21
G	0.30	0.32	0.38	----------------	0.38
Average	0.28	0.30	0.36		0.32

FUTURE UNIT VALUE OF POLOWIJO PER HA BY BLOCK AREA

Unit : 10^6Rp

	1985	1990	2010	2025	2050
Area of Block					
A1	0.005	0.005	0.006		0.006
A2	0.004	0.004	0.005		0.005
B	0.007	0.007	0.009		0.009
C	0.006	0.006	0.008		0.008
D	0.006	0.006	0.008	0.008	0.003
E	0.006	0.006	0.008		0.008
F	0.004	0.004	0.005	0.005	0.003
G	0.005	0.005	0.006		0.006
Average	0.005	0.005	0.007		0.006

Remarks : Maximum unit value of crops will be attained in the year of 2010. After 2010, unit value of crops will be the same up to 2050.

The reduction of farm land is assumed to happen in only Block areas, D and F after 2025.

Table 10.6 FUTURE UNIT COST PER BUILDING

Unit : 10^6 Rp.

		1985	1990	2000	2050
House	Urban	7.70	9.50	14.20	62.50
	Rural	1.33	1.62	2.40	10.50
Industry		2.10	2.55	3.77	16.50
Store		7.70	9.34	13.83	60.60
Restaurant		15.40	18.70	27.70	121.40
Public & Private		171.13	208.21	308.20	1351.12

FUTURE VALUE OF INDOOR MOVABLES PER BUILDING

Unit : 10^6 Rp.

		1985	1990	2000	2050
House	Urban	0.84	1.02	1.56	11.68
	Rural	0.42	0.51	0.78	5.84
Industry		0.83	1.34	2.74	38.40
Store		3.80	4.60	7.10	86.90
Restaurant		2.40	2.90	4.50	34.00
Public & Private		9.00	10.80	22.30	177.00

Table 10.7 THE NUMBER OF MESHES BY LAND USE AND AREA

Block Area	Paddy	Upland	Desa	Other	Total
A1	60	9	16	29	114
A2	143	30	75	0	248
B	62.5	2.5	14	0	79
C	37.5	0	35	0	72.5
D	44.5	0	39.5	0	84
E	60.5	4.5	36.5	0	101.5
F	22	0	19.5	0	41.5
G	52	0	50.5	0	102.5
Total	482	46	286	29	843

Note : Imesh = 25 ha.

Table 10.8 AVERAGE DENSITY OF BUILDINGS AND VEHICLES PER MESH BY AREA

Area	House		Industry	Store	Restaurant	Public & Private	Car and Motorcycle
	Urban	Rural					
A1	-	47.3	11.0	1.0	1.3	0.8	3.0
A2	-	54.7	2.3	1.3	1.3	0.8	3.5
B	-	33.7	1.6	0.9	0.9	0.6	2.2
C	-	14.1	1.4	0.4	0.4	0.2	0.9
D	104.6	54.7	13.7	7.1	3.3	2.4	20.0
E	28.2	49.4	7.2	2.0	1.5	0.7	5.0
F	65.2	57.0	6.4	5.0	2.8	1.8	7.9
G	-	70.1	2.4	2.4	1.3	0.5	4.6

Note: The above figure shows average density per mesh belonging to desa.

Table 10.9 THE NUMBER OF BUILDINGS AND BEHICLES BY AREA

Area	Urban	Rural	Industry	Store	Restaurant	Public & Private	Car and Motorcycle
A1	-	756	176	16	20	13	49
A2	-	4,101	173	99	97	58	266
B	-	472	22	12	12	9	31
C	-	493	50	15	15	7	32
D	4,132	2,160	543	282	129	93	685
E	1,030	1,803	264	73	53	26	184
F	1,272	1,112	124	97	55	35	155
G	-	3,542	120	123	65	23	230

Table 10.10 DAMAGEABLE VALUE IN MILLION RIPIAH PER MESH (25 HA)

ITEM	BLOCK							
	1	2	3	4	5	6	7	8
Building								
Houses								
- Urban	0.00	0.00	0.00	0.00	805.40	217.10	502.00	0
- Rural	62.90	72.80	44.80	18.80	72.80	65.70	75.80	93.20
Industry	23.10	4.80	3.40	2.90	28.80	15.10	13.40	5.00
Store	7.70	10.00	6.90	3.10	54.70	15.40	38.50	18.50
Restaurant	20.00	20.00	13.90	6.20	50.80	23.10	43.10	20.00
Public Bldg	137.00	137.00	102.70	34.20	410.70	119.80	308.00	85.60
Household								
Houses								
- Urban	0.00	0.00	0.00	0.00	87.90	23.70	54.80	0.00
- Rural	19.90	23.00	14.20	5.90	23.00	20.70	23.90	29.40
Industry	9.10	1.90	1.30	1.20	11.40	6.00	5.30	2.00
Store	3.80	4.90	3.40	1.50	27.00	7.60	19.00	9.10
Restaurant	3.10	3.10	2.20	1.00	8.00	3.60	6.70	3.10
Public Bldg	7.20	8.20	5.40	1.80	22.00	6.30	16.20	4.50
Crop								
- Paddy	4.70	0.70	3.20	11.50	10.70	11.50	8.00	0.00
- Polowijo	0.12	0.42	0.08	0.14	0.10	0.17	0.06	0.00
Mobile	0.21	0.52	0.20	0.22	5.38	0.88	1.83	1.09

Note: Block 1 ... Widas retarding basin

2 ... Between Leng Kong and the confluence with the Kedungsoko river

3 ... Widas river upstream of the confluence with the Kedungsoko river

4 ... Ulo retarding basin

5 ... Upstream of the Ulo river

6 ... Kedungsoko retarding basin

7 ... Upstream of the Kuncir river

8 ... Upstream of the Kedungsoko river

Table 10.11 FUTURE INCREASE RATE OF BUILDING

Unit : % p.a.

		1985 1990	1990 2000	2000 2050
House	Urban	2.5	2.5	2.5
	Rural	0.7	0.5	- 1.2
Industry		1.5	1.5	1.5
Store		1.0	0.7	- 0.1
Restaurant		1.0	0.7	- 0.1
Public & Private		1.0	0.7	- 0.1

Table 10.12 FUTURE INCREASE RATE OF VEHICLES

	1985	1990	2000	2050
Total number of Vehicles	1,738 (1.5)	1,878(1.3)	2,135(1.3)	3,975

Remarks : The above figure indicates total number of vehicles existing within flood plain area

Parentheses shows an annual increase rate of vehicles

Table 10.13 DISCHARGE RATING CURVES INCLUDING FLOOD PLAIN

(1) Retarding Basin

Widas

Discharge (m3/sec)	50	100	150	200	250
Water Level (EL.m)	37.71	37.87	38.08	38.29	38.64

Ulo

Discharge (m3/sec)	20	40	60	80	100
Water level (EL.m)	42.20	43.00	43.7	44.4	45.5

Kedungsoko

Discharge (m3/sec)	20	40	60	80	100
Water Level (EL.m)	42.40	43.27	43.98	44.30	45.22

(2) Overland flow

	Block A-2		Block B		Block D		Block F		Block G	
	H	V	H	V	H	V	H	V	H	V
1.	37.5	0	43.0	0	46.0	0	46.3	0	45.1	0
2.	37.7	5.01	43.2	0.24	46.2	0.56	46.5	0.41	45.3	00.86
3.	37.9	8.68	43.4	0.72	46.4	1.39	46.7	1.00	45.5	2.27
4.	38.1	13.36	43.6	1.54	46.6	2.96	46.9	1.83	45.7	4.29
5.	38.3	19.04	43.8	2.77	46.8	4.79	47.1	2.94	45.9	6.73
6.	38.5	25.58	44.0	4.31	47.0	6.8	47.3	4.28	46.1	9.51
7.	38.7	33.09	44.2	6.07	47.2	9.21	47.5	5.69	46.3	12.65
8.	38.9	41.33	44.4	7.99	47.4	11.96	47.7	7.20	46.5	16.28
9.	39.1	50.16	44.6	10.02	47.6	14.94	47.9	8.87	46.7	20.24
10.	39.3	59.63	44.8	12.32	47.8	18.16	48.1	10.67	46.9	24.56

H ; water level at the end of block in EL. m

V ; overflow volume in the block in million m^3.

Table 10.14 INUNDATION AREA, DEPTH AND DURATION

Unit ; ha

	Return Period (Year)						
	Annual	1.4	5	10	25	50	100
BUILDING							
H<0.5	1000.0	1650.0	1487.5	1262.5	1012.5	1175.0	1187.5
0.5=<H<1.0	300.0	625.0	1125.0	1500.0	1925.0	1462.5	1250.0
1.0=<H<2.0	87.5	337.5	412.5	1125.0	1025.0	1900.0	2387.5
2.0=<H<3.0	0.0	25.0	75.0	87.5	87.5	87.5	162.5
H>=3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	1387.5	2637.5	3100.0	3975.0	4050.0	4625.0	4987.5
PADDY+POLOWIJO							
DEPTH 0.0-0.5							
DURATION 1-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7-	1087.5	1037.5	1037.5	825.0	612.5	387.5	250.0
SUB-TOTAL	1087.5	1037.5	1037.5	825.0	612.5	387.5	250.0
DEPTH 0.5-1.0							
DURATION 1-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-4	1925.0	3737.5	4637.5	5862.5	5612.5	5412.5	5375.0
5-6	62.5	50.0	50.0	400.0	887.5	1912.5	2525.0
7-	175.0	287.5	262.5	287.5	250.0	250.0	250.0
SUB-TOTAL	2162.5	4075.0	4950.0	6550.0	6750.0	7575.0	8150.0
DEPTH 1.0-							
DURATION 1-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7-	0.0	0.0	50.0	0.0	87.5	112.5	87.5
SUB-TOTAL	0.0	0.0	50.0	0.0	87.5	112.5	87.5
SUB-TOTAL	3250.0	5112.5	6037.5	7375.0	7450.0	8075.0	8487.5
POLOWIJO							
DEPTH 0.0-0.5							
DURATION 1-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5-6	25.0	12.5	12.5	12.5	62.5	112.5	162.5
7-	25.0	50.0	50.0	50.0	50.0	50.0	50.0
SUB-TOTAL	50.0	62.5	62.5	62.5	112.5	162.5	212.5
DEPTH 0.5-1.0							
DURATION 1-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-4	62.5	112.5	175.0	475.0	412.5	462.5	612.5
5-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	62.5	112.5	175.0	475.0	412.5	462.5	612.5
DURATION 1-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5-6	0.0	0.0	0.0	0.0	12.5	12.5	12.5
7-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	0.0	0.0	0.0	0.0	12.5	12.5	12.5
SUB-TOTAL	112.5	175.0	237.5	537.5	537.5	637.5	837.5
TOTAL	4750.0	7925.0	9375.0	11887.5	12037.5	13337.5	14312.5

Note: Block-wise data are shown in ANNEX.

Table 10.15 DAMAGE RATES
BUILDING, INDOR MOVABLES AND CAR/MOTOR BIKE

	Below Floor Level	0 - 0.5m	0.5-0.99	1.0-1.99	2.0-2.99	3.0
Building /1	0.03	0.053	0.072	0.109	0.152	0.220
-do- /2	0.03	0.083	0.126	0.177	0.266	0.344
Household Effects	0.0	0.086	0.191	0.331	0.499	0.690
Properties /3 of building	0.0	0.154	0.295	0.399	0.509	0.597
Car/Motor Bike	0.0	0.176	0.540	0.725	0.826	0.850

/1 : Slope loss than 1/1000

/2 : Slope more than 1/1000 and less than 1/500
This standard is applied in Upper Ulo and Kuncir area in this study.

/3 : Rates are determined based on the study in America, titled as

Agricultural crops

Depth	Duration (days)	Paddy	Average of damage rate of upland crops
Less than 0.5 m deep	1 - 2	0.21	0.27
	3 - 4	0.30	0.42
	5 - 6	0.36	0.54
	7 -	0.50	0.67
0.5 - 1.0 m deep	1 - 2	0.24	0.35
	3 - 4	0.44	0.48
	5 - 6	0.50	0.67
	7 -	0.71	0.74
More than 1.0 m deep	1 - 2	0.37	0.57
	3 - 4	0.54	0.67
	5 - 6	0.64	0.81
	7 - 8	0.74	0.91

Source : Criteria for the engineering of River and Sabo Project, Ministry of Construction,Japan

Table 10.16 PROBABLE FLOOD DAMAGE IN K.WIDAS IN MILLION RUPIAH

PROBABLE FLOOD DAMAGE IN K. WIDAS BASIN IN MILLION RUPIAH

DAMAGE IN 1985 Unit: 10^6Rp

PROPERTY	ANNUAL	RECURRENCE PERIOD (YEAR) 1.4	5	10	25	50	100
BUILDING							
HOUSES							
- URBAN	510.235	326.092	477.528	617.266	813.449	959.264	1204.069
- RURAL	349.332	207.596	328.214	599.898	611.211	810.100	995.209
INDUSTRY	55.758	29.339	44.705	70.488	78.076	96.723	119.755
STORE	75.627	44.549	70.277	116.584	130.196	167.146	206.813
RESTAURANT	112.268	64.840	103.108	181.002	189.952	248.185	306.200
PUBLIC BLDG	680.442	366.946	600.909	1105.725	1151.587	1520.632	1879.819
HOUSEHOLD							
HOUSES							
- URBAN	95.371	86.928	131.754	171.209	216.502	265.239	320.943
- RURAL	189.154	141.938	243.568	504.623	517.033	706.948	860.481
INDUSTRY	56.913	38.466	61.093	98.691	111.424	136.406	158.683
STORE	93.511	73.006	121.731	209.807	236.464	298.017	354.254
RESTAURANT	44.211	33.492	55.646	101.897	109.037	139.584	165.025
PUBLIC BLDG	92.909	65.712	112.586	223.400	232.908	303.336	362.696
CROP							
- PADDY	493.630	338.420	505.492	758.377	799.442	957.283	1045.705
- POLOWIJO	0.396	0.353	0.645	2.135	2.223	2.944	4.062
MOBILE	11.395	13.170	23.417	42.537	48.800	60.286	72.108
SUB-TOTAL	2861.159	1830.855	2880.681	4803.646	5248.310	6672.099	8055.828
PABLIC FACILITY	858.347	549.256	864.204	1441.093	1574.493	2001.629	2416.748
INDIRECT DAMAGE	371.950	238.011	374.488	624.474	682.280	867.372	1047.257
TOTAL	4091.457	2618.123	4119.374	6869.214	7505.084	9541.102	11519.834
ANNUAL MEAN DAMAGE	4091.457	4471.085	6189.147	6738.577	7169.806	7340.267	7560.770

Block wise data are show in ANNEX

Table 10.17 PROBABLE FLOOD DAMAGE IN K.WIDAS BASIN IN MILLION RUPIAH

PROBABLE FLOOD DAMAGE IN K. WIDAS BASIN IN MILLION RUPIAH

DAMAGE IN 2000 Unit : 10^6Rp

PROPERTY	ANNUAL	RECURRENCE PERIOD (YEAR) 1.4	5	10	25	50	100
BUILDING							
HOUSES							
- URBAN	780.213	498.635	730.199	943.876	1243.865	1466.833	1841.170
- RURAL	489.459	290.869	459.872	840.535	856.386	1135.056	1394.418
INDUSTRY	79.233	41.692	63.527	100.164	110.947	137.445	170.175
STORE	106.858	62.946	99.299	164.729	183.961	236.170	292.219
RESTAURANT	158.621	91.611	145.679	255.734	268.379	350.654	432.623
PUBLIC BLDG	958.167	516.717	846.173	1557.032	1621.612	2141.285	2647.076
HOUSEHOLD							
HOUSES							
- URBAN	158.502	144.470	218.968	284.539	359.814	440.812	533.389
- RURAL	287.684	215.874	370.441	767.479	786.353	1075.194	1308.701
INDUSTRY	131.657	88.982	141.327	228.300	257.755	315.544	367.077
STORE	143.886	112.334	187.307	322.829	363.847	458.559	545.090
RESTAURANT	66.799	50.603	84.077	153.956	164.745	210.898	249.337
PUBLIC BLDG	158.923	112.402	192.581	382.132	398.395	518.864	620.400
CROP							
- PADDY	573.089	392.895	586.861	880.452	928.127	1111.376	1214.031
- POLOWIJO	0.460	0.410	0.749	2.479	2.581	3.418	4.716
MOBILE	14.079	16.272	28.933	52.556	60.294	74.485	89.091
SUB-TOTAL	4107.636	2636.720	4155.999	6936.800	7607.068	9676.600	11709.518
PABLIC FACILITY	1232.290	791.016	1246.799	2081.040	2282.120	2902.980	3512.855
INDIRECT DAMAGE	533.992	342.773	540.279	901.784	988.918	1257.958	1522.237
TOTAL	5873.920	3770.510	5943.078	9919.624	10878.107	13837.538	16744.611
ANNUAL MEAN DAMAGE	5873.920	6420.644	8897.609	9690.744	10314.676	10561.833	10882.190

Data in 1990, 1995, 2005, 2010, 2015, 2020, 2025, 2030, 2035, 2040, 2045 1nd 2050 are shown in ANNEX.